Australian Government

Department of Health and Aged Care

Australian Industrial Chemicals Introduction Scheme

Ethoxylated alcohols

Evaluation statement (EVA00168)

31 March 2025

Draft

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Evaluation statement (EVA00168)

Subject of the evaluation

Ethoxylated alcohols

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Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-	3055-94-5
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Ethanol, 2-(dodecyloxy)-	4536-30-5
Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-, mixt. with .alpha.-octadecyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl)	8065-80-3
Poly(oxy-1,2-ethanediyl), .alpha.-dodecyl-.omega.-hydroxy-	9002-92-0
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Poly(oxy-1,2-ethanediyl), .alpha.-octadecyl-.omega.-hydroxy-	9005-00-9
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-	9043-30-5
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Poly(oxy-1,2-ethanediyl), .alpha.-(2-octyldodecyl)-.omega.-hydroxy-	32128-65-7
Poly(oxy-1,2-ethanediyl), .alpha.-nonyl-.omega.-hydroxy-	39587-22-9
Poly(oxy-1,2-ethanediyl), .alpha.-isooctadecyl-.omega.-hydroxy-	52292-17-8

CAS name	CAS number
Poly(oxy-1,2-ethanediyl), .alpha.-[3,5-dimethyl-1-(2-methylpropyl)hexyl]-.omega.-hydroxy-	60828-78-6
Poly(oxy-1,2-ethanediyl), .alpha.-[1,3-dimethyl-1-(2-methylpropyl)hexyl]-.omega.-hydroxy-	61702-78-1
Poly(oxy-1,2-ethanediyl), .alpha.-isooctyl-.omega.-hydroxy-	61723-78-2
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Alcohols, C_{10-12}, ethoxylated	67254-71-1
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Alcohols, C_{8-22}, ethoxylated	69013-19-0
Alcohols, C_{16-22}, ethoxylated	69227-20-9
Alcohols, C_{6-10}, ethoxylated	70879-83-3
Alcohols, C_{8-10}, ethoxylated	71060-57-6
Alcohols, C_{8-16}, ethoxylated	71243-46-4

CAS name	CAS number
Alcohols, C_{9-11}-iso-, C_{10}-rich, ethoxylated	78330-20-8
Alcohols, C_{11-14}-isoalcohols, C_{13}-rich, ethoxylated	78330-21-9
Secondary alcohols, C_{12-14}, ethoxylated	84133-50-6
Alcohols, C_{10-18}, ethoxylated	85422-93-1
Alcohols, $C_{>30}$, ethoxylated	97953-22-5
Alcohols, C_{16-20}, ethoxylated	106232-82-0
Alcohols, C_{12-15}-branched and linear, ethoxylated	106232-83-1
Alcohols, C_{18-22}, ethoxylated	116810-32-3
Alcohols, C_{14-15}-branched and linear, ethoxylated	120944-68-5
Alcohols, C_{10-12}-secondary, ethoxylated	125736-52-9
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-, branched and linear	127036-24-2

Reason for the evaluation

Evaluation Selection Analysis indicated a potential environmental risk.

Parameters of evaluation

These chemicals are a group of structurally similar, medium to long chain (C6–C>30) ethoxylated alcohols that are listed on the Australian Inventory of Industrial Chemicals (the Inventory). This group of chemicals belongs to a widely used class of non-ionic surfactants. This evaluation is an environmental risk assessment of the identified industrial uses of the chemicals in Australia.

These chemicals have been assessed as a group as they have similar chemical structure and use patterns.

The risks posed to the environment associated with the industrial uses of these chemicals have been evaluated according to the following parameters:

- introduction to Australia at up to 9,999 tonnes/year
- expected release into sewage treatment plants (STPs) due to consumer and commercial use.

In this evaluation, chemical names have been abbreviated to describe alkyl chain lengths and ethoxylate chain lengths, where relevant. For example, ‘Alcohols, C_{9-11}, ethoxylated’ is abbreviated to $C_{9–11}EO_x$.

Summary of evaluation

Summary of introduction, use and end use

Ethoxylated alcohols have functional use as surfactants used in a wide variety of consumer and commercial products. Available Australian and international data indicate that these chemicals are used in high volumes worldwide (>1,000 tonnes/year).

Significant quantities of ethoxylated alcohols have site-limited application with functional use as intermediates in the manufacture of alcohol ethoxysulfate surfactants.

Based on international and limited Australian use data, these chemicals are also expected to have widespread use in a range of products, including:

- adhesive and sealants,
- air care products,
- apparel and footwear care products,
- automotive care products,
- cleaning and furniture care products,
- fuel, oil, fuel oil additives and related products,
- lubricants and greases,
- paints and coatings,
- paper products,
- personal care products not covered by other end uses.

Chemicals in this evaluation are expected to have broad commercial use in the pulp and paper industry, the textiles industry, and the chemical industry.

Environment

Summary of environmental hazard characteristics

According to domestic environmental hazard thresholds (DCCEEW 2022) and based on the available data, chemicals with CAS RNs 60828-78-6 and 61702-78-1 are Persistent (P). All other chemicals are Not Persistent (Not P).

All chemicals in this group are Not Bioaccumulative (Not B).

Based on the available data, the following chemicals are Toxic (T):

- C12 ethoxylated alcohols (CAS RN 3055-93-4; 3055-94-5; 3055-95-6; 4536-30-5; 9002-92-0, 60828-78-6; 61702-78-1)
- C13 ethoxylated alcohols (CAS RN 9043-30-5; 24938-91-8; 69011-36-5)
- C14 ethoxylated alcohols (CAS RN 27306-79-2)
- C16 ethoxylated alcohols (CAS RN 9004-95-9)
- C12–13 ethoxylated alcohols (CAS RN 66455-14-9)
- C12–14 ethoxylated alcohols (CAS RN 68439-50-9; 84133-50-6)
- C12–15 ethoxylated alcohols (CAS RN 68131-39-5; 106232-83-1)
- C12–16 ethoxylated alcohols (CAS RN 68551-12-2)
- C13–15 ethoxylated alcohols (CAS RN 64425-86-1)
- C14–15 ethoxylated alcohols (CAS RN 120944-68-5)

- C16–18 ethoxylated alcohols (CAS RN 8065-80-3; 68439-49-6)

All other chemicals are Not Toxic (Not T).

Environmental hazard classification

Most of these chemicals satisfy the criteria for classification according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) (UNECE 2017) for environmental hazards. This does not consider classification of physical hazards.

Many chemicals are UVCBs (unknown or variable composition, complex reaction products or of biological origin) comprising homologues with different alkyl chain lengths and different ethoxylate chain lengths. The hazards of these chemicals will depend on the composition, which may differ between different manufacturers. For this reason, UVCBs have been classified according to the criteria for mixtures using available ecotoxicity data (UNECE 2017). UVCBs without specific ecotoxicity data were classified using the 'summation method' based on the expected alkyl chain length distribution of the precursor alcohols. Although longer ethoxylate chains are expected to reduce overall toxicity, these trends were not clear from the available ecotoxicity data.

Some of the proposed hazard classifications are based on read across principles and available composition data (see **Supporting information**). They should be used as a default for these chemicals. If empirical data become available for a specific chemical, this data may be used to amend the default classification for that chemical. The following chemicals are classified according to the table below:

- C6 ethoxylated alcohols (CAS RN 112-59-4; 31726-34-8)
- C8 ethoxylated alcohols (CAS RN 26468-86-0; 27252-75-1; 61723-78-2)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 3	H402: Harmful to aquatic life

The following chemicals are classified according to the table below:

- C9 ethoxylated alcohols (CAS RN 39587-22-9)
- C10 ethoxylated alcohols (CAS RN 26183-52-8; 61827-42-7)
- C18 ethoxylated alcohols (CAS RN 9005-00-9; 52292-17-8)
- C6–10 ethoxylated alcohols (CAS RN 70879-83-3)
- C6–12 ethoxylated alcohols (CAS RN 68439-45-2)
- C8–10 ethoxylated alcohols (CAS RN 71060-57-6)
- C18–22 ethoxylated alcohols (CAS RN 116810-32-3)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 2	H401: Toxic to aquatic life

The following chemicals are classified according to the table below:

- C11 ethoxylated alcohols (CAS RN 127036-24-2)
- $C_{12}EO_7$ (CAS RN 3055-97-8)
- C9–11 ethoxylated alcohols (CAS RN 68439-46-3; 78330-20-8)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 2	H401: Toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 3	H412: Harmful to aquatic life with long lasting effects

The following chemicals are classified according to the table below:

- C10–12 ethoxylated alcohols (CAS RN 67254-71-1; 125736-52-9)
- C12–18 ethoxylated alcohols (CAS RN 68213-23-0)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 2	H401: Toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 2	H411: Toxic to aquatic life with long lasting effects

The following chemicals are classified according to the table below:

- $C_{12}EO_3$ and $C_{12}EO_5$ (CAS RN 3055-94-5; 3055-95-6)
- C13 ethoxylated alcohols (CAS RN 9043-30-5; 24938-91-8; 69011-36-5)
- C14 ethoxylated alcohols (CAS RN 27306-79-2)
- C12–13 ethoxylated alcohols (CAS RN 66455-14-9)
- C16–18 ethoxylated alcohols (CAS RN 8065-80-3; 68439-49-6)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 1	H400: Very toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 3	H412: Harmful to aquatic life with long lasting effects

The following chemicals are classified according to the table below:

- C12 ethoxylated alcohols (CAS RN 3055-93-4; 4536-30-5; 9002-92-0)
- C16 ethoxylated alcohols (CAS RN 9004-95-9)
- C10–14 ethoxylated alcohols (CAS RN 66455-15-0)
- C10–16 ethoxylated alcohols (CAS RN 68002-97-1)
- C10–18 ethoxylated alcohols (CAS RN 85422-93-1)
- C11–13 ethoxylated alcohols (CAS RN 68439-54-3)
- C11–14 ethoxylated alcohols (CAS RN 78330-21-9)
- C11–15 ethoxylated alcohols (CAS RN 68131-40-8)
- C12–14 ethoxylated alcohols (CAS RN 68439-50-9; 84133-50-6)
- C12–15 ethoxylated alcohols (CAS RN 68131-39-5; 106232-83-1)
- C12–16 ethoxylated alcohols (CAS RN 68551-12-2)
- C13–15 ethoxylated alcohols (CAS RN 64425-86-1)
- C14–15 ethoxylated alcohols (CAS RN 120944-68-5)
- C16–20 ethoxylated alcohols (CAS RN 106232-82-0)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 1	H400: Very toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 2	H411: Toxic to aquatic life with long lasting effects

The following chemicals are classified according to the table below:

- Highly branched C12 ethoxylated alcohols (CAS RN 60828-78-6; 61702-78-1)

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 1	H400: Very toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 1	H410: Very toxic to aquatic life with long lasting effects

The following chemicals are not classified for aquatic hazards:

- C20 ethoxylated alcohols (CAS RN 32128-65-7)
- C>30 ethoxylated alcohols (CAS RN 97953-22-5)

The following chemicals are not classifiable for aquatic hazards:

- C7–21 ethoxylated alcohols (CAS RN 68991-48-0)
- C8–16 ethoxylated alcohols (CAS RN 71243-46-4)
- C8–22 ethoxylated alcohols (CAS RN 69013-19-0)
- C12–20 ethoxylated alcohols (CAS RN 68526-94-3)
- C16–22 ethoxylated alcohols (CAS RN 69227-20-9)

Summary of environmental risk

Ethoxylated alcohols have cumulative Australian use volumes up to approximately 9,999 tonnes per year. These chemicals are used as surfactants in a wide range of consumer and commercial products and are released in wastewater as a normal part of their use pattern.

Ethoxylated alcohols C12 to C16 are toxic according to Australian thresholds. All ethoxylated alcohols have low bioaccumulation potential. Only highly branched C12 ethoxylated alcohols (CAS RN 60828-78-6; 61702-78-1) are expected to be persistent.

Based on measured international concentrations in sewage treatment plant (STP) effluent and surface waters, ethoxylated alcohols are expected to be present in Australian surface waters at concentrations below the level of concern.

The calculated risk quotient (RQ) obtained for ethoxylated alcohols in surface water is less than 1. Therefore, the current industrial use of these chemicals in Australia is not expected to pose a significant risk to the environment.

Conclusions

The Executive Director proposes to be satisfied that the identified risks to the environment from the introduction and use of these industrial chemicals can be managed.

Note:

1. Obligations to report additional information about hazards under *Section 100 of the Industrial Chemicals Act 2019* apply.
2. You should be aware of your obligations under environmental, workplace health and safety and poisons legislation as adopted by the relevant state or territory

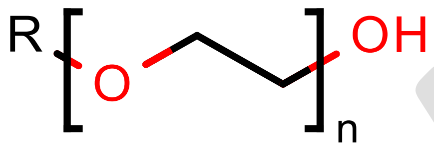
Supporting information

Grouping rationale

This evaluation considers the environmental risks associated with industrial uses of a group of 57 ethoxylated alcohols. Chemicals in this evaluation are used in high volumes worldwide and were selected for evaluation because the Evaluation Selection Analysis indicated a potential risk to the environment. These chemicals have been assessed as a group as they have similar chemical structures, industrial uses and environmental release patterns, and are expected to have similar environmental effects.

Chemical identity

Representative structure



R = C_mH_{2m+1}, m ≥ 6

Additional chemical identity information

The chemicals in this evaluation are structurally similar non-ionic surfactants. They consist of a saturated linear or branched alkyl chain attached to a polyethoxylate chain with a hydroxyl (OH) end group. The typical structure is of the form R-$(OCH_2CH_2)_n$-OH (pictured), where R is an alkyl chain in the form C_mH_{2m+1} (m ≥ 6), and OCH_2CH_2 is an ethoxylate (EO) unit.

Chemicals in this evaluation are referred to by the shorthand notation C_mEO_n, where 'm' is the size of the alkyl chain and 'n', if specified, is the degree of ethoxylation, which can be a specific chain length or the average chain length from a distribution. For example, the chemical '3,6,9,12,15-Pentaoxaheptacosan-1-ol' (CAS RN 3055-95-6), which has a C12 alkyl chain attached to an ethoxylate chain containing five EO units, is referred to as $C_{12}EO_5$. The nomenclature $C_{(m1–m2)}EO_n$ is used for chemicals comprising a range of alkyl chain lengths. For example, 'Alcohols, C6-12, ethoxylated' (CAS RN 68439-45-2), which contains chemicals with alkyl chains nominally ranging from C6 to C12, is referred to as $C_{6–12}EO_x$.

Chemicals in this evaluation are mostly UVCBs (unknown or variable composition, complex reaction products or biological materials) comprising homologues with different alkyl chains and with different ethoxylate chain lengths:

- This evaluation contains chemicals with alkyl chains ranging from C6 to C>30. The alkyl chains may contain differing degrees of branching.
- Alkyl chain length distribution may vary between different manufacturers.
- Many chemical names do not specify a specific ethoxylation level and commercial products with these CAS RNs may have very different ethoxylate chain lengths:

- Typical ethoxylate chain lengths in domestic products are expected to be between 1 EO units and 22 EO units long (AISE and Cefic 2009).
- Commercial products are expected to contain a small percentage (<10%) of unreacted alcohol (zero EO units) (AISE and Cefic 2009).

Chemicals in this evaluation are manufactured through base-catalysed ethoxylation of fatty alcohols with sodium or potassium hydroxide, followed by neutralisation with an acid such as acetic or phosphoric acid (AISE and Cefic 2009). Commercial products may be sold in solid, paste and solution forms.

Fatty alcohols used to manufacture ethoxylated alcohols are derived from oleochemical sources (vegetable oils and animal fats), manufactured from ethylene using the Ziegler process, or manufactured from olefins using oxo-synthesis (addition of CO to an olefin) (OECD 2006). The size and linearity of the alkyl group varies depending on the production method used.

- Alcohols manufactured from oleochemical feedstocks or from the Ziegler process are practically 100% linear and have even alkyl chains between C6 and C22.
- Alcohols manufactured from linear olefins using oxo-synthesis are mostly linear or mono-branched (e.g. iso-/sec- alkanes, ethylhexyl alkanes) and have odd and even chains between C7 and C17.
- Alcohols manufactured from highly branched olefins using oxo-synthesis may contain tertiary and quaternary carbon centres (Bragin et al. 2020).

Relevant physical and chemical properties

Chemicals in this evaluation consist of a hydrophobic alkyl chain attached to a hydrophilic ethoxylate chain. The size of the alkyl chain and the length of the ethoxylate chain have competing effects on water solubility and log K_{OW}. These trends in turn influence the fate and hazard characteristics of these chemicals in the environment.

The following trends in physical and chemical properties of ethoxylated alcohols were summarised from a 2009 HERA report on these chemicals (AISE and Cefic 2009).

Chemicals in this evaluation exhibit a large range of aqueous solubilities. Solubility tends to decrease as the number of carbon atoms in the alkyl chain increases. According to available experimental data, linear fatty alcohols vary between moderately soluble at C8 (551 mg/L) to very slightly soluble at C18 (0.0011 mg/L). For ethoxylated alcohols, aqueous solubility (given by the critical micelle concentration) increases as the number of EO units in the ethoxylate chain increases. According to available experimental data, ethoxylated alcohols can have an aqueous solubility in excess of 25 times the solubility of the precursor alcohol (AISE and Cefic 2009).

Chemicals in this evaluation are expected to be lipophilic (log K_{OW} > 0). Lipophilicity increases as the number of carbon atoms in the alkyl chain increases. According to available experimental data, log K_{OW} values of linear fatty alcohols vary between 3.15 at C8 and 7.19 at C18. For ethoxylated alcohols, lipophilicity tends to decrease with the length of the ethoxylate chain. Calculated log K_{OW} values indicate that every 5 EO units added to the ethoxylate chain lowers the log K_{OW} by approximately 0.5 units. Therefore, only the shortest alkyl chain length (C<9) chemicals with very long ethoxylate chains (n > 30) are expected to be hydrophilic (log K_{OW} < 0).

Chemicals in this evaluation are expected to be non-volatile. According to available experimental data, fatty alcohols vary between volatile (VP > 1 Pa) at C10 to very slightly volatile (VP < $1x10^{-4}$ Pa) at C20. Experimental vapour pressures are not available for ethoxylated alcohols. However, only short alkyl chain length chemicals with short ethoxylate chains are expected to be volatile. Estimated vapour pressures of linear C6 ethoxylates vary between volatile (6.05 Pa) at one EO unit to very slightly volatile ($6.74x10^{-5}$ Pa) at 4 EO units (US EPA 2017).

Experimental information for representative chemicals is tabulated below. These chemicals have relatively low levels of ethoxylation (n = 1–2.5) but demonstrate trends due to alkyl chain length. The data were retrieved from registration dossiers submitted under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation in the European Union (EU) (REACH n.d.-f; REACH n.d.-g; REACH n.d.-h; REACH n.d.-n):

Chemical	$C_8EO_{1–2.5}$	$C_{12}EO_{1–2.5}$	$C_{16}EO_{1–2.5}$	$C_{18}EO_{1–2.5}$
CAS RN	27252-75-1	9002-92-0	9004-95-9	9005-00-9
Physical form	Liquid	Liquid	Solid	Solid
Melting point	<-20°C	-5.37°C	5–43°C	-3–53°C
Boiling point	204°C	242°C	>346°C	>371°C
Water solubility (cmc)	1,850 mg/L	281.1 mg/L	0.002–0.911 mg/L	<0.005 mg/L
log K_{OW}	2.19	2.26	>6.06	>7.06

Introduction and use

Australia

According to volume information provided to the former National Industrial Chemicals Notification and Assessment Scheme (NICNAS) under previous calls for information (NICNAS 2002; NICNAS 2006), the following chemicals have reported Australian use volumes of 1,000–9,999 tonnes per year:

- $C_{12–15}EO_x$ (CAS RN 68131-39-5)
- $C_{10–16}EO_x$ (CAS RN 68002-97-1)

The following chemicals have reported Australian use volumes of 100–999 tonnes per year:

- Iso-$C_{10}EO_x$ (CAS RN 61827-42-7)
- $C_{12–13}EO_x$ (CAS RN 66455-14-9)
- $C_{12–18}EO_x$ (CAS RN 68213-23-0)
- $C_{12–14}EO_x$ (CAS RN 84133-50-6)

According to use information provided under previous calls for information, chemicals in this evaluation have reported Australian uses in a range of end products (NICNAS 2019):

- laundry and dishwashing products

- cleaning and furniture care products
- personal care products
- fuel, oil, fuel oil additives and related products
- adhesives and sealant products
- automotive care products
- lubricants and grease products.

International

Available data from international regions indicate high use volumes of ethoxylated alcohols worldwide:

- In Europe, the total volume of ethoxylated alcohols used in domestic cleaning products was estimated at 275,000 tonnes in 2002 (AISE and Cefic 2009). In 1999, 290,000 tonnes were sold for use in domestic cleaning products and another 80,000 tonnes were reportedly used in other applications.
- In North America, the total volume of ethoxylated alcohols used for non-intermediate use was reportedly 166,070 tonnes in 2008 (Cowan-Ellsberry et al. 2014). In 2000, the total volume used for non-intermediate use was approximately 216,800 tonnes (Environment Canada 2013).
- In Japan, use volumes of 100,000–200,000 tonnes per year have been reported for chemicals under a generic term, 'Polyoxyalkylene (C 2-4,8) monoalkyl(or alkenyl) (C 1-24) ether (n=1-150)' during the years 2015–2020 and 2022 (NITE n.d.). A higher volume of 700,000–800,000 tonnes was reported in 2021.

Ethoxylated alcohols are primarily used as intermediates in the manufacture of alcohol ethoxysulfate surfactants. In 2008, around 58% of ethoxylated alcohols used in North America were reportedly converted to ethoxysulfates (Cowan-Ellsberry et al. 2014).

The primary non-intermediate use of ethoxylated alcohols is as surfactants in laundry detergents (Cowan-Ellsberry et al. 2014). They are used to a lesser extent in other domestic and commercial cleaning products. According to the Consumer Product Information Database (CPID) (DeLima Associates n.d.), chemicals in this evaluation are present in laundry and dishwashing detergents, cleaning and furniture care products, apparel and footwear care products, air care products, and automotive care products.

Another major use of ethoxylated alcohols is as surfactants in cosmetics (Cowan-Ellsberry et al. 2014). Generally, chemicals with fewer EO units function as emulsifying agents while chemicals with longer ethoxylate chains function as solubilising and cleansing agents (Fiume et al. 2012).

Chemicals in this evaluation are reportedly used in paints and coatings (REACH n.d.-b; REACH n.d.-c; REACH n.d.-d; REACH n.d.-e; REACH n.d.-n).

Ethoxylated alcohols are used in various process industries, including chemicals, pulp and paper, and textiles (AISE and Cefic 2009).

Chemicals in this evaluation have reported non-industrial uses in pesticides, food additives and pharmaceuticals (NICNAS 2019).

Ethoxylated alcohols have been identified as potential replacements for nonylphenol ethoxylates and octylphenol ethoxylates in oil and gas extraction (Pawar and Vidic 2024).

Uses of chemicals in this group in resource extraction (including oil and gas production, and mining) are not considered in this evaluation.

International regulatory status

United Nations

Chemicals in this evaluation are not currently identified as a Persistent Organic Pollutants (POP) (UNEP 2001), ozone depleting substances (UNEP 1987), or hazardous substances for the purpose of international trade (UNEP & FAO 1998).

Environmental exposure

These chemicals are used as surfactants in products that are typically released to sewers as part of their domestic or commercial use. Depending on the degradation and partitioning processes of chemicals in STPs, a fraction of the quantity of chemicals in raw sewage entering STPs will be emitted to rivers or oceans in treated effluent, or to soil by application of biosolids to agricultural land.

A subset of uses may result in direct or diffuse release of ethoxylated alcohols to the environment, such as use in car washing products. In such uses, these chemicals may be emitted to the soil compartment, or to surface waters without STP treatment through stormwater drainage systems. However, these uses are expected to be minor compared to the widespread, continuous use of personal care and laundry and cleaning products that make up most of the use volume.

Environmental fate

Partitioning

Chemicals in this evaluation have high adsorption potentials and will rapidly and reversibly partition to sludge and organic carbon in sediments. Adsorption increases with the overall size of the molecule. According to available experimental data, soil-adsorption coefficients (K_{OC}) vary between 370 L/kg (moderate sorption potential) at $C_{10}EO_3$ to 896,500 L/kg (very-strong sorption potential) at $C_{15}EO_9$ (Van Compernolle et al. 2006).

Chemicals released to wastewater are treated at STPs, where they will partition preferentially to the sludge and solids fractions, releasing a relatively minor proportion in effluent. Chemicals in this evaluation may be released to the soil compartment due to application of contaminated STP biosolids residues to land. Chemicals released to surface water are expected to partition significantly to sediments.

Degradation

Most chemicals in this evaluation are not persistent and will rapidly and ultimately degrade in the environment. A subset of highly branched homologues may be persistent. While it is possible that a small proportion of highly branched chemicals are present in some UVCBs, measured biodegradation data suggest that these generally pass ready biodegradation tests.

Mechanisms for biodegradation of ethoxylated alcohols change depending on the amount of branching of the alkyl chain.

Primary biodegradation of linear and mono-branched homologues with short side chains (i.e. 2-methyl, 2-ethyl and 2-propyl) proceeds mainly by central cleavage of the hydrophilic ethoxylate chain from the hydrophobic fatty alcohol (Marcomini et al. 2000a). Ultimate degradation is subsequently achieved by oxidative degradation of the fatty alcohol and hydrolytic and or hydrolytic-oxidative degradation of the ethoxylate chain.

Chemicals with longer side chains (i.e. 2-butyl) undergo a more complex biodegradation mechanism involving oxidative degradation of the alkyl chain, starting at the terminal carbon, and hydrolytic shortening of the ethoxylate chain (Marcomini et al. 2000a). This mechanism is slower than central cleavage but is expected to lead to ultimate degradation in the environment.

Standard test results for ready biodegradability are available for a variety of different linear and non-highly branched ethoxylated alcohols. These results cover pure homologues of ethoxylated alcohols and UVCBs with alkyl chains between C8 and C18 and ethoxylate chains between 1 and 30 EO units in length (AISE and Cefic 2009). These chemicals generally achieve passing results in 28 to 30 day tests conducted according to OECD 301 test guidelines (TG), indicating rapid degradation in the environment for most of the chemicals in this evaluation.

No data are available forchemicals in this evaluation with longer alkyl chain lengths (C>18). However, these chemicals are not expected to be persistent. Chemical identity information for these chemicals suggests they are linear or non-highly branched. Therefore, they are expected to ultimately biodegrade in the environment.

Linear ethoxylated alcohols ultimately biodegrade under anaerobic conditions but at slower rates compared to aerobic biodegradation. Anaerobic biodegradation begins with stepwise shortening of the ethoxylate chain and continues via oxidative degradation of the fatty alcohol (Huber et al. 2000). A laboratory study using an anaerobic digester operating at 35°C demonstrated >80% biodegradation of linear $C_{18}EO_7$ by loss of total radioactivity after 28 days (AISE and Cefic 2009). A similar laboratory study involving lightly branched ethoxylates showed only partial degradation to mono-ethoxylated metabolites (Mösche 2004). Therefore, only linear ethoxylates are expected to be ultimately degradable under anaerobic conditions.

Biodegradation of highly branched ethoxylated alcohols involves hydrolytic shortening of the ethoxylate chain followed by slow, oxidative degradation of the resulting fatty acid (Marcomini et al. 2000b). Some highly branched fatty acids may be persistent. In particular, chemicals with CAS RNs 60828-78-6 and 61702-78-1 are expected to degrade to the fatty acid derivatives of 2,6,8-trimethylnonan-4-ol (CAS RN 123-17-1) and 2,4,6-trimethylnonan-4-ol (CAS RN 84110-44-1), which are not readily biodegradable. No experimental data were identified for 2,4,6-trimethylnonan-4-ol, but the structurally similar 2,6,8-trimethylnonan-4-ol underwent only 5.1% biodegradation by O_2 consumption in a 28 day study conducted according to OECD TG 301 D (REACH n.d.-a).

UVCBs containing highly branched ethoxylated alcohols undergo slower rates of biodegradation compared to linear and mostly linear UVCBs (Kravetz et al. 1991; Marcomini et al. 2000b). However, according to a series of industry tests conducted according to OECD TG 301 F, commercial ethoxylates manufactured from highly branched alcohols are generally readily biodegradable. Passing results for ready biodegradability were reported for 21 commercial ethoxylates derived from highly branched oligomers of propylene and butene, including one with an average branching of 3.1 branches per molecule (Bragin et al. 2020). While these UVCBs passed the ready biodegradation test, the total degradation percentages may mask the presence of minor persistent constituents.

Abiotic degradation is not expected to be an important removal process for ethoxylated alcohols in the environment. Ethoxylated alcohols are not hydrolysable under environmentally relevant conditions (pH range of 4–9). Photodegradation is unlikely due to the low volatility and the lack of a chromophore in the substances in this group.

Bioaccumulation

Chemicals in this evaluation are not expected to bioaccumulate in aquatic life. Available experimental data for fish indicate low bioaccumulation potential, with bioconcentration factor (BCF) values below domestic categorisation thresholds (≤2,000 L/kg), and evidence of rapid biotransformation (EPHC 2009).

A non-standard aquatic bioaccumulation study is available for a series of linear ethoxylated alcohols with alkyl chain lengths between C12 and C18 and ethoxylate chain lengths between 4 and 14 EO units (AISE and Cefic 2009; Tolls et al. 2000). Fathead minnows (*Pimephales promelas*) with an average lipid content of 4.9% were exposed to ^{14}C-labelled test substance over a period of 54–72 h, then transferred to elimination tanks for an unspecified depuration period. Steady state BCF values of <5–387.5 L/kg were determined based on total radioactivity of the parent compound. These BCF values correlated positively with alkyl chain length and negatively with ethoxylate chain length, following expected trends in lipophilicity based on log K_{OW} (AISE and Cefic 2009; Tolls et al. 2000).

A 2005 dietary bioaccumulation study conducted similarly to the 2012 OECD TG305 is available for branched C11-rich ethoxylated alcohols (Bragin et al. 2020). Juvenile rainbow trout (*Oncorhynchus mykiss*) were fed a diet containing 527 mg/kg of test substance during an uptake period of 10 days, followed by a depuration period of 14 days. Gastrointestinal tracts were removed prior to tissue analysis to ensure measurement of absorbed substance and not residues in the gut. The 5% lipid-normalised biomagnification factor (BMF) value was 0.012 and the whole-body half-life was 0.36 days (Bragin et al. 2020).

Environmental transport

Chemicals in this evaluation are not expected to undergo long range transport based on their short half-lives in the environment and their tendency to partition to surfaces such as sediments.

Predicted environmental concentration (PEC)

Emissions of the substances to environmental surface waters have been estimated as part of this evaluation. A PEC value of 19 μg/L has been selected for ethoxylated alcohols in Australian surface water. This value is based on the highest average reported levels of ethoxylated alcohols in STP effluents from relevant international monitoring studies. Emissions to soil have not been estimated as part of this evaluation as these chemicals are not toxic to terrestrial life according to the available data (see **effects on terrestrial life**).

No Australian monitoring data were identified for chemicals in this evaluation. STP monitoring studies are available for Europe, Canada and the United States of America (USA). Some surface water data are available for the USA.

Three STP monitoring studies for the USA were identified in the scientific literature (McAvoy Drew C. et al. 1998; McAvoy Drew C et al. 2006; Morrall et al. 2006). The following summary is based on a 2014 review of ethoxylated alcohols (Cowan-Ellsberry et al. 2014). The full dataset covers 21 municipal STPs treating sewage to at least secondary levels. Linear ethoxylated alcohols of varying alkyl chain length and ethoxylate chain length, including fatty alcohol (EO = 0), were measured in wastewater. Total concentrations in influents averaged between 0.39 and 2.06 mg/L. Total concentrations in final effluents following secondary treatment by activated sludge averaged between 0.7 and 19 µg/L with an average removal rate of 99.6% (Cowan-Ellsberry et al. 2014).

A STP monitoring study from Europe and Canada was identified in the scientific literature (Eadsforth et al. 2006). The full dataset covers 20 municipal STPs serving populations of 3,800–1,900,000 people. Linear ethoxylated alcohols with alkyl chain lengths between C12 and C18, excluding C17, and ethoxylate chain lengths between 0 and 18 EO units were measured in final effluents. Total concentrations following secondary treatment by activated sludge were 0.96–16.8 µg/L. The average concentration in European effluents was 4.88 µg/L and the average concentration in Canadian effluents was 3.10 µg/L. The average concentration across all effluents was 4.28 µg/L. Homologues were evenly distributed with respect to alkyl chain length, but there were no clear trends based on ethoxylate chain length. However, fatty alcohols were disproportionately common (43%) in all effluents (Eadsforth et al. 2006).

A monitoring study from the San Francisco Bay area in the USA was identified in the scientific literature (Lindborg et al. 2023). Effluent samples were taken from eight STPs serving 60% of the San Francisco population and 11 stormwater drainage sites. Ambient water samples were taken from 19 sites across San Francisco Bay. Chemicals with alkyl chain lengths between C12 and C16, excluding C15, and ethoxylate chain lengths between 3 and 15 EO units were measured in samples. Total concentrations in STP effluents were less than 4.8 µg/L, excluding one outlier of 45 µg/L from a STP receiving 20% of its influent from a paint manufacturing plant. Total concentrations in stormwater runoff were 0.004–4.7 µg/L and total concentrations in Ambient Bay water samples were 0.0001–0.71 µg/L. Urban stormwater runoff was a significant contributor to contamination in the bay during the wet season (Lindborg et al. 2023).

Sediment monitoring data from the New York City area in the USA was identified in the literature (Lara-Martín et al. 2012). Chemicals with even alkyl chain lengths between C12 and C18 and varying ethoxylate chain lengths (1, 2, 3, 6 and 8 EO units) were measured in sediment samples (0–2 cm deep). Samples were collected from eight locations in the Jamaica Bay estuary, which receives roughly 1.1×10^9 Litres/day of treated effluent from six STPs and has limited tidal access to the greater New York Bight. Total concentrations of ethoxylated alcohols varied between 60 and 1,500 mg/kg sediment dry weight between sites (Lara-Martín et al. 2012).

In Australia, 80% of wastewater is subject to at least secondary treatment (BOM 2023). An internal survey of Australian STPs indicated that only a minor proportion of wastewater is treated using trickling-filter processes and that most Australian secondary treatment plants currently utilise activated sludge processes. Considering river flows can consist entirely of STP effluent in some drier parts of Australia, a reasonable worst case environmental concentration for these chemicals in Australian rivers is 19 µg/L, based on the highest average concentration reported in final effluents following secondary treatment by activated sludge. This value is considered sufficiently conservative to account for the broader spectrum of homologues not measured in available monitoring data, as well as contributions from stormwater runoff.

Environmental effects

Effects on aquatic Life

Chemicals in this evaluation have the potential to cause toxic effects in aquatic organisms across multiple trophic levels. The aquatic toxicity of ethoxylated alcohols is well studied and acute and chronic endpoints, as well as mesocosm data, are available for many standard test species across multiple trophic levels.

Standard ecotoxicity tests conducted according to internationally recognised test guidelines are available for a range of UVCBs, and pure homologues.

The toxicity mechanism of ethoxylated alcohols is expected to be non-polar narcosis (AISE and Cefic 2009). Consistent with expected trends in bioavailability and log K_{OW}, toxicity will vary with alkyl chain length and level of ethoxylation.

Branched ethoxylated alcohols are not expected to have higher aquatic toxicity compared to linear chemicals of similar degree of ethoxylation (Bragin et al. 2020). Commercial ethoxylates with the same CAS RN can have very different degrees of ethoxylation, which may impact aquatic hazards. Although the level of ethoxylation is expected to impact toxicity sufficient data are not available to establish any trends. Therefore, the ecotoxicity of ethoxylated alcohols has been discussed in terms of alkyl chain length only.

Ecotoxicity data were identified in the following sources:

- International risk assessments (AISE and Cefic 2009; OECD 2006)
- Literature studies and reviews (Belanger et al. 2006; Bragin et al. 2020)
- Online databases (US EPA n.d.)
- REACH registration dossiers (REACH n.d.-c; REACH n.d.-d; REACH n.d.-f; REACH n.d.-g; REACH n.d.-i; REACH n.d.-j; REACH n.d.-k; REACH n.d.-l; REACH n.d.-m; REACH n.d.-n; REACH n.d.-o).

According to the available information, acute ecotoxicity endpoints (EC50 or LC50) vary between ~0.05 mg/L to more than 100 mg/L and chronic endpoints (EC10 or NOEC) vary between 0.03 mg/L and 9.8 mg/L. Chemicals with alkyl chain lengths between C6 and C11 are generally not toxic based on acute endpoints greater than 1 mg/L and chronic endpoints greater than 0.1 mg/L. Chemicals with alkyl chain lengths between C12 and C16 are generally toxic with acute endpoints between 0.1 mg/L and 10 mg/L and chronic endpoints between 0.01 mg/L and 1 mg/L. Available data for C18 ethoxylates indicate low acute toxicity to fish and invertebrates, with all endpoints higher than 1 mg/L.

Limited toxicity information is available for ethoxylated alcohols with alkyl chains larger than C16. This makes it difficult to determine toxicity trends at these longer alkyl chain lengths. For example, results for $C_{16-18}EO_x$ are mixed, with endpoints lower than 1 mg/L for x = 11, and endpoints higher than 1 mg/L for higher and lower ethoxylation levels. The ecotoxicity of fatty alcohols with alkyl chains larger than C16 are generally limited by poor water solubility and low bioavailability. In general, while ethoxylation is expected to increase water solubility of these alcohols, the increase in overall molecular size is likely to affect bioavailability and limit overall ecotoxicity. Therefore, these chemicals are expected to have low toxicity.

In Australia, default guideline values for ethoxylated alcohols in surface water are outlined in the Australia New Zealand Guidelines for Fresh and Marine Water Quality (ANZ Water Quality Guidelines) (ANZG n.d.-b). Water quality guidelines represent a starting point for assessing water quality and are recommended for generic applications in the absence of more relevant guideline values. In freshwater, a moderately reliable default guideline value of 140 µg/L is available for ethoxylated alcohols (ANZG n.d.-a). This value is expected to protect 95% of aquatic species and was derived from a species sensitivity distribution (SSD) comprising 15 chronic endpoints normalised to the homologue $C_{13.3}EO_{8.2}$ (ANZG n.d.-b).

Effects on terrestrial Life

Chemicals in this evaluation are not toxic to terrestrial organisms.

Acute toxicity data for terrestrial plants and soil invertebrates are available for commercial ethoxylated alcohols with alkyl chains lengths between C12 and C18 and ethoxylate chain lengths between 3 and 11 EO units. Available data for earthworms (*Eisenia foetida*) indicate no mortality at concentrations up to 1,000 mg/kg in soil. Only 2 plant growth studies have measured effect concentrations lower than the highest test concentration. These are a 17 day LC0 value of 10 mg/kg (LC50 > 100 mg/L) for branched $C_{13}EO_3$, based on survival of garden cress (*Lepidium sativum*), and a 21 day EC50 value of 300 mg/kg for $C_{18}EO_{10}$, based on growth rates of radish (*Raphanus sativus*). All other plant studies showed no effects at the highest test concentrations, which were either 100 mg/kg or 1,000 mg/kg (AISE and Cefic 2009).

Acute toxicity data for soil invertebrates (*E. foetida, Folsomia candida, Caenorhabditis elegans* and *Heterocypris incongruens*) are available for the pure homologues C_8EO_4, $C_{12}EO_4$, commercial $C_{12}EO_{10}$ and the fatty alcohols 1-decanol (C10) and 1-tetradecanol (C14). Measured EC50 values were between 98 mg/kg and 850 mg/kg or above the highest test concentration of 1,000 mg/kg (AISE and Cefic 2009).

Chronic toxicity data for soil invertebrates (*E. foetida, F. candida* and *C. elegans*) are available for the pure homologues $C_{12}EO_4$ and $C_{16}EO_4$. Measured NOEC values for adult mortality and reproduction were between 220 mg/kg and 1,000 mg/kg (AISE and Cefic 2009).

Effects on sediment dwelling life

Available ecotoxicity data for ethoxylated alcohols are insufficient to assess effects to sediment dwelling life. No experimental studies were identified.

Endocrine effects/activity

No evidence of endocrine effects or activity have been identified for chemicals in this evaluation.

Predicted no-effect concentration (PNEC)

The surface water PNEC for ethoxylated alcohols is 28 µg/L. This value was derived from the current ANZ water quality guideline value of 140 µg/L adjusted using an assessment factor of 5. The normalised homologue $C_{13.3}EO_{8.2}$ used to derive the water quality guideline is likely to be protective of chemicals in this evaluation as it represents the average distribution in STP effluents. However, an assessment factor is necessary to account for the moderate reliability of the guideline value.

Categorisation of environmental hazard

The categorisation of the environmental hazards of the assessed chemical according to Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic chemicals is presented below (DCCEEW 2022):

Persistence

Persistent (P). Based on lack of degradation in measured studies for the corresponding highly branched fatty alcohols, highly branched C12 ethoxylated alcohols (CAS RN 60828-78-6; 61702-78-1) are classified as Persistent.

Not Persistent (Not P). Based on measured degradation studies of chemicals with specific alkyl groups, all other chemicals in this evaluation are categorised as Not Persistent.

Bioaccumulation

Not Bioaccumulative (Not B). Based on low measured bioconcentration factors (BCF) in fish and evidence of rapid biotransformation, chemicals in this evaluation are categorised as Not Bioaccumulative.

Toxicity

Chemicals in this evaluation have been categorised using available aquatic ecotoxicity data and read across principles. Chemicals without sufficient data were categorised as Not Toxic (Not T).

Toxic (T). Based on measured acute ecotoxicity endpoints below or equal to 1 mg/L, the following chemicals are categorised as Toxic:

- C12 ethoxylated alcohols excluding $C_{12}EO_7$ (CAS RN 3055-93-4; 3055-94-5; 3055-95-6; 4536-30-5; 9002-92-0; 60828-78-6; 61702-78-1)
- C13 ethoxylated alcohols (CAS RN 9043-30-5; 24938-91-8; 69011-36-5)
- C14 ethoxylated alcohols (CAS RN 27306-79-2)
- C16 ethoxylated alcohols (CAS RN 9004-95-9)
- C12–13 ethoxylated alcohols (CAS RN 66455-14-9)
- C12–14 ethoxylated alcohols (CAS RN 68439-50-9; 84133-50-6)
- C12–15 ethoxylated alcohols (CAS RN 68131-39-5; 106232-83-1)
- C13–15 ethoxylated alcohols (CAS RN 64425-86-1)
- C14–15 ethoxylated alcohols (CAS RN 120944-68-5)
- C16–18 ethoxylated alcohols (CAS RN 8065-80-3; 68439-49-6).

Toxic (T). Based on the chemical identity and expected composition, C12–16 ethoxylated alcohols (CAS RN 68551-12-2) is categorised as Toxic.

Not Toxic (Not T). Based on a lack of measured acute endpoints below 1 mg/L and a lack of measured chronic endpoints below 0.1 mg/L, all other chemicals in this evaluation are categorised as Not Toxic.

Environmental hazard classification

Chemicals in the evaluation have been classified according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) for aquatic hazards (UNECE 2017). Chemicals in this evaluation which are UVCBs have been classified according to the criteria for mixtures. UVCBs without specific ecotoxicity data were classified using the ‘summation method’ based on the expected alkyl chain length distribution of the precursor alcohols (UNECE 2017). Although level of ethoxylation is expected to reduce overall toxicity, this trend was not clear from the available ecotoxicity data and was not considered for chemicals with unspecified ethoxylation.

Due to a lack of experimental ecotoxicity data or alkyl chain length distribution data, the following chemicals are not classifiable for aquatic hazards:

- C7–21 ethoxylated alcohols (CAS RN 68991-48-0)
- C8–16 ethoxylated alcohols (CAS RN 71243-46-4)
- C8–22 ethoxylated alcohols (CAS RN 69013-19-0)
- C12–20 ethoxylated alcohols (CAS RN 68526-94-3)
- C16–22 ethoxylated alcohols (CAS RN 69227-20-9).

Based on available information, the following chemicals are not classified for aquatic hazards:

- C20 ethoxylated alcohols (CAS RN 32128-65-7)
- C>30 ethoxylated alcohols (CAS RN 97953-22-5).

The remaining chemicals satisfy the criteria as follows:

Hazardous to the aquatic environment (acute / short term)

Based on measured EC50 and LC50 values less than or equal to 1 mg/L, the following chemicals satisfy the criteria for hazard category ‘Aquatic Acute 1’ with the hazard statement ‘H400: Very toxic to aquatic life’:

- C12 ethoxylated alcohols (CAS RN 3055-93-4; 3055-94-5; 3055-95-6; 4536-30-5; 9002-92-0; 60828-78-6; 61702-78-1)
- C13 ethoxylated alcohols (CAS RN 9043-30-5; 24938-91-8; 69011-36-5)
- C14 ethoxylated alcohols (CAS RN 27306-79-2)
- C16 ethoxylated alcohols (CAS RN 9004-95-9)
- C12–13 ethoxylated alcohols (CAS RN 66455-14-9)
- C12–14 ethoxylated alcohols (CAS RN 68439-50-9; 84133-50-6)
- C12–15 ethoxylated alcohols (CAS RN 68131-39-5; 106232-83-1)
- C13–15 ethoxylated alcohols (CAS RN 64425-86-1)
- C14–15 ethoxylated alcohols (CAS RN 120944-68-5)
- C16–18 ethoxylated alcohols (CAS RN 8065-80-3; 68439-49-6).

The following UVCB substances are expected to contain at least 25% ethoxylated alcohols with C12, C13, C14, C15, and C16 chain lengths. Therefore, these UVCB substances satisfy the criteria for hazard category ‘Aquatic Acute 1’ with the hazard statement ‘H400: Very toxic to aquatic life’:

- C10–14 ethoxylated alcohols (CAS RN 66455-15-0)

- C10–16 ethoxylated alcohols (CAS RN 68002-97-1)
- C10–18 ethoxylated alcohols (CAS RN 85422-93-1)
- C11–13 ethoxylated alcohols (CAS RN 68439-54-3)
- C11–14 ethoxylated alcohols (CAS RN 78330-21-9)
- C11–15 ethoxylated alcohols (CAS RN 68131-40-8)
- C12–16 ethoxylated alcohols (CAS RN 68551-12-2)
- C16–20 ethoxylated alcohols (CAS RN 106232-82-0).

Based on measured EC50 and LC50 values in the range 1–10 mg/L, the following chemicals satisfy the criteria for hazard category 'Aquatic Acute 2' with the hazard statement 'H401: Toxic to aquatic life':

- C10 ethoxylated alcohols (CAS RN 26183-52-8; 61827-42-7)
- C11 ethoxylated alcohols (CAS RN 127036-24-2)
- $C_{12}EO_7$ ethoxylated alcohol (CAS RN 3055-97-8)
- C18 ethoxylated alcohols (CAS RN 52292-17-8; 9005-00-9)
- C9–11 ethoxylated alcohols (CAS RN 68439-46-3; 78330-20-8)
- C10–12 ethoxylated alcohols (CAS RN 67254-71-1; 125736-52-9)
- C12–18 ethoxylated alcohols (CAS RN 68213-23-0).

The following UVCB substances are expected to contain at least 25% ethoxylated alcohols with C10, C11, and/or C18 chain lengths (but <25% ethoxylated alcohols with C12, C13, C14, C15, and/or C16 chain lengths). Therefore, these UVCB substances satisfy the criteria for hazard category 'Aquatic Acute 2' with the hazard statement 'H401: Toxic to aquatic life':

- C6–10 ethoxylated alcohols (CAS RN 70879-83-3)
- C6–12 ethoxylated alcohols (CAS RN 68439-45-2)
- C8–10 ethoxylated alcohols (CAS RN 71060-57-6)
- C18–22 ethoxylated alcohols (CAS RN 116810-32-3).

Based on read across to C10 ethoxylated alcohols, C9 ethoxylated alcohols (CAS RN 39587-22-9) satisfies the criteria for hazard category 'Aquatic Acute 2' with the hazard statement 'H401: Toxic to aquatic life'.

Based on measured EC50 and LC50 values in the range 10–100 mg/L, the following chemicals satisfy the criteria for hazard category 'Aquatic Acute 3' with the hazard statement 'H402: Harmful to aquatic life':

- C6 ethoxylated alcohols (CAS RN 112-59-4; 31726-34-8)
- C8 ethoxylated alcohols (CAS RN 26468-86-0; 27252-75-1; 61723-78-2).

Hazardous to the aquatic environment (chronic / long-term)

Highly branched C12 ethoxylated alcohols (CAS RN 60828-78-6; 61702-78-1) are not rapidly degradable. Based on measured EC10 endpoints less than or equal to 0.1 mg/L, these chemicals satisfy the criteria for hazard category 'Aquatic Chronic 1' with the hazard statement 'H410: Very toxic to aquatic life with long lasting effects'.

All other chemicals in this evaluation are expected to be rapidly degradable.

Based on measured NOEC and EC10 endpoints in the range 0.01–0.1 mg/L, the following chemicals satisfy the criteria for hazard category 'Aquatic Chronic 2' with the hazard statement 'H411: Toxic to aquatic life with long lasting effects':

- C12 ethoxylated alcohols (CAS RN 3055-93-4; 4536-30-5; 9002-92-0)
- C16 ethoxylated alcohols (CAS RN 9004-95-9)
- C12–14 ethoxylated alcohols (CAS RN 68439-50-9; 84133-50-6)
- C12–15 ethoxylated alcohols (CAS RN 68131-39-5; 106232-83-1)
- C13–15 ethoxylated alcohols (CAS RN 64425-86-1)
- C14–15 ethoxylated alcohols (CAS RN 120944-68-5).

The following UVCB substances are expected to contain at least 25% ethoxylated alcohols with C12, C15 and/or C16 chain lengths. Therefore, these UVCB substances satisfy the criteria for hazard category 'Aquatic Chronic 2' with the hazard statement 'H411: Toxic to aquatic life with long lasting effects':

- C10–12 ethoxylated alcohols (CAS RN 67254-71-1; 125736-52-9)
- C10–14 ethoxylated alcohols (CAS RN 66455-15-0)
- C10–16 ethoxylated alcohols (CAS RN 68002-97-1)
- C10–18 ethoxylated alcohols (CAS RN 85422-93-1)
- C11–13 ethoxylated alcohols (CAS RN 68439-54-3)
- C11–14 ethoxylated alcohols (CAS RN 78330-21-9)
- C11–15 ethoxylated alcohols (CAS RN 68131-40-8)
- C12–16 ethoxylated alcohols (CAS RN 68551-12-2)
- C12–18 ethoxylated alcohols (CAS RN 68213-23-0)
- C16–20 ethoxylated alcohols (CAS RN 106232-82-0).

Based on measured NOEC and EC10 endpoints in the range 0.1–1 mg/L, the following chemicals satisfy the criteria for hazard category 'Aquatic Chronic 3' with the hazard statement 'H412: Harmful to aquatic life with long lasting effects':

- C11 ethoxylated alcohols (CAS RN 127036-24-2)
- C12 ethoxylated alcohols (CAS RN 3055-94-5; 3055-95-6; 3055-97-8)
- C13 ethoxylated alcohols (CAS RN 9043-30-5; 24938-91-8; 69011-36-5)
- C14 ethoxylated alcohols (CAS RN 27306-79-2)
- C9–11 ethoxylated alcohols (CAS RN 68439-46-3; 78330-20-8)
- C12–13 ethoxylated alcohols (CAS RN 66455-14-9)
- C16–18 ethoxylated alcohols (CAS RN 8065-80-3; 68439-49-6).

Based on measured NOEC and EC10 endpoints greater than 1 mg/L, the following chemicals satisfy the criteria for 'Not classified for long-term (chronic) toxicity':

- C6 ethoxylated alcohols (CAS RN 112-59-4; 31726-34-8)
- C8 ethoxylated alcohols (CAS RN 26468-86-0; 27252-75-1; 61723-78-2)
- C10 ethoxylated alcohols (CAS RN 26183-52-8; 61827-42-7)
- C8–10 ethoxylated alcohols (CAS RN 71060-57-6),

Based on read across to C8 and C10 ethoxylated alcohols, C9 ethoxylated alcohols (CAS RN 39587-22-9) satisfies the criteria for 'Not classified for long-term (chronic) toxicity'.

These chemicals C6–10 ethoxylated alcohols (CAS RN 70879-83-3) are expected to contain <2.5% ethoxylated alcohols with C12 chain lengths. Therefore, this UVCB substance satisfies the criteria for 'Not classified for long-term (chronic) toxicity'.

Due to a lack of experimental ecotoxicity data or alkyl chain length distribution data, the following chemicals are not classifiable for long term (chronic) toxicity:

- C18 ethoxylated alcohols (CAS RN 9005-00-9; 52292-17-8)
- C6–12 ethoxylated alcohols (CAS RN 68439-45-2)
- C18–22 ethoxylated alcohols (CAS RN 116810-32-3).

Environmental risk characterisation

Based on the PEC and PNEC values determined above, the following Risk Quotient (RQ = PEC ÷ PNEC) have been calculated for release of the chemicals in this evaluation into surface water:

Compartment	PEC	PNEC	RQ
Surface water	19 µg/L	28 µg/L	0.68

For surface water, an RQ less than 1 indicates that ethoxylated alcohols are not expected to pose a significant risk to the environment based on estimated emissions, as environmental concentrations are below levels likely to cause harmful effects.

Uncertainty

This evaluation was conducted based on a set of information that may be incomplete or limited in scope. Some relatively common data limitations can be addressed through use of conservative assumptions (OECD n.d.) or quantitative adjustments such as assessment factors (OECD 1995). Others must be addressed qualitatively, or on a case-by-case basis (OECD n.d.).

The most consequential areas of uncertainty for this evaluation are:

- Limited Australian monitoring information is available for the chemicals in this evaluation. This includes environmental concentration data, as well as a lack of Australia specific homologue distribution information for products, STP effluent, and surface waters.
- Pooled concentrations from monitoring data have been used to calculate risk, rather than individually measured homologue concentrations. These include contributions from fatty alcohols. As fatty alcohols may come from a variety of sources, the magnitude of these concentrations may be overestimating the contributions from the use of ethoxylated alcohols.
- Pooled concentrations from environmental monitoring data do not consider the relative ecotoxicity of these chemicals. Ecotoxicity normalised equivalent concentrations were not calculated for any pooled measurements. The available information suggests that the average ethoxylated alcohol homologue found in the environment is likely similar to the $C_{13.3}$ homologue used in the Australian water quality guideline derivation. As such, the impact on the risk calculation is likely minimal.

- Insufficient data are available for chemicals in this evaluation to characterise the risk to the sediment compartment.
- Limited composition data is available to assess the ecotoxicity of ethoxylated alcohols in terms of ethoxylate chain length. Commercial ethoxylates with the same CAS RN can have very different degrees of ethoxylation, which may impact aquatic hazards.

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