



**Australian Government**  
**Department of Health and Ageing**  
**NICNAS**

**Environmental Exposure Assessment of Short Chain  
Chlorinated Paraffins (SCCPs) in Australia**

July 2004

A follow up report to the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) Short Chain Chlorinated Paraffins (SCCPs) Priority Existing Chemical Assessment Report No. 16.

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## ABBREVIATIONS AND ACRONYMS

ACT	Australian Capital Territory
DEH	Australian Government Department of Environment and Heritage
EC	European Commission
EC50	median effective concentration
ECB	European Chemicals Bureau
EHC	Environmental Health Criteria
EPHC	Environment Protection Heritage Council
ESD	Emission Scenario Document
EU	European Union
g/mol	gram per mole
IPCS	International Programme on Chemical Safety
kg	kilogram
kg/m <sup>3</sup>	kilogram per cubic metre
Kow	octanol/water partition coefficient
LCCPs	long chain chlorinated paraffins
MCCPs	medium chain chlorinated paraffins
mg/L	milligram per litre
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NOEC	no-observed effect concentrations
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration
PEC	predicted environmental concentrations
PNEC	predicted no-effect concentrations
POP	persistent organic pollutants
QLD	Queensland
SA	South Australia
SCCP	short chain chlorinated paraffins
SIDS	Screening Information Data Set
STP	sewage treatment plant
TAS	Tasmania
TGD	European Technical Guidance Document
VIC	Victoria
WHO	World Health Organisation
wt	weight
µg/L	microgram per litre

## **1 INTRODUCTION**

Short chain chlorinated paraffins (SCCPs) were declared by NICNAS as Priority Existing Chemicals for preliminary assessment on 7 March 2000. Their widespread use and persistence in the environment prompted concerns regarding the long term health and environmental impacts from these chemicals.

This preliminary assessment was finalised in 2001 (NICNAS, 2001) and is referred to as ‘the NICNAS 2001 report’ in the current assessment. It indicated that in Australia SCCPs were mainly used in manufacturing of metal working fluids and a range of products such as fillers, adhesives and coating materials used in the building industry. Other minor uses include manufacture of pigment dispersants, rubber and leather treatment products. The formulated products are either used directly or further diluted or mixed with other components by end users. The final concentration of SCCPs in the products ranges from 1 to 15%. Some of the final products containing SCCPs such as adhesives, paints and sealants may be available to the general public.

The NICNAS 2001 report indicated that the potential for release to the aquatic compartment through inappropriate disposal of extreme pressure lubricants used in metal working fluids may be high. It was recommended that a full environmental risk assessment of the use of SCCPs in metal work was needed. A full copy of the NICNAS 2001 report is available on line at <http://www.nicnas.gov.au/publications/CAR/PEC/PEC16/PEC16.pdf>.

While industry were invited to comment on disposal assumptions for metal working fluids during the comments phase of the NICNAS 2001 report and following the publication of the NICNAS 2001 report, no information was provided. In February 2002, a scoping exercise was undertaken to determine the most appropriate way to act on the recommendations of the NICNAS 2001 report.

## **2 SCOPE**

The result of the scoping exercise was that, prior to undertaking a full environmental risk assessment, a more comprehensive exposure assessment should be conducted in the areas flagged as being of concern, namely, metal working industries. It was considered that this refinement in the exposure assessment would allow a clearer understanding of likely risks prior to any full environmental risk assessment being considered.

This report, therefore, focuses on environmental exposure to SCCPs arising from use and disposal of metal working fluids containing these compounds. From this, predicted environmental concentrations (PEC) of SCCPs in water, sediment and soil may be determined.

While the current report is not a risk assessment per se, some discussions on environmental toxicity and likely risks have been included.

### **3 DATA COLLECTION**

Data collection was undertaken in two main stages. The first stage occurred in early 2002 and consisted of a scoping exercise comprising extensive internal research using NICNAS communications with the main importers/manufacturers of SCCPs and formulators of metal working fluids. Through this process, six companies were interviewed and provided input.

Based on the scoping exercise, it was decided during the second stage to send questionnaires to the known importers and selected end users. As the area of focus was disposal from small metal working companies, this was the industry area targeted for surveying.

Companies were identified by random from metal fabricators listed in the telephone directory in each State and Territory. For five States (NSW, VIC, QLD, SA and TAS), a total of 20 surveys in each State were sent to the selected metal fabricators, with 10 forwarded to companies operating in the metropolitan area, and 10 to companies in the rural area. For Western Australia, 10 metropolitan companies and 8 rural companies were surveyed. In the Northern Territory (NT) and Australian Capital Territory (ACT), 10 surveys in each Territory were sent. In total, 138 surveys were sent to end users Australian wide. The questionnaires were also sent to importers/manufacturers and known formulators.

### **4 OTHER SOURCES OF INFORMATION**

The final report of a comprehensive risk assessment on SCCPs was published by the European Chemicals Bureau (ECB) after the NICNAS 2001 report was finalised (ECB, 2000). This is referred to as “the EU risk assessment” throughout this current assessment. The EU risk assessment is an in-depth assessment carried out by one Member State of the EU (United Kingdom), working in co-operation with other Member States, industry and public interest groups. The report has been scientifically peer reviewed and presented to the Organisation for Economic Cooperation and Development (OECD) Work on Investigation of High Production Volume Chemicals, of which Australia is a member, as a Screening Information Data Set (SIDS) document. During the preparation of the NICNAS 2001 report, the then draft SIDS document (referenced as ‘OECD, 1999’ in the NICNAS 2001 report) was used as a main source for the health effects and environmental fate and toxicity sections of the NICNAS 2001 report. The EU risk assessment is considered suitable to be a reliable source document for this current assessment.

While the exposure and risk assessment components in the EU risk assessment are considered typical to the EU and not necessarily Australia, relevant industry practices described in the document, such as release patterns, environmental fate and environmental toxicity data, are considered relevant for Australia. This information has been used where appropriate in this report.

Since the publication of the NICNAS 2001 report, an OECD Emission Scenario Document (ESD) has been prepared on lubricants and includes information on environmental exposure and release of lubricants used in metal working (cutting fluids). The ESD was prepared through extensive consultation with industry and considered by the Environmental Exposure Assessment Task Force within the OECD. It is still in draft form, and consequently is not yet available to the public.

In 2002, the Australian Government Department of Environment and Heritage (DEH) held a workshop with State and Territory environment agencies to develop an agreed model for exposure to receiving waters where chemicals are released through a sewage treatment plant. This model (DEH, 2003) has been used in the current exposure assessment of SCCPs.

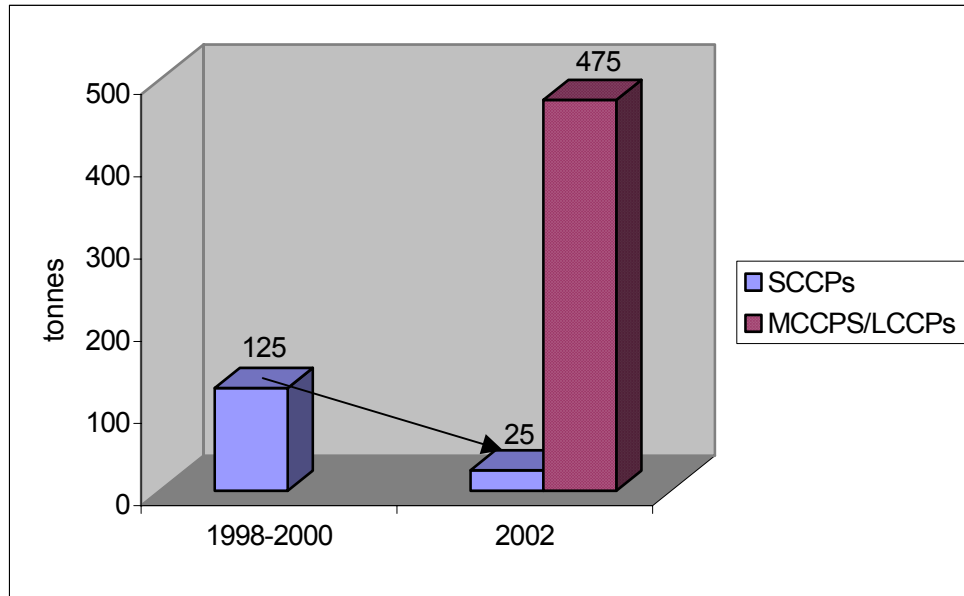
## **5 MANUFACTURE, IMPORTATION AND USES**

SCCPs are reported not to be manufactured in Australia. The NICNAS 2001 report identified that over the two-year period (March 1998 to March 2000), approximately 360 tonnes of the materials were imported from Britain and the United States. Approximately 70% of the total importation (250 tonnes) was used as lubricants in the metal working industry.

In the NICNAS 2001 report, it was indicated that the SCCPs were imported into Australia and sold by two companies. Since then the situation appears to have changed quite significantly. One of these companies no longer imports chlorinated paraffin products. The second company advised during the scoping exercise that the metal working fluid market in Australia is approximately 500 tonnes per annum, but only about 5% of this is SCCPs, the remainder being medium chain chlorinated paraffins (MCCPs) and long chain chlorinated paraffins (LCCPs). This indicates an annual use of around 25 tonnes per annum of SCCPs in the metal working industry in Australia, which is approximately 20% of the size of the market identified in the NICNAS 2001 report.

In the scoping exercise (see Section 3), contact with the three main formulators and the two importers established that while significant quantities of SCCPs were used in the past, their use for metal working fluid application was declining rapidly due to their replacement by longer chain chlorinated paraffins or the introduction of new technology in formulations which do not use chlorinated paraffins. The quantities of MCCPs and LCCPs used in Australia were not investigated during the NICNAS 2001 report. However, it is likely that the quantities of longer chain chlorinated paraffins being used in Australia have increased due to their replacing SCCPs as indicated by the SCCPs importer. Figure 1 shows the trend in importation quantity of SCCPs from 1998 to 2002 and quantities of MCCPs/LCCPs used in Australia in 2002.

**Figure 1: Annual quantities of SCCPs, MCCPs and LCCPs used in metal working fluids in Australia from 1998 to 2002**



During the second stage of data collection (see Section 3), a total of 138 questionnaires were sent to metal fabricators. Sixty-nine responses were received representing a response rate of 50%. The responses received included return of completed questionnaires and phone responses resulting from a follow up by NICNAS of non-responses.

Of the 50% of metal fabricators that responded, 40% (28) indicated use of metal cutting fluids. Of these, 18% (5) were using SCCPs products, 7% (2) had used SCCPs in the past and 75% (21) were not aware if the cutting fluids used by them contained SCCPs. The remaining 60% (41) of respondents noted that they had never used metal cutting fluids.

NICNAS attempted to follow up the 69 (50%) that did not respond, however, 16 were not contactable, 2 refused to participate and 51 did not return the questionnaires.

During the second phase of data collection little information on environmental exposure was received from end users of SCCPs. This was because not all relevant questions in the questionnaire were addressed by respondents, such as disposal patterns. In addition, no quantitative data on disposal was provided.

For the purposes of the current environmental exposure assessment it is assumed that, as a worst case, 25 tonnes per annum of SCCPs are currently used in the preparation of metal cutting fluids in Australia, although it appears this figure is likely to be an overestimate.

## **6 ENVIRONMENTAL EXPOSURE**

### **6.1 Environmental release**

The exposure assessment focuses on release through use in metal working fluids.

#### **The NICNAS 2001 exposure assessment**

The NICNAS 2001 report identified some 180 tonnes per annum of SCCPs imported into Australia, of which 70% was estimated to be used in metal working fluids. Without good estimates of release, it was assumed as a worst case that 50% of these imports would be inappropriately disposed of in Australia. The report carried a recommendation (Recommendation 5 – Environmental Health), that a full risk assessment should be undertaken unless information on sewer releases comes forward which indicates an acceptable level of exposure. No information was provided in this regard. It should be noted that the NICNAS 2001 report referred to release figures from the draft UK document that has subsequently been published as the EU risk assessment (2000). However, as the EU risk assessment report was not finalised then it was not considered appropriate to use the EU figures in environmental exposure assessment of the NICNAS 2001 report.

With the agreed DEH exposure model (DEH, 2003), the now final EU risk assessment and OECD ESD available (see Section 4), it is considered possible to refine the NICNAS 2001 environmental exposure assessment even with no additional release information from the Australian metal working industry.

#### **Assessment of current exposure**

The use of SCCPs in metal working fluids is as an extreme pressure additive. SCCPs are used in a variety of engineering and metal working operations such as drilling, machining/cutting, drawing and stamping. Chlorinated paraffins improve the pressure-accepting capacity of cutting fluids. They are believed to work by liberating hydrogen chloride as the metal surface heats up. This leads to the formation of metal chlorides, which have a good lubricating and parting effect, thereby helping to prevent the welding together of metal parts under high pressure and temperature involved. Generally, the efficiency of the metal working fluid increases as the chlorine content of the chlorinated paraffin increases (ECB, 2000).

A secondary function of cutting fluid is to flush away chips and metal fines from the tool/workpiece interface to prevent a finished surface from becoming marred and also to reduce the occurrence of built-up edge. Monitoring and maintenance of cutting fluid is required due to contamination and degradation. Eventually, fluids require disposal once their efficiency is lost. Waste management and disposal become a major problem concerning environmental liability (Sutherland J, 2002. See also: Filipovic A, 1998 and Bergstrom A, 1997).

Limited information is available on Australian industry practices, particularly those for small and medium enterprises, relating to disposal of waste fluids. Of the 28 companies that used metal cutting fluids, 11 companies (40%) indicated that no or little waste was generated by using metal cutting fluids, due to recycled use. Seven companies (25%) indicated that the waste generated was collected by licensed waste disposal contractors.

Guidance on disposal practices in general appears scarce. The United States Department of Labor provides a Safety and Health Best Practices Manual for Metalworking Fluids (OSHA, 2003). This document deals in depth with occupational and public health issues, but is relatively brief on environmental concerns. On the issue of disposal of fluids, the document refers to the need to adhere to Government regulations. In other areas of this document, disposal of spent fluids is referred to in broad terms, and guidance for rinse waters used in cleaning is for such rinse waters to be “dumped”.

***Release to sewer***

Attempts were made to gain a better understanding of importation in Australia of SCCPs and their use in metal working industries (see Section 3). The problem for environmental exposure as initially identified in the NICNAS report 2001 was the potential for inappropriate disposal of SCCPs by small metal working companies. Attempts to target this end of the industry through the NICNAS survey provided limited information due to incomplete responses from survey respondents.

Nonetheless, information obtained through the data collection phase (see Section 3) suggests the importation figure for SCCPs of 180 tonnes per annum estimated for the NICNAS 2001 report is substantially greater than the volumes in 2002.

According to the EU risk assessment, breakdown of the total losses for a large and small machine shop using oil-based cutting fluids are shown in Table 1.

**Table 1: Breakdown of the total losses for a large and small machine shop using oil-based cutting fluids (ECB, 2000).**

	Large Facility with swarf reprocessing		Small Facility - no swarf reprocessing	
<b>Misting/evaporation</b>	2%	to air	2%	to air
<b>Overalls</b>	1%	to water	2%	to water
<b>Leaks</b>	1%	to water	3%	to water
<b>Dragout/swarf</b>	27%	incinerated	81%	incinerated
	3%	to landfill	9%	to landfill
<b>Dragout/workpiece</b>	1%	to water	1%	to water
	2%	chemical waste	2%	chemical waste
<b>Internal processing</b>	1%	to water		
<b>External processing</b>	10%	Reuse/discard as waste oil		
<b>Total Losses</b>	48%		100%	

The EU risk assessment goes on to conclude that a worst case release to water could amount to 18% based on the following considerations:

- Misting/evaporation losses may be initially to air, but these have the potential to settle within the facility and reach waste water through cleaning;
- Losses through external reprocessing are due to line flushing. While this will be collected and re-used in a well controlled facility, in less controlled facilities, this waste could be discharged to sewer;
- Loss related to dragout of the cutting fluid on the work piece is generally through either alkaline washing or solvent washing. It is thought in both cases the remaining cutting fluid is distributed between emission to water and chemical waste. However, as a worst case, it could be assumed that all this dragout loss occurs to waste water.

While details of industry practice in Australia are limited, it has to be assumed that they are not significantly different between Europe and Australia. PEC calculations for Australia has been undertaken assuming:

- all SCCPs are used in oil-based (i.e. neat) cutting fluids;
- a total of 25 tonnes per annum are used, and
- all will be released from small operators with a worst case release to sewer of 18% or 4.5 tonnes per annum.

The main concern using assumptions solely based on the EU industry practice is that incineration is not a major disposal route in Australia. Therefore, the potential for exposure to aquatic and terrestrial compartments increases through greater likely release to sewer, and application of sewage sludge to agricultural land. This is considered further in the discussion below.

### ***Removal through sewage treatment***

Normal assessment practice would be to consider the worst case release from sewage treatment as being 100% i.e. no removal through a sewage treatment plant (STP). In the event that a concern was found due to such release, consideration of removal by STP would follow. The purpose of this assessment, however, is to revise the exposure assessment to be more representative. Therefore, release through the STP is considered prior to predicting environmental concentrations.

The properties of SCCPs will lead to a degree of removal through an STP. The model developed by the DEH in agreement with Australian State/Territory agencies considers removal within an STP based on the likely degradation of the chemical, its octanol/water partition co-efficient to estimate binding to biosolids, and its Henry's Law Constant which gives an indication of likely volatilisation from the waste water.

As noted in the NICNAS 2001 report, the LogKow values increase with the number of heavy atoms (carbon plus chlorine). The lowest LogKow value reported in the NICNAS 2001 report is 4.39 for C<sub>10-13</sub> with 49% chlorine, increasing to a LogKow value of 8 with 71% chlorine. A conservative figure of LogKow = 5 was used for modelling removal which resulted in a greater portion remaining in the water column.

SCCPs are not ready-biodegradable and a Henry's Law Constant of  $17.1 \text{ Pa}\cdot\text{m}^3/\text{mol}$  ( $\text{Log } H = 1.2$ ) is calculated using representative values of  $377 \text{ g/mol}$  molecular weight (eg,  $\text{C}_{12}\text{H}_{20}\text{Cl}_6$ ), vapour pressure of  $0.0213 \text{ Pa}$  and a water solubility of  $0.47 \text{ mg/L}$ .

Using these inputs, it is predicted that the following removals will occur in the STP:

- 2% to air
- 13.6% to water
- 84.4% to sludge
- 0% degraded

### ***Predicted environmental concentrations (PEC)***

The Australian model developed to determine PECs in receiving waters assumes release over percentages of the population. Release over 100% of the population equates to continental release and is used where this is known to be the case, for example, consumer chemicals. Where it is not possible to use this figure, the model will concentrate the release area to give increasingly conservative values. For SCCPs, it is considered appropriate to use the value of 100% of the population, as small metal working operations are found around the country and are not concentrated in any one geographic region.

The model predicts in this case, the concentration in receiving waters would be  $0.05 \mu\text{g/L}$  where release is to the ocean, and  $0.52 \mu\text{g/L}$  where release is to a river system (see Table 2).

Due to the concern expressed over exposure to sediment dwelling organisms, it is useful to try and predict a concentration in sediments. Australia has no formal guidelines on estimating concentrations in sediment. However, it would be expected that sediment partitioning would be a function of the chemical's sorption potential to solids and could be predicted from the water concentration.

The European Technical Guidance Document (TGD) (European Communities, 2003) gives guidance on predicting a sediment concentration based on the surrounding PEC in water, and the suspended matter-water partition coefficient (calculated to be 12 300 in this case, Trent University, 1999). This parameter is determined based on the chemical's  $K_{oc}$ , and how the chemical partitions between the solid and water phase in suspended matter.

Following the procedures outlined in the TGD, a  $\text{PEC}_{\text{sediment}}$  for ocean and river release has been calculated as  $0.53 \text{ mg/kg}$  and  $5.6 \text{ mg/kg}$ , respectively. There are no Australian monitoring data to support these calculations.

The Australian model also predicts concentrations in the soil compartment as a result of application of sewage biosolids to agricultural land. It is predicted that with 10 tonnes dry weight biosolids applied per hectare in a year, the concentration in 10 cm of soil will approach  $0.32 \text{ mg/kg}$ .

The above-mentioned PECs are summarised in Table 2.

**Table 2: Calculated PECs for water, sediment and soil**

PEC <sub>water</sub>	0.05 µg/L (Ocean)	0.52 µg/L (River)
PEC <sub>sediment</sub>	0.53 mg/kg (Ocean)	5.6 mg/kg (River)
PEC <sub>soil</sub>	0.32 mg/kg	

## 6.2 Environmental fate

The environmental fate of SCCPs is described in detail in the NICNAS 2001 report and is summarised as follows:

Where released to the environment, the compounds are expected to be stable, both microbially and abiotically although partial hydrolysis may be observed. However, SCCPs with low chlorine contents (e.g. <50% wt Cl) may biodegrade slowly in the environment, particularly in the presence of adapted microorganisms. Certain bacteria have also been shown to dechlorinate short chain chlorinated paraffins with high chlorine contents in a cometabolic process. Therefore, under certain conditions, biodegradation of these compounds might also be expected to occur slowly in the environment.

When released to land, SCCPs should bind strongly to the organic component of soils and be immobile. In the event of release to water, movement from the water column is likely to be rapid with the compounds partitioning to sediments and biota. Otherwise, they may volatilise to the atmosphere where they are expected to bind strongly to atmospheric particles, and potentially undergo long-range atmospheric transport further increasing environmental exposure.

Reported LogKow ranging in value from 4.39 to 8.69 indicate a high potential for bioaccumulation. High bioconcentration factors (ranging from 1000 to 50 000 for whole body, with high values for individual tissues) have been reported with a variety of freshwater and marine organisms. Chlorinated paraffins were taken up rapidly and uptake may be slower at the higher end of the chlorination range.

Most studies report moderate loss of bioaccumulated chlorinated paraffins on return to 'clean' water. Depuration half-lives have been reported at between 9 and 20 days. A single study suggests that 71% chlorinated compounds may be retained longer. It has been suggested that more rapid depuration from the liver, as compared to whole body, is indicative of metabolism and excretion.

## 6.3 Environmental effects

The environmental effects of SCCPs are described in detail in the NICNAS 2001 report and are summarised here.

Available data indicate SCCPs do not demonstrate acute toxicity to fish at levels far in excess of water solubility. However, they may be considered highly toxic to aquatic invertebrates. The effects of the carrier substance, or the degree of chlorination on the acute toxicity to invertebrates is not well understood. Toxicity was observed within the limits of solubility although there is a possibility the effects could be physical, particularly in the case of *Daphnia*.

SCCPs may also be considered highly toxic to algae, although in instances the EC50 values exceeded the highest mean measured concentrations of the test substance employed in the study. Some results exceeded the limit of solubility.

No data are available for sediment dwelling organisms. This is an area for further consideration, as it is likely to receive significant exposure in localised areas.

Whilst the current assessment focuses on environmental exposures of SCCPs for use in metalworking, it is useful for comparison to provide predicted no-effect concentrations (PNEC). PNECs were not determined in the NICNAS 2001 report. Based on the available data, the following PNECs are proposed:

**PNEC<sub>aquatic</sub>** There is a complete base set of data for SCCPs including acute and chronic data (as described in the NICNAS 2001 report). Because there are reported long term no-observed effect concentrations (NOEC) for three trophic levels (fish, invertebrates and algae), the PNEC can be derived from the most sensitive NOEC with an assessment factor of 10.

The most sensitive NOEC was a 21 day multi-generation study on *Daphnia magna*. While the original test report was not reviewed, it was carefully analysed by the EU competent authority (ECB, 2000). Although there was a problem with one of the three control groups, the study is regarded as valid. The 21 day NOEC was 0.005 mg/L. Applying the assessment factor gives a **PNEC = 0.5 µg/L**.

**PNEC<sub>sediment</sub>** There are no ecotoxicological data for sediment-dwelling organisms. It is possible to calculate a PNEC for sediment organisms using the equilibrium partition method, and this is described in the EC Technical Guidance Document (EC, 2003). This method calculated the sediment-water partition coefficient to be 2132 based on a LogKow of 5 (Trent University, 1999). The calculated **PNEC<sub>sediment</sub> = 0.82 mg/kg** (sediment density of 1300 kg/m<sup>3</sup>).

**PNEC<sub>soil</sub>** There are no data for terrestrial organisms, and again, it is possible to calculate a PNEC for soil following the equilibrium partition method and considering the soil-water partition coefficient. Again, using a LogKow value of 5, the soil-water partition coefficient is calculated to be 2050 (Trent University, 1999). The calculated **PNEC<sub>soil</sub> = 0.68 mg/kg** (soil density of 1500 kg/m<sup>3</sup>).

The PEC/PNEC ratios for water, sediment and soil are summarised in Table 3.

**Table 3: The PEC/PNEC ratios for water, sediment and soil**

	<u>Water</u>		<u>Sediment</u>		<u>Soil</u>
	Ocean	River	Ocean	River	
<b>PEC/PNEC ratio</b>	0.1	1.04	0.65	6.83	0.47

## 7 DISCUSSION AND CONCLUSIONS

When released to the environment, SCCPs are expected to be stable and degrade only slowly. However, they will bind strongly to soils and sediments and there is a high potential for bioaccumulation, supported by the limited available data. Long range transport through the air also appears to occur.

The NICNAS 2001 report concluded there was the potential for SCCP release during metal working use to have localised impacts on sediment dwelling organisms. No firm conclusion could be drawn, however, due to the lack of toxicity data in this area.

The current assessment has focussed on the environmental exposure possible through end use in small metal working facilities. It has used very conservative assumptions in ascertaining likely concentrations in receiving waters and sediments from release to the sewer, and soil resulting through application of sewage sludge to agricultural land. For comparative purposes, predicted no-effect concentrations have been derived for receiving waters, and calculated for soil and sediments.

It needs to be recognised that the lack of information on Australian industry practices is an impediment to being able to properly characterise exposure. Releases to water have been based on information on European practices. However, these involve significant levels of incineration. Incineration is not a main route of disposal in Australia. Therefore, the potential is for much higher levels to be reaching the aquatic and terrestrial environment through release to waste waters, and subsequent application of sewage sludge to agricultural land. While there seems to be significant declining use of SCCPs in cutting fluids in Australia, use of cutting fluids themselves is not declining. The issue of disposal will need to be fully considered in any tools developed for end users (see below).

The results of this more in-depth exposure assessment are as follows:

1. Importation volumes of SCCPs to Australia appear to have declined dramatically since the data collection for the NICNAS 2001 report. Only around 20% of the original volumes were identified as being used in metal working industries (25 tonnes per annum), with the remainder of the market being taken by medium and long chain chlorinated paraffins. Indications from industry surveys are that this trend is likely to continue.
2. Information with respect to methods of use and disposal by small and medium end users of metalworking fluids in Australia is limited; therefore, concerns still exist in this area. Moreover, the NICNAS survey indicated that 75% of the companies responded did not know if metal working fluid products contain SCCPs.
3. Based on the reported much lower use volumes, calculations performed in this assessment indicate there may still be the potential for adverse environmental impacts where release is to river systems (assume no dilution) in both water and sediment with indicative PEC/PNEC ratios of greater than 1 (1.04 and 6.8, for water and sediment respectively) (see Table 3).

4. Release to receiving waters and sediments in the ocean, and concentrations in soil from application of sewage sludge are not expected to result in adverse environmental impacts based on this assessment (see Table 3).

### **Risk reduction measures**

Risk reduction measures instigated in Europe following the EU risk assessment involved phasing out SCCPs from metal working fluids. SCCPs are classified as Dangerous for the Environment (very toxic to aquatic organisms/may cause long-term adverse effects in the aquatic environment) and Harmful, Carcinogen Category 3 in EU. The European Commission (EC) adopted a Directive (2001/C 213 E/20) in 2001 (EC, 2001) stating that SCCPs may not be placed on the market for use as substances or as constituents of preparations in metalworking fluids and for fat liquoring of leather in order to protect the aquatic environment. Member States were required to adopt and publish the laws, regulations and administrative provisions to comply with the Directive no later than 31 December 2001 and apply these provisions from 1 July 2002.

A recent Helsinki Commission report (EC, 2002) described the reduction in the use of SCCPs in Europe arising from the risk reduction activities. Use of SCCPs in EU has reduced from 13 000 tonnes in 1994 to 4000 tonnes in 1998. This represents a reduction of nearly 70%, mainly due to voluntary agreements by industry, although the main use in 1998 was still in metal working fluids. In 1998, about 50 % of European sales and about 10 % of MCCPs and LCCPs sales were used for formulation of metal working fluids.

The reduction in use of SCCPs and risk reduction activities in a number of EU countries are summarised and showed in Table 4.

Considering the similar trend in SCCPs consumption in Australia, voluntary phase-out use of SCCPs by industry should be considered.

**Table 4: Risk reduction activities in a number of EU countries (EC, 2002)**

---

<b>Country</b>	<b>Risk reduction activities</b>
<b>Germany</b>	<ul style="list-style-type: none"><li>• The production of SCCPs ceased by the end of 1995;</li><li>• Substitution of chlorinated paraffins started in the mid-1980s. By 1999, 99 % of metal working fluids were chlorine free.</li></ul>
<b>Sweden</b>	<ul style="list-style-type: none"><li>• The total use of SCCPs reduced by 90 % between 1990 and 1998, mainly due to reductions within the use in metal working fluids and paints;</li><li>• Met the national goal of a total phase-out in chemical products in 2001, mainly through voluntary phase-out activities by importers, producers and users of chemical products;</li><li>• Further, 90 % of the use of MCCPs and LCCPs has been phased out.</li></ul>
<b>Norway</b>	An almost complete phase-out of SCCPs used for formulation of metal working fluids.
<b>Belgium</b>	Phase-out activities have been reported.
<b>UK</b>	Phase-out activities have been reported.
<b>Denmark</b>	<ul style="list-style-type: none"><li>• Emissions, discharges and losses of SCCP reduced due to a voluntary agreement with the Danish EPA and the PVC industry in 1991;</li><li>• Granting of discharging licenses;</li><li>• The consumption reduced by 69 % within 1990s;</li><li>• Denmark will amend national legislation according to the EU Directive on chlorinated paraffins.</li></ul>
<b>Finland</b>	The consumption of SCCP decreased about 97 % between 1988 (840 tonnes) and 1997 (27 tonnes).

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### **Alternatives**

The Helsinki Commission report (EC, 2002) stated that MCCPs is being used as replacements in the EU for SCCP as extreme pressure additives in metal working fluids, plasticisers in paint, and additives in sealants.

LCCPs have, at least in Sweden, been used in some demanding applications in metal working fluids instead of SCCPs. LCCPs are also suggested as replacements to SCCPs in the leather industry as well as in paint, coatings, and in sealants and rubber. No international reviews or assessments on LCCPs are available.

Other substitutes were also reported in the Helsinki Commission report (EC, 2002) and are summarised in Table 5.

**Table 5: Alternatives to SCCPs being used in EU countries (EC, 2002)**

<b>Alternative</b>	<b>Uses</b>
Alkyl phosphate esters, Sulfonated fatty acid esters	Extreme pressure additives in metal working fluids
Natural animal and vegetable oils	Leather industry
Phthalate esters, polyacrylic esters, diisobutyrate, phosphate and boron containing compounds	Paint and coatings
Phthalates esters	Sealants
Antimony trioxide, aluminium hydroxide, acrylic polymers and phosphate containing compounds	Flame retardant in rubber, textiles and PVC

Sweden considers above-mentioned substitutes less harmful than chlorinated paraffins, however, reports that there might be uses for which these alternatives do not fulfil all technical and security demands (EC, 2002). Other risk reduction measures, such as closed production and/or further regulation of emission limits, should be taken into account (EC, 2002).

The EU is currently assessing the risks from use of MCCPs, including uses in metal working fluids. The draft EU risk assessment on MCCPs (ECB, 2002), prepared by UK, indicates that MCCPs have similar characteristics to SCCPs regarding biodegradation and can be considered not biodegradable based on available data. Some risk reduction measures may be required for use in some applications including metal working fluids. The risk from use in oil-based metal cutting fluids may also be of concern. It is, however, too early in the process to conclude what the actual proposals on risk reduction measures will be. According to comments from the UK, these considerations need to include potential implications of other substitutes to SCCPs.

The World Health Organisation (WHO) Environmental Health Criteria (EHC) Monograph 181 for chlorinated paraffins published under the International Programme on Chemical Safety (IPCS) (IPCS, 1996) stated that chlorinated paraffins including SCCPs and longer chain chlorinated paraffins are generally stable in the natural environment. In this review, a study of microbial degradation of several short, medium and long chain chlorinated paraffins indicated that the degradation rate decreased with increasing carbon chain length and chlorination degree. However, SCCPs accumulate in mussels and fish to a higher degree than longer chain chlorinated paraffins.

While substitution is a potential option in Australia, it may not fully address the issue. SCCPs are being replaced with MCCP and LCCPs in Australia. Also, the main problem with environmental exposure is not just the SCCPs, rather the poorly controlled use and release of metal working fluids in general, possibly due to their low cost and hence, a lack of incentive to preserve such chemicals. It may be that a better goal is to increase awareness among users of the need to control release of these substances, thereby reducing environmental exposure to not only the SCCPs which are present as extreme pressure additives, but also all other components of metal working fluids such as emulsifiers, biocides, anti-foaming additives etc. that are present in cutting fluid formulations.

In this regard, a number of recommendations to industry and industry associations are made. This report will also be forwarded to the Environment Protection Heritage Council (EPHC), along with the State and Territory Environment Departments for their consideration.

## **8 RECOMMENDATIONS**

### **Preamble**

Recommendation 5 from the NICNAS 2001 report was as follows:

The potential for release to the aquatic compartment through inappropriate disposal of extreme pressure lubricants used in metal working fluids may be high, and a worst case assumption in the case of the latter is for 50% to be disposed of to sewer from smaller operators.

There are no data on sediment dwelling organisms, and these may be subject to localised high exposure. Based on the reasonable worst-case assessment of 50% disposal to sewer, the potential for environmental risks is of concern. Therefore a full environmental risk assessment for metal-working is recommended, unless information on sewer release comes forward which indicates acceptable releases.

This recommendation identified disposal of metal working fluid to be of concern and limited the scope of further risk assessment work to the metal working industry. Prior to investing the resources required for a full risk assessment in this area, a decision was taken to conduct a more in-depth environmental exposure assessment into releases from the metal-working industry. The outcomes of this assessment could then determine the need for implementing Recommendation 5 of the NICNAS 2001 report.

The current environmental exposure assessment has found as follows:

- A very large reduction in the annual usage of SCCPs, with indications that this trend is likely to continue.
- While this is not a risk assessment, conservative calculations indicate a potential risk from exposure to SCCPs used in metalworking fluids where release occurs to river systems for both the water and sediment compartments.
- Although there is a decline in the use of SCCPs in cutting fluids, indications are that SCCPs are being replaced by MCCPs/LCCPs, which may not deliver any better outcomes for the environment.
- Additionally, the use of cutting fluids themselves is not declining and constitutes a significant ongoing exposure to the environment. As such, the issue of disposal of cutting fluids in general could be considered in the future.

Of further importance is that since the completion of the NICNAS 2001 report, the Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted and opened for signature in May 2001. It is clear that the persistence of SCCPs in all environmental media, and the bioaccumulation potential of these substances, meet the POPs screening criteria outlined in Annex D of the Convention.

### **Specific recommendations pertaining to SCCPs**

#### ***Recommendation 1***

A full environmental risk assessment for SCCPs in the metal working industry is not recommended. Any future risk assessment activity in this area should focus on chlorinated paraffins in general to cover short, medium and long chain molecules. Substitution of SCCPs with longer chain chlorinated paraffins is a potential concern due to the properties of the longer chain molecules.

#### ***Recommendation 2***

This report along with the NICNAS 2001 report will be forwarded to the Environment Protection and Heritage Council (EPHC) for its consideration for action.

The EPHC should note:

- The risk reduction activities undertaken in the EU leading to a decrease in use of SCCP;
- Substitutes used in the EU;

- Declining use in Australia is still a concern to the environment because of POPs like characteristics of SCCPs;
- Replacements by MCCPs and LCCPs are of concern due to their similar characteristics to SCCPs.

***Recommendation 3 (to end users)***

Voluntary industry phase-out of the use of SCCPs in metal working fluids is recommended. Substitution of chlorinated paraffins with non-chlorinated extreme pressure additives should be carefully considered and implemented wherever possible. Source of the substitutes used overseas are listed in Table 5.

**Recommendations pertaining to metal working fluids**

Regardless of any future environmental risk assessment work, there are measures industry can immediately implement to reduce the burden of contaminants from metal working fluids in the environment. Recommendations 3 and 4 address these measures.

***Recommendation 4 (to end users)***

To reduce the potential environmental exposure from splashing/spillage, on a day-to-day basis, spills should be cleaned up immediately. Wastes should not be dumped or swept into sumps or coolant return trenches. Waste material, including solvent-soaked rags used for clean-up, should be deposited in airtight metal receptacles prior to disposal to landfill.

***Recommendation 5 (to end users)***

Risk mitigation action should be focussed predominantly on strategies to extend the useful life of metal working fluids as much as possible thus reducing waste levels and release to the environment.

Measures aimed at extending life of metal working fluids include:

- Removal of substances that physically interfere with the cutting fluid. The fluids should be filtered and recycled regularly;
- Removal of organisms that can degrade the coolant. Bacteria and fungi can reduce the effectiveness of the cutting fluid;
- Removal of substances that create habitats for destructive organisms. Swarf and tramp oil my create a habitat that promotes the growth of bacteria; and
- Initiation of a long-term management system to extend the life of cutting fluids.

***Recommendation 6***

Following the current assessment, NICNAS will prepare an Information Sheet for distribution to workplaces. It is recommended that state jurisdictions and industry associations disseminate the Information Sheet widely.

***Recommendation 7 (to state and territory environment authorities)***

State and territory environment authorities should note recommendations 3 and 4 and could work in partnership with industry to ensure take up of voluntary initiatives. Environment authorities should explore compliance measures as necessary and may wish to build into their chemical program a measure to monitor for the poor management and disposal of metal working fluids.

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