FINAL BASIC ASSESSMENT REPORT

Basic Assessment for the proposed development of the up to 150 MW Padloper Solar PV Facility 2 (i.e., Padloper PV 2), as well as the proposed development of a 132 kV Overhead Power Line between the Padloper PV 2 and the proposed authorised Ishwati Emoyeni Collector Substation (i.e., Padloper EGI 2), and their associated infrastructure, near Murraysburg in the Western Cape Province



APPENDIX D.9:
Geohydrology



Geohydrological Assessment for groundwater development and identification of potential borehole locations for the proposed Padloper Solar Facilities 1 -4

REPORT:	***PREPARED BY:***
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Revision 1

29 July 2023

EXECUTIVE SUMMARY

GEOSS South Africa (Pty) Ltd (GEOSS) was appointed by African Clean Energy Developments (Pty) Ltd (ACED) (hereafter referred to as the "Project Developer") to undertake a groundwater potential and development assessment for the proposed Padloper Solar Facilities 1-4. The Padloper Solar Facilities 1 -4 are located approximately 20 km north-northwest of Murraysburg, and forms part of a larger development of several Solar PV facilities comprising the Padloper Solar Cluster. This geohydrological assessment was necessary to establish baseline conditions, identify potential boreholes for groundwater supply and potential areas for groundwater development.

The sites proposed for Padloper Solar Facilities 1 -4 is mostly underlain by mudstones, siltstones, and sandstones of the Karoo-aged Balfour and Hoedemaker Formations of the Beaufort Group which have locally been intruded by Jurassic-aged dolerites, and overlain by quaternary-aged alluvium.

Based on regional data available, the Padloper Solar Facilities 1 - 4 are underlain a fractured aquifer with an average borehole yield potential of 0.5 – 2.0 L/s. Further, a hydrocensus has revealed the regional groundwater quality, the electrical conductivity (EC) of the groundwater in the area ranges between 44 – 257 mS/m. Data was collected during a site visit, which was carried out early in January 2023, as well as from the National Groundwater Archive (NGA) and GEOSS databases.

Several boreholes were identified in the across/surrounding the proposed sites for the Solar Facilities of the Padloper Solar Cluster and anecdotal evidence suggests that many deliver limited supply. Some of the boreholes on the affected properties may require upgrading and/or deepening to deliver the requisite volumes required by the development.

The water requirements for the proposed the Padloper Solar Facilities 1 - 4 are as follows:

Facility Number	Capacity (MW)	Water Requirements (m^3/a) during project phases	
		Construction	Operational
1	250	50 000	12 000
2	150	30 000	8 000
3	150	30 000	8 000
4	150	30 000	8 000

Cumulatively proposed Padloper Solar Cluster (comprising seven Solar Facilities) demands 220 000 m^3/a during the Construction Phase, and 57 000 m^3/a during the Operational Phase.

Finally, the following recommendations have been made in this report:

- The groundwater supply can be sourced from either existing boreholes, newly developed boreholes, or a combination of these options.
- The legal status of groundwater use at each property should be confirmed. This will inform the need for future water use authorisations.

- The planned water demand for Padloper Solar PV Facility 1 is 50 000 m^3/a (1.59 L/s) during the construction phase, but the GA volumes for the farm portion (7/109) on which this facility is to be constructed is 40 000 m^3/a (1.27 L/s). A water use license (WUL) will be required to supply groundwater at this rate (1.59 L/s) (if such groundwater resources are scientifically proven to be sustainable from this property) on this property. Alternatively, the water demand could potentially be divided across Farm (7/109) and a neighbouring property to negate the need for a WUL. The criteria required for a water use to be generally authorized will need to be taken into consideration as well.
- Every effort should be made to visit all boreholes and undertake yield and quality tests at boreholes that could be considered for future supply (based on their relative proximity). The information obtained from the NGA database would be a useful starting point in determining which of the boreholes should be tested for their yields. Further, the relative sizes, GA volumes/abstraction rates (and cap volumes/rates) of the respective farm portions should also be considered when planning scientific yield testing.
- Groundwater exploration via geological and geophysical methods is recommended for the proposed Padloper Solar PV Facilities 1 to 4, should existing boreholes not be sufficient to meet the water demands. Groundwater exploration aims to understand the geological environment, which can increase the chance of borehole success, and provide more realistic yields and depths of a borehole to be drilled, which could be expected.
- All boreholes planned for use will require scientific yield and quality testing and analysis.
- Monitoring of groundwater (abstraction volumes, quality and water levels) will be required, this should ideally be implemented one year prior to the start of construction if the project timeframes permit.

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ABBREVIATIONS

AOI	Area of Interest
BH	Borehole
CGS	Council for Geoscience
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water Affairs and Sanitation
EC	electrical conductivity
L/s	litres per second
m	metres
mbch	meters below collar height
mbgl	metres below ground level
mS/m	milli-Siemens per metre
NGA	National Groundwater Archive
WEF	Wind Energy Facility

GLOSSARY OF TERMS

Aquifer: a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].

Borehole: includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].

Electrical Conductivity: the ability of groundwater to conduct electrical current, due to the presence of charged ionic species in solution (Freeze and Cherry, 1979).

Fractured aquifer: Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.

Groundwater: Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.

Solar PV facility supporting infrastructure: proposed Site Camps, Batching Plants, Substations and related infrastructure.

Suggested citation for this report:

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Cover photo:

Photo taken during site visit, January 2023.

GEOSS project number:

2022_03-4708 (Phase F)

Review by:

Dale Barrow (06 February 2023)

1. INTRODUCTION

GEOSS was appointed by the ACED to complete a groundwater potential and development assessment for the proposed Padloper Solar Cluster. The Padloper Solar Cluster comprises of seven smaller facilities, with capacities ranging between 100 MW and 250 MW, which are located approximately 15 km to 23 km northwest of Murraysburg (**Map 1**). This geohydrological assessment is necessary to identify potential boreholes and potential areas for groundwater development to provide sufficient water for the proposed Padloper Solar Facilities 1 - 4. The water requirements for the proposed the Padloper Solar Facilities 1 - 4 are as follows:

Facility Number	Capacity (MW)	Requirement (m^3/a)	
		Construction	Operational
1	250	50 000	12 000
2	150	30 000	8 000
3	150	30 000	8 000
4	150	30 000	8 000

It is understood that the water will be used across the Solar farms, i.e., in the proposed Site Camps, Laydown Areas, Concrete Batching Plants, and Substations, as well as for dust suppression of the internal roads of the proposed Padloper Solar Cluster.

This report outlines the work completed to assess the likelihood of using existing sources of groundwater for the project, as well as the potential to develop additional areas for groundwater abstraction.

2. TERMS OF REFERENCE

The project objective is to characterize the groundwater conditions at each of the three individual Padloper Solar Facility sites, as well as the potential risks the developments could have on groundwater in the area surrounding the proposed sites. This study also seeks to evaluate the suitability of groundwater for potential use on site. The terms of reference for this project are as follows:

1. Desktop study.
2. Site visit and hydrocensus investigation. Groundwater supply source identification.
3. Guidance on water use permitting requirements.
4. Indication of potential impacts of development on surrounding environment.
5. Data analysis and hydrogeological report.

3. PROPOSED DEVELOPMENT

ACED is proposing the development of a of seven (7) Solar PV photovoltaic (PV) energy facilities, with capacities ranging from 100 MW to 250 WM, and seven 132 kV associated overhead

transmission power lines on various properties near Murraysburg in the Western and Northern Cape provinces. Note this report is focussed on Padloper Solar Facilities 1- 4.

The proposed project aims to enhance the capacity of the Eskom grid and optimize the functionality of the grid area. This will be achieved through the implementation of seven 132 kV overhead power lines, which will connect the facilities to the Gamma MTS via the proposed authorized Ishwati Collector Substation

A preliminary number of 330 3.5 MW inverters will be required across all projects. Therefore, there will be 165 Inverter-Transformation stations each occupying 0.022 ha. Each solar facility will have an on-site substation complex extending 2 ha in area, and will have a height of up to 18 m.

We understand that each PV Facility will have a temporary laydown area of up to 22 ha. There will be 1 site office at each solar facility which will include a warehouse/workshop and an operational and maintenance (O&M) control centre (300 m^2 footprint). Each SEF will have 2 guardhouse facilities with a footprint of up to 36 m^2 as well as 2 ablution facilities of up to 242 m^2. It is proposed that the BESS is located at the project substation site and laydown area. Each solar facility will have 1 BESS facility.

Internal roads between SEFs will be 5 m wide with a total preliminary length of 117 km. Existing access roads will be used as far as practically achievable however, should any upgrading be required the existing access roads will be upgraded to have a 6 m wide road surface with 1 m wide drainage on either side. Site access points are proposed to be on the Western side of the proposed SEF development areas, from existing farm road running further north.

All on-site medium voltage cabling (22 or 33 kV) will be buried to a maximum depth of 1.5 m.

The construction period for each of the facilities comprising the Padloper Solar Cluster is planned to be between 18 – 36 months, with a minimum of 20 year operational lifespan.

In order of priority water for the facility will be sourced as follow:

1. Borehole/s drilled on site.
2. Arrangements with the Local Municipality.
3. Investigation into a third-party water supplier which may include a nearby mine or other private services company.

4. METHODOLOGY

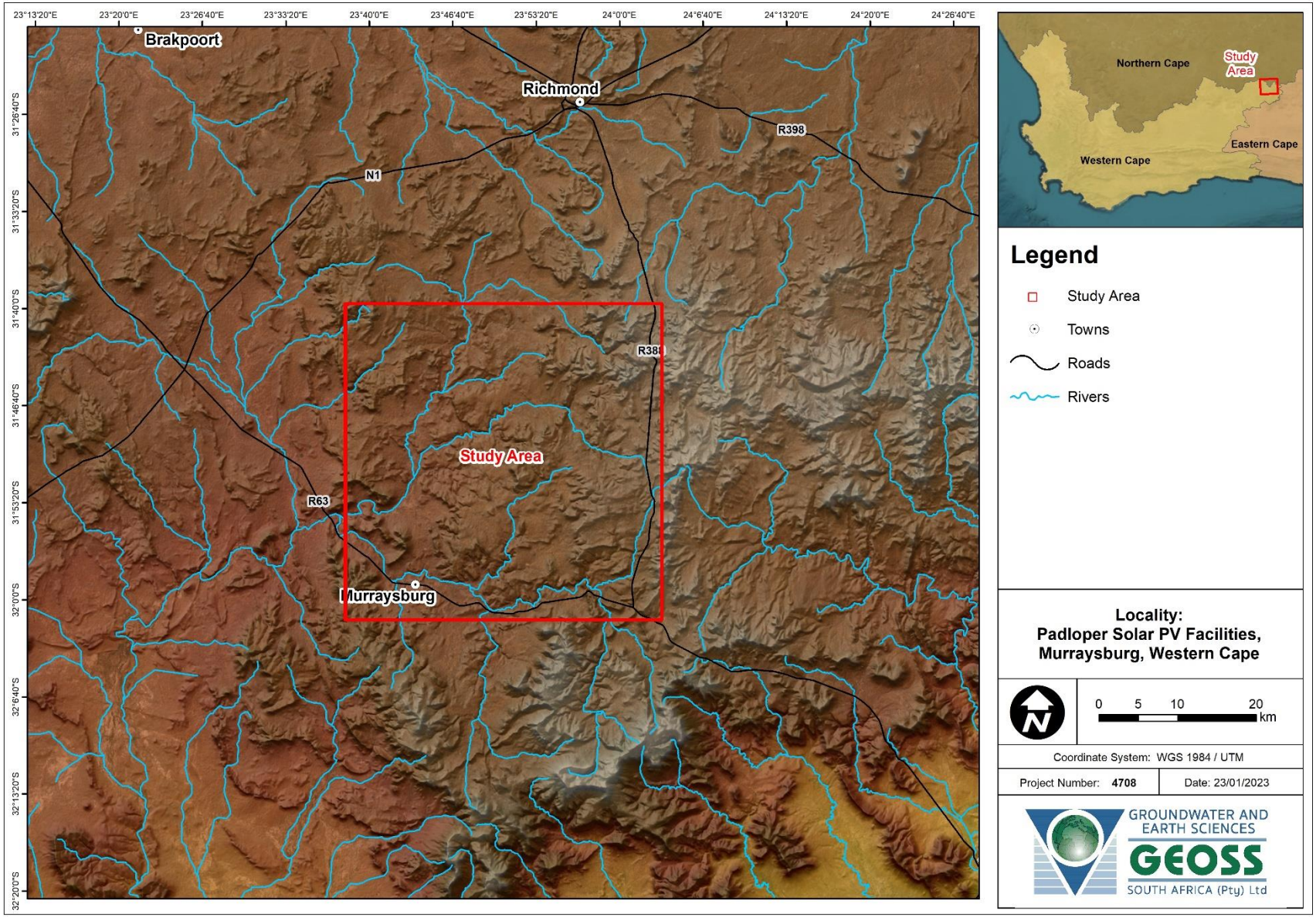
The procedure adopted for this study involved a desktop study. The initial desktop study involved obtaining and reviewing all relevant data to the project. This included analysing data from the National Groundwater Archive (NGA), as well as additional groundwater yield and groundwater chemistry from other databases, as well as geological maps of the area.

The site visit was conducted between 3 - 6 January 2023 to verify collected/existing data and collect additional data, where possible. This included a hydrocensus of groundwater users in the area and noting hydrogeological features of relevance.

Calculations based on the General Authorisation (GA) abstraction rates per land portion/farm within the respective quaternary catchments were carried out to determine whether the water volumes required for construction and operation of the proposed development could be met by groundwater abstraction under a GA water use, or whether a Water Use License (WUL) would be required. It should be noted that there are factors apart from the volume that might require that the water use be licensed.

Additional information will be discussed in this report addressing the potential use of boreholes identified during the hydrocensus, as well as, providing areas optimal for further groundwater development should existing sources prove insufficient.

Finally, the hydrogeological risks associated with the proposed developments have been highlighted and appropriate mitigation measures have been provided where possible.



Map 1: Regional locality of the Padloper Solar Cluster, northwest of Murraysburg.

5. SETTING

5.1 The sites

The Padloper Solar Facilities 1- 4 are located approximately 13 km and 20 km northwest to north-northwest of Murraysburg, (**Map 1**). The topography across the site varies between 1259 and 1389 metres above mean sea level (mamsl). The site is mostly used for grazing of livestock, and is covered by low spiny scrub and occasional shrubs.

5.2 Climate

In the vicinity of the Padloper Solar CLuster a continental climate exists, with hot summers, scattered rains throughout the year, and cold; and often dry winters. **Figure 1** shows the monthly average range of air temperatures, and **Figure 2** shows the monthly mean rainfall and evaporation distribution for the general area in which Padloper Solar Cluster is to be constructed (Schulze, 2009). The long-term (1950 – 2000) mean annual precipitation for the Padloper Solar PV Development is 274 mm/a. The evaporation rates rainfall typically exceeds the rainfall throughout the year.

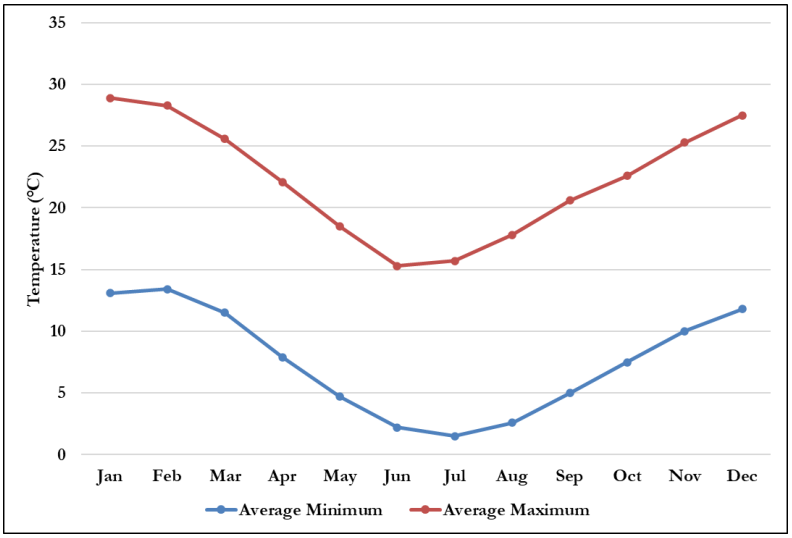


Figure 1: Monthly average air temperature for the area in which the Padloper Solar Cluster development is being proposed (Schulze, 2009).

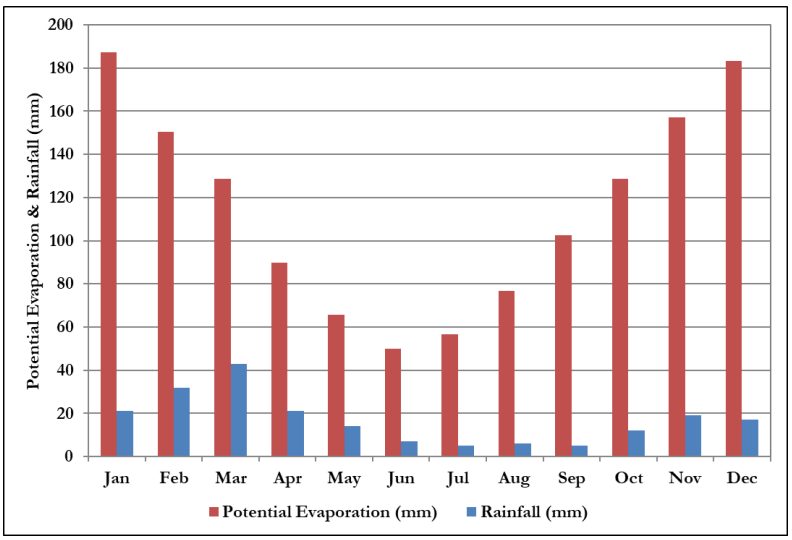


Figure 2: Monthly average rainfall and potential evaporation for the area in which the Padloper Solar Cluster development is being proposedPadloper area (Schulze, 2009).

5.3 Geology

The Council for Geoscience (CGS) mapped the regions underlying the proposed developments at a 1:250 000 scale (3122 Victoria West, GCS 1991). The geological setting is shown in **Map 2** and the main geology of the area is listed in **Table 1**.

Table 1: Geological formations within the study area.

Code	Formation	Group	Description
	Quaternary-aged sediments		Alluvium
Jd	*Intrusive*		*dolerite*
Pb	Balfour	Beaufort	Greenish- to bluish-grey and greyish-red mudstone, siltstone, subordinate sandstone.
Pte	Teekloof	Beaufort	Brownish-red and greenish-grey mudstone, subordinate siltstone and sandstone

The Padloper Solar Facilities 1 - 4 are mostly underlain by mudstones and sandstones of the Karoo-aged Balfour and Hoedemaker Formations of the Beaufort Group (**Figure 6**), which have been intruded by Jurassic-aged dolerites, and overlain by quaternary-aged alluvium (**Map 2**).

5.4 Hydrogeology

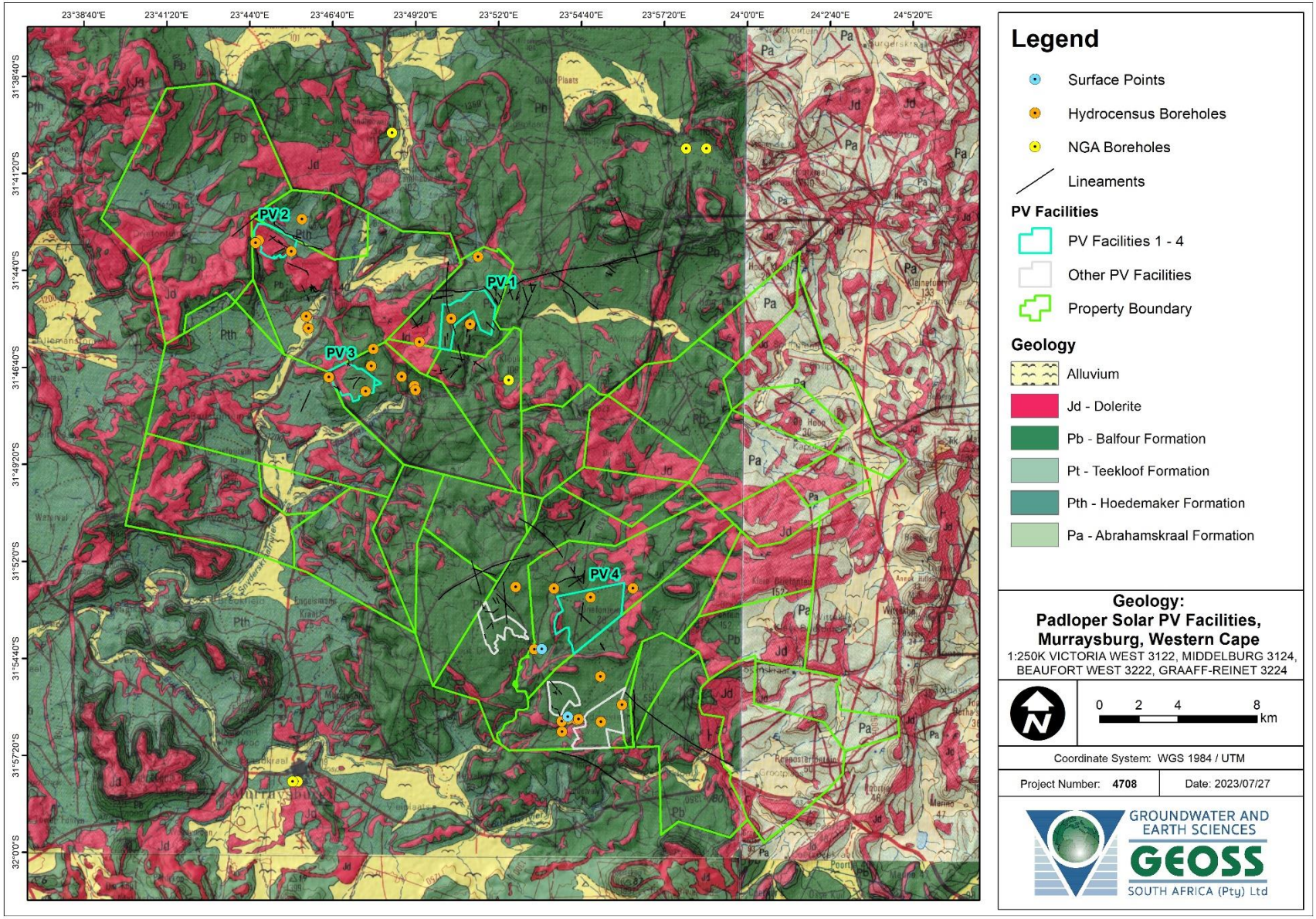
The Padloper Solar Facility 1 - 4 are shown to be underlain by a **fractured aquifer** as classified by the Department of Water Affairs and Forestry (DWAF, 2002). A fractured aquifer refers to an aquifer in which groundwater flows in joints, fissures, cracks and fractures within the rock. The aquifer is classified as having average **yield potential of 0.5 – 2.0 litres per second (L/s)** (**Map 3**).

Based on the DWAF (2002) mapping of the **regional groundwater quality**, the electrical conductivity[§] (EC) of the groundwater in the area generally ranges between 70 and 300 milli-Siemens per metre[**] (mS/m). This is considered "**moderate**" groundwater quality (**Map 4**), with respect to drinking water standards.

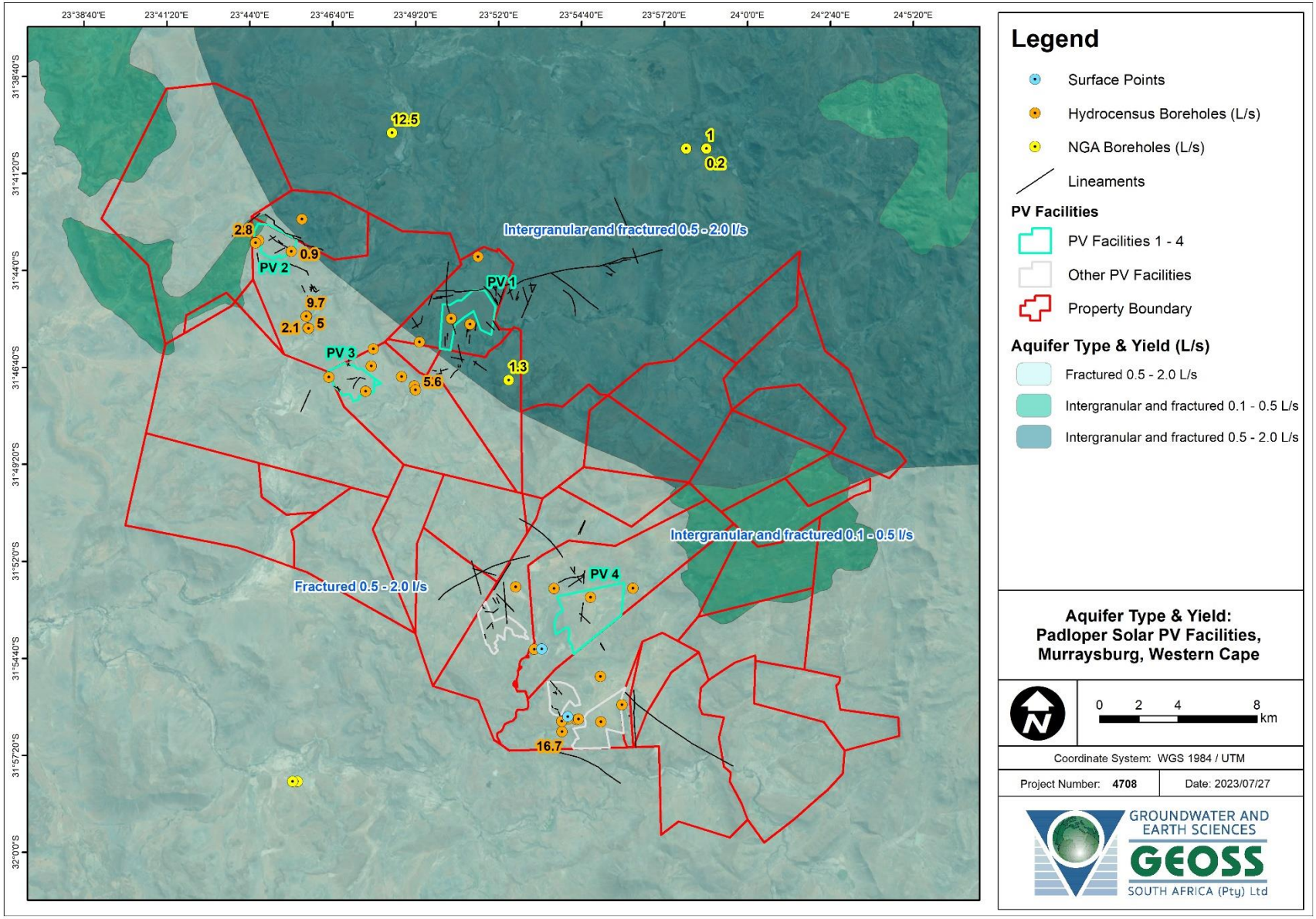
Both these classifications are based on regional datasets, and therefore, only provide an indication of the possible/likely conditions. Groundwater in the area is generally considered as being of moderate quality and boreholes have a low yield.

[§] EC indicates the level of dissolved substances, chemicals, and minerals present in the water. Higher amounts of these impurities will lead to a higher conductivity.

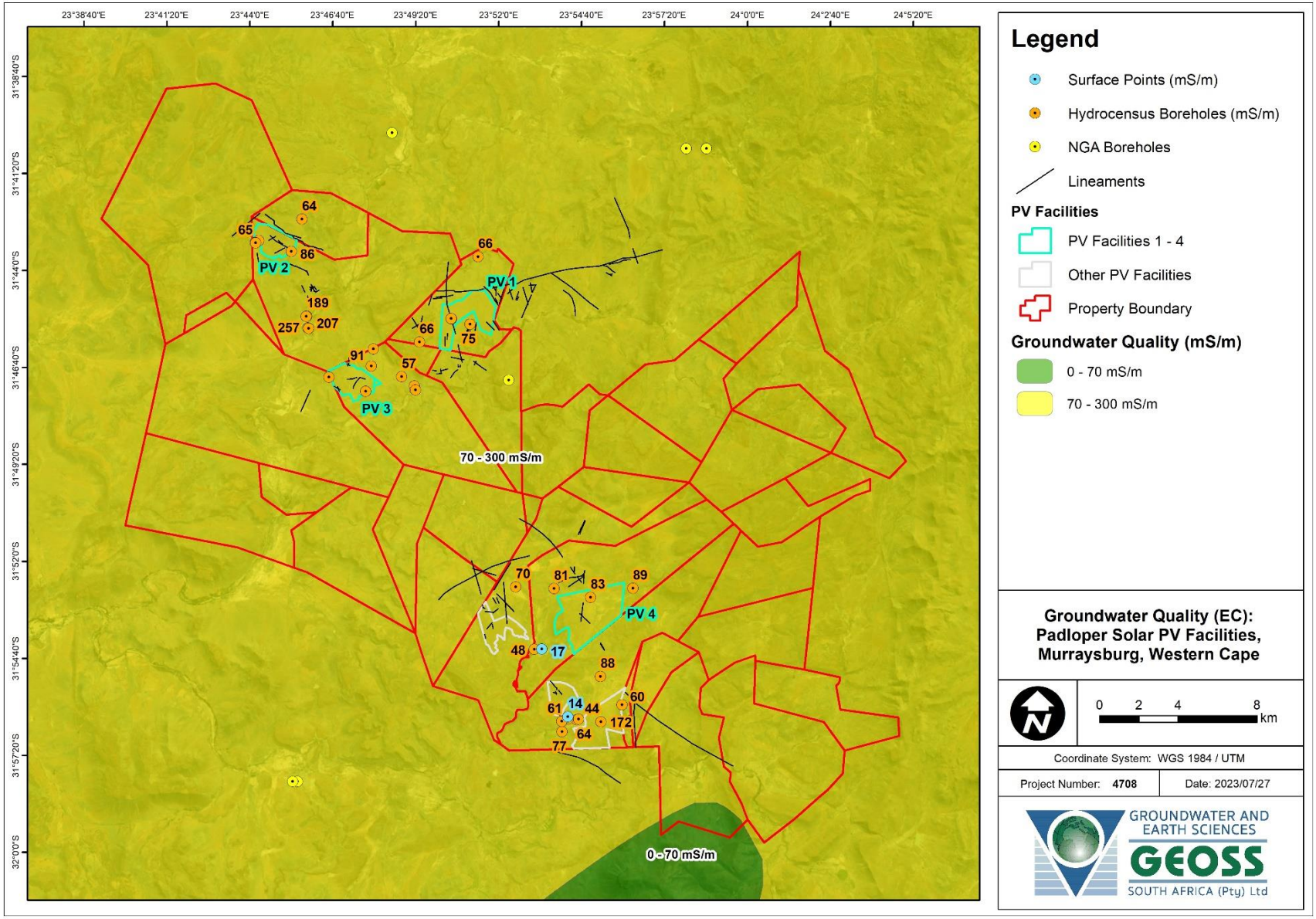
[**] Millisiemens per meter is a unit of measurement for electrical conductivity. It describes electrical conductivity of material which as electrical conductance of one millisiemens per length of one meter.



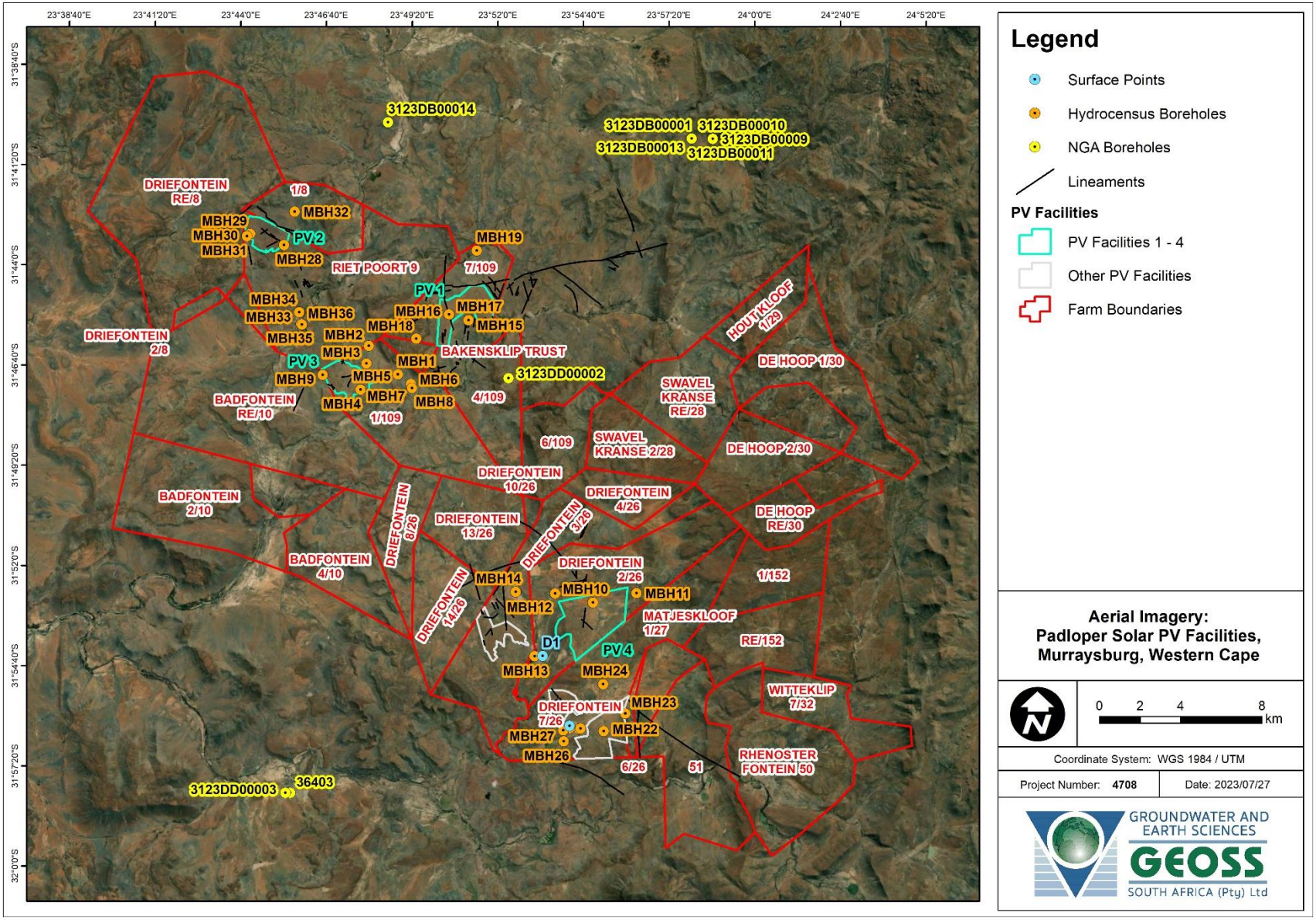
Map 2: Geological setting of Padloper Solar Facilities 1 - 4, and surrounds (1: 250 000 scale 3122 Victoria West (CGS, 1991)). Note this report is focussed on Padloper Solar Facilities 1 - 4.



Map 3: Regional aquifer yield (DWAF, 2002) and borehole yields (L/s). Note this report is focussed on Padloper Solar Facilities 1- 4.



Map 4: Regional groundwater quality (mS/m) from DWAF (2002) and borehole groundwater quality (EC in mS/m). Note this report is focussed on Padloper Solar Facilities 1 - 4.



Map 5: Aerial imagery showing hydrocensus & NGA boreholes, property/ farm boundaries in relation to the development boundaries of Padloper Solar Facilities 1 to 4. Note this report is focussed on Padloper Solar Facilities 1 - 4.

6. HYDROCENSUS AND FIELD WORK

6.1 NGA Database (Desktop)

A desktop assessment was carried out within the boundaries of the proposed Padloper Solar Cluster. A search of the National Groundwater Archive (NGA) was completed to determine if there are any groundwater users in the area. The NGA database provides data on borehole positions, groundwater chemistry, borehole yield, groundwater level and borehole geology, where available. The NGA search indicated 12 boreholes exist within the greater vicinity of the Padloper Solar Cluster (**Table 2**). The NGA boreholes are shown spatially in **Map 5**. The accuracy of NGA borehole data requires validation prior to use, but does provide an indication of conditions that are to be anticipated for an area. Some of these boreholes are located ~20 km away from Padloper Solar Facilities 1 -4 (**Map 5**).

Based on the information collected by means of a NGA database search on 10 November 2022, the following can be said:

- The water levels of the boreholes in the region are shown to range between 3.0 m and 19.15 mbgl, with a mean depth of 7.91 mbgl.
- The pH of the groundwater in the area ranges between 7.2 and 7.4, with a mean pH of 7.3.
- Borehole depths in the area range between 19.2 m and 84.8 m, with a mean depth of 47.5 m.
- Few yield values are available for the area, presumably since water is mostly used for watering of livestock (often <31 563 m^3/a). The available yield data has a range of 0.17 L/s and 12.5 L/s, with an average yield of 3.7 L/s.

It is worth noting that the above remarks are based on data drawn from the NGA which spans an area exceeding 140 000 ha, and therefore the above information is only to provide general information on the area.

Table 2: NGA data in the greater Padloper Solar Cluster area.

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	WL (mbgl)	pH	Depth (m)	Yield (L/s)	Lithology	Comment
36403	-31.9669	23.76167	-	7.23	71	-		-
3123DD00003	-31.9669	23.75914	19.15	7.40	53.05	-		-
3123DD00002	-31.7822	23.87362	-	-	19.20	1.26	Soil, Shale, Sandstone & Limestone	-
3123DB00013	-31.6753	23.96779	-	-	84.82	-	Soil & Shale	-
3123DB00011	-31.6753	23.96779	-	-	70	-	Soil & Shale	-
3123DB00009	-31.6753	23.97862	6.00	-	33	1	Soil, Sandstone & Dolerite	-
3123DB00001	-31.6753	23.96779	-	-	60.96	-	Soil, Shale & Dolerite	-
3123DB00012	-31.6753	23.96780	-	-	73	-	Soil, Shale & Dolerite	-
3123DB00007	-31.6753	23.97862	-	-	24	-	Sandstone	-
3123DB00008	-31.6753	23.97863	3.50	-	21	0.17	Sandstone & Dolerite	-
3123DB00010	-31.6753	23.97864	-	-	30	-	Soil	-
3123DB00014	-31.6691	23.81001	3.00	-	30	12.5	Shale	Blow yield

6.2 Hydrocensus (field work)

A site visit was conducted between 3 - 6 January 2023 to assess groundwater use and hydrogeological features of interest within the study area. During the hydrocensus, meetings were held with most landowners to discuss their groundwater use and borehole distribution. From these meetings, it became clear that the farmers make use of a number of boreholes. Most boreholes in this area are used for watering of livestock/ 'veldwater'; therefore, the farmers often pointed to certain boreholes which they believed should be targeted for the field visit to represent the 'best' boreholes for groundwater potential, in their experience. Further, in effort to provide a representative spread across the proposed Padloper Solar Cluster, boreholes encountered in between were also visited. In total 36 boreholes were visited, of which at the time of the investigation, 10 were equipped with functioning windpumps, 8 with submersible pumps (5 Solar PV powered), one that was closed, and least 17 boreholes with no equipment. Further, at two (2) dams surface samples were tested for field chemistry (i.e. pH and EC). The boreholes and dams are indicated spatially in **Map 3**, the data collected at these locations can be found in **Table 3**, and images of the boreholes in **Appendix A**. It is important to note that at some points shown on the map represent several boreholes.

Field chemistry and water level measurements were taken at boreholes, where possible (**Map 5**). The field chemistry (EC, pH[††]; and TDS[‡‡]) provide a reasonable indication of the expected groundwater quality in the region (**Table 3**). The mean Electrical conductivity (EC) measured for these boreholes was 93.91 mS/m, and ranged between 44 – 257 mS/m, which falls within the ideal to moderate (0 – 300 mS/m) classification according to DWAF (2002). The pH (hydrogen potential) of the groundwater assessed varied between 6.70 and 8.60 with an average pH of 7.46. This is considered 'neutral', and a good property for groundwater. Seven yield values could be collected during the hydrocensus, these ranged from 0.97 and 16.67 L/s. Based on the information available, the average depth of boreholes in the area of 35 m.

†† pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base.

‡‡ Total dissolved solids (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. The principal constituents are usually calcium, magnesium, sodium, and potassium cations and carbonate, hydrogencarbonate, chloride, sulphate, and nitrate anions.

Table 3: Hydrocensus borehole data collected across the Padloper Solar Cluster.

ID	Type	Latitude (DD, WGS84)	Longitude (DD, WGS84)	WL (mbgl)	EC (mS/m)	pH	Depth (m)	Yield (L/s)	Lithology	Comment	Sampled
MBH1	Borehole	-31.78094	23.81610	7.50	57.00	6.70	31.00	1.00	-	Anecdotal evidence suggests drilled between 1980 and 1985, yield approximate.	-
MBH2	Borehole	-31.76833	23.80087	-	-	-	-	-	-	Not operational, no head on windpump	-
MBH3	Borehole	-31.77616	23.79971	15.40	91.00	6.80	30.00	-	-	Lower yields during the drought	Yes
MBH4	Borehole	-31.78782	23.79678	-	-	-	-	-	-	Approximate location, anecdotal evidence suggests that yield is 20 000 L/hr.	-
MBH5	Borehole	-31.78781	23.79679	36.00	-	-	-	-	-	-	-
MBH6	Borehole	-31.78684	23.82339	-	-	-	-	5.56	-	-	-
MBH7	Borehole	-31.78522	23.82297	-	-	-	-	-	-	-	Yes
MBH8	Borehole	-31.78696	23.82360	-	-	-	-	-	-	-	-
MBH9	Borehole	-31.78139	23.77707	-	-	-	-	-	-	-	-
MBH10	Borehole	-31.88147	23.91850	18.00	83.00	7.10	50.00	-	-	Windpump	Yes
MBH11	Borehole	-31.87716	23.94120	12.00	89.00	7.40	30-50	-	-	Windpump	-
MBH12	Borehole	-31.87754	23.89885	20.00	81.00	7.20	30.00	-	-	Windpump	-
MBH13	Borehole	-31.90550	23.88848	4.30	48.00	7.30	-	-	-	Windpump	Yes
MBH14	Borehole	-31.87698	23.87824	11.40	70.00	7.30	-	-	-	Two adjacent boreholes, one with no equipment; and one windpump	Yes
MBH15	Borehole	-31.75666	23.85268	9.60	75.00	7.10	>21	-	-	Didn't struggle during drought	Yes
MBH16	Borehole	-31.75429	23.84260	-	-	-	-	-	-	-	-
MBH17	Borehole	-31.75415	23.84245	-	-	-	-	-	-	-	-
MBH18	Borehole	-31.76499	23.82554	1.90	66.00	8.60	-	-	-	Solar PV pump, sampled some 600 m away from reservoir.	-
MBH19	Borehole	-31.72572	23.85666	4.00	66.00	7.60	-	-	-	Understood to have relatively yield, was fitted with submersible pump	-
MBH20	Borehole	-31.93751	23.91167	1.00	64.00	7.50	30.00	-	-	Water level dropped during drought	-

ID	Type	Latitude (DD, WGS84)	Longitude (DD, WGS84)	WL (mbgl)	EC (mS/m)	pH	Depth (m)	Yield (L/s)	Lithology	Comment	Sampled
MBH21	Borehole	-31.93736	23.91258	1.60	44.00	8.40	>50	-	-	Borehole was open during visit, previous farmer drilled hole	-
MBH22	Borehole	-31.93847	23.92470	18.10	172.00	7.30	30.00	-	-	Windpump with no head; roots encountered in hole?	Yes
MBH23	Borehole	-31.93053	23.93587	21.90	60.00	7.20	-	-	-	Old, no infrastructure	-
MBH24	Borehole	-31.91766	23.92417	-	88.00	7.30	-	-	-	Solar PV pump	-
MBH25	Borehole	-31.93723	23.90708	-	61.00	7.80	-	-	-	Old wind pump, Solar PV panels, but no pump	-
MBH26	Borehole	-31.94310	23.90385	2.20	77.00	7.60	-	16.67	-	Apparently ACED has yield testing results, has been tested twice, yield was lower during drought	Yes
MBH27	Borehole	-31.93830	23.90356	-	-	-	-	-	-	Closed could not dip/sample	-
MBH28	Borehole	-31.72391	23.75647	8.80	86.00	7.30	40.00	0.97	-	Sited by diviner, sampled from ball value in water trough	Yes
MBH29	Borehole	-31.71899	23.73891	18.20	65.00	7.90	-	2.78	-	Sampled from ball value in water trough, sited by diviner	Yes
MBH30	Borehole	-31.72001	23.73701	-	-	-	-	-	-	-	-
MBH31	Borehole	-31.72006	23.73718	-	-	-	-	-	-	-	-
MBH32	Borehole	-31.70903	23.76198	64.00	7.30	-	-	-	-	Wind pump at wagon wheel	Yes
MBH33	Borehole	-31.75352	23.76489	-	189.00	7.60	-	9.72	-	-	Yes
MBH34	Borehole	-31.75367	23.76462	-	-	-	-	-	-	This borehole is a redrill	-
MBH35	Borehole	-31.75886	23.76562	-	207.00	7.60	-	5.00	-	Yield shown is extraction rate	-
MBH36	Borehole	-31.75909	23.76604	-	257.00	7.60	-	2.08	-	Yield shown is extraction rate	-
D1	Surface	-31.90534	23.89256	-	17.00	8.10	-	-	-	-	-
D2	Surface	-31.93629	23.90687	-	14.00	8.10	-	-	-	-	-

6.3 Groundwater Quality

During the present investigation seven (7) groundwater samples were collected from MBH7, MBH10, MBH13, MBH15, MBH22, MBH26 and MBH29, between 3 and 6 January 2023. The samples were collected from boreholes in the areas proposed for development of Solar facilities (**Table 7**). The samples have been classified according to the South African National Standard (SANS) 241-1: 2015 standards for domestic water, as a common point of reference. The limits and associated risks for domestic water as determined by the SANS 241:2015 are as follows, where:

- Health risks: parameters falling outside these limits may cause acute or chronic health problems in individuals.
- Aesthetic risks: parameters falling outside these limits indicate that water is visually, aromatically or palatably unacceptable.
- Operational risks: parameters falling outside these limits may indicate that operational procedures to ensure water quality standards are met may have failed.

Table 4 enables an evaluation of the water quality with regards to the various SANS241-1: 2015 limits. **Table 5** allows for evaluation of the water chemistry results according to DWAF drinking water assessment standards.

Table 4: Classification table for specific limits according to the SANS241-1: 2015 standard

Acute Health	Chronic Health	Aesthetic	Operational	Acceptable

Table 5: Classification table for the groundwater results as per DWAF (1998).

Blue	**(Class 0)**	**Ideal water quality** - suitable for lifetime use.
Green	**(Class I)**	**Good water quality** - suitable for use, rare instances of negative effects.
Yellow	**(Class II)**	**Marginal water quality** - conditionally acceptable. Negative effects may occur.
Red	**(Class III)**	**Poor water quality** - unsuitable for use without treatment. Chronic effects may occur.
Purple	**(Class IV)**	**Dangerous water quality** - totally unsuitable for use. Acute effects may occur.

The groundwater chemistry analysis results have been colour coded according to the SANS241-1: 2015 standard in **Table 6**, and according to the DWAF (1998) guideline in **Table 7**.

From the chemical results displayed in **Table 6** and **Table 7** several parameters were found to be elevated in the samples analysed:

- MBH 29 - Turbidity and hardness (as $CaCO_3$)
- MBH 26 - Turbidity, iron and hardness (as $CaCO_3$)
- MBH 22 - Turbidity, colour, calcium, sulphate, fluoride, manganese, iron, conductivity, total dissolved solids and hardness (as $CaCO_3$).
- MBH 15 - Colour, fluoride and hardness (as $CaCO_3$).
- MBH 13 - Turbidity.
- MBH 10 - Turbidity and hardness (as $CaCO_3$).
- MBH7 - Turbidity.

The laboratory analysis results of this study have been plotted on a tri-linear diagram known as a Piper diagram (**Figure 3**). This diagram indicates the distribution of cations and anions in separate triangles and then a combination of the chemistry in the central diamond. From the figure (central diamond) the samples are classified as having a **calcium-bicarbonate** hydrofacies with MBH 22 tending to the **calcium-sodium-chloride** hydrofacies.

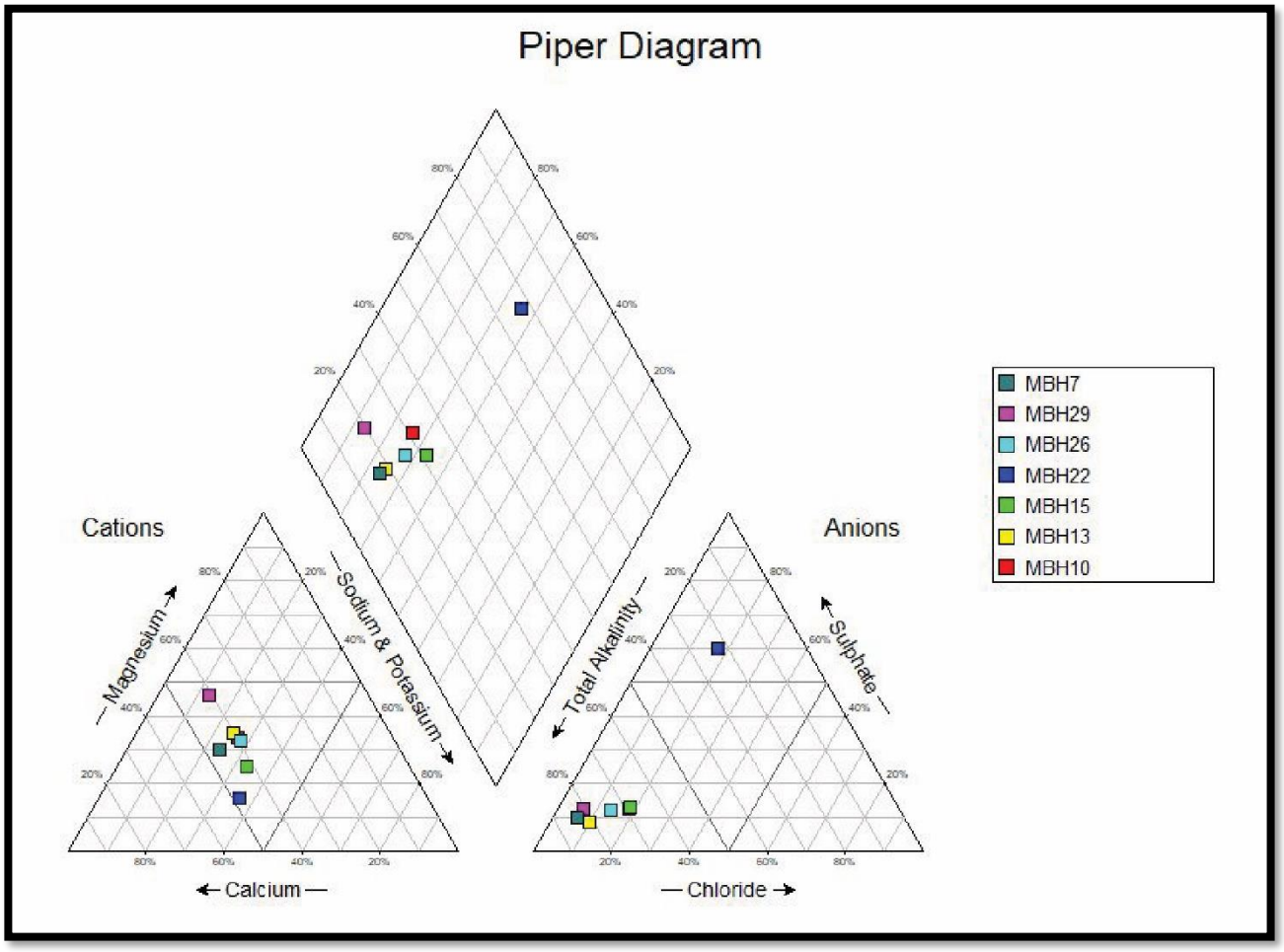


Figure 3: Piper diagram showing representative groundwater chemistry in the region.

The results were also plotted on Stiff Diagrams, which are graphical representations of the relative concentrations of the cations (positive ions) and anions (negative ions). This diagram shows concentrations of cations and anions relative to each other and direct reference can be made to specific salts in the water.

The shape of the Stiff plots below indicate that similar concentrations of major ions are present in the groundwater across the proposed Padloper Solar Cluster Footprint and surrounding areas (**Figure 4**). The water samples collected from the proposed Padloper Solar Cluster are notably elevated in bicarbonate (alkalinity) with calcium being the dominant cation (six of the seven samples). For the sample extracted from MBH 22, the dominant anion is sulphate with elevated concentrations of sodium-potassium and calcium cations.

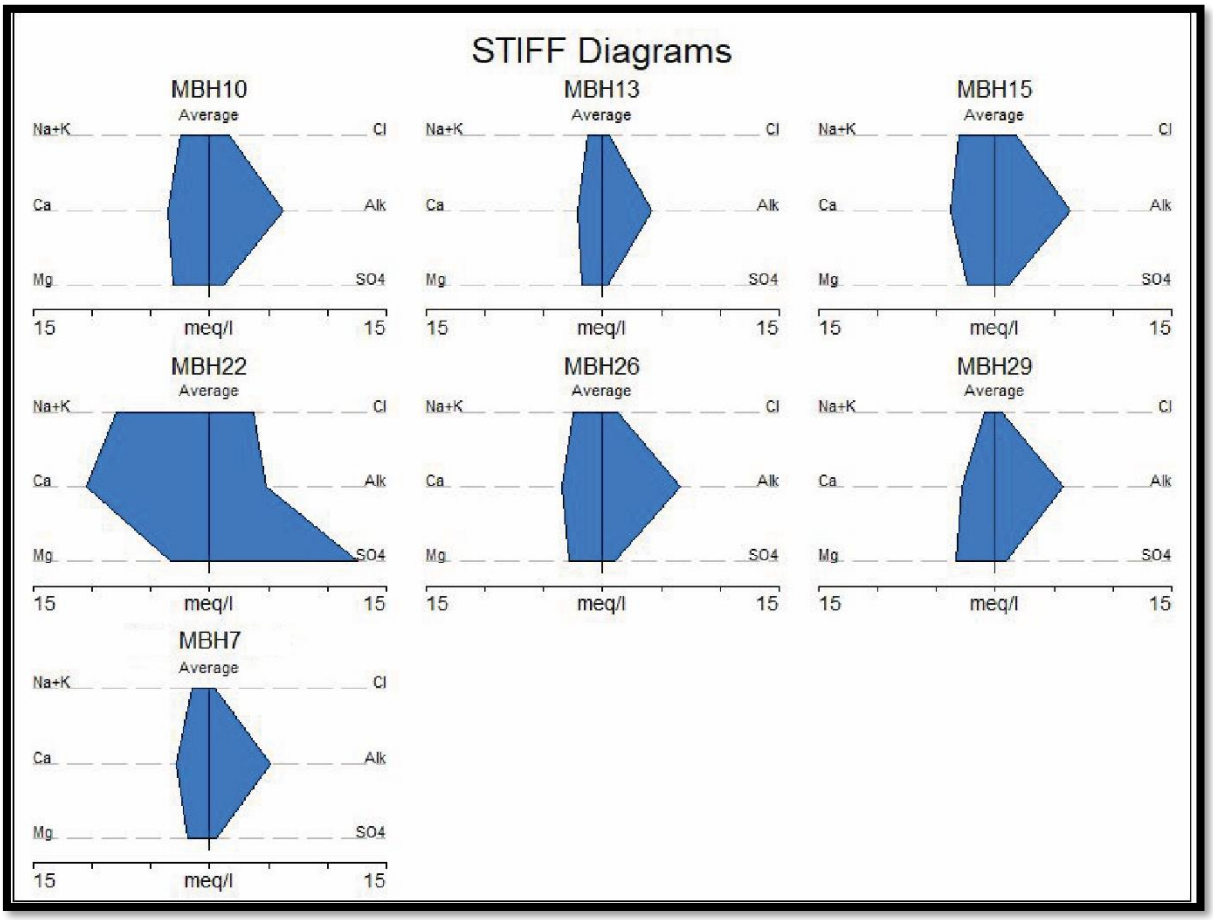


Figure 4: Stiff diagram showing representative groundwater chemistry in the region.

The stiff diagram of MBH 22, by comparison to the stiff plots for the remaining samples, is notably different. It is speculated that these variations relate to the different host lithologies of the groundwater namely quaternary sediments, fractured intrusive doleritic aquifers, and/or fractured sandstone, siltstone and shale aquifers of the Karoo Supergroup.

Table 6: Groundwater sample analysis results in relation to SANS 241-1: 2015 standard limits.

Analyses	**MBH29**	**MBH26**	**MBH22**	**MBH15**	**MBH13**	**MBH10**	**MBH7**	**SANS 241-1:2015**
pH (at 25 °C)	8.2	7.3	7.0	7.0	7.3	7.4	7.6	≥5 - ≤9.7 Operational
Conductivity (mS/m) (at 25 °C)	65.8	82.4	196.0	89.0	51.0	86.0	59.8	≤170 Aesthetic
Total Dissolved Solids (mg/L)	446.12	558.67	1328.88	603.42	345.78	583.08	405.44	≤1200 Aesthetic
Turbidity (NTU)	4.42	127.00	28.30	0.70	1.30	2.61	1.35	≤5 Aesthetic ≤1 Operational
Colour (mg/L as Pt)	<15	<15	44.00	32.00	19.00	<15	<15	≤15 Aesthetic
Sodium (mg/L as Na)	21	55	177	69	29	54	34	≤200 Aesthetic
Potassium (mg/L as K)	2	3	7	3	2	3	2	N/A
Magnesium (mg/L as Mg)	40	35	41	28	22	37	23	N/A
Calcium (mg/L as Ca)	58	69	209	76	42	72	58	N/A
Chloride (mg/L as Cl)	17.52	44.69	130.28	60.72	19.47	58.88	14.32	≤300 Aesthetic
Sulphate (mg/L as SO_4)	42.86	51.10	600.54	57.87	21.01	54.94	29.80	≤250 Aesthetic ≤500 Acute Health
Nitrate & Nitrite Nitrogen (mg/L as N)	1.09	<1.05	<1.05	2.22	2.06	2.94	2.07	≤12 Acute Health
Nitrate Nitrogen (mg/L as N)	1.09	<1.00	<1.00	2.22	2.06	2.94	2.07	≤11 Acute Health
Nitrite Nitrogen (mg/L as N)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	≤0.9 Acute Health
Ammonia Nitrogen (mg/L as N)	<0.15	<0.15	0.90	<0.15	<0.15	0.26	<0.15	≤1.5 Aesthetic
Total Alkalinity (mg/L as $CaCO_3$)	288.8	333.6	237.2	317.4	211.8	311.1	258.9	N/A
Total Hardness (mg/L as $CaCO_3$)	309.0	316.0	690.6	304.8	195.2	331.7	239.3	N/A
Fluoride (mg/L as F)	0.36	0.97	1.87	1.13	0.71	0.82	0.67	≤1.5 Chronic Health
Manganese (mg/L as Mn)	0.005	0.060	0.523	0.015	0.002	0.002	0.002	≤0.1 Aesthetic ≤0.4 Chronic Health
Iron (mg/L as Fe)	0.225	5.330	1.555	0.005	0.069	0.130	0.005	≤0.3 Aesthetic ≤2 Chronic Health
Copper (mg/L as Cu)	0.006	0.004	0.006	0.004	0.003	0.006	0.016	≤2 Chronic Health
Zinc (mg/L as Zn)	<0.008	<0.008	0.013	<0.008	0.072	0.057	0.045	≤5 Aesthetic
Charge balance %	0.0	-0.1	1.9	-0.5	0.0	0.2	0.9	≥-5 - ≤5 Acceptable

Table 7: Classified borehole results in relation to DWAF 1998 parameter limits.

Sample Marked :	**MBH 29**	**MBH26**	**MBH22**	**MBH15**	**MBH13**	**MBH10**	**MBH7**	**DWA (1998) Drinking Water Assessment Guide**				
								Class 0	**Class I**	**Class II**	**Class III**	**Class IV**
pH	8.2	7.3	7.0	7.0	7.3	7.4	7.6	5-9.5	4.5-5 & 9.5-10	4-4.5 & 10-10.5	3-4 & 10.5-11	< 3 & >11
Conductivity (mS/m)	65.8	82.4	196.0	89.0	51.0	86.0	59.8	<70	70-150	150-370	370-520	>520
Turbidity (NTU)	4.42	127.00	28.30	0.70	1.30	2.61	1.35	<0.1	0.1-1	1.0-20	20-50	>50
	mg/L											
Total Dissolved Solids	446.12	558.67	1328.88	603.42	345.78	583.08	405.44	<450	450-1000	1000-2400	2400-3400	>3400
Sodium (as Na)	21	55	177	69	29	54	34	<100	100-200	200-400	400-1000	>1000
Potassium (as K)	2	3	7	3	2	3	2	<25	25-50	50-100	100-500	>500
Magnesium (as Mg)	40	35	41	28	22	37	23	<70	70-100	100-200	200-400	>400
Calcium (as Ca)	58	69	209	76	42	72	58	<80	80-150	150-300	>300	
Chloride (as Cl)	17.52	44.69	130.28	60.72	19.47	58.88	14.32	<100	100-200	200-600	600-1200	>1200
Sulphate (as SO_4)	42.86	51.10	600.54	57.87	21.01	54.94	29.80	<200	200-400	400-600	600-1000	>1000
Nitrate& Nitrite (as N)	1.09	<1.05	<1.05	2.22	2.06	2.94	2.07	<6	6.0-10	10.0-20	20-40	>40
Fluoride (as F)	0.36	0.97	1.87	1.13	0.71	0.82	0.67	<0.7	0.7-1.0	1.0-1.5	1.5-3.5	>3.5
Manganese (as Mn)	0.005	0.060	0.523	0.015	0.002	0.002	0.002	<0.1	0.1-0.4	0.4-4	4.0-10.0	>10
Iron (as Fe)	0.225	5.330	1.555	0.005	0.069	0.130	0.005	<0.5	0.5-1.0	1.0-5.0	5.0-10.0	>10
Copper (as Cu)	0.006	0.004	0.006	0.004	0.003	0.006	0.016	<1	1-1.3	1.3-2	2.0-15	>15
Zinc (as Zn)	<0.008	<0.008	0.013	<0.008	0.072	0.057	0.045	<20	>20			
Hardness (as $CaCO_3$)	309.000	316.00	690.60	304.80	195.20	331.70	239.30	<200	200-300	300-600	>600	
	counts/100 mL											
Charge Balance %	0.0	-0.1	1.9	-0.5	0.0	0.2	0.9	≥-5 - ≤5 Acceptable				

6.4 Groundwater Flow Direction

Groundwater level data was obtained from the field hydrocensus and other available information used to generate a groundwater level contour map to evaluate groundwater flow direction. Bayesian interpolation was used, making use of surface topography. The groundwater generally flows westward towards the Snyderskraal River (**Map 6**).

In order to evaluate the relationship between groundwater levels and topography, and the applicability of the interpolation technique, the surface elevations and water table elevations are plotted relative to each other. The data is presented in **Figure 5**, and indicates a 98.82% correlation between surface topography and water level elevation. Bayesian interpolation is considered an acceptable interpolation technique.

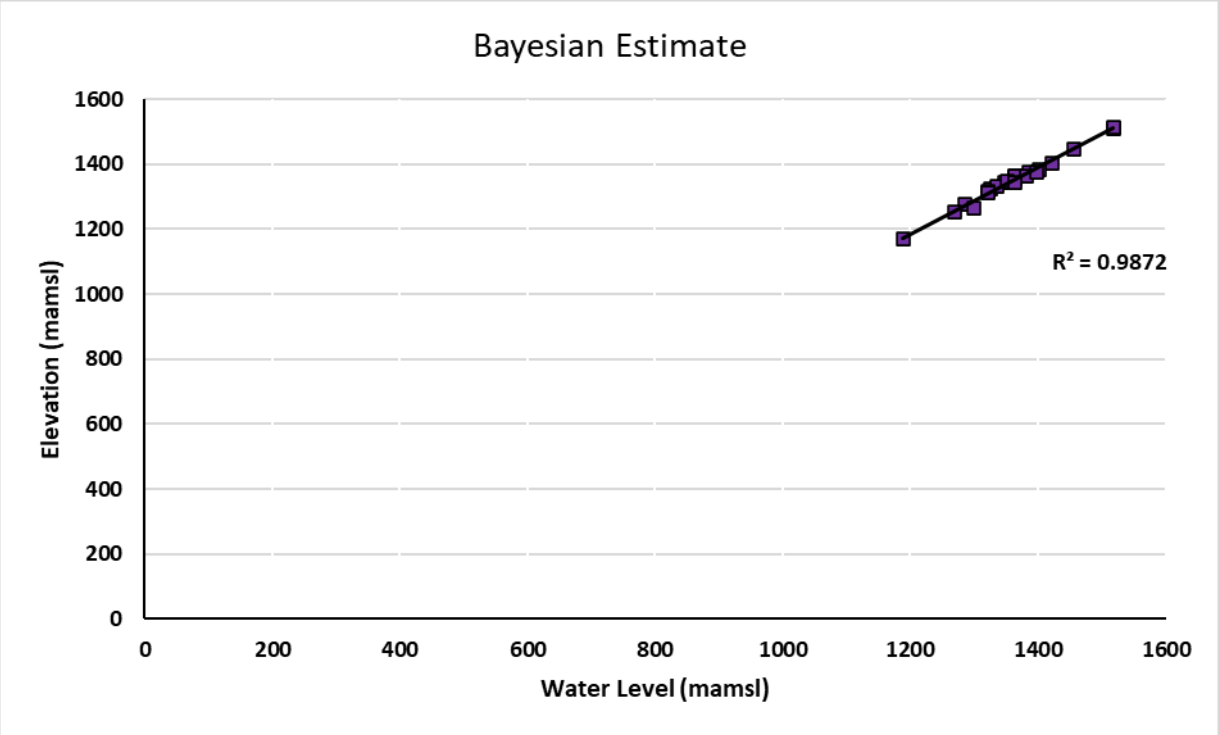
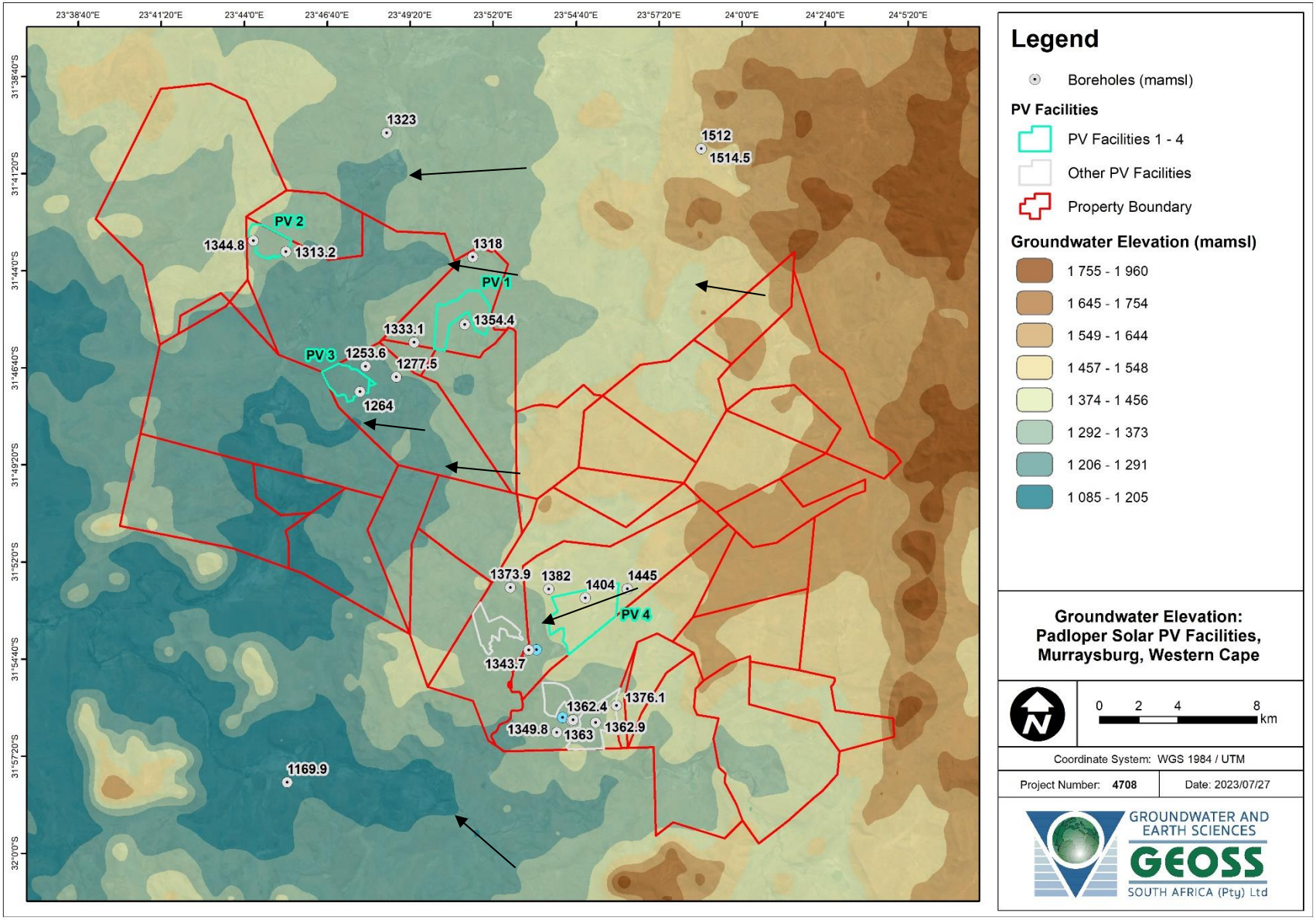


Figure 5: Correlation between surface topography and groundwater elevation for boreholes proximal within study area.



Map 6: Study area showing farm and Solar PV development boundaries in relation to groundwater elevation (mamsl). Note this report is focussed on Padloper Solar Facilities 1- 4.

7. LEGISLATION AND PERMIT REQUIREMENTS

The National Water Act (1998) is administered by the Department of Water and Sanitation (DWS) and is the main legislation for managing water resources in South Africa. The purpose of the National Water Act is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

The proposed Padloper Solar PV Development Cluster boundary spans across two quaternary catchments, namely L21C and L21E. The proposed Padloper Solar Cluster 1 – 3 is located in catchment area L21C while catchment area L21E will contain Padloper Solar Cluster 4 – 7. This proposed Padloper Solar Cluster falls under the Mzimvubu-Tsitsikamma Management Area (DWS, 2016). The groundwater General Authorisation (GA) for these catchments is 45 m^3/ha/a. This means that in these catchments, 45 m^3 of water can be abstracted per year for every hectare, under the GA. For example, a 100 ha property/farm could be abstracting a maximum of 4 500 (45 x 100) m^3/a under the GA use. The GA volume is also capped at 40 000 m^3/a per property, i.e. properties larger than 889 ha would be allocated 40 000 m^3/a. This would mean that a property with the extent of 20 000 ha, as an example, would still only be allowed to abstract 40 000 m^3/a under the GA. If larger volumes are needed, a WUL will have to be applied for.

We understand that the water requirement for Padloper Solar PV Facilities 1 to 4 is 140 000 m3/a (4.44 L/s) during the Construction Phase, and 36 000 m3/a (1.14 L/s) during the Operational Phase. Since the cumulative area for the farm portions across which these facilities are to be constructed is 14 353.71 ha the cumulative allowable abstraction under a General Authorisation (GA) for the combined areas is 5.07 L/s. Therefore, if the project is planned appropriately with regards to groundwater use, all the water demand can be met by means of groundwater, with the use being Generally Authorised. Registration of the usage in terms of the GA with DWS would be required.

Table 8: General Authorisation Threshold and Water demands per Proposed Padloper Solar Facilities.

Farm Portion	Padloper Solar Facility	Generation Capacity (MW)	Area (ha)	General Authorisation Water Use Threshold			Water Demands			
				GA (m3/ha/a)	m3/a	L/s	Construction (m3/a)	Operation (m3/a)	Construction (L/s)	Operation (m3/a)
7/109	1	250	1 942.20	45	40 000	1.27	50000	12000	1.59	0.38
9	2	150	5 102.54	45	40 000	1.27	30000	8000	0.95	0.25
1/109	3	150	3 236.64	45	40 000	1.27	30000	8000	0.95	0.25
2/26	4	150	4 072.33	45	40 000	1.27	30000	8000	0.95	0.25
Total		700	14 353.71	-	160 000	5.07	140 000	36 000	4.44	1.14

8. SCENARIO 1: EXISTING BOREHOLES

There are several existing boreholes that could potentially be utilised for groundwater abstraction to meet the required volumes for construction. An overview of the potential groundwater supply from existing boreholes for the respective Solar Facilities is given in Table 9. A summary of the information collected during the hydrocensus for at the boreholes shown in Table 9 is given in Table 10. This summary of the relevant boreholes provides an indication of the local water quality in the area of Padloper Solar Facilties 1 - 4.

Table 9: Existing boreholes to potentially meet demands for Padloper Solar PV Facilities.

Padloper Solar Facility Number	Farm Portion/ Number	Borehole(s)	Approximate distance from development (km)	Comment
1	7/109	MBH15	0.6	
		MBH16	within	
		MBH17	within	
		MBH18	1.0	
		MBH19	1.7	
2	11	MBH28	within	
		MBH29	within	
		MBH30	0.1	
		MBH31	0.1	
	1/8	MBH32	1.0	
3	1/109	MBH1	1.2	
		MBH2	1.3	
		MBH3	0.4	
		MBH5	within	
		MBH6	2.1	
		MBH7	2.1	
		MBH8	2.1	
		MBH4	within	
	11	MBH34 to MBH36	2.4 – 3.0	
	RE/10	MBH9	0.1	
4	2/26	MBH10	within	
		MBH11 MBH12	0.5 0.5	PV5 is to be constructed on this farm portion. Could potentially supplement supply.

General – comments that be given consideration to meet water demands.

Table 10: Summary statistics of field data collected during hydrocensus of boreholes pertinent to the Padloper Solar Facilities 1 - 4.

	WL (mbgl)	EC (mS/m)	pH	Depth (m)	Yield (L/s)
Minimum	1.00	44.00	7.10	30.00	16.67
Maximum	21.90	89.00	8.40	50.00	16.67
Average	10.13	69.50	7.48	37.50	16.67
Standard deviation	8.90	16.32	0.39	9.57	-
Variance	79.20	266.50	0.15	91.67	-
Number of observations	8	10	10	5	1

It is anticipated that the existing boreholes will require some upgrading to meet the water demands of each of the respective Solar PV facilities and that at least two (2) boreholes situated on two (2) different farm portions will be required to meet the demand of each of the solar farms. Further, reservoirs will likely be required to store the water.

Based on the hydrocensus results, an overview of boreholes that could potentially be used is provided in **Table 9**. It is important to stress that the GA volume is capped at 40 000 m^3/a (1.27 L/s) per farm portion. The water requirements of the solar PV facilities vary; for this reason, potential groundwater resource requirement explanations have been divided in the subsequent sections.

8.1 General

We understand that the water requirements for each of the facilities are variable depending on the scale/extent/generation capacity of the Facility (**Table 8**).

8.2 Padloper Solar PV Facilities 5 to 7 water requirements

We understand that the cumulative water requirement for Padloper Solar Facilities 1 to 4 is 140 000 m3/a (4.44 L/s) during the Construction Phase, and 36 000 m3/a (1.14 L/s) during the Operational Phase. Since the cumulative area for the farm portions across which these facilities are to be constructed is 14 353.71 ha the cumulative allowable abstraction under a General Authorisation (GA) for the combined areas is 5.07 L/s (**Table 8**).

It is important to mention that the planned water consumption for Padloper Solar Facility 1 is 50 000 m3/a (1.59 L/s) during the construction phase, but the GA rates for the farm portion (7/109) on which this facility is to be constructed is 40 000 m3/a (1.27 L/s) (**Table 8**). To supply this volume of water annually from this farm portion alone, a water use license will be required. On the other hand, this facility only requires 12 000 m3/a (0.38 L/s) during the operational phase. For ease of reference, it should be noted that GA volumes refer to abstraction volumes which are generally authorised by DWS and a water use license (WUL) is not required for abstraction.
Padloper Solar Facilities 2, 3 and 4; on the other hand, require 30 000 m3/a (0.95 L/s) during the construction phase, and 8 000 m3/a (0.25 L/s) during the operational phase, both of these demands are well below the abstraction rates that are generally authorised for this area (**Table 8**

Therefore, only a General Authorisation water use is required for this rate of groundwater to be abstracted from these farm portions.

In this region, most boreholes are equipped with wind pumps, which deliver yields of between 0.1 and 0.25 L/s depending on the size of the rotor, the local wind rose, and the depth of the pump (and water table). For a borehole to supply 10 000 m3/a it will need to deliver 0.32 L/s, 24 hours per day, year-round. For a borehole to supply 5 000 m3/a it will need to deliver 0.16 L/s, 24 hours per day, year-round.

8.3 General remarks

Boreholes that could potentially be used to meet the water requirements are presented in **Table 9**. The following will need to be considered when only making use of existing boreholes for water supply for each of the Padloper Solar Facilities:

- A maximum of either 45/m^3/ha/a, or 40 000 m^3/a (for farms larger than 889 ha) can be abstracted from a single farm portion in terms of the GA. The relevant conditions for use in terms of the GA would need to be met. Where water demands exceed the GA, or where the use falls outside the ambit of the GA, use on other farm portions will be required to meet the demand, or a WULA will be required.
- Boreholes on neighbouring properties may be several kilometres away from the proposed development (**Table 9**). This would either require carting of water, or development of pipelines for transport of water. Further, water storage may be required in this case.
- The majority of the boreholes in this region are equipped with windpumps and Solar PV pumps which deliver between 0.1 L/s and 0.25 L/s depending on the size of the rotor, the climate (windrose/cloud cover) and the depth of the pump (and water table). To meet the demands, upgrades to such windpumps and/or Solar PV pumps may be required.
- Boreholes that are selected for supply will need to scientifically yield tested according to relevant standards to ensure that the supply can be sustainably met by the borehole.
- Boreholes may need to be deepened, or additional boreholes may need to be drilled.
- Permissions and access would need to be provided.

9. SCENARIO 2: NEW BOREHOLES

An alternative to the utilisation of existing boreholes, is the development of additional groundwater supply. Accordingly, GEOSS sought to identify potential Areas of Interest (AOI) that can be targeted for groundwater development. The delineation of AOIs has been based on identified geologic structures that may potentially control groundwater flow, which in this area, consist mainly of dolerite dykes, contacts between different geological units, and potentially fractured units. The identification of dolerite dykes has been based on published geological maps of the area, interpretation of the available aerial imagery, as well as basic geological mapping and ground truthing during the site visit. GEOSS made use of available Google Earth imagery and ESRI Imagery (sourced from Cape Farm Mapper) of the area. In this section, all the identified dykes, and discontinuities, coupled with areas of interest for the Padloper Solar PV Facilities have been presented and are discussed.

Several observations that may be helpful during exploration have been made including the identification of several lineaments, potential discontinuities which have been delineated based on the aerial imagery. Where these are abundant, pervasive, and/or intersect has been delineated as an Area of Interest (AOI) (**Map 7**). For ease of reference, general descriptions of the AOI locations with reference to each Solar PV Facility and proximal farm portions for the respective Solar PV Facilities are presented below:

Solar PV Facility 1:

- Approximately 1 km from the western boundary of Farm 7/109.
- About 500 m from the northern boundary on Farm 7/109.
- Approximately 500 m northwest of the Solar PV facility boundary on Farm 7/109.

Solar PV Facility 2:

- Two areas have been delineated that are relevant for this Solar PV Facility, one in the central portion of the Solar PV Facility, and another in the south-western portion of the site on Riet Poort 9.

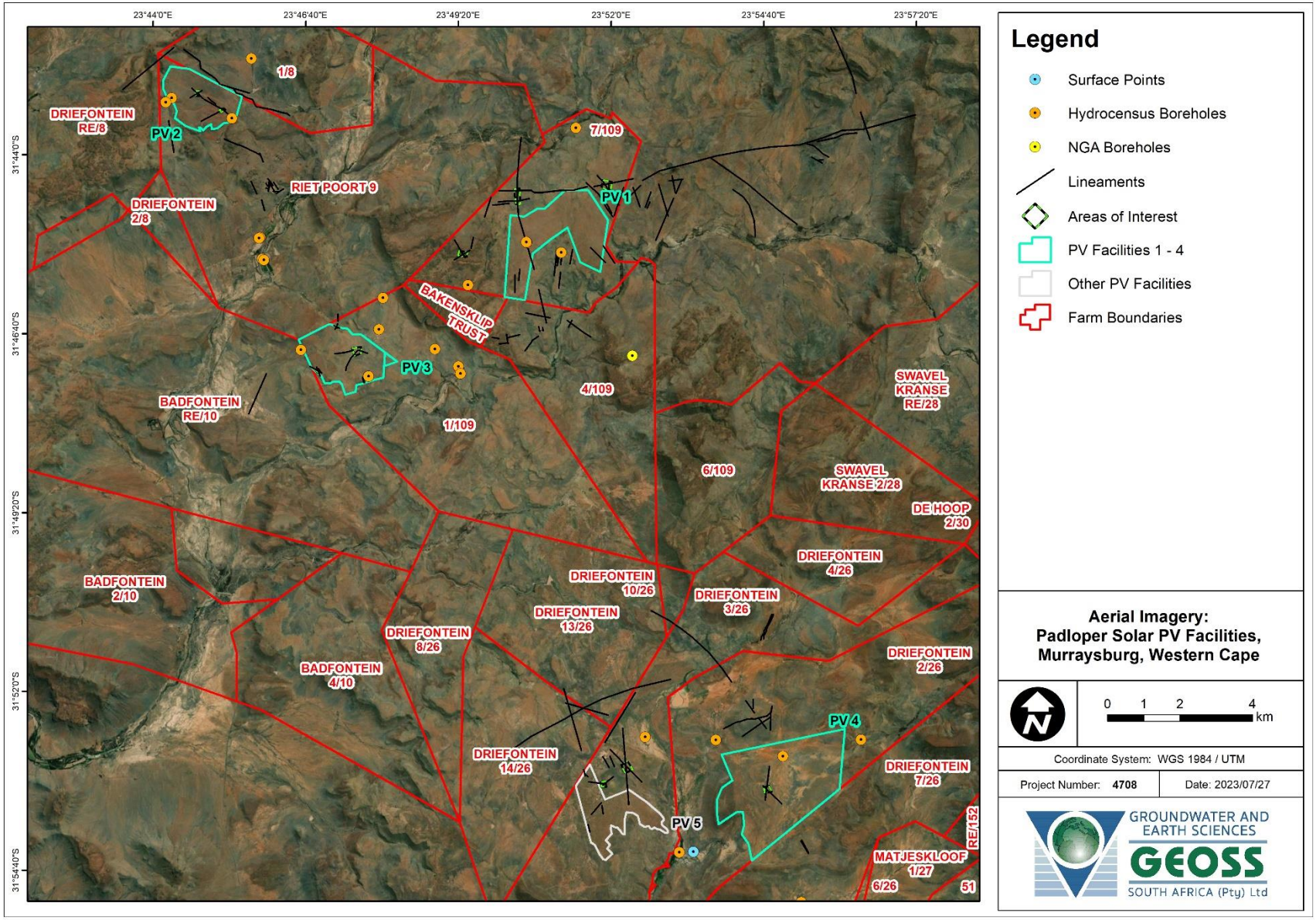
Solar PV Facility 3:

- Along the western boundaries of Padloper Solar PV3 (and Farm 1/109).
- Within a portion of Padloper Solar Facility PV3 (within Farm 1/109).
- On/near the northern boundaries of Padloper Solar PV3 (and Farm 1/109).

Solar PV Facility 4:

- One area of interest has been delineated in the central region of the site.

It is recommended that these areas be further explored for groundwater development, e.g. using geophysical methods and ground truthing and/or detailed field lithological mapping.



Map 7: Arial Imagery showing farm and solar development boundaries in relation to lineaments and Areas of Interest (AOIs). Note this report is focussed on Padloper Solar Facilities 1 - 4.

10. SCENARIO 3: COMBINATION OF SENARIO 1 AND SENARIO 2

Finally, a third option to consider is to make use of a combination of existing boreholes and drilling new boreholes for further groundwater development. This scenario will depend on the following:

- Whether permission is granted by land/farm owner to make use of the existing boreholes on their properties.
- The volumes that could sustainably be abstracted from the relevant boreholes, this would need to be proven by scientific yield testing according to relevant standards.
- The volumes that are currently being used by the farmer while bearing in mind permissible abstraction in terms of the GA.
- Successful borehole drilling, i.e. intersection of groundwater with a reasonable quality and sufficient sustainable yield, which could supplement any shortfall required on the remaining nearby Padloper Solar PV Facilities.

Groundwater quality will be a further factor in determining which boreholes are considered most appropriate for supply.

11. POTENTIAL IMPACTS

11.1 Groundwater impact as a result of groundwater abstraction.

Presently, these boreholes are solely used for livestock watering and domestic use, the impact of which is minimal in terms of groundwater abstraction. The cumulative peak (construction) water demands of Padloper Solar PV facilities 1 to 4 (140 000 m3/a) is lower than the GA abstraction rates for the area (160 000 m3/a) (**Table 8**). It is believed that the impact on the groundwater availability of this facility is low/insignificant, since there is likely a similar/lower cumulative volume presently being extracted. It is anticipated that several boreholes across each of the farm portions on which Padloper Solar Facilities 1 to 4 are to be constructed will be required to meet the demands for construction and operation of the facilities.

Groundwater monitoring is recommended to ensure that groundwater abstraction is sustainable due to the high number of existing boreholes in the area. This would also be required to ensure that the abstraction volume is kept under the calculated GA volume per annum for the development of the proposed Padloper Solar Facilities, should the water be used under a General Authorisation water use.

The monitoring will also indicate if the groundwater resource is impacted and mitigation measures can be instituted before long term impacts occur. Mitigation for over-abstraction would be reduction in abstraction and implementation of any saving techniques where possible. It is therefore improbable that the groundwater resource will be depleted as a result of over abstraction, should a quarterly monitoring programme be instated.
Broadly, the quarterly monitoring programme should include the following:

1. Monitoring of abstracted volumes, this would allow for the determination of the cumulative abstraction across each of the Farm portions and boreholes to be made. This can be achieved using flow meters.
2. Monitoring of groundwater levels, to evaluate the response of groundwater abstraction on the water table. This was be conducted manually or using telemetry systems.
3. Monitoring of general field chemistry, e.g. pH, EC and temperature. However, during the construction period, the analysis and sample collection should include SANS 241 analysis for one year before and after the construction period – if the project schedule allows.

The final monitoring programme should be guided by a hydrogeologist.

11.2 Aquifer vulnerability classification (DRASTIC)

The national scale groundwater vulnerability map, which was developed according to the DRASTIC methodology (DWAF, 2005), indicates that the site has a "Low / Medium" vulnerability to surface-based contaminants (Conrad and Munch, 2007) (**Map 8**).

The DRASTIC method considers the following factors:

D = depth to groundwater (5)
R = recharge (4)
A = aquifer media (3)
S = soil type (2)
T = topography (1)
I = impact of the vadose zone (5)
C = conductivity (hydraulic) (3)

The number indicated in parenthesis at the end of each factor description is the weighting or relative importance of that factor. The "Low / Medium" rating is associated with, amongst other factors, the depth to the water table, the geology/soil type(s) in the area, the amount of recharge and the topography in this region.

11.3 Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages

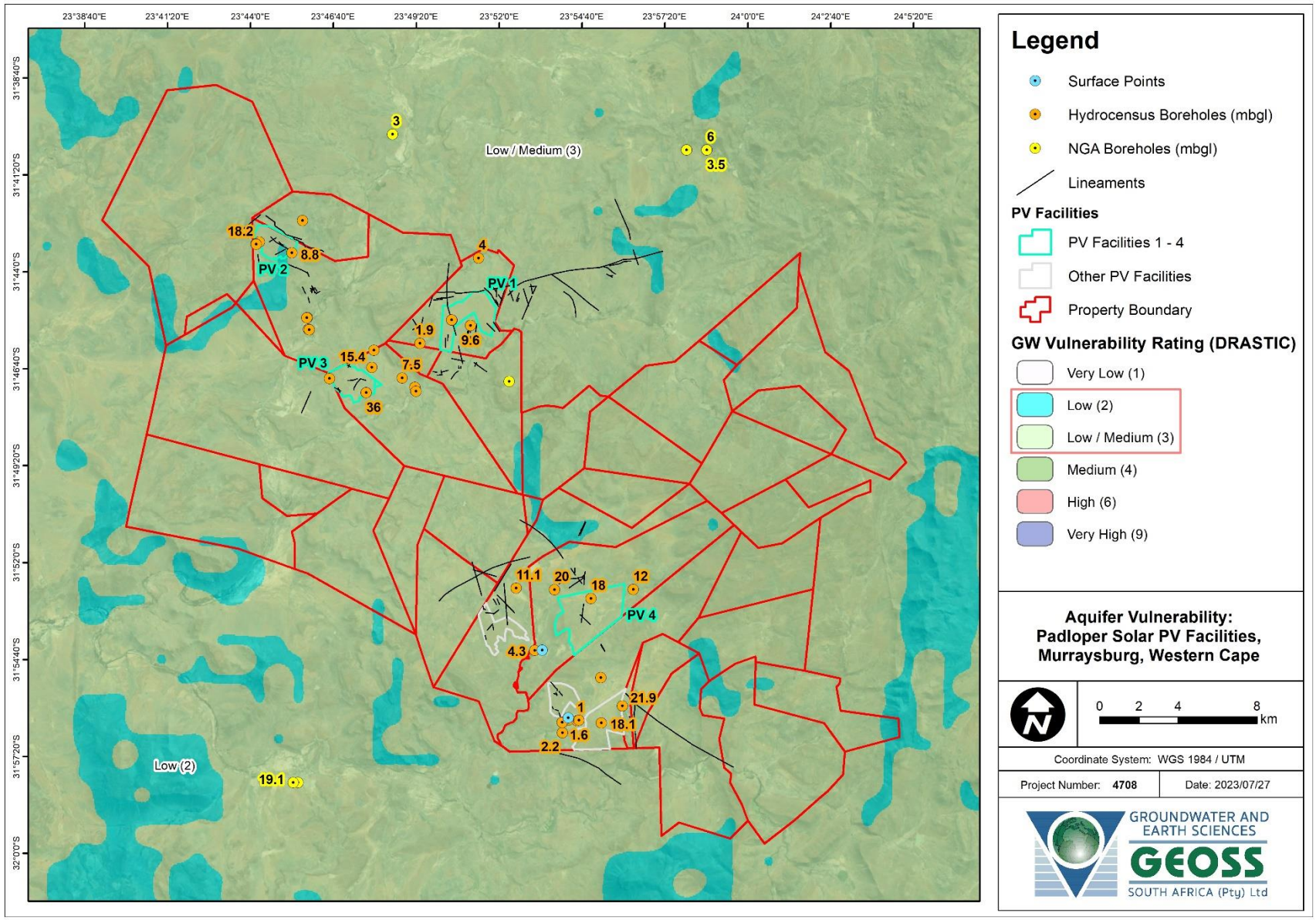
Groundwater vulnerability can be defined as the "tendency for contaminants to reach a specified position in the groundwater system after introduction at some location" (National Research Council, 1993). The national scale groundwater vulnerability map, which was developed according to the DRASTIC[§§] methodology (Conrad and Munch, 2007) indicates that that Padloper Solar Facilities 5 to 7 has a low/medium vulnerability to surface-based contaminants (**Map 8**).

A precautionary approach must be implemented and reasonable measures must be undertaken to prevent oil spillages and fuel leakages from occurring during the construction phase:

1. Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. A designated area should be established at the construction site camp for this purpose.
2. Any engines that stand in one place for an excessive length of time must have drip trays.
3. Diesel fuel storage tanks should be above ground on an impermeable concrete surface in a bunded area.
4. Construction vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refuelling is not possible.
5. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported.
6. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.

Further, biodegradable cleaning agents should be selected for cleaning Solar PV panels. With effective implementation of the above prevention / mitigation actions, the impact of the project on groundwater as a consequence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

[§§] DRASTIC is a model that considers the main hydrological and geological factors with a potential impact on aquifer pollution. Its acronym stands for D—depth to groundwater, R—recharge rate, A—aquifer, S—soil, T—topography, I—vadose zone's impact, and C—aquifer's hydraulic conductivity



Map 8: Vulnerability rating superimposed on aerial imagery showing borehole locations and associated depths to groundwater (Conrad and Munch, 2007). Note this report is focussed on Padloper Solar Facilities 1 - 4.

11.4 Cumulative Impacts

The water requirements for the construction and operational phases of the proposed Padloper Solar Cluster is listed in **Section 7**. The following cumulative impacts of the proposed Padloper Solar Cluster are considered:

- Groundwater Availability:
    - Potential risk of over abstraction in the area exists; however, the cumulatively proposed Padloper Solar Cluster demands 220 000 m^3/a during the Construction Phase, and 57 000 m^3/a during the Operational Phase. The total extent of the proposed Padloper Solar Cluster is 22 309.95 ha and the total amount of groundwater that can be abstracted for such an extent (in this region) under a GA water use is 240 000 m^3/a. Since the cumulative demand of the development is lower than the amount available under a GA water use, the impact on groundwater availability of the proposed Padloper Solar Cluster is anticipated to be low and very low under the Construction and Operational phases, respectively.
    - Boreholes used for groundwater supply will need to be scientifically yield tested to ensure abstraction of groundwater is sustainable.
    - Provided appropriate mitigation measures (e.g. water saving techniques) are in place during all phases of the proposed development, the impact on groundwater quality is anticipated to be low to negligible.
    - An appropriate groundwater monitoring program (i.e. abstraction volumes, chemistry, and water levels) will need to be instated to ensure proper management and protection of the groundwater resources locally and minimise potential impacts on neighbouring properties.
    - If and when details of other developments are planned for the region, this impact assessment will need to be required based on the neighbouring facilities groundwater demands. Further, if the water/groundwater demands of the proposed development changes, the assessment will need to be revised.
- Groundwater Quality:
    - Potential risk of groundwater contamination exists during all phases of the development.
    - The cumulative impacts of the proposed development on the groundwater resources in the area is anticipated to be low, particularly if an appropriate groundwater monitoring program is established (with chemical sampling at appropriate time intervals, e.g. quarterly/biannually) to ensure little to no groundwater contamination is taking place. The cumulative impacts of the proposed development could be reduced by implementing mitigation measures which mainly involve physical barriers between contaminant sources and the bare soil surface, e.g. drip trays beneath vehicles, and/or making use of biodegradable cleaning agents when cleaning Solar PV panels.

Chemical contamination of the soils, rocks and groundwater beneath the sites that have been proposed for development also pose risk to the environment albeit low. However, it is advised that (chemical) groundwater monitoring be conducted on at least a quarterly basis as precaution for

contamination during the construction phase and for a year following. It would be prudent to consider the implementation of a quarterly monitoring programme, ideally initiated at least one year prior to the commencement of construction if the project timeframes permit. This would serve to confirm the baseline water levels throughout one wet and dry season cycle, as well as confirm the baseline water quality. Monitoring would also ensure that the extracted volumes comply with relevant authorised abstraction volumes. Temporal water level, water quality and abstraction data should be collected. These data should be reviewed and interpreted on at least a quarterly basis.

The amount and use of water during decommissioning phases of each solar farm, at this stage, is uncertain. Decommissioning will likely require the usage of heavy machinery and other equipment; therefore, precaution should be taken for spilling of hydrocarbons and contamination related to the operation of this equipment (similar measures to those listed in prior sections). It is recommended that monitoring of groundwater quality, water levels, and abstraction volumes be implemented during this phase. The monitoring interval would depend on the works to be undertaken and the stipulated time-frame in which the works would have to take place.

This assessment (and similar assessments in the area) would need to be reviewed if and when final water requirements for the area become available, e.g. if additional water is required for additional/new developments in the region, or if water requirements for any of the facilities change.

12. RECOMMENDATIONS

The following recommendations are made:

- The groundwater supply can be sourced from either existing boreholes, newly developed boreholes, or a combination of these options.
- The legal status of groundwater use at each property should be confirmed. This will inform the need for future water use authorisations.
- It is anticipated that several boreholes across each of the farm portions on which Padloper Solar Facilities 1 to 4 are to be constructed will be required to meet the demands for construction and operation of the facilities.
- The planned water demand for Padloper Solar PV Facility 1 is 50 000 m^3/a (1.59 L/s) during the construction phase, but the GA volumes for the farm portion (7/109) on which this facility is to be constructed is 40 000 m^3/a (1.27 L/s). A water use license (WUL) will be required to supply groundwater at this rate (1.59 L/s) (if such groundwater resources are scientifically proven to be sustainable from this property) on this property. Alternatively, the water demand could potentially be divided across Farm (7/109) and a neighbouring property to negate the need for a WUL.
- Every effort should be made to visit all boreholes and undertake yield and quality tests at boreholes that could be considered for future supply (based on their relative proximity). The information obtained from the NGA database would be a useful starting point in determining which of the boreholes should be tested for their yields. Further, the relative sizes, GA volumes/abstraction rates (and cap volumes/rates) of the respective farm portions should also be considered when planning scientific yield testing.

- Groundwater exploration via geological and geophysical methods is recommended for all of the proposed solar farms, should existing boreholes not be sufficient to meet the demand. Groundwater exploration aims to understand the geological environment, which can increase the chance of borehole success, and provide more realistic yields and depths of a borehole to be drilled, which could be expected.
- All boreholes planned for use will require scientific yield and quality testing and analysis.
- Monitoring of groundwater (abstraction volumes, quality and water levels) will be required, this should ideally be implemented one year prior to the start of construction if the project timeframes permit.

13. CONCLUSION

There are multiple sources and scenarios that the water demands of the proposed Padloper Solar PV Facilities 1 to 4. This could be achieved through utilising existing boreholes only which are close to existing and planned infrastructure. The use of existing boreholes will depend on a number of factors such as scientifically proven sustainable yields of the boreholes, existing use and authorisation of the farmer, as well as whether the farmer would engage in an agreement for the solar farms to make use of his boreholes. It is anticipated that the bulk of the requisite 140 000 m3/a and 36 000 m3/a (for construction and operational phases, respectively) could be sourced from existing boreholes. However, this would depend on cost and logistics and supply available from each borehole

An additional option would be to drill new boreholes. This can be achieved by conducting a geological and geophysical study to confirm lineaments (dykes) visible on aerial imagery followed by drilling and scientific yield and quality testing. The region shows promise for further groundwater development; however, this will need to be confirmed by groundwater exploration, drilling and testing.

The third and final scenario entails a combination of the above-mentioned options, i.e., making use of existing borehole and drilling of new boreholes.

It must be stressed that the GA limit of 40 000 m^3 applies to each farm portion larger than 889 hectares and this should be adhered to – should the application for a water use license not be an option. All conditions of groundwater use in terms of the general authorisation will be applicable and important to consider. This can be guided by a professional with knowledge of the National Water Act ensuring that the water used, during construction and operation of the solar farms, is lawful.

In general, it is anticipated that the underlying aquifers will be able to deliver the requisite cumulative demands during the construction (220 000 m^3/a) and operational (57 000 m^3/a) phases, for each of the proposed Padloper Solar PV Development Cluster, i.e., Padloper Solar PV Facility 1 to 7. The impact of the proposed Padloper Solar PV Facility Facilities 5 to 7 is anticipated to be low in terms of groundwater quality and groundwater availability.

Further, the cumulative water demands of the proposed Padloper Solar PV Development are anticipated to be low in terms of groundwater availability and quality. However, the needs of the neighbouring developments and farm owners/ landowners will also need to be established to ensure sustainable groundwater abstraction.

Instatement of an appropriate groundwater monitoring plan is paramount to ensure sustainable and responsible management of the groundwater reserves in the region. That being said, a quarterly groundwater monitoring programme should be instated to ensure that no groundwater contamination takes place during the construction or decommissioning phases of this

development. Further, monitoring would serve to ensure that the water use is lawful, and confirm that impacts of abstraction on the regional aquifer(s) is negligible. Therefore, these recommendations are considered imperative.

14. REFERENCES

CGS (1989). The 1:250 000 geological map series. Council for Geoscience. Map number: 3122 Victoria West.

DWAF (1998). Revision of General Authorisations in Terms of Section 39 of the National Water Act, (Act no. 36 OF 1998). Government Gazette 36820, notice 665.

DWAF (2002). The hydrogeological map series of the republic of South Africa. Beaufort West, 3122. Scale: 1:500 000.

DWAF (2005). Groundwater Resource Assessment Phase II (GRA II). Department of Water Affair and Forestry. Pretoria.

DWS (2016). National Water Act, 1998: New nine (9) water management areas of South Africa. (Notice 1056). *Government Gazette, 40279: 169, 16 September.*

Freeze, R.A., and Cherry, J.A., (1979), Groundwater: Englewood Cliffs, NJ, Prentice-Hall.

National Water Act (1998). The National Water Act, No 36. Department of Water Affair and Forestry. Pretoria.

National Research Council, 1993, Ground water vulnerability assessment, contamination potential under conditions of uncertainty: National Academy Press, Washington, D.C., 210 p. Accessed December 2000 at URL http://books.nap.edu/books/0309047994/html.

WRC, 2012. A Groundwater Planning Toolkit for the Main Karoo Basin: Identifying and quantifying groundwater development options incorporating the concept of wellfield yields and aquifer firm yields. WRC Report No. 1763/1/11, Pretoria, South Africa.

15. APPENDIX A: BOREHOLE PHOTOS

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH1	-31.78094	23.81610	
MBH2	-31.76833	23.80087	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH3	-31.77616	23.79971	
MBH4	-31.78782	23.79678	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH5	-31.78781	23.79679	
MBH6	-31.78684	23.82339	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH7	-31.78522	23.82297	
MBH8	-31.78696	23.82360	

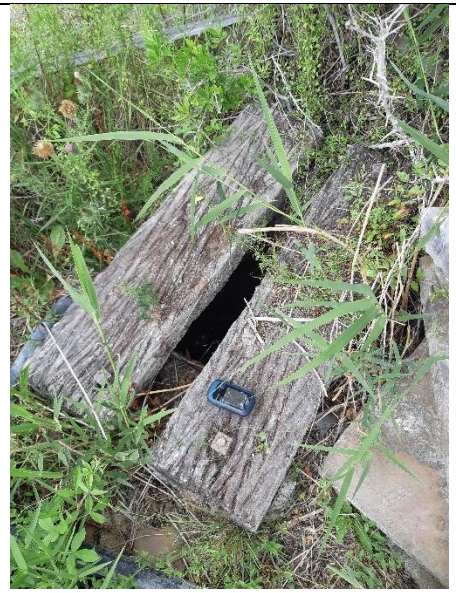
ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH9	-31.78139	23.77707	
MBH10	-31.88147	23.91850	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH11	-31.87716	23.94120	
MBH12	-31.87754	23.89885	

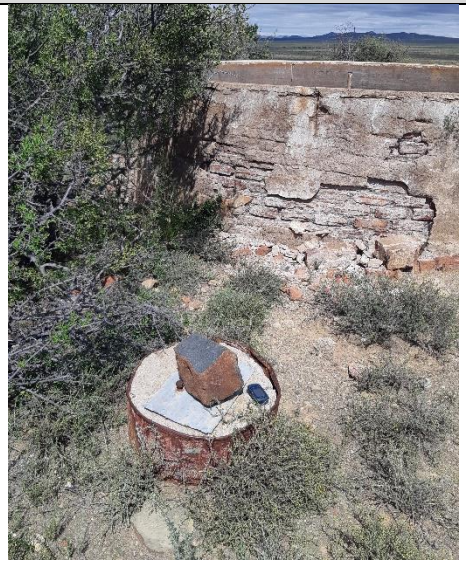
ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH13	-31.90550	23.88848	
MBH14	-31.87698	23.87824	 

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH15	-31.75666	23.85268	
MBH16	-31.75429	23.84260	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH17	-31.75415	23.84245	
MBH18	-31.76499	23.82554	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH19	-31.72572	23.85666	
MBH20	-31.93751	23.91167	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH21	-31.93736	23.91258	
MBH22	-31.93847	23.92470	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH23	-31.93053	23.93587	
MBH24	-31.91766	23.92417	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH25	-31.93723	23.90708	
MBH26	-31.94310	23.90385	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH27	-31.93830	23.90356	
MBH28	-31.72391	23.75647	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH29	-31.71899	23.73891	
MBH30	-31.72001	23.73701	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH31	-31.72006	23.73718	
MBH32	-31.70903	23.76198	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH33	-31.75352	23.76489	
MBH34	-31.75367	23.76462	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
MBH35	-31.75886	23.76562	
MBH36	-31.75909	23.76604	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Photo
D1	-31.90534	23.89256	
D2	-31.93629	23.90687	

16. APPENDIX B: GENERAL SITE PHOTOGRAPHS



Figure 6: Fractured/jointed nature (annotated in red) of mudrocks and shales of the Karoo Supergroup observed near D1.

17. APPENDIX C: LABORATORY ANALYSES OF WATER SAMPLES

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2023-01-25

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: - Alison

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Die Boord, Stellenbosch
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Sample Details					
SampleID	W34841	W34842	W34843	W34844	W34845
Water Type	Drinking Water	Drinking Water	Drinking Water	Drinking Water	Drinking Water
Water Source	Borehole				
Sample Temperature					
Description	MBH7 (Kobus)	MBH10	MBH13	MBH15	MBH22
Batch Number	MBH7 (Kobus)	MBH10	MBH13	MBH15	MBH22
PO Number	4708_F	4708_F	4708_F	4708_F	4708_F
Date Received	2023-01-23	2023-01-23	2023-01-23	2023-01-23	2023-01-23
Condition	Good	Good	Good	Good	Good

Water - Routine	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	7.63	7.38	7.34	7.02	6.96
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	59.8	86	51	89	196
Turbidity (Water)*	ntu			<= 5	1.35	2.61	1.30	0.70	28.3
Total dissolved solids (Water)*	mg/L			<= 1200	405.44	583.08	345.78	603.42	1328.88
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	2.5%	<= 1.5	<0.15	0.26	<0.15	<0.15	0.90
Nitrate as N (Water)	mg/L	VIN-05-MW08	10%	<= 11	2.07	2.94	2.06	2.22	<1.00
Nitrite as N (Water)	mg/L	VIN-05-MW08	10%	<= 0.9	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	2.73%	<= 300	14.32	58.88	19.47	60.72	130.28
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	29.80	54.94	21.01	57.87	600.54
Fluoride (F) - Water	mg/L	VIN-05-MW08	9.74%	<= 1.5	0.67	0.82	0.71	1.13	1.87
Alkalinity as CaCO3 (Water)*	mg/L				258.90	311.10	211.80	317.40	237.20
Colour (Water)*	mg/L Pt-Co			<= 15	<15	<15	19	32	44
Carbonate as CO3 (Water)*	mg/L				<1.00	<1.00	<1.00	<1.00	<1.00
Bicarbonate (HCO3) - Water*	mg/L				258.90	311.10	211.80	317.40	237.20
Langelier Index (Water)*					0.25	0.16	-0.26	-0.17	0.05
Date Tested					2023-01-23	2023-01-23	2023-01-23	2023-01-23	2023-01-23

Water - Metals	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results

Please click here for SANS241-1:2015 drinking water limits

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the scope of SANAS accreditation. Results for methods VIN-05-MW12, 13 and 14, are based on Cq values, a positive result (detected) indicates a Cq value <35 and a negative result (non-detected) indicates a Cq value of >35.

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^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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TEST REPORT

Water

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Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		58	72	42	76	209
Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		23	37	22	28	41
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	34	54	29	69	177
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		2	3	2	3	7
Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	0.045	0.057	0.072	<0.008	0.013
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	80	132	78	150	798
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	16	6	3	4	6
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	<10	130	69	<10	1555
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	<4	<4	<4	15	523
Phosphorous (P) - Water*	mg/L				<0.50	<0.50	<0.50	<0.50	<0.50
Date Tested					2023-01-24	2023-01-23	2023-01-23	2023-01-23	2023-01-23

Comments
W34841 Ion balance = 7.1%
W34842 Ion balance = 5.1%
W34843 Ion balance = 5.7%
W34844 Ion balance = 4.6%
W34845 Ion balance = 3.8%

AEFourie

Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
M01,M02,M03,M04,M05,MO8,M10,M28,
M43, MW01, MW02, MW03, MW04,
MW05, MW06, MW07, MW08/9/10,
MW12, MW13, MW14

Please click here for SANS241-1:2015 drinking water limits

Test results relate only to the items tested as received. This Document shall not be reproduced without the written approval of Vinlab (Pty) Ltd.Opinions and interpretations expressed herein are outside
the scope of SANAS accreditation. Results for methods VIN-05-MW12, 13 and 14, are based on Cq values, a positive result (detected) indicates a Cq value <35 and a negative result (non-detected) indicates a Cq value of >35.

*** Not SANAS Accredited. Results marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for Vinlab.**
Vinlab is not liable to any client for any loss or damages suffered which could, directly or remotely, be linked to our services Alcohol results are obtained using the most appropriate or a combination of one of the following methods: Py= pycnometer; W=winescan; Al=alcolyzer, W = Winescan. Micro results: Enumeration of yeast: WL nutrient, 3 days unless otherwise specified, 30ºC. Samples that have had prior microbiological spoilage or treatment for spoilage should always be sterile filtered at bottling. SO2 additions less than 10 days may depress the growth of microbes in culture although they are viable/active in the wine. Some microbes, especially lactobacilli, may not grow in culture even where viable/potentially active in the wine.

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

sanas Testing Laboratory
T0885

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Your partner in quality water analysis

Distillery Road
Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2023-01-25

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: - Alison

P.O.Box 12412
Die Boord, Stellenbosch
Die Boord, Stellenbosch
7613

0218801079

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Sample Details					
SampleID	W34846	W34847			
Water Type	Drinking Water	Drinking Water			
Water Source					
Sample Temperature					
Description	MBH26	MBH29			
Batch Number	MBH26	MBH29			
PO Number	4708_F	4708_F			
Date Received	2023-01-23	2023-01-23			
Condition	Good	Good			

Water - Routine

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	7.34	8.15			
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	82.4	65.8			
Turbidity (Water)*	ntu			<= 5	127.00	4.42			
Total dissolved solids (Water)*	mg/L			<= 1200	558.67	446.12			
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	2.5%	<= 1.5	<0.15	<0.15			
Nitrate as N (Water)	mg/L	VIN-05-MW08	10%	<= 11	<1.00	1.09			
Nitrite as N (Water)	mg/L	VIN-05-MW08	10%	<= 0.9	<0.05	<0.05			
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	2.73%	<= 300	44.69	17.52			
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	51.10	42.86			
Fluoride (F) - Water	mg/L	VIN-05-MW08	9.74%	<= 1.5	0.97	0.36			
Alkalinity as CaCO3 (Water)*	mg/L				333.60	288.80			
Colour (Water)*	mg/L Pt-Co			<= 15	<15	<15			
Carbonate as CO3 (Water)*	mg/L				<1.00	<1.00			
Bicarbonate (HCO3) - Water*	mg/L				333.60	288.80			
Langelier Index (Water)*					0.14	0.82			
Date Tested					2023-01-23	2023-01-23			

Water - Metals

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		69	58			

Please click here for SANS241-1:2015 drinking water limits

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^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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Doc No V40172 VIN 09-01 30-11-2022 Page: 1 of 2 Visit Vinlab H20

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2023-01-25

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: - Alison

P.O.Box 12412
Die Boord, Stellenbosch
Die Boord, Stellenbosch
7613

0218801079

@VinlabSA

Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		35	40			
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	55	21			
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		3	2			
Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	<0.008	<0.008			
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	138	39			
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	4	6			
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	5330	225			
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	60	5			
Phosphorous (P) - Water*	mg/L				<0.50	<0.50			
Date Tested					2023-01-24	2023-01-23			

Comments
W34846 Ion balance = 5.3%
W34847 Ion balance = 6.5%

Kalinke Rossouw
Laboratory Technician
VIN-05-M01, M02, M04, M05, M08, M10, M28,M40, MW01, MW02, MW03, MW04, MW08,MW09,MW10,MW12,MW13,MW14, MW43, VIN-05-M42, M44, M45, M46, M48, M49, M50, M51, M52, M53, M54, M55

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^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

sanas Testing Laboratory T0885

forestry, fisheries
& the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE

Basic Assessment for the proposed development of the Padloper Solar PV Facility 2 and associated infrastructure (i.e., Padloper PV 2), near Murraysburg in the Western Cape Province

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with *'the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)'*, where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Geotechnical & Geohydrological Assessment
Specialist Company Name	GEOSS SA (Pty) Ltd
Specialist Name	Hartwig Luttig
Specialist Identity Number	[redacted]
Specialist Qualifications:	MEng; PGDip; BSc Earth Science
Professional affiliation/registration:	SACNASP (Pending)
Physical address:	GEOSS SA: Unit 12, Technostell Building, 9 Quantum Street, Techno Park, Stellenbosch, 7600
Postal address:	As Above
Postal address	As Above
Telephone	[redacted]
Cell phone	
E-mail	

SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Hartwig Luttig declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
    - any decision to be taken with respect to the application by the competent authority; and;
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

GEOSS SA (Pty) Ltd

Name of Company:

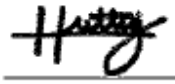
05 Sep 2023

Date

SPECIALIST DECLARATION FORM – AUGUST 2023

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Hartwig Luttig_____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.



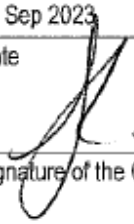
Signature of the Specialist

GEOSS SA (Pty) Ltd

Name of Company

05 Sep 2023

Date



Signature of the Commissioner of Oaths

05 Sep 2023

Date

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoeman ACMA – 1-7FUWGN
. The Boulevard Office Park, Block B
Ground Floor, Searle Street, Woodstock, 7925

forestry, fisheries
& the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

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1. SPECIALIST INFORMATION

Title of Specialist Assessment	Geotechnical & Geohydrological Assessment
Specialist Company Name	GEOSS SA (Pty) Ltd
Specialist Name	Shane Teek
Specialist Identity Number	[redacted]
Specialist Qualifications:	MEng; BSc Hon Earth Science
Professional affiliation/registration:	SACNASP - 126397
Physical address:	GEOSS SA: Unit 12, Technostell Building, 9 Quantum Street, Techno Park, Stellenbosch, 7600
Postal address:	As Above
Postal address	As Above
Telephone	[redacted]
Cell phone	
E-mail	

2. DECLARATION BY THE SPECIALIST

I, Shane Teek declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
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- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
    - any decision to be taken with respect to the application by the competent authority; and;
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

GEOSS SA (Pty) Ltd

Name of Company:

05 Sep 2023

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Shane Teek_____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SA (Pty) Ltd

Name of Company

05 Sep 2023

Date

Signature of the Commissioner of Oaths

05 Sep 2023

Date

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoeman ACMA – 1-7FUWGN
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