ntepa Northern Territory Environment Protection Authority

# Statement of Reasons

**ORIGIN ENERGY LIMITED – ENVIRONMENT MANAGEMENT PLAN (EMP) FOR THE BEETALOO BASIN DRILLING, HYDRAULIC FRACTURE STIMULATION AND WELL TESTING PROGRAM 2019 – 2024: KYALLA EP117 N2**

## PROPOSAL

The Environment Management Plan (EMP) for the Beetaloo Basin drilling, hydraulic fracture stimulation[1] and well testing program Kyalla Exploration Permit (EP) 117 N2 (the Proposal)[2] was prepared by Origin Energy Limited (the Proponent)[3] and referred to the Northern Territory Environment Protection Authority (NT EPA) on 1 May 2019 for consideration under the Environmental Assessment Act 1982 (EA Act).

The program occurs at one well location (N2-1) on the Kyalla EP117 N2 lease pad/site, and includes:

- drilling of an exploration well
- hydraulic fracture stimulation of an exploration well
- completion and workover maintenance of an exploration well
- well testing of an exploration well
- well suspension and decommissioning of an exploration well
- construction and operation of a temporary camp
- installation of up to two water extraction bores
- routine maintenance and monitoring activities
- minor ancillary works associated with the above activities

The target formation, the lower Kyalla Shale Source Rock (SSR), lies approximately 1,420 m below the Gum Ridge aquifer. The intermediate vertical pilot section exploration petroleum well will reach an approximate depth of 1,875 m before being plugged back with cement to a kick-off point for drilling a horizontal well section. The total depth for the production hole section is likely to be reached at approximately 2,000 m below the surface and extend up to 3,000 m laterally within the reservoir.

This Proposal will use an estimated 38 megalitres (ML) of groundwater sourced from existing up-gradient control bore RN040895 and future impact groundwater monitoring bores will be installed 20 m down-gradient of the petroleum well prior to the commencement of hydraulic fracture stimulation activities in accordance with the Code of Practice: Onshore Petroleum Activities in the Northern Territory (the Code).[4] The Proponent has estimated approximately 76,500 tonnes of carbon dioxide equivalent ($tCO_2e$) emissions from the regulated activities.

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1 Hydraulic fracture stimulation means the underground gas and oil extraction process that involves the injection of fluids at high pressure into a geological formation to induce fractures that conduct hydrocarbons for extraction.

2 'Proposal' has the same meaning as 'Regulated Activity' under the Petroleum Act 1984.

3 'Proponent' has the same meaning as 'Interest Holder' under the Petroleum Act 1984.

4 The Code is available at: https://denr.nt.gov.au/environment-information/onshore-gas-in-the-northern-territory.

The well is planned to be drilled in 2019 with finalisation of the well testing activities in December 2020. On completion of well evaluation, the well will either be suspended for future re-entry, suspended or decommissioned with permanent cement plugs, in accordance with the requirements outlined in the Code. Decommissioning and rehabilitation are planned for December 2024.

The Proposal includes drilling, hydraulic fracture stimulation and well testing.

Surface water contamination pathways have been mitigated through initial site selection, which focussed on avoidance of sensitive areas and clearing of a relatively small disturbance footprint for the lease pad area (4.5 ha). The Proposal is situated on higher ground than the surrounding areas and measures have been taken to avoid surface water flow impacts, including the design of the bunded well site area to divert any overland flow around the well pad. No land clearing or civil works are proposed under the scope of this EMP, other than minor maintenance.

## CONSULTATION

The EMP has been reviewed as a notification under the EA Act in consultation with Northern Territory Government (NTG) advisory bodies (Attachment A) and the responsible Minister, in accordance with clause 8(1) of the Environmental Assessment Administrative Procedures.

The Proposal includes the drilling and hydraulic fracture stimulation of a petroleum exploration well. In accordance with the Petroleum (Environment) Regulations 2016, the EMP was made available for public comment for a period of 28 days from 3 – 30 May 2019. During the public comment phase, the department received 6,311 submissions, consisting of 6,284 submissions (form email letters) via internet campaigns and 27 submissions via the advertised Department of Environment and Natural Resources public engagement modes. Submissions were received from community members, business entities and non-government organisations.

An overview of the key topics raised during the public consultation is provided under **Public consultation**. The NT EPA has reviewed the public submissions as part of its decision-making and when making recommendations to the Minister.

## JUSTIFICATION

The NT EPA assessed the potentially significant environmental impacts and risks associated with the Proposal in line with the NT EPA's environmental factors and objectives, and in accordance with the requirements under the EA Act. The NT EPA identified seven environmental factors that could be significantly impacted by the Proposal (Table 1). The NT EPA considered other environmental factors during the course of its assessment, however those factors were not identified as potentially significantly impacted.

*Table 1: Key environmental factors considered for this assessment*

| Theme | Environmental factor | Objective |
|---|---|---|
| Water | Inland water environmental quality | Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected. |
| | Hydrological processes | Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected. |
| Land | Terrestrial flora and fauna | Protect NT's flora and fauna so that biological diversity and ecological integrity are maintained. |
| | Terrestrial environmental quality | Maintain the quality of land and soils so that environmental values are protected. |

| Theme | Environmental factor | Objective |
|---|---|---|
| People and Communities | Human health | Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated. |
| | Social, economic and cultural surroundings | Protect the rich social, economic, cultural and heritage values of the Northern Territory. |
| Air quality | Air quality and greenhouse gases | Maintain air quality and minimise emissions and their impact so that environmental values are protected. |

## 1. Inland water environmental quality

**Objective:** Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.

Potential impacts to inland water quality (surface water and groundwater) and aquifers, from multiple pollutant pathways have been assessed by the Proponent, including:

- storm water run-off
- wastewater spills from open tanks
- contaminants from flowback fluids
- radon decay products
- contaminants from hydraulic fracturing fluids

***Surface water***

The closest pastoralist bore is located 16 km upstream from the Proposal. The closest major creek system to the proposal site is Newcastle Creek approximately 60 km downstream from the proposal area. The EMP identifies a number of small ephemeral streams (Stream Order 1 and 2) located along existing access tracks. The streams are overland flow paths that only flow for a short period during the wet season. Lake Woods lies approximately 100 km south of the proposed activity. Spills and/or loss of containment from the activity impacting on sensitive receptors, are considered unlikely and low.

The EMP specifies that wastewater and sewage will be managed via transport offsite to a licensed disposal facility. The exploration lease pad and camp pad will be surrounded by a 1.2 m bund to contain and prevent overland flow of contaminants in the event of a major spill. Pad surfaces will be engineered and compacted for machinery stability and to minimise impacts of infiltration from spills. Stormwater run-off from the pad will be collected in purpose built retention ponds and will be used onsite for dust suppression or released, after water quality testing confirms it meets stormwater release limits. Activity specific Wastewater Management and Spill Management Plans have been developed. These sub plans include secondary containment barriers where hazardous chemicals, liquids and fuels are stored in accordance with the Code.

NT Government advisory agencies have assessed the potential impacts to downstream environments and advised that considering the distance of the proponent's lease pad from sensitive receptors, and risk mitigation measures outlined in the EMP, the proposed activities have no likely foreseeable impacts.

*Wastewater management*

Proposed water management on site involves the use of three above ground enclosed tanks of 3.5 ML capacity each and one 2.9 ML above ground open evaporation tank to reduce the amount of wastewater required to be disposed of offsite and the subsequent impacts of transporting large

volumes offsite. Large pumps will be installed, capable of transferring the entire volume of a single open tank to closed tanks within eight hours. Pumping capacity is approximately 16,000 L per minute (23 ML per day). All flowback fluid will be transferred to enclosed / covered tanks within 72-hours when a significant rainfall event is predicted.

The storage volume of the enclosed tanks will be maximised during the wet season to reduce potential risk of overtopping, in accordance with the Code. As outlined in the EMP, the estimated residual volume of wastewater (3.6 ML) will be transported offsite to an interstate treatment facility when safe to do so.

The Proponent will be required to monitor and report the characterisation and analysis of flowback fluid in accordance with the Code, within one month of commencement of flowback for publishing on the DENR onshore petroleum webpage.[5]

The Spill Management Plan outlines estimated volumes of hazardous materials, required storage and containment practices and a spill response strategy. Wastewaters including drilling mud and flowback fluid during activities will be managed in accordance with the Waste Water Management Plan and subsequent mitigation measures including:

- marking of drill cutting sumps with the Maximum Water Level (MOL)
- Coletanche®, composite lined drill cutting and drilling mud/fluid sump
- above ground double lined flowback storage tanks with built-in leak detection
- daily inspections of all wastewater storages during operations
- daily monitoring of open evaporation tank level, with management response criteria implemented in the event of forecasted wet weather including transfer to enclosed / covered tanks within 72-hours
- shutting in operations (i.e. ceasing any flowback operations) where freeboard requirements cannot be met

*Drill cuttings and drilling fluids*

Approximately 700 $m^3$ of drill cuttings solids and up to 2,400 $m^3$ of drilling fluids, comprised of drilling mud and saline well control fluid, will be generated as a result of drilling the exploration well. Drilling fluids are saline and polymer/bentonite based. All drilling will be conducted using water-based muds (WBM) that exclude BTEX substances. No chemicals or other substances that could leave a residual toxic effect will be used while drilling through aquifers. The primary contaminants associated with drilling operations are likely to be from elevated hydrocarbons during drilling of the horizontal section of the well and these cuttings will be segregated in the drilling sump; and from chlorides (e.g. potassium chloride and sodium chloride) in the residue drilling mud at the end of the drilling operation. In accordance with the Code, third party leachability testing will be undertaken on drilling muds and cuttings to determine the most appropriate method of disposal.

The minimum engineered design standard for the drill cuttings/mud sump includes a composite geofabric lining to meet the sump liner barrier requirements prescribed in the Code including a coefficient of permeability of less than $10^{-9}$ m/s tested in accordance with AS 1289.6.7.2 and with resistance to tearing >0.5 kN (ASTM D4073); static puncture >0.5 kN (ASTM D4833) and tensile strength >20 kN/m (ASTM D7275). Sumps are also designed with a 1:1000 ARI or 1.3 m freeboard which meets requirements of the Code. Potential storm water overland flow into the drilling sump is prevented by bunding around the well site.

[5] DENR onshore petroleum website: https://denr.nt.gov.au/environment-information/onshore-gas-in-the-northern-territory.

*Hydraulic fracturing fluid*

Up to 20 hydraulic fracturing stages are proposed to be pumped along the horizontal section of the Kyalla well. It is anticipated that each stage will require one day to complete. The maximum total of water and sand required per hydraulic fracturing stage is 1.3 ML and 180 tonnes, respectively. Other chemical additives (excluding BTEX substances)[6] will be used in the hydraulic fracturing fluid. Each stage will comprise approximately 94% water, 5% sand and 1% chemicals by volume. The list of chemical additives that may potentially be used in the hydraulic fracturing fluid, including a specialist independent, tiered risk assessment of these chemicals is provided as Appendix C to the EMP.

*Flowback fluid*

Upon completion of hydraulic fracture stimulation the petroleum well will be allowed to flowback from the stimulated reservoir under controlled conditions. Storage of flowback fluid must be undertaken in accordance with the Code. This includes a minimum freeboard of 1.3 m for storage tanks to accommodate total rainfall anticipated (based on 1:1000 year average recurrence interval rainfall estimates for the period that tanks contain wastewater). In this case the freeboard required to be maintained in storage tanks for flowback fluid is more than 200% of the total average annual rainfall in the region.

Key management controls for flowback include:

- the use of a three phase separator to separate entrained gas, hydrocarbon liquids and saline flowback water
- flaring of entrained gas and condensate via a horizontal flare flume
- storage of condensate hydrocarbon liquids in self-bunded double skin tanks as per AS 1940
- approximate onsite storage capacity of 120,000 L
- four above-ground double lined waste water storage tanks with leak detection
- waste water storage tanks will comprise three enclosed 3.5 ML tanks and one open top 2.9 ML evaporation tank, each 2 m high, designed for local environmental conditions such as wind loading and bushfires as described in Appendix A of the EMP
- large pumps capable of transferring the volume of a single waste water storage tank in eight hours based on a forecast significant rainfall event[7] (approximately 16,000 L/minute or 23 ML/day)
- flowback fluid will be evaporated down to as small a volume as possible and maintained to levels below the minimum freeboard requirement; residual flowback fluid and precipitate on the bottom of the tanks will be vacuum pumped to tanker trucks for transport
- the waste water, estimated to be up to 3.6 ML, will be transported interstate to a licensed treatment facility in accordance with licensing requirements of the NT Waste Management and Pollution Control Act and Queensland Environmental Protection Act 1994

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6 The Code outlines prescribed levels of benzene, toluene, ethylbenzene or xylene (BTEX) that must not be exceeded during drilling and hydraulic fracture stimulation.

7 The definition of a 'significant rainfall event' used by the Proponent aligns with the requirements of the Code: "*The 7 day Bureau of Meteorology 4 day total rain forecast* and will be reviewed daily to identify periods of significant rainfall. Significant rainfall as defined in this WWMP is for an event where greater than 300 mm of total rainfall is predicted over a 4 day period. This type of rainfall level is consistent with that from a significant rainfall event; such as a monsoonal trough, tropical low or a cyclone. Commencement time to transfer the flowback fluid will be selected to ensure that it is completed at least 8 hours prior to the predicted commencement of the significant rainfall event.

*Approximate composition of flowback fluid*

Reports on laboratory analysis of a suite of more than 100 analytes tested in flowback fluid from two previously hydraulically fractured petroleum exploration wells in the Beetaloo sub-basin were reviewed by DENR. Contaminants of potential concern in the flowback fluid, due to their persistence and higher toxicity in the environment, including heavy metals (such as arsenic, cadmium, chromium and mercury) and polyaromatic hydrocarbons (such as benzo-a-pyrene) were below limits of reporting. In terms of composition, the flowback was found to be comprised of approximately 93% sodium chloride, 5.3% calcium carbonate, 0.8% magnesium chloride, 0.25% barium sulphate, 0.2% potassium chloride and 0.12% boron, which collectively accounts for 99.67% of the flowback fluid.

The NT EPA will provide advice to the Minister that the results of monitoring and reporting on the characterisation and analysis of flowback fluid is provided to DENR within one month of commencement of flowback for publishing on the DENR webpage.

*Naturally occurring radionuclide material*

Naturally occurring radioactive material (NORM) such as uranium, radium, and radon and associated decay products are dissolved in very low concentrations during normal reactions between water and rock or soil. Routine assessment for presence of NORM is conducted by measuring gross alpha and gross beta concentrations measured in becquerels (Bq)/L and compared to a range of standards such as drinking water guidelines; 1 Bq is equivalent to one nuclear disintegration per second. The analytes specified in the Code for groundwater monitoring, drilling material assessment and flowback assessment include the requirement for assessment of gross alpha and gross beta as a means of detecting and evaluating NORM levels. The baseline groundwater monitoring of the Gum Ridge Aquifer conducted at the proposed well site shows that gross alpha slightly exceeds (up to four times) the drinking water guideline of 0.5 Bq/L. This is not unusual in aquifers where concentrations of dissolved constituents can build up during prolonged periods of water/rock contact. While radon has a relatively short half-life measured in days, the decay product lead-210 has a much longer half-life because it is more stable and consequently emits orders of magnitude less radiation than radon. The NHMRC health guideline value for lead-210 in drinking water is 0.01 mg/L (10 µg/L).[8]. Groundwater monitoring of the Gum Ridge Aquifer conducted at the proposed well site by the Proponent shows that lead levels were generally less than 0.01 µg/L.

***Groundwater***

*Anthony Lagoon Aquifer and Gum Ridge Aquifer*

The Kyalla petroleum well will intersect two key regional aquifers, namely the Anthony Lagoon Aquifer and the deeper and more regionally extensive Gum Ridge Aquifer. Both are karstic to cavernous in nature. The petroleum well is designed to isolate the Anthony Lagoon Aquifer from surface infiltration and the deeper Gum Ridge Aquifer by means of cemented steel conductor casing. The Gum Ridge Aquifer will be isolated from the deeper formations by means of a cemented surface casing as well as a cemented intermediate and production casing.

*Bukalara Aquifer*

The Bukalara Aquifer, which lies below the Gum Ridge Aquifer in this location is not presently intersected by any known water bores. Water quality and production are likely to be marginal based on records from previous petroleum wells drilled in the area. However, the petroleum well design has ensured that the Bukalara Aquifer will be isolated from the important surficial aquifers, namely the Anthony Lagoon Aquifer and the Gum Ridge Aquifer, and the deeper hydrocarbon zone by means of three well barriers (namely the surface, intermediate and production steel casing and associated annulus cementing). The surface casing will extend down below the Bukalara Aquifer to the Hayfield formation which is a mudstone aquitard thus ensuring isolation from deeper hydrocarbon bearing

[8] NHMRC, NRMMC 2011. *Australian Drinking Water Guidelines 6 National Water Quality Management Strategy.* Version 3.6 Updated August 2018. https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines#block-views-block-file-attachments-content-block-1

formations. In addition the base of the Bukalara Aquifer is separated from the target hydrocarbon formation for hydraulic fracture stimulation by more than twice the minimum vertical separation distance of 600 m required by the Code, including a number of thick aquitards, thus ensuring that hydraulic fractures cannot intercept the aquifers, located over 1 km above the shale gas resource.

*Contamination of groundwater from hydraulic fracturing fluids*

All drilling and hydraulic fracture stimulation activities will be undertaken in accordance with the Code. Engineering parameters associated with well construction and integrity are described in the Well Operations Management Plan (WOMP). The WOMP is a specialised engineering management plan that must be prepared and submitted for approval and oversight by the regulator, the Department of Primary Industry and Resources (DPIR), prior to well construction. The key elements of the WOMP to ensure ongoing environmental protection of aquifers include detailed engineering controls and well acceptance criteria to ensure overall integrity of the completed well. The WOMP also provides for ongoing well integrity monitoring and verification through the life-cycle of the well(s) as specified in the Code.

Strict well construction and well integrity practices are mandated in the Code to mitigate potential impacts from drilling and hydraulic fracture stimulation, such as contamination to, or mixing of, groundwater aquifers, such as the Anthony Lagoon and Gum Ridge aquifers within the Cambrian Limestone Aquifer (CLA) system. Examples of primary mitigation measures described in the EMP include:

- initial development of well acceptance criteria used to verify the integrity of all well barriers established and designed to prevent uncontrolled flow of fluids and hydrocarbons into another formation, or to escape at surface
- drilling rig, comprising a rig floor, mast or derrick, rig engine, and Blow Out Preventer (BOP) system to maintain well control during pressure events
- surface, intermediate and production casing strings cemented to surface to provide hydraulic isolation between the casing and formation (i.e. multiple barriers in place to prevent cross-flow of formation fluids between aquifers and hydrocarbon zones)
- intermediate and production strings will have premium casing connections to ensure redundancy in the unlikely case of a leak from the production casing
- construction of the well to international standards and tested to ensure well integrity before and after hydraulic fracture stimulation, with the well barrier integrity validation test results certified by the regulator and publicly disclosed online
- installation of control monitoring bores prior to drilling the well, located approximately 100 m up-gradient of the proposed well screened in the Anthony Lagoon and Gum Ridge aquifers for baseline and ongoing background water quality monitoring and impact monitoring bores 20 m downgradient of the petroleum well in the Anthony Lagoon and Gum Ridge aquifers prior to hydraulic fracture stimulation

The NT EPA will provide advice to the Minister that the Proponent must demonstrate ‘no change’ in the natural range of values in baseline groundwater quality as a result of the regulated activity at the Kyalla well site.

The exploration well will have multiple strings of steel casing with each casing string cement grouted to the surface and multiple engineered and system controls to mitigate water quality threats to the CLA. The NT EPA will provide advice to the Minister on the provision of a cementing completion report to DENR for the 13-3/8” steel conductor casing through the Anthony Lagoon and Gum Ridge aquifers.

Hydraulic fracturing fluid chemicals in the chemical risk assessment were identified not to be persistent and bioaccumulative and in very low concentrations. Inorganic chemicals such as acids will be

neutralised in the reservoir and organic chemicals (such as biocide to prevent introduction of groundwater bacteria to the petroleum reservoir), will decay at the very high temperature and pressure in the reservoir and during evaporation. (Chemicals are further discussed in section 3 **Human Health** and section 4 **Terrestrial flora and fauna**.)

Additional mitigation measures committed to in the EMP include a groundwater monitoring program in the lease pad area, compliant with the Code. As outlined in the Code, this consists of a control monitoring bore array, located up-gradient and within 100 m of the planned or existing location of a petroleum well pad; and an impact monitoring bore array, screened at similar depths to the control monitoring bore array, 20 m down-gradient of the location of the petroleum well. This layout enables ongoing comparison of background groundwater quality with that immediately downstream of the petroleum well. One monitoring bore is required for each discrete aquifer unit, which is screened near the top, middle and bottom of the vertical extent of that unit. In the Beetaloo Basin this may include the Anthony Lagoon Aquifer and the deeper regional Gum Ridge Aquifer. Water is sampled from each of these monitoring bores on a quarterly basis and analysed at a NATA accredited laboratory for an array of analytes, including Total Dissolved Solids, chloride, electrical conductivity, boron, strontium, barium, NORM and dissolved methane. Monitoring will continue for three years and all groundwater monitoring data will be published quarterly on the DENR website.[9] The baseline dataset will provide for the establishment of well site-specific performance targets to ensure there is no change to existing water quality as a result of the activity. The NT EPA will provide separate advice to the Minister on this matter in relation to ongoing groundwater monitoring performance requirements at the Kyalla well site.

As outlined above, all onshore shale gas wells (including exploration wells constructed for the purposes of production testing) will be constructed to international standards, with cementing extending up to at least the shallowest problematic hydrocarbon-bearing, organic carbon rich or saline aquifer zone. Engineering parameters associated with well construction and integrity will be described in the WOMP, which will be prepared and submitted for approval to DPIR well engineers, prior to well construction. The key elements of the WOMP to ensure ongoing environmental protection of aquifers are included in the EMP risk mitigation and monitoring measures.

*NT EPA Assessment*

Provided that the mitigation and management measures outlined in the EMP are implemented and all drilling and well operations occur in accordance with the Code and the WOMP approved by DPIR, the NT EPA considers that the proposal is unlikely to have a significant impact on surface water and groundwater quality, and the NT EPA's objective for inland water environmental quality is likely to be met.

### 2. Hydrological processes

**Objective:** Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

Hydrological processes include the occurrence, distribution, connectivity, movement, and quantity of water. The main potential impact pathways to these processes include:

- groundwater drawdown leading to over extraction of groundwater
- contamination of aquifers during hydraulic fracturing via existing geological faults
- contamination of groundwater during hydraulic fracturing affecting groundwater dependent ecosystems
- cumulative impacts from groundwater extraction

[9] See Preliminary guideline: Groundwater monitoring bores for exploration petroleum wells in the Beetaloo Sub-basin: https://denr.nt.gov.au/environment-information/onshore-gas-in-the-northern-territory/guidelines

The Controller of Water Resources has issued a groundwater extraction licence under section 60 of the Water Act 1992 to the Proponent for 175 ML per year for three years from May 2019 to December 2023. A condition of the groundwater licence is a requirement for metering on all water bores used for the regulated activity and annual reporting to DENR of the quantity of water extracted. Groundwater extraction is informed by the NT Water Allocation Planning Framework, which indicates the volume of groundwater held in storage in the Gum Ridge Aquifer is estimated to range from 1,766,000 GL to 3,532,000 GL.

The Framework states the total extraction over the period of at least 100 years should not exceed approximately 1,412,800 – 2,825,600 GL. Cumulative groundwater extraction from the Gum Ridge Aquifer from May 2019 to December 2023 is predicted to be approximately 1,492.5 ML, significantly less than the estimated water available for extraction under the Framework. The Proponent's licence allocation of 175 ML per year is less than 0.01% of cumulative current groundwater extraction from the Gum Ridge Aquifer.

In addition, there is limited demand for groundwater for domestic water in the vicinity of the Proposal. Approximately 300 ML of water per year is estimated for domestic and stock water use including 100 ML for 26 homesteads and 200 ML from the Gum Ridge Aquifer for the township of Elliott. Due to the remote location and pastoral land use in the area, future domestic demand is unlikely to change significantly.

*Hydrogeology*

Groundwater from the CLA – Gum Ridge Aquifer will be extracted from two bores on the lease pad. The estimated groundwater volume required for the proposed activities is 38 ML. Research tabled during the Hydraulic Fracturing Inquiry (HFI) indicates that the combined current groundwater extraction and projected demand for gas development in the Beetaloo Basin represents 7% of the estimated water resource available from the CLA.[10] Based on transmissivity analysis completed by the Proponent, the proposed 30 ML per year take is well within sustainable recharge levels, noting that the nearest sensitive receptor is a pastoralist bore situated 16 km from the Proposal.

The majority of the groundwater usage occurs during well hydraulic fracture stimulation (up to 15 ML). To minimise groundwater use, drilling mud will be recycled during the drilling activities. The drilling mud that returns to the surface will be separated from drill cuttings using shale shakers and screened through sieves, before being transferred to the closed mud recycle system for reuse.

DENR Water Resources Division has reviewed the EMP. The proponent must follow the Minimum Construction Requirements for Water Bores in Australia (2012) and any other guidance provided by the NT Government relating to groundwater extraction and monitoring for onshore gas projects.

DENR Water Resources Division has assessed the Proponent's groundwater extraction licence application that includes groundwater for drilling, hydraulic fracture stimulation and well testing. The assessment indicates groundwater extraction for the Proposal will have negligible drawdown impacts. Groundwater extraction volumes will be recorded and submitted to the DENR Water Resources Division, in accordance with the requirements of the relevant groundwater extraction licence. Groundwater level at the well site groundwater monitoring bores will be reported quarterly and published on the DENR website.[11]

[10] Fulton, S & Knapton, A, 2015. *Beetaloo Basin Hydrogeological Assessment.* Report by CloudGMS, February 2015.

[11] See Preliminary guideline: Groundwater monitoring bores for exploration petroleum wells in the Beetaloo Sub-basin: https://denr.nt.gov.au/environment-information/onshore-gas-in-the-northern-territory/guidelines

*Geological faults*

The EMP outlines mitigation measures that are to be implemented to avoid major faults, prior to both drilling and hydraulic fracture stimulation operations. The Proponent has committed to assess geohazards via the following steps:

- *Locating exploration wells:* Exploration well location is informed by more than 9,500 km of 2D data used to screen for large scale, regional faults or structures prior to the finalisation of any exploration well location. Current data of the broader Beetaloo exploration area indicates there are very few major faults present and that the strata within the Basin (i.e. away from the steep flanks) are relatively gently dipping. There are no identified faults with significant propagation length within Origin's Kyalla play fairway.
- *Stratigraphic definition at the well site:* An accurate understanding of what aquifers exist at the well site and their depth from surface, and their relationships to each other and other hydro-stratigraphic units during the well design phase has been informed by the drilling of control groundwater monitoring bores at the Kyalla well site as required in the Code
- *Geohazard assessment during drilling:* Small scale formation offsets that are not previously identified, may be encountered during the drilling operations and are managed via depth correction while drilling and hydraulic fracture stimulation stage spacing. Logging while drilling will enable detection of faults and other potential loss zones.
- *Geohazard assessment post drilling:* Prior to completing hydraulic fracture stimulation, geological data is analysed to determine the presence of minor and major faults which may pose a hazard to hydraulic fracture stimulation activities. Faults encountered during drilling are risk assessed to determine whether the hydraulic fracture stimulation activities can occur safely, or whether the well bore needs to be moved / removed to isolate the fault.
- *Real-time monitoring of pressure during hydraulic fracture stimulation:* Pressure data provides a tool to prevent fault activation and fluid / pressure communication out of the target interval. If anomalous pressure behaviour is observed, hydraulic fracture stimulation operations can be ceased immediately. This prevents any substantial volume of fluid or proppant from being pumped into an open geological structure.

Monitoring of seismic events will be undertaken using the Geoscience Australia's Waramungu seismic array located approximately 300 km from the proposed Kyalla 117 N2 well pad.

*Groundwater dependent ecosystems*

Groundwater discharges from the Gum Ridge Aquifer are associated with groundwater dependent ecosystems of Bitter Springs and Rainbow Springs located near Mataranka over 200 km north of the Kyalla well site. Modelling undertaken by DENR concluded that the proposed extraction would cause no change in reliability of spring flows to Bitter Springs or Rainbow Springs, or other indicator sites located at Elsey National Park and Red Rock in the Roper River.

A study by Cooke & Eamus (2018)[12] indicates that terrestrial groundwater dependent ecosystems generally access water to depths of 15 - 20 metres below ground level. The standing water level of the shallowest aquifer, the Anthony Lagoon Aquifer is measured at 64 metres below ground level at the Kyalla well site, which is outside the reaches of terrestrial groundwater dependent ecosystems.

*Cumulative Impacts*

The estimated quantity of groundwater required for the Proposal is 38.0 ML. This volume combined with the 20.0 ML estimated for works proposed under a separate, previously approved Civil Construction EP117 N2 EMP[13], totals a cumulative groundwater requirement of 58.0 ML. This water

[12] Cook, PG and Eamus, D (2018). The Potential for Groundwater Use by Vegetation in the Australian Arid Zone.

[13] The Kyalla civils EMP received ministerial approval on 6 June 2019. Approved EMPs are available at: https://denr.nt.gov.au/environment-information/onshore-gas-in-the-northern-territory/environment-management-plan/approved-emps

extraction licence volume includes allowance of water requirements for all activities, and is well within the volume of groundwater the Proponent is permitted to extract under its water extraction licence of 175 ML/year.

*NT EPA Assessment*

Provided that the conditions of the water extraction licence are complied with and mitigation and management measures outlined in the EMP are implemented, the NT EPA considers that the Proposal is unlikely to have a significant impact on the groundwater hydrological regime in the region, and the NT EPA's objective for hydrological processes is likely to be met.

### 3. Human Health

**Objective:** Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.

Potential impacts to human health were identified from hydraulic fracturing chemicals entering aquifers that are known groundwater sources for community and/or livestock. As discussed under section 2 **Hydrological processes**, there is currently limited demand for groundwater for domestic water in the vicinity of the Proposal from the Gum Ridge Aquifer.

*Chemicals*

A full chemical risk assessment for all drilling and hydraulic fracturing chemicals (EMP Appendix C) was completed in accordance with the following guidance:

- NT Government, Department of Environmental and Natural Resources, Draft Guideline for the Preparation of an Environmental Management Plan under the Petroleum (Environment) Regulations, 2019
- Department of the Environment and Energy, Exposure Draft - Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction, 2017
- National Industrial Chemicals Notification and Assessment Scheme (NICNAS), National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, 2017
- enHealth "Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards", 2012
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM); Schedule B4, Site-specific health risk assessment methodology, 2013

As outlined previously, the majority of the chemicals were identified not to be persistent and bioaccumulative and in very low concentrations with inorganic chemicals being quickly neutralised and organic chemicals quickly denaturing under high temperature and pressure. The flowback fluid consists chiefly of salts, metals and petroleum products (which are separated or flared) that originate in the reservoir. Management of bacteria during the well suspension phase must be undertaken in accordance with the Code. The only chemical to undergo a Tier 2 chemical risk assessment was Hydrotreated light petroleum distillate, which was classified as a bioaccumulative and toxic substance. As per NICNAS (2017)[14] and DOE (2017)[15] guidance, the Margin of Exposure approach (MOE) was used to assess the health risk to workers, derived from each occupational activity scenario (i.e. transport and storage, mixing/blending drilling of hydraulic fracturing chemicals, injection of drilling

[14] NICNAS, 2017. *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia*. Department of Health National Industrial Chemicals Notification and Assessment Scheme.

[15] Department of the Environment, 2017. *Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction*. Australian Government, Department of Energy.

chemicals and cleaning and maintenance). Based on the calculated MOEs the chemical is of low concern for workers.

The chemical risk assessment identified 18 chemicals in flowback fluid generated during well hydraulic fracture stimulation will require management, due to their volume of use and elevated concentrations that were above ecotoxicity values. These chemicals are used for various purposes, including but not limited to: surfactants, scale inhibitors, corrosion inhibitors, crosslinkers, and biocides. None of these chemicals were identified to be persistent and bioaccumulative and they will be managed in accordance with the Waste Water Management Plan and disposal program.

Mitigation measures associated with well construction and integrity to minimise potential impacts to human health, including development of the WOMP have been addressed under section 1 **Inland water environmental quality** and section 2 **Hydrological processes**. Ongoing well integrity monitoring and verification through the life-cycle of the well(s) is required under the WOMP as specified in the Code. Procedures for the handling of chemicals at surface during preparation of hydraulic fracturing fluid for each stage are provided in the WOMP for DPIR approval. NORM and radon decay products in flowback and produced water have been addressed previously in section 1 **Inland water environmental quality**.

*NT EPA Assessment*

The NT EPA considers that the potential impacts and risks to human health can be mitigated through implementation of the management measures presented in the EMP and that its objective of ensuring that the risks to human health are identified, understood and adequately avoided and/or mitigated is likely to be met.

### 4. Terrestrial flora and fauna

**Objective:** Protect NT's flora and fauna so that biological diversity and ecological integrity are maintained.

The EMP risk assessment is based on baseline surveys from 2004 – 2018. The terrestrial vegetation is bloodwood (Corymbia) low woodland with a tussock grass understorey community. This community is regionally extensive, intact and free of weeds at the proposal site. During assessment of Origin's Kyalla Civil Construction EP117 N2 EMP,[13] the area of disturbance for the proposal was assessed as non-critical habitat, based on regional extensiveness and lack of sensitive, significant or essential vegetation/habitat types. Impacts to threatened species were also evaluated during assessment of the Origin's Civil Construction EP117 N2 EMP and deemed unlikely to result in significant impacts to regional populations.

Potential impacts and risks to flora and fauna from the Proposal include increases in key threatening process such as cane toads and bushfires. Potential impacts and risks to the welfare of fauna include entrapment in cuttings pits of individual animals or ingestion of contaminated water/materials collected during drilling and hydraulic fracturing.

*Fire*

The whole area is subject to periodic fires, with almost the whole region having been burnt at some time in the last decade. The property falls with the Savanna Fire Management Zone. When a Fire Danger Period has been declared, no burning may take place except where a permit to burn has been obtained from a fire control officer or a fire warden. A fire management plan has been developed for EP117.

Effective fire management requires the fire management plan be implemented, including that fire suppression equipment be available and that fire control zones, established around each of the well sites, be cleared of vegetation and maintained to limit the risk of fire spread during project activities. EMPs must comply with the Code and regional management plans, developed in accordance with the Bushfires Management Act 2016. The main firefighting suppressant will be water. Areas such as the camp will have hand-held fire extinguishers installed in accordance with Australian Standards and based on fire class category.

In relation to flaring, the Proponent has committed to undertaking horizontal flaring into a flume and water curtain, as requested by DENR. This method reduces condensate carry-over and the potential for the flare to be a bushfire ignition source.

***Animal welfare***

*Entrapment and/or ingestion of drilling fluids and flowback wastewater*

Drilling fluids drawn from the well are composed primarily of cuttings and muds. As outlined previously, the maximum total volume of solid drilling cuttings estimated to be generated by the Proposal is 700 $m^3$. 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 requirements of the Code.

Potential risks to fauna from access to the open sump and above ground wastewater evaporation tank have been considered by the Proponent. The open water storages, drilling sump and the above ground flowback wastewater tanks (approximately 2 m high) are located within the lease pad area, which will be fenced to prevent stock and fauna access. The drilling sump also includes design features such as fauna ladders to mitigate potential entrapment.

The Proponent intends to implement a routine monitoring program to log fauna interactions with wastewater storages (including the area surrounding the lease). Where fauna interactions with wastewater storage are identified (i.e. bird or fauna mortalities have occurred >5 individuals), the Proponent will implement additional controls such as netting or the use of bird deterrents.

*Fauna access to flowback wastewater*

Based on previous flowback fluid quality analysis in the Beetaloo it is expected that the gross salinity prior to evaporation will exceed twice the salinity of seawater. Neither cane toads nor their progeny can survive in seawater. Therefore evaporation tanks are unlikely to lead to increases in cane toad numbers in the region.

The management of hydraulic fracture stimulation flowback using separators and flaring prior to discharge into open tank systems in the Beetaloo, Cooper Basin in South Australia, Canning Basin in Western Australia and Western Queensland during hydraulic fracturing flowback fluid evaporation have reported low risk to birdlife.

*NT EPA Assessment*

The NT EPA considers that the potential impacts and risks to flora and fauna can be mitigated through implementation of the EMP mitigation measures and that its objective for terrestrial flora and fauna is likely to be met.

## 5. Terrestrial environmental quality

**Objective:** Maintain the quality of land and soils so that environmental values are protected.

The proposed activity has the potential to result in soil degradation / contamination from spills of drilling mud, flowback fluid and/or chemicals.

The EMP describes the three main soils types within the vicinity of the activity as very strongly leached soils of the Tertiary land surface: Tertiary Lateritic Red Earths, Tertiary Lateritic Red Sands and Tertiary Lateritic Podzolic Soils. The risks associated with the incorrect storage, disposal or spill of a hazardous material may result in an impact on local terrestrial environmental quality. The proposed lease pad area will be an engineered, hardstand compacted to 200 kPa bearing capacity. Compaction to 200 kPa has the added benefit of reducing infiltration and leaching compared to non-compacted soil.

The Proponent has prepared a Spill Management Plan, Emergency Response Plan and Wastewater Management Plan, attached as appendices to the EMP. These sub-plans describe effective response management strategies and mitigation measures to be implemented to manage the transport, handling, storage, bunding and clean-up of hazardous substances and materials.

*Drilling fluids, muds and cuttings*

As outlined previously, approximately 700 $m^3$ of drill cuttings solids and up to 2,400 $m^3$ of drilling fluids compromised of drilling mud and saline well control fluid will be generated as a result of drilling the exploration well.

Liquid from the cuttings and residue drilling mud will be transferred from the sump to the double-lined wastewater storage tanks upon completion of activity. Transfer of the liquids also allows the muds and cuttings contained in the drilling/mud sump to dry out prior to leachability testing as prescribed in the Code and final disposal. In addition to being double-lined, the wastewater tanks also have leak detection, to monitor for any leaks between the primary and secondary liner, providing greater seepage protection for soils in the near vicinity of the activity.

At the completion of the drilling operations, a suitably qualified independent third party approved by DENR, as defined in Section C.4.1.2(f) of the Code, will undertake sampling for laboratory testing of drill cuttings and residual drilling muds, including leachability testing of heavy metals, NORM and other contaminants of potential concern, to determine suitability of in-situ burial. Approval for this method of disposal will also be sought by DENR. If certification, or departmental approval cannot be obtained for onsite disposal then this waste will be disposed of to an offsite, licensed facility. The NT EPA will provide advice to the Minister about laboratory reporting on leachability testing of drill cuttings and drilling mud.

The 4.5 ha exploration lease pad and camp pad will be surrounded by a 1.2 m bund to contain and prevent overland flow of contaminants in the event of a major spill.

*Hydraulic fracturing flowback fluids*

Impacts from drilling muds, flowback fluids and produced water have been addressed previously in section 1 **Inland water environmental quality**.

Management of hydraulic fracturing flowback will include the use of a three phase separator to separate entrained gas, hydrocarbon liquids and saline flowback water; flaring of entrained gas and condensate via a horizontal flare flume; storage of condensate hydrocarbon liquids in self-bunded double skin tanks as per AS 1940; and four above-ground double lined waste water storage tanks with leak detection.

Following reduction of wastewater volume the residual flowback fluid and precipitate on the bottom of the tanks will be vacuum pumped to tanker trucks. The residue following evaporation of flowback fluid is considered a listed waste and therefore must be managed under listed waste provisions of the Waste Management and Pollution Control Act 1998.

As outlined previously, a tiered chemical risk assessment has been completed. The majority of the chemicals were identified not to be persistent and bioaccumulative and in very low concentrations.

*Fuels and Ancillary Chemicals*

The estimate for onsite diesel fuel, hydraulic oil and potential condensate storage for the Proposal is approximately 260 kL. Estimates of other chemical usage is provided in Appendix C to the EMP. Each of these hazardous substances and other ancillary chemicals will be stored in accordance with Australian Standards, in a location on the lease pad area that is protected through secondary containment (bunding) to minimise potential escape/spills into the surrounding environment.

In addition to the mitigation measures for the individual structures engineered to manage the hazardous substance used or generated during the life of the activities, the lease pad is bunded and includes an engineered, lined sediment pond to capture any water runoff generated on the pad during operations from a storm event or in the unlikely event of a tank spill.

*NT EPA Assessment*

The EMP outlines the overarching rehabilitation strategy for the regulated activity, which is adequate for assessment. The NT EPA will provide advice to the Minister on the development of a progressive rehabilitation plan, to minimise the risk of contamination and return the disturbed land to provide an environment similar to the original conditions.

The NT EPA considers that the potential impacts and risks to terrestrial environmental quality from the localised exploration program can be mitigated through the implementation of the EMP, sub-plans, which incorporate mandatory Code requirements. Further assessment of the WOMP by DPIR, prior to the commencement of drilling and hydraulic fracture stimulation adds a second tier assessment and approval requirement to the Proposal. Based on these mitigation measures and procedures, the NT EPA considers that the objective for terrestrial environmental quality is likely to be met.

## 6. Social, economic and cultural surroundings

**Objective:** Protect the rich social, economic, cultural and heritage values of the Northern Territory.

Potential impacts to social, economic, cultural and heritage values have been assessed in the EMP.

*Social considerations*

Social values assessed include potential impacts to public and tourism from increased traffic.

The EMP sets out the stakeholder engagement undertaken and summarises the method of contact and matters raised during consultation with land owners in the vicinity of the Proposal.

The nearest sensitive receptor to the activity is Hayfield Homestead, approximately 21 km north-west from the proposed Kyalla N2-1 well. Potential amenity impacts such as noise and dust from the Proposal were assessed in the Civil Construction EP117 N2 EMP[13] and are not considered to be significant due to implementation of control measures and proximity. Vehicle speed limits are imposed by the Proponent on access tracks. Noise from the drilling rig operations will be negligible at the drillers' camp located less than 500 m metres from the well site. All personnel are required to comply with relevant NT Worksafe codes of practice. The Proponent has committed to ongoing stakeholder engagement with all affected pastoral property owners to ensure nuisance factors do not impact pastoral activities.

*Traffic management*

The Proponent engaged with the road authority; the Department of Infrastructure, Planning and Logistics, to determine traffic management requirements for the Stuart Highway. A traffic impact assessment has been prepared and provided to the road authority. The Proponent has assessed the impacts of traffic from their activity on the existing traffic levels/flows. Additional peak project vehicle movement is 44 vehicles/day in addition to the existing peak Dry season traffic volumes of 827 vehicles/day. The results demonstrate that there are minimal changes in traffic composition associated with the Proposal, with an additional 1.2% of large combination vehicles when compared to the total volume composition. This percentage is unlikely to significantly impact upon the road's capacity and level of service.

*Cultural and heritage values*

The Proponent has undertaken stakeholder engagement with NT Government, landholders and land managers, traditional owners, the Northern Land Council (NLC) and the Aboriginal Areas Protection Authority (AAPA). The EMP sets out stakeholder engagement summarising the method of contact and matters raised during consultation with land owners in the vicinity of the Proposal.

Engagement with traditional owners is co-ordinated through the NLC.

AAPA has confirmed this Proposal is covered under Authority Certificate C2019/039.

The Heritage Branch of the Department of Tourism and Culture has reviewed the EMP and indicated no concerns with the Proposal. All archaeological surveys have been completed and no sites of significance should be impacted by any activities associated with drilling, hydraulic fracture stimulation and well testing. In the unlikely event that new Aboriginal archaeological sites are discovered whilst undertaking an activity, the EMP has included an unexpected heritage finds stop works procedure, which is to be implemented for the duration of the Proposal. Induction of staff on site is also to include reference to the wider area having indigenous heritage values and the stop works procedure.

*NT EPA Assessment*

The NT EPA considers that the potential impacts and risks on social, economic and cultural surroundings can be mitigated through implementation of the management measures presented in the EMP and that its objective for social, economic and cultural surroundings is likely to be met.

## 7. Air quality

**Objective:** Maintain air quality and minimise emissions and their impact so that environmental values are protected.

Ambient air quality within the vicinity of the Proposal is good, except during bushfires, and occasional dust from exposed soils during high wind. The Proposal has the potential to increase greenhouse gas (GHG) emissions generated from scope 1 direct and fugitive emission sources, including methane emissions generated during flaring. Other sources of impact to ambient air quality are dust generated from vehicle movements along access tracks and dust generated during drilling.

The nearest sensitive receptors for air quality (environmental and community) are located at least 20 km from the Proposal. The Proponent has calculated the total GHG emissions generated for the duration of the activity (drilling, hydraulic fracture stimulation and well testing) to be approximately 76,500 $tCO_2e$; assuming a worst case well testing period of 12 months. Total emissions from the Proposal represent less than 0. 5% of total annual 2017 GHG emissions for the NT. Standard mitigation measures outlined in the Code such as combustion flaring will be implemented. Combustion flaring is expected to reduce the emissions by approximately 85% compared to venting. Other mitigation measures include:

- measurement of the amount of gas and condensate to be flared using flow meters compliant with the National Greenhouse Energy Reporting Scheme (NGERS)
- all flares will be designed to meet the requirements of the Code including:
  - continuous ignition systems
  - 98% combustion efficiency as per US EPA new Source Performance Standards
- six monthly well testing
- ongoing emissions reporting compliant with NGERS
- compliance with the methane emissions monitoring program, provided as Appendix L to the EMP

Combined emissions from the Kyalla civils activities and the drilling, hydraulic fracture stimulation and well testing and flow evaluation activities described in the EMP are estimated to be approximately 77,000 $tCO_2e$. The NT EPA considers that cumulative GHG emissions are not significant when considered in context of 2017 NT and Australian emissions, which were approximately 16.5 million tonnes and 535 million tonnes, respectively.[16]

[16] Department of the Environment and Energy (2019) *State and Territory Greenhouse Gas Inventories 2017.* http://www.environment.gov.au/system/files/resources/917a98ab-85cd-45e4-ae7a-bcd1b914cfb2/files/state-territory-inventories-2017.pdf

All emissions must be reported in accordance with section D.5.9 Venting and Flaring of the Code. Emissions from exploration, well construction (including during flowback) and workovers must be measured and reports submitted. These emissions must be measured using methods consistent with those specified under the National Greenhouse and Energy Reporting (Measurement) Determination 2008. The NT EPA will provide advice to the Minister that the Proponent provide a mass balance of actual greenhouse gas emissions that incorporates flare efficiency and by-pass calculations, including emissions directly vented as methane. The NT EPA has also provided advice that should the combustion of liquid hydrocarbons exceed an average 5000 litres per day during in any month of flaring, the Proponent is to provide an analysis of offsite disposal and beneficial use options other than flaring to the DENR.

Dust impacts generated from activities such as vehicle movements and wind at the well site will be suppressed through the use of water trucks.

*NT EPA Assessment*

Provided that the mitigation and management measures outlined in the EMP are implemented, the NT EPA considers that the Proposal is unlikely to have a significant impact on air quality in the region, and the NT EPA's objective for air quality is likely to be met.

**Public consultation**

The majority of the 6,311 submissions (>90%) were opposed to onshore gas development and raised similar issues to those considered during the HFI. The NT EPA notes that many of these issue have been addressed through the NT Government's commitment to implement the 135 HFI recommendations. A cross-section of frequently raised issues by environmental category is provided below:

- **Water quantity:** Detrimental impacts on the community, other industries and the environment attributed to water use by the industry; ineffective regulation to manage water use during drought conditions; lack of data and understanding of regional groundwater dynamics; concern that other industries may miss out on access because preferential treatment will be given to petroleum companies; volume of water used not appropriate for an inland arid area; all life relies on water and a high level of concern about lack of alternatives should this supply become unusable; lack of ability to manage wastewater; concern about inappropriate disposal of wastewater; groundwater pollution caused by chemicals used in the industry
- **Human health:** Chemicals may pollute aquifers that are used for agriculture and/or drinking and have long-term impacts on human populations; lack of adequate testing by regulatory agencies to determine chemical safety; lack of information about chemicals used by industry; lack of appropriate scrutiny; migration of chemicals through food chain and/or aquifers; volumes of chemicals that will be used by industry exceed current testing; lack of bio-accumulation data
- **Climate change:** Development of the industry does not support transition to renewable energy; compromise of Australia's international obligations; insufficient greenhouse gas emission data/assessment
- **Traditional owners/ social & cultural impacts:** Lack of indigenous consultation and limited consultation timeframe; lack of genuine engagement; concerns regarding traditional owner lack of power over activities occurring on their lands; potential negative impacts to social fabric; local services not able to cope with large sudden changes in demographic
- **Economy:** Government bias towards the petroleum industry to the detriment of all other industries; lack of ability to capitalise on economic opportunities for Territorians meaning only the negatives will be left for the rate payer; downturn in the price of gas as a result of increased (cheaper) renewables will leave ratepayers with a large clean-up legacy; increase in local traffic will lower amenity for residents; damage to road infrastructure will have to be covered by ratepayers; impacts of petroleum on tourism.

- **Pollution:** Short term economic gains outweighing long-term productive land use activities (e.g. farming); cropping land being over-run by mining; food supply being sacrificed for gas; open tanks will pollute water ways and spill across landscape, leading to contamination of the food supply; increased risk of the spread of weeds/exotic species; NT Government not adhering to the recommendations of the Hydraulic Fracturing Inquiry; wildlife have lower pollution/toxicity threshold; lack of wet season risk mitigation measures
- **Environment:** General environmental impacts; risks to flora and fauna not given enough weight in consideration of impacts; principles of Ecologically Sustainable Development not addressed; increase in habitat fragmentation due to land clearing

The NT EPA has reviewed the public submissions from community members, business entities and non-government organisations, as part of its decision-making and when making recommendations to the Minister. The NT EPA considers many of the concerns raised about the protection of environmental values have been adequately addressed by the Proponent in the EMP and through the implementation of the mitigation and management measures provided in the various supplementary management plans.

Under the Petroleum (Environment) Regulations 2016, the EMP must be published as well as all reportable and recordable incident reports, methane monitoring, flowback monitoring and groundwater monitoring data. The NT EPA supports the public release of monitoring data and environmental performance reporting as part of a transparent regulatory regime that will assist in informing the community about the potential impacts and risks associated with the onshore petroleum industry and their management.

The NT EPA notes that the Minister must take into account any comments submitted when making a decision whether to approve the EMP in accordance with the Petroleum (Environment) Regulations 2016. The NT EPA's advice to the Minister for Environment and Natural Resources under the Petroleum (Environment) Regulations provides a more comprehensive response to the issues raised in public submissions.

**CONCLUSION**

The EMP has assessed cumulative impacts as they apply to the activities described in the EMP. At this stage, EMPs are only dealing with exploration activities of short duration and limited scope and involve the drilling, hydraulic fracturing and testing of one exploration well. Cumulative impacts associated with multiple wells will be assessed in accordance with Schedule 1, clause (3)(2)(b) of the Petroleum (Environment) Regulations 2016.

The NT EPA considers that the potential environmental impacts and risks associated with the Proposal are not significant and that the Proposal does not require assessment under the EA Act. The Proponent has prepared the EMP in accordance with the Petroleum (Environment) Regulations 2016 and to demonstrate how it will also meet compliance with the Code of Practice: Onshore Petroleum Activities in the Northern Territory (2019).

Comments from NTG advisory bodies and public submissions received via the advertised DENR public engagement modes have been provided to the Proponent for consideration and amendment during the EMP assessment.

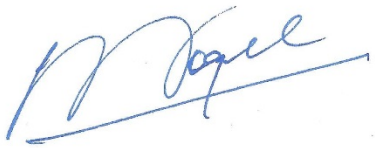
The Minister for Environment has asked the NT EPA to provide advice under the Petroleum (Environment) Regulations as to whether the EMP meets certain requirements of the Regulations (specifically regulations 9(1)(b), 9(1)(c) and 9(2)(a)). As part of the assessment to provide that advice, the NT EPA may make recommendations to the Minister for Environment on conditions to improve environmental outcomes. The NT EPA's decision not to assess the EMP under the EA Act is not reliant on the Minister accepting the NT EPA recommendations.

## DECISION

The proposal by Origin Energy Limited has been examined by the NT EPA and investigations and inquiries conducted.

The NT EPA has decided that the potential environmental impacts and risks of the Proposal are not so significant as to warrant environmental impact assessment by the NT EPA under provisions of the EA Act. Management of the potential environmental impacts is the responsibility of Proponent through preparation and implementation of the procedures and management plans presented in the EMP, and any conditions imposed by the Minister for Environment under the Petroleum Regulations. Groundwater extraction will be subject to a licence under the Water Act 1992. Prior to commencing well activities (including drilling), a WOMP will be prepared and approved by the DPIR.

This decision is made in accordance with clause 8(2) of Environmental Assessment Administrative Procedures, and subject to clause 14A the administrative procedures under the Environment Assessment Act are at an end with respect to the proposed action.



DR PAUL VOGEL AM MAICD

CHAIRMAN

NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

7 AUGUST 2019

**Attachment A: Northern Territory Government Advisory bodies consulted on the Notice of Intent**

| Department | Division |
|---|---|
| Department of Environment and Natural Resources | Flora and Fauna<br>Water Resources<br>Weeds<br>Environment<br>Bushfires NT<br>Rangelands |
| Department of Infrastructure, Planning and Logistics | Infrastructure<br>Transport |
| Department of Primary Industry and Resources | Petroleum<br>Mining Compliance |
| Department of Tourism and Culture | Heritage<br>Tourism NT<br>Parks and Wildlife |
| Department of Health | Environmental Health<br>Medical Entomology |
| Department of Trade, Business and Innovation | Strategic Policy and Research |
| Department of Local Government Housing and Community Development | Office of the Chief Executive |
| Power and Water Corporation | |
| NT Police, Fire and Emergency Services | Business Improvement and Planning |
| Aboriginal Areas Protection Authority | Technical |
| Department of the Attorney-General and Justice | Commercial Division<br>NT Worksafe |
| Department of the Chief Minister | Economic and Environmental Policy |