ntepa Northern Territory Environment Protection Authority

Onshore Petroleum Activity – NT EPA Advice

IMPERIAL OIL & GAS PTY LTD – ENVIRONMENT MANAGEMENT PLAN (EMP) FOR THE 2021-2025 EP187 WORK PROGRAM (IMP4-3)

BACKGROUND

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

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

- whether the EMP is appropriate for the nature and scale of the regulated activity to which the EMP relates (regulation 9(1)(b))
- 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	Imperial Oil & Gas Pty Ltd
Petroleum interest(s)	Exploration Permit 187 (EP187)
Environment Management Plan (EMP) title	2021-2025 EP187 Work Program
EMP document reference	IMP4-3
Regulated activity	This EMP describes the whole of the proposed exploration program for EP187, rather than submitting multiple EMPs, and addresses the following regulated activity: • collection of 166 km of seismic data • construction of up to six well pads • establishment of up to six gravel pits • upgrade of a single intersection on the Carpentaria Highway • drilling of up to seven exploration wells

	• potential for establishment of multiple wells per well pad, with a maximum of four wells on a single pad, and a commensurate reduction of the number of well pads required to be constructed • construction of up to 50 km of access tracks within EP187, using seismic lines • installation of up to 57 km of buried, low pressure wastewater flowlines, which, if implemented, will lead to a reduced size of some well pads • evaluation, logging, testing and coring of the seven new wells, including diagnostic fracture injection testing • hydraulic fracturing of the seven new wells • completion, workover and maintenance of the seven new wells • extended production testing for up to 90 days for each new well • if identified as required, suspension and/or decommissioning of any of the seven new wells.
Public consultation	Public consultation on the EMP required under regulation 8A(1)(b) was undertaken from 21 April 2021 to 19 May 2021.

NT EPA ADVICE

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

Information relating to the nature and scale of the regulated activity is provided in the EMP in a clear format. The technical works program includes collection of seismic data, civil works for establishment of well pads, access tracks and buried, low pressure wastewater flowlines, drilling and hydraulic fracturing of seven wells, evaluation, workover and extended production testing of the new wells, and (as may be determined in the future) suspension and/or decommissioning of any of the new wells. In addition, a 40-person accommodation camp will be established on an existing well pad for use during conduct of the regulated activity. The activities are located approximately 85 km southwest of Borroloola, Northern Territory (NT).

Table 1 provides an overview of the key components of the regulated activity previously approved within EP187, and proposed new activities under this EMP (IMP4-3).

Table 1: Key components of previously approved EMPs for activities within EP187 and the 2021-2025 EP187 Work Program EMP (IMP4-3).

Component	Previously Approved Activities in EP187	Proposed New Activities in 2021-2025 EP187 Work Program EMP
Seismic	2D Seismic Work Program EP187 EMP (IMP1-3, approved 26 September 2019): • up to 231 km of 2D seismic (completed) • rehabilitation (commenced)	• 166 km 2D seismic (infill of previous seismic)
Drilling	2020-21 Drilling Program NT EP187 (Revision) EMP (IMP2-6.1, originally approved 2 March 2020, reapproved 20 September 2020) • civil works (construction of up to 2 well pads (one constructed),	• civils works (construction of up to six well pads, up to six gravel pits, upgrade of an intersection on the Carpentaria Highway, construction of up to 50 km of access tracks, installation of

Component	Previously Approved Activities in EP187	Proposed New Activities in 2021-2025 EP187 Work Program EMP
	construction of 6.5 km access track) • drilling of up to two wells (one drilled) • evaluation, logging, testing and coring of the seven new wells, including diagnostic fracture injection testing • well integrity monitoring • suspension of wells • rehabilitation	up to 57 km of buried, low pressure wastewater flowlines) • drilling of up to seven exploration wells, including option for multiwell pads • evaluation, logging, testing and coring of the seven new wells, including diagnostic fracture injection testing • well integrity testing • completion, workover and maintenance • if identified as required, suspension and/or decommissioning of any of the seven new wells • rehabilitation
Hydraulic fracturing and testing	2021 Carpentaria-1 Work Program NT EP187 (IMP3-4, approved 15 February 2021) • hydraulic fracturing of the Carpentaria-1 appraisal well • extended production testing	• hydraulic fracturing of the seven new wells • extended production testing and flowback for up to 90 days per well
Petroleum wells	Carpentaria-1	Carpentaria-1H Carp AA Carp AB CSP AA CSP AB CSP AC CSP AD
Duration:	2D Seismic Work Program EP187 EMP (IMP1-3): • 4 weeks (July - August 2019) - completed 2020-21 Drilling Program NT Exploration Permit EP187 EMP (IMP2-6.1): • 8 weeks (September - October 2020) - completed 2021 Carpentaria-1 Work Program NT EP187 (IMP3-4): • 4-5 months (May – September 2021) - commenced Rehabilitation: • Ongoing	Seismic: • 6 weeks Civils: • 4 weeks/well pad, estimated 2 per year, including access tracks Drilling, testing and evaluation: • 4-6 weeks/well Hydraulic fracturing: • 2 weeks/well Extended production testing and flowback: • 3 months Installation of low pressure wastewater flowline: • 4 weeks/well pad Well suspension and/or decommissioning: • 4 weeks/well Rehabilitation: • progressive, ongoing

Component	Previously Approved Activities in EP187	Proposed New Activities in 2021-2025 EP187 Work Program EMP
AAPA Authority Certificate	C2019/016 (seismic, 28 February 2019) C2020/012 (civils, drilling and hydraulic fracturing, 5 February 2021)	Under application (application number 202100005)
Groundwater aquifers	Gum Ridge Formation GRF10316 (22 ML/year)	Gum Ridge Formation GRF10316 (up to 85 ML/year), noting a further application for increase is required
Groundwater monitoring bores	RN041678 RN041800	Six impact monitoring bores and six control bores
Estimated groundwater required (total ML)	22 (~15.5 ML used)	~435 (up to 125 ML in a given year)
Land clearing (ha)	2D Seismic Work Program EP187 EMP (IMP1-3): • 70 ha 2020-21 Drilling Program NT Exploration Permit EP187 EMP (IMP2-6.1): • 5.4 ha 2021 Carpentaria-1 Work Program NT EP187 (IMP3-4): • 10.5 ha	Seismic: • 58 ha Well pads (including firebreaks): • 56 ha Access tracks: • 12 ha Installation of low pressure wastewater flowline: • 34 ha Gravel pits: • 6 ha
Workforce	~40 - 45 peak workforce	~65 peak workforce/year (for 4-6 weeks during drilling and testing of two wells)
Accommodation camp	1 accommodation camp (30 people)	Establishment of temporary accommodation camps at the existing Carpentaria-1 well pad and new well pads (40 people)
Traffic - heavy vehicle movements (per week)	Peak ~30	Peak ~75 for 2 weeks on four occasions over five years
Traffic – all vehicle movements (per day)	Peak ~50 Average ~1-10	Peak ~50 per day (all activities) Average for 3 months/well ~10-30 Average for remainder ~ 1-10
Drill cuttings/fluids generated (m^3)	~240	5,530 (790/well)
Flowback/wastewater generated (ML)	4	~175 (~25 ML per well)
Flowback/wastewater predicted for offsite disposal (ML)	~ 1 ML	~7 (~1 ML per well after evaporation)
Greenhouse gas emissions (tCO_2-e)	~10,619 (total)	~249,893 (total) maximum ~ 70,500 (in 2022-2023 financial year)

1.1 Activity scope and duration

The EMP clearly describes the scope of the activity and its duration. The regulated activity is expected to be undertaken sequentially during the five year life of the EMP, subject to seasonal site conditions. Initial activities will focus on installation of groundwater monitoring bores and collection of additional seismic data, with seismic program estimated to be conducted over a six week period.

The EMP proposes up to seven new wells across the existing Carpentaria-1 well pad and six new well pads. However, the EMP is also clear that not all well pads will be constructed if the infill seismic data to be collected indicates that multi-wells on a single pad will be a suitable design. Therefore, civil works will be undertaken in a staged approach across an approximately two month period for each well pad location determined as needed, to avoid unnecessary land clearing and to minimise the disturbance footprint.

The EMP estimates that a total area of up to 166 ha may be cleared, all of which is required to be rehabilitated. This area assumes that the entire length of the seismic lines will be cleared of vegetation. However, the EMP states that for the majority of the seismic lines, no clearing will occur and trees with hollows and mature trees will be avoided wherever possible. The total area also assumes that all six well pads will need to be cleared, but this may not be required (some pads may have multiple wells). It is expected that the actual area to be cleared over the term of the EMP will be less.

Installation of low pressure (less than 1,500 kilopascal gauge) wastewater flowlines is considered in the EMP, for the purpose of transferring high volumes of fluids between well pads. A decision on whether to install the flowlines will be made taking into account the number of well pads actually installed, and the timing of drilling of wells. For example, if two wells are drilled relatively close together in a short time, flowlines will likely be installed, whereas if wells are drilled in a more dispersed pattern across the project, flowlines may not be constructed because the benefit of reduced clearing and efficient transfer of wastewater would be reduced. The well pad design in the EMP assumes each well pad will is large enough to accommodate closed storage tanks and open treatment tanks for wastewater, whereas if flowlines are installed, the well pads can be reduced in size, reducing the area to be cleared. The EMP identifies the benefits of installing flowlines as:

- reduction in land clearing
- increasing capability for recycling and reuse of fluids between well sites
- reducing groundwater use
- decreasing truck movements
- optimisation of management of wastewater to a central location; reducing environmental risk at multiple locations.

The EMP commits to burying the flowlines, to protect them from fire, flood, and damage from livestock and human activity, in line with industry best practice. It is also proposed to have flowlines follow access tracks to reduce additional land clearing. The EMP describes the methods for monitoring the flowlines for leaks, which includes monitoring of volumes in and out of the flowlines, leak inspections and contingency environmental monitoring should a leak be detected.

The drilling program includes four potential well designs: 1) a vertical well which is cased and suspended; or 2) a cased vertical pilot well with a horizontal sidetrack; or 3) a cased horizontal production hole with no vertical pilot; or 4) a vertical cased-hole pilot with a horizontal sidetrack. Vertical pilot wells will be used to provide more information on formations below the target formation. The wells drilled with the vertical pilot will be plugged back to the kick-off point before the lateral section is drilled. All proposed well designs will have aquifers isolated behind cemented casing before drilling into hydrocarbon-bearing zones. Figures 1 and 2 illustrate the difference between a well with a vertical pilot and a lateral, and a lateral well without a vertical pilot. A minimum of two layers of casing and cementing will be used to isolate aquifers, in accordance with Code requirements.

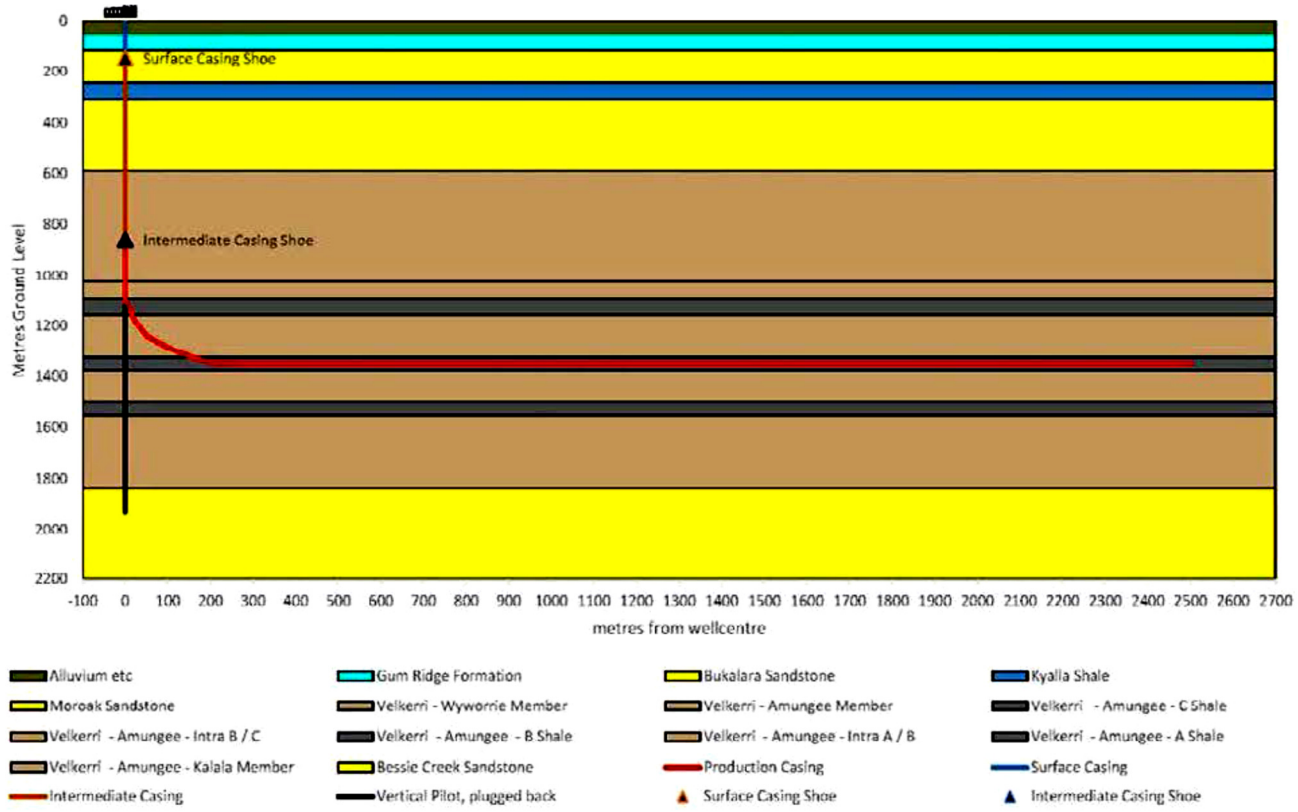

Figure 1: Diagrammatic representation of an exploration well with a vertical pilot well.

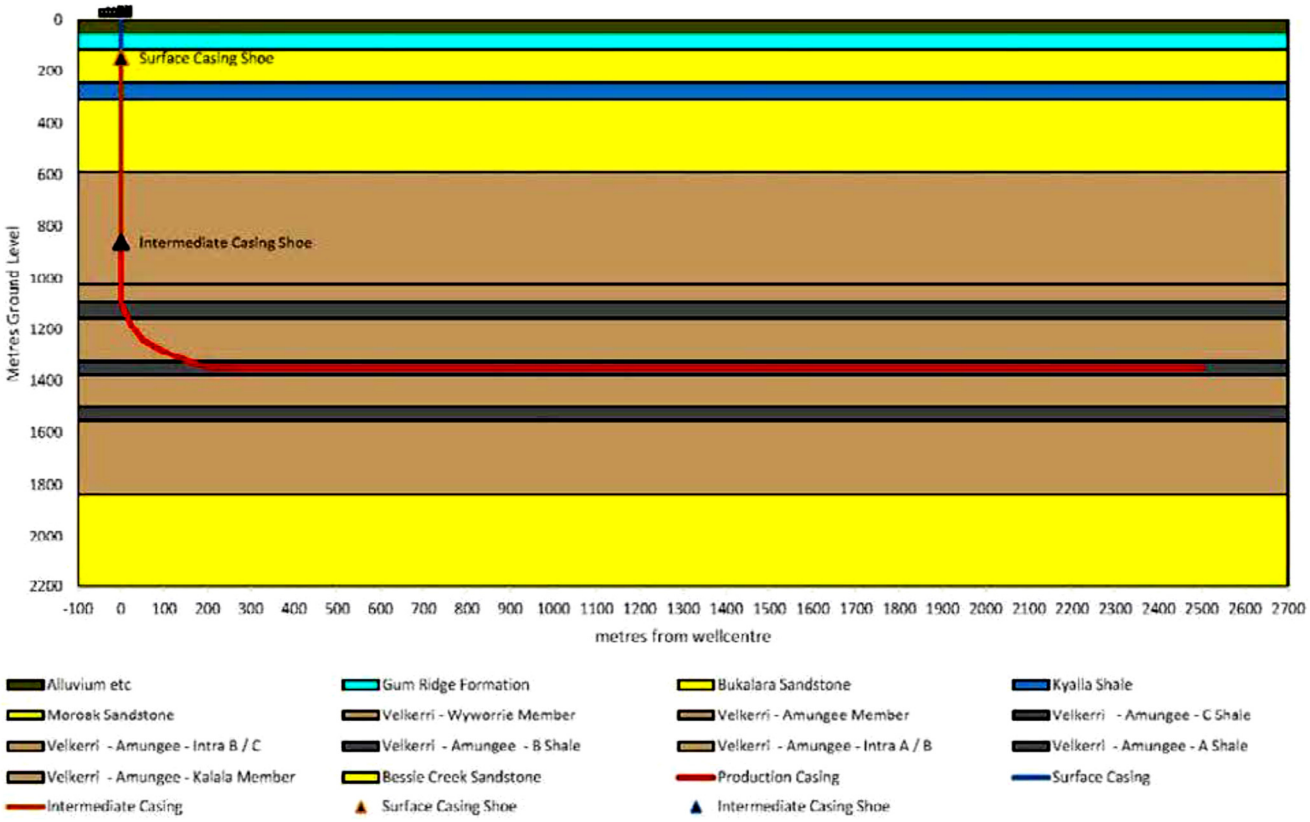

Figure 2: Diagrammatic representation of a lateral exploration well.

The shallowest formation targeted by the drilling and hydraulic fracturing program is the Velkerri - Amungee C Shale formation, which is approximately 850 m below the deepest groundwater aquifer[1] (Bukalara Sandstone). Water based drilling fluids will be used to minimise the risk of environmental impacts while drilling, that are also free from benzene, toluene, ethylbenzene and xylene. All proposed chemicals have been assessed to determine whether they could be considered to be, or to contain, hazardous substances. Where the assessment has identified a potential hazard, further assessment has been undertaken to determine the extent of the hazard, including to fauna.

The wells will be constructed, maintained and decommissioned so there are at least two verified well barriers between the well bore and aquifers. This meets the mandatory requirements of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory* (the Code). Formation Integrity Test (FIT) or Leak-off Test (LOT) will be carried out at the intermediate casing shoe to prove integrity before drilling into following sections.

Drill cuttings will be produced for each well, which will be contained in lined pits, in accordance with the Code. Pits will be designed to accommodate the expected ~790 m^3 of drill cuttings per well, and managed to maintain a minimum freeboard of 500 mm in the dry season and 1,100 mm in the wet season, to accommodate a 1 in 1000 average recurrence interval (ARI) rainfall rate. Drilling fluids will initially be reused, and after evaporation, any remaining fluids will be disposed of offsite prior to the onset of the wet season. Residual solid waste (from evaporated drill fluids) will be mixed in with drill cuttings, and subject to an assessment of suitability, will either be buried and disposed of in-situ, or removed for disposal in a licensed facility.

The EMP describes the precautionary measures that will be in place for multi-well well pads, including use of collision avoidance of wellbores and separation factors. While directionally drilling, standard directional drilling techniques and equipment are employed to enable accurate wellbore direction to be recorded and maintained. The separation factor for each well is also continually calculated and monitored. The infill seismic data will also be used to update the geohazard assessment already completed for the Carpentaria-1 well.

A number of well evaluation techniques will be conducted during and/or on completion of drilling at the well sites including evaluation, logging, testing and coring of the seven new wells, as well as diagnostic fracture injection testing. Before the stimulation of each well, the wellbores will be assessed to ensure that sufficient well integrity is in place to withstand hydraulic fracturing pressures as per the Code and 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 over up to 50 stages per well. Once all stages are complete, the well is suspended, awaiting completion and well-testing activities. Wellbore pressures are monitored during each hydraulic fracturing to ensure operations have not compromised the production casing or the cement barriers' integrity.

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. A three-phase separator will be used to split the well flowback fluids into gas, oil and water. The gas will be directed to a flare equipped with an auto-ignition system that generates a spark every 1.3 seconds to ensure that the flare is always operational, to avoid unintentional venting. Flare tips

[1] The Code defines an aquifer as 'a body of rock that is sufficiently permeable to conduct groundwater and currently supplying, or potentially being able to supply, water for environmental, cultural or consumptive (stock or domestic) uses'.

will have a minimum 96% efficiency. Extended production testing will be undertaken for up to 90 days per well. Water will be directed to flowback tanks, and condensate to storage tanks or flare, depending on the composition. All gas, water and condensate flow volumes will be measured and recorded.

The volume and concentration of chemicals proposed to be used in hydraulic fracturing have been identified and a detailed chemical risk assessment 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.

Suspension and/or decommissioning of wells, as may be determined to be required in the future, will be conducted in accordance with the requirements outlined in the Code and in accordance with the Well Operations Management Plan (WOMP) to be accepted by the Minister for Mining and Industry. The WOMP is assessed by petroleum engineers in the Department of Industry Tourism and Trade DITT). These officers have the technical expertise necessary to evaluate well construction and integrity and ensure that the WOMP complies with the *Schedule of Onshore Petroleum Exploration and Production Requirements* and the relevant sections of the Code. There can be no drilling or hydraulic fracturing before a WOMP has been accepted.

It is estimated up to 435 ML of groundwater will be extracted in total (up to 125 ML per annum) from the Gum Ridge Formation from existing bores, with approximately 385 ML to be used in hydraulic fracturing (approximately 55 ML per well). An application will made to increase the existing Gum Ridge Formation extraction licence (GRF10316) from its current maximum of 85 ML per annum. If the application is granted, total extraction under GRF10316 represents approximately 13% of all licensed users from this aquifer. Annual cumulative groundwater extraction from the Gum Ridge Formation from all licensed bores (currently approximately 915 ML) is currently well below the storage ranges of 1,766,000 to 3,532,000 GL.[2]

Wastewater is proposed to be stored in enclosed tanks, and evaporated in open treatment tanks, for ultimate disposal offsite at a licenced waste management facility. Open treatment tanks are also designed to accommodate the expected ~25 ML of flowback fluid and produced water per well, and managed to maintain a minimum freeboard of 500 mm in the dry season and 1,100 mm in the wet season, to accommodate a 1 in 1000 average recurrence interval (ARI) rainfall rate. Closed storage tanks will be managed to maintain a 500 mm freeboard at all times. It is expected that produced water and flowback fluid will be evaporated onsite and that approximately 7 ML will be required to be disposed of offsite.

Ancillary activities such as weed management, installation of additional groundwater monitoring bores and installation of erosion and sediment controls are also described in the EMP. Peak traffic movements are considered in the context of seasonal public use of roads.

The existing environment has been adequately described through two previous baseline surveys and is sufficiently understood. The EMP has committed to avoiding placement of well pads near to ephemeral drainage lines, streams and creeks, and ensuring buffer zones are adhered to as required under the NTG Land Clearing Guidelines.[3] Location of well pads is also informed by flood modelling provided in the EMP. Where a seismic line, access track or flowline crosses an ephemeral drainage line, stream or creek, the EMP commits to adhering to the *Land Clearing Guidelines* to ensure drainage is not impeded and erosion risk is not increased. The EMP provides adequate mitigation measures for minimising potential for impact to sensitive riparian areas and to prevent contamination of surface waters during periods of flow.

Of the 12 fauna species listed under the *Territory Parks and Wildlife Conservation Act 1976* (NT) and/or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), two

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[2] Tickell, SJ & Q Bruwer. 2019. *Georgina Basin Groundwater Assessment: Daly Waters to Tennant Creek*. Water Resources Division, Report 17/2017 (Version 2, April 2019).

[3] Department of Environment and Natural Resources. 2020. *Land Clearing Guidelines: NT Planning Scheme* (Version 1.2, 31 July 2020).

are considered to have a moderate potential to occur in the project area (the Grey Falcon and the Yellow Spotted Monitor), one species is known to occur there (the Gouldian Finch), and the remainder are considered to have low or low to moderate potential to occur, based on lack of habitat and/or no previous records in the proposed area of activity. The EMP includes assessment of the risk and mitigations for those species which may occur, including an assessment of toxicity risk to birds from ingestion of wastewater which concluded there are no unacceptable exposures to the avian species. One species listed as Critically Endangered (the Golden-backed Tree-rat) has not been observed in the area for over 100 years and is considered locally extinct.

The impact and risk assessment is based on information gathered during environmental baseline surveys and experience drilling Carpentaria-1. The potential impacts and risks of the regulated activity have been identified and critical controls are reflected in the relevant environmental outcomes, performance standards and measurement criteria 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. As a precautionary step the NT EPA has recommended a relevant Ministerial condition for this activity.

1.2 General compliance with Code

The EMP demonstrates how the interest holder will comply with relevant requirements of the Code in undertaking this regulated activity. This includes selection of materials for use in well construction and related engineering controls contained in the WOMP, which will be reviewed and assessed by technical experts in DITT prior to any drilling or hydraulic fracturing. The risk assessment provided in Appendix 04 of the EMP cross-references relevant sections of the Code that apply to the mitigation and management measures to enable the reviewer to identify and confirm that the proposed regulated activity complies with the Code. The EMP also provides the following plans, which are compliant with the Code:

- Erosion and Sediment Control Plan
- Wastewater Management Plan, including an assessment of the hazardous nature of all chemicals proposed to be used
- Spill Management Plan, including a spill risk assessment and chemical risk assessment
- Emergency Response Plan
- Weed Management Plan
- Fire Management Plan
- Methane Emissions Management Plan
- Rehabilitation Management Plan.

Groundwater monitoring has commenced in the Gum Ridge Formation and preliminary data has been collected from the Bukalara Formation. The EMP commits to establishing control and impact monitoring bores in accordance with the Code and the *Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin (Preliminary Guideline)* and includes ensuring sufficient groundwater quality information for the Gum Ridge Formation is obtained to the satisfaction of the DEPWS Water Resources Division, prior to commencement of hydraulic fracturing. Groundwater will continue to be monitored on a quarterly basis and analysed at a NATA accredited laboratory for an array of analytes. As required in the Code and the *Preliminary Guideline*, the interest holder must undertake ongoing groundwater monitoring for three years from the approval date of the EMP, to demonstrate 'no change' to groundwater quality or quantity.

Environmental monitoring and inspections include annual fire fuel load and weed surveys, drilling fluid and cuttings characterisation, daily monitoring during operations of predicted weather, fire conditions and tank and sump levels, pits, dams and fences, reverting to weekly during non-operational periods. The EMP also includes a visual inspections of flowlines, implementation of a leak detection monitoring program for flowlines and a contingency monitoring program for surface water quality for implementation in the unlikely event of a leak from a low pressure flowline.

The level of detail and quality of information provided in the EMP is sufficient to inform the evaluation, assessment and management of potential environmental impacts and risks, and meets the EMP approval criteria under Regulation 9(1)(b). As a further precautionary step, the NT EPA has provided advice relating to Ministerial Conditions for this EMP at the end of this advice.

2. Principles of ecologically sustainable development (regulation 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. The regulated activity will increase activity intensity within the western portion of EP187, and the EMP notes the activity footprint may be further reduced through use of multi-well well pads and sequential land clearing for well pads based on seismic information. The outcomes of this regulated activity will continue to inform decision-making about longer-term petroleum activities in the McArthur Basin and the Beetaloo Sub-basin.

The impacts and risks associated with this work program have been assessed in the EMP. Of the 65 risks identified, 39 are assessed as lowest risk (category 1) and the remaining 26 risks are assessed as category 2. If carried out in accordance with the risk management controls specified in the EMP they will achieve ALARP and acceptability. The adequacy of controls were also assessed by NT Government agencies.

Drill cutting pits and open treatment tanks have been designed to comply with the Code to conservatively accommodate a 1:1,000 year rainfall occurrence during the wet season. A wet season freeboard of 1,100 mm is applied to all open sumps and tanks.

The EMP demonstrates the interest holder has conducted stakeholder engagement with identified, directly-affected stakeholders as required under regulation 7 of the Regulations. The EMP includes a commitment to ongoing stakeholder engagement, including completion of engagement facilitated by the Northern Land Council (NLC), which has twice been cancelled as a result of COVID-19 travel restrictions. These additional NLC-facilitated engagement activities will proceed prior to commencement of hydraulic fracturing activities. The EMP was also made available for public comments (21 April 2021 to 19 May 2021).

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

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

The risk assessment clearly demonstrates consideration of risk events in the context of the environment in which the regulated activity is conducted and its particular values and sensitivities, and the spatial extent and duration of the potential impact. The EMP outlines the interest holder's investigations into the physical, biological and cultural environment and demonstrates a sound understanding of the environment at the location, providing a satisfactory scientific basis to assess potential environmental impacts and risks for the activity, and to identify measures to avoid or minimise those impacts and risks. Where refinement of the location of the regulated activity may be required, on the basis of seismic data, the interest holder has committed to undertake further site investigation prior to proceeding.

The risks associated with conducting the regulated activity over the wet season are well understood and described. The EMP demonstrates adherence to the Code that establishes best practice management measures for exploration activities, as set out in the risk assessment and Wastewater Management and Spill Management Plans. The EMP commits to avoiding significant operational activities during the peak of the local wet season and includes the assessment of impacts and risks for wet season operations and management strategies, including measures such as daily monitoring of access tracks for weather related impacts, ensuring no transfer of chemicals unless risks are ALARP, daily monitoring for predicted significant rainfall events, use of telemetered wastewater level

monitoring and inspections to ensure safe operating fluid levels are maintained and assessment of erosion and sediment controls within 18 hours of rainfall.

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 must comply with.

The NT EPA is of the view that the precautionary principle has been considered in assessing the regulated activity and has not been triggered due to the low threat of serious or irreversible damage occurring and the presence of a satisfactory scientific basis to assess potential impacts and risks. In addition, the existing environmental monitoring commitments contained in the EMP are compliant with the Code and provide measureable performance measures to ensure that the environmental outcomes are met. As a precautionary step the NT EPA has recommended a relevant Ministerial condition for this activity.

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

The EMP demonstrates an adequate understanding of the environment in which the regulated activity will be undertaken, and considers all relevant aspects of the environment that have potential to be affected. As the EMP proposes to establish multiple wells at each well pad, it includes a consideration of potential environmental impacts and risks associated with increased storage requirements for chemicals and wastewater. If implemented, the proposed use of low pressure flowlines further reduces the potential for impacts associated with loss of containment of wastewater by reducing the number of locations where wastewater would be treated or stored.

Preliminary flood modelling indicates the provisional location of three of the six new well pads may be affected by minor and partial inundation during a 1 in 100 annual exceedance probability flood event, but the final location of well pads within the areas surveyed will be ground-truthed[4] to confirm the presence of drainage channels and where required, well pads will be constructed such that overland flow in minor drainage channels is diverted.

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

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

- compliance with the Code requirement to ensure a minimum physical vertical separation distance of 600 m between the base of the deepest aquifer and the target formation to prevent any migration of drilling fluid to aquifers (~ 850 m)
- compliance with the Code requirements to ensure a minimum distance of 1 km horizontal separation distance between exploration wells and existing water supply bores used for domestic or stock consumption (~1.1 km)
- storage of hazardous chemicals or those that may cause environmental harm within secondary containment with sufficient capacity to hold 110% of the largest stored container or within tanks equipped with safety features such as double-skin, spill kits available at all potential spill areas and a compliant spill management plan

[4] "Ground-truthing" refers to further field-based assessment of the final proposed locations for ground-disturbing activities, such that the location of drainage lines and streams, boundary of riparian zones, high value vegetation, high density of hollow-bearing trees, potential Gouldian Finch breeding habitat and current Grey Falcon breeding sites (if any) can be identified and required buffer zones established, or the location of activities altered, prior to commencement of ground-disturbing activities.

- use of conservative wet and dry season freeboard for drill cutting pits and open wastewater treatment tanks.

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 for hazardous spill prevention, monitoring, assessment, response and clean-up. The NT EPA recommends the interest holder maintain a register for all spills of contaminants or hazardous substances that is provided to the Department of Environment, Parks and Water Security (DEPWS).

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 field studies undertaken by the interest holder to inform the EMP affords the interest holder with an adequate knowledge of the potential environmental impacts and risks and the most appropriate measures for mitigation of those impacts and risks. Further ground-truthing prior to ground disturbance will ensure site-specific values are considered and the location of activities will be adjusted accordingly.

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

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

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

Protection of Sacred Sites 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 two archaeological assessments to identify and avoid archaeological heritage impacts. The regulated activity is subject to requirements of an Authority Certificate that will be issued for the regulated activity (application number 202100005). The interest holder has also committed to having Aboriginal monitors present during ground-disturbing activities.

The EMP commits the interest holder to progressive rehabilitation throughout the life of the activity which, combined with the Code requirements, is considered to reduce the risks to biodiversity and soil contamination to ALARP and acceptable levels.

Total greenhouse gas (GHG) emissions generated by the regulated activity (approximately 249,893 tCO_2-e over the five year life of the EMP) are considered ALARP and acceptable noting the regulated activity will result in an overall increase in NT GHG emissions of 1.21% in total, or approximately 0.24% per year over the whole program, based on conservative estimates of emissions from fuel combustion, land clearing, flaring and fugitive emissions. The EMP also refers to the cumulative GHG emissions from the regulated activity and the interest holder's previously approved regulated activities since the commencement of activities in 2019. Imperial's cumulative GHG emissions (across four EMPs) are approximately 271,308 tCO2-e, representing a total increase of approximately 1.3% overall on annual NT GHG emissions reported for 2019. The EMP also considers cumulative GHG emissions in or near the permit area from petroleum and mining activities and concludes the total GHG emissions are approximately 632,034 tCO_2-e across all currently approved programs, representing a 3.1% increase in total NT 2019 GHG emissions of approximately 20,700,000 tCO2-e.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 (s 22 *Environment Protection Act 2019* (NT))

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

Cumulative impacts of groundwater extraction have been assessed. The interest holder has groundwater extraction licence GRF10316, with a maximum water entitlement of up to 85 ML/year from the Gum Ridge Formation. The anticipated water demand for this regulated activity is approximately 435 ML in total, with a peak use of approximately 125 ML in 2023. Further application will be made to the Controller of Water Resources for an increase in groundwater extraction to accommodate the required groundwater usage. Groundwater extracted to date to support previously approved regulated activities is ~ 15.5 ML. Annual cumulative groundwater extraction from the Gum Ridge Formation from all licensed bores in this aquifer (approximately 915 ML per annum) is currently well below the storage ranges of 1,766,000 to 3,532,000 GL and the sustainable extraction rate of 14,128,000 ML per annum, and significantly lower than estimates of stock water required at approximately 8,900 ML per annum.[5] A further increase in the interest holder's extraction licence, to a maximum of approximately 125 ML per annum will have negligible effect.

A conservative estimate of total GHG emissions likely to be generated by the regulated activity is approximately 249,893 tCO_2-e in total, or approximately 49,800 tCO_2-e per annum across five years (maximum of ~70,500 tCO_2-e in the 2022-2023 financial year). This estimate includes an assumption that seismic lines will be cleared and all well pads and access roads will be installed, whereas the interest holder has committed to avoiding clearing on a substantial part of seismic lines and will not establish all six new well pads and associated access ways or flowlines, if multi-well well pads are established. The NT EPA notes that the Government has committed to implementing all recommendations of the *Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory* (HFI Final Report), including that the NT Government seeks to ensure there is no net increase in the lifecycle GHG emissions emitted in Australia from any onshore petroleum produced in the NT. To support the NT Government's commitment, the NT EPA has provided advice that the interest holder provide to DEPWS annual actual scope 1 and scope 2 GHG emissions reported under the National Greenhouse Energy Reporting Scheme (NGERS) versus predicted emissions in the EMP.

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

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

Site selection for establishment of well pads, seismic lines, flowline corridors and access tracks has been informed by two field-based ecological and archaeological assessments, inclusive of buffer areas to allow for adjustment in locations and alignments where required to protect riparian zones.

The proximity of groundwater dependent ecosystems is known and the interest holder has committed to protecting riparian zones, high value vegetation, mature trees, and trees with hollows, to the greatest extent possible, through use of an ecologist to undertake ground-truthing prior to clearing. The installation of access tracks and flowlines is estimated to affect 0.23 hectares of riparian zone vegetation (0.06% of the estimated 375 hectares of riparian vegetation mapped in the project area) and approximately 252 m of stream bed (<0.001% of the 426 km of streams in the project area). The regulated activity is not within proximity to any declared ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

[5] Water Resources Division Water Extraction Licence Decision, GRF10316, 15 May 2020.

The regulated activity is located within the Gulf Fall and Upland and Sturt Plateau bioregions and poses a low risk to the ecosystems within these bioregions, given the relatively small area footprint of the regulated activity and the very large area of similar habitat. Six listed fauna species may occur within EP187, with a low to medium likelihood of occurrence, and one, the Gouldian Finch, has been sighted east of the location of the regulated activity. The interest holder has committed to avoiding clearing of mature trees and trees with hollows to the greatest extent possible and will have an ecologist present prior to all land clearing activities, to confirm the presence and extent of riparian zones, high value vegetation and hollow-bearing trees. 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 and potential impacts and risks to flora, fauna, and ecosystems have been mitigated to an acceptable level.

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

Potential offsite impacts to surface water have been considered in the EMP and have been adequately addressed by the mitigation and management measures provided in the Wastewater Management Plan (Appendix 6) and Spill Management Plan (Appendix 7) that were developed in accordance with the Code. The NT EPA recommends surface water monitoring is undertaken during the wet season at locations where wastewater flowlines cross streams, whenever the flowlines are in use.

The EMP outlines measures to minimise impacts on affected environmental values, including the management of threatening processes such as weeds and fire. Where relevant, management measures for the aforementioned threatening process 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 installation of fencing around drill cutting pits, installation of fauna ladders/escapes in drill cutting pits and open flowline trenches during installation, inspections for fauna presence, use of vertical-walled and above ground wastewater treatment tanks which prevents access by ground fauna, appropriate storage of waste and use of speed limits on access roads.

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

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

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

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

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

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

The interest holder has committed to identified measures to avoid impacts on environmental values, informed by baseline studies and previously collected seismic data in the exploration permit.

The EMP demonstrates a systematic identification and assessment of environmental impacts and risks associated with the regulated activity. The key potential environmental impacts and risks considered in the EMP are:

- impacts of vehicle and machinery movements on soils, wildlife and other road and land users
- impacts to other land users, stock and wildlife from light, noise and vibration generating activities
- potential for contamination of soil, surface water and groundwater from generation and handling of wastewater, use of chemicals and hydraulic fracturing
- impacts from increase in GHG emissions
- impacts to soil and surface water from land clearing and erosion and sedimentation
- impacts to biodiversity, cultural heritage and other land users from introduction or spread of weeds, introduction of pest species and uncontrolled bushfires
- impacts to listed species and high conservation value habitat from land clearing, vehicle movements and potential interaction with wastewater
- impacts to cultural heritage from land clearing, unauthorised access and fire
- increased risk from larger volume of wastewater generated from operating a multi-well well pad.

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

The EMP has demonstrated why the proposed controls are considered ALARP and acceptable. Of the 65 environmental risks identified by the interest holder, 39 have a residual risk score of 1 after controls are applied, which is considered acceptable, and it is assumed that ALARP has been achieved. The remaining 26 risks have a residual risk score of 2, which considered is acceptable provided that ALARP has been demonstrated. These 26 risks are summarised as follows:

1. *Impacts of vehicle and machinery movements on other road and land users:* The interest holder has committed to preparation of a Traffic Management Plan for approval by the Department of Infrastructure, Planning and Logistics (DIPL), which has been deemed adequate to mitigate this risk. The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'moderate'.
2. *Impacts to wildlife from light, noise and vibration generating activities*: The interest holder has identified the potential for noise, vibration and light to potentially impact on wildlife. The EMP includes specific measures to minimise impacts to noise-sensitive species such as the Grey Falcon, but vehicle and machinery use and well pad lighting is unavoidable. The residual risk is based on a likelihood of 'almost certain', but the consequence is considered to be 'negligible' with the controls implemented.
3. *Impacts to air quality from generation of dust*: Movement of vehicles and machinery and land clearing will generate dust. The residual risk ranking is based on a likelihood of 'almost certain', but the consequence is considered to be 'negligible' because of the isolated location (lack of sensitive receptors) and use of dust suppression methods.
4. *Impacts to soil and surface water from land clearing and erosion and sedimentation*: The interest holder has committed to implement buffers around riparian zones for drainage channels and streams, and will undertake ground-truthing and mapping prior to commencement of ground disturbance. The consequence of interference with waterways is considered 'moderate' but is considered 'unlikely' with the proposed controls implemented. The consequence of sedimentation of waterways is considered 'minor', but is considered 'possible'.
5. *Impacts to biodiversity and other land users from introduction or spread of weeds*: The EMP includes an approved Weed Management Plan (Appendix 9) which includes appropriate weed hygiene measures, inspections and control activities. The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'moderate'.

6. *Impacts to other land users from loss of amenity and interference with pastoral operations*: The impact of conduct of the regulated activity on other land users and stakeholders is mitigated through ongoing engagement, ensuring only approved areas are accessed, all hazards are signposted and implementation of the Rehabilitation Management Plan (Appendix 12). The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'moderate'.
7. *Impacts to local workforce through failure to use local resources*: The interest holder has committed to using local contractors with the capability to meet the required scope. The consequence is considered 'minor' as the scopes are short duration and the likelihood is considered 'possible', where there is competition for use of those resources or there is a lack of local capability.
8. *Impacts to high conservation value habitat, including riparian vegetation from land clearing*: The EMP identifies measures for avoiding or minimising impacts to high value habitat from land clearing, including avoiding clearing of seismic lines where it is possible to move around trees, and ensuring buffer zones for riparian zones are not cleared. The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'moderate'.
9. *Impacts to cultural heritage, other land users and wildlife from fire*: The EMP includes a Fire Management Plan (Appendix 8) which aligns with the requirements of the *Bushfires Management Act 2016* (NT) and the interest holder has committed to maintaining low fuel load zones and firebreaks around well pads. The consequence of uncontrolled fire is considered to be 'moderate' to 'major', but is considered 'unlikely' to occur with the controls in place.
10. *Potential for contamination of surface water and groundwater from generation and handling of wastewater, use of chemicals, drilling and hydraulic fracturing and operation of multi-well well pads*: The EMP adheres to the requirements of the Code for groundwater protection, including well integrity measures that will also be included in a WOMP accepted by the Minister for Mining and Industry, wastewater management and monitoring, secondary containment for storage of hazardous chemicals, and ensuring adequate separation distances exist between the nearest aquifer and the target formation. Confirmation that the WOMP complies with the provisions of the Code that relate to aquifer protection, environmental protection and well-integrity must be provided by technical experts in DITT to the Minister for Environment prior to any drilling or hydraulic fracturing. Continuous positional tracking of the drill bit is used to detect and respond to vertical and horizontal well deviations during drilling and each adjacent well is designed and constructed with multiple casing barriers and specifically-engineered cement in place to protect aquifers. Blow-out preventers will be in place during drilling. The interest holder has committed to ensuring well integrity is maintained at all stages of the regulated activity. The new seismic data will further inform the previous geohazard assessment to mitigate for subsurface hazards such as abnormal pressure zones, shallow gas, lost circulation and potential zones of instability. The interest holder uses a Mechanical Earth Model based on logging, coring and drilling, and offset data is created to aide in understanding hydraulic fracture geometry and subsequent design. Groundwater monitoring will be undertaken at control and impact sites at each established well pad in accordance with the requirements of DEPWS Water Resources Division, and the EMP includes a commitment to undertake surface water monitoring to detect impact if there is a leak in the wastewater flowline. The controls applied for use of the wastewater flowline are sufficient to ensure a leak can be readily detected in an appropriate timeframe. The Waste Management Plan (Appendix 6) provides estimates of the volume of wastewater to be generated and its proposed treatment, and the Spill Management Plan (Appendix 7) includes measures for implementation should a spill occur. The Emergency Response Plan (Appendix 14) includes measures for unplanned events, including spills of hazardous chemicals or wastewater during general use and during transportation. Well pads are sited to avoid potential for flood inundation, and will be constructed with a 500 mm bund on the perimeter to prevent water entry form overland flow. Drill cutting pits will also be constructed with a 500 mm bund, and the interest holder will maintain the required freeboard on all open wastewater treatment tanks and drill cutting pits in the dry and wet seasons. The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'major'.

11. *Impacts to cultural heritage*: The EMP is informed by two archaeological assessments and the activity will be subject to the conditions of an Authority Certificate issued by the Aboriginal Areas Protection Authority. The EMP includes strict requirements to avoid movement outside of approved areas, a commitment to include Aboriginal monitors during ground disturbing activities and implementation of a chance find procedure should heritage items be located. The residual risk ranking is based on the likelihood being considered 'unlikely', but the consequence of the event occurring being considered to be 'major'.
12. *Potential for contamination of soil from transportation of chemicals and wastewater*: The interest holder has considered potential for chemical leaks and spills associated with transportation of wastewater and chemicals during the wet season. Road conditions for heavy vehicle transport will be assessed before mobilisation on unsealed roads and no transport of chemicals or wastewater will occur if the conditions are assessed as unsuitable. The risk assessment of hydraulic fracturing chemicals concluded that under a hypothetical maximum wastewater release scenario, contamination of soil would not be detectable at levels above soil screening criteria, based on the concentration of those chemicals used. The interest holder has complied with requirements of the Code to minimise the potential for soil contamination to occur, including a commitment to remediate any contaminated soil. The residual risk ranking is based on a consequence of 'minor', but a likelihood of 'possible'.
13. *Impacts to soil from erosion*: The interest holder has considered potential impacts of erosion particularly where well pads are partially located in areas with slopes > 2%. The Erosion and Sediment Control Plan (Appendix 5) includes additional measures for such locations, including soil stabilisation and additional sedimentation controls, as well as a comprehensive range of inspections and monitoring requirements pre- and post-rainfall. The EMP (Appendix 2) also describes the methods for levelling of well pads, including cut and fill methods. The residual risk ranking is based on a consequence of 'minor' but a likelihood of 'possible'.
14. *Impacts to other land users from use of groundwater*: DEPWS Water Resources Division has assessed that the impact of drawdown from the Gum Ridge Formation is unlikely to create a significant drawdown effect such that other users will be affected, and the proposed use will have a negligible effect on the resource. The residual risk ranking is based on a consequence of 'major' but a likelihood of 'unlikely'.

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. As a further precautionary step, the NT EPA has provided advice relating to Ministerial Conditions for this EMP.

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
Water and Wastewater	• Daily monitoring of stored groundwater volume and evaporation rate • Weekly assessment of flowback fluid and produced water in open wastewater treatment tanks and closed wastewater storage tanks until stable results, and then assessment every six months, in accordance with the Code (clause C.8) • Daily monitoring of wastewater level and evaporation rates of flowback fluid and produced water in open wastewater treatment tanks and enclosed wastewater storage tanks • Six-hourly monitoring of freeboard in open treatment tanks, drill cutting pits and closed wastewater storage tanks, using telemetry. • Assessment of wastewater in accordance with the Code (clause C.8)

Aspect	Monitoring and inspections
	• Assessment of drilling fluids and cuttings in accordance with the Code (clause C.4.1) • Daily inspections of liners and structural integrity of drill cutting pits and tanks, while operational • Daily inspection for leaks of well pad transfer lines, valves and hoses while operational • Monitoring of surface water quality both upstream and downstream in the event of a leak of 100 L or more from a wastewater flowline • Continuous monitoring (hourly reporting) for leaks of buried wastewater flowlines while operational
Groundwater	• Establishment of impact and control monitoring bores at each new well pad and collection of a minimum of eight samples and analysis in accordance with the Code (clause B.4.17), prior to commencement of hydraulic fracturing and in accordance with DEPWS Water Resources advice • Quarterly monitoring of groundwater quality and groundwater level from control groundwater bores for a minimum of three years from the date of commencement of drilling (spud date), and then annually • Ongoing monitoring of volume of groundwater extracted using flow meters
Hydraulic fracturing fluid	• Concentration of additives to water and the total volume pumped at each stage, for each hydraulic fracturing stage
Waste	• Weekly site inspections including litter and waste receptors
Fauna	• Weekly inspection of tanks and drill cutting pits for entrapped fauna • Ad hoc fauna observations
Bushfire	• Weekly assessment of bushfire weather alerts • Annual fire mapping in accordance with the Code (clause A.3.7)
Rainfall	• Daily weather forecast and predicted significant rainfall events during the wet season
Weeds	• Annual post-wet season weed surveys to determine whether any weed introductions have occurred and to monitor existing weed populations
Rehabilitation	• Monitoring of rehabilitation progress following the first wet season, and annual monitoring thereafter in accordance with the Code (clause A.3.9)
Erosion	• Daily site inspections (during rainfall), including all drainage, erosion and sediment control measures, occurrences of excessive sediment deposition (whether on-site or off-site) and all site discharge points (including dewatering activities as appropriate) • Weekly site inspections (even if work is not occurring on-site), including all drainage, erosion and sediment control measures, occurrences of excessive sediment deposition (whether on-site or off-site), occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements • Prior to anticipated runoff producing rainfall (within 24 hours of expected rainfall), inspection of all drainage, erosion and sediment control measures, all temporary flow diversion and drainage works • Following runoff producing rainfall (within 18 hours of rainfall event), inspection of all drainage, erosion and sediment control measures, occurrences of excessive sediment deposition (whether on-site or off-site) and occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
Greenhouse gas emissions and fugitive emissions	• Ongoing monitoring of fugitive methane emissions during well testing • Six monthly leak detection during non-well testing periods and within 48 hours of recommissioning • Use of personal gas detectors for all operational personnel
Chemicals	• Weekly site inspections including oil, fuel and chemical storage facilities • Daily inspections for leaks during operational periods

Aspect	Monitoring and inspections
	• Daily inspections of fuel and chemical storage, while operational • Daily inspections of bunded areas for structural integrity and presence of a spill or leak or rainwater while operational
Roads	• Weekly inspections of sealed carriageways and unsealed shoulders during operations to ensure integrity

5. Relevant matters raised through public submissions

Public consultation on the EMP was required under regulation 8A. The EMP was advertised for public comment on Have Your Say and made available for public comment for 28 days from 21 April 2021 to 19 May 2021. A total of 1,620 submissions were received,[6] of which 1,608 were form letters from a public campaign. One hundred and seventy-three submissions (10.7%) were identified as originating within the NT, noting 606 submissions (37.4%) did not identify their origin. Table 3 summarises the issues raised. In summary, most submissions were opposed to onshore petroleum development generally and raised substantially similar issues as those addressed through the HFI Final Report and subsequent implementation of the 135 HFI recommendations. Several submissions did not raise any matters specifically relevant to the EMP under assessment.

Table 3: Consideration of relevant matters raised in public submissions

Theme	Overview of issues raised
Flora and fauna (environment)	• increase in predation on native fauna and weed spread from land clearing • impact on stygofauna in groundwater from drilling and hydraulic fracturing • permanent environmental damage • impacts on groundwater dependent ecosystems, including stygofauna • lack of baseline ecological surveys and extent of SREBA • impacts on birds and amphibians from wastewater • direct and indirect impacts and edge effects • incremental increase in land clearing • sufficiency of surface rehabilitation only • lack of survey of entire EP187 • impacts from noise, light and vibration • cumulative impacts
Social and cultural	• impacts to other road users • consent for onshore petroleum activities • inclusion of Authority Certificate • damage to cultural heritage • concerns as to the extent of stakeholder engagement • adequacy of 28 day comment period and use of Have Your Say • concern about management of Covid-19 pandemic
Climate change	• greenhouse gas emissions • lack of NT emissions policy
Water	• distance between well pad and existing water bore • adequacy of baseline groundwater monitoring • groundwater over-extraction • design of groundwater monitoring program • downstream impacts
Waste	• cyclone risks to transport of wastewater and storage of wastewater in open tank • storage of wastewater in open tanks • waste disposal • transport of wastes

[6] A total of 1631 submissions were received, but there were multiple submissions from 10 individuals which have not been included in the total, but are included in the consolidated public comments for publication.

Theme	Overview of issues raised
Chemicals	• transport of chemicals and cyclone risk • adequacy of chemical risk assessment
Well integrity	• lack of transparency of Well Operations Management Plan • corrosion of wells from hyper-salinity, high temperature and sulphate-reducing and sulphur oxidising bacteria
Regulation and compliance	• lack of regulatory scrutiny • Commonwealth funding of onshore petroleum activities in the Beetaloo • referral under the *Environment Protection Act 2019* (NT) (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) • application of precautionary principle of ecological sustainable development • Minister's consideration of the Well Operations Management Plan • adequacy of Northern Land Council consultation of affected Aboriginal stakeholders • amendment of the *Mining Management Act 2001* (NT) and *Environment Protection Act 2019* (NT) • exploration creep

The issues raised by the community were considered by the NT EPA. While most of the issues were already addressed in the draft EMP, the interest holder has also amended the EMP where required, and the NT EPA has also recommended extra conditions to to improve transparency.

1. *Flora and fauna:* Submissions raised concern about impacts to fauna and flora, including listed species, citing a lack of ecological studies, including across the entirety of EP187, as well as the adequacy of the surveys that have been undertaken. The interest holder conducted targeted assessments of all areas of proposed ground disturbance, which is sufficient to understand the potential impacts of the proposed regulated activity. It is not necessary to survey the entirety of EP187, as the area of ground disturbance is strictly controlled by the interest holder and confirmed by the regulator. Further the interest holder has committed to undertaking further ground-truthing by an ecologist prior to the commencement of ground-disturbing activities, in recognition that the available datasets and mapping does not provide sufficient detail to identify sensitive environmental features, such as riparian zones, high value (intact) vegetation, and the location and density of hollow-bearing trees. No ground-disturbance will occur until the additional surveys are conducted and final locations for well pads, seismic lines, access ways and flowlines can be determined.

   The assertion that land clearing will result in an increase in predation on native fauna and weed spread is not substantiated. Weed management is underpinned by initial assessments of the presence of weeds, ongoing application of vehicle hygiene measures and annual weed assessment and control activities. The only feral predator known to occur in the region are feral cats. None of the listed species with potential to occur in the location of the regulated activity are included in the list of species at threat from feral cats.[7] There is also no evidence to suggest that onshore petroleum activities have resulted in the spread of cane toads or an increase in numbers in the location of onshore petroleum activities.

   Claims that stygofauna will be impacted by drilling and hydraulic fracturing are not substantiated. Interest holders are required to use only drilling fluids that are non-toxic while drilling through aquifers,[8] in order to avoid impacts to groundwater. Hydraulic fracturing does not interact with groundwater and cannot have an impact on stygofauna. The potential impact on groundwater dependent ecosystems in general is negligible, given the depth to groundwater in the location of

[7] Department of the Environment (2015) *Threat Abatement Plan for Predation by Feral Cats* Commonwealth of Australia <https://www.legislation.gov.au/Details/F2017C00219>.

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

the regulated activity is greater than 20 m (~ 50 m at Carpentaria-1), the typical depth at which terrestrial groundwater dependent ecosystems are found.[9]

Concern was raised about the Strategic Regional Environmental Baseline Assessment (SREBA) not including areas outside of the Beetaloo Sub-basin and the progression of exploration without SREBA having been completed. The SREBA covers the Beetaloo Region,[10] inclusive of the location of the regulated activity. Recommendation 15.1 of the HFI Final Report refers to the requirement of SREBA to be conducted prior to issue of further production approvals, not exploration approvals.

Concern was raised about indirect impacts of the proposed regulated activity, including impacts from noise, light and vibration, edge effects and permanent environmental damage. The EMP includes commitments to minimising light shed and noise, whereas vibration from seismic acquisition is unavoidable and is limited to a six week program. It is highly unlikely that offsite impacts to wildlife will be created as a result of noise, light or vibration and the interest holder has taken into account the sensitivity of the Grey Falcon to noise, on advice of DEPWS Flora and Fauna Division. It is also highly unlikely that there will be measurable edge effects from conduct of the regulated activity, noting the total area proposed to be cleared under the EMP represents the upper limit of land clearing, and is likely to be substantially less than this upper limit.

Concern was raised about cumulative impacts. The EMP considers the cumulative effect of land clearing from this and other local activities, and concludes that 0.0014% of the Beetaloo Sub-basin has been cleared to date. All ground-disturbing activities from onshore petroleum are required to be rehabilitated. The DEPWS Water Resources Division has confirmed that the cumulative annual extraction of approximately 915 ML across all licences is well within the sustainable extraction rate of 14,128,000 ML per annum. The EMP also refers to cumulative GHG emissions from onshore petroleum in or near the permit areas of the petroleum and mining operations and concludes that publically available data shows emissions to date represent 3.1% of the total 2019 NT emissions.

Concerns were raised about the adequacy of subsurface rehabilitation, and in particular whether decommissioning processes are sufficient. The Code outlines the requirements of decommissioning and is based on best practice. Further, clause A.3.9 of the Code requires rehabilitated areas to be ecologically integrated with the surrounding landscape at the end of the regulated activity, and free from contamination.

Concerns were raised about impacts to amphibians and birds from open wastewater storage tanks. No wastewater may be stored in open tanks. Where wastewater is placed into open tanks for treatment, these tanks have vertical sides, which prevents access by amphibians, and therefore there is unlikely to be any impact on amphibians from wastewater treatment. Similar operations conducted in the NT and other jurisdictions have found impacts to birdlife from open cuttings pit are considered low due to the saline nature of the water not being attractive or injurious to bird species. Open drill cutting pits may be accessed by amphibians and the interest holder has included in the EMP a trigger and proposed actions should observations of impact on fauna from open drill cutting pits be detected.

2. *Social and cultural*: Public submissions raised concerns about social aspects such as the adequacy of stakeholder engagement and granting of consent for onshore petroleum activities, and whether a 28 day comment period and use of Have Your Say was sufficient for obtaining public feedback. The 28-day public comment period is a legislated period. Use of Have Your Say allows for a notice about an EMP to be available for 28 days, rather than a single day in the print media. Online mediums also allow for a wider range of stakeholders to receive the message. The NT EPA understands that all subscribers to the Hydraulic Fracturing Community Bulletin also received the notice for this EMP. The NT EPA notes that Have Your Say is also used to provide notices by a range of government agencies.

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[9] Department of Environment and Natural Resources (2020) *Land Clearing Guidelines*, section 4.4.8.1.
[10] Northern Territory Government (undated) *Strategic Regional Environmental and Baseline Assessment (SREBA) Fact Sheet* <https://hydraulicfracturing.nt.gov.au/__data/assets/pdf_file/0007/984148/sreba-fact-sheet.pdf>.

The EMP includes a stakeholder engagement report, which demonstrates that the interest holder has engaged with a range of stakeholders, that is, individuals whose rights and activities may be directly affected by the environmental impacts of conducting the regulated activity, as defined in regulation 7(3) of the Regulations. This has included direct engagement with leaseholders and Aboriginal stakeholders, as well as engagement conducted through the NLC (as an agent for Aboriginal stakeholders). The interest holder has also committed to ongoing engagement with all stakeholders and a condition has been recommended in relation to stakeholder engagement interrupted by COVI-19 travel restrictions.

Concern was also raised about impact to other road users. The EMP includes a detailed traffic impact assessment, and the estimated truck movements are provided. The EMP was reviewed by the DIPL Road Transport Division, and the interest holder is working with the Department to meet its requirements and have a Traffic Management Plan approved, prior to commencement of the regulated activity. Further, the interest holder proposes to upgrade an intersection with the Carpentaria Highway to ensure safe egress and ingress to the location of the regulated activity.

Damage to cultural heritage and failure to include an Authority Certificate in the EMP were also raised. The EMP cannot be approved until an Authority Certificate is issued. Authority Certificates provide the strongest protection for Sacred Sites under Australian law. Further, two archaeological assessments have been undertaken in the location of the regulated activity, and the interest holder commits to also have Aboriginal monitors present during ground disturbing activities and implementation of a chance find procedure should heritage items be located. The EMP includes strict requirements to avoid movement outside of approved areas.

A question was also raised as to the safety of the NT community in light of the Covid-19 Pandemic. The interest holder, like all organisations in the NT, have a Covid-Safe Plan, approved by the Department of Health. The interest holder is also subject to strict controls applied by the Northern Land Council when considering issue of access permits.

3. *Climate change*: Concerns were raised about GHG emissions and the lack of an NT emissions policy. A conservative estimate of total GHG emissions likely to be generated by the regulated activity is approximately 49,800 tCO_2-e per annum across five years (maximum of 70,500 tCO_2-e in the 2022-2023 financial year). Further, given the regulated activity is a whole-of exploration scope, the predicted emissions are considered ALARP and acceptable noting the regulated activity will result in an overall increase in NT GHG emissions of approximately 0.24% per year over the whole program, based on conservative estimates of emissions from fuel combustion, land clearing, flaring and fugitive emissions.

   The NT government has a Climate Change Response, a Climate Action Plan and is undertaking research to inform an emissions reduction strategy. Government is developing an emissions reduction strategy and a policy for managing emissions from new and expanding large emitters. Government is also developing a draft greenhouse gas emissions offset policy and has committed to implement recommendation 9.8 of the HFI, which relates to the offsetting of GHG from the onshore petroleum industry.

4. *Water*: Concerns were raised about the state of knowledge of groundwater aquifers in the region, as well as the adequacy of groundwater monitoring and the design of the monitoring program. Groundwater monitoring has already commenced in the Gum Ridge Formation and preliminary data has been collected from the Bukalara Formation. The interest holder commits to establishing control and impact monitoring bores in accordance with the Code and the *Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin* to ensure sufficient groundwater quality information for the Gum Ridge Formation is obtained to the satisfaction of the DEPWS Water Resources Division, prior to commencement of hydraulic fracturing. The comparatively small volumes of groundwater proposed to be extracted are unlikely to have an impact on water supply to nearby groundwater bores, noting annual cumulative groundwater extraction from the Gum Ridge Formation from all licenced bores in this aquifer (approximately 915 ML per annum) is well below the storage ranges of 1,766,000 to 3,532,000 GL and the sustainable extraction rate of 14,128,000 ML per annum, and significantly lower than estimates of stock water required at approximately 8,900 ML per annum.

The draft EMP included a well pad which was closer to an existing groundwater bore used for domestic or stock purposes. The well pad has been relocated by the interest holder, to ensure it meets the required separation distance of 1 km, which is consistent with the recommendation in the HFI Final Report as a measure to avoid drawdown impacts on other groundwater users.

Concern was raised about the potential for downstream impacts to Limmen Bight River and the Limmen Bight Marine Park, from contamination of streams in the location of the regulated activity. Appendix 07 of the EMP includes an assessment of the potential for a spill to spread and infiltrate to groundwater. In the unlikely event of a catastrophic release (defined in the modelling as 1 ML, which is greater than the largest possible amount of wastewater that could be released by a flowline), it was concluded that an area of 300 m radius could be affected. It was also concluded that it would take approximately 158 years to infiltrate through to 50 m below ground level in siltstone, or 115 days in fractured limestone. As the Code requires an immediate response to any contamination detected, a spill management plan for spills of hazardous materials, and primary and secondary containment for all potentially hazardous materials stored, the risk of causing offsite contamination of surface waters is considered unlikely. The EMP also includes a commitment to initiate a surface water monitoring program in the event of a leak of 100 L or more from a wastewater flowline into a waterway during the wet season.

5. *Waste*: Public submissions raised concern about overtopping of wastewater storage ponds in the event of a cyclone. Storage tanks and pits are designed and operated to prevent overtopping due to rainfall and drill cutting sumps include sufficient freeboard to accommodate in excess of the anticipated rainfall based on a 1:1000-year Average Recurrence Interval (ARI) for the duration of the regulated activity. The risk of overtopping is considered unlikely. The EMP also includes additional measures such as a 0.5 m bund wall on top of drill cutting sumps and all wastewater is stored in enclosed tanks.

   Transportation of chemicals and wastewater during the wet season is dependent on an assessment of road conditions prior to mobilisation on any unsealed roads, which includes daily assessment during the wet season. In addition, the Spill Management Plan (Appendix 07) and Emergency Response Plan (Appendix 14) consider spill responses in relation to loss of containment during transport.

6. *Chemicals*: Concerns were raised about the loss of containment of chemicals during transportation and the adequacy of the chemical risk assessment. Management of transport risk is addressed under 'Waste' above. The chemical risk assessment has been conducted by an independent third party, and is based on standard chemical risk assessment processes, with reference to:

   - 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.
   - The majority of the chemicals were identified not to be persistent or bioaccumulative and in very low concentrations.

   Concern was also raised about the avian fauna referred to in the Chemical Risk Assessment not including local species. The species selected are typical of a range of a different types of birds which may occur locally, which is standard practice.

7. *Well integrity*: Concerns were raised about the potential for corrosion of wells from hyper-salinity, high temperature and sulphate-reducing and sulphur oxidising bacteria, as well as the WOMP not being available to the Minister for Environment for review, as part of the EMP assessment process.

   In accordance with clause B.4 of the Code, all onshore shale gas wells (including exploration wells constructed for the purposes of production testing) have mandatory requirements for well construction, with cementing extending up to at least the shallowest problematic hydrocarbon-bearing, organic carbon rich or saline aquifer zone. The interest holder must have a WOMP

accepted by the Minister for Mining and Industry prior to commencement of the regulated activity that will be implemented for the drilling program design, to ensure isolation of the Gum Ridge Formation and overall petroleum well integrity is achieved, verified and monitored.

Concerns regarding increasing salinity and temperature with depth below surface, and sulphate-reducing and sulphur oxidising bacteria, have previously been addressed in responses to queries raised outside of the EMP assessment process by the same organisation, and no substantive new issues were raised.

Consideration of the WOMP by the Minister is provided under "regulation and compliance', below.

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

   Concerns were raised about application of the precautionary principle of ecologically sustainable development and the principle on intergenerational equity. Managing the NT's valuable water and other environmental assets in regions that may be developed for gas requires a detailed knowledge of the ecology and biodiversity of surface and groundwater ecosystems, and a sound understanding of aquifers and surface water systems. The Inquiry recognised that this detailed knowledge is lacking in many parts of the Territory. To address this, the NT government is working with independent experts, research agencies such as CSIRO, and industry to undertake a comprehensive Strategic Regional Environmental and Baseline Assessment (SREBA) in prospective onshore gas basins before granting any production approvals. The proposed whole-of-scope exploration program under the EMP is informed by targeted ecological assessments, and the interest holder commits to undertaking ground-truthing to identify specific environmental features prior to on-ground disturbance. Aspects relevant to intergenerational equity are addressed in section 2.4 above.

   Concerns were also raised about 'exploration creep'. This EMP is the first EMP to holistically describe the full exploration program proposed, which addresses previous public comments regarding lack of transparency of the full exploration program. The NT EPA is satisfied that measures are in place to ensure that the final locations of well pads, access roads, wastewater flowline corridors can be located such that impacts are managed to ALARP and acceptable levels. Uncertainty around the final location of various activities is mitigated by having an ecologist on site prior to ground disturbance and to have Aboriginal monitors present during ground disturbance. Further, the NT EPA recognises that multiple EMPs for the same project impose an extra burden on the regulator and the NT EPA, and encourages the submission of a consolidated EMP to enable a 'holistic' assessment of potential risks and impacts, which this EMP has done.

   Public submissions have asserted that the Minister may not make a decision on the EMP, without also considering the WOMP, which is a document accepted by the Minister for Mining and Industry. The WOMP is assessed by petroleum engineers in DITT. These officers have the technical expertise necessary to evaluate well construction and integrity and ensure that the WOMP complies with the *Schedule of Onshore Petroleum Exploration and Production Requirements* and the relevant sections of the Code. There can be no drilling or hydraulic fracturing before a WOMP has been accepted by DITT.

   Submissions relating to Commonwealth grants for support of onshore exploration, amendment of the *Mining Management Act 2001* (NT) and *Environment Protection Act 2019* (NT) and adequacy of consultation of affected Aboriginal stakeholders by the Northern Land Council are not related to the assessment of the regulated activity under the Regulations.

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 DEPWS, on a quarterly basis.

CONCLUSION

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

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

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

RECOMMENDATION

The NT EPA recommends that should the EMP for Imperial Oil and Gas Pty Ltd be approved, the following conditions be considered:

***Condition 1*:** The interest holder must submit to the Department of Environment, Parks and Water Security (DEPWS), via Onshoregas.DEPWS@nt.gov.au the following:

i. Notification of the commencement of hydraulic fracturing activities prior to commencement.

ii. An updated timetable for the regulated activity that is to be provided on the last day of each quarter (being 31 March, 30 June, 30 September and 31 December each year), that identifies activities completed in the current quarter and:

- regulated activities in the next quarter, including duration;
- activities in the next quarter based on commitments in the EMP relevant to the stage of the activity, including duration;
- due dates for satisfaction of Ministerial approval conditions in the next quarter; and
- due dates for regulatory reporting in the next quarter.

iii. During civil works (and noting civil works is taken to include any type of earth moving, land clearing, installation of gravel pits, establishment of well pads, establishment of access tracks and installation of wastewater flowlines) and seismic activities, weekly reports indicating:

- the status and progress of vegetation clearing and civil works at each location the activity is conducted;
- the outcome of any assessments undertaken by a suitably qualified person of geomorphic and hydrological investigations and the conclusion as to whether directional drilling is required, in advance of installing wastewater flowlines across a stream;
- the status and progress of seismic activities;
- any fires potentially threatening the activity from external or internal sources;
- the outcome of inspections of erosion and sediment control measures, and corrective actions taken; and

- the outcome of inspections and risk assessments for determining suitability of use of unsealed roads by any vehicle or machinery other than a light vehicle in the wet season.

iv. During drilling, daily on-site reports, to be consolidated and provided weekly, indicating:

- status and progress of drilling at each location;
- freeboard available in drill cutting pits (in cm); and
- the outcome of general site inspections relevant to drilling and waste, and corrective actions taken.

v. During hydraulic fracturing and flowback, weekly reports indicating:

- status and progress of hydraulic fracturing;
- weekly measurement of stored volume (in ML) and freeboard available (in cm) of wastewater storage tanks, unless operated in the wet season, during which it must be measured daily;
- volume of wastewater transferred via wastewater flowlines, including records of inflow and outflow (in L) for each transfer; and
- the outcome of general site inspections relevant to hydraulic fracturing and waste, and corrective actions taken.

vi. During the wet season, weekly reports indicating:

- daily measurements of freeboard available in drill cutting pits and wastewater treatment tanks (in cm);
- the outcome of inspections of erosion and sediment control measures, and corrective actions taken;
- the outcome of daily inspections of any secondary containment in use, and corrective actions taken; and
- any halt to the regulated activity due to wet season conditions.

vii. For avoidance of doubt, if wastewater is present in tanks or flowlines, or drill cutting pits contain waste drill fluids and cuttings, these are considered to be operational, irrespective of whether there is manned activity occurring on site, reports must continue to be provided as per conditions ii to vi above.

viii. The weekly submission of consolidated daily reports may be further consolidated to a single submission where activities are being conducted concurrently, but must clearly identify the locations and activities to which the information pertains, against each item listed in conditions iii to vi above.

Condition 2**:** The interest holder must provide an annual report to DEPWS, via Onshoregas.DEPWS@nt.gov.au, on its environmental performance, in accordance with item 11(1)(b) in schedule 1 of the Petroleum (Environment) Regulations 2016 (NT). With respect to the reports required to submitted in accordance with item 11(1)(b) in schedule 1 of the Petroleum (Environment) Regulations 2016 (NT):

i. The first report must cover the 12 month period from the date of the approval, and be provided within 3 calendar months of the end of the reporting period.

ii. Each report must align with the template and Guideline prepared by DEPWS for this purpose and be provided each year until such time a notification is made to the Minister under regulation 14 that the activity is complete, or until the EMP is revised and re-approved.

Condition 3**:** An emissions report must be provided to DEPWS by 30 September each year, via Onshoregas.DEPWS@nt.gov.au, which summarises actual annual greenhouse gas emissions from conduct of the regulate activities reported under the Commonwealth *National Greenhouse*

and Energy Reporting Act 2007 versus predicted emissions in the EMP.[11] The emissions report should include:

i. a summary of regulated activities conducted which have contributed to greenhouse gas emissions; and

ii. explanation of differences between actual and predicted emissions with reference to all parts of the regulated activity with potential to create greenhouse gas emissions.

***Condition 4*:** Audits of compliance must be undertaken by a suitably accredited, qualified and independent person and the audit report provided to DEPWS via Onshoregas.DEPWS@nt.gov.au, no later than 4 weeks after the completion of the audits. The following must be adhered to:

i. Audits must include a field-based inspection by the auditor to verify implementation of controls.

ii. Audits must be conducted as follows:

- within 2 weeks of establishment of the first well pad and focussed on implementation of the Erosion and Sediment Control Plan, and again within 2 weeks of establishment of another well pad;
- immediately prior to the commencement of drilling of the first exploration well and focussed on all controls listed in the EMP relevant to drilling activities, and again immediately prior to commencement of drilling another exploration well; and
- during flowback and extended production testing for two different exploration wells, and focused on all controls listed in the EMP relevant to management of wastewater and containment of contaminants, including the Wastewater Management Plan and the Spill Management Plan.

iii. Audits must focus on implementation of the EMP.

iv. Audit reports must be conducted in accordance with any published guidance issued by DEPWS and at a minimum must:

- include audit objectives, scope and audit methods used;
- include the audit criteria used for determining compliance with the commitments in the EMP;
- provide detail on the evidence used for determining compliance with the commitments in the EMP;
- include photographic evidence from the field-based components of the audit;
- include clear identification of opportunities for improvement, compliances and non-compliances, as determined by the audit; and
- include recommended corrective actions for any identified non-compliances.

***Condition 5*:** In support of clause B.4.17.2 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*, the interest holder must provide to DEPWS, via Onshoregas.depws@nt.gov.au:

i. Groundwater monitoring data within one month of collection and thereafter quarterly, in a format to be determined by DEPWS.

ii. An interpretative report of groundwater quality based on the groundwater monitoring required to be conducted at the well site(s) in accordance with Table 6 of the Code. The interpretative report must be provided annually within 3 months of the anniversary of the approval date of the EMP and include:

[11] Clause D.6.2(b) of the Code requires annual actual greenhouse gas emissions to be provided even where emissions are below the NGERs threshold of 25 ktCO_2-e for scope 1 and scope 2 emissions reporting.

- demonstration that there is no change to groundwater quality or level attributable to conduct of the regulated activity at the well site(s);
- interpretation of any statistical outliers observed from baseline measured values for each of the analytes;
- discussion of any trends observed; and
- a summary of the results inclusive of descriptive statistics.

iii. Site-specific performance standards for groundwater quality and interquartile ranges for analytes at each of the impact monitoring bores established, based on the first 3 years of groundwater monitoring, within 6 months of the 3 year anniversary of approval of the EMP.

***Condition 6*:** In support of clause 16 of the *Water Act 1992* (NT) and clause B.4.2 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*, the interest holder must undertake groundwater level/pressure monitoring at each impact monitoring bore established, using a logger to record water level for 4 weeks prior to, during, and 4 weeks after completion of hydraulic fracturing operations at each new well pad. Data logging should record at a minimum of every 4 minutes for the duration of the recording period. The logging data should be provided to DEPWS via Onshoregas.DEPWS@nt.gov.au within 2 weeks of completion of groundwater level monitoring in each impact monitoring bore.

***Condition 7*:** The ground-truthing committed to in the EMP must be undertaken one week in advance of commencement of ground-disturbing activities by a qualified and experienced ecologist with experience in Gouldian finch habitat requirements to ensure alternative routes are identified in the field prior to commencement of clearing.

***Condition 8*:** Prior to the commencement of ground-disturbing activities, the interest holder must engage an ecologist with experience in Gouldian Finch habitat requirements to prepare a map of potential breeding habitat of the Gouldian Finch that could be impacted by the regulated activity. The potential Gouldian Finch breeding habitat mapping must:

i. be provided to DEPWS via Onshoregas.dewps@nt.gov.au in advance of commencement of ground-disturbing activities; and

ii. quantify the proportion of the regulated activity footprint that consists of potential Gouldian Finch breeding habitat.

***Condition 9*:** Clearing of vegetation within potential Gouldian Finch breeding habitat for access tracks, wastewater flowlines, gravel pits and well pads must avoid trees with a diameter of >25 cm at breast height, to the maximum extent practicable.

***Condition 10*:** In support of schedule 1, item 11 of the Petroleum (Environment) Regulations 2016 (NT) and clause A.3.5 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*, the interest holder must provide geospatial files to DEPWS, via Onshoregas.DEPWS@nt.gov.au, within 2 months of completion of each ground-disturbing or land clearing activity, as specified in Figure 3.2 of the EMP (Project schedule), which must:

i. include information on how the data was obtained;

ii. meet the requirements specified by DEPWS at https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land/spatial-data-for-clearing-applications;

iii. include riparian zones, areas of high value vegetation (which includes potential Gouldian Finch breeding habitat), areas of high density of hollow-bearing trees and the buffers applied as a result of ground-truthing activities, as polygons and with metadata indicating the area in hectares;

iv. include any resultant deviations to the location of the regulated activity;

v. include the location of any listed species sighted during ground-truthing; and

vi. include the proposed and actual areas of vegetation cleared, as polygons and with

metadata indicating the area in hectares.

***Condition 11*:** To support clause C.7.2 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*, all accidental releases of liquid contaminant or hazardous chemical must be immediately recorded in a spill register, including all spills or leaks from the wastewater flowlines regardless of volume. The spill register and geospatial files specifying the location of the spill must be submitted to DEPWS via Onshoregas.DEPWS@ nt.gov.au with the Annual Environment Performance Report each year while the EMP is in force. The register must include:

i. the location source and volume of the spill;

ii. volume of impacted soil removed for appropriate disposal and the depth of any associated excavation;

iii. the corrective actions taken or proposed to be taken to prevent recurrence of an incident of a similar nature; and

iv. GPS co-ordinates of the location of the spill.

***Condition 12*:** The interest holder must undertake monthly surface water monitoring in accordance with section C.8 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory* upstream and downstream of streams which are crossed by wastewater flowlines, if those flowlines are operational during the wet season. The interest holder must provide a Surface Water Sampling and Analysis Plan to DEPWS via Onshoregas.DEPWS@nt.gov.au, 2 months in advance of commencement of any wet season during which it is proposed to use wastewater flowlines that cross streams, and include:

i. the location and number of proposed monitoring points;

ii. the method for sample collection; and

iii. quality control and chain of custody procedures.

***Condition 13*:** All freshwater used to flush the wastewater flowlines must be treated as contaminated wastewater until such time analysis of the water against section C.8 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory* indicates that contaminants are not detectable.

***Condition 14*:** The interest holder must provide to DEPWS, via Onshoregas.DEPWS@nt.gov.au, a Rapid Response Site Demobilisation and Stabilisation Plan that details the strategy for managing environmental risks, including management of drill cuttings and wastewater that may result in the event a flood inundates access and/or a well pad, within 2 months of approval of the EMP. The Plan should:

i. include response strategies, including options for removal of drill cuttings and removal, covering and/or transfer of wastewater in open treatment tanks;

ii. identify personnel who would implement;

iii. identify equipment required, including pumping capacity and number of pumps for the transfer of wastewater from open to enclosed tanks;

iv. identify access constraints that would affect the response and how this would be managed;

v. specify the timeframes for responses and demonstrate they are as low as reasonably practicable; and

vi. include a commitment to commence site preparation and wet season planning by 31 July each year.

***Condition 15*:** Prior to the commencement of drilling, the interest holder must provide to DEPWS, via Onshoregas.DEPWS@nt.gov.au, bowtie diagrams that demonstrate how loss of containment of wastewater will be managed, inclusive of preventative and mitigative controls, that:

i. consider loss of containment from wastewater treatment and storage tanks, drill cutting

pits and wastewater flowlines;

ii. consider wet and dry season conditions; and

iii. consider the location of a loss of containment event.

Condition 16**:** The interest holder must provide to DEPWS, via Onshoregas.DEPWS@nt.gov.au, a cementing report for the surface casing through the Gum Ridge Formation and the Bukalara Formation, as soon as practicable but not more than 14 days after completion of the cementing job for each well.

Condition 17**:** In support of clause C.4.1.2 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*, the interest holder must provide to DEPWS, via Onshoregas.DEPWS@nt.gov.au, no later than 3 months of completion of the drilling program on one well pad north and one well pad south of the Carpentaria Highway, a report that:

i. provides the outcome of assessment and leachability testing of residual drill fluids and drill cuttings; and

ii. provides the recommended disposal option.

Condition 18**:** The interest holder must not commence hydraulic fracturing until enclosed wastewater storage tanks sufficient to contain the volume of wastewater in storage and under treatment at any given time during conduct of the regulated activity are installed on the well pad, in accordance with the secondary containment requirements of clause A.3.8 of the Code.

Condition 19**:** Prior to the commencement of hydraulic fracturing at any new exploration well, the interest holder must provide an updated Stakeholder Engagement Log (Appendix 11) which demonstrates engagement that was postponed as a result of Covid-19 travel restrictions has been completed. Any required amendments to the EMP resulting from an objection or claim from a stakeholder must be submitted to DEPWS via Onshoregas.DEPWS@nt.gov.au in accordance with regulation 22 or 23, as applicable.

Condition 20**:** The interest holder must provide to DEPWS within 6 weeks of completion of well flowback operations at each new exploration well established on EP187 a report on a comprehensive risk assessment of flowback wastewater from the hydraulic fracturing phase, via Onshoregas.DEPWS@nt.gov.au. The risk assessment report must:

i. be prepared by a suitably qualified person;

ii. be prepared in accordance with the monitoring wastewater analytes specified in section C.8 of the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*;

iii. assess degradation of hydraulic fracturing chemicals in the wastewater; and

iv. consider the impacts and risks on fauna and potential for soil and water contamination from a loss of containment, based on the analytical results obtained.

Condition 21**:** The interest holder must report to the community via its website on the following matters:

i. the area actually cleared, within 1 month of completion of each land clearing activity;

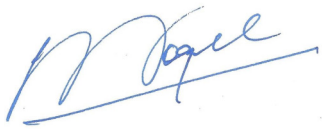
ii. chemical species to be used in hydraulic fracturing activities, one week before hydraulic fracturing activities commence;

iii. the concentrations of chemicals and NORMS found in flowback and produced water, as part of an annual environment report;

iv. results of the well integrity test, including measures taken to manage and minimise adverse outcomes, within 1 month of completing these activities;

v. results of groundwater monitoring, as part of an annual environment report; and

vi. rehabilitation of cleared areas, as part of an annual environmental report.



DR PAUL VOGEL AM

CHAIRMAN

NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

31 AUGUST 2021