water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Geohydrology, Western Cape Region

Groundwater Status Report - Breede Gouritz WMA

GH4250

Author: M Jacobs

Photo by M Jacobs

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CONTENTS

1. Introduction

The main purpose of the groundwater monitoring status report is to monitor the communal aquifer status in the various towns of the Breede Gouritz water management area (wma). In places, groundwater plays a vital role in providing domestic supply, agricultural irrigation water and supporting ecosystem functioning. Groundwater monitoring in the Breede Gouritz wma is a multi-faceted activity that requires considerable dedication of staff, equipment and funds. It is however a crucial activity required for the responsible and sustainable management of groundwater within the Breede Gouritz Water Management Area.

Groundwater section monitors the general status of aquifers in the Western Cape. Our focus is not on Municipal well field monitoring and management which is the water service provider's responsibility.

The key elements in the monitoring report are:

- borehole water levels;
- borehole water quality (key indicators such as pH and electrical conductivity/ total dissolved solids); and
- rainfall

2. Breede-Gouritz Water Management Area (WMA)

In the **Breede WMA,** Stanford and Grabouw area groundwater levels show typical seasonal variation and are very stable. The early 2015-2016 dry season groundwater levels declined to marginally lower levels and the low subsequent winter recharge has resulted in groundwater levels not recovering fully to typical winter high levels. There is a slow response to recharge. In the Breede river valley (Worcester), Ceres area groundwater levels are currently stable, typical seasonal variation. In areas impacted by abstraction groundwater levels may drop locally during the dry season but recover generally to normal levels in the wet season due to non-abstraction. In 2016 the low winter recharge resulted in lower than typical winter recharge of groundwater level in the entire area. In the Agterwitzenberg, Koo & Nuy Valley area there has been a steep decline in groundwater levels, both the summer 2015 low levels and the winter high levels are lower than the past four years. The 2016 winter recharge has shown some recovery of water level to normal fluctuations. In the Eastern Breede WMA, Grabouw there is a steady upward trend during the 2016 winter recharge period due to good recharge events but is declining steadily late 2016 due increase groundwater abstraction.

In the **Gouritz WMA**, **Great Karoo**, groundwater levels remain below normal despite the recent rainfall/recharge events. There is been a steady decline in groundwater levels for wellfields in the vicinity of Beaufort West since 2013 -2016 period, reaching levels of the 2010 drought period and is cause for concern. The Brandwag and Lemoenfontein wellfields need to be closely monitored and managed especially during the current 2016 drought situation. The Quaggasfontein wellfield south of Beaufort West needs to be brought into operation to relieve the town wellfields north east of Beaufort West as these wellfields are overexploited.

In Leeu Gamka, Prince Albert area Good rainfall events early 2016 and during winter months have seen an increase in groundwater levels returning to normal levels. In the Merweville area groundwater levels dropped substantially during the 2015 period due to increase groundwater abstraction for irrigation. Groundwater levels had improved by the end of 2015 early 2016 but were still relatively low. Groundwater levels is continuing to drop mid 2016 due localized over exploitation which are evident close to the Leeu River where heavy irrigation takes place.

The **Klein Karoo area** which includes areas such as Oudtshoorn (Blossoms, Waboomskraal), groundwater levels remain relatively stable and high for these areas after good recharge events 2013 – 2016. Groundwater levels in the Ladismith area increase to normal levels during the 2016 winter recharge events but has been declining slightly in the summer of 2016 due increase groundwater abstraction and less snowfall in the Swartberg mountains has resulted in less surface runoff flow. There is still a problem with well fields struggling to meet demand in the Klein Karoo Rural Water Supply Scheme as Groundwater levels continues to decline in the Vermaaksrivier well field due to increase abstraction. Recent recharge events have not improved the situation as groundwater levels still remain below normal. Groundwater levels needs to be closely monitored and managed to keep up with the struggling demand. The Blossom wellfield needs to be tapped into for municipal supply to relieve the current situation.

3. Standard Precipitation Index (SPI) Maps

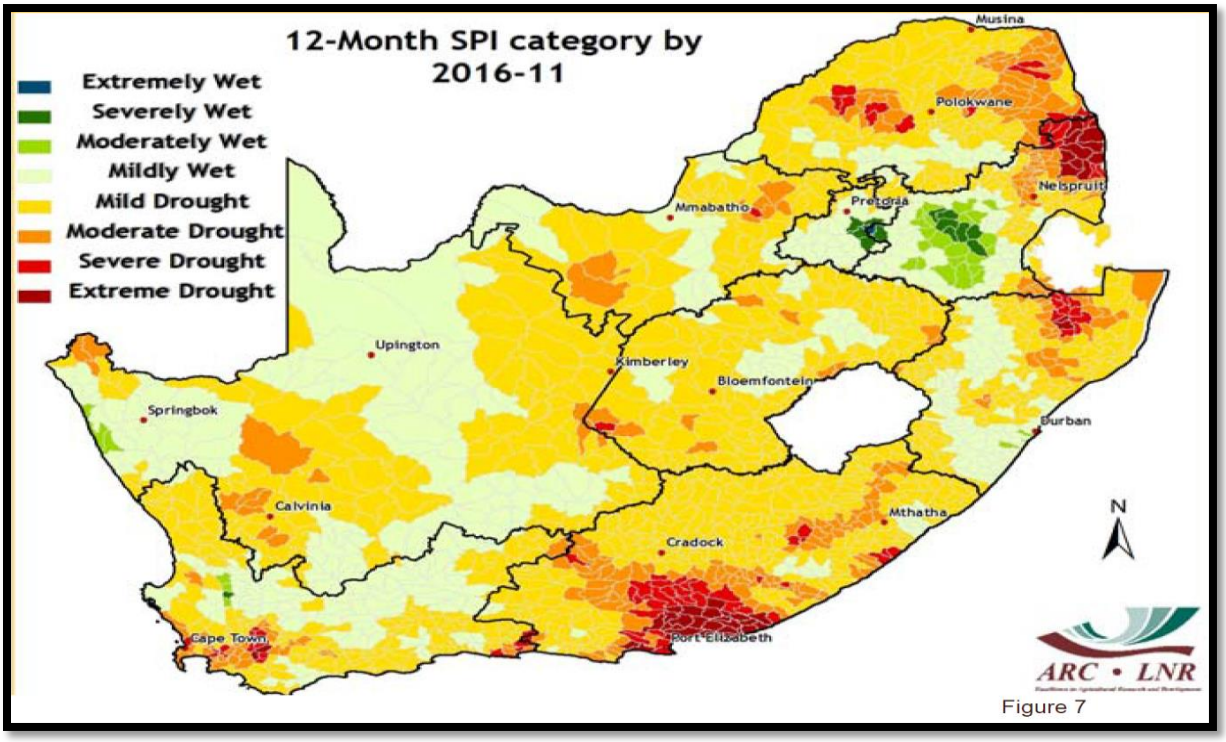

Figure 1: ARC - Standard Precipitation Index MAPS – 12 month

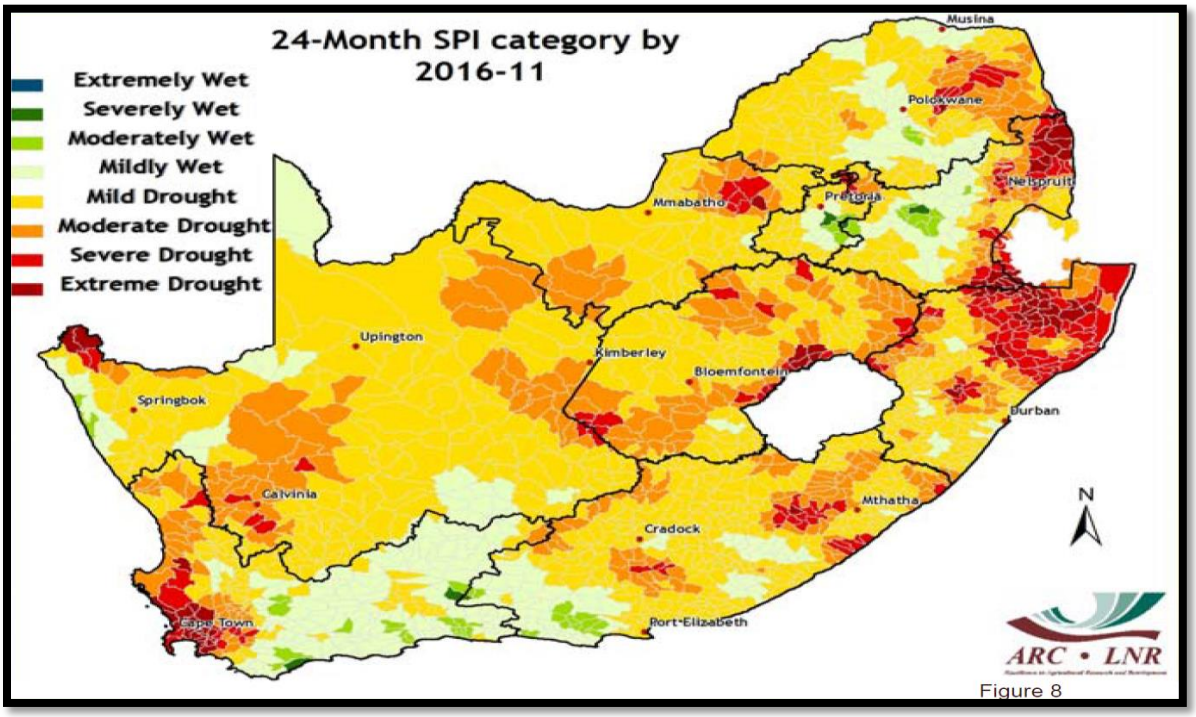

Figure 2: ARC – Standard Precipitation Index MAPS - 24 month

Using the Standard Precipitation Index (SPI) analysis variations in precipitation patterns were observed such as the intensity, duration and shifts in seasons. The SPI analysis clearly showed that there has been a persistent low to medium rainfall in the Breede_Gouritz water management area (wma) in particular since 2015 – 2016 period, coupled with greater groundwater abstraction has greatly influenced the continual decline in water levels in the Breede_Gouritz wma wellfields. A particularly significant drought period was observed for 2010 and 2015 for Beaufort West, Merweville and Leeu Gamka, the drought is reflected due to low rainfall coupled with greater groundwater abstractions has greatly influenced the continual decline in water levels in these well fields in the areas. The analysis has shown for the 24 month period that areas along the coast of the Breede Gouritz wma have received moderately to mildly wet variations in rainfall.

The results of the SPI have shown that there are wide variations in rainfall records in most of the stations which could be attributed to climate variability. Higher temperatures would however, increase evapotranspiration which would in turn reduce direct recharge. In the catchment area there have been more drought effects in recent years resulting in reduced recharge which together with groundwater abstraction have resulted in massive groundwater level declines the area.

4. Conclusion and Recommendations

Groundwater can be used to improve medium to long term security of supply across the Province but this will require comprehensive local investigation to ensure sustainability.

Conjunctive use of groundwater with surface water remains the most feasible option not only during droughts but potential future use.

At a Provincial level there remains significant groundwater in storage, which can be tapped into for emergency supplies with well sited boreholes.

In circumstances where there is large scale groundwater abstraction, the storage can become locally depleted.

Municipal wellfields need to be carefully monitored and assessed to provide early warning of impending supply problems. As a precautionary measure it has been recommended to all Municipalities using groundwater, that they appoint hydrogeologists to assess the wellfield status, ensure appropriate monitoring and data collection, and provide management recommendations to ensure security of supply.

Industrial and Agricultural users are similarly advised to assess the status of their boreholes and the local aquifer.

5. REFERENCES

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Van Niekerk, A, Jacobs, M, Smart, M. (2014). Hydrocensus within the Gouritz Water Management Area (WMA) for Groundwater Reserve Determination of the Oudtshoorn Municipality; Geotechnical Report GH4173, Department of Water and Sanitation, Pretoria.

Smart, M, Jonck, F. (2016). Annual Groundwater Monitoring Report; Department of Water and Sanitation, Bellville.

6.0 APPENDIX

Monitoring Routes:

1 Ceres & Agterwitzenberg

2 Koo & Nuy

3 Stanford

4 Tesselaarsdal

5 Cape Infanta

6 Worcester

7 Leeu Gamka

8 Beaufort West

9 Merweville

10 Oudtshoorn

11 Swartberg Mountain Range

12 Prince Albert

13 Kammanassie

14 Waboomskraal / DAGEOS

15 Southern Cape

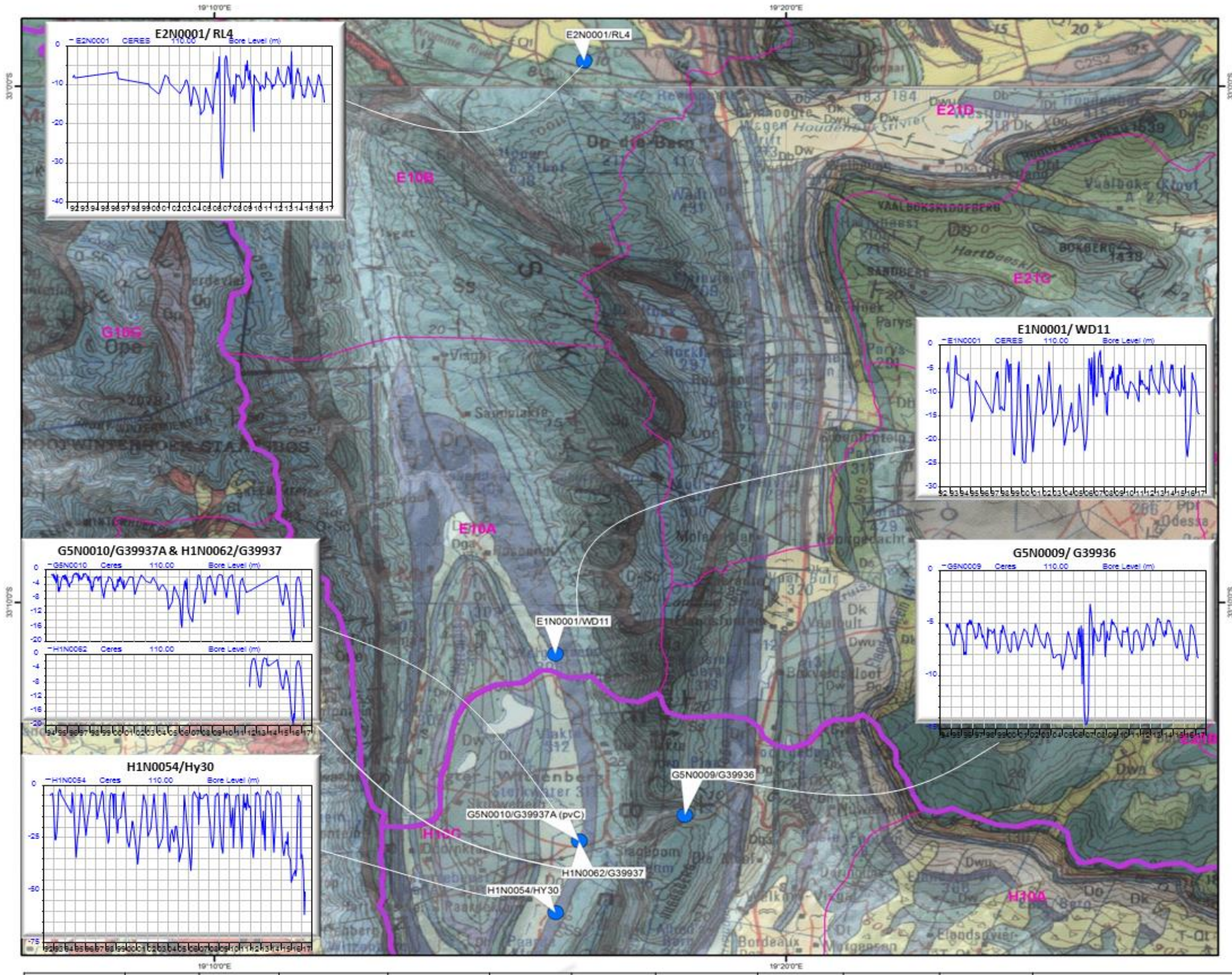
16 Albertinia

17 Ladismith, Zoar, Calitzdorp

ACKNOWLEDGEMENT:

The assistance of the entire groundwater monitoring and data management team is acknowledged in the production of this report. Each member contributed by playing a role in one or more of the following:

- **Maintaining the monitoring stations**
- **Collecting the field data**
- **Entering data to databases**
- **Data presentation / graphics production**
- **Reporting on their respective WMA's**



Ceres:

Groundwater Monitoring Route

-Groundwater level

A) CERES

Main Purpose:
To Monitor the Bokkeveld aquifer in vicinity of Ceres Basin.

Long-term trend:
The abstraction has been normal in the previous years and appears to be sustainable.

Short-term trend:
The low winter rainfall in 2016 resulted in low groundwater recharge in the area.
The low rainfall in the period of late 2016 to mid 2017 resulted in groundwater level to decline in the entire area.
Abstraction also contributed to groundwater level decline in the area.

Comment/Emerging trends:
Stable – fluctuations reflect seasonal variation.

Recommendations:
On DWS recommendation BGCMA appointed Geoss to carry out a situation assessment of the monitoring network suitability for BGCMA purposes. This includes the Ceres basin which is reported in the Breede WMA Internal Strategic Perspective as being stressed (DWA, 2004).

B) AGTERWITZENBERG

Main Purpose:
To evaluate the sustainability of agricultural irrigation in the area.

Long-term trend:
Seasonal groundwater level variations are observed. The abstraction has been normal in the previous years and appears to be sustainable.

Short-term trend:
The low winter rainfall in 2016 resulted in low groundwater recharge in the area.
The low rainfall in the period of late 2016 to mid 2017 resulted in groundwater level to decline in the entire area.
Abstraction also contributed to groundwater level decline in the area.
The monitoring station H1N0054/Hy30 showed significant abstraction during summer seasons with groundwater level fluctuating from >60m to <10m below the surface.

Comment/Emerging trends:
Indications are that current level of abstraction is sustainable.

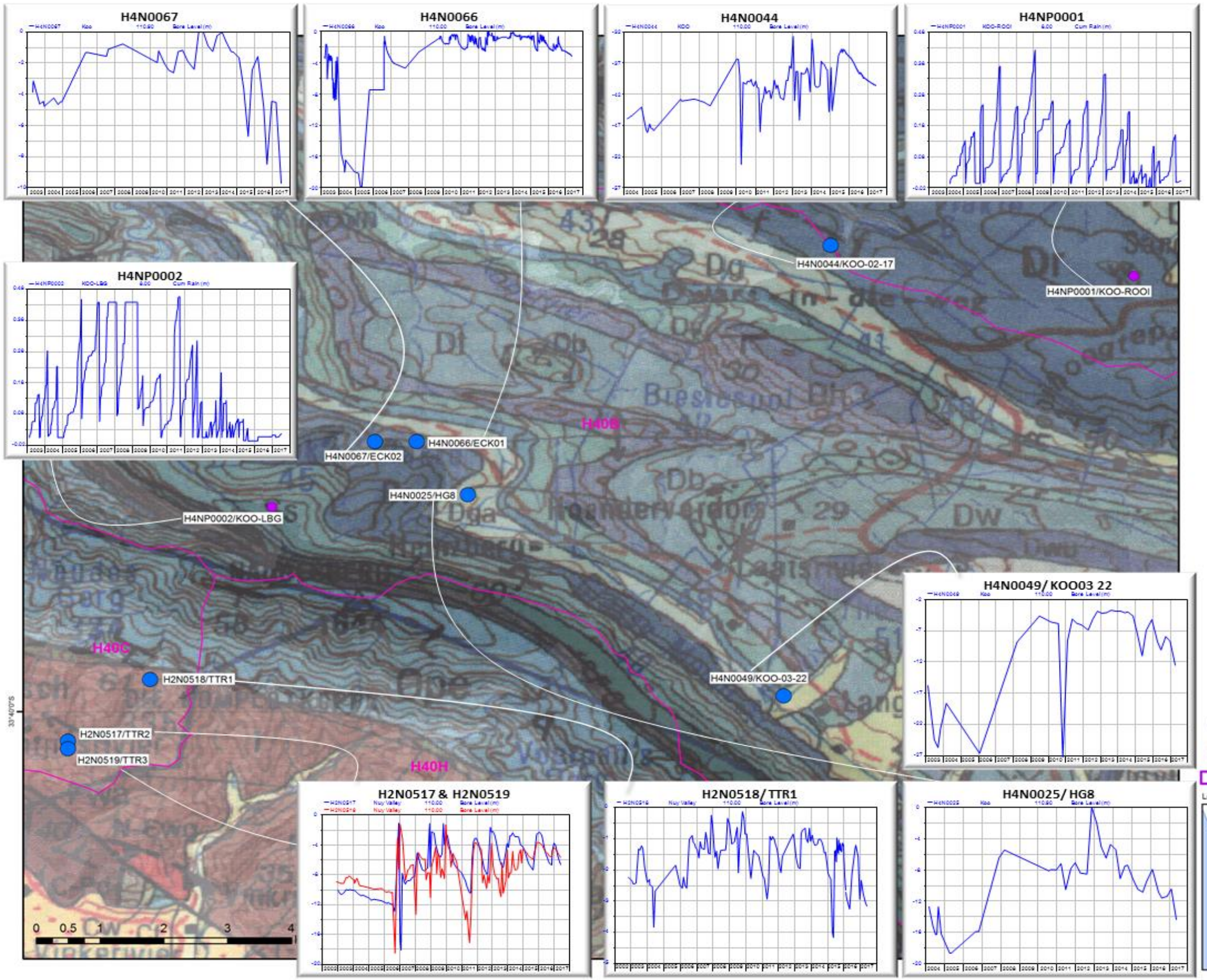
Recommendations:
Continue monitoring programme unchanged.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	B Rolinyati	Signature	Date: 14/06/2017	Report compiled by:	B Rolinyati	Signature	Date: 14/06/2017	Approved by:	N Tumana	Signature	Date
Map reference:	X:GEOHYDRO/BREEDEWMA/Ceres/Ceres_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/BREEDE/Ceres/.....			Imagery / data used: Geology 1:250 000 map series; gcs_3319, gcs_3318. (Council of Geoscience)			

Ceres



Koo & Nuy:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
TMG groundwater has been developed for an agricultural irrigation scheme in the Koo Valley. Departmental monitoring supplements Koo Irrigation Board groundwater monitoring. The pre-production condition is currently being monitored in the Koo valley and at Nuy on the southern side of the Langeberge – where concerns of impacts /potential impacts have been raised.

Long-term trend:
Stable – fluctuations reflect seasonal variation in the general region.

Short-term trend:
Water levels partly recovered during winter 2015, then declined again in early 2016 but rises slightly over the winter recharge period but began to decline again early 2017 reaching levels of the 2010 drought. Since last monitoring the water levels have remained stable.

Comment/Emerging trends:
Stable, but the influence of abstraction is becoming evident in Koo valley. Abstraction appears to influence a borehole at Nuy (H2N0518). Further investigation would be needed to determine the origin of this influence.

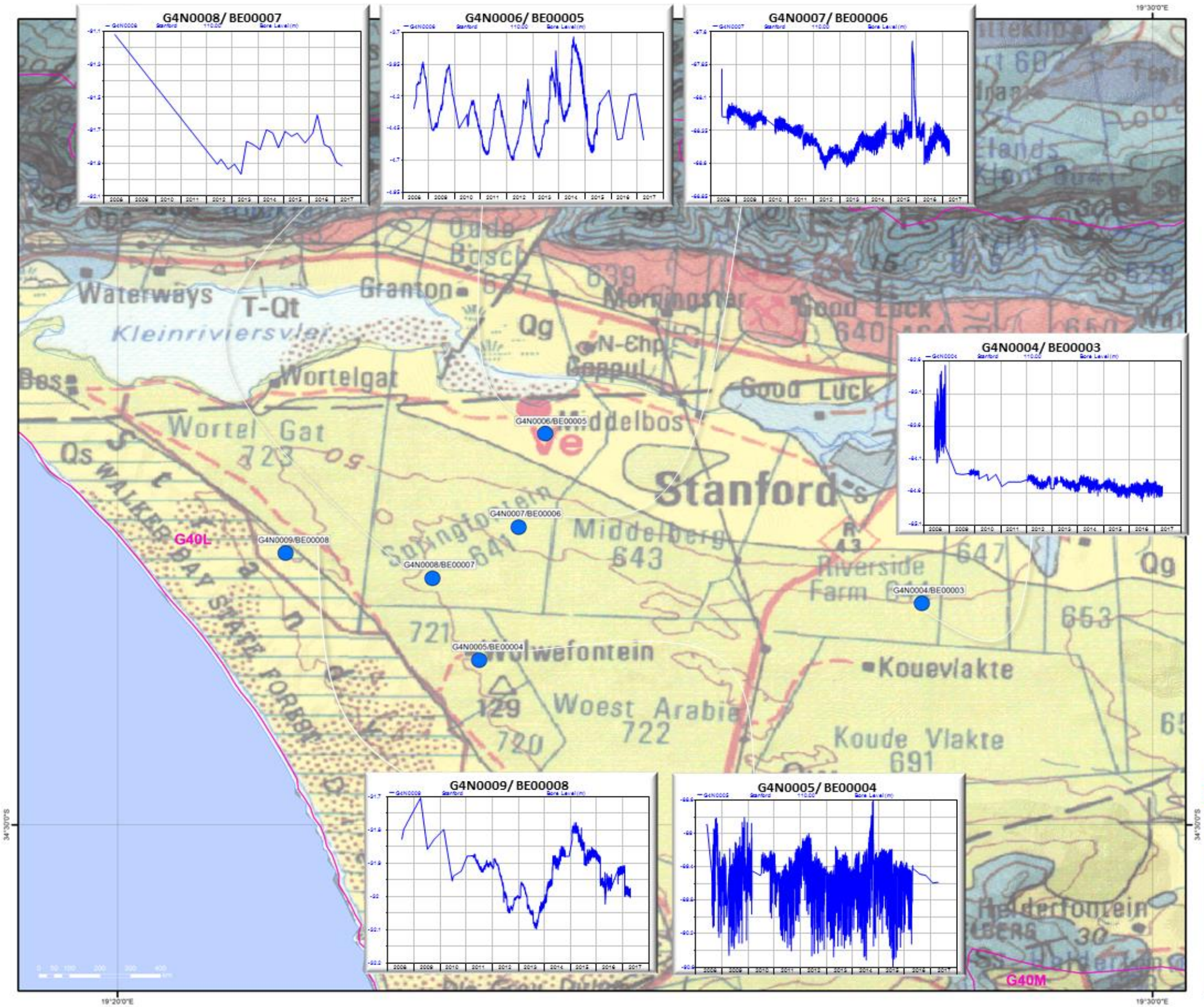
Recommendations:
Continue with monitoring as is and collaborate data with that of the Koo irrigation board.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	N Makiwane	Signature	Date	Report compiled by:	N Makiwane	Signature	Date:14/06/2017	Approved by:	M. Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/OlifnatsDoornWMA/Koo&Nuy/Koo&Nuy_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/BREEDE/Koo&Nuy/.....			Imagery / data used: Geology 1:250 000 map series; gcs_3119, gcs_3219. (Council of Geoscience)			

Koo and Nuy



Stanford:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
The Stanford primary aquifer is a sole source communal aquifer. Monitoring was established in response to imminent aquifer development (e.g Municipal supplies as well as a potential golf course). Data assists in determining regional flow paths and pre and post development aquifer behavior. This will assist in protecting existing lawful users interests. The Municipality developed the Koudevlakte wellfield (2 boreholes) licensed on 12 September 2013 – maximum 1.6 million m3/a. A further license application for irrigation agriculture in the Middelburg farm vicinity is anticipated.

Long-term trend:
The early 2015 - 2016 dry season groundwater levels declined to slightly lower levels and high winter recharge has resulted in groundwater levels recovering to typical winter high levels. Groundwater displays seasonal variation of less than a meter, from the wet winter and lows after summer. There was a slight downward trend of 0.5 meters from 2008 to 2013 , rising through 2014 and 2015. An apparent accentuated decline is observed at BE0005 in late 2014 and early 2015.

Short-term trend:
For the past couple of years seasonal groundwater level fluctuations records are similar.
Groundwater levels have progressively dropped since the last monitoring assessment in October 2016. There has been very little rainfall. The area of high porosity sand aquifers has lead to a slow shallow response to recharge

Comment/Emerging trends:
Groundwater levels are gradually rising but have not recovered fully.

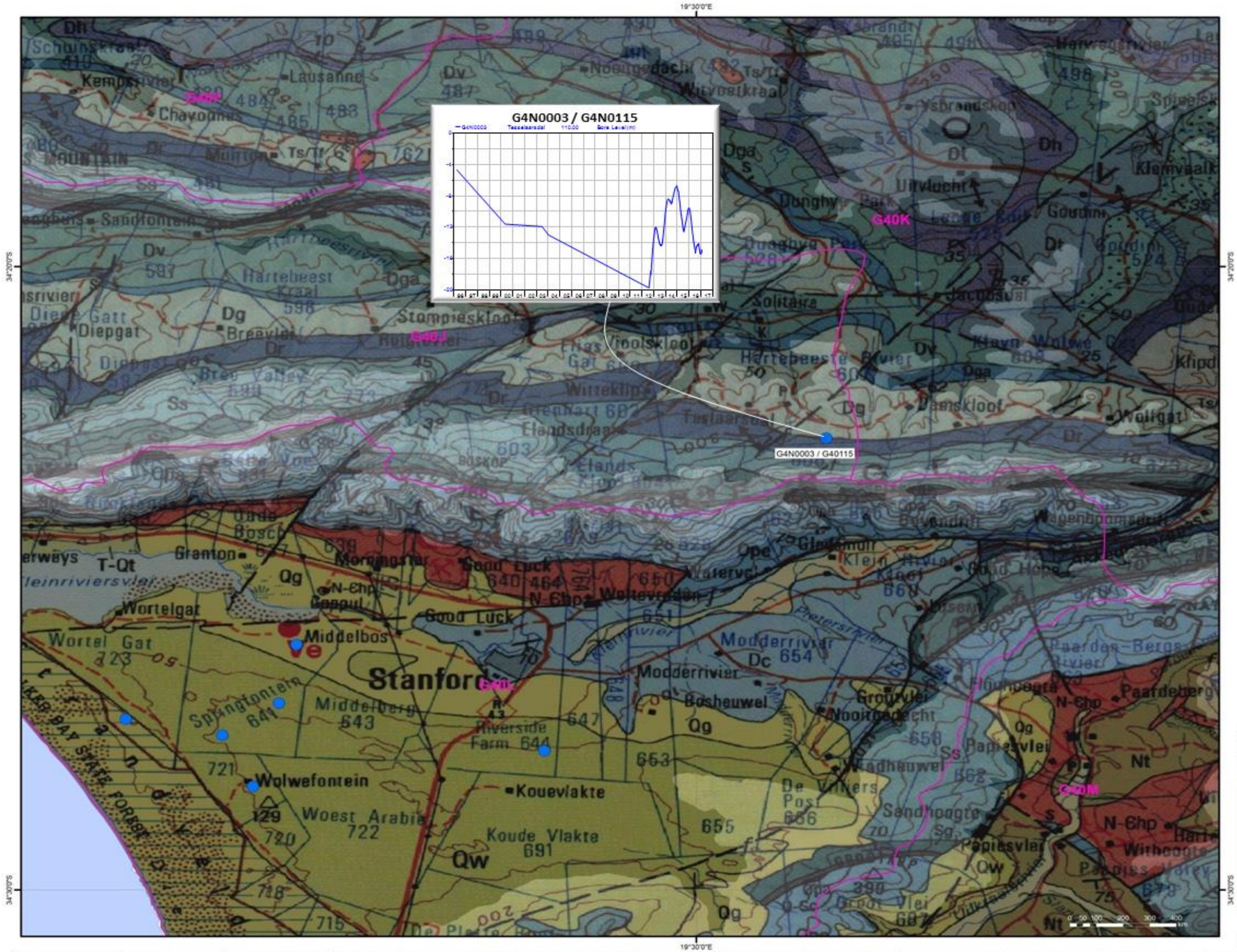
Recommendations:
Survey of boreholes is recommended so that the groundwater flow paths can be more accurately determined. This will assist in resource quantification and protection against saline intrusion from the sea.

- Geosite (Water level monitoring point)
- Geosite (Water quality monitoring point)
- Geosite (Water level & quality monitoring point)
- Geosite (Rainfall monitoring point)
- WMA boundary
- Quartemary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	N Seralker	Signature	Date	Report compiled by:	N Makiwane	Signature	Date26/06/2017	Approved by:	M. Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/BreedeWMA/Stanford/Stanford_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/BREEDE/Stanford/Standford_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3419. (Council of Geoscience)			

Stanford



Tesselaarsdal:

Groundwater Monitoring Route
-Groundwater level & rainfall-

Main Purpose:
Infrequent historical measurements indicate a marked long term groundwater level decline of approx. 15 meters between 1996 and 2012. A better understanding was needed of the situation, and whether overexploitation of this aquifer is taking place. This is especially important because springs can be expected at the lithological contact between the Nardouw (Goudini Formation) / Bokkeveld Group. Declining groundwater levels in this setting could impact springs.

Long term trend:
The water level trend is indicating a decline in the water level although the level is not as low as in 2012.

Short-term trend:
An upward trend is observed from 2012-2014. This was followed by rapid declining trend from late 2014 to 2015. Abstraction from nearby Municipal borehole impacts this borehole G40115.
Currently there is a dry period being experienced influencing the recharge. Water level drop is likely a result of monitoring borehole being in very close proximity to the Municipal supply combined with the lack of recharge.

Recommendations:
Further investigation is needed of the situation, to access whether over exploitation of this aquifer is taking place. Continue to monitor the groundwater level signature over at least one more year period.
Abstraction data for the nearby production boreholes to be obtained from the relevant Municipality.

Geosite (Water level Monitoring point)
Geosite (Water quality Monitoring point)
Geosite (Water level & quality Monitoring point)
Geosite (Rainfall Monitoring point)
WMA boundary
River
Quaternary drainage region boundary & number

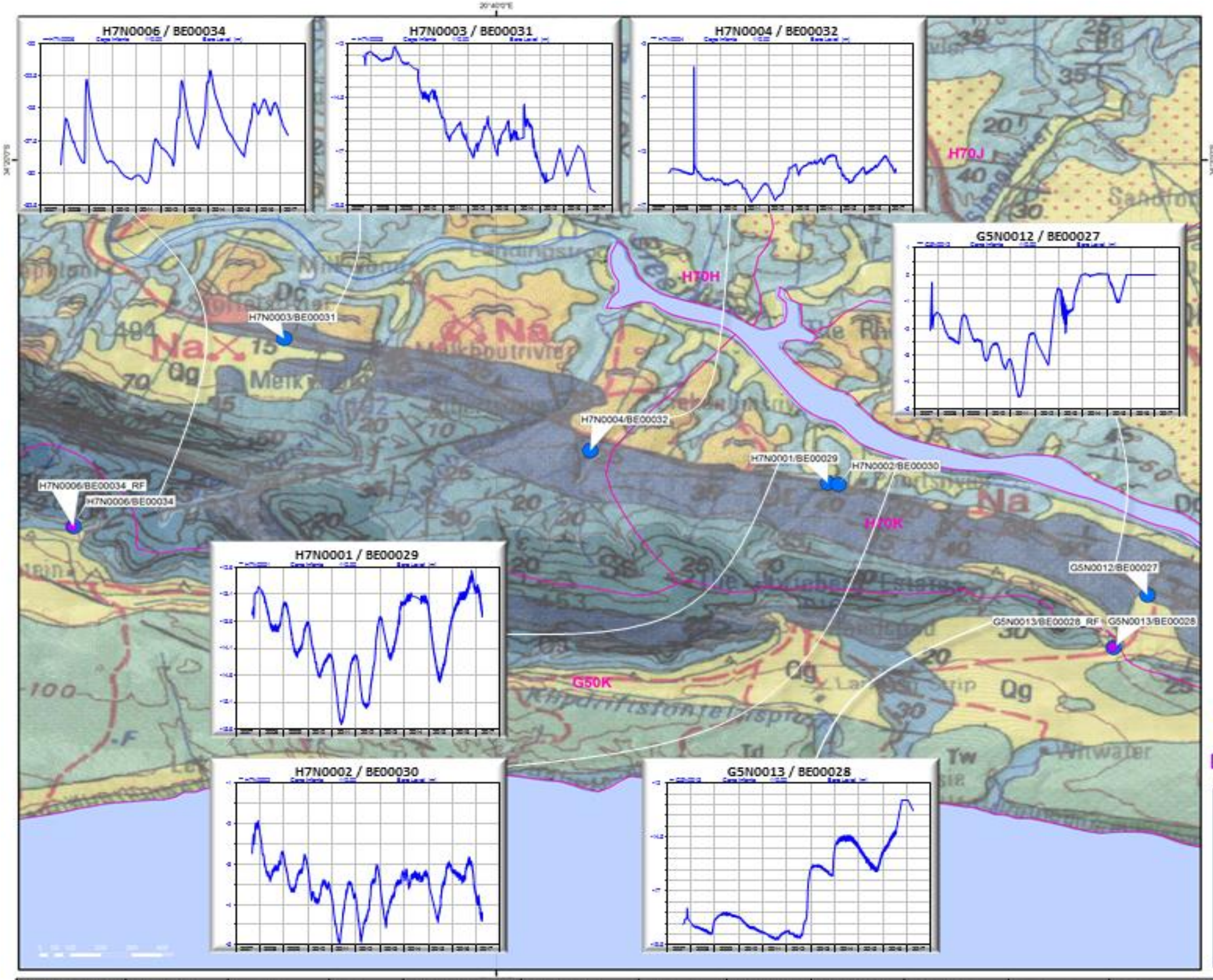
Imagery used:
Geology: gcs_3218_c ? gcs_3219_c (Council of Geoscience)
Satellite: Spot5 2011

Compiled by: Freda Jonck
Date: 21 January 2013
Ref: X: Geohydro/BreedeWMA/Tesselaarsdal/Tesselaarsdal_mon_Oct2012-A3

Tesselaarsdal: Groundwater Monitoring Route

Map compiled by:	N Seralker	Signature	Date	Report compiled by:	N. Makiwane	Signature	Date	Approved by:	M. Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/BreedeWMA/Teselaarsdal/Teselaarsdal_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/BREEDE/Teselaarsdal/Tesselaarsdal_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3419. (Council of Geoscience)			

Tesselaarsdal



Cape Infanta:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:

Monitoring was established in response to large scale (1.6 million m³/a) artesian groundwater development of the TMG aquifer for olive irrigation. The TMG aquifer is a sole source to Cape Infanta and a potential potable water source to support growth in the area – including Witzand on the opposite side of the Breede River. It also sustains wetlands in the Potsberg Nature reserve. Refer to GH 4039 (Smart et al., 2009) for detail on network design.

Long-term trend:
Groundwater levels have remained generally stable and display seasonal trends. In the past couple of months beginning 2017 certain parts of the Province have not received significant amount of rain and as a result there has been a decline in the water levels in the area.

Short-term trend:
An downward trend in groundwater levels is observed in the summer 2016 to 2017 period possibly due to greater groundwater abstraction and limited recharge in the area but enough groundwater still remain in storage. Groundwater levels still remain fairly stable despite the on going 2015 – 2017 dry period.

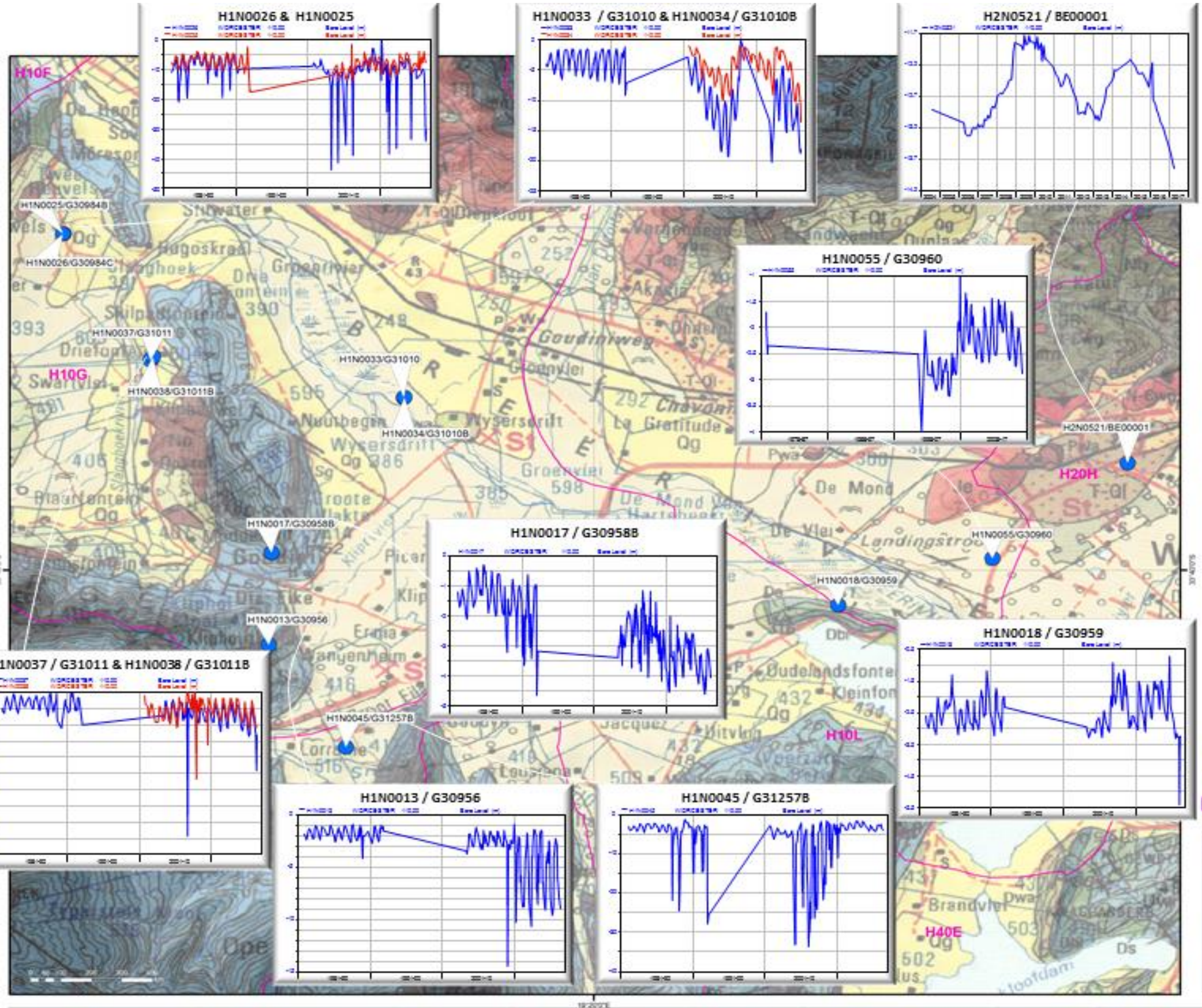
Comment/Emerging trends:
Indications are that the water level in the general aquifer is increasing. This is supported by the Winter groundwater levels that tend to return to similar high levels each year.

- Geosite (Water level monitoring point)
- Geosite (Water quality monitoring point)
- Geosite (Water level & quality monitoring point)
- Geosite (Rainfall monitoring point)
- WMA boundary
- Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	N. Seraliker	Signature	Date	Report compiled by:	N. Makiwane	Signature	Date14/06/2017	Approved by:	M. Jacobs	Signature	Date
Map reference:	X:GECHYDROBreede\WMA\Cape_Infanta\Cape_Infanta_mon2016-A3			Report reference:	H:\B-GEO\INFORMATION PRODUCTIO\LIFANTS-DOORN\Sandveld/.....			Imagery / data used: Geology 1:250 000 mapseries: gcs_3420, gcs_3320. (Council of Geoscience)			

Cape Infanta



Worcester:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To monitor the status of the Breede River valley alluvial aquifer which is extensively used for agriculture, contributes the Breede River base flow and sustains wetlands.

Long-term trend:
Groundwater levels between 0 and 5 meter below surface in winter "wet season", dropping by 1 or two meters in summer. In areas impacted by abstraction groundwater levels may drop locally as deep as 40m below the surface in the dry season but recover generally to within 10m below the surface in the wet season due to non abstraction.

Short-term trend:
The low winter rainfall in 2016 resulted in low groundwater recharge in the area.
The low rainfall in the period of late 2016 to mid 2017 resulted in groundwater level to decline in the entire area.
Abstraction due to summer season with low rainfall contributed to groundwater level decline.

Comment/Emerging trends:
Indications are that current level of abstraction is sustainable. There are localized areas which show signs of over abstraction over a period of a few years but then return to sustainable levels.

Recommendations:
As per the 2012 monitoring report recommendation, BGCMA initiated a project to investigate the adequacy of the existing network for BGCMA purposes. Close collaboration between DWS and BGCMA on this project should continue.
Long term monitoring is required to ensure sustainability of abstraction and survival of wetlands fed by shallow groundwater.

Map compiled by:	B Rollinyati	Signature	Date: 14/09/2017	Report compiled by:	B Rollinyati	Signature	Date: 14/09/2017	Approved by:	N Tumana	Signature	Date	**Worcester**
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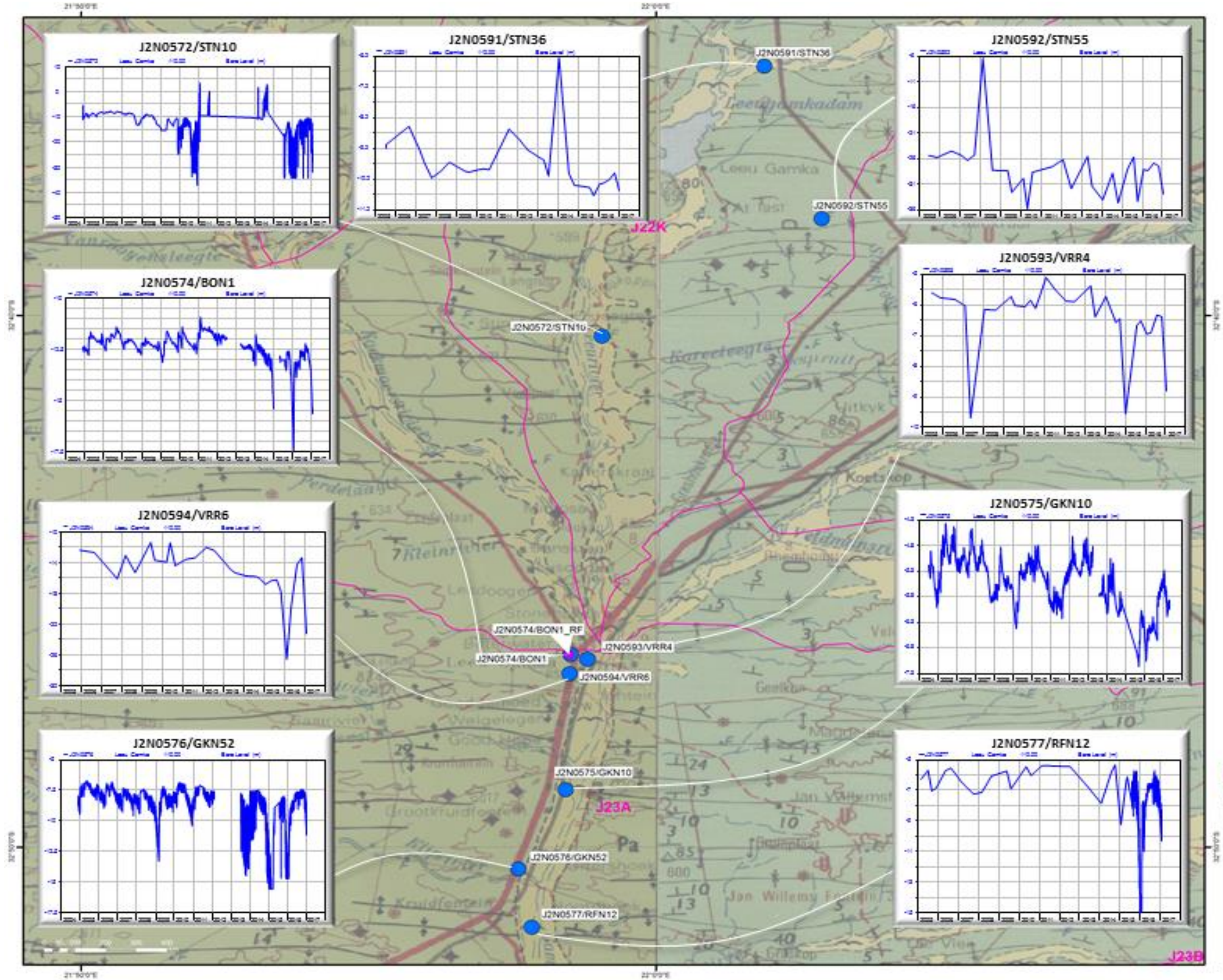


Leeu Gamka:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To monitor the sustainability of large scale groundwater abstraction for irrigation taking place mainly along the Leeuw river, and potential impact on domestic supply to the town.

Long-term trend:
Generally stable.

Short-term trend:
A relatively sharp drop in groundwater level noted during 2013 in the southern most part of the map area (RFN12 and GKN 52) thought to indicate development in the vicinity – recovered in 2014.

In late 2014 there was a sharp general decline in water levels at Leeu Gamka, in many cases to the lowest levels in the past ten years. There was however relatively good recovery in 2015 but levels are not back to the norm for the area. Groundwater levels returned to their normal levels early 2016 after the good recharge events. The groundwater levels declined end 2016 early 2017 due to greater groundwater abstraction and limited recharge.

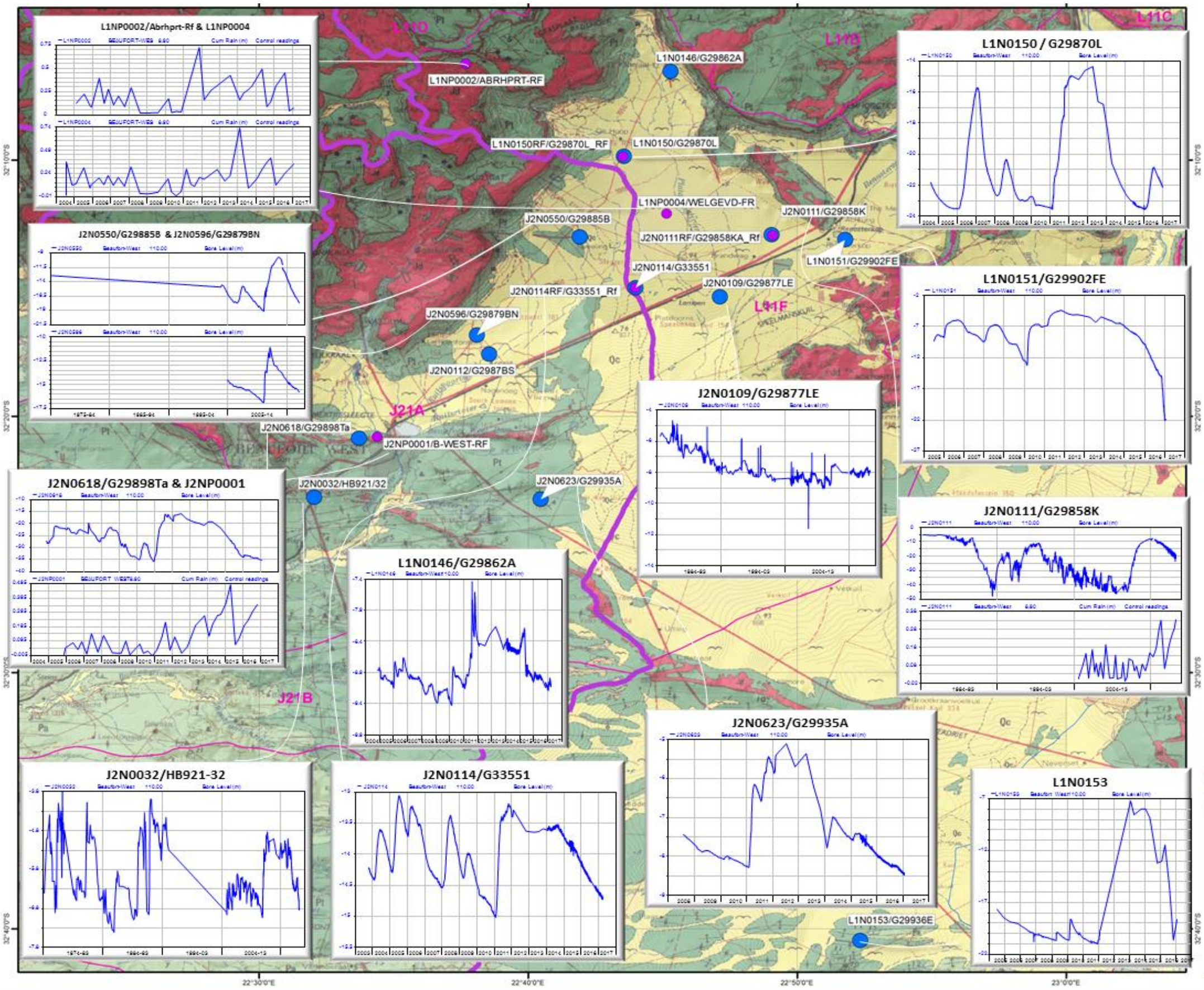
Emerging trends / Comment:
Sharp recent declines indicate more heavy abstraction is taking place.

Recommendations:
The existing data provide a good record of the general behavior of the aquifer.

Groundwater quality monitoring should be incorporated to determine any indications of diffuse agricultural

Map compiled by:	O. Tshongweni	Signature	Date	Report compiled by:	O. Tshongweni	Signature	Date	Approved by:	M Jacobs	Signature	Date
Map reference:	X:\GEOHYDRO\Gouritz\WMI\Leeu Gamka\LeeuGamka_mon2016-10			Report reference:	H:\GEOINFORMATION PRODUCTS\GOURITZ\LeeuGamka\LeeuGamka_mon2016-2017			Imagery / data used: Geology 1:250 000 map series: gcs_3320, gcs_3322. (Council of Geoscience)			

Leeu Gamka



BeaufortWest:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
Monitor the communal aquifer status, used for Municipal supply, agriculture and private residents in the town.

Long-term trend:
Downward long term trend accentuated in vicinity of production wellfields was reversed by 2011 floods resulting in the Brandwag wellfield case in virtual full recovery since records began in 1984. In general groundwater in all well fields surrounding Beaufort west are showing a declining trend since the 2011 floods.

Short-term trend:
In the Beaufort West area the 2010 drought was broken when groundwater levels replenished well during 2011. Since then in the Beaufort West area there is a steady decline in groundwater levels in 2013 -2015 period, but the current groundwater levels are generally still significantly above those of 2010.

Groundwater levels at Brandwag aquifer (Brandwag wellfield vicinity) north east of Beaufort West has since the 2011 end of drought recovered strongly from 45meter below ground level (m.b.g.l.) to less than 10 m.b.g.l. This progressive recovery in 2013, two years after the flood may indicate a lagged deep regional groundwater flow contribution to the wellfield combined with reduced abstraction. Furthermore, it has been noticed that groundwater level has been slightly declining since 2014 up to date, which significant decline in two geosites G29870L & G29898Ta with a column of 1 and 11 m.b.g.l., respectively.

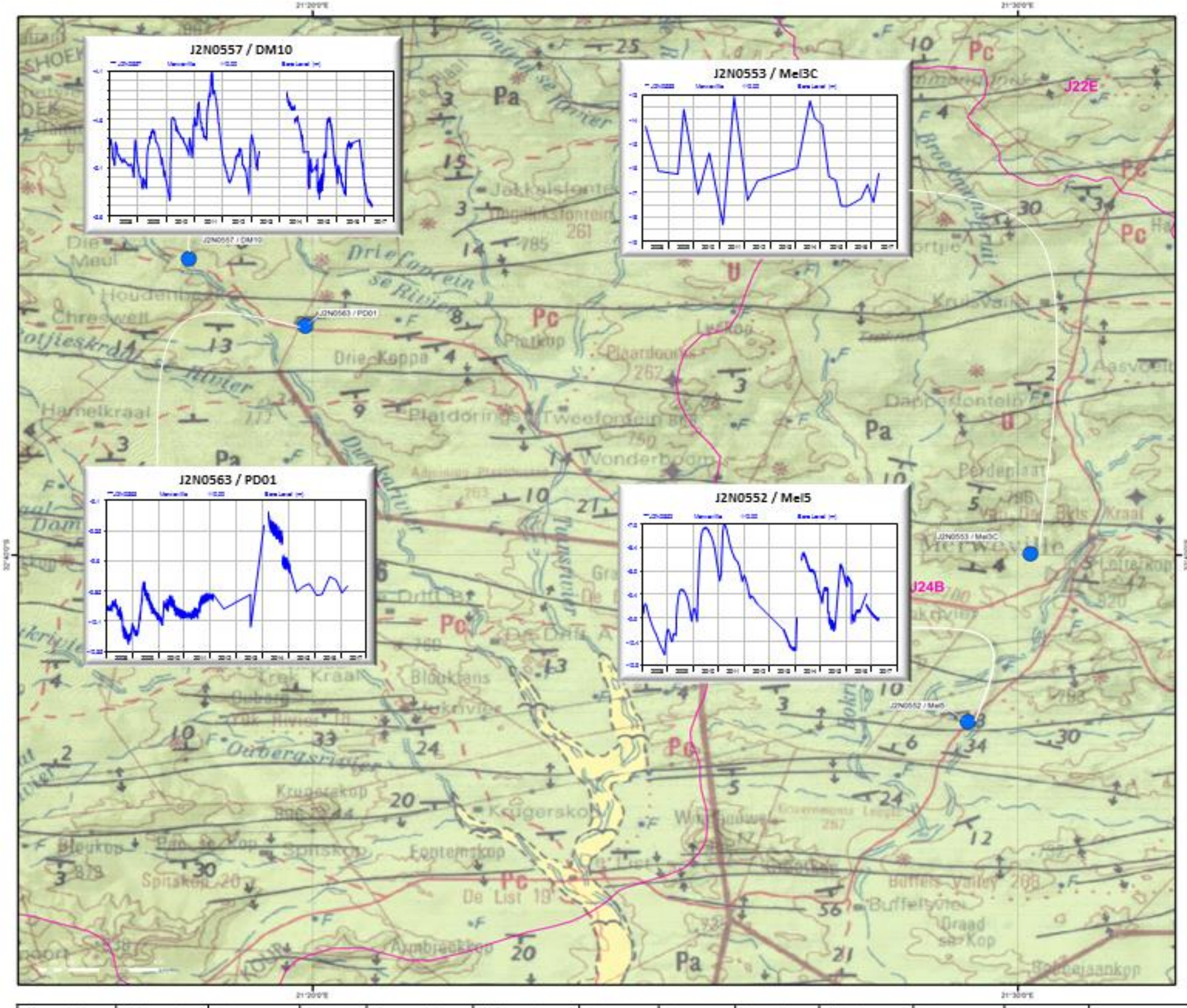
Comment/Emerging trends:
The resource becomes locally stressed during prolonged drought. The situation has been relieved to some extent by Municipal development of further resources to the south of Beaufort West. Long term sustainability would be better assured by developing groundwater resources even further afield where there is less competition for the resource.

Monitoring recommendations:
Further expansion of monitoring should be achieved via licensing conditions.

- Geosite (Water level monitoring point)
- Geosite (Water quality monitoring point)
- Geosite (Water level & quality monitoring point)
- Geosite (Rainfall monitoring point)
- WMA boundary
- Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	O. Tshongweni	Signature	Date: 30/03/2017	Report compiled by:	O. Tshongweni	Signature	Date: 28/06/2017	Approved by:	M Jacobs	Signature	Date
Map reference:	X:GEOHYDRO\GOURITZ\WMA/BeaufortWest/BeaufortWest_mon2016-A3			Report reference:	H:B-GEO\INFORMATION PRODUCT/GOURITZ/BeaufortWest/BeaufortWest_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3222. (Council of Geoscience)			**Beaufort West**



Merweville:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
Initiated in 2004 to evaluate the groundwater situation in response to user complaints of overexploitation by some farmers in the area. Eight years of data were collected from private boreholes in the area to get a picture of the situation. The data were analysed by Brits (DWA 2012), and the network rationalized in accordance with recommendation - from twenty down to four boreholes selected to be representative of the regional aquifer. Data for the remaining sixteen are archived for future reference.

Groundwater level trend:
Good recharge in early 2014 resulted in a rise to similar levels to that of the wet 2011. Groundwater levels dropped substantially during 2014 and early 2015. Groundwater levels had improved by the end of 2016 but declined again early 2017 and is still relatively low.

Comment / Emerging trends:
The groundwater levels are low.. Limited recharge and a further continuation of this dropping trend in 2015 – 2016 may become problematic for groundwater users in the area.

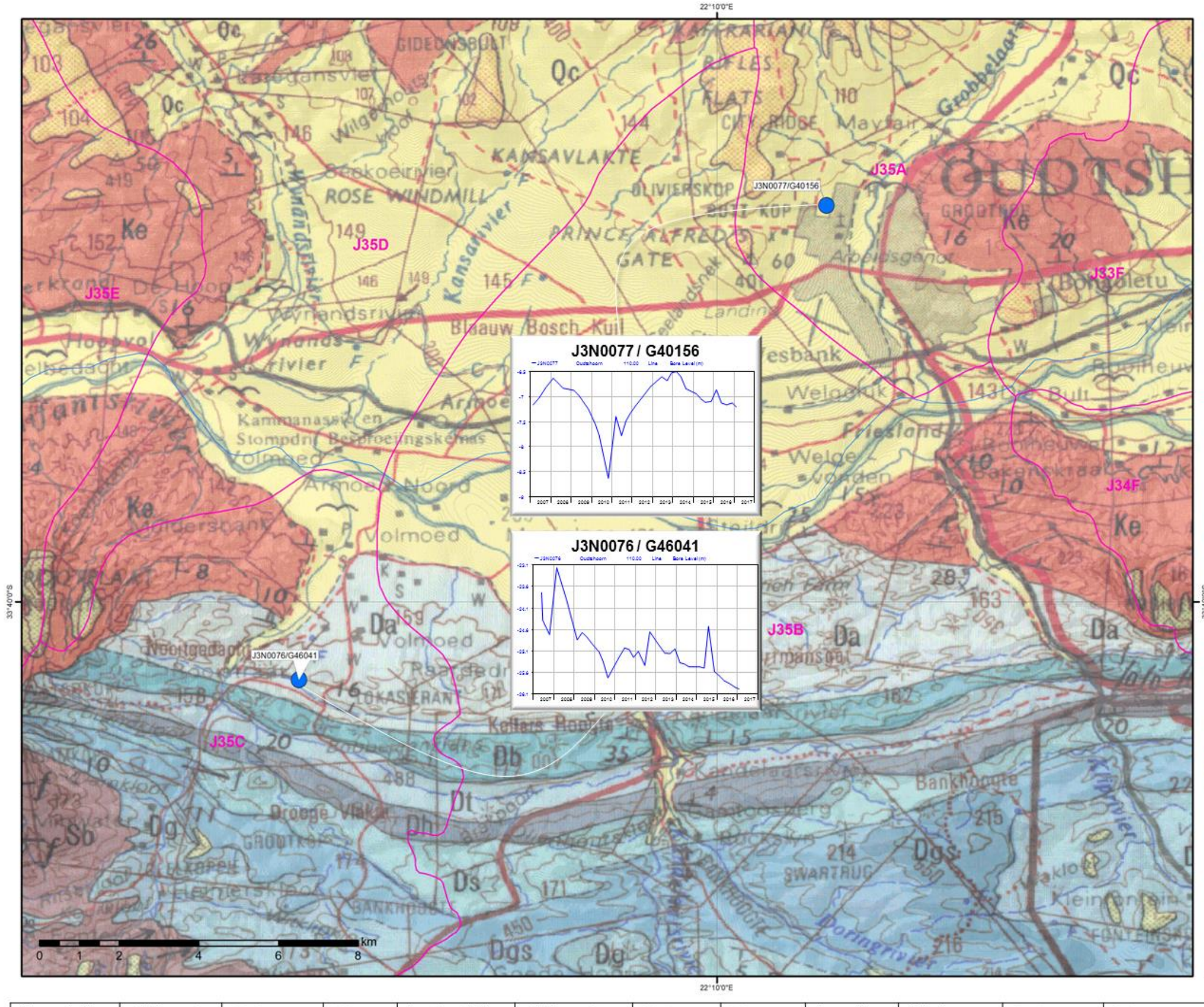
Monitoring Recommendations:
Consideration needs to be given to drilling dedicated monitoring boreholes in areas of most concern to the community.

Quality Monitoring Borehole
Geosite (Rainfall monitoring point)
Water level & quality monitoring point)
Quaternary drainage region boundary & number
WMA boundary

Locality map: WESTERN CAPE

Map compiled by:	O Tshongweni	Signature	Date	Report compiled by:	O. Tshongweni	Signature	Date	Approved by:	M Jacobs	Signature	Date
Map reference:	X:\GEOHYDRO\Gouritz\WMA\Merweville\Merweville_mon2016-03			Report reference:	HG-GEOINFORMATION PRODUCTIGOURITZ\Merweville\Merweville_mon2016-2017			Imagery / data used: Geology 1:250 000 map series: gcs_3200. (Council of Geoscience)			

Merweville



Oudtshoorn:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
Record the un-impacted groundwater levels in the Oudtshoorn area.

Long-term trend:
Overall stable trend since monitoring started in 2005.

Short-term trend:
Groundwater levels since the drought was broken in 2010 continue to rise, and in vicinity of Oudtshoorn town the early 2014 groundwater levels are at the highest on record since 2005. The level has dropped slightly during 2014 and 2015. Groundwater levels have decrease slightly over the end summer period (end 2015 beginning 2016). . Groundwater levels slightly decline beginning 2017 but is generally stable.

Recommendations:
Maintain periodic hand measurements as a long term impacted record.

G40156 (J 3N0077) recommended as a National monitoring point representative of the Oudtshoorn region aquifer status.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quartemary drainage region boundary & number

Locality map: WESTERN CAPE

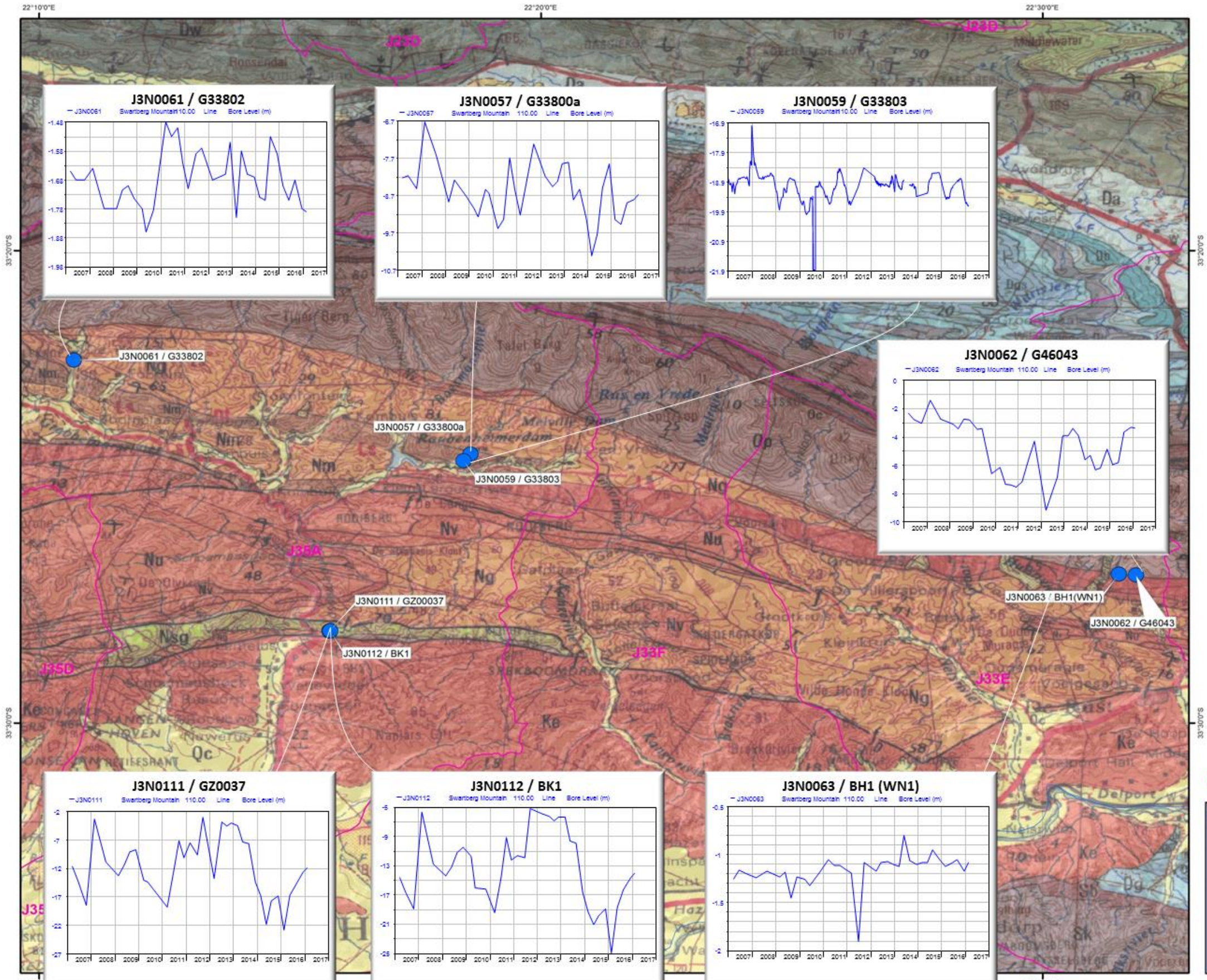
Map compiled by:	O. Tshongweni	Signature	Date	Report compiled by:	O. Tshongweni	Signature	Date	Approved by:	M Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/GouritzWMA/Oudtshoorn/ Oudtshoorn_mon2016wl-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/ Oudtshoorn/ Oudtshoorn_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

Oudtshoorn
Period: 2007 – February 2017

Swartberg Mountain Range:

Groundwater Monitoring Route

-Groundwater level



Main Purpose:
The eastern boreholes (J3N62 and J2N63) were established to measure shallow un-impacted TMG Peninsula aquifer groundwater level - to assist in evaluating natural spring behavior in the general area (assist to evaluate reports of impacts). Groundwater levels in the dolomitic Kango Group are measured in J3N 57,J3N58, J3N59. Groundwater level and quality changes under abstraction by emerging farmers at Schoemanshoek are measured in J3N 111 and J3N112.

Groundwater level trends:
One of the Eastern boreholes (J3N0062) is on a declining trend since 2010 potentially influenced by pumping in vicinity. Eastern boreholes are in relatively close proximity to each other. Water level variation in J3N0062 appears to be increasing and a larger drop than expected has occurred since 2009. J3N0063 behaves as expected for the general area.
Groundwater levels in the Kango Group are steadily declining since late 2013 till early 2015. The fact that levels dropped to the lowest on record may indicate abstraction impacts in the vicinity. Good recharge in winter 2015 has recharged the aquifer. Groundwater levels continues to decline to its lowest levels over the 2015-2016 summer period possibly due to over abstraction in the vicinity. A slight increased in water levels is evident early 2016 due to recharge events. In the general area over the summer 2016 – 2017 groundwater levels have declined but recover slightly but still remain stable.

Comment/Emerging trends:
The eastern monitoring boreholes may be influenced by pumping in the vicinity.

Recommendations:
The value of continued monitoring of the eastern boreholes to be re-evaluated considering potential influence of pumping.
Electrical conductivity trends need to be evaluated at Schoemanshoek.

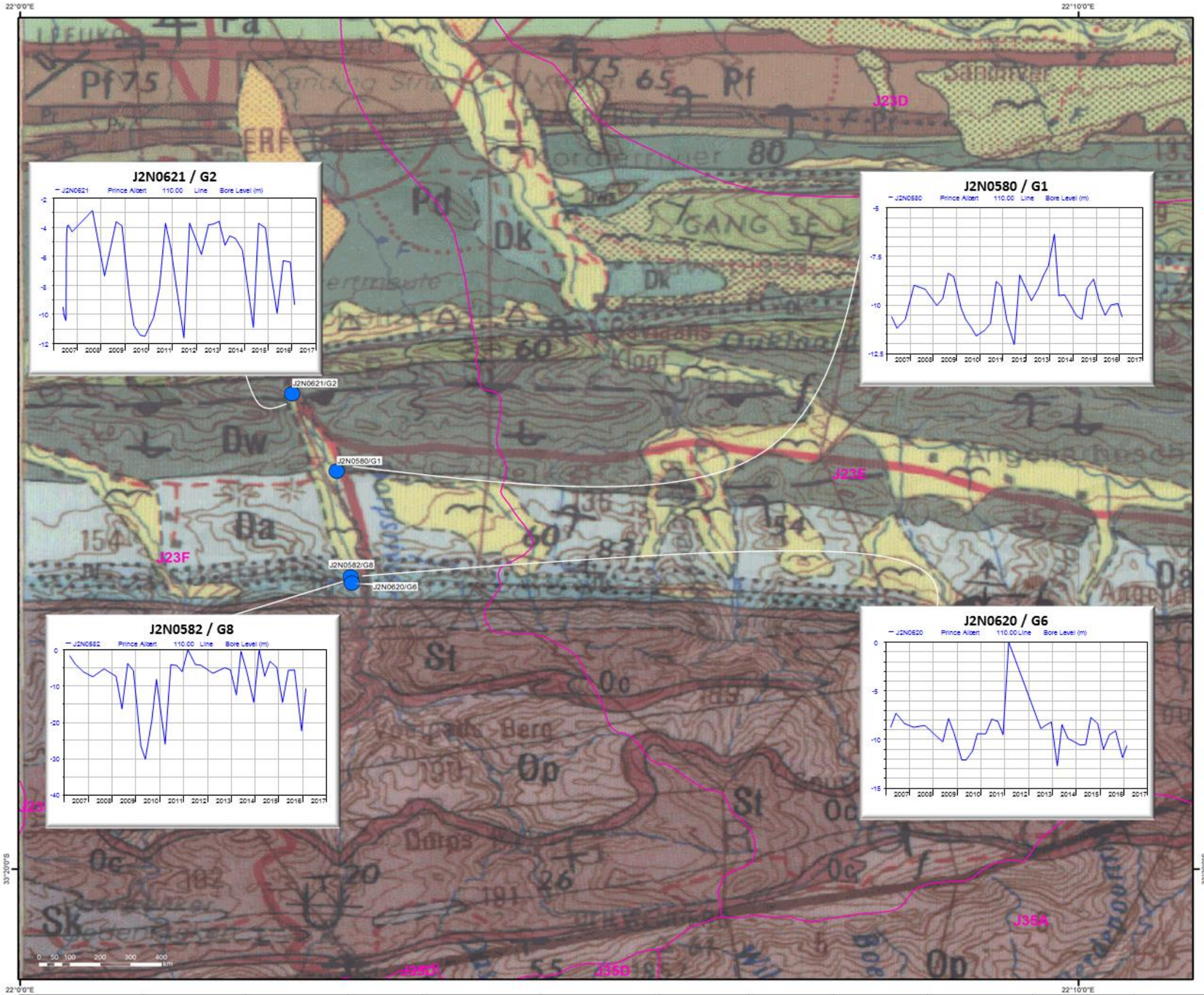
Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quartemary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	O. Tshongweni	Signature	Date	Report compiled by:	O. Tshongweni	Signature	Date	Approved by:	M Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/GouritzWMA/Swartberg Mountain Range/Swartberg_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/Swartberg Mountain Range/Swartberg Mountain Range_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

Swartberg Mountain Range

Period: **2007 – February 2017**



Prince Albert:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To determine the response of the aquifer to Municipal abstraction in support of the Planning funded Roll out of the Artificial Recharge Strategy (ROARS)

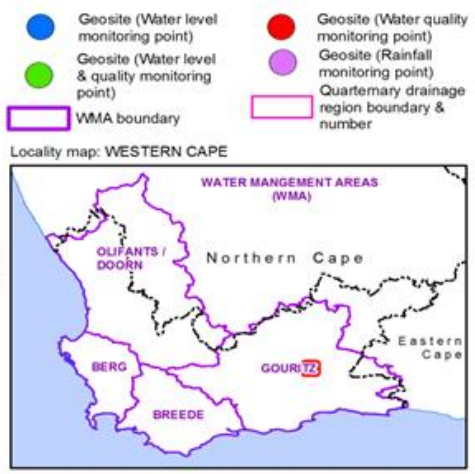
Long-term trend:
Not available.

Short-term trend:
Indications of local over abstraction evident during 2010 and 2012 was not apparent in 2013-2014 period. There was a slight decline in water level in 2014-2015 hydrological year but after good rainfall in mid 2015 the water levels returned to normal. There is a slight decline in water levels end of 2015 but after recharge events over the 2016-2017 summer period groundwater levels returned to slightly normal levels but still remain stable.

Comment/Emerging trends:

The aquifer is vulnerable to over exploitation in dry years.

Monitoring recommendations:
Municipality needs to appoint a hydrogeologist to manage the wellfield, and make recommendations for expansion of monitoring as necessary. An annual wellfield performance report should be compiled by the Municipality.



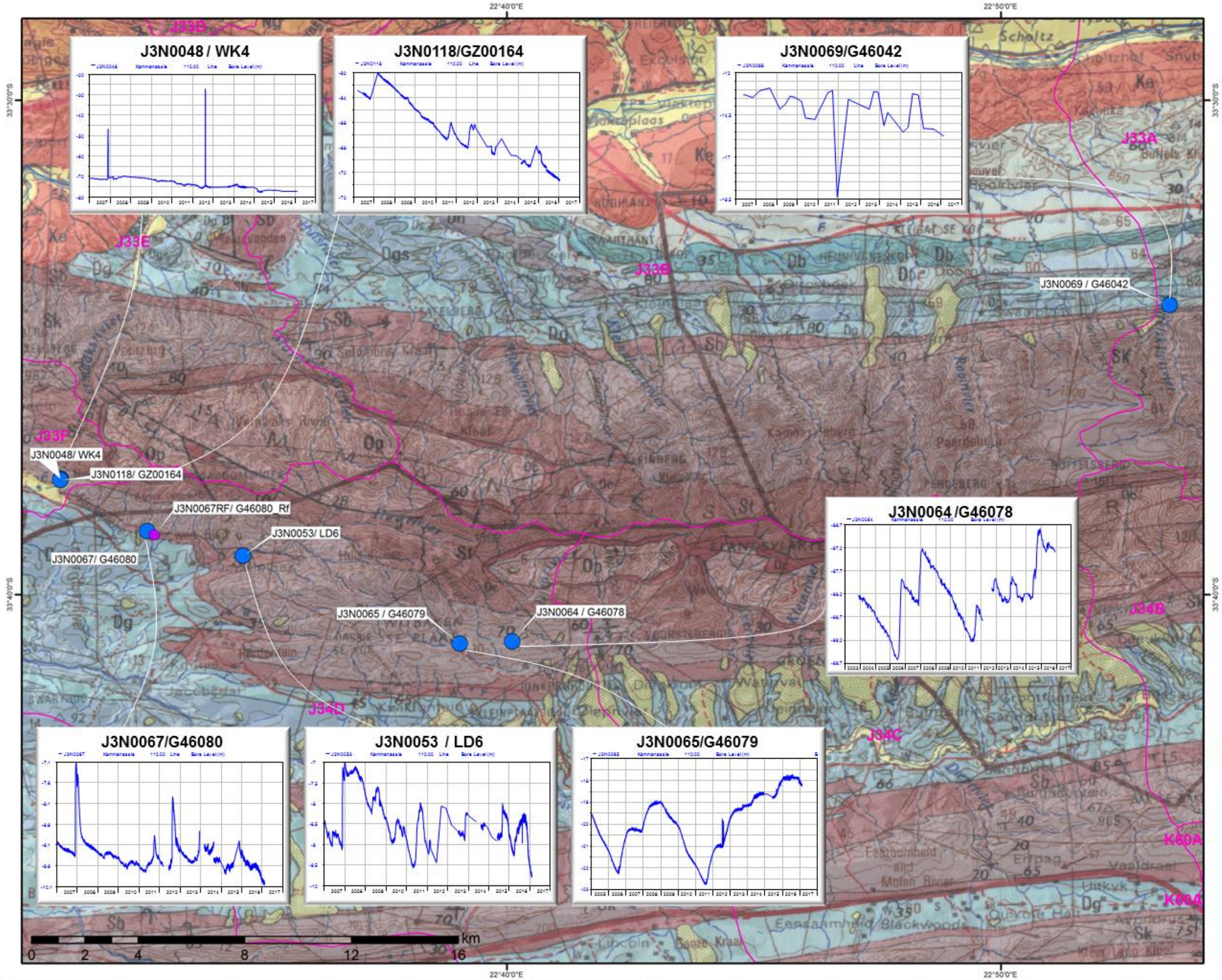
Map compiled by:	O Tshongweni	Signature	Date	Report compiled by:	O.Tshongweni	Signature	Date	Approved by:	M Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/GOURITZWMA/PrinceAlbert/Prince Albert_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/PrinceAlbert/PrinceAlbert_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

Prince Albert
Period: 2007 – February 2017

Kamannassie:

Groundwater Monitoring Route

-Groundwater level



Main Purpose:
To monitor the joint impact of groundwater use by the Klein Karoo Rural Water Supply Scheme and irrigation agriculture in the Southern and Western parts of the Kammanassie Mountain.

Long-term trend:
Groundwater levels are overall relatively stable in the area. Groundwater levels in the agricultural areas south of the Vermaaks River wellfield appear not to be influenced by the wellfield abstraction. The Wagenpadsnek area to the south west is however probably influenced and shows a steady decline (WK4).

Short-term trend:
A groundwater level rise is evident 2011 – 2014 since the drought was broken in 2011. A slight drop in water level occurred during 2014 and early 2015 but levels have risen since mid 2015 up to 2016far after good recharge events. Groundwater levels has since been declining steeply for the period 2016 - 2017.

Comment/Emerging trends:
The existing data provide a good record of the general behavior of the aquifer. The current Gouritz "reserve" study has identified this for more in depth investigation to detect unacceptable impacts. Further monitoring recommendations may come from the reserve study.

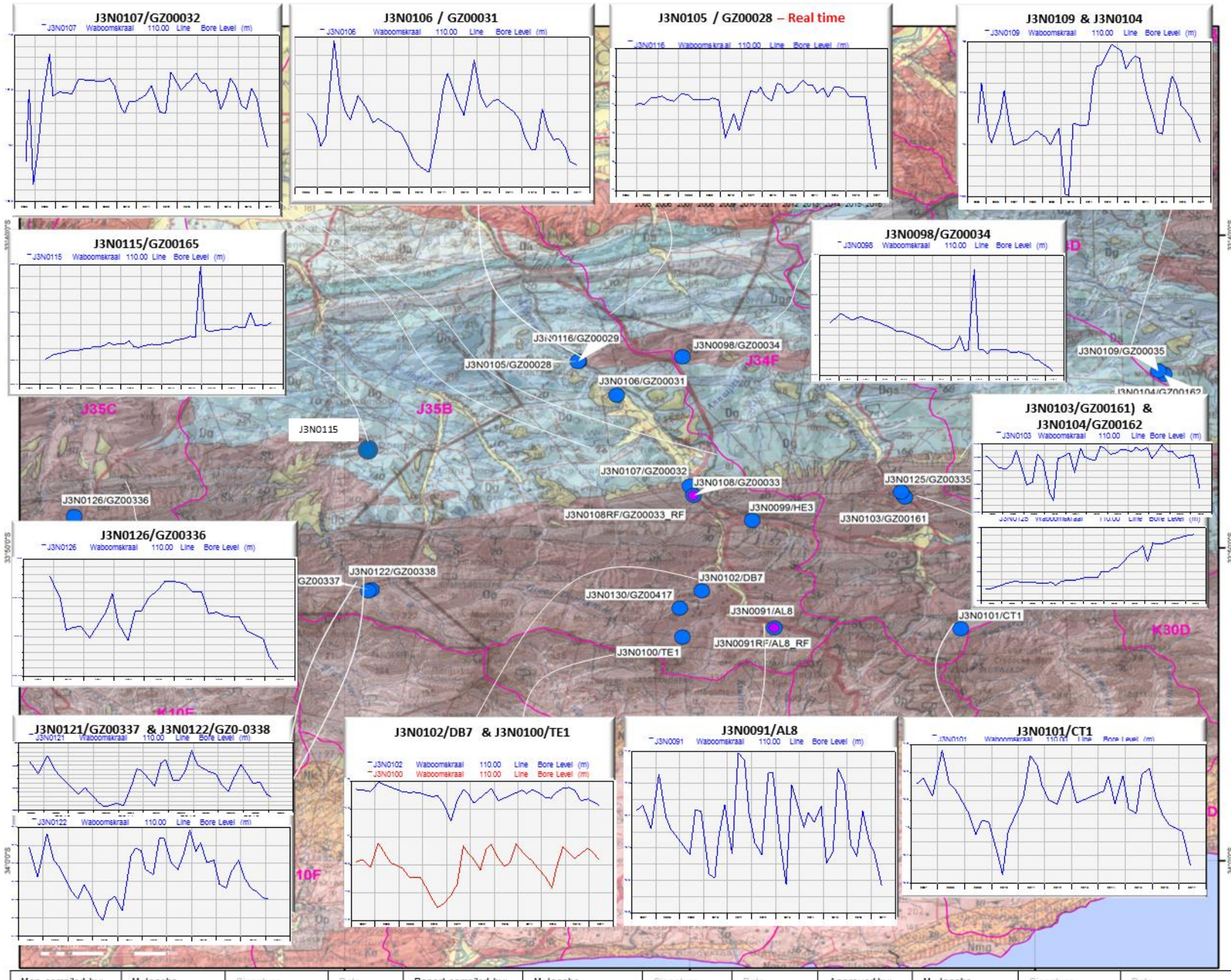
Monitoring recommendations: Maintain the existing network as is.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	O Tshongweni	Signature	Date 30/03/2017	Report compiled by:	O. Tshongweni	Signature	Date 30/03/2017	Approved by:		Signature	Date 30/03/2017
Map reference:	X:GEOHYDRO/GouritzWMA/Kammanassie/ Kammanassie_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/ Kammanassie/ Kammanassie_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

Kamannassie
Period: 2007 – February 2017



Waboomskraal:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To provide baseline regional monitoring in anticipation of large scale (up to 8 million m^3/a) municipal supply development. The monitoring will continue into production phase for evaluation of regional impact. Refer to GH 4039 (Smart et al., 2009) for detail on network design.

Long-term trend:
In the Outeniqua Range good recharge in 2011 and 2012 and 2013 progressively replenished the unconfined Peninsula aquifer. Groundwater levels at end 2013 were at their highest since monitoring commenced in 2005. Groundwater level subsided substantially during 2014 and early 2015 but recharge toward the end of the hydrological year reversed the decline.

Groundwater levels in the confined Peninsula aquifer are near Blossoms are impacted by test pumping / drilling operations, therefore not representative of an undisturbed situation.

Groundwater levels in the Nardouw aquifer anticline structures north of the Outeniqua range show a lagged response to Outeniqua recharge events, rising in the 2006 to 2008 period, then flattening till 2011 when a further rise occurred till end 2015 when the levels are the highest on record. Groundwater levels beginning 2016 have been steadily declining across the entire area possibly due to increase abstraction.

Comment/Emerging trends:
Ten years of valuable data reflecting the pre-wellfield development situation has been established.

Recommendations:
Technical problems with electronic measuring equipment to be rectified urgently.

Geosite (Water level monitoring point)
Geosite (Water & quality monitoring point)
Geosite (Water quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

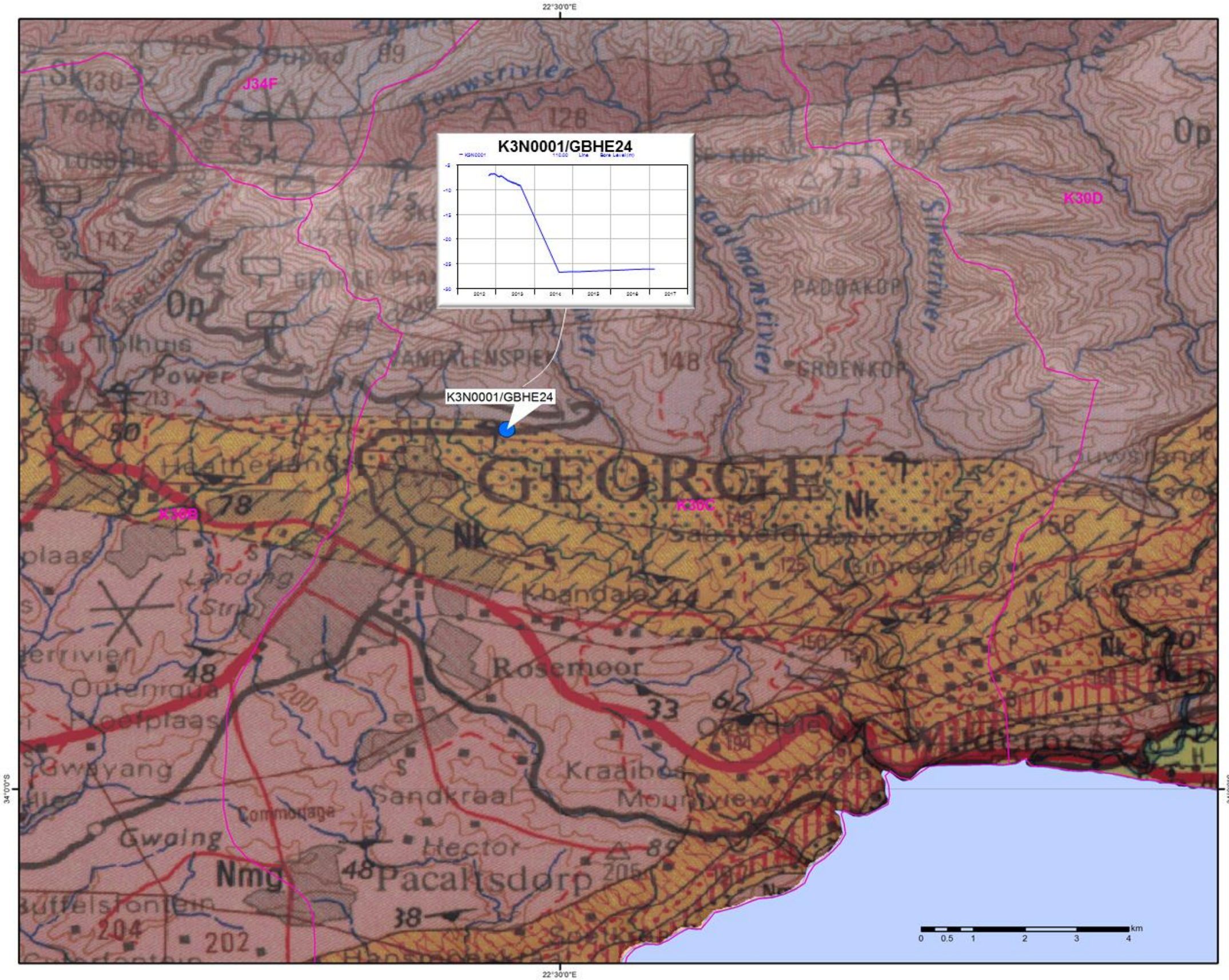
Map compiled by:	M Jacobs	Signature	Date	Report compiled by:	M Jacobs	Signature	Date	Approved by:	M. Jacobs	Signature	Date
Map reference:	X:GEOHYDRO/GOURITZWMA/Waboomskraal/Sandveld_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/Waboomskraal/Waboomskraal-Mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322, gcs_3422. (Council of Geoscience)			

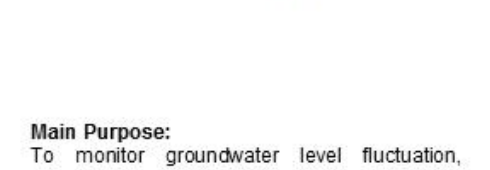
Waboomskraal
Period: 2005 – August 2017

George:

Groundwater Monitoring Route

-Groundwater level





Main Purpose:
To monitor groundwater level fluctuation, drought was broken in 2011 for alternative use by Municipality for domestic supply and Western parts of the George Area.

Long-term trend:
Groundwater levels are overall relatively stable in the area. Groundwater levels within the Outeniqua forest appear not to be influenced by the municipal abstraction for domestic use in that area. The Geosite GBHE24 drop signature in groundwater level from 2014 to 2014 however probably influenced by the draught events occurred between 2011 and 2012. Groundwater levels is fairly stable 2014 – 2017.

Short-term trend:
A groundwater level rise slightly from 2014 up to date, since the drought was broken in 2011.

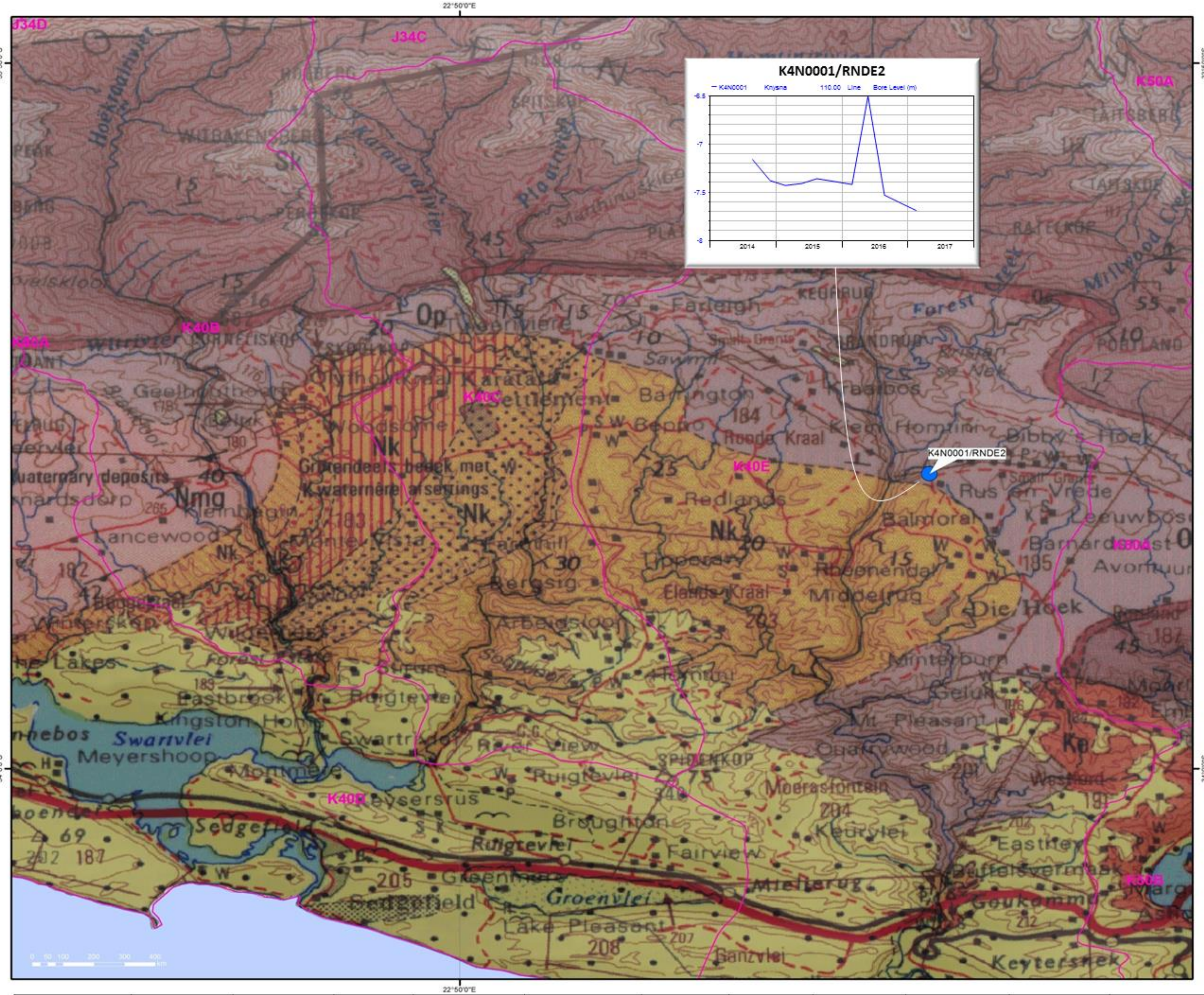
Comment/Emerging trends:
The existing data provide a good record of the general behavior of the aquifer.
Monitoring recommendations: Maintain the existing network as is.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	O Tshongweni	Signature	Date	Report compiled by:	O. Tshongweni	Signature	Date	Approved by:		Signature	Date
Map reference:	X:GEOHYDRO/GOURITZWMA/George/George_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/George/George_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

George



Knysna:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To monitor groundwater level fluctuation, drought was broken in 2011 for alternative use by Municipality for domestic supply and Western parts of the Knysna Area.

Long-term trend:
Groundwater levels are overall relatively stable in the area. Groundwater levels within that agricultural areas appear not to be influenced by the abstraction for domestic use in that area. The Geosite GBHE24 drop signature in groundwater level from 2014 to 2014 however probably influenced by the draught events occurred between 2011 and 2012.

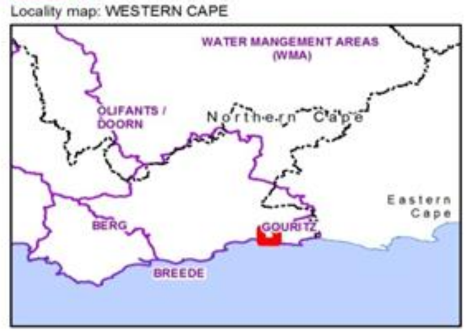
Short-term trend:
A groundwater level experienced a slightly decline in 2014, since the drought was broken in 2011. furthermore, from 2015 up to February 2016 groundwater level have been fairly stable and gain a significant recharge signature between March and May 2016. Further decline during the period between May – August 2016 has been experienced.

Comment/Emerging trends:
The existing data provide a good record of the general behavior of the aquifer.

Monitoring recommendations:
Maintain the existing network as is.

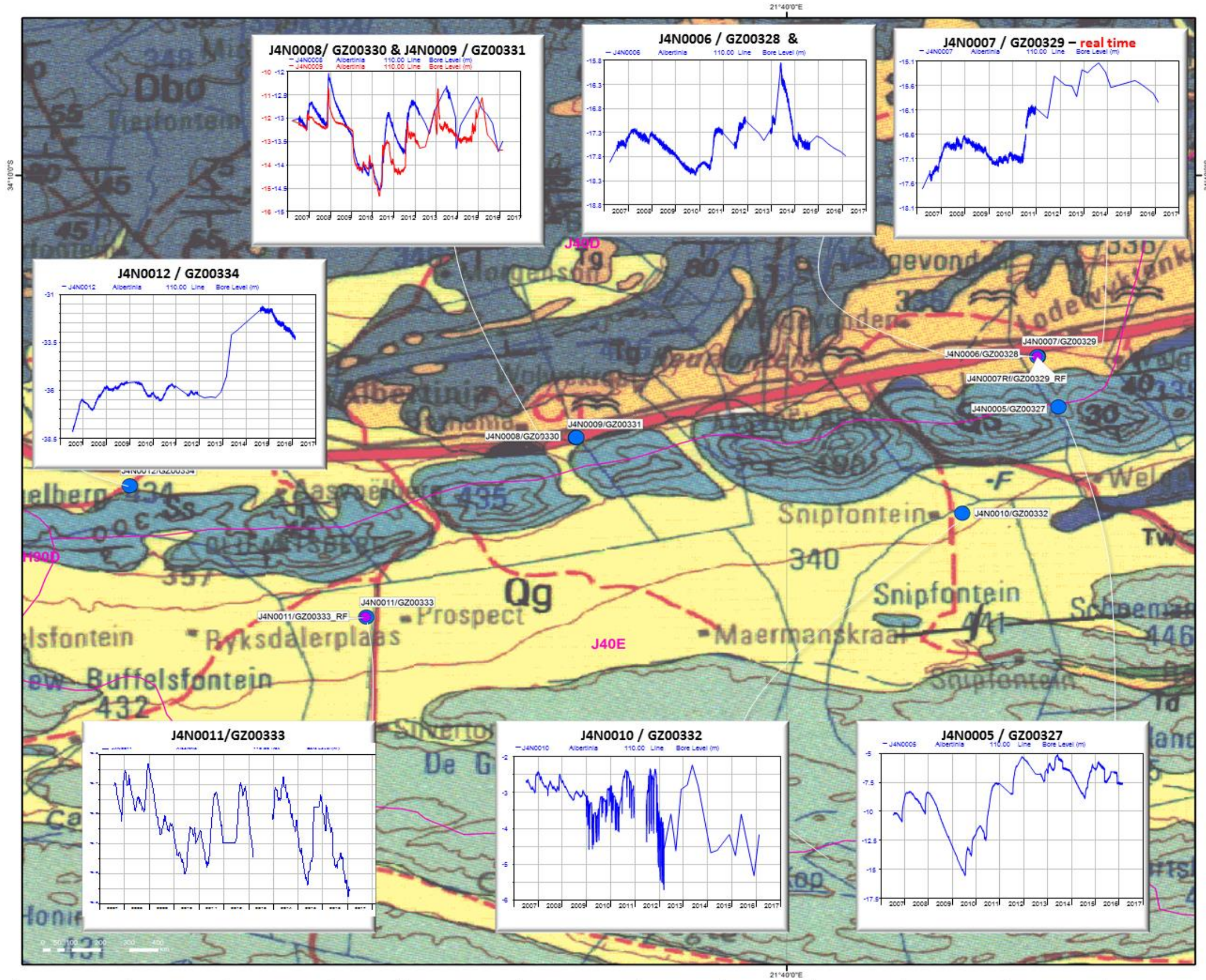
Geosite (Water level monitoring point)
Geosite (Water level & quality monitoring point)
WMA boundary
Geosite (Water quality monitoring point)
Geosite (Rainfall monitoring point)
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE



Map compiled by:	N Seralker	Signature	Date 30/03/2017	Report compiled by:	O. Tshongweni	Signature	Date 30/07/2017	Approved by:	M Jacobs	Signature	Date 30/07/2017
Map reference:	X:GEOHYDRO/GOURITZWMA/Knysna/Knysna_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/Knysna/Knysna_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3322. (Council of Geoscience)			

Knysna
Period: 2014 – February 2017



Albertinia:

Groundwater Monitoring Route

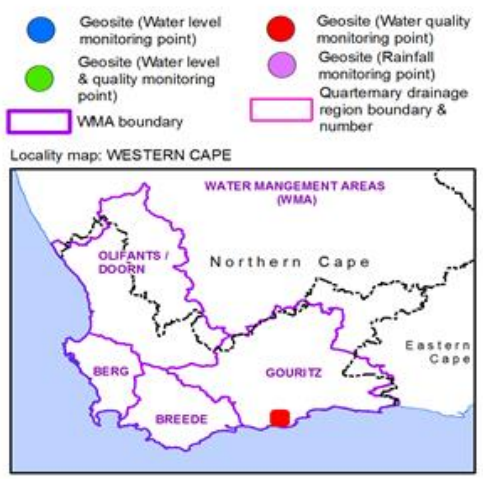
-Groundwater level

Main Purpose:
To assist decision making on future groundwater allocations, while protecting the rights of existing users. Groundwater is the proposed future supply to Albertina. Baseline monitoring of the likely source - Table Mountain Group aquifer was established along the Aasvoelberg to determine aquifer stress status and provide data to assist in protecting existing lawful users interests in the event of future large scale development. Refer to GH 4039 (Smart et al., 2009) for detail on network design.

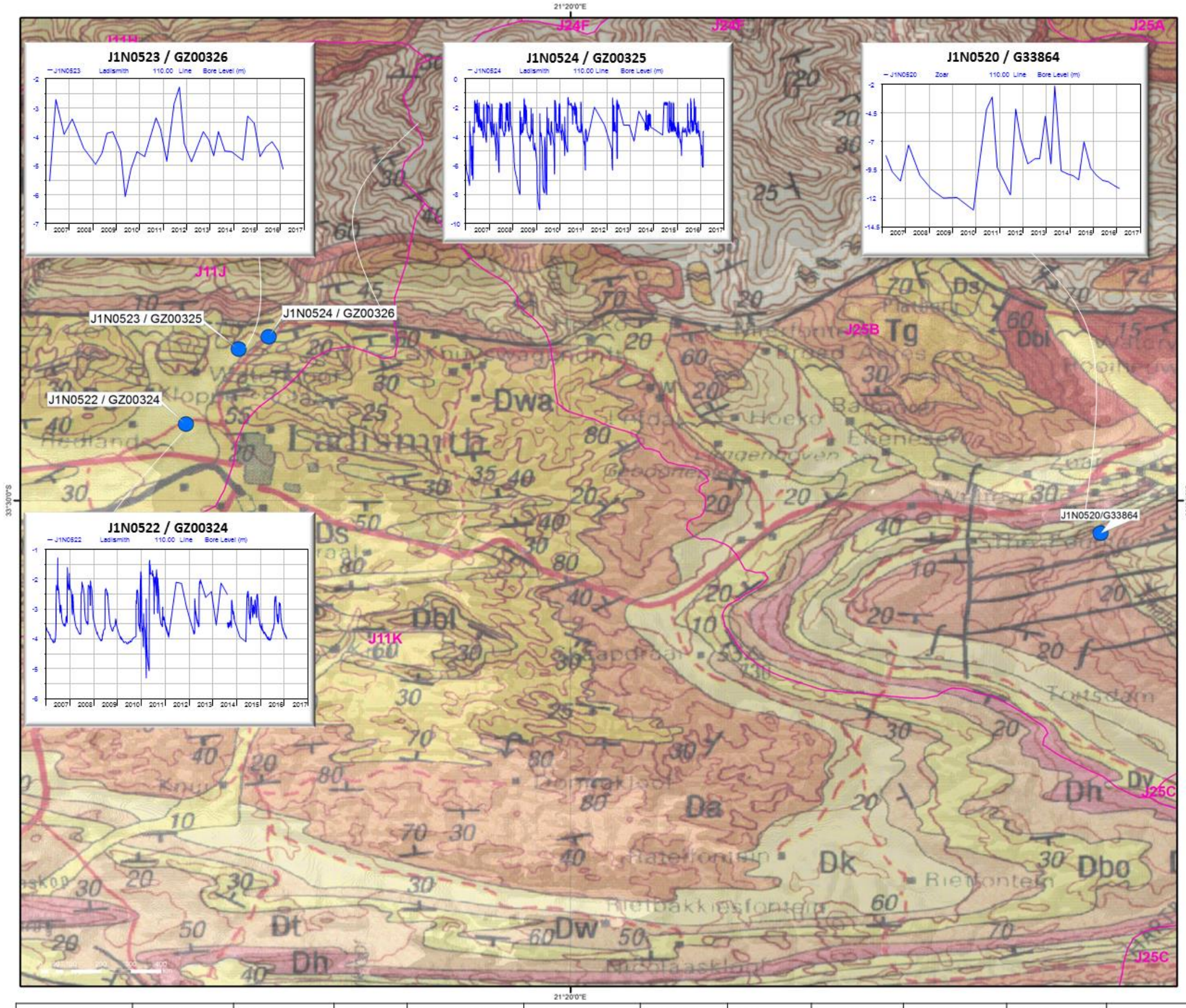
Long-term trend:
Asevoelberg range running east –west immediately south Albertinia – a downward trend from 2008 till drought was broken in mid 2010. Good recharge from 2011 through to mid 2014 resulted in groundwater levels reaching their highest levels since monitoring began in 2006. In the primary/karst aquifer south and West of Albertinia water levels are relatively stable despite apparent influence of pumping.

Short-term trend:
There has been limited recharge since end 2015 till early 2017 resulting in a steady decline in groundwater levels due to limited recharge but groundwater levels is still above normal.

Comment/Emerging trends:
The short term 2015 -2016 water level decline is not of immediate concern as groundwater levels remain relatively high given the good 2014 recharge.



Map compiled by:	O Tshongweni	Signature	Date 30/03/2017	Report compiled by:	O. Tshongweni	Signature	Date 30/03/2017	Approved by:		Signature	Date 30/03/2017	**Albertinia**
Map reference:	X:GEOHYDRO/GOURITZWMA/Albertinia/Albertinia_mon2016-2017A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOOURITZ/Albertinia/Albertinia_mon2016-2017			Imagery / data used: Geology 1:250 000 map series; gcs_3420. (Council of Geoscience)				



Ladismith and Zoar:

Groundwater Monitoring Route

-Groundwater level

Main Purpose:
To track storage levels in alluvial aquifer at Ladismith and the TMG aquifer at Zoar. The aquifer is possibly hydraulicaly connected to the underlying TMG aquifer that has been developed for Municipal supply.

Calitzdorp area is monitored by the Oudtshoorn Municipality in vicinity of their Klein Karoo Scheme Wellfield. Data are not shown on this map.

Long-term trend:
- Ladismith, stable.
-Zoar, stable.
- Calitzdorp,
Klein Karoo Rural Water Supply Scheme wellfield: Yield in the wellfield has declined probably as a result of Fe biofouling as opposed to aquifer depletion. Steps that were being considered in early 2013 to supplement the wellfield by deep drilling into the Peninsula Aquifer target have been put on hold. The uncertainty / risk of failure is high considering the expense of the deep drilling option. Blossoms scheme water is an augmentation option. The aquifer is largely replenished and options to drill new efficient boreholes / rehabilitation of existing boreholes can be considered.

Short-term trend:
Groundwater levels at Ladismith and Zoar fluctuate seasonally but are on a generally rising trend since drought broken in late 2010. Good rainfall in 2014-2015 resulted in an upward trend. Baseline conditions were established before groundwater was developed predominantly in the TMG aquifer at Ladismith in the course of 2014 - 2015. There is a slight decline over the summer of 2016-2017 probably due to greater groundwater abstraction and limited recharge

Monitoring recommendations: Municipality to monitor wellfield and report.

Geosite (Water level monitoring point)
Geosite (Water quality monitoring point)
Geosite (Water level & quality monitoring point)
Geosite (Rainfall monitoring point)
WMA boundary
Quarternary drainage region boundary & number

Locality map: WESTERN CAPE

Map compiled by:	N Seralker	Signature	Date 30/03/2017	Report compiled by:	O. Thshongweni	Signature	Date 30/03/2017	Approved by:	M Jacobs	Signature	Date 30/03/2017
Map reference:	X:GEOHYDRO/GouritzWMA/Ladismith/Ladismith and Zoar_mon2016-A3			Report reference:	H:B-GEO/INFORMATION PRODUCT/GOURITZ/Ladismith/Ladismith and			Imagery / data used: Geology 1:250 000 map series; gcs_3320. (Council of Geoscience)			

Ladismith and Zoar
Period: 2007 – February 2017