
	VICKERY COAL MINE	Document Owner:	Environmental Supt
		Issue:	1.0
		Last Revision Date:	Dec 2023
		Date Printed:	12/01/2024
Quarterly Groundwater Report			

Vickery Coal Mine (EPBC 2016/7649)

Quarterly Groundwater Monitoring Report

Initial Monitoring Report October/November 2023

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1 Introduction, Purpose and Project Update

This report has been compiled for Vickery Coal Mine (VCM) to comply with Condition 8(c) of EPBC 2016/7649. Groundwater monitoring began in October 2023 following the commencement of mining in October 2023 in accordance with Condition 8(b). Mining operations are not yet advanced to mining below the water table with operational activities focusing on construction of infrastructure and removal of the initial overburden in advance of coal extraction.

Previous groundwater level results have been collected for a significant number of bores listed in the Water Management Plan (**WMP**) prior to the commencement of mining operations. The data is included in the hydrographs produced for this initial report. A brief discussion regarding the performance measures specified in the State Development Consent and interim triggers discussed in the WMP has been included in accordance with Condition 8(c). This discussion will be continued and progressed in subsequent reports as more data is collected and analysed. The data will be used to develop specific trigger levels over the initial monitoring period of two years from the commencement of mining operations.

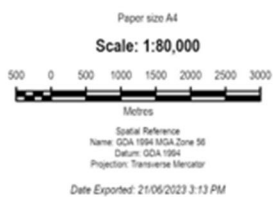
2 Monitoring Results

2.1 Groundwater Monitoring Network

VCM’s groundwater monitoring network is displayed in Figure 1. Several additional bores were proposed in the recently approved WMP and are currently being implemented as monitoring sites. These are anticipated to be operational before the groundwater monitoring period in April 2024. Two additional bores for monitoring seepage (WR1 and WR2) are anticipated to be installed in January 2024 allowing an initial measurement of groundwater level to be collected in the January 2024 monitoring period.



WHITEHAVEN COAL PTY LTD
Groundwater Monitoring Locations



Legend

- ▲ Government monitoring wells
 - Vickers northern borefield (proposed)
 - VEP bore
 - ▲ Proposed seepage monitoring locations
 - Private bore
 - Proposed monitoring location
 - ▲ Proposed monitoring location (data logger)
 - Permian
 - ▲ Alluvial (data logger)
 - ▲ Permian (data logger)
 - Yr 2 overburden emplacement
 - Yr 5 overburden emplacement
 - Mine lease
 - Yr 5 Mining Pit
- VEP Monitoring locations**
- Geological Unit
- Alluvial
 - Alluvial

Figure 1: Groundwater Monitoring Network

2.2 Groundwater Levels

2.2.1 Alluvial Groundwater Bores

Groundwater levels in the alluvial monitoring bores are displayed in the hydrograph shown in Figure 2 below.

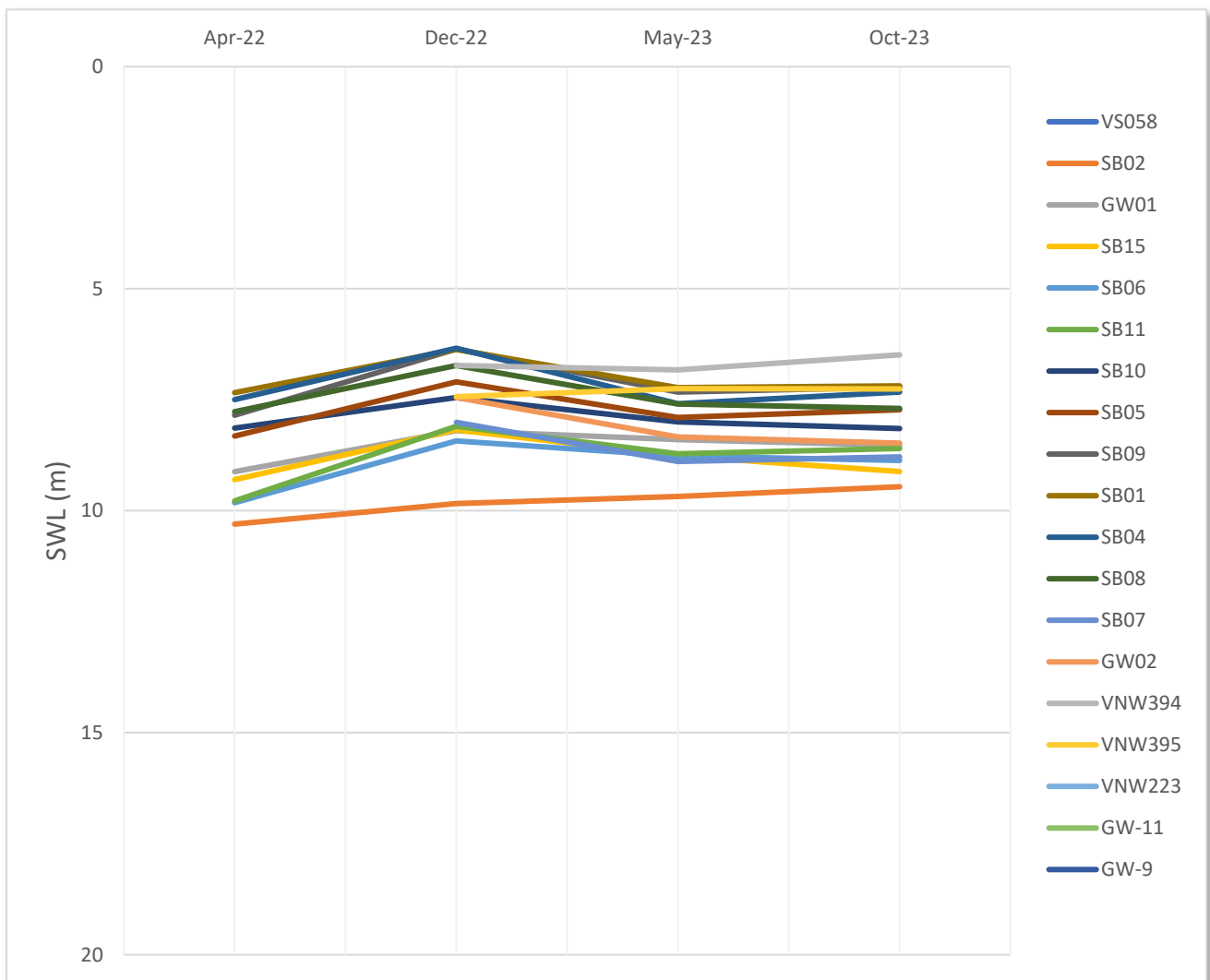


Figure 2: Hydrograph of Alluvial Monitoring Bores

2.2.2 Permian Groundwater Bores

Groundwater levels in the Permian monitoring bores are displayed in the hydrograph shown in Figure 3 below.

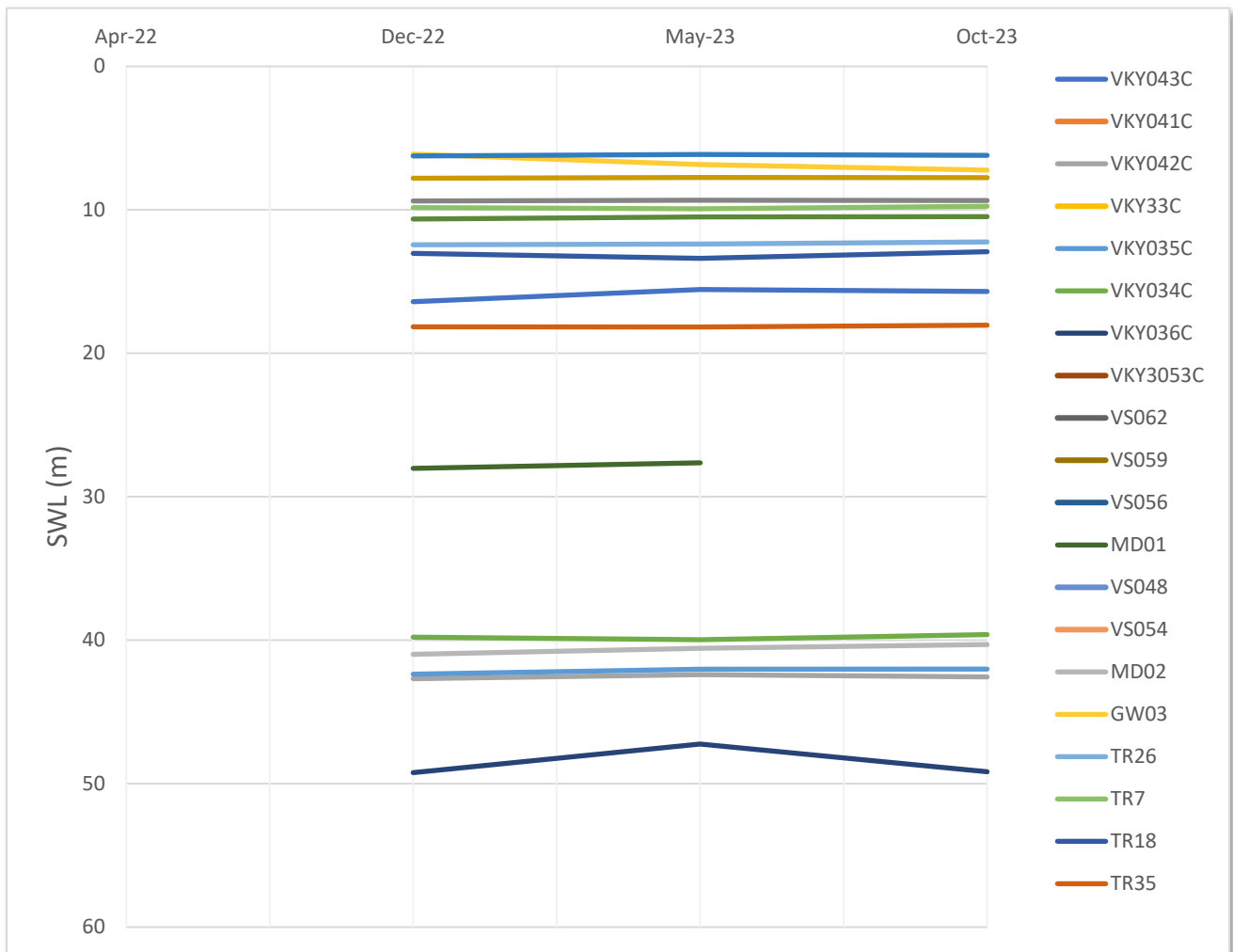



Figure 3: Hydrograph of Permian Monitoring Bores

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3 Discussion


Groundwater levels in the Permian and Alluvial bores have remained steady with no significant change in levels between April 2023 and October/November 2023. There is insufficient data (less than 2 years) to provide any commentary on seasonal fluctuations or changes in responds to climate conditions (residual rainfall mass). Analyses on these patterns will be included when more than 2 years of data has been collected.

Initial groundwater quality analysis has been undertaken and the results (refer Table 2 in Appendix) indicate the following bores have exceedances of the interim trigger values as set out in Table 8-3 of the Groundwater MP. The exceedances summarized in Table 1 are unlikely to be a result of mining and highly likely to be due to natural variation in water quality as mining has not yet impacted the water table. These results indicate that more data and analysis is required to develop specific trigger levels for each bore. The interim trigger values have been developed from some generic triggers due to not having 2 years of data and therefore will be developed further as more data is collected.


Table 1: Summary of GW Interim Trigger Values Compared to Initial Results

Groundwater Bore ID	Trigger Values Exceeded
GW03	EC of 839 $\mu\text{S}/\text{cm}$ compared to trigger value of 811.
GW11	pH of 6.7 compared to lower trigger value of 7.0
TR7	pH of 6.99 compared to lower trigger value of 7.4
GW7	pH of 8.85 compared to upper trigger value of 8.5
GW9	SO ₄ value of 104 mg/L compared to trigger value of 86
SB02	SO ₄ value of 1120 compared to trigger value of 365
SB06	SO ₄ value of 372 compared to trigger value of 365
SB05	SO ₄ value of 735 compared to trigger value of 365
MD01	pH value of 11.8 compared to trigger value of 8.4
TR26	SO ₄ value of 194 compared to trigger value of 86
TR18	SO ₄ value of 702 compared to trigger value of 86 EC value of 13000 $\mu\text{S}/\text{cm}$ compared to trigger value of 12315 $\mu\text{S}/\text{cm}$
TR35	SO ₄ value of 660 compared to trigger value of 86 EC value of 14900 $\mu\text{S}/\text{cm}$ compared to trigger value of 12315 $\mu\text{S}/\text{cm}$
VKY042C	SO ₄ value of 302 compared to trigger of 86
VKY035C	SO ₄ value of 87 compared to trigger value of 86

The groundwater quality results detailed in Table 1 indicate a ‘normal condition’ TARP response. If the same levels are observed in the next quarterly monitoring results this will become a level 1 TARP trigger whereby a resample of GW quality will be initiated. The pH at MD01 is anomalous and a purge of the bore will be undertaken prior to the next monitoring event.

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As discussed above generic trigger levels (i.e. SO₄ 86 mg/L for Permian) have been implemented for each water source (Alluvium or Permian) for sites with less than 2 years of data. Subsequent monitoring events will inform the development of specific trigger levels for each bore. Following the initial monitoring period where these trigger levels have been developed certain bores may be removed from the monitoring program if the data indicates that some monitoring locations are superfluous. Similarly additional monitoring locations will be established if the analysis of monitoring results indicates that data beneficial to refining the groundwater model or trigger levels can potentially be obtained by monitoring different locations.

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4 Appendix- Groundwater Monitoring Data



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Table 2: Raw GW Monitoring Data

Sample Location	Date	Bore Depth	Depth to water	Appearance	Colour	pH value	Electrical Conductivity @ 25C	Total Dissolved Solids (TDS)	Hydride Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4 - Turbimetric	Chloride	Calcium (F/L)	Sodium (F/L)	Potassium (F/L)	Aluminium (Dissolved)	Antimony (Dissolved)	Arsenic (Dissolved)	Cadmium (Dissolved)	Chromium (Dissolved)	Cobalt (Dissolved)	Copper (Dissolved)	Lead (Dissolved)	Manganese (Dissolved)	Molybdenum (Dissolved)	Nickel (Dissolved)	Selenium (Dissolved)	Zinc (Dissolved)	Boron (Dissolved)	Iron (Dissolved)	Mercury (Dissolved)	Nitrite as N	Nitrate as N	Nitrate + Nitrite as N	Total Anions	Total Cations	Ionic Balance	
S802	24-Oct-23			9.46	Slightly turbid	Orange	7.29	7210	4830	<1	<1	830	830	1120	1310	82	1570	2	<0.01		0.002	<0.0001	<0.001	0.002	<0.001	<0.001	0.798	0.003	0.001	<0.01	<0.005	0.18	0.06	<0.0001	<0.01	0.09	0.09	76.8	78.7	1.18
GW01	24-Oct-23	35.00		8.53	Clear	Colourless	7.37	1010	602	<1	<1	442	442	96	37	69	127	1	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.01	<0.005	0.08	<0.05	<0.0001	<0.01	0.17	0.17	12.4	12.6	0.7	
S815	24-Oct-23			9.12	Clear	Colourless	7.34	974	628	<1	<1	438	438	90	33	72	109	1	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.002	<0.001	<0.001	<0.01	0.007	0.07	<0.05	<0.0001	<0.01	0.28	0.28	12.1	12	0.58	
S806	24-Oct-23			8.87	Clear	Colourless	7.71	3370	2090	<1	<1	563	563	372	622	35	685	1	<0.01	0.002	<0.0001	<0.001	<0.001	0.002	<0.001	0.142	0.002	<0.001	<0.01	<0.005	0.14	<0.05	<0.0001	<0.01	0.01	0.01	36.5	34.7	2.59	
S811	24-Oct-23			8.6	Clear	Colourless	7.68	1030	677	<1	<1	460	460	85	56	32	196	1	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.01	<0.005	0.08	<0.05	<0.0001	<0.01	0.18	0.18	12.5	12.1	1.69	
S810	23-Oct-23			8.15	Clear	Colourless	7.57	1830	1180	<1	<1	632	632	190	201	45	365	<1	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.027	0.001	<0.001	<0.01	<0.005	0.1	<0.05	<0.0001	<0.01	0.03	0.03	22.2	21.2	2.31	
S805	23-Oct-23			7.73	Clear	Colourless	7.77	3820	2480	<1	<1	700	700	735	350	33	847	1	<0.01	0.003	<0.0001	<0.001	<0.001	0.002	<0.001	0.089	0.004	<0.001	<0.01	0.005	0.16	<0.05	<0.0001	<0.01	0.07	0.07	44.8	40.7	4.75	
S809	23-Oct-23			7.22	Slightly turbid	Orange/brown	7.68	934	568	<1	<1	436	436	71	29	45	191	2	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.005	<0.001	<0.001	<0.01	<0.005	0.07	<0.05	<0.0001	<0.01	0.03	0.03	11	11.2	1.1	
S801	23-Oct-23			7.19	Clear	Colourless	7.52	1610	970	<1	<1	543	543	182	186	97	208	2	<0.01	0.001	<0.0001	<0.001	<0.001	0.002	<0.001	0.002	<0.001	<0.001	<0.01	0.011	0.07	<0.05	<0.0001	<0.01	0.22	0.22	19.9	19.2	1.74	
S804	23-Oct-23			7.33	Slightly turbid	Grey	7.5	2570	1650	<1	<1	677	677	284	348	72	539	1	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.295	<0.001	<0.001	<0.01	<0.005	0.11	0.12	<0.0001	<0.01	0.14	0.15	0.29	29.2	32.7	5.62
S808	23-Oct-23			7.70	Clear	Colourless	7.33	986	598	<1	<1	386	386	86	85	68	122	<1	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.01	<0.005	0.06	<0.05	<0.0001	<0.01	0.13	0.13	11.9	11.8	0.31	
S807	23-Oct-23			8.79	Clear	Colourless	7.49	886	558	<1	<1	378	378	74	60	54	129	<1	<0.01	<0.001	<0.0001	<0.001	<0.001	0.002	<0.001	0.004	<0.001	<0.001	<0.01	0.006	0.06	<0.05	<0.0001	<0.01	0.41	0.41	10.8	10.6	0.82	
GW02	23-Oct-23	17.72		8.48	Clear	Colourless	7.53	886	530	<1	<1	372	372	77	64	49	142	<1	<0.01	<0.001	<0.0001	<0.001	<0.001	0.003	<0.001	0.011	<0.001	<0.001	<0.01	0.012	0.06	<0.05	<0.0001	<0.01	0.39	0.39	10.8	10.8	0.37	
MD01	25-Oct-23			27.68	Clear	Colourless	11.8	1690	658	254	152	<1	405	22	132	11	230	27	0.52	<0.001	<0.0001	<0.001	<0.001	0.014	<0.001	0.002	0.017	0.004	<0.01	0.26	<0.05	<0.05	<0.0001	<0.01	8.05	2.45	10.5	12.3	11.2	4.38
MD02	25-Oct-23			40.3	Clear	Colourless	6.89	1160	666	<1	<1	528	528	28	110	78	128	9	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.039	0.001	<0.001	<0.01	0.007	<0.05	1.37	<0.0001	0.01	0.31	0.32	14.2	14	0.94	
GW03	23-Oct-23			7.23	Clear	Colourless	7.32	839	523	<1	<1	409	409	52	22	83	76	1	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.009	<0.001	<0.001	<0.01	0.006	<0.05	<0.05	<0.0001	<0.01	0.17	0.17	9.88	10.3	1.97	
TR26	25-Oct-23			12.24	Clear	Colourless	7.32	6100	3900	<1	<1	1200	1200	194	1470	149	1130	11	<0.01	<0.001	<0.0001	0.001	<0.001	0.006	<0.001	0.015	0.001	<0.001	<0.01	0.011	0.08	<0.05	<0.0001	<0.01	0.73	0.73	69.5	70	0.4	
TR7	25-Oct-23	18.63		9.75	Clear	Colourless	6.99	14800	9500	<1	<1	740	740	508	4960	285	2620	15	<0.01	<0.001	<0.0001	<0.001	0.004	0.048	<0.001	0.545	<0.001	0.029	<0.01	0.007	0.06	0.05	<0.0001	<0.01	<0.01	<0.01	165	157	2.42	
TR18	25-Oct-23	21.1		12.92	Clear	Colourless	6.94	13000	8360	<1	<1	703	703	702	4320	245	2330	12	<0.01	<0.001	<0.0001	<0.001	0.003	0.003	<0.001	0.005	<0.001	0.014	<0.001	0.008	0.06	<0.05	<0.0001	<0.01	0.1	0.1	150	140	3.57	
TR35	25-Oct-23			18.04	Clear	Colourless	7	14900	9940	<1	<1	739	739	660	5200	282	2570	20	<0.01	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	2.02	<0.001	0.003	<0.01	0.011	0.07	0.23	<0.0001	<0.01	0.11	0.11	175	163	3.58	
VKY043C	26-Oct-23			15.7	Clear	Colourless	7.84	2950	1790	<1	<1	1140	1140	<1	399	10	727	5	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.009	<0.001	<0.001	<0.01	0.011	0.06	<0.05	<0.0001	<0.01	<0.01	<0.01	34	32.6	2.18	
VKY042C	26-Oct-23			42.56	Clear	Colourless	6.89	5540	3540	<1	<1	810	810	302	1340	200	742	22	<0.01	<0.001	<0.0001	<0.001	<0.001	0.002	<0.001	0.215	<0.001	0.003	<0.01	0.022	<0.05	1	<0.0001	<0.01	0.07	0.07	60.3	61.1	0.67	
VKY035C	26-Oct-23	80.1		42.01	Clear	Colourless	7.2	3200	1910	<1	<1	909	909	87	569	49	652	8	<0.01	0.003	<0.0001	<0.001	<0.001	<0.001	<0.001	0.317	0.002	<0.001	<0.01	<0.005	0.01	<0.05	0.56	<0.0001	<0.01	0.02	0.02	36	34.7	1.85
VKY034C	26-Oct-23	127.45		39.61	Clear	Colourless	7.31	3500	2120	<1	<1	1090	1090	123	569	26	798	7	<0.01	<0.001	<0.0001	<0.001	<0.001	0.029	<0.001	0.037	<0.001	<0.001	<0.01	<0.01	<0.01	<0.05	<0.05	<0.0001	<0.01	0.01	0.01	40.4	38.8	1.98
VKY036C	26-Oct-23	117.4		49.17	Clear	Colourless	7.17	5500	3400	<1	<1	949	949	244	1290	112	1080	11	<0.01	0.003	<0.0001	<0.001	<0.001	0.004	<0.001	0.067	0.001	<0.001	<0.01	0.09	0.06	0.65	<0.0001	<0.01	0.05	0.05	60.4	60.2	0.14	
VNW390	24-Oct-23			9.36	Clear	Colourless	7.22	2310	1380	<1	<1	597	597	95	407	187	271	12	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.214	<0.001	0.001	<0.01	<0.005	0.11	0.14	<0.0001	<0.01	<0.01	<0.01	25.4	25	0.67	
VNW391	24-Oct-23			7.76	Clear	Colourless	7.34	2420	1430	<1	<1	626	626	88	447	190	271	14	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.221	<0.001	<0.001	<0.01	0.014	0.1	0.91	<0.0001	<0.01	0.02	0.02	26.9	26.4	1.03	
VNW392	22-Nov-23	62.05		6.21	Clear</																																			