

Onshore Petroleum Activity – NT EPA Advice

SWEETPEA PETROLEUM PTY LTD (SWP4-3) – ENVIRONMENT MANAGEMENT PLAN (EMP) FOR THE WELL DRILLING, HYDRAULIC FRACTURE STIMULATION AND WELL TESTING NT EXPLORATION PERMIT (EP) 136 BEETALOO SUB-BASIN NT

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 (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))
- the principles of ecologically sustainable development (regulation 2(a)), as set out in sections 18 to 24 of the *Environment Protection Act 2019* (NT)
- 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 reasonably practicable and acceptable (regulation 9(1)(c))
- any relevant matters raised through the public submission process.

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

ACTIVITY

Subject	Description
Interest holder	Sweetpea Petroleum Pty Ltd (Sweetpea)
Petroleum interest(s)	Exploration Permit 136 (EP136)
Environment Management Plan (EMP) title	Well Drilling, Hydraulic Fracture Stimulation and Well Testing NT Exploration Permit (EP) 136 Beetaloo Sub-basin NT
EMP document reference	SWP4-3
Regulated activity	<ul style="list-style-type: none"> • Exploration well drilling and completions at up to seven well pads - vertically to a depth no greater than 4,000 metres • Hydraulic fracture stimulation (horizontal wells and associated vertical wells), including water storage. • Production testing and follow up testing, monitoring and work-over activities and management of wastewater • The use of the previously installed water bores for monitoring and extraction of water for hydraulic fracturing

	<ul style="list-style-type: none"> • Routine and ongoing maintenance of any infrastructure and or services • All activities associated with the plugging, abandonment, decommissioning and/or remediation of wells after testing and monitoring • Any other minor works ancillary to the above-mentioned works.
Public consultation	Public consultation on the EMP required under regulation 8A(1)(b) was undertaken from 23 May 2022 to 20 June 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 well drilling, hydraulic fracture-stimulation and well testing within EP136. 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 regulated activity and worst-case scenario values (SWP4-3).

Table 1: Key components of the proposed Sweetpea Well Drilling, Hydraulic Fracture Stimulation and Well Testing Program

Component/aspect	Proposed
AAPA certificate	C2020/072
Total area of exploration permit (EP136)	4,181 km ² (418,100 ha)
Total area of surface disturbance	1.2 ha
Total area of rehabilitation	1.2 ha
Number of exploration wells	7
Groundwater: extraction licence # and quantity	GRF 10346 (299 ML/annum)
Groundwater: Estimated groundwater usage	~897 ML (total)
Duration	Approximately April-December, annually, from 2022 – 2025: <ul style="list-style-type: none"> • Drilling, hydraulic fracture stimulation and testing at Well 1 (May-December 2022) • Drilling, hydraulic fracture stimulation and testing at Wells 2, 3 and 4 (April-December 2023) • Drilling, hydraulic fracture stimulation and testing at Wells 5, 6 and 7 (April-December 2024)
Duration of well testing (appraisal) operations (days)	Approximately 90 days per well, with up to 300 days per well
Workforce: operational (list separately over activity phase)	~60 persons during drilling and hydraulic fracturing (~6 persons during well testing)
Workforce: number of camps	1 camp, 2 possible locations
Workforce: camp capacity	100 persons

Component/aspect	Proposed
Traffic: peak traffic movements for all activities (per day)	~40-50
Traffic: average movements per day for first 3 months per well	~44
Traffic: average movements per day for the balance	~1-10
Sump volume	2,000 m ³ to 2,750 m ³
Volume of drilling mud and cuttings generated	~650-850 m ³ per well
Flowback generated	Up to ~20ML per well
Waste drilling and completion fluids (after treatment)	~1 ML per well
Truck load-out: wastewater transport (if applicable)	5-15 trucks per well
Maximum number of tanks	Up to 4 enclosed storage tanks per well pad Up to 4 open treatment tanks per well pad
Proppant usage	9000 t/well (for maximum 50 stages, or 180 t per stage)
Greenhouse gas emissions	~450,505 – 728,399 tCO ₂ -e

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 in Q3 2022 and continue over approximately four years. 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. Drilling, hydraulic fracturing and well testing will be conducted at up to seven wells. The priority and order of wells and lease pads may vary pending operational readiness, access agreements with stakeholders, and/or exploration results. All wells will have up to 50 hydraulic fracturing stages. Extended production testing will be conducted, followed by completions and testing. Upon completion, the wells will be suspended for build-up testing and/or plugged and abandoned and rehabilitation completed.

The EMP estimates that a total of 1.2 ha of vegetation may be cleared for the purpose of expanding the camp pad, all of which is required to be rehabilitated.

Drill cuttings produced for each well will be contained and managed in a drilling sump in accordance with the Code. Sumps will be designed to accommodate the expected 650 to 850 m³ 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 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.

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. All seven wells will be horizontal, with a target length of 1,000-3,000 m. Figure 1 shows the expected profile of the horizontal and vertical wells.

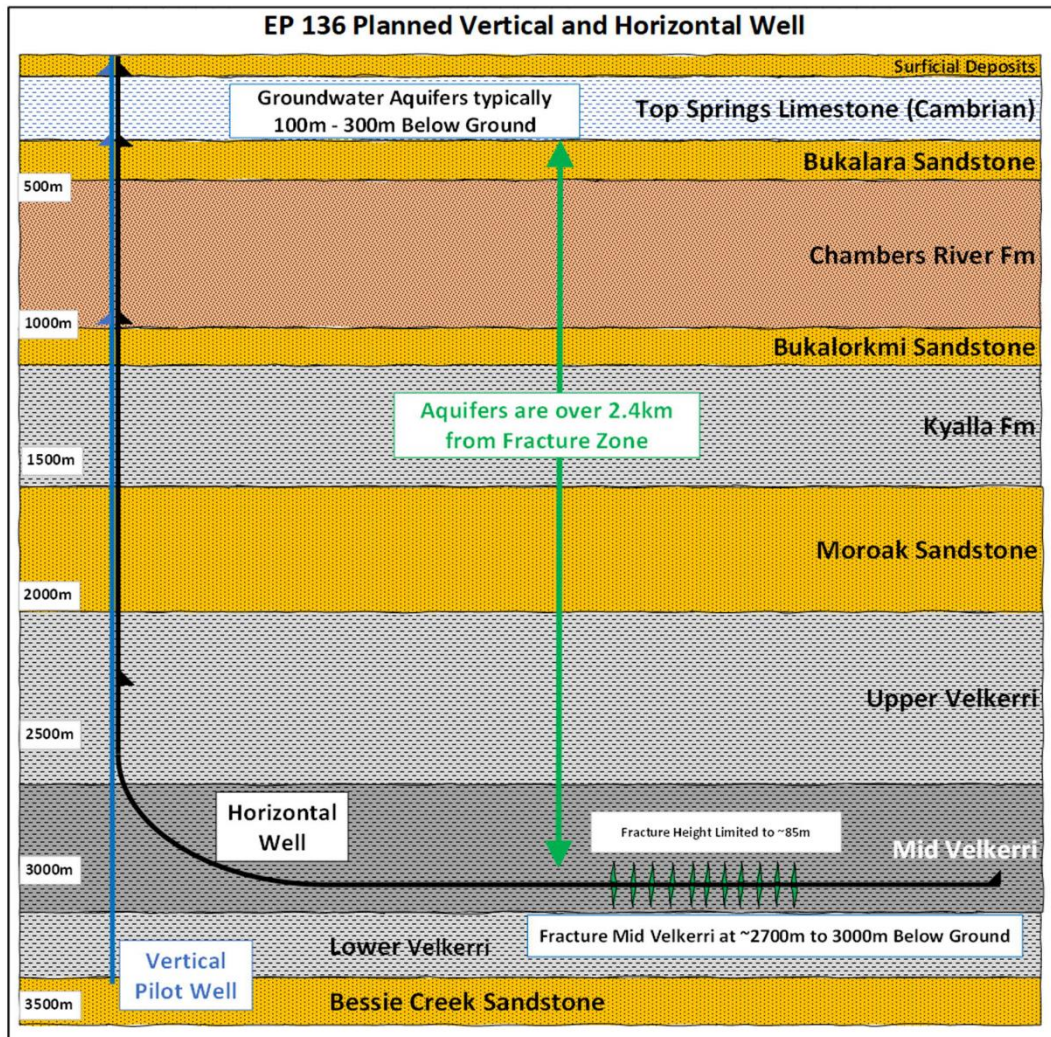


Figure 1: Schematic of a vertical and horizontal well profile.

Prior to hydraulic fracturing each well, the wellbore will be assessed to ensure that required 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.

Hydraulic fracturing will be undertaken with up to a maximum of 50 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 60 days on three wells, up to 90 days on two wells, and up to 300 days on two wells. 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 ~140 ML of flowback fluid and produced water per well, and managed to maintain a minimum freeboard of 1.3 m in both the dry season and 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 1 ML to be disposed of offsite.

It is estimated that up to 897 ML of groundwater will be extracted over the life of the EMP from the Gum Ridge Formation using existing extraction bores. Approximately 140 ML will be used for hydraulic fracturing (approximately 20 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 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 A 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 provides the following plans, which are compliant with the Code:

- Erosion and Sediment Control Plan
- Chemical Risk Assessment
- Methane Emission Plan
- Wastewater Management Plan
- Spill Prevention and Response Plan
- Weed Management Plan
- Bushfire Management Plan
- Rehabilitation Plan
- Emergency Response 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). Where ambiguity exists in application of the Code requirements, the NT EPA has recommended relevant Ministerial conditions at the end of this advice.

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

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

The EMP adequately assesses the environmental impacts and risks associated with the regulated activity and outlines appropriate avoidance and mitigation measures. All of the 42 identified risks were assessed as 'low' if carried out in accordance with the mitigations and controls proposed in the EMP. Wet season contingencies and controls are proposed to mitigate potential erosion and sediment impacts associated with runoff from disturbed areas, off-site wastewater release, or transport of chemicals and wastewater. These controls have been assessed as adequate.

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 1.3 m freeboard will be maintained in all open treatment tanks throughout the year.

The interest holder has demonstrated ongoing stakeholder engagement in the EMP as required by the Regulations with directly affected stakeholders identified. The EMP was also made available for public comments from 23 May 2022 to 20 June 2022.

2.2 Precautionary principle

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 hydraulic fracturing 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 wastewater in open treatment tanks 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.

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 existing 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 should provide measureable performance measures to ensure that the environmental outcomes are met.

2.3 Principle of evidence-based decision-making

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 hydraulic fracturing fluid to aquifers (> 2,000 m);
- A minimal horizontal separation distance of approximately 3.6 km between the exploration wells and the closest existing water supply bore used for domestic or stock consumption;
- Use of double lined wastewater tanks with leak detection for flowback fluid storage and treatment;
- Use of conservative 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.

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 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

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.

Total predicted worst-case greenhouse gas (GHG) emissions generated by the regulated activity over four financial years and applicable for up to a 300 day testing period are approximately 728,399 tCO₂-e. These emissions will result in an overall increase in NT GHG emissions (based on 20.6 million tCO₂-e in 2019) of 3.54% 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 and previously approved regulated activities for the 2022-2026 period. Sweetpea's total cumulative GHG emissions (across 3 EMPs) for this period are estimated to be approximately 748,685 tCO₂-e (between 96,242 and 217,611 tCO₂-e per annum). The range of estimated annual potential emissions for this regulated activity in the NT represent between 0.47% and 1.06% of the total GHG emissions for 2019 or 0.019% to 0.043% of Australia's total emissions, if emissions are not offset.

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 regulated activity is subject to requirements of the AAPA Certificate C2020/72.

The NT EPA considers that 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

Exploration activities are 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, in order to assess the viability of the resource prior to production.

Cumulative impacts of groundwater extraction have been assessed. The interest holder has a groundwater extraction licence GRF10346 with a maximum water entitlement of 299 ML per annum from the Gum Ridge Formation. The anticipated water demand for this regulated activity is 158 – 213 ML per annum, which is less than the interest holder's maximum water entitlement.

GHG emissions were estimated using tools developed for the National Greenhouse and Energy Reporting Scheme. The total predicted emissions from this regulated activity are estimated to total 450,505 - 728,399 tCO₂-e over four financial years (2022-23, 2023-24, 2024-25 and 2025-26). Diesel combustion will contribute 2093 tCO₂-e from hydraulic fracturing and completions, 9485 tCO₂-e from vertical and horizontal drilling, 524 tCO₂-e from transport on-site, 996 tCO₂-e from camp operations and 13 tCO₂-e for civil construction activity to expand the camp. Fugitive emissions from drill cuttings, venting and wastewater storage will produce 20,304 tCO₂-e.

The bulk of the predicted emissions are generated during flaring (416,998 - 694,997 tCO₂-e). The flaring emissions estimates in the EMP were based on 2 extended production tests (EPTs) up to 300 days, 2 EPTs up to 90 days and 3 EPTs up to 60 days.

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 capacity to regulate GHG 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 GHG 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 GHG 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 tCO₂-e of scope 1 emissions in any financial year over 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 provided a GGAP, as the activities described in the EMP will result in emissions that exceed the 100,000 tCO₂-e threshold in a given financial year. Section 3.11.3 of the EMP summarises the information in the GGAP, in which 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 Sub-basin. The GGAP commits the interest holder to:

- Minimising well test durations to reduce flaring emissions
- Achieving a minimum flare tip combustion efficiency of 96%
- Equipping flares with auto-ignition to avoid unintentional venting
- Using best practice emission management controls outlined in Part 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
- Annual assessment and reporting of actual GHG emissions against EMP estimated emissions to ensure performance standards are met.

The interest holder's GGAP has provided interim offset targets and demonstrated a trajectory to net zero by 2050 consistent with the NT government's commitments to GHG emissions reductions. The interest holder has committed to:

- a clear linear trajectory towards net zero by 2050, extending beyond the five year life of the EMP using Australian Carbon Credit Units (ACCU), which are eligible offsets under the draft NT EPA Greenhouse Gas Emissions Offsets Policy
- minimum carbon offset levels shall increase year-on-year by 3.7% (based on a baseline financial year of 2023) to result in a linear decrease in GHG 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 emission 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 mirrors 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 (93-95%) 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 (~4 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 proposed location for the regulated activity is not within proximity to groundwater dependent ecosystems; nor is it within proximity to a declared ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The regulated activity poses a low risk to the ecosystem within the Sturt Plateau bioregion. Given the relatively small area of impact (approximately 1.2 ha), and the very large area of similar habitat within the region, the regulated activity does not pose a significant risk to any regional populations of threatened species. The following species were identified as 'possibly' occurring within the regulated activity area and are known to occur in the wider landscape of EP136: 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); painted honeyeater *Grantiella picta* (Vulnerable EPBC Act, Vulnerable 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. Impacts and risks to flora, fauna, and ecosystems have been mitigated to an acceptable level.

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

The Department's Flora and Fauna Division is satisfied the proposed activities do not pose a significant risk to threatened species or significant habitats and vegetation types. Further, that avoidance and mitigation measures identified in the EMP are adequate to reduce risks from, for

example, vehicle-strike, dust, erosion and/or spills to as low as reasonably practicable, in relation to potential impacts on biodiversity.

The EMP outlines measures to minimise impacts on 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, including inspections for fauna presence, fauna ladders on storage tanks, fencing around well pads, 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

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, to be supported by independent contractor quotes 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 undertaken identified measures to avoid impacts on environmental values, informed by a baseline studies and surveys.

The EMP demonstrates a systematic identification and assessment of environmental impacts and risks associated with the regulated activity. Through adoption of the mandatory controls in the Code, the potential environmental impacts and risks are considered low in the EMP:

- Changes in aquifer quality from subsurface (drilling and stimulation) activities impacting a receptor (groundwater user or Groundwater Dependent Ecosystem)
- Contamination of aquifer from surface activities (chemical and waste storage, handling and spills) impacting a receptor (groundwater user or GDE)
- Contamination of surface water from surface activities
- Spillages of wastewater and chemicals during wet weather transport
- Increased risk of spills or overtopping during the wet season from contained wastewater or chemicals
- Soil contamination due to spills and leaks of chemicals, wastes or wastewater
- Reduction in air quality associated with exploration emissions (drilling, stimulating and well testing)

These risks were considered low through the adoption of mandatory controls in the Code including controls for:

- Well construction, aquifer isolation, well integrity verification, monitoring and reporting
- Double-lined wastewater storage within enclosed tanks, open tanks with a 1:1000 ARI freeboard, transfer and storage of wastewater within enclosed tanks 8 hours prior to a significant rainfall event

- Secondary containment will be deployed in areas where chemicals, fuels and wastes are stored and handled
- Transportation of chemicals and wastewater during wet season will be avoided where possible.
- Gas disposal and venting method, regular inspection of equipment, emissions monitoring and reporting, and well barriers

The EMP also considers cumulative impacts to groundwater, flora and fauna, GHG emissions, traffic and social and concludes these have been managed to ALARP and acceptable levels, noting the proposed offsetting of GHG emissions.

The EMP demonstrates why the controls to be implemented are considered ALARP and acceptable. All of the 42 identified risks were assessed as 'low' if carried out in accordance with the mitigations and controls proposed in the EMP.

The NT EPA considers that all reasonably practicable measures will be 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"> • Daily monitoring of local weather, bushfire and climate information • Fire Officer to monitor ground conditions from the NAFI site and scan the surrounding area during regulated activities daily • Monitoring fuel loads within APZ to determine maintenance requirements in accordance with Annual Works Calendar • Monitor Bushfire Alerts and Warnings issued by Secure NT and act according to the advice. • Monitoring of welding activities on total fire ban days if written approval obtained by fire control officer or warden • All incidents of fire recorded in an incident register.
Dust	<ul style="list-style-type: none"> • Visual monitoring will be carried out daily in the vicinity of the public roads (i.e. Carpentaria Highway) to ensure that visibility for motorists is not obscured • Visual monitoring of the vegetation conducted for the duration of the works along the access track ensure not being impacted by dust.
Erosion and sediment control	<ul style="list-style-type: none"> • Visual inspection and monitoring of access tracks (including creek crossings), gravel pits and exploration lease pads: <ul style="list-style-type: none"> ○ during siting of access tracks, civil construction and lease pad areas (baseline assessment) ○ after completion of a key phase of activity ○ after the wet season for signs of erosion as part of ○ the 6-monthly monitoring program during operations • Routine visual inspections of the creek and drainage line crossings and the wastewater containment system at the camp • Inspection of all ESC devices across the worksite and physical water quality testing (physical parameters only) at the lease pad sediment basin: <ul style="list-style-type: none"> ○ Weekly or following a rainfall event (i.e. greater than 20 mm in 24 hours).
Flora and fauna	<ul style="list-style-type: none"> • General observations recorded of bird and other fauna around wastewater storages. • Daily checks of open treatment tanks and pits for fauna mortality • Weekly checks of fauna mortality around lease pad (~50 m) • Fauna remains identified during tank and pit emptying or decommissioning.

Aspect	Monitoring and inspections
	<ul style="list-style-type: none"> • Record all fauna encounters, injuries and deaths in database for the duration of the works • Records of observed presence of feral animals or pests in GIS database for duration of the works
Greenhouse gas emissions and fugitive emissions	<ul style="list-style-type: none"> • Monitoring of potential fugitive emissions from well flowlines, all gas containing equipment following major maintenance: <ul style="list-style-type: none"> ○ Personal gas detectors use ongoing during well testing and within 48 hrs of recommissioning during routine operational visits ○ Potential fugitive methane emissions six monthly leak detections during non-well testing periods • Vehicle maintenance in accordance with manufacturers requirements to reduce vehicle and plant emissions during operations • Real-time monitoring of flaring and venting emissions during production testing and reported to NGERs • Flowline high point vents monitored for leaks weekly while they contain wastewater.
Groundwater	<ul style="list-style-type: none"> • Extraction bores used for exploration activities are to be tested for analytes as described in section B4.17.1 of the Code: <ul style="list-style-type: none"> ○ Control monitoring bore: 6 months prior to drilling apart from a single bore which will be 6 months prior to hydraulic fracturing ○ Impact monitoring bore: quarterly for one year, then annually • Weekly recording of groundwater take from a continuous flow meter • Monitoring of wastewater in storages daily during operations • Real time pressure monitoring during hydraulic fracturing (in accordance with the WOMP)
Rainfall	<ul style="list-style-type: none"> • Daily 7-day rainfall forecasting during the wet season and weekly during dry season operations
Rehabilitation	<ul style="list-style-type: none"> • Rehabilitation Monitoring (including provision of spatial data to the Department): <ul style="list-style-type: none"> ○ before disturbance, after disturbance and at completion of construction to ensure site stabilised ○ Annual post-wet season monitoring of rehabilitation
Waste and wastewater	<ul style="list-style-type: none"> • Inspect all wastewater storage containment systems weekly, or after significant rainfall event (greater than 20 mm in 24-hour period) • Maintain waste register, including receipts to verify waste has been properly disposed of • Inspect the structural integrity of liners, pits and tanks for leaks daily while operational • Weekly inspection of the structural integrity of secondary containment for damage - daily during the wet season • Daily visual inspection for leaks of the structural integrity of well pads transfer lines, valves and hoses when in operation • Monitor of the structural integrity (leaks) of buried flowlines (if used) using numerical telemetry monitoring continuously (hourly reporting). • Daily monitoring of the structural integrity of banded areas for the presence of spill or rainwater daily while operational • Continuous monitoring of flowback fluid and produced waters (sampling frequency of once per 24 hrs) for electrical conductivity, pH and temperature • Weekly monitoring of the quality of flowback fluid or produced water based on the wastewater chemistry analytes detailed in section C.8 of the Code until the weekly fluid is stable, then every six months • For each stage of hydraulic fracturing: <ul style="list-style-type: none"> ○ total volume of hydraulic fracturing fluid pumped ○ quality of the water used in accordance with section C.8 (only once if same water source used for each stage) ○ Typical and maximum concentrations of chemicals and other substances used. • Monitor flowback fluid and produced waters storage weekly for all stored volumes and available freeboard, and daily telemetry inspections during wet season

Aspect	Monitoring and inspections
	<ul style="list-style-type: none"> Analyse fluids stored in tanks every 6 months to characterise for disposal options Continuous tank leak detection to detect fluid migration through the primary containment Weekly visual inspections of tank structural integrity to detect potential structural weakness Daily volume balance of flowlines (if used) Routine emergency response drills at least once during operations, or quarterly.
Drill cuttings, fluids and mud	<ul style="list-style-type: none"> Drill cuttings and residual drilling fluids to be analysed to confirm composition as required or to inform disposal options, including: <ul style="list-style-type: none"> chemicals of concern (e.g. BTEX, metals) naturally occurring organic materials (NORMS)
Weeds	<ul style="list-style-type: none"> Visual survey of weed and pest species on site and areas used/disturbed: baseline, pre and post wet season, then 6-monthly for the first 12 months following completion of rehabilitation activities; then annually over 5-year period. All plant, equipment and machinery to be inspected by designated and trained weed officer prior to entering and existing the station and the permit.

5. Relevant matters raised through public submissions

Public consultation on the EMP was required under regulation 8A as the EMP proposes drilling and hydraulic fracturing. The EMP was made available for public comment for 28 days from the 23 May to 20 June 2022. A total of six submissions were received, all of which were unique submissions.

In summary, the submissions received did not identify new issues that have not already been addressed in this, or previously approved EMPs. All submissions identified issues of concern regarding petroleum development and raised substantially similar issues as those addressed through the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* (HFI) and subsequent implementation of the exploration-phase HFI recommendations.

Table 3: Issues raised in public submissions

Theme	Overview of issue raised
Flora and fauna (environment)	<ul style="list-style-type: none"> Contaminated aquifers causing impacts to stygofauna Desktop review underestimated the impact to threatened fauna Risks to fauna from open treatment tanks/pits not properly addressed Lack of site-specific surveys at locations of proposed regulated activities The rehabilitation plan is over-reliant on natural revegetation
Social and cultural	<ul style="list-style-type: none"> Lack of stakeholder engagement with Traditional Owners The EMP did not include an assessment of the economic and social impacts of the pastoral activities
Climate change	<ul style="list-style-type: none"> A Greenhouse Gas Abatement Plan (GGAP) was not included with the EMP
Water	<ul style="list-style-type: none"> The interest holder did not hold a valid water extraction licence to source water from existing bore
Waste	<ul style="list-style-type: none"> Well casing corrosion from sulphate reducing bacteria The environmental impact and water usage cannot be managed due to the EMP not specifying the number of stages for each well Concentration of chemicals and radioactivity in wastewater
Regulation and compliance	<ul style="list-style-type: none"> Cumulative impacts not considered from other exploration activities in the region

	<ul style="list-style-type: none"> • Not all activities in the EMP are covered by the current AAPA certificate
Chemicals	<ul style="list-style-type: none"> • Toxic chemicals proposed to be used by the project were not properly analysed

1. *Flora and fauna:* Some submissions raised concern about contamination of aquifers impacting the biodiversity of stygofauna. Hydraulic fracturing poses a low risk of interaction with groundwater and is 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. The potential impact on groundwater dependent ecosystems in general is negligible, given the depth to groundwater in the location of the regulated activity (> 2000 m) is greater than 20 m, the typical depth at which terrestrial groundwater dependent ecosystems are found.

There was a concern that the low risk attributed of the regulated activity to threatened fauna in the EMP was not justified by the desktop review conducted by the interest holder. The DEPWS Flora and Fauna Division were satisfied that the risks to threatened species and biodiversity are low and the EMP contained sufficient measures to reduce the risks to levels that are 'as low as reasonably practicable' (ALARP). 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.

There was a concern that the risks to fauna from open treatment tanks and evaporation pits had not been properly assessed. In compliance with the Code, the interest holder has provided control measures in the Wastewater Management Plan (WWMP) included in the EMP to be implemented to prevent interactions of wildlife and stock with wastewater. These controls include:

- fencing open treatment tanks to prevent fauna access
- installing escape routes/fauna ladders in pits and tanks as a contingency measure to assist egress of any large or small wildlife

In addition, open treatment tanks have tall, vertical wells which will limit access by amphibians.

The effectiveness of the proposed controls will be determined by the interest holder conducting:

- General observations recorded of bird and other fauna around wastewater storages.
- Daily checks of open treatment tanks and pits for fauna mortality
- Weekly checks of fauna mortality around lease pad (~50 m).
- Identifying fauna remains during tank and pit emptying or decommissioning.
- When fauna mortality is triggered further mitigation measures may be required including installation of small fauna-proof barrier, reflective flicker-tape or netting over open treatment tanks and pits.

A concern was raised that no site-specific assessment has occurred at each regulated activity location and the existing assessment relies on aerial imagery. The EMP summarises the outcomes of the environmental assessment conducted by the interest holder. An aerial survey was conducted of the project area along the seismic buffer and lease pad locations. On-ground (site-specific) surveys were conducted at the locations around the lease pads.

A concern was raised that the revegetation plan in the EMP is over-reliant on natural revegetation. The revegetation plan states that disturbed areas will be ripped and scarified to promote natural revegetation. In addition, the plan states that native seed will be used to assist in revegetation where applicable.

2. *Social and cultural:* Some concern was raised about the lack of stakeholder engagement with Traditional Owners. The interest holder conducted stakeholder engagement with Traditional Owners through the Northern Land Council (NLC) 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.

Concern was raised that the EMP did not include an assessment of the economic and social impacts of the pastoral activities occurring on the Tanumbirini and Beetaloo stations. The potential social and economic impacts to the community that may arise from conduct of the regulated activity are considered in the EMP.

3. *Climate change (emissions)*: The EMP provides details of predicted emissions for this regulated activity and cumulative GHG emissions from existing and proposed regulated activities being undertaken by the interest holder. The EMP commits to the GHG emission mitigation and monitoring requirements of the Code and the NT EPA has recommended the interest holder provide to DEPWS annual actual GHG emissions generated by the regulated activity from all sources.

Concern was raised that a GGAP was not submitted for assessment with the EMP. Feedback on the EMP included a requirement for a GGAP to be provided, which has been achieved. The Minister will consider the commitments made in the GGAP, including provisions for offsets of GHG emissions, when making a decision on an EMP.

4. *Water*: A concern was raised that Sweetpea did not have a valid groundwater extraction licence and therefore could not extract water from an existing bore (RN037655). A groundwater extraction licence (GRF10346) has been granted to Sweetpea to extract water from existing bores RN037655 and RN039070, and future installed water monitoring bores. The licence was approved by DEPWS on June 23 2021 and expires on 31 December 2024.

A concern was raised that seismic activity could cause saline contaminated groundwater to enter the shallower aquifers. According to the HFI, seismic surveys demonstrate that most of the Beetaloo Sub-basin contains relatively little internal faulting. The HFI also assessed the potential for migration of hydraulic stimulation fluids due to fracture outgrowth out of the production zone and through fractures intersection the geological features such as a permeable faults or pre-existing natural features and found the following:

- The likelihood of fractures growing out of the shale rock region for distances of 1,000 to 3,000 m is extremely low. For example, the majority of fractures in the Marcellus shale basin were found to have heights of less than 100 m, although fracture lengths up to approximately 600 m have been recorded¹.
- The location of geological faults is taken into consideration during the design and construction of each well and the gas companies actively avoid faults because their

¹ Davis R, Mathias S, Moss J, Hustoft S and Newport L. (2012) Hydraulic fractures: How far can they go? *Marine and Petroleum Geology* 37, 1-6.

occurrence can seriously compromise the effectiveness of the hydraulic fracturing operation, as well as being a potential environmental risk².

This was the case for the Origin Amungee NW-1H well, where a section of the horizontal bore was not fractured because of the inferred existence of a small fault system.

In relation to management of long chain hydrocarbons and gases, CSIRO reviewed the well barrier and well integrity failure rates reported in the open literature during the Inquiry. The review noted that many studies of well integrity do not make the distinction between failures of individual barriers and well integrity failures, a distinction that is critical because a full integrity failure (that is, the failure of multiple barriers) is required in order to provide a pathway for any contamination of the environment.

CSIRO, largely using data sets from the US, found that the rate of well integrity failures that have the potential to cause environmental contamination is in the order of 0.1%, with several studies finding no well integrity failures, while the rate for a single well barrier failure was in the order of 1–10%.

In accordance with the Code, all onshore shale gas wells (including exploration wells constructed for the purposes of production testing) must be constructed to meet international standards, with cementing extending up to at least the shallowest problematic hydrocarbon-bearing, organic carbon rich or saline aquifer zone. The Code also requires all aquifers which are suitable for stock or domestic use to be protected.

5. *Waste*: Concern was raised about sulphate reducing bacteria causing corrosion of well casing. The Code provides specific detail on mandatory corrosion considerations through the well life cycle including for well design, construction, monitoring and maintenance and well decommissioning. Petroleum wells are designed with multiple barriers, so that a single barrier failure will not lead to a loss of containment. Complete well integrity failure where all well barriers fail is an extremely rare occurrence in contemporary petroleum wells including shale wells.

Concern was expressed that the environmental impact and water usage cannot be managed due to the EMP not specifying the number of stages for each well. The EMP provides information on the approximate number of stages per well, along with the estimated water and flowback fluid usage per stage. The interest holder has committed to monitor the properties of flowback fluid, and reports will be submitted as required under the Code of Practice.

Concerns have been raised about the concentrations of chemicals and the radioactivity in the wastewater, especially after evaporation. The interest holder is required to undertake a risk assessment within 6 weeks after completion of well flowback. The results of this assessment will indicate the potential risks associated with chemical concentration and radioactivity in the wastewater.

6. *Regulation and compliance*: Concern was raised about cumulative impacts not being considered from other exploration activities in the region. 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 GHG emissions, water use, flora and fauna, traffic and community have been included in the EMP.

Concern was raised that the current AAPA certificate (AC2020/072) does not cover all the regulated activities in the EMP, in particular a creek crossing within a Restricted Work Area and water extraction for hydraulic fracturing. These activities will not be undertaken by the interest holder unless covered under an appropriate AAPA certificate.

² See Westwood RF, Toon SM, Styles P and Cassidy NJ. (2017) Horizontal respect distance from hydraulic fracturing in the vicinity of existing faults in deep geological reservoirs: a review and modelling study. *Geomechanics and Geophysics for Geo-Energy and Geo-Resources* 3, 379-391.

7. *Chemicals*: Some of the submissions raised concern about the toxicity of hydraulic fracturing 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.

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.

RECOMMENDATIONS

The NT EPA recommends that should the EMP for Sweetpea Petroleum Pty Ltd be approved, the Minister considers approval conditions to achieve the following outcomes:

1. Provision of quarterly timetable updates and weekly reports.
2. Submission of an annual performance report to DEPWS to demonstrate the interest holder has met environmental outcomes and complied with the requirements set out in the Regulations, the Code, the ministerial conditions and the EMP.
3. Provision of an annual emissions report to DEPWS that summarises GHG emissions reported under the Australian Government's National Greenhouse and Energy Reporting Act 2007 versus the predicted GHG emissions in the EMP, with actual emissions to be verified by an independent auditor registered by the Clean Energy Regulator.
4. Provision of a revised greenhouse gas abatement plan annually, to specify actual emissions (as measured and reported on in item 3 above), the quantum of emissions to be offset in compliance with the offset commitments in the GGAP, and provision of annual demonstration of how those commitments have been met.
5. 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.
6. Groundwater quality monitoring in accordance with the Code to be conducted before, during and after hydraulic fracturing and continue for three years, and annual submission of an interpretive report on groundwater quality.
7. 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.
8. Flowback fluid risk assessment and reporting must consider the impacts and risks to fauna and potential for soil and water contamination from a loss of containment, and if necessary, take appropriate mitigation measures to achieve an acceptable risk



PAUL VOGEL AM
CHAIRMAN

NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

05 AUGUST 2022