

# Onshore Petroleum Activity – NT EPA Advice

## ENVIRONMENT MANAGEMENT PLAN (EMP) – SANTOS QNT PTY LTD, REVISED EMP FOR THE MCARTHUR BASIN HYDRAULIC FRACTURING PROGRAM NT EXPLORATION PERMIT (EP) 161 (STO3-8)

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### BACKGROUND

The Minister for Environment has formally requested under section 29B of the *Northern Territory Environment Protection Authority Act 2012* (NT EPA Act) that the Northern Territory Environment Protection Authority (NT EPA) provide advice on all Environment Management Plans (EMPs) received under the Petroleum (Environment) Regulations 2016 (NT) (the Regulations).

That advice must include a recommendation on whether the EMP should be approved or not, supported by a detailed justification that considers:

- whether the EMP is appropriate for the nature and scale of the regulated activity to which the EMP relates (regulation 9(1)(b));
- whether the EMP demonstrates that the activity will be carried out in a manner by which the environmental impacts and environmental risks of the activity will be reduced to a level that is as low as reasonable practicable and acceptable (regulation 9(1)(c));
- the principles of ecologically sustainable development (regulation 9(2)(a)); and
- any relevant matters raised through the public submission process.

In providing that advice, the NT EPA Act provides that the NT EPA may also have regard to any other matters it considers relevant.

### ACTIVITY

Subject	Description
Interest holder	Santos QNT Pty Ltd
Petroleum interest(s)	Exploration Permit 161 (EP161)
Environment Management Plan (EMP) title	Environment Management Plan McArthur Basin Hydraulic Fracturing Program NT Exploration Permit (EP) 161
EMP document reference	STO3-8
Regulated activity	<p>This revised EMP covers the program of work for the hydraulic fracturing, flowback and appraisal testing for five wells on two locations (Inacumba and Tanumbirini) within EP161, located in the McArthur Basin, approximately 350 km south-east of Katherine, NT. In addition to the 3 wells previously approved, the revised EMP proposes the hydraulic fracture stimulation, and flowback and appraisal testing of one additional well at each of the Inacumba and Tanumbirini well sites.</p> <p>The specific activities proposed are as follows:</p> <ul style="list-style-type: none"> <li>• Fracture stimulation preparation activities including cement bond logging, drifting and pressure testing;</li> <li>• Fracture stimulation and evaluation;</li> <li>• Pressure monitoring;</li> <li>• Placement of chemical tracers;</li> <li>• Walkaway vertical seismic profiling;</li> </ul>

	<ul style="list-style-type: none"> <li>• Microseismic monitoring;</li> <li>• Flowback fluid recovery and well testing;</li> <li>• Installing appraisal (production) testing tubing;</li> <li>• Suspension and build-up testing; and</li> <li>• Well appraisal testing.</li> </ul> <p>The revised EMP does not include civils and seismic or drilling activities, approved under separate EMPs and remain active.</p>
Public consultation	Public consultation on the revised EMP required under regulation 8A(1)(b) was undertaken from 9 June 2021 to 7 July 2021.

## NT EPA ADVICE

### 1. Is the EMP appropriate for the nature and scale of the regulated activity (regulation 9(1)(b))

Information relating to the nature and scale of the regulated activity is provided in the revised EMP in a clear format. The technical works program includes hydraulic fracturing, flowback and appraisal testing of five wells on two locations (Inacumba and Tanumbirini) within EP161. The future scope of works is scheduled to take place from 2021 to 2025. Hydraulic fracturing (HF) at Tanumbirini-1 was done in October 2019. On completion of well evaluation (long term build up test of hydrocarbon flows), the wells will either be suspended for future re-entry, or decommissioned with permanent cement plugs. This will be done in accordance with the requirements outlined in the Code of Practice: Onshore Petroleum Activities in the Northern Territory (the Code). Decommissioning and rehabilitation works sits within the previously approved Civil and Seismic Program EMP (approved 12 June 2019) and the McArthur Basin Drilling Program EP161 EMP (STO2-7, 21 February 2021).

Table 1 provides an overview of the key components of the regulated activity previously approved within EP161, and proposed new activities under this EMP (STO3-8).

Table 1: Key components of previously approved activities and 2021-2025 Work Program EMP (STO3-8).

Component	Previously Approved Activities in EP161	Proposed New Activities in Revised McArthur Basin HF Program NT EP161
<b>Petroleum wells to undergo hydraulic fracturing (HF)</b>	<ul style="list-style-type: none"> <li>• Inacumba-1/1H</li> <li>• Tanumbirini-1</li> <li>• Tanumbirini-2H</li> </ul>	<ul style="list-style-type: none"> <li>• Inacumba-2H</li> <li>• Tanumbirini-3H</li> </ul>
<b>Duration</b>	<ul style="list-style-type: none"> <li>• DFIT Tanumbirini-1 (11 weeks, Jun 2019)</li> <li>• Hydraulic fracture stimulation (8 weeks, Nov 2019)</li> <li>• Well testing (12 weeks, Dec 2019)</li> <li>• Well evaluation (36-52 weeks, Dec 2019)</li> <li>• Well suspension/abandonment (4 weeks)</li> <li>• Rehabilitation post well suspension (1-2 weeks)</li> <li>• Rehabilitation post decommissioning (2-4 weeks)</li> <li>• Post-rehabilitation monitoring (2 weeks per event)</li> </ul>	<ul style="list-style-type: none"> <li>• Hydraulic fracture stimulation (3-4 weeks, Oct 2021 (Tanumbirini) and Sep 2022 (Inacumba))</li> <li>• Well completion (2 weeks, Nov 2021 (Tanumbirini), Dec 2022 (Inacumba))</li> <li>• Production testing (90-300 days, Nov 2021 (Tanumbirini), Dec 2022 (Inacumba)).</li> <li>• Well surveillance (2 years)</li> </ul>
<b>AAPA Authority Certificate</b>	C2019/043, issued 13 May 2019 (variation to C2014/053)	C2019/043, issued 13 December 2019 (a minor amendment was made by AAPA to the certificate and reissued on 13 December 2019).
<b>Water licences</b>	<ul style="list-style-type: none"> <li>• <b>GRF10280 (Gum Ridge Formation)</b> 193.5 ML/year</li> <li>• <b>U10335 (Inacumba Unit)</b> 195 ML/year</li> </ul>	No change
<b>Groundwater monitoring bores</b>	<ul style="list-style-type: none"> <li>• RN040930 (Tanumbirini, Control)</li> <li>• RN040936 (Tanumbirini, Impact)</li> <li>• RN041242 (Inacumba, Control)</li> </ul>	No change

Component	Previously Approved Activities in EP161	Proposed New Activities in Revised McArthur Basin HF Program NT EP161	
	<ul style="list-style-type: none"> <li>RN041243 (Inacumba, Impact)</li> </ul>		
Estimated groundwater required (total ML)	<b>EMP</b>	<b>ML</b>	
	McArthur Basin Civils and Seismic Program (STO1)	45.5	Future HF scope water use: 175.5 ML
	McArthur Basin Drilling Program (STO2-7)	40	Historic HF scope water use: 8 ML
	McArthur Basin Hydraulic Fracturing Program (STO3)	85.2	Total HF scope (STO3): 183.5 ML
	<b>Total:</b>	170.7	
Land clearing (ha)	McArthur Basin Civils and Seismic Program (STO1): 59.2 ha	No change. Proposed activities are conducted on existing cleared well pads and no further land clearing is required.	
Workforce	Peak workforce ~35-65	No change.	
Accommodation camp	Camp provides for 116 people at each location.	No change.	
Traffic – vehicle movements	<ul style="list-style-type: none"> <li>Food (0.5 truck per week)</li> <li>Waste removal (1 truck per week)</li> <li>Potable water (2 truck per week)</li> <li>Fuel (1 truck per week)</li> <li>HF spread (30-50 trucks per well)</li> <li>Material delivery (40-60 trucks per well)</li> </ul>	Material delivery for two additional wells (40-60 trucks per well)	
Flowback/wastewater produced (predicted) (ML)	5-20 ML per well.	10-20 ML per well.	
Greenhouse gas emissions (tCO <sub>2</sub> -e)	<b>EMP</b>	<b>tCO<sub>2</sub>-e</b>	2 scenarios for the HF scope (STO3):
	McArthur Basin Civils and Seismic Program (STO1)	11,714	<u>90 days extended production testing:</u>
	McArthur Basin Drilling Program (STO2-7)	5,206	Total: 102,018 tCO <sub>2</sub> -e Max. per financial year: 55,537 tCO <sub>2</sub> -e
	McArthur Basin Hydraulic Fracturing Program (STO3)	130,853	<u>300 days extended production testing:</u>
	<b>Total:</b>	145,325	Total: 241,735 tCO <sub>2</sub> -e Max. per financial year: 89,216 tCO <sub>2</sub> -e

### 1.1. Activity scope and duration

The EMP clearly describes the scope of the activity and its duration. The regulated activity is expected start at Tanumbirini (2021-2024) and then move to Inacumba (2022-2025). Initial activities will focus on hydraulic fracturing preparation activities, including cement bond logging, drifting and pressure testing. Seismic monitoring devices will be installed to assist in analysing the fractures. The Tanumbirini-2H well will have 10 hydraulic fracturing stages, the Tanumbirini-3H will have 16 stages, and the Inacumba wells will have up to 25 stages. A 90-300 day period of extended production testing (EPT) will follow. Once this has been completed, the well is suspended for build-up testing for a period of two years. Upon completion of this testing, the wells are suspended and/or plugged and abandoned, and rehabilitated as addressed and approved under the Revised McArthur Basin Drilling Program (STO2-7, 21 February 2021).

In preparation of hydraulic fracturing, the well integrity will be assessed. A cement bond log (CBL) will be developed through the use of an acoustic device that measures the properties of the cement sheath and the quality of the cement bond between the casing and the formation (casing with no or poor quality cement will return a large amplitude acoustic signal vs. a low amplitude for good cement, as

good cement absorbs the acoustic signal). The pressure control systems are equipped with programmable pressure triggers that can individually shut down high pressure pumping units. This safety control ensures the wells are not exposed to pressures above their design specifications.

A walkaway vertical seismic profile (VSP) will be created to determine the velocity distribution of the formation. This is a calibration exercise to assist subsequent modelling of the fractures. The mobile seismic source will move across the 10km seismic track used and approved under the McArthur Basin Civil and Seismic Program (STO1, 6 June 2019). Based on the recordings from the geophone array, triangulation can be used to determine the location of the fracturing events and gain an insight in the direction and dimension (height and length) of the fractures.

Figure 1 below shows the location of the proposed wells in the Beetaloo Sub-basin. Tanumbirini-1 is a vertical well that has already undergone hydraulic fracturing in October 2019. Tanumbirini-2H and 3H are both horizontal wells. Similarly, Inacumba has 1 vertical well (Inacumba-1) and 2 horizontal wells (1H and 2H).

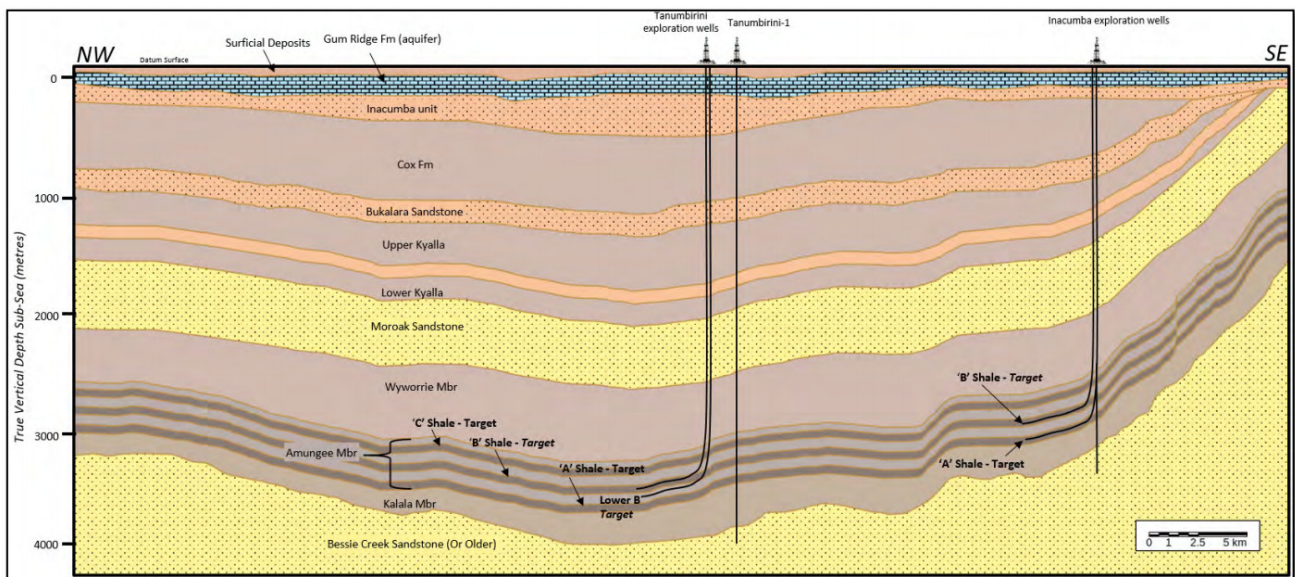


Figure 1, Illustrative section through the Beetaloo Sub-basin showing proposed Velkerri target intervals at the Tanumbirini and Inacumba locations (relative to the deepest aquifer).

Hydraulic fracturing (HF) will involve up to 25 fracturing stages using the plug and perforation technique. 32-40 ML of water will be used per well for the HF. Sand will be added to the water to keep fractures open once the pressure is released, and accounts for 5-9% of the water mixture going down the well. Chemicals will also be added and account for less than 1% of the mixture. The chemicals assist with viscosity, friction, corrosion, surface tension and controlling algae and bacteria. They do not contain benzene, toluene, ethylbenzene or xylene (BTEX). The volume and concentration of chemicals have been identified and a detailed risk assessment has been undertaken. The two tier risk assessment included the full cycle of chemical use (transportation, use and storage) and concluded there are no unacceptable risks to human and ecological receptors associated with the use of these chemicals.

Upon completion of HF, flowback activities start. Fracturing fluids will be produced while the plugs in the well are removed over a period of 1-2 weeks. The volume of fluid that is returned varies per well. Tanumbirini-1 had a return of approximately 40% of what was pumped into the impermeable shale. Flowback fluid is run through a three-phase separator, which segregates hydrocarbons and water. After separation, water is sent to flowback fluid storage tanks, gas is sent through a flare stack where it is flared and liquid hydrocarbon (oil/condensate) is stored in onsite storage tanks. An oil vacuum truck or equivalent is traditionally used for the transport and disposal of condensate. All gas, water and condensate flow volumes will be measured and recorded.

It is anticipated that each well produces a maximum of 20 ML of flowback fluid. Results of testing of the Tanumbirini-1 flowback fluid showed that (1) the chemicals used in the HF process are degradable

or ionisable to the analytical suite included in the Code; (2) hypothetical spills from the wastewater would not result in exceedance of conservative screening criteria protective of terrestrial receptors; and (3) there is no unacceptable risk to potential avian receptors should they be exposed to the wastewater<sup>1</sup>. Similar results are expected for the flowback fluid from the other wells.

Flowback is stored in enclosed tanks and treated (evaporation) in open tanks. A water-balance is provided that shows the anticipated flowback water quantities present at each site over time, and the associated required enclosed storage capacity. Based on this water-balance, the enclosed tank storage capacity will be 18.8 ML at Tanumbirini (3 covered ponds) and 32.4 ML at Inacumba (5 covered ponds), and the open tank capacity will be approximately 6 ML at each site. The risk of overtopping will be managed by maintaining freeboard (1,500 mm in wet season, 300 mm in dry season) and transferring water to the enclosed storage tank in the event of a predicted significant rainfall event. The tank pad has a low permeability and is bunded to contain the volume of the largest tank (13 ML), minimising any risks associated with spills or a failure of a tank. After treatment, the residual water will be transported to a licensed interstate disposal facility.

The flare stack used at each location is capable of withstanding three second wind gusts of up to 100 km/h. Distance to vegetation is 30 metres and vegetation will not be exposed to radiant heat exceeding 6.31 kW/m<sup>2</sup>. Mitigation measures are in place to minimise the risk of fire, including firebreaks, firefighting equipment and restricted smoking requirements. Bushfire alerts are actively monitored and communicated through daily toolbox meetings.

If the well produces a continuous flow of hydrocarbons, it will be tested for 90-300 days, followed by a build-up test (through suspension of the well) of 2 years. The flare system has a >99% combustion efficiency. During suspension, pressures on the well will be continuously monitored to confirm well integrity.

Both locations are equipped with a camp. The camps have their own sewage treatment plant and treated water will be dispersed via drainage away from the camp to a designated irrigation area in accordance with the approval issued by the Department of Health. The irrigation areas will be fenced to exclude livestock access. The camps will be managed in compliance with the relevant health requirements of mining and construction camps.

The HF equipment requires 25-50 truck deliveries per location, material delivery requires 40-60 truck deliveries per well, and general operations (food, rubbish, water, fuel) require a weekly movement of 6 trucks. The 1,400 metre airstrip adjacent to the Tanumbirini Homestead will be used for crew changes and emergency response evacuations. The peak workforce is 35-65 employees, with an estimated local employment rate of 10-20%.

The water use for the proposed future activities totals 175.5 ML. This is 98.3 ML more than the previous (approved) version of this EMP. The cumulative water use for EP161 is 269 ML. The water is sourced through two water licences: (1) 193 ML/year from the Gum Ridge Formation and (2) 195 ML/year from the Inacumba Unit. Both aquifers are being monitored through a control and impact bore at each location.

Greenhouse gas (GHG) emissions were estimated using tools developed for the National Greenhouse and Energy Reporting Scheme. Transport and fuel combustion will contribute 6 tCO<sub>2</sub>-e, diesel combustion for HF 499 tCO<sub>2</sub>-e and well completions 545 tCO<sub>2</sub>-e. Flaring emissions have been provided for two scenarios: 90 days (100,968 tCO<sub>2</sub>-e) and 300 days (240,685 tCO<sub>2</sub>-e). The actual emissions are likely somewhere in between these two scenarios, and depend on the days of flaring required for each well and the flaring rate.

All proposed activities are permitted within the C2019/043 AAPA Authority Certificate, issued on 13 December 2019. Stakeholder engagement has been and will be ongoing. The Northern Land Council (NLC) was engaged and Santos has an executed Co-Operation and Exploration Agreement in place with NLC and Native Title Parties. A community consultation was undertaken in April 2021 with presence of NLC and Native Title Parties.

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<sup>1</sup> [santos-waste-water-risk-assessment.pdf](#)

## **1.2. General compliance with Code**

The EMP demonstrates how the interest holder will comply with the relevant requirements of the Code in undertaking this regulated activity. This includes the acceptance of an updated Well Operations Management Plan (WOMP) by the Department of Industry, Tourism and Trade (DITT) prior to commencement of hydraulic fracturing. The risk assessment in Table 6-1 of the EMP cross-references relevant sections of the Code that apply to the mitigation and management measures to enable the reviewer to identify and confirm that the proposed regulated activity complies with the Code. The EMP also provides the following plans, which are compliant with the Code:

- Chemical risk assessment of chemicals to be used in the HF activity;
- Wastewater Management Plan;
- Spill Management Plan;
- Emergency Response Plan;
- Weed Management Plan;
- Fire Management Plan;
- Methane Emissions Management Plan; and
- Rehabilitation Management Plan.

Erosion and sediment control and rehabilitation of all ground disturbance are managed under the approved Civils and Seismic EMP. The level of detail and quality of information provided in the EMP is sufficient to inform the evaluation and assessment of potential environmental impacts and risks, and meets the EMP approval criteria under Regulation 9(1)(b). As a further precautionary step, the NT EPA has provided advice relating to Ministerial Conditions for this EMP contained at the end of this advice.

## **2. Principles of ecologically sustainable development (regulation 9(2)(a))**

### **2.1. Decision making principle (s 18 *Environment Protection Act 2019* (NT))**

The revised EMP adequately assesses the environmental impacts and risks associated with the regulated activity and outlines appropriate avoidance and mitigation measures. The regulated activity will increase activity intensity at each of the Inacumba and Tanumbirini well sites. HF will be done simultaneously for the wells on the same well pad. The HF will be done over a period of 2 years: one year per location. This minimises the potential disturbance and impact associated with the activities in this EMP. The outcomes of the regulated activity will continue to inform decision-making about longer-term petroleum activities in the McArthur Basin, in which lies the Beetaloo Sub-basin.

The impacts and risks associated with the HF program have been assessed in the EMP. Of the 34 risk identified, 25 are assessed as “negligible” (category 1) if carried out in accordance with the mitigations and controls proposed in the EMP. These controls have been assessed by NT Government agencies and deemed adequate. The remainder of the risks (category 2) are demonstrated to be ALARP and acceptable (refer to section 3).

Wastewater storage and treatment tanks are designed to comply with the Code to conservatively accommodate a 90 day 1:1000 year rainfall occurrence during the wet season. A minimum of 300 mm freeboard will be maintained in all open treatment tanks through the dry season, and a minimum of 1,500 mm throughout the wet season. A water-balance has been provided in the EMP for each location, which outlines the anticipated flowback water quantity over time, the expected evaporation of this water, and the number enclosed tanks required to store the flowback water. The water-balance demonstrates that the proposed enclosed water storage capacity at Tanumbirini (18.8 ML) and Inacumba (32.4 ML) is sufficient for the proposed activities.

As required by the regulations, the interest holder has demonstrated ongoing stakeholder engagement in the revised EMP with identified, directly-affected stakeholders. The revised EMP was also made available for public comments (9 June 2021 to 7 July 2021).

## **2.2. Precautionary principle (s 19 *Environment Protection Act 2019* (NT))**

The NT EPA considers there is a low threat of serious or irreversible damage from the regulated activity. The interest holder's investigations into the physical, biological and cultural environment provide a satisfactory scientific basis to assess potential environmental impacts and risks, and to identify measures to avoid or minimise those impacts and risks and address scientific uncertainty.

The risk assessment clearly demonstrates consideration of risk events in the context of the environment in which the regulated activity is conducted and its particular values and sensitivities, and the spatial extent and duration of the potential impact. Uncertainty in relation to the environmental features was assessed, with no areas of environmental uncertainty identified. The revised EMP outlines the interest holder's investigations into the physical, biological and cultural environment and demonstrates a sound understanding of the environment at the location, providing a satisfactory scientific basis to assess potential environmental impacts and risks for the activity, and to identify measures to avoid or minimise those impacts and risks.

A geohazard assessment has been performed to identify subsurface hazards that could pose an environmental risk during the HF program. The seismic sections have been reviewed and no major geohazards or faults have been identified at the proposed locations. The risks associated with conducting the regulated activity over the wet season are well understood and described. The risk assessment and wastewater and spill management plans demonstrate that the proposed activities implement best practice management measures for exploration activities. All flowback fluid will be transferred to enclosed tanks 8 hours before a forecast significant rainfall event. Open treatment tanks have enough freeboard to accommodate a 90 day, 1:1000 years rainfall event. Freeboard levels are monitored daily to ensure the required levels are adhered to. Transportation of wastewater or chemicals on unsealed roads without a prior risk assessment is avoided. The interest holder will use helicopters to transport personnel when access is restricted.

There are internationally recognised standards and established management measures in well design, hydraulic fracturing and well integrity monitoring to ensure aquifer protection. These are reflected in the mandatory requirements of the Code, which the interest holder has committed to comply with.

The NT EPA is of the view that the precautionary principle has been considered in assessing the regulated activity and has not been triggered due to the low threat of serious or irreversible damage occurring and the presence of a satisfactory scientific basis to assess potential impacts and risks. In addition, the existing environmental monitoring commitments contained in the EMP are compliant with the Code and provide measurable performance measures to ensure that the environmental outcomes are met. As a precautionary step the NT EPA has recommended the Minister applies an approval condition in relation to groundwater level/pressure monitoring prior, during and after completion of HF.

## **2.3. Principle of evidence-based decision-making (S 20 *Environment Protection Act 2019* (NT))**

The EMP includes a detailed risk assessment related to transport, storage and use of chemicals. It includes an assessment of potential impacts to human receptors and avian fauna interacting with open treatment tanks. The assessment concludes that there is a low risk of environmental harm with implementation of the proposed management measures.

The information in the EMP indicates there are no potential exposure pathways from hydraulic fracturing chemicals to impact potable groundwater sources in proximity to the regulated activity. Environmental impact mitigations include:

- Physical vertical separation distances between the aquifer and target formation to prevent any migration of stimulation fluid to aquifers (>2,000 m);
- Approximately 1.5 km horizontal separation distance between the exploration well and the closest existing water supply bore used for domestic or stock consumption at Tanumbirini, and approximately 3 km horizontal separation distance at Inacumba.
- Use of double lined wastewater tanks with leak detection for flowback fluid storage and treatment;

- Use of conservative wet and dry season freeboard for wastewater treatment tanks;
- A secondary containment system for the wastewater storage tank, capable of containing the volume of the largest enclosed tank ( $\leq 13$  ML).

The EMP aligns with the requirements of the Code, including tracking of water use, and wastewater generation and movement. The NT EPA has assessed the potential for spills from chemicals and hydrocarbons (e.g. diesel) stored in designated bunded areas at each location and concluded that the proposed management measures are satisfactory. The mitigations described in the EMP include bunding around chemical storage areas, containment of hydrocarbons in double-lined diesel storage tanks, and spill prevention and response procedures.

The proposed environmental outcomes are likely to be achieved based on the best available information on the nature and scale of the activity, and the environment in which the regulated activity will be conducted. The studies previously undertaken by the interest holder to inform the EMP affords the interest holder with a detailed and reliable knowledge of the potential environmental impacts and risks and the most appropriate measures for mitigation of those impacts and risks.

The NT EPA is of the view that the evidence-based decision-making principle has been considered in assessing the regulated activity and that in the circumstances, decisions can be based on best available evidence that is relevant and reliable. As a precautionary step the NT EPA has recommended a Ministerial condition for this activity relating to the recording of spills.

#### **2.4. Principle of intergenerational and intra-generational equity (S 21 *Environment Protection Act 2019* (NT))**

The potential environmental impacts and risks associated with the regulated activity can be adequately avoided or managed through the management measures and ongoing monitoring programs proposed in the EMP.

Protection of cultural interests is achieved through compliance with the requirements of Authority Certificates issued by the Aboriginal Areas Protection Authority under the *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) and the previously completed archaeological assessment at the site to avoid archaeological heritage impacts.

Previously approved EMPs relating to EP161 commit the interest holder to progressive rehabilitation throughout the life of the activity which, combined with the Code requirements, is considered to reduce the risks to biodiversity and soil contamination to ALARP and acceptable levels.

The total emissions for the scope of the EMP are 102,018 tCO<sub>2</sub>-e (90 days EPT) to 241,735 tCO<sub>2</sub>-e (300 days EPT) which includes transport, diesel combustion, well completions and flaring. The maximum emissions per financial year are 89,216 tCO<sub>2</sub>-e, which is expected to occur in the 2021-2022 financial year. The NT EPA notes that the extended production testing (EPT) is a significant component (93.5%) of total cumulative emissions (118,938 for 90 days to 258,655 for 300 days tCO<sub>2</sub>-e) for the entire EP161 exploration program. The outcome of the EPT will be used to inform the future exploration program in the Beetaloo Sub-basin and help assess whether progressing to the next phase of appraisal is likely to be viable. In unconventional reservoirs, particularly in basins where there is virtually no data, production testing to build an understanding of the resource potential may be required for a longer timeframe than seen in conventional reservoirs, and with reservoirs that have more data available. This requires the EPT to be flexible, which is why the EMP proposes a timeframe of 90-300 days. The maximum yearly emissions of the scope of this EMP equates to 0.43% of the annual Northern Territory emissions reported 2019 (20.6 million tCO<sub>2</sub>-e).<sup>2</sup>

The NT EPA considers that the environmental values will be protected in the short and long term from the activities outlined in the EMP and that the health, diversity and productivity of the environment will be maintained for the benefit of future generations.

<sup>2</sup> Source: DISER 2020. *State Greenhouse Gas Inventory*. <https://ageis.climatechange.gov.au/SGGI.aspx>.



## **2.5. Principle of sustainable use (S 22 Environment Protection Act 2019 (NT))**

Exploration is necessary to enable commercial appraisal of resources. In the absence of reliable data regarding the shale resource, exploration will take a number of years to complete so that the viability of the resource can be assessed prior production.

Cumulative impacts of groundwater extraction have been assessed. The interest holder has groundwater extraction licences GRF10280 and U10335, with a maximum water entitlement of 193.5 ML/year from the Gum Ridge Formation and 195 ML/year from the Inacumba Unit. The anticipated water demand for this regulated activity is 175.5 ML. The anticipated water use is less than the interest holder's maximum water entitlement. The Gum Ridge Formation licence represents 22.7% of the available 850 ML/year. The Inacumba Unit has an estimated capacity of 300 GL.

The NT EPA notes that the Government has committed to implementing all recommendations of the Hydraulic Fracturing Inquiry, including that the NT Government seeks to ensure there is no net increase in the lifecycle greenhouse gas emissions emitted in Australia from any onshore petroleum produced in the NT. To support the NT Government's commitment, the NT EPA has recommended the interest holder provide to DEPWS annual actual scope 1 and scope 2 greenhouse gas emissions reported under the National Greenhouse Energy Reporting Scheme (NGERS) versus predicted emissions in the EMP. The interest holder has also committed to reduce company-wide scope 1 & 2 emissions from 2019-20 levels by 26-30% by 2030 and targets a net-zero scope 1 and 2 emissions by 2040.

The NT EPA is of the view that the sustainable use principle has been considered in assessing the regulated activity.

## **2.6. Principle of conservation of biological diversity and ecological integrity (s 23 Environment Protection Act 2019 (NT))**

The location of the regulated activity is not within close proximity to groundwater dependent ecosystems; nor is it within proximity to a declared ecological community under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999*.

The regulated activity is located at the junction of the Gulf Fall and Upland bioregion and the Sturt Plateau bioregion. It poses a low risk to the ecosystems within these bioregions, given the relatively small area footprint of the regulated activity and the very large area of similar habitat. The regulated activity does not pose a significant risk to any regional populations of threatened species. Four of the identified threatened species and one listed migratory species with potential to occur in the immediate vicinity (10 km) of the well sites are considered to have a medium likelihood of occurrence. These are the Crested Shrike-tit, Gouldian Finch, Grey Falcon, Mertens's Water Monitor, and Fork-tailed Swift. Due to the management strategies outlined in the EMP and the relatively small area of impact, it is unlikely that the regulated activity will pose a risk to the identified threatened species. Springs (Beauty Creek Springs) are located approximately 30 km to the north of Tanumbirini. The riparian vegetation communities present along the watercourse and dominated by *Eucalyptus camaldulensis* may rely on groundwater, however project activities are unlikely to include impacts on these communities. Impacts and risks to flora, fauna and ecosystems have been mitigated to an acceptable level.

Avoidance and mitigation measures identified in the EMP are adequate to reduce risks from, for example, vehicle-strike, dust, erosion and/or spills to as low as reasonably practicable, in relation to potential impacts on biodiversity.

The EMP outlines measures to minimise impacts on affected environmental values, including the management of threatening processes such as weeds and fire. Where relevant, management measures consistent with the requirements of the Code, the *NT Land Clearing Guidelines* and the *Weed Management Planning Guideline: Onshore Petroleum Projects*. Specific precautions to ensure interaction with wildlife is avoided are included in the EMP. These include: restriction of night time operations, separation distances between flares and surrounding fauna habitats, fauna ladders in open pits, daily checks of infrastructure, restricted speed limits, and the use of above-ground tank pads with steep sides to prevent animal entry.

The NT EPA considers that implementation of, and compliance with, the EMP will ensure the conservation of biological diversity and ecological integrity is not impacted by the regulated activity.

### **2.7. Principle of improved valuation, pricing and incentive mechanisms (s 24 *Environment Protection Act 2019* (NT))**

The interest holder is required to prevent, manage, mitigate and make good any contamination or pollution arising from the regulated activity, including contamination of soils, groundwater and surface waters through accidental spills.

All stages of the regulated activity, including disposal of waste, commercial purchase of groundwater, and progressive rehabilitation of all disturbed areas to an acceptable standard, are at the cost of the interest holder. The interest holder is required to provide an adequate environmental rehabilitation security bond to indemnify the NT Government. This is based on an assessment by DEPWS on the estimated rehabilitation cost submitted by the interest holder.

The NT EPA is of the view the principle of improved valuation, pricing and incentive mechanisms has been considered in assessing the regulated activity and is based on the interest holder bearing any environmental costs for the activity.

### **3. Environmental impacts and risks reduced to a level that is as low as reasonably practicable (ALARP) and acceptable (regulation 9(1)(c))**

The interest holder has committed to identified measures to avoid impacts on environmental values, informed by baseline studies, surveys and data derived from seismic data and drilling of Tanumbirini-1.

The revised EMP systematically identifies and assesses environmental impacts and risks associated with the regulated activity. The key potential environmental impacts and risks considered in the EMP are:

- impact to air quality through emissions of greenhouse gases during production testing flaring
- impacts to native vegetation through introduction of pest species as a result of vehicle movements
- impacts to soil and water from chemical spills and leaks associated with chemical and fuel storage as a result of inappropriate storage or handling
- impacts to water quality and associated dependant ecosystems through loss of stimulation or flowback fluid due to cross-flow during HF or insufficient isolation between wells
- impacts to water quality due to overflow or leakage from wastewater infrastructure.

The EMP also considers cumulative impacts to groundwater, traffic, and GHG emissions and concludes these have been managed to ALARP and acceptable levels.

The EMP demonstrates why the controls to be implemented are considered ALARP and acceptable. Of the 34 risks identified, 25 are considered 'negligible', and therefore ALARP and acceptable. The remaining 9 risks are considered 'acceptable' as long as mitigation measures are implemented such that the risks will be managed at levels that are ALARP. Specifically:

1. *Greenhouse gas emissions*: flaring is the primary method of gas disposal and venting will only be used in accordance with the Code (clause B.4.13.2(k)). The interest holder has a methane emissions management plan, which will be implemented. Gas detection monitoring will be conducted during all phases of the flowback and production testing operations and the flaring will be measured using flow meters compliant with the NGERs. Emissions will be reported in accordance with the NGERs. The risks are considered 'acceptable', based on a likelihood of 'likely' and a localised consequence with short term environmental or community impact.
2. *Introduction of weeds*: a weed management plan has been developed for the project, which will be implemented, and includes yearly weed inspections and the requirement to have valid weed hygiene declarations upon entry of the site. The risk is considered 'acceptable', based on a likelihood of 'unlikely' and a consequence to areas, plants or animals of significant environmental value that is localised and medium term, or extensive and short-term.

3. *Chemical spills and leaks associated with chemical and fuel storage handling*: a wastewater and a spill management plan have been developed for the project, which will be implemented. In the event of significant rainfall, all wastewater will be transferred to enclosed storage tanks. All tanks containing HF stimulation fluid are enclosed. Chemicals are stored on a bunded pad with spill management kits located nearby, and drip trays will be used when transferring chemicals and fuel. Any spills will be contained and remediated. The risk is considered 'acceptable', based on a likelihood of 'unlikely' and a consequence to areas, plants or animals of significant environmental value that is localised and medium term, or extensive and short-term.
4. *Loss of stimulation fluid or flowback fluid from a multi-well pad operation due to insufficient isolation between wells*: the design of the multi-well pad will be in accordance with the accepted WOMP. A geohazard assessment has been performed to mitigate for geohazards or faults, and the spatial extent and orientation of the induced fractures will be monitored. The distance from the nearest high quality aquifer is over 3,223 m at Tanumbirini and 2,160 m at Inacumba, which is significantly more than the 600 m prescribed by the Code. A chemical risk assessment has been completed for all chemical used in the proposed hydraulic fracture stimulation activities. The risk is considered 'acceptable' with a likelihood of 'unlikely' and a localised consequence with short term environmental or community impact.
5. *Loss of stimulation fluid due to cross-flow or major structures or faults*: further to the above-mentioned mitigation measures, the cemented casing will follow the Code requirements and design standards to prevent aquifer cross-flow once the well is constructed and passes well acceptance criteria. The risk is considered 'acceptable' with a likelihood of 'unlikely' and a localised consequence with short term environmental or community impact.
6. *Overflow or leaks of fluid storage tanks*: a wastewater and a spill management plan have been developed for the project which will be implemented. The weather is monitored and the minimum freeboard requirements will be adhered to. The flowback fluid tanks are double lined and have leak detection systems in place. The tank pad is bunded to accommodate the volume of the largest tank, and the tank storage volumes are monitored for loss of containment. The risk is considered 'acceptable' with a likelihood of 'unlikely' and a localised consequence with short term environmental or community impact.

The NT EPA considers that all reasonably practicable measures are used to control the environmental impacts and risks, considering the level of consequence and the resources needed to mitigate them, and the nature, scale and location of the regulated activity. The NT EPA considers that the environmental impacts and risks will be reduced to a level that is ALARP and acceptable, considering the sensitivity of the local environment, relevant standards and compliance with the Code.

#### 4. Summary of monitoring and inspections

Table 2 provides a summary of the monitoring and inspections committed to in the EMP. These programs are used by the interest holder to meet prescribed requirements and to confirm the effectiveness of the mitigations committed to.

Table 2: Monitoring and inspections relevant to the scope of the regulated activity

Aspect	Monitoring and inspections
Weeds	<ul style="list-style-type: none"> <li>• Annual post-wet season monitoring of lease pads and access tracks</li> <li>• Annual monitoring of fuel loads post-wet season</li> <li>• Periodic audit of hygiene declarations available for all vehicles coming into EP161 on each occasion</li> </ul>
Bushfire	<ul style="list-style-type: none"> <li>• Daily assessment of bushfire weather alerts during operations</li> <li>• Annual fire mapping</li> <li>• Weekly inspection of fire suppression equipment at chemical stores and in vehicles</li> </ul>
Water and Wastewater	<ul style="list-style-type: none"> <li>• Daily checks fluid levels in tanks, including during and after rainfall events, to confirm available freeboard</li> <li>• Periodic audits to ensure only waste from approved wastewater systems and grey water is disposed of to land</li> </ul>

Aspect	Monitoring and inspections
	<ul style="list-style-type: none"> <li>Ongoing during conduct of the regulated activity (as applicable to the scope); tracking of volumes of water to be used during hydraulic fracture stimulation, volumes of water used for dust suppression and construction, volumes of water and wastewater removed for off-site disposal and end-destination, and volumes of any spills of water or wastewater</li> </ul>
Groundwater	<ul style="list-style-type: none"> <li>Ongoing monitoring of groundwater quality from control groundwater bores (including 6 months prior to drilling and including wet and dry season conditions)</li> <li>Ongoing monitoring of groundwater extraction</li> <li>Daily monitoring of stored water volumes during operations</li> </ul>
Greenhouse gas emissions	<ul style="list-style-type: none"> <li>Real time monitoring of gas detection</li> </ul>
Fauna	<ul style="list-style-type: none"> <li>Daily inspection during operations of fences, excavations, pits and sumps for entrapped fauna and fauna and to ensure fauna escapes are intact</li> <li>Daily inspection of waste storage areas to ensure no fauna access</li> <li>Periodic audits to ensure lighting directed inwards at well pads to minimise potential fauna impacts</li> </ul>
Weather	<ul style="list-style-type: none"> <li>Daily monitoring of weather during operations for predicted significant rainfall</li> </ul>
Vehicles and equipment	<ul style="list-style-type: none"> <li>Ongoing use of in-vehicle monitoring systems to ensure compliance with speed restrictions and no unauthorised travel outside of designated areas</li> <li>Ongoing use of equipment maintenance logs to demonstrate engines and machinery have been maintained in accordance with required maintenance schedule and have been fitted with noise suppression devices</li> <li>Periodic audits to show no use of petrol vehicles and petrol-powered pumps have spark arrestors fitted</li> <li>Periodic audits to show all vehicles have portable fire extinguishers and operational VHF or UHF radio transceivers.</li> </ul>
Dust	<ul style="list-style-type: none"> <li>Maintenance of records of use of water cart for dust suppression and locations (linked to weather observations)</li> </ul>

## 5. Relevant matters raised through public submissions

Public consultation on the revision to the EMP was required under regulation 8A(1)(b) as the EMP proposes hydraulic fracturing of a well. The EMP was made available for public comment for a period of 28 days from 9 June 2021 to 7 July 2021, during which 12 submissions were received. 10 of the 12 submissions originate from the NT. Table 3 provides a summary of the issues raised in public submissions. Consideration of these issues raised follow Table 3.

Table 3: Consideration of relevant matters raised in public submissions

Theme	Issues raised	Response
Chemicals	<ul style="list-style-type: none"> <li>Impact of HF fluids on birds, specifically migratory birds</li> <li>Adequacy of Chemical Risk Assessment: some HF chemicals are a major risk which should be thoroughly analysed.</li> </ul>	The chemical risk assessment was undertaken in accordance with the <a href="#">Environment Management Plan Content Guideline</a> and included in the EMP.
Climate change	<ul style="list-style-type: none"> <li>Greenhouse gas emissions</li> <li>Lack of NT emissions policy</li> <li>Underestimation of fugitive emissions</li> </ul>	The extended production testing period was reduced in a revision of the EMP to lower the GHG emissions by the project. The interest holder also added a section about company-wide emission targets (net zero scope 1 and 2 emissions by 2040). Fugitive emissions have been provided in the EMP in accordance with standard methodology.

Theme	Issues raised	Response
		On 1 September 2021, the NT Government released the Greenhouse Gas Emissions Management for New and Expanding Large Emitters policy (Large Emitters Policy).
Flora and fauna (environment)	<ul style="list-style-type: none"> <li>Absence of adequate baseline assessment</li> <li>Noise impacts driving species away from habitats</li> <li>Impacts to stygofauna</li> <li>Inconsistencies in assessment groundwater dependent ecosystems (GDEs)</li> <li>Impacts from cane toads on biodiversity</li> </ul>	<p>A comprehensive Strategic Regional Environmental and Baseline Assessment (SREBA) is being undertaken before granting any production approvals. The SREBA covers the Beetaloo Region<sup>3</sup>, inclusive of the location of the regulated activity.</p> <p>Recent noise modelling has shown that the maximum sound power level (121 dBA) is reduced to 25 dBA at a distance of 4 km. This demonstrates the low level of noise disturbance by the activity.</p> <p>The EMP was revised to clearly identify GDEs in the project area, and to include information about stygofauna.</p> <p>All wastewater from the activities will be stored in above-ground tanks, preventing access to cane toads. An impact on biodiversity from cane toads is unlikely to occur.</p>
Human health	<ul style="list-style-type: none"> <li>Impact on human health and safety (silica inhalation, exposure to radioactive materials)</li> <li>Impact from venting and flaring</li> </ul>	<p>All interest holders must comply with NT occupational health and safety legal requirements, under legislation and regulations administered by NT Worksafe.</p> <p>Flares and flare stacks are designed, prepared and operated in accordance with the relevant industry standards and have appropriate buffers.</p>
Regulation and compliance	<ul style="list-style-type: none"> <li>Referral under the <i>Environment Protection Act 2019</i> (NT) (EP Act) and the Australian Government <i>Environment Protection Biodiversity Conservation Act 1999</i> (EPBC Act)</li> <li>Regulatory separation (transparency of the WOMP)</li> <li>Lack of transparency</li> <li>Scientific uncertainty</li> <li>Cumulative impacts</li> </ul>	<p>The WOMP is assessed by petroleum engineers in the Department of Infrastructure, Tourism and Trade (DITT). These officers have the technical expertise necessary to evaluate well construction and integrity and ensure that the WOMP complies with the relevant sections of the Code. There can be no hydraulic fracturing before a WOMP has been accepted by DITT.</p> <p>All EMPs that relate to drilling or hydraulic fracturing are subject to 28-day public consultation, and their availability for public review is advertised. All EMPs are also subject to review by specialists in the relevant NT government agencies. This process allows for transparency and a scientifically sound assessment.</p> <p>The EMP was updated to include a section about greenhouse gas emissions in conjunction with other activities near EP161.</p>
Social and cultural	<ul style="list-style-type: none"> <li>Social and cultural impacts from hydraulic fracturing</li> <li>Adequacy of stakeholder engagement</li> <li>Informed consent</li> <li>Environmental protection bond for pastoralists</li> <li>Impact of increased traffic in relation to safety of mustering cattle</li> <li>Benefits to NT residents</li> </ul>	<p>The EMP includes a stakeholder engagement log, which demonstrates that the interest holder has engaged with a range of stakeholders including direct engagement with leaseholders, Aboriginal stakeholders and the Northern Land Council. As a result of the public submission, the interest holder has reached out to the local Aboriginal Corporation that raised concern about receiving adequate representation during the stakeholder engagement process.</p> <p>Specialised staff are sourced from interstate, however equipment (machinery, infrastructure) and consultants are sourced from the NT</p>

<sup>3</sup> [Strategic regional environmental and baseline assessment \(SREBA\) fact sheet](#)

Theme	Issues raised	Response
		where available. The EMP was updated to include an estimated local employment for the activities.
Waste	<ul style="list-style-type: none"> <li>• Impact of drilling fluids or fracking fluids on stygofauna</li> <li>• Wastewater storage – fauna access</li> <li>• Concentration of chemicals</li> <li>• Radioactivity in wastewater</li> <li>• Reliance on US data for flowback fluid estimates</li> <li>• Capacity of wastewater tanks</li> </ul>	<p>Hydraulic fracturing does not interact with groundwater and cannot have an impact on stygofauna.</p> <p>Wastewater is stored in above-ground tanks with tall, vertical walls, which prevents entrapment and breeding of amphibians. The chemical risk assessment demonstrates there are no unacceptable exposures to avian species.</p> <p>The interest holder is required to undertake a risk assessment within 6 weeks after completion of well flowback. The results of this assessment will indicate the potential risks associated with chemical concentration and radioactivity in the wastewater.</p> <p>The US data provided in the EMP informs the reader about the range of flowback recovery seen across the industry. The EMP is clear on that flowback fluid volumes will mostly depend on the number of fracture stimulation stages, and actual volumes may be significantly lower than the conservative estimates provided in the EMP.</p> <p>The EMP has been updated to include a water balance, which confirms that the wastewater tanks will have enough capacity to store and treat the wastewater.</p>
Water	<ul style="list-style-type: none"> <li>• Impact on water availability</li> <li>• Pollution of water</li> <li>• Impact of drilling fluids on groundwater quality</li> <li>• Corrosion of well casing</li> <li>• Understanding of Inacumba aquifer</li> <li>• Adequacy of monitoring</li> </ul>	<p>The interest holder has obtained two water extraction licences, which included a detailed assessment of resource availability by DEPWS.</p> <p>Mitigation measures are in place to minimise any spills or leakages from the activity, and the risk of water pollution has been demonstrated to be ALARP and acceptable.</p> <p>The EMP does not have any drilling in scope.</p> <p>Petroleum wells are designed with multiple barriers, so that a single barrier failure will not lead to a loss of containment. Complete well integrity failure where all well barriers fail is an extremely rare occurrence in contemporary petroleum wells including shale wells.</p> <p>The interest holder has a groundwater monitoring program in place. As the risk of water pollution is demonstrated to be ALARP and acceptable, the current understanding of the Inacumba aquifer is sufficient for the activities proposed in the EMP.</p>

The issues raised by the community were considered by the NT EPA. While most of the issues were already addressed in the draft EMP, the interest holder amended the EMP where required. The NT EPA recommends the Minister requires the interest holder to provide an interpretive report on groundwater quality based on groundwater monitoring data collected in accordance with the Code.

## 6. Other relevant matters

Regulation 9 requires that an EMP provides a comprehensive description of the regulated activity, including provision of a detailed timetable for the activity. The EMP includes a detailed schedule for the regulated activity. As the schedule is likely to change, the NT EPA recommends the Minister requires the interest holder to submit an updated timetable for the regulated activity to DEPWS.

## CONCLUSION

The NT EPA considers that, subject to the consideration of the recommended EMP approval conditions, the EMP:

- is appropriate for the nature and scale of the regulated activity
- demonstrates that the regulated activity can be carried out in a manner that potential environmental impacts and environmental risks of the activity will be reduced to a level that is as low as reasonably practicable and acceptable.

In providing this advice the NT EPA has considered the principles of ecologically sustainable development.

## RECOMMENDATION

The NT EPA recommends that, should the EMP for Santos QNT Pty Ltd be approved, the Minister places conditions on the approval to ensure that the following outcomes are achieved:

1. Provision of regular timetable updates and weekly reports.
2. Submission of an annual performance report to DEPWS to demonstrate the interest holder has met environmental outcomes and complied with the requirements set out in the Regulations, the Code, the ministerial conditions and the EMP.
3. Provision of an annual emissions report to DEPWS that summarises greenhouse gas emissions reported under the Australian Government's *National Greenhouse and Energy Reporting Act 2007* versus the predicted emissions in the EMP.
4. Recording of all spills in an internal register that includes location, source and volume of the spill and corrective actions to ensure subject land is free from contamination to meet rehabilitation requirements.
5. Flowback fluid risk assessment and reporting.
6. Groundwater monitoring to be conducted before, during and after hydraulic fracturing and submission of an interpretive report on groundwater quality based on groundwater monitoring data collected in accordance with the Code.
7. Provision of enclosed wastewater storage capacity before commencement of hydraulic fracturing at each site.
8. Provision of regular weather forecasts to actively monitor wet weather and high bushfire danger.
9. Publishing of reports and data on corporate website to increase transparency.



DR PAUL VOGEL AM  
CHAIRPERSON

NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

27 September 2021