Groundwater monitoring results at Santos Tanumbirini and Inacumba well sites in the Beetaloo Sub-basin in accordance with the Code of Practice: December 2018 – December 2019

Introduction

This report is a continuation of a series of quarterly public reports compiled by the Department of Environment and Natural Resources (DENR). The Code of Practice: Onshore Petroleum Activities in the Northern Territory (the Code) (2019) requires 6 months of baseline monitoring of groundwater at a well site prior to undertaking hydraulic fracturing activities. This report presents results of on-going groundwater monitoring undertaken by Santos at its well sites in the Beetaloo sub-basin in compliance with the Code. The report includes updated ongoing groundwater monitoring data for the control monitoring bores (CMB) at the Tanumbirini and Inacumba petroleum well site on EP161 and groundwater monitoring data for the newly constructed impact monitoring bore (IMB) at the Tanumbirini well site (Figure 1).

Groundwater Monitoring Program

Companies are required to submit groundwater monitoring data quarterly, in compliance with the the Code. DENR has committed to publishing the monitoring results from interest holders to increase the transparency of monitoring and reporting of groundwater potential impacts by the onshore gas industry in the Northern Territory.

The Santos groundwater monitoring program consists of:

- Control Montoring Bore (CMB), which is located "upstream'' and within 100 m of each planned or existing petroleum well pad, screened across the Gum Ridge aquifer and a separate CMB screened across the Anthony Lagoon aquifer in compliance with the Code; and
- Impact Monitoring Bore (IMB), which is located 20 m "downstream" of the location of the petroleum well(s).

These bores enable an ongoing comparison of the groundwater upstream and downstream of the petroleum well, to allow for an immediate identification of any variation in the groundwater that can be directly related to the petroleum activity.

Groundwater quality

At both the Tanumbirini and Inacumba petroleum well sites the regional Cambrian Limestone Aquifer (CLA) system consists of only the Gum Ridge aquifer. This karstic aquifer is used as a source of groundwater by pastoralists and regional communities. A groundwater extraction licence (GRF10280) has been granted to Santos for extraction of up to a total of 190 ML per year from the Gum Ridge aquifer across it's exploration permit areas in the Beetaloo sub-basin. At the Tanumbirini well site both a control monitoring bore (CMB) and an impact monitoring bore (IMB) have been constructed. The approved hydraulic fracturing of the vertical Tanumbirini-1 petroleum well was completed in November 2019. At the Inacumba well site the drilling of the approved Inacumba exploration petroleum well had not yet commenced during the monitoring period (Dec 2018-Dec 2019). An IMB has not yet been installed at Inacumba.

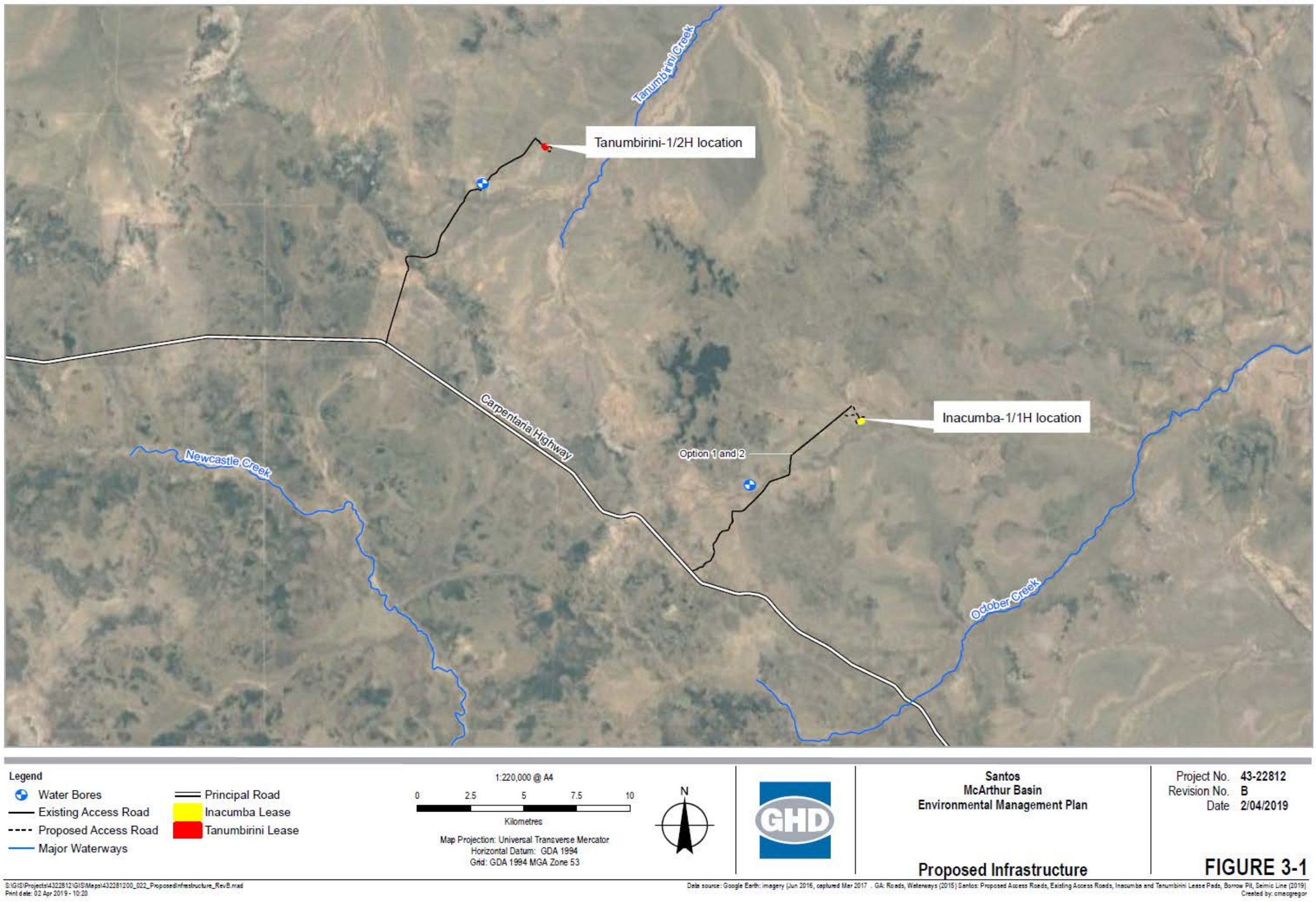

Figure 1: Santos Tanumbirini and Inacumba well sites on Exploration Permit (EP) 161 area in the Beetaloo sub-basin (courtesy: Santos)

Summary and Interpretation of Results

The updated raw groundwater monitoring results reported quarterly by Santos for the Beetaloo Sub-basin are available at Appendix 1.

Table 1 lists a summary of key "indicator" analyte averages and standard deviations for the sampling events at both Tanumbirini and Inacumba well sites. 19 sampling events for the CMB at Tanumbirini and 12 sampling events for the CMB at Inacumba were undertaken during the sampling period from December 2018 to December 2019. Three sampling events were undertaken during the sampling period from November to December 2019 for the IMB at Tanumbirini, prior to and following the hydraulic fracturing operations on the Tanumbirini-1 petroleum well.

Groundwater quality was different between the Tanumbirini and Inacumba well sites for a range of water quality parameters, the most notable being salinity related variables such as total dissolved solids, electrical conductivity and chloride concentration (Table 1). Tanumbirini well site, situated approximately 20 kms northwest of the Inacumba well site, was "fresher" than Inacumba.

Figure 2 provides graphical presentation of the baseline quartile ranges for key "indicator" analytes in the CMB and IMB at the Tanumbirini well site. Methane levels were below the limits of detection (> 1 µg/L) at

Tanumbirni CMB over the monitoring period. Trace levels of methane (~3 µg/L) were detected in the Tanumbirini IMB during the monitoring period (November to December 2019). Water quality was in general very similar (no significant difference) between the CMB and IMB at Tanumbirini both before and following the hydraulic fracture operations undertaken on the Tanumbirni-1 well in late November, 2019. Each analyte has been scaled appropriately for graphing. For example, electrical conductivity (E.C.) is divided by a factor of 10 so in the Tanumbirini CMB the E.C. quartile range is approximately 1290 to 1410 µS/cm. Similarly gross alpha is multiplied by a factor of 100 so in the Tanumbirini CMB the quartile range is approximately 0.35 to 0.91 Bq/L. Average values for all analytes in both aquifers were below drinking water guidance values except for gross alpha radionuclides. Radionuclides (both alpha and beta) also had the largest variation in the range of values among the key analytes, as can be seen in Figure 1. While groundwater may on occasion exceed gross alpha drinking water standard in the Gum Ridge aquifer (Table 1) at both Tanumbirini and Inacumba, this is not uncommon in groundwater systems where concentrations of dissolved natural constituents can build up during prolonged periods of water/rock contact. For example, similar results have been reported around Katherine (1996):

https://www.territorystories.nt.gov.au/jspui/bitstream/10070/228526/1/WRD96073.pdf

Figure 3 presents similar data for the CMB only at Inacumba well site. Inacumba well site is situated "up-gradient" of Tanumbirini well site in the Gumridge aquifer. This can be determined by comparison of water level height relative to Australian height datum (AHD) which is approximately 157.3m AHD at Tanumbirini and 158.6m AHD at Inacumba (Table 1).

Figure 4 -6 provide water level logger data for Tanumbirini and Inacumba well sites from Dev '18 to Dec '19. The change in standing water levels that can be observed is due to pumping activities both in the monitored bores and from nearby bores. These variations are relatively minor and overall water level is considered reliable.

The groundwater will continue to be monitored in accordance with the Code and the Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin (2018).

Conclusion

In accordance with the Code and Ministerial condition of approval of the EMP, results of ongoing groundwater monitoring must be provided by Santos every quarter for three years from the approval date of the EMP (2019). This data will be reported and published on the DENR website as they become available.

Table 1: Average and standard deviation results for key 'indicator' analytes for Santos control monitoring bores (CMB) at Tanumbirini and Inacumba and impact monitoring bores (IMB) at Tanumbirini..

Key analyte	Drinking Water Guidance	Tanumbirini Control Monitoring Bore n = 19	Tanumbirini Impact Monitoring Bore n = 3	Inacumba Control Monitoring Bore n = 12
Standing Water Level AHD (m)	-	156.9 -157.3	157.3 - 157.4	158.6 ± 0.02
Total Dissolved Solids (mg/L)	600	828 ± 57	864 ± 13	1186 ± 89
Total Alkalinity (mg/L)		406 ± 41	408 ± 17	431 ± 38
Electrical Conductivity (µS/cm)	< 2,500	1304 ± 109	1316 ± 6	1778 ± 123
Chloride (mg/L)	~ 250	108 ± 11	110 ± 0.6	155 ± 3
Barium (mg/L)	0.7	0.04 ± .02	0.04 ± .01	0.038 ± .001
Boron (mg/L)	4.0	0.18 ± 0.02	0.18 ± 0.02	0.27 ± 0.02
Strontium (mg/L)	N.A	0.82 ± 0.08	0.79 ± 0.05	0.95 ± 0.12
Methane µg/L	N.A.	<0.01	3.33 ± 0.58	<0.01
Gross alpha (Bq/L)	0.5	0.76 ± 0.12	0.72 ± 0.15	0.28 ± 0.06
Gross beta (Bq/L)	1.0	0.39 ± 0.06	0.34 ± 0.02	0.23 ± 0.07

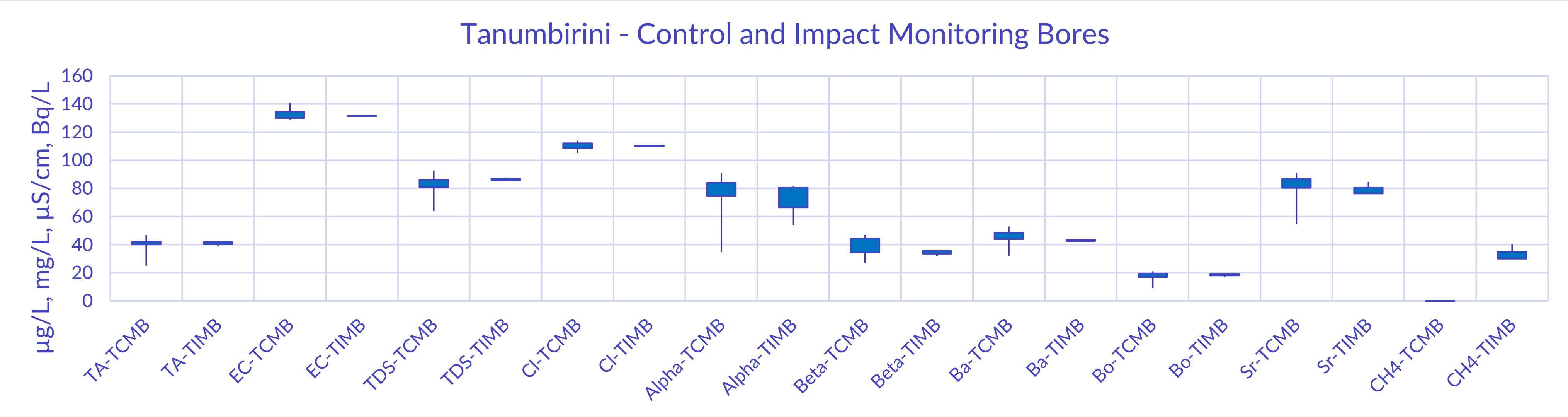

Figure 2: Natural background quartile ranges for key "indicator" analytes in control monitoring bore (CMB) and impact monitoring bore (IMB) at Tanumbirni well site based on sampling events from Dec' 18 to Dec '19. Analytes have been scaled for graphical presentation.

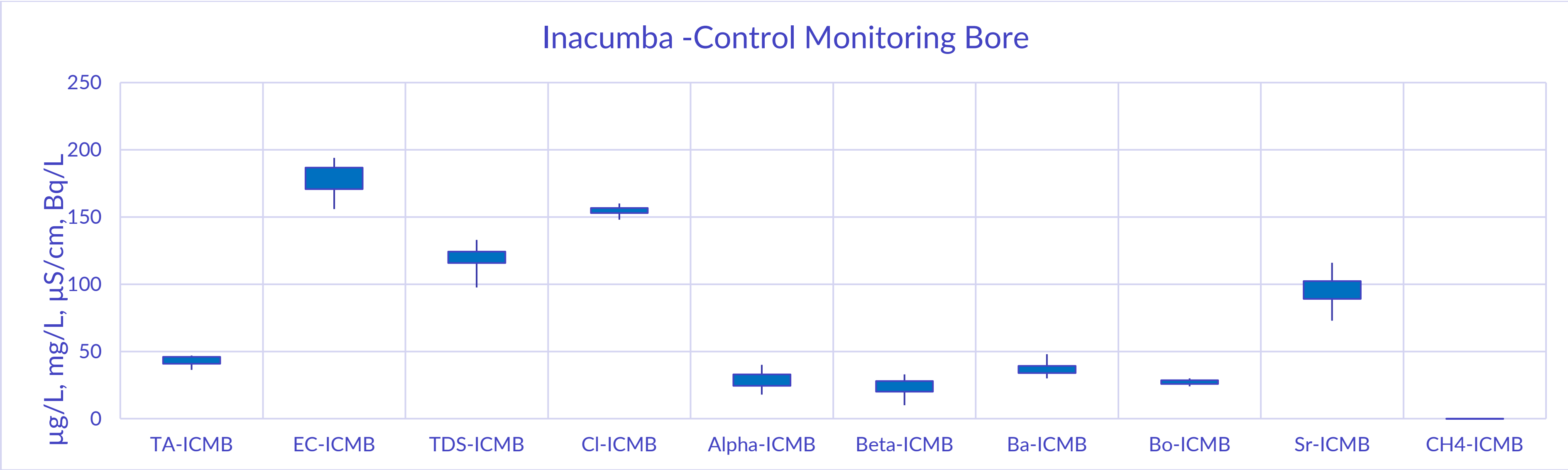

Figure 3: Natural background quartile ranges for key “indicator” analytes in the Gum Ridge aquifer at the Inacumba well site based on sampling events from Dec’ 18 to Dec ’19. Analytes have been scaled for graphical presentation.

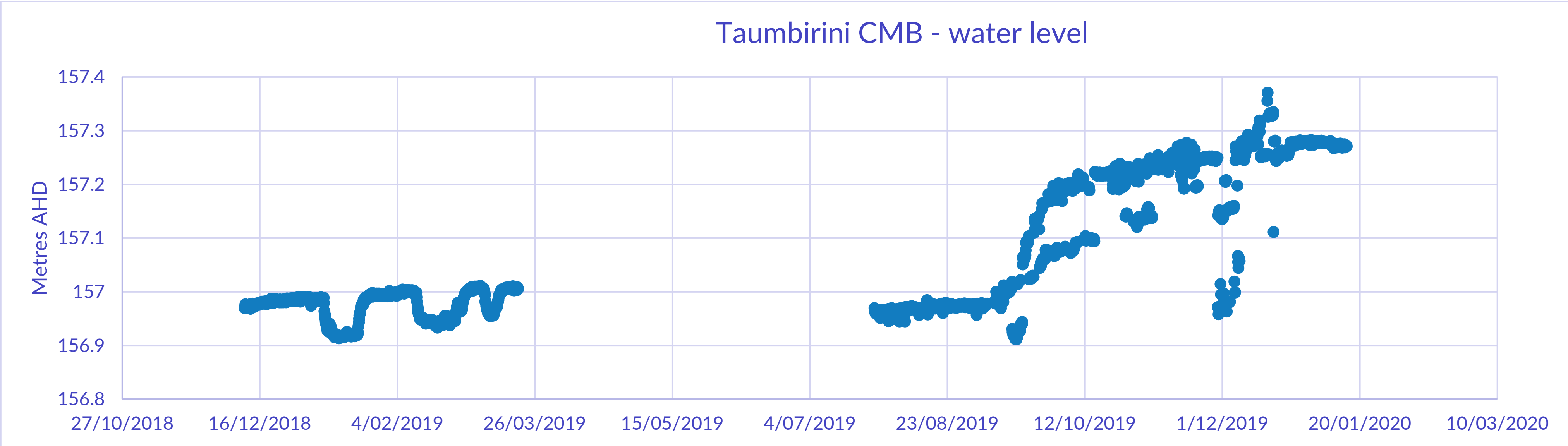

Figure 4: Water level logger data for Tanumbirini CMB. The change in standing water levels that can be observed is due to pumping activities both in the monitored bores and from nearby bores. These variations are relatively minor and overall water level is considered reliable.

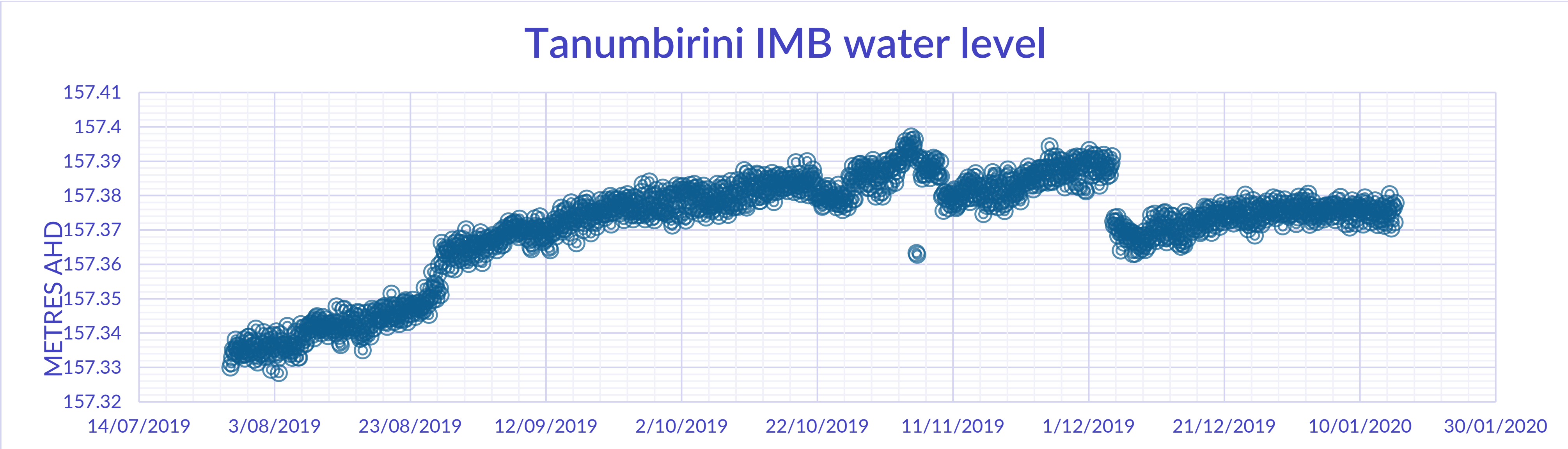

Figure 5: Water level logger data for Tanumbirini IMB.

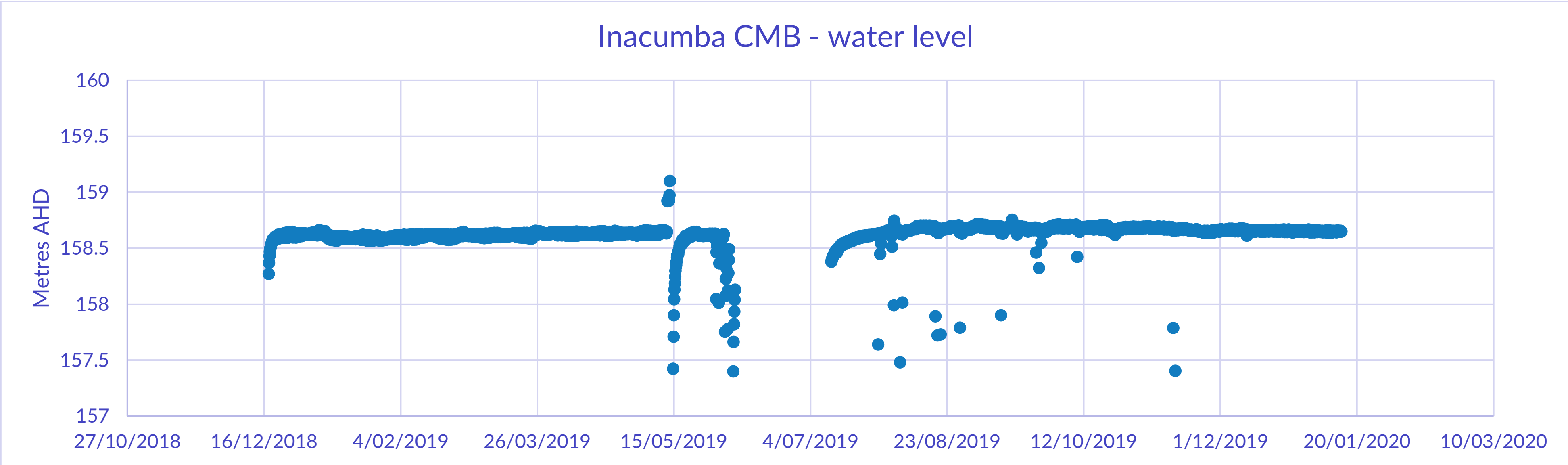

Figure 6: Water level logger data for Inacumba CMB. The change in standing water levels that can be observed is due to pumping activities both in the monitored bores and from nearby bores.

Groundwater monitoring results at Santos Tanumbirini and Inacumba well sites in the Beetaloo Sub-basin in accordance with the Code of Practice: December 2018 – December 2019

Appendix 1

TANUMBIRINI 2 WATER SUPPLY BORE - RN040930 - Control Monitoring Bore

	CHEMICAL NAME	9/12/2018 1:30	14/07/2019 2:00	24/07/2019 1:50	31/07/2019 11:00	6/08/2019 10:15	14/08/2019 5:00	19/08/2019 7:30	27/08/2019 12:20	28/08/2019 7:05	10/09/2019 4:00	11/09/2019 8:30	25/09/2019 7:45	26/09/2019 6:50	9/10/2019 7:40	10/10/2019 6:30	22/10/2019 8:00	23/10/2019 6:18	14/11/2019 7:00	15/11/2019 10:05
General, anions, cations and metal	Total Alkalinity as CaCO3	396	467	424	419	424	441	410	407	409	412	414	419	418	251	389	393	395	418	420
	Electrical Conductivity @ 25°C	1290	1330	1400	1410	1410	1320	1300	1310	1300	1360	1360	1300	1300	886	1290	1300	1300	1310	1310
	Total Dissolved Solids @180°C	818	805	805	789	812	835	786	894	837	862	830	862	847	639	928	860	862	836	835
	Suspended Solids	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	40	6	<5	<5	<5	<5
	Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Calcium	140	147	152	149	148	141	127	141	141	134	133	144	139	109	136	137	136	149	144
	Magnesium	59	60	63	62	63	54	53	56	57	55	55	58	60	37	57	55	54	58	55
	Potassium	12	13	12	12	12	12	11	11	12	12	12	12	12	8	12	11	11	12	11
	Chloride	105	112	109	112	110	108	107	112	107	110	109	114	113	65	113	109	110	109	110
	Fluoride	0.8	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.5	0.6	0.7	0.7	0.6	0.6
	pH - Lab	8.16	7.78	7.4	7.27	7.41	7.37	8.02	7.96	8.08	7.58	7.73	7.93	7.94	7.64	7.77	7.82	7.83	7.66	7.72
	Nitrite as N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Nitrate as N	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Sulfate as SO4 2-	206	139				168	175	164	174	164	170	181	175	132	178	168	162	188	172
	Sulfate as SO4 2-			180	177	164														
	Gross alpha	1.42	0.43																	
	Gross beta activity - 40K	0.78	0.21																	
	Gross alpha			0.79	0.86	0.87		0.75	0.67	0.77	0.72	0.35	0.83	0.91	0.77	0.8	0.75	0.84	0.84	0.74
	Gross alpha						1.1													
	Gross beta activity - 40K			0.46	0.44	0.45		0.4	0.27	0.34	0.47	<0.1	0.42	0.46	0.37	0.43	0.34	0.35	0.36	0.29
	Gross beta activity - 40K						<1.1													
	Arsenic	0.002	0.004	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.002	0.005	0.005	0.005	0.006	0.004	0.004	0.004
	Arsenic	0.002	0.001	0.006	0.007	0.007	0.008	0.008	0.006	0.007	0.007	0.014	0.004	0.006	0.005	0.006	0.007	0.005	0.005	0.004
	Barium	0.038	0.043	0.046	0.047	0.039	0.044	0.043	0.046	0.047	0.044	0.044	0.022	0.044	0.043	0.044	0.043	0.043	0.047	0.044
	Barium	0.04	0.053	0.049	0.048	0.048	0.048	0.049	0.044	0.044	0.05	0.052	0.032	0.048	0.046	0.046	0.048	0.046	0.043	0.043
	Boron	0.18	0.18	0.19	0.19	0.19	0.18	0.19	0.18	0.18	0.17	0.17	0.06	0.2	0.18	0.17	0.17	0.17	0.18	0.17
	Boron	0.18	0.19	0.17	0.17	0.17	0.18	0.21	0.2	0.2	0.2	0.2	0.09	0.18	0.18	0.18	0.19	0.19	0.16	0.17
	Cadmium	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Cadmium	0.0002	0.0002	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
	Copper	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Copper	<0.001	<0.001	0.015	0.013	0.002	<0.001	0.01	<0.001	0.001	0.003	0.011	0.007	0.007	0.008	0.005	0.01	0.007	0.001	<0.001
	Iron	<0.05	0.15	0.25	0.22	<0.05	0.34	0.45	0.44	0.4	0.7	0.26	0.27	0.41	0.35	0.53	<0.05	0.07	0.56	0.46
	Iron	0.09	0.32	0.35	0.28	0.21	0.41	0.87	0.21	0.49	0.86	3.54	0.44	0.53	0.43	1.82	0.94	0.52	0.68	0.5
	Lead	<0.001	0.003	0.002	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Lead	<0.001	0.002	0.028	0.021	0.005	0.006	0.009	<0.001	0.004	0.005	0.016	0.003	0.003	0.003	0.008	0.008	0.004	0.002	0.002
	Lithium	0.07	0.057	0.073	0.073	0.069	0.066	0.076	0.068	0.065	0.064	0.065	0.021	0.076	0.07	0.066	0.066	0.065	0.07	0.063
	Lithium	0.064	0.057	0.069	0.072	0.075	0.069	0.076	0.08	0.078	0.075	0.076	0.031	0.066	0.064	0.066	0.068	0.069	0.063	0.066
	Manganese	0.028	0.008	0.018	0.016	0.016	0.015	0.019	0.016	0.016	0.019	0.046	0.007	0.017	0.016	0.027	0.019	0.016	0.018	0.017
	Manganese	0.03	0.008	0.018	0.017	0.017	0.016	0.022	0.016	0.017	0.022	0.058	0.011	0.017	0.017	0.031	0.024	0.018	0.018	0.016
	Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Selenium	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Silver	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Silver	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Strontium	0.732		0.84	0.835	0.819	0.786	0.781	0.804	0.794	0.766	0.775	0.308	0.862	0.76	0.787	0.796	0.786	0.796	0.764
	Strontium	0.724		0.848	0.834	0.833	0.834	0.873	0.9	0.911	0.794	0.785	0.546	0.869	0.834	0.835	0.874	0.863	0.839	0.776
	Zinc	0.1	0.01	0.068	0.07	0.02	0.027	0.047	0.035	0.024	0.04	0.013	0.015	0.034	0.023	0.019	0.019	0.016	0.016	0.013
	Zinc	0.103	0.01	0.098	0.095	0.049	0.034	0.064	0.026	0.027	0.049	0.058	0.024	0.045	0.035	0.052	0.069	0.044	0.024	0.018
Diss. pet. gases	Ethane		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Methane		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Propane		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Ethane	<10																		
	Methane	<10																		
	Propane	<10																		

Appendix 1 cont.

Total recoverable hydrocarbons	USEPA_8015	>C10 - C16 Fraction	N	µg/L	19	>100	-	>100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C10 - C16 Fraction minus Naphthalene (F2)	N	µg/L	19	>100	-	>100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C10 - C40 Fraction (sum)	N	µg/L	19	>100	-	>100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C16 - C34 Fraction	N	µg/L	19	>100	-	>100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C34 - C40 Fraction	N	µg/L	19	>100	-	>100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	C6 - C36 Fraction (Sum)	N	µg/L	14	>20	-	>20	20						<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	USEPA_8260	C6 - C10 Fraction	N	µg/L	19	>20	-	>20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	USEPA_8260	C6 - C10 Fraction minus BTEX (F1)	N	µg/L	19	>20	-	>20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	USEPA_8260	C6 - C9 Fraction	N	µg/L	19	>20	-	>20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
BTEX	USEPA_8260	Benzene	N	µg/L	19	>1	-	>1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	USEPA_8260	Ethylbenzene	N	µg/L	19	>2	-	>2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	meta- & para-Xylene	N	µg/L	19	>2	-	>2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Naphthalene	N	µg/L	19	>5	-	>5	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	USEPA_8260	ortho-Xylene	N	µg/L	19	>2	-	>2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Sum of BTEX	N	µg/L	19	>1	-	>1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	USEPA_8260	Toluene	N	µg/L	19	>2	-	>2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Total Xylenes	N	µg/L	19	>2	-	>2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
PAH Suite	USEPA_8270_UT	3-Methylcholanthrene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	7,12-Dimethylbenz(a)anthracene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthylene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Anthracene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benz(a)anthracene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(a)pyrene	N	µg/L	15	>0.05	-	>0.05	0.05			<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	USEPA_8270_UT	Benzo(a)pyrene TEQ (zero)	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(b+j)fluoranthene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(g,h,i)perylene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(k)fluoranthene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Chrysene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Dibenz(a,h)anthracene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluoranthene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluorene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Indeno(1,2,3,cd)pyrene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Naphthalene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Phenanthrene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Pyrene	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Sum of polycyclic aromatic hydrocarbons (PAHs)	N	µg/L	15	>0.1	-	>0.1	0.1			<0.1	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270B_PAH	Acenaphthene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Acenaphthylene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Anthracene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Benz(a)anthracene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Benzo(a)pyrene	N	µg/L	2	>0.05	-	>0.05	0.5	<0.5					<0.5													
	USEPA_8270B_PAH	Benzo(a)pyrene TEQ (zero)	N	µg/L	2	>0.1	-	>0.1	0.5	<0.5					<0.5													
	USEPA_8270B_PAH	Benzo(b+j)fluoranthene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Benzo(g,h,i)perylene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Benzo(k)fluoranthene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Chrysene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Dibenz(a,h)anthracene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Fluoranthene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Fluorene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Indeno(1,2,3,cd)pyrene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Naphthalene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Phenanthrene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Pyrene	N	µg/L	2	>0.1	-	>0.1	1	<1					<1													
	USEPA_8270B_PAH	Sum of polycyclic aromatic hydrocarbons (PAHs)	N	µg/L	2	>0.1	-	>0.1	0.5	<0.5					<0.5													

Appendix 1 cont.

TANUMBIRINI-1/2 IMB (GRF)

	LABORATORY METHOD	CHEMICAL NAME	FRACTION D/T/N	RESULT UNIT	No. results	Min	Median	Max	LIMIT OF DETECTION	13/11/2019	14/11/2019	11/12/2019
General, anions, cations and metal	APHA_2320_B	Total Alkalinity as CaCO3	N	mg/L	2	416	418	420	1	416	420	388
	APHA_2510_B	Electrical Conductivity @ 25°C	N	µS/cm	2	1320	1320	1320	1	1320	1320	1310
	APHA_2540_C	Total Dissolved Solids @180°C	T	mg/L	2	853	857.5	862	10	853	862	878
	APHA_2540_D	Suspended Solids	N	mg/L	2	6	7	8	5	6	8	7
	APHA_3112_CV_FIMS	Mercury	D	mg/L	2	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
	APHA_3112_CV_FIMS	Mercury	T	mg/L	2	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
	APHA_3120	Calcium	D	mg/L	2	151	151.5	152	1	151	152	140
	APHA_3120	Magnesium	D	mg/L	2	57	57.5	58	1	57	58	57
	APHA_3120	Potassium	D	mg/L	2	12	12	12	1	12	12	13
	APHA_4500_Cl	Chloride	N	mg/L	2	110	110.5	111	1	111	110	110
	APHA_4500_F_C	Fluoride	N	mg/L	2	0.6	0.6	0.6	0.1	0.6	0.6	0.6
	APHA_4500_H_B	pH - Lab	N	pH Unit	2	7.46	7.47	7.48	0.01	7.46	7.48	7.28
	APHA_4500_NO2_B	Nitrite as N	N	mg/L	2	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01
	APHA_4500_NO3_F	Nitrate as N	N	mg/L	2	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01
	APHA_4500_SO4_E	Sulfate as SO4 2-	D	mg/L	2	186	186.5	187	1	187	186	162
	CSN_75_7611_75_7612	Gross alpha	N	Bq/L	2	0.79	0.805	0.82	0.05	0.79	0.82	0.54
	CSN_75_7611_75_7612	Gross beta activity - 40K	N	Bq/L	2	0.35	0.355	0.36	0.1	0.36	0.35	0.32
	USEPA_6020	Arsenic	D	mg/L	2	0.004	0.004	0.004	0.001	0.004	0.004	0.003
	USEPA_6020	Arsenic	T	mg/L	2	0.004	0.004	0.004	0.001	0.004	0.004	0.039
	USEPA_6020	Barium	D	mg/L	2	0.045	0.0455	0.046	0.001	0.045	0.046	0.044
	USEPA_6020	Barium	T	mg/L	2	0.043	0.0435	0.044	0.001	0.043	0.044	0.042
	USEPA_6020	Boron	D	mg/L	2	0.19	0.19	0.19	0.05	0.19	0.19	0.17
	USEPA_6020	Boron	T	mg/L	2	0.17	0.17	0.17	0.05	0.17	0.17	0.08
	USEPA_6020	Cadmium	D	mg/L	2	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
	USEPA_6020	Cadmium	T	mg/L	2	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
	USEPA_6020	Chromium	D	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Chromium	T	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Copper	D	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Copper	T	mg/L	2	0.002	0.003	0.004	0.001	0.004	0.002	<0.001
	USEPA_6020	Iron	D	mg/L	2	3.68	4.205	4.73	0.05	3.68	4.73	<0.05
	USEPA_6020	Iron	T	mg/L	2	4.12	5.155	6.19	0.05	4.12	6.19	4.48
	USEPA_6020	Lead	D	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Lead	T	mg/L	2	0.002	0.003	0.004	0.001	0.004	0.002	0.002
	USEPA_6020	Lithium	D	mg/L	2	0.07	0.0705	0.071	0.001	0.07	0.071	0.074
	USEPA_6020	Lithium	T	mg/L	2	0.065	0.067	0.069	0.001	0.069	0.065	0.064
	USEPA_6020	Manganese	D	mg/L	2	0.05	0.056	0.062	0.001	0.05	0.062	0.042
	USEPA_6020	Manganese	T	mg/L	2	0.052	0.057	0.062	0.001	0.052	0.062	0.042
	USEPA_6020	Selenium	D	mg/L	2	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01
	USEPA_6020	Selenium	T	mg/L	2	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01
	USEPA_6020	Silver	D	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Silver	T	mg/L	2	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001
	USEPA_6020	Strontium	D	mg/L	2	0.794	0.794	0.794	0.001	0.794	0.794	0.854
	USEPA_6020	Strontium	T	mg/L	2	0.763	0.8045	0.846	0.001	0.763	0.846	0.764
	USEPA_6020	Zinc	D	mg/L	2	0.006	0.0075	0.009	0.005	0.006	0.009	0.011
	USEPA_6020	Zinc	T	mg/L	2	0.015	0.0185	0.022	0.005	0.015	0.022	0.013
Diss. pet. gases	EP033-LL	Ethane	N	µg/L	2	<1	-	<1	1	<1	<1	<1
	EP033-LL	Methane	N	µg/L	2	3	3.5	4	1	3	4	3
	EP033-LL	Propane	N	µg/L	2	<1	-	<1	1	<1	<1	<1

Total recoverable hydrocarbons	USEPA_8015	>C10 - C16 Fraction	N	µg/L	1	<100	-	<100	100		<100	<100
	USEPA_8015	>C10 - C16 Fraction minus Naphthalen	N	µg/L	1	<100	-	<100	100		<100	<100
	USEPA_8015	>C10 - C40 Fraction (sum)	N	µg/L	1	<100	-	<100	100		<100	<100
	USEPA_8015	>C16 - C34 Fraction	N	µg/L	1	<100	-	<100	100		<100	<100
	USEPA_8015	>C34 - C40 Fraction	N	µg/L	1	<100	-	<100	100		<100	<100
	USEPA_8015	C6 - C36 Fraction (Sum)	N	µg/L	1	<20	-	<20	20		<20	80
	USEPA_8260	C6 - C10 Fraction	N	µg/L	1	<20	-	<20	20		<20	<20
	USEPA_8260	C6 - C10 Fraction minus BTEX (F1)	N	µg/L	1	<20	-	<20	20		<20	<20
	USEPA_8260	C6 - C9 Fraction	N	µg/L	1	<20	-	<20	20		<20	<20
BTEX	USEPA_8260	Benzene	N	µg/L	2	<1	-	<1	1	<1	<1	<1
	USEPA_8260	Ethylbenzene	N	µg/L	2	<2	-	<2	2	<2	<2	<2
	USEPA_8260	meta- & para-Xylene	N	µg/L	2	<2	-	<2	2	<2	<2	<2
	USEPA_8260	Naphthalene	N	µg/L	2	<5	-	<5	5	<5	<5	<5
	USEPA_8260	ortho-Xylene	N	µg/L	2	<2	-	<2	2	<2	<2	<2
	USEPA_8260	Sum of BTEX	N	µg/L	2	<1	-	<1	1	<1	<1	<1
	USEPA_8260	Toluene	N	µg/L	2	<2	-	<2	2	<2	<2	<2
	USEPA_8260	Total Xylenes	N	µg/L	2	<2	-	<2	2	<2	<2	<2
PAH Suite	USEPA_8270_UT	3-Methylcholanthrene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	7.12-Dimethylbenz(a)anthracene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthylene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Anthracene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benz(a)anthracene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(a)pyrene	N	µg/L	2	<0.05	-	<0.05	0.05	<0.05	<0.05	<0.05
	USEPA_8270_UT	Benzo(a)pyrene TEQ (zero)	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(b+j)fluoranthene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(g.h.i)perylene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(k)fluoranthene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Chrysene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Dibenz(a.h)anthracene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluoranthene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluorene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Indeno(1.2.3.cd)pyrene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Naphthalene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Phenanthrene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Pyrene	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Sum of polycyclic aromatic hydrocarbor	N	µg/L	2	<0.1	-	<0.1	0.1	<0.1	<0.1	<0.1

Groundwater monitoring results at Santos Tanumbirini and Inacumba well sites in the Beetaloo Sub-basin in accordance with the Code of Practice: December 2018 – December 2019

INACUMBA 1 WATER SUPPLY BORE - RN040931 - Control Monitoring Bore

	LABORATORY METHOD	CHEMICAL NAME	FRACTION D/T/N	RESULT UNIT	No. results	Min	Median	Max	LIMIT OF DETECTION	17/12/2018 2:30	29/07/2019 5:45	3/08/2019 10:30	6/08/2019 1:30	19/08/2019 3:30	27/08/2019 4:00	28/08/2019 9:10	11/09/2019 3:50	12/09/2019 8:00	25/09/2019 1:25	26/09/2019 8:40	9/10/2019 12:25	10/10/2019 8:20	22/10/2019 1:25	23/10/2019 8:43	13/11/2019 4:00
General, anions, cations and metal	APHA_2320_B	Total Alkalinity as CaCO3	N	mg/L	16	363	450.5	470	1	363	451	461	463	463	459	470	447	455	468	456	364	426	366	408	450
	APHA_2510_B	Electrical Conductivity @ 25°C	N	µS/cm	16	1560	1800	1940	1	1560	1900	1940	1900	1830	1830	1810	1860	1890	1670	1790	1580	1770	1590	1720	1790
	APHA_2540_C	Total Dissolved Solids @180°C	T	mg/L	16	976	1185	1330	10	976	1130	1170	1160	1200	1240	1230	1250	1270	1150	1270	1160	1330	1040	1170	1230
	APHA_2540_D	Suspended Solids	N	mg/L	16	9	21	36	5	35	15	13	20	<5	11	36	9	20	24	23	21	31	21	30	<5
	APHA_3112_CV_FIMS	Mercury	D	mg/L	16	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	APHA_3112_CV_FIMS	Mercury	T	mg/L	16	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	APHA_3120	Calcium	D	mg/L	16	88	141	163	1	134	150	163	159	138	162	155	139	143	114	147	98	133	88	122	150
	APHA_3120	Magnesium	D	mg/L	16	88	104.5	122	1	88	109	117	115	97	122	106	103	102	103	114	102	106	97	102	108
	APHA_3120	Potassium	D	mg/L	16	22	27	29	1	22	29	28	28	25	28	27	26	26	27	28	27	26	27	27	26
	APHA_4500_Cl	Chloride	N	mg/L	16	148	155	160	1	148	154	156	155	151	159	152	155	156	160	159	156	159	153	153	155
	APHA_4500_F_C	Fluoride	N	mg/L	16	1.8	2.65	3	0.1	1.8	2.7	2.8	2.7	3	2.7	2.8	2.6	2.7	2.5	2.8	2.2	2.5	2.3	2.6	2.4
	APHA_4500_H_B	pH - Lab	N	pH Unit	16	7.36	7.77	8.11	0.01	8.06	7.42	7.36	7.47	8.03	7.96	8	7.51	7.43	8.11	7.81	7.50	7.83	7.73	7.53	7.6
	APHA_4500_NO2_B	Nitrite as N	N	mg/L	16	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	APHA_4500_NO3_F	Nitrate as N	N	mg/L	16	0.02	0.09	2.12	0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.12	<0.01	<0.01
	APHA_4500_SO4_E	Sulfate as SO4 2-	D	mg/L	16	304	382	451	1	328	444	451	450	396	368	386	380	384	343	377	346	407	304	350	410
	ASTM_D7283-06	Gross alpha	N	Bq/L	1	1.7	1.7	1.7	0.05	1.7															
	ASTM_D7283-06	Gross beta activity - 40K	N	Bq/L	1	0.84	0.84	0.84	0.1	0.84															
	CSN_75_7611_75_7612	Gross alpha	N	Bq/L	15	0.18	0.27	0.4	0.05		0.27	0.27	0.26	0.36	0.32	0.34	0.27	0.25	0.27	0.35	0.24	0.4	0.18	0.2	0.34
	CSN_75_7611_75_7612	Gross beta activity - 40K	N	Bq/L	15	0.1	0.26	0.33	0.1		0.33	0.2	0.28	0.26	0.28	0.27	0.12	0.2	0.27	0.28	0.22	0.24	0.1	0.16	0.3
	USEPA_6020	Arsenic	D	mg/L	16	0.001	0.001	0.003	0.001	0.003	0.001	0.002	<0.001	0.002	0.002	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
	USEPA_6020	Arsenic	T	mg/L	16	0.001	0.002	0.01	0.001	0.01	0.001	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	<0.001
	USEPA_6020	Barium	D	mg/L	16	0.019	0.0315	0.047	0.001	0.028	0.036	0.032	0.026	0.029	0.03	0.033	0.031	0.031	0.019	0.036	0.027	0.033	0.032	0.041	0.047
	USEPA_6020	Barium	T	mg/L	16	0.03	0.037	0.048	0.001	0.036	0.038	0.034	0.034	0.032	0.03	0.033	0.037	0.038	0.037	0.04	0.035	0.044	0.039	0.048	0.045
	USEPA_6020	Boron	D	mg/L	16	0.12	0.25	0.31	0.05	0.31	0.26	0.27	0.28	0.27	0.23	0.25	0.24	0.24	0.12	0.28	0.23	0.25	0.23	0.24	0.25
	USEPA_6020	Boron	T	mg/L	16	0.24	0.26	0.3	0.05	0.27	0.25	0.24	0.26	0.3	0.3	0.3	0.28	0.3	0.26	0.25	0.26	0.26	0.26	0.28	0.25
	USEPA_6020	Cadmium	D	mg/L	16	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	USEPA_6020	Cadmium	T	mg/L	16	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	USEPA_6020	Chromium	D	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Chromium	T	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Copper	D	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Copper	T	mg/L	16	0.001	0.001	0.002	0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Iron	D	mg/L	16	0.24	2.49	9.58	0.05	<0.05	3.3	2.21	3.02	2.49	5.37	8.65	1.39	6.37	<0.05	9.58	<0.05	0.24	0.88	4.97	1.33
	USEPA_6020	Iron	T	mg/L	16	3.47	10.41	19.1	0.05	7.33	3.67	8.28	9.52	4.28	5.7	13.3	5.03	11.3	14.6	16.4	13.1	19.1	12	15.5	3.47
	USEPA_6020	Lead	D	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Lead	T	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Lithium	D	mg/L	16	0.19	0.4225	0.485	0.001	0.416	0.406	0.396	0.423	0.424	0.448	0.424	0.422	0.413	0.19	0.485	0.358	0.394	0.44	0.443	0.431
	USEPA_6020	Lithium	T	mg/L	16	0.365	0.449	0.515	0.001	0.365	0.475	0.435	0.463	0.452	0.503	0.515	0.431	0.448	0.404	0.461	0.45	0.433	0.408	0.408	0.422
	USEPA_6020	Manganese	D	mg/L	16	0.081	0.1805	0.249	0.001	0.142	0.203	0.081	0.234	0.133	0.21	0.249	0.123	0.226	0.108	0.232	0.164	0.197	0.172	0.189	0.098
	USEPA_6020	Manganese	T	mg/L	16	0.097	0.213	0.269	0.001	0.163	0.221	0.231	0.255	0.137	0.183	0.269	0.137	0.249	0.213	0.237	0.191	0.218	0.2	0.213	0.097
	USEPA_6020	Selenium	D	mg/L	16	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	USEPA_6020	Selenium	T	mg/L	16	<0.01	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	USEPA_6020	Silver	D	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Silver	T	mg/L	16	<0.001	-	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	USEPA_6020	Strontium	D	mg/L	16	0.428	0.925	1.02	0.001	0.868	0.957	1.02	0.99	0.984	0.974	0.98	0.916	0.934	0.428	1	0.871	0.871	0.866	0.853	0.902
	USEPA_6020	Strontium	T	mg/L	16	0.729	0.959	1.16	0.001	0.835	0.958	1	1.02	1.03	1.13	1.16	0.946	0.97	0.879	1.03	0.729	0.959	0.729	0.896	0.959
	USEPA_6020	Zinc	D	mg/L	16	0.012	0.024	0.098	0.005	0.014	0.047	0.078	0.017	0.044	0.05	0.023	0.024	0.016	0.098	0.012	<0.005	<0.005	<0.005	0.012	0.036
	USEPA_6020	Zinc	T	mg/L	16	0.031	0.049	0.473	0.005	0.044	0.052	0.081	0.067	0.056	0.05	0.064	0.04	0.031	0.473	0.047	0.043	0.044	0.06	0.048	0.044
Diss. pet. gases	EP033-LL	Ethane	N	µg/L	15	<1	-	<1	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	EP033-LL	Methane	N	µg/L	15	<1	-	<1	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	EP033-LL	Propane	N	µg/L	15	<1	-	<1	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Groundwater monitoring results at Santos Tanumbirini and Inacumba well sites in the Beetaloo Sub-basin in accordance with the Code of Practice: December 2018 – December 2019

Total recoverable hydrocarbons	USEPA_8015	>C10 - C16 Fraction	N	µg/L	16	100	100	100	100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C10 - C16 Fraction minus Naphthal	N	µg/L	16	100	100	100	100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C10 - C40 Fraction (sum)	N	µg/L	16	100	240	380	100	380	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C16 - C34 Fraction	N	µg/L	16	100	190	280	100	280	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	>C34 - C40 Fraction	N	µg/L	16	<100	-	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	USEPA_8015	C6 - C36 Fraction (Sum)	N	µg/L	12	60	60	60	20					<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	60
	USEPA_8260	C6 - C10 Fraction	N	µg/L	16	<20	-	<20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	USEPA_8260	C6 - C10 Fraction minus BTEX (F1)	N	µg/L	16	<20	-	<20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	USEPA_8260	C6 - C9 Fraction	N	µg/L	16	<20	-	<20	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
BTEX	USEPA_8260	Benzene	N	µg/L	16	<1	-	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	USEPA_8260	Ethylbenzene	N	µg/L	16	<2	-	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	meta- & para-Xylene	N	µg/L	16	<2	-	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Naphthalene	N	µg/L	16	<5	-	<5	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	USEPA_8260	ortho-Xylene	N	µg/L	16	<2	-	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Sum of BTEX	N	µg/L	16	2	-	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	USEPA_8260	Toluene	N	µg/L	16	2	-	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	USEPA_8260	Total Xylenes	N	µg/L	16	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
PAH Suite	USEPA_8270_UT	3-Methylcholanthrene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	7,12-Dimethylbenz(a)anthracene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Acenaphthylene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Anthracene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benz(a)anthracene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(a)pyrene	N	µg/L	14	<0.05	-	<0.05	0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	USEPA_8270_UT	Benzo(a)pyrene TEQ (zero)	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(b+j)fluoranthene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(g,h,i)perylene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Benzo(k)fluoranthene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Chrysene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Dibenz(a,h)anthracene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluoranthene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Fluorene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Indeno(1,2,3-cd)pyrene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Naphthalene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Phenanthrene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Pyrene	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270_UT	Sum of polycyclic aromatic hydrocarb	N	µg/L	14	<0.1	-	<0.1	0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	USEPA_8270B_PAH	Acenaphthene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Acenaphthylene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Anthracene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Benz(a)anthracene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Benzo(a)pyrene	N	µg/L	1	<0.5	-	<0.5	0.5	<0.5															
	USEPA_8270B_PAH	Benzo(a)pyrene TEQ (zero)	N	µg/L	1	<0.5	-	<0.5	0.5	<0.5															
	USEPA_8270B_PAH	Benzo(b+j)fluoranthene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Benzo(g,h,i)perylene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Benzo(k)fluoranthene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Chrysene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Dibenz(a,h)anthracene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Fluoranthene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Fluorene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Indeno(1,2,3-cd)pyrene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Naphthalene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Phenanthrene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Pyrene	N	µg/L	1	<1	-	<1	1	<1															
	USEPA_8270B_PAH	Sum of polycyclic aromatic hydrocarb	N	µg/L	1	<0.5	-	<0.5	0.5	<0.5															