

<b>Interest holder</b>	Origin Energy B2 Pty Ltd	<b>EMP Title</b>	Beetaloo Sub-basin Multi-well Drilling, Stimulation and Well Testing Program Exploration Permit (EP) 98 & 76 EMP		<b>Unique EMP ID</b>	ORI10-3	<b>Mod #</b>	1	<b>Date</b>	15 August 2022
<b>Brief Description</b>	<p>1 [REDACTED]</p> <p>2. Revised location of access track and groundwater monitoring bores at Amungee NW2 in response to a late pastoral request to move Amungee NW2 infrastructure approximately 1.4 km from an existing stock watering trough.</p>									
<b>Geospatial files included?</b>	Attached.									
<b>Does the proposed change result in a new, or increased, or potential or actual environmental impact or risk?</b>	<b>If an INCREASE in the existing potential or actual environmental risk, is it provided for in the EMP?</b>	<b>Does the proposed change require additional mitigation measures to be included?</b>	<b>Has additional stakeholder engagement been conducted?</b>	<b>Does it require additional environmental performance standards and measurement criteria?</b>	<b>Does it affect compliances with Sacred Site Authority Certificates?</b>	<b>Does it affect current rehabilitation, weed fire, wastewater, erosion and sediment control, spill or emergency response plans?</b>	<b>Will the environmental outcome continue to be achieved and will the impacts and risks be managed to ALARP and acceptable?</b>			
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]			
[REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED]  [REDACTED] [REDACTED] [REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]  [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]			
[REDACTED] [REDACTED]	<p>[REDACTED]</p> <p>[REDACTED]</p> <ul style="list-style-type: none"> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> <li>  [REDACTED]</li> </ul> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p>									

[illegible]



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Current EMP text	Amended EMP text
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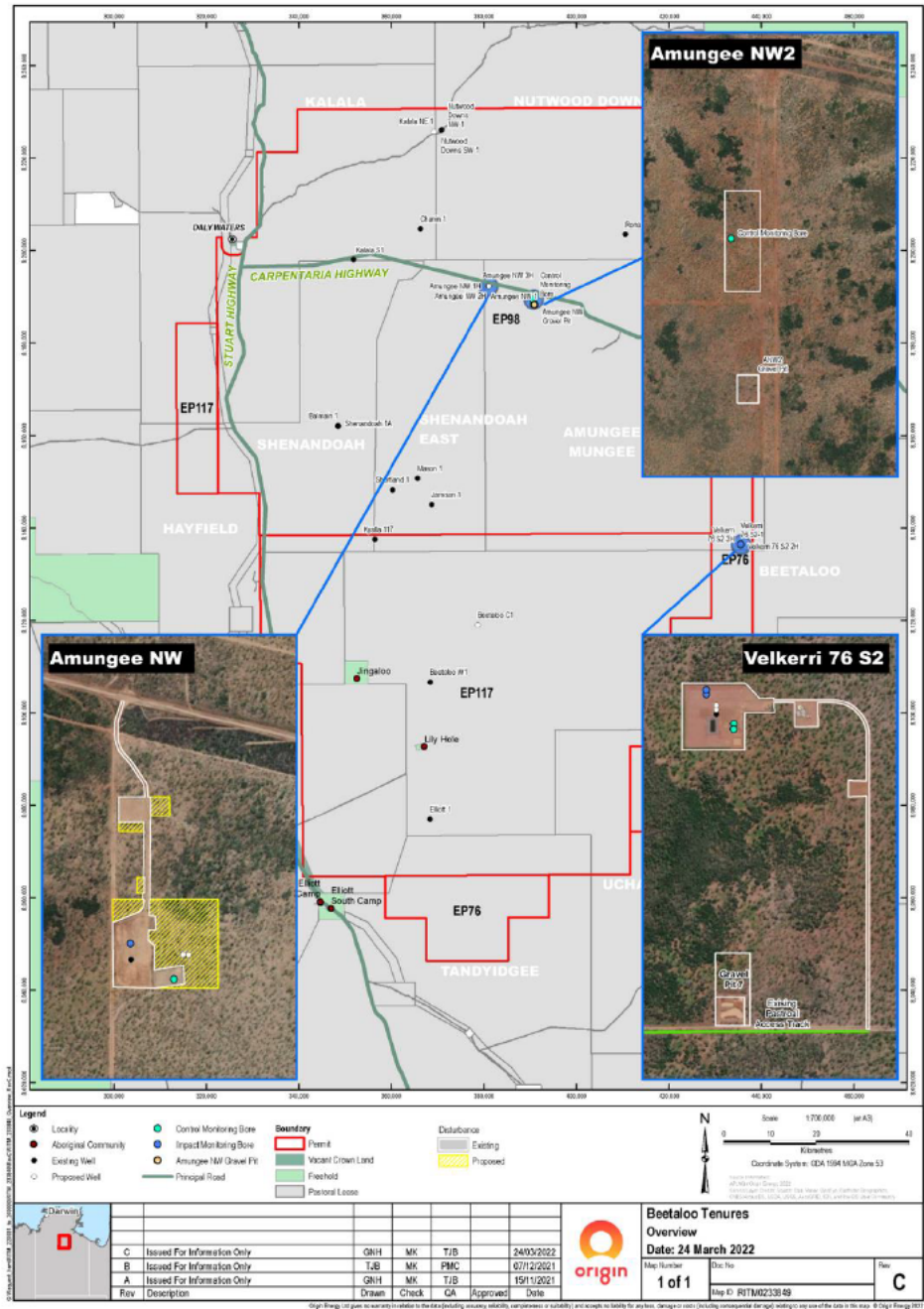


Figure 1: Location of the Amungee NW and Velkerri 76 S2 sites

Table 1: Description of the proposed exploration and appraisal activities for the Amungee NW and Velkerri 76 S2 sites

Activity	Description
<b>Amungee NW scope</b>	
Civil construction activities	<ul style="list-style-type: none"> <li>Expansion of the existing Amungee NW site lease pad from 3.56 ha to 10 ha to accommodate the new exploration and appraisal (E&amp;A) wells and anticipated freshwater and wastewater storage</li> </ul>

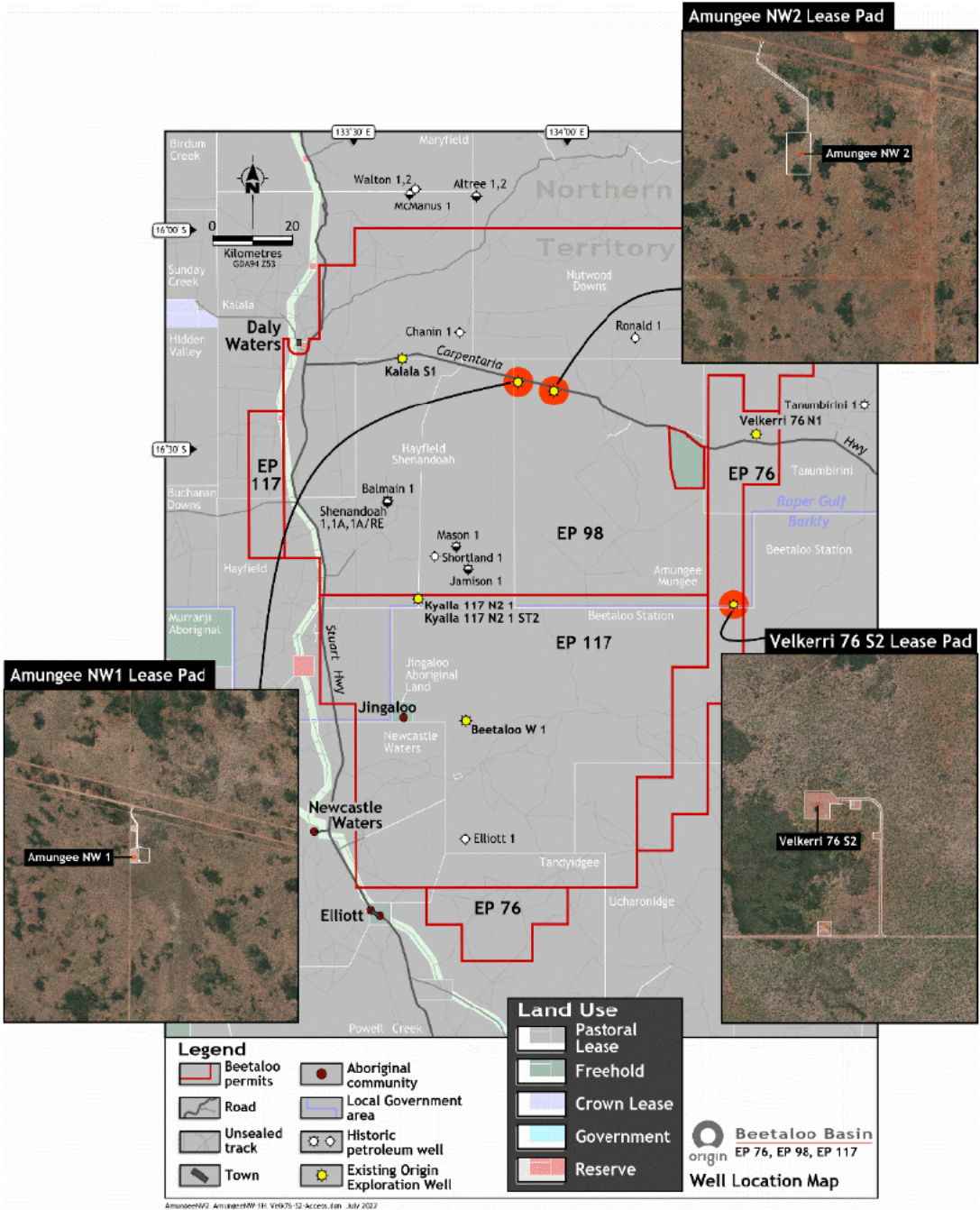


Figure 1: Location of the Amungee NW and Velkerri 76 S2 sites

Table 1: Description of the proposed exploration and appraisal activities for the Amungee NW and Velkerri 76 S2 sites

Activity	Description
<b>Amungee NW scope</b>	
Civil construction activities	<ul style="list-style-type: none"> <li>Expansion of the existing Amungee NW site lease pad from 3.56 ha to 10 ha to accommodate the new exploration and appraisal (E&amp;A) wells and anticipated freshwater and wastewater storage</li> </ul>




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Current EMP text				Amended EMP text					
<ul style="list-style-type: none"> <li>Upgrade of the access track intersection with the Carpentaria Highway to comply with Department of Infrastructure, Planning and Logistics requirements</li> <li>Expansion of the existing camp pad from 0.9 ha to 1.2 ha</li> <li>Installation of two additional E&amp;A well cellars and conductors on the lease pad to accommodate the proposed Amungee NW-2H and Amungee NW-3H wellhead and surface facilities</li> <li>Construction of a drilling sump on the lease pad to manage drilling fluids, muds and cuttings of up to 5,000m<sup>3</sup></li> <li>Construction of a site bund for wastewater storage</li> <li>Construction of a sediment basin to manage stormwater during wastewater storage</li> <li>Drilling of up to four additional groundwater monitoring/ extraction bores within the proposed exploration areas (if required), including the construction of a groundwater monitoring bore approximately 11 km to the east of the existing Amungee NW lease pad in preparation for future exploration activities.</li> <li>Construction of a helipad (up to 1 ha) and laydown area (up to 1 ha)</li> <li>Construction of a 20m x 2km fence line and firebreak around the Amungee NW site (~4 ha)</li> <li>Construction and operation of a gravel pit up to 3.5 ha</li> </ul>				<ul style="list-style-type: none"> <li>Upgrade of the access track intersection with the Carpentaria Highway to comply with Department of Infrastructure, Planning and Logistics requirements. Including construction of a new access track (1.1 km) into the Amungee NW2 location (1.5 ha)</li> <li>Expansion of the existing camp pad from 0.9 ha to 1.2 ha</li> <li>Installation of two additional E&amp;A well cellars and conductors on the lease pad to accommodate the proposed Amungee NW-2H and Amungee NW-3H wellhead and surface facilities</li> <li>Construction of a drilling sump on the lease pad to manage drilling fluids, muds and cuttings of up to 5,000m<sup>3</sup></li> <li>Construction of a site bund for wastewater storage</li> <li>Construction of a sediment basin to manage stormwater during wastewater storage</li> <li>Drilling of up to four additional groundwater monitoring/ extraction bores within the proposed exploration areas (if required), including 2 groundwater monitoring bores at Amungee NW2 (2.0 ha) approximately 11 km to the east of the existing Amungee NW lease pad in preparation for future exploration activities.</li> <li>Construction of a helipad (up to 1 ha) and laydown area (up to 1 ha)</li> <li>Construction of a 20m x 2km fence line and firebreak around the Amungee NW site (~4 ha)</li> <li><del>Construction and operation of a gravel pit up to 3.5 ha</del></li> </ul>					
<b>1.2 Project boundary</b> The boundary of this EMP is defined as the area which may be affected by E&A activities. This includes: <ul style="list-style-type: none"> <li>existing access tracks to the Velkerri 76 S2 site and Amungee NW site</li> <li>existing Amungee NW and Velkerri 76 S2 lease pad, camp pad, and associated infrastructure (water bores)</li> <li>existing Velkerri 76 S2 chemical storage areas, lease pad bund, sediment basin, wastewater tanks and drilling sump</li> <li>proposed expansion of the existing Amungee NW lease pad and camp pad, including the installation of a new fence line and fire break</li> <li>proposed construction of a helipad and laydown yard at Amungee NW</li> <li>proposed installation of groundwater extraction/ monitoring bores</li> <li>Proposed construction of a new gravel pit on the Amungee Mungee Station</li> <li>proposed drilling, stimulation, well testing and suspension and abandonment of an additional two petroleum E&amp;A wells at each of the Amungee NW and Velkerri 76 S2 sites</li> <li>proposed well testing on the existing Amungee NW-1H and Velkerri 76 S2-1 wells.</li> </ul>				<b>1.2 Project boundary</b> The boundary of this EMP is defined as the area which may be affected by E&A activities. This includes: <ul style="list-style-type: none"> <li>existing access tracks to the Velkerri 76 S2 site and Amungee NW site</li> <li>proposed access track (1.1 km) to the Amungee NW2 location (1.5 ha)</li> <li>existing Amungee NW and Velkerri 76 S2 lease pad, camp pad, and associated infrastructure (water bores)</li> <li>existing Velkerri 76 S2 chemical storage areas, lease pad bund, sediment basin, wastewater tanks and drilling sump</li> <li>proposed expansion of the existing Amungee NW lease pad and camp pad, including the installation of a new fence line and fire break</li> <li>proposed construction of a helipad and laydown yard at Amungee NW</li> <li>proposed installation of groundwater extraction/ monitoring bores, including 2 groundwater monitoring bores at the Amungee NW2 location (2.0 ha)</li> <li><del>Proposed construction of a new gravel pit on the Amungee Mungee Station</del></li> <li>proposed drilling, stimulation, well testing and suspension and abandonment of an additional two petroleum E&amp;A wells at each of the Amungee NW and Velkerri 76 S2 sites</li> <li>proposed well testing on the existing Amungee NW-1H and Velkerri 76 S2-1 wells.</li> </ul>					

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Current EMP text						Amended EMP text					
Table 6: Associated exploration sites and infrastructure covered under this EMP						Table 6: Associated exploration sites and infrastructure covered under this EMP					
Exploration Permit	Infrastructure name	Station	Zone*	Approx. Easting	Approx. Northing	Exploration Permit	Infrastructure name	Station	Zone*	Approx. Easting	Approx. Northing
Amungee NW						Amungee NW					
EP98	Proposed control monitoring bore at the Amungee NW2 location	Amungee Mungee	53	390693	8189431	EP98	Proposed monitoring bores (x2) at the Amungee NW2 location	Amungee Mungee	53	389882	8190068
EP98	Proposed new Amungee gravel pit	Carpentaria Highway road corridor	53	390900	8188279	EP98	Proposed new Amungee gravel pit	Carpentaria Highway road corridor	53	390900	8188279
EP98	Existing access tracks	Amungee Mungee	Not Applicable			EP98	Existing access tracks	Amungee Mungee	Not Applicable		
Table 8: Description of the exploration and appraisal activities at Amungee NW and Velkerri 76 S2						Table 8: Description of the exploration and appraisal activities at Amungee NW and Velkerri 76 S2					
Activity	Description					Activity	Description				
Amungee NW scope						Amungee NW scope					
Civil construction activities	<ul style="list-style-type: none"><li>Expansion of the existing Amungee NW site lease pad from 3.56 ha to 10 ha to accommodate the new exploration and appraisal (E&amp;A) wells and anticipated freshwater and wastewater storage</li><li>Upgrade of the access track intersection with the Carpentaria Highway to comply with Department of Infrastructure, Planning and Logistics requirements</li><li>Expansion of the existing camp pad from 0.9 ha to 1.2 ha</li><li>Installation of two additional E&amp;A well cellars and conductors on the lease pad to accommodate the proposed Amungee NW-2H and Amungee NW-3H wellhead and surface facilities</li><li>Construction of a drilling sump on the lease pad to manage drilling fluids, muds and cuttings of up to 5,000m<sup>3</sup></li><li>Construction of a site bund for wastewater storage</li><li>Construction of a sediment basin to manage stormwater during wastewater storage</li><li>Drilling of up to four additional groundwater monitoring/ extraction bores within the proposed exploration areas (if required), including the construction of a groundwater monitoring bore approximately 11km to the east of the existing Amungee NW lease pad in preparation for future exploration activities.</li><li>Construction of a helipad (up to 1ha) and laydown area (up to 1ha)</li><li>Construction of a 20m x 2km fence line and firebreak around the Amungee NW site (~4 ha)</li><li>Construction and operation of a gravel pit up to 3.5 ha</li></ul>					Civil construction activities	<ul style="list-style-type: none"><li>Expansion of the existing Amungee NW site lease pad from 3.56 ha to 10 ha to accommodate the new exploration and appraisal (E&amp;A) wells and anticipated freshwater and wastewater storage</li><li>Upgrade of the access track intersection with the Carpentaria Highway to comply with Department of Infrastructure, Planning and Logistics requirements</li><li>Construction of an access track (1.1 km) to the Amungee NW2 location (1.5 ha)</li><li>Expansion of the existing camp pad from 0.9 ha to 1.2 ha</li><li>Installation of two additional E&amp;A well cellars and conductors on the lease pad to accommodate the proposed Amungee NW-2H and Amungee NW-3H wellhead and surface facilities</li><li>Construction of a drilling sump on the lease pad to manage drilling fluids, muds and cuttings of up to 5,000 m<sup>3</sup></li><li>Construction of a site bund for wastewater storage</li><li>Construction of a sediment basin to manage stormwater during wastewater storage</li><li>Drilling of up to four additional groundwater monitoring/ extraction bores within the proposed exploration areas (if required), including 2 groundwater monitoring bores at Amungee NW2 (2.0 ha) approximately 11 km to the east of the existing Amungee NW lease pad in preparation for future exploration activities.</li><li>Construction of a helipad (up to 1ha) and laydown area (up to 1 ha)</li><li>Construction of a 20m x 2km fence line and firebreak around the Amungee NW site (~4 ha)</li></ul>				






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Current EMP text					Amended EMP text					
						Construction and operation of a gravel pit up to 3.5 ha				
Table 12: Amungee NW site activity summary table					Table 12: Amungee NW site activity summary table					
Component	Existing Amungee NW site	EMP scope	Total site activity summary		Component	Existing Amungee NW site	EMP scope	Total site activity summary		
General					General					
Number of water extraction/monitoring bores	3 existing bores: RN039896 (production bore), RN038493 (production), RN040894 (monitoring/production)	3 bores on the Amungee NW site and 1 control bore on the Amungee NW2 location	7		Number of water extraction/monitoring bores	3 existing bores: RN039896 (production bore), RN038493 (production), RN040894 (monitoring/production)	2 bores on the Amungee NW site and 2 monitoring bores on the Amungee NW2 location	7		
Number of gravel pits approved under EMP	0	Gravel to be sourced from approved DIPL gravel pits covered by AAPA certificate C2022/02	Gravel to be sourced from approved DIPL gravel pits covered by AAPA certificate C2022/02		Number of gravel pits approved under EMP	0	Gravel to be sourced from other approved Origin sites or DIPL approved pits covered by AAPA certificate C2022/002	Gravel to be sourced from other approved Origin sites covered by AAPA certificate C2022/002		
3.7 Gravel pit construction					Delete section 3.7 Gravel pit construction.					
<p>Gravel will be required to surface the expanded lease pad, camp pad, laydown area, helipad and access tracks. Gravel will be sourced from a new gravel pit located approximately 11km East of the Amungee NW site within the Amungee Mungee Station. The pit will be constructed and expanded progressively to 3.5ha, with approximately 10,000m<sup>3</sup> of gravel sourced from the pit. The typical image of a gravel pit in the Beetaloo is provided in Figure 14.</p> <p>Gravel pits will be cleared, with topsoil and subsoil stripped, segregated and stockpiled onsite for future revegetation.</p> <p>Gravel pit rehabilitation will commence within 12 months once there is no viable gravel left. However, if viable gravel remains, gravel pits may be transferred to the pastoralist subject to approval form both DEPWS and pastoralist.</p> <p>Gravel pits are anticipated to be up to 3m in depth, with the final depth dependent on the level of gravel present at the site. Fencing will be used around gravel pits where the pit batters represent a potential fall hazard to livestock and fauna.</p> <p>Upon cessation of activities, the gravel pits will be recontoured back to a stable, safe and non-polluting form. Subsoils and topsoil will be reinstated across the gravel pit and natural revegetation used as the primary vegetation reinstatement measure.</p>					<p>No gravel pits will be constructed on Amungee NW site under this EMP. The surface disturbance associated with this activity – i.e. 3.5 ha will be used to construct the new access track to Amungee NW2 (1.5 ha) and 2 bore pads (2 ha).</p>					

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 <p>Figure 1: Example of a typical operational gravel pit</p>									
<p><b>3.3 Groundwater bore installation</b></p> <p>Groundwater monitoring / extraction bores have been installed at each of the Amungee NW (three existing bores) and Velkerri 76 S2 sites (two existing control bores). Up to 3 additional groundwater monitoring/production bores are to be installed under this EMP at Amungee NW site and 1 new control monitoring bore located at the Amungee NW2 location (refer Table 6). Additional groundwater monitoring bores will be installed on the Velkerri 76 S2 site prior to the stimulation of the vertical well in 2022 under the existing approved Velkerri 76 S2 drilling, stimulation and well testing EMP.</p> <p>The Amungee NW bores will be installed on the proposed activity area (either on the lease pad, camp pad or laydown area). The new Amungee NW2 monitoring bore will be installed in a lightly vegetated area which is the location of a future exploration site. The bores will target the Gum Ridge Formation, as the Anthony Lagoon formation is absent at the Amungee NW site.</p>				<p><b>3.3 Groundwater bore installation</b></p> <p>Groundwater monitoring / extraction bores have been installed at each of the Amungee NW (three existing bores) and Velkerri 76 S2 sites (two existing control bores). Up to 2 additional groundwater monitoring/production bores are to be installed under this EMP at Amungee NW site and 2 new control monitoring bore located at the Amungee NW2 location (refer Table 6). Additional groundwater monitoring bores will be installed on the Velkerri 76 S2 site prior to the stimulation of the vertical well in 2022 under the existing approved Velkerri 76 S2 drilling, stimulation and well testing EMP.</p> <p>The Amungee NW bores will be installed on the proposed activity area (either on the lease pad, camp pad or laydown area). The new Amungee NW2 monitoring bores (2) will be installed in the location of the future exploration site. The bores will target the Gum Ridge Formation, as the Anthony Lagoon formation is absent at the Amungee NW site.</p>					





## Appendix B: Land condition assessment of the original (approved) Amungee NW 2 site

Amungee NW2 (original)				
Location	GDA94, Zone 53, 0390739E, 8189607N	Vegetation community	<i>Erythrophleum chlorostachys</i> and <i>Eucalyptus chlorophylla</i> open woodland	
Vegetation description	<i>Erythrophleum chlorostachys</i> and <i>Eucalyptus chlorophylla</i> mid high open woodland, over <i>Petalostigma pubescens</i> mid high open shrubland, over <i>Chrysopogon fallax</i> sparse tussock grassland			
Vegetation transect	No canopy 61.3%, <i>Erythrophleum chlorostachys</i> 10.2%, <i>Petalostigma pubescens</i> 9.5%, <i>Terminalia canescens</i> 8.2%, <i>Corymbia ferruginea</i> 6.7%, <i>Acacia difficilis</i> 1.2%, <i>Terminalia volucris</i> 1.2%, <i>Bauhinia cunninghamii</i> 0.7%, <i>Hakea arborescens</i> 0.7%, <i>Grevillea parallela</i> 0.25%			
Basal area (5 sweeps)	17 ( <i>Macropteranthes kekwickii</i> 1.5, <i>Petalostigma pubescens</i> , <i>Corymbia dichromophloia</i> , <i>Erythrophleum chlorostachys</i> , <i>Terminalia canescens</i> , <i>Eucalyptus chlorophylla</i> , <i>Bauhinia cunninghamii</i> )		Stand basal area (average)	3.4 m <sup>2</sup> /ha
Landform				
Simple slope				
Habitat				
Poor – scattered fallen logs, shallow leaf litter. Tree hollows, mistletoe and flowering plants absent				
Slope				
1%				
Disturbance				
Fire damage > 2 years ago. No erosion. Cattle impacts				
Vegetation Structure	Upper storey: 5 - 12 m	<i>Erythrophleum chlorostachys</i> (8%) and <i>Eucalyptus chlorophylla</i> (2%)		
	Mid-storey: 0.5 - 5 m	<i>Petalostigma pubescens</i> (15%), <i>Terminalia canescens</i> (2%) and <i>Terminalia volucris</i> (1%)		
	Understorey: 0 - 0.5 m	<i>Chrysopogon fallax</i> (6%) and <i>Eriachne ciliaris</i> (2%) tussock grasses		
Soil texture	Loamy sand and sandy loam in upper 0.25 m.			
Soil drainage	Well drained			
Soil colour	5YR 3/3. Dark brown			
Soil pH	6.0 (0-0.1m), 5.7 (0.1-0.25m)			
Termite mounds	Sparse			
Ground cover	20% Vegetation, 10% Litter, 70% Bare Soil			



## Appendix C: Land condition assessment of the proposed new Amungee NW 2 site

Amungee NW-2 (new site)				
Location	GDA94, zone 53, 0389927E, 8190027N	Vegetation community	Corymbia dichromophloia and Eucalyptus chlorophylla open woodland	
Vegetation description	Corymbia dichromophloia and Eucalyptus chlorophylla mid high open woodland, over Erythrophleum chlorostachys, Acacia difficilis and Santalum lanceolatum mid high open shrubland, over Chrysopogon fallax and Sorghum plumosum open tussock grassland			
Vegetation transect	No canopy 68.2%, Eucalyptus chlorophylla 7.6%, Macropteranthes kekwickii 5.9%, Acacia difficilis 5.6%, Corymbia ferruginea 3.8%, Erythrophleum chlorostachys 2.8%, Terminalia canescens 1%, Brachychiton paradoxus 0.8%, Bauhinia cunninghamii 0.8%			
Basal area (5 sweeps)	42 (Macropteranthes kekwickii 10, Acacia shirleyi 10, Dead tree 9, Corymbia ferruginea 4, Erythrophleum chlorostachys 3.5, Acacia difficilis 3, Eucalyptus chlorophylla 2.5)		Stand basal area (average)	8.4m <sup>2</sup> /ha
Landform				
Simple slope				
Habitat				
Scattered tree hollows, common falling logs. Mistletoe and flowering plants absent.				
Slope				
1%				
Disturbance				
Fire damage > 2 years ago. No erosion. Cattle impacts				
Vegetation Structure	Upper storey: 5 - 12 m	Corymbia dichromophloia (7%), Eucalyptus chlorophylla (3%)		
	Mid-storey: 0.5 - 5 m	Erythrophleum chlorostachys (6%), Acacia difficilis (4%), Santalum lanceolatum (3%)		
	Understorey: 0 – 0.5 m	Chrysopogon fallax (16%), Sorghum plumosum (2%)		
Soil texture	Sandy loam grading to sandy clay loam at 0.2 m			
Soil drainage	Well drained			
Soil colour	2.5YR 3/4 dark reddish brown			
Soil pH	5.7 (0-0.2m), 6.0 (0.2-0.55m)			
Termite mounds	Sparse			

Amungee NW-2 (new site)		
Ground cover	20% Vegetation, 10% Litter, 70% Bare Soil	