Imperial Oil and Gat Pty Limited

Regulation 23 - Environment Notice

Interest Holder	Imperial Oil and Gas Pty Limited	EMP title	2021-2025 EP187 Work Program	Unique EMP ID No.	IMP4-3	Notice No.	1	Date	13.11.2021

Brief Description	On 8 October 2021 Imperial requested Water Resources Division (WRD) review bore logs for the control monitoring bores for Carpentaria 2 (Carp AA). The request was made in accordance with recommendations in section 5 of P*reliminary Guidelines: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub Basin 2018* (the preliminary Guideline). Water Resources Division's interpretation of the downhole logs (gamma) was that Imperial's water monitoring bores had penetrated the Anthony Lagoon formation and not yet in the Gum Ridge formation. It was previously considered unlikely that this aquifer was present based on drilling results at the Carpentaria-1 location. Following the steps in the approved Environment Management Plan and the Preliminary Guideline, Imperial has begun drilling a second set of monitoring bores to accommodate this aquifer and the Environmental Notice is being submitted under Regulation 23 of the Petroleum (Environment) Regulations.
Geospatial Files Included?	Geospatial files of the well bore location will be sent in accordance with Ministerial Condition

Does the change in existing environment result in a new, or increased, potential or actual environmental impact or risk?	If a new potential or actual environmental impact or risk is it provided for in the approved EMP?	If an increase in an existing potential or actual environmental impact or risk is it provided for in the approved EMP?	Does the change in the existing environment require additional mitigation measures to be included?	Has additional stakeholder engagement been conducted?	Does it require additional environmental performance standards and measurement criteria?	Does it affect compliance with sacred site authority certificates?	Does it affect current rehabilitation, weed, fire, wastewater, erosion and sediment control, spill or emergency response plans?	Will the environmental outcome continue to be achieved and will the impacts and risks be managed to ALARP and acceptable
Yes, while the regulated activity has not been modified, and the potential for impact on groundwater is already considered in the EMP. There is a change in the existing environment which may result in a potential impact.	N/A	Yes, the EMP refers to the potential for a different aquifer, and recognises that the Anthony Lagoon may be regionally present. The aquifer will be isolated during well construction and will not be utilised for water supply so there is no additional impact.	No, the aquifers will be isolated as already required in the EMP.	Yes.	No, the approved EMP covers the requirements.	No	No	Yes, consultation has been undertaken with Water Resources and the Department of Infrastructure Tourism and Trade have been engaged during throughout the process.

EMP Section	Current EMP Text	Amended EMP Text (blue indicates new text, text with a strikethrough over it "~~this~~" is to be removed)
3.1.2 Cumulative Impacts in conjunction with other activities near the permit area	"The annual cumulative groundwater extraction from all licenced bores from the Gum Ridge aquifer of 953ML is well below the sustainable extraction rate of 14,128,000ML per annum DEPWS (2018). Water Resources believes that the addition of 100ML per annum for the activities under this EMP will have a negligible effect. A DEPWS Water Resources Division assessment found that the impact of drawdown on the Gum Ridge Formation from this extraction is unlikely to create a significant drawdown effect that would affect other users."	"The annual cumulative groundwater extraction from all licenced bores from the Gum Ridge aquifer of 953ML is well below the sustainable extraction rate of 14,128,000ML per annum DEPWS (2018). Water Resources believes that the addition of 100ML per annum for the activities under this EMP will have a negligible effect. A DEPWS Water Resources Division assessment found that the impact of drawdown on the Gum Ridge Formation from this extraction is unlikely to create a significant drawdown effect that would affect other users. While undertaking this program it was determined that the Anthony Lagoon aquifer is present in certain parts of EP187. The Anthony Lagoon will be isolated from the Gum Ridge aquifer and will not be used as a source of water for program activities. The Anthony Lagoon will be monitored and sampled in line with the Code and EMP requirements."

<table>
<tr><td>3.17.4 Groundwater monitoring</td><td>Imperial will install a Control Monitoring Bore (CMB) and Impact Monitoring Bore (IMB) to monitor the known Gum Ridge aquifer on each wellpad in line with the Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin. If any unknown aquifers are discovered during the drilling activities, the requirements of the same guideline will be followed.</td><td>Imperial will install a Control Monitoring Bore (CMB) and Impact Monitoring Bore (IMB) to monitor the known Gum Ridge aquifer on each wellpad in line with the Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin. If any unknown aquifers are discovered during the drilling activities, the requirements of the same guideline will be followed. While undertaking this program it was determined that the Anthony Lagoon aquifer is present in certain parts of EP187. Where the Anthony Lagoon or any further aquifer is found to be present in exploration it be will monitored inline with the same guideline requirements."</td></tr>
<tr><td>Table 27 Monitoring Plan</td><td>IMPERIAL OIL & GAS Environment Management Plan
Table 27: Monitoring Plan<table><tr><th>Monitoring program</th><th>Location</th><th colspan="2">Factors Assessed/Actions</th><th>Frequency</th></tr><tr><th></th><th></th><th>Quality</th><th>Quantity</th><th></th></tr><tr><td>Risk Analysis Reviews</td><td>Operationally, office based</td><td>Review of the monitoring programs outcomes</td><td>N/A</td><td>Review officed based yearly against the risk matrix, or as required due to operational incident.</td></tr><tr><td>Baseline water</td><td>CMBs
IMBs</td><td>• Bore water tested for analytes, as described in Table 6 of The Code</td><td>Water level of the Gum Ridge aquifer.

Tracking of water level when taking samples</td><td>A minimum of eight samples before undertaking hydraulic fracturing</td></tr></table></td><td>yellow to be altered to

"water level of the Gum Ridge and the Anthony Lagoon aquifer where either are present. Any other discovered aquifers will also be monitored."</td></tr>
<tr><td>Appendix 01, 1.3 Geology</td><td>"The Bukalara Sandstone is unconformably overlain by the Cambrian age Top Springs Limestone (also known as the Gum Ridge Formation and informally as the Cambrian Limestone Aquifer). This unit is recognised as a regional aquifer and is considered the deepest aquifer present at the Location of the Regulated Activity"</td><td>"The Bukalara Sandstone is unconformably overlain by the Cambrian age Top Springs Limestone (also known as the Gum Ridge Formation and informally as the Cambrian Limestone Aquifer). This unit is recognised as a regional aquifer and is considered the deepest aquifer present at the Location of the Regulated Activity. While undertaking this program it was determined that the shallower Anthony Lagoon aquifer is present in certain parts of EP187. The Anthony Lagoon is possible to occur above the Gum Ridge Formation as seen in Table:5 Summary of Beetaloo Basin Hydrostratigraphy"</td></tr>
<tr><td>Appendix 01, 1.7 Groundwater</td><td>EP187 is not within a water allocation plan area. It lies immediately to the east of the Daly Roper Beetaloo Water Control District, straddling the northeast boundary of the Georgina Basin. It partially overlies the aquifer known as the Gum Ridge Formation, part of the extensive regional Cambrian Limestone Aquifer, including the Tindall Limestone Aquifer to the North in the Daly Basin.</td><td>" EP187 is not within a water allocation plan area. It lies immediately to the east of the Daly Roper Beetaloo Water Control District, straddling the northeast boundary of the Georgina Basin. It partially overlies the aquifer known as the Gum Ridge Formation, part of the extensive regional Cambrian Limestone Aquifer, including the Tindall Limestone Aquifer to the North in the Daly Basin. While undertaking this program it was determined that the Anthony Lagoon aquifer is present in certain parts of EP187. The Anthony Lagoon is possible to occur as part of the Cambrian Limestone Aquifer, above the Gum Ridge Formation as seen in Table:5 Summary of Beetaloo Basin Hydrostratigraphy"</td></tr>
<tr><td>Appendix 01, 1.7.1 Regional Groundwater within the Cambrian Limestone Aquifer (CLA)</td><td>" Control and Impact monitoring bores were drilled into the Gum Ridge aquifer on Carpentaria 1 during the 2020 drilling program, RN04168 and RN041800, respectively.

Monitoring samples have been undertaken from the nearby water supply bores (RN027848 and RN039574) and the Gum Ridge Monitoring bores to demonstrate a baseline of water quality data for the area and to comply with recommendations from the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory, March 2018 (NT Government, 2018). Figure 10 presents the water bores in relation to the location of the regulated activities. The Stratigraphy in the Location of the Regulated Activity, as confirmed in the 2020 drilling program, is shown in the EMP.

Naturally occurring elevated heavy metal concentrations (zinc) above trigger levels were reported in House Bore (HB-1), No.5 Bore (5B-1), and No.4 Bore (4B-1). These concentrations are consistent with the natural ore bodies in the area and are expected. Total Petroleum Hydrocarbons (TPH), Total Recoverable Hydrocarbons (TRH) fractions of benzene, toluene, ethylbenzene and xylenes (BTEX) from all samples collected were less than the laboratory level of reporting (LoR). Physical parameters (pH, conductivity and TDS), major cations and total hardness were consistent with historical results."</td><td>" Control and Impact monitoring bores were drilled into the Gum Ridge aquifer on Carpentaria 1 during the 2020 drilling program, RN04168 and RN041800, respectively.

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</table>

		While implementing this program it was confirmed that the Anthony Lagoon aquifer was present in certain parts of EP187, previously recognised as a possibility shown in Table 5. Following the approved Environment Management Plan and the Preliminary Guideline Imperial is drilling a second set Control and Impact monitoring bores."
Appendix 2 2.6.2 Surface Hole Section	The surface hole section will be drilled from the pre-installed cellar and conductor to a depth that isolates any shallow aquifer/s, the Gum Ridge Formation in this region.	The surface hole section will be drilled from the pre-installed cellar and conductor to a depth that isolates any shallow aquifer/s, ~~the Gum Ridge Formation~~ in this region. removal of the "the gum ridge formation" to remove ambiguity.
Appendix 2 2.6.2 Surface Hole Section	During drilling of the Carpentaria 1 well, total drilling fluid losses were observed in the Gum Ridge Formation. This scenario was anticipated during the well design and in current well designs, with high permeability conduits, fractures and cavernous zones expected in karstic formations. Loss of circulation material (LCM) is generally not successful for responding to fluid losses in these formations. When total losses occur, the drilling fluid systems are reduced back to water to maintain dynamic well control while minimising drilling additive losses to the formation.	During drilling of the Carpentaria 1 well, total drilling fluid losses were observed in the Gum Ridge Formation. This scenario was anticipated during the well design and in current well designs, with high permeability conduits, fractures and cavernous zones expected in karstic formations. Loss of circulation material (LCM) is generally not successful for responding to fluid losses in these formations. When total losses occur, the drilling fluid systems are reduced back to water to maintain dynamic well control while minimising drilling additive losses to the formation. While implementing this program it was determined that the Anthony Lagoon aquifer was present in certain parts of EP187. This same drilling process will be followed if any other aquifers are found to be present during drilling.
Appendix 06 5.2 Aquifers to be monitored	"If other aquifers are encountered during the drilling of wells under this EMP, monitoring bores will be installed to monitor those aquifers"	"If other aquifers are encountered during the drilling of wells under this EMP, monitoring bores will be installed to monitor those aquifers. While implementing this program it was determined that the Anthony Lagoon aquifer was present in certain parts of EP187. Imperial confirm that this process was followed and will continue to be followed.
Appendix 06 5.3 Location	" Control monitoring bores (CMBs) and impact monitoring bores (IMBs) will be installed 100m upgradient and 20m down-gradient respectively of the well as per the Guidelines requirements. The bores' purpose is to monitor the Gum Ridge Formation. CMBs and IMBs must be monitored six months before drilling, preferably and include both wet and dry season samples. In the circumstances where six months of monitoring data from the CMBs and IMBs are not achievable before drilling, a minimum of eight samples will be required from CMB and IMB at each new wellpad before undertaking hydraulic fracturing of the well over approximately three months or longer."	Control monitoring bores (CMBs) and impact monitoring bores (IMBs) will be installed 100m upgradient and 20m down-gradient respectively of the well as per the Guidelines requirements. The bores' purpose is to monitor aquifers as determined on location ~~the Gum Ridge Formation~~. CMBs and IMBs must be monitored six months before drilling, preferably and include both wet and dry season samples. In the circumstances where six months of monitoring data from the CMBs and IMBs are not achievable before drilling, a minimum of eight samples will be required from CMB and IMB at each new well pad before undertaking hydraulic fracturing of the well over approximately three months or longer.