

Modification Notice - Regulation 22

Interest Holder	Santos QNT Pty Ltd		EMP Title	McArthur Basin Drilling Program NT Exploration Permit (EP) 161		Unique EMP ID No.	STO2-7	Change/Mod No.	3	Date	16/09/2021
Brief Description	The modification to the activity is that the lateral sections of horizontal wells at Tanumbirini will not be separated by 50mTVD and are planned to target the same shale interval. The Tanumbirini 3H Well Plan Summary, Attachment 1, has been updated accordingly, review by the Department of Industry Tourism and Trade and accepted.										
Geospatial Files Included?											
Does the proposed change result in a new, or increased, potential or actual environmental impact or risk?	If an INCREASE in an existing potential or actual environmental impact or risk is it provided for in the approved EMP?	Does the proposed change 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?				
No	N/A	No	No	No	No	No	No	Yes			
Current EMP Text					Amended EMP Text						
See section 3.4.1.2 second paragraph The proposed horizontal wells have been planned to be approximately 10m apart at surface i.e. wellhead to wellhead, and the lateral sections planned to be 500m apart (Figure 3-10). The horizontals will target separate shale intervals and be vertically separated with a minimum spacing of approximately 50mTVD. After being completed with casing/tubing, the wells will also be monitored with					Replace the second paragraph in section 3.4.1.2 with the text highlighted in grey below. This sentence has been removed "The horizontals will target separate shale intervals and be vertically separated with a minimum spacing of approximately 50mTVD." The proposed horizontal wells have been planned to be approximately 10m apart at surface i.e. wellhead to wellhead, and the lateral sections						

pressure gauges to detect communication during operations. The horizontal wells will be geosteered to remain in the optimum zone of the selected A, B, Lower B or C Shale intervals using real-time LWD tools. Tanumbirini-1 source rock analysis for core and cutting samples have been used to confirm TOC and calibrate petrophysical models for future data acquisition and indicates that the proposed Tanumbirini horizontal exploration wells should intersect highly mature Velkerri shale intervals with an expected dry gas composition i.e. primarily methane. The horizontal wells are currently planned to reach a total depth of 5,900 mMD/3,500 mTVD.

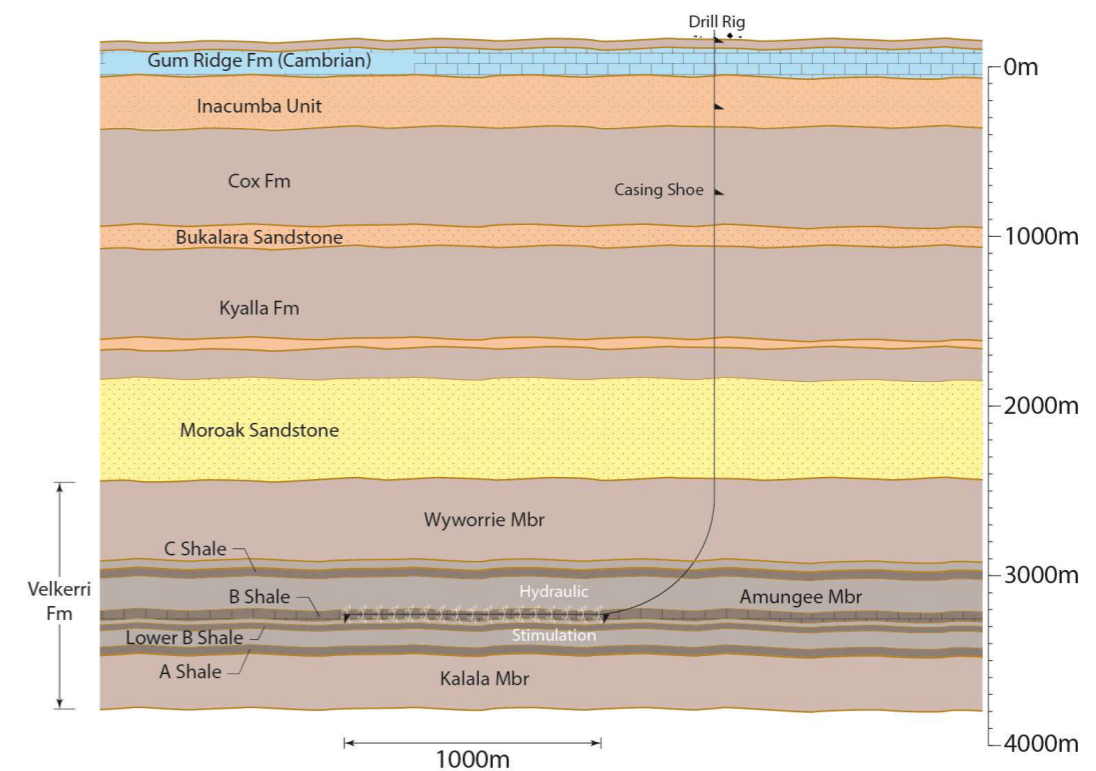
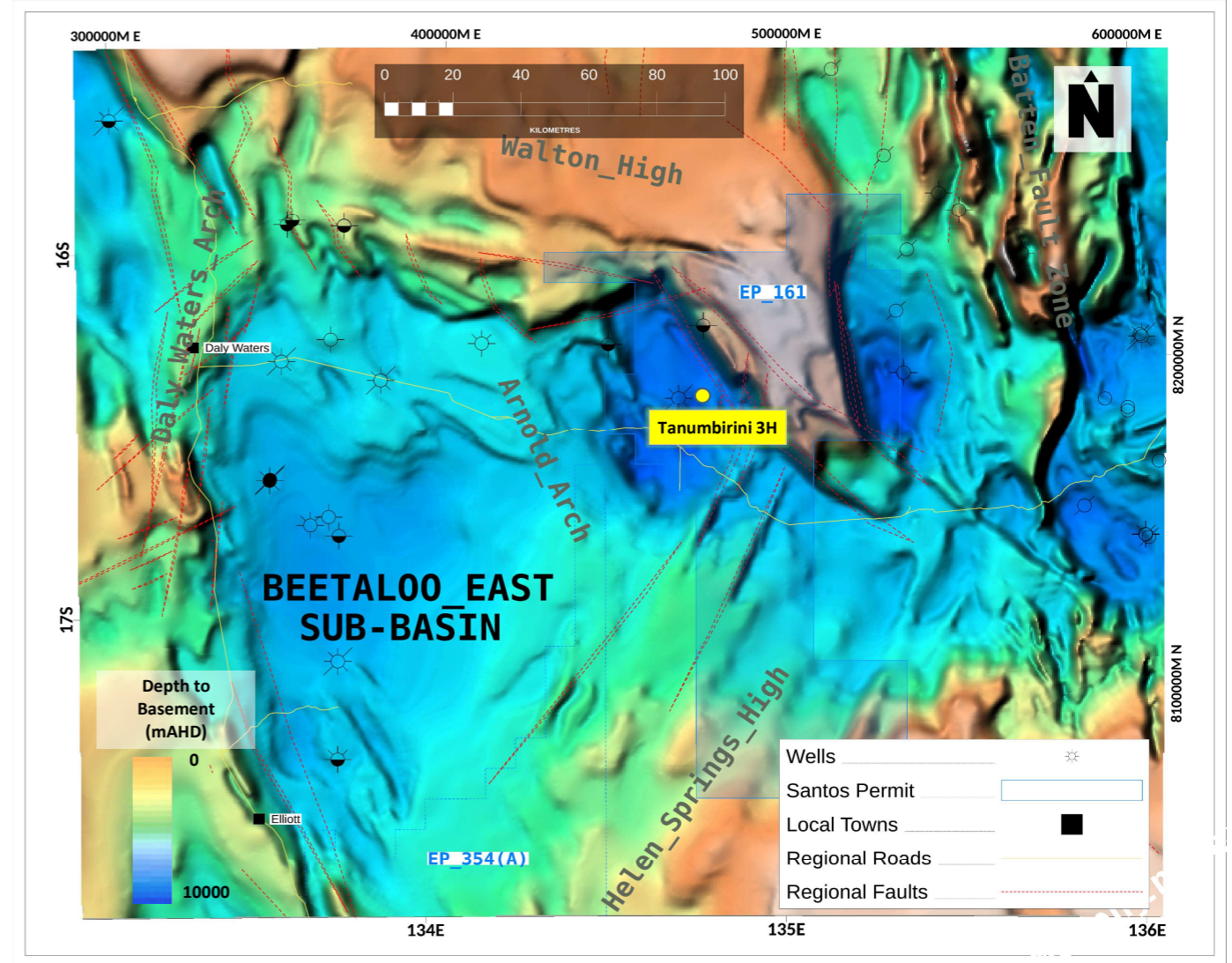
planned to be 500m apart (Figure 3-10). After being completed with casing/tubing, the wells will also be monitored with pressure gauges to detect communication during operations. The horizontal wells will be geosteered to remain in the optimum zone of the selected A, B, Lower B or C Shale intervals using real-time LWD tools. Tanumbirini-1 source rock analysis for core and cutting samples have been used to confirm TOC and calibrate petrophysical models for future data acquisition and indicates that the proposed Tanumbirini horizontal exploration wells should intersect highly mature Velkerri shale intervals with an expected dry gas composition i.e. primarily methane. The horizontal wells are currently planned to reach a total depth of 5,900 mMD/3,500 mTVD.

Tanumbirini 3H Well Plan Summary (EP161)



Approx Casing Depth (mTVD)	Formation/Member	Notes	Hydrocarbon Bearing	HPHT	Proposed Shale Target	Top Cement	Hole/Casing Size	Section	
								Conductor #1	Conductor #2
9	Surficial		No	No			26"/20"	Conductor #1	
235	Gum Ridge Fm	Aquifer	No	No			17 1/2" 13 3/8"	Conductor #2	
	Inacumba Unit	Possible local aquifer	No	No		Cement returns to surface for both 17-1/2" and 12-1/4" hole sections.	12 1/4" 9 5/8"	Surface Casing	
1075	Cox Formaiton	Approx. 2560m True Vertical Thickness (TVT) between base of lowest known aquifer and top of Amungee Member. Approx. 2930m (TVT) between base of lowest known aquifer and proposed horizontal section.	No	No		Top Cement proposed to be >200mMD inside 9-5/8" casing shoe based on returns to surface.	8 1/2" 7"	Intermediate Casing	
	Bukalara Sandstone		Yes	No					
	Upper Kyalla		Yes	No					
	Lower Kyalla		Yes	No					
	Moroak Sandstone		Yes	No					
	Wyworrie Member	Yes	No						
3446	Amungee Member	Primary Target	Yes	No	B Shale Horizontal section	TOC planned to be >150mTVD above planned stimulation depth and >200mMD inside 7" casing shoe. Confirm TOC with CBL.	6 1/8" 4 1/2"	Production Casing	

Notes:
 High Pressure High Temperature (HPHT) refers to temperatures > 150°C and pressures > 0.8psi/ft.
 CBL = Cement Bond Log



Structural Geological Elements:
 No major faults have been observed in the vicinity of the proposed Tanumbirini 3H wellpath, which parallels the MCSAN19-01 (SE-NW) 2D seismic line and offset by 400m. There is always the potential of small scale faulting, however fractured flexure zones were observed while drilling Tanumbirini 2HST1 with no significant offset observed. These zone are not considered as a a risk to connecting to the overburden while drilling or during fracture stimulation of the Amungee Member shales.