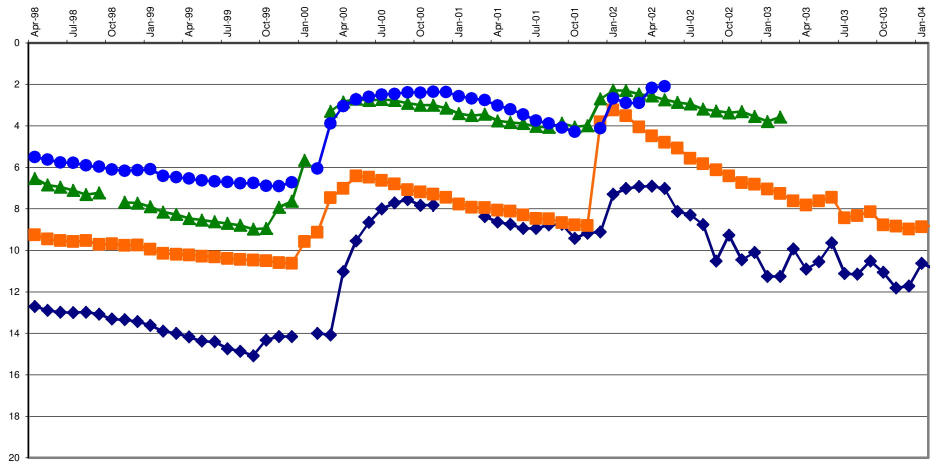
LIMPOPO REGION

DIRECTORATE
WATER REGULATION AND USE

STATUS REPORT ON GROUNDWATER LEVELS & TRENDS 1 MAY 2011 – 1 MAY 2012



H VERSTER
JUNE 2012

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SUMMARY

The general slow declining trend noted for some years still continues. Recharge the past rainy season was limited mostly to the escarp and eastward as well as the Waterberg mountainous area. Despite the good recharge in a few localised areas, the majority of groundwater levels are lower than last year at the same time. The northern part of the province experienced a dry season with virtually no recharge.

Long-term data available however indicate no need for immediate concern as cycles of declining/rising trends of medium to long-term are natural and current levels are generally above the worst recorded. This however does not imply that groundwater can be abstracted uncontrolled and unmanaged. Future recharge or drought periods cannot be predicted and climate change leads to erratic weather patterns. Data obtained from the groundwater monitoring network give an indication of the general situation over a large area and local circumstances may vary dramatically.

1. BACKGROUND

Groundwater level responses to the past rainy season are discussed and comparison made with the corresponding time last year. The period "November 2011 to May 2012" represent the past rainy, or recharge, season.

The distribution of Limpopo's groundwater level monitoring stations from which water level data was obtained is depicted by (FIGURE1)

The distribution of the South African Weather Services rainfall monitoring stations from which rainfall data was obtained is depicted by (FIGURE2)

For reasons such as wet inaccessible conditions, recently equipped and vandalism, not all stations have data for the whole period.

Groundwater level data was collected during May 2012. All water level values used are that on the 1st of each month in question and taken at 12H00 in the case of logger data. Where logger data is not available the hand measurement taken during the site visit is used.

171 Of the 183 stations visited have water level data available for the past season and 164 for the whole year.

2. RAINFALL

2.1 TOTAL RAINFALL; NOVEMBER 2011 TO FEBRUARY 2012 (FIGURE 3)

Figure 3 depict the total rainfall received for the first half of the past rainy season. Less than 250mm was recorded over the bigger part of the Province. Higher rainfall was mostly recorded in the recharge areas of the Mokolo and Lephalale drainages and over the eastern part of the Province. The highest rainfall was, as can be expected, received along the escarpment. An exception is the area in the south east (Hoedspruit area) where exceptionally high rainfall causing severe flooding was recorded in January 2012.

2.2 TOTAL RAINFALL; MARCH TO MAY 2012 (FIGURE 4)

Figure 4 depicts the rainfall over the last part of the rainy season. The second half of the season was unfortunately a dry one with less than 100 mm recorded over virtually the whole Province. The highest rainfall recorded at a single station was 198mm over the whole period.

2.3 PERCENTAGE OF NORMAL PRECIPITATION; 1 FEBRUARY TO 30 APRIL 2012 (FIGURE 5)

This figure, obtained from the US Climate Prediction Centre website, indicates the percentage of normal rainfall recorded over the southern part of Africa for February, March and April. The unusually dry second half of the season is confirmed by the fact that less than 50% and even less than 25% of normal rain was received.

2.4 PERCENTAGE OF NORMAL PRECIPITATION; JULY 2011 TO APRIL 2012 (FIGURE 6)

Figure 6, compiled by the South African Weather Services, covers the whole period since the previous wet season. Normal to below normal rainfall was received over the whole Province with below normal mostly the case.

2.5 RAINFALL PATTERN IN IN LIMPOPO SINCE 2010 (GRAPH 1)

Graph 1 indicates that rainfall over the past rainy season was generally lower than the previous season with Hoedspruit being an exception, as was mentioned earlier. The drier latter part (February to May) is very clear, especially compared to the latter part of the 2009-2010 season.

3. GROUNDWATER LEVELS

Although some good rains were recorded early in the season, groundwater levels did not respond very well in all areas. The reason for this is that a high intensity event is required for noteworthy recharge to take place and such instances were restricted to the southern escarp and lowveld, the eastern Soutpansberg and the Waterberg mountain areas. In other areas the total rainfall was less than 250mm over three months.

3.1. GROUNDWATER LEVEL BEHAVIOUR; NOVEMBER 2011 TO MAY 2012 (FIGURE 7)

Areas with higher groundwater levels since the start of the wet season corresponds well with the higher rainfall (Above 300mm) distribution as depicted in Figure 3. The diffusion of recharge downstream in the Hout and Mogalakwena River basins is noteworthy.

Despite the apparent relative large area with higher groundwater water levels, the actual rise was generally not significant. 119 (69.6%) of the 171 stations with data for the whole season indicate lower water levels with 50 (29.2%) higher groundwater levels. If the 8 boreholes that are either affected by pumping or extreme recharge such as at Mica are ignored, the average rise is only 0.2m. The overall average is 0.26 m down with 2 boreholes showing no difference in water level.

The fact that almost 70% of the stations still have lower water levels at the end of the season than at the start is clear indication that the past rainy season did not result in significant recharge

3.2 GROUNDWATER LEVEL BEHAVIOUR; MAY 2011 TO MAY 2012 (FIGURE 8)

As indicated by Figure 8, higher groundwater levels than those of the same time last year, are restricted to a few small areas or single stations. 164 Stations have data for the whole year. 138 (84.2%) Of these have lower groundwater levels with an average decline of 0.97m.

4. GROUNDWATER LEVELS AND RAINFALL; SOME EXAMPLES

- STATION B7MICA (GRAPH 2): The relationship between rainfall and groundwater levels is clearly demonstrated by this graph. It was mentioned above that high intensity precipitation events are needed for significant recharge. The dramatic response to a rainfall event of >300mm over a 24 hour period can be clearly seen.
- STATION B8TZANEEN (GRAPH 3): Despite the lag between rainfall and recharge that can be noted, the response to good rains is clearly discernable. A significant response to the previous season's good rains compared to the limited response to the past season's lower rainfall is well-defined.
- STATION A4NABOOM-VAALWATER (GRAPH 4): This area had reasonable consistent rains the past three seasons and the effect on groundwater levels is evident. The response in groundwater levels to a high intensity event when 180mm was recorded in the last week of December 2011 can again be noted.

5. SHORT AND LONG-TERM PERSPECTIVES (GRAPHS 5-8)

- Graph 5: The graph illustrates groundwater level trends at some stations in the A4 drainage. Monitoring in this drainage only started in 2008 and no longer-term data is available. Despite trends varying from slight declines to slight rises, conditions in this drainage are quite stable. The area has very low groundwater impact due to the fact that land use is mostly restricted to game and cattle farming and irrigation from the Mokolo and Matlabas Rivers. The seasonal recharge and declining cycles is well demonstrated by the trend of station A4MatlabasMamba.
- GRAPH 6: For some time a general slow declining trend in groundwater levels has been noted. The trend is seen as part of a normal cycle and no reason for concern at this stage. This decline is illustrated by the trend at station A6Mokopane Dorp since 2000 when the last major recharge was recorded in that area.
- GRAPH 7: Both stations are along the Sand River. Station A7Doornkraal 2 is located within the Municipal well field and the effect of nearby pumping is clear, especially 2007 to 2008 when large scale abstraction was needed to compensate while work was done on the Ebenezer pipeline. When normal abstraction resumed the groundwater level recovered well. Station A7Sterkloop Farm is not directly affected by pumping but a good correlation between the two trends still exists. The declining trend at A7Sterkloop Farm and for the first part at A7Doornkraal 2 in also evident. Some artificial recharge takes place at the well field and the long-term trend indicate efficient aquifer management.
- GRAPH 8: 30 Year trends are illustrated for A6Mokopane Nyl and A6Mokopane Dorp. The effect of the prolonged drought since the early 80's and the good recharge in 1996 and again in 2000 is demonstrated by the response in groundwater levels. The declining trend mentioned above and illustrated by Graph 6 is the latter part of that for A6Mokopane Dorp and seen in isolation may lead to incorrect conclusion of the 12 year period. Despite the slow decline since 2000, the current level is still well above the critical level reached at the end of the drought period.

6. IMPORTANCE OF GROUNDWATER MANAGEMENT (GRAPH 9)

Normal seasonal recharge is not always sufficient to restore the annual aquifer losses, especially as the resource is becoming more and more impacted and stressed. Historical data indicate different cycles of decline and recharge but the most important is sporadic events of major recharge such as 1958, 1976, and 1996 and in some areas 2000. Such events is clearly not an every year occurrence and the time lapse between cannot be predicted, especially with the influence of factors like climate change. The current general decline in groundwater levels is considered part of a natural longer term cycle between major recharge events but how long it may continue is unknown. The situation may in the meantime improve by a very good rainy season but it can suddenly get worse due to an extreme dry year or even a prolonged drought situation. This emphasizes the absolute necessity for sound groundwater management at all times. Failure to assess aquifer potential and monitoring of aquifer response to abstraction may lead to a sudden unexpected disaster situation that can have far reaching consequences.

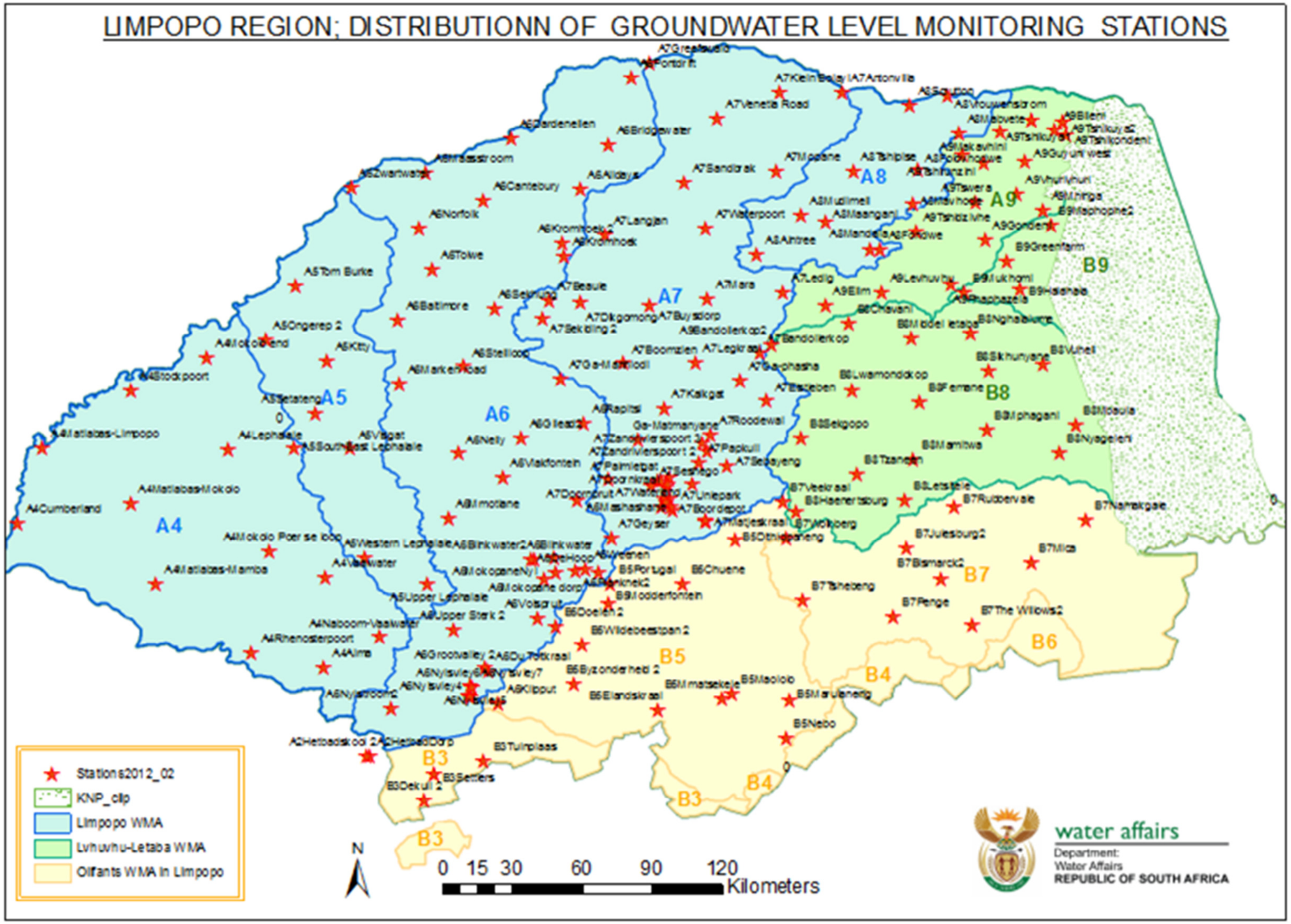
The trend at station A6Kromhoek for which data since 2005 is available also indicate the declining trend discussed above. The trend was however severely amplified by abstraction started in the area in October 2010 for water supply to the town of Alldays. The water level is declining steeply, if the aquifer potential in such case is not known and no monitoring is done by the abstractor it is impossible to predict how long the project can continue before it fails.

7. ACKNOWLEDGEMENTS

7.1. info@weathersa.co.za http://www.weathersa.co.za/web/Content.asp?contentID=88 (Rainfall data for Limpopo Province as well as Figure 6)

7.2 The U. S. National Climate Prediction Centre (Figure 5)
http://www.cpc.ncep.noaa.gov/products/fews/global/CMORPH/cmorph_dly_africa_south.png

NOAA/ National Weather Service
National Centers for Environmental Prediction
Climate Prediction Center



LIMPOPO REGION; DISTRIBUTIONN OF GROUNDWATER LEVEL MONITORING STATIONS
A4
A5
A6
A7
A8
A9
B3
B4
B5
B6
B7
B8
B9
Stations2012_02
KNP_clip
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
N
0 15 30 60 90 120
Kilometers
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 1

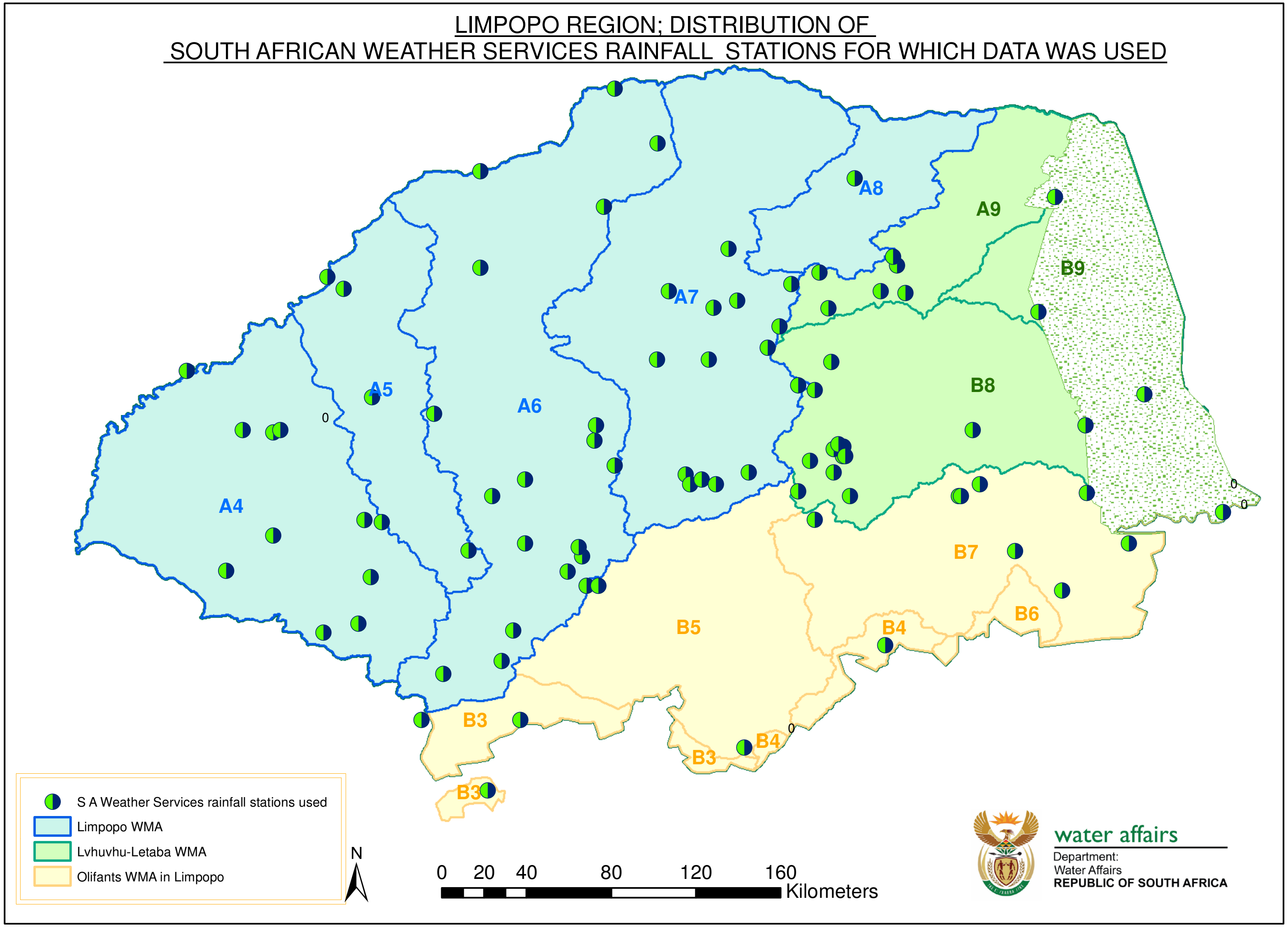

LIMPOPO REGION; DISTRIBUTION OF
SOUTH AFRICAN WEATHER SERVICES RAINFALL STATIONS FOR WHICH DATA WAS USED
A4
A5
A6
A7
A8
A9
B9
B8
B7
B6
B5
B4
B3
S A Weather Services rainfall stations used
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
N
0 20 40 80 120 160
Kilometers
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 2

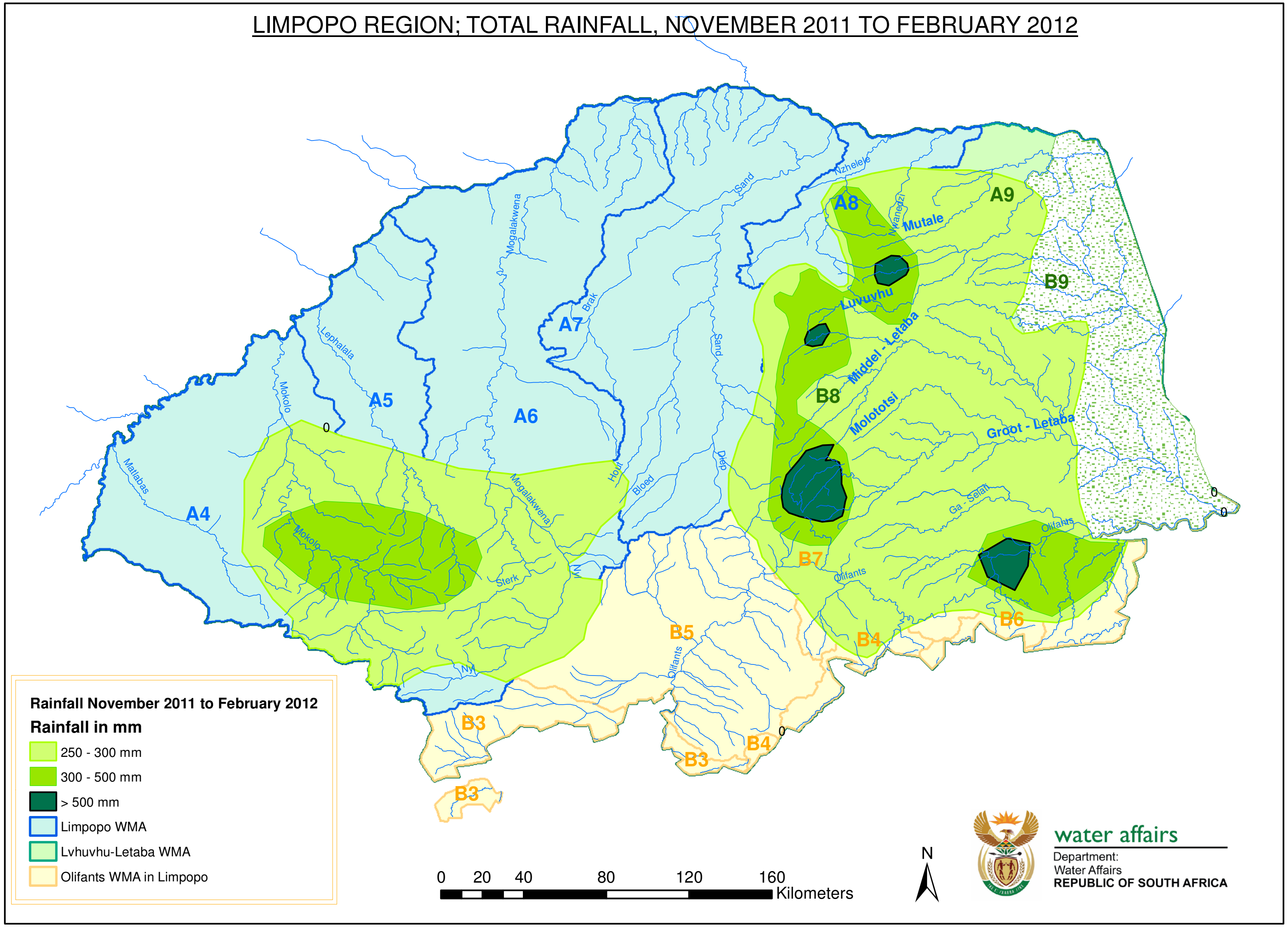
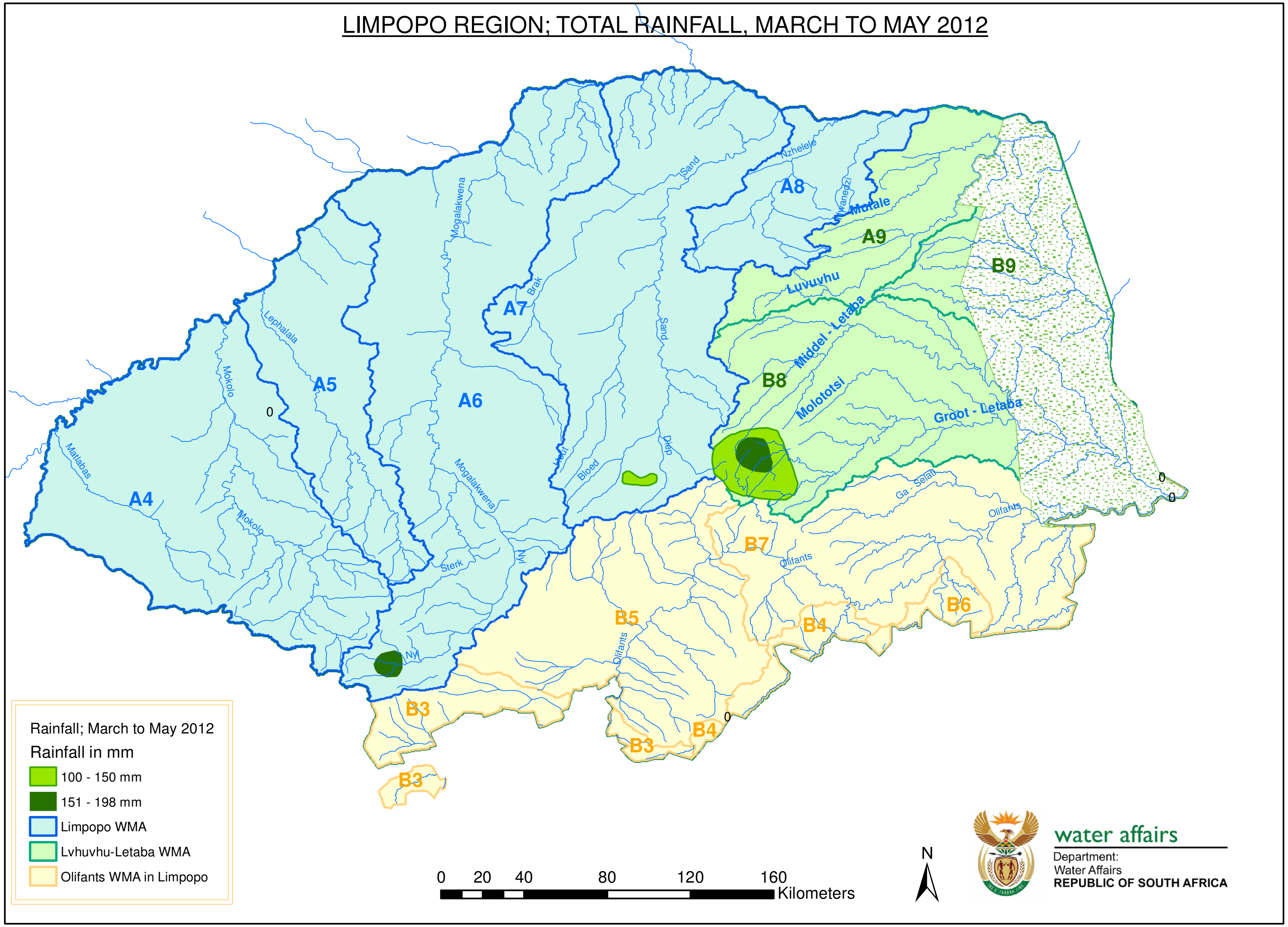

LIMPOPO REGION; TOTAL RAINFALL, NOVEMBER 2011 TO FEBRUARY 2012
A4
A5
A6
A7
A8
A9
B3
B4
B5
B6
B7
B8
B9
Mutale
Luvuvhu
Middel - Letaba
Molototsi
Groot - Letaba
Rainfall November 2011 to February 2012
Rainfall in mm
250 - 300 mm
300 - 500 mm
> 500 mm
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
0 20 40 80 120 160
Kilometers
N
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 3



LIMPOPO REGION; TOTAL RAINFALL, MARCH TO MAY 2012
A4
A5
A6
A7
A8
A9
B3
B4
B5
B6
B7
B8
B9
Luvuvhu
Mutale
Middel - Letaba
Molototsi
Groot - Letaba
Olifants
Mogalakwena
Mokolo
Lephalala
Sand
Nyl
Rainfall; March to May 2012
Rainfall in mm
100 - 150 mm
151 - 198 mm
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
0 20 40 80 120 160
Kilometers
N
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 4

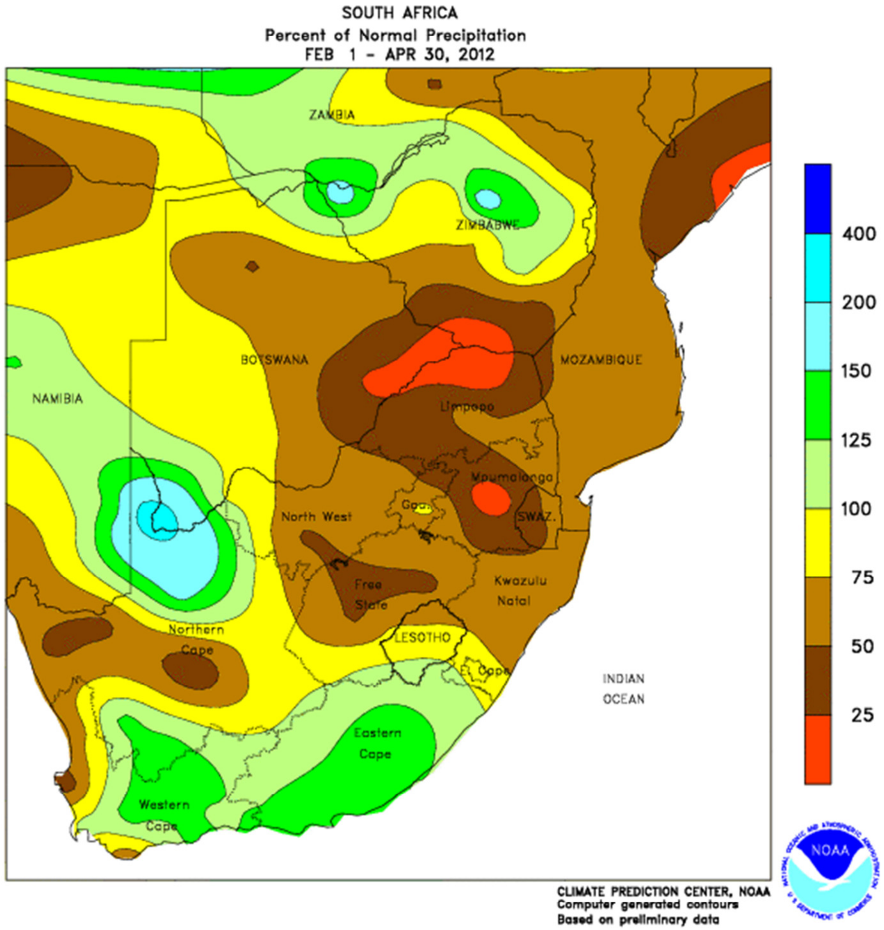

SOUTH AFRICA
Percent of Normal Precipitation
FEB 1 - APR 30, 2012
ZAMBIA
ZIMBABWE
BOTSWANA
MOZAMBIQUE
NAMIBIA
Limpopo
Mpumalanga
North West
SWAZ.
Free State
Kwazulu Natal
Northern Cape
LESOTHO
INDIAN OCEAN
Eastern Cape
Western Cape
400
200
150
125
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data

FIGURE 5

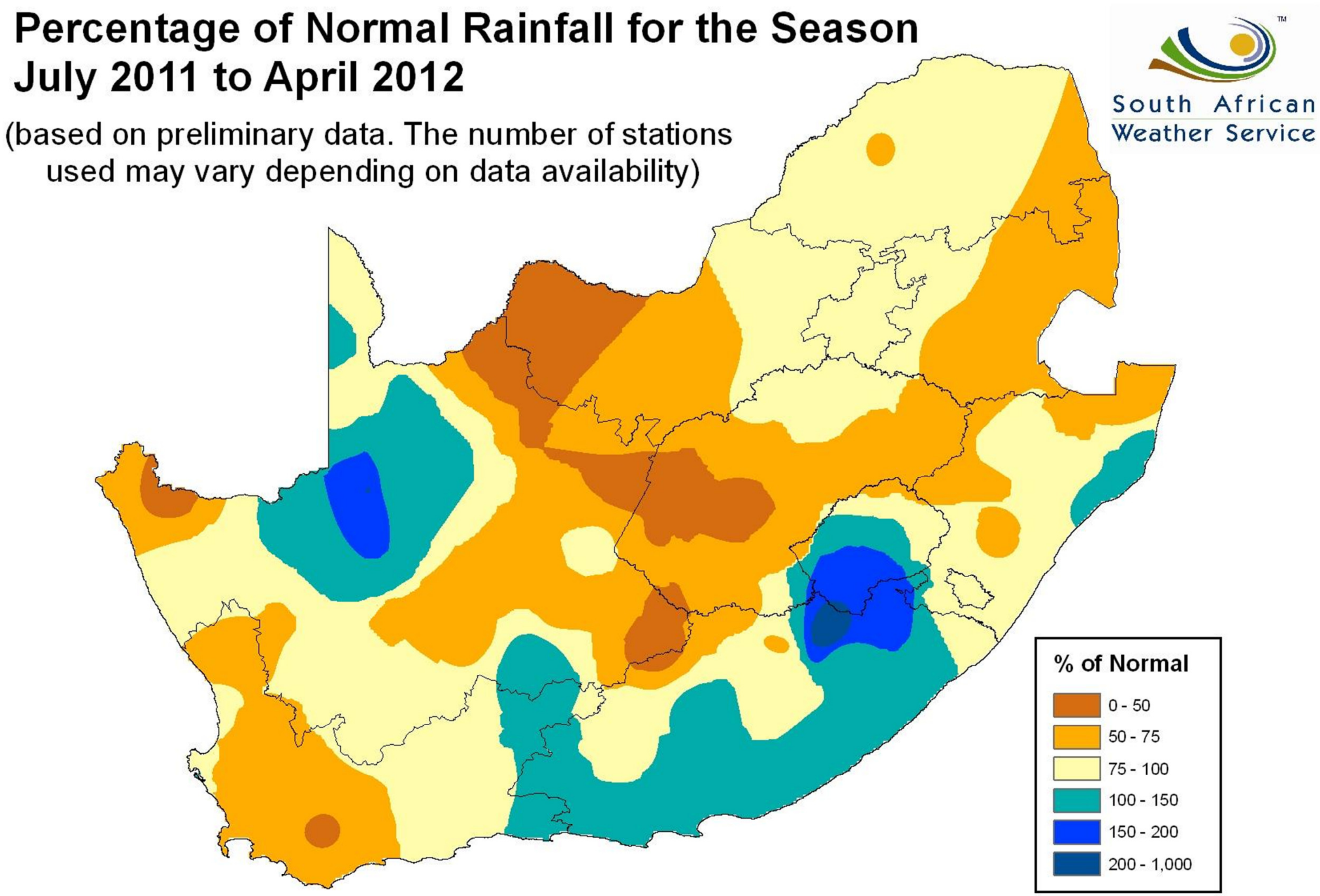

Percentage of Normal Rainfall for the Season
July 2011 to April 2012
(based on preliminary data. The number of stations used may vary depending on data availability)
South African Weather Service
% of Normal
0 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 1,000

FIGURE 6

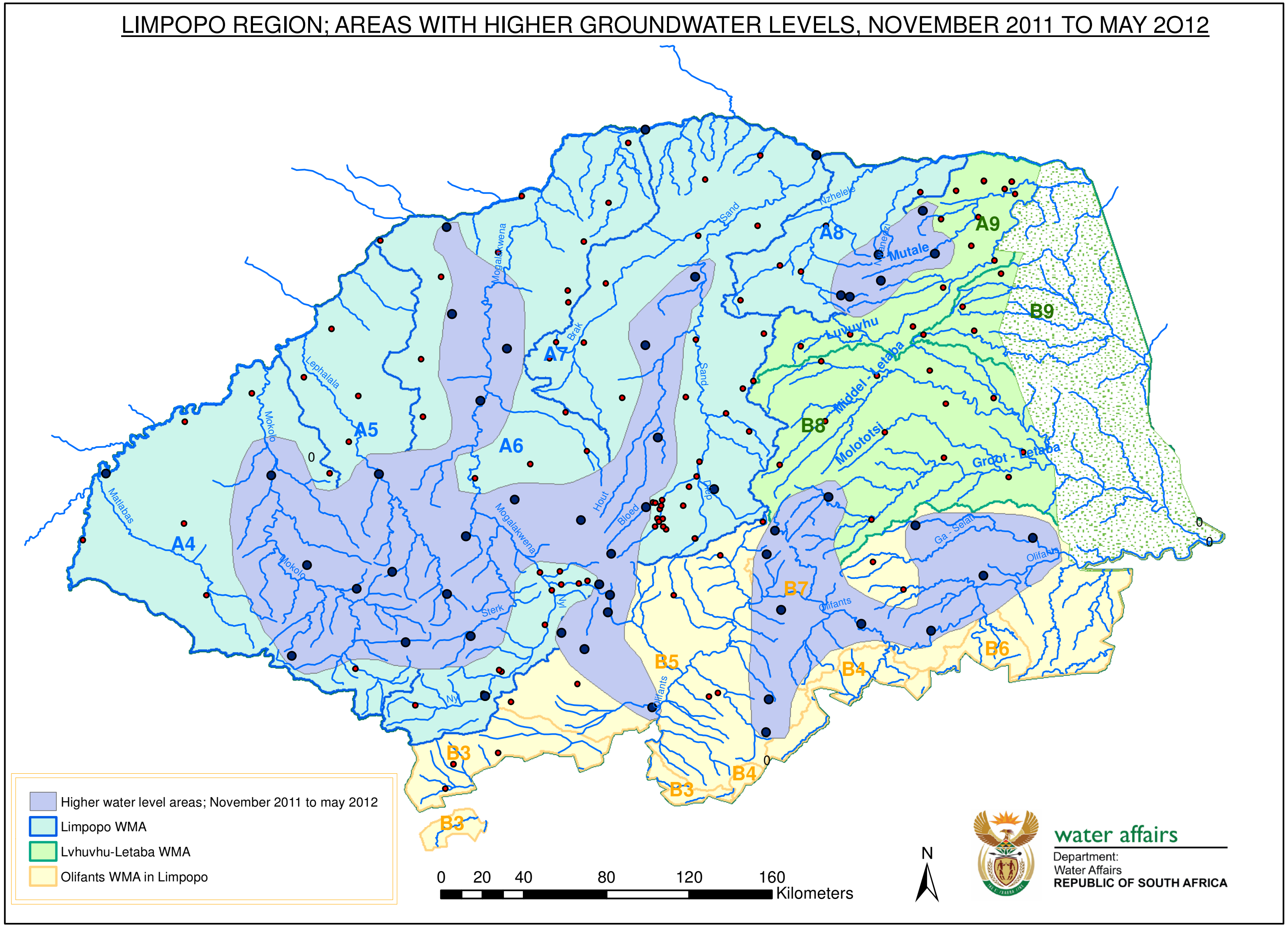

LIMPOPO REGION; AREAS WITH HIGHER GROUNDWATER LEVELS, NOVEMBER 2011 TO MAY 2O12
A4
A5
A6
A7
A8
A9
B3
B4
B5
B6
B7
B8
B9
Mutale
Luvuvhu
Middel - Letaba
Molototsi
Groot - Letaba
Ga - Selati
Olifants
Mogalakwena
Mokolo
Lephalala
Matlabas
Sand
Brak
Hout
Bloed
Sterk
Nzhelele
Higher water level areas; November 2011 to may 2012
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
0 20 40 80 120 160
Kilometers
N
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 7

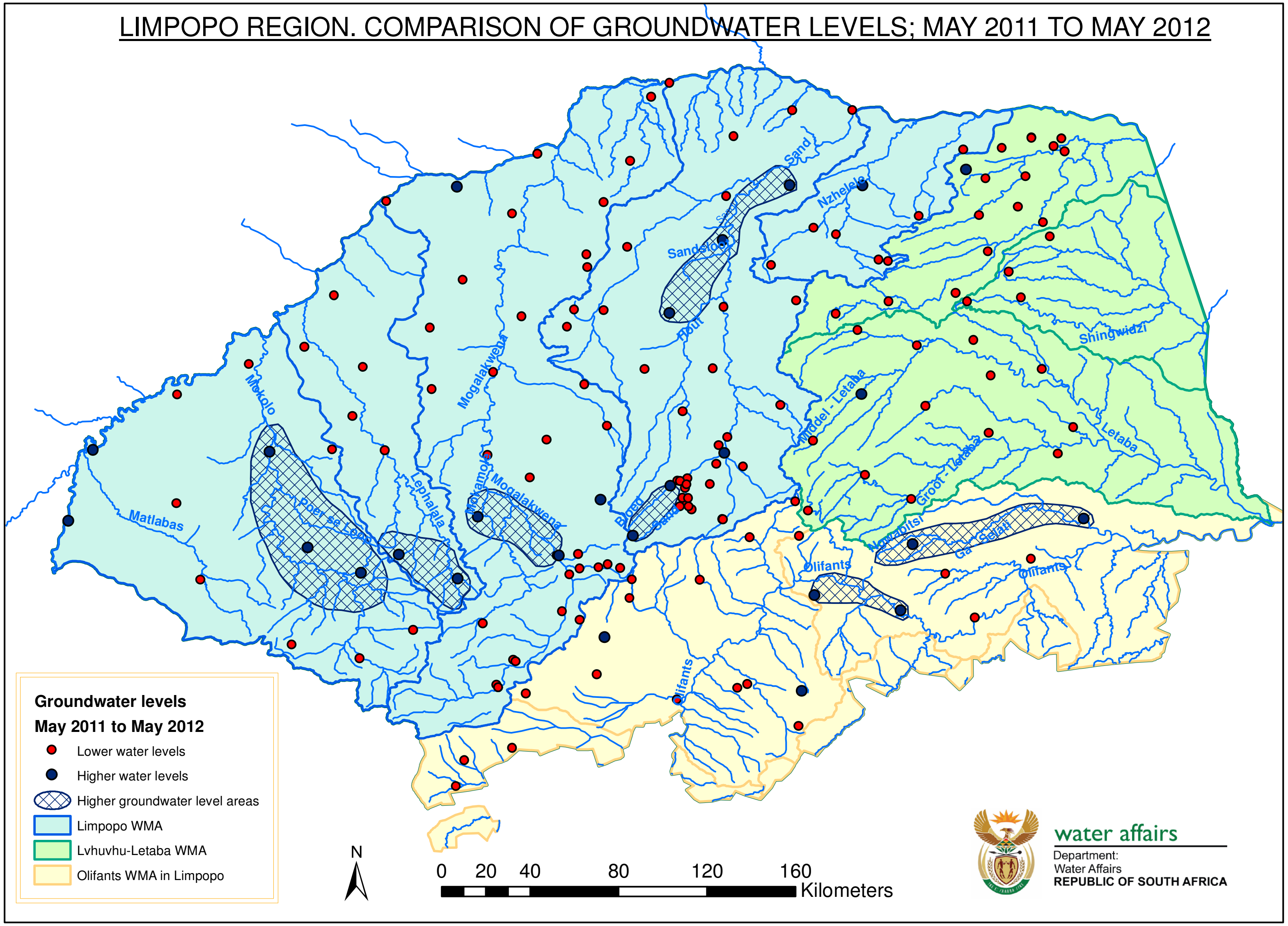
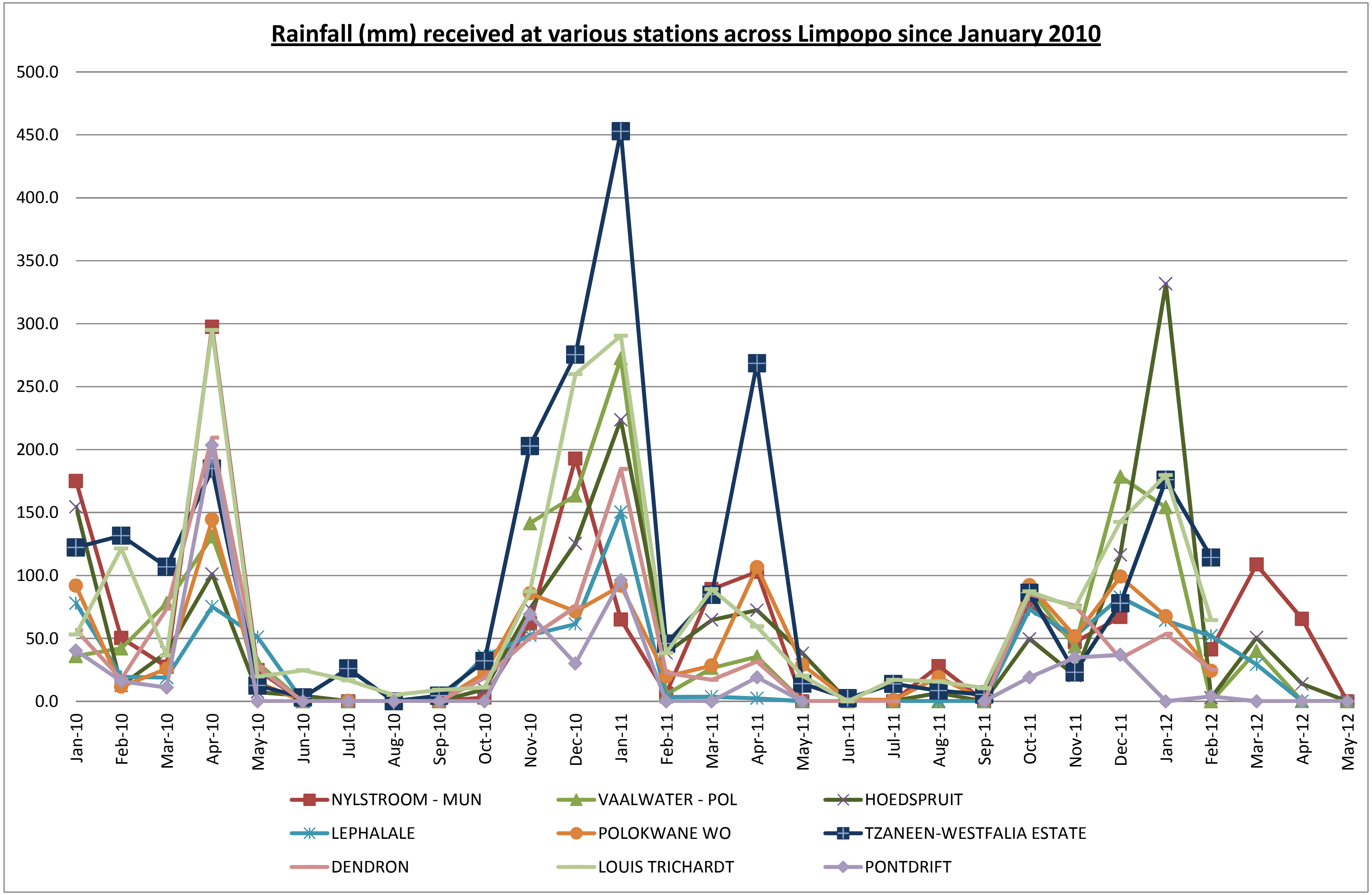
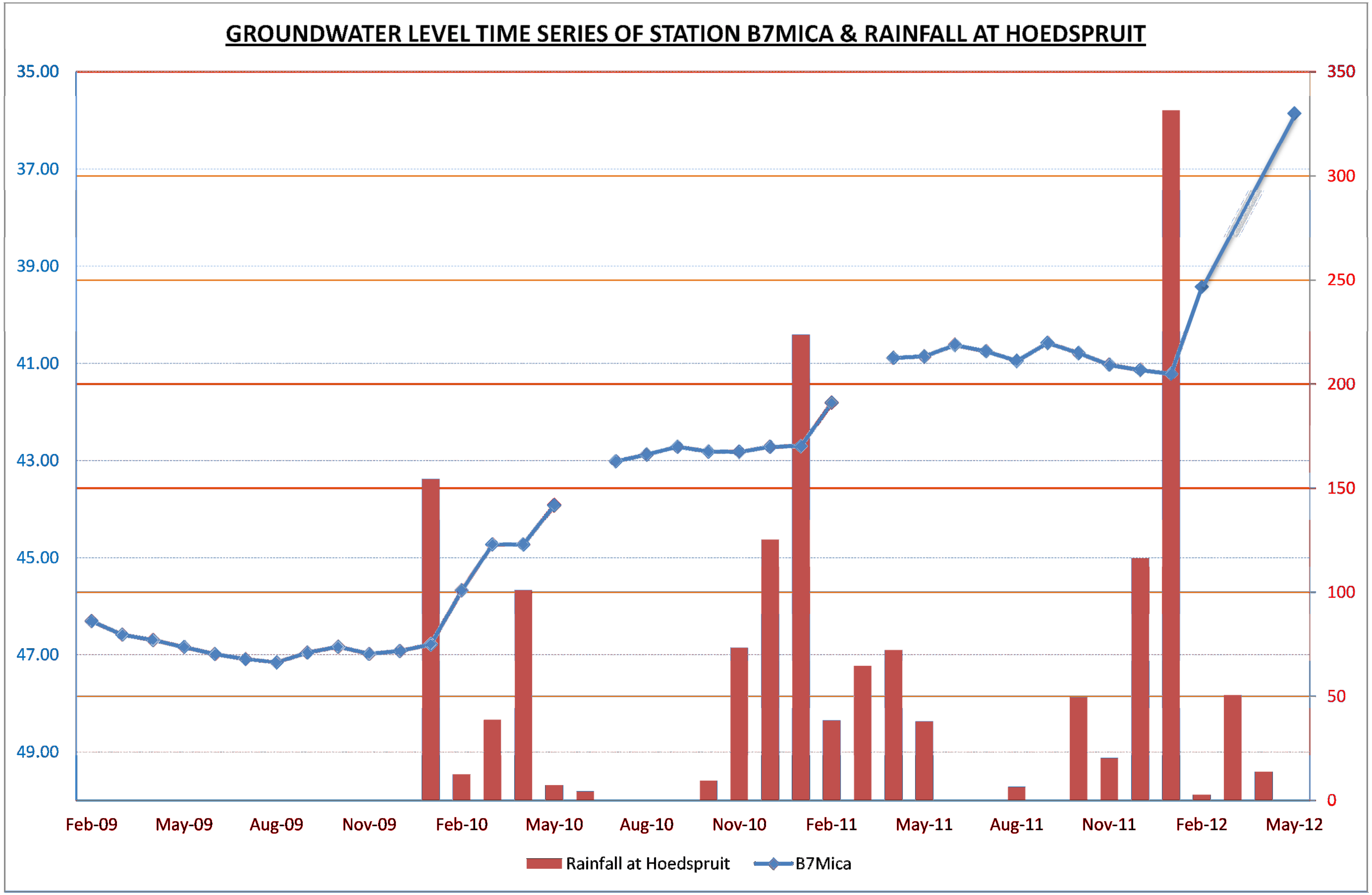

LIMPOPO REGION. COMPARISON OF GROUNDWATER LEVELS; MAY 2011 TO MAY 2012
Groundwater levels
May 2011 to May 2012
Lower water levels
Higher water levels
Higher groundwater level areas
Limpopo WMA
Lvhuvhu-Letaba WMA
Olifants WMA in Limpopo
N
0 20 40 80 120 160
Kilometers
Sand
Nzhelele
Sandsloot
Mogalakwena
Mokolo
Matlabas
Lephalala
Shingwidzi
Letaba
Olifants
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

FIGURE 8

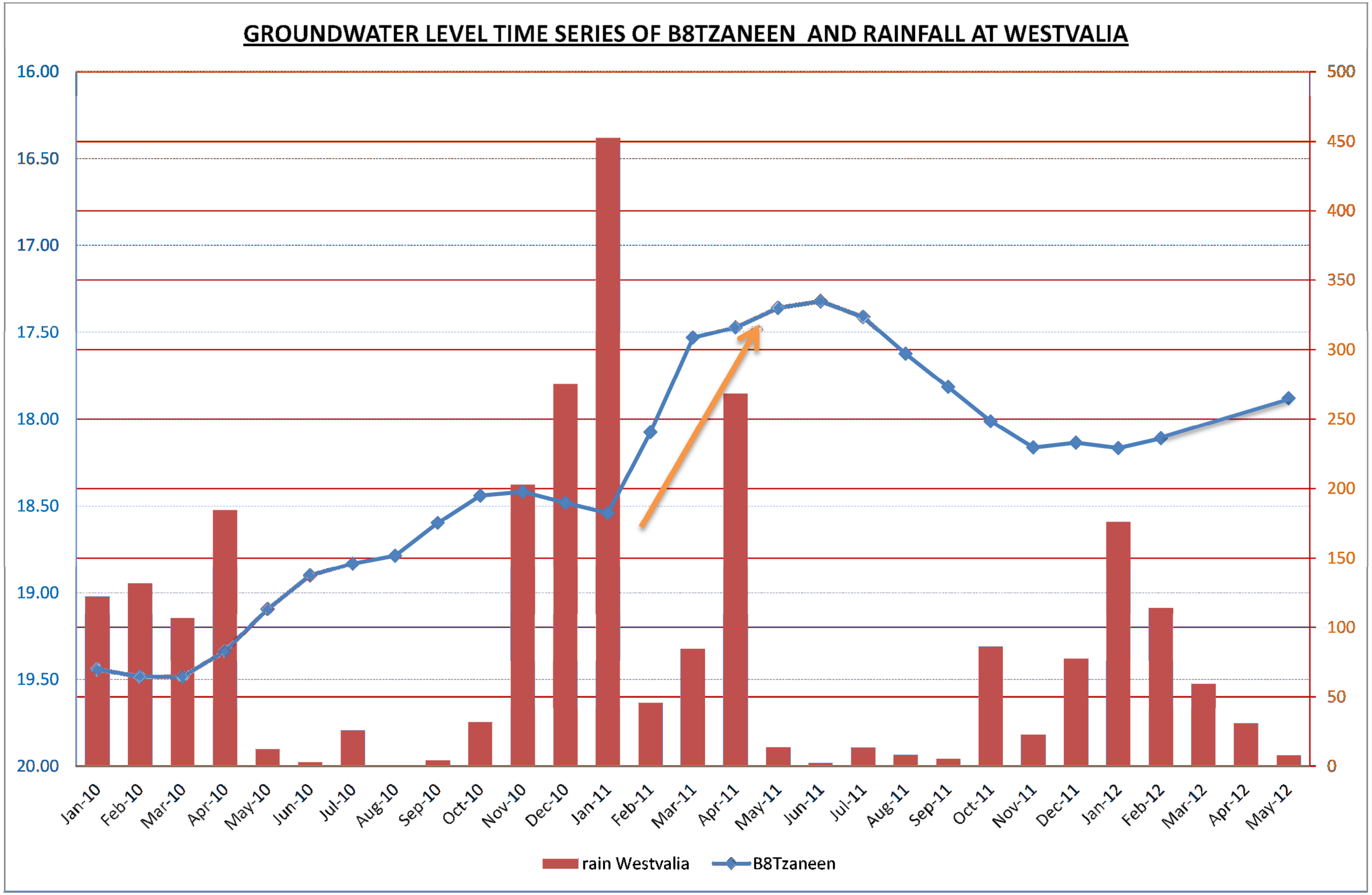

Rainfall (mm) received at various stations across Limpopo since January 2010
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
NYLSTROOM - MUN
VAALWATER - POL
HOEDSPRUIT
LEPHALALE
POLOKWANE WO
TZANEEN-WESTFALIA ESTATE
DENDRON
LOUIS TRICHARDT
PONTDRIFT

GRAPH 1

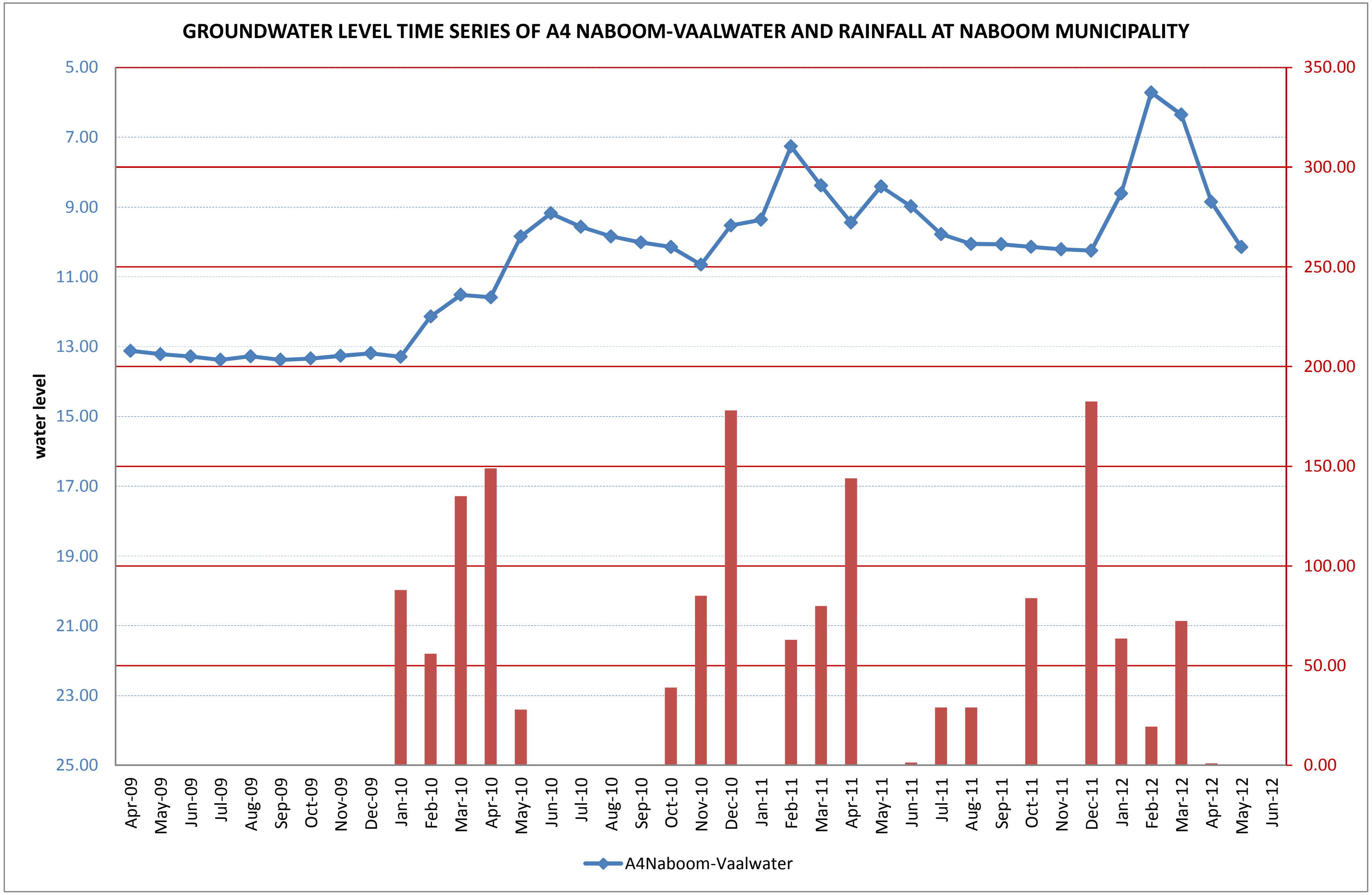


GROUNDWATER LEVEL TIME SERIES OF STATION B7MICA & RAINFALL AT HOEDSPRUIT
35.00
37.00
39.00
41.00
43.00
45.00
47.00
49.00
350
300
250
200
150
100
50
0
Feb-09
May-09
Aug-09
Nov-09
Feb-10
May-10
Aug-10
Nov-10
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Rainfall at Hoedspruit
B7Mica

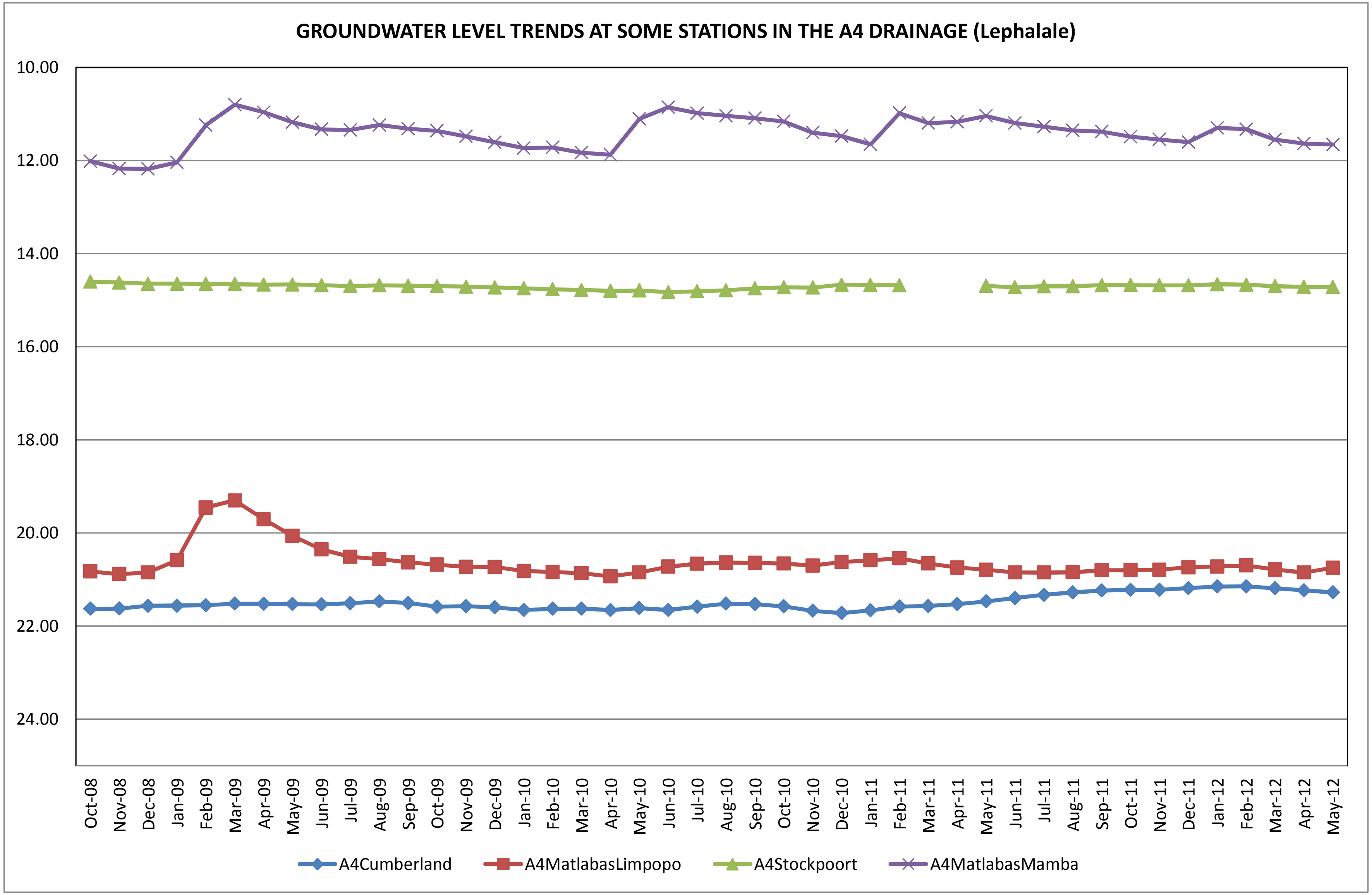
GRAPH 2


GROUNDWATER LEVEL TIME SERIES OF B8TZANEEN AND RAINFALL AT WESTVALIA
16.00
16.50
17.00
17.50
18.00
18.50
19.00
19.50
20.00
500
450
400
350
300
250
200
150
100
50
0
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
rain Westvalia
B8Tzaneen

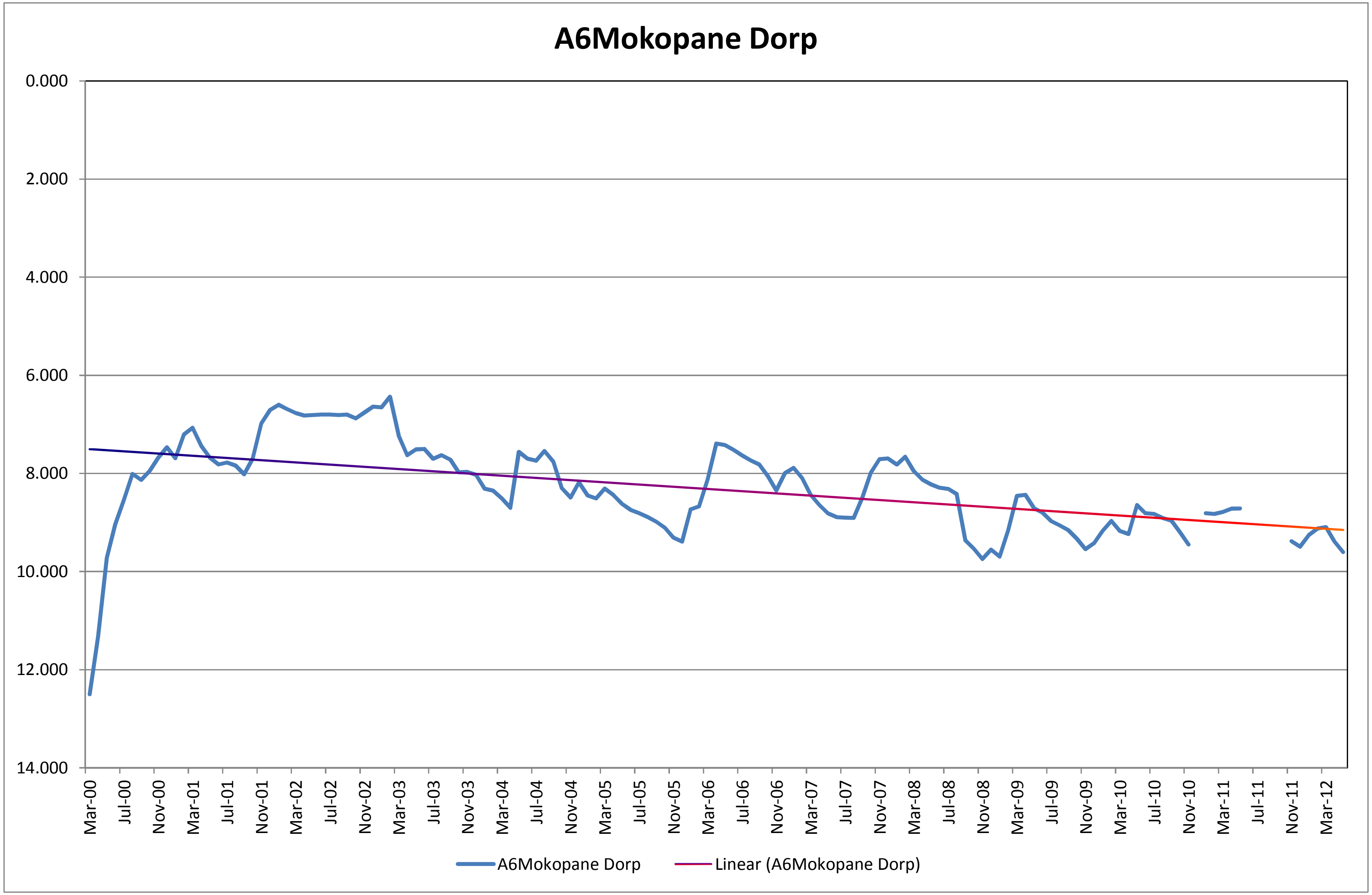
GRAPH 3


GROUNDWATER LEVEL TIME SERIES OF A4 NABOOM-VAALWATER AND RAINFALL AT NABOOM MUNICIPALITY
water level
5.00
7.00
9.00
11.00
13.00
15.00
17.00
19.00
21.00
23.00
25.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Apr-09
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
Jun-12
A4Naboom-Vaalwater

GRAPH 4

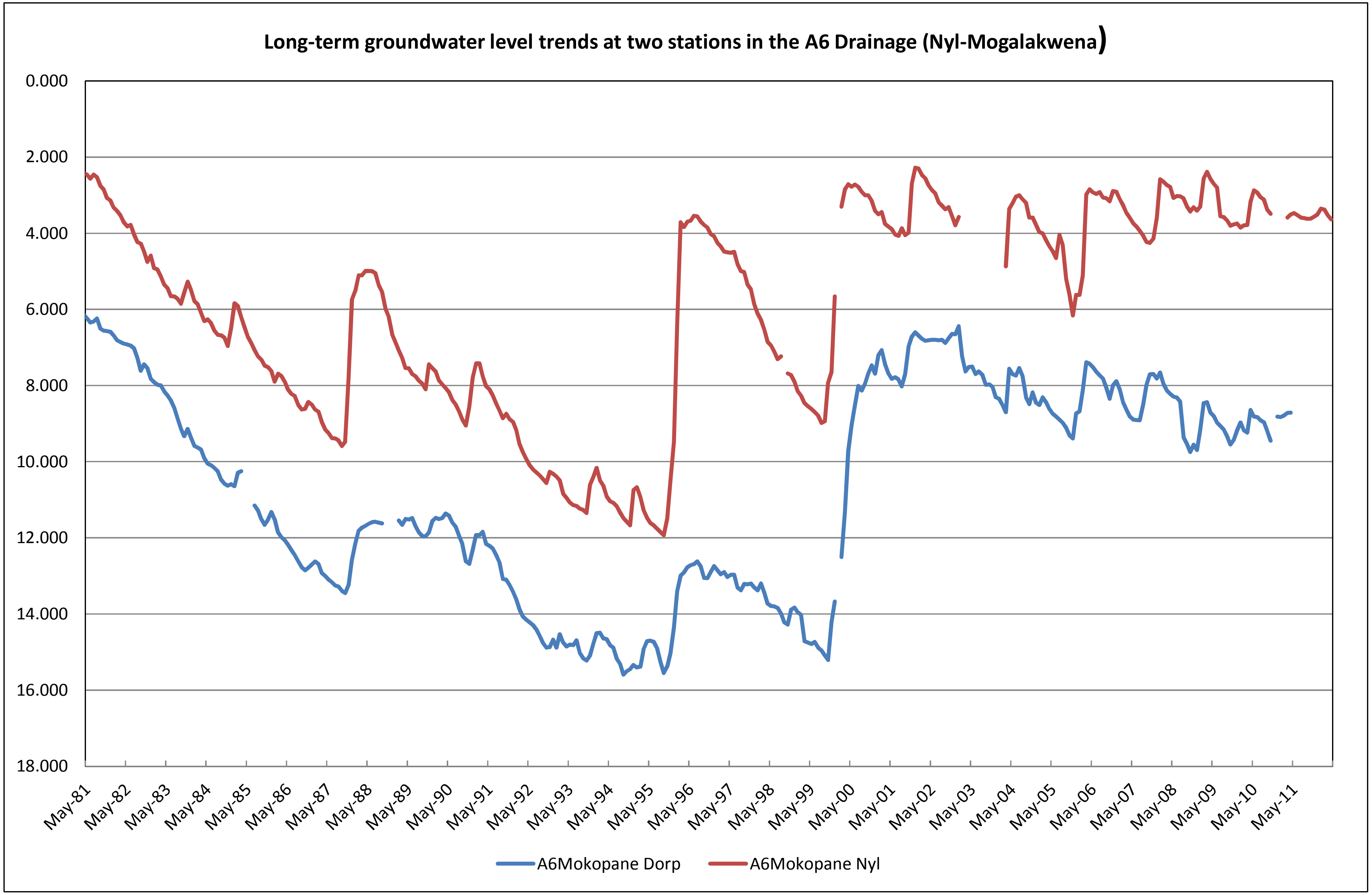

GROUNDWATER LEVEL TRENDS AT SOME STATIONS IN THE A4 DRAINAGE (Lephalale)
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Mar-09
Apr-09
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
A4Cumberland
A4MatlabasLimpopo
A4Stockpoort
A4MatlabasMamba

GRAPH 5

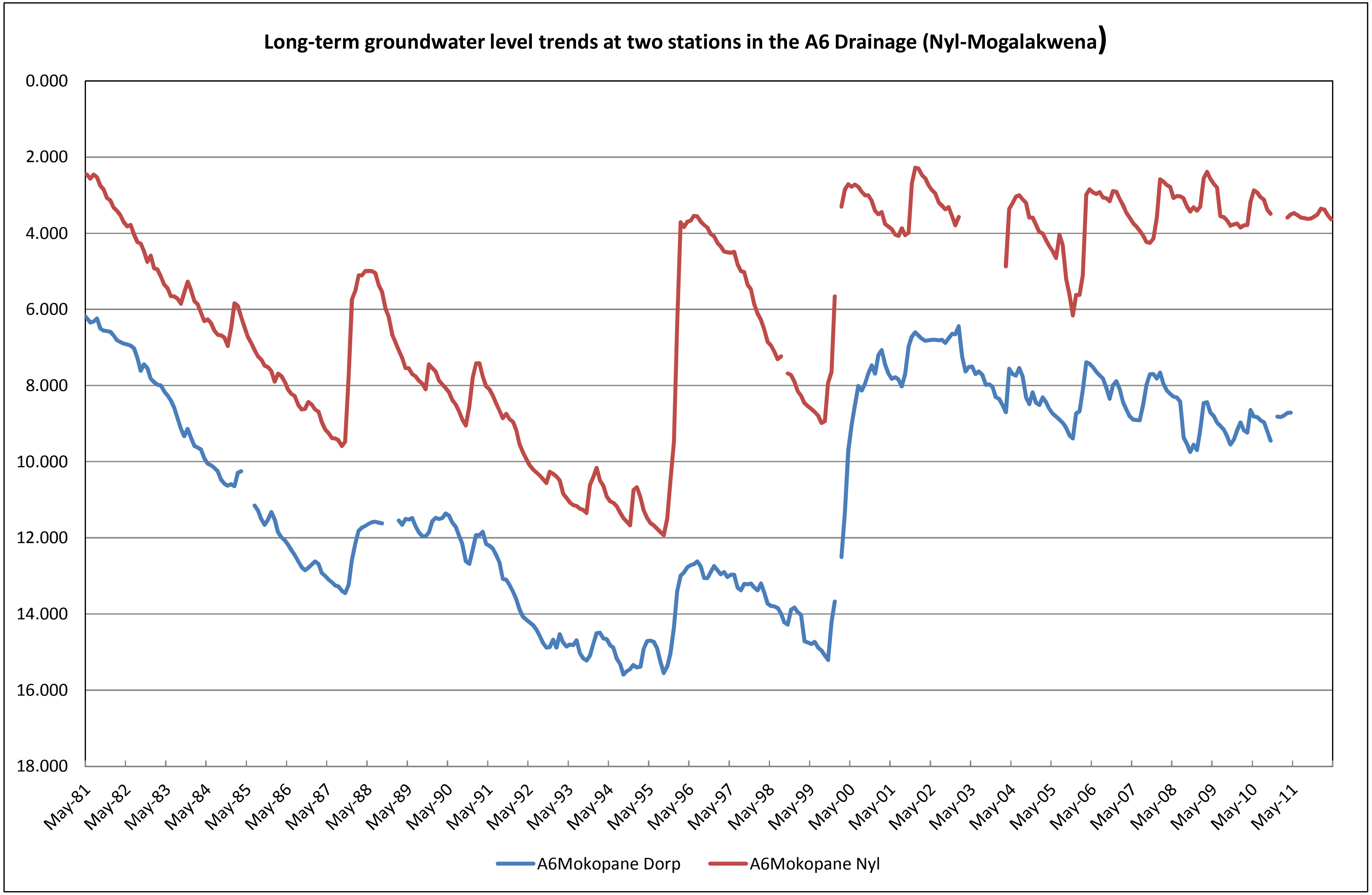


A6Mokopane Dorp
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Jul-08
Nov-08
Mar-09
Jul-09
Nov-09
Mar-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
A6Mokopane Dorp
Linear (A6Mokopane Dorp)

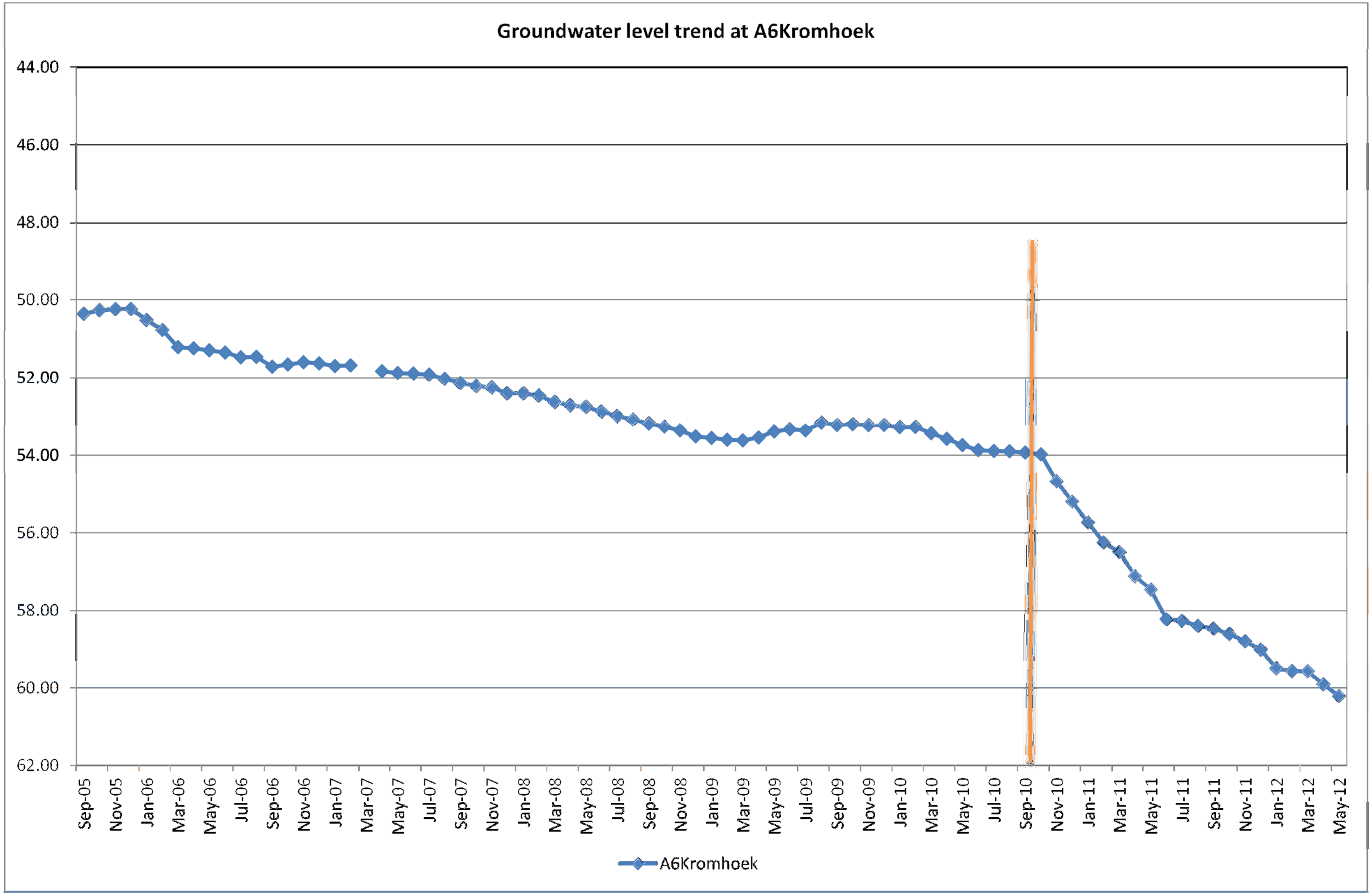
GRAPH 6


Long-term groundwater level trends at two stations in the A6 Drainage (Nyl-Mogalakwena)
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
16.000
18.000
May-81
May-82
May-83
May-84
May-85
May-86
May-87
May-88
May-89
May-90
May-91
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
A6Mokopane Dorp
A6Mokopane Nyl

GRAPH 7


Long-term groundwater level trends at two stations in the A6 Drainage (Nyl-Mogalakwena)
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
16.000
18.000
May-81
May-82
May-83
May-84
May-85
May-86
May-87
May-88
May-89
May-90
May-91
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
A6Mokopane Dorp
A6Mokopane Nyl

GRAPH 8



Groundwater level trend at A6Kromhoek
44.00
46.00
48.00
50.00
52.00
54.00
56.00
58.00
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A6Kromhoek

GRAPH 9