# MEMO

To: [redacted] inGauge

From: [redacted] EHS Support, LLC

CC: [redacted]

Date: 9 December 2025

Re: Carpentaria 5H Flowback Wastewater Assessment and Produced Water Report

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## Introduction

Imperial Oil and Gas Pty Ltd ("Imperial") is conducting an exploration and appraisal program within Exploration Permit (EP)-187, located in the Beetaloo Sub-basin of the broader McArthur Basin in the Northern Territory (NT). As requested, EHS Support, PTY ("EHS Support") performed a risk assessment on flowback water from the Carpentaria 5H well.

The McArthur Basin is located southeast of Katherine, NT, and covers approximately 180,000 square kilometres. Imperial has undertaken exploration activities within EP-187 since 2013. Imperial prepared an Environment Management Plan (EMP), titled Environmental Management Plan Imperial Oil & Gas 2021-2025 EP187 Work Program NT Exploration Permit (EP) 187 (IMP4-3) (Imperial, 2021). The EMP proposed Hydraulic Fracture Stimulation to be conducted in 2021 through 2025 at various well locations within EP187. The EMP IMP4-3 for Imperial did not include use of flowback water for make-up water in the hydraulic fracturing process. Consistent with Regulation 22 of the Petroleum (Environment) Regulations 2016 as in force 8 April 2025 (NT, 2025a), an assessment was completed in 2022 and 2024 to modify regulated activities for the EMP IMP4-3 to include use of flowback water as make-up water in the hydraulic fracturing process (NT, 2022, 2024).

The primary objective of this assessment is to meet the reporting requirements of Condition 20 of the NT Government Approval Notice and Statement of Reasons (EMP Reference IMP4-3), which requires a comprehensive risk assessment for each new exploration well (NT, 2021).

In addition, this report fulfils the regulatory reporting obligations for the Carpentaria 5H well under Item 2A of Regulation 37A, Part 3A (reporting requirements for hydraulic fracturing) of the *Petroleum (Environment) Regulations (2016)* as well as the *Code of Practice: Onshore Petroleum Activities in the Northern Territory* ("Code of Practice") (NT, 2025a, 2025b). Regulation 37A requires submission of a report accompanied by a full human health risk assessment relating to any chemical detected in the flowback fluid, defined as a *fluid that is a mixture of hydraulic fracturing fluid and formation fluid that is allowed to flow from the well following hydraulic fracturing*.

This report also addresses the produced water reporting requirements under Regulation 37B of the *Petroleum (Environment) Regulations (2016)* (NT, 2025a), as applicable at this stage of the project. Regulation 37B requires completion of a human health risk assessment for any chemical detected in the produced water, defined as *naturally occurring water that is extracted from the geological formation following hydraulic fracturing*. To date, no produced water has been generated from Carpentaria 5H.

This assessment leverages information in the following documents:

- Environment Management Plan (EMP) – Environmental Management Plan Imperial Oil & Gas 2021-2025 EP187 Work Program NT Exploration Permit (EP) 187 (IMP4-3) (Imperial, 2021).
- Hydraulic Stimulation Chemical Risk Assessment Update – Imperial Oil and Gas Exploration Permit 187 (Appendix 06 of the EMP; Imperial, 2021; and as updated)
- Regulation 22 Flowback Water Risk Assessment (EHS Support, 2022)
- Regulation 22 Flowback Water Risk Assessment (EHS Support, 2024)
- Regulation 22 Human Health and Environment Risk Assessment (EHS Support, 2024)

## Conceptual Exposure Model

Carpentaria 5H is located along with the Carpentaria 2H and 3H wells on the Carpentaria 2/3/5 well pad, which is approximately 10 kilometres (km) north of the Carpentaria Highway and 200 km east-southeast of Daly Waters (**Figure 1**). The well pad is approximately 6.2 hectare (ha) in area. **Figure 2** presents the layout of the well pad. The well pad currently contains a 12 megalitre (ML) enclosed waste water storage tank (Tank 1) and 13.5 ML open-topped wastewater treatment tank (Tank 2).

Flowback water from the Carpentaria 2H and Carpentaria 3H wells was used as makeup water for hydraulic stimulation of Carpentaria 5H. According to inGauge, flowback water will be stored on the Carpentaria 2/3/5 well pad in Tank 1 or Tank 2 until either re-use of the flowback as makeup water occurs or off-site disposal at a licensed facility. During the intervening time, inGauge anticipates significant reduction in Carpentaria 5H flowback water volume because approximately 5 millimetre (mm) of fluid is evaporated from the open top tank daily.

The Carpentaria 2/3/5 well pad is in a sparsely populated area of the NT (Imperial, 2021). Land use within EP187 is primarily undeveloped with agricultural (e.g., grazing stock) and resource exploration being the primary land uses. As advised by inGauge, the nearest dwelling is West Balbarini, which is located approximately 9 km to the southeast along the Carpentaria Highway. A search within EP187 for Parks, World Heritage Properties, National Heritage Places, Wetlands of International Importance, conservation areas or Sites of Conservation significance did not yield any results. The closest site of significance (Limmen National Park) is adjacent to the north-east boundary of EP187 and is greater than 50 km from the Carpentaria 2 well pad.

Climate within EP187 is tropical savannah within the humid zone with distinct wet and dry seasons; rainfall within the wet season averages between 600 to 800 mm per year (Imperial, 2021). Vegetation within EP187 is mostly open forests and woodlands (predominately Dawin Stringybark [*E. tetrodonta*]). Carpentaria 2 well pad is located within the Gulf Fall and Uplands bioregion which includes water holes, gorges, and desiccated sandstone plateaus. Watercourses of varying stream orders are within the broader EP187 (Imperial, 2021). However, consistent with EMP IMP4-3, the Carpentaria 2 well pad is situated outside of sensitive receptor buffer zones, including water courses

and is approximately 150 m from the closest stream (Table 10 of IMP4-3; Imperial, 2021). The closest spring to a well pad within EP187 is 22 km.

The Cambrian Limestone Aquifer (CLA) within the Top Springs Limestone, also commonly referred to as Tindal Limestone or Gum Ridge Formation, is the shallowest regional aquifer within EP187 (EHS Support, 2023). Infiltration through sinkholes and preferential recharge through soil cavities are believed to be the likely groundwater recharge mechanisms for the CLA (Imperial, 2021).

**Table 1** lists water supply bores located within 5 km of the well pad. According to the EMP, well pads were to be constructed greater than 1 km from landowner bores and existing water supply bores used for domestic or stock consumption. Other than water supply bores located on the Carpentaria 2/3/5 well pad (i.e., associated with well operations and not used for domestic or stock purposes), the closest water supply bore is located 2.6 km northeast of the well pad (NT, 2025c). Based on bore logs for the wells, the CLA begins at a depth of approximately 50 m below ground level in the well pad area (NT, 2025c).

**TABLE 1 WATER SUPPLY BORES WITHIN 5 KM OF CARPENTARIA 2/3/5 WELL PAD (NT, 2025C)**

| Bore no | Location and direction relative to Carpentaria 2/3/5 well pad | Latitude | Longitude | Completion date | Drilled depth (m) | Completion depth (m) | Depth to water (m) |
|---|---|---|---|---|---|---|---|
| RN043017 | 2.6 km NE | -16.6896 | 135.1233 | 22/08/2022 | 88 | 88 | 58 |
| RN042461 | Within well pad | -16.7008 | 135.1022 | 25/10/2021 | 234 | 234 | 68 |
| RN042462 | | -16.7009 | 135.1022 | 19/10/2021 | 100 | 100 | 68 |
| RN042463 | | -16.7017 | 135.1037 | 26/10/2021 | 100 | 100 | 66 |
| RN042464 | | -16.7016 | 135.1037 | 1/11/2021 | 228 | 228 | 66 |
| RN044440 | | -16.7001 | 135.1031 | 11/10/2024 | 163 | 163 | 66 |
| RN044441 | | -16.7009 | 135.1034 | 26/10/2024 | 160 | 160 | 66 |


**Figure 1 Carpentaria 5H location**

**Figure 2 Carpentaria 2 well pad layout**

In development of the EMP, potential exposures to humans and the environment to chemicals used in hydraulic stimulation were evaluated (Imperial, 2021). Multiple mitigation measures and control measures were specified within the EMP and associated Spill Management Plan (Appendix 07 of EMP) and Wastewater Management Plan (Appendix 06 of the EMP) to reduce residual risks from exposure to flowback water to As Low As Reasonably Practical (ALARP).

Flowback water from Carpentaria 5H is stored in Tank 1 and/or Tank 2 throughout the year. Both tanks are fitted with leak detection, and a bunded area surrounds each tank to prevent overland flow with a secondary storage capacity of approximately 400 cubic metres ($m^3$).

An assessment of potential release scenarios from storage tanks was completed as part of the Hydraulic Stimulation Chemical Risk assessment (CRA; Imperial, 2021) and the Human Health and Environmental Risk Assessment (HHERA) of chemicals used in hydraulic stimulation included as a Regulation 22 Modification to IMP4-3 (EHS Support, 2024). In a potential release scenario of 100,000 litres (L) outside of containment and the storage area, the maximum affected area of spreading was estimated to be less than 4.7 ha and limited to the proximity of the release area. Given buffer distances from water courses and size of Carpentaria 2/3/5 well pad, potential complete exposure pathways to surface water bodies associated with runoff from an accidental release from the flowback storage tank is considered unlikely and not assessed further.

The shallow geology in the region is characterised as Cretaceous interbedded siltstone and claystone/mudstone sequences of the Kyalla Member. These low permeability sequencies overlie the Top Springs Limestone (also referred to as Tindal Limestone or Gum Ridge Formation) which is at a depth of approximately 50 m below ground level. Note that this geology is generally consistent with the strata described in the logs for the water bores within the Carpentaria 2/3/5 well pad. Based on this stratigraphy, direct vertical aquifer recharge from rainfall, surface water or surficial spills of water is likely to be negligible due to the low permeability of the siltstone and claystone lithology.

An infiltration assessment was also performed as part of the HHERA predicted that it would take groundwater approximately 158 years to infiltrate the siltstone and claystone lithology to a depth of 50 m below ground (i.e., to the top of the Top Springs Limestone). Given the limited infiltration rate and distance from nearest bore, potential exposure to groundwater affected by a release of flowback water from the storage tank is not considered a complete exposure pathway.

Human receptors identified in the EMP with potential exposures to flowback water stored in tanks or during re-use activities include oil and gas workers (Imperial, 2021). The Carpentaria well pad site is fenced and controlled areas limit access to the public and preclude entry by livestock to the tank. Additionally, the well site is not visible from the closest highway, further reducing the likelihood of potential trespassers entering the secured well pad. Chemical exposures to workers are controlled through occupational hygiene practices, which include 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 (therefore, the exposures are considered unlikely). Respiratory protection may not always be standard on hydraulic fracturing worksites; therefore, inhalation of vapours by oil and gas workers was considered a potentially complete exposure pathway for volatile constituents for chemicals used within the hydraulic stimulation process in the CRA. However, as flowback water is stored in tanks that are open to the atmosphere (i.e., not under cover or housed within an enclosed structure), potential inhalation exposures will be mitigated by natural ventilation (NICNAS, 2017) and are considered negligible. Therefore, no

complete exposure pathways were identified for human receptors requiring further evaluation in this risk assessment.

Flowback water is typically hypersaline (i.e. total dissolved solids [TDS] greater than 50,000 milligrams per litre [mg/L]), which is unpalatable and a deterrent for avian receptors and other fauna from consuming and interacting with wastewater (Australian and New Zealand Guidelines [ANZG], 2023; Adams et al, 2013; Smith et al, 2010). This is due to the osmotic regulatory (or water balance) requirements of fauna. Ingestion of hypersaline water can lead to dehydration, weight loss, and mortality. The maximum observed salinity ingested by an avian species (Zebra Finch) was 47,000 mg/L TDS. TDS concentrations in the flowback samples from Carpentaria 5H ranged from 74,500 mg/L to 130,000 mg/L, with an average of 97,500 mg/L (**Attachment A, Table A-1**), and is consistent with a hypersaline characteristic. Avian receptors have reportedly been observed interacting with water in the open top tanks; however, no associated mortalities have been documented in the fauna register. Based on hypersaline nature of flowback water, potential exposure to avian receptors is considered low. However, as a conservative measure, potential exposure to avian receptors via incidental ingestion was evaluated in this risk assessment.

Management controls and mitigation measures outlined in the EMP are utilized to minimise potential for releases, including catastrophic failure, from storage tanks. However, as a conservative measure, evaluation of potential release of liquids to soils within the containment area was performed for the Carpentaria 5H flowback water and exposure to terrestrial receptors was included in this flowback risk assessment.

## Data Used in the Risk Assessment

Carpentaria 5H was stimulated 16 July to 24 July 2025. Approximately 11.6 megalitres (ML) of flowback water from Carpentaria 2H and 3H were used as makeup water for stimulation activities at Carpentaria 5H. Consistent with the EMP, this volume may reduce over time due to evaporation (Imperial, 2021).

Seven samples of Carpentaria 5H flowback water were collected from 17 July 2025 to 5 September 2025. Samples of the flowback water were either collected from the choke manifold or from the storage tank where the flowback water is stored. **Attachment A, Table A-1** presents the analytical data from the sampling events.

Based on the CEM, no potentially complete exposure pathways were identified for human receptors. For avian receptors, the point of exposure is flowback water stored in open-top tanks. Additionally, the terrestrial assessment evaluates releases of flowback water from these tanks. Samples collected from the choke manifold and flowback water tank were used in this risk assessment.

## Avian Risk Assessment

As a conservative measure, an avian risk assessment was completed to evaluate potential exposure of avian receptors to chemicals detected above screening criteria in flowback water samples from Carpentaria 5H. Laboratory analyses of these wastewater samples for inorganic, organic and radionuclide analytes was completed pursuant to the monitoring wastewater chemistry analytes specified in Section C.8 of the Code of Practice (NT, 2025b).

Consistent with the avian risk assessment completed for the stimulation chemical risk assessment (EHS Support, 2023), this avian risk assessment conducted on the flowback water samples included the following two steps:

1. Screening Assessment – Identify chemicals of low ecological concern that do not require additional evaluation in the risk assessment process based on a comparison to the Australian and New Zealand Guidelines (AZNG) for Fresh & Marine Water Quality (ANZG, 2018) trigger values or, absent such values, alternative screening criteria as noted in **Attachment B**.
2. Quantitative Risk Evaluation – Identify chemicals that are a concern for avian receptors, and therefore require an additional evaluation to characterise the potential risks. The potential exposure was assessed using a quantitative evaluation of the potentially complete avian exposure pathway and the screening assessment.

## Tier 1 Screening Assessment

The screening assessment consisted of a focused evaluation of the potential risks to avian receptors if exposed to chemicals detected in flowback water samples (**Attachment B**, **Table B-1**). The objective of the screening assessment was to identify chemicals of low concern to avian receptors that do not require additional evaluation in the risk assessment process.

The screening assessment used freshwater trigger values (ANZG, 2018) which are deemed to be protective of aquatic species such as fish, invertebrates, and algae assuming chronic, continual, and prolonged contact with surface water at a 95 percent (%) protection level. In instances where no trigger values were available, alternative screening criteria were employed and are noted as such in **Attachment B**, **Table B-1**. Inherently this approach is considered highly conservative given the following:

- In toxicological testing, aquatic species are more sensitive than terrestrial species to chemicals due to their emersion within the fluid, additional modes of action (for example, impacts on gill function) and the potential for secondary stressors to impact health.
- Even if exposed, avian receptors will have limited periods of duration in contact with the fluids. Roosting, breeding, and continuous access will not occur on the water body; therefore, contact will be episodic in nature and possibly only involve ingestion during dry periods.

Chemicals detected in the flowback water samples with concentrations exceeding the conservatively adopted water quality criteria were carried through the quantitative risk evaluation.

The detected chemicals analysed in the wastewater samples that had concentrations exceeding the conservatively adopted water quality criteria and that may pose a potential risk to avian receptors include:

- Antimony
- Ammonia as N
- Arsenic
- Barium
- Boron
- Cadmium
- Chromium
- Copper
- Gross alpha
- Gross beta activity - 40K
- Magnesium
- Nickel
- Total Cyanide
- Total Nitrogen as N
- Total Phosphorus as P
- Zinc
- >C10-C16 Fraction minus Naphthalene (F2)

The maximum result of total nitrogen exceeded the water quality criteria. Total nitrogen is the sum of total Kjeldahl nitrogen (TKN), nitrate, and nitrite. In the Carpentaria 5H flowback water, nitrate and nitrite were either not detected or detected at negligible concentrations and TKN is equivalent to the reported total nitrogen concentrations. The maximum concentration of TKN did not exceed the corresponding water quality criteria; therefore, total nitrogen will not be included for further assessment in this evaluation as the total nitrogen concentration is representative of TKN.

It should be noted that the gross alpha and gross beta screening criteria are only generic screening values for irrigation water. These values are based on risks to human health to due transfer of radionuclides to crop and animal products for human consumption (ANZECC, 2001; ANZG, 2023). These screening values are consistent with the Australian Drinking Water Guidelines (ADWG; National Health and Medical Research Council [NHMRC], National Resource Management Ministerial Council [NRMMC], 2011, and as updated), and if exceeded trigger a more detailed assessment. As outlined in the detailed assessment framework, an order-of-magnitude higher radiological exposure is acceptable as the natural background is higher than the screening level and thresholds for active intervention have been established at corresponding doses 10 to 50 times higher than the corresponding screening value.

In samples of flowback from Carpentaria 5H, gross alpha ranged from 61.3 Bq/L to 309 Bq/L (**Attachment A**). The observed range of gross alpha in flowback from the Carpentaria 1H, 2H and 3H wells was 8 Bq/L to 669 Bq/L; gross alpha activity in Carpentaria 5H flowback water were within similar range.

Gross beta activity is corrected for potassium-40 (K40) because K40 is a natural beta emitter. As potassium does not accumulate in the body despite intake (NHMRC, 2023), gross beta – K40 activity was used to assess potential exposures to gross beta in flowback water. Gross beta – K40 ranged from 22.3 Bq/L to 88.6 Bq/L. Gross beta- K40 activity observed in the Carpentaria 5H flowback are within the range of flowback anticipated from the formation (2.08 Bq/L to 431 Bq/L; Kleinfelder, 2021).

As discussed above, hypersaline water is unpalatable to fauna and unlikely to be consumed due to the inability for avian receptors. Additionally, precipitation of naturally occurring radioactive materials (NORMs) typically occurs in the flowback tank and accompany non-NORM solids that were produced with the flowback, rather than remaining dissolved in flowback water (Australian Radiation Protection and Nuclear Safety Agency [ARPANSA], 2008). Solids within the frac tank will be managed in accordance with the EMP IMP4-3. Therefore, there is no further need to evaluate gross alpha and gross beta in this risk assessment.

## Tier 2 Quantitative Risk Assessment

Potential exposure of avian receptors to the chemicals of concern in the flowback water samples was quantitatively assessed for representative avian species that were previously evaluated in the stimulation chemical risk assessments (EHS Support, 2023). The potential avian exposure pathway was assessed based on the potential ingestion of flowback water by avian receptors using standard methods and in accordance with the methodologies used in the previous avian risk assessments.

Potential dietary intake of water containing these chemicals was compared to toxicity reference values (TRVs) developed specifically for avian wildlife. Exposure assumptions for the dietary intake and TRV development were designed to be conservative to reduce uncertainty in the quantitative

risk estimates. The potential risks were estimated using a chemical-specific hazard quotient (HQ). As with the human health risk assessment, an HI is the sum of the HQs on an avian species-specific basis. A potential hazard index (HI) threshold level of less than 1 indicates there are no unacceptable exposures to the avian species.

**Table 2** summarises the results of the quantitative risk evaluation and includes a short-term (21-day) and long-term (1-year) scenario of fluid exposure. These values were calculated based on the highly conservative assumption that all daily water ingestion during the exposure period is exclusively from flowback water. While there are no projected plans for short-term use or disposal of flowback water, the 21-day scenario provides a range of risk to avian receptors under different temporal scenarios. The HIs for all the assessed avian species were less than the threshold HI of 1 for the 21-day scenario exposure scenarios. Under the longer-term on-site storage scenario, the HIs slightly exceeded the target of 1 and ranged from 2 to 3. Barium was the primary risk drivers for this scenario.

Given the hypersaline nature of the flowback water, it is unlikely that avian receptors would ingest the flowback water stored in open top tanks. In addition, the evaluation did not account for precipitation of chemicals within the tank or degradation over time. Therefore, the potential for unacceptable exposures to the avian species from potential ingestion of chemicals in flowback is unlikely.

**Table 2 Hazard Indices for Target Avian Species Exposed to Flowback Water**

| Avian Species | Hazard Index for 21 days of Storage | Hazard Index for 1 year of Storage |
|---|---|---|
| Crested Pigeon | 1E-01 | 2E+00 |
| Willie Wagtail | 1E-01 | 3E+00 |
| Peaceful Dove | 1E-01 | 2E+00 |
| Cattle Egret | 1E-01 | 2E+00 |
| Brown Honeyeater | 2E-01 | 3E+00 |

**Attachment B**, **Table B-2** through **Table B-7** present the detailed calculations and outcomes of the quantitative risk evaluation for the target avian species in **Table 2**.

## Terrestrial Risk Assessment

This terrestrial soil risk assessment was conducted assuming chemicals detected in flowback water samples would ultimately be incorporated into soils within the bund that could pose an exposure risk to terrestrial receptors. To assess a potential release of liquids to soil within the containment area, concentrations of chemicals in soil that would result from a release of flowback water to soil within the bunded area were calculated. These concentrations were compared, where possible, to ecological soil screening criteria.

### Calculation of Chemical Concentrations in Soil

This terrestrial risk assessment evaluated the potential for a release of flowback from the tank to the bunded area soils. The vertical depth of associated infiltration from this hypothetical release was estimated as 1 metre (m) based on modelling (EHS Support, 2023). Using this information, the area of the bund and the depth of infiltration of the volume of affected soil with the bund area were

calculated at 5,000 cubic metres ($m^3$). Maximum and median concentrations of detected chemicals in flowback water from the sampled flowback water samples were used to determine their respective maximum and median concentrations in soils ($C_{soil}$) according to Equation 1 below.

$$C_{soil} = C_{wat} \times V_{tank} / M_{Soil} / D_{soil} \qquad \text{Eq. 1}$$

Where:

- $C_{wat}$ = maximum detected concentration of chemical in flowback
- $V_{tank}$ = volume of the water within the bund area in the event of a release (litres [L])
- $M_{soil}$ = mass of soil ($6.75 \times 10^6$ kg)
- $D_{soil}$ = bulk density of soil (1,350 kilograms per cubic metre [$kg/m^3$])

To evaluate the potential release to the bund area, a maximum volume of 400,000 L was used in the calculation of soil concentrations.

## Tier 1 Screening Assessment

Chemical calculated maximum and median soil concentrations are presented in (**Attachment C**, **Table C-1**). These concentrations reflect a range of chemical concentrations potentially expected in the 1-m stratum of soil adjacent to the enclosed storage tanks as a result of a release from the storage tank. Ecological soil screening levels defined by National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) were used to determine a ratio of the calculated concentration in soil to screening criteria. In certain instances, where NEPM values were not available, other data available from the European Union, the USEPA, or background threshold values for the McArthur Basin surficial soils were used as the screening level.

To determine whether the maximum or median soil concentrations exceeded the screening level, a ratio of the soil concentration to the screening levels was calculated. If the ratio exceeded 1, the estimated concentration for the chemical exceeded the screening level. Calculated ratios of bromide for both the maximum concentration and median detected concentration exceeded 1. The HQ calculated based on the maximum concentrations was 1.9 and 1.5 based on the median concentration of bromide. Therefore, with the exception of bromide, the calculated soil concentrations for both the maximum and median flowback concentrations did not exceed the terrestrial screening levels.

Given that the predicted soil concentrations were based on a hypothetical maximum flowback volume entering the bunded area (a highly conservative assumption that is very unlikely to occur), it is unlikely that a potential release of flowback water to soils would result in unacceptable ecological risk. A maximum-volume release scenario would require both a sudden and near-catastrophic loss of water within the bund, and that volume of water would have to be allowed to fully infiltrate into the underlying soils. In a realistic operational context, a loss of containment would develop gradually, allowing time for detection and response, and recoverable water would be captured and removed. This would substantially reduce both the mass of contaminants reaching soil and the potential for soil concentrations to approach the conservative screening values, particularly given that the exceedances for bromide are marginal. On this basis, the marginal exceedance of the bromide screening value is not considered to represent a plausible risk of unacceptable impact to terrestrial receptors.

In accordance with the Waste and Wastewater Management Plan (Appendix 06 of the EMP IMP4-3), should a release occur, it would be reported in Imperial's incident reporting system and corrective action would be implemented in accordance with guidance.

## Assessment of BTEX

In addition to the risk evaluations, assessment of benzene, toluene, ethylbenzene, and xylene (BTEX) in flowback water was conducted pursuant to Section B.5 of the Code of Practice (NT, 2025b). Section B.5 states that recycled produced water or flowback water used in hydraulic fracturing fluids must not contain BTEX levels greater than those expected in produce water from the well being drilled, or in the event BTEX levels expected in produced water are unknown, then BTEX levels in water cannot exceed levels prescribed in Table 8 of Section B.5.

As shown in **Attachment A**, **Table A-1**, benzene, toluene and xylene were detected in a subset of samples collected from the Carpentaria 5H flowback water. **Table 3** presents a comparison of the maximum detection from the Carpentaria 5H flowback data to the BTEX levels in water used for stimulation and drilling fluids from Table 8 in Section B.5 of the Code of Practice (NT, 2025b). None of the detections exceeded the ANZG 99 % Protection Level. Therefore, conditions set forth in Section B.5 of the Code of Practice regarding BTEX are satisfied.

**Table 3 BTEX Evaluation**

| Chemical | ANZG (99% Protection Level) (µg/L) | Maximum Detection (µg/L) |
|---|---|---|
| Benzene | 600 | 67 |
| Toluene | 180 | 40 |
| Ethylbenzene | 80 | 2 |
| Xylene | 200 | 10 |

Table Notes:
% = percent
µg/L = micrograms per litre
< = less than limit of detection
ANZG = Australian and New Zealand Guidelines

## 37A Report about Flowback Fluid

The reporting requirements under Section 37A of the *Petroleum (Environment) Regulations (2016)* have been incorporated into this document. For clarity, **Table 4** provides a summary of how each of these elements have been addressed.

**TABLE 4 REGULATION 37A FLOWBACK FLUID REPORT REQUIRED INFORMATION**

| Requirement | |
|---|---|
| (a) the identity of any chemical or NORM found in the flowback fluid; | Refer to:<br>Attachment A, Table A-1<br>Attachment B, Table B-1<br>Attachment C, Table C-1 |
| (b) the concentration of any chemical or NORM found in the flowback fluid; | |

| Requirement | |
|---|---|
| (c) details regarding how any chemical or NORM has been or will be managed; | Control measures for flowback water are described in the *Conceptual Exposure Model* section. Based on screening-level and quantitative risk assessment results, additional management measures are not required to mitigate risks to human health or ecological receptors. The concentrations of radionuclides are well below the generally accepted threshold of 1,000 Bq/kg, below which materials are not considered NORM and do not require special handing measures. |
| (d) details regarding how any chemical or NORM has been or will be transported; | If flowback water is required to be transported, it will be transported by a licensed waste transporter in compliance with the WWMP (Appendix 06 of EMP IMP4-3; Imperial, 2021) and the Code of Practice. As per above, based on the low levels of radionuclides in the water, it does not meet the generally accepted threshold for NORM, and therefore does not require special handling measures for transport. |
| (e) details regarding how any chemical or NORM has been or will be treated; | Water treatment is not required for chemicals or NORM. |
| (f) details regarding any action proposed to be taken to prevent any chemical or NORM spill; | Control measures for flowback water are described in the *Conceptual Exposure Model* section. Wastewater storage, management, and spill handling is otherwise detailed in the WWMP and SMP (Appendices 06 and 07) of approved EMP IMP4-3. |
| (g) details of the emergency contingency plan included in the environment management plan to which the activity relates; | In the event of a spill, the most current version of the SMP (Appendix 07) under EMP IMP4-3 will be used. |
| (h) the requirements in relation to the management of any chemical or NORM of the prescribed chemical legislation. | In accordance with approved EMP IMP4-3, activities that involved wastewater and chemical storage will be aligned with the WWMP (Appendix 06 of EMP IMP4-3) and the SMP (Appendix 07 of EMP IMP4-3). |
| 2A A report under subregulation (2) must be accompanied by a full human health risk assessment relating to any chemical found in the flowback fluid. | This report includes a human health risk assessment. It is considered that human health exposure pathways are incomplete with respect to potential environmental contamination events from flowback fluids. |

Notes:
EMP = Environmental Management Plan
NORM = normally occurring radioactive material
WWMP = wastewater management plan
SMP = spill management plan

## 37B Report about Produced Water

In accordance with Petroleum Regulations, the following presents the required information for produced water, as applicable at this stage of the project. Consistent with Carpentaria 3H, and as advised by InGauge, no produced water was generated from Carpentaria 5H. Therefore, produced water from Carpentaria 5H is not being managed. **Table 5** presents the required information detailed in Regulation 37B. A full human health risk assessment was not undertaken at this time.

As advised by InGauge, a total of 85.3 ML of water was used for fracture stimulation of Carpentaria 5H, of which 13.9 ML has been recovered as flowback to date. This equates to approximately 16% of the total injected volume. Given the relatively low recovery, it is unlikely that the flowback water contains a significant amount of formation water, and the recovered water is representative of flowback water from injected fracture stimulation fluids.

**TABLE 5 REGULATION 37B PRODUCED WATER REPORT REQUIRED INFORMATION**

| Requirement | |
|---|---|
| (a) the identity of any chemical or NORM found in the produced water; | No produced water occurred to date. |
| (b) the concentration of any chemical or NORM found in the produced water; | No produced water occurred to date. |
| (c) details regarding how any chemical or NORM has been or will be managed; | If produced water occurs, it will be managed in compliance with the WWMP (Appendix 06 of EMP IMP4-3; Imperial, 2021) |
| (d) details regarding how any chemical or NORM has been or will be transported; | If produced water occurs and it is required to be transported, it will be transported by a licensed waste transporter in compliance with the WWMP (Appendix 06 of EMP IMP4-3; Imperial, 2021) and the Code of Practice. |
| (e) details regarding how any chemical or NORM has been or will be treated; | If produced water occurs, it will be managed and treated in accordance with WWMP (Appendix 06 of EMP IMP4-3; Imperial, 2021) and the Code of Practice. |
| (f) details regarding any action proposed to be taken to prevent any chemical or NORM spill; | Wastewater storage, management, and spill handling is detailed in the WWMP and SMP (Appendices 06 and 07) of approved EMP IMP4-3 (Imperial, 2021). |
| (g) details of the emergency contingency plan included in the environment management plan to which the activity relates; | In the event of a spill, the most current version of the SMP (Appendix 07) under EMP IMP4-3 will be used. |
| (h) the requirements in relation to the management of any chemical or NORM of the prescribed chemical legislation. | In accordance with approved EMP IMP4-3, activities that involved wastewater and chemical storage will be aligned with the WWMP (Appendix 06 of EMP IMP4-3) and the SMP (Appendix 07 of EMP IMP4-3). |

Notes:
EMP = Environmental Management Plan
NORM = normally occurring radioactive material
WWMP = wastewater management plan
SMP = spill management plan

## Conclusions and Recommendations

In accordance with Regulation 37A under part 3A of the *Northern Territory Petroleum (Environment) Regulations* (2023) and pursuant to Condition 20 of the EMP approval (NT, 2022), a risk assessment of flowback water from the hydraulic fracturing phase of Carpentaria 5H well was conducted. A produced water report was developed consistent with Regulation 37B of the *Northern Territory Petroleum (Environment) Regulations (2016)*.

The flowback assessment included determination of potential risk to humans and avian receptors exposed to flowback from wells Carpentaria 5H. Additionally, an assessment was conducted of a potential release of flowback water to soils within the bunded area. As noted above, the risk

evaluation methods used are consistent with those used for the EMP and the hydraulic fracturing fluid risk assessment conducted prior to approval of the activities at the Carpentaria 2 well pad (Imperial, 2021).

No potentially complete exposure pathways for humans were identified for the storage of flowback water or potential reuse of water as make-up water. The risk assessment conducted for the avian receptors potentially exposed to flowback water concluded there is no unacceptable risk to these receptors potentially exposed to chemicals in the Carpentaria 5H flowback water samples. Therefore, with respect to avian use of flowback water from wells Carpentaria 5H and the approved Site activities and associated management controls, no further action is recommended.

Likewise, a screening assessment was performed to determine the potential risk to terrestrial receptors exposed to soils affected by Carpentaria 5H flowback water based on a hypothetical release scenario. The assessment consisted of a screening level evaluation to determine if a further quantitative risk assessment would be required to assess the potential risk to terrestrial receptors. The screening-level risk assessment determined that, under a hypothetical maximum release scenario, predicted soil concentrations for all chemicals detected in the flowback water at their maximum or median concentrations would remain below terrestrial screening criteria, with the exception of bromide, which exhibited only minor exceedances of the target hazard quotient. However, However, in the event of a release, incident notification and response actions would be implemented in accordance with the WWMP (Imperial, 2021), thereby limiting the mass of contaminants entering soils and reducing the potential for exceedance of screening values. Considering the approved Site activities and associated management controls (including those outlined in the EMP), along with the marginal nature of the exceedance for bromide, no further assessment or action is recommended.

These findings are consistent with the flowback risk assessments that were completed for Carpentaria 1H, Carpentaria 2H and 3H which also concluded that there were no unacceptable risks to human or avian receptors. This risk assessment satisfies Condition 20 of the EMP approval (NT, 2022) and requirement 3(a) of Regulation 37A of the Petroleum (Environment) Regulations 2016 (NT, 2025a).

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# Attachment A Analytical Data

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | | **Sample Type** | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | | **ALS Sample Nu** | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 |
| **Project name/number:** | CARPENTARIA 5H | | **Sample Date** | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 |
| | | | **Client sample ID** | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | |
| ***EA005P: pH by PC Titrator*** | | | | | | | | | | |
| pH Value | | pH Unit | 0.01 | **6.51** | **6.53** | **6.49** | **6.31** | **6.12** | **6.06** | **6.01** |
| ***EA006: Sodium Adsorption Ratio (SAR)*** | | | | | | | | | | |
| Sodium Adsorption Ratio | | | 0.01 | **55.1** | **57.9** | **56.2** | **58.8** | **62.9** | **66.8** | **64.4** |
| ***EA010P: Conductivity by PC Titrator*** | | | | | | | | | | |
| Electrical Conductivity @ 25°C | | µS/cm | 1 | **82700** | **99000** | **112000** | **135000** | **150000** | **156000** | **159000** |
| ***EA015: Total Dissolved Solids dried at 180 ± 5 °C*** | | | | | | | | | | |
| Total Dissolved Solids @180°C | | mg/L | 10 | **74500** | **88000** | **97500** | **130000** | **140000** | **149000** | **160000** |
| ***EA025: Total Suspended Solids dried at 104 ± 2°C*** | | | | | | | | | | |
| Suspended Solids (SS) | | mg/L | 5 | **63** | **56** | **81** | **98** | **137** | **72** | **86** |
| ***ED009: Anions*** | | | | | | | | | | |
| Bromide | 24959-67-9 | mg/L | 0.010 | **636** | **714** | **932** | **1630** | **1330** | **1280** | **1470** |
| ***ED037P: Alkalinity by PC Titrator*** | | | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | mg/L | 1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | mg/L | 1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | mg/L | 1 | **198** | **168** | **146** | **138** | **87** | **94** | **72** |
| Total Alkalinity as CaCO3 | | mg/L | 1 | **198** | **168** | **146** | **138** | **87** | **94** | **72** |
| ***ED041G: Sulfate (Turbidimetric) as SO4 2- by DA*** | | | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | mg/L | 1 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| ***ED045G: Chloride by Discrete Analyser*** | | | | | | | | | | |
| Chloride | 16887-00-6 | mg/L | 1 | **39900** | **44900** | **53500** | **76500** | **78400** | **84600** | **85300** |
| ***ED093F: Dissolved Major Cations*** | | | | | | | | | | |
| Calcium | 7440-70-2 | mg/L | 1 | **5050** | **7700** | **7950** | **13800** | **16500** | **17800** | **19600** |
| Magnesium | 7439-95-4 | mg/L | 1 | **1010** | **1370** | **1530** | **2330** | **2700** | **3140** | **3120** |
| Sodium | 7440-23-5 | mg/L | 1 | **16400** | **21000** | **20900** | **28400** | **33100** | **36800** | **36800** |
| Potassium | 7440-09-7 | mg/L | 1 | **133** | **148** | **161** | **222** | **242** | **253** | **258** |
| ***ED093T: Total Major Cations*** | | | | | | | | | | |
| Calcium | 7440-70-2 | mg/L | 1 | **5600** | **7020** | **8780** | **13500** | **16600** | **18500** | **18900** |
| Magnesium | 7439-95-4 | mg/L | 1 | **1150** | **1420** | **1750** | **2590** | **2680** | **2760** | **3000** |
| Sodium | 7440-23-5 | mg/L | 1 | **18100** | **20500** | **23500** | **31200** | **33900** | **34700** | **37500** |
| Potassium | 7440-09-7 | mg/L | 1 | **148** | **164** | **182** | **242** | **224** | **224** | **240** |
| ***EG005(ED093)U: Unfiltered Metals by ICP-AES*** | | | | | | | | | | |
| Silica | 7631-86-9 | mg/L | 0.100 | **51.2** | **62.6** | **65.5** | **41.5** | **22.2** | **25.0** | **25.4** |
| ***EG020F: Dissolved Metals by ICP-MS*** | | | | | | | | | | |
| Aluminium | 7429-90-5 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Antimony | 7440-36-0 | mg/L | 0.001 | **0.013** | **0.014** | **0.013** | **0.011** | <0.010 | <0.010 | <0.010 |
| Arsenic | 7440-38-2 | mg/L | 0.001 | **0.018** | <0.010 | <0.010 | **0.022** | <0.010 | **0.011** | <0.010 |
| Beryllium | 7440-41-7 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Barium | 7440-39-3 | mg/L | 0.001 | **461** | **647** | **800** | **1340** | **1640** | **1700** | **1960** |
| Cadmium | 7440-43-9 | mg/L | 0.0001 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | **0.0017** | **0.0017** | **0.0014** |
| Chromium | 7440-47-3 | mg/L | 0.001 | **0.020** | <0.010 | <0.010 | **0.013** | **0.029** | **0.041** | **0.034** |
| Cobalt | 7440-48-4 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | | **Sample Type** | REG | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | | **ALS Sample Number** | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 | |
| **Project name/number:** | CARPENTARIA 5H | | **Sample Date** | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 | |
| | | | **Client sample ID** | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) | |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | | |
| Copper | 7440-50-8 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Lead | 7439-92-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | **0.011** | **0.013** | **0.016** | **0.015** | |
| Manganese | 7439-96-5 | mg/L | 0.001 | **8.91** | **11.6** | **13.0** | **19.8** | **24.8** | **27.9** | **28.3** | |
| Molybdenum | 7439-98-7 | mg/L | 0.001 | **0.058** | **0.048** | **0.036** | **0.030** | **0.024** | **0.021** | **0.019** | |
| Nickel | 7440-02-0 | mg/L | 0.001 | <0.010 | **0.020** | **0.032** | **0.026** | **0.021** | **0.013** | **0.016** | |
| Selenium | 7782-49-2 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| Silver | 7440-22-4 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Strontium | 7440-24-6 | mg/L | 0.001 | **356** | **422** | **587** | **878** | **1130** | **1220** | **1340** | |
| Thorium | 7440-29-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Tin | 7440-31-5 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Uranium | 7440-61-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Vanadium | 7440-62-2 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| Zinc | 7440-66-6 | mg/L | 0.005 | **0.255** | **0.379** | **0.533** | **0.912** | **0.700** | **0.900** | **0.800** | |
| Boron | 7440-42-8 | mg/L | 0.05 | **7.76** | **9.88** | **6.87** | **7.15** | **6.89** | **4.75** | **6.76** | |
| Iron | 7439-89-6 | mg/L | 0.05 | **54.6** | **3.03** | **41.9** | **90.6** | **110** | **133** | **126** | |
| ***EG020T: Total Metals by ICP-MS*** | | | | | | | | | | | |
| Aluminium | 7429-90-5 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| Antimony | 7440-36-0 | mg/L | 0.001 | **0.014** | **0.016** | **0.018** | **0.015** | <0.010 | <0.010 | <0.010 | |
| Arsenic | 7440-38-2 | mg/L | 0.001 | **0.020** | **0.037** | **0.037** | **0.031** | **0.022** | **0.015** | **0.014** | |
| Beryllium | 7440-41-7 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Barium | 7440-39-3 | mg/L | 0.001 | **473** | **643** | **833** | **1170** | **1980** | **2250** | **2310** | |
| Cadmium | 7440-43-9 | mg/L | 0.0001 | <0.0010 | <0.0010 | <0.0010 | **0.0014** | **0.0016** | **0.0018** | **0.0012** | |
| Chromium | 7440-47-3 | mg/L | 0.001 | **0.029** | **0.022** | **0.019** | **0.028** | **0.067** | **0.075** | **0.063** | |
| Cobalt | 7440-48-4 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Copper | 7440-50-8 | mg/L | 0.001 | **0.012** | <0.010 | <0.010 | <0.010 | <0.010 | **0.035** | <0.010 | |
| Lead | 7439-92-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | **0.022** | **0.029** | **0.026** | **0.024** | |
| Manganese | 7439-96-5 | mg/L | 0.001 | **10.2** | **12.4** | **15.3** | **22.2** | **22.4** | **24.0** | **25.2** | |
| Molybdenum | 7439-98-7 | mg/L | 0.001 | **0.060** | **0.053** | **0.044** | **0.054** | **0.044** | **0.040** | **0.041** | |
| Nickel | 7440-02-0 | mg/L | 0.001 | **0.016** | **0.022** | **0.033** | **0.026** | **0.035** | **0.022** | **0.022** | |
| Selenium | 7782-49-2 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| Silver | 7440-22-4 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Strontium | 7440-24-6 | mg/L | 0.001 | **352** | **478** | **613** | **768** | **1170** | **1290** | **1330** | |
| Thorium | 7440-29-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Tin | 7440-31-5 | mg/L | 0.001 | **0.021** | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Uranium | 7440-61-1 | mg/L | 0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Vanadium | 7440-62-2 | mg/L | 0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| Zinc | 7440-66-6 | mg/L | 0.005 | **0.274** | **0.435** | **0.610** | **1.12** | **0.978** | **0.963** | **0.997** | |
| Boron | 7440-42-8 | mg/L | 0.05 | **8.75** | **8.65** | **8.24** | **7.38** | **6.82** | **6.01** | **6.24** | |
| Iron | 7439-89-6 | mg/L | 0.05 | **59.6** | **60.2** | **69.7** | **103** | **113** | **118** | **120** | |
| ***EG035F: Dissolved Mercury by FIMS*** | | | | | | | | | | | |
| Mercury | 7439-97-6 | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| ***EG035T: Total Recoverable Mercury by FIMS*** | | | | | | | | | | | |
| Mercury | 7439-97-6 | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| ***EK010-1: Chlorine*** | | | | | | | | | | | |
| Total Residual Chlorine | | mg/L | 0.02 | **0.20** | <0.20 | **0.40** | <0.40 | <0.40 | <0.40 | <0.40 | |
| Free Chlorine | | mg/L | 0.02 | <0.20 | <0.20 | <0.20 | <0.40 | <0.40 | <0.40 | <0.40 | |
| Monochloramine | 10599-90-3 | mg/L | 0.02 | <0.20 | <0.20 | **0.40** | <0.40 | <0.40 | <0.40 | <0.40 | |
| Dichloroamine | 3400-09-7 | mg/L | 0.02 | **0.20** | <0.20 | <0.20 | <0.40 | <0.40 | <0.40 | <0.40 | |
| Combined Chlorine | | mg/L | 0.02 | **0.20** | <0.20 | **0.40** | <0.40 | <0.40 | <0.40 | <0.40 | |
| Free Chlorine as Sodium Hypochlorite | | mg/L | 0.02 | <0.20 | <0.20 | <0.20 | <0.40 | <0.40 | <0.40 | <0.40 | |

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | **Sample Type** | | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | **ALS Sample Number** | | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 |
| **Project name/number:** | CARPENTARIA 5H | **Sample Date** | | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 |
| | | **Client sample ID** | | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | |
| ***EK026SF: Total CN by Segmented Flow Analyser*** | | | | | | | | | | |
| Total Cyanide | 57-12-5 | mg/L | 0.004 | - | - | - | **0.008** | <0.004 | <0.004 | <0.004 |
| ***EK040P: Fluoride by PC Titrator*** | | | | | | | | | | |
| Fluoride | 16984-48-8 | mg/L | 0.1 | **0.7** | **0.4** | **0.7** | **0.3** | **0.5** | **0.5** | **0.5** |
| ***EK055G: Ammonia as N by Discrete Analyser*** | | | | | | | | | | |
| Ammonia as N | 7664-41-7 | mg/L | 0.01 | **35.5** | **42.2** | **45.3** | **61.7** | **65.0** | **74.5** | **79.0** |
| ***EK057G: Nitrite as N by Discrete Analyser*** | | | | | | | | | | |
| Nitrite as N | 14797-65-0 | mg/L | 0.01 | <0.01 | <0.01 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| ***EK058G: Nitrate as N by Discrete Analyser*** | | | | | | | | | | |
| Nitrate as N | 14797-55-8 | mg/L | 0.01 | **0.04** | **0.04** | **0.46** | <0.10 | <0.10 | <0.10 | <0.10 |
| ***EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser*** | | | | | | | | | | |
| Nitrite + Nitrate as N | | mg/L | 0.01 | **0.04** | **0.04** | **0.46** | <0.10 | <0.10 | <0.10 | <0.10 |
| ***EK061G: Total Kjeldahl Nitrogen By Discrete Analyser*** | | | | | | | | | | |
| Total Kjeldahl Nitrogen as N | | mg/L | 0.1 | **41.0** | **43.7** | **50.4** | **64.8** | **70.8** | **76.9** | **74.5** |
| ***EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser*** | | | | | | | | | | |
| Total Nitrogen as N | | mg/L | 0.1 | **41.0** | **43.7** | **50.9** | **64.8** | **70.8** | **76.9** | **74.5** |
| ***EK067G: Total Phosphorus as P by Discrete Analyser*** | | | | | | | | | | |
| Total Phosphorus as P | | mg/L | 0.01 | **2.43** | **2.59** | **2.80** | **1.97** | **8.74** | **4.77** | **3.86** |
| ***EK071G: Reactive Phosphorus as P by discrete analyser*** | | | | | | | | | | |
| Reactive Phosphorus as P | 14265-44-2 | mg/L | 0.01 | **1.25** | **1.77** | **2.56** | **1.46** | **8.69** | **4.41** | **1.56** |
| ***EN055: Ionic Balance*** | | | | | | | | | | |
| Total Anions | | meq/L | 0.01 | **1130** | **1270** | **1510** | **2160** | **2210** | **2390** | **2410** |
| Total Cations | | meq/L | 0.01 | **1050** | **1410** | **1440** | **2120** | **2490** | **2750** | **2840** |
| Ionic Balance | | % | 0.01 | **3.56** | **5.38** | **2.59** | **0.92** | **5.91** | **7.11** | **8.28** |
| ***EP002: Dissolved Organic Carbon (DOC)*** | | | | | | | | | | |
| Dissolved Organic Carbon | | mg/L | 1 | **60** | **56** | **48** | **46** | **40** | **39** | **37** |
| ***EP005: Total Organic Carbon (TOC)*** | | | | | | | | | | |
| Total Organic Carbon | | mg/L | 1 | **65** | **59** | **53** | **48** | **42** | **41** | **36** |
| ***EP006 Total Inorganic Carbon*** | | | | | | | | | | |
| Total Inorganic Carbon | | mg/L | 1 | **54** | **39** | **35** | **37** | **30** | **30** | **25** |
| ***EP007 Total Carbon*** | | | | | | | | | | |
| Total Carbon | TC | mg/L | 1 | **116** | **99** | **82** | **91** | **78** | **80** | **61** |
| ***EP010: Formaldehyde*** | | | | | | | | | | |
| Formaldehyde | 50-00-0 | mg/L | 0.1 | **13.0** | **12.8** | **16.1** | **19.4** | **23.7** | **25.7** | **25.1** |
| ***EP025: Oxygen - Dissolved (DO)*** | | | | | | | | | | |
| Dissolved Oxygen | | mg/L | 0.1 | **6.1** | **5.1** | **5.6** | **3.6** | **5.3** | **5.1** | **4.5** |

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | | **Sample Type** | REG | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | | **ALS Sample Number** | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 | |
| **Project name/number:** | CARPENTARIA 5H | | **Sample Date** | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 | |
| | | | **Client sample ID** | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) | |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | | |
| ***EP033: C1 - C4 Hydrocarbon Gases*** | | | | | | | | | | | |
| Methane | 74-82-8 | µg/L | 10 | **4060** | **2830** | **862** | **1870** | **1460** | **1070** | **1700** | |
| Ethane | 74-84-0 | µg/L | 10 | **722** | **517** | **205** | **654** | **724** | **351** | **667** | |
| Propane | 74-98-6 | µg/L | 10 | **43** | **37** | <10 | **61** | **68** | **54** | **61** | |
| ***EP075(SIM)A: Phenolic Compounds*** | | | | | | | | | | | |
| Phenol | 108-95-2 | µg/L | 1.0 | **5.4** | **3.9** | **4.3** | **2.5** | **2.4** | **2.4** | **2.2** | |
| 2-Chlorophenol | 95-57-8 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2-Methylphenol | 95-48-7 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | **1.3** | <1.0 | <1.0 | <1.0 | |
| 3- & 4-Methylphenol | 1319-77-3 | µg/L | 2.0 | **13.1** | **9.8** | **9.9** | **4.9** | **4.4** | **3.5** | **2.5** | |
| 2-Nitrophenol | 88-75-5 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2.4-Dimethylphenol | 105-67-9 | µg/L | 1.0 | **1.0** | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2.4-Dichlorophenol | 120-83-2 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2.6-Dichlorophenol | 87-65-0 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 4-Chloro-3-methylphenol | 59-50-7 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2.4.6-Trichlorophenol | 88-06-2 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 2.4.5-Trichlorophenol | 95-95-4 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Pentachlorophenol | 87-86-5 | µg/L | 2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | |
| ***EP075(SIM)B: Polynuclear Aromatic Hydrocarbons*** | | | | | | | | | | | |
| Naphthalene | 91-20-3 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Acenaphthylene | 208-96-8 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Acenaphthene | 83-32-9 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Fluorene | 86-73-7 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Phenanthrene | 85-01-8 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Anthracene | 120-12-7 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Fluoranthene | 206-44-0 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Pyrene | 129-00-0 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Benz(a)anthracene | 56-55-3 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Chrysene | 218-01-9 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Benzo(b+j)fluoranthene | 205-99-2 205-82-3 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Benzo(k)fluoranthene | 207-08-9 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Benzo(a)pyrene | 50-32-8 | µg/L | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 3-Methylcholanthrene | 56-49-5 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Indeno(1.2.3.cd)pyrene | 193-39-5 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Dibenz(a.h)anthracene | 53-70-3 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Benzo(g.h.i)perylene | 191-24-2 | µg/L | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | |
| Sum of polycyclic aromatic hydrocarbons | | µg/L | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| Benzo(a)pyrene TEQ (zero) | | µg/L | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| ***EP080/071: Total Petroleum Hydrocarbons*** | | | | | | | | | | | |
| C6 - C9 Fraction | | µg/L | 20 | **130** | **80** | **50** | **110** | **110** | **40** | <20 | |
| C10 - C14 Fraction | | µg/L | 50 | **580** | **270** | **260** | **270** | **14000** | **3490** | **200** | |
| C15 - C28 Fraction | | µg/L | 100 | **180** | <100 | <100 | **150** | **6830** | **1820** | **190** | |
| C29 - C36 Fraction | | µg/L | 50 | <50 | <50 | <50 | **80** | <50 | <50 | <50 | |
| C10 - C36 Fraction (sum) | | µg/L | 50 | **760** | **270** | **260** | **500** | **20800** | **5310** | **390** | |
| ***EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions*** | | | | | | | | | | | |
| C6 - C10 Fraction | C6_C10 | µg/L | 20 | **140** | **80** | **50** | **120** | **110** | **40** | <20 | |
| C6 - C10 Fraction minus BTEX (F1) | C6_C10-BTEX | µg/L | 20 | **20** | <20 | <20 | **30** | **30** | **20** | <20 | |
| >C10 - C16 Fraction | | µg/L | 100 | **540** | **260** | **240** | **290** | **20700** | **5220** | **330** | |
| >C16 - C34 Fraction | | µg/L | 100 | <100 | <100 | <100 | **160** | **390** | **160** | <100 | |
| >C34 - C40 Fraction | | µg/L | 100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | |

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | | **Sample Type** | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | | **ALS Sample Number** | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 |
| **Project name/number:** | CARPENTARIA 5H | | **Sample Date** | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 |
| | | | **Client sample ID** | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | |
| >C10 - C40 Fraction (sum) | | µg/L | 100 | **540** | **260** | **240** | **450** | **21100** | **5380** | **330** |
| >C10 - C16 Fraction minus Naphthalene (F2) | | µg/L | 100 | **540** | **260** | **240** | **290** | **20700** | **5220** | **330** |
| ***EP080: BTEXN*** | | | | | | | | | | |
| Benzene | 71-43-2 | µg/L | 1 | **67** | **40** | **23** | **45** | **41** | **8** | **5** |
| Toluene | 108-88-3 | µg/L | 2 | **40** | **22** | **13** | **35** | **33** | **8** | **4** |
| Ethylbenzene | 100-41-4 | µg/L | 2 | **2** | <2 | <2 | <2 | <2 | <2 | <2 |
| meta- & para-Xylene | 108-38-3 106-42-3 | µg/L | 2 | **6** | **4** | **2** | **8** | **6** | <2 | <2 |
| ortho-Xylene | 95-47-6 | µg/L | 2 | **3** | <2 | <2 | **2** | **2** | <2 | <2 |
| Total Xylenes | | µg/L | 2 | **9** | **4** | **2** | **10** | **8** | <2 | <2 |
| Sum of BTEX | | µg/L | 1 | **118** | **66** | **38** | **90** | **82** | **16** | **9** |
| Naphthalene | 91-20-3 | µg/L | 5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| ***EP075(SIM)S: Phenolic Compound Surrogates*** | | | | | | | | | | |
| Phenol-d6 | 13127-88-3 | % | 1.0 | 41.8 | 33.1 | 41.2 | 24.9 | 28.6 | 28.6 | 25.9 |
| 2-Chlorophenol-D4 | 93951-73-6 | % | 1.0 | 77.6 | 57.5 | 71.0 | 40.1 | 57.7 | 57.7 | 49.6 |
| 2.4.6-Tribromophenol | 118-79-6 | % | 1.0 | 55.1 | 75.3 | 81.9 | 53.7 | 43.5 | 63.0 | 56.1 |
| ***EP075(SIM)T: PAH Surrogates*** | | | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | % | 1.0 | 96.8 | 75.0 | 79.8 | 54.1 | 50.2 | 57.3 | 51.8 |
| Anthracene-d10 | 1719-06-8 | % | 1.0 | 93.5 | 86.7 | 93.3 | 59.7 | 72.4 | 56.8 | 50.1 |
| 4-Terphenyl-d14 | 1718-51-0 | % | 1.0 | 62.6 | 84.4 | 91.5 | 77.3 | 67.6 | 72.8 | 65.1 |
| ***EP080S: TPH(V)/BTEX Surrogates*** | | | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | % | 2 | 96.2 | 85.2 | 124 | 79.6 | 134 | 135 | 119 |
| Toluene-D8 | 2037-26-5 | % | 2 | 87.7 | 76.1 | 111 | 89.9 | 112 | 116 | 88.1 |
| 4-Bromofluorobenzene | 460-00-4 | % | 2 | 94.9 | 75.2 | 108 | 90.7 | 115 | 110 | 86.8 |
| ***EA250CA: Gross Alpha and Beta Activity*** | | | | | | | | | | |
| Gross alpha | | Bq/L | 0.05 | **61.3** | **91.8** | **127** | - | **255** | **289** | **309** |
| Gross beta | | Bq/L | 0.10 | **29** | **43.1** | **52.2** | - | **79.7** | **95.3** | **101** |
| Gross beta activity - 40K | | Bq/L | 0.10 | **22.3** | **34** | **43.5** | - | **68.9** | **84.6** | **88.6** |
| ***EP132B: Polynuclear Aromatic Hydrocarbons*** | | | | | | | | | | |
| 3-Methylcholanthrene | 56-49-5 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| 7.12-Dimethylbenz(a)anthracene | 57-97-6 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| ***EP132A: Phenolic Compounds*** | | | | | | | | | | |
| m-Cresol | 108-39-4 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| p-Cresol | 106-44-5 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| Hexachlorophene | 70-30-4 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| 2.3.4.6-Tetrachlorophenol | 58-90-2 | µg/L | 0.1 | - | - | - | - | <0.2 | <0.1 | <0.1 |
| ***EP075S: Acid Extractable Surrogates (Waste Classification)*** | | | | | | | | | | |
| Phenol-d6 | 13127-88-3 | % | 0.2 | - | - | - | - | 54.3 | 45.4 | 45.2 |
| 2-Chlorophenol-D4 | 93951-73-6 | % | 0.2 | - | - | - | - | 77.7 | 62.8 | 62.2 |
| 2.4.6-Tribromophenol | 118-79-6 | % | 0.2 | - | - | - | - | 72.9 | 61.8 | 60.5 |
| ***EP075T: Base/Neutral Extractable Surrogates (Waste Classification)*** | | | | | | | | | | |
| Nitrobenzene-D5 | 4165-60-0 | % | 0.2 | - | - | - | - | 81.5 | 63.7 | 64.0 |
| 1.2-Dichlorobenzene-D4 | 2199-69-1 | % | 0.2 | - | - | - | - | 79.9 | 65.2 | 63.4 |
| 2-Fluorobiphenyl | 321-60-8 | % | 0.2 | - | - | - | - | 90.2 | 72.8 | 65.2 |
| Anthracene-d10 | 1719-06-8 | % | 0.2 | - | - | - | - | 81.9 | 68.1 | 66.7 |
| 4-Terphenyl-d14 | 1718-51-0 | % | 0.2 | - | - | - | - | 83.7 | 68.3 | 66.2 |

**Table A-1**
**Flowback Data**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix:** | WATER | | **Sample Type** | REG | REG | REG | REG | REG | REG | REG | REG |
| **Workgroup:** | ES2522583 | | **ALS Sample Number** | ES2522583001 | ES2522583002 | ES2522583003 | ES2526182001 | ES2528266001 | ES2528264001 | ES2528265001/ES2528418001 | |
| **Project name/number:** | CARPENTARIA 5H | | **Sample Date** | 17/07/2025 | 20/07/2025 | 23/07/2025 | 18/08/2025 | 25/08/2025 | 01/09/2025 | 05/09/2025 | |
| | | | **Client sample ID** | 01 | 02 | 03 | D/S C/M (Downstream choke manifold) | D/S C/M (Downstream manifold) | D/S C/M (Downstream choke mainfold) | D/S C/M (Downstream choke manifold) | |
| **Analyte grouping/Analyte** | **CAS Number** | **Unit** | **LOR** | | | | | | | | |
| ***EP132S: Acid Extractable Surrogates*** | | | | | | | | | | | |
| 2-Fluorophenol | 367-12-4 | % | 0.1 | - | - | - | - | ND | 30.5 | 29.1 | |
| Phenol-d6 | 13127-88-3 | % | 0.1 | - | - | - | - | ND | 31.2 | 26.9 | |
| 2-Chlorophenol-D4 | 93951-73-6 | % | 0.1 | - | - | - | - | 42.5 | 64.7 | 56.6 | |
| 2.4.6-Tribromophenol | 118-79-6 | % | 0.1 | - | - | - | - | ND | 62.2 | 67.7 | |
| ***EP132T: Base/Neutral Extractable Surrogates*** | | | | | | | | | | | |
| 2-Fluorobiphenyl | 321-60-8 | % | 0.1 | - | - | - | - | 56.2 | 70.6 | 64.8 | |
| Anthracene-d10 | 1719-06-8 | % | 0.1 | - | - | - | - | 68.6 | 66.6 | 59.0 | |
| 4-Terphenyl-d14 | 1718-51-0 | % | 0.1 | - | - | - | - | 69.3 | 84.7 | 75.3 | |
| ***EP075A: Phenolic Compounds (Non-halogenated)*** | | | | | | | | | | | |
| 4-Nitrophenol | 100-02-7 | µg/L | 50 | - | - | - | - | <50 | <50 | <50 | |
| 2-Methyl-4.6-dinitrophenol | 8071-51-0 | µg/L | 50 | - | - | - | - | <50 | <50 | <50 | |
| Dinoseb | 88-85-7 | µg/L | 50 | - | - | - | - | <50 | <50 | <50 | |

# Attachment B Avian Risk Assessment – Carpentaria 5H Flowback Water

**Table B-1**
**Tier 1 Avian Screening Assessment**
**Carpentaria 5H Flowback Water**
**InGauge**

| Analyte grouping/Analyte | Unit | Minimum Detected | Maximum Detected | Average Detected | Median Detected | Sample Count | Detection Frequency | Freshwater Trigger Value by Protection Level (% Species) 99% | 95% | 90% | 80% | Alternative SW Screening Criteria | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH Value | pH Unit | 6.01 | 6.53 | 6.29 | 6.31 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Sodium Adsorption Ratio | | 55.1 | 66.8 | 60.30 | 58.8 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Electrical Conductivity @ 25°C | µS/cm | 82700 | 159000 | 127671.43 | 135000 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Dissolved Solids @180°C | mg/L | 74500 | 160000 | 119857.14 | 130000 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Suspended Solids (SS) | mg/L | 56 | 137 | 84.71 | 81 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Bromide | mg/L | 636 | 1630 | 1141.71 | 1280 | 7 | 7 / 7 | NC | NC | NC | NC | NC | |
| Hydroxide Alkalinity as CaCO3 | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Carbonate Alkalinity as CaCO3 | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Bicarbonate Alkalinity as CaCO3 | mg/L | 72 | 198 | 129.00 | 138 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Alkalinity as CaCO3 | mg/L | 72 | 198 | 129.00 | 138 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Sulfate as SO4 - Turbidimetric | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | 2000 | a |
| Chloride | mg/L | 39900 | 85300 | 66157.14 | 76500 | 7 | 7 / 7 | NC | NC | NC | NC | NC | |
| Calcium | mg/L | 5600 | 18900 | 12700.00 | 13500 | 7 | 7 / 7 | NC | NC | NC | NC | NC | |
| Magnesium | mg/L | 1150 | 3000 | 2192.86 | 2590 | 7 | 7 / 7 | NC | NC | NC | NC | 2000 | a |
| Sodium | mg/L | 18100 | 37500 | 28485.71 | 31200 | 7 | 7 / 7 | NC | NC | NC | NC | NC | |
| Potassium | mg/L | 148 | 242 | 203.43 | 224 | 7 | 7 / 7 | NC | NC | NC | NC | NC | |
| Silica | mg/L | 22.2 | 65.5 | 41.91 | 41.5 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Aluminium | mg/L | - | - | - | - | 7 | 0 / 7 | 0.027 | 0.055 | 0.08 | 0.15 | | |
| Antimony | mg/L | 0.014 | 0.018 | 0.016 | 0.0155 | 7 | 4 / 7 | NC | NC | NC | NC | 0.009 | h |
| Arsenic | mg/L | 0.014 | 0.037 | 0.0251 | 0.022 | 7 | 7 / 7 | 0.0008 | 0.013 | 0.042 | 0.14 | | |
| Beryllium | mg/L | - | - | - | - | 7 | 0 / 7 | 0.66 | 0.66 | 0.66 | 0.66 | | |
| Barium | mg/L | 473 | 2310 | 1379.86 | 1170 | 7 | 7 / 7 | 4 | 4 | 4 | 4 | | |
| Cadmium | mg/L | 0.0012 | 0.0018 | 0.0015 | 0.0015 | 7 | 4 / 7 | 0.00006 | 0.0002 | 0.0004 | 0.0008 | | |
| Chromium | mg/L | 0.019 | 0.075 | 0.043 | 0.029 | 7 | 7 / 7 | 0.00001 | 0.001 | 0.006 | 0.04 | | |
| Cobalt | mg/L | - | - | - | - | 7 | 0 / 7 | 0.0014 | 0.0014 | 0.0014 | 0.0014 | | |
| Copper | mg/L | 0.012 | 0.035 | 0.024 | 0.0235 | 7 | 2 / 7 | 0.001 | 0.0014 | 0.0018 | 0.0025 | | |
| Lead | mg/L | 0.022 | 0.029 | 0.03 | 0.025 | 7 | 4 / 7 | 1 | 3.4 | 5.6 | 9.4 | | |
| Manganese | mg/L | 10.2 | 25.2 | 18.81 | 22.2 | 7 | 7 / 7 | 1200 | 1900 | 2500 | 3600 | | |
| Molybdenum | mg/L | 0.04 | 0.06 | 0.05 | 0.044 | 7 | 7 / 7 | NC | NC | NC | NC | | h |
| Nickel | mg/L | 0.016 | 0.035 | 0.0251 | 0.022 | 7 | 7 / 7 | 0.008 | 0.011 | 0.013 | 0.017 | | |
| Selenium | mg/L | - | - | - | - | 7 | 0 / 7 | 5 | 11 | 18 | 34 | | |
| Silver | mg/L | - | - | - | - | 7 | 0 / 7 | 0.00002 | 0.00005 | 0.0001 | 0.0002 | | |
| Strontium | mg/L | 352 | 1330 | 857.29 | 768 | 7 | 7 / 7 | NC | NC | NC | NC | 1500 | d |
| Thorium | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Tin | mg/L | 0.021 | 0.021 | 0.02 | 0.021 | 7 | 1 / 7 | 73 | 73 | 73 | 73 | | |
| Uranium | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | 0.00005 | h |
| Vanadium | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | 0.006 | h |
| Zinc | mg/L | 0.274 | 1.12 | 0.77 | 0.963 | 7 | 7 / 7 | 0.0024 | 0.008 | 0.015 | 0.031 | | |
| Boron | mg/L | 6.01 | 8.75 | 7.44 | 7.38 | 7 | 7 / 7 | 0.34 | 0.94 | 1.5 | 2.5 | | |
| Iron | mg/L | 59.6 | 120 | 91.93 | 103 | 7 | 7 / 7 | 300 | 300 | 300 | 300 | | |
| Mercury | mg/L | - | - | - | - | 7 | 0 / 7 | 0.00006 | 0.0006 | 0.0019 | 0.0054 | | |
| Total Residual Chlorine | mg/L | 0.2 | 0.4 | 0.30 | 0.3 | 7 | 2 / 7 | NC | NC | NC | NC | | |
| Free Chlorine | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Monochloramine | mg/L | 0.4 | 0.4 | 0.40 | 0.4 | 7 | 1 / 7 | NC | NC | NC | NC | | |
| Dichloroamine | mg/L | 0.2 | 0.2 | 0.20 | 0.2 | 7 | 1 / 7 | NC | NC | NC | NC | | |
| Combined Chlorine | mg/L | 0.2 | 0.4 | 0.30 | 0.3 | 7 | 2 / 7 | NC | NC | NC | NC | | |
| Free Chlorine as Sodium Hypochlorite | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Total Cyanide | mg/L | 0.008 | 0.008 | 0.0080 | 0.008 | 7 | 1 / 7 | 0.004 | 0.007 | 0.011 | 0.018 | | |
| Fluoride | mg/L | 0.3 | 0.7 | 0.51 | 0.5 | 7 | 7 / 7 | 1300 | 3100 | 4800 | 8200 | | |
| Ammonia as N | mg/L | 35.5 | 79 | 57.60 | 61.7 | 7 | 7 / 7 | 0.32 | 0.9 | 1.43 | 2.3 | 0.01 | b |
| Nitrite as N | mg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Nitrate as N | mg/L | 0.04 | 0.46 | 0.18 | 0.04 | 7 | 3 / 7 | NC | NC | NC | NC | | |
| Nitrite + Nitrate as N | mg/L | 0.04 | 0.46 | 0.18 | 0.04 | 7 | 3 / 7 | NC | NC | NC | NC | | |
| Total Kjeldahl Nitrogen as N | mg/L | 41 | 76.9 | 60.30 | 64.8 | 7 | 7 / 7 | 350 | 350 | 350 | 350 | | |

**Table B-1**
**Tier 1 Avian Screening Assessment**
**Carpentaria 5H Flowback Water**
**InGauge**

| Analyte grouping/Analyte | Unit | Minimum Detected | Maximum Detected | Average Detected | Median Detected | Sample Count | Detection Frequency | Freshwater Trigger Value by Protection Level (% Species) | | | | Alternative SW Screening Criteria | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 99% | 95% | 90% | 80% | | |
| Total Nitrogen as N | mg/L | 41.0 | 76.9 | 60.37 | 64.8 | 7 | 7 / 7 | NC | NC | NC | NC | 0.35 | b |
| Total Phosphorus as P | mg/L | 1.97 | 8.74 | 3.88 | 2.8 | 7 | 7 / 7 | NC | NC | NC | NC | 0.01 | b |
| Reactive Phosphorus as P | mg/L | 1.25 | 8.69 | 3.10 | 1.77 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Anions | meq/L | 1130 | 2410 | 1868.57 | 2160 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Cations | meq/L | 1050 | 2840 | 2014.29 | 2120 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Ionic Balance | % | 0.92 | 8.28 | 4.82 | 5.38 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Dissolved Organic Carbon | mg/L | 37 | 60 | 46.57 | 46 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Organic Carbon | mg/L | 36 | 65 | 49.14 | 48 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Inorganic Carbon | mg/L | 25 | 54 | 35.71 | 35 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Total Carbon | mg/L | 61 | 116 | 86.71 | 82 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Formaldehyde | mg/L | 12.8 | 25.7 | 19.40 | 19.4 | 7 | 7 / 7 | NC | NC | NC | NC | 1610 | c |
| Dissolved Oxygen | mg/L | 3.6 | 6.1 | 5.04 | 5.1 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Methane | µg/L | 862 | 4060 | 1978.86 | 1700 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Ethane | µg/L | 205 | 724 | 548.57 | 654 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Propane | µg/L | 37 | 68 | 54.00 | 57.5 | 7 | 6 / 7 | NC | NC | NC | NC | | |
| Phenol | µg/L | 2.2 | 5.4 | 3.30 | 2.5 | 7 | 7 / 7 | 85 | 320 | 600 | 1200 | | 1 |
| 2-Chlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | 340 | 490 | 630 | 870 | | |
| 2-Methylphenol | µg/L | 1.3 | 1.3 | 1.30 | 1.3 | 7 | 1 / 7 | NC | NC | NC | NC | | |
| 3- & 4-Methylphenol | µg/L | 2.5 | 13.1 | 6.87 | 4.9 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| 2-Nitrophenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| 2.4-Dimethylphenol | µg/L | 1 | 1 | 1.00 | 1 | 7 | 1 / 7 | NC | 2 | NC | NC | 2 | h |
| 2.4-Dichlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | 120 | 160 | 200 | 270 | | |
| 2.6-Dichlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | 34 | NC | NC | 34 | h |
| 4-Chloro-3-methylphenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| 2.4.6-Trichlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | 3 | 20 | 40 | 95 | | |
| 2.4.5-Trichlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | 0.5 | NC | NC | | |
| Pentachlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | 3.6 | 10 | 17 | 27 | | |
| Naphthalene | µg/L | - | - | - | - | 7 | 0 / 7 | 2.5 | 16 | 37 | 85 | | |
| Acenaphthylene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Acenaphthene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Fluorene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Phenanthrene | µg/L | - | - | - | - | 7 | 0 / 7 | 0.6 | 2 | 4 | 8 | | |
| Anthracene | µg/L | - | - | - | - | 7 | 0 / 7 | 0.01 | 0.4 | 1.5 | 7 | | |
| Fluoranthene | µg/L | - | - | - | - | 7 | 0 / 7 | 1 | 1.4 | 1.7 | 2 | | |
| Pyrene | µg/L | - | - | - | - | 7 | 0 / 7 | 0.025 | 0.025 | 0.025 | 0.025 | | |
| Benz(a)anthracene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Chrysene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Benzo(b+j)fluoranthene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Benzo(k)fluoranthene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Benzo(a)pyrene | µg/L | - | - | - | - | 7 | 0 / 7 | 0.1 | 0.2 | 0.4 | 0.7 | | |
| 3-Methylcholanthrene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Indeno(1.2.3.cd)pyrene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| 7.12-Dimethylbenz(a)anthracene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Dibenz(a.h)anthracene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Benzo(g.h.i)perylene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Sum of polycyclic aromatic hydrocarbons | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Benzo(a)pyrene TEQ (zero) | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| C6 - C9 Fraction | µg/L | 40 | 130 | 86.67 | 95 | 7 | 6 / 7 | NC | NC | NC | NC | | |
| C10 - C14 Fraction | µg/L | 200 | 14000 | 2724.29 | 270 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| C15 - C28 Fraction | µg/L | 150 | 6830 | 1834.00 | 190 | 7 | 5 / 7 | NC | NC | NC | NC | | |
| C29 - C36 Fraction | µg/L | 80 | 80 | 80.00 | 80 | 7 | 1 / 7 | NC | NC | NC | NC | | |
| C10 - C36 Fraction (sum) | µg/L | 260 | 20800 | 4041.43 | 500 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| C6 - C10 Fraction | µg/L | 40 | 140 | 90.00 | 95 | 7 | 6 / 7 | NC | NC | NC | NC | | |
| C6 - C10 Fraction minus BTEX (F1) | µg/L | 20 | 30 | 25.00 | 25 | 7 | 4 / 7 | NC | NC | NC | NC | 500 | f |

**Table B-1**
**Tier 1 Avian Screening Assessment**
**Carpentaria 5H Flowback Water**
**InGauge**

| Analyte grouping/Analyte | Unit | Minimum Detected | Maximum Detected | Average Detected | Median Detected | Sample Count | Detection Frequency | Freshwater Trigger Value by Protection Level (% Species) | | | | Alternative SW Screening Criteria | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 99% | 95% | 90% | 80% | | |
| >C10 - C16 Fraction | µg/L | 240 | 20700 | 3940.00 | 330 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| >C16 - C34 Fraction | µg/L | 160 | 390 | 236.67 | 160 | 7 | 3 / 7 | NC | NC | NC | NC | 640 | f |
| >C34 - C40 Fraction | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| >C10 - C40 Fraction (sum) | µg/L | 240 | 21100 | 4042.86 | 450 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| >C10 - C16 Fraction minus Naphthalene (F2) | µg/L | 240 | 20700 | 3940.00 | 330 | 7 | 7 / 7 | NC | NC | NC | NC | 500 | f |
| Benzene | µg/L | 5 | 67 | 32.71 | 40 | 7 | 7 / 7 | 600 | 950 | 1300 | 2000 | | |
| Toluene | µg/L | 4 | 40 | 22.14 | 22 | 7 | 7 / 7 | 110 | 180 | 230 | 330 | | |
| Ethylbenzene | µg/L | 2 | 2 | 2.00 | 2 | 7 | 1 / 7 | 50 | 80 | 110 | 160 | | |
| meta- & para-Xylene | µg/L | 2 | 8 | 5.20 | 6 | 7 | 5 / 7 | 50 | 75 | 100 | 150 | | |
| ortho-Xylene | µg/L | 2 | 3 | 2.33 | 2 | 7 | 3 / 7 | 200 | 350 | 470 | 640 | | |
| Total Xylenes | µg/L | 2 | 10 | 6.60 | 8 | 7 | 5 / 7 | NC | NC | NC | NC | | |
| Sum of BTEX | µg/L | 9 | 118 | 59.86 | 66 | 7 | 7 / 7 | NC | NC | NC | NC | | |
| Naphthalene | µg/L | - | - | - | - | 7 | 0 / 7 | 2.5 | 16 | 37 | 85 | | |
| Gross alpha | Bq/L | 61.3 | 309 | 188.85 | 191 | 7 | 6 / 7 | NC | NC | NC | NC | 0.5 | |
| Gross beta | Bq/L | 29 | 101 | 66.72 | 65.95 | 7 | 6 / 7 | NC | NC | NC | NC | | |
| Gross beta activity - 40K | Bq/L | 22.3 | 88.6 | 56.98 | 56.2 | 7 | 6 / 7 | NC | NC | NC | NC | 0.5 | |
| 3-Methylcholanthrene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| 7.12-Dimethylbenz(a)anthracene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| m-Cresol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| p-Cresol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Hexachlorophene | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| 2.3.4.6-Tetrachlorophenol | µg/L | - | - | - | - | 7 | 0 / 7 | 10 | 20 | 25 | 30 | | |
| 4-Nitrophenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | 58 | NC | NC | | |
| 2-Methyl-4.6-dinitrophenol | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |
| Dinoseb | µg/L | - | - | - | - | 7 | 0 / 7 | NC | NC | NC | NC | | |

**Table B-1**
**Tier 1 Avian Screening Assessment**
**Carpentaria 5H Flowback Water**
**InGauge**

| Notes | |
|---|---|
| BLANK CELL | Information not available |
| FRACTION | T - Total |
| | D - Dissolved |
| | N - Null |
| SAMPLE TYPE | N - Normal Grab Sample |
| | TB - Trip Blank |
| | NST - No Sample Taken |
| | FD - Field Duplicate |
| WORKORDER (Empty) | Field measurement only |

< less than limit of reporting
°C = degrees Celsius
µg/L = micrograms per liter
µS/cm = microsiemen per centimetre
Bq/L = becquerel per litre
BTEX = benzene, toluene, ethylbenzene, xylene
CaCO3 = calcium carbonate
LOR = limit of reporting
meq/L = milliequivalents per litre
mg/L = milligrams per litre

NC = no criteria
PAH = polycyclic aromatic hydrocarbons
SO4 2- = sulfate
TEQ = toxic equivalence quotient
USEPA = United States Environmental Protection Agency

**WATER QUALIY SCREENING CRITERIA EXCEEDANCE KEY**

Results shaded exceeds Freshwater Trigger Value 95%
**Bold Green exceeds alternative screening criterion**

**ALTERNATIVE WATER SCREENING CRITERIA NOTES**
NA - Not applicable due to lack of appropriate screening criterion or lack of detects.
NC - No appropriate screening criterion

1 - API Publication 4709 September 2001. Frequently Asked Questions About TPH Analytical Methods for Crude Oil
a - Major ions of concern for livestock drinking water quality - https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf
b - Default trigger values for physical and chemical stressors for Tropical Australia for slightly disturbed ecosystems (Table 3.3.4). FW Lakes and Reservoirs. https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf
c - Chronic aquatic life water quality criterion from Hohreiter DW1, Rigg DK.Derivation of ambient water quality criteria for formaldehyde. Chemosphere. 2001. Chemosphere. Nov;45(4-5):471-86. https://www.ncbi.nlm.nih.gov/pubmed/11680743
d - Trigger values for radioactive contaminants for irrigation water. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf
e -Australian and New Zealand Guidelines for Fresh and Marine Water Quality Screening Benchmarks (October 2000) from (From Oak Ridge National Laboratory - Risk Assessment Information System) https://rais.ornl.gov/tools/eco_search.php
f - CRWQCB . 2007. Screening For Environmental Concerns at Sites
g - Minimum guideline for m-cresol and p-cresol. Guidelines for chemical compounds in water found to cause tainting of fish flesh and other aquatic organisms (Table 4.4.5) - https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf
h - Freshwater trigger value with unknown level of species protection.
i - Default short-term trigger value for irrigation (Table 4.2.10). https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf

**Attachment B - Table B-2**
**Avian Receptor Summary**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Common Name | Scientific Name | Body Mass | | | | | | | | Drinking WIR (L/day)[3,4] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sex[1] | N | Mean (kg) | Standard Deviation (kg) | Min (kg) | Max (kg) | Location | Source ID[2] | Mean |
| Crested Pigeon | *Ocyphaps lophotes* | **B** | **21** | **0.204** | **---** | **0.142** | **0.26** | **Australia** | **515a** | **0.020** |
| Willie Wagtail | *Rhipidura leucophrys picata* | **B** | **13** | **0.0201** | **---** | **0.0145** | **0.0255** | **Australia** | **518a** | **0.004** |
| Peaceful Dove | *Geopelia placida* | **B** | **38** | **0.0478** | **---** | **0.035** | **0.065** | **Australia** | **515a** | **0.008** |
| Cattle Egret | *Bubulcus ibis* | M | 27 | 0.372 | --- | 0.296 | 0.46 | FL, USA | 1207 | 0.0304 |
| Cattle Egret | *Bubulcus ibis* | **F** | **59** | **0.36** | **---** | **0.27** | **0.512** | **FL, USA** | **1207** | **0.0298** |
| Brown Honeyeater | *Lichmera indistincta* | M | 37 | 0.0118 | 0.0015 | 0.009 | 0.015 | Australia | 517 | 0.0030 |
| Brown Honeyeater | *Lichmera indistincta* | **F** | **15** | **0.0106** | **0.0021** | **0.008** | **0.014** | **Australia** | **517** | **0.0028** |

**Notes:**

[1] Sex: M, Male; F, Female; B, Both

[2] Body mass statistics compiled in Dunning (2008); Original source documents based on Source ID in Dunning (2008) include: Dunning. J. 2008. CRC Handbook of Avian Body Masses 2nd Edition. CRC Press; 2 edition Boca Raton : CRC Press, [2008].

515a. Higgins, P.J. and S.J.J.F. Davies. 1996. *Handbook of Australian, New Zealand and Antarctic birds.* Oxford University Press, Melbourne, Australia. Volume 3.

518a. Higgins, P.J. , J.M. Peter, and S.J. Cowling. 2006. *Handbook of Australian, New Zealand and Antarctic birds.* Oxford University Press, Melbourne, Australia. Volume 7.

1207. Telfair, R.C. 1994. *Cattle Egret (Bubulcus ibis) In The Birds of North America.* A. Poole and F. Gill (editors). The Birds of North America, Inc , Philadelphia, PA, and The American Ornithologists' Union, Washington, DC. Number 113.

517. Higgins, P.J., J.M. Peter, and W.K. Steele. 2001. *Handbook of Australian, New Zealand and Antarctic birds.* Oxford University Press, Melbourne, Australia. Volume 5.

[3] Drinking WIR based on the allometric relationship developed by Calder and Braun (1983). *Scaling of osmotic regulation in mammals and birds.* Am J Physiol. 1983 May;244(5): R601-6., where WIR (L/day) = 0.059 x BW $(Kg)^{0.67}$

[4] Proposed WIR shown in bold, estimated based on the arithmetic mean of female or combined body mass; WIR may be estimated based on other body mass statistics depending on the appropriate exposure scenario.

--- = no data
BW = body weight
N = number
kg = kilogram
L = litre
WIR = water ingestion rate

**Attachment B - Table B-3**
**Crested Pigeon**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | Mammal NOAEL (mg/kg-day) | Mammal NOAEL Test Animal | | Avian NOAEL [1] (mg/kg-day) | Avian NOAEL Test Animal | | | Avian Receptor Crested Pigeon | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Animal | Body Weight (kg) | | Animal | Body Weight (kg) | | Body Weight (kg) | Derived TRV |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 250 | Rat | 0.35 | NA | NA | NA | | 0.204 | 2.9E+02 |
| Antimony (ADWG) | 7440-36-0 | 0.43 | Rat | 0.35 | NA | NA | NA | | 0.204 | 4.9E-01 |
| Arsenic (ECHA) | 7440-38-2 | NA | NA | NA | 2.24 | Mallard Duck | 1.58 | a | 0.204 | 3.74E+00 |
| Barium | 7440-39-3 | 45 | Rat | 0.35 | NA | NA | NA | | 0.204 | 5.2E+01 |
| Boron (Released from disodium octaborate tetrahydrate) | 7440-42-8 | 10.3 | Rat | 0.35 | 28.8 | Mallard Duck | 1.580 | | 0.204 | 4.8E+01 |
| Cadmium | 7440-43-9 | 0.20 | Rat | 0.35 | NA | NA | NA | | 0.204 | 2.3E-01 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 1368.0 | Rat | 0.35 | NA | NA | NA | | 0.204 | 1.6E+03 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 4.2 | Mouse | 0.012 | NA | NA | NA | | 0.204 | 2.1E+00 |
| Magnesium | 7439-95-4 | 300 | Rat | 0.35 | NA | NA | NA | | 0.204 | 3.4E+02 |
| Nickel (ADWG) | 7440-02-0 | 5.0 | Rat | 0.35 | NA | NA | NA | | 0.204 | 5.7E+00 |
| Total Cyanide | 57-12-5 | 68.7 | Rat | 0.35 | NA | NA | NA | b | 0.204 | 7.9E+01 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 1000 | Rat | 0.35 | NA | NA | NA | | 0.204 | 1.1E+03 |
| Zinc (as ZnSO4 - ECHA) | 7440-66-6 | 13.0 | Rat | 0.35 | 15 | White Leghorn Hen | 1.766 | | 0.204 | 2.6E+01 |
| >C10 - C16 Fraction minus Naphthalene F2 (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 750 | Rat | 0.35 | NA | NA | NA | | 0.204 | 8.6E+02 |

**Notes:**
[1] - If an avian NOAEL was not available, the mammal NOAEL was used to derive the TRV for the avian receptor.
a -Oak Ridge National Laboratory. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program Health Sciences Research Division Oak Ridge, Tennessee 37831
b-Sample et al (1996.
ADWG = Australian Drinking Water Guidelines
CAS = Chemical Abstracts Service
ECHA = European Chemical Agency
kg = kilogram
mg = milligram
NA = not applicable
ND = no data available
NOAEL = No observed adverse effect level
NOAELtest = No observed adverse effect level test animal - mg/kg/day
TRV = toxicity reference value

$$Derived\ TRV = NOAEL_{test} * \left(\frac{Body\ Weighttest}{Body\ WeightAvian}\right)^{(1/4)}$$

| Exposure Route | Parameter Code | Parameter Definition | Units (a) | Parameter Value | Source (b) |
|---|---|---|---|---|---|
| Ingestion | IR | Ingestion rate | L/day | 0.020 | Table B-1 |
| | $EF_{shortterm}$ | Exposure frequency | day/yr | 21 | BPJ |
| | $EF_{longterm}$ | Exposure frequency | day/yr | 365 | BPJ |
| | ED | Exposure duration | yr | 1 | BPJ |
| | BW | Body weight | kg | 0.204 | Table B-1 |
| | AT-NC | Averaging time - noncancer | days | 365 | BPJ |

**Notes:**
a/ Units:
L/day = litres per day
day/yr = days per year
yr = year
kg = kilogram
b/ Source:
BPJ = Best Professional Judgement

**Attachment B - Table B-3**
**Crested Pigeon**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | EPC[1] | Toxicity | Short-Term Storage (21 days) | | Long-Term Storage (1 year) | |
|---|---|---|---|---|---|---|---|
| | | | | Total Intake (mg/kg/day) | Hazard Quotient | Total Intake (mg/kg/day) | Hazard Quotient |
| | | Average CW (mg/L) | TRVs | | Ingestion | | Ingestion |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 46.18 | 2.86E+02 | 2.6E-01 | 9.3E-04 | 4.60E+00 | 1.6E-02 |
| Antimony (ADWG) | 7440-36-0 | 0.016 | 4.92E-01 | 9.0E-05 | 1.8E-04 | 1.57E-03 | 3.2E-03 |
| Arsenic (ECHA) | 7440-38-2 | 0.0313 | 3.74E+00 | 1.8E-04 | 4.8E-05 | 3.12E-03 | 8.3E-04 |
| Barium | 7440-39-3 | 779.75 | 5.15E+01 | 4.5E+00 | 8.7E-02 | 7.77E+01 | 1.5E+00 |
| Boron | 7440-42-8 | 8.26 | 4.80E+01 | 4.7E-02 | 9.9E-04 | 8.23E-01 | 1.7E-02 |
| Cadmium | 7440-43-9 | 0.0014 | 2.29E-01 | 8.0E-06 | 3.5E-05 | 1.40E-04 | 6.1E-04 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 0.025 | 1.57E+03 | 1.4E-04 | 9.0E-08 | 2.44E-03 | 1.6E-06 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 0.012 | 2.07E+00 | 6.9E-05 | 3.3E-05 | 1.20E-03 | 5.8E-04 |
| Magnesium | 7439-95-4 | 1728 | 3.43E+02 | 9.9E+00 | 2.9E-02 | 1.72E+02 | 5.0E-01 |
| Nickel (ADWG) | 7440-02-0 | 0.0243 | 5.72E+00 | 1.4E-04 | 2.4E-05 | 2.42E-03 | 4.2E-04 |
| Total Cyanide | 57-12-5 | 0.0080 | 7.86E+01 | 4.6E-05 | 5.8E-07 | 7.98E-04 | 1.0E-05 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 2.45 | 1.14E+03 | 1.4E-02 | 1.2E-05 | 2.44E-01 | 2.1E-04 |
| Zinc | 7440-66-6 | 0.61 | 2.57E+01 | 3.5E-03 | 1.4E-04 | 6.08E-02 | 2.4E-03 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 332.5 | 8.58E+02 | 1.9E+00 | 2.2E-03 | 3.31E+01 | 3.9E-02 |
| | | | | **Cumulative:** | **1E-01** | **Cumulative:** | **2E+00** |

**Notes:**
ADWG = Australian Drinking Water Guidelines
BW = body weight
CAS = Chemical Abstracts Service
CW = concentration in water
ECHA = European Chemical Agency
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration
IR = ingestion rate
mg/kg/day = milligrams per kilograms per day
mg/L = milligrams per litre
NA = not available/applicable
TRV = toxicity reference value
1 - EPC is average concentration presented in Attachment A.

$$Total\ Intake = \frac{EPC \times IR \times EF \times ED}{BW \times ED\ x\ 365\ ^{days}/_{year}}$$

$$Hazard\ Quotient = \frac{Total\ Intake\ \left(\frac{mg}{kg-day}\right)}{TRV\ \left(\frac{mg}{kg-day}\right)}$$

**Attachment B - Table B-4**
**Willie Wagtail**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | Mammal NOAEL (mg/kg-day) | Mammal NOAEL Test Animal | | Avian NOAEL[1] (mg/kg-day) | Avian NOAEL Test Animal | | Avian Receptor Willie Wagtail | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Animal | Body Weight (kg) | | Animal | Body Weight (kg) | Body Weight (kg) | Derived TRV |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 250 | Rat | 0.35 | NA | NA | NA | 0.0201 | 5.11E+02 |
| Antimony (ADWG) | 7440-36-0 | 0.43 | Rat | 0.35 | NA | NA | NA | 0.0201 | 8.78E-01 |
| Arsenic (ECHA) | 7440-38-2 | NA | NA | NA | 2.24 | Mallard Duck | 1.58 | 0.0201 | 6.67E+00 |
| Barium | 7440-39-3 | 45 | Rat | 0.35 | NA | NA | NA | 0.0201 | 9.19E+01 |
| Boron (Released from disodium octaborate tetrahydrate) | 7440-42-8 | 10.3 | Rat | 0.35 | 28.8 | Mallard Duck | 1.58 | 0.0201 | 8.58E+01 |
| Cadmium | 7440-43-9 | 0.20 | Rat | 0.35 | NA | NA | NA | 0.0201 | 4.09E-01 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 1368.0 | Rat | 0.35 | NA | NA | NA | 0.0201 | 2.79E+03 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 4.2 | Mouse | 0.012 | NA | NA | NA | 0.0201 | 3.69E+00 |
| Magnesium | 7439-95-4 | 300 | Rat | 0.35 | NA | NA | NA | 0.0201 | 6.13E+02 |
| Nickel (ADWG) | 7440-02-0 | 5.0 | Rat | 0.35 | NA | NA | NA | 0.0201 | 1.02E+01 |
| Total Cyanide | 57-12-5 | 68.7 | Rat | 0.35 | NA | NA | NA | 0.0201 | 1.40E+02 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 1000 | Rat | 0.35 | NA | NA | NA | 0.0201 | 2.04E+03 |
| Zinc | 7440-66-6 | 13.0 | Rat | 0.35 | 15 | White Leghorn Hen | 1.766 | 0.0201 | 4.59E+01 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 750 | Rat | 0.35 | NA | NA | NA | 0.0201 | 1.53E+03 |

**Notes:**
ADWG = Australian Drinking Water Guidelines
CAS = Chemical Abstracts Service
ECHA = European Chemical Agency
kg = kilogram
mg = milligram
NA = not applicable
NOAEL = No observed adverse effect level
NOAELtest = No observed adverse effect level test animal
TRV = toxicity reference value
1/ If an avian NOAEL was not available, the mammal NOAEL was used to derive the TRV for the avian receptor.

$$Derived\ TRV = NOAEL_{test} * \left(\frac{Body\ Weight test}{Body\ Weight Avian}\right)^{(1/4)}$$

| Exposure Route | Parameter Code | Parameter Definition | Units (a) | Parameter Value | Source (b) |
|---|---|---|---|---|---|
| Ingestion | IR | Ingestion rate | L/day | 0.004 | Table B-1 |
| | $EF_{shortterm}$ | Exposure frequency | day/yr | 21 | BPJ |
| | $EF_{longterm}$ | Exposure frequency | day/yr | 365 | BPJ |
| | ED | Exposure duration | yr | 1 | BPJ |
| | BW | Body weight | kg | 0.0201 | Table B-1 |
| | AT-NC | Averaging time - noncancer | days | 365 | BPJ |

**Notes:**
a/ Units:
L/day = litres per day
day/yr = days per year
yr = year
kg = kilogram
b/ Source:
BPJ = Best Professional Judgement

**Attachment B - Table B-4**
**Willie Wagtail**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | EPC[1] | Toxicity | Short-Term Storage (21 days) | | Long-Term Storage (1 year) | |
|---|---|---|---|---|---|---|---|
| | | | | Total Intake (mg/kg/day) | Hazard Quotient | Total Intake (mg/kg/day) | Hazard Quotient |
| | | CW (mg/L) | TRVs | | Ingestion | | Ingestion |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 46.18 | 5.11E+02 | 5.7E-01 | 1.1E-03 | 9.9E+00 | 1.9E-02 |
| Antimony (ADWG) | 7440-36-0 | 0.016 | 8.78E-01 | 1.9E-04 | 2.2E-04 | 3.4E-03 | 3.8E-03 |
| Arsenic (ECHA) | 7440-38-2 | 0.0313 | 6.67E+00 | 3.9E-04 | 5.8E-05 | 6.7E-03 | 1.0E-03 |
| Barium | 7440-39-3 | 779.75 | 9.19E+01 | 9.6E+00 | 1.0E-01 | 1.7E+02 | 1.8E+00 |
| Boron | 7440-42-8 | 8.26 | 8.58E+01 | 1.0E-01 | 1.2E-03 | 1.8E+00 | 2.1E-02 |
| Cadmium | 7440-43-9 | 0.0014 | 4.09E-01 | 1.7E-05 | 4.2E-05 | 3.0E-04 | 7.3E-04 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 0.025 | 2.79E+03 | 3.0E-04 | 1.1E-07 | 5.2E-03 | 1.9E-06 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 0.012 | 3.69E+00 | 1.5E-04 | 4.0E-05 | 2.6E-03 | 7.0E-04 |
| Magnesium | 7439-95-4 | 1728 | 6.13E+02 | 2.1E+01 | 3.5E-02 | 3.7E+02 | 6.0E-01 |
| Nickel (ADWG) | 7440-02-0 | 0.0243 | 1.02E+01 | 3.0E-04 | 2.9E-05 | 5.2E-03 | 5.1E-04 |
| Total Cyanide | 57-12-5 | 0.0080 | 1.40E+02 | 9.9E-05 | 7.0E-07 | 1.7E-03 | 1.2E-05 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 2.45 | 2.04E+03 | 3.0E-02 | 1.5E-05 | 5.2E-01 | 2.6E-04 |
| Zinc | 7440-66-6 | 0.61 | 4.59E+01 | 7.5E-03 | 1.6E-04 | 1.3E-01 | 2.8E-03 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 332.5 | 1.53E+03 | 4.1E+00 | 2.7E-03 | 7.1E+01 | 4.6E-02 |
| | | | | **Cumulative:** | **1E-01** | **Cumulative:** | **3E+00** |

**Notes:**
ADWG = Australian Drinking Water Guidelines
BW = body weight
CAS = Chemical Abstracts Service
CW = concentration in water
ECHA = European Chemical Agency
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration
IR = ingestion rate
mg/kg/day = milligrams per kilograms per day
mg/L = milligrams per litre
TRV = toxicity reference value
1 - EPC is average concentration presented in Attachment A. If constituent was not detected, 1/2 the detection limit was used to calculate the average.

$$Total\ Intake = \frac{EPC \times IR \times EF \times ED}{BW \times ED\ x\ 365\ ^{days}/_{year}}$$

$$Hazard\ Quotient = \frac{Total\ Intake\ \left(\frac{mg}{kg-day}\right)}{TRV\ \left(\frac{mg}{kg-day}\right)}$$

**Attachment B - Table B-5**
**Peaceful Dove**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | Mammal NOAEL (mg/kg-day) | Mammal NOAEL Test Animal | | Avian NOAEL [1] (mg/kg-day) | Avian NOAEL Test Animal | | Avian Receptor Peaceful Dove | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Animal | Body Weight (kg) | | Animal | Body Weight (kg) | Body Weight (kg) | Derived TRV |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 250 | Rat | 0.35 | NA | NA | NA | 0.0478 | 4.11E+02 |
| Antimony (ADWG) | 7440-36-0 | 0.43 | Rat | 0.35 | NA | NA | NA | 0.0478 | 7.07E-01 |
| Arsenic (ECHA) | 7440-38-2 | NA | NA | NA | 2.24 | Mallard Duck | 1.58 | 0.0478 | 5.37E+00 |
| Barium | 7440-39-3 | 45 | Rat | 0.35 | NA | NA | NA | 0.0478 | 7.40E+01 |
| Boron (Released from disodium octaborate tetrahydrate) | 7440-42-8 | 10.3 | Rat | 0.35 | 28.8 | Mallard Duck | 1.580 | 0.0478 | 6.91E+01 |
| Cadmium | 7440-43-9 | 0.20 | Rat | 0.35 | NA | NA | NA | 0.0478 | 3.29E-01 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 1368.0 | Rat | 0.35 | NA | NA | NA | 0.0478 | 2.25E+03 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 4.2 | Mouse | 0.012 | NA | NA | NA | 0.0478 | 2.97E+00 |
| Magnesium | 7439-95-4 | 300.0 | Rat | 0.35 | NA | NA | NA | 0.0478 | 4.93E+02 |
| Nickel (ADWG) | 7440-02-0 | 5.0 | Rat | 0.35 | NA | NA | NA | 0.0478 | 8.22E+00 |
| Total Cyanide | 57-12-5 | 68.7 | Rat | 0.35 | NA | NA | NA | 0.0478 | 1.13E+02 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 1000 | Rat | 0.35 | NA | NA | NA | 0.0478 | 1.64E+03 |
| Zinc | 7440-66-6 | 13 | Rat | 0.35 | 15 | White Leghorn Hen | 2 | 0.0478 | 3.70E+01 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 750 | Rat | 0.35 | NA | NA | NA | 0.0478 | 1.23E+03 |

**Notes:**
ADWG = Australian Drinking Water Guidelines
CAS = Chemical Abstracts Service
ECHA = European Chemical Agency
kg = kilogram
mg = milligram
NA = not applicable
NOAEL = No observed adverse effect level
NOAELt = No observed adverse effect level test animal
TRV = toxicity reference value
1/ If an avian NOAEL was not available, the mammal NOAEL was used to derive the TRV for the avian receptor.

$$Derived\ TRV = NOAEL_{test} * \left(\frac{Body\ Weight test}{Body\ Weight Avian}\right)^{(1/4)}$$

| Exposure Route | Parameter Code | Parameter Definition | Units (a) | Parameter Value | Source (b) |
|---|---|---|---|---|---|
| Ingestion | IR | Ingestion rate | L/day | 0.008 | Table B-1 |
| | $EF_{shortterm}$ | Exposure frequency | day/yr | 21 | BPJ |
| | $EF_{longterm}$ | Exposure frequency | day/yr | 365 | BPJ |
| | ED | Exposure duration | yr | 1 | BPJ |
| | BW | Body weight | kg | 0.0478 | Table B-1 |
| | AT-NC | Averaging time - noncancer | days | 365 | BPJ |

**Notes:**
a/ Units:
L/day = litres per day
day/yr = days per year
yr = year
kg = kilogram
b/ Source:
BPJ = Best Professional Judgement

**Attachment B - Table B-5**
**Peaceful Dove**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | EPC[1] | Toxicity | Short-Term Storage (21 days) | | Long-Term Storage (1 year) | |
|---|---|---|---|---|---|---|---|
| | | | | Total Intake (mg/kg/day) | Hazard Quotient | Total Intake (mg/kg/day) | Hazard Quotient |
| | | CW (mg/L) | TRVs | | Ingestion | | Ingestion |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 46.18 | 4.11E+02 | 4.3E-01 | 1.0E-03 | 7.4E+00 | 1.8E-02 |
| Antimony (ADWG) | 7440-36-0 | 0.016 | 7.07E-01 | 1.5E-04 | 2.1E-04 | 2.5E-03 | 3.6E-03 |
| Arsenic (ECHA) | 7440-38-2 | 0.0313 | 5.37E+00 | 2.9E-04 | 5.4E-05 | 5.0E-03 | 9.4E-04 |
| Barium | 7440-39-3 | 779.75 | 7.40E+01 | 7.2E+00 | 9.8E-02 | 1.3E+02 | 1.7E+00 |
| Boron | 7440-42-8 | 8.26 | 6.91E+01 | 7.6E-02 | 1.1E-03 | 1.3E+00 | 1.9E-02 |
| Cadmium | 7440-43-9 | 0.0014 | 3.29E-01 | 1.3E-05 | 3.9E-05 | 2.3E-04 | 6.8E-04 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 0.025 | 2.25E+03 | 2.3E-04 | 1.0E-07 | 3.9E-03 | 1.8E-06 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 0.012 | 2.97E+00 | 1.1E-04 | 3.7E-05 | 1.9E-03 | 6.5E-04 |
| Magnesium | 7439-95-4 | 1728 | 4.93E+02 | 1.6E+01 | 3.2E-02 | 2.8E+02 | 5.6E-01 |
| Nickel (ADWG) | 7440-02-0 | 0.0243 | 8.22E+00 | 2.2E-04 | 2.7E-05 | 3.9E-03 | 4.7E-04 |
| Total Cyanide | 57-12-5 | 0.0080 | 1.13E+02 | 7.4E-05 | 6.6E-07 | 1.3E-03 | 1.1E-05 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 2.45 | 1.64E+03 | 2.3E-02 | 1.4E-05 | 3.9E-01 | 2.4E-04 |
| Zinc | 7440-66-6 | 0.61 | 3.70E+01 | 5.6E-03 | 1.5E-04 | 9.8E-02 | 2.7E-03 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 332.5 | 1.23E+03 | 3.1E+00 | 2.5E-03 | 5.4E+01 | 4.3E-02 |
| | | | | Cumulative: | 1E-01 | Cumulative: | 2E+00 |

**Notes:**
ADWG = Australian Drinking Water Guidelines
BW = body weight
CAS = Chemical Abstracts Service
CW = concentration in water
ECHA = European Chemical Agency
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration
IR = ingestion rate
mg/kg/day = milligrams per kilograms per day
mg/L = milligrams per litre
NA = not available/applicable
TRV = toxicity reference value
1 - EPC is average concentration presented in Attachment A. If constituent was not detected, 1/2 the detection limit was used to calculate the average.

$$Total\ Intake = \frac{EPC \times IR \times EF \times ED}{BW \times ED\ x\ 365\ ^{days}/_{year}}$$

$$Hazard\ Quotient = \frac{Total\ Intake\ \left(\frac{mg}{kg-day}\right)}{TRV\ \left(\frac{mg}{kg-day}\right)}$$

**Attachment B - Table B-6**
**Cattle Egret**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | Mammal NOAEL (mg/kg-day) | Mammal NOAEL Test Animal | | Avian NOAEL [1] (mg/kg-day) | Avian NOAEL Test Animal | | Avian Receptor Cattle Egret | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Animal | Body Weight (kg) | | Animal | Body Weight (kg) | Body Weight (kg) | Derived TRV |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 250 | Rat | 0.35 | NA | NA | NA | 0.36 | 2.48E+02 |
| Antimony (ADWG) | 7440-36-0 | 0.43 | Rat | 0.35 | NA | NA | NA | 0.36 | 4.27E-01 |
| Arsenic (ECHA) | 7440-38-2 | NA | NA | NA | 2.24 | Mallard Duck | 1.58 | 0.36 | 3.24E+00 |
| Barium | 7440-39-3 | 45 | Rat | 0.35 | NA | NA | NA | 0.36 | 4.47E+01 |
| Boron (Released from disodium octaborate tetrahydrate) | 7440-42-8 | 10.3 | Rat | 0.35 | 28.8 | Mallard Duck | 1.580 | 0.36 | 4.17E+01 |
| Cadmium | 7440-43-9 | 0.20 | Rat | 0.35 | NA | NA | NA | 0.36 | 1.99E-01 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 1368.0 | Rat | 0.35 | NA | NA | NA | 0.36 | 1.36E+03 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 4.2 | Mouse | 0.012 | NA | NA | NA | 0.36 | 1.79E+00 |
| Magnesium | 7439-95-4 | 300.0 | Rat | 0.35 | NA | NA | NA | 0.36 | 2.98E+02 |
| Nickel (ADWG) | 7440-02-0 | 5.0 | Rat | 0.35 | NA | NA | NA | 0.36 | 4.96E+00 |
| Total Cyanide | 57-12-5 | 68.7 | Rat | 0.35 | NA | NA | NA | 0.36 | 6.82E+01 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 1000 | Rat | 0.35 | NA | NA | NA | 0.36 | 9.93E+02 |
| Zinc | 7440-66-6 | 13 | Rat | 0.35 | 15 | White Leghorn Her | 2 | 0.36 | 2.23E+01 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 750 | Rat | 0.35 | NA | NA | NA | 0.36 | 7.45E+02 |

**Notes:**
ADWG = Australian Drinking Water Guidelines
CAS = Chemical Abstracts Service
ECHA = European Chemical Agency
kg = kilogram
mg = milligram
NA = not applicable
NOAEL = No observed adverse effect level
NOAELtest = No observed adverse effect level test animal
TRV = toxicity reference value
1/ If an avian NOAEL was not available, the mammal NOAEL was used to derive the TRV for the avian receptor.

$$Derived\ TRV = NOAEL_{test} * \left(\frac{Body\ Weight test}{Body\ Weight Avian}\right)^{(1/4)}$$

| Exposure Route | Parameter Code | Parameter Definition | Units (a) | Parameter Value | Source (b) |
|---|---|---|---|---|---|
| Ingestion | IR | Ingestion rate | L/day | 0.0298 | Table B-1 |
| | $EF_{shortterm}$ | Exposure frequency | day/yr | 21 | BPJ |
| | $EF_{longterm}$ | Exposure frequency | day/yr | 365 | BPJ |
| | ED | Exposure duration | yr | 1 | BPJ |
| | BW | Body weight | kg | 0.36 | Table B-1 |
| | AT-NC | Averaging time - noncancer | days | 365 | BPJ |

**Notes:**
a/ Units:
L/day = litres per day
day/yr = days per year
yr = year
kg = kilogram
b/ Source:
BPJ = Best Professional Judgement

**Attachment B - Table B-6**
**Cattle Egret**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | EPC[1] | Toxicity | Short-Term Storage (21 days) | | Long-Term Storage (1 year) | |
|---|---|---|---|---|---|---|---|
| | | | | Total Intake (mg/kg/day) | Hazard Quotient | Total Intake (mg/kg/day) | Hazard Quotient |
| | | CW (mg/L) | TRVs | | Ingestion | | Ingestion |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 46.18 | 2.48E+02 | 2.2E-01 | 8.8E-04 | 3.8E+00 | 1.5E-02 |
| Antimony (ADWG) | 7440-36-0 | 0.016 | 4.27E-01 | 7.5E-05 | 1.8E-04 | 1.3E-03 | 3.0E-03 |
| Arsenic (ECHA) | 7440-38-2 | 0.0313 | 3.24E+00 | 1.5E-04 | 4.6E-05 | 2.6E-03 | 8.0E-04 |
| Barium | 7440-39-3 | 779.75 | 4.47E+01 | 3.7E+00 | 8.3E-02 | 6.4E+01 | 1.4E+00 |
| Boron | 7440-42-8 | 8.26 | 4.17E+01 | 3.9E-02 | 9.4E-04 | 6.8E-01 | 1.6E-02 |
| Cadmium | 7440-43-9 | 0.0014 | 1.99E-01 | 6.7E-06 | 3.4E-05 | 1.2E-04 | 5.8E-04 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 0.025 | 1.36E+03 | 1.2E-04 | 8.6E-08 | 2.0E-03 | 1.5E-06 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 0.012 | 1.79E+00 | 5.7E-05 | 3.2E-05 | 9.9E-04 | 5.5E-04 |
| Magnesium | 7439-95-4 | 1728 | 2.98E+02 | 8.2E+00 | 2.8E-02 | 1.4E+02 | 4.8E-01 |
| Nickel (ADWG) | 7440-02-0 | 0.0243 | 4.96E+00 | 1.2E-04 | 2.3E-05 | 2.0E-03 | 4.0E-04 |
| Total Cyanide | 57-12-5 | 0.0080 | 6.82E+01 | 3.8E-05 | 5.6E-07 | 6.6E-04 | 9.7E-06 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 2.45 | 9.93E+02 | 1.2E-02 | 1.2E-05 | 2.0E-01 | 2.0E-04 |
| Zinc | 7440-66-6 | 0.61 | 2.23E+01 | 2.9E-03 | 1.3E-04 | 5.0E-02 | 2.3E-03 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 332.5 | 7.45E+02 | 1.6E+00 | 2.1E-03 | 2.7E+01 | 3.7E-02 |
| | | | | **Cumulative:** | **1E-01** | **Cumulative:** | **2E+00** |

**Notes:**
ADWG = Australian Drinking Water Guidelines
BW = body weight
CAS = Chemical Abstracts Service
CW = concentration in water
ECHA = European Chemical Agency
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration
IR = ingestion rate
mg/kg/day = milligrams per kilograms per day
mg/L = milligrams per litre
NA = not available/applicable
TRV = toxicity reference value
1 - EPC is average concentration presented in Attachment A. If constituent was not detected, 1/2 the detection limit was used to calculate the average.

$$Total\ Intake = \frac{EPC \times IR \times EF \times ED}{BW \times ED\ x\ 365\ ^{days}/_{year}}$$

$$Hazard\ Quotient = \frac{Total\ Intake\ \left(\frac{mg}{kg-day}\right)}{TRV\ \left(\frac{mg}{kg-day}\right)}$$

**Attachment B - Table B-7**
**Brown Honeyeater**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | Mammal NOAEL (mg/kg-day) | Mammal NOAEL Test Animal | | Avian NOAEL [1] (mg/kg-day) | Avian NOAEL Test Animal | | Avian Receptor Brown Honeyeater | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Animal | Body Weight (kg) | | Animal | Body Weight (kg) | Body Weight (kg) | Derived TRV |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 250 | Rat | 0.35 | NA | NA | NA | 0.0106 | 6.0E+02 |
| Antimony (ADWG) | 7440-36-0 | 0.43 | Rat | 0.35 | NA | NA | NA | 0.0106 | 1.0E+00 |
| Arsenic (ECHA) | 7440-38-2 | NA | NA | NA | 2.24 | Mallard Duck | 1.58 | 0.0106 | 7.8E+00 |
| Barium | 7440-39-3 | 45 | Rat | 0.35 | NA | NA | NA | 0.0106 | 1.1E+02 |
| Boron (Released from disodium octaborate tetrahydrate) | 7440-42-8 | 10.3 | Rat | 0.35 | 28.8 | Mallard Duck | 1.580 | 0.0106 | 1.0E+02 |
| Cadmium | 7440-43-9 | 0.20 | Rat | 0.35 | NA | NA | NA | 0.0106 | 4.8E-01 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 1368.0 | Rat | 0.35 | NA | NA | NA | 0.0106 | 3.3E+03 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 4.2 | Mouse | 0.012 | NA | NA | NA | 0.0106 | 4.3E+00 |
| Magnesium | 7439-95-4 | 300.0 | Rat | 0.35 | NA | NA | NA | 0.0106 | 7.2E+02 |
| Nickel (ADWG) | 7440-02-0 | 5.0 | Rat | 0.35 | NA | NA | NA | 0.0106 | 1.2E+01 |
| Total Cyanide | 57-12-5 | 68.7 | Rat | 0.35 | NA | NA | NA | 0.0106 | 1.6E+02 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 1000 | Rat | 0.35 | NA | NA | NA | 0.0106 | 2.4E+03 |
| Zinc | 7440-66-6 | 13 | Rat | 0.35 | 15 | White Leghorn Hen | 2 | 0.0106 | 5.4E+01 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 750 | Rat | 0.35 | NA | NA | NA | 0.0106 | 1.8E+03 |

**Notes:**
ADWG = Australian Drinking Water Guidelines
CAS = Chemical Abstracts Service
ECHA = European Chemical Agency
kg = kilogram
mg = milligram
NA = not applicable
NOAEL = No observed adverse effect level
NOAELtest = No observed adverse effect level test animal
TRV = toxicity reference value
1/ If an avian NOAEL was not available, the mammal NOAEL was used to derive the TRV for the avian receptor.
2/ LOAEL for copper used.

$$Derived\ TRV = NOAEL_{test} * \left(\frac{Body\ Weight test}{Body\ Weight Avian}\right)^{(1/4)}$$

| Exposure Route | Parameter Code | Parameter Definition | Units (a) | Parameter Value | Source (b) |
|---|---|---|---|---|---|
| Ingestion | IR | Ingestion rate | L/day | 0.0028 | Table B-1 |
| | $EF_{shortterm}$ | Exposure frequency | day/yr | 21 | BPJ |
| | $EF_{longterm}$ | Exposure frequency | day/yr | 365 | BPJ |
| | ED | Exposure duration | yr | 1 | BPJ |
| | BW | Body weight | kg | 0.0106 | Table B-1 |
| | AT-NC | Averaging time - noncancer | days | 365 | BPJ |

**Notes:**
a/ Units:
L/day = litres per day
day/yr = days per year
yr = year
kg = kilogram
b/ Source:
BPJ = Best Professional Judgement

**Attachment B - Table B-7**
**Brown Honeyeater**
**Carpentaria 5H Flowback Water - Avian Risk Assessment**
**InGauge**

| Constituent Name | CAS No. | EPC[1] | Toxicity | Short-Term Storage (21 days) | | Long-Term Storage (1 year) | |
|---|---|---|---|---|---|---|---|
| | | | | Total Intake (mg/kg/day) | Hazard Quotient | Total Intake (mg/kg/day) | Hazard Quotient |
| | | CW (mg/L) | TRVs | | Ingestion | | Ingestion |
| Ammonia (ECHA - Ammonia, anhydrous) | 7664-41-7 | 46.18 | 6.0E+02 | 7.0E-01 | 1.2E-03 | 1.2E+01 | 2.0E-02 |
| Antimony (ADWG) | 7440-36-0 | 0.016 | 1.0E+00 | 2.4E-04 | 2.3E-04 | 4.2E-03 | 4.0E-03 |
| Arsenic (ECHA) | 7440-38-2 | 0.0313 | 7.8E+00 | 4.8E-04 | 6.1E-05 | 8.3E-03 | 1.1E-03 |
| Barium | 7440-39-3 | 779.75 | 1.1E+02 | 1.2E+01 | 1.1E-01 | 2.1E+02 | 1.9E+00 |
| Boron | 7440-42-8 | 8.26 | 1.0E+02 | 1.3E-01 | 1.2E-03 | 2.2E+00 | 2.2E-02 |
| Cadmium | 7440-43-9 | 0.0014 | 4.8E-01 | 2.1E-05 | 4.4E-05 | 3.7E-04 | 7.7E-04 |
| Chromium (ECHA - as chromium III) | 7440-47-3 | 0.025 | 3.3E+03 | 3.7E-04 | 1.1E-07 | 6.5E-03 | 2.0E-06 |
| Copper (ECHA - copper sulphate pentahydrate) | 7440-50-8 | 0.012 | 4.3E+00 | 1.8E-04 | 4.2E-05 | 3.2E-03 | 7.3E-04 |
| Magnesium | 7439-95-4 | 1728 | 7.2E+02 | 2.6E+01 | 3.7E-02 | 4.6E+02 | 6.4E-01 |
| Nickel (ADWG) | 7440-02-0 | 0.0243 | 1.2E+01 | 3.7E-04 | 3.1E-05 | 6.4E-03 | 5.4E-04 |
| Total Cyanide | 57-12-5 | 0.0080 | 1.6E+02 | 1.2E-04 | 7.4E-07 | 2.1E-03 | 1.3E-05 |
| Total Phosphorus as P (Organic Phosphate as P) | 7723-14-0 | 2.45 | 2.4E+03 | 3.7E-02 | 1.6E-05 | 6.5E-01 | 2.7E-04 |
| Zinc | 7440-66-6 | 0.61 | 5.4E+01 | 9.3E-03 | 1.7E-04 | 1.6E-01 | 3.0E-03 |
| >C10 - C16 Fraction minus Naphthalene (ECHA: Surrogate as hydrocarbons, C9-16, hydrotreated, dearomatized) ) | 93763-35-0 | 332.5 | 1.8E+03 | 5.1E+00 | 2.8E-03 | 8.8E+01 | 4.9E-02 |
| | | | | **Cumulative:** | **2E-01** | **Cumulative:** | **3E+00** |

**Notes:**
ADWG = Australian Drinking Water Guidelines
BW = body weight
CAS = Chemical Abstracts Service
CW = concentration in water
ECHA = European Chemical Agency
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration

$$Total\ Intake = \frac{EPC \times IR \times EF \times ED}{BW \times ED\ x\ 365\ ^{days}/_{year}}$$

$$Hazard\ Quotient = \frac{Total\ Intake\ \left(\frac{mg}{kg-day}\right)}{TRV\ \left(\frac{mg}{kg-day}\right)}$$

IR = ingestion rate
mg/kg/day = milligrams per kilograms per day
mg/L = milligrams per litre
NA = not available/applicable
TRV = toxicity reference value
1 - EPC is average concentration presented in Attachment A. If constituent was not detected, 1/2 the detection limit was used to calculate the average.

# Attachment C Terrestrial Risk Assessment – Carpentaria 5HFlowback Water

**Table C-1**
**Summary of Terrestrial Tier 1 Screening Evaluation**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| Analyte grouping/Analyte | CAS Number | Maximum Detected Concentration in Water (mg/L) | Maximum Calculated Concentration in Soil (mg/kg) | Soil Screening Level (mg/kg) | Note | Maximum Concentration/ Soil Screening Level Ratio | Median Detected Concentration in Water (mg/L) | Median Calculated Concentration in Soil (mg/kg)* | Soil Screening Level (mg/kg) | Note | Median Concentration/ Soil Screening Level Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| >C10 - C16 Fraction | | 20.7 | 1.2E+00 | 120 | 1 | 0.01 | 0.33 | 2.0E-02 | 120 | 1 | 0.00016 |
| >C10 - C16 Fraction minus Naphthalene (F2) | C6_C10-Naph | 20.7 | 1.2E+00 | 120 | 1 | 0.01 | 0.33 | 2.0E-02 | 120 | 1 | 0.00016 |
| >C16 - C34 Fraction | C6_C34 | 0.39 | 2.3E-02 | 300 | 1 | 0.000077 | 0.16 | 9.5E-03 | 300 | 1 | 3.2E-05 |
| 2.4-Dimethylphenol | 105-67-9 | 0.001 | 5.9E-05 | NV | | NA | 0.001 | 5.9E-05 | NV | | NA |
| 2-Methylphenol | 95-48-7 | 0.0013 | 7.7E-05 | 0.1 | 15 | 0.00077 | 0.0013 | 7.7E-05 | 0.1 | 15 | 0.00077 |
| 3- & 4-Methylphenol | 1319-77-3 | 0.0131 | 7.8E-04 | 0.08 | 15 | 0.0097 | 0.0049 | 2.9E-04 | 0.08 | 15 | 0.0036 |
| Ammonia as N | 7664-41-7 | 79 | 4.7E+00 | NV | | NA | 61.7 | 3.7E+00 | NV | | NA |
| Antimony | 7440-36-0 | 0.018 | 1.1E-03 | 0.27 | 2 | 0.004 | 0.0155 | 9.2E-04 | 0.27 | 2 | 0.0034 |
| Arsenic | 7440-38-2 | 0.037 | 2.2E-03 | 40 | 3 | 0.000055 | 0.022 | 1.3E-03 | 40 | 3 | 0.000033 |
| Barium | 7440-39-3 | 2310 | 1.4E+02 | 820 | 4 | 0.17 | 1170 | 6.9E+01 | 820 | 4 | 0.085 |
| Benzene | 71-43-2 | 0.067 | 4.0E-03 | 0.12 | 15 | 0.033 | 0.04 | 2.4E-03 | 0.12 | 15 | 0.02 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 198 | 1.2E+01 | NV | | NA | 138 | 8.2E+00 | NV | | NA |
| Boron | 7440-42-8 | 8.75 | 5.2E-01 | 5.7 | 5 | 0.091 | 7.38 | 4.4E-01 | 5.7 | 5 | 0.077 |
| Bromide | 24959-67-9 | 1630 | 9.7E+01 | 50 | 6 | **1.9** | 1280 | 7.6E+01 | 50 | 6 | **1.5** |
| C10 - C14 Fraction | | 14 | 8.3E-01 | NV | | NA | 0.27 | 1.6E-02 | NV | | NA |
| C10 - C36 Fraction (sum) | | 20.8 | 1.2E+00 | NV | | NA | 0.5 | 3.0E-02 | NV | | NA |
| C15 - C28 Fraction | | 6.83 | 4.0E-01 | NV | | NA | 0.19 | 1.1E-02 | NV | | NA |
| C29 - C36 Fraction | | 0.08 | 4.7E-03 | NV | | NA | 0.08 | 4.7E-03 | NV | | NA |
| C6 - C10 Fraction | C6_C10 | 0.14 | 8.3E-03 | NV | | NA | 0.095 | 5.6E-03 | NV | | NA |
| C6 - C10 Fraction minus BTEX (F1) | C6_C10-BTEX | 0.03 | 1.8E-03 | 180 | 1 | 0.0000099 | 0.025 | 1.5E-03 | 180 | 1 | 0.0000082 |
| C6 - C9 Fraction | | 0.13 | 7.7E-03 | NV | | NA | 0.095 | 5.6E-03 | NV | | NA |
| Cadmium | 7440-43-9 | 0.0018 | 1.1E-04 | 0.36 | 2 | 0.0003 | 0.0015 | 8.9E-05 | 0.36 | 2 | 0.00025 |
| Calcium | 7440-70-2 | 18900 | 1.1E+03 | NV | | NA | 13500 | 8.0E+02 | NV | | NA |
| Chloride | 16887-00-6 | 85300 | 5.1E+03 | NV | | NA | 76500 | 4.5E+03 | NV | | NA |
| Chromium | 7440-47-3 | 0.075 | 4.4E-03 | 100 | 7 | 0.000044 | 0.029 | 1.7E-03 | 100 | 7 | 0.000017 |
| Combined Chlorine | | 0.4 | 2.4E-02 | NV | | NA | 0.3 | 1.8E-02 | NV | | NA |
| Copper | 7440-50-8 | 0.035 | 2.1E-03 | 20 | 8 | 0.0001 | 0.0235 | 1.4E-03 | 20 | 8 | 0.00007 |
| Dichloroamine | 3400-09-7 | 0.2 | 1.2E-02 | NV | | NA | 0.2 | 1.2E-02 | NV | | NA |
| Ethane | 74-84-0 | 0.724 | 4.3E-02 | NV | | NA | 0.654 | 3.9E-02 | NV | | NA |
| Ethylbenzene | 100-41-4 | 0.002 | 1.2E-04 | 0.27 | 15 | 0.00044 | 0.002 | 1.2E-04 | 0.27 | 15 | 0.00044 |
| Fluoride | 16984-48-8 | 0.7 | 4.1E-02 | 120 | 4 | 0.00035 | 0.5 | 3.0E-02 | 120 | 4 | 0.00025 |
| Formaldehyde | 50-00-0 | 25.7 | 1.5E+00 | NV | | NA | 19.4 | 1.1E+00 | NV | | NA |
| Gross alpha | gross_alpha | 309 | 1.8E+01 | NV | | NA | 191 | 1.1E+01 | NV | | NA |
| Gross beta activity - 40K | gross_beta | 88.6 | 5.3E+00 | NV | | NA | 56.2 | 3.3E+00 | NV | | NA |
| Iron | 7439-89-6 | 120 | 7.1E+00 | 19566 | 9 | 0.00036 | 103 | 6.1E+00 | 19566 | 9 | 0.00031 |
| Lead | 7439-92-1 | 0.029 | 1.7E-03 | 470 | 14 | 0.0000037 | 0.025 | 1.5E-03 | 470 | 14 | 0.0000032 |
| Magnesium | 7439-95-4 | 3000 | 1.8E+02 | 1469 | 9 | 0.12 | 2590 | 1.5E+02 | 1469 | 9 | 0.1 |
| Manganese | 7439-96-5 | 25.2 | 1.5E+00 | 4300 | 10 | 0.00035 | 22.2 | 1.3E+00 | 4300 | 10 | 0.00031 |
| meta- & para-Xylene | 108-38-3 106-42-3 | 0.008 | 4.7E-04 | 0.1 | 15 | 0.0047 | 0.006 | 3.6E-04 | 0.1 | 15 | 0.0036 |
| Methane | 74-82-8 | 4.06 | 2.4E-01 | NV | | NA | 1.7 | 1.0E-01 | NV | | NA |
| Molybdenum | 7439-98-7 | 0.06 | 3.6E-03 | 9.9 | 11 | 0.00036 | 0.044 | 2.6E-03 | 9.9 | 11 | 0.00026 |
| Monochloramine | 10599-90-3 | 0.4 | 2.4E-02 | NV | | NA | 0.4 | 2.4E-02 | NV | | NA |

**Table C-1**
**Summary of Terrestrial Tier 1 Screening Evaluation**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| Analyte grouping/Analyte | CAS Number | Maximum Detected Concentration in Water (mg/L) | Maximum Calculated Concentration in Soil (mg/kg) | Soil Screening Level (mg/kg) | Note | Maximum Concentration/ Soil Screening Level Ratio | Median Detected Concentration in Water (mg/L) | Median Calculated Concentration in Soil (mg/kg)* | Soil Screening Level (mg/kg) | Note | Median Concentration/ Soil Screening Level Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nickel | 7440-02-0 | 0.035 | 2.1E-03 | 5 | 12 | 0.00041 | 0.022 | 1.3E-03 | 5 | 12 | 0.00026 |
| Nitrate as N | 14797-55-8 | 0.46 | 2.7E-02 | NV | | NA | 0.04 | 2.4E-03 | NV | | NA |
| Nitrite + Nitrate as N | | 0.46 | 2.7E-02 | NV | | NA | 0.04 | 2.4E-03 | NV | | NA |
| ortho-Xylene | 95-47-6 | 0.003 | 1.8E-04 | 0.1 | 15 | 0.0018 | 0.002 | 1.2E-04 | 0.1 | 15 | 0.0012 |
| pH Value | | 6.53 | 3.9E-01 | NV | | NA | 6.31 | 3.7E-01 | NV | | NA |
| Phenol | 108-95-2 | 0.0054 | 3.2E-04 | 0.79 | 16 | 0.00041 | 0.0025 | 1.5E-04 | 0.79 | 16 | 0.00019 |
| Potassium | 7440-09-7 | 242 | 1.4E+01 | NV | | NA | 224 | 1.3E+01 | NV | | NA |
| Propane | 74-98-6 | 0.068 | 4.0E-03 | NV | | NA | 0.0575 | 3.4E-03 | NV | | NA |
| Reactive Phosphorus as P | 14265-44-2 | 8.69 | 5.1E-01 | NV | | NA | 1.77 | 1.0E-01 | NV | | NA |
| Silica | 7631-86-9 | 65.5 | 3.9E+00 | NV | | NA | 41.5 | 2.5E+00 | NV | | NA |
| Sodium | 7440-23-5 | 37500 | 2.2E+03 | NV | | NA | 31200 | 1.8E+03 | NV | | NA |
| Sodium Adsorption Ratio | | 66.8 | 4.0E+00 | NV | | NA | 58.8 | 3.5E+00 | NV | | NA |
| Strontium | 7440-24-6 | 1330 | 7.9E+01 | 95 | 3 | 0.83 | 768 | 4.6E+01 | 95 | 3 | 0.48 |
| Suspended Solids (SS) | | 137 | 8.1E+00 | NV | | NA | 81 | 4.8E+00 | NV | | NA |
| Tin | 7440-31-5 | 0.021 | 1.2E-03 | 7.62 | 4 | 0.00016 | 0.021 | 1.2E-03 | 7.62 | 4 | 0.00016 |
| Toluene | 108-88-3 | 0.04 | 2.4E-03 | 0.15 | 15 | 0.016 | 0.022 | 1.3E-03 | 0.15 | 15 | 0.0087 |
| Total Alkalinity as CaCO3 | | 198 | 1.2E+01 | NV | | NA | 138 | 8.2E+00 | NV | | NA |
| Total Anions | | 2410 | 1.4E+02 | NV | | NA | 2160 | 1.3E+02 | NV | | NA |
| Total Carbon | TC | 116 | 6.9E+00 | NV | | NA | 82 | 4.9E+00 | NV | | NA |
| Total Cations | | 2840 | 1.7E+02 | NV | | NA | 2120 | 1.3E+02 | NV | | NA |
| Total Cyanide | 57-12-5 | 0.008 | 4.7E-04 | NV | | NA | 0.008 | 4.7E-04 | NV | | NA |
| Total Dissolved Solids @180°C | | 160000 | 9.5E+03 | NV | | NA | 130000 | 7.7E+03 | NV | | NA |
| Total Inorganic Carbon | | 54 | 3.2E+00 | NV | | NA | 35 | 2.1E+00 | NV | | NA |
| Total Kjeldahl Nitrogen as N | TKN | 76.9 | 4.6E+00 | NV | | NA | 64.8 | 3.8E+00 | NV | | NA |
| Total Organic Carbon | | 65 | 3.9E+00 | NV | | NA | 48 | 2.8E+00 | NV | | NA |
| Total Phosphorus as P | TP | 8.74 | 5.2E-01 | NV | | NA | 2.8 | 1.7E-01 | NV | | NA |
| Total Residual Chlorine | | 0.4 | 2.4E-02 | NV | | NA | 0.3 | 1.8E-02 | NV | | NA |
| Zinc | 7440-66-6 | 1.12 | 6.6E-02 | 15 | 13 | 0.0044 | 0.963 | 5.7E-02 | 15 | 13 | 0.0038 |

**Table C-1**
**Summary of Terrestrial Tier 1 Screening Evaluation**
**Carpentaria 5H Flowback Water Assessment**
**InGauge**

| Analyte grouping/Analyte | CAS Number | Maximum Detected Concentration in Water (mg/L) | Maximum Calculated Concentration in Soil (mg/kg) | Soil Screening Level (mg/kg) | Note | Maximum Concentration/ Soil Screening Level Ratio | Median Detected Concentration in Water (mg/L) | Median Calculated Concentration in Soil (mg/kg)* | Soil Screening Level (mg/kg) | Note | Median Concentration/ Soil Screening Level Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Notes:**

ACL = Added contaminant limits
As = Arsenic
BTEX = Benzene, Toluene, Ethylbenzene, and Xylene
CEC = Cation Exchange Capacity
Cu = Copper
D = dissolved
DDT = dichlorodiphenyltrichloroethane
ECHA = European Chemical Agency
EIL = Ecological Investigation Level
ESL = Ecological Screening Level
HQ = hazard quotient
mg/kg = milligrams per kilogram
mg/L = milligrams per litre
N = null
NEPM = National Environment Protection Measures
NOAEL = no-observed-adverse=effect-level
NV = No readily available screening criterion
PNEC = predicted no effect concentration
T = total
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
USEPA = United States Environmental Protection Agency

1 = NEPM. 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination)Measure April 2011. Table 1B(6) Schedule B (1) - ESLs for TPH fractions F1 – F4, BTEX and benzo(a)pyrene in soil Urban residential and public open spaces.
2 = USEPA 2018. Region 4 Ecological Risk Assessment Supplemental Guidance. Table 3 Region 4 Soil Screening Values for Hazardous Waste Sites Value for mammalian species
3 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination)Measure April 2011 Table 1B(5)Table 1B(6) Schedule B (1) - Generic EILs for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physicochemical properties.
4 = USEPA 2018. Region 4 Ecological Risk Assessment Supplemental Guidance. Table 3 Region 4 Soil Screening Values for Hazardous Waste Sites Value for avian species.
6 = ECHA 2020. Boron Predicted no effect concentration (PNEC) in soil for terrestrial species. https://echa.europa.eu/brief-profile/-/briefprofile/100.028.319
5 = ECHA 2020. NOAEL as concentration in food source for Wistar Han rat
6 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Table 1B(3) Schedule B (1) Soil-specific added contaminant limits for aged chromium III and nickel in soil. Areas of ecological significance.
7 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B (1) Table 1B(2) ACL for aged Cu at pH 4.5 and CEC 5.
8 = Background threshold value based on 95 percent upper confidence limit (UCL) of mean for McArther Basin surficial soils. Note, UCL of the mean represents a central tendency and is a conservative value to use for comparison.
9 = USEPA 2007. Ecological Soil Screening Levels for Manganese Interim Final OSWER Directive 9285.7-71. Table 2.1-Avian Wildlife Manganese Eco-SSLs (mg/kg dry weight in soil).
10 = ECHA 2020. Molybdenum predicted no effect concentration (PNEC) in soil for terrestrial species. Hazard for Terrestrial
11 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Table 1B(3) Soil-specific added contaminant limits for aged chromium III and nickel in soil. Areas of ecological significance Schedule B (1)
12 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B (1), Table 1B(3) Soil-specific added contaminant limits for aged chromium III and nickel in soil. Areas of ecological significance
13 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B (1), Table 1B(1) Soil-specific added contaminant limits for aged zinc in soil at pH 4 and CEC 5.
14 = NEPM 2011. Guideline on Investigation Levels for Soil and Groundwater. National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B (1) Table 1B(4) Generic added contaminant limits for lead in soils irrespective of their physicochemical properties. Areas of ecological significance.
15 = USEPA 2018. Region 4 Ecological Risk Assessment Supplemental Guidance. Table 3 Region 4 Soil Screening Values for Hazardous Waste Sites Value for soil invertebrates.
16 = USEPA 2018. Region 4 Ecological Risk Assessment Supplemental Guidance. Table 3 Region 4 Soil Screening Values for Hazardous Waste Sites Value