

# Onshore Petroleum Activity – NT EPA Advice

## **ENVIRONMENT MANAGEMENT PLAN (EMP) – ORIGIN ENERGY B2 PTY LTD, BEETALOO SUB-BASIN MULTI-WELL DRILLING, STIMULATION AND WELL TESTING PROGRAM EXPLORATION PERMIT (EP) 98 & 76 (ORI10-2)**

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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**

<b>Subject</b>	<b>Description</b>
Interest holder	Origin Energy B2 Pty Ltd
Petroleum interest(s)	Exploration Permits 98 and 76 (EP98 & EP76)
Environment Management Plan (EMP) title	Origin Beetaloo Sub-basin Multi-well Drilling, Stimulation and Well Testing Program Exploration Permit (EP) 98 & 76
EMP document reference	ORI10-2
Regulated activity	<p>This EMP covers the program of work for the civil works, drilling, stimulation (hydraulic fracturing), flowback and appraisal testing for up to four wells at two locations (Amungee NW and Velkerri 76) within EP98 and EP76 respectively. Both sites are on the Amungee Mungee pastoral lease in the Beetaloo Sub-basin, approximately 300 km southeast of Katherine, NT.</p> <p>The specific activities proposed are as follows:</p> <ul style="list-style-type: none"> <li>• civil construction activities at the existing Amungee NW site, including expansion of the existing well pad and camp pad</li> <li>• site set-up and mobilisation to support the Amungee NW-2H, Amungee NW-3H E&amp;A, Velkerri 76 S2-2H and Velkerri 76 S2-3H wells</li> <li>• exploration and appraisal (E&amp;A) activities at the Amungee NW and Velkerri 76 sites including drilling, hydraulic fracture stimulation (HF), evaluation, workover and extended</li> </ul>

	<p>production testing of Amungee NW-1H, Amungee NW-2H and Amungee NW -3H, Velkerri 76 S2-2H and Velkerri 76 S2-3H</p> <ul style="list-style-type: none"> <li>• on-site wastewater management to support ongoing E&amp;A program</li> <li>• site demobilisation</li> <li>• site rehabilitation</li> <li>• suspension and/or decommissioning of any of the new wells (as may be determined in the future).</li> </ul>
Public consultation	Public consultation on the EMP required under regulation 8A(1)(b) was undertaken from 13 January 2022 to 10 February 2022.

The Amungee NW-1H exploration and appraisal (E&A) well was drilled in October - November 2015 to a total depth of 2,611 m below ground level (mbgl), with a 1,229 m horizontal section. A hydraulic fracture (HF) was conducted in August - September 2016, followed by a 57 day well test. The well was suspended in November 2016 and the site was demobilised. In 2021, the Amungee NW-1H well was brought back online and underwent a 3-day extended production test (ORI7-2). Additional production testing of the NW-1H well is proposed in the EMP.

The Velkerri 76 S2-1 E&A well was drilled in August - October 2021 into the Kalala member (below the Velkerri) at a total depth of 2,128 mbgl. The well is currently suspended, with a vertical HF proposed to be completed in 2022.

## 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 EMP in a clear format. The technical works program includes civil works, drilling and hydraulic fracturing of up to four wells at two locations (Amungee NW and Veklerri 76) within EP98 and 76 respectively; evaluation, workover and extended production testing; and (as may be determined in the future) suspension and/or decommissioning of any of the new wells. These activities will be done in accordance with the requirements outlined in the *Code of Practice: Onshore Petroleum Activities in the Northern Territory* (the Code). [Table 1](#) provides an overview of the key components of the proposed regulated activity (ORI10-2).

Table 1: Key components of Origin Multi-well Drilling and Testing Program.

Component	Regulated Activity
<b>Petroleum wells to undergo hydraulic fracturing (HF)</b>	<ul style="list-style-type: none"> <li>• Amungee NW-2H</li> <li>• Amungee NW-3H</li> <li>• Velkerri 76 S2-2H</li> <li>• Velkerri 76 S2-3H</li> </ul>
<b>Duration</b>	<ul style="list-style-type: none"> <li>• Civils: Amungee NW site preparation (H1 2022)</li> <li>• Well drilling Amungee NW-2H, Amungee NW-3H (H2 2022)</li> <li>• Hydraulic fracturing Amungee NW-2H, Amungee NW-3H (H2 2022)</li> <li>• Extended production testing and flowback Amungee NW-1H, NW-2H, Amungee NW-3H (H2 2022 and H1 2023)</li> <li>• Well drilling Velkerri 76 S2-2H, Velkerri 76 S2-3H (H2 2022/H1 2023)</li> <li>• Well suspension and/or decommissioning (H1 2023)</li> <li>• Amungee NW full site demobilisation and stabilisation (H1 2023)</li> <li>• Well stimulation (hydraulic fracture HF) Velkerri 76 S2-2H, Velkerri 76 S2-3H (H1/H2 2023)</li> <li>• Well testing Velkerri 76 S2-1, Velkerri 76 S2-2H Velkerri 76 S2-3H (H2 2023)</li> <li>• Well suspension Velkerri 76 S2-1, Velkerri 76 S2-2H, Velkerri 76 S2-3H (H2 2023)</li> <li>• Velkerri 76 S2 full site demobilisation and stabilisation (H2 2023)</li> <li>• Well decommissioning (if determined as required) - all wells (2028)</li> <li>• Rehabilitation of site (2028)</li> </ul>
<b>AAPA Authority Certificate</b>	C2020/003 and C2014/184

Component	Regulated Activity	
<b>Water licences</b>	<b>GRF 10285 (Gum Ridge Formation)</b> 175 ML/year (across both EP98 and EP76)	
<b>Groundwater monitoring bores</b>	<ul style="list-style-type: none"> <li>• Three groundwater/ monitoring production bores at Amungee NW</li> <li>• One control monitoring bore at Amungee NW2</li> <li>• No additional bores at Velkerri 76</li> </ul>	
<b>Estimated groundwater use (total ML)</b>	<b>Site</b>	<b>ML</b>
	<b>Amungee NW</b>	110
	<b>Velkerri 76</b>	110
	<b>Total:</b>	220
<b>Land clearing</b>	Amungee NW: 16.24 ha <ul style="list-style-type: none"> <li>• 6.44 ha for expansion of well pad</li> <li>• 0.3 ha for expansion of camp pad</li> <li>• 1 ha for construction of helipad</li> <li>• 1 ha for construction of laydown yard</li> <li>• 4 ha for construction of new fence line/firebreak</li> <li>• 3.5 ha for a new gravel pit ~11 km east of Amungee NW</li> </ul> No clearing is proposed at Velkerri 76.	
<b>Workforce</b>	Peak workforce: 70 during drilling and hydraulic fracturing activities, 2-4 during well testing	
<b>Accommodation camp</b>	Main camp provides for 70 persons, drilling camp for 8 persons	
<b>Gravel pit (ha)</b>	~ 3.5 ha	
<b>Traffic – vehicle movements</b>	<ul style="list-style-type: none"> <li>• Peak traffic movements per day: 44 (both sites)</li> <li>• Truck load-out wastewater transport: ~ 20 movements (Amungee NW); ~40 movements (Velkerri 76)</li> </ul>	
<b>Sump (m<sup>3</sup>)</b>	5000 (Amungee NW)	
<b>Drilling muds/cuttings (m<sup>3</sup>)</b>	~750 m <sup>3</sup> /well	
<b>Flowback/wastewater produced (predicted) (ML)</b>	12 ML per well; 24 ML per site; 48 ML total	
<b>Greenhouse gas emissions (tCO<sub>2</sub>-e)</b>	<b>Site</b>	<b>tCO<sub>2</sub>-e</b>
	<b>Amungee NW</b>	76,289 to 142,178 (over three years)
	<b>Velkerri 76</b>	70,229 to 130,852 (over three years)
	<b>Total:</b>	146,518 to 273,030 (over three years)

### 1.1. Activity scope and duration

The EMP clearly describes the scope of the activity and its duration. The regulated activity is expected to commence at both sites in mid-2022 and continue until 2028. Under Regulation 18 of the Petroleum (Environment) Regulations 2016, the interest holder will be required to submit a revised EMP if the activities continue past the 5-year timeframe of an approved EMP. Initial activities will focus on civil works at Amungee NW to expand the well pad, camp pad and installation of a helipad. Drilling will be conducted for up to four wells: two at Amungee NW (NW-2H and NW-3H), and two at Velkerri 76 (S2-2H and S2-3H). All four wells will have up to 25 hydraulic fracturing stages. Extended production testing of the Amungee NW-1H, Amungee NW-2H and Amungee NW-3H E&A wells will follow. Completion and well testing will be conducted on the horizontal Velkerri 76 S2-2H and S2-3H wells and the 76 S2-1 horizontal well. Upon completion of the testing, the wells will be suspended for build-up testing and/or plugged and abandoned and rehabilitation completed.

The EMP estimates that a total area of 16.24 ha of vegetation may be cleared, all of which is required to be rehabilitated. All clearing will be conducted at the Amungee NW site - no clearing is proposed at the Velkerri 76 site.

Drill cuttings produced for each well will be contained and managed in the Velkerri 76 S2 drilling sump and proposed Amungee NW sump, in accordance with the Code. The sumps have been designed to support multiple wells. Sumps will be designed to accommodate the expected ~750 m<sup>3</sup> of waste drilling solids (cuttings, muds and cement returns) per well.

Drilling waste material will either be buried on-site in accordance with C4.1.2 of the Code, left in-situ across the wet season to allow for the material to dry during the subsequent dry season, or be transported off-site. Off-site disposal will be undertaken in accordance with the NT *Waste Management and Pollution Control Act 1998* (WMPC Act). All drilling fluids collected in the sumps will either be evaporated in the sump or transferred to wastewater tanks for storage and evaporation. The residual concentrated liquid waste stream will be disposed of off-site at a licensed facility in accordance with the WMPC Act.

The EMP describes the precautionary measures that will be in place for multi-well well pads, including using Global Positioning System (GPS) for collision avoidance of wellbores and separation envelopes around existing wells. While directionally drilling, standard directional drilling techniques and equipment are employed to enable accurate wellbore direction to be recorded and maintained. The separation envelope for each well is also continually calculated and monitored.

A number of well evaluation techniques will be conducted during and/or on completion of drilling at the well sites including evaluation, logging, coring and diagnostic fracture injection testing of the seven new wells. Figure 1 shows the location of the proposed wells at the Amungee NW site. NW-1H is a horizontal well that underwent hydraulic fracturing in August and September 2016. NW-2H and 3H will both be horizontal wells. Figure 2 shows the location of the proposed wells at the Velkerri 76 site. Velkerri S2-1 is a vertical well that is currently suspended. Velkerri 76 2H and 3H will both be horizontal wells.

Prior to hydraulic fracturing each well, the wellbore will be assessed to ensure that sufficient well integrity is in place to withstand hydraulic fracturing pressures as per the Code and Section 302A of the Schedule of Onshore Petroleum Exploration and Production Requirements. This includes ensuring cement evaluation logs demonstrate a minimum 150 mTVD of good quality cement is present from the target reservoir to the nearest aquifer to ensure zonal isolation, all geological barriers are confirmed, geological hazards are identified, and the production casing is pressure tested.

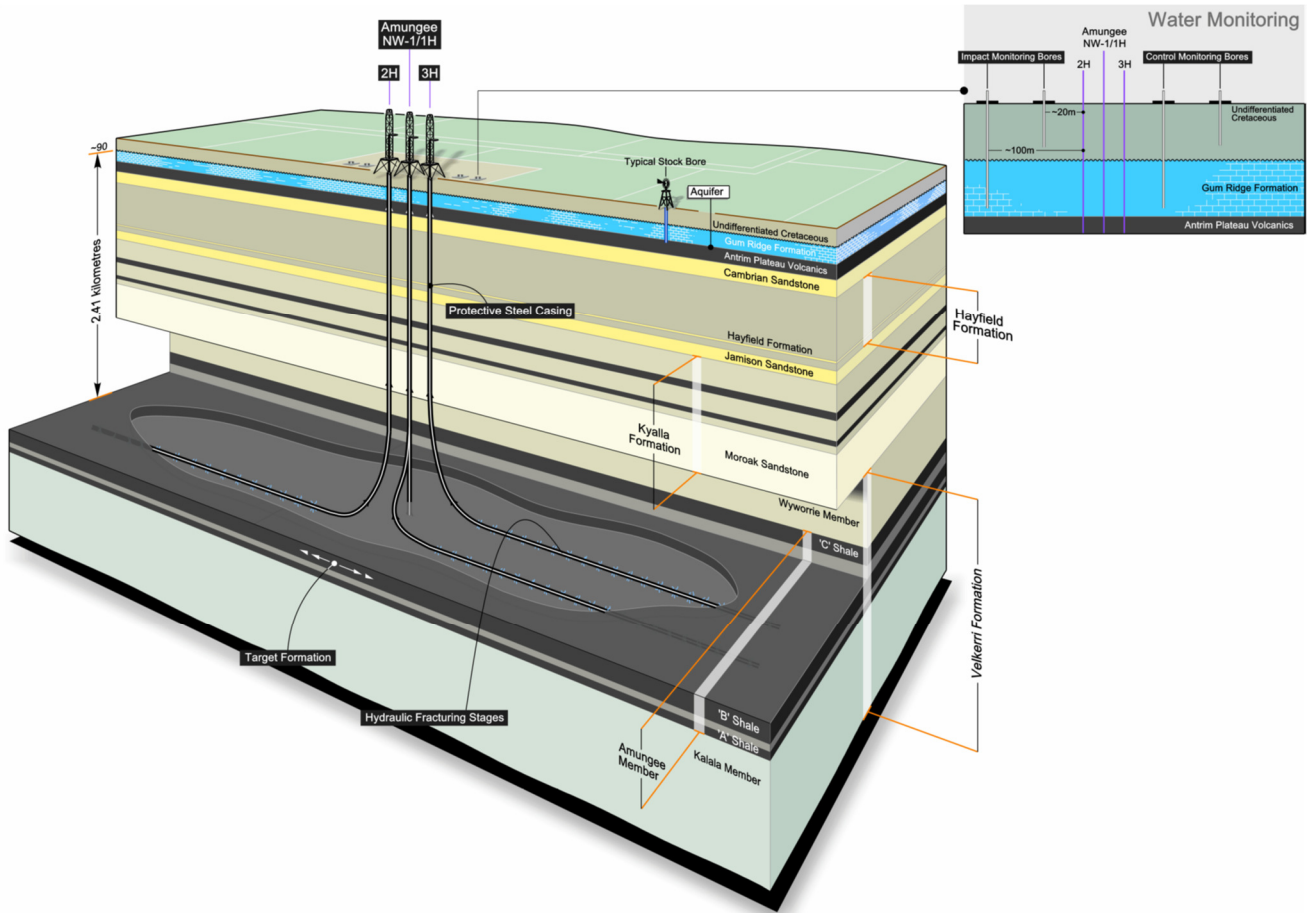


Figure 1, Illustrative section through the Beetaloo Sub-basin showing proposed Velkerri target intervals at the Amungee NW location (1400 m below the deepest aquifer).

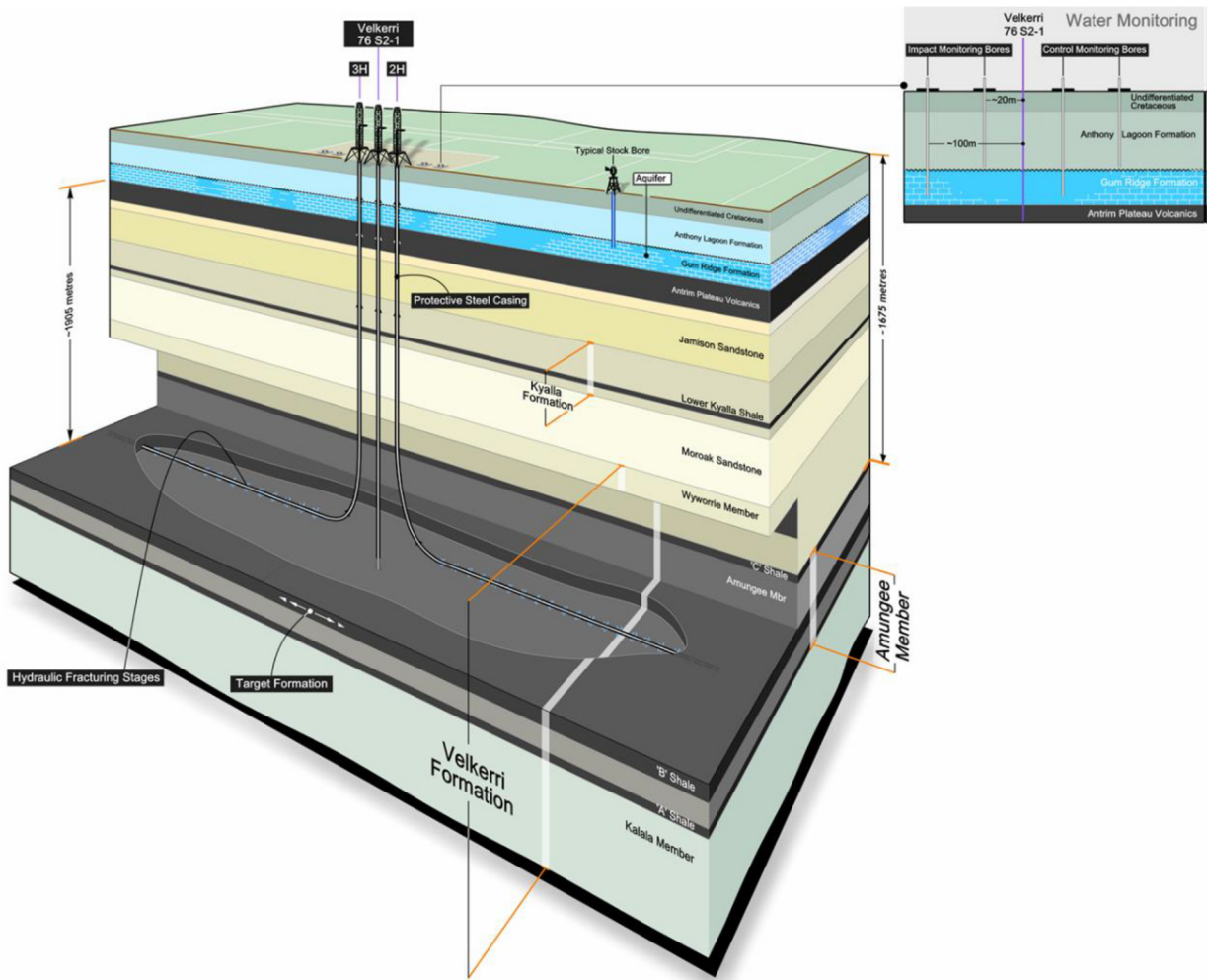


Figure 2, Illustrative section through the Beetaloo Sub-basin showing proposed Velkerri target intervals at the Velkerri 76 location (1400 m below the deepest aquifer).

Hydraulic fracturing will be undertaken over 25 stages per well using the plug and perforation technique. Once all stages are complete, the well will be suspended, awaiting completion and well-testing activities. Wellbore pressures will be monitored during each hydraulic fracture to ensure operations have not compromised the production casing or the integrity of the cement barriers. All fluid additives (water and chemicals) and sand will be mixed on the surface, and the mixture and pumping schedules (rates, volumes and proppant) will be based on a hydraulic fracturing model, to be completed before commencement of hydraulic fracturing and underpinned by a Mechanical Earth Model (MEM) generated from data collected during drilling, wireline logging, core analysis and DFIT tests.

Flowback and extended production testing will be conducted to validate the well production rates. Extended production testing will be undertaken for up to 90 days per well. Water will be directed to flowback tanks, and condensate to storage tanks or flare, depending on the composition. All gas, water and condensate flow volumes will be measured and recorded.

Wastewater is proposed to be stored in enclosed tanks, and evaporated in open treatment tanks, for ultimate disposal offsite at a licensed waste management facility. Open treatment tanks are also designed to accommodate the expected ~12ML of flowback fluid and produced water per well, and managed to maintain a minimum freeboard of 300 mm in the dry season and 1,300 mm in the wet season, to accommodate a 1 in 1000 average recurrence interval (ARI) rainfall rate. Enclosed tanks will be constructed on-site with enough capacity to store all wastewater on-site. Produced water and flowback fluid will be evaporated onsite with approximately 0.6 ML from Amungee NW and 0.5 ML from Velkerri 76 to be disposed of offsite.

Both the Amungee NW and Velkerri 76 sites will be equipped with a main camp and a drilling mini-camp located on the lease pad. The camps will have their own sewage treatment and wastewater treatment plants. The camps will be managed in compliance with the relevant health requirements of mining and construction camps.

It is estimated that up to 220 ML of groundwater (110 ML each for the Amungee NW and Velkerri 76 sites) will be extracted over the five year duration of the EMP from the Gum Ridge Formation using existing extraction bores and proposed groundwater bores at Amungee NW. Any new bores constructed to support exploration activities will be registered and added to the Water Extraction Licence. Approximately 160 ML will be used for hydraulic fracturing (approximately 40 ML per well).

The potential impacts and risks of the regulated activity have been identified and controls are reflected in the relevant environmental outcomes, performance standards and measurement criteria that have been provided in the EMP. Mitigations outlined in the risk register are classified based on the hierarchy of controls and the level of certainty is indicated for each risk. Where appropriate the NT EPA has also provided advice relating to Ministerial conditions at the end of this advice.

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

The EMP demonstrates how the interest holder will comply with the relevant requirements of the Code in undertaking the regulated activity. This includes selection of materials for well construction and related engineering controls contained in the Well Operations Management Plan (WOMP). The risk assessment provided in Appendix M 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:

- Erosion and Sediment Control Plan
- Chemical Risk Assessment
- Wastewater Management Plan
- Spill Management Plan
- Emergency Response Plan
- Weed Management Plan
- Fire Management Plan
- Methane Emissions Management Plan
- Rehabilitation Management Plan.

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).

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

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

The EMP adequately assesses the environmental impacts and risks associated with the regulated activity and outlines appropriate avoidance and mitigation measures. Of the 72 risks identified, 64 were ranked as 'low' if carried out in accordance with the mitigations and controls proposed in the EMP. The remainder of the risks ('moderate') are demonstrated to be ALARP and acceptable (refer to section 3).

Open working evaporation tanks and mud sumps are designed to comply with the Code to have enough freeboard to manage an entire 1:1000 ARI wet season event. A minimum of 300 mm freeboard will be maintained in all open treatment tanks through the dry season, and a minimum of 1,300 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 of 26.5 ML at both Amungee NW and Velkerri is sufficient for the proposed activities.

As required by the regulations, the interest holder has demonstrated ongoing stakeholder engagement in the EMP with identified, directly-affected stakeholders. The EMP was also made available for public comment (13 January 2022 to 10 February 2022).

## **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.

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 an entire 1:1000 ARI wet season event. Freeboard levels will be monitored daily to ensure the required levels are adhered to. Transportation of wastewater or chemicals on unsealed roads without a prior risk assessment will be avoided. The interest holder will use helicopters to transport personnel to site 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 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. This condition will support clause 16 of the *Water Act 1992* (NT) and clause B.4.2 of the Code.

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

The EMP includes a detailed risk assessment related to the transport, storage and use of chemicals. It includes an assessment of potential impacts to human receptors and wildlife 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 HF fluid to aquifers (1,400 m);



- Approximately 4 km horizontal separation distance between the exploration well and the closest existing water supply bore used for domestic or stock consumption at Amungee NW, and approximately 11.4 km horizontal separation distance at Velkerri 76;
- 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; and
- A secondary containment system for the wastewater storage tank, capable of holding 110% of the volume of the largest enclosed tank.

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. As a precautionary step the NT EPA has recommended a Ministerial condition for this activity relating to the recording of spills.

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.

#### **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.

The EMP commits 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.

Total predicted worst-case greenhouse gas (GHG) emissions generated by the regulated activity for both sites combined over 3 years and applicable for a 180-day testing period are approximately 273,030 tCO<sub>2</sub>-e. These emissions will result in an overall increase in NT GHG emissions (based on 20.6 million tCO<sub>2</sub>-e in 2019) of 1.33% in total, based on conservative estimates of emissions from fuel consumption, land clearing, flaring and fugitive emissions. The EMP also refers to the cumulative GHG emissions from the current regulated activity, previously approved regulated activities and potential activities for the 2022-2024 period. Origin's total cumulative GHG emissions (across 11 EMPs) for this period are estimated to be approximately 283,527 tCO<sub>2</sub>-e (between 45,297 and 177,780 tCO<sub>2</sub>-e per annum). The potential emissions of all of Origin's activities in the NT represent between 0.22% and 0.86% of the total NT GHG emissions for 2019 or 0.009% to 0.034% of Australia's total emissions.

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.

## 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.

The cumulative impact associated with current and future groundwater takes were addressed in the Water Extraction Licence (WEL) GRF 10285 statement of reason<sup>1</sup>. The anticipated water demand for this regulated activity is 220 ML for the Amungee NW and Velkerri 76 sites over two years. The anticipated water use is less than the interest holder's maximum water entitlement.

Greenhouse gas (GHG) emissions were estimated using tools developed for the National Greenhouse and Energy Reporting Scheme. The total predicted emissions from the activities described above for the Amungee NW and Velkerri 76 sites are estimated to total 273,030 tCO<sub>2</sub>e over 3 years (2022, 2023 and 2024) and based on a 180-day testing period. Diesel combustion will contribute: 1280 tCO<sub>2</sub>e from transport, 8376 tCO<sub>2</sub>e from horizontal drilling, 732 tCO<sub>2</sub>e from the drilling and stimulation camps, 770 tCO<sub>2</sub>e from land clearing (Amungee NW only), 1464 tCO<sub>2</sub>e from well testing and 2832 tCO<sub>2</sub>e from well stimulation. Fugitive emissions from drill cuttings, completion and wastewater storage will produce 6015 tCO<sub>2</sub>e.

Flaring emissions have been provided for two scenarios: 90 days (125,781 tCO<sub>2</sub>e) and 180 days (251,561 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.

The NT EPA notes the requirement to assess all impacts and risks under the Regulations, which are to be managed to levels that are ALARP and acceptable. The NT EPA notes the NT capacity to regulate greenhouse gas emissions is established in the Regulations and the EP Act. The NT Government is working towards responding to the impacts of climate change through a suite of initiatives that are being implemented to achieve net zero greenhouse gas emissions by 2050.

One such initiative is the 'Greenhouse Gas Emissions Management for New and Expanding Large Emitters' policy that came into effect on 1 September 2021. The policy identifies the NT Government's minimum requirements for the management of greenhouse gas emissions (emissions) from new or expanding industrial and land use development projects. Under the policy, 'large greenhouse gas emitters' are defined as industrial projects that expect to produce more than 100 000 tCO<sub>2</sub>e of scope 1 emissions in any financial year or the life cycle of the project (excluding emissions from land clearing). Proponents (and interest holders) of all new projects and expansions of existing projects subject to this policy must develop and implement a greenhouse gas abatement plan (GGAP) that has been tailored specifically for their project.

The interest holder submitted a GGAP, as the activities described in the EMP will result in emissions that exceed the 100,000 tCO<sub>2</sub>e threshold in a given financial year. Section 3.18 of the EMP covers the information requirements of the GGAP and in the plan the interest holder commits to a long term target (inclusive of future production activity) of net zero scope 1 and 2 emissions for future shale gas development in the Beetaloo. The interest holder made commitments in the EMP and GGAP to:

- Minimise well test durations to reduce flaring emissions
- Achieve a flare tip combustion efficiency of 98%
- Equip flares with auto-ignition to avoid unintentional venting
- Use best practice emission management controls outlined in section D of the Code including:
  - Development and implementation of methane emission management plan
  - Restrictions on venting
  - Using a reduced emissions completion
  - Implementation of a routine leak detection and repair program
  - Pressure and gas testing all in service equipment to ensure any leaks are identified and fixed prior to commission
  - Flanges, valves and fittings are all API compliant and gas tight
  - Equipment appropriately sized and maintained to minimise diesel usage

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<sup>1</sup> <http://www.ntlis.nt.gov.au/walaps-portal/report/current/gwel>

- Annual assessment and reporting of actual of GHG emissions against EMP estimated levels to ensure performance standards are met.

The NT EPA requested further information from the interest holder on its proposal for interim offset targets and demonstrating a trajectory to net zero by 2050 consistent with the NT government's commitments to emissions reductions. In response the interest holder further committed to:

- a clear linear trajectory towards net zero by 2050, extending beyond the three year life of the EMP using Australian Carbon Credit Units (ACCU), which are eligible offsets under the draft NT Greenhouse Gas Emissions Offsets Policy
- increase in minimum offset levels year-on-year by 3.7% (based on a baseline financial year of 2023) to result in a linear decrease in residual emission levels to net zero by 2050 as per the following schedule:
  - financial year 2023: 3.7% of total emissions offset
  - financial year 2024 7.4% of total emissions offset
  - financial year 2025: 11% of total emission offset
  - financial year 2026 14.7% of total emissions offset
  - financial year 2027 18.4% of total emissions offset
- estimation of actual emission levels produced during a financial year in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS) reporting methodology
- calculation of offsets volumes retrospectively, by multiplying the actual emission volumes generated during a financial year with the corresponding financial year offset % requirement level
- securing and retiring offsets within 6 months of the end of a financial year
- use of an appropriately qualified independent person with extensive carbon accounting experience to verify the actual emission levels generated, the procurement and retirement of the required offset volumes for emission generated in the specified financial year
- provision of a report from the appropriately qualified independent person to DEPWS by January 31 each year verifying the actual emission levels estimated and confirming the required offset for the previous financial year have been acquired and retired
- update of the GGAP annually based on actual emissions from the preceding year to ensure currency.

The proposed method for calculating actual emissions is consistent with the existing requirements under the Code.

To support the NT Government's commitment to net zero emissions, the NT EPA has previously provided advice that interest holders provide to DEPWS annual actual scope 1 and scope 2 GHG emissions as reported under the National Greenhouse Energy Reporting Scheme (NGERS) versus predicted emissions in the EMP. The GGAP commitment to provide actual GHG emissions mirror this requirement.

Well testing data is required to determine the technical and commercial viability of the potential resource and the interest holder has committed to reduce well testing timeframes to 90 – 180 days. The NT EPA notes that flaring during well testing is a significant component (90%) of total cumulative emissions and an essential activity for proving the viability of the resource. The NT EPA notes the scale of GHG emissions, short term nature of exploration activities (<5 years), and the interest holder's long term commitment to offset production emissions.

Noting the interest holder's commitment to offsetting emissions, the NT EPA is of the view that the sustainable use principle has been considered in conducting 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 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 within the Stuart Plateau bioregion. It poses a low risk to the ecosystems within this bioregion, 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. No core habitat for threatened fauna was been identified in areas surrounding the Amungee NW and Velkerri 76 S2 sites. However, some species may possibly occur and are known to occur in the wider landscape: Gouldian Finch *Erythrura gouldiae* (Endangered EPBC Act, Vulnerable TPWC Act); Grey Falcon *Falco hypoleucos* (Vulnerable TPWC Act); Crested Shrike-tit (northern) *Falcunculus frontatus whitei* (Vulnerable EPBC Act, Near Threatened TPWC Act); and Yellow-spotted Monitor *Varanus panoptes* (Vulnerable TPWC Act). 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.

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

The EMP outlines measures to minimise impacts on environmental values, including the management of threatening processes such as weeds and fire. Where relevant, management measures are 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: inspections for fauna presence, use of speed limits on access roads, above ground tanks with raised walls, and daily checks of infrastructure.

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 the Department of Environment, Parks and Water Security (the Department) 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 Amungee NW and Velkerri 76.

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

- Loss in soil productivity and viability due to soil erosion from cleared areas (existing access tracks, lease pad and camp pad)

- Impact to fauna habitats and threatened flora and fauna through the introduction and spread of weeds
- Impact to fauna habitats and threatened flora and fauna through accidental ignition of fire from exploration activities (drilling, HFS, flaring, general access)
- Disturbance of sacred sites or culturally sensitive areas and decline in environmental value of area used for cultural purposes through the accidental ignition of fire by site activities
- Reduction in agriculture productivity through the introduction and spread of weeds
- Reduction in agriculture productivity through bushfire from accidental ignition by site activities or site personnel
- Increased nuisance from dust emissions associated with the activities
- Increased nuisance from dust due to accidental ignition of bushfire during the site activities.

The EMP also considers cumulative impacts to water, flora and fauna, greenhouse gasses, traffic and social 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 72 risks identified, 64 were ranked as 'low', after controls are applied, which is considered acceptable, and it is assumed that ALARP has been achieved. The remaining 8 risks were ranked as 'moderate', which considered is acceptable provided that ALARP has been demonstrated. These risks are summarised as follows:

1. *Loss in soil productivity and viability due to soil erosion from cleared areas (existing access tracks, lease pad and camp pad):*  
Land clearing will be undertaken in accordance with NT Land Clearing Guidelines; lease pads will be stripped of topsoil; stockpile debris will be used to discourage water connection; the interest holder will implement an erosion and sediment control plan. The 'medium' risk rating is considered 'acceptable', based on the likelihood being considered 'possible', but the consequence of the event being considered 'minor'.
2. *Impact to fauna habitats and threatened flora and fauna through the introduction and spread of weeds:*  
The weed management plan in the EMP includes pre- and post-wet season weed inspections and the requirement to have valid weed hygiene declarations upon entry of the site; and activity will be restricted to defined lease pads and camp pads; and monitoring implemented around infrastructure to detect the spread/ introduction of weed species. The 'medium' risk rating is considered 'acceptable', based on the likelihood being considered 'unlikely', but the consequence of the event being considered 'moderate'.
3. *Impact to fauna habitats and threatened flora and fauna through accidental ignition of fire from exploration activities (drilling, HFS, flaring, general access):*  
A bushfire management plan will be implemented; bushfire awareness included in site inductions; firefighting equipment available to deal with fires; fire breaks implemented around lease and camp pads; appropriate separation distances between flares and surrounding vegetation; activities will comply with landholder and regional bushfire management plans; and classification of hazardous zones while drilling. The 'medium' risk rating is considered 'acceptable', based on the likelihood being considered 'highly unlikely', but the consequence of the event being considered 'serious'.
4. *Reduction in agriculture productivity through the introduction and spread of weeds:*  
Refer to 2.
5. *Disturbance of sacred sites or culturally sensitive areas and decline in environmental value of area used for cultural purposes through the accidental ignition of fire by site activities:*  
Refer to 3.
6. *Reduction in agriculture productivity through bushfire from accidental ignition by site activities or site personnel:*  
Refer to 3.
7. *Increased nuisance from dust emissions associated with the activity:*

Water trucks will be used to reduce dust emissions; roads will be maintained to prevent bull dust formation; and the activities will be localised (no sensitive receptors within 20 km). The 'medium' risk rating is considered 'acceptable', based on the likelihood being considered 'likely' and the consequence of the event being considered 'minor'.

8. *Increased nuisance from dust due to accidental ignition of bushfire during the site activities:*  
Refer to 3.

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
Bushfire	<ul style="list-style-type: none"> <li>Monitor NAFI and visual scan horizon for smoke daily during periods of high fire risk</li> <li>Annual fire mapping</li> </ul>
Chemicals	<ul style="list-style-type: none"> <li>Routine inspections (weekly) of chemical storage areas (daily during drilling weekly post drilling)</li> </ul>
Dust	<ul style="list-style-type: none"> <li>Stormwater monitored for pH and EC limits prior to off-site release and dust-suppression</li> </ul>
Erosion and sediment control	<ul style="list-style-type: none"> <li>Visual inspection of all disturbed areas pre- and post-wet season</li> <li>Visual inspection of infrastructure and erosion and sediment controls pre- and post-wet season</li> </ul>
Flora and fauna	<ul style="list-style-type: none"> <li>Daily inspections (during operations) of fauna interactions with wastewater tanks and sumps</li> <li>Weekly checks of area immediately surrounding lease pad for fauna deaths</li> <li>6-monthly pre- and post-wet season weed surveys completed on all Origin controlled disturbed areas</li> </ul>
Greenhouse gas emissions and fugitive emissions	<ul style="list-style-type: none"> <li>6-monthly methane leak detection program completed on each well</li> <li>Daily reports of gas flow volume</li> <li>All emissions related data (fuel use, flaring volumes etc.) reported in accordance with NGERs requirements</li> <li>Monthly monitoring of gas composition and isotopes post-separator</li> </ul>
Groundwater	<ul style="list-style-type: none"> <li>Quarterly monitoring of water levels in impact/monitoring bores with real-time (continuous) level logging before, during and one month after HF</li> <li>Quarterly monitoring of impact/monitoring bores temperature, electrical conductivity and pH commencing six months prior (baseline) and three-monthly after HF and then annually for 3-years</li> <li>Quarterly monitoring of BTEX and dissolved methane in impact/monitoring bores commencing six months prior (baseline) and three-monthly after HF</li> <li>Baseline water level monitoring data for pastoral bore collected three-months prior to HF and 12- months after HF</li> <li>Baseline data collected from pastoral bore of temperature, electrical conductivity and pH three-months prior to HF and 12- months after HF</li> <li>Baseline data collected of BTEX and dissolved methane in pastoral bore three-months prior to HF and 12- months after HF</li> <li>Volume of groundwater take from a continuous flow meter</li> </ul>
Hydraulic fracturing fluid	<ul style="list-style-type: none"> <li>Flowback monitoring daily during the first 4 weeks and weekly thereafter</li> </ul>

Aspect	Monitoring and inspections
	<ul style="list-style-type: none"> <li>Laboratory analysis of HF fluid prior to injection (field chemistry and analytical suite)</li> </ul>
Rainfall	<ul style="list-style-type: none"> <li>Daily review of BOM 4-day total rain forecast to identify periods of potentially significant rainfall</li> </ul>
Rehabilitation	<ul style="list-style-type: none"> <li>Annual monitoring of all rehabilitated areas, including lease pads, access tracks, gravel pits and camp pads</li> <li>Visual inspections of stem count, vegetation cover, species diversity and erosion</li> </ul>
Vehicles and equipment	<ul style="list-style-type: none"> <li>Visual inspect (pre and post-wet season) of infrastructure and sediment controls</li> </ul>
Waste and wastewater	<ul style="list-style-type: none"> <li>Weekly wastewater tank integrity inspections to identify any liner or tank defects</li> <li>Real-time monitoring of fluid volumes of each wastewater tank using level sensors</li> <li>Weekly tracking of freeboard and storage forecasting</li> </ul>
Drill cuttings, fluids and mud	<ul style="list-style-type: none"> <li>Wastewater volumes within the mud sumps monitored daily during operations</li> <li>Post-drilling sump levels monitored weekly during the dry season and daily during the wet season</li> <li>Characterise the quality of drill cuttings, fluids and muds prior to disposal</li> </ul>
Weeds	<ul style="list-style-type: none"> <li>6-monthly pre and post-wet season inspections and periodic audits of all disturbed areas, including lease pads, access tracks, gravel pits, laydown yards and camp pads to identify and report weed outbreaks</li> <li>All equipment and vehicles to be washed-down and to have a Biosecurity Declaration Certificate prior to access to site</li> </ul>

## 5. Relevant matters raised through public submissions

Public consultation on the EMP was required under regulation 8A(1)(b) as the EMP proposes drilling and hydraulic fracturing. The EMP was made available for public comment for a period of 28 days from 13 January 2022 to 10 February 2022. A total of 376 submissions were received, of which 367 were form letters from a public campaign; 57 submissions (15%) were identified as originating from within the NT; and four submissions (1%) did not identify their origin. Several submissions did not raise any matters specifically relevant to the EMP under assessment. The issues raised by the community were considered by the NT EPA. Most submissions were opposed to onshore petroleum development and raised substantially similar issues as those addressed through the HFI Final Report and subsequent implementation of the 135 HFI recommendations. While most of the issues were already addressed in the draft EMP, the interest holder amended the EMP where required.

Table 3 summarises the issues raised.

Table 3: Consideration of relevant matters raised in public submissions

Theme	Issues raised
Chemicals	<ul style="list-style-type: none"> <li>Adequacy of Chemical Risk Assessment and description of chemicals</li> <li>Toxicity of HF fluids</li> <li>Lack of clarity on the treatment path and environmental impacts for drilling waste</li> <li>Chemical spills</li> </ul>
Climate change	<ul style="list-style-type: none"> <li>Greenhouse gas emissions (project specific and cumulative)</li> <li>Compatibility of emissions with NT Government net zero 2050 targets</li> <li>Carbon offsets</li> </ul>
Flora and fauna (environment)	<ul style="list-style-type: none"> <li>Open tanks risk for birds (e.g. Gouldian finch)</li> <li>Absence of adequate baseline assessment for flora and fauna or sufficient follow-up surveys</li> <li>Proximity of activities to wetland habitat of bird species, incl. migratory birds</li> <li>Impacts to fauna from human activity, noise, light and traffic</li> <li>Contamination of aquifers impacting stygofauna</li> <li>Potential Impacts of fragmentation on vegetation communities</li> </ul>

Theme	Issues raised
	<ul style="list-style-type: none"> <li>Potential impacts to threatened species not fully understood</li> </ul>
Regulation and compliance	<ul style="list-style-type: none"> <li>SREBA incomplete</li> <li>Referral under the Environment Protection Act 2019 (NT) (EP Act) and the Australian Government Environment Protection Biodiversity Conservation Act 1999 (EPBC Act)</li> <li>Regulatory separation (transparency of the WOMP)</li> <li>Cumulative impacts not considered from other exploration activities in the region ('exploration creep')</li> </ul>
Social and cultural	<ul style="list-style-type: none"> <li>Free prior and informed consent from Traditional Owners not received</li> <li>Benefits to affected communities versus environmental costs</li> <li>Limited direct consultation with Traditional Owners</li> <li>Lack of 'social licence' to operate</li> </ul>
Waste	<ul style="list-style-type: none"> <li>Overtopping of storage tanks/ponds/sumps during the wet season</li> </ul>
Water	<ul style="list-style-type: none"> <li>Well casing corrosion</li> <li>Contamination of aquifers and connected surface water (e.g. Lake Woods)</li> </ul>

1. Chemicals: Some of the submissions raised concern about the toxicity of HF chemicals and the adequacy of the chemical risk assessment and description of chemicals. The volume and concentration of chemicals proposed to be used in hydraulic fracturing have been identified and a detailed chemical risk assessment (Appendix E) has been undertaken. The assessment included the full life cycle of chemical use (transportation, use and storage) and concluded potential risk of exposure to human and ecological receptors has been eliminated or reduced to as low as reasonably practicable.

Concern was raised about the lack of clarity on the treatment path and environmental impacts for drilling waste. As outlined in the EMP, the solid material resulting from drilling operations will be tested and a suitably qualified third party will determine whether the material is suitable to be disposed of on the lease pad using a 'mix-bury-cover' approach as per the Code, the WMPC Act and the National Environmental Protection Site Contamination Assessment) measures. Drilling material will be contained in a bunded lined sump that is capped with topsoil to mitigate infiltration. If on-site disposal is not feasible, all solid material waste from the four proposed wells will be transported off-site to an alternative suitable exploration location (such as Kyalla 117 N2) or a licensed facility. All fluids collected in the sumps will either be evaporated in the sump or transferred to wastewater tanks for storage and evaporation. The residual concentrated liquid waste stream will be disposed of off-site at a licensed facility.

Concern was raised about the potential environmental impacts from chemical spills. The EMP contains a Wastewater Management Plan (WWMP) and Spill Management Plan (SMP) that include secondary containment barriers where hazardous chemicals and fuel are stored. The interest holder will conduct monitoring and management to meet environmental performance standards for spills or unauthorised releases of potential contaminants at the Amungee NW and Velkerri 76 sites, with the interest holder required to report to the Department if an environmental performance standard in the EMP is not met. All wastes from the regulated activity will be transported in accordance with the WMPC Act.

2. Climate change: Some submissions raised concern about a lack of carbon offsets. The NT Government is developing a draft greenhouse gas emissions offset policy and has committed to implement recommendation 9.8 of the HFI, which relates to the offsetting of GHG from the onshore petroleum industry. Concern was also raised about the compatibility of the emissions with NT Government net zero 2050 targets. The NT government has a Climate Change Response, a Climate Action Plan and is developing an emissions reduction strategy and has developed a policy for managing emissions from new and expanding large emitters.

Concern was raised about greenhouse gas emissions, both project specific and cumulative. Each EMP is assessed on its merits and compliance with the Code of Practice in accordance with the Regulations. Greenhouse gas emissions have been considered in the assessment of the EMP. The cumulative impact assessment of greenhouse gas emissions was restricted to the current existing wells and those approved and proposed by the interest holder. It is noted that a high proportion of emissions are generated during the exploration phase from flaring during well testing.



3. Flora and fauna (environment): Concern was raised about the risk of open tanks on birds (e.g. Gouldian finch). Experience from similar operations conducted in the Northern Territory and other jurisdictions shows impacts to birdlife from open cuttings pit are considered low due to the saline nature of the water not being attractive or injurious to bird species. Based on industry experience in management of hydraulic fracturing flowback using separators and flaring prior to discharge into open tank systems in the Beetaloo, Cooper Basin in South Australia, Western Queensland and the Kimberley as well as internationally, the risk to birdlife from open tank storage of hydraulic fracturing flowback water is considered low.

Some submissions raised concern about contamination of aquifers impacting stygofauna. Hydraulic fracturing does not interact with groundwater and unlikely to have an impact on stygofauna. Interest holders are required to use only drilling fluids that are non-toxic while drilling through aquifers, in order to avoid impacts to groundwater<sup>2</sup>. The potential impact on groundwater dependent ecosystems in general is negligible, given the depth to groundwater in the location of the regulated activity is greater than 20 m (~ 89 m at Velkerri 76 S2 and 106 m at Amungee NW), the typical depth at which terrestrial groundwater dependent ecosystems are found.<sup>3</sup>

Some concern was raised about the absence of adequate baseline assessment for flora and fauna or sufficient follow-up surveys. A detailed baseline assessment of flora and fauna in the proposed areas and potential impacts from clearing were considered in the EMP. The EMP refers to flora and fauna baseline surveys conducted at Velkerri 76 and Amungee NW. Vegetation surveys have been conducted at those two sites from 2004 to 2018. These surveys involved detailed habitat assessments which included identification of vegetation community, dominant flora species at each strata, habitat condition, disturbance factors, and fauna attributes. A recent follow-up vegetation survey was conducted at the site in August/September 2021, which included the proposed disturbance areas. The interest holder used data from the NT Fauna database, data from fauna surveys undertaken elsewhere within the region and incidental fauna surveys at Amungee NW in 2021.

Concern was raised about the proximity of activities to wetland habitat of bird species, including migratory birds. The nearest wetland to the proposed activity is Lake Woods (listed in the National directory of important Wetlands), located 161 km from Amungee NW and 125 km to Valkerri 76. The closest creek to any site is Newcastle Creek, located 13 km from the Velkerri 76 S2 site. Ephemeral streams (Stream Order 1 and 2) are located over 20km from Amungee NW and along the existing Velkerri access tracks. The streams are overland flow paths that only flow for a short period during the wet season, with waterholes forming at the beginning of the dry season. Due to the separation distance from the sites to the closest watercourse, these features are unlikely to be directly impacted by the activities proposed in the EMP.

Concern was raised about the potential Impacts of fragmentation on vegetation communities. The Amungee NW and Velkerri 76 sites are 30-40 km away from the Bullwaddy Conservation Reserve and are unlikely to have a significant environmental impact. The likelihood of impact on vegetation communities from the proposed 16.24 ha of land clearing at Amungee NW resulting in fragmentation is low. Land clearing will be conducted in accordance with NT Land Clearing Guidelines. No land clearing will occur at the existing Velkerri 76 site. The vegetation communities in at and around the sites are regionally extensive and not subjected to extensive clearing.

The potential impacts to fauna from human activity was raised as an issue. It is highly unlikely that offsite impacts to wildlife will be created as a result of noise, light and traffic. The duration of drilling and HF activities is short and lighting levels will be minimised to the level required to complete work safely. Traffic volumes are expected to be small, with impact levels consistent with standard road traffic levels.

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<sup>2</sup> Department of Environment and Natural Resources and Department of Primary Industry and Resources (2019) Code of Practice: Onshore Petroleum Activities in the Northern Territory clause B.4.10.2(i), which requires only air, water or water-based drilling, and no chemicals or other substances that could leave a residual toxic effect in the aquifer are allowed to be added to the drilling fluid, when drilling through aquifers.

<sup>3</sup> Department of Environment and Natural Resources (2021) Land Clearing Guidelines, section 4.4.8.1.

Concern was raised that the potential impacts to threatened species are not fully understood. The NTG flora and Fauna Division considered that the proposed activities in the EMP do not pose a significant risk to threatened species. This assessment was based on a search of DEPWS flora and fauna databases (using a 50km buffer), environmental descriptions in the EMP and expert knowledge of species' habitat requirements.

4. Regulation and compliance: Various public submissions requested the NT EPA 'call-in' the EMP under the *Environment Protection Act 2019* (EP Act) and requested the NT government refer the EMP to the Commonwealth for assessment under the and the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EMP was considered by the NT EPA, as is reflected by this Advice, and was subject to review by a full range of NT government agencies, including by specialists in environmental impact assessment, fauna and flora, water quality and quantity, land management, bushfire, weeds, traffic, public health and social impacts. As recommended by NT EPA referral guidance, the interest holder also undertook a self-assessment against both the EP Act and the EPBC Act, and concluded a referral is not required.

Concern was raised about regulatory separation, with regards to the transparency of the WOMP. The interest holder must have a WOMP accepted by the Minister for Industry, Tourism and Trade prior to commencement of the regulated activity that will be implemented for the drilling program design, to ensure isolation of the Gum Ridge Formation and overall petroleum well integrity is achieved, verified and monitored.

Concern was raised about cumulative impacts not being considered from other exploration activities in the region ('exploration creep'). The Petroleum (Environment) Regulations do not preclude an interest holder submitting separate EMP for each activity. Each EMP is assessed on its merits and compliance with the Code of Practice in accordance with the Regulations. Cumulative impacts from greenhouse gas emissions and water use have been included in the EMP.

5. Social and cultural: Concern was raised that free prior and informed consent was not received from Traditional Owners, in addition to limited direct consultation. The interest holder conducted stakeholder engagement with Traditional Owners through the Northern Land Council (NLC) and undertaken in accordance with:
  - section 41(6) of the Aboriginal Land Rights (Northern Territory) Act 1976, when supplying information to Native Title holders for the purposes of negotiating an onshore gas exploration agreement
  - regulation 7 of the Petroleum (Environment) Regulations 2016, during the preparation of an EMP, which outlines the minimum requirements that an interest holder must meet when undertaking stakeholder engagement
  - regulation 9 of the Petroleum (Environment) Regulations 2016 during the preparation of an EMP, which requires the proponent to include an Authority Certificate in accordance with section 3 of the Northern Territory Aboriginal Sacred Sites Act 1984 (NT).

The interest holder has engaged with the Traditional Owners, NLC, and the Aboriginal Areas Protection Authority (AAPA) as part of their stakeholder engagement. They also hold an AAPA Authority Certificate that covers the proposed works areas. The EMP includes a stakeholder engagement report, which makes clear that there are processes to ensure there is no risk or impact to sacred sites and cultural heritage as a result of the proposed work.

A concern was raised about the benefits to affected communities versus environmental costs. The Regulations define 'environmental impact' as an adverse change, or potential adverse change. Beneficial effects are therefore outside of this definition.

A number of submissions commented on the lack of a 'social licence' to operate. The NT Government has worked with a range of stakeholders, including industry, to develop a transparent

and codified framework for decision making and compliance reporting of the industry. Examples of some of the initiatives being delivered through the NT Government's hydraulic fracturing Implementation Plan includes:

- increased transparency of gas companies' activities and impacts on our community or environment, through development of a new online portal as the central point for data on industry activity and environmental, social, health and cultural baselines and impacts
- publication of drilling and hydraulic fracturing EMPs for public comment, the rationale for government decisions, and environmental monitoring and compliance reporting data.

6. **Waste:** Concern was raised about overtopping of storage tanks/ponds/sumps during the wet season. The outcome intended by the Inquiry's recommendation (7.12) was that the use of enclosed tanks was to prevent the risk of open wastewater ponds overflowing during significant rainfall events. This outcome has been maintained in the Code. The NT Government sought advice from CSIRO and its scientific peers on best practice for wastewater storage. Water will be allowed into evaporation ponds to reduce the amount of water stored in tanks and the impacts of transporting large volumes offsite for subsequent treatment and disposal. This is necessary during the early stages of exploration when on-site treatment and recycling is not feasible. All storage tanks will be designed and engineered to meet Australian Standards and the Code. Tanks are a fully engineered storage solution, including meeting secondary containment being double-lined or double-walled. Storage tanks and pits are designed and operated to prevent overtopping due to rainfall and drill cutting sumps include sufficient freeboard to accommodate in excess of the anticipated rainfall based on a 1:1000-year Average Recurrence Interval (ARI) for the duration of the regulated activity. In conclusion, the risk of overtopping is considered low.
7. **Water:** Concern was raised about well casing corrosion. In accordance with clause B.4 of the Code, all onshore shale gas wells (including exploration wells constructed for the purposes of production testing) have mandatory requirements for well construction, with cementing extending up to at least the shallowest problematic hydrocarbon bearing, organic carbon rich or saline aquifer zone.

Concern was also raised about contamination of aquifers and connected surface water (e.g. Lake Woods). In accordance with the Code clause B.4, all onshore shale gas wells (including exploration wells constructed for the purposes of production testing) are to be constructed to international standards, with cementing extending up to at least the shallowest problematic hydrocarbon-bearing, organic carbon rich or saline aquifer zone. The EMP outlines the controls identified in the Well Operations Management Plan (WOMP) that will be implemented for the drilling program design to ensure isolation of the Gum Ridge Formation, aquifer protection and overall petroleum well integrity is achieved. These include:

- development of critical controls and hold points throughout the well construction process that will need verification by a competent person prior to proceeding to the next operation
- barrier verifications and monitoring throughout well construction, maintaining primary and secondary well control measures
- a cemented production casing string that will provide an additional barrier between producing hydrocarbon bearing zones and shallow aquifers, with pressure testing once the cement is set to ensure overall integrity of the production casing
- multiple strings of steel casing with each casing string cement grouted to the surface and multiple engineered and system mitigations to adequately detect water quality threats to the Gum Ridge Formation and Anthony Lagoon aquifers
- well barrier integrity validation testing for each well with a report demonstrating compliance with the Code to be provided to the regulator (DITT) for approval

Development of the Amungee NW-1H and Velkerri 76 wells has verified the distances between aquifers and hydraulic fracturing will be greater than 1 km, minimising groundwater pathways/contamination. The well design and construction method described in the EMP surpasses the requirements of the Code for protection of aquifers. The interest holder will install control and impact groundwater monitoring bores in the vicinity of the exploration wells, with monitoring results

made public. A Well Integrity Management Plan and a Well Operations Management Plan (WOMP) is provided separately to this EMP and sent to DITT for review and acceptance prior to works commencing.

These plans will only be accepted if they comply with the requirements detailed in the Code. As per the Code, the interest holder must demonstrate that they have a system or process for managing well integrity throughout the whole well life cycle that complies with ISO 165301:2017 Well integrity - Part 1: Life cycle governance.

## **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 interest holder be required to submit an updated timetable for the regulated activity to the Department, on a quarterly basis.

## **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 Origin Energy B2 Pty Ltd be approved, the Minister considers approval conditions to achieve the following outcomes:

1. Provision of regular timetable 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. 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.
6. Groundwater level/pressure monitoring at impact monitoring bores to support of section 16 of the *Water Act 1992* (NT) and clause B.4.2 of the Code.
7. Flowback fluid risk assessment and reporting to consider the impacts and risks to fauna and potential for soil and water contamination from a loss of containment.



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11 May 2022