Department: Water Affairs

Annual Groundwater Monitoring Report - Western Cape Region

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Compiled by: M Smart assisted by the Groundwater team, Western Cape Region.

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EXECUTIVE SUMMARY

Long term background groundwater levels are relatively stable across the Central Karoo as a whole, indicating that storage is not being depleted at the regional scale. Local overexploitation occurs at some localities – especially in an area north of Beaufort West.

Reported drying up of boreholes in the Klein Karoo is probably a result of localised dewatering in the vicinity of a particular production boreholes / wellfields, rather than depletion of groundwater storage in the Klein Karoo region as a whole. The Vermaaks River wellfield of the Klein Karoo Rural Water Supply Scheme is overexploited and requires urgent augmentation.

Groundwater monitoring needs to be developed in the Southern Cape area.

Over much of the Breede Water Managemet Area, recharge in 2008-2009 resulted in full recovery from the low 2004-2006 groundwater levels. Since 2009 the groundwater levels are on a slight declining trend accentuated by the very dry 2010 period.

Groundwater monitoring information from the Sandveld collected by DWA needs to be better integrated with - and better disseminated to - local groundwater management, i.e. via the Northern Sandveld Water Users Association. Other opportunities for integrated monitoring in the Sandveld need to be explored.

Thought needs to be given to the intensity of monitoring in the West Coast Area, which is very high in proportion to the amount of groundwater being abstracted. There would appear to be grounds for rationalizing and reducing the monitoring in this area and re-deploying resources in less well-monitored areas.

Attention needs to be given to developing integrated monitoring networks to better understand regional groundwater flows and groundwater surface water interactions. These data will provide the information needed to manage the resource as a whole in an integrated way.

The monitoring network needs to be expanded and improved. As a result there will be an ongoing need for additional monitoring boreholes technology / devices / and the associated budget. Additional personnel are required to adequately perform the monitoring and associated data management tasks.

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1 Introduction

The purpose of this report is to provide an overview of Departmental groundwater monitoring and the status / health of the groundwater resources in the Western Cape Region in 2010. It also provides an opportunity to assess progress with data capture and quality control.

Departmental monitoring is concentrated in areas where highest volumes of abstraction currently take place, or where such abstraction is planned in the near future. Monitoring boreholes are added to the monitoring programme as the needs are identified. Additions to the monitoring programme currently usually arise through the complaints from the public about declining groundwater levels / quality or from concerns associated with pending license applications (e.g. Koo Valley, Hermanus, Albertinia, Oudtshoorn, City of Cape Town). These are largely reactionary reasons for monitoring.

Future attention needs to be given to improving integrated monitoring networks to better understand regional groundwater flows and groundwater surface water interactions. These data will provide the information needed for management of the resource as a whole in an integrated way. The confidence of such analyses will improve with increased duration of the monitoring record and by adapting the monitoring programme as necessary.

The hydrogeological settings of monitoring sites and data collected are currently being examined to determine the usefulness of particular sites and well as assist in planning the modification of the monitoring networks.

2 Present groundwater monitoring sites

Appendix 1 is a map showing monitoring points across the region. A spreadsheet containing details of monitoring boreholes is contained in Appendix 2. The spreadsheet contains boreholes monitored by the Region. The monitoring programme is dynamic, the spreadsheet therefore requires regular updating and verification. Optimisation of monitoring sometimes results in terminating monitoring of individual boreholes. In other instances monitoring is added. Numerous boreholes are also privately monitored by users across the Region, but these are not reflected on the map. The Groundwater section aims to obtain details for these boreholes, for display on these maps in future.

Some DWA monitoring boreholes are hand measured while others are equipped with continuous monitoring devices. As most boreholes are not equipped with pumps, only groundwater levels are generally monitored. Water quality parameters are

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obtained in some cases (field electrical conductivities and pH). Samples are obtained either by inserting a portable sampling pump into unequipped boreholes, or using existing pumping equipment. In some instances samples are submitted for detailed chemical analysis. Historically continuous water level monitoring was carried out using clockwork Ott water level recorders but since 2002 an increasing number of boreholes are equipped with electronic data loggers. The loggers have differing capability, some measure water level only, others EC and temperature as well.

Positions of boreholes sampled quarterly as part of the National Groundwater Quality Monitoring programme are shown in Appendix 3. These samples are analysed for the Major inorganic ions (Macro) and Trace elements.

3 Groundwater level status per WMA – an overview

Appendix 4 summarises the groundwater level status across the Region. Groundwater level graphs are displayed for specific monitoring sites that are considered to be representative of the aquifer water level status.

3.1 Gouritz WMA

3.1.1 Central Karoo.

Long term background groundwater levels are relatively stable across the area as a whole, indicating that storage is not being depleted at the regional scale.

3.1.1.1Beaufort West:

A combination of long term local over abstraction and severe drought resulted in critical supply shortage at Beaufort West in late 2010. There was increasing reliance on the groundwater as the dam levels declined and finally dried up.

Groundwater levels in the Beaufort West area in general showed a continual downward trend from around 2005 to 2010. A slight but incomplete recovery occurred in response to limited recharge in early 2010. Fairly good recovery of groundwater levels is reported since the early 2011 rains (L Smit pers. Comm., 2011) however the Departmental data for this period are not yet available to verify the extent to which recovery has occurred.

To the north of Beaufort West a long term groundwater level decline in the aquifer exploited by the Brandwag and Lemoenfontein wellfields is evident. The Brandwag Wellfield, situated 25 km north east of Beaufort West is seriously depleted and needs to be augmented.

Although data are not currently available – an indication of the Brandwag situation has been obtained from communications with field staff (Havenga pers.comm., 2011). From these communications the situation has improved since the early 2011 recharge, but groundwater is still depleted in the area. Back in the 1970's the pre pumping groundwater level at the Brandwag wellfield was 3.5 meters below

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surface. A continuous downward trend has established over the years of operation, and in the 2010 / 2011 drought groundwater levels in the vicinity of the wellfield dropped to approximately 50 meters deep. The deepest water strikes are about 60 meters indicating that the wellfield is nearly depleted. On 23 February 2011 the water level in monitoring borehole G 33542 (situated 1.82 km east of the wellfield) had only risen by 3 meters in response to 60 mm rainfall - from 48.2 meters to 45.3 meters.

In the Lemoenfontein wellfield area (South West of Brandawag) where the pre wellfield groundwater level was 5-6 meters below surface (Havenga, pers. comm., 2011) recovery has been better - water levels having risen from 42 to 27 meters below surface in response to early 2011 rainfall and reduced pumping in the area. The Gamka unit (Karoo National Park vicinity) groundwater level is reportedly up by 9 meters.

Interestingly groundwater levels in an area 5-15 km to the north-north west of the Brandwag wellfied are relatively stable and appear not to have been impacted by the combination of drought and intensive abstraction in the area over the years. This un-impacted compartment could potentially be a target area for future expansion of Beaufort West groundwater supplies.

Although Beaufort West augmented its supply in 2010 with establishment of the Hansrivier well field south east of town, and several additional emergency boreholes concentrated to the south of the town, additional measures are required to increase water security. To avoid further over exploitation of the local resource – it is recommended that Beaufort West's future wellfields be established further a field than to date. In so doing, demand could be met by accessing recharge over a wider area than currently.

3.1.1.2 Leeu Gamka:
Groundwater levels over the long term are stable, indicating that abstraction in the Leeu Gamka area is sustainable. Despite the severe 2010 Central Karoo drought, groundwater levels only dropped to the typical dry season level. Good recharge was experienced in early 2011, groundwater levels rising to the highest level on record.

3.1.1.3 Merwerville:
Monitoring was established in the Merweville area in 2005 in response to complaints from farmers that over abstraction is taking place. From data collected to date there does not appear to be a regional scale dewatering problem. There are indications that localised over abstraction may be occurring at some loclalities, however further fieldwork would be required to verify the situation. Groundwater levels responded well to good recharge in 2009, but subsequently declined in the 2010 drought. Response to early 2011 rains in the Central Karoo is unknown as data are not available as yet.

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3.1.1.4 Prince Albert:

Departmental monitoring boreholes are situated in the vicinity of the Municipal Wellfields. In 2010 groundwater levels in Prince Albert dropped to the lowest levels since records started in 2006. This was a result of a combination of wellfield over abstraction and severe drought. The town was in a critical supply situation in late 2010, with production borehole groundwater levels at pump suction (Groundwater Africa, 2010). Although no current groundwater levels are available, the groundwater situation has improved as a result of good recharge in early 2011 (Dr. R Murray, pers. comm., 2011). Crises such as that in late 2010 can be avoided by improving water demand management and wellfield management at the town.

3.1.2 Klein Karoo

The severe drought that has affected the Gouritz WMA over the past two years was broken with good rainfall in late 2010 and early 2011. However the drought has not been broken in the Klein Karoo / Kammanassie area east of Oudtshoorn. Agriculture reports that farmers boreholes have been drying up.

3.1.2.1 Kammanassie area.

Relatively large scale groundwater abstractions occur in the Kammanassie area east of Oudtshoorn, for both agriculture irrigation as well as domestic supply and stockwatering. At the regional scale there is no indication of continual long term groundwater level decline. This indicates that groundwater abstraction in these areas is in general sustainable under the current abstraction regime. It would appear therefore that the drying up of farmer's boreholes is probably a result of localised dewatering in the vicinity of a particular production borehole / wellfield, rather than depletion of groundwater storage in the region as a whole.

Groundwater levels were very low in 2006 but responded well to good recharge occurring in late 2006 and again in late 2007. Although groundwater levels declined substantially in the subsequent drought, they have not yet dropped as far as the 2006 pre-recharge event level.

Local Municipal over abstraction on the Vermaaks River wellfield of the Klein Karoo Rural Water Supply Scheme is resulting in Municipal supply problems in the Oudtshoorn Municipal area - at Dysselsdorp and De Rust in particular. The wellfield has been over abstracted for a number of years, and the current drought in that area is exacerbating the supply problem. Urgent augmentation of the Scheme is required, and funding has been requested by the Municipality to bring an emergency scheme on line from the Blossoms wellfield situated 15 km south east of Oudtshoorn.

3.1.2.2 Waboomskraal area.

Groundwater levels south of Oudtshoorn in the Waboomskraal area of the Outeniqua mountain range have responded well to major recharge

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events in June 2006 and December 2007 and to a lesser extent to rainfall between August 2009 and October 2009. However the levels declined rapidly during to the 2010 drought, but not as low as the 2006 pre-recharge event levels. Decline can be exacerbated by increasing reliance by water users on groundwater, as surface water resources dwindle. From mid 2010 onward the water levels gradually rose in response to recharge.

In one instance (TE1) the 2010 groundwater levels declined to below the 2006 levels, probably representing local irrigation abstraction impacts.

3.1.2.3 Blossoms Area

A valuable baseline dataset is being built up in the Blossoms area north of Waboomskraal. This is the area potentially impacted by a wellfield currently being developed for Oudtshoorn Municipal supply. Data are provided to the Municipality whose specialist consultant periodically reports on the aquifer behaviour (Umvoto, 2010).

3.1.2.4 Kango Area

The monitoring boreholes are situated north of Oudtshoorn in the Kango Group, between the Mellville and Raubenheimer dams. Groundwater levels show seasonal fluctuation but are stable over the longer term.

3.1.2.5 Uniondale

An overall upward groundwater level trend from 2005 to 2008 (1.2 meter rise) was followed by a slight decline (0.3 meters) in 2009 and 2010. There is no evidence of overexploitation.

3.1.3 Southern Cape

3.1.3.1 Mossel Bay to Plettenberg Bay

No Departmental groundwater monitoring takes place in the coastal stretch from Mossel Bay to Plettenberg Bay. This area has not been priority because there has historically been limited groundwater use in this area, as the surface supplies have been adequate. The area is however vulnerable to drought due to the heavy reliance of Municipalities on river flow.

Focus shifted to groundwater to assist in salvaging the 2009-2010 severe drought induced water shortages in the area. Mossel Bay, George, Sedgefield, Knysna and Plettenberg Bay all developed emergency groundwater supply schemes in the drought crisis. Groundwater held in aquifer storage provided a short term cushion. Sustainable alternative long term solutions need to be put in place (including well planned ecosystem friendly incremental groundwater developments) to secure the supply in these areas.
Although groundwater was historically not directly used by the

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Municipalities, they relied heavily on groundwater contributions to river base flow in dry periods. River flow – especially in the low flow dry months - is sustained by groundwater discharging from aquifer storage.

The fact that the Municipalities have developed wellfields, means that there will be increasing pressure on the groundwater resource. There is therefore a need to develop groundwater monitoring in the Southern Cape area. Sustainability will depend on good management based on reliable monitoring data. Monitoring design will need to take into account the fact that there is a strong relationship between groundwater level and the surface water flows upon which the Municipalities depend for supply. An understanding of the groundwater / surface water relationship will enable optimisation of conjunctive water use.

3.1.3.2 Albertinia

Groundwater levels were low in 2005 but recovered as a result of a series of good recharge years in 2006, 2007 and 2008. Thereafter groundwater levels progressively declined in the 2009-2010 Southern Cape drought. In July 2010 recharge events commenced with associated groundwater level rise. By November 2010 there had been significant recovery, but not to pre-drought levels. Data for 2011 are not yet available to evaluate the impact of the good rains in 2011.

Some of the groundwater levels to the west of Albertinia display a rising trend, despite the severe 2009-2010 drought. It appears that this rise may be a result of recovery due to reduced abstraction.

3.2 Breede WMA

Monitoring is concentrated in the Breede River Valley to the west of Worcester, the Koo valley and Nuy area to the northeast of Worcester and in the Agter Witzenberg valley to the north of Ceres. More recently monitoring has been established near the Theewaterskloof dam and Stanford.

3.2.1 Area west of Worcester

To the west of Worcester, boreholes are concentrated in the topographically low / discharge areas, and groundwater levels are approximately between 1 and 5 meters below surface in the winter "wet season". In the summer "dry season" groundwater levels drop by about one to two metres. Where monitoring boreholes are influenced by abstraction, seasonal water table drops of up to 40 metres are recorded, and there are indications of localised over abstraction.

Groundwater levels in parts of the area currently tend to be a meter or two deeper than in the 1980-1990 monitoring period. The causes of this observed water level decline are likely the combined effect of the dry period between 2004 and 2006 as well as the low rainfall of 2010.

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Recent recharge in 2008 and 2009 resulted in full recovery of groundwater levels over much of the area. Since then the groundwater levels are on a slight declining trend probably as a combined result of the water levels returning to their "normal" levels after the wet 2008 - 2009 period, but this rate of decline is probably accentuated by the subsequent very dry 2010 period.

3.2.2 Papenkuils Wetland – south of Worcester

Long term monitoring is required to better understand the role that groundwater plays in the survival of wetlands fed by shallow groundwater.

Groundwater levels are monitored in the vicinity of the Papenkuils Wetand situated on the Breede river just south of Worcester. Groundwater levels generally fluctuate between 1 and 2 meters seasonally. The summer "troughs" have remained stable at approximately 3.25 metres below ground level throughout the monitoring period from 1981 to present. However the winter "peaks" are generally lower than they were in the earlier years of monitoring. In the 1981-1994 period the "peaks" were typically in the 1.2 to 2.2 m.b.g.l. range. More recently the level typically only rizes to 2.5 m.b.g.l. (except of course in anomalously wet years such as 2007-2009).

Further work is required to better understand the role groundwater plays in the functioning of this important wetland. Groundwater level data gathered in its vicinity will provide valuable input to such an investigation. The fact that the groundwater levels in the dry season have remained stable since monitoring commenced in 1981 indicate that the groundwater contribution to the wetland has probably remained intact despite groundwater development in catchment.

3.2.3 Ceres basin

The borehole (EIN0001) monitors the Bokkeveld aquifer of the Ceres basin. Groundwater levels are currently similar to the first records in 1992, indicating that groundwater in that vicinity is not over exploited.

An expanded monitoring network would be required to establish the groundwater situation in the basin as a whole and including the Table Mountain Group aquifers. This would assist in determining whether the Ceres catchment is indeed overexploited as indicated in the Breede WMA Internal Strategic Perspective (DWA, 2004).

3.2.4 Agterwitzenberg Valley

In the Agterwitzenberg valley (located to the west of Ceres) a downward trend was evident in the 2004 - 2006 period as a result of low rainfall / recharge, but groundwater levels have recovered fully as a result of subsequent high recharge in 2007-2008. Although a declining trend is currently present in 2009 and 2010 in particular the groundwater levels remain higher than in the pre 2006 period.

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Groundwater abstraction for irrigation in the Agterwitzenberg valley impacts groundwater levels in some of the monitoring boreholes. However recovery in response to recharge is good indicating that current abstraction for irrigation in this valley is sustainable.

3.2.5 Koo Valley

The Koo irrigation board under guidance of consultants (SRK) monitors groundwater in the Koo valley where a feasibility study for development of groundwater for an agricultural supply scheme (2 Mm^3/a from the TMG, Nardouw aquifer) has been carried out. The license application is currently being processed by the Department. Data loggers and rain gauges have been provided by DWA to assist in the monitoring programme in this valley.

DWA monitoring indicates that generally groundwater levels have been on a relatively steep rising trend between 2005 and late 2010. At Heinzberg wellfield, the water levels have shown a similar rising trend, however there has been slight drop in water level since peaking in 2008. The groundwater levels reflect the annual rainfall for this monitoring period. Low 2003 rainfall was followed successive years of increasing rainfall until 2008, declining thereafter.

3.2.6 Nuy

The Langeberg mountain range separates the Koo valley from the Nuy valley to the south of the range. DWA is currently monitoring three boreholes on this side of the mountain as there have been claims from Nuy farmers that their spring flows are being affected by the Koo Valley scheme. These data provide a valuable dataset that could potentially be used in the verification / discounting of such claims.

The Nuy groundwater levels show a similar trend to the Koo Valley groundwater levels, and these too can be explained by the rainfall pattern. There has been a relatively sharp drop in groundwater level in 2010 when only 200 mm rainfall was recorded.

3.2.7 Monitoring associated with the City's TMG Bulk Supply investigations.

Target areas within the Breede WMA, for the development of Table Mountain Group aquifers for bulk supply to City of Cape Town, are located mainly in the vicinity of the Theewaterskloof Dam / Grabouw. Monitoring was established by the Region (8 boreholes) to provide baseline data that will assist in evaluation of influence on other users and ecosystems.

Seasonal fluctuations are evident, ranging from 1.9 meters to 8.3 meters. The fluctuations increase with increasing groundwater level below surface (Geoss, 2010). In other words, the groundwater levels in boreholes situated on topographically high ground (recharge areas) fluctuate more than the groundwater levels in the lower lying areas (in the vicinity of discharge areas). The three years of data collected to

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date will form a valuable baseline dataset, as there has been no abstraction from the aquifer by the City as yet.

In addition, baseline-monitoring sites were established by the Water Research Commission (WRC, 2007) in areas where no influence of the proposed City abstraction. The sites are at Purgatory near the north western end of the Theewaterskloof dam and at the Kogelberg Nature Reserve near Kleinemond. This monitoring will track the groundwater levels and natural state of ecosystems, for comparison with potentially impacted ecosystems. The City of Cape Town is responsible for the ongoing monitoring at these and other sites in the general area of the proposed well field development (summary on page 17 of Geoss, 2010 report) to provide data in support of their possible future license application.

3.2.8 Stanford

DWA monitoring was initiated in 2008 due to imminent groundwater developments in the Stanford area. The Department established five monitoring boreholes to supplement Overstrand Municipality's monitoring which started in 2004. The Municipality periodically produces monitoring reports for Stanford (Umvoto, 2010).

Groundwater in the Stanford area varies from 5 m amsl to 23 m amsl. Seasonal groundwater level variation is generally less than 1 meter and there is no noticeable response to individual rainy days. There is no significant long term change in groundwater level since monitoring began in 2004 (Umvoto, 2010). A very slight downward trend is apparent in the DWA monitoring boreholes.

3.2.9 Cape Infanta

Monitoring was established along the East-West Potberg range in response to four uncontrolled flowing artesian boreholes being established at Milkwood River Farm on the northern slopes in 2005-2006. The range comprises Table Mountain Sandstone – an important aquifer that sustains wetlands (e.g. De Hoop Nature Reserve) and could potentially support future growth in the area.

A license for between 1.1 million and 1.6 million m3/a was applied for to irrigate olive trees at Milkwood farm. Departmental monitoring was established so that data could be available to assist in determining the impacts of the development on the aquifer and other existing/potential users.

In general the groundwater level has dropped by between 0.1meters and 2.5 meters to date. In one case the groundwater level has dropped by 7 meters. Unfortunately there are no pre-development monitoring data for baseline comparison.

Flooding has complicated interpretation further. A flood occurred just after the DWA monitoring boreholes were established in November

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2007. It flooded again a year later in October / November 2008 (96mm rainfall from 7-8 October and another 281 mm between 7-15 November). The following two years were relatively dry (< 400mm p.a. recorded at Bredasdorp – the driest two years since 1991). It is therefore difficult to determine whether the observed overall downward trend in groundwater levels across the area is attributable the floods followed by two exceptionally dry years, or whether the decline is attributable to abstraction at Milkwood.

There are indications however that the general groundwater level decline across the area is a natural phenomenon. This deduction is made on the basis that far field monitoring boreholes 12 km to the east of Milkwood Farm show a downward trend, similar to the monitoring boreholes nearer to the abstraction. The far field monitoring boreholes probably reflect the natural trend.

However this does not necessarily mean that the Milkwood Farm abstraction is not impacting on groundwater levels – it is likely that abstraction contributes to the observed decline, especially in the nearby vicinity of the wellfield. The borehole exhibiting the largest drop in water level (approximately 7 m) is drilled into the same aquifer as the irrigation boreholes - about 1.5 km away. The fact that a far field monitoring borehole in a high topopgraphic setting showed limited drop (approx 0.1m) may indicate that the 7m drop is abstraction related. Impacts are however inconclusive without further in-depth study, monitoring and analysis.

3.2.10 Monitoring by other parties.

Overstrand Municipality has established baseline monitoring in the Hermanus in support of groundwater use license applications in these areas. The license is currently being processed by the Department. Monitoring reports are produced on a 6 monthy basis by the Municipality. The latest report was produced in January 2011 (Umvoto, 2011).

The Hex river Irrigation Board monitors boreholes the Hex river valley where 20 million m^3/a is abstracted for agriculture. The Hex river abstraction has in previous years matched recharge and appears to be sustainable. Monitoring has become crucial due to increasing demand and need for management of the aquifer and to provide answers on the availability for licensing additional abstractions.

3.3 Olifants Doring WMA

The most comprehensive monitoring is taking place in the Sandveld area, much of which was established as part of Reserve Determination studies, which have been completed and are being used to guide the Management Plan for the area. The monitoring and Reserve studies were a response to the perceived groundwater stress in the area and the need to address this via compulsory licensing in the future. Water levels in the Wadrif area have been declining steadily for almost a decade and have lead to Lamberts Bay being in

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a precarious water supply situation since groundwater from the Wadrif area is the source of its municipal water supply. Although the existing wellfield at Wadrif was abandoned because of water quality reasons it is still not clear whether this was due to declining water levels and an ingress of saline or water, or due to recent recharge events flushing salts into the system. A replacement borehole further inland is being utilised while Lamberts Bay plans to develop a desalinisation plant. Despite the stress at the municpal wellfield, irrigation for potato irrigation appears to be continuing unabated and – on the whole – without any immediate threats to its sustainability.

Recent data from the wellfield at Bitterfontein are not available, the Citrusdal groundwater supplies are only used as backup to surface water in times of drought, and water levels at the Graafwater municpal wellfield are essentially stable although the regional aquifer within which the wellfield is situated shows declining water levels and possible over-abstraction. The Elands Bay boreholes have been compromised by declining water quality rather than declining water levels, leading to additional boreholes being commissioned further inland and further away from Verlorenvlei

Van Rhynsdorp groundwater levels are showing a steady decline over the past 10 years. Groundwater levels in the area have dropped by 3-5 meters in this period – probably as a result of agricultural over-abstraction, but a more detailed study would be required to evaluate the contribution of climatic changes to this declining groundwater level trend. Of major concern is the salinization with increase of up to 150 mS/m (from 200 – 350 mS/m in one instance, and 80 – 250 mS/m in another instance). This may threaten the viability of irrigation, and pushes the quality out of the recommended ranges for human consumption.

3.4 Berg

In the Cape Town Metropole area groundwater is monitored on the Cape Flats and Bellville. The longest groundwater level record is for the Cape Flats (20 years) where groundwater some levels have declined by about 2 meters in the past 10 years. The decline is probably climate related as opposed to over exploitation of the aquifer. The level is currently at similar to what it was in the mid 1980s. Other monitoring boreholes have shown significant water level rises caused by the high rainfall of the past few years. Monitoring in the Bellville area has only been carried out for the past 3 years. Seasonal fluctuations of around 3 metres are evident with a slight groundwater level decline, which is probably a result of lower rainfall. A longer monitoring period and detailed analysis of abstraction and climatic patterns would be required to confirm this.

In the Dieprivier catchment groundwater level are relatively stable since monitoring started in 1998 - a slight rise is evident in the last year.

Along the West Coast groundwater is monitored at Silwerstroom, Jakkalsfontein and the Langebaan Elandsfonteyn and Adamsboerskraal aquifer systems. Groundwater levels have risen at Silwerstroom despite lower rainfall. At Jakkalsfontein groundwater levels are dropping and will need to

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be watched to ensure overexploitation does not take place if rainfall continues to decline. At Langebaan groundwater levels in the Municipal well field (which abstracts groundwater from the lower aquifer for the West Coast District Municipality) have risen significantly, after being basically stable for several years, indicating that the current rate of abstraction is sustainable and may even be under-utilising the resource. Some caution in drawing conclusions is however needed since 3 events occurred more or less at the same time: reduced abstraction; high rainfall and natural recharge; and some artificial recharge. Current thinking is that the artificial recharge tests contributed the least to the rise in water levels. It will be necessary to carefully monitor quality to ensure that there is no ingress of brackish water into the lower aquifer. Some upper aquifer groundwater levels have declined in recent years probably as a result of the drier climate, while some have risen. An intensive monitoring programme is currently being carried out to identify any linkages between the upper and lower aquifers.

The Admboerskraal and Elandsfonteyn aquifers are exploited for Agricultural irrigation purposes. The general picture is of no overall trend, but many different trends taking place, often within short distances of each other. Many boreholes have shown rising water levels as a result of the high rainfall the past few years, but there are also many boreholes with falling water levels. In both of these instances detailed study of climatic and abstraction trends would be required to be more definitive about the reasons for the trends

4 Water quality

The Regional groundwater quality (electrical conductivity) as mapped in the Departmental National Geohydrological Mapping programme in the late 1990's is given in Appendix 5. This figure provides an overview of water quality which is not expected to change significantly at the regional scale from year to year. Local scale groundwater quality variation may however occur, but this requires detailed local monitoring to detect.

Groundwater samples are in general submitted to the Departmental laboratory at Roodeplaat for analysis. Analytical data are loaded by the laboratory to the WMS database once complete. Currently there is a backlog at the laboratory, with data only available to Feb 2007. The Region therefore has recently started submitting samples to an accredited private laboratory until Roodeplaat is again fully functional.

Monitoring carried out by the Region is primarily for determining background water quality trends which, if changing, are usually only slow to manifest due to the naturally slow flow rate of groundwater. A backlog in analyses of the Regions groundwater monitoring is therefore not critical for detecting immediate water quality threats to human safety. Results for monitoring carried out as part of the National Groundwater Quality Monitoring programme are superimposed on the regional water quality map in Appendix 5.

"Early warning" type water groundwater quality monitoring addresses human safety issues, and is carried out by water services authorities / municipalities - not the Departmental Groundwater section. Potential polluters (e.g. petroleum industry) are

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themselves required to monitor in terms of licensing conditions? Petrol / Diesel spills at *inter-alia* Leeu Gamka and Beaufort West are receiving attention by private companies.

A more advanced water quality-monitoring needs to be network designed for the Region. This is to include monitoring of diffuse agricultural sources as well as the coastal area where saline intrusion can occur.

5 Aquatic ecosystems

Aquatic ecosystems in the Region are protected by considering Reserve requirements in applying the National Water Act. Reserve determinations for particular quaternary catchments are carried out by National Office in response to groundwater license applications. Appendix 6 contains a map of the status of Reserve Determinations in the Western Cape as produced by the National Office.

Groundwater license applicants are required to provide an assessment of the potential impacts of the development on groundwater dependent aquatic ecosystems. Licensing conditions are recommended by the groundwater section, and where necessary these contain a requirement for monitoring by the applicant - specifically aimed at ensuring the Reserve is not unacceptably impacted.

Where available, data from the Department's Regional monitoring provides supplementary information which can assist in the evaluation of impacts of developments. In some cases the Groundwater section has established monitoring boreholes where large scale abstractions, that may have a regional impact on discharges to wetlands, are anticipated (e.g. Grabouw area and Outeniqua south of Oudtshoorn).

Numerous wetlands occur throughout the Western Cape Region and map of the wetland distribution has been requested from the Chair of the Western Cape Wetlands forum. It is not possible to monitor each wetland, and it is not feasible to carry out intensive localised investigations to fully understand the extent of groundwater dependence of the wetlands. However there are some particularly vulnerable and threatened wetlands that are known to be groundwater fed, and the establishment of detailed monitoring is recommended in these cases (e.g. Wilderness lakes area – Groenvlei).

6 Groundwater use

Accurate groundwater use data are not available for the Region in general. Use volumes obtained during Registration groundwater users are available on the WARMS database. This database however only contains the larger scale groundwater users as only use greater than $10m^3$ per day were registered. The registered use needs to be verified by the Department and there are indications that the registered use is not reliable figure. Verification is labour intensive, time consuming and therefore expensive process and can only be carried out in the highest priority cases.

It is not possible for the Department to keep track of each borehole drilled in the Region, monitor the use and maintain an updated database of the ever changing

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groundwater use situation. Groundwater licensing conditions require the applicant to monitor their own use and keep on record. It will however not be possible to get a good handle on total groundwater use even if all licensed users are individually tracked. This is because licensed users only form a small proportion of the current users which include existing lawful users, Schedule 1 users and those using groundwater in terms of the General Authorization.

Groundwater use estimates from Groundwater Resource Assessment GRAII for the Western Cape is provided in map form in Appendix 7. Although this does provide an indicator of groundwater use the authors of GRAII question the reliability of the source data.

The most effective way to monitor and manage groundwater use will be via the establishment of groundwater user associations, where the users themselves become involved in the monitoring and recording of their own use. This underlines the importance of establishing the relevant institutions, staffing them with groundwater personnel that can provide support to the user associations.

7 Data collection and management

7.1 Departmental data

The efficient systematic collection and storage of geohydrological data is a challenge given the capacity constraints of the section. The situation is improving with the appointment of a Data Manager (F Jonck) and the assistance of graduate trainees with the field data collection.

A *minimum* of three additional personnel are required to fill critical posts i.e. a data capturer, a librarian, and a GIS specialist operator.

Monitoring data are entered onto the Hydstra database which is currently being phased in as the storage point for time series hydrogeological data. Hydstra graphical plots for each site are given in Appendix 8 (CD in sleeve at back of report). The purpose of inclusion of the graphs is to display the current status of water level data entry, and to assist in the identification of further quality control actions.

The following aspects require attention in the next year:

- The Link between databases and CHART – the activation/facilitation of the existing link between the various databases (HYDSTRA, NGA, and WMS) and CHART.
- Borehole Logs – data capturing of borehole logs.

7.2 External data

The capture of Departmental data is currently receiving attention. However a vast amount of geohydrological data generated outside the Department does not reach the National database. Sources are *inter alia* – the Water Research Commisison, Local Government and the Private Sector.

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A plan of action is required to secure these data. One possibility is the embarking on a GRIP process as a means to gather external data, and this route will be assessed in the next year.

This nationwide problem is recognised in the National Groundwater Strategy and it is anticipated that support and impetus to adequately tackle this problem will emanate from the Strategy. In the interim the Region intends identifying and classifying the various data sources and making a start with capturing priority data.

8 Conclusions

- Long term background groundwater levels are relatively stable across the Central Karoo as a whole, indicating that storage is not being depleted at the regional scale. Local overexploitation occurs at some localities – especially in an area north of Beaufort West.

- Reported drying up of boreholes in the Klein Karoo is probably a result of localised dewatering in the vicinity of a particular production boreholes / wellfields, rather than depletion of groundwater storage in the Klein Karoo region as a whole.

- The Vermaaks River wellfield of the Klein Karoo Rural Water Supply Scheme is overexploited and requires urgent augmentation.

- Groundwater monitoring needs to be developed in the Southern Cape area.

- Over much of the Breede Water Managemet Area, recharge in 2008-2009 resulted in full recovery from the low 2004-2006 groundwater levels. Since 2009 the groundwater levels are on a slight declining trend accentuated by the very dry 2010 period.

- The hydrogeological settings of monitoring sites and data collected at the sites are currently being assessed to determine the usefulness of these sites and well as assist in planning the modification of the monitoring networks.

- Attention needs to be given to developing integrated monitoring networks to better understand regional groundwater flows and groundwater surface water interactions. These data will provide the information needed to management of the resource as a whole in an integrated way.

- The monitoring network needs to be expanded and improved. As a result there will be an ongoing need for additional monitoring boreholes technology /devices / and the associated budget.

- Additional personnel are required to adequately perform the monitoring and associated data management tasks.

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9 Recommendations

- The existing monitoring network must be assessed and modified / expanded.

- A *minimum* of three additional personnel are required to fill critical data management posts i.e. a data capturer, a librarian, and a GIS specialist operator.

- A control technician, 4 technicians and 2 auxilliary services officers need to be employed for field collection and associated database functions. An additional two hydrogeologists are required for the analysis and interpretation of data.

- Priority needs to be given to establishment of water user associations to effectively monitor and manage groundwater use.

- Real time monitoring of selected representative boreholes is recommended especially in drought sensitive areas, to eliminate lag time between data collection and reporting.

- Groundwater monitoring information from the Sandveld collected by DWA needs to be better integrated with - and better disseminated to - local groundwater management, i.e. via the Northern Sandveld Water Users Association. Other opportunities for integrated monitoring in the Sandveld need to be explored.

- Thought needs to be given to the intensity of monitoring in the West Coast Area, which is very high in proportion to the amount of groundwater being abstracted. There would appear to be grounds for rationalizing and reducing the monitoring in this area and re-deploying resources in less well-monitored areas.

- If drilling services is phased out, the drilling services budget must be retained / ring fenced for the purposes of establishing a geohydrological monitoring network.

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APPENDIX 1: Map showing groundwater monitoring points.
APPENDIX 2: Spreadsheet with monitoring point details. (See CD)
APPENDIX 3: Map showing National groundwater quality monitoring points
APPENDIX 4: Map summarising groundwater level status. (A0 map see CD)
APPENDIX 5: Groundwater quality and hydrochemistry map. (A0 map see CD)
APPENDIX 6: Status map of Reserve determinations
APPENDIX 7: Groundwater use - GRAII
APPENDIX 8: Hydstra Graphs (See CD)

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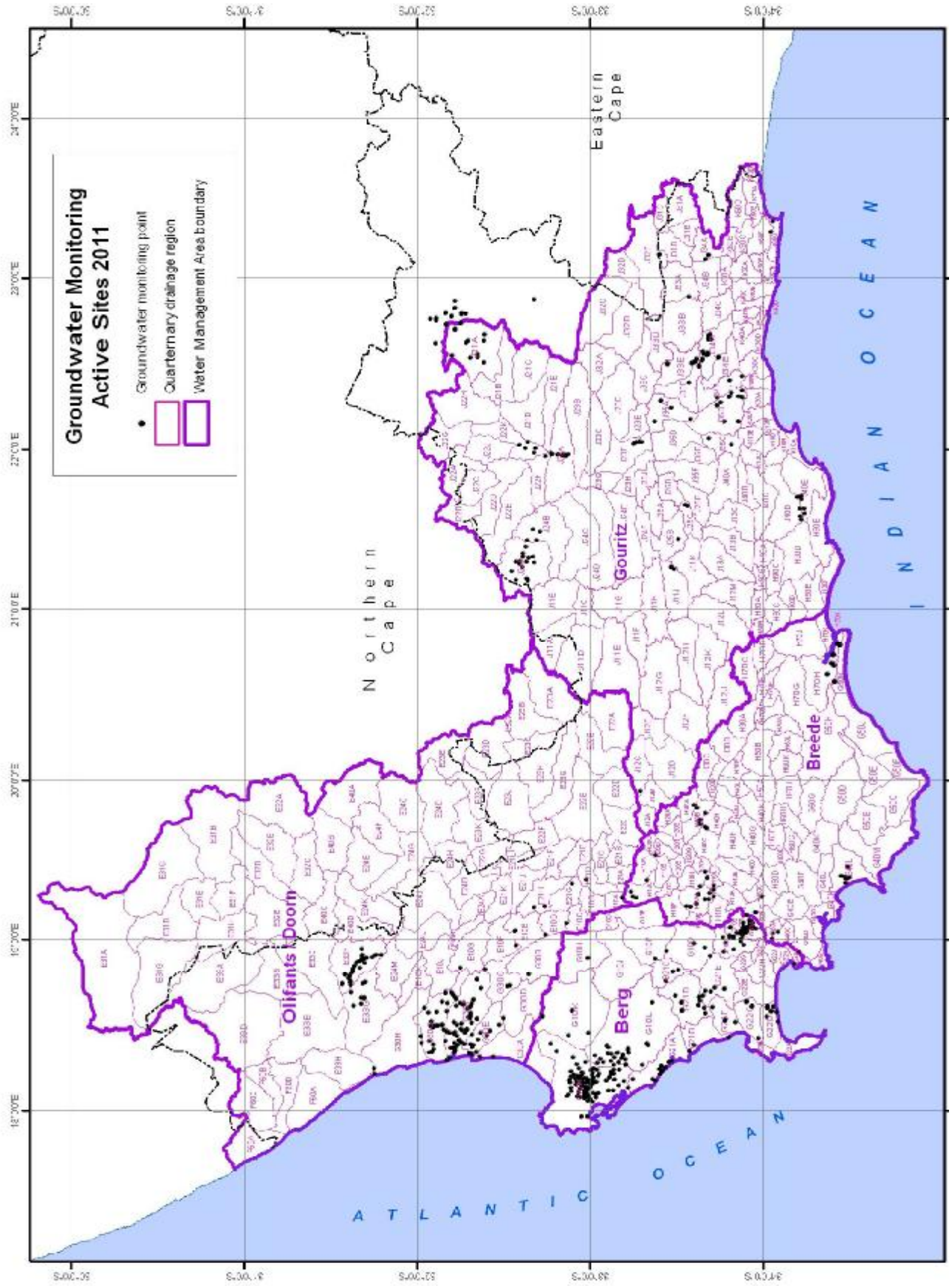
APPENDIX 1: Map showing groundwater monitoring points.



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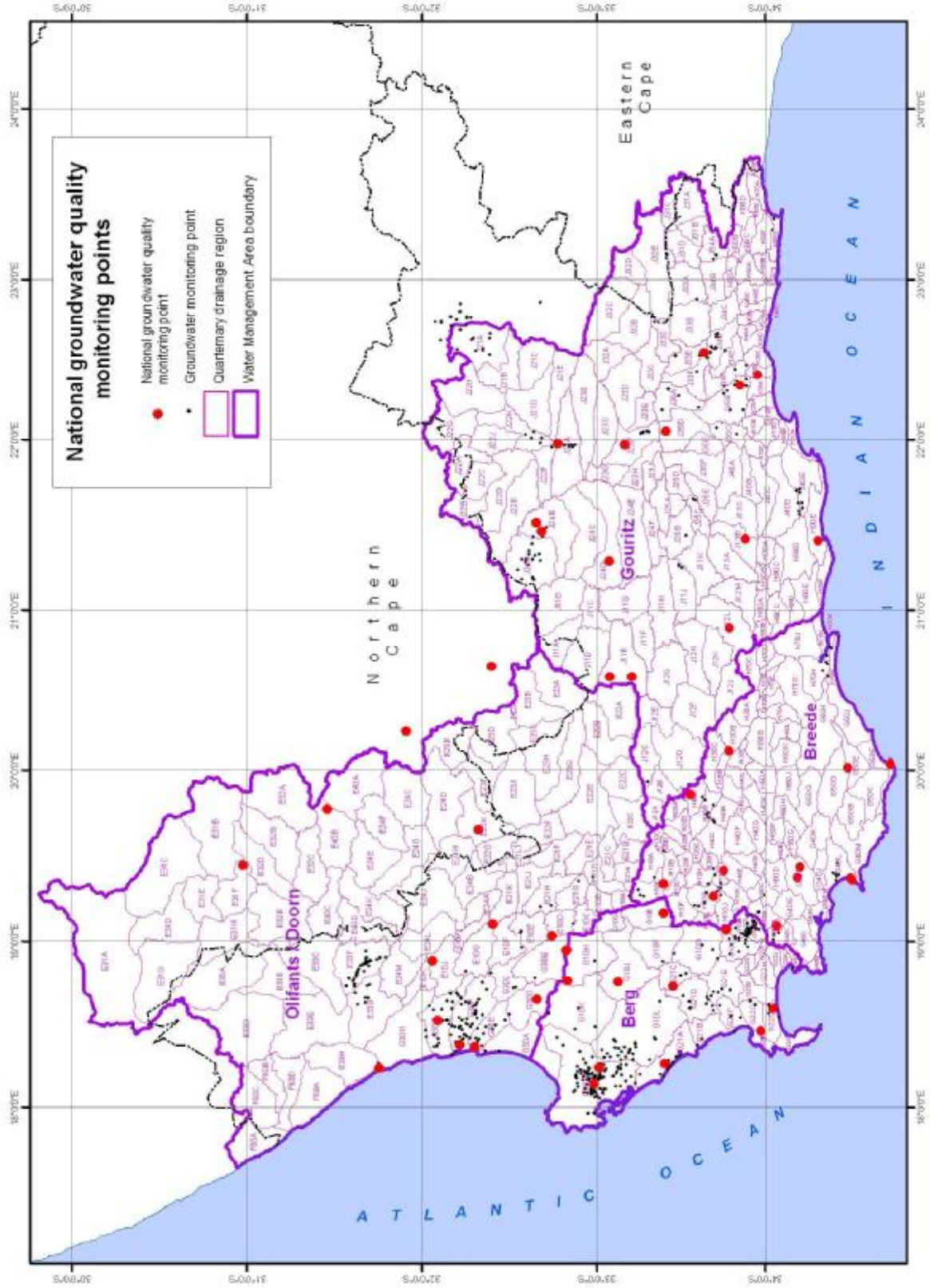
APPENDIX 3: Map showing National groundwater quality monitoring points



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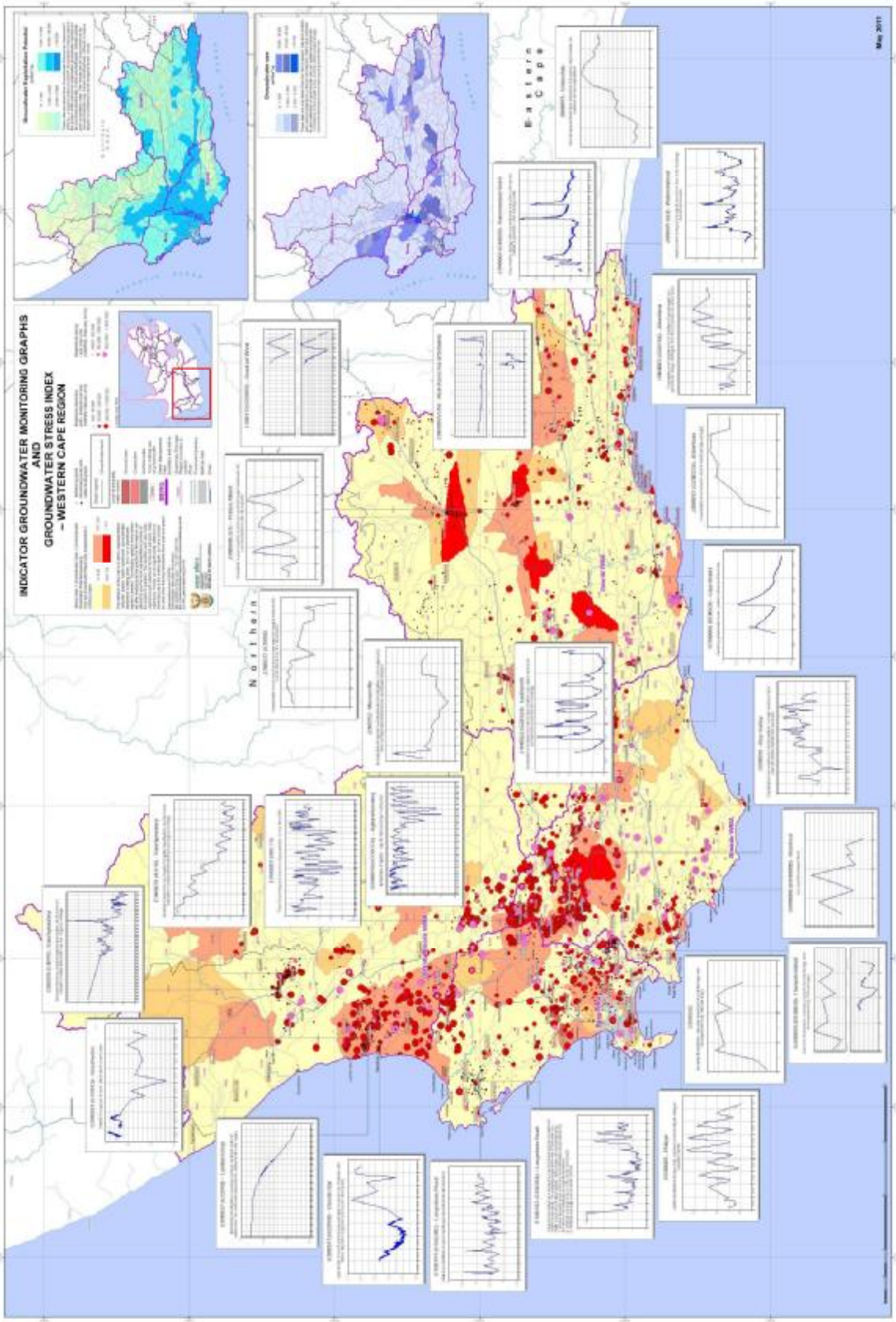
APPENDIX 4: Map summarising groundwater level status.



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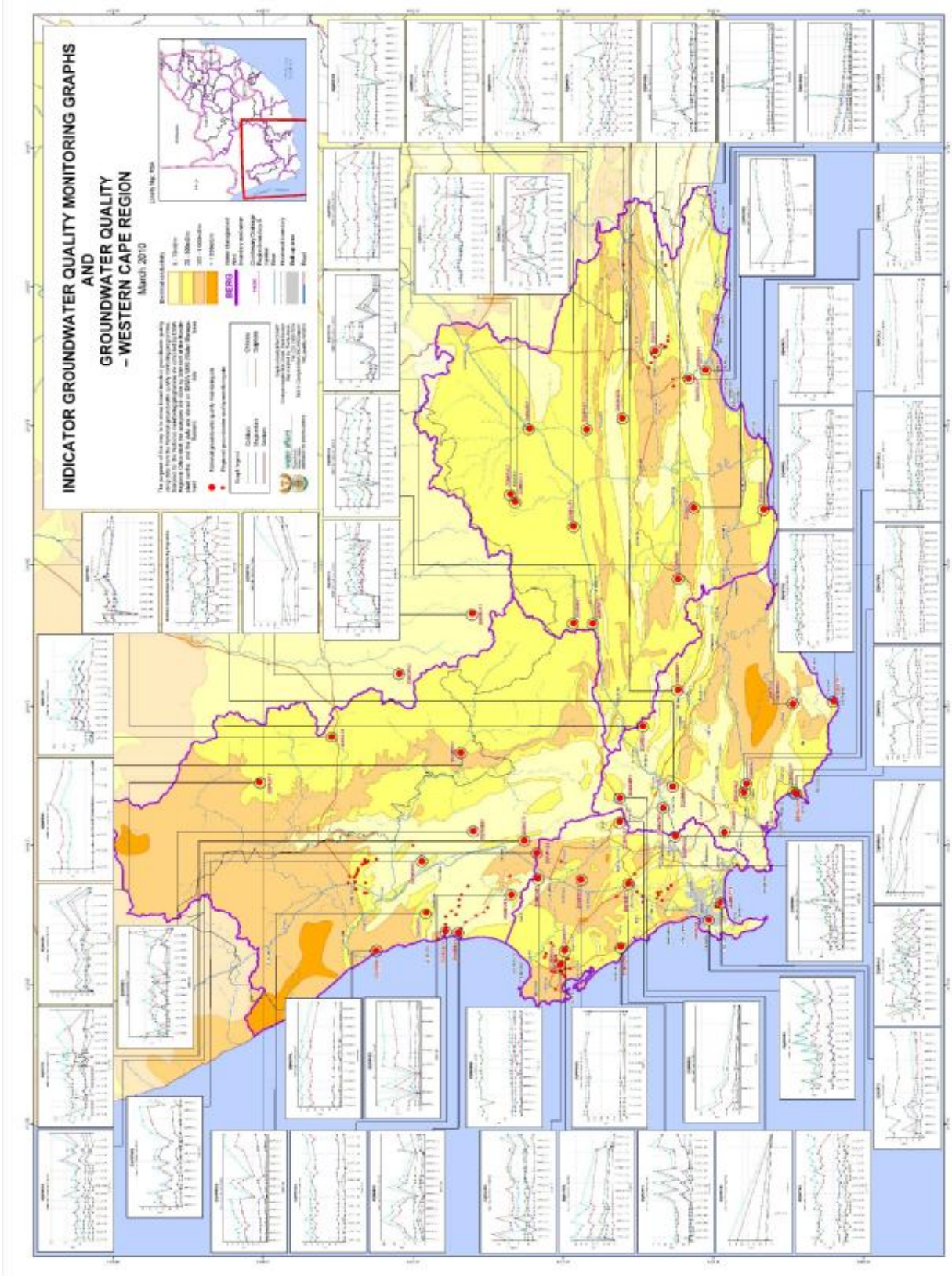
APPENDIX 5: Groundwater quality and hydrochemistry map.



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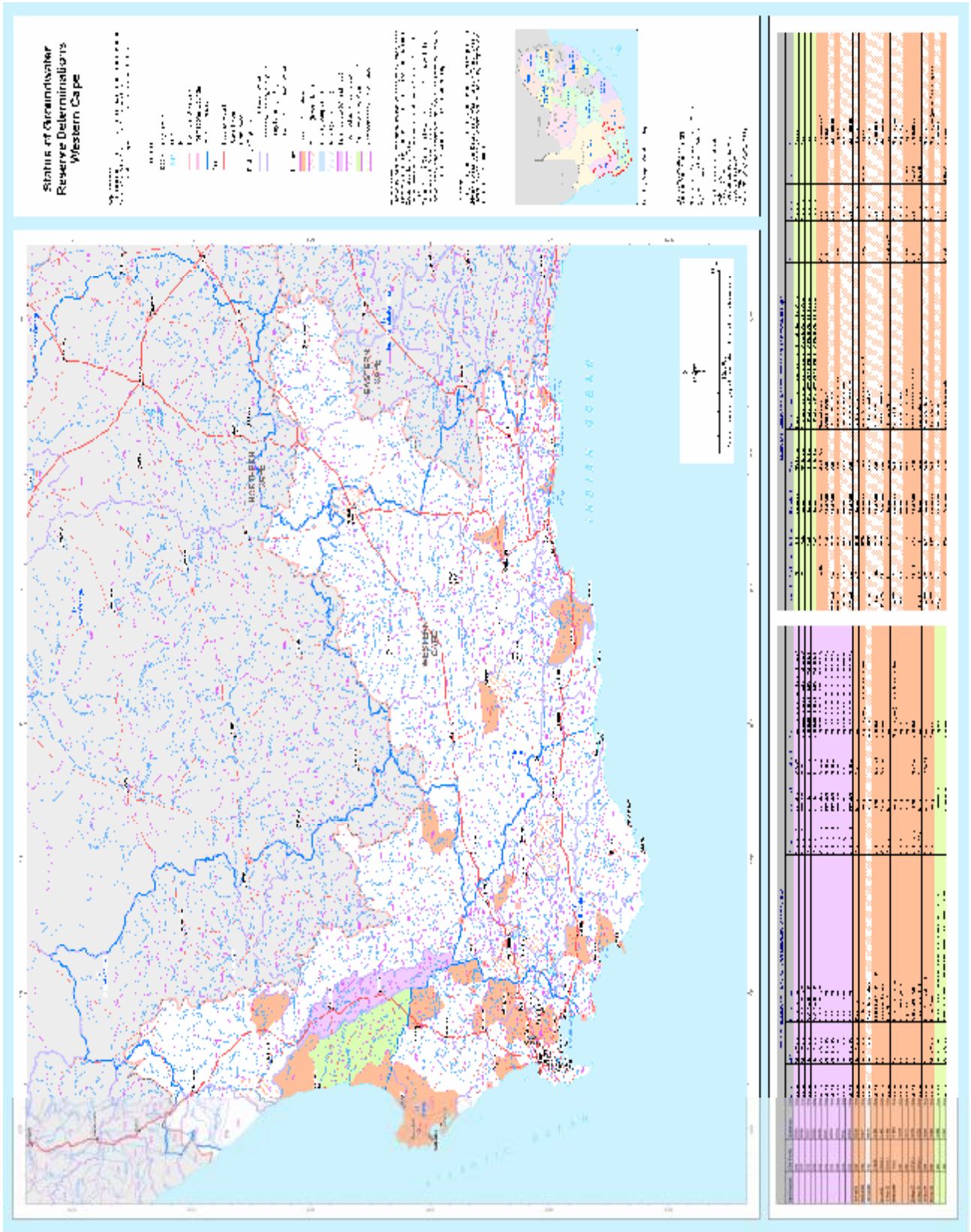
APPENDIX 6: Status map of Reserve determinations



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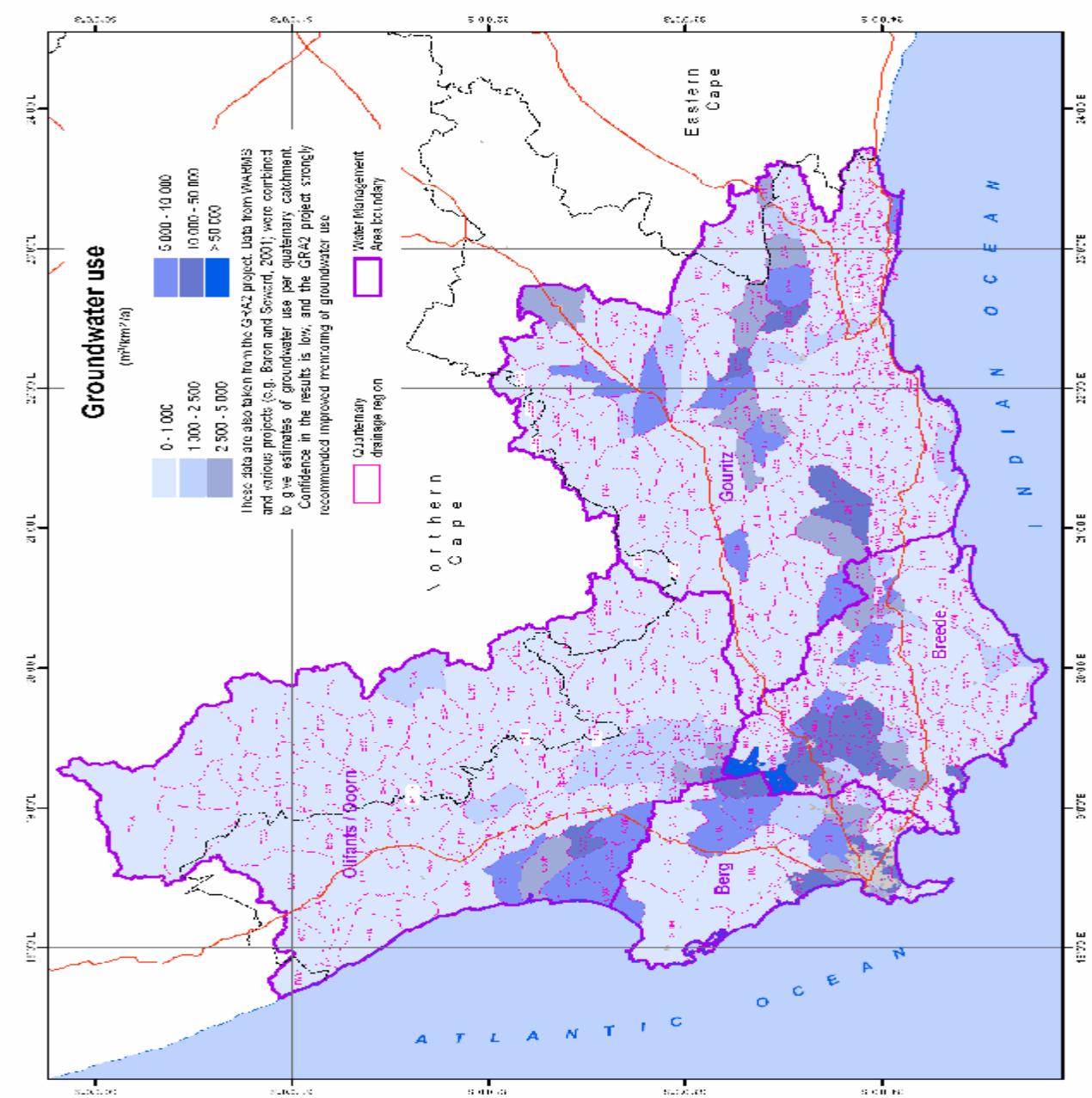
APPENDIX 7: Groundwater use – GRAII



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