450MW

EMERGENCY RISK MITIGATION POWER PLANT (RMPP) ON LOTS 1854 AND 1795, ALTON, RICHARDS BAY

PRELIMINARY GEOHYDROLOGICAL ASSESSMENT REPORT

Reference
18/3388-01A-GH

Prepared By
A. J. Greet

Date
September 2020

DAVIES LYNN & PARTNERS

Geotechnical Consultants & Engineering Geologists

6 Dias House
Fairway Green Office Park
3 Abrey Road, Kloof, 3610

Telephone: (031) 764 7335
Fax (031) 764 7385
Email: dlpdbn@dlp.co.za
Reg. No. 01/028679/07

REVISION HISTORY

Date	Rev No.	Description	Revised By
09/2020	A	Creation of New Document	A.J.G
09/2020	B	Updated after Client review	A.J.G

TABLE OF CONTENTS

DRAWINGS

APPENDICES

1. BACKGROUND

Savannah Environmental (Pty) Ltd provided a project brief and description for the proposed new 450MW Emergency Risk Mitigation Power Plant (RMPP) including associated infrastructure, electricity transmission infrastructure and the LPG or Naphtha Storage Tanks, which is summarized below:

In a response to the procurement process by the Independent Power Producer Office ("IPP Office") which has been initiated in July 2020, for the procurement of up to 2000MW of dispatchable generation capacity from a range of technologies, in accordance with the new generation capacity required and as specified in the Integrated Resource Plan 2019 and accompanying ministerial determination from the Minister for the Department of Resources and Energy to which the National Energy Regulator of South Africa has concurred, Phinda Power Producers (Pty) Ltd ("Phinda") have proposed the construction of the following:

- a 450MW Emergency Risk Mitigation Power Plant (RMPP) with associated infrastructure as well as storage of up to 10,000m^3 of liquid petroleum gas ("LPG") or alternatively 60,000 metric tons of Naphtha with associated infrastructure; and
- electricity transmission infrastructure.

The IPP Office has initiated 2000MW of new generation capacity procurement under a programme to be administered by it and titled the Risk Mitigation Power Procurement Programme ("RMPPP"), targeting first generation and transmission of energy to the grid by 31 December 2021. The IPP Office is attempting to fast track the implementation of the 2000MW of new generation capacity to be procured under the RMPPP in order to alleviate the frequent load shedding being experienced in South Africa at present and is specifically targeting new generation capacity that can be brought onto the grid as quickly as possible.

<u>450MW Emergency Risk Mitigation Power Plant (RMPP)</u>

The 450MW Emergency Risk Mitigation Power Plant (RMPP) involves the construction of a gas-fired power station which will provide mid-merit power supply[1]

[1] Mid-merit electricity generation capacity refers to the generation of electricity which is adjusted according to the fluctuations in demand in the national grid. Baseload electricity generating capacity refers to the generation of electricity continuously for all hours of the day and night in order to satisfy the minimum demand required in the national grid.

to the electricity grid. The 450MW RMPP is planned to operate on a mid-merit basis at an average annual minimum dispatch rate of ~50% (i.e. operational between 5am and 9:30pm daily and being deployed on average for a minimum 72% over the year during this time period) and has been designed and developed as a power balance system to manage electricity demand during peak periods to stabilise the grid, as well as provide back up support for base load generation in the event of unscheduled maintenance on the coal fired power stations. The power station will have an installed capacity of up to 450MW, to be operated on LPG or naphtha and later converted from utilising LPG to natural gas. The natural gas or naphtha is to be supplied via a pipeline to the RMPP from the supply take-off point at the Richards Bay Harbour with LPG being supplied via truck from the import terminal at the Richards Bay harbour. The use of Naphtha or LPG and the associated infrastructure will be investigated further within the EIA phase and the preferred fuel source presented. The LNG terminal infrastructure and naphtha supply infrastructure at the port and the relevant pipelines do not form part of the scope of this assessment, whereas LPG infrastructure does form part of this report.

<u>450MW RMPP Electricity Transmission Infrastructure</u>

The establishment of the 450MW RMPP will simultaneously require the implementation of the 450MW RMPP Electricity Transmission infrastructure project to allow for the evacuation of the electricity produced by the Power Plant to the existing high voltage electricity transmission infrastructure in close proximity to the Power Plant.

The 450MW RMPP Electricity Transmission Infrastructure project is being undertaken as a separate application for environmental authorisation as:

- a basic assessment process is required for the transmission infrastructure; and
- Phinda wishes to secure a separate Environmental Authorisation for the 132kV transmission line as ultimately it is expected that the Environmental Authorisation will need to be transferred to Eskom when Eskom takes over ownership and control of the transmission infrastructure.

Due to the large number of existing high voltage transmission lines between the 450MW RMPP site and the electricity evacuation connection point, electricity evacuation is proposed via underground transmission cables to connect to an existing unutilized 132kV transmission line.

2. TERMS OF REFERENCE

Davies Lynn & Partners (Pty) Ltd were initially requested by Ilifa Africa Engineers (Pty) Ltd on behalf of the Client, Moondream Trading (Pty) Ltd, to undertake a Geohydrological Investigation for the proposed new Phinda Combined Cycle Power Plant (CCPP) Development on Lot 1854 in Alton, an industrial area of Richards Bay, which would be suitable for both the Rezoning Application to be lodged at the Local Authority as well as for the application for Environmental Authorization to be lodged at the Provincial Authority.

Davies Lynn & Partners (Pty) Ltd subsequently undertook the Geohydrological Investigation, which culminated in a Report titled "*Phinda Combined Cycle Power Plant (CCPP) on Lot 1854, Alton, Richards Bay – Geohydrological Investigation Status Report*", referenced 18/3388-02 in March 2020.

DLP were then requested by Savannah Environmental (Pty) Ltd to provide quotations to undertake the required Specialist Report revisions as well as costing for the additional Scope of Works, which was duly supplied on the 17th August 2020 and again on the 25th August 2020. The quotations were subsequently accepted by Savannah Environmental (Pty) Ltd on behalf of the Client, Phinda Power Producers (Pty) Ltd, in four (4No.) Letter of Appointments dated, 1st and 2nd September 2020 and DLP were authorized to proceed with the required additional investigations and Specialist Report revisions.

This Report documents the results of the **Preliminary Geohydrological Assessment for the 450MW Emergency Risk Mitigation Power Plant (RMPP)**. This Report has largely been based on extracted information from the abovementioned Davies Lynn & Partners (Pty) Ltd.'s original Geohydrological Investigation Status Report, referenced 18/3388-02 and dated March 2020.

3. SCOPE OF WORK

The scope of work as part of this Preliminary Geohydrological Assessment for the 450MW Emergency Risk Mitigation Power Plant (RMPP) for is detailed hereafter:

Phase A – Initial Desktop Assessment

- Identification and delineation of all surface water sources / bodies in proximity to the site,
- Assessment of any applicable existing reports / information pertaining to the project, should they be available,
- Desktop study of, and collation of information pertaining to, the geology and geohydrology of the area,
- Undertaking of a desktop hydrocensus within a 5 km radius of the sites, utilizing the Department of Water and Sanitation (DWS) National Groundwater Archives (NGA),
- Assessment of DWS-mapped structures in proximity to the site, in accordance with the regional geological map,
- Assessment of other relevant GIS data and mapping information pertaining to the site and this project.

Phase B – Surface Water Investigation

- Site walkover inspection and reconnaissance of the receiving environment to identify surface and subsurface migration pathways as well as potential receptors located in the vicinity of the site,
- Performance of a basic hydrocensus within a 5 km radius of the sites / the area deemed geohydrologically sensitive by an on-site assessment, to identify springs and existing boreholes, and where possible:
  - borehole ages, depths, construction types, water strikes, static water levels, equipment and volumes of water currently being abstracted.
- Collection of five (5No.) water samples from boreholes and surface water sources located in close proximity to the site, for submission to a SANAS- accredited laboratory for analysis according to the abbreviated SANS 241: 2015 suite of determinants to allow for the assessment of baseline water quality on-site / within the study area.

Phase C – Data Evaluation and Reporting

- Preparation of a Preliminary Geohydrological Assessment report, where the following has been included:
  - field investigation methodologies and applicable principles,
  - results of the hydrocensus, including the position of, and distance to, identified groundwater sources as well as the gathered pertinent groundwater field characteristics,
  - inferred geology and geohydrology of the area, through the inclusion of gathered field data, laboratory data and the available desktop information,
  - possible impacts of this project on the surface water / groundwater resources in its vicinity, and any existing geohydrological constraints,
  - interpretation of the water quality results from the selected water sources within the study area,
  - interpretation of field and desktop data to give estimated anticipated water table levels,
  - identification of the surface water / geohydrological risks,
  - preparation of a conceptual site model (CSM), incorporating applicable gathered data and information,
  - recommendations for the mitigation of potentially significant impacts.

4. SITE DESCRIPTION

4.1 Location

The site of the proposed 450MW Emergency Risk Mitigation Power Plant (RMPP) Development (hereon also referred to as 'the site') is located on a predominantly undeveloped area on Lot 1854 in Alton, an industrial area of Richards Bay, KwaZulu-Natal, at the following approximate co-ordinates 28° 45' 50" S and 32° 0' 43" E (see attached Locality Plan – Dwg No. 18/3388-01A-GH - Figure A). An abandoned and dilapidated industrial development operated by Antioxidants Aromas and Fine Chemicals (Pty) Ltd (or AAFC) is located across the central/western portions of Lot 1854. This plant produced food additives, edible oils and fats which was closed in 2014.

The site of the Naphtha Storage Facility is located on Lot 1854, Richards Bay, whilst the site of the proposed new LPG Storage Tanks is located on Lot 1795, Richards Bay which is to the immediate south of Lot 1854 and Kraft Link road. Lot 1795, Richards Bay has been developed and currently houses a number of parallel warehouse structures.

4.2 Topography and Drainage

According to the available information, the proposed site has a topographical elevation ranging between approximately 25m MSL in the south eastern portions of the site and 33m MSL across the north western portions of the site

The site is typically gently sloping and displays typical gentle inland hummocky type dune topography, while there are portions across the central and northern plateau areas of the site that are largely level. Along the eastern boundary of the site lies an approximately north-east to south-west trending natural surface water drainage feature, with ±6m difference in elevation between the base of the channel and the central flat lying plateau area (see attached Area Plan – Dwg No. 18/3388-01A-GH – Figure B). It appears that streams/natural drainage courses are artificially channelled through upstream industrial sites and into this natural surface water drainage feature. It is expected that surface runoff and subsurface seepage of contaminants from these upstream industrial sites potentially impacts the site of the proposed 450MW RMPP development, particularly after periods of heavy rainfall or major storm events.

5. GEOLOGY AND GEOHYDROLOGY

5.1 Geology

The 1 : 250 000 St. Lucia Geological Sheet shows that the site and much of the surrounding areas are underlain by unconsolidated, Quaternary-age sediments (see the attached Geological Plan – Dwg No. 18/3388-01A-GH - Figure C). These redistributed cover sands are underlain by recent clays and sands of the upper Port Durnford Formation of the Maputaland Group.

The Port Durnford Formation rests unconformably on either Cretaceous sediments or partially calcified / lithified sediments of the Uloa or Umkwelane Formations. It comprises a succession of carbonaceous muds and sands, with basal sandstones, black muds and lignite in evidence. Nearer the surface however, white and orange mottled clayey sands are overlain by younger dune sands, which cover much of the coastal plain.

At much greater depths these formations are underlain by either, consolidated sedimentary units of the Karoo Supergroup that have been subjected to faulting and fracturing associated with the breakup of the ancient Gondwana super-continent, as illustrated by the coast-parallel faults situated away to the north of the site, or by the older Granitic-Gneiss bedrock of the Natal Metamorphic Province.

5.2 Geohydrology

5.2.1 Shallow Aquifers

A shallow water table is typically associated with surface drainage features such as rivers, streams, wetlands, pans and dams, together with the flood plains and low-lying areas associated with them, and in this case is represented by the north-east to south-west trending natural surface water drainage feature along the eastern boundary of the site in which surface water is very gently flowing (see the attached Geological Plan – Dwg No. 18/3388-01A-GH - Figure E).

5.2.2 Deep Aquifers

The unconsolidated sediments of the Maputaland Group are considered inter-granular aquifers, with groundwater storage and movement occurring within the interconnected pore spaces between the sand grains. Typical borehole yields, which are to be expected in this area in these sediments, are considered to be moderate and in the range of >0.5 ℓ/s to 3.0 ℓ/s according to "*Characterisation and Mapping of the Groundwater Resources of KwaZulu-Natal Province Mapping Unit 7*" of August 1995, prepared by the Centre for Scientific and Industrial Research for the former Department of Water Affairs and Forestry.

Boreholes drilled into the unconsolidated sediments typically intercept groundwater of good quality, with pH values generally varying between 6.0 – 9.0 and electrical conductivity (EC) values below 100 mS/m. Within the upper layers of the Port Durnford Formation, calcium (Ca) concentrations reportedly vary between 1.02 mg/ℓ – 15.24 mg/ℓ, magnesium (Mg) between 2.23 mg/ℓ – 4.33 mg/ℓ and sodium (Na) between 15.51 mg/ℓ – 26.21 mg/ℓ.

Recharge to the underlying inter-granular aquifer has been reportedly estimated at 5% to 18% of mean annual precipitation (MAP), which is described as holding 'huge and renewable' groundwater reserves.

5.2.3 Climate

The general area surrounding and including the study area, experiences warm, wet summers and mild moist and dry winters, which are frost free. Annual rainfall in these areas typically ranges between 994mm to 1500mm per annum, or averages approximately 1228mm per annum. The climate is considered to be *Cfa* according to the Köppen Climate Classification.

6. SURFACE WATER AND GEOHYDROLOGICAL SITE INVESTIGATION

The information contained in this Report is largely based on information extracted from the abovementioned Davies Lynn & Partners (Pty) Ltd.'s original *Geohydrological Investigation Status Report*, referenced 18/3388-02 and dated March 2020, which included the combined results of both the Surface Water and Groundwater Assessments.

Although this Report is considered the "*Geohydrological Assessment Report*" for the EIA submission requirements, the results of the Surface Water Assessment will be included as the interactions between the surface water and groundwater are intrinsically linked.

6.1 Initial Desktop Assessment

Prior to the site visit, a desktop study of the region was initially conducted using the DWS NGA borehole database.

The results of this exercise indicated that twenty-six (26No.) borehole records occur within a 5 km radius of the site. However, some of these records may be duplicates. No on-site monitoring boreholes were identified during the site investigation.

The locations of these boreholes are shown on the attached Area Plan – Dwg No. 18/3388-01A-GH - Figure B, whilst the tabulated data is attached in Appendix A. From the available data the following was derived:

Water Level of Borehole (m bgl) Ranged From	:	0m bgl to 20.42m bgl
Water Strike Levels (m bgl) Ranged From	:	6.10m bgl to 52.43m bgl
Abstraction Rate (ℓ/sec) Ranged From	:	0.23 ℓ/sec to 3.15 ℓ/sec

It is clear that the various data sets are not entirely complete. Historically, the DWS NGA borehole database is fairly unreliable, however, they do provide some information on the geohydrology of the greater study area.

6.2 Field Assessment and Hydrocensus

A site visit was conducted on the 15th August 2019 and included a site walkover, hydrocensus and a groundwater and surface water sampling event. A hydrocensus was undertaken within a 5km radius of the proposed areas deemed geohydrologically sensitive by an on-site assessment of the proposed development.

During the hydrocensus, the proposed site and neighbouring properties were investigated in order to identify groundwater users, especially users immediately down-gradient of the site. The results of this investigation are detailed overleaf in Table 1. Furthermore, a photographic report has been included in Appendix B.

A total of three (3No.) dual-purpose geotechnical and geohydrological boreholes were drilled at strategic locations across the site, by Geopractica Contracting (Pty) Ltd during July 2019, under the supervision of Davies Lynn & Partners (Pty) Ltd.

The Boreholes were drilled using a 100mm Ø rotary biodegradable mud drilling technique and incorporated Standard Penetration Tests (SPTs) at 1m vertical intervals. The disturbed samples recovered by the SPT Raymond Spoon were logged and used together with the SPT "N" values to develop a log sheet / Borehole profile. In order to attempt to record both the shallow and deeper groundwater elevations across the site, the Boreholes were equipped with stand-pipe piezometers, comprising 6m long, 100mm Ø slotted screens surrounded by a silica sand "gravel" filter installed at depths ranging between 23m and 29m (BH 1-19 and BH 2-19), and between 7m and 13m (BH 3-19). The Borehole stand-pipe piezometers were protected with a custom-made circular plastic protective cover and lid. These protective covers were then buried and covered with approx. 100mm of sand to conceal and safeguard the Boreholes from damage / vandalism and were subsequently marked with a concreted wooden stake positioned approx. 1m away from the Borehole. The static groundwater level in each of the boreholes was sampled once it had stabilized.

Two (2No.) stream locations (one up-gradient and one down-gradient of the site) were also sampled (see the attached Geological Plan – Dwg No. 18/3388-01A-SW - Figure D). The detailed laboratory test results are included in Appendix C.

Given that the DWS NGA identified boreholes within the 5km radius service individual properties, intrinsic borehole details (age, depth, water strikes and SWL, etc.) could not be attained. Furthermore, some boreholes were otherwise inaccessible and hence the given information could not necessarily be verified.

Table 1: 450MW RMPP Development - Hydrocensus Information

No.	Borehole Number	Source	Latitude	Longitude	Water Level (m BGL)	Water Strike (m BGL)	Abstraction Rate / Amount (l/sec)
1	2832CA00080	Dept Water - Pretoria	-28,721320	32,012860	0,00		
2	2832CA00077	Dept Water - Pretoria	-28,721310	32,012860	12,19	44,5	1,28
3	2832CA00079	Dept Water - Pretoria	-28,721310	32,012870	0,00		
4	2832CA00083	Dept Water - Pretoria	-28,717150	32,008690	14,94	52,43	3,15
5	2832CA00081	Dept Water - Pretoria	-28,717140	32,008690	20,42	51,82	1,09
6	2832CA00082	Dept Water - Pretoria	-28,717140	32,008700	0,00	41,76	0,23
7	2832CC00059	Dept Water - Pretoria	-28,794200	32,015180			
8	2832CC00058	Dept Water - Pretoria	-28,787210	32,022420			
9	2832CC00066	Dept Water - Pretoria	-28,778620	32,049220			
10	2832CC00015	Dept Water - Pretoria	-28,778250	32,016470			
11	2832CC00016	Dept Water - Pretoria	-28,778250	32,016480	13,41	24,38	1,63
12	2832CC00067	Dept Water - Pretoria	-28,778030	32,054280			
13	2832CC00064	Dept Water - Pretoria	-28,777320	32,051970			
14	2832CC00057	Dept Water - Pretoria	-28,777030	32,024400			
15	2832CC00069	Dept Water - Pretoria	-28,776400	32,049080			

No.	Borehole Number	Source	Latitude	Longitude	Water Level (m BGL)	Water Strike (m BGL)	Abstraction Rate / Amount (l/sec)
16	2832CC00068	Dept Water - Pretoria	-28,775340	32,052770			
17	2832CC00063	Dept Water - Pretoria	-28,775170	32,050720			
18	2832CC00065	Dept Water - Pretoria	-28,773750	32,055070			
19	2832CC00056	Dept Water - Pretoria	-28,773580	32,023780			
20	2832CC00055	Dept Water - Pretoria	-28,772620	32,030940			
21	2832CC00054	Dept Water - Pretoria	-28,772370	32,018980			
22	2832CC00060	Dept Water - Pretoria	-28,767240	32,026800			
23	2832CC00061	Dept Water - Pretoria	-28,763060	32,030540			
24	2831DB00020	Dept Water - Pretoria	-28,743510	31,974770	6,10	28,96	0,44
25	2831DB00021	Dept Water - Pretoria	-28,743510	31,974780	4,57	6,10	0,40
26	2831DB00021	Dept Water - Pretoria	-28,743510	31,974780	4,57	25,91	0,40
27	BH 1-19	DLP Geohydro Investigation	28°45'42.24"S	32° 0'30.09"E	3.28		
28	BH 2-19	DLP Geohydro Investigation	28°46'1.79"S	32° 0'43.07"E	4.15		
29	BH 3-19	DLP Geohydro Investigation	28°45'39.80"S	32° 0'51.40"E	2.25		

From Table 1 above, the following can be deduced:

- As mentioned previously, many of the intrinsic borehole details (age, depth, water strikes and SWL) could not be attained. From the information that was obtained, it was determined that:

Water Level of Borehole (m bgl) ranged from	:	0m bgl to 20.42m bgl
Water Strike Levels (m bgl) ranged from	:	6.10m bgl to 52.43m bgl
Abstraction Rate (ℓ/sec) ranged from	:	0.23 ℓ/sec to 3.15 ℓ/sec

6.3 Groundwater and Surface Water Sampling

In order to determine the baseline or ambient groundwater and surface water quality in the vicinity of the 450MW RMPP Development, the three (3No.) dual-purpose geotechnical and geohydrological boreholes that were drilled at strategic locations along the perimeter site were sampled, as well as the surface water points located along the eastern boundary of the site, directly up-gradient and down-gradient were sampled. The locations of the 450MW RMPP sampling points are shown on the attached Sampling Plan – Dwg No. 18/3388-01A-GH - Figure D1, whilst the cumulative sampling points for both the 450MW RMPP and 4000MW CCPP development are included as Dwg No. 18/3388-01A-GH - Figure D2.

These samples were submitted to the SANAS-accredited Talbot Laboratories for analysis according to the abbreviated SANS 241: 2015 suite of determinants, such that the current (pre-development) or baseline water quality in the area could be determined. The boreholes that were sampled were both up- and down- gradient boreholes located at strategic positions along the perimeter of the site and sample names of BH 01 (WS01), BH 02 (WS02) and BH 03 (WS03) were assigned.

The surface water samples from the adjacent drainage course along the eastern boundary were sampled from both up- and down- gradient locations and sample names Upstream (WS04) up-gradient and Downstream (WS05) down- gradient were assigned.

The laboratory test results are included in Appendix C, where the groundwater samples are compared to the SANS 241: 2015 Standards for Drinking Water as all groundwater should conform to potable standards, whilst the surface water sample results are compared to Volume 7 of the South African Water Quality Guidelines for Aquatic Ecosystems, as prepared by DWAF.

6.3.1 Baseline Groundwater Quality Results

A summary of the laboratory test results of the groundwater samples from the three (3No.) boreholes, namely BH 01 (WS01), BH 02 (WS02) and BH 03 (WS03), in which either the Physical, Macro Chemical, Micro Chemical or Microbiological Determinands exceed the prescribed limits, are presented in Table 2 below:

Table 2: 450MW RMPP Development Elevated Determinants

– SANS 241: 2015 Drinking Water Standards

Determinand	Risk	Unit	Standard Limit	BH 01-19 (WS01)	BH 02-19 (WS02)	BH 03-19 (WS03)
Physical – Water Quality						
Colour	Aesthetic	mg Pt-Co/ℓ	≤15	120	75	23
Turbidity	Operational	NTU	4	39	21	18
Macro Chemical - Determinands						
Chloride	Chronic Health	mg Cl/ℓ	≤300	433	355	82
Nitrate	Chronic Health	mg N/ℓ	≤11	2.33	14.1	19.5
Combined Nitrate & Nitrite	Chronic Health	-	≤1	0.23	1.3	1.8
Sodium	Chronic Health	mg Na/ℓ	≤200	429	256	59
Total Organic Carbon	Chronic Health	mg C/ℓ	≤10	18	29	7.1
Micro Chemical – Determinands						
Aluminium	Chronic Health	µg Al/ℓ	≤300 µg/ℓ	490	558	83
Iron	Chronic Health	µg Fe/ℓ	Chronic: ≤2000 µg/ℓ Aesthetic: ≤300 µg/ℓ	3356	2032	2053
Manganese	Chronic Health	µg Mn/ℓ	Chronic: ≤400 µg/ℓ Aesthetic: ≤100 µg/ℓ	494	414	96
Microbiological - Determinands						
Total Coliforms	Operational	colonies / 100mℓ	≤10	132000	129000	380
E. Coli	Acute	colonies / 100mℓ	0	3	4	0
Standard Plate Count	Operational	colonies / mℓ	≤1000	>10000	>10000	>10000

The results of the laboratory testing for BH 1-19 WS01 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as aluminium, chloride, colour, *E.coli,* iron, manganese, sodium, standard plate count, total coliforms, total organic carbon and turbidity all exceed the prescribed limits.

The results of the laboratory testing for BH 2-19 WS02 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as aluminium, chloride, colour, *E.coli,* iron, manganese, nitrate, combined nitrate + nitrite, sodium, standard plate count, total coliforms, total organic carbon and turbidity all exceed the prescribed limits.

The results of the laboratory testing for BH 3-19 WS03 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as colour, iron, nitrate, combined nitrate + nitrite, standard plate count, total coliforms and turbidity all exceed the prescribed limits.

The elevated E. Coli, total Coliform and Standard Plate Count levels are likely attributed to organic sources (i.e. any up-gradient existing sewerage networks, etc).

General Comments:

- The aluminium levels exceed the SANS recommended limit of <300 μg Al/ℓ. The main effects of aluminium in domestic water are aesthetic, relating to the discolouration in the presence of iron and manganese.
- The chloride content of the water is above the limit of 300 mg Cl/ℓ recommended by the SANS specification for drinking water. Increasing levels of chloride in water can cause a health risk to sensitive groups and gives the water a distinct salty taste.
- The colour of the water exceeds the SANS limit of 15mg Pt-Co/ℓ for drinking water. Colour in water can be of natural mineral origin or it may be an industrial result of effluents containing soluble coloured materials (discharges from pulp and paper, and textile industries). The presence of iron and manganese can also cause a natural brown discolouration in water.
- The presence of E.coli shows faecal contamination and renders this water unsuitable for human consumption unless properly disinfected.
- The iron content of the water exceeds the SANS limit of <5 NTU and is one of the indirect indications of microbiological water quality and of inefficient water

treatment. The presence of turbidity in water results in a cloudy or muddy appearance and may also affect taste and colour of the water.

- The sodium content of the water exceeds the SANS limit of 200 mg NA/ℓ. Excessive intake of sodium salts can cause possible health risks, particularly in sensitive health groups and excessive sodium in water can impart a salty taste to the water.
- At these levels, manganese causes off-putting tastes and brown discolouration of the water. Severe staining of clothes and fixtures can occur.
- The nitrate result on this sample is higher than the SANS specification of 11 mg N/ℓ but lower than 20 mg N/ℓ where we would see slight chronic risk to some babies. High nitrate causes methemoglobinemia, which reduces the oxygen carrying capacity of the blood. This especially affects young children and the aged.

6.3.2 Baseline Surface Water Quality Results

The surface water quality limits used for comparison purposes in accordance with Aquatic Ecosystems are as follows:

Target Water Quality Range (TWQR)

- Levels in excess of TWQR Limit but below CEV

Chronic Effect Value (CEV)

- Levels in excess of CEV but below AEV

Acute Effect Value (AEV)

- Levels in excess of the AEV

A summary of the laboratory test results for the Determinands which exceed the prescribed limits for Aquatic Ecosystems is outlined in Table 3 below:

Table 3: 450MW RMPP Development Elevated Determinants

– South African Water Quality Guidelines for Aquatic Ecosystems

Determinand	Unit	Target	CEV	AEV	UPSTREAM WS04	DOWN-STREAM WS05
Aluminium	µg/l	5	10	100	**520**	**73**
Ammonia	mg/l	0.007	0.015	0.100	**6.10**	**0.46**
Cadmium	µg/l	0.15	0.3	3	**11.1**	**0.96**
Copper	µg/l	0.3	0.53	1.6	**135**	**5.48**
Cyanide	µg/l	1	4	110	**5**	**3**
Fluoride	mg/l	0.75	1.50	2.54	**0.45**	**0.82**
Lead	µg/l	0.2	0.5	4	**0.49**	**0.08**
Manganese	µg/l	2	3.60	36	**313**	**386**
Mercury	µg/l	0.04	0.08	1.7	**0.16**	**0.14**
Zinc	µg/l	2	3.60	36	**4782**	**92**

The laboratory test results of the surface water samples, from both the upstream and downstream sample locations, indicate that ammonia, copper, cyanide, manganese and zinc concentrations all exceed the AEV limits, whilst aluminium and cadmium exceeded the AEV limits in the upstream sample and the CEV limits in the downstream sample. Cyanide and Mercury exceeded the CEV limits for both samples. Fluoride exceeded the CEV only for the downstream sample whilst lead exceeded the CEV only for the upstream sample.

Additionally, E. Coli, total Coliform, Standard Plate Count, Turbidity levels and Colour, which currently have no limits, are also excessive in terms of the SANS 241: 2015 standards.

<u>General Comments:</u>

- All levels should be below the Chronic Effect Value (CEV) to ensure protection of ecosystems.
- Elevated levels of Aluminium are toxic to a variety of organisms.
- Elevated levels of Copper are toxic at low concentrations in water and can cause brain damage in mammals.

- Cyanide interferes with aerobic respiration and is consequently toxic to aerobic organisms like fish and other vertebrates.
- Fish exposed to chlorine may experience decreased growth rate, changes in blood chemistry, damage to gills and death.
- Mercury is severely poisonous to mammals because of its neuro and renal toxicity.
- Zinc levels can contribute to reduced fitness, oedema, liver necrosis and death.
- Lead is a toxic metal which accumulates readily in living tissue. Certain fish develop spinal deformities after lead exposure in soft water.

7. CONCEPTUAL SITE MODEL

From the limited information available at this stage of the investigation, a basic conceptual site model (CSM) was prepared for the site which is included as Dwg No. 18/3388-01A-GH - Figure E, attached.

The line A-A' represented on the Sampling Plan – Dwg No. 18/3388-01A-GH - Figure D1 represents the approximate line, which is orientated from north-east to south-west, along which the CSM was created.

From the conceptual site model, it is apparent that the site drainage is in a south and south-easterly direction towards the natural surface water drainage feature which bounds the site on the east and south-east.

8. GEOHYDROLOGICAL IMPACT ASSESSMENT

8.1 Identification of Potential Impacts

The following potential impacts have been identified for the proposed 450MW RMPP development, during both the Construction Phase and Operation Phase, which are outlined below:

Construction Phase

- a potential impact exists on groundwater and surface water bodies (receptors) as a result of on-site accidental fuel spills and leaks (sources) from construction vehicles/plant, equipment and/or fuel storage areas as well as cleaning fluids, cement power, wet concrete, shutter-oil, etc. These spills can either migrate off-site to surrounding surface bodies by means of rainwater surface runoff or infiltration through the subsoils and into the groundwater by means of rainwater seepage (pathways).

- a potential impact exists for identified receptors as a result of leachate from construction waste disposal areas (sources) and infiltration through the soil (pathway) of dirty water/wastewater from supplied ablution facilities (sources).

Operational Phase

- a potential impact exists on groundwater and surface water bodies (receptors) due to the possible leak of diesel, LPG and/or Naphtha and/or chemicals from storage facilities and/or pipelines and from emergency backup generators leaks (sources). Following rainwater infiltration, hydrocarbon products can migrate through highly permeable unconsolidated sediments and infiltrate into the groundwater or migrate off-site to adjacent surface water bodies by rainwater surface runoff (pathways).

- a potential impact exists on identified receptors due to wastewater discharging from wastewater treatment facilities and/or contaminated stormwater retention ponds (sources) or from effluent reticulation systems by means of rainwater infiltration or by rainwater surface runoff.

8.2 Impact Risk Ratings

Direct, indirect and cumulative impacts associated with the project/s have been assessed based on the methodology supplied by Savanah Environmental (Pty) Ltd.

The Impact Assessment Criteria involves a scoring process which allows for the determination of an Impact Assessment Significance Rating. The following scales are applied to each identified potential impact and summarized in Table 4 below:

Table 4: Scales for Potential Impact Rating

Extent: Spatial Scale	**Duration: Temporal Scale**
0 – None	1 – Immediate
1 – Site only	2 – Short term: 0 to 5 years
2 – Local	3 – Medium term: 5 to 15 years
3 – Regional	4 – Long term: >15 years
4 – National	5 – Permanent
5 – International	
Magnitude: Severity	**Probability: Likelihood of Occurring**
0 – Small (no effect)	0 – None
2 – Minor (no impact on processes)	1 – Very improbable (probably will not happen)
4 – Low (slight impact on processes)	2 – Improbable (some possibility, low likelihood)
6 – Moderate (processes continuing but in a modified way)	3 – Probable (distinct possibility)
8 – High (processes are altered to the extent that they temporarily cease)	4 – Highly probable (most likely)
10 – Very high (complete destruction of processes)	5 – Definite

The significance is calculated by combining the criteria in the following formula:

S = (E+D+M) P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The significance weightings for each impact are as follows:

- **<30 points: Low** (i.e. where this impact would not have a direct influence on the decision to develop in the area),

- **30 to 60 points: Medium** (i.e. where the impact could influence the decisions to develop in the areas unless it is effectively mitigated),

- **>60 points: High** (i.e. where the impact must have an influence on the decision process to develop in the area).

The Construction Phase Impacts, Operational Phase Impacts and Cumulative Impacts are outlined in Sections 8.3, 8.4 and 8.5 overleaf:

8.3 Construction Phase Impacts

Impact Nature: Impact 1 – Impact on localised Groundwater Quality during Construction Phase

During the Construction Phase, chemical pollutants (hydrocarbons from equipment, vehicles and plant, cleaning fluids, cement powder, wet concrete, shutter-oil, etc) associated with site clearing machinery and construction activities, as well as the demolition of existing structures (existing warehousing on Lot 1795) could migrate downwards through the subsoils and into the groundwater by rainfall infiltration. Appropriate ablution facilities should be provided for the construction workers during the construction phase of the 450MW RMPP development.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site Only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (21)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Medium	Low
Can impacts be mitigated	Yes, to a large extent.	
Mitigation	• Implement appropriate measures to ensure strict use and management of all hazardous materials used on site. • Implement appropriate measures to ensure strict management of potential pollutants (e.g. hydrocarbons from vehicles and machinery, cement during construction, etc.) • Implement appropriate measures to ensure strict control over the behaviour of construction workers. • Ensure appropriate ablutions facility are available. • Surface and stormwater runoff needs to be diverted through an oil/water separator before leaving the site. • Emergency spill kits should always be present on site. • Good housekeeping practices are to be implemented. • Immediate reporting of significant spillages and initiate an environmental site assessment for risk assessment and remediation if necessary. • Working protocols incorporating pollutions control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.	
Residual Impacts	Residual impacts will be negligible after appropriate mitigation.	

8.4 Operational Phase Impacts

Impact Nature: Impact 2 – Impact on localised Surface Water Quality during Operational Phase

During the Operational Phase, chemical pollutants (hydrocarbons from operational equipment, vehicles and plant, cleaning fluids, emergency backup generators, maintenance equipment, etc), LPG and other chemical storage areas or pipelines associated with the operation of the facility could migrate downwards through the subsoils and into the groundwater by rainfall infiltration. Appropriate ablution facilities should be provided for the workers during the Operational Phase of the 450MW RMPPP Power Plant.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site Only (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (21)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Medium	Low
Can impacts be mitigated	Yes, to a large extent.	
Mitigation	• Implement appropriate measures to ensure strict use and management of all hazardous materials used on site. • Implement appropriate measures to ensure strict management of potential pollutants (e.g. hydrocarbons from vehicles and machinery, emergency backup generators, maintenance equipment, etc.) • Ensure appropriate ablutions facility are available. • Surface and stormwater runoff needs to be diverted through an oil/water separator before leaving the site. • Emergency spill kits should always be present on site. • Good housekeeping practices are to be implemented. • Immediate reporting of significant spillages and initiate an environmental site assessment for risk assessment and remediation if necessary. • Implement appropriate measures to ensure strict control over the behaviour of workers during the Operational Phase of the Power Plant. • Working protocols incorporating pollutions control measures (including approved Standard Operating Procedures (SOP)) should be clearly set out in the Environmental Management Plan (EMP).	
Residual Impacts	Residual impacts will be negligible after appropriate mitigation.	

8.5 Cumulative Impacts

Impact Nature: Cumulative Impact 1 – Cumulative Impact on localised Groundwater Quality as a result of the development of both the 450MW RMPP and the 4000MW CCPP Facilities. Cumulative Impacts of both the 450MW RMPP and the 4000MW CCPP Facilities during the Construction Phases and Operational Phases (as outlined in Impact 1 and Impact 2 above) on the subsurface groundwater aquifers.		
	Overall impact of the proposed project considered in isolation (450MW RMPP)	**Cumulative impact of the project and other projects in the area (both the 450MW RMPP and 4000MW CCPP)**
Extent	Site Only (1)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Medium (30)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Low	Medium
Can impacts be mitigated	Yes, to a large extent	
Mitigation	• Implement appropriate measures to ensure strict use and management of all hazardous materials used on site. • Implement appropriate measures to ensure strict management of potential pollutants (e.g. hydrocarbons from vehicles and machinery, emergency backup generators, maintenance equipment, etc.) • Ensure appropriate ablutions facility are available. • Surface and stormwater runoff needs to be diverted through an oil/water separator before leaving the site. • Emergency spill kits should always be present on site. • Good housekeeping practices are to be implemented. • Immediate reporting of significant spillages and initiate an environmental site assessment for risk assessment and remediation if necessary. • Implement appropriate measures to ensure strict control over the behaviour of workers during the Operational Phase of the Power Plant. • Working protocols incorporating pollutions control measures (including approved Standard Operating Procedures (SOP)) should be clearly set out in the Environmental Management Plan (EMP).	
Residual Impacts	Residual impacts will be negligible after appropriate mitigation.	

9. CONCLUSIONS

On the basis of the information set out above, the following can be concluded:

- Davies Lynn & Partners (Pty) Ltd have undertaken a surface water and geohydrological investigation for the proposed 450MW RMPP development.

- The surface water and geohydrological investigation has been undertaken for both the Rezoning Application to be lodged at the Local Authority as well as for the application for Environmental Authorization to be lodged at the Provincial Authority.

- The area is underlain by unconsolidated, Quaternary-age sediments comprising redistributed cover sands, underlain by recent clays and sands of the upper Port Durnford Formation of the Maputoland Group. These sedimentary lithologies are reported to yield moderate groundwater yields of >0.5 ℓ/sec to 3.0 ℓ/sec.

- A total of twenty-six (26No.) boreholes were found within a 5 km radius of the site at a desktop level, and although the various complete various data sets are not entirely complete, they do provide valuable basic information.

- A total of three (3No.) dual-purpose geotechnical and geohydrological boreholes were drilled at strategic locations across the site and the static water levels samples and two (2No.) surface water samples (one up- gradient and one down- gradient) were similarly sampled.

- During the field hydrocensus, it was established that borehole depths recorded ranged from 0m to 20.42m bgl, while Water Strike Levels ranged from 6.10m to 52.43m bgl and Abstraction Rates ranged from 0.23 ℓ/sec to 3.15 ℓ/sec.

- The groundwater and surface water samples were submitted to the SANAS accredited Talbot Laboratories for analysis according to the SANS 241: 2015 Drinking Water suite of determinants.

- The groundwater results were compared to the SANS 241: 2015 Drinking Water Standards. The results of the laboratory testing for BH 1-19 WS01 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as aluminium, chloride, colour, *E.coli,* iron, manganese, sodium, standard plate count, total coliforms, total organic carbon and turbidity all exceed the prescribed limits. The results of the laboratory testing for BH 2-19 WS02 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as aluminium, chloride, colour, *E.coli,* iron, manganese, nitrate, combined nitrate + nitrite, sodium, standard plate count, total coliforms, total organic carbon and turbidity all exceed the prescribed limits. The results of the laboratory testing for BH 3-19 WS03 indicates that this sample does not conform to the SANS 241:2015 requirements for drinking water, as colour, iron, nitrate, combined nitrate + nitrite, standard plate count, total coliforms and turbidity all exceed the prescribed limits.

- The laboratory test results of the surface water samples, from both the upstream and downstream sample locations, indicate that ammonia, copper, cyanide, manganese and zinc concentrations all exceed the AEV limits, whilst aluminium and cadmium exceeded the AEV limits in the upstream sample and the CEV limits in the downstream sample. Cyanide and Mercury exceeded the CEV limits for both samples. Fluoride exceeded the CEV only for the downstream sample whilst lead exceeded the CEV only for the upstream sample.

- The elevated contaminants reported from Boreholes BH 1-19 and BH 3-19 located in the north-west and north-east of the site respectively, in particular, suggest that groundwater contamination is most likely attributed to industrial activities to the north-west and north-east of the site.

- The results of the surface water laboratory testing further corroborate that the sources of surface water contamination are likely attributed to industrial activities to the north of the project site. Of particular concern, are the elevated Microbiological Determinands (Total Coliforms, *E.coli* and Standard Plate Count) suggesting recent and/or longterm sewerage contamination.

- The Geohydrological Impact Assessment determined that the risks of impact from the development of the 450MW Emergency Risk Mitigation Power Plant (RMPP) Facility are considered **Low** provided the mitigation measures are strictly implemented.

- **From the Geohydrological Assessment, no objections, or motives for the project not to proceed was determined, and therefore the development may occur within the proposed development boundaries.**

10. RECOMMENDATIONS

A thorough surface water and groundwater monitoring programme will need to be implemented for this site, as outlined below:

Surface Water Monitoring Programme

- It is recommended that a surface water monitoring programme be undertaken both up-gradient and down-gradient of the natural surface water drainage feature along the eastern boundary of the site, initially on quarterly basis, this may need to be reviewed to monthly if there is a dramatic increase in reported surface water contamination.

- The collected samples should be sent to an independent SANAS accredited laboratory for the full SANS 241: 2015 Standards for Drinking Water analysis.

Groundwater Monitoring Programme

- It is recommended that the existing three (3No.) dual-purpose geotechnical and geohydrological monitoring boreholes also be sampled on a quarterly basis, this may also need to be reviewed to monthly if there is a dramatic increase in reported groundwater contamination.

- The collected samples should be sent to an independent SANAS accredited laboratory for the full SANS 241: 2015 Standards for Drinking Water analysis.

- Prior to construction of the proposed new development, there will be a requirement to install additional groundwater monitoring boreholes around the perimeter of the site. The exact location for the installation of the proposed monitoring boreholes should be determined by a qualified geohydrologist /

environmental geologist and will largely be based on the final stormwater management plan and infrastructure layouts.

- The shallow and deep monitoring boreholes should be installed according to the proposed borehole construction details or similar, as shown below:

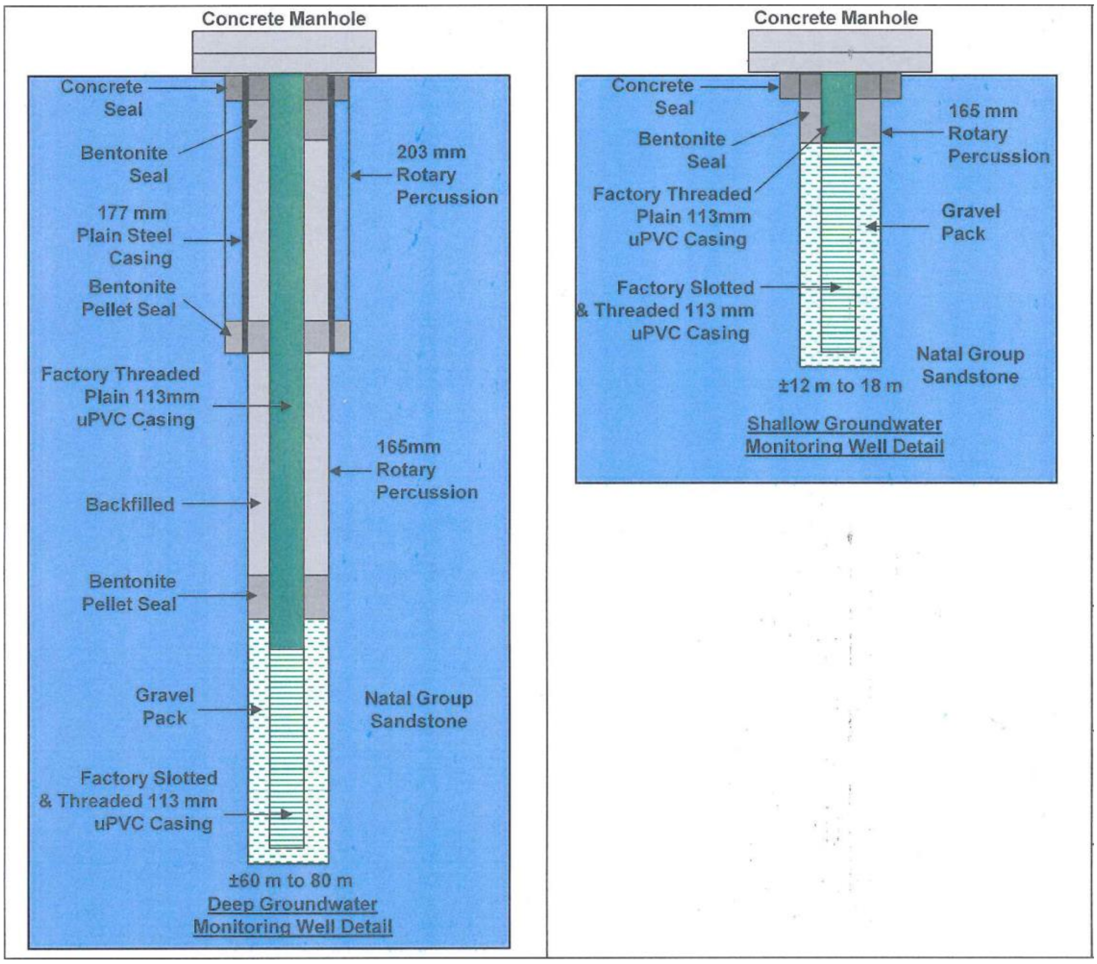


Figure 1: Construction Details for Shallow and Deep Monitoring Wells

- Once drilled, the boreholes should be allowed to stabilize before being thoroughly purged to remove any sediments/rock flour and contaminants introduced during the drilling process.

- The boreholes should then be allowed to recover, prior to recording the static groundwater levels and collection of groundwater samples utilizing a dedicated sampling pump.

- If the groundwater and/or surface water monitoring programme indicate that accelerated contamination is occurring from this new facility, then remediation and rehabilitation measures will need to be discussed and implemented.

11. FURTHER RECOMMENDED SURFACE WATER AND GEOHYDROLOGICAL INVESTIGATIONS

As no detailed Surface Water and Geohydrological Assessments have been carried out at the site of the proposed LPG Storage Tanks on Lot 1795, Richards Bay, additional investigations to fulfil the EIA submission requirements will be required.

In order to determine the baseline or ambient groundwater and surface water quality in the vicinity of Lot 1795, Richards Bay, two (2No.) additional dual-purpose Geotechnical and Geohydrological boreholes will be required, allowing firstly for the preliminary determination of the pile founding levels (in the vicinity of the boreholes) for different pile types (i.e. DCIP and CFA piles), for a range of pile diameters at differing compressive load carrying capacities (when preliminary foundation costs are required in the future), and secondly to enable the measurement of the ambient groundwater elevations across the site, providing the necessary information related to the direction of groundwater movement for the required Geohydrological Investigations and Reporting. The piezometers installed in the boreholes will also permit groundwater samples to be removed, when required, for baseline geochemistry data, i.e. groundwater entering and leaving the site.

Costed proposals to undertake the required additional Geotechnical, Geohydrological and Surface Water investigations have been provided by DLP in a Letter Quotation, referenced 18/3388 and dated 25th August 2020. The quotations were subsequently accepted by Savannah Environmental (Pty) Ltd on behalf of the Client, Phinda Power Producers (Pty) Ltd, in four (4No.) Letter of Appointments dated, 1st and 2nd September 2020 and DLP have been authorized to proceed with the required additional investigations and Specialist Report revisions. The results of the additional investigations will be issued as an Addendum to this Report.

-------oo0oo-------

APPENDIX A

Tabulated Desktop Hydrocensus Data

TABLE 1 : NGA BOREHOLE DATA WITHIN 5KM RADIUS OF PHINDA COMBINED CYCLE POWER PLANT (CCPP) DEVELOPMENT

GeositeInf	GeositeI_1	GeositeI_2	GeositeI_3	GeositeI_4	WaterLevel	WaterStrik	WaterStrik 1	Yield
Dept Water - Pretoria	2832CA00080	Borehole	-28,721320	32,012860	0,000000			
Dept Water - Pretoria	2832CA00077	Borehole	-28,721310	32,012860	12,190000	44,5		1,28
Dept Water - Pretoria	2832CA00079	Borehole	-28,721310	32,012870	0,000000			
Dept Water - Pretoria	2832CA00083	Borehole	-28,717150	32,008690	14,940000	52,43		3,15
Dept Water - Pretoria	2832CA00081	Borehole	-28,717140	32,008690	20,420000	51,82		1,09
Dept Water - Pretoria	2832CA00082	Borehole	-28,717140	32,008700	0,000000	41,76		0,23
Dept Water - Pretoria	2832CC00059	Borehole	-28,794200	32,015180				
Dept Water - Pretoria	2832CC00058	Borehole	-28,787210	32,022420				
Dept Water - Pretoria	2832CC00066	Borehole	-28,778620	32,049220				
Dept Water - Pretoria	2832CC00015	Borehole	-28,778250	32,016470				
Dept Water - Pretoria	2832CC00016	Borehole	-28,778250	32,016480	13,41	24,38	32,92	1,63
Dept Water - Pretoria	2832CC00067	Borehole	-28,778030	32,054280				
Dept Water - Pretoria	2832CC00064	Borehole	-28,777320	32,051970				
Dept Water - Pretoria	2832CC00057	Borehole	-28,777030	32,024400				
Dept Water - Pretoria	2832CC00069	Borehole	-28,776400	32,049080				
Dept Water - Pretoria	2832CC00068	Borehole	-28,775340	32,052770				
Dept Water - Pretoria	2832CC00063	Borehole	-28,775170	32,050720				
Dept Water - Pretoria	2832CC00065	Borehole	-28,773750	32,055070				
Dept Water - Pretoria	2832CC00056	Borehole	-28,773580	32,023780				
Dept Water - Pretoria	2832CC00055	Borehole	-28,772620	32,030940				
Dept Water - Pretoria	2832CC00054	Borehole	-28,772370	32,018980				
Dept Water - Pretoria	2832CC00060	Borehole	-28,767240	32,026800				
Dept Water - Pretoria	2832CC00061	Borehole	-28,763060	32,030540				
Dept Water - Pretoria	2831DB00020	Borehole	-28,743510	31,974770	6,100000	28,960000		0,440000
Dept Water - Pretoria	2831DB00021	Borehole	-28,743510	31,974780	4,570000	6,100000		0,400100
Dept Water - Pretoria	2831DB00021	Borehole	-28,743510	31,974780	4,570000	25,910000		0,400100

APPENDIX B

Photographic Record

PHOTOGRAPHIC REPORT

PHINDA COMBINED CYCLE POWER PLANT

Plate 1 : BH 1-19 (WS01)

Plate 2 : BH 2-19 (WS02)

Plate 3 : BH 1-19 (WS01)

Plate 4 : BH 3-19 (WS03)

Plate 5 : Upstream Sampling Location (WS04)

Plate 6 : Downstream Sampling Location (WS05)

APPENDIX C

Laboratory Certificates

Certificate of Analysis

Project details

Customer Details

Order number:	18/3388
Company name:	DAVIES, LYNN & PARTNERS
Contact address:	P O BOX 586, KLOOF, 3610
Contact person:	ANDREW GREET

Sampling Details

Sampled by:	CUSTOMER
Sampled date:	NO SAMPLED DATE PROVIDED

Sample Details

Sample type(s):	GROUNDWATER SAMPLES
Date received:	2019/08/21
Delivered by:	CUSTOMER - GILLITTS DEPOT
Sample condition:	SPLIT SAMPLE MADE
Deviations:	015449/19,015450/19,015451/19,015452/19 - No sample date, Inappropriate bottle, Preservation

Report Details

Testing commenced:	2019/08/21
Report date:	2019/09/12
Our reference:	006666/19

Analytical Results

Determinand	Units	Method No	SANS 241-1:2015 RECOMMENDED LIMITS	Results	
				015448/19	015449/19
				PHINDA POWER BH01 WS01	PHINDA POWER BH02 WS02
Aluminium	µg Al/ℓ	83A	≤300 µg/ℓ (≤0.3 mg/ℓ)	**490**	**558**
Ammonia	mg N/ℓ	64G	≤1.5	<0.11	1.02
Antimony	µg Sb/ℓ	83A	≤20 µg/ℓ (≤0.02 mg/ℓ)	0.38	0.65
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.88	2.80
Barium	µg Ba/ℓ	83A	≤700 µg/ℓ (≤0.7 mg/ℓ)	29	65
Boron	µg B/ℓ	83A	≤2400 µg/ℓ (≤2.4 mg/ℓ)	51	73
Cadmium	µg Cd/ℓ	83A	≤3 µg/ℓ (≤0.003 mg/ℓ)	0.11	<0.1
Chloride	mg Cl/ℓ	16G	≤ 300	**433**	**355**
Coliphages*	PFU/10mℓ	-	Not Detected	0#	0#
Colour*	mg Pt-Co/ℓ	48	≤15	**120**	**75**
Copper	µg Cu/ℓ	83A	≤2000 µg/ℓ (≤2 mg/ℓ)	8.06	10.4
Cyanide*	µg CN/ℓ	-	≤200 µg/ℓ (≤0.2 mg/ℓ)	<20	<20
E.coli	colonies/100mℓ	31	0	**3**	**4**
Electrical Conductivity at 25°C	mS/m	2A	≤170	160	135
Fluoride	mg F/ℓ	18G	≤1500 µg/ℓ (≤1.5 mg/ℓ)	1.26	0.88
Iron	µg Fe/ℓ	83A	Chronic: ≤ 2000 µg/ℓ (≤2 mg/ℓ) Aesthetic: ≤ 300 µg/ℓ (≤0.3 mg/ℓ)	**3 356**	**2 032**
Lead	µg Pb/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.86	1.72
Manganese	µg Mn/ℓ	83A	Chronic: ≤ 400 µg/ℓ (≤0.4 mg/ℓ) Aesthetic: ≤100 µg/ℓ (≤0.1 mg/ℓ)	**494**	**414**
Mercury	µg Hg/ℓ	83A	≤6 µg/ℓ (≤0.006 mg/ℓ)	0.32	0.31
Nickel	µg Ni/ℓ	83A	≤70 µg/ℓ (≤0.07 mg/ℓ)	11.9	8.72
Nitrate	mg N/ℓ	65Gc	≤11	2.33	**14.1**
Nitrite	mg N/ℓ	65Gb	≤0.9	0.02	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	≤1	0.23	**1.3**
pH at 25°C	pH units	1A	5.0 - 9.7	7.0	6.9
Selenium	µg Se/ℓ	83A	≤40 µg/ℓ (≤0.04 mg/ℓ)	0.39	0.62
Sodium	mg Na/ℓ	84	≤200	**429**	**256**
Standard Plate Count	colonies/mℓ	31	≤1000	**>10 000**	**>10 000**
Sulphate	mg SO_4/ℓ	67G	Acute: ≤ 500 Aesthetic: ≤ 250	68.0	52.4
Total Chromium	µg Cr/ℓ	83A	≤50 µg/ℓ (≤0.05 mg/ℓ)	43	37
Total Coliforms	colonies/100mℓ	31	≤10	**132 000**	**129 000**
Total Dissolved Solids at 180°C	mg/ℓ	41	≤1200	988	878
Total Organic Carbon*	mg C/ℓ	-	≤10	**18#**	**29#**
Total Phenols*	µg/ℓ	-	≤10 µg/ℓ (≤0.01 mg/ℓ)	2	4
Turbidity	NTU	4	Operational ≤1 Aesthetic ≤5	**39**	**21**
Uranium	µg U/ℓ	83A	≤30 µg/ℓ (≤0.03 mg/ℓ)	<0.1	0.14
Zinc	µg Zn/ℓ	83A	≤5000 µg/l (≤5 mg/ℓ)	23	18.4

Determinand	Units	Method No	SANS 241-1:2015 RECOMMENDED LIMITS	Results	
				015450/19	015451/19
				PHINDA POWER BH03 WS03	PHINDA POWER UPSTREAM WS04
Aluminium	µg Al/ℓ	83A	≤300 µg/ℓ (≤0.3 mg/ℓ)	83	**520**
Ammonia	mg N/ℓ	64G	≤1.5	0.24	**6.10**
Antimony	µg Sb/ℓ	83A	≤20 µg/ℓ (≤0.02 mg/ℓ)	<0.12	0.67
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	1.77	1.01
Barium	µg Ba/ℓ	83A	≤700 µg/ℓ (≤0.7 mg/ℓ)	41	41
Boron	µg B/ℓ	83A	≤2400 µg/ℓ (≤2.4 mg/ℓ)	37	67
Cadmium	µg Cd/ℓ	83A	≤3 µg/ℓ (≤0.003 mg/ℓ)	<0.1	**11.1**
Chloride	mg Cl/ℓ	16G	≤ 300	82	103
Coliphages*	PFU/10mℓ	-	Not Detected	0#	**4#**
Colour*	mg Pt-Co/ℓ	48	≤15	**23**	**47**
Copper	µg Cu/ℓ	83A	≤2000 µg/ℓ (≤2 mg/ℓ)	2.86	135
Cyanide*	µg CN/ℓ	-	≤200 µg/ℓ (≤0.2 mg/ℓ)	<20	<20
E.coli	colonies/100mℓ	31	0	0	**97**
Electrical Conductivity at 25°C	mS/m	2A	≤170	40	77
Fluoride	mg F/ℓ	18G	≤1500 µg/ℓ (≤1.5 mg/ℓ)	0.09	0.45
Iron	µg Fe/ℓ	83A	Chronic: ≤ 2000 µg/ℓ (≤2 mg/ℓ) Aesthetic: ≤ 300 µg/ℓ (≤0.3 mg/ℓ)	**2 053**	**1 210**
Lead	µg Pb/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.55	0.49
Manganese	µg Mn/ℓ	83A	Chronic: ≤ 400 µg/ℓ (≤0.4 mg/ℓ) Aesthetic: ≤100 µg/ℓ (≤0.1 mg/ℓ)	96	**313**
Mercury	µg Hg/ℓ	83A	≤6 µg/ℓ (≤0.006 mg/ℓ)	0.15	0.16
Nickel	µg Ni/ℓ	83A	≤70 µg/ℓ (≤0.07 mg/ℓ)	7.12	27
Nitrate	mg N/ℓ	65Gc	≤11	**19.5**	6.31
Nitrite	mg N/ℓ	65Gb	≤0.9	<0.01	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	≤1	**1.8**	0.58
pH at 25°C	pH units	1A	5.0 - 9.7	7.1	6.9
Selenium	µg Se/ℓ	83A	≤40 µg/ℓ (≤0.04 mg/ℓ)	0.50	0.45
Sodium	mg Na/ℓ	84	≤200	59	73
Standard Plate Count	colonies/mℓ	31	≤1000	**>10 000**	**>10 000**
Sulphate	mg SO_4/ℓ	67G	Acute: ≤ 500 Aesthetic: ≤ 250	32.3	93.4
Total Chromium	µg Cr/ℓ	83A	≤50 µg/ℓ (≤0.05 mg/ℓ)	37	38
Total Coliforms	colonies/100mℓ	31	≤10	**380**	**37 000**
Total Dissolved Solids at 180°C	mg/ℓ	41	≤1200	272	502
Total Organic Carbon*	mg C/ℓ	-	≤10	7.1#	10#
Total Phenols*	µg/ℓ	-	≤10 µg/ℓ (≤0.01 mg/ℓ)	2	**24**
Turbidity	NTU	4	Operational ≤1 Aesthetic ≤5	**18**	**39**
Uranium	µg U/ℓ	83A	≤30 µg/ℓ (≤0.03 mg/ℓ)	<0.1	0.31
Zinc	µg Zn/ℓ	83A	≤5000 µg/l (≤5 mg/ℓ)	17.7	4 782

Determinand	Units	Method No	SANS 241-1:2015 RECOMMENDED LIMITS	Results
				015452/19
				PHINDA POWER DOWNSTREAM WS05
Aluminium	µg Al/ℓ	83A	≤300 µg/ℓ (≤0.3 mg/ℓ)	73
Ammonia	mg N/ℓ	64G	≤1.5	0.46
Antimony	µg Sb/ℓ	83A	≤20 µg/ℓ (≤0.02 mg/ℓ)	<0.12
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.30
Barium	µg Ba/ℓ	83A	≤700 µg/ℓ (≤0.7 mg/ℓ)	27
Boron	µg B/ℓ	83A	≤2400 µg/ℓ (≤2.4 mg/ℓ)	69
Cadmium	µg Cd/ℓ	83A	≤3 µg/ℓ (≤0.003 mg/ℓ)	0.96
Chloride	mg Cl/ℓ	16G	≤ 300	**400**
Coliphages*	PFU/10mℓ	-	Not Detected	0#
Colour*	mg Pt-Co/ℓ	48	≤15	**31**
Copper	µg Cu/ℓ	83A	≤2000 µg/ℓ (≤2 mg/ℓ)	5.48
Cyanide*	µg CN/ℓ	-	≤200 µg/ℓ (≤0.2 mg/ℓ)	<20
E.coli	colonies/100mℓ	31	0	**3**
Electrical Conductivity at 25°C	mS/m	2A	≤170	143
Fluoride	mg F/ℓ	18G	≤1500 µg/ℓ (≤1.5 mg/ℓ)	0.82
Iron	µg Fe/ℓ	83A	Chronic: ≤ 2000 µg/ℓ (≤2 mg/ℓ) Aesthetic: ≤ 300 µg/ℓ (≤0.3 mg/ℓ)	**359**
Lead	µg Pb/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	<0.29
Manganese	µg Mn/ℓ	83A	Chronic: ≤ 400 µg/ℓ (≤0.4 mg/ℓ) Aesthetic: ≤100 µg/ℓ (≤0.1 mg/ℓ)	**386**
Mercury	µg Hg/ℓ	83A	≤6 µg/ℓ (≤0.006 mg/ℓ)	<0.15
Nickel	µg Ni/ℓ	83A	≤70 µg/ℓ (≤0.07 mg/ℓ)	27
Nitrate	mg N/ℓ	65Gc	≤11	1.25
Nitrite	mg N/ℓ	65Gb	≤0.9	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	≤1	0.12
pH at 25°C	pH units	1A	5.0 - 9.7	6.9
Selenium	µg Se/ℓ	83A	≤40 µg/ℓ (≤0.04 mg/ℓ)	<0.24
Sodium	mg Na/ℓ	84	≤200	**314**
Standard Plate Count	colonies/mℓ	31	≤1000	**>10 000**
Sulphate	mg SO_4/ℓ	67G	Acute: ≤ 500 Aesthetic: ≤ 250	70.2
Total Chromium	µg Cr/ℓ	83A	≤50 µg/ℓ (≤0.05 mg/ℓ)	39
Total Coliforms	colonies/100mℓ	31	≤10	**2 100**
Total Dissolved Solids at 180°C	mg/ℓ	41	≤1200	870
Total Organic Carbon*	mg C/ℓ	-	≤10	4.6#
Total Phenols*	µg/ℓ	-	≤10 µg/ℓ (≤0.01 mg/ℓ)	<2
Turbidity	NTU	4	Operational ≤1 Aesthetic ≤5	**8.0**
Uranium	µg U/ℓ	83A	≤30 µg/ℓ (≤0.03 mg/ℓ)	<0.1
Zinc	µg Zn/ℓ	83A	≤5000 µg/l (≤5 mg/ℓ)	92

Determinand	Units	Method No	Target Water Quality Range (TWQR)	Results	
				015448/19	015449/19
				PHINDA POWER BH01 WS01	PHINDA POWER BH02 WS02
Aluminium	µg Al/ℓ	83A	≤5 µg/ℓ (≤0.005 mg/ℓ)	**490**	**558**
Ammonia*	mg N/ℓ	64G	≤7 µg/ℓ (≤0.007 mg/ℓ)	**0.03**	**1.02**
Antimony	µg Sb/ℓ	83A	Not specified	0.38	0.65
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.88	2.80
Barium	µg Ba/ℓ	83A	Not specified	29	65
Boron	µg B/ℓ	83A	Not specified	51	73
Cadmium*	µg Cd/ℓ	83A	≤0.15 µg/ℓ (≤0.00015 mg/ℓ)	0.11	0.09
Chloride	mg Cl/ℓ	16G	Not specified	433	355
Coliphages*	PFU/10mℓ	-	Not specified	0#	0#
Colour*	mg Pt-Co/ℓ	48	Not specified	120	75
Copper	µg Cu/ℓ	83A	≤0.3 µg/ℓ (≤0.0003 mg/ℓ)	**8.06**	**10.4**
Cyanide*	µg CN/ℓ	-	≤1µg/ℓ (≤0.001 mg/ℓ)	<1	**4**
E.coli	colonies/100mℓ	31	Not specified	3	4
Electrical Conductivity at 25°C	mS/m	2A	Not specified	160	135
Fluoride	mg F/ℓ	18G	≤750 µg/ℓ (≤0.75 mg/ℓ)	**1.26**	**0.88**
Iron	µg Fe/ℓ	83A	Not specified	3 356	2 032
Lead	µg Pb/ℓ	83A	≤0.2 µg/ℓ (≤0.0002 mg/ℓ)	**0.86**	**1.72**
Manganese	µg Mn/ℓ	83A	≤ 180 µg/ℓ (≤0.18 mg/ℓ)	**494**	**414**
Mercury	µg Hg/ℓ	83A	≤0.04 µg/ℓ (≤0.00004 mg/ℓ)	**0.32**	**0.31**
Nickel	µg Ni/ℓ	83A	Not specified	11.9	8.72
Nitrate	mg N/ℓ	65Gc	Not specified	2.33	14.1
Nitrite	mg N/ℓ	65Gb	Not specified	0.02	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	Not specified	0.23	1.3
pH at 25°C	pH units	1A	Not specified	7.0	6.9
Selenium	µg Se/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	0.39	0.62
Sodium	mg Na/ℓ	84	Not specified	429	256
Standard Plate Count	colonies/mℓ	31	Not specified	>10 000	>10 000
Sulphate	mg SO_4/ℓ	67G	Not specified	68.0	52.4
Total Chromium	µg Cr/ℓ	83A	Not specified	43	37
Total Coliforms	colonies/100mℓ	31	Not specified	132 000	129 000
Total Dissolved Solids at 180°C	mg/ℓ	41	Not specified	988	878
Total Organic Carbon*	mg C/ℓ	-	Not specified	18#	29#
Total Phenols*	µg/ℓ	-	30	2	4
Turbidity	NTU	4	Not specified	39	21
Uranium	µg U/ℓ	83A	Not specified	<0.1	0.14
Zinc	µg Zn/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	**23**	**18.4**

Determinand	Units	Method No	Target Water Quality Range (TWQR)	Results	
				015450/19	015451/19
				PHINDA POWER BH03 WS03	PHINDA POWER UPSTREAM WS04
Aluminium	µg Al/ℓ	83A	≤5 µg/ℓ (≤0.005 mg/ℓ)	**83**	**520**
Ammonia	mg N/ℓ	64G	≤7 µg/ℓ (≤0.007 mg/ℓ)	0.24	6.10
Antimony	µg Sb/ℓ	83A	Not specified	<0.12	0.67
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	1.77	1.01
Barium	µg Ba/ℓ	83A	Not specified	41	41
Boron	µg B/ℓ	83A	Not specified	37	67
Cadmium*	µg Cd/ℓ	83A	≤0.15 µg/ℓ (≤0.00015 mg/ℓ)	0.05	**11.1**
Chloride	mg Cl/ℓ	16G	Not specified	82	103
Coliphages*	PFU/10mℓ	-	Not specified	0#	4#
Colour*	mg Pt-Co/ℓ	48	Not specified	23	47
Copper	µg Cu/ℓ	83A	≤0.3 µg/ℓ (≤0.0003 mg/ℓ)	**2.86**	**135**
Cyanide*	µg CN/ℓ	-	≤1µg/ℓ (≤0.001 mg/ℓ)	**2**	**5**
E.coli	colonies/100mℓ	31	Not specified	0	97
Electrical Conductivity at 25°C	mS/m	2A	Not specified	40	77
Fluoride	mg F/ℓ	18G	≤750 µg/ℓ (≤0.75 mg/ℓ)	0.09	0.45
Iron	µg Fe/ℓ	83A	Not specified	2 053	1 210
Lead	µg Pb/ℓ	83A	≤0.2 µg/ℓ (≤0.0002 mg/ℓ)	**0.55**	**0.49**
Manganese	µg Mn/ℓ	83A	≤ 180 µg/ℓ (≤0.18 mg/ℓ)	96	**313**
Mercury	µg Hg/ℓ	83A	≤0.04 µg/ℓ (≤0.00004 mg/ℓ)	**0.15**	**0.16**
Nickel	µg Ni/ℓ	83A	Not specified	7.12	27
Nitrate	mg N/ℓ	65Gc	Not specified	19.5	6.31
Nitrite	mg N/ℓ	65Gb	Not specified	<0.01	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	Not specified	1.8	0.58
pH at 25°C	pH units	1A	Not specified	7.1	6.9
Selenium	µg Se/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	0.50	0.45
Sodium	mg Na/ℓ	84	Not specified	59	73
Standard Plate Count	colonies/mℓ	31	Not specified	>10 000	>10 000
Sulphate	mg SO_4/ℓ	67G	Not specified	32.3	93.4
Total Chromium	µg Cr/ℓ	83A	Not specified	37	38
Total Coliforms	colonies/100mℓ	31	Not specified	380	37 000
Total Dissolved Solids at 180°C	mg/ℓ	41	Not specified	272	502
Total Organic Carbon*	mg C/ℓ	-	Not specified	7.1#	10#
Total Phenols*	µg/ℓ	-	30	2	24
Turbidity	NTU	4	Not specified	18	39
Uranium	µg U/ℓ	83A	Not specified	<0.1	0.31
Zinc	µg Zn/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	**17.7**	**4 782**

Determinand	Units	Method No	Target Water Quality Range (TWQR)	Results 015452/19 PHINDA POWER DOWNSTREAM WS05
Aluminium	µg Al/ℓ	83A	≤5 µg/ℓ (≤0.005 mg/ℓ)	**73**
Ammonia	mg N/ℓ	64G	≤7 µg/ℓ (≤0.007 mg/ℓ)	**0.46**
Antimony	µg Sb/ℓ	83A	Not specified	<0.12
Arsenic	µg As/ℓ	83A	≤10 µg/ℓ (≤0.01 mg/ℓ)	0.30
Barium	µg Ba/ℓ	83A	Not specified	27
Boron	µg B/ℓ	83A	Not specified	69
Cadmium	µg Cd/ℓ	83A	≤0.15 µg/ℓ (≤0.00015 mg/ℓ)	**0.96**
Chloride	mg Cl/ℓ	16G	Not specified	400
Coliphages*	PFU/10mℓ	-	Not specified	0#
Colour*	mg Pt-Co/ℓ	48	Not specified	31
Copper	µg Cu/ℓ	83A	≤0.3 µg/ℓ (≤0.0003 mg/ℓ)	**5.48**
Cyanide*	µg CN/ℓ	-	≤1µg/ℓ (≤0.001 mg/ℓ)	**3**
E.coli	colonies/100mℓ	31	Not specified	3
Electrical Conductivity at 25°C	mS/m	2A	Not specified	143
Fluoride	mg F/ℓ	18G	≤750 µg/ℓ (≤0.75 mg/ℓ)	**0.82**
Iron	µg Fe/ℓ	83A	Not specified	359
Lead*	µg Pb/ℓ	83A	≤0.2 µg/ℓ (≤0.0002 mg/ℓ)	0.08
Manganese*	µg Mn/ℓ	83A	≤ 180 µg/ℓ (≤0.18 mg/ℓ)	**386**
Mercury	µg Hg/ℓ	83A	≤0.04 µg/ℓ (≤0.00004 mg/ℓ)	**0.14**
Nickel	µg Ni/ℓ	83A	Not specified	27
Nitrate	mg N/ℓ	65Gc	Not specified	1.25
Nitrite	mg N/ℓ	65Gb	Not specified	<0.01
Combined Nitrate + Nitrite (sum of Ratios)*	-	-	Not specified	0.12
pH at 25°C	pH units	1A	Not specified	6.9
Selenium	µg Se/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	<0.24
Sodium	mg Na/ℓ	84	Not specified	314
Standard Plate Count	colonies/mℓ	31	Not specified	>10 000
Sulphate	mg SO_4/ℓ	67G	Not specified	70.2
Total Chromium	µg Cr/ℓ	83A	Not specified	39
Total Coliforms	colonies/100mℓ	31	Not specified	2 100
Total Dissolved Solids at 180°C	mg/ℓ	41	Not specified	870
Total Organic Carbon*	mg C/ℓ	-	Not specified	4.6#
Total Phenols*	µg/ℓ	-	30	<2
Turbidity	NTU	4	Not specified	8.0
Uranium	µg U/ℓ	83A	Not specified	<0.1
Zinc	µg Zn/ℓ	83A	≤2 µg/ℓ (≤0.002 mg/ℓ)	**92**

Comments:

1. The parameters tested on the sample submitted (lab number 015448/19) conform to the SANS 241:2015 requirements for drinking water, with the exception of aluminium, chloride, colour, *E.coli,* iron, manganese, sodium, standard plate count, total coliforms, total organic carbon and turbidity.

2. The parameters tested on the sample submitted (lab number 015448/19) conform to the Target Water Quality Ranges for Aquatic Ecosystems, with the exception of aluminium, ammonia, copper, fluoride, lead, manganese, mercury and zinc.

3. The parameters tested on the sample submitted (lab number 015449/19) conform to the SANS 241:2015 requirements for drinking water, with the exception of aluminium, chloride, colour, *E.coli,* iron, manganese, nitrate, combined nitrate + nitrite, sodium, standard plate count, total coliforms, total organic carbon and turbidity.

4. The parameters tested on the sample submitted (lab number 015449/19) conform to the Target Water Quality Ranges for Aquatic Ecosystems, with the exception of aluminium, ammonia, copper, cyanide, fluoride, lead, manganese, mercury and zinc.

5. The parameters tested on the sample submitted (lab number 015450/19) conform to the SANS 241:2015 requirements for drinking water, with the exception of colour, iron, nitrate, combined nitrate + nitrite, standard plate count, total coliforms and turbidity.

6. The parameters tested on the sample submitted (lab number 015450/19) conform to the Target Water Quality Ranges for Aquatic Ecosystems, with the exception of aluminium, copper, cyanide, lead, mercury and zinc.

7. The parameters tested on the sample submitted (lab number 015451/19) conform to the SANS 241:2015 requirements for drinking water, with the exception of aluminium, ammonia, cadmium, coliphages, colour, *E.coli*, standard plate count, total coliforms, total phenols and turbidity.

8. The parameters tested on the sample submitted (lab number 015451/19) conform to the Target Water Quality Ranges for Aquatic Ecosystems, with the exception of aluminium, cadmium, copper, cyanide, lead, mercury, manganese and zinc.

9. The parameters tested on the sample submitted (lab number 015452/19) conform to the SANS 241:2015 requirements for drinking water, with the exception of chloride, colour, *E.coli*, sodium, standard plate count, total coliforms and turbidity.

10. The parameters tested on the sample submitted (lab number 015452/19) conform to the Target Water Quality Ranges for Aquatic Ecosystems, with the exception of aluminium, ammonia, cadmium, copper, cyanide, fluoride, manganese, mercury and zinc.

General Comments 1 (Water Quality Guidelines for Aquatic Ecosystems):

- All levels should be below the Chronic Effect Value to ensure protection of ecosystems.
- Elevated levels of Aluminium are toxic to a variety of organisms.
- Elevated levels of Copper are toxic at low concentrations in water and can cause brain damage in mammals.
- Cyanide interferes with aerobic respiration and is consequently toxic to aerobic organisms like fish and other vertebrates.
- Mercury is severely poisonous to mammals because of its neuro and renal toxicity.
- Zinc levels can contribute to reduced fitness, oedema, liver necrosis and death.
- Lead is a toxic metal which accumulates readily in living tissue. Certain fish develop spinal deformities after lead exposure in soft water.

General Comments 2 (SANS 241-1:2015 RECOMMENDED LIMITS):

- The aluminium level exceeds the SANS recommended limit of <300µg Al/ℓ. The main effects of aluminium in domestic water are aesthetic, relating to discolouration in the presence of iron and manganese.
- The chloride content of the water is above the limit of 300 mg Cl/ℓ recommended by the SANS specification for drinking water. Increasing levels of chloride in water can cause a health risk to sensitive groups and gives the water a distinctive salty taste.
- The colour of the water exceeds the SANS limit of 15 mg Pt-Co/ℓ for drinking water. Colour in water can be of natural mineral origin or it may be as an industrial result of effluents containing soluble coloured materials (discharges from pulp and paper, and textile industries). The presence of iron and manganese can also cause a natural brown discolouration in water.
- The presence of *E.coli* shows faecal contamination and renders this water unsuitable for human consumption unless properly disinfected.
- The iron content of the water exceeds the limit of 2000 µg Fe/ℓ recommended by the SANS 241 specifications for drinking water. This concentration of iron in water has increasing effects in sensitive groups and can cause objectionable taste and appearance.
- The turbidity of the water exceeds the SANS limit of <5 NTU and is one of the indirect indicators of microbiological water quality and of inefficient water treatment. The presence of turbidity in water results in a cloudy or muddy appearance, and may also affect taste and colour of the water.
- The sodium content of the water exceeds the SANS limit of 200 mg Na/ℓ. Excessive intake of sodium salts can cause possible health risks, particularly in sensitive health groups and excessive sodium in the water can impart a salty taste to the water.
- At these levels, manganese causes off-putting tastes and brown discolouration of the water. Severe staining of clothes and fixtures can occur.
- The nitrate result on this sample is higher than the SANS specification of 11 mg N/ℓ but lower than 20mg/ℓ where we would see slight chronic risk to some babies. High nitrate causes methaemoglobanaemia, which reduces the oxygen carrying capacity of the blood. This especially affects young children and the aged.

Quality Assurance

Technical signatories

Chemistry: Dr. Abie Khan

Microbiology: Jocelyn Winchester

Notes to this report

Limitations

This report shall not be reproduced except in full without prior written approval of the laboratory.
Results in this report relate only to the samples as taken, and the condition received by the laboratory.
Any opinions and interpretations expressed herein are outside the scope of SANAS accreditation.
The decision rule applicable to this laboratory is available on request.
Sample preparation may require filtration, dilution, digestion or similar. Final results are reported accordingly. Customers to contact Talbot Laboratories for further information.

Uncertainty of measurement

Talbot Laboratories' Uncertainty of Measurement (UoM) values are:

- Identified for relevant tests in the attached Appendix.
- Calculated as a percentage of the respective results.
- Applicable to total, dissolved and acid soluble metals for ICP element analyses.
- Available upon request for microbiological results.
- Available upon request for subcontracted tests.

Analysis explanatory notes

Tests may be marked as follows:

^	Tests conducted at our Port Elizabeth satellite laboratory.
*	Tests not included in our Schedule of Accreditation and therefore that are not SANAS accredited.
#	Tests that have been sub-contracted to a peer laboratory.
NR	Not required -shown, for example, where the schedule of analysis varied between samples.
σ	Field sampling point on-site results.
a	Testing has deviated from Method.

Appendix 1: Uncertainty of Measurement (UoM)

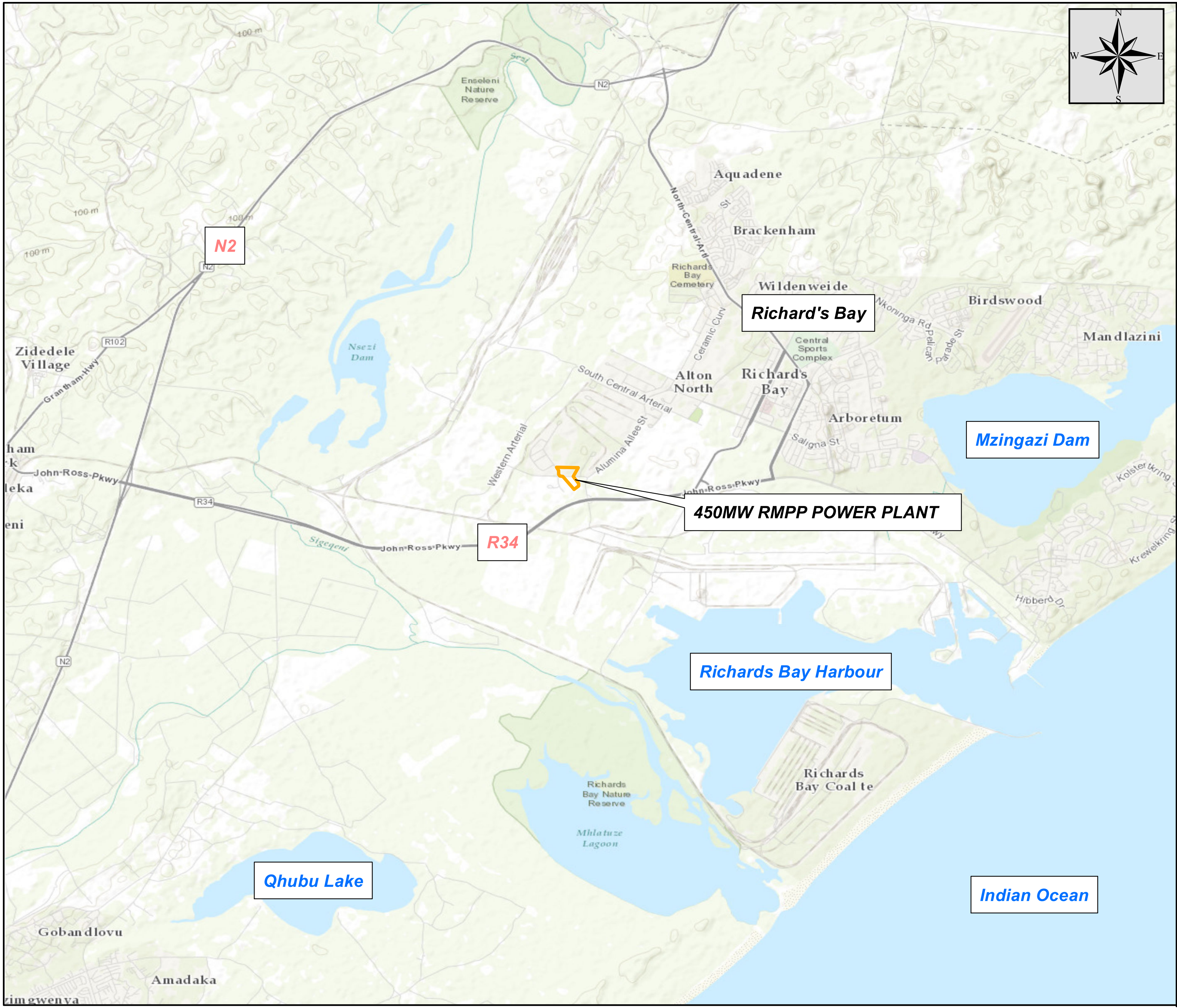
Determinands	Method No	Uncertainty of Measurement (%)	Determinands	Method No	Uncertainty of Measurement (%)
Alkalinity (Total)	10	± 3.49	Magnesium (OES)	85	± 5.38
Alkalinity (Total)	10G	± 4.39	Mercury (ICP-MS)	83A	± 16.32
Ammonia	64G	± 6.29	Mercury (ICP-OES)	86	± 10.54
Aluminium (ICP-MS)	83A	± 20.62	Molybdenum (ICP-MS)	83A	± 11.08
Aluminium (ICP-OES)	87	± 8.09	Molybdenum (ICP-OES)	87	± 15.20
Antimony (ICP-MS)	83A	± 17.73	Nickel (ICP-MS)	83A	± 10.00
Antimony (ICP-OES)	87	± 30.16	Nickel (ICP-OES)	87	± 8.06
Arsenic (ICP-MS)	83A	± 12.04	Nitrate/Nitrite	65Ga	± 12.55
Arsenic (ICP-OES)	87	± 20.17	Nitrite	65Gb	± 12.83
Barium (ICP-MS)	83A	± 12.29	Nitrate	65Gc	± 12.55
Barium (ICP-OES)	87	± 10.25	Oxygen Absorbed	39	± 6.37
Beryllium (ICP-MS)	83A	± 23.10	Potassium (ICP-OES)	85	± 15.20
Beryllium (ICP-OES)	87	± 7.96	Orthophosphate	66G	± 11.76
Boron (ICP-MS)	83A	± 24.83	Phosphate (Total)	90	± 9.16
Boron (ICP-OES)	87	± 17.33	pH Value 25°C	1A	± 1.22
Cadmium (ICP-MS)	83A	± 9.59	Selenium (ICP-MS)	83A	± 21.40
Cadmium (ICP-OES)	87	± 7.69	Selenium (ICP-OES)	88	± 31.56
Calcium (ICP-OES)	85	± 5.09	Silver (ICP-MS)	83A	± 11.35
Chromium (ICP-MS)	83A	± 8.45	Sodium (ICP-OES)	84	± 8.99
Chromium (ICP-OES)	87	± 8.13	Strontium (ICP-MS)	83A	± 10.55
Cobalt (ICP-MS)	83A	± 8.39	Strontium (ICP-OES)	87	± 8.29
Cobalt (ICP-OES)	87	± 7.83	Sulphate	67G	± 6.96
Copper (ICP-MS)	83A	± 8.36	Suspended Solids	5	± 3.72
Copper (ICP-OES)	87	± 7.77	Thallium (ICP-MS)	83A	± 12.51
Chemical Oxygen	3	± 16.04	Thallium (ICP-OES)	87	± 8.57
Chloride	16G	± 3.56	Tin (ICP-MS)	83A	± 12.17
Electrical Conductivity	2A	± 2.87	Tin (ICP-OES)	87	± 12.39
Fluoride	18G	± 17.67	Titanium (ICP-OES)	87	± 7.20
Hexavalent Chromium	68G	± 5.36	Total Dissolved Solids	41	± 1.29
Iron (ICP-MS)	83A	± 14.03	Total Solids at 105°C	59	± 0.59
Iron (ICP-OES)	87	± 7.83	Turbidity	4	± 4.60
Lead (ICP-MS)	83A	± 10.64	Uranium (ICP-MS)	83A	± 12.13
Lead (ICP-OES)	87	± 8.18	Uranium (ICP-OES)	87	± 7.26
Lithium (ICP-MS)	83A	± 20.65	Vanadium (ICP-MS)	83A	± 10.17
Lithium (ICP-OES)	87	± 6.79	Vanadium (ICP-OES)	87	± 7.18
Manganese (ICP-MS)	83A	± 10.71	Zinc (ICP-MS)	83A	± 22.86
Manganese (ICP-OES)	87	± 8.01	Zinc (ICP-OES)	87	± 7.41

Determinands	Method No	Uncertainty of Measurement (%)
Total Hydrocarbons	101	± 22.76
Vinyl Chloride	100	± 23.42
Bromomethane	100	± 22.89
Ethyl Chloride	100	± 23.25
1,1-Dichloroethylene	100	± 20.00
Trans1,2-Dichlororethylene	100	± 19.22
Tert-Butylmethyl Ether (MTBE)	100	± 22.90
1,1-Dichloroethane	100	± 17.24
Cis-1,2-Dichloroethylene	100	± 22.06
Chloroform (THM)	100	± 18.67
2,2-Dichloropropane	100	± 19.27
1,2-Dichloroethane	100	± 15.27
1,1,1-Trichloroethane	100	± 21.72
1,1-Dichloropropene	100	± 20.33
Carbon Tetrachloride	100	± 19.86
Benzene (BTEX)	100	± 22.33
Dibromomethane	100	± 18.63
1,2-Dichloropropane	100	± 18.26
Trichloroethylene	100	± 21.76
Bromodichloromethane (THM)	100	± 15.31
Trans-1,3-Dichloropropene	100	± 14.50
Cis-1,3-Dichloropropene	100	± 15.77
1,1,2-Trichloroethane	100	± 16.46
Toluene (BTEX)	100	± 24.36
1,3-Dichloropropane	100	± 15.78
Dibromochloromethane (THM)	100	± 18.00
1,2-Dibromoethane	100	± 14.72

Determinands	Method No	Uncertainty of Measurement (%)
Tetrachloroethylene	100	± 17.04
1,1,1,2-Tetrachloroethane	100	± 21.13
Chlorobenzene	100	± 16.08
Ethylbenzene (BTEX)	100	± 20.59
m,p-Xylene (BTEX)	100	± 24.59
Styrene	100	± 18.91
Bromoform (THM)	100	± 19.74
1,1,2,2-Tetrachloroethane	100	± 24.71
o-Xylene (BTEX)	100	± 23.70
1,2,3-Trichloropropane	100	± 22.64
Isopropylbenzene	100	± 21.01
Bromobenzene	100	± 19.61
n-Propylbenzene	100	± 24.17
2-Chlorotoluene	100	± 22.92
4-Chlorotoluene	100	± 22.11
1,3,5-Trimethylbenzene	100	± 18.19
Tert-Butylbenzene	100	± 18.74
1,2,4-Trimethylbenzene	100	± 24.08
Sec-Butylbenzene	100	± 20.11
1,3-Dichlorobenzene	100	± 24.31
1,4-Dichlorobenzene	100	± 24.31
1,2-Dichlorobenzene	100	± 20.31
n-Butylbenzene	100	± 14.50
1,2,4-Trichlorobenzene	100	± 18.90
Naphthalene	100	± 23.66
Hexachlorobutadiene	100	± 18.39
1,2,3-Trichlorobenzene	100	± 24.70

End of Report

FIGURES



Meters

0 800 1 600 3 200

LEGEND:

SITE LOCATION

DAVIES LYNN & PARTNERS

CLIENT:

PHINDA POWER PRODUCERS (PTY) LTD.

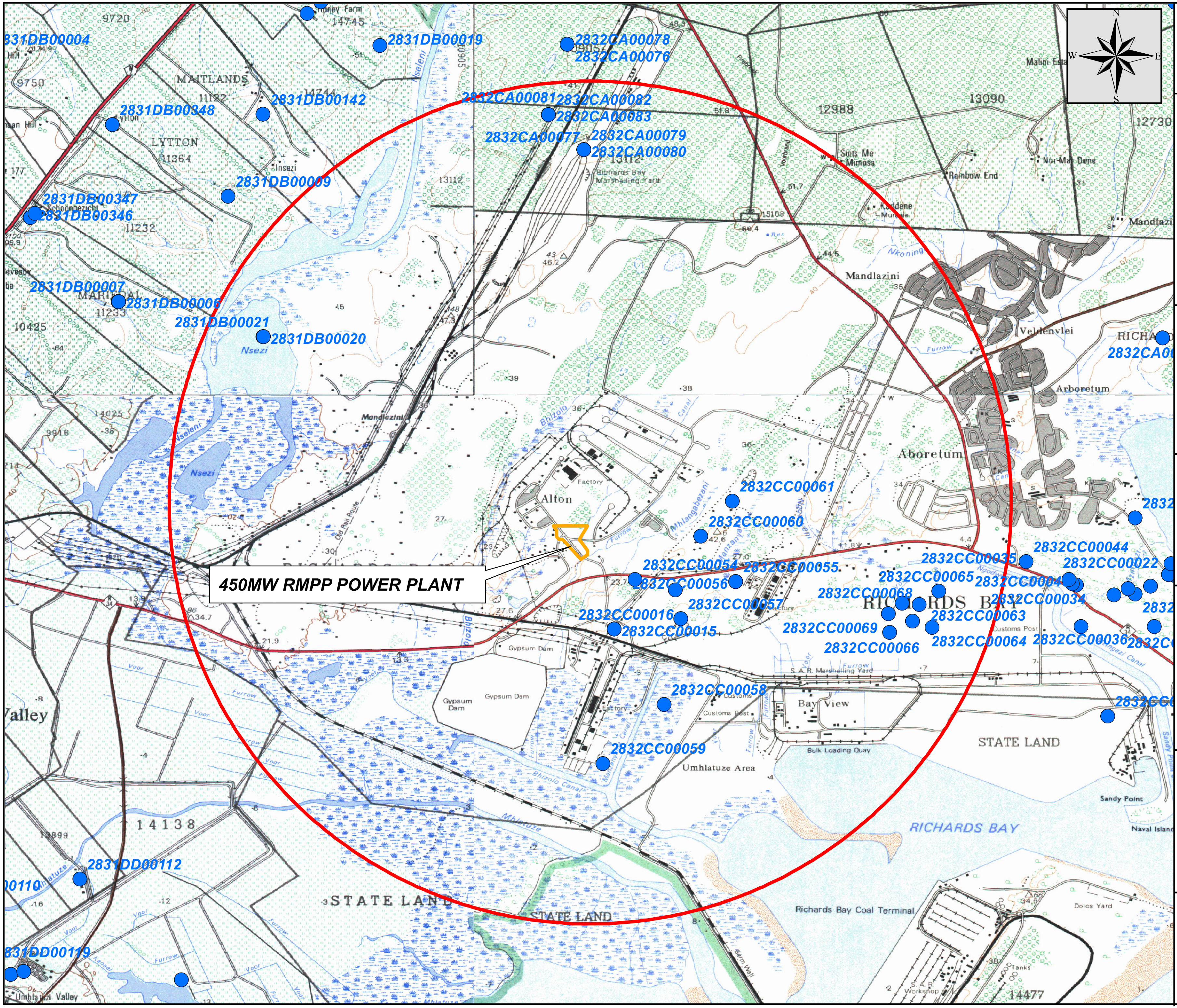
JOB TITLE:

450MW EMERGENCY RISK MITIGATION POWER PLANT (RMPP)

FIGURE TITLE:

LOCALITY PLAN

JOB NO.	FIGURE NO.
18 / 3388 - 01A - GH	**FIGURE A**



Meters

0 500 1 000 2 000

LEGEND:

SITE LOCATION

NGA BH DATABASE

5KM RADIUS

DAVIES LYNN & PARTNERS

CLIENT:

PHINDA POWER PRODUCERS (PTY) LTD.

JOB TITLE:

450MW EMERGENCY RISK MITIGATION POWER PLANT (RMPP)

FIGURE TITLE:

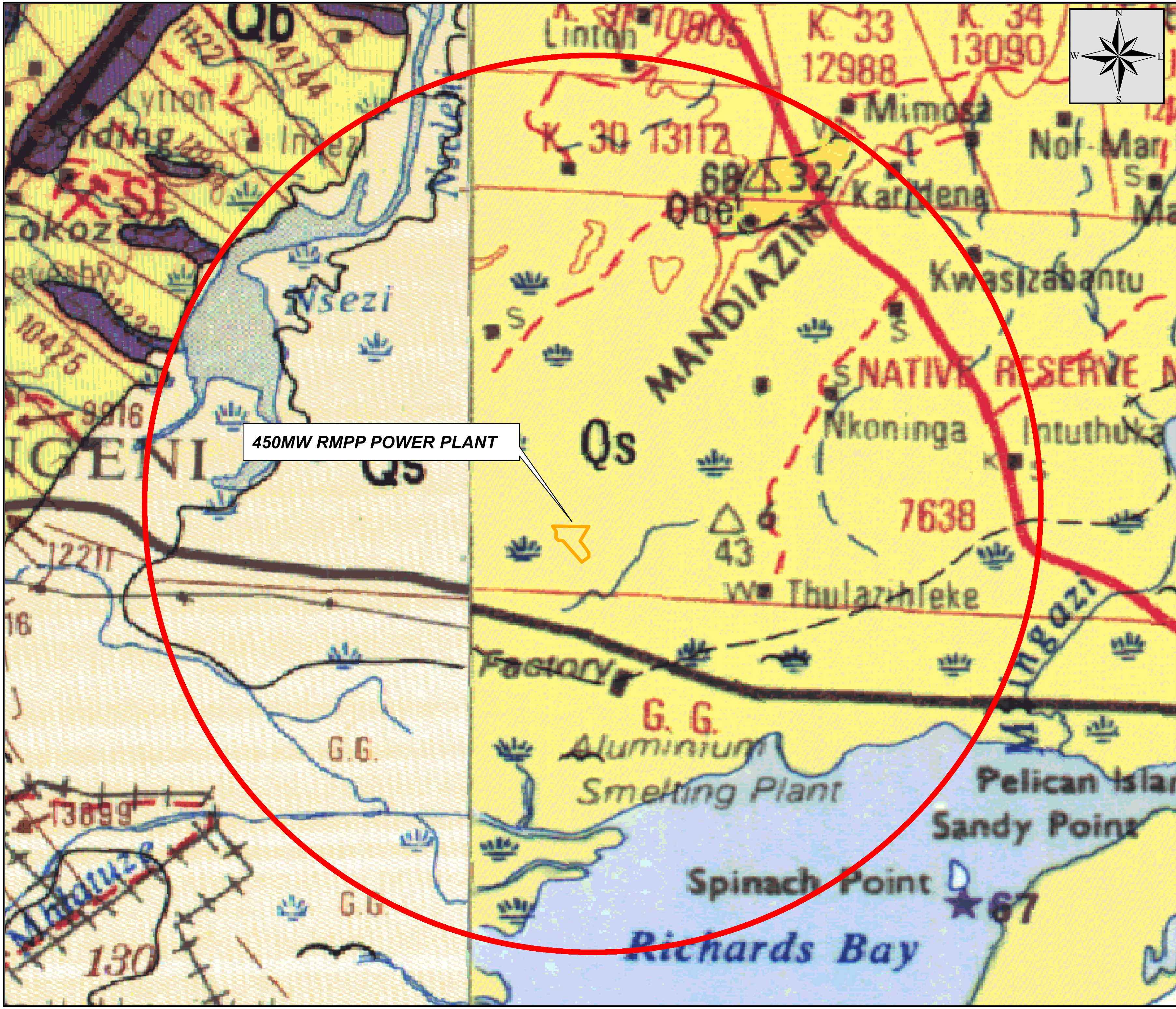
HYDROCENSUS DATA

JOB NO.

18 / 3388 -01A - GH

FIGURE NO.

FIGURE B



0 480 960 1 920 Meters

LEGEND:

- SITE LOCATION
- 5KM RADIUS
- Qs QUATERNARY SANDS
- Qb BLUFF FORMATION
- Zl LUBANA FORMATION

DAVIES LYNN & PARTNERS

CLIENT:

PHINDA POWER PRODUCERS (PTY) LTD.

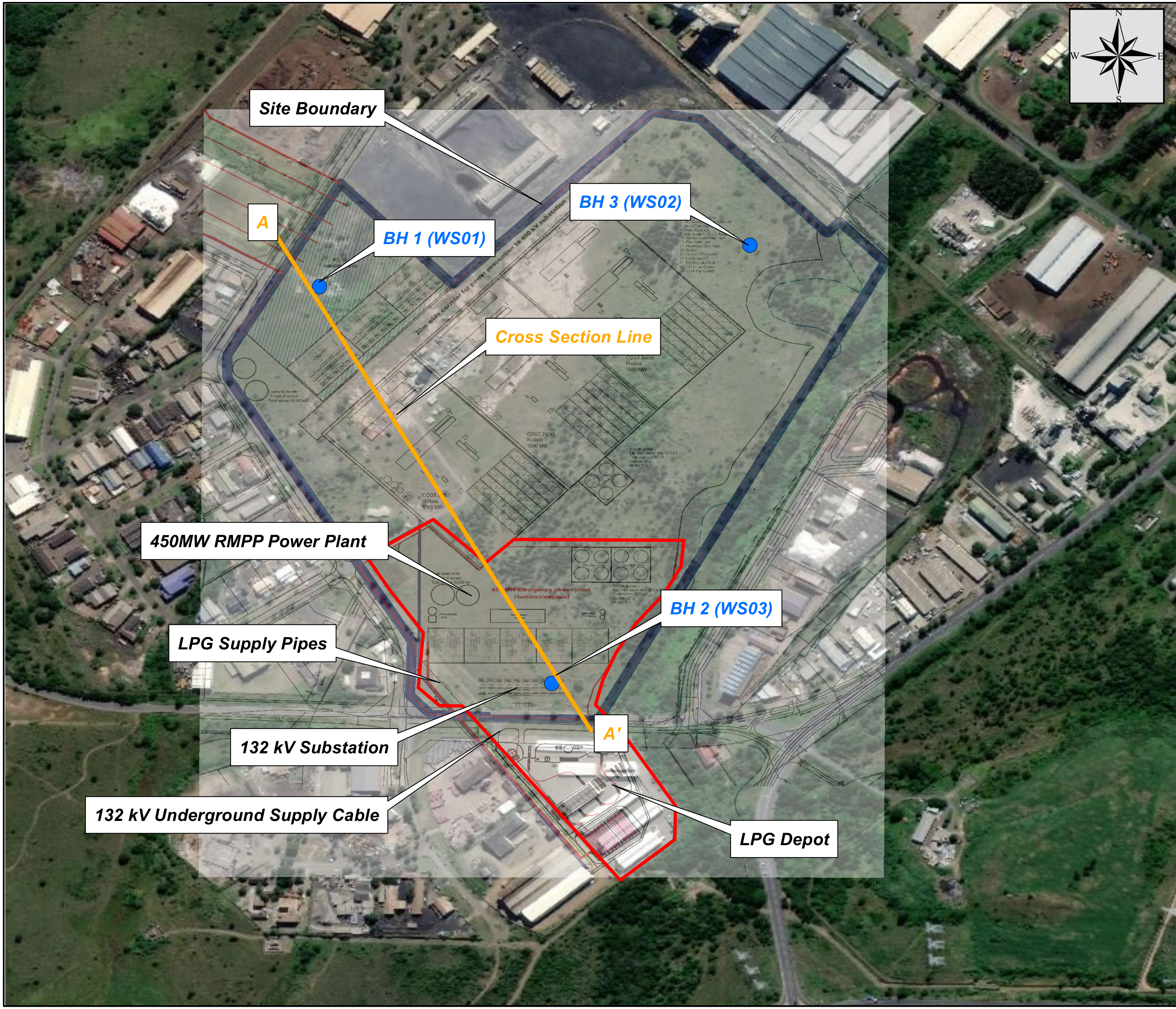
JOB TITLE:

450MW EMERGENCY RISK MITIGATION POWER PLANT (RMPP)

FIGURE TITLE:

GEOLOGICAL PLAN

JOB NO.	FIGURE NO.
18 / 3388 -01A - GH	**FIGURE C**



Meters
0 60 120 240

LEGEND:

GROUNDWATER SAMPLE

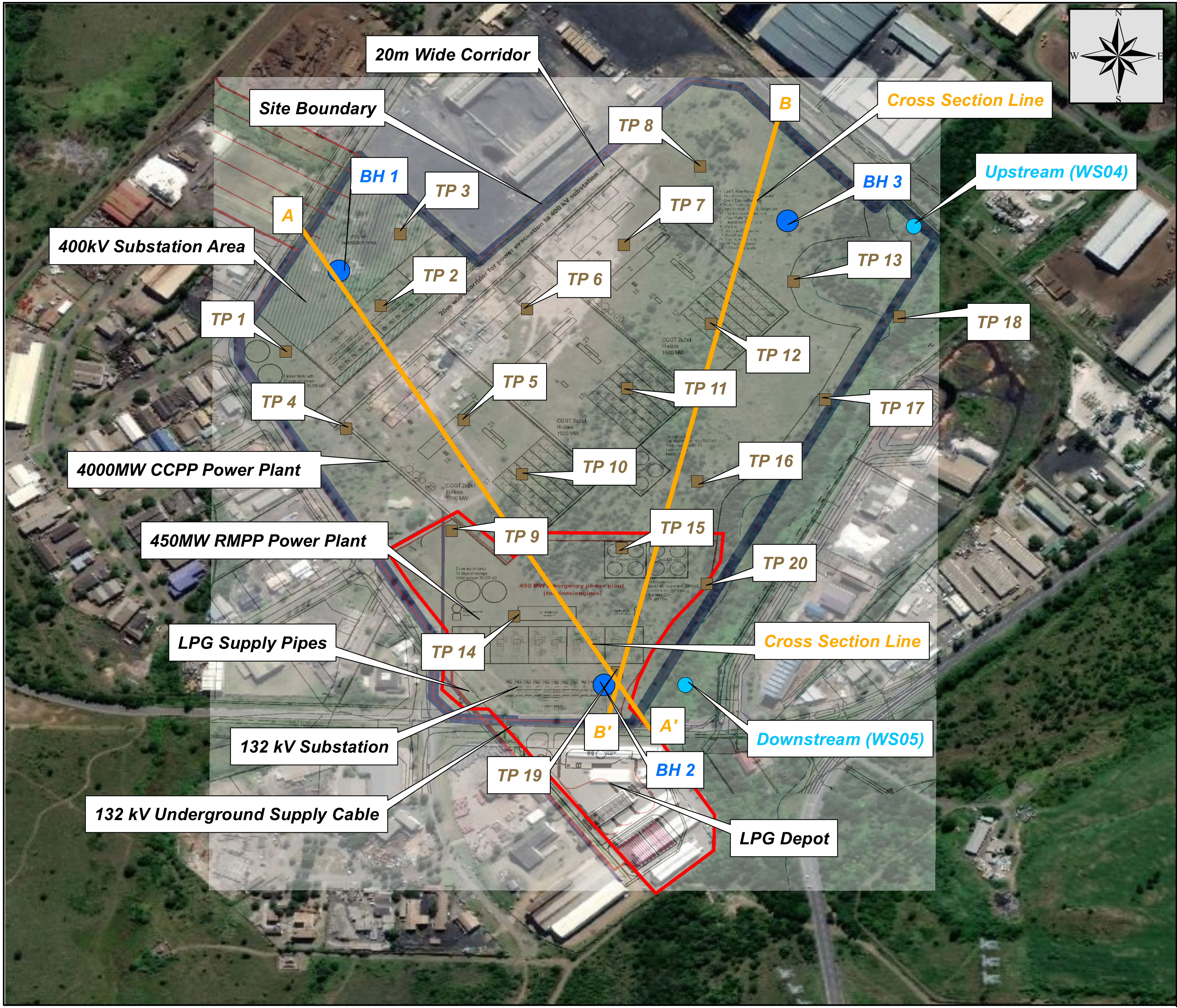
DAVIES LYNN & PARTNERS

CLIENT:
PHINDA POWER PRODUCERS (PTY) LTD.

JOB TITLE:
450MW EMERGENCY RISK MITIGATION POWER PLANT (RMPP)

FIGURE TITLE:
GROUNDWATER SAMPLING PLAN

JOB NO.	FIGURE NO.
18 / 3388 -01A - GH	**FIGURE D1**



LEGEND:

- SURFACE WATER SAMPLE
- GROUNDWATER SAMPLE
- IP / DCP POSITIONS

DAVIES LYNN & PARTNERS

CLIENT:

PHINDA POWER PRODUCERS (PTY) LTD.

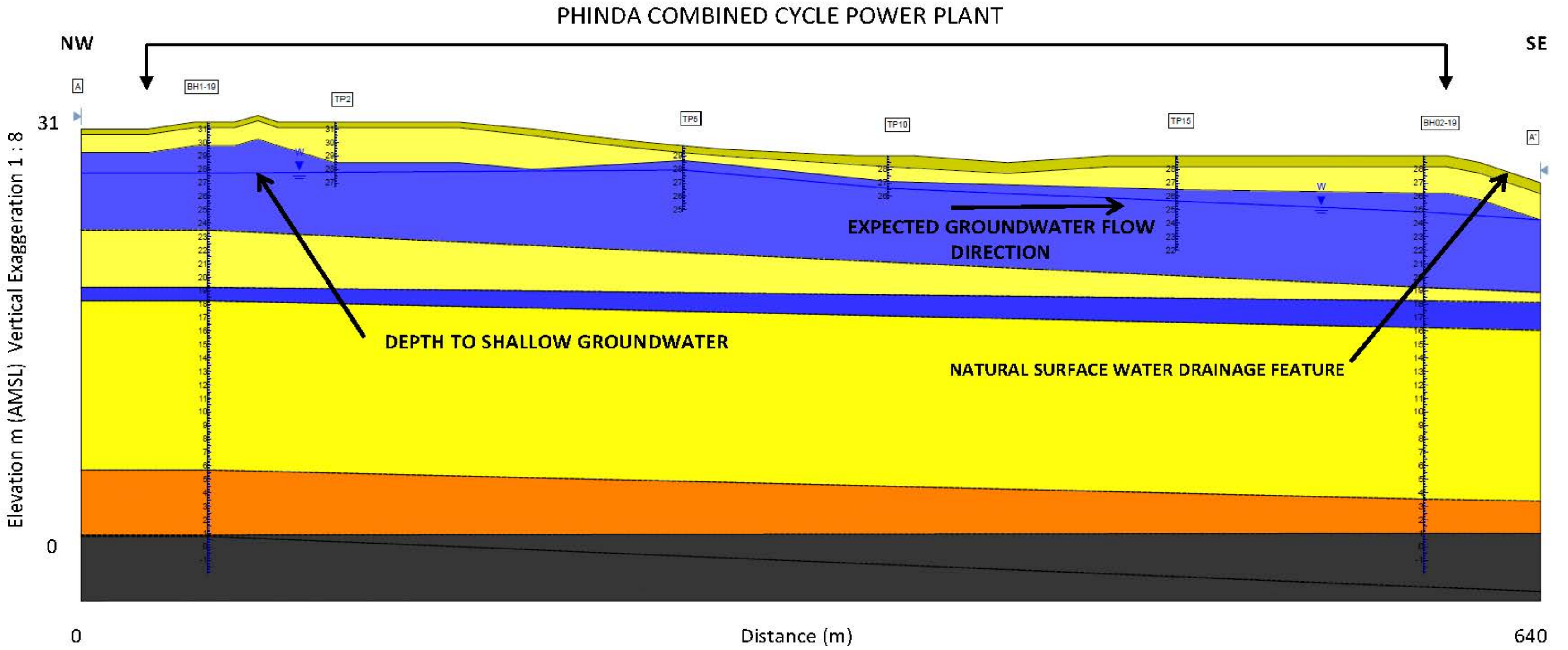
JOB TITLE:

450MW RMPP AND 4000MW CCPP FACILITIES

FIGURE TITLE:

OVERALL SOIL, SURFACE WATER AND GROUNDWATER SAMPLING PLAN

JOB NO.	FIGURE NO.
18 / 3388 -01A - GH	FIGURE D2



LEGEND:

Material Name	Color
SAND 1	
SAND 2	
CLAY 1	
SAND 3	
CLAY 2	
SAND 4	
ULOA FORMATION	
ST LUCIA FORMATION	

DAVIES LYNN & PARTNERS

CLIENT:

PHINDA POWER PRODUCERS (PTY) LTD.

JOB TITLE:

450MW EMERGENCY RISK MITIGATION POWER PLANT (RMPP)

FIGURE TITLE:

CONCEPTUAL SITE MODEL

JOB NO.	FIGURE NO.
18 / 3388 -01A - GH	**FIGURE E**