Qualitative Tier 2 Assessment

Monoethanolamine

In accordance with the Chemical Risk Assessment Framework (CRAF), chemicals assigned a Tier 2 designation require a hazard assessment and qualitative assessment of risk.

Consistent with National Industrial Chemicals Notification and Assessment Scheme (NICNAS), the human health hazards for each chemical are characterised by analysing the toxicokinetics (the absorption, distribution, metabolism and excretion of the chemical in humans or laboratory animals), acute toxicity, irritation and corrosivity, repeat dose toxicity, genotoxicity, carcinogenicity, reproductive toxicity, and other health effects. The environmental hazards for each chemical are characterized by analysing the environmental fate properties (such as mobility, persistence, bioavailability and bioaccumulation), acute toxicity and chronic toxicity. In support of the hazard assessment, a risk assessment dossier is prepared for each of the chemicals included in the assessment.

The qualitative assessment of risk evaluates exposure to the vendor chemical that may occur during activities that do not intentionally result in a release to the environment, but where a potential release may occur. For this evaluation, these potential releases primarily are focused on the vendor chemical transported to the well pad site or water management facility (WMF), chemicals utilised in drilling fluid systems that may impact groundwater, residual chemicals that may be present in hydraulic flowback and workover fluids and chemicals and chemicals and residues of chemicals that may be present in water undergoing treatment or beneficially re-used.

Potentially complete exposure pathways (in that a source, a migration pathway, a mechanism for exposure, and a potential receptor are present) are assessed herein to determine the potential for risk (an incomplete pathway precludes an exposure occurring and an associated potential risk). In this context, site setting and management protocols associated with the action are evaluated. Key controls limiting the potential for exposure include:

- Engineering controls (including fencing and secondary containment);
- Storage (drums, totes and storage tanks) constructed in accordance with Australian standards and managed and monitored in accordance with regulatory requirements;
- Maintenance of access control restrictions during site activities that will preclude access by the public, livestock and large native fauna; and,
- Australia SafeWork Place and Santos Occupational Safety Guidance used to minimise human health exposure.

As a result, the assessment for this Tier 2 chemical includes the following components: completing the screening; developing a risk assessment dossier and Predicted No Effect Concentrations (PNECs) for water and soil; and, providing a qualitative discussion of risk. Each of these components is detailed within this memorandum.

Background

Monoethanolamine is a component in a drilling fluid product (BARASURE™ W-988) used as a shale stabiliser in the following fluid systems: Inhibitive Mud System and Inhibited Star Shield Mud System. The first fluid system is one of the primary systems to be used as drilling fluids. The Inhibited Star Shield mud system is used as a preventative wellbore shielding additive during drilling operations for the production of coal seam gas.

The purpose and maximum quantity (i.e., in all muds) for this chemical is summarised in **Table 1**. A safety data sheet (SDS) for the drilling fluid product is included as **Attachment 1**.

Table 1 Drilling Fluid Chemicals

Chemical Name	CAS No.	Use	Quantity[1]
Monoethanolamine	141-43-5	Shale Stabiliser	NA

[1] Based on maximum of combined muds assessed
CAS No = Chemical Abstracts Service Number
NA = Not available

The assessment of toxicity of this chemical was used to evaluate human health exposure scenarios and is presented in the risk assessment dossier provided in **Attachment 2**. There are no adequate or reliable carcinogenic studies available for monoethanolamine; and, as a result, only a non-carcinogenic oral reference dose (RfD) was calculated. A detailed discussion of the derivation of the oral RfD and drinking water guideline values is presented in the attachment. **Table 2** provides a summary of the derivation.

Table 2 Oral Reference Doses and Derived Drinking Water Guidelines

Constituent (CAS No.)	Study	Critical Effect/ Target Organ(s)	NOAEL (mg/kg-day)	Uncertainty Factors	Oral Reference Dose (mg/kg-day)	Drinking Water Guideline (mg/L)
Monoethanolamine (141-43-5)	2-year rat dietary reproduction	General Systemic Toxicity	300	300	1	3.5

Refer to **Attachment 2** for information on the key studies selected for oral reference dose and drinking water level development.
CAS = Chemical Abstracts Service
mg/kg-day = milligram per kilogram-day
mg/L = milligram per litre
NOAEL = No observed adverse effect level

For ecological receptors, the assessment utilises the information presented in the dossiers on the relative toxicity of the aquatic and terrestrial flora and fauna to the chemical. This assessment focuses on the aquatic invertebrate and fish species within the surface water resources and the soil flora and fauna associated with releases to the soil.

The determination of toxicological reference values (TRVs) was conducted according to the PNEC guidance in the *Environmental Risk Assessment Guidance Manual for Industrial Chemicals* prepared by the Australian Environmental Agency (AEA, 2009). PNECs for freshwater and sediment were developed to assess aquatic receptors, and PNECs for soil were developed for terrestrial receptors.

Table 3 present the chemical, the endpoint, no observable effects concentration (NOEC) (milligrams per litre [mg/L]), assessment factor, and the aquatic PNEC (mg/L). PNECs for sediment and soil are detailed in **Tables 4** and **5,** respectively. Refer to **Attachment 2** for the development of PNECs, or the rational for PNECs that do not have a calculated PNEC.

Table 3 PNECs Water – Tier 2 Chemicals

Constituents	Endpoint	EC_{50} or NOEC (mg/L)	Assessment Factor	$PNEC_{water}$ (mg/L)
Monoethanolamine (141-43-5)	Algae	0.70	10	0.07

EC_{50} = effects concentration – 50%
mg/L = milligram per litre
NOEC = no observable effects concentration
PNEC = predicted no effect concentration
Refer to **Attachment 2** for information on the development of PNECs listed above.

Table 4 PNECs Sediment – Tier 2 Chemicals

Constituents	Endpoint	EC_{50} or NOEC (mg/kg wet wt)	Assessment Factor	$PNEC_{sed}$ (mg/kg wet wt)
Monoethanolamine (141-43-5)	[a]	-	-	0.060

[a] Calculated using equilibrium partitioning method
EC_{50} = effects concentration – 50%
mg/kg wet wt = milligram per kilogram wet weight
NOEC = no observable effects concentration
PNEC = predicted no effect concentration
Refer to **Attachment 2** for information on the development of PNECs listed above.

Table 5 PNECs Soil – Tier 2 Chemicals

Constituents	Endpoint	EC_{50} or NOEC (mg/kg dry wt)	Assessment Factor	$PNEC_{soil}$ (mg/kg dry wt)
Monoethanolamine (141-43-5)	[a]	-	-	0.014

[a] Calculated using equilibrium partitioning method
EC_{50} = effects concentration – 50%
mg/kg dry wt = milligram per kilogram dry weight
NOEC = no observable effects concentration
PNEC = predicted no effect concentration
Refer to **Attachment 2** for information on the development of PNECs listed above.

A detailed assessment of the potential risks posed by this Tier 2 chemical is provided in the following sections.

General Overview

Monoethanolamine is a clear liquid with a fish odour. The molecular structure for monoethanolamine is presented in **Figure 1**.

Figure 1 Molecular Structure of Monoethanolamine[1]

Monoethanolamine is highly soluble in water. The measured pKa of 9.5 indicates that the substance will primarily exist as a cation in the environment. Based upon an organic carbon partition coefficient (K_{oc}) of 15 L/Kg for the charged molecule, if released to soil, monoethanolamine is not expected to adsorb to soil and has a potential for high mobility. If released into water, monoethanolamine is also not expected to adsorb to suspended solids and sediment. However, absorption is affected by the acidity of the substrate.

Monoethanolamine is readily biodegradable and is not expected to bioaccumulate.

The Persistent, Bioaccumulative and Toxic (PBT) assessment for monoethanolamine is included in the dossier provided in **Attachment 2**. Based on physico-chemical properties and screening data detailed below, the overall conclusion was that the substance is not a PBT substance.

Human Health Hazards

The acute toxicity of monoethanolamine is low by the oral, dermal and inhalation routes. It is a skin and eye irritant, but it is not a skin or respiratory sensitiser. Based on the data available, the chemical is not considered to cause serious damage to health from repeated oral exposure or through inhalation. No critical effects were observed. No data are available to evaluate systemic exposure via the dermal pathway. The substance is not genotoxic when tested in both in vitro and in vivo assays. There is no indication that this substance will have an adverse effect on reproduction and development.

Based on a review of a two-year oral reproductive study in rats, TRVs were derived for monoethanolamine. The drinking water guideline value derived for monoethanolamine using the non-carcinogenic oral RfD is 3.5 mg/L (see **Table 2**). Description of the oral RFD and calculation of the drinking water guideline value is included in the dossier provided in **Attachment 2**.

[1] Source https://chem.nlm.nih.gov/chemidplus/rn/141-43-5

The lifecycle of chemicals, including monoethanolamine, used during the drilling and completion of wells includes the following general categories: transportation of chemicals; drilling, stimulation and completion operations; and, treatment, recycling, disposal and beneficial reuse. Without management controls in place, there is the potential for human receptors to be exposed to drilling fluid chemicals that contain monoethanolamine during drilling and completion operations and management of drilling fluids and cuttings. Based on an assessment of land use and an understanding of the project description provided in the Environmental Impact Statement (EIS) (URS, 2014) and the CRAF developed for the GFD Project Area, potential human receptors include:

1. Workers at the well lease involved with blending, storage, transfer, reuse, recovery and recycling of drilling fluids and cuttings; recycling, reuse or disposal of recovered materials including beneficial reuse activities such as land applications of drilling materials and dust suppression; and, mitigating releases at the well lease or along the transport or conveyance routes.
2. Agricultural workers or residents in irrigation areas.
3. Landholders that have access to the water supply from a bore hydraulically downgradient of the well lease.

In terms of risks associated with transport of chemicals and wastes, this risk is considered to be managed to a level as low as reasonably practicable. This is because the potential for a release is controlled through implementation of traffic management principles including use of designated trucking routes, vehicle signage, vehicle management systems (to manage speed and driving behaviour/habits) and, in the unlikely event of a vehicular accident, implementation of incident and spill response procedures. Given the highly regulated nature of transportation of chemicals (at both a Commonwealth and State level), transport-related scenarios are not evaluated further in this assessment. However, the outcome of the assessment should be used to inform emergency response actions.

Exposure of workers to drilling fluid chemicals is possible via inadvertent spills and leaks, during the recycling and beneficial reuse of recovered materials (e.g., drilling fluids and cuttings), and during application of the recovered material to land. However, chemical exposures to workers are controlled through engineering, management controls and personal protective equipment, which are focused on elimination and mitigation of the potential for dermal contact and potential for incidental ingestion. In addition, Australia SafeWork Place and Santos Occupational Safety Guidance are used to minimise human health exposure. As a result, petroleum workers, are also excluded from assessment. No potentially complete exposure pathways were identified.

The management of chemicals and wastes will be conducted at the well lease using drums, totes and engineered tanks designed to contain the fluids. In the unlikely event of a release to ground, the potential for exposures (other than workers) is limited. Releases on the well pad would be of limited volumes and the well pad sites are fenced and access is controlled, which limits access to the public. If drilling fluid chemicals are spilled to ground then investigation, remediation and rehabilitation activities would be implemented to address soil impacts.

On-lease storage may utilise tanks, pits or turkey nests and there is the possibility that a containment failure could result in the release of the materials to the well lease and the surrounding environment. Releases on the well pad would be of limited volumes and as such these products would not be anticipated to migrate a significant distance off lease to the surrounding environment, including proximal water bodies.

The potential for a significant drilling fluid loss during drilling is rare, particularly given the volumes used and the management controls in place during drilling. Where lost circulation is identified during drilling, a lost circulation fluid (i.e., cellulose) is used to plug the interval and prevent further loss of fluids. Despite the limited potential for large scale losses during drilling, EHS Support (2015) completed modelling of how a conservative tracer or highly soluble organic constituents could migrate in the subsurface to assess the potential effects of potential loss of drilling muds on groundwater systems. The BIOSCREEN model was utilized to facilitate assessment of organic constituent mobility with and without biodecay. The modelling indicated that the potential for impact on ground water quality is limited even under a worst-case scenario utilising conservative assumptions.

Exposure of potential receptors (other than workers) is also possible to residual chemicals in areas adjacent to a well lease that have been used for the application of materials for beneficial reuse. The primary land use within the development area is agricultural (grazing on improved or unimproved pastures), and it is sparsely populated. There may be potential for human receptors such as residents and agricultural workers to be exposed to residual chemicals in recovered materials via direct contact (ingestion and dermal) and inhalation pathways. Relative potential exposure to agricultural workers/residents is considered low due to the remote location of the well leases and the sparse population. In addition, activities are undertaken in operational and controlled areas of the well lease.

However, Environmental Authority (EA) or End of Waste Code/Approval conditions regulate project reuse. A plan for the beneficial reuse of materials has been developed by a Suitably Qualified Person (SQP) in accordance with the EA conditions which require materials of a certain quality and controls the maximum volumes that can be applied to land. In addition, the application techniques and location of application are controlled with specific monitoring required. Irrigation areas are designed to manage the risk of pooling and runoff with a general deficit irrigation strategy employed; and, are fitted with monitoring bores to manage the risk of vertical and horizontal migration. Additional details regarding mitigation and management controls are discussed in the CRAF.

As a result, potential exposures during the drilling process are low due to the employment of mechanical equipment/processes, engineering controls (including secondary containment) and other mitigation and management strategies. Similarly, there is a low potential for human receptors exposed to surface water bodies that may receive runoff from beneficial reuse applications. Finally, the probability of any surface related discharge infiltrating subsurface soils and migrating to groundwater is very low.

Environmental Hazards

In standard aquatic toxicity tests, monoethanolamine is moderately toxic to aquatic organisms. In acute toxicity studies, algae were more sensitive compared to fish and invertebrates (ECHA). However, in chronic toxicity studies algae and invertebrates were equally sensitive (ECHA).

Monoethanolamine is readily biodegradable. It is not expected to bioaccumulate, and it has low potential to adsorb to soil.

PNECs for monoethanolamine are provided in **Tables 3 – 5**. Experimental toxicity data on water organisms was available for three trophic levels to calculate PNECs in water. However, there are no toxicity data for sediment-dwelling organisms or soil organisms. Therefore, PNECs for sediment and

soil were calculated using the equilibrium partitioning method. PNEC calculations and assumptions are detailed in the dossier provided in **Attachment 2**.

During the drilling process, there is the potential for environmental receptors to be exposed to drilling fluid chemicals that contain monoethanolamine. Pipelines (where treated water is conveyed) can transect sensitive ecological areas (including Matters of National Environmental Significance [MNES]). There is the concern of wildlife (terrestrial and aquatic receptors) and livestock in the vicinity of the well leases to have adverse effects from potential exposures. Potential environmental receptors include:

1. Wildlife and livestock accessing the well lease and areas adjacent to the well lease, including surface water features, that have received runoff from an accidental release during drilling and completion operations or loss of containment.
2. Wildlife and livestock accessing areas of the well lease where materials have been applied, as well as accessing stored materials in pits and turkey nests.
3. Aquatic flora and fauna within a proximal surface water body that has received runoff from an accidental release during drilling and completion operations or loss of containment, or from beneficial use applications.
4. Wildlife, including livestock, that have access to the water supply from a bore hydraulically downgradient of the well lease.

The potential for exposure of sensitive receptors (including MNES) is considered low. The drilling and completion activities occur over a short duration and are conducted in controlled/operational areas within a perimeter fence. Further, the activity level, noise, etc. will be a disincentive for wildlife and livestock to access the lease through gaps in the fencing or unsecured gates.

Based on the engineering and management controls described in the previous section (Human Health Hazards), there is a low potential for ecological receptors exposed to surface water bodies that may receive runoff from an accidental release. There is also concern that recovered material applied to the land surface could migrate to groundwater or surface water, and therefore result in adverse effects to the environment (e.g., uptake by aquatic receptors). Due to EA conditions regulating land application techniques, the remote nature of the well leases, vertical separation of groundwater and distances to watercourses, the ephemeral nature of the watercourses and the physical and chemical properties of the residual chemicals post treatment or beneficial reuse, these potential exposures are low.

References

Australian Environmental Agency (AEA). (2009). Environmental Risk Assessment Guidance Manual for Industrial Chemicals, Commonwealth of Australia.

ECHA. ECHA REACH database: http://echa.europa.eu/information-on-chemicals/registered-substances

EHS Support. (2015). Santos GLNG Upstream Hydraulic Fracturing Risk Assessment Compendium of Assessed Fluid Systems. Revision 1. 23 November 2015.

URS. (2014). Santos GLNG Project: Gas Field Development Project Environmental Impact Statement. Available online at: http://www.santosglng.com/environment-and-water/gas-field-development-project-eis.aspx

Attachment 1 Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

BaraSure™ W-988

Revision Date: 09-Apr-2019 **Revision Number:** 2

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name BaraSure™ W-988

Other means of Identification

Synonyms None

Hazardous Material Number: HM009037

Recommended use of the chemical and restrictions on use

Recommended Use Shale stabilizer

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Not classified

Label elements, including precautionary statements

Hazard Pictograms

Signal Word Not Hazardous

Hazard Statements: Not Classified

Precautionary Statements

Prevention	None
Response	None
Storage	None
Disposal	None

Contains

Substances	**CAS Number**
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA

Other hazards which do not result in classification
None known

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not classified

4. First aid measures

Description of necessary first aid measures

Inhalation	Move person to fresh air.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Ingestion	Rinse mouth with water many times. Get medical attention, if symptoms occur

Symptoms caused by exposure
No significant hazards expected.

Medical Attention and Special Treatment

Notes to Physician	Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment
Suitable Extinguishing Media
Water spray. Carbon dioxide (CO2). Foam. Dry powder
Extinguishing media which must not be used for safety reasons
None known.

Specific hazards arising from the chemical
Special exposure hazards in a fire
Decomposition in fire may produce harmful gases.

Special protective equipment and precautions for fire fighters
Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Do not breathe dust/fume/gas/mist/vapors/spray.

6.2. Environmental precautions
None known.

6.3. Methods and material for containment and cleaning up
Dike far ahead of liquid spill for later disposal. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

7. Handling and storage

7.1. Precautions for safe handling
Handling Precautions
Use appropriate protective equipment. Ensure adequate ventilation. Avoid creating or inhaling dust. Avoid extended skin contact.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities
Storage Information
Keep containers tightly closed in a cool, well ventilated place
Other Guidelines
No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring
Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

Appropriate engineering controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits. Ensure adequate ventilation, especially in confined areas

Personal protective equipment (PPE)
Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Safety glasses with side-shields. If splashes are likely to occur, wear: Goggles, Face-shield.
Other Precautions None known.
Environmental Exposure Controls No information available

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Viscous liquid	**Color**	Clear Colorless to Light yellow
Odor:	Odorless	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	6.5 - 8.0
Freezing Point / Range	No data available
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	~ 1.1
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity

Not expected to be reactive.

10.2. Chemical stability

Stable

10.3. Possibility of hazardous reactions

Will Not Occur

10.4. Conditions to avoid

None anticipated

10.5. Incompatible materials

Strong oxidizers. Strong acids. Strong alkalis.

10.6. Hazardous decomposition products

Oxides of nitrogen. Carbon oxides.

11. Toxicological Information

Information on routes of exposure

Symptoms related to exposure

Most Important Symptoms/Effects

No significant hazards expected.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

Immediate, delayed and chronic health effects from exposure

Inhalation May cause mild respiratory irritation.
Eye Contact May cause eye irritation.
Skin Contact May cause mild skin irritation.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels
No data available

Interactive effects
No data available

Data limitations
No data available

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Dispose in accordance with local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Special precautions during transport

None

HazChem Code

None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number

None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 09-Apr-2019

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
None

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used

bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
NZ CCID

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This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Attachment 2 Risk Assessment Dossier

MONOETHANOLAMINE

This dossier on monoethanolamine presents the most critical studies pertinent to the risk assessment of monoethanolamine in its use in coal seam gas extraction activities. This dossier does not represent an exhaustive or critical review of all available data. Most of the information presented in this dossier was obtained from the ECHA database which provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch et al., 1997).

Screening Assessment Conclusion – Monoethanolamine was not identified in chemical databases used by NICNAS as an indicator that the chemical is of concern and is not a PBT substance. Monoethanolamine was assessed as a tier 2 chemical for acute and chronic toxicity. Therefore, monoethanolamine is classified overall as a **tier 2** chemical and requires a hazard assessment and qualitative assessment of risk.

1 BACKGROUND

Monoethanolamine is readily biodegradable. It is not expected to bioaccumulate, and it has low potential to adsorb to soil. The acute toxicity of monoethanolamine is low by the oral, dermal and inhalation routes. It is a skin and eye irritant, but it is not a skin or respiratory sensitiser. Based on the data available, the chemical is not considered to cause serious damage to health from repeated oral exposure or through inhalation. No critical effects were observed. No data are available to evaluate systemic exposure via the dermal pathway. The substance is not genotoxic when tested in both *in vitro* and *in vivo* assays. There is no indication that this substance will have an adverse effect on reproduction and development. Monoethanolamine has moderate toxicity to aquatic organisms based on chronic studies.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): 2-aminoethanol

CAS RN: 141-43-5

Molecular formula: C_2H_7NO

Molecular weight: 61.08 g/mol

Synonyms: Monoethanolamine; MEA; ethanolamine

3 PHYSICO-CHEMICAL PROPERTIES

Key physical and chemical properties for the substance are shown in Table 1.

Table 1 Overview of the Physico-chemical Properties of Monoethanolamine

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	Clear liquid with fish odour	2	ECHA
Melting Point	4 °C	2	ECHA
Boiling Point	167 °C @ 101.3 kPa	2	ECHA
Density	1016 kg/m^3 @ 20 °C	2	ECHA
Vapor Pressure	50 Pa @ 20 °C	2	ECHA
Partition Coefficient (log K_{ow})	-2.3 @ 25 °C	2	ECHA
Water Solubility	>1000 g/L @ 20 °C (pH 12.1)	2	ECHA
Dissociation Constant (pKa)	9.5 @ 25 °C	2	ECHA
Viscosity	23.86 mPa·s (dynamic) @ 20 °C	2	ECHA

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No specific environmental regulatory controls or concerns were identified within Australia and internationally for monoethanolamine.

NICNAS has assessed monoethanolamine in an IMAP Tier 1 assessment and it was concluded that this chemical poses no unreasonable risk to the environment[1].

Table 2 Existing International Controls

Convention, Protocol or other international control	Listed Yes or No?
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
REACH (Substances of Very High Concern)	No
United States Endocrine Disrupter Screening Program	No
European Commission Endocrine Disruptors Strategy	No

[1] https://www.industrialchemicals.gov.au/chemical-information/search-assessments?assessmentcasnumber=141-43-5

5 ENVIRONMENTAL FATE SUMMARY

A. Summary

Monoethanolamine is readily biodegradable. It is not expected to bioaccumulate, and it has low potential to adsorb to soil.

B. Partitioning

Monoethanolamine is highly soluble in water. A pKa of 9.5 indicates monoethanolamine will exist almost entirely in the cation form at pH values of 5 to 9 and, therefore, volatilization from water surfaces is not expected to be an important fate process. Likewise, volatilization from moist soil is not expected because cations do not volatilize. Monoethanolamine is not expected to volatilize from dry soil surfaces based upon its vapor pressure.

Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyse under environmental conditions (pH 5 to 9) (PubChem).

C. Biodegradation

Monoethanolamine is considered readily biodegradable. In OECD 301A test, degradation was found to be > 90% after 21 days (ECHA) [KI. Score = 2].

If a chemical is found to be readily biodegradable, it is categorised as Not Persistent since its half-life is substantially less than 60 days (DoEE, 2017).

D. Environmental Distribution

No reliable experimental data are available for monoethanolamine. Using KOCWIN in EPISuite™ (USEPA, 2017), the estimated K_{oc} value from log K_{ow} is 0.166 L/kg. The estimated K_{oc} value from the molecular connectivity index (MCI) is 1.2 L/kg. Both estimates refer to the uncharged molecule. While the substance was completely inside the applicability domain of the MCI model, the log K_{ow} of monoethanolamine was slightly outside of the range of the training set of the K_{ow} method. Therefore, the estimate of the log K_{ow} method may be less accurate. (ECHA) [KI. Score = 2].

The measured pKa of 9.5 indicates that the substance will primarily exist as a cation in the environment. Cations generally adsorb stronger to soils containing organic carbon and clay than their neutral counterparts. Franco & Trapp (2008, 2009, 2010) have developed a method to take this effect into consideration when assessing the adsorption potential. The model is not yet validated; in addition, the applicability domain is not clearly defined. Nevertheless, the K_{oc} values of the Franco & Trapp method give a good indication on the adsorption potential of a substance depending on the pH conditions of soil. The method is based on the dissociation constant pKa and the log K_{ow} for the uncharged molecule. Regarding the charged molecule, at pH 7 the log K_{oc} was estimated to be 1.16 (K_{oc} = 15 L/kg) following the method of Franco & Trapp (2008, 2009, 2010) based on a pKa value of 9.5 and a log K_{ow} value of -1.61. (ECHA) [KI. Score = 2].

Based upon these K_{oc} values, if released to soil, monoethanolamine is not expected to adsorb to soil and has a potential for high mobility. If released into water, monoethanolamine is also not expected

to adsorb to suspended solids and sediment. However, absorption is affected by the acidity of the substrate (PubChem).

E. Bioaccumulation

A QSAR study using OASIS Catalogic v 5.13.1 [BCF base line model-v.03.10] was used to derive a bioaccumulation factor (BCF) of 2.5 L/kg which considers all mitigating factors. A BCF value of 9.2 was derived assuming no mitigating factors. (ECHA)[KI. Score=2] These BCF values suggests that monoethanolamine is not expected to bioaccumulate, which is consistent with a log K_{ow} of -2.3 (ECHA).

6 HUMAN HEALTH HAZARD ASSESSMENT

A. Summary

The acute toxicity of monoethanolamine is low by the oral, dermal and inhalation routes. It is a skin and eye irritant, but it is not a skin or respiratory sensitiser. Based on the data available, the chemical is not considered to cause serious damage to health from repeated oral exposure or through inhalation. No critical effects were observed. No data are available to evaluate systemic exposure via the dermal pathway. The substance is not genotoxic when tested in both *in vitro* and *in vivo* assays. There is no indication that this substance will have an adverse effect on reproduction and development.

B. Toxicokinetics

There are no studies available to determine the toxicokinetics of monoethanolamine via the oral or inhalation routes of exposure. *In vivo* studies using radioactive monoethanolamine, show that it penetrates the skin and then it is widely distributed throughout the body. More specifically 24% of the radioactive dose was found in the liver, 24.3% on skin, 18% exhaled CO_2, 4.6% urine, 2.5% kidneys, and 1.8% feces. (ECHA) [KI. Score =2].Transdermal uptake was determined to be slower than intraperitoneal administration. In short, monoethanolamine is readily metabolized in the skin and other organs with the liver being the target organ for metabolism. Dermal absorption for workers and consumers is 37.5% and 75% respectively.

C. Acute Toxicity

In an OECD Guideline 401 (Acute oral Toxicity) study, the oral LD_{50} value in rats was found to be 1089 mg/kg/bw for males and females (ECHA) [KI. Score =2].

LC_{50} values of 1487 mg/m^3 (4 hours) and >1300 mg/m^3 (6 hours) was determined for acute inhalation toxicity in rats (ECHA) [KI. Score =2].

In an OECD Guideline 402 (Acute Dermal Toxicity) study, the dermal LD_{50} in rabbits was found to be 2504 mg/kg/bw (ECHA) [KI. Score = 2].

D. Irritation

In an OECD Guideline 404 (Acute Dermal Irritation/Corrosion) study, monoethanolamine was found to be corrosive to rabbits with irreversible effects after 8 days of exposure (ECHA) [KI. Score =2).

In an OECD Guideline 405 (Acute Eye Irritation/ Corrosion) study, monoethanolamine was found to be corrosive to the eyes of rabbits with irreversible effects after 8 days of exposure (ECHA) [KI. Score =2]. The mean of the 24-, 48-, and 72-hour scores were: 3 for corneal opacity, 0.88 iridial lesions, 0.89 conjunctival redness, and 1.33 chemosis.

E. Sensitisation

Monoethanolamine was identified as a not sensitising in a guinea pig maximisation test after 48h and 72 h readings (ECHA) [KI.Score =2).

A respiratory sensitisation test (bronchoconstriction [Pao] and analysis of Histamine in Bronchoalveolar Lavage Fluid [BALF]) in guinea pigs did not identify an adverse effect (not sensitising) following exposure to monethanolamine (ECHA)[KI.Score =2].

F. Repeated Dose Toxicity

Oral

Read-across substance monoethanolamine HCI was tested in a two-generation reproduction toxicity study as per an OECD Guideline 416. The F0 parental generation consisted of 25 Male and 25 female Wistar rats that were fed monoethanolamine HCI at the following doses: 0, 100,300, and 1000 mg/kg/bw/day. After 75 days of treatment the F0 animals were mated to produce a litter (F1 generation). There were no adverse effects were observed in the 100 and 300 mg/kg F0 and F1 parental animals. Systemic toxicity, in parental females, was characterized by lowered food consumption and/or body weight during gestation and lactation. The absolute and relative kidney weights were significantly increased without corresponding histopathological findings in the F1 animals dosed at 300 mg/kg/bw/day. The kidneys of all the treated males and females showed a low incidence of basophilic tubules in a slightly higher number of animals compared to the controls. The severity (minimal to slight) was comparable between treated, and controls and a clear dose-response relationship was not observed. The no observed adverse effect level (NOAEL) for general toxicity is 300 mg/kg-day (ECHA) [KI. score = 1].

Inhalation

In an OECD Guideline 412 (Subacute Inhalation Toxicity: 28-day Study) study, five male and five female Wistar rats were exposed by inhalation (nose-only) to 0, 10, 50, or 150 mg/m^3 monoethanolamine aerosol, 6 hours/day, 5 days/week for 28 days (20 exposures). The mean mass aerodynamics diameters (MMADs) in the 150 mg/m^3 group were 1.1 and 1.2 μm with a GSD of 5.3 and 5.4. The calculated mass fractions of particles <3 μm aerodynamic size were 70.0% and 70.3%, respectively. There were no effects that were considered to be from systemic exposure. Histopathological effects were seen in the larynx, trachea, and lung; these effects were considered to be site-of-contact effects from the irritating nature of the test material. The no observed adverse effect concentration (NOAEC) for systemic toxicity is 150 mg/m^3, the highest exposure concentration tested. The lowest observed adverse effect concentration (LOAEC) for localized (irritation) effects is 10 mg/m^3; a NOAEC was not determined (ECHA) [KI. score = 1]

Dermal

There are no adequate or reliable studies available.

G. Genotoxicity

In Vitro Studies

The results of the *in vitro* genotoxicity studies on monoethanolamine are presented in Table 3.

Table 3 *In Vitro* Genotoxicity Studies on 2-Ethylhexanol

Test System	Results*		Klimisch Score	Reference
	-S9	+S9		
Mammalian cell gene mutation (Chinese hamster lung fibroblasts, V79)	-	-	2	ECHA
Chromosome aberration study in mammalian cells (Rat hepatocytes, RL4)	-	-	2	ECHA
Gene mutation study in mammalian cells (mouse lymphoma L5178 Y cells)	-	-	1	ECHA
Gene mutation study in bacteria (S. typhimurium and E. coli strains)	-	-	1	ECHA

*+, positive; -, negative

In Vivo Studies

In an OECD guideline 474 (Mammalian Erythrocyte Micronucleus Test) study, five male and five female Naval Medical Research Institute (NMRI) mice, at each dose level, received monoethanolamine on two consecutive days at the following doses, oral gavage, 0, 375, 750, or 1,500 mg/kg. There were no biologically relevant or statistical differences observed in the frequency of micronucleated polychromatic erythrocytes in the treated mice when compared to the controls (ECHA) [Kl. score = 1].

H. Carcinogenicity

Oral

There are no adequate or reliable carcinogenicity studies available.

Inhalation

No studies are available.

I. Reproductive Toxicity

In an OECD Guideline 416 (Two-Generation Reproduction Toxicity Study) study, male and female Crl:WI (Han) rats were fed in their diet 0, 100, 300, or 1,000 mg/kg methanolamine. There were no adverse effects seen in the 100 and 300 mg/kg F0 and F1 parental animals. Feed consumption was lower in the 1,000 mg/kg F0 females during lactation. Body weight gain and, for the F0 generation, body weights of the 1,000 mg/kg dams were significantly lower during gestation, which was considered to be secondary to increased post-implantation loss in these animals. At 1,000 mg/kg, absolute and relative epididymides and cauda epididymidis weights were reduced and,

in the F0 generation only, the number of homogenization resistant caudal epididymal sperm was slightly, but significantly, reduced. There was no accompanying histopathogical findings. In the F0 and F1 1,000 mg/kg females, the numbers of implants were decreased and the resorption rates were increased, resulting in significantly smaller litters. There were no other treatment-related effects on the reproductive parameters measured. There were no indications for any developmental toxicity in the F1 and F2 offspring. The NOAEL for systemic toxicity and fertility and reproductive performance is 300 mg/kg-day. The NOAEL for pre- and post-natal developmental toxicity is 1,000 mg/kg-day, the highest dose tested (ECHA) [Kl. score = 1].

Moore and co-workers investigated the potential role of choline antagonism in the aetiology of monoethanolamine (MEA)-induced implantation loss. When administered to pregnant rats during gestation days (GD) 1–3, 4–5, or 6–7, MEA had no effect upon implantation success. In a second experiment, MEA was administered either in the diet or by oral gavage from two weeks prior to mating through to GD 8. Parallel groups also received a diet supplemented with choline. In the absence of supplementary choline, MEA induced early resorptions, statistically significant only when administered in the diet. A slight reduction in implantation success was ameliorated by supplementary choline. It was concluded that implantation is affected by MEA only when exposure starts before mating; that dietary administration is more effective than gavage dosing; and that interference with choline homeostasis may play a role in the aetiology of this lesion (ECHA). [Kl. score = 1] Rodents appear to be more sensitive towards effects on choline homeostasis and effects observed have been assessed to lack human relevance (ECHA).

J. Developmental Toxicity

Oral

In an OECD Guideline 414 (Prenatal Developmental Toxicity Study) study, pregnant female Wistar rats were dosed by oral gavage with 0, 40, 120, or 450 mg/kg monoethanolamine on GD 6-15. Feed consumption, lower mean body weights and reduced body weight gain was observed in the 450 mg/kg dams. There was no developmental toxicity. The NOAEL for maternal is 120 mg/kg-day; the NOAEL for developmental toxicity is 450 mg/kg-day, the highest dose tested (ECHA) [Kl. score = 1].

Inhalation

No adequate and reliable studies available.

Dermal

In an OECD Guideline 414 (Prenatal Developmental Toxicity Study) study, pregnant female New Zealand White rabbits were given dermal applications of 0, 10, 25, and 75 mg/kg monoethanolamine 6 hours/day on GD 6-18. There was severe skin irritation at the site of exposure in the 75 mg/kg animals. Skin irritation was also observed in some of the 25 mg/kg females, but to a much less degree of severity. There were no other maternal toxic effects. There was no developmental toxicity. The NOAEL for maternal toxicity is 10 mg/kg-day; the NOAEL for developmental toxicity is 75 mg/kg-day, the highest dose tested (ECHA) [Kl. score = 2].

Pregnant female SD rats were given dermal applications of 0, 10, 25, 75, or 225 mg/kg monoethanolamine 6 hours/day on GD 6-15. In the 225 mg/kg group, there was skin irritation at the site of application and body weight gain was reduced during the exposure period. There was no

developmental toxicity. The NOAEL for maternal toxicity is 75 mg/kg-day; the NOAEL for developmental toxicity is 225 mg/kg-day, the highest dose tested (ECHA) [Kl. score = 2]

K. Derivation of Toxicological Reference and Drinking Water Guidance Values

The toxicological reference values developed for monoethanolamine follow the methodology discussed in enHealth (2012). The approach used to develop drinking water guidance values is described in the Australian Drinking Water Guidelines (ADWG, 2021).

Non-Cancer

Oral

In a two-generation oral reproductive toxicity study, there was reduced food consumption and/or body weight gain, as well as organ weight changes unaccompanied by histopathological findings, in the male and female rats fed 1,000 mg/kg-day monoethanolamine. The NOAEL for general systemic toxicity was set at 300 mg/kg-day from this study. The NOAEL of 300 mg/kg-day will be used to determine the oral reference dose and drinking water guidance value for monoethanolamine.

Oral Reference Dose (oral RfD)

Oral RfD = NOAEL / (UF_A x UF_H x UF_L x UF_{Sub} x UF_D)

Where:
UF_A (interspecies variability) = 10
UF_H (intraspecies variability) = 10
UF_L (LOAEL to NOAEL) = 1
UF_{Sub} (subchronic to chronic) = 3
UF_D (database uncertainty) = 1

Oral RfD = 300/(10 x 10 x 1 x 3 x 1) = 300/300 = 1 mg/kg-day

Drinking water guidance value

Drinking water guidance value = (animal dose) x (human weight) x (proportion of intake from water) / (volume of water consumed) x (safety factor)

Using the oral RfD,

Drinking water guidance value = (oral RfD) x (human weight) x (proportion of water consumed) / (volume of water consumed)

Where:
Human weight = 70 kg (ADWG, 2021)
Proportion of water consumed = 10% (ADWG, 2021)
Volume of water consumed = 2L (ADWG, 2021)

Drinking water guidance value = (1 x 70 x 0.1)/2 = 3.5 mg/L

Cancer

There are no adequate or reliable carcinogenic studies available for monoethanolamine. Therefore, a cancer reference value was not derived.

L. Human Health Hazard Assessment of Physico-Chemical Properties

Monoethanolamine does not exhibit the following physico-chemical properties:

- Explosivity
- Flammability
- Oxidising potential

7 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Monoethanolamine has moderate toxicity to aquatic organisms based on chronic studies.

B. Aquatic Toxicity

Acute Studies

Table 4 lists the results of acute aquatic toxicity studies conducted on monoethanolamine.

Table 4 Acute Aquatic Toxicity Studies on Monoethanolamine

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
Oncorhynchus mykiss (Rainbow Trout)	96-hour LC_{50}	105	2	ECHA
Cyprinus carpio (Common Carp)	96-hour LC_{50}	349	1	ECHA
Oryzias latipes (Medaka)	96-hour LC_{50}	> 100	2	ECHA
Pimephales promelas (Fathead Minnow)	96-hour LC_{50}	2070	2	ECHA
Carassius auratus (goldfish)	96-hour LC_{50}	170	2	ECHA
Danio rerio (zebrafish)	96-hour LC_{50}	3682	2	ECHA
Daphnia magna	48-hour EC_{50}	27	1	ECHA
Pseudokirchneriella subcapitata	72-hour EC_{50}	2.80	2	ECHA

Chronic Studies

A 41-day NOEC for Oryzias latipes (Medaka) in an OECD 210 test is 1.24 mg/L (ECHA)[KI. Score= 2].

The long-term effects on aquatic invertebrates were assessed in a 21-day chronic reproduction test on Daphnia magna, according to OECD guideline 202. The 21-day NOEC was determined to be 0.85 mg/L for reproduction (ECHA)[KI. Score = 2].

Monoethanolamine has been evaluated for its toxicity towards the fresh water algae *Pseudokirchneriella subcapitata* (formerly *Selenastrum capricornutum*) in an Alga growth inhibition test according to OECD 201 under GLP requirements. The exposure duration was 72 hours under static conditions. The 72-hr EC_{10} growth rate determined from the study was 0.7 mg/L (ECHA) [KI. Score = 2].

C. Terrestrial Toxicity

Indirect exposure to the soil compartment is unlikely since the substance is readily biodegradable. Consequently, no tests on soil organisms are required. However, long-term toxicity studies are available for earthworms, collembolans, and terrestrial plants. Chronic effect values (EC_{10} or NOEC) were not reported. Acute data is summarized below:

A 35-day LC_{50} earthworm (*Eisenia Andrei*) - 3,715 mg/kg (mortality) (ECHA) [KI. Score = 2]

A 63-day EC_{50} earthworm - 4,033 mg/kg (reproduction)(ECHA) [KI. Score = 2]

A 63-day EC_{25} earthworm - 2,016 mg/kg (reproduction)(ECHA) [KI. Score = 2]

A 28-day LC_{50} springtails (*Folsomia candida*) 1,893 mg/kg (mortality) (ECHA) [KI. Score = 2]

A 14-day EC_{50} plants (*Hordeum vulgare*) - 2,939 mg/kg (growth, shoot dry mass) (ECHA) [KI. Score = 2]

No studies on the toxicity to birds are available for the substance.

D. Calculation of PNEC

The PNEC calculations for monoethanolamine follow the methodology discussed in DEWHA (2009).

PNEC water

Experimental results are available for three trophic levels. Acute $E(L)C_{50}$ values are available for fish (105 mg/L), invertebrates (27 mg/L), and algae (2.8 mg/L). Results from chronic studies are also available for all three trophic levels, with the lowest NOEC or EC_{10} value being 0.70 mg/L for algae. On the basis that the data consists of short-term and long-term results from three trophic levels, an assessment factor of 10 has been applied to the lowest reported EC_{10} value of 0.70 mg/L for algae. The resulting $PNEC_{water}$ is 0.07 mg/L.

PNEC sediment

There are no toxicity data for sediment-dwelling organisms. Therefore, the $PNEC_{sed}$ was calculated using the equilibrium partitioning method. The $PNEC_{sed}$ is 0.060 mg/kg sediment wet weight.

The calculations are as follows:

$PNEC_{sed} = (K_{sed\text{-}water}/BD_{sed}) \times 1000 \times PNEC_{water}$
$= (1.088/1280) \times 1000 \times 0.07$
$= 0.0595$ mg/kg

Where:
$K_{sed\text{-}water}$ = suspended matter-water partition coefficient (m^3/m^3)
BD_{sed} = bulk density of sediment (kg/m^3) = 1,280 [default]
$PNEC_{water}$ = predicted no effect concentration in water (mg/L) [calculated above]

$K_{sed\text{-}water} = 0.8 + [0.2 \times Kp_{sed}/1000 \times BD_{solid}]$
$= 0.8 + [0.2 \times 0.6/1000 \times 2400]$
$= 1.088\ m^3/m^3$

Where:
Kp_{sed} = solid-water partition coefficient (L/kg)
BD_{solid} = bulk density of the solid phase (kg/m^3) = 2,400 [default]

$Kp_{sed} = K_{oc} \times f_{oc}$
$= 15 \times 0.04$
$= 0.6$ L/kg

Where:
K_{oc} = The calculated K_{oc} value for monoethanolamine is 15 L/Kg following the method of Franco & Trapp (2008, 2009, 2010) (ECHA)[KI.Score=2]
f_{oc} = fraction of organic carbon in sediment = 0.04 [default]

PNEC soil

Indirect exposure to the soil compartment is unlikely since the substance is readily biodegradable. In addition, chronic effect levels were not reported in available long-term toxicity studies. Therefore, the $PNEC_{soil}$ was calculated using the equilibrium partitioning method. The $PNEC_{soil}$ is 0.014 mg/kg soil dry weight.

The calculations are as follows:

$PNEC_{soil} = (Kp_{soil}/BD_{soil}) \times 1000 \times PNEC_{water}$
$= (0.3/1500) \times 1000 \times 0.07$
$= 0.014$ mg/kg

Where:
Kp_{soil} = soil-water partition coefficient (m^3/m^3)
BD_{soil} = bulk density of soil (kg/m^3) = 1,500 [default]

$PNEC_{water}$ = predicted no effect concentration in water (mg/L) [calculated above]

$Kp_{soil} = K_{oc} \times f_{oc}$
$= 15 \times 0.02$
$= 0.3\ m^3/m^3$

Where:
K_{oc} = The calculated K_{oc} value for monoethanolamine is 15 L/Kg following the method of Franco & Trapp (2008, 2009, 2010) (ECHA)[KI.Score=2]
f_{oc} = fraction of organic carbon in soil = 0.02 [default]

8 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REACH Criteria methodology (DEWHA, 2009; ECHA, 2008).

Monoethanolamine is readily biodegradable; thus, it does not meet the screening criteria for persistence.

Based on a measured log K_{ow} of -2.3, monoethanolamine does not meet the screening criteria for bioaccumulation.

The chronic NOEC values for monoethanolamine are >0.1 mg/L. Thus, monoethanolamine does not meet the screening criteria for toxicity.

Therefore, monoethanolamine is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for monoethanolamine.

9 SCREENING ASSESSMENT

Chemical Name	CAS No.	Overall PBT Assessment [1]	Chemical Databases of Concern Assessment Step		Persistence Assessment Step		Bioaccumulative Assessment Step	Toxicity Assessment Step			Risk Assessment Actions Required[3]
			Listed as a COC on relevant databases?	Identified as Polymer of Low Concern	P criteria fulfilled?	Other P Concerns	B criteria fulfilled?	T criteria fulfilled?	Acute Toxicity [2]	Chronic Toxicity[2]	
Monoethanolamine	141-43-5	Not a PBT	No	No	No	No	No	No	1 (fish, inv) 2 (algae)	1 (fish), 2 (inv, algae)	2

Footnotes:

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 - Tier 2 - Hazard Assessment and Qualitative Assessment Only. Develop toxicological profile and PNECs for water and soil and provide qualitative discussion of risk.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

10 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

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B. Abbreviations and Acronyms

°C	degrees Celsius
ADWG	Australian Drinking Water Guidelines
AICS	Australian Inventory of Chemical Substances
BCF	bioconcentration factor
COC	constituent of concern
DEWHA	Department of the Environment, Water, Heritage and the Arts
EC	effective concentration
ECHA	European Chemicals Agency
EU	European Union
g/L	grams per litre
hPa	hectopascal
IMAP	Inventory Multitiered Assessment and Prioritisation Program
IUPAC	International Union of Pure and Applied Chemistry
kg	kilograms
kg/m^3	kilograms per cubic metre
KI	Klimisch scoring system
KOCWIN™	USEPA organic carbon partition coefficient estimation model
kPa	kilopascal
L	litre
L/kg	litres per kilogram
LC	lethal concentration
LD	lethal dose
LOAEL	lowest observed adverse effect level
m^3	cubic metre
MCI	molecular connectivity index
mg/kg	milligrams per kilogram
mg/L	milligrammes per litre
mg/m^3	milligrams per cubic metre
mL	millilitre
mPa s	millipascal second
NICNAS	The National Industrial Chemicals Notification and Assessment Scheme
NOAEC	No Observed Adverse Effect Concentration
NOAEL	no observed adverse effect level

OECD	Organisation for Economic Co-operation and Development
Pa	pascal
PBT	Persistent, Bioaccumulative and Toxic
PNEC	Predicted No Effect Concentration
ppm	parts per million
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RfD	Reference Dose
SGG	Synthetic Greenhouse Gases
TG	Test Guideline
USEPA	United States Environmental Protection Agency