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PROGRESS REPORT TECHNICAL MEMORANDUM

Date: 29th March 2019
Reference No.: KIM-WAT-2017-208_Mem03

To: Thato Mashinini
Metsweding Consulting Engineers
15 Platinum Sunrise
Bloemfontein
9300

From: Collen Monokofala
Cc: Kagiso Ositang
Goitsemodimo Olifants

PROGRESS REPORT ON GROUNDWATER INVESTIGATIONS FOR OLIFANTSHOEK GROUNDWATER SOURCE VERIFICATION - GAMAGARA LOCAL MUNICIPALITY

1. PROJECT BACKGROUND

Kimopax (Pty) Ltd (herein referred to as Kimopax) was appointed by Metsweding Consulting Engineers (Pty) Ltd (herein referred to as Metsweding) to conduct hydrogeological investigations to develop groundwater sources within the Olifantshoek communities. This includes hydrogeological investigation activities such as hydrocensus, pumping tests of existing boreholes, geophysical surveys, exploration drilling and water quality assessments and issuing of borehole management recommendations.

This document lists activities undertaken since the project inception to the 29th March 2019.

2. PROJECT OBJECTIVES

The main objectives were to verify the sustainable yields of existing potential production boreholes, understand and manage the groundwater resources on a sustainable basis, and establish additional sources that will meet projected water demands for Olifantshoek communities.

3. SCOPE OF WORK

The scope of work for the reporting period:

a) Desktop study and remote sensing;
b) Geophysical surveys using magnetic and electromagnetic techniques

c) Selection of drilling sites;
d) Exploration borehole drilling;
e) Pumping tests of newly drilled boreholes and
f) Compile progress report.

4. PROGRESS UP TO DATE

4.1 Desktop Study and Remote Sensing

Collation of available data (geophysical field data, borehole logs, test pumping data and water quality data) concerning the project area was assessed. This information provided valuable background data to assist in the planning of the field work and, importantly, duplication of work was avoided.

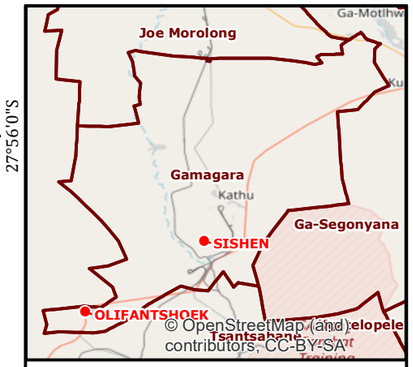
The following specific and relevant activities were being undertaken under this task:

a) Collate and update existing groundwater information obtained from the National Groundwater Archives (NGA), our in-house database and previous study reports.
b) Valuable existing test pumping data exist of which those for higher yielding boreholes will be captured for assessment of aquifer parameters.
c) Compile GIS layers and base maps, including high resolution Google image
d) Detailed remote sensing to identify areas of potentially enhanced groundwater occurrence such as lineaments, dykes and faults.

22°44'0"E 22°44'30"E 22°45'0"E 22°45'30"E

27°56'0"S 27°56'30"S 27°57'0"S

Postmasburg NU
Olifantshoek SP
Ditloung SP
D3332
Sixth St
Perry St
N14
Warren St
BH01
BH02
BH03
BH04 (Police Station)
BH05 (Farm)
BH06 (Municipal Office)
BH07 (Hospital)
BH08 (School)



LEGEND

- Hydrocensus data
- Village

0 50 100 200 300 400 500 Meters

N

REFERENCE: Transverse Mecartor (Gauss-Kruger)
WGS84 Ellipsoid
Hartebeesthoek 94 Datum
Central Meridian 23º

PROJECT: OLIFANTSHOEK

TITLE: SATELLITE MAP OF OLIFANTSHOEK

PROJECT No.		KIM-WAT-2017-208
SCALE	1:10 000	A3
GIS	CSG	01/04/2019
CHECK	CM	01/04/2019
REVIEW		01/04/2019

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4.2 Borehole Pump Testing

Borehole and aquifer testing is done to provide a background understanding of the distribution of groundwater in the study area, to determine hydraulic parameters in the water strata, define the distribution of aquifers and determine sustainable borehole yields. During the hydrocensus, seven boreholes were identified as potential production boreholes (with reported yields in excess of 0.5 l/s to 5.0 l/s for 12 hours), six (BH01, BH02, BH04, BH05, BH06 and BH07) of these were subjected for borehole and aquifer testing. Borehole BH03 was blocked with stones and was not subjected to pumping test.

4.2.1 Test Pumping Results

A Step Discharge Test (SDT) is carried out before the Constant Discharge Test (CDT). Water level recovery measurements were taken for the full pumping period of the step test and constant discharge tests of each borehole. During the SDT's if the last discharge rate reached pump inlet the yield at pump-inlet was measured as listed in Table 2.

Borehole test pumping is summarized as follows:

a) Number of boreholes Tested 6
b) Number of SDT's 6
c) Number of 12 hour CDT's 3
d) Number of 24 hour CDT's 2

Six (6) boreholes (BH01, BH02, BH04, BH05, BH06 and BH07) were subjected to pump testing. A Step Discharge Test (SDT) was carried out before the Constant Discharge Test (CDT). Water level recovery measurements were taken for the full pumping period of the step test and constant discharge tests of each borehole. Summary of the pump testing programme is listed in Table 1 and location shown in Figure 2.

Figure 2: Location of tested boreholes

Table 1: Summary of the pump testing programme

Borehole Number	Latitude	Longitude	Borehole Depth (m)	Measured WL (mbgl)	Borehole -Testing						
					NO: SDT	Date	Test Type	Final SDT Yield	PI	CDT Yield	CDT Duration
						Completed	SDT/CDT	l/s	l/s	l/s	hrs
BH01	-27.94298	22.75660	105.00	19.22	4	24/01/2018	CDT	1.91	0.68	0.60	12
BH02 (G57NC)	-27.94337	22.76092	120.00	23.30	2	24/01/2019	No CDT	0.70	0.34	--	--
BH03	-27.95027	22.74128	Not Test	--	--	--	--	--	--	--	--
BH04 (Police Station)	-27.94742	22.73772	78.10	24.40	5	29/01/2018	CDT	6.55	--	5.00	24
BH05 (Farm)	-27.94865	22.73263	102.00	16.94	3	26/01/2018	CDT	1.01	0.51	0.50	12
BH06 (Municipal Office)	-27.93828	22.73764	76.46	19.45	4	02-Jan-18	CDT	7.00	--	6.50	24
BH07 (Hospital)	-27.93755	22.73457	85.00	33.86	3	23/03/2019	CDT	1.02	0.65	0.52	12

4.2.2 Preliminary Borehole Management Recommendations

The FC-method aquifer testing software for estimation of aquifer parameters and sustainable borehole yields was used to interpret the pump testing data. The software includes various methods and aquifer boundary conditions. Methods used include the basic FC, Cooper-Jacob and Barker-Bangoy. Detailed pump testing graphs and borehole management recommendations are attached at the end of this document (Appendix A).

In the assessment of safe borehole yields the following conservative assumptions or provisions were made:

a) Recommended abstraction of other production boreholes within 500 m radius
b) Available drawdown >7 m
c) Effective recharge of 0.0 mm/a for 2 year extrapolation period

A summary of the borehole testing results and recommended safe yields is given in

Table **2**. Detailed borehole management recommendations are presented in Appendix B. It should be noted that for the proposed production boreholes the water level recovery tests were good with 90% to 100% recovery achieved within pumping time.

The preliminary borehole management recommendations from the four tested boreholes indicate that the combined yield amounts to **9.4 l/s** daily which is equivalent to **406,080 l/s** per day which can supply a total population of ***5 076 per day using 80 l/p/d***.

Table 2: Borehole management recommendations (Existing Boreholes)

Borehole No.			Depth (m)	SWL (m)	Water Quality			Management Recommendation					
	Latitude	Longitude			EC (mg/l)	N (mg/l)	DWA (class)	Yield (l/s)	Duty (hrs/day)	Pump Set	T (m2/d)	Dynamic WL	Comments
BH01	-27.94298	22.75660	105.00	19.22	55.6	1.6	Class I	0.5	12	80	2.3	47	Production Borehole
BH02 (G57NC)	-27.94337	22.76092	120.00	23.30	--	--	Class I	--	--	--	--	--	Low yielding borehole
BH03	-27.95027	22.74128	--	--	--	--	--	--	--	--	--	--	Borehole Destroyed
BH04 (Police Station)	-27.94742	22.73772	78.10	24.40	171	13	Class II	4.0	12	60	49.1	35	Production Borehole
BH05 (Farm)	-27.94865	22.73263	102.00	16.94	108	0.5	Class I	0.4	10	90	1.9	46	Standby Borehole
BH06 (Municipal Office)	-27.93828	22.73764	76.46	19.45	207	16	Class II	4.0	12	50	12.1	44	Production Borehole
BH07 (Hospital)	-27.93755	22.73457	85.00	33.86	--	--	Await Chem.	0.5	12				Production/Standby Borehole
Totals								**9.4**	**12**				

4.3 Hydrochemical Sampling

The water quality in the andesitic lava and quartzite aquifers is generally acceptable for human consumption with some elevated alkalinity in some areas. Sampling of all four tested boreholes was undertaken to primarily determine if the water is suitable for human consumption and to obtain an understanding of the water quality environment.

Water samples were collected at the end of the pump testing exercise and submitted to Water Lab (SANAS Accredited) for water quality analysis based on SANS 241 standards and DWAF guideline for domestic use.

Parameters analyzed during the water sampling are based on water quality guidelines for domestic and drinking water use. **Table 3** shows the list of main parameters analyzed together with other trace metals included in the Water Quality Standards.

Table 3: List of parameters analyzed

Physical Parameters	**Macro determinants**	**Micro determinants**
pH	Ammonium as NH_4	Aluminium (Al)
Electrical Conductivity (EC)	Calcium (Ca)	Antimony (Sb)
Total Dissolved Solids (TDS)	Chloride (Cl)	Arsenic (As)
Total Alkalinity	Fluoride (F)	Cadmium (Cd)
	Magnesium (Mg)	Total Chromium as Cr
	Nitrate as N	Copper (Cu)
	Potassium (K)	Total Fe (Fe)
	Sodium (Na)	Lead (Pb)
	Sulphate (SO_4)	Manganese (Mn)
	Zinc (Zn)	Nickel (Ni)

Four samples were collected at the end of each test and submitted to WaterLab in Pretoria (SANAS accredited laboratory) for analysis for the standard cations and anions, pH, conductivity, Fe and NO_3 as recommended in the SANS:241:2015 guidelines. The analytical results will be interpreted to determine the chemical quality of the groundwater and suitability for the intended use.

4.3.1 Water Quality Standards

The analytical results of the four groundwater samples were compared to the following standards;

a) Department of Water Affairs and Forestry, domestic water quality guidelines, volume 1,1996 and Water Research Commission, water quality guidelines, 1998; and
b) South African National Standards, drinking water standards, 2015 (SANS 241:2015).

The SANS 241:2015 drinking water standard is used as reference as it includes risk based elements, whereas the DWAF 1998 guidelines were used to classify and discuss the baseline water quality water quality classes discussing the baseline water quality (**Error! Reference source not found.**).

Table 4: DWAF Water Quality Classes (1998)

Water quality class	Description	Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users, but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

4.3.2 Groundwater Quality Results

The analytical results (major cations and anions) of the sampled borehole are listed in Table 5. All the sampled boreholes BH01, and BH05 returned class I water quality that is suitable for domestic use and human consumption long-term. BH04 and BH06 returned water quality that exceeds maximum allowable limit in comparison with the SANS241:2015 parameters, the elevated parameters include the electrical conductivity (EC), total dissolved solids (TDS), chloride (Cl), nitrate (N as NO3), calcium (Ca) and aluminium (Al).

Table 5: Summarized water quality results for Olifantshoek

Parameter	Maximum Allowable Limits (SANS241:2015	BH01	BH02	BH04	BH05	BH06
pH - Value @ 25 ºC	≥5 - ≤9.7	7.5		7.0	7.0	7.0
Electrical Conductivity in mS/m @ 25°C	≤170	55.6		171	108	207
Total Dissolved Solids @ 180°C mg/l	≤1200	376		1098	730	1324
Total Alkalinity as $CaCO_3$ mg/l	N/A	296		364	536	368
Total Hardness as $CaCO_3$ mg/l	N/A	229		674	318	880
Chloride as Cl mg/l	≤300	19		307	62	396
Sulphate as SO_4 mg/l	≤500	14		78	26	124
Fluoride as F mg/l	≤1.5	0.2		0.2	1.0	0.2
Nitrate as N mg/l	≤11	1.6		13	0.5	16
Free Cyanide as CN mg/l	≤0.2	<0.010		<0.010	<0.010	<0.010
Free and Saline Ammonia as N mg/l	≤1.5	<0.1		<0.1	<0.1	<0.1
Sodium as Na mg/l	≤200	31		66	118	75
Potassium as K mg/l	≤50	1.0		3.4	3.2	3.4
Calcium as Ca mg/l	≤80	54		156	61	206
Magnesium as Mg mg/l	≤70	23		69	40	89
Aluminium as Al mg/l	≤0.15	<0.100		<0.100	<0.100	<0.100
Boron as B mg/l	≤2.4	0.067		0.134	0.157	0.154
Cadmium as Cd mg/l	≤0.003	<0.003		<0.003	<0.003	<0.003
Copper as Cu mg/l	≤2.0	<0.010		<0.010	0.019	<0.010
Iron as Fe mg/l	≤2.0	0.066		0.045	0.029	0.045
Lead as Pb mg/l	≤0.01	<0.010		<0.010	<0.010	<0.010
Manganese as Mn mg/l	≤0.1	<0.025		<0.025	0.409	<0.025
Nickel as Ni mg/l	≤0.07	<0.025		<0.025	<0.025	<0.025
Zinc as Zn mg/l	≤5	<0.025		0.341	2.97	0.408
% Balancing		93.0		94.1	93.7	97.0
Potability and Suitability for human consumption		**Acceptable**		**Not Acceptable**	**Acceptable**	**Not Acceptable**

4.4 Geophysical Surveys

The main objective of the geophysical surveys was to investigate zones of deep weathering and fracturing associated with geological structures which could act as preferential groundwater flow paths, and to assist in selecting positions for the drilling of the boreholes.

4.4.1 The Magnetic Method

The aim of magnetic surveys is to investigate sub surface geology on the basis of anomalies in the earth's magnetic field resulting from the varying magnetic properties of underlying rocks. Different rock types have different magnetic susceptibilities, which may have remnant magnetism. The contrast in magnetic susceptibility and/or remnant magnetism gives rise to anomalies related to structures like intrusive dykes, faults, lithologic contacts and weathered/ fractured bedrock.

4.4.2 Geonics Em34 Terrain Conductivity Meter

The EM-34 is used for rapid measurements of terrain conductivity with a maximum effective penetration depth of 60 meters. The transmitter coil is energized with an alternating current. The time-varying primary magnetic field arising from the alternating current induces very small currents in the earth. These currents generate a secondary magnetic field, which is measured by the receiver coil, together with the primary magnetic field. The EM-34 system utilizes a transmitter coil and a receiver coil at specific designed operating frequencies, coil separations and orientations to directly measure apparent terrain conductivity in mS/m.

The EM-34, which is two-man portable, has the two coils flexibly connected. The coil spacing is measured electronically, which can be 10, 20 or 40 meters to directly vary the effective exploration depths. For the purpose of the study 40m coil separation was used.

With the horizontal coil orientation the EM-34 system is effective in locating near vertical conductive (fracture) zones, provided conductor width is less than the coil separation. The associated EM-34 anomaly is typically a negative peak response (relative to background conductivities) centered above the fracture and flanked with two positive peaks. Background crossover, between negative and positive peaks, is a function of coil separation and generally equals to inter coil spacing. The detectability of fracture zones depends on

their width, the thickness and conductivity of the overburden layer, the quality of the groundwater and the depth of the ground water level.

Seven (7) geophysical traverses were conducted within the study area as shown in Figure 3. The major geological structure targeted was the main SE-NW trending dyke/faults.

4.4.3 Geophysical Survey Results

A total of seven (7) prioritized and seven (7) alternative sites were selected based on the magnetics and electromagnetics surveyed data and is listed and summarized in Table 6 and shown in Figure 3.

4.5 Borehole Exploration Drilling

Based on the results of the geophysical survey and hydrogeological observations, the selected potential drill sites were drilled using rotary air percussion drilling. The technique uses a pneumatic reciprocating hammer that drives and submerges a heavy drill bit beneath the earth's surface into the underlying rock lithologies. The cuttings or drill chips, as well as water, get ejected from the borehole by compressed air as the drill bit is further submerged beneath the surface of the earth. The cuttings are then lined on the surface to better define and understand the underlying geology of the area. The air percussion technique is best suited for rock formations that are relatively rigid however, it is capable of drilling through most unconsolidated material such as gravel.

Table 6: Summarized list of sites selected for exploration drilling

Traverse No/Station	Latitude	Longitude	Geological Structure	Proposed Drill Depth (m)	Description
OFH01/300	-27.93201	22.75351	Fault	100	Fault zone, fracturing expected
OFH01/940	-27.93785	22.75417	Dyke	100	Fractured zone at dyke contact
OFH02/450	-27.94982	22.76270	Dyke	100	Fractured zone at dyke contact
0FH02/680	-27.94971	22.76017	Fault	100	Fault zone, fracturing expected
OFH02/950	-27.94959	22.75763	Fault/Dyke	100	Fracturing expected at fault zone
OFH03/360	-27.95091	22.74110	Weathered zone	80	Porosity increases with depth
OFH04/240	-27.94330	22.71872	Dyke	100	Fractured zone at dyke contact
OFH04/760	-27.94519	22.72333	Dyke	100	Fractured zone at dyke contact
OFH05/120	-27.93023	22.77087	Weathered zone	100	Fracturing expected at depth
OFH05/430	-27.93239	22.77252	Fault/Dyke	100	Fractured zone at fault/dyke contact
0FH06/230	-27.94909	22.71624	Fault	100	Fault zone, fracturing expected
OFH06/460	-27.94950	22.71815	Dyke	100	Fractured zone at dyke contact
OFH06/690	-27.94971	22.72106	Lineament	100	Fracturing expected at contact zone
OFH07/180	-27.95760	22.73961	Lineament	100	Fracturing expected at contact zone
OFH07/320	-27.95836	22.74081	Lineament	80	Fracturing expected at contact zone

22°44'0"E

22°46'0"E

27°56'0"S

27°58'0"S

Postmasburg NU

OFH-01

OFH-05

OFH05/120

OFH05/430

OFH01/300

OFH01/940

Olifantshoek SP

BH06 (Municipal Office)

Ditloung SP

BH01

BH02

OFH-04

OFH04/240

OFH04/760

OFH-06

OFH06/230

OFH06/460

OFH06/690

BH04 (Police Station)

BH05 (Farm)

OFH02/950

OFH02/680

OFH02/450

OFH-02

BH03

OFH-03

OFH03/360

Postmasburg NU

Ditloung SP

D3342

D3341

N14

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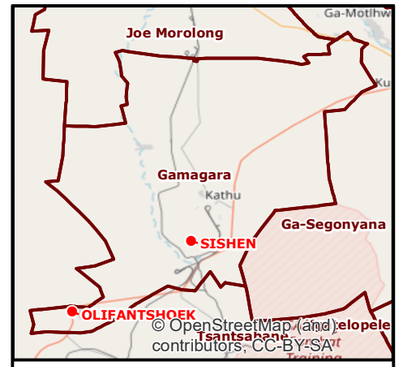

LEGEND

- Selected Sites
- Hydrocensus data
- Proposed_Line
- Village
- Erf Boundary

0 125 250 500 750 1 000 1 250

Meters

N

REFERENCE: Transverse Mecartor (Gauss-Kruger)
WGS84 Ellipsoid
Hartebeesthoek 94 Datum
Central Meridian 23º

PROJECT:
OLIFANTSHOEK

TITLE:
PLANNED GEOPHYSICAL MAP
OF
OLIFANTSHOEK

PROJECT No.		KIM-WAT-2017-208
SCALE	1:25 000	A3
GIS	CSG	06/02/2019
CHECK	CM	06/02/2019
REVIEW		06/02/2019

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4.5.1 Drilling Results

Seven exploration target sites were investigated up to date with a total of thirteen (13) exploration boreholes drilled to the total depth of 823 m using a nominal diameter of 165 mm. the first and the third sites (traverses OFH02 and OFH06) were drilled with no economical yield (<0.5 l/s) and were pronounced dry. The second, forth and fifth sites (on traverse OFH03 and OFH07) were drilled with successful yield ranging from 0.8 l/s to 6.6 l/s as listed in **Table 7**.

Steel casings (solid and perforated) of 4mm thickness were installed on the successfully drilled borehole KIM-OLF-BH02, KIM-OLF-BH04, KIM-OLF-BH05 and KIM-OLF-BH07. Solid casings were installed to support unstable geological formation whilst perforated casings were inserted to allow water to seep into the boreholes. Crushed stones were inserted in the annulus space from the bottom to the top of the perforated casings. From the top of the perforated casings, the annulus spaces were then filled up with the drill cuttings to the ground level. The annulus spaces outside the perforated casings from the bottom to the top of the borehole and sealed off with cement block.

Table 7 present summary of drilling results and positions of the newly drilled boreholes are depicted on Figure 4. The drilling is still in progress, we however anticipate to complete the drilling programme by mid-April 2019.

Table 7: Summary of exploration drilling programme

Borehole No.	Latitude	Longitude	Drill Depth (m)	Casing Depth (m)	Water Strike (mbgl)	Strike yield (l/s)	Final Air-lift Yield (l/s)	Date Completed	Geology intersected/Comment
KIM-OLF-BH01A	-27.94960	22.75338	42	--	--	--	--	Thursday, February 21, 2019	Lava-Dolerite Contact
KIM-OLF-BH01B	-27.94959	22.75326	48	--	--	--	--	Friday, February 22, 2019	Quartzite-Dolerite Contact
KIM-OLF-BH01C	-27.94959	22.75305	49	--	--	--	--	Friday, February 22, 2019	Quartzite-Dolerite Contact
KIM-OLF-BH02	-27.95027	22.74126	80	48	41	6.6	6.6	Thursday, February 28, 2019	Quartzite-Shale
KIM-OLF-BH03A	-27.94929	22.71875	37	--	--	--	--	Wednesday, March 6, 2019	Mudstone-Dolerite Contact
KIM-OLF-BH03B	-27.94933	22.71858	36	--	--	--	--	Wednesday, March 6, 2019	Quartzite-Dolerite Contact
KIM-OLF-BH03C	-27.94936	22.71838	55	--	--	--	--	Thursday, March 7, 2019	Quartzite-Dolerite Contact
KIM-OLF-BH03D	-27.94967	22.72096	80	--	--	--	--	Friday, March 8, 2019	Quartzite-Gabbro Contact
KIM-OLF-BH04	-27.95760	22.73961	100	48	47	0.46	0.8	Monday, March 11, 2019	Quartzite-Shale
KIM-OLF-BH05	-27.95822	22.74101	100	52	43, 52	0.78	2.85	Wednesday, March 20, 2019	Shale-Quartzite
KIM-OLF-BH06A	-27.95002	22.75564	40	--	--	--	---	Thursday, March 21, 2019	Lava-Dolerite Contact
KIM-OLF-BH06B	-27.95001	22.75556	76	--	--	--	--	Friday, March 22, 2019	Lava-Dolerite Contact
KIM-OLF-BH07	-27.95425	22.73781	80	54	36, 54	2	2	Thursday, March 28, 2019	Shale-Quartzite
Totals			**823**	**148**	**88**	**9.84**	**10.25**		

22°44'0"E

22°46'0"E

27°56'0"S

27°58'0"S

Postmasburg NU

OFH-01

OFH-05

OFH01/300

OFH05/120

OFH05/430

OFH01/940

N14

D3332

Sixth St

Olifantshoek SP

BH07 (Hospital)

BH06 (Municipal Office)

Perry St

OFH-04

OFH04/240

OFH04/760

BH01

BH02

Ditloung SP

Warren St

OFH-06

OFH06/230

BH04 (Police Station)

BH05 (Farm)

KIM-OLF-BH03C

KIM-OLF-BH03D

OFH06/460

OFH06/690

KIM-OLF-BH03B

KIM-OLF-BH03A

Postmasburg NU

BH03

OFH-03

OFH03/360

KIM-OLF-BH02 (6.6)

KIM-OLF-BH01C

OFH02/950

OFH02/680

OFH02/450

OFH-02

KIM-OLF-BH06A

KIM-OLF-BH06B

KIM-OLF-BH01A

KIM-OLF-BH01B

Ditloung SP

KIM-OLF-BH07 (2)

BH08 (School)

D331

KIM-OLF-BH04 (0.8)

KIM-OLF-BH05 (2.85)

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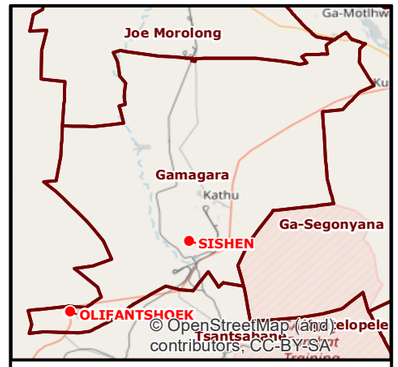

LEGEND

Newly Drilled Borehole (Blow yield)

- Successful
- Unsuccessful
- Selected Sites
- Hydrocensus data
- Proposed_Line
- Village

0 125 250 500 750 1 000 1 250

Meters

REFERENCE: Transverse Mecartor (Gauss-Kruger)
WGS84 Ellipsoid
Hartebeesthoek 94 Datum
Central Meridian 23°

PROJECT:
OLIFANTSHOEK

TITLE:
EXPLLORATION BOREHOLES MAP OF OLIFANTSHOEK

PROJECT No.		KIM-WAT-2017-208
SCALE	1:25 000	A3
GIS	CSG	01/04/2019
CHECK	CM	01/04/2019
REVIEW		01/04/2019

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4.6 Pumping Tests of Newly Drilled Boreholes

A Step Discharge Test (SDT) is carried out before the Constant Discharge Test (CDT). Water level recovery measurements were taken for the full pumping period of the step test and constant discharge tests of each borehole. During the SDT's if the last discharge rate reached pump inlet the yield at pump-inlet was measured as listed in Table 2.

Borehole test pumping is summarized as follows:

a) Number of boreholes Tested 3
b) Number of SDT's 3
c) Number of 12 hour CDT's 0
d) Number of 24 hour CDT's 3

Three (3) newly drilled boreholes (KIM-OLF-BH02, KIM-OLF-BH04 and KIM-OLF-BH05) were subjected to pump testing. A Step Discharge Test (SDT) was carried out before the Constant Discharge Test (CDT). Water level recovery measurements were taken for the full pumping period of the step test and constant discharge tests of each borehole. Summary of the pump testing programme is listed in Table 1 and location shown in Figure 2.

22°44'0"E 22°44'30"E 22°45'0"E 22°45'30"E

27°56'30"S

27°57'0"S

27°57'30"S

Sixth St

BH07 (Hospital)

BH06 (Municipal Office)

Perry St

N14

Postmasburg NU

Warren St

Olifantshoek SP

BH04 (Police Station)

BH05 (Farm)

BH03 KIM-OLF-BH02

KIM-OLF-BH04

KIM-OLF-BH05

Ditloung SP

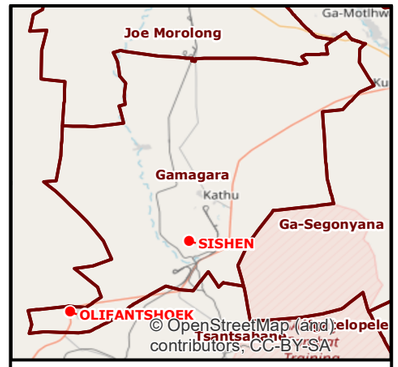
BH01

BH02 (G57NC)

Postmasburg NU

Ditloung SP

Esri, HERE, Garmin, © OpenStreetMap contributors



LEGEND

- Tested Borehole
- Not tested Borehole
- Village

0 50 100 200 300 400 500

Meters

N

REFERENCE: Transverse Mecartor (Gauss-Kruger)
WGS84 Ellipsoid
Hartebeesthoek 94 Datum
Central Meridian 23º

PROJECT: OLIFANTSHOEK

TITLE: SATELLITE MAP OF OLIFANTSHOEK

PROJECT No.		KIM-WAT-2017-208
SCALE	1:10 000	A3
GIS	CSG	01/04/2019
CHECK	CM	01/04/2019
REVIEW		01/04/2019

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Table 8: Summary of pumping tests of newly drilled boreholes

Borehole Number	Latitude	Longitude	Borehole Depth (m)	Measured WL (mbgl)	Borehole -Testing						
					NO: SDT	Date	Test Type	Final SDT Yield	PI	CDT Yield	CDT Duration
						Completed	SDT/CDT	l/s	l/s	l/s	hrs
KIM-OLF-BH02	-27.95027	22.74126	46.08	21.09	4	14/03/2019	CDT	8.10	6.62	4.55	24
KIM-OLF-BH05	-27.95836	22.74081	79.20	30.25	4	24/03/2019	CDT	4.05	2.94	2.11	24
KIM-OLF-BH04	-27.9576	22.73961	90.00	28.90	3	28/03/2019	No CDT	1.01	0.75	--	--
Totals										**6.66**	

22°44'0"E 22°44'30"E 22°45'0"E 22°45'30"E

27°56'30"S

27°57'0"S

27°57'30"S

Sixth St

Perry St

Warren St

N14

BH07 (Hospital) (0.50; 12; Pending)

BH06 (Municipal Office) (4.00; 12; II)

Postmasburg NU

Olifantshoek SP

Ditloung SP

BH01 (0.50; 12; I)

BH02 (G57NC) (--; --; I)

BH04 (Police Station) (4.00; 12; II)

BH05 (Farm) (0.40; 10; I)

BH03 (--)

KIM-OLF-BH02 (4.00; 12; Pending)

KIM-OLF-BH04 (0.50; 12; Pending)

KIM-OLF-BH05 (1.50; 12; Pending)

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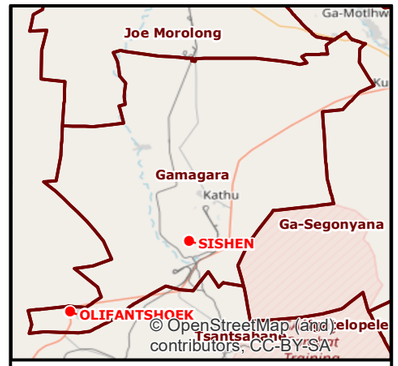

LEGEND

- Tested Borehole (Rec yield; Duration; Class)
- Not tested Borehole
- Village

0 50 100 200 300 400 500

Meters

N

REFERENCE: Transverse Mecartor (Gauss-Kruger)
WGS84 Ellipsoid
Hartebeesthoek 94 Datum
Central Meridian 23º

PROJECT:
OLIFANTSHOEK

TITLE:
MANAGEMENT RECOMMENDATION MAP OF OLIFANTSHOEK

PROJECT No.		KIM-WAT-2017-208
SCALE	1:10 000	A3
GIS	CSG	01/04/2019
CHECK	CM	01/04/2019
REVIEW		01/04/2019

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5. CONCLUSIONS

The following conclusions are made from the groundwater study:

a) The hydrocensus exercise confirmed that there is six existing boreholes within the Olifantshoek and only four (BH01, BH02, BH04, BH05 and BH06) were pump tested successfully. BH03 was found to be collapsed and blocked with stones.
b) The area is characterised by slightly shallow aquifers with water levels ranging from 16.94 mbgl to 24.4 mbgl, the latter indicates possible dewatering of the groundwater management unit.
c) Water quality for the two sampled boreholes (BH01 and BH05) returned class I water quality that is suitable for human consumption long-term. BH04 and BH06 returned water quality that exceeds maximum allowable limit according to the SANS241:2015 standards with elevated EC, TDS, CL, Ca, Al, N and Mg parameters.
d) The current (GAADD) water demand for Olifantshoek communities is estimated at 600 m^3/day and the SDD estimated water demand is 15 l/s for 12 hours daily.
e) Four newly drilled production boreholes were drilled with recommended yield of 6.0 l/s for 12 hours, which makes a combined recommended yield of 15.4 l/s.
f) The total recommended abstraction from four verified boreholes in Olifantshoek amounts to 15.4 l/s; this indicates a shortfall of 4.6 l/s which includes a standby facility, and this doesn't take into account water balances.
g) The exploration drilling programme is in progress with additional two planned production boreholes, this is anticipated to be completed by mid-April 2019.

6. RECOMMENDATIONS

Based on the above discussions and conclusions the following is recommended:

a) Production boreholes must be protected by a fenced area/pump house and be equipped with a water monitoring and sampling facility;
b) Critical water levels as indicated in the borehole management recommendations must not be exceeded. Once these levels are reached daily abstraction rates must be reduced;
c) Water levels and abstraction should be monitored and recorded monthly;

d) Monthly water quality monitoring of production boreholes, samples to be analysed for macro chemical elements as well as bacteriological analysis (fit for human consumption).

e) Boreholes that exceeds maximum allowable limit water quality should be blended at storage with potable water obtain acceptable standards.

f) In view of the complexity and heterogeneity of the study area aquifers, a 3D numerical groundwater flow model is essential to identify target areas for additional source development, calculate water balances in respective compartment units and predict long-term aquifer response to current abstraction.

7. PLANNED ACTIVITIES AND PROGRAMME

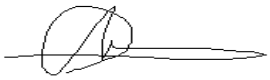
The programme for the March-April 2019 reporting month is listed in **Table** 9 below:

Table 9: Summary of the study programme progress and planned activities

Activity	Progress to Date	Planned Completion Date	Comments
Desktop Study	90%	On-going	Desktop study throughout the project. Major data collated and assessed
Hydrocensus	100%	Completed	Site visits and verification of existing boreholes complete
Pumping Test of existing boreholes	100%	Completed	Five boreholes tested successfully
Geophysical Surveys	100%	Completed	Geophysical traverses are planned, awaiting instruction to proceed
Selection of Drilling position	100%	Completed	Geophysical surveys conducted successfully on six (6) traverses with the aid of magnetic and electromagnetic techniques
Exploration Drilling	**85%**	**16th April 2019**	Three successful boreholes drilled with a cumulative/combined air-lift yield of 10.25 l/s. outstanding drilling underway, anticipated to be completed 30th March 2019
Borehole Pumping Tests	**40%**	**19th April 2019**	Three newly drilled boreholes tested successfully, borehole KIM-OLF-BH07 testing underway, and two new boreholes planned
Borehole Management recommendations	**50%**	**19th April 2019**	
Water Use License Application	**0%**	**30th April 2019**	
Study Investigation Report	**20%**	**30th April 2019**	

8. CLOSURE

We trust that this document meets the expectations of the envisaged progress report for the groundwater source development in Olifantshoek. However, we remain available to discuss any queries or comments you may have pertaining to this document.
Yours Sincerely,



Collen Monokofala
Senior Hydrogeologist: Kimopax
collen@kimopax.com

Appendix A:
Borehole Construction and Geological Logs

LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

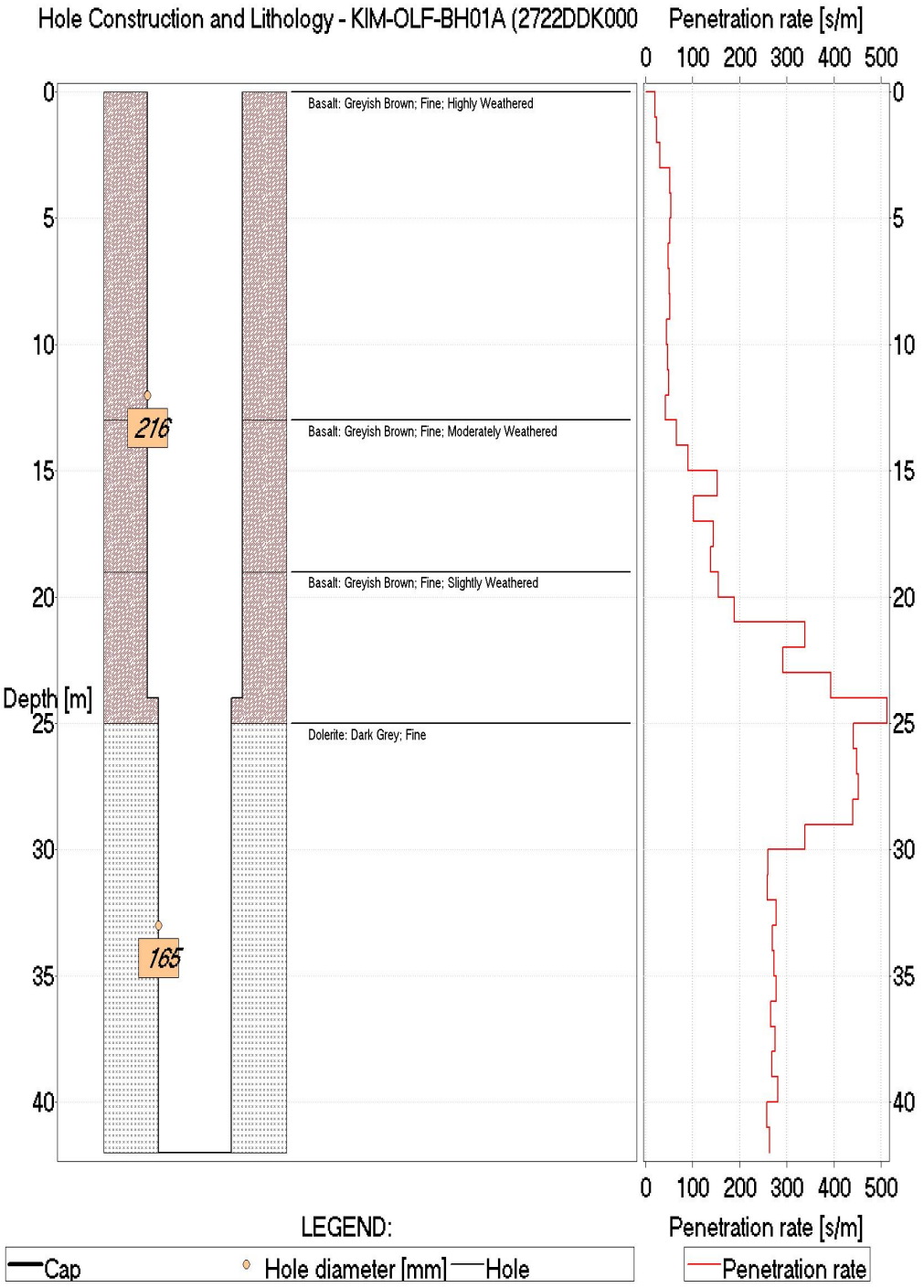
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DDK0001 ***Number:*** KIM-OLF-BH01A ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9496000	***Alt. No. 1:***	***Diam. [mm]:***	177	***Site Status:*** Dry
Longitude [°]	22.7533800	***Alt. No. 2:***	***Depth [m]:***	42.00	***Purpose:*** Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***	***Col. Ht. [m]:***	0.00	***Consumer:*** Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:*** Kimopax (Pty) Ltd			***Use applic.:*** Domestic - all purposes
Altitude: [m]:	1313.00	Coordinate System: WGS 84 / Lat/Long			***Topo. sett.:*** Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)				***Drain. regn.:*** D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190221	0.00	24.00	216	Kimopax (Pty) Ltd	
20190221	24.00	42.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	13.00	Basalt	Brown	Greyish	Fine	Weathered		Highly
13.00	19.00	Basalt	Brown	Greyish	Fine	Weathered		Moderately
19.00	25.00	Basalt	Brown	Greyish	Fine	Weathered		Slightly
25.00	42.00	Dolerite	Grey	Dark	Fine			

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

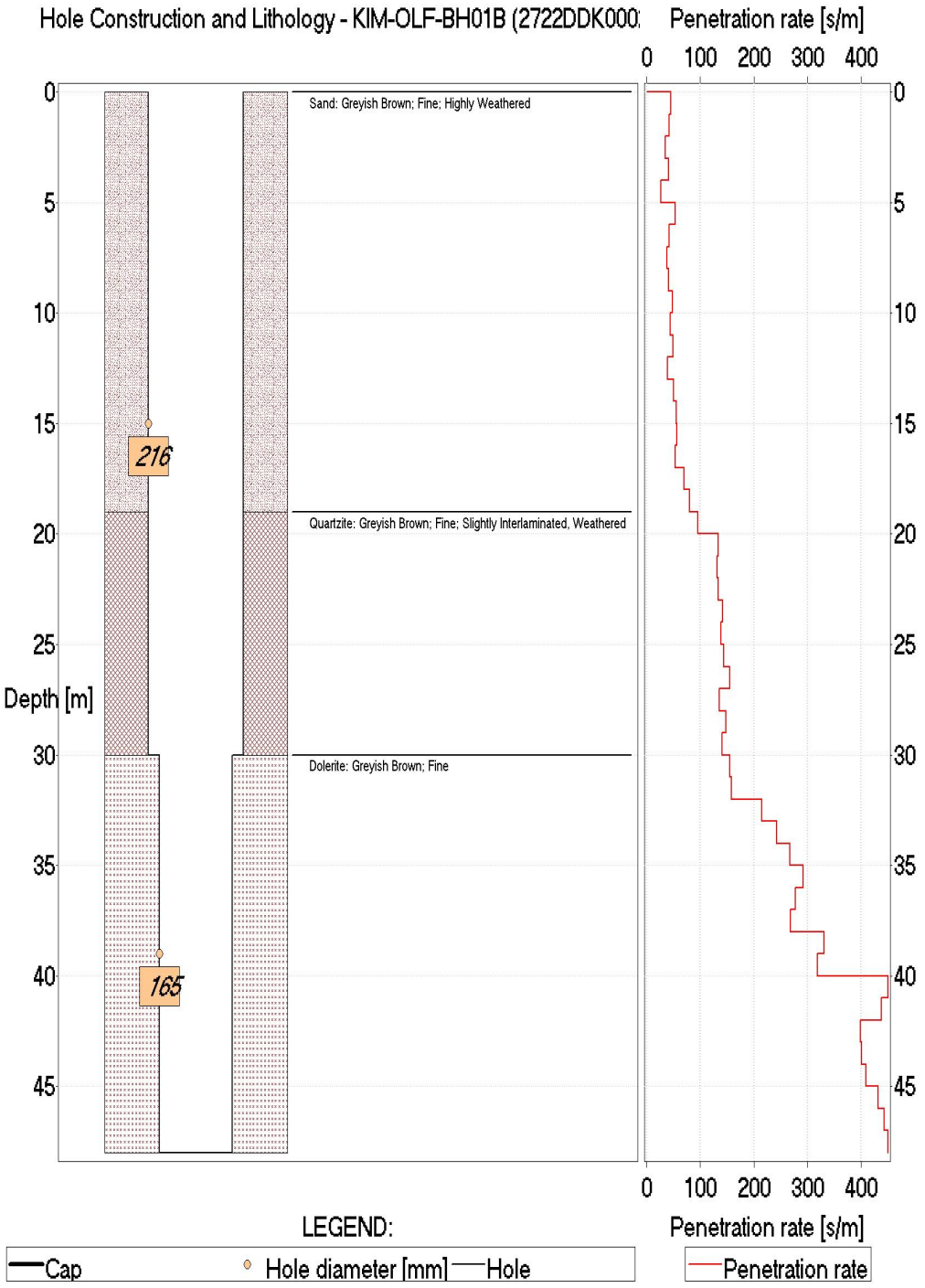
BASIC SITE INFORMATION: ***Site Identifier:*** 2722DDK0002 ***Number:*** KIM-OLF-BH01B ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9495900	***Alt. No. 1:***		***Diam. [mm]:***	165
Longitude [°]	22.7532600	***Alt. No. 2:***		***Depth [m]:***	48.00
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:***	0.00
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			
Altitude: [m]:	1312.00	Kimopax (Pty) Ltd			
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			

Site Status:	Dry
Purpose:	Production (water supply)
Consumer:	Non-urban
Use applic.:	Domestic - all purposes
Topo. sett.:	Flat surface, plain
Drain. regn.:	D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190222	0.00	30.00	216	Kimopax (Pty) Ltd	
20190222	30.00	48.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	19.00	Sand	Brown	Greyish	Fine	Weathered		Highly
19.00	30.00	Quartzite	Brown	Greyish	Fine	Weathered	Interlaminated	Slightly
30.00	48.00	Dolerite	Brown	Greyish	Fine			

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

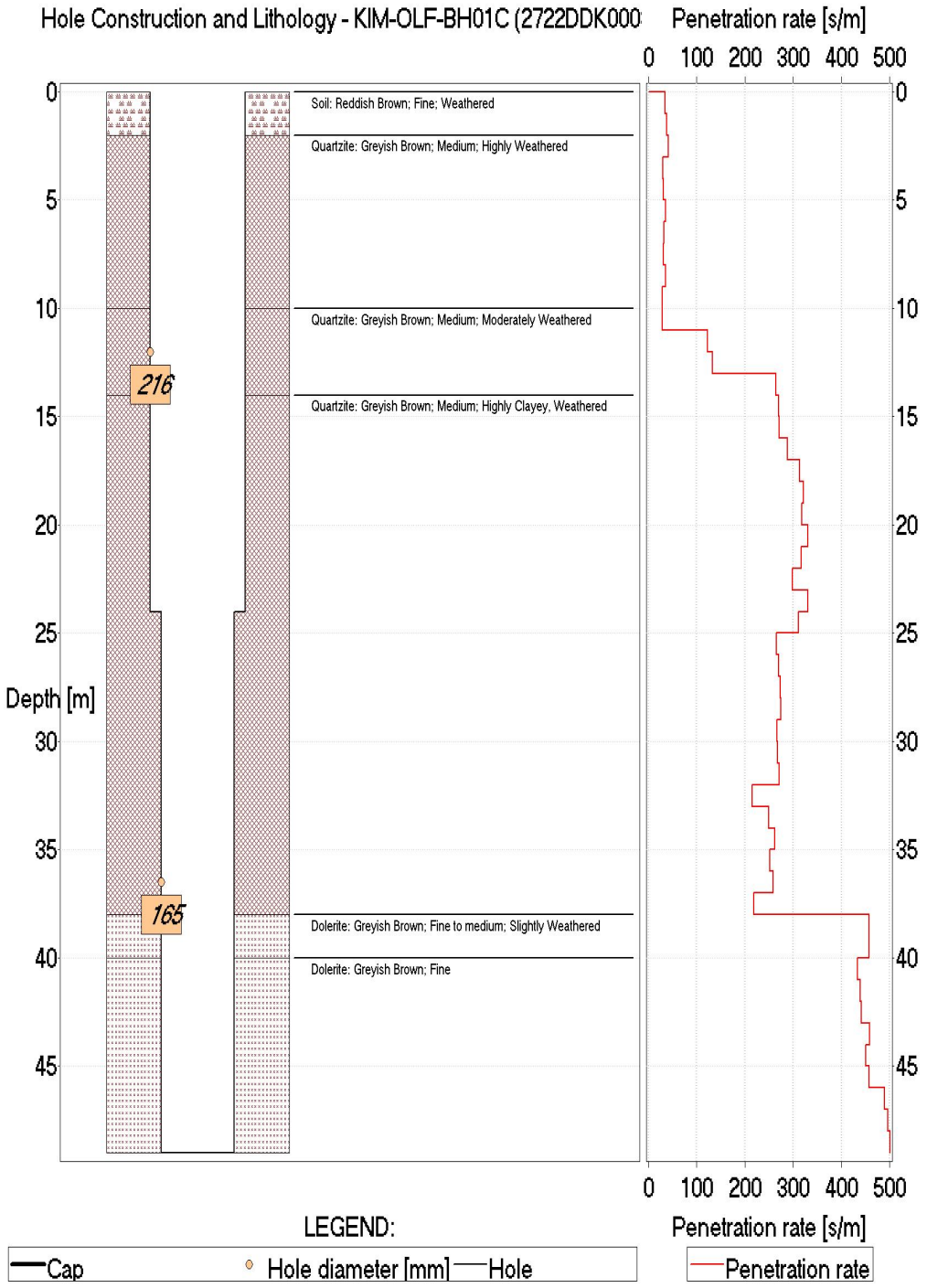
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DDK0003 ***Number:*** KIM-OLF-BH01C ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9495900	***Alt. No. 1:***		***Diam. [mm]:***	165	***Site Status:***	Dry
Longitude [°]	22.7530500	***Alt. No. 2:***		***Depth [m]:***	49.00	***Purpose:***	Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:***	0.00	***Consumer:***	Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***				***Use applic.:***	Domestic - all purposes
Altitude: [m]:	1291.00	Kimopax (Pty) Ltd				***Topo. sett.:***	Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long				***Drain. regn.:***	D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190222	0.00	24.00	216	Kimopax (Pty) Ltd	
20190222	24.00	49.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	2.00	Soil	Brown	Reddish	Fine	Weathered		
2.00	10.00	Quartzite	Brown	Greyish	Medium	Weathered		Highly
10.00	14.00	Quartzite	Brown	Greyish	Medium	Weathered		Moderately
14.00	38.00	Quartzite	Brown	Greyish	Medium	Weathered	Clayey	Highly
38.00	40.00	Dolerite	Brown	Greyish	Fine to medium	Weathered		Slightly
40.00	49.00	Dolerite	Brown	Greyish	Fine			

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

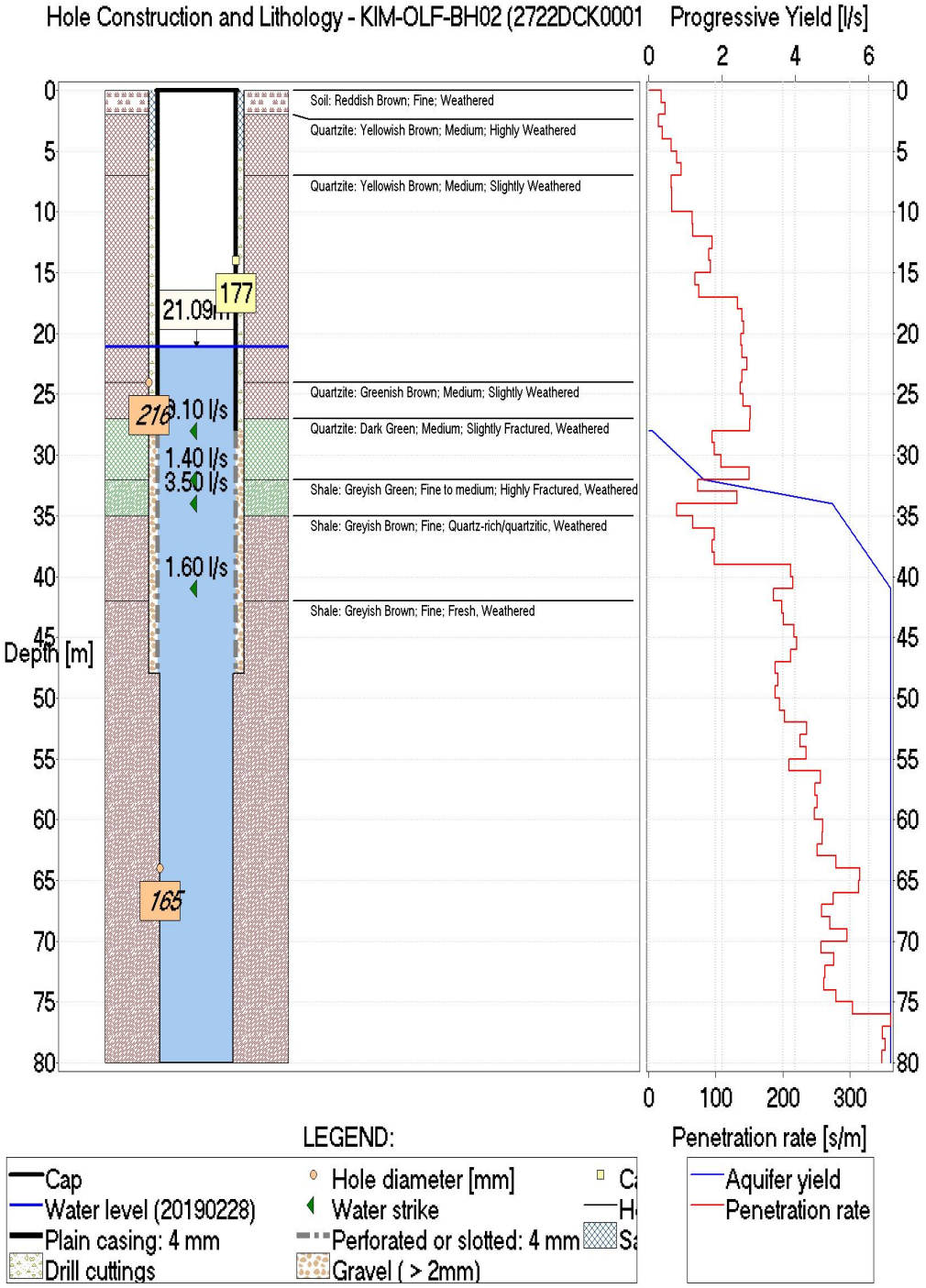
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0001 ***Number:*** KIM-OLF-BH02 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9502700	***Alt. No. 1:***		***Diam. [mm]:*** 177	***Site Status:*** To be tested
Longitude [°]	22.7412600	***Alt. No. 2:***		***Depth [m]:*** 80.00	***Purpose:*** Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:*** 0.31	***Consumer:*** Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			***Use applic.:*** Domestic - all purposes
Altitude: [m]:	1270.00	Kimopax (Pty) Ltd			***Topo. sett.:*** Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			***Drain. regn.:*** D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20180228	0.00	48.00	216	Kimopax (Pty) Ltd	
20180228	48.00	80.00	165	Kimopax (Pty) Ltd	

CASING DETAILS:

Date inst.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Material*	*Thickn. [mm]*	*Type of openings*	*Openings [mm] Length*	*Width*	*Hor. Dist.*	*Vert. Dist.*
20180228	0.00	28.00	177	Steel	4	Plain casing				
20180228	28.00	48.00	177	Steel	4	Perforated or slotted				

AQUIFER:

Report. Institution	*Depth to: Top [m]*	*Bot. [m]*	*Yield [l/s]:*	*Meth. meas.*	*Aquifer type*	*Info. source*	*Comment*
KIMO	28.00	28.00	0.10	Notch (V- or U-notch)		Geologist, technician,	
KIMO	32.00	32.00	1.50	Notch (V- or U-notch)		Geologist, technician,	
KIMO	34.00	34.00	5.00	Notch (V- or U-notch)		Geologist, technician,	
KIMO	41.00	80.00	6.60	Notch (V- or U-notch)		Geologist, technician,	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	2.00	Soil	Brown	Reddish	Fine	Weathered		
2.00	7.00	Quartzite	Brown	Yellowish	Medium	Weathered		Highly
7.00	24.00	Quartzite	Brown	Yellowish	Medium	Weathered		Slightly
24.00	27.00	Quartzite	Brown	Greenish	Medium	Weathered		Slightly
27.00	32.00	Quartzite	Green	Dark	Medium	Weathered	Fractured	Slightly
32.00	35.00	Shale	Green	Greyish	Fine to medium	Weathered	Fractured	Highly
35.00	42.00	Shale	Brown	Greyish	Fine	Weathered	Quartz-rich/quartzitic	
42.00	80.00	Shale	Brown	Greyish	Fine	Weathered	Fresh	

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

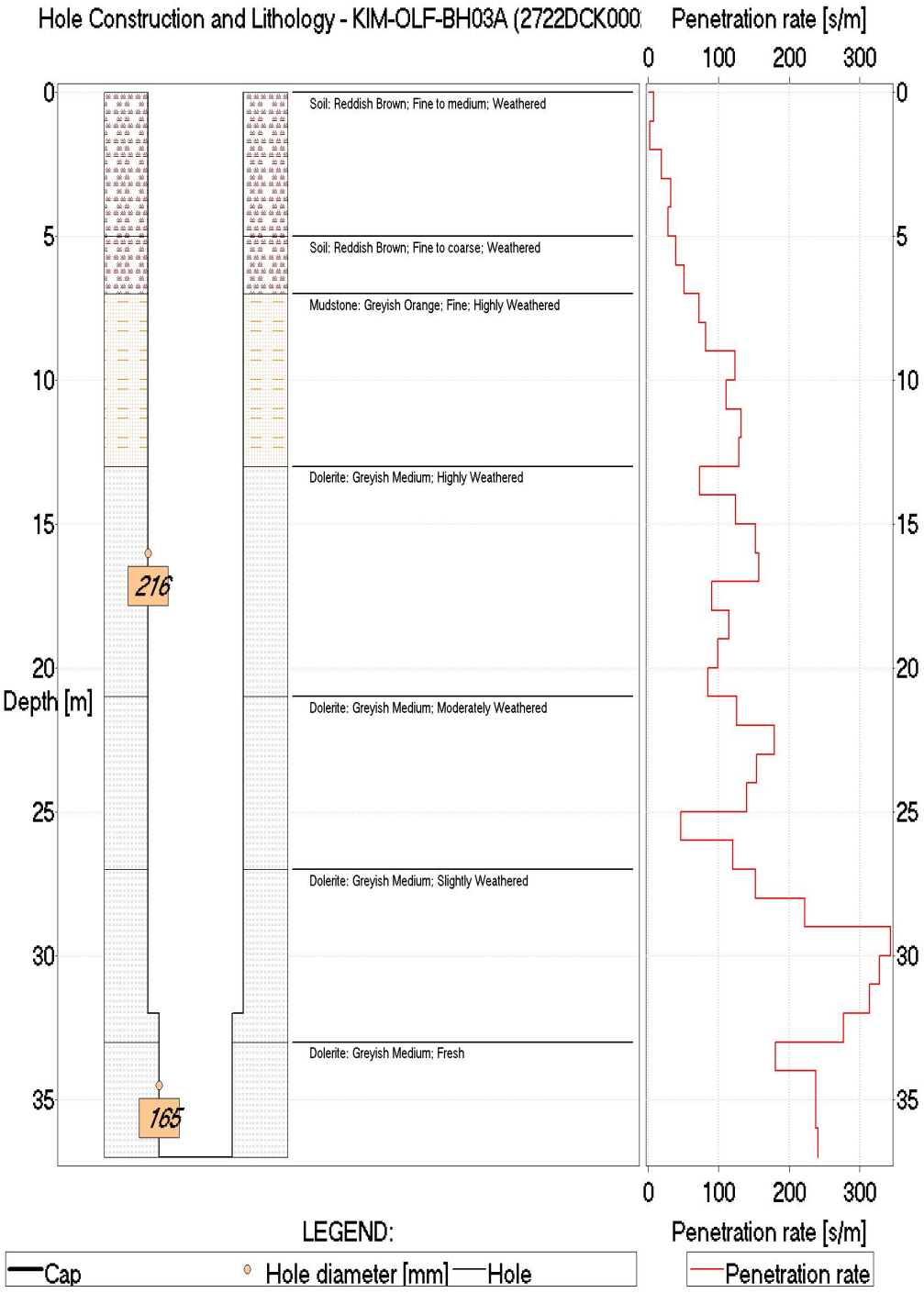
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0002 ***Number:*** KIM-OLF-BH03A ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9492900	***Alt. No. 1:***		***Diam. [mm]:*** 165	***Site Status:*** Dry
Longitude [°]	22.7187500	***Alt. No. 2:***		***Depth [m]:*** 37.00	***Purpose:*** Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:*** 0.00	***Consumer:*** Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			***Use applic.:*** Domestic - all purposes
Altitude: [m]:	1296.00	Kimopax (Pty) Ltd			***Topo. sett.:*** Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			***Drain. regn.:*** D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190306	0.00	32.00	216	Kimopax (Pty) Ltd	
20190306	32.00	37.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	5.00	Soil	Brown	Reddish	Fine to medium	Weathered		
5.00	7.00	Soil	Brown	Reddish	Fine to coarse	Weathered		
7.00	13.00	Mudstone	Orange	Greyish	Fine	Weathered		Highly
13.00	21.00	Dolerite		Greyish	Medium	Weathered		Highly
21.00	27.00	Dolerite		Greyish	Medium	Weathered		Moderately
27.00	33.00	Dolerite		Greyish	Medium	Weathered		Slightly
33.00	37.00	Dolerite		Greyish	Medium	Fresh		

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

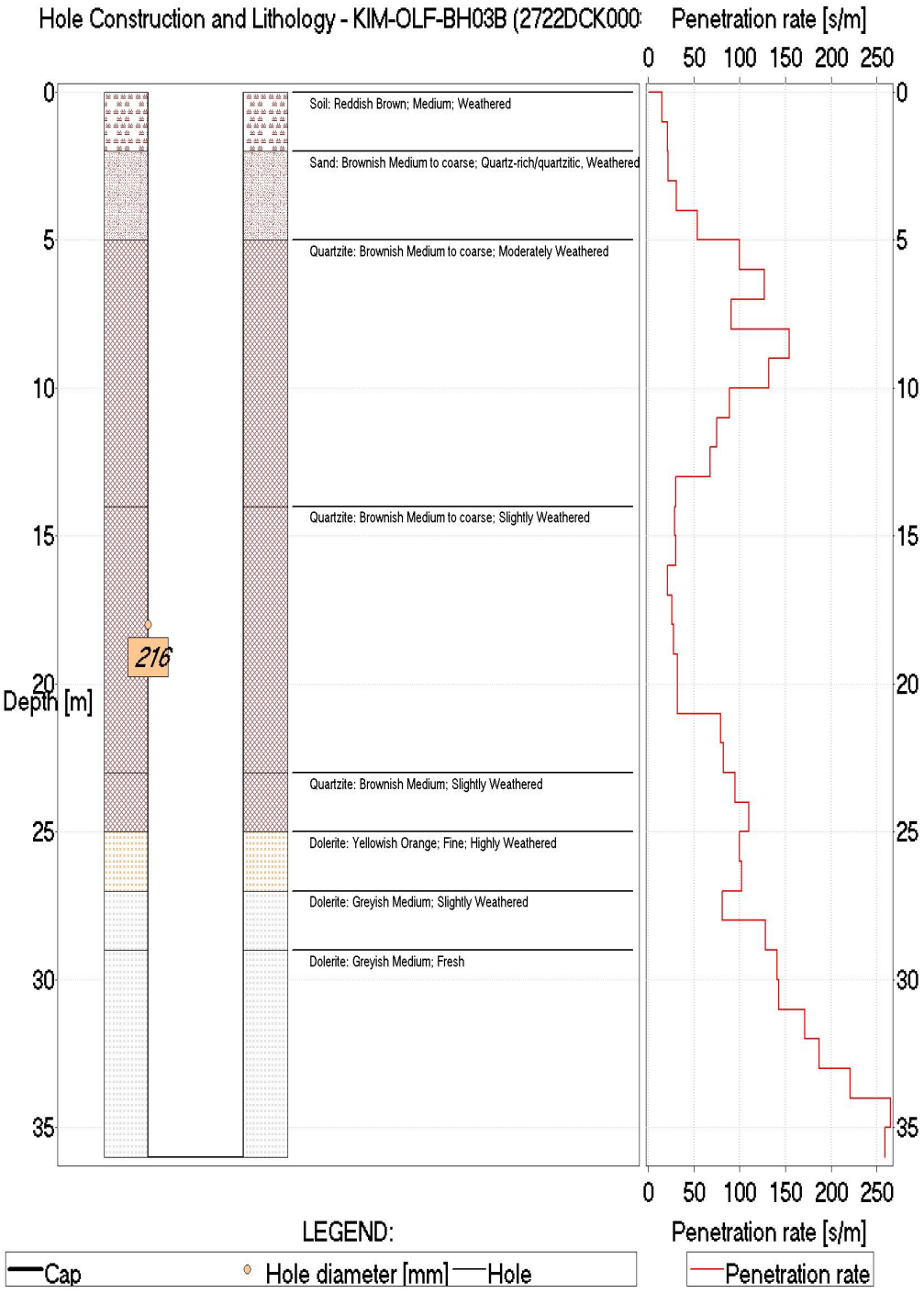
BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0003 ***Number:*** KIM-OLF-BH03B ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9493300	***Alt. No. 1:***		***Diam. [mm]:***	216
Longitude [°]	22.7185800	***Alt. No. 2:***		***Depth [m]:***	36.00
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:***	0.00
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			
Altitude: [m]:	1292.00	Kimopax (Pty) Ltd			
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			

Site Status:	Dry
Purpose:	Production (water supply)
Consumer:	Non-urban
Use applic.:	Domestic - all purposes
Topo. sett.:	Flat surface, plain
Drain. regn.:	D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190306	0.00	36.00	216	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	2.00	Soil	Brown	Reddish	Medium	Weathered		
2.00	5.00	Sand		Brownish	Medium to coarse	Weathered	Quartz-rich/quartzitic	
5.00	14.00	Quartzite		Brownish	Medium to coarse	Weathered		Moderately
14.00	23.00	Quartzite		Brownish	Medium to coarse	Weathered		Slightly
23.00	25.00	Quartzite		Brownish	Medium	Weathered		Slightly
25.00	27.00	Dolerite	Orange	Yellowish	Fine	Weathered		Highly
27.00	29.00	Dolerite		Greyish	Medium	Weathered		Slightly
29.00	36.00	Dolerite		Greyish	Medium	Fresh		

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

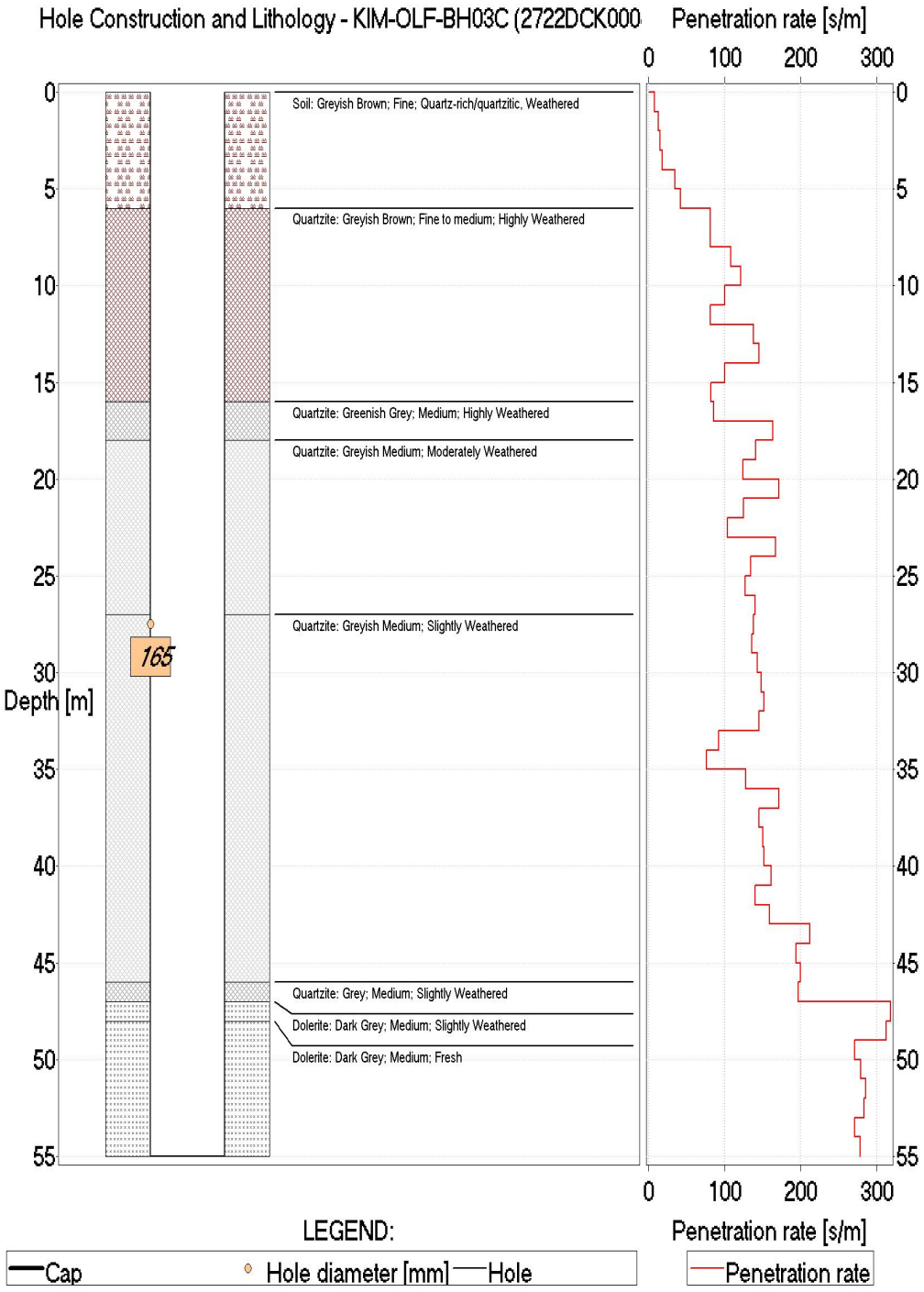
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0004 ***Number:*** KIM-OLF-BH03C ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCL MUNICIPALITY

Latitude [°]	-27.9493600	***Alt. No. 1:***		***Diam. [mm]:*** 165	***Site Status:*** Dry
Longitude [°]	22.7183800	***Alt. No. 2:***		***Depth [m]:*** 55.00	***Purpose:*** Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:*** 0.00	***Consumer:*** Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			***Use applic.:*** Domestic - all purposes
Altitude: [m]:	1289.00	Kimopax (Pty) Ltd			***Topo. sett.:*** Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			***Drain. regn.:*** D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190307	0.00	55.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	6.00	Soil	Brown	Greyish	Fine	Weathered	Quartz-rich/quartzitic	
6.00	16.00	Quartzite	Brown	Greyish	Fine to medium	Weathered		Highly
16.00	18.00	Quartzite	Grey	Greenish	Medium	Weathered		Highly
18.00	27.00	Quartzite		Greyish	Medium	Weathered		Moderately
27.00	46.00	Quartzite		Greyish	Medium	Weathered		Slightly
46.00	47.00	Quartzite	Grey		Medium	Weathered		Slightly
47.00	48.00	Dolerite	Grey	Dark	Medium	Weathered		Slightly
48.00	55.00	Dolerite	Grey	Dark	Medium	Fresh		

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

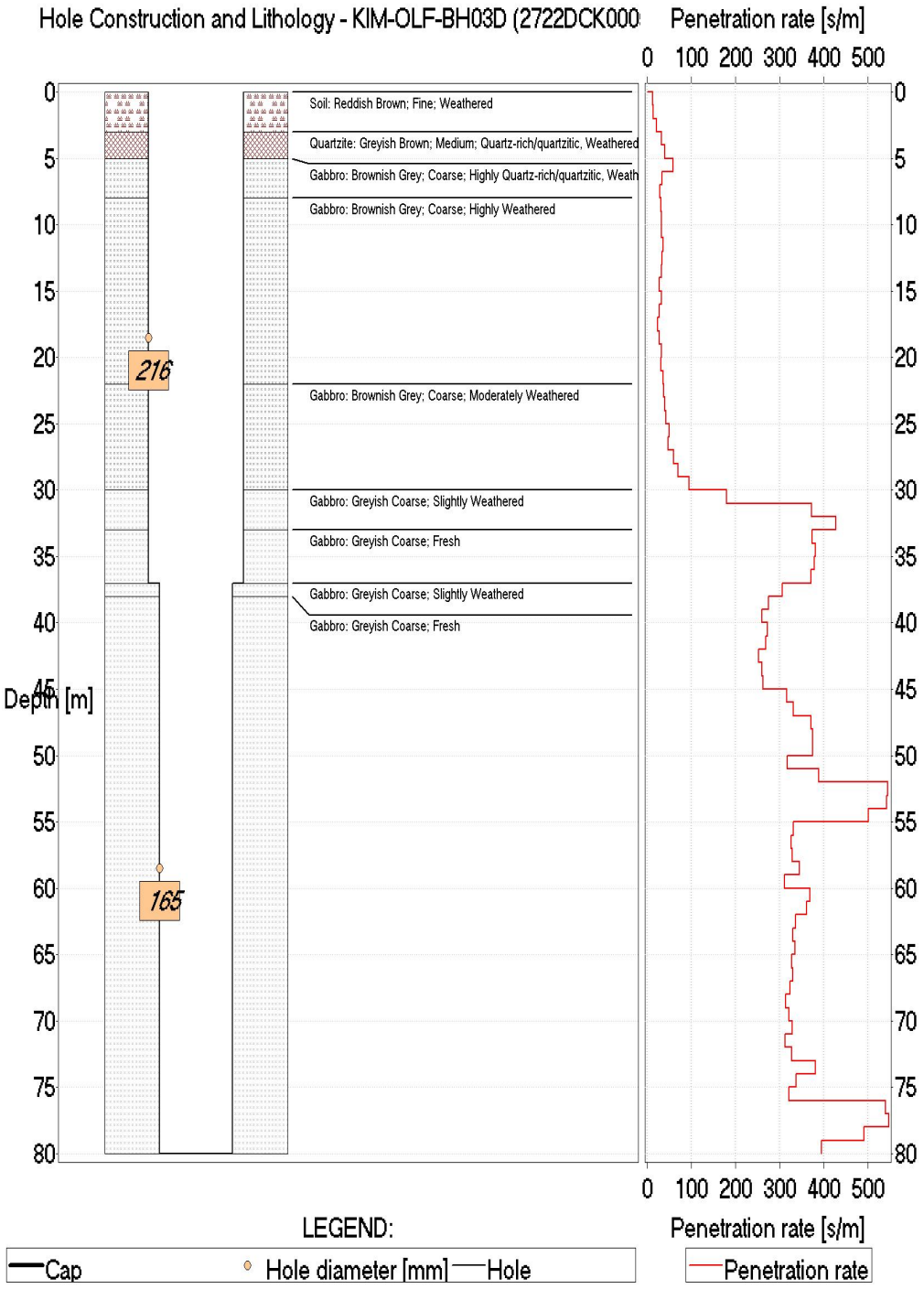
BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0005 ***Number:*** KIM-OLF-BH03D ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9496700	***Alt. No. 1:***		***Diam. [mm]:***	165
Longitude [°]	22.7209600	***Alt. No. 2:***		***Depth [m]:***	80.00
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:***	0.00
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			
Altitude: [m]:	1286.00	Kimopax (Pty) Ltd			
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			

Site Status:	Dry
Purpose:	Production (water supply)
Consumer:	Non-urban
Use applic.:	Domestic - all purposes
Topo. sett.:	Flat surface, plain
Drain. regn.:	D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190308	0.00	37.00	216	Kimopax (Pty) Ltd	
20190308	37.00	80.00	165	Kimopax (Pty) Ltd	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	3.00	Soil	Brown	Reddish	Fine	Weathered		
3.00	5.00	Quartzite	Brown	Greyish	Medium	Weathered	Quartz-rich/quartzitic	
5.00	8.00	Gabbro	Grey	Brownish	Coarse	Weathered	Quartz-rich/quartzitic	Highly
8.00	22.00	Gabbro	Grey	Brownish	Coarse	Weathered		Highly
22.00	30.00	Gabbro	Grey	Brownish	Coarse	Weathered		Moderately
30.00	33.00	Gabbro		Greyish	Coarse	Weathered		Slightly
33.00	37.00	Gabbro		Greyish	Coarse	Fresh		
37.00	38.00	Gabbro		Greyish	Coarse	Weathered		Slightly
38.00	80.00	Gabbro		Greyish	Coarse	Fresh		

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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

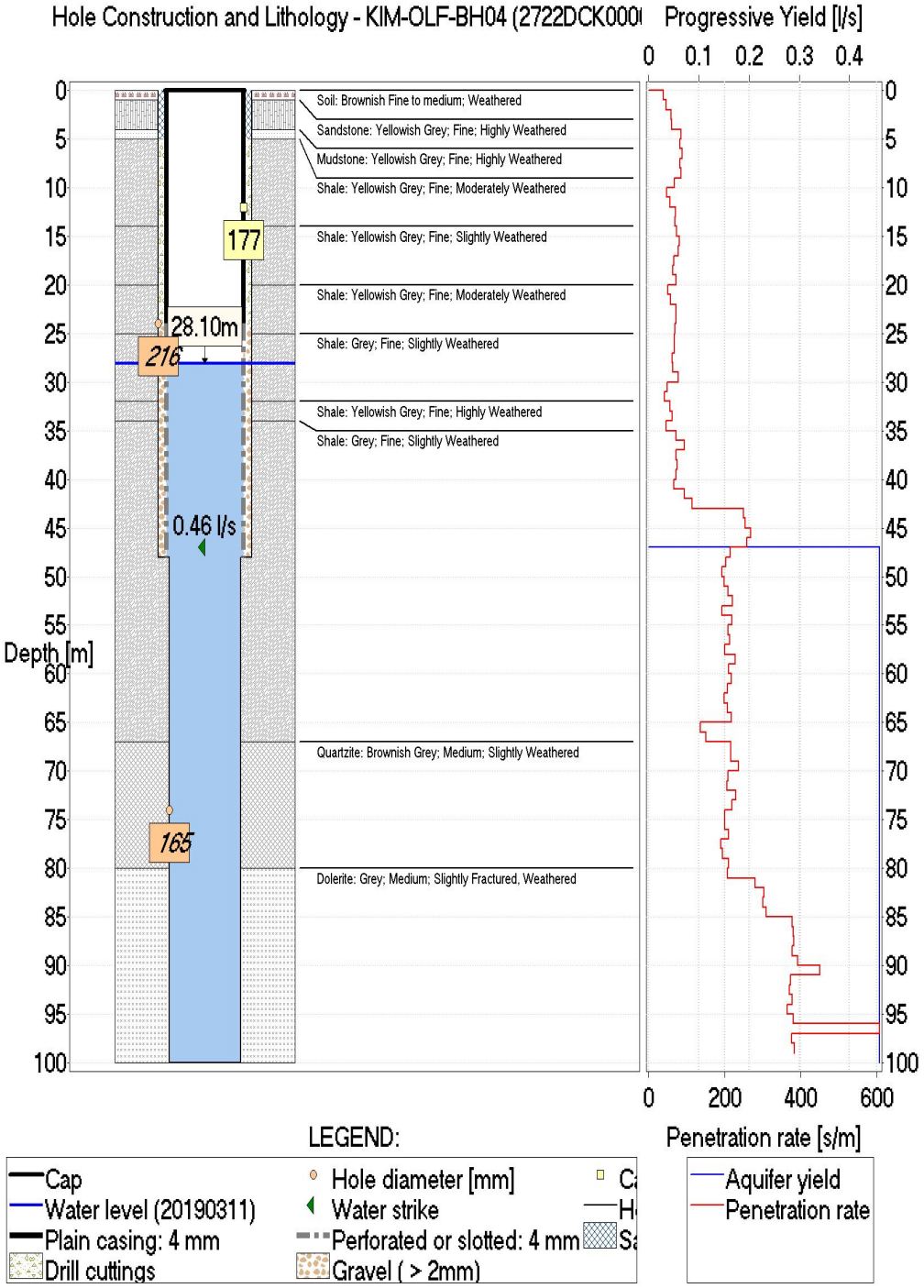
Date Compiled: 2019/03/20

BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0006 ***Number:*** KIM-OLF-BH04 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Region Type: Municipality ***Region Descr.:*** GAMAGARA LOCAL MUNICIPALITY

Latitude [°]	-27.9576000	***Alt. No. 1:***		***Diam. [mm]:*** 165	***Site Status:*** To be tested
Longitude [°]	22.7396100	***Alt. No. 2:***		***Depth [m]:*** 100.00	***Purpose:*** Production (water supply)
Coor. Acc.:	Accurate to within 10 units	***Reg./BB.:***		***Col. Ht. [m]:*** 0.55	***Consumer:*** Non-urban
Coor. Meth.:	Global Positioning System (handheld)	***Reporting Institution:***			***Use applic.:*** Domestic - all purposes
Altitude: [m]:	1285.00	Kimopax (Pty) Ltd			***Topo. sett.:*** Flat surface, plain
Surv. Meth.:	Global Positioning System (handheld)	Coordinate System: WGS 84 / Lat/Long			***Drain. regn.:*** D41J



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LITHOLOGY, CONSTRUCTION AND DEPTH DATA REPORT

Date Compiled: 2019/03/20

HOLE DIAMETER:

Date constr.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Reporting Institution*	*Comment*
20190311	48.00	100.00	165	Kimopax (Pty) Ltd	
20190311	0.00	48.00	216	Kimopax (Pty) Ltd	

CASING DETAILS:

Date inst.	*Depth to: Top [m]*	*Bot. [m]*	*Diam. [mm]*	*Material*	*Thickn. [mm]*	*Type of openings*	*Openings [mm] Length*	*Width*	*Hor. Dist.*	*Vert. Dist.*
20190311	0.00	24.00	177	Steel	4	Plain casing				
20190311	24.00	48.00	177	Steel	4	Perforated or slotted				

AQUIFER:

Report. Institution	*Depth to: Top [m]*	*Bot. [m]*	*Yield [l/s]:*	*Meth. meas.*	*Aquifer type*	*Info. source*	*Comment*
KIMO	47.00	100.00	0.46	Estimated		Geologist, technician,	

GEOLOGY: Lithology Colour, texture & feature

Depth to: Top [m]	*Bot. [m]*	*Lithology*	*Prim. Colour*	*Second. Colour*	*Texture*	*Primary Feature*	*Secondary Feature*	*Feature Attribute*
0.00	1.00	Soil		Brownish	Fine to medium	Weathered		
1.00	4.00	Sandstone	Grey	Yellowish	Fine	Weathered		Highly
4.00	5.00	Mudstone	Grey	Yellowish	Fine	Weathered		Highly
5.00	14.00	Shale	Grey	Yellowish	Fine	Weathered		Moderately
14.00	20.00	Shale	Grey	Yellowish	Fine	Weathered		Slightly
20.00	25.00	Shale	Grey	Yellowish	Fine	Weathered		Moderately
25.00	32.00	Shale	Grey		Fine	Weathered		Slightly
32.00	34.00	Shale	Grey	Yellowish	Fine	Weathered		Highly
34.00	67.00	Shale	Grey		Fine	Weathered		Slightly
67.00	80.00	Quartzite	Grey	Brownish	Medium	Weathered		Slightly
80.00	100.00	Dolerite	Grey		Medium	Weathered	Fractured	Slightly

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Appendix B:
Pumping Graphs and Details

MANAGEMENT RECOMMENDATIONS

Date Compiled: 2018/09/11

BASIC SITE INFORMATION:

Site Identifier: 2722DDK0001 ***Number:*** BH 01 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Latitude [°]	-27.9429800	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	19.22
Longitude [°]	22.7566000	***Alt. No. 2:***		***Depth [m]:***	105.00	***Piezometer:***	0
Altitude [m]:	0.00	***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.38	***Date WL meas.:***	20180124

Coordinate System: WGS 84 / Lat/Long

EXISTING EQUIPMENT:

Pump:		**Engine:**	
Type of Inst.:		***Type of Power:***	
Manufacturer:		***Manufacturer:***	
Depth to intk. [m]:		***Power Rating [kW]:***	

USE APPLICATION:

Site Status:	Unused
Purpose:	Production (water supply)
Consumer:	Urban
Application:	Domestic - all purposes

WATER CHEMISTRY:

Sample No.: BH 01 ***Date sampled:*** 20180124 ***Depth sampl. [m]:*** 86.00 ***Comment:***

Chemical and Physical Parameters:						**Bacteriol. Parameters:**		**Calculated Parameters:**	
pH:	7.50	***Na:***	31.00	***Cl:***	19.00	***E. Coli:***		***Langelier:***	0.061
EC [mS/m]:	55.60	***K:***	1.00	***NO3 as N:***	1.60	***Faec. Col.:***		***Aggr. Index:***	12.10
TDS:	376.00	***Si:***		***SO4:***	14.00	***Total Col.:***		***Ion Bal. Err. [%]:***	-7.10
Tot. Alk.:	296.00	***Al:***	0.100	***F:***	0.200	***SPC:***		***Tot. Hardness:***	229.33
Ca:	54.00	***Fe:***	0.066					***SAR:***	0.890
Mg:	23.00	***Mn:***	0.025	Concentrations in [mg/l] where applicable Bacteriological parameters in [counts/100ml]					

TESTING DETAILS:

Description	*Date*	*Durat. [min]*	*Depth to intk. [m]*	*Disch. rate l/s*	*Drawd. [m]*	*Recovery [m]*	*%*	*[min]*	*T [m²/d]*	*Storage*	*Spec. capac.*	*Comment*
STEP TEST 1	20180123	60	86.00	0.50	6.57	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 2	20180123	60	86.00	1.00	27.14	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 3	20180123	60	86.00	1.50	55.83	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 4	20180123	5	86.00	1.90	66.78	0.11	99.0	300	0.00	0.000	0.000	
CONSTANT	20180124	720	86.00	0.60	29.72	).00000	100.0	420	2.30	0.000	0.000	

RECOMMENDATIONS:

Prior.	*Rec. equipm.*	*Depth to intk. [m]*	*Type of power*	*Duty cyc. [hrs]*	*Disch. rate l/s*	*Water quality*	*Dyn. water level [m]*	*Crit. water level [m]*
1	Mono-type pump	80.00	Electric motor	12	0.50	CLASS 1	47.00	0.00

Note:

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PUMPING TEST REPORT

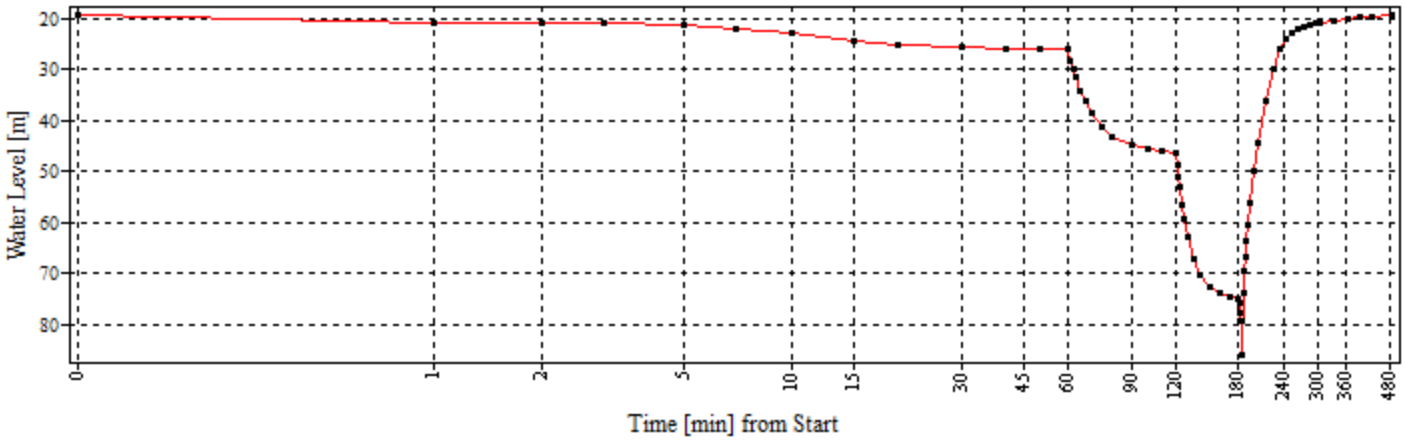
Date Compiled: 2018/02/06

BASIC SITE INFORMATION:

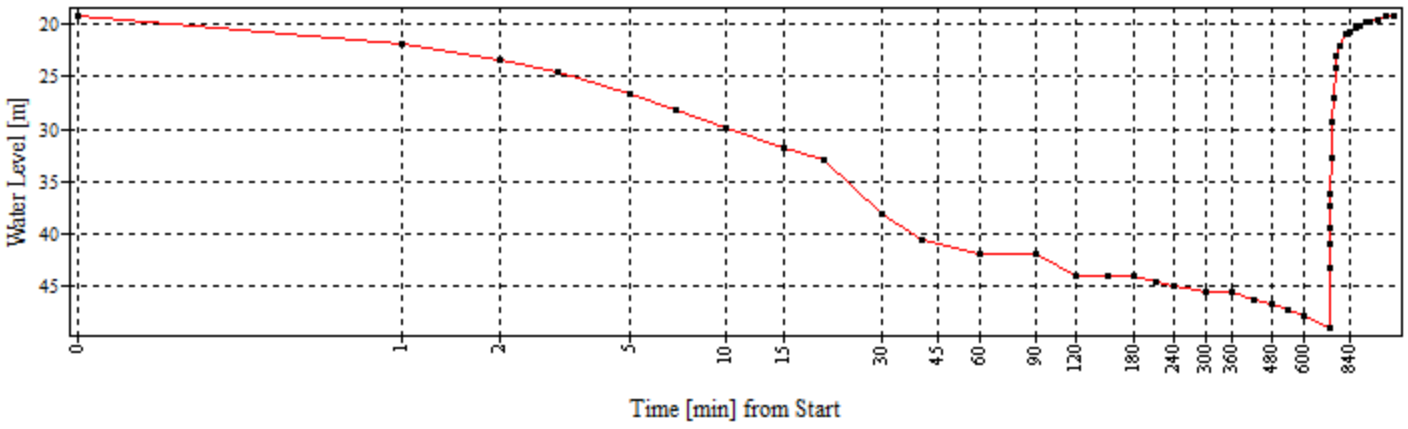
Site Identifier:	2722DDK0001	***Number:***	BH 01	***Site Type:***	Borehole		
Distr./Farm No.:	OLIFANTS	***Site Name:***	OLIFANTSHOEK				
Latitude [°]	-27.9429800	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	19.22
Longitude [°]	22.7566000	***Alt. No. 2:***		***Depth [m]:***	105.00	***Piezometer:***	0
Altitude [m]:		***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.38	***Date WL meas.:***	20180124

Coordinate System: WGS 84 / Lat/Long

MULTIRATE TEST



CONSTANT RATE TEST



PUMPING TEST

Rep. Inst.	***Meth. tested***	***Depth to intk. [m]***	***Starting Date***	***Time***	***End Date***	***Time***	***Transm. [m²/d]***	***Storativity***
Kimopax (Pty) Ltd	Step test	86.00	20180123	2045	20180124	0450		
Kimopax (Pty) Ltd	Constant rate test	86.00	20180124	0700	20180125	0200	2.3	

TESTING DETAILS:

Description	***Time started***	***Durat. [min]***	***Depth to intake [m]***	***Disch. rate [l/s]***	***Drawd. [m]***	***Recovery: [m]***	***%***	***Durat. [min]***	***Transm. [m²/d]***	***Perm. [m/d]***	***Storat.***	***Spec. Capac.***	***Q/st***
STEP TEST 1	2045	60	86.00	0.50	6.57								0.076
STEP TEST 2	2145	60	86.00	1.00	27.14								0.037
STEP TEST 3	2245	60	86.00	1.50	55.83								0.027
STEP TEST 4	2345	5	86.00	1.90	66.78	0.11	99	300					0.028
CONSTANT	0700	720	86.00	0.60	29.72		100	420	2.30				0.020

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MANAGEMENT RECOMMENDATIONS

Date Compiled: 2018/09/11

BASIC SITE INFORMATION:

Site Identifier: 2722DCK0003 ***Number:*** BH 04 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Latitude [°]	-27.9474200	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	24.40
Longitude [°]	22.7377200	***Alt. No. 2:***		***Depth [m]:***	78.10	***Piezometer:***	0
Altitude [m]:	0.00	***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.10	***Date WL meas.:***	20180128

Coordinate System: WGS 84 / Lat/Long

EXISTING EQUIPMENT:

Pump:		**Engine:**	
Type of Inst.:		***Type of Power:***	
Manufacturer:		***Manufacturer:***	
Depth to intk. [m]:		***Power Rating [kW]:***	

USE APPLICATION:

Site Status:	In use
Purpose:	Production (water supply)
Consumer:	Urban
Application:	Domestic - all purposes

WATER CHEMISTRY:

Sample No.: BH 04 ***Date sampled:*** 20180129 ***Depth sampl. [m]:*** 71.00 ***Comment:***

Chemical and Physical Parameters:						**Bacteriol. Parameters:**		**Calculated Parameters:**	
pH:	7.00	***Na:***	66.00	***Cl:***	307.00	***E. Coli:***		***Langelier:***	0.008
EC [mS/m]:	171.00	***K:***	3.40	***NO3 as N:***	13.00	***Faec. Col.:***		***Aggr. Index:***	12.15
TDS:	1098.0	***Si:***		***SO4:***	78.00	***Total Col.:***		***Ion Bal. Err. [%]:***	-5.97
Tot. Alk.:	364.00	***Al:***	0.100	***F:***	0.200	***SPC:***		***Tot. Hardness:***	673.02
Ca:	156.00	***Fe:***	0.045					***SAR:***	1.11
Mg:	69.00	***Mn:***	0.025	Concentrations in [mg/l] where applicable Bacteriological parameters in [counts/100ml]					

TESTING DETAILS:

Description	*Date*	*Durat. [min]*	*Depth to intk. [m]*	*Disch. rate l/s*	*Drawd. [m]*	*Recovery [m]*	*%*	*[min]*	*T [m²/d]*	*Storage*	*Spec. capac.*	*Comment*
STEP TEST 1	20180127	60	71.00	1.00	2.21	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 2	20180127	60	71.00	2.00	5.07	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 3	20180127	60	71.00	4.00	7.49	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 4	20180127	60	71.00	6.50	12.22	).00000	100.0	360	0.00	0.000	0.000	
CONSTANT	20180128	1440	71.00	5.00	11.23	).00000	100.0	1200	49.10	0.000	0.000	

RECOMMENDATIONS:

Prior.	*Rec. equipm.*	*Depth to intk. [m]*	*Type of power*	*Duty cyc. [hrs]*	*Disch. rate l/s*	*Water quality*	*Dyn. water level [m]*	*Crit. water level [m]*
1	Mono-type pump	60.00	Electric motor	12	4.00	CLASS 3	35.00	0.00

Note: Class 3: Total Hardness = 674 mg/l CaCO

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PUMPING TEST REPORT

Date Compiled: 2018/02/06

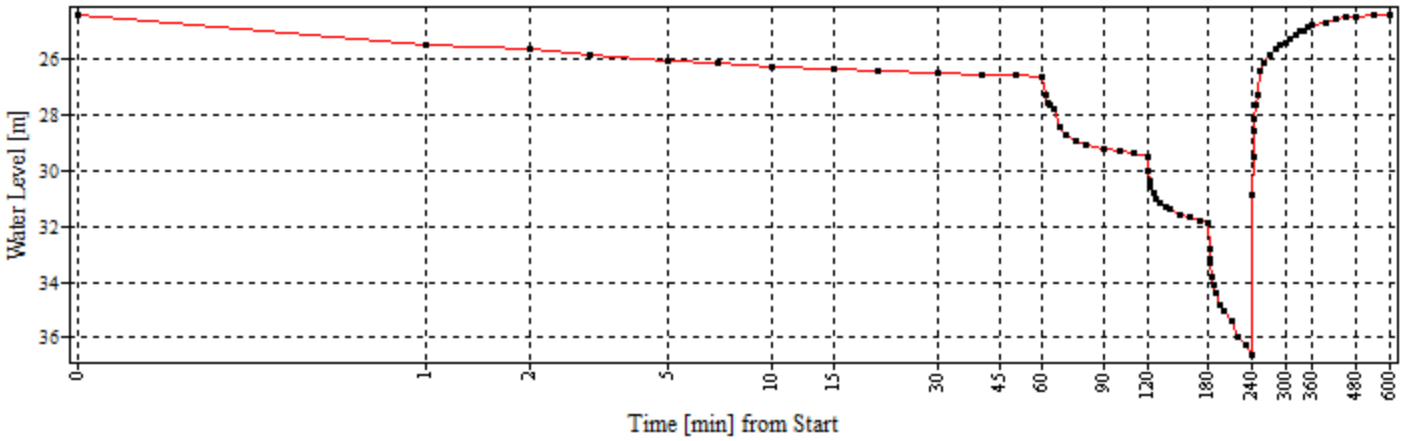
BASIC SITE INFORMATION: *Site Identifier:* 2722DCK0003 *Number:* BH 04 *Site Type:* Borehole

Distr./Farm No.: OLIFANTS *Site Name:* OLIFANTSHOEK

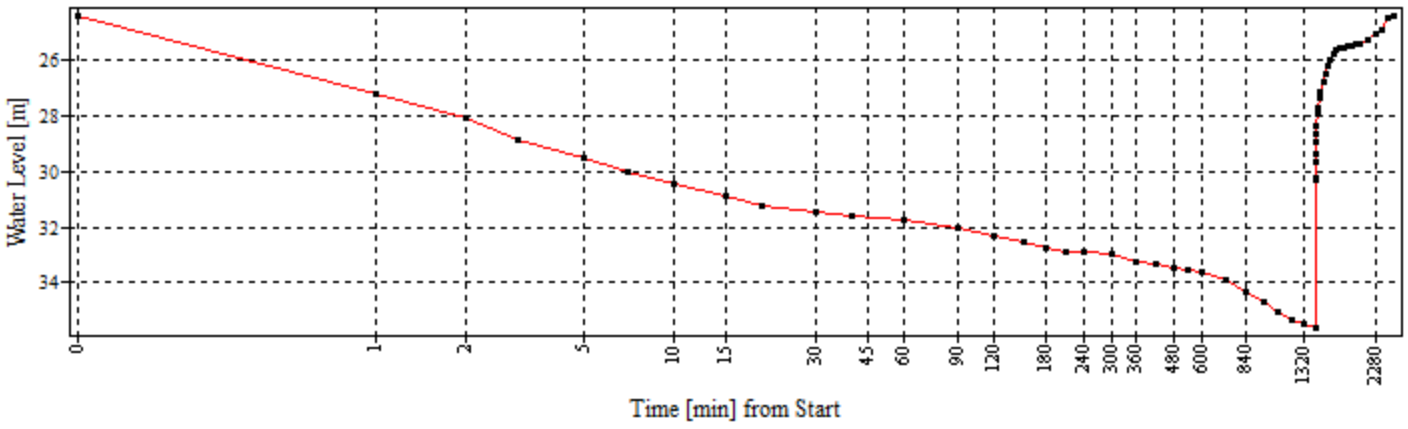
Latitude [°]	-27.9474200	*Alt. No. 1:*		*Diam. [mm]:*	165	*Last static water lev. [m]:*	24.40
Longitude [°]	22.7377200	*Alt. No. 2:*		*Depth [m]:*	78.10	*Piezometer:*	0
Altitude [m]:		*Rep. Inst.:*	Kimopax (Pty) Ltd	*Col. Ht. [m]:*	0.10	*Date WL meas.:*	20180128

Coordinate System: WGS 84 / Lat/Long

MULTIRATE TEST



CONSTANT RATE TEST



PUMPING TEST

Rep. Inst.	*Meth. tested*	*Depth to intk. [m]*	*Starting Date*	*Time*	*End Date*	*Time*	*Transm. [m²/d]*	*Storativity*
Kimopax (Pty) Ltd	Step test	71.00	20180127	1710	20180128	0310		
Kimopax (Pty) Ltd	Constant rate test	71.00	20180128	0630	20180130	0230	49	

TESTING DETAILS:

Description	*Time started*	*Durat. [min]*	*Depth to intake [m]*	*Disch. rate [l/s]*	*Drawd. [m]*	*Recovery: [m]*	*%*	*Durat. [min]*	*Transm. [m²/d]*	*Perm. [m/d]*	*Storat.*	*Spec. Capac.*	*Q/st*
STEP TEST 1	1710	60	71.00	1.00	2.21								0.452
STEP TEST 2	1810	60	71.00	2.00	5.07								0.394
STEP TEST 3	1910	60	71.00	4.00	7.49								0.534
STEP TEST 4	2010	60	71.00	6.50	12.22		100	360					0.532
CONSTANT	0630	1440	71.00	5.00	11.23		100	1200	49.10				0.445

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MANAGEMENT RECOMMENDATIONS

Date Compiled: 2018/09/11

BASIC SITE INFORMATION:

Site Identifier: 2722DCK0001 ***Number:*** BH 05 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Latitude [°]	-27.9486500	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	16.94
Longitude [°]	22.7326300	***Alt. No. 2:***		***Depth [m]:***	102.00	***Piezometer:***	0
Altitude [m]:	0.00	***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.10	***Date WL meas.:***	20180125

Coordinate System: WGS 84 / Lat/Long

EXISTING EQUIPMENT:

Pump:		**Engine:**	
Type of Inst.:		***Type of Power:***	
Manufacturer:		***Manufacturer:***	
Depth to intk. [m]:		***Power Rating [kW]:***	

USE APPLICATION:

Site Status:	Unused
Purpose:	Production (water supply)
Consumer:	Urban
Application:	Domestic - all purposes

WATER CHEMISTRY:

Sample No.: BH 05 ***Date sampled:*** 20180126 ***Depth sampl. [m]:*** 86.00 ***Comment:***

Chemical and Physical Parameters:						**Bacteriol. Parameters:**		**Calculated Parameters:**	
pH:	7.00	***Na:***	118.00	***Cl:***	62.00	***E. Coli:***		***Langelier:***	-0.207
EC [mS/m]:	108.00	***K:***	3.20	***NO3 as N:***	0.500	***Faec. Col.:***		***Aggr. Index:***	11.91
TDS:	730.00	***Si:***		***SO4:***	26.00	***Total Col.:***		***Ion Bal. Err. [%]:***	-6.25
Tot. Alk.:	536.00	***Al:***	0.100	***F:***	1.00	***SPC:***		***Tot. Hardness:***	316.72
Ca:	61.00	***Fe:***	0.029					***SAR:***	2.88
Mg:	40.00	***Mn:***	0.409	Concentrations in [mg/l] where applicable Bacteriological parameters in [counts/100ml]					

TESTING DETAILS:

Description	*Date*	*Durat. [min]*	*Depth to intk. [m]*	*Disch. rate l/s*	*Drawd. [m]*	*Recovery [m]*	*%*	*[min]*	*T [m²/d]*	*Storage*	*Spec. capac.*	*Comment*
STEP TEST 1	20180125	60	86.00	0.50	14.54	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 2	20180125	60	86.00	0.70	27.84	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 3	20180125	60	86.00	1.00	69.06	0.60	99.0	300	0.00	0.000	0.000	
CONSTANT	20180125	720	86.00	0.50	31.67	).00000	100.0	540	1.90	0.000	0.000	

RECOMMENDATIONS:

Prior.	*Rec. equipm.*	*Depth to intk. [m]*	*Type of power*	*Duty cyc. [hrs]*	*Disch. rate l/s*	*Water quality*	*Dyn. water level [m]*	*Crit. water level [m]*
1	Mono-type pump	90.00	Electric motor	10	0.40	AWAIT CHEM	46.00	0.00

Note: Class 2: Total Hardness = 318 mg/l CaCO, Fluoride = 1.0 mg/l and Manganese = 0.409 mg/l

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PUMPING TEST REPORT

Date Compiled: 2018/02/06

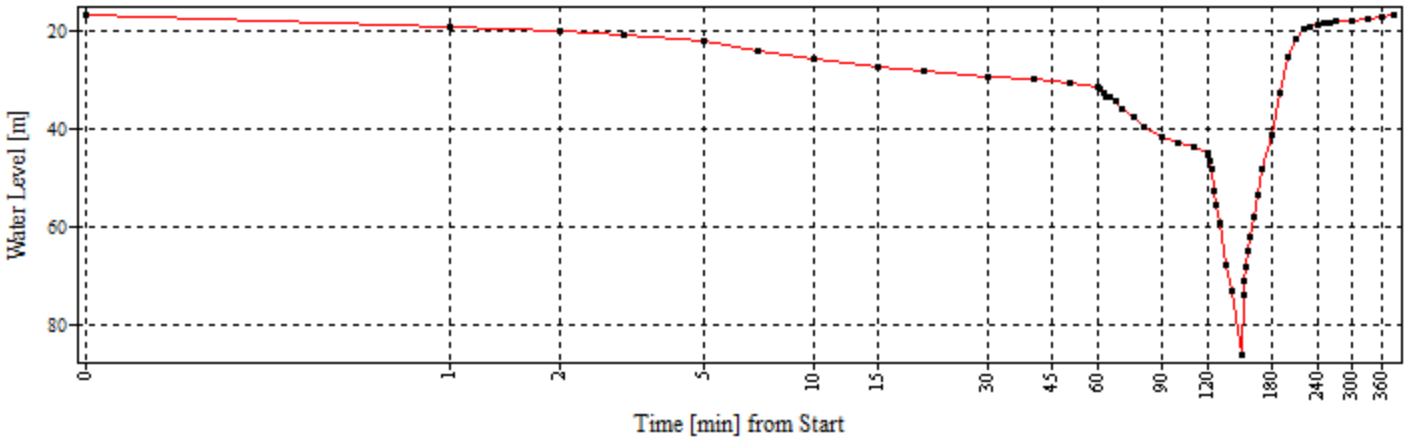
BASIC SITE INFORMATION: *Site Identifier:* 2722DCK0001 *Number:* BH 05 *Site Type:* Borehole

Distr./Farm No.: OLIFANTS *Site Name:* OLIFANTSHOEK

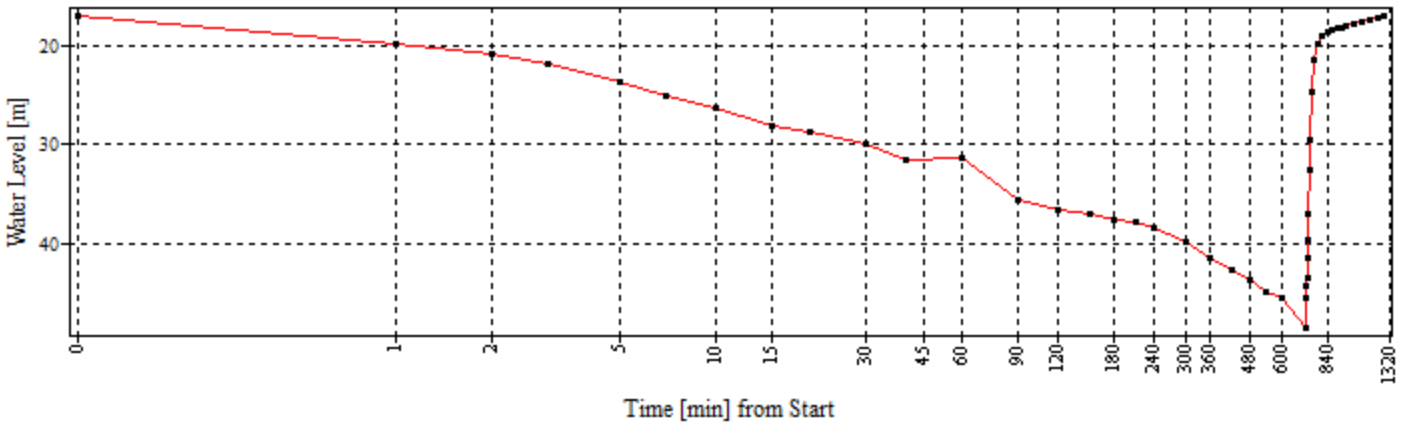
Latitude [°]	-27.9486500	*Alt. No. 1:*		*Diam. [mm]:*	165	*Last static water lev. [m]:*	16.94
Longitude [°]	22.7326300	*Alt. No. 2:*		*Depth [m]:*	102.00	*Piezometer:*	0
Altitude [m]:		*Rep. Inst.:*	Kimopax (Pty) Ltd	*Col. Ht. [m]:*	0.10	*Date WL meas.:*	20180125

Coordinate System: WGS 84 / Lat/Long

MULTIRATE TEST



CONSTANT RATE TEST



PUMPING TEST

Rep. Inst.	*Meth. tested*	*Depth to intk. [m]*	*Starting Date*	*Time*	*End Date*	*Time*	*Transm. [m²/d]*	*Storativity*
Kimopax (Pty) Ltd	Step test	86.00	20180125	1500	20180125	2130		
Kimopax (Pty) Ltd	Constant rate test	86.00	20180125	2200	20180126	1900	1.9	

TESTING DETAILS:

Description	*Time started*	*Durat. [min]*	*Depth to intake [m]*	*Disch. rate [l/s]*	*Drawd. [m]*	*Recovery: [m]*	*%*	*Durat. [min]*	*Transm. [m²/d]*	*Perm. [m/d]*	*Storat.*	*Spec. Capac.*	*Q/st*
STEP TEST 1	1500	60	86.00	0.50	14.54								0.034
STEP TEST 2	1600	60	86.00	0.70	27.84								0.025
STEP TEST 3	1700	60	86.00	1.00	69.06	0.60	99	300					0.014
CONSTANT	2200	720	86.00	0.50	31.67		100	540	1.90				0.016

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MANAGEMENT RECOMMENDATIONS

Date Compiled: 2018/09/11

BASIC SITE INFORMATION:

Site Identifier: 2722DCK0002 ***Number:*** BH 06 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

Latitude [°]	-27.9382800	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	19.45
Longitude [°]	22.7376400	***Alt. No. 2:***		***Depth [m]:***	76.46	***Piezometer:***	0
Altitude [m]:	0.00	***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.05	***Date WL meas.:***	20180131

Coordinate System: WGS 84 / Lat/Long

EXISTING EQUIPMENT:

Pump:		**Engine:**	
Type of Inst.:		***Type of Power:***	
Manufacturer:		***Manufacturer:***	
Depth to intk. [m]:		***Power Rating [kW]:***	

USE APPLICATION:

Site Status:	In use
Purpose:	Production (water supply)
Consumer:	Urban
Application:	Domestic - all purposes

WATER CHEMISTRY:

Sample No.: BH 06 ***Date sampled:*** 20180201 ***Depth sampl. [m]:*** 65.00 ***Comment:***

Chemical and Physical Parameters:						**Bacteriol. Parameters:**		**Calculated Parameters:**	
pH:	7.00	***Na:***	75.00	***Cl:***	396.00	***E. Coli:***		***Langelier:***	0.110
EC [mS/m]:	207.00	***K:***	3.40	***NO3 as N:***	16.00	***Faec. Col.:***		***Aggr. Index:***	12.28
TDS:	1324.0	***Si:***		***SO4:***	124.00	***Total Col.:***		***Ion Bal. Err. [%]:***	-3.04
Tot. Alk.:	368.00	***Al:***	0.100	***F:***	0.200	***SPC:***		***Tot. Hardness:***	880.03
Ca:	206.00	***Fe:***	0.045					***SAR:***	1.10
Mg:	89.00	***Mn:***	0.025	Concentrations in [mg/l] where applicable Bacteriological parameters in [counts/100ml]					

TESTING DETAILS:

Description	*Date*	*Durat. [min]*	*Depth to intk. [m]*	*Disch. rate l/s*	*Drawd. [m]*	*Recovery [m]*	*%*	*[min]*	*T [m²/d]*	*Storage*	*Spec. capac.*	*Comment*
STEP TEST 1	20180130	60	65.00	1.00	2.02	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 2	20180130	60	65.00	2.00	3.99	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 3	20180130	60	65.00	4.00	6.19	).00000	0.0	0	0.00	0.000	0.000	
STEP TEST 4	20180130	60	65.00	7.00	11.59	0.76	93.0	360	0.00	0.000	0.000	
CONSTANT	20180131	1440	65.00	6.50	18.75	0.68	96.0	1440	12.10	0.000	0.000	

RECOMMENDATIONS:

Prior.	*Rec. equipm.*	*Depth to intk. [m]*	*Type of power*	*Duty cyc. [hrs]*	*Disch. rate l/s*	*Water quality*	*Dyn. water level [m]*	*Crit. water level [m]*
1	Mono-type pump	50.00	Electric motor	12	4.00	CLASS 3	44.00	0.00

Note: Class 3: Total Hardnes = 880 mg\l

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PUMPING TEST REPORT

Date Compiled: 2018/02/06

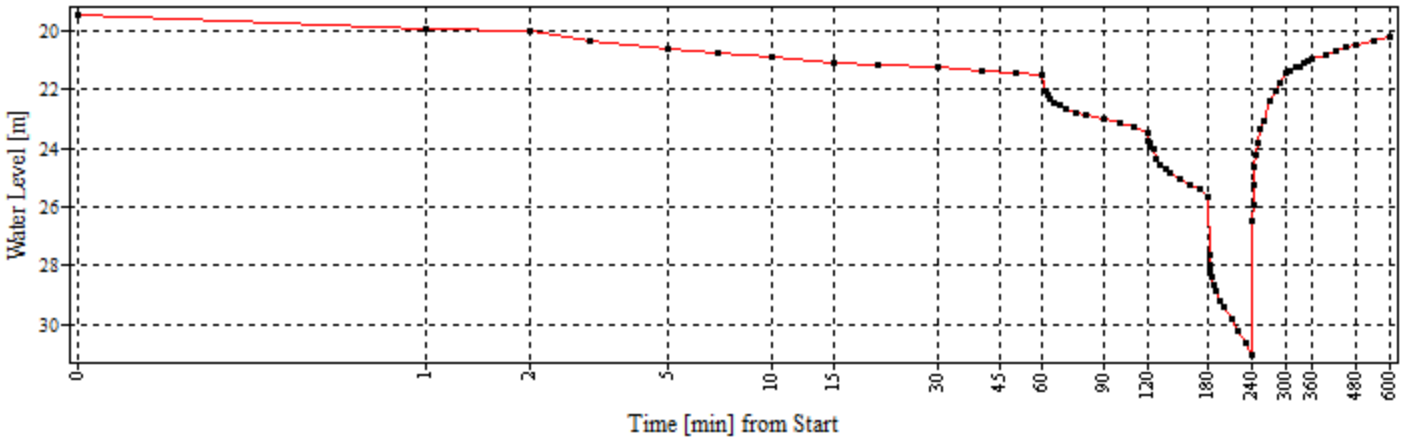
BASIC SITE INFORMATION: ***Site Identifier:*** 2722DCK0002 ***Number:*** BH 06 ***Site Type:*** Borehole

Distr./Farm No.: OLIFANTS ***Site Name:*** OLIFANTSHOEK

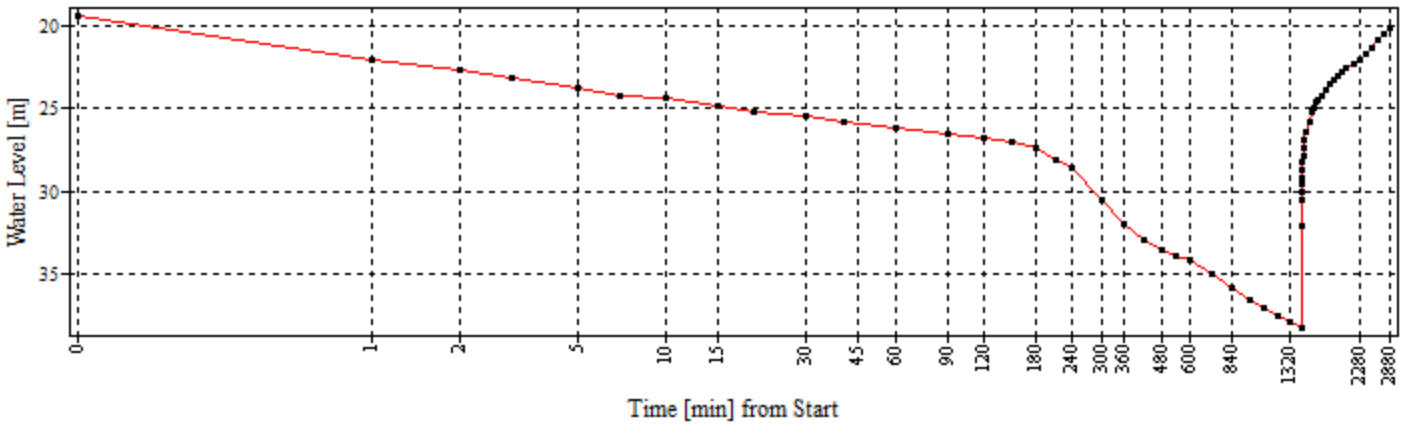
Latitude [°]	-27.9382800	***Alt. No. 1:***		***Diam. [mm]:***	165	***Last static water lev. [m]:***	19.45
Longitude [°]	22.7376400	***Alt. No. 2:***		***Depth [m]:***	76.46	***Piezometer:***	0
Altitude [m]:		***Rep. Inst.:***	Kimopax (Pty) Ltd	***Col. Ht. [m]:***	0.05	***Date WL meas.:***	20180131

Coordinate System: WGS 84 / Lat/Long

MULTIRATE TEST



CONSTANT RATE TEST



PUMPING TEST

Rep. Inst.	***Meth. tested***	***Depth to intk. [m]***	***Starting Date***	***Time***	***End Date***	***Time***	***Transm. [m²/d]***	***Storativity***
Kimopax (Pty) Ltd	Step test	65.00	20180130	1530	20180131	0130		
Kimopax (Pty) Ltd	Constant rate test	65.00	20180131	0730	20180202	0730	12	

TESTING DETAILS:

Description	***Time started***	***Durat. [min]***	***Depth to intake [m]***	***Disch. rate [l/s]***	***Drawd. [m]***	***Recovery: [m]***	***%***	***Durat. [min]***	***Transm. [m²/d]***	***Perm. [m/d]***	***Storat.***	***Spec. Capac.***	***Q/st***
STEP TEST 1	1530	60	65.00	1.00	2.02								0.495
STEP TEST 2	1630	60	65.00	2.00	3.99								0.501
STEP TEST 3	1730	60	65.00	4.00	6.19								0.646
STEP TEST 4	1830	60	65.00	7.00	11.59	0.76	93	360					0.604
CONSTANT	0730	1440	65.00	6.50	18.75	0.68	96	1440	12.10				0.347

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