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Groundwater level status assessment for the Hydrogeological regions of the Western Cape, Northern Cape and Free State Provinces

-Volume 2-

REPORT STATUS

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2026/03/17

Date:

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1. Introduction

The Department of Water and Sanitation is mandated to protect develop and conserve water resources of the country. This is acknowledged by the National Water Act (Act 36 of 1998). The act further states that monitoring of the water resources is required and further outlines the number of required monitoring programmes to be established are outlined. Groundwater resources form part of these monitoring programmes to be established. Strides have been made over the years with monitoring of groundwater resources for the country, with datasets (albeit having monitoring gaps) dating back more than 40years. Several information products which are the conversion of these datasets into information have been produced, aiding the public, the scholars and groundwater consultants with understanding of basic groundwater information (quality and quantity) at national scale.

As with any data gathering programme, there will always be areas for development needed when it comes to analysis and interpretation of the datasets gathered to expand the audience benefiting from the information. This starts with internal stakeholders (whom are the data gatherers so that they get to understand the latest information about groundwater resources and where active effort on management is required. This report aims to interpret groundwater trends over identified periods to ascertain whether any active management efforts or interventions are required.

South Africa is subdivided into sixty-four (64) hydrogeological regions, which define the groundwater units based on unique hydrogeological characteristics. These have been utilized to interpret the groundwater datasets. They crosscut the catchment and provincial boundaries, as geology or groundwater knows no catchment of provincial boundaries. These hydrogeological units, however, give a better understanding of the groundwater performance for those regions.

1.1 Report Objectives

The object of this report is to outline both the historic and the latest groundwater trends, give status quo of national groundwater resources and zoom-in into areas where impacts are observed, discuss them further and offer recommendations on management steps to take. Its primary focus is to alert the management to imminent impacts that might affect groundwater resources. This is in line with the mandate of protection of water resources.

2. Methodology

The existing datasets from the groundwater database (the National Groundwater Archive) were extracted with the purpose of analyzing water level trends of the monitoring boreholes from the various hydrogeological regions alluded to earlier. The processing of datasets was primarily done on MS Excel. The initial plan was to utilize data dating back to 2015. However, this was not possible with other hydrogeological regions. Some of the shortcomings included a delayed comprehensive monitoring programme which commenced recently. In some instances, the gaps were too big to close them using both the forward and backward data patching method that MS Excel offers. A summary of step by step into ensuring completeness and accuracy of datasets involved:

- Assessing the data gaps and how best they could be closed.
- Gap closure/ data patching utilizing the forecasting method to obtain consistent trends. This was limited to small gaps using linear regression to project future data points along a line that best fits the historical data.
- Data smoothing, utilizing the exponential method to define clearly the trends. This forecasting technique for time-series data assigns exponentially decreasing weights to past observations, placing more importance on recent data than older datasets. The utilized statistical formula is as follows:

  $s(t) = \alpha x(t) + (1-\alpha)st-1$

  Where:

  $s(t)$ is the smoothed value (or forecast) for the current period.

  α is the smoothing factor.

  $x(t)$ is the actual observed value for the current period.

  $st-1$ is the smoothed value (or forecast) from the previous period.

Subsequently, hydrographs could be generated. The water level elevations were chosen as these have a better-defined reference point i.e. the mean sea level. These hydrographs were coupled with zoom-in analysis of level fluctuations, setting the initial water level where dataset starts (as the reference point) to determine the gains or losses, indicated as a declining or a rising trend, over the assessment period.

Because the emphasis was on hydrogeological regions, the individual borehole trends were aggregated and an average water level trend for the hydrogeological region was determined using the formula:

$Average\ GWL = \sum (GWL\ of\ individual\ wells) / Number\ of\ wells$

This allowed for determination of the groundwater level trends with reference to the selected background point, determining whether there is a general water level decline or a rise and how steep or gradual it is.

3. The results

The results outline the outcomes of the water level assessments conducted for the hydrogeological regions in the provinces of the Western Cape, The Northern Cape and the Free State. Thirty-eight hydrogeological regions make up the three provinces mentioned above. The extent and coverage of these hydrogeological regions is shown in Figure 1.

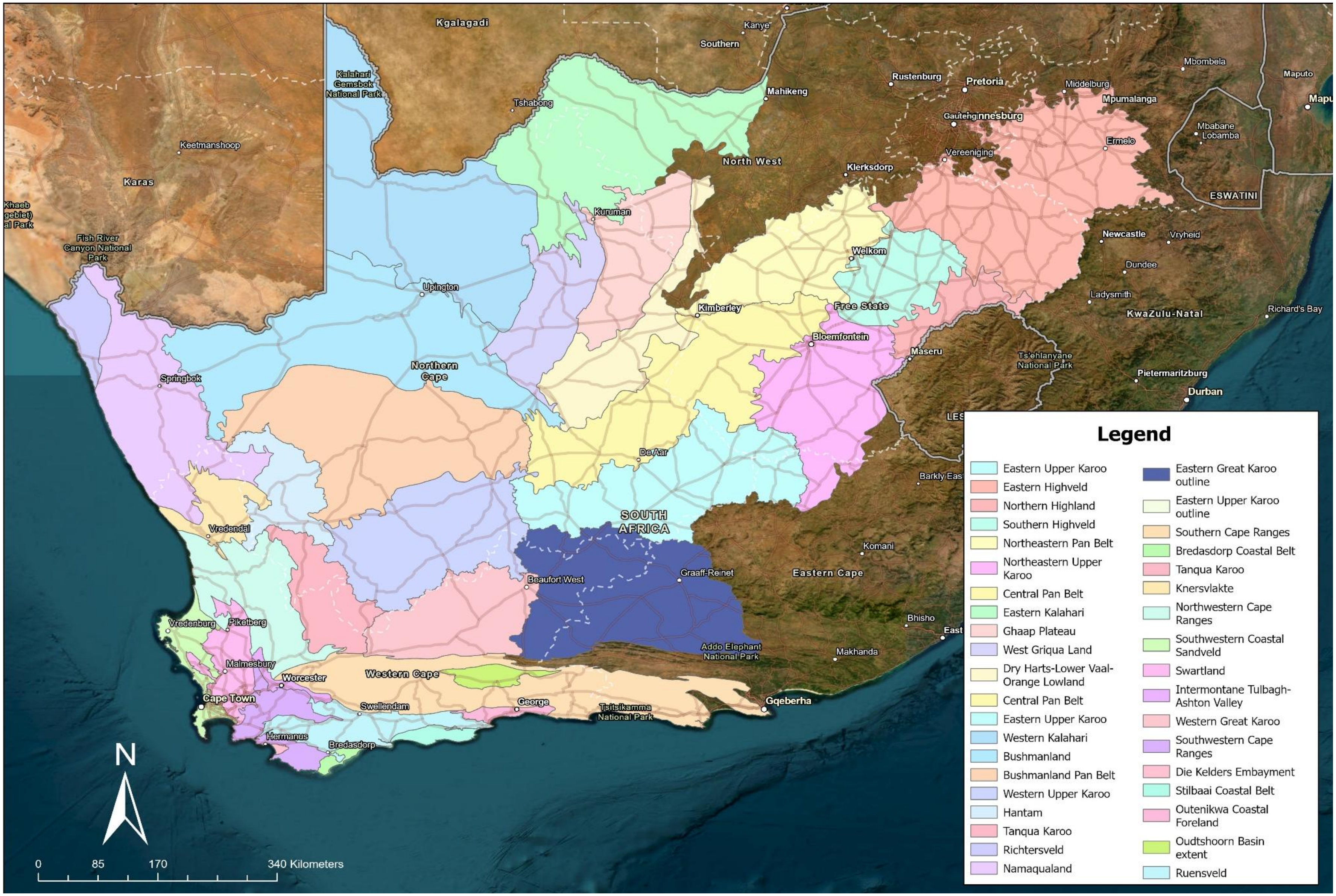


Figure 1: Hydrogeological region for the Western Cape, Northern Cape and Free State Provinces

3.1 The Oudtshoorn Basin Hydrogeological Region

The Oudtshoorn Basin lies on the southern extremity of South Africa, with its extent stretching to Zaor in the west, while the eastern, northern and southern borders are represented by the small towns of De Rust, Prince Albert and Volmoed respectively (Figure 2). The region is bounded by the Southern Cape Ranges to its north and south. Arterial routes such N12 and R62 traverse this tourism and agriculture dominated area.

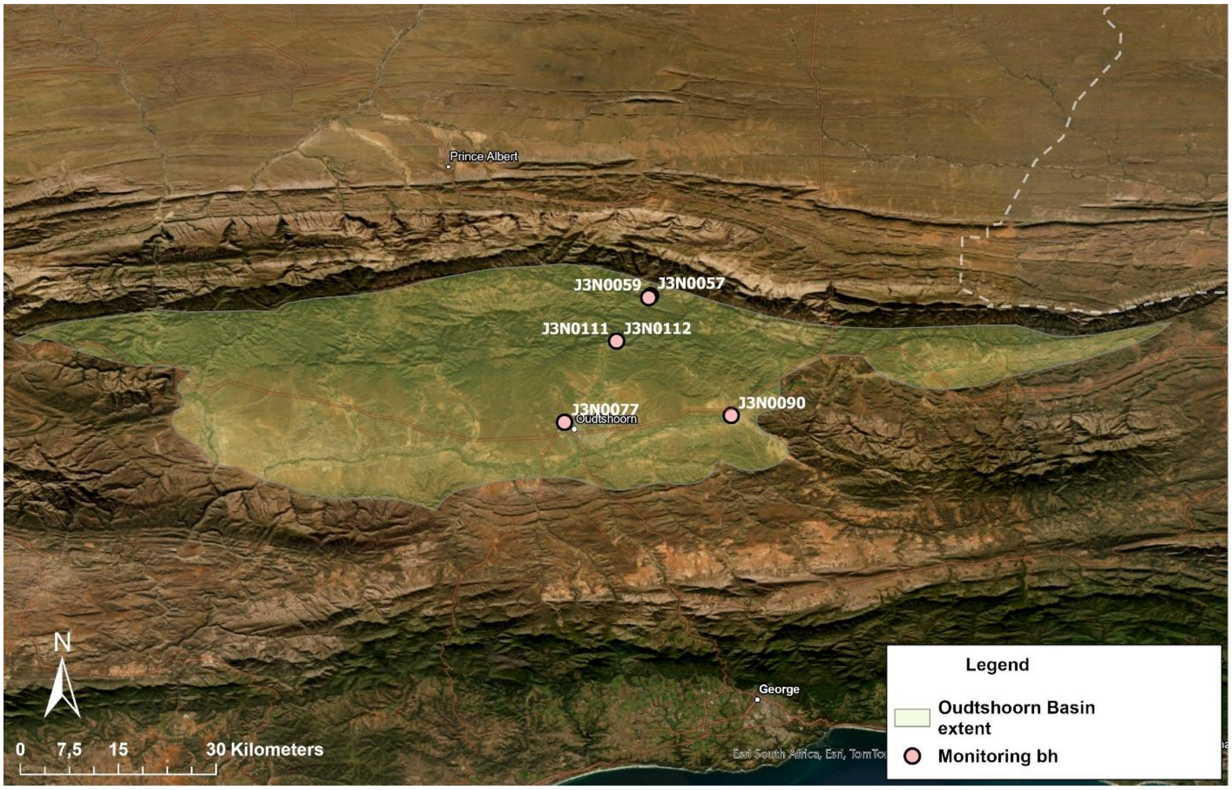


Figure 2: The extent of the Oudtshoorn Basin and its monitoring boreholes

Rainfall

Figure 3 indicates the rainfall records for the Oudtshoorn Basin logged between 2015 and 2025. According to the graph, the area has experienced fluctuation in rainfall, with lowest records recorded between late 2016 and 2017. Since 2021, high rainfall records have been noted for the region. These would significantly contribute to recharge of groundwater.

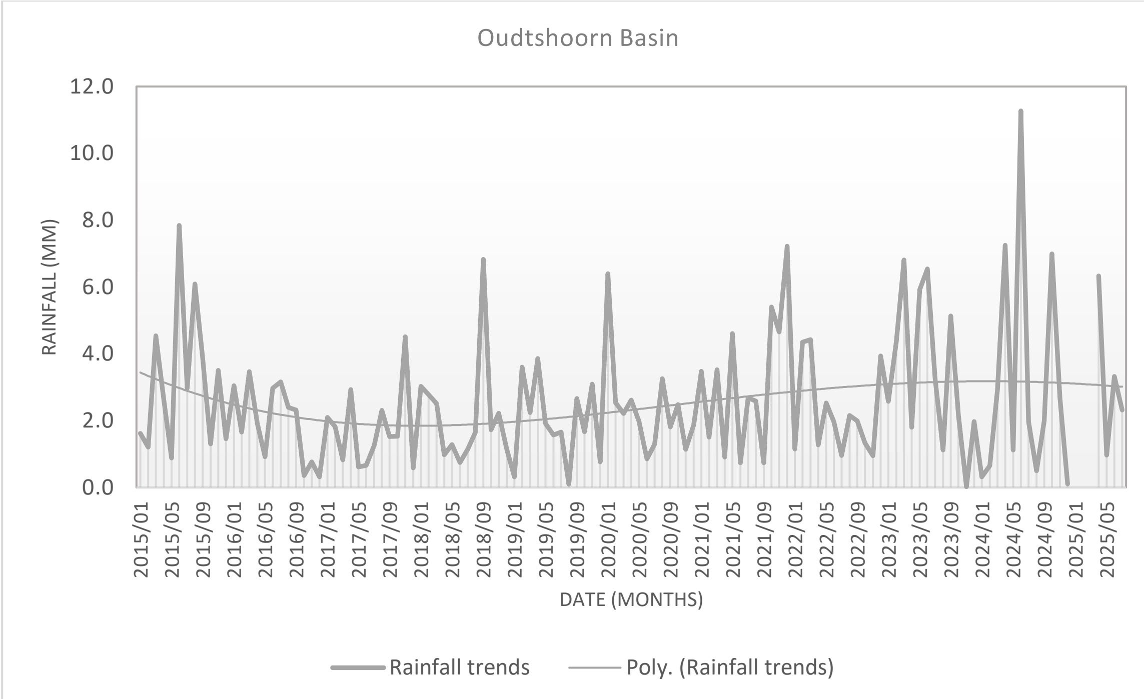


Figure 3: Monthly rainfall trends for the Oudtshoorn Basin

Water level assessment

According to monitoring boreholes existing in the basin, the basin isn't well represented. About six boreholes exist for monitoring and are located slightly central to the eastern side of the Oudtshoorn Basin. There is no representation to the far east and western side. Nevertheless, the groundwater level assessment was still conducted. An upward Groundwater level drawdown has been recorded over the observation period marking a positive response to recharge. This has been noted in all the observed boreholes, except for borehole J3N0077 which started showing water level drawdown decline in 2017 (possibly related to localized dewatering), and later took an inflection point around February 2022 (Figure 4). Since this date a steady, yet gradual rise has been observed until equilibrium was reached in June 2024. Since then, horizontal trends have dominated this borehole, though still below what was initially recorded between 2016 and 2017.

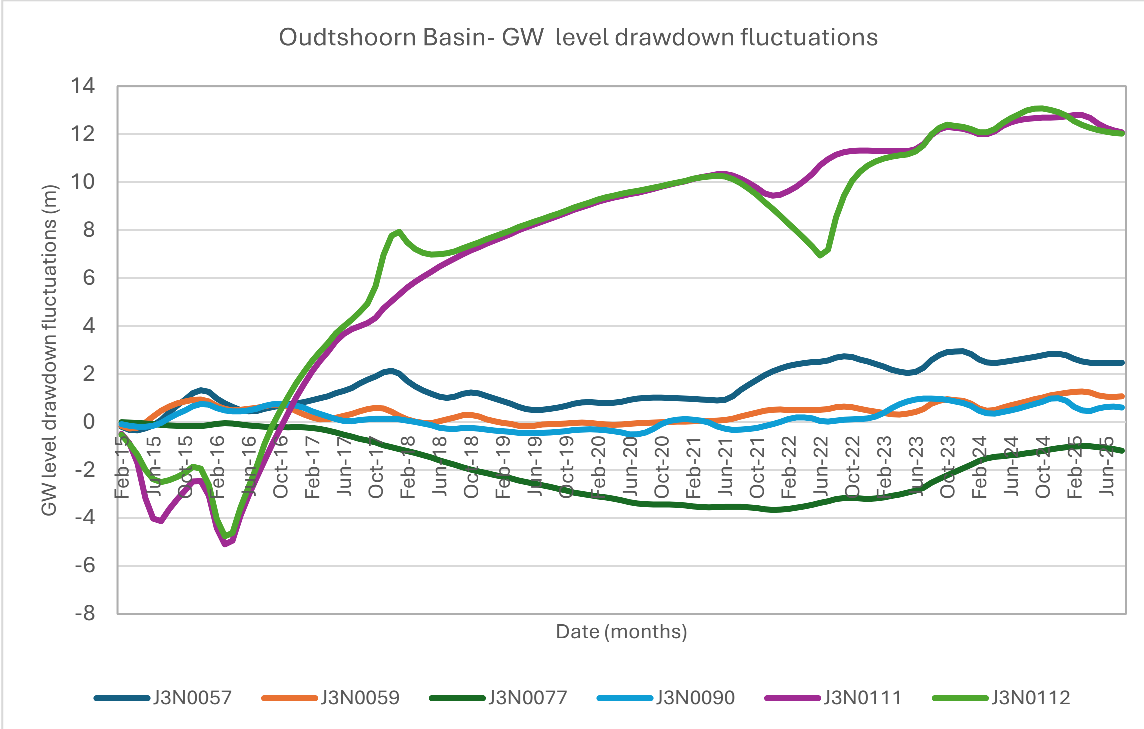


Figure 4: Groundwater level drawdown fluctuation trends for the boreholes in the Oudtshoorn Basin

Overall, the groundwater levels of the basin indicated an upward trend over the observation period indicating little to no impact on groundwater availability of the region (Figure 5).

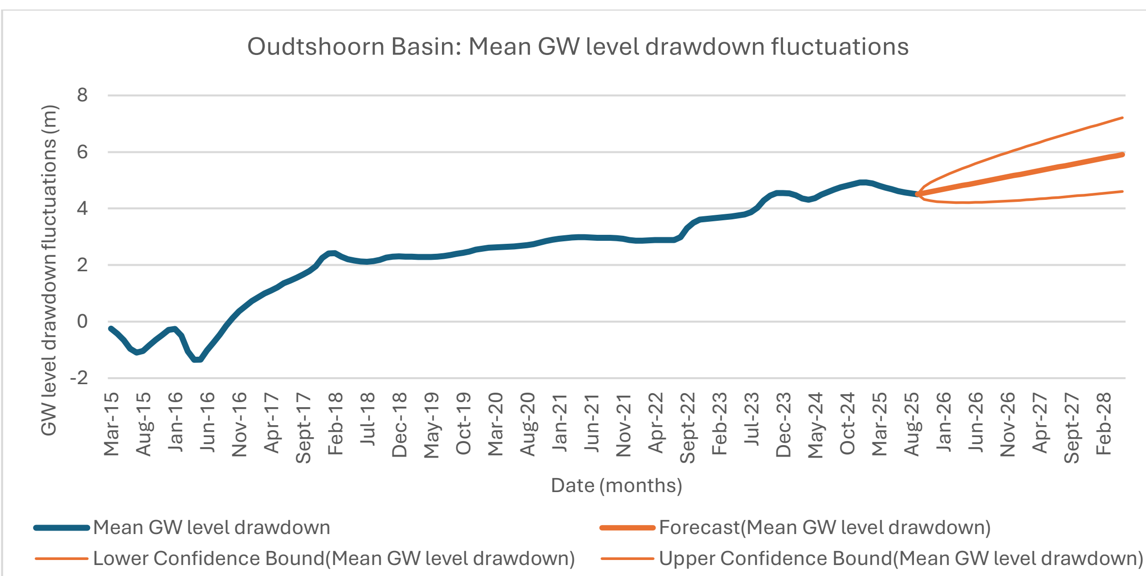


Figure 5: The mean groundwater level drawdown for the Oudtshoorn Basin

3.2 The Ruensveld Hydrogeological Region

The Ruensveld Hydrogeological Region lies on the coastal edge of the Southwestern Cape, with the eastern border formed by Mosselbay, Caledon to the west, Hermanus and Bredasdorp to the south and Swellendam and Montagu to the north (Figure 6). Generally, the upper/ northern reaches of this region are formed by the Southern Cape Ranges. Figure 6 indicates the extent of the hydrogeological region.

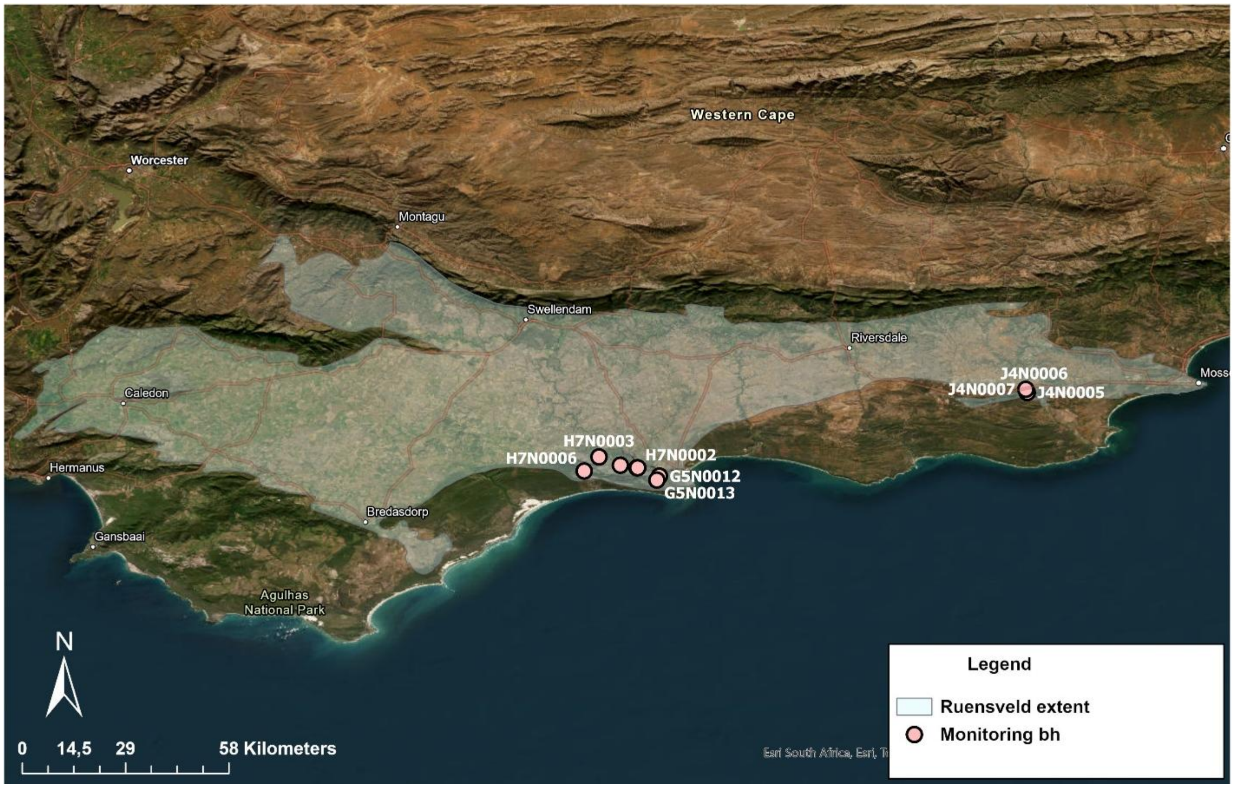


Figure 6: an extent and locality of the Ruensveld Hydrogeological region and its monitoring boreholes

Rainfall

The rainfall records for the Ruensveld Hydrogeological Region were obtained from SAWS District 7 rainfall station. The rainfall trends presented in Figure 7 indicated that since 2021 to date the region has been experiencing rainfall relatively above average. This is in comparison with the period between 2015 and 2020 where on average 25mm of monthly rain was observed.

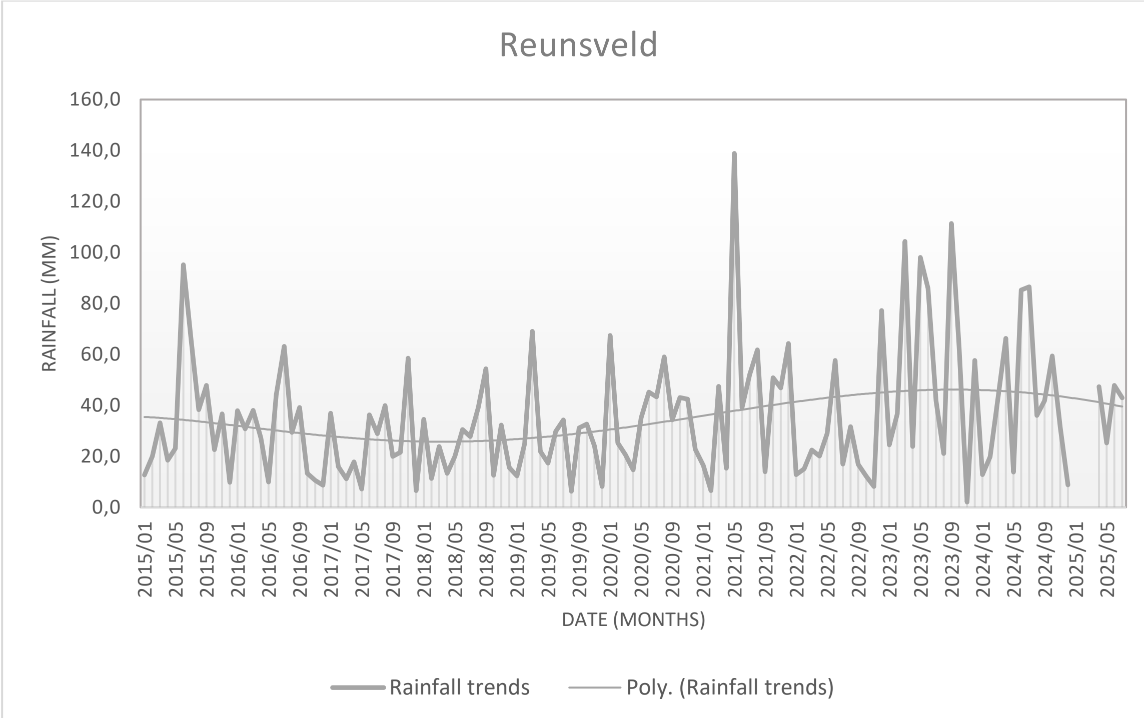


Figure 7: Rainfall trends for the Ruensveld hydrogiological region.

Water level assessment

About nine (9) boreholes are used for monitoring groundwater in the Ruensveld hydrogeological region. These boreholes are clustered on the central southern shore of the region and another cluster to the east (Figure 6). In essence, the entire region isn't well represented with monitoring boreholes. Nevertheless, the groundwater level drawdown from these boreholes responded to the rainfall patterns, indicating a decline from 2017 to August 2021, thereafter an upward trend was recorded (Figure 8). This upward trend responded more with the rains observed since 2023, allowing water level drawdown trends to recover back to the positive trends once seen prior to the decline in 2017. The latest trends reveal a gradual decline once again, however, still above the initial water levels. This is clearly shown in Figure 9 which represents the average groundwater level drawdown fluctuations for the region. The groundwater resource of this region has recovered optimally after a period of environmental stress and now is stabilizing.

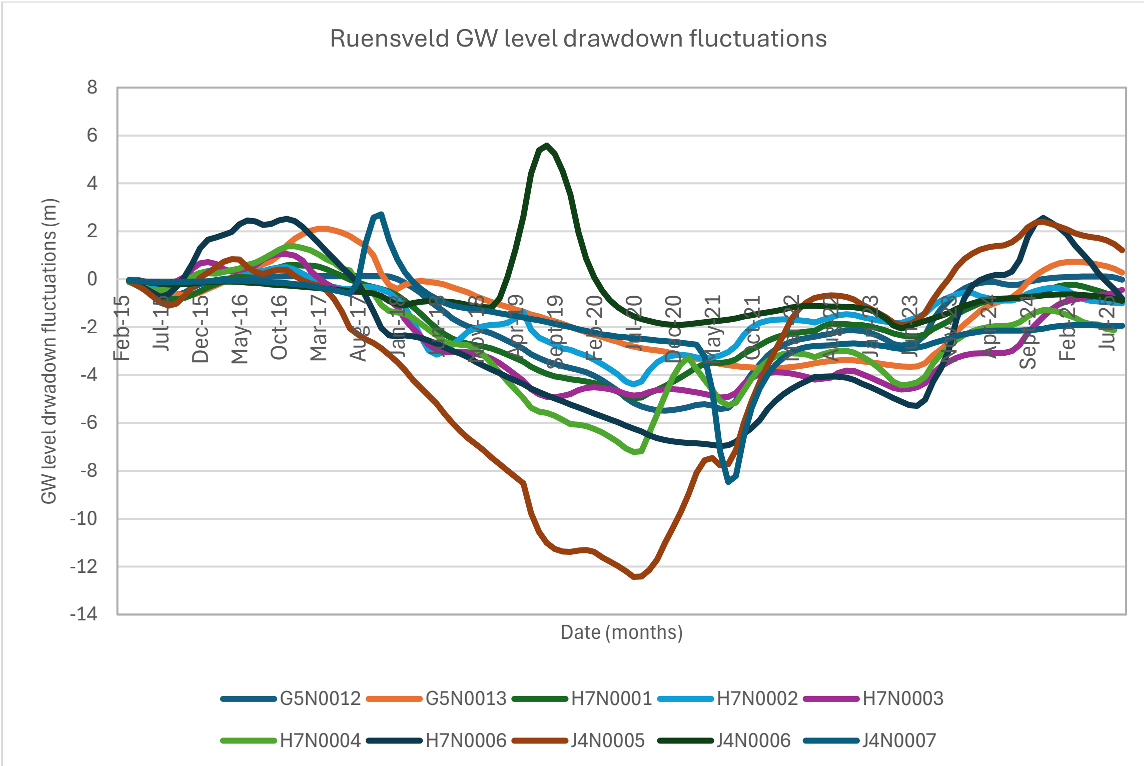


Figure 8: Groundwater level drawdown fluctuations trends for the Ruensveld boreholes

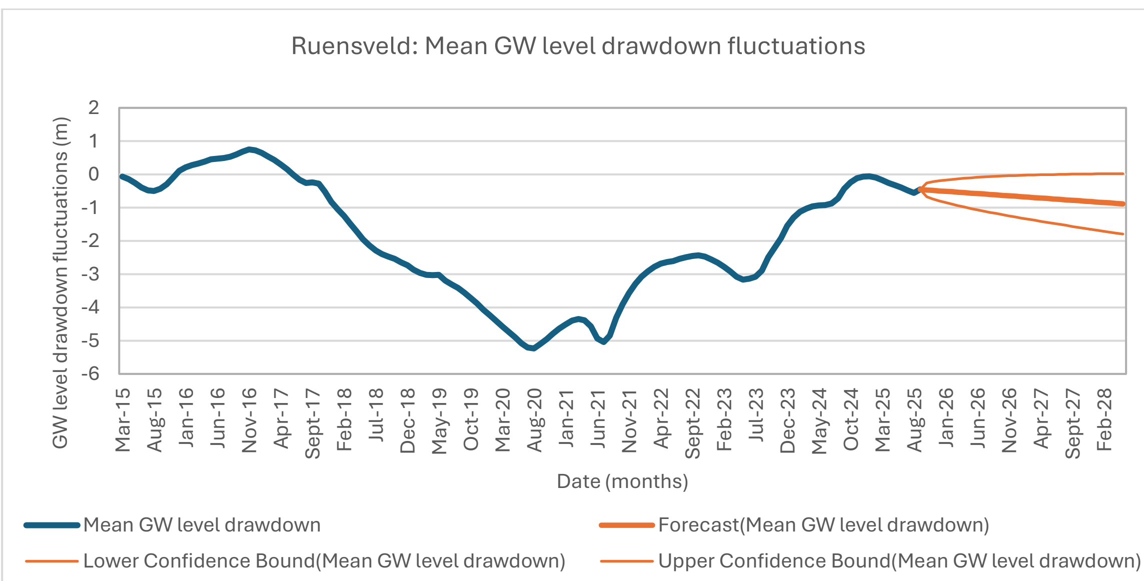


Figure 9: Maen groundwater level drawdown fluctuations for the Ruensveld Hydrogeological Region

3.3 The Outenikwa Coastal Foreland Hydrogeological Region

The Outenikwa Coastal Foreland Hydrogeological region lies between Sedgefield to the east, Herbertsdale to the west, and Mosselbay to the south. This region is underrepresented with groundwater monitoring. Only two boreholes are currently monitored (Figure 10). Therefore, no groundwater level assesment will be conducted due to limited available groundwater level dataset. Its groundwater monitoring progarmme needs to be expanded to fully represent the region.

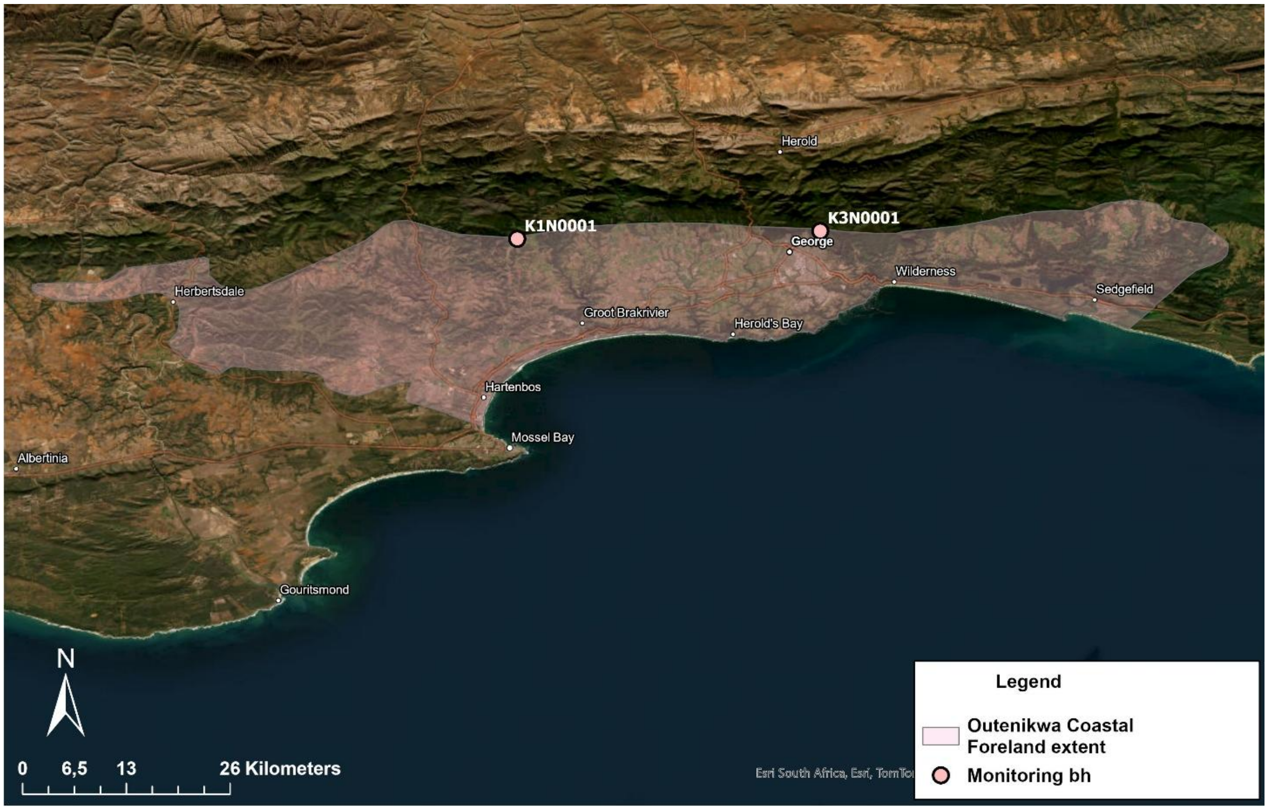


Figure 10: The extent of the Outenikwa Coastal Foreland Hydrogeological region and its boreholes

3.4 The Stillbaai Coastal Belt Hydrogeological Region

The Stillbaai Coastal Belt hydrogeological region lies on the southern coast slightly west of Mosselbay and stretches to the west where Witsand is located. To the north, the area is bordered by the town of Albertinia and its surroundings (Figure 11).

The groundwater monitoring is underrepresented for this region. Four boreholes which are clustered in one zone exist (Figure 11). These do not and cannot be used to represent the entire region. The monitoring network needs to be expanded across the region.

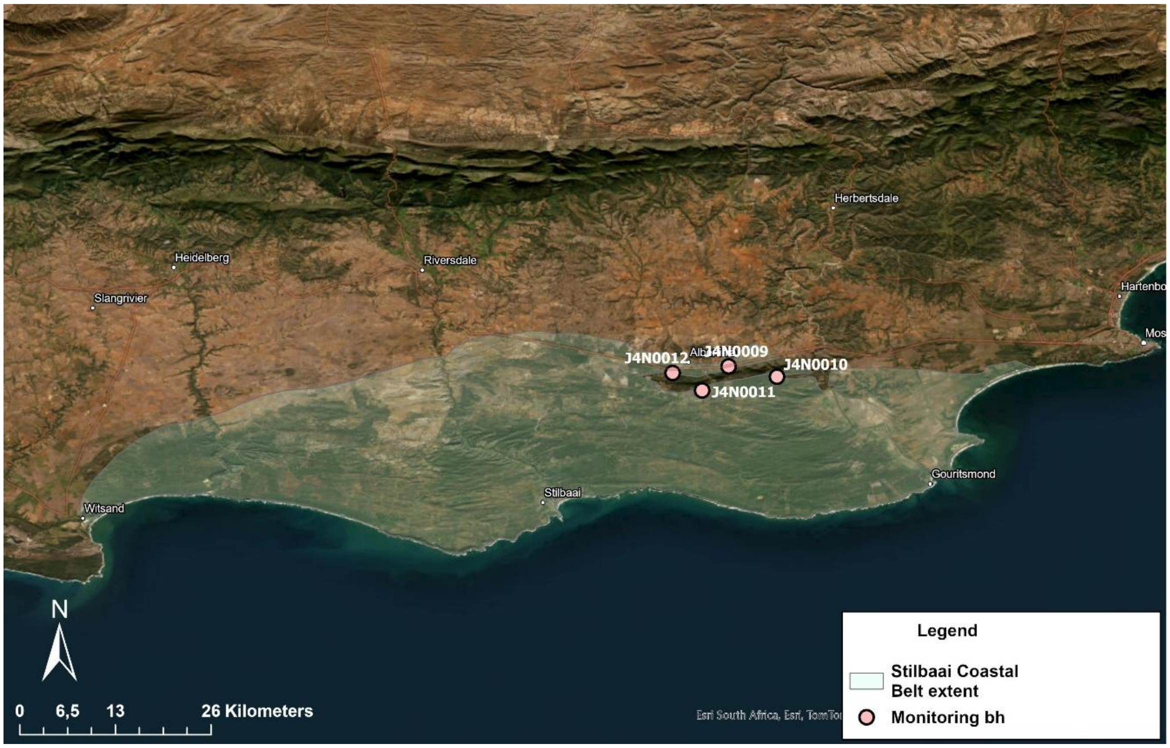


Figure 11: Stilbaai Coastal Belt Hydrogeological region and its boreholes

3.5 The Die Kelders Embayment Hydrogeological Region

The Die Kelders Embayment Hydrogeological Region lies on the west coast, northeast of Gansbaai. To the north it is represented by Stanford and its surroundings (Figure 12). The boreholes monitored for this region (also indicated in Figure 12) occupy the northern section, leaving no representation in the south. This calls for expansion of the monitoring programme so that a full representation can be achieved.

To assess the rainfall patterns for the region, the SAWS District 7 rainfall station was utilized (Figure 13). Generally, above average rainfall was observed between 2020 and 2025 compared to earlier years. Such rainfall periods would contribute positively to replenishment of aquifers. Figure 14 confirms so, as the water level drawdown fluctuations from the Die Kelders Embayment started taking an upward trend (in a fluctuating manner) from 2020 onwards. This holds true for all the observed boreholes except for G4N0008 which had taken a negative trend since October 2016 with fluctuating levels that suggest recovery till to date. This 2019 decline was also noted in G4N0004, but within a year period, a recovery was observed, with its water level drawdown bouncing back to positive levels before a subsequent decline, stabilizing below the initial level till to date was observed. The water level decline in these two boreholes is attributed to anthropogenic factors as the dataset suggests strong negative fluctuations even during periods of good rains. These fluctuations were observed with average water level drawdown for the region, though a positive trajectory is prominent, (Figure 15), suggesting no imminent impacts to the groundwater resource of the region.

Figure 12: The Die Kelders Embayment hydrogeological region and its monitoring boreholes

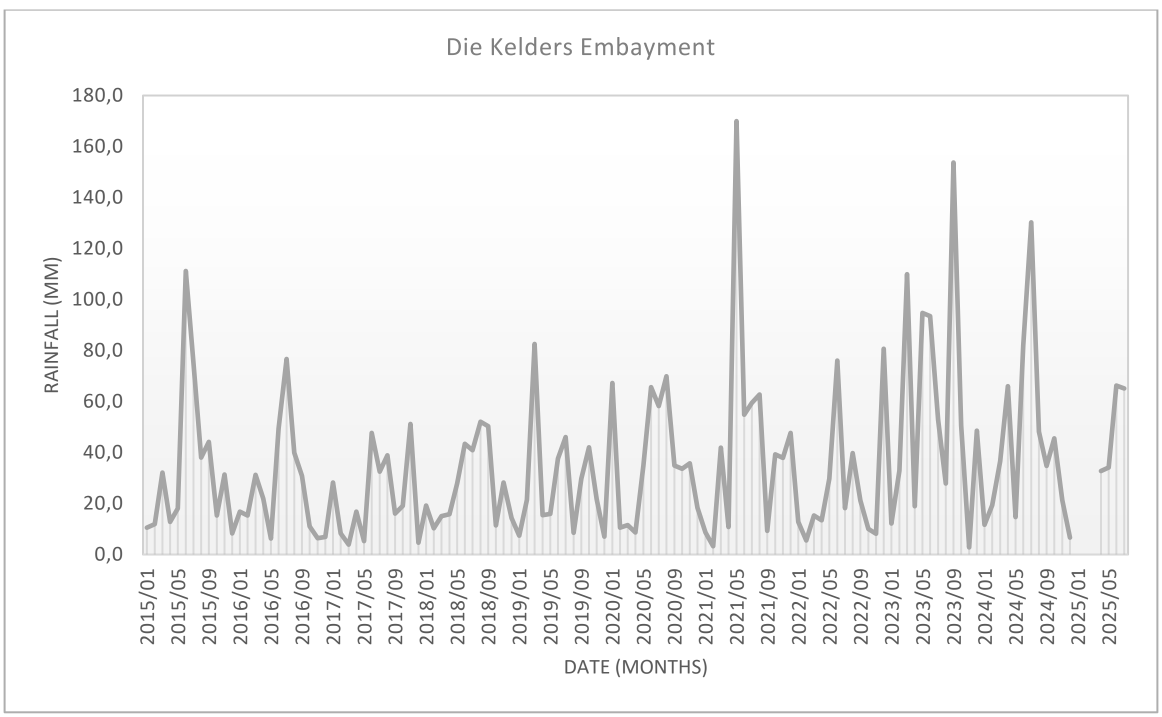


Figure 13: 10yr monthly rainfall trends for the Die Kelders Embayment hydrogeological region

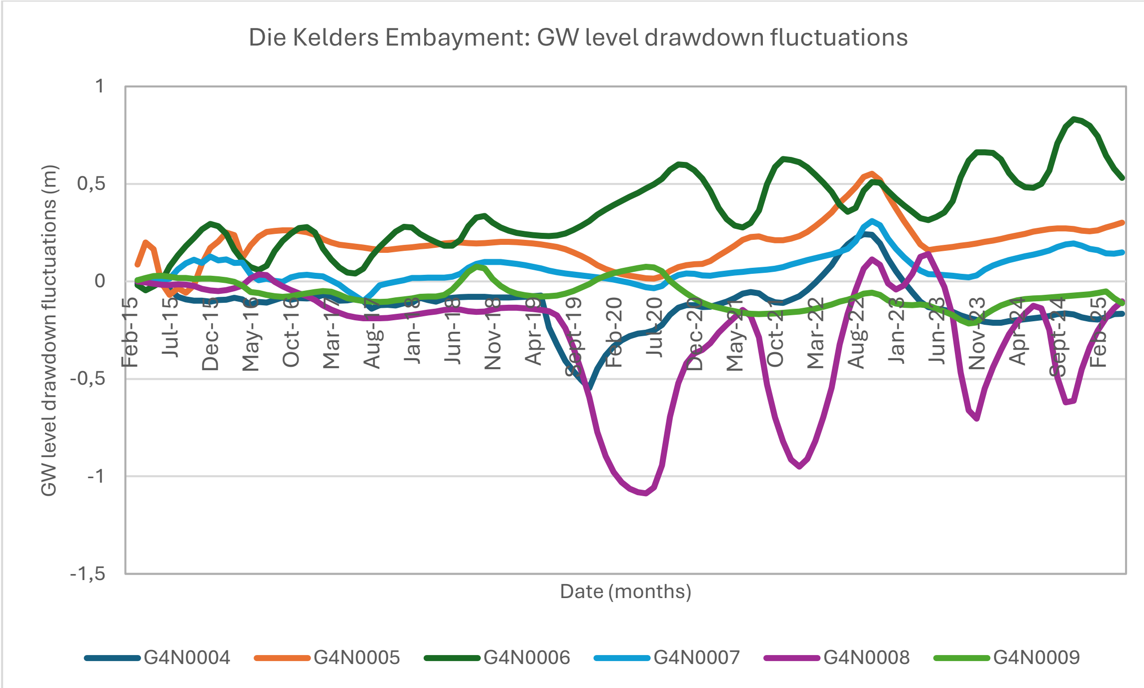


Figure 14: Groundwater level drawdown fluctuations for the Die Kelders Embayment boreholes

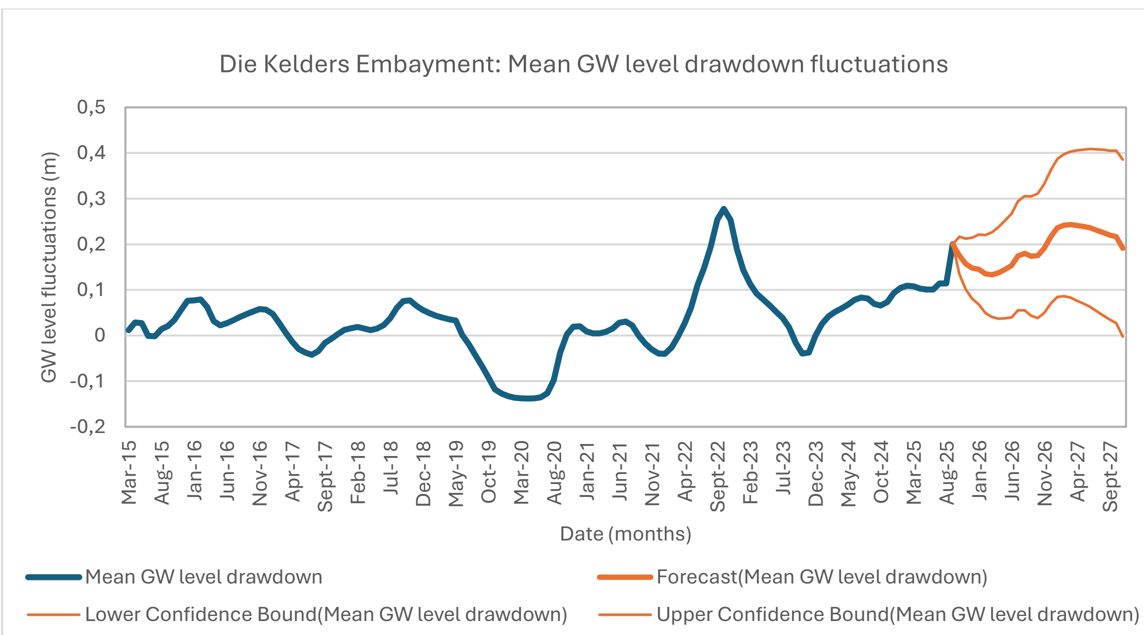


Figure 15: Mean groundwater level drawdown fluctuations for the Die Kelders Embayment Hydrogeological region

3.6 The Southwestern Cape Ranges Hydrogeological Region

The South Western Cape Ranges Hydrogeological Region lies on the southern coastal side of the Western Cape Province, where Agulhas National Park and Bredasdorp are located. To the south, the region stretches up to Betty's Bay; to the west it stretches to the east of Paarl, and bounded by Worcester in the extreme north, while Riversonderend serves as the eastern border (Figure 17).

The Southwestern Cape Ranges borehole monitoring distribution, is, just like observed with Die Kelders Embayment, clustered to the north, leaving the whole area from Bettys Bay to Agulhas National Park with no monitoring boreholes (Figure 17). The monitoring gap in this zone needs to be closed with additional boreholes.

The rainfall for the region was obatined from SAWS District 4. Figure shows the rainfall trend since 2015 with a steady increase over time till 2025.

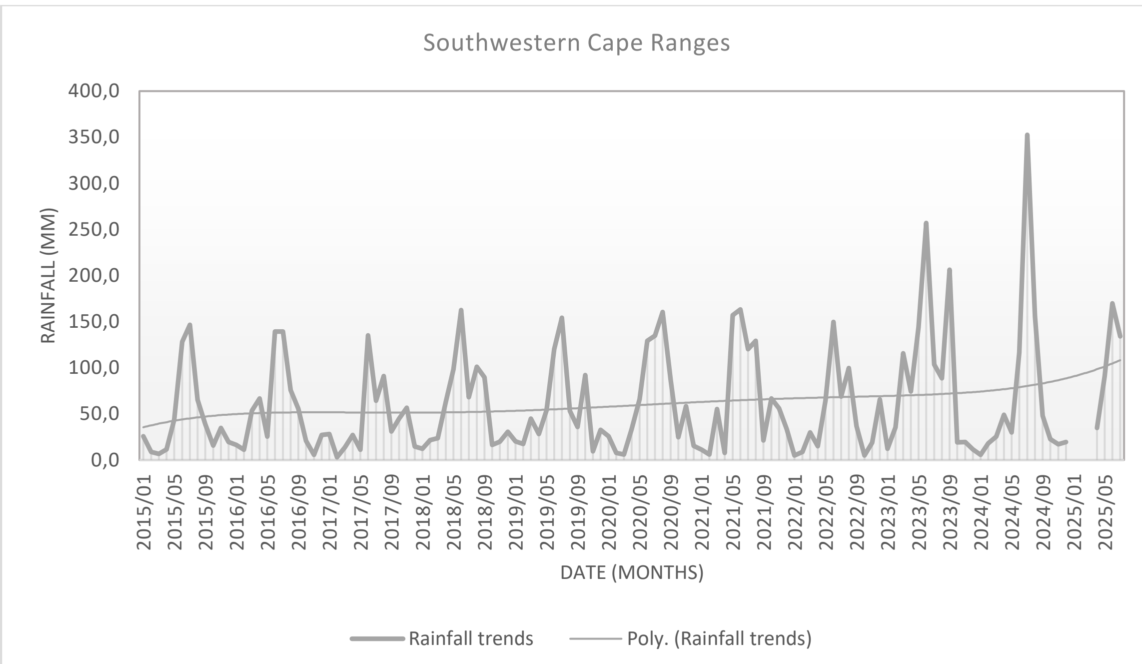


Figure 16: Rainfall trends for the Southwestern Cape Ranges

With regards to groundwater level drawdown for the area, it has shown to be relatively stable since the onset of observation period, with horizontal positive trends. Strong fluctuations were noted, though still maintaining horizontal trends, and were noted in G1N0440 whilst a positive, rising trend was recorded borehole G1N0449. The increase is more apparent in Figure 19 where mean groundwater level drawdown for the Southwestern Cape Ranges is shown.

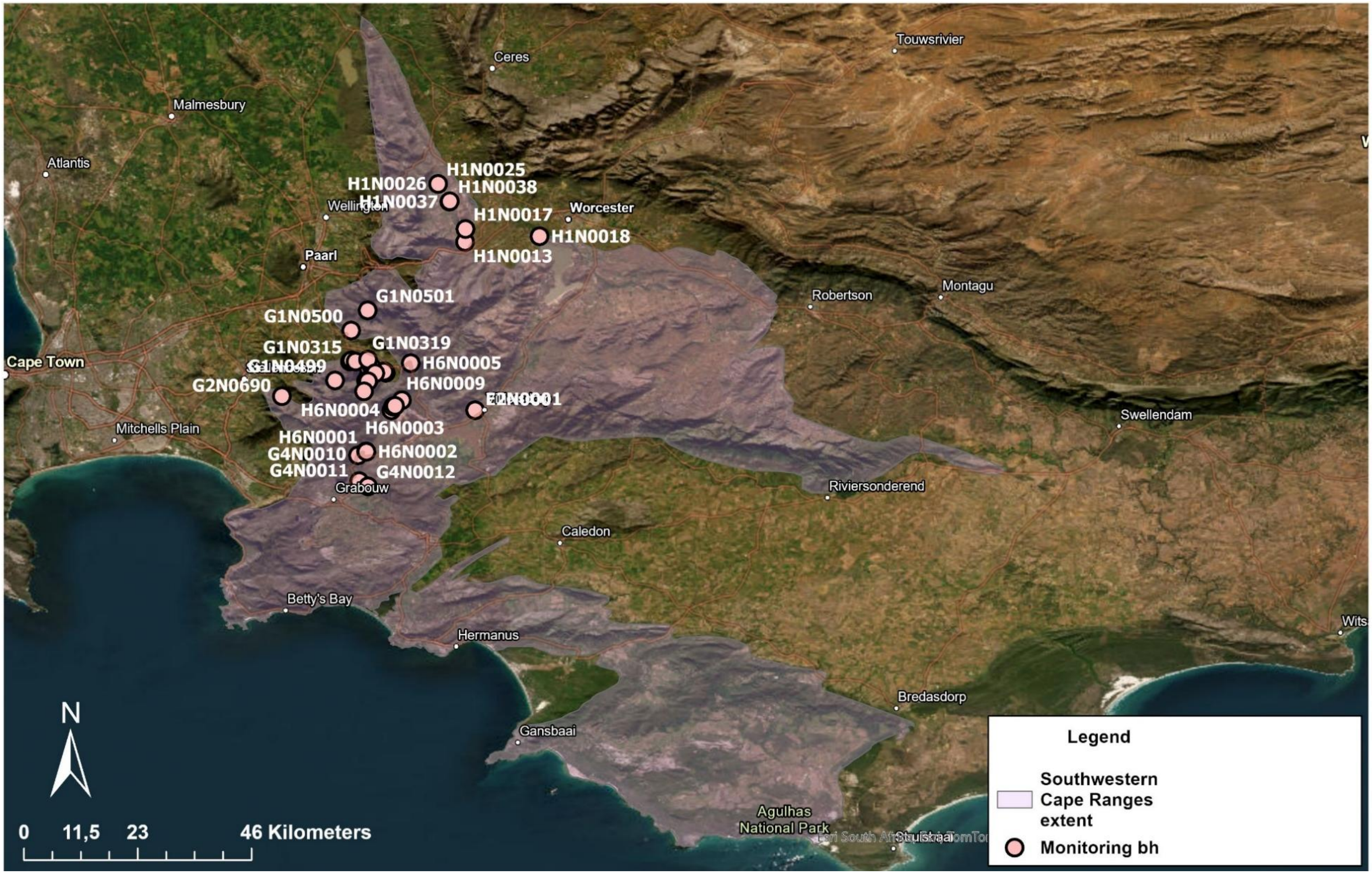


Figure 17: The extent of the Southwestern Cape Ranges Hydrogeological Region and its monitor4ing boreholes

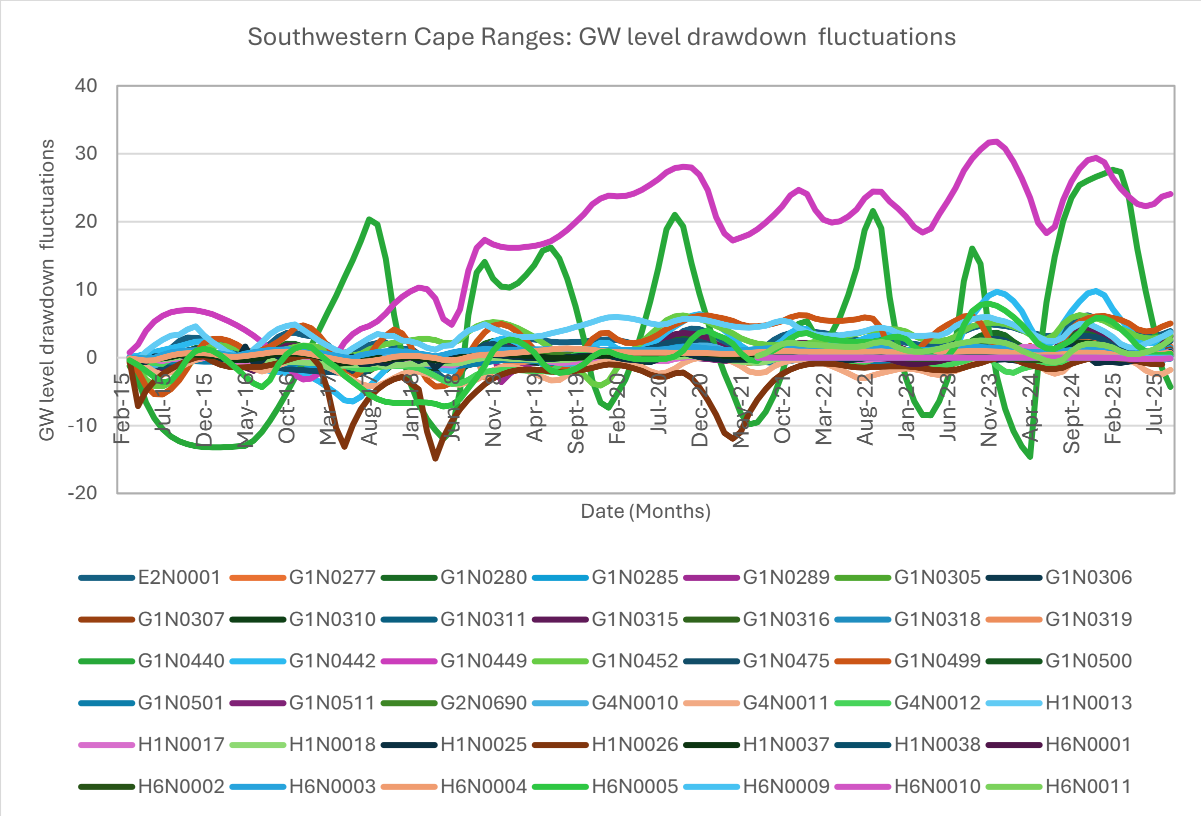


Figure 18: Groundwater level drawdown fluctuation for the Southwestern Cape Ranges boreholes

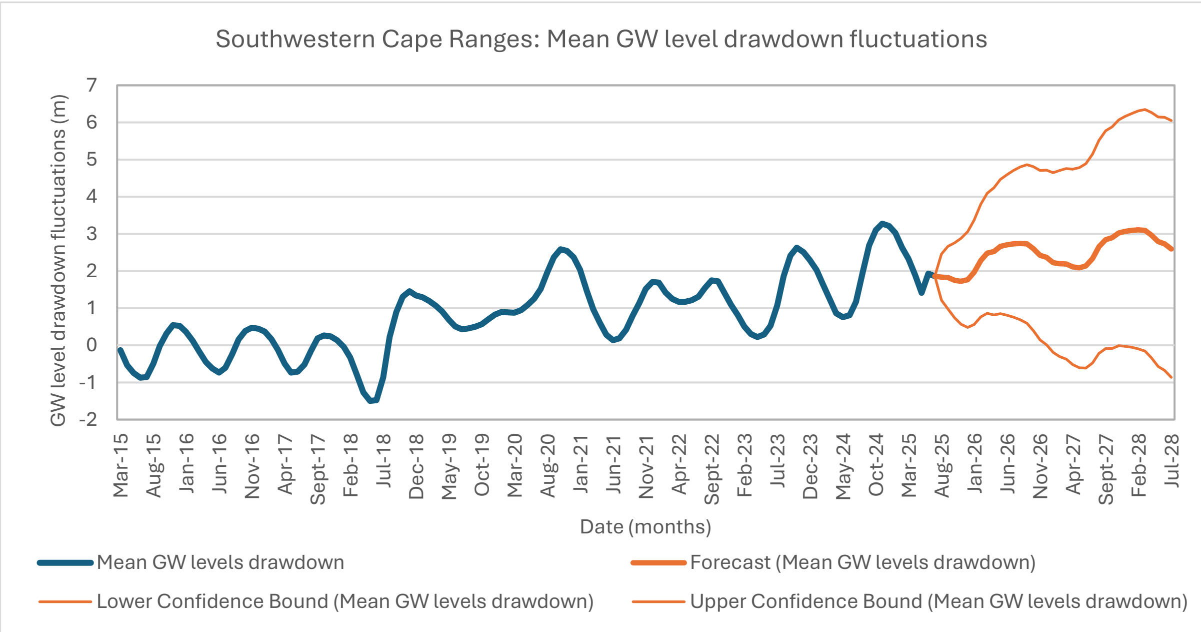


Figure 19: Mean groundwater level drawdown fluctuations for the Southwestern Cape Ranges Hydrogeological Region

3.7 The Southern Cape Ranges Hydrogeological Region

As the name suggests, the Southern Cape Ranges Hydrogeological Region is located to the southern end of the country, covering coastal towns such as Gqebera on the eastern side, and extending to the west where Swellendam is located, while on the south it cuts off at Mosselbay.

Approximately 75 boreholes are monitored for this region (Figure 20). The region is well represented with monitoring boreholes.

The 10yr rainfall trends for the region were derived from the average of SAW District 8,10,11 and 12 rainfall stations. The rainfall trends revealed a period of lower rainfall between 2016 and 2019, thereafter, the rain increased gradually, peaking in 2023-2024 (Figure 21). Prominent water level drawdown decline between 15m and 70m were observed over the period October 2016 to October 2020, evident mostly in the boreholes located in far western side of Southern Cape Ranges and to a lesser degree the central boreholes (Figure 20 and Figure 22). This is the period that was marked by the low rainfall. Furthermore, the towns in the far western side of the Southern Cape Ranges heavily rely on agricultural activities, supported by both surface and groundwater, as their form of economic activities. It is no surprise that such declines could be observed during drought periods as users tend to rely heavily on groundwater. The positive though is that this was for a short while, the boreholes recovered from the beginning of 2021 and the latest data is marked by a slight water level drawdown decline. An exception is with borehole GZ0009, located in the central part of the Southern cape Ranges. Due to the large number of boreholes monitoring this region, the legend for hydrograph (Figure 22) isn't included but the trends only.

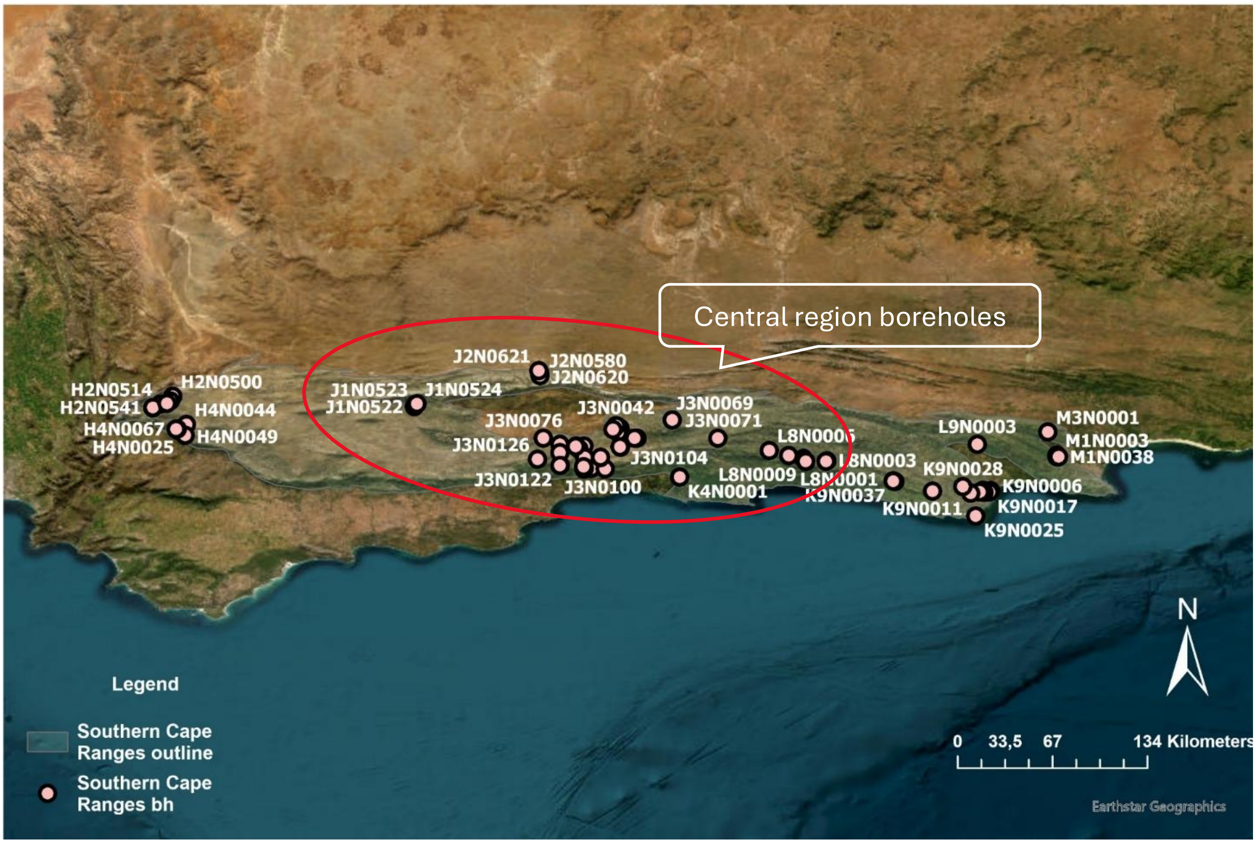


Figure 20: An extent of Southern Cape Ranges Hydrogeological region and its monitoring boreholes.

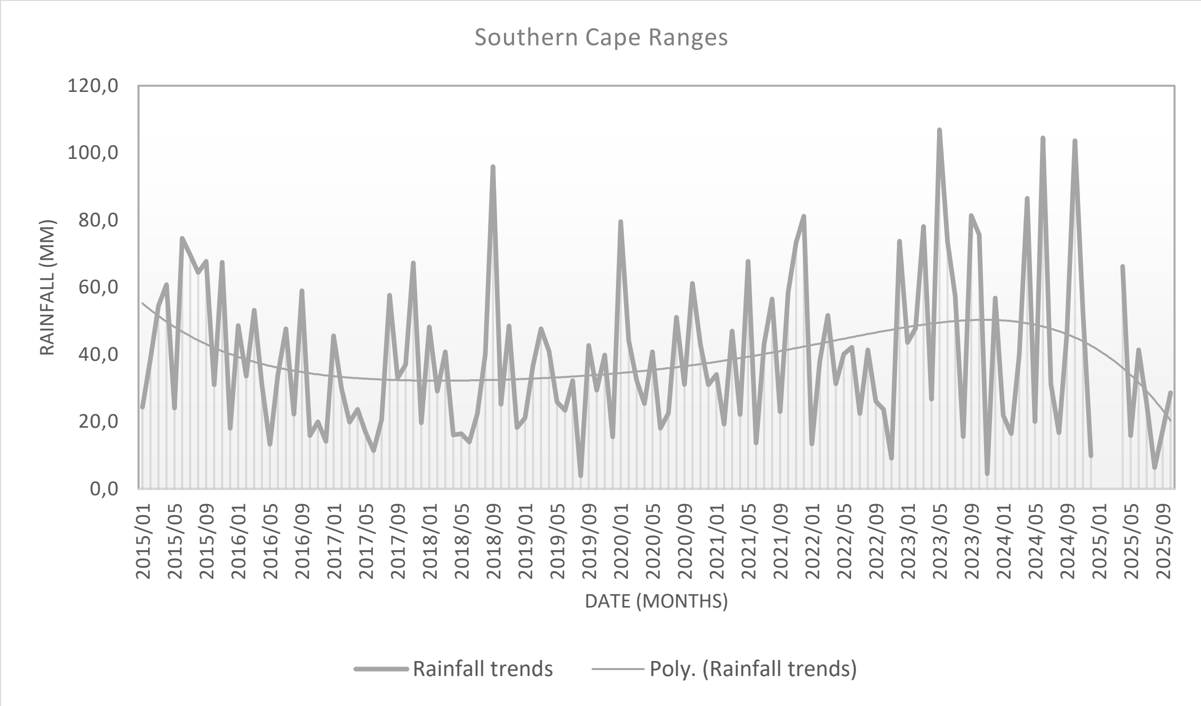


Figure 21: Rainfall trends for the Southern Cape Ranges Hydrogeological Region (SAWS Districts 8, 10, 11&12)

The average groundwater level drawdown for the entire region in Figure 23 suggest a downward trend with forecasted horizontal-to-downward trends with the latest data, after a peak rise was obtained in October 2024, more aligned with regional rainfall trends. Close monitoring of groundwater levels is recommended as this could be an onset to another drier season.

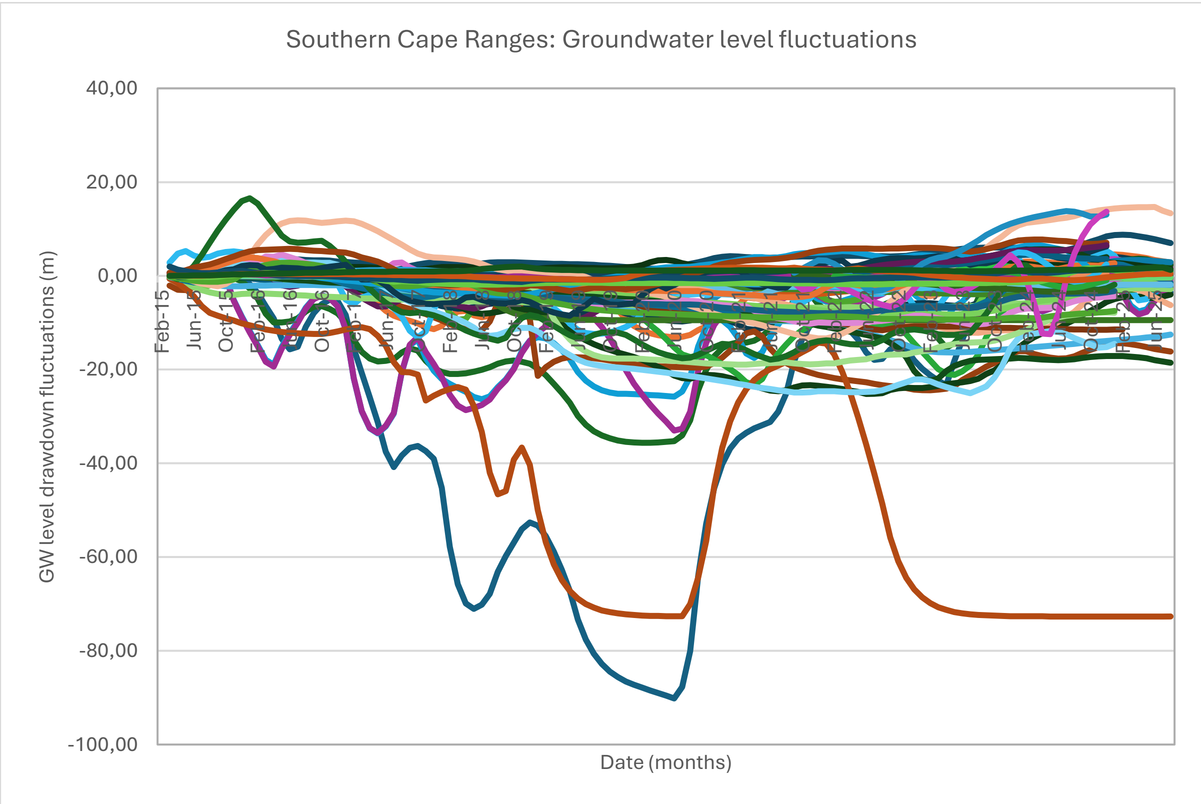


Figure 22: The Southern Cape Ranges- Groundwater level drawdown fluctuations

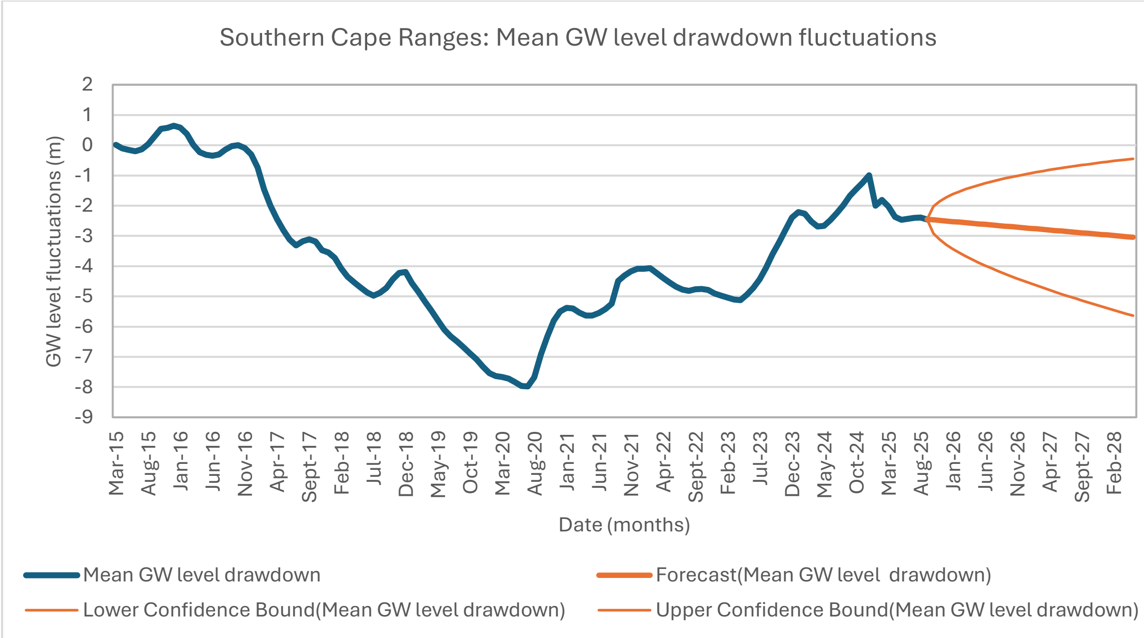


Figure 23: The Southern Cape Ranges mean groundwater level drawdown fluctuation trends

3.8 The Western Great Karoo Hydrogeological Region

The Western Great Karoo Hydrogeological Region extends from Prince Albert in the southeast and Matjiesfontein to the west. To the north, it is bounded by the Karoo National Park (Figure 25). As the name suggests, it forms part of the Great Karoo. The monitoring boreholes for this region are located centrally and to the northeastern side. To the south and west, there is no representation (Figure 25). The monitoring programme needs to be expanded to cover the identified gaps.

The rainfall for the region indicated below average rainfall between 2016 and August 2019. The period post September 2021enjoyed relatively higher rainfall than average (Figure 24).

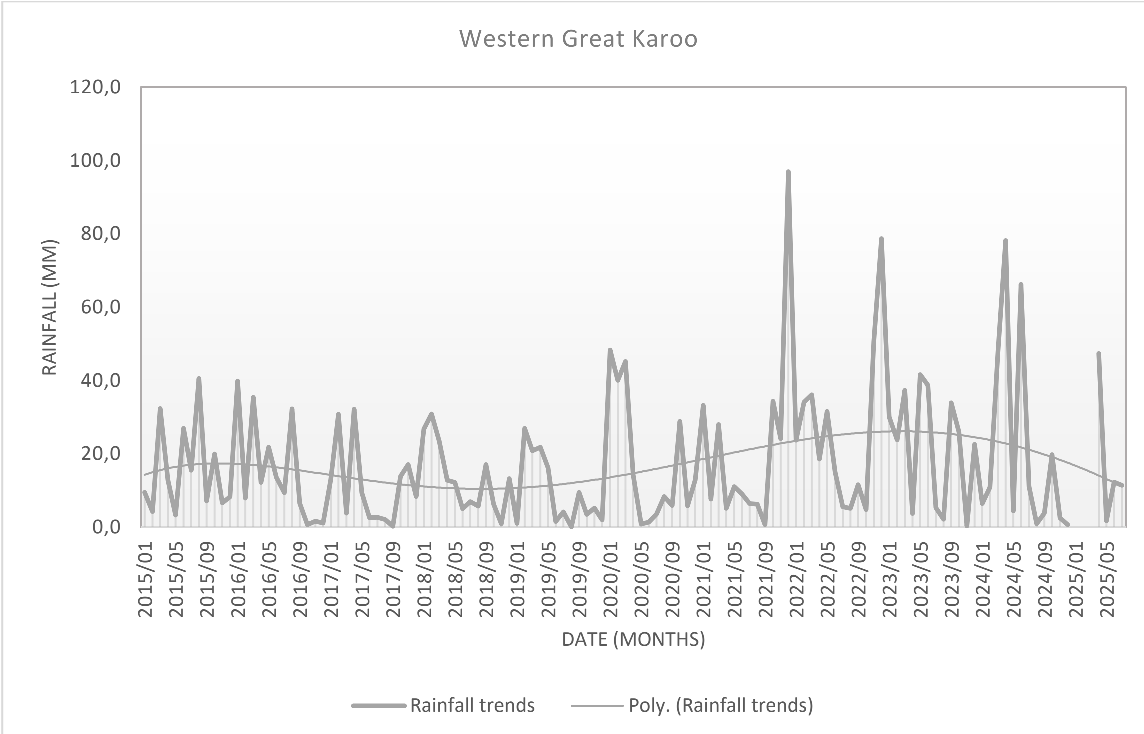


Figure 24: Rainfall trends for the Western Great Karoo

The groundwater levels drawdown corresponding to the rainfall period presented above revealed a steady decline from 2015 to November 2018 for some boreholes (Figure 26). Post November 2018 a prominent dip in all the boreholes was observed, lasting for a year period before a consistent rise could be observed (Figure 26). This prominent decline in groundwater level drawdown trends of the Western Great Karoo can be attributed to response to below average rainfall experienced in this region in 2015-2018, but later fully recovered. This marked prominent decline in groundwater levels is clearly indicated in Figure 27, which depicts the mean groundwater level drawdown of the Western great Karoo Hydrogeological Region. The latest according to this figure shows a positive fluctuating groundwater system. Based on the current data, the groundwater resource for this region is in its vital state, with insignificant impacts on its availability.

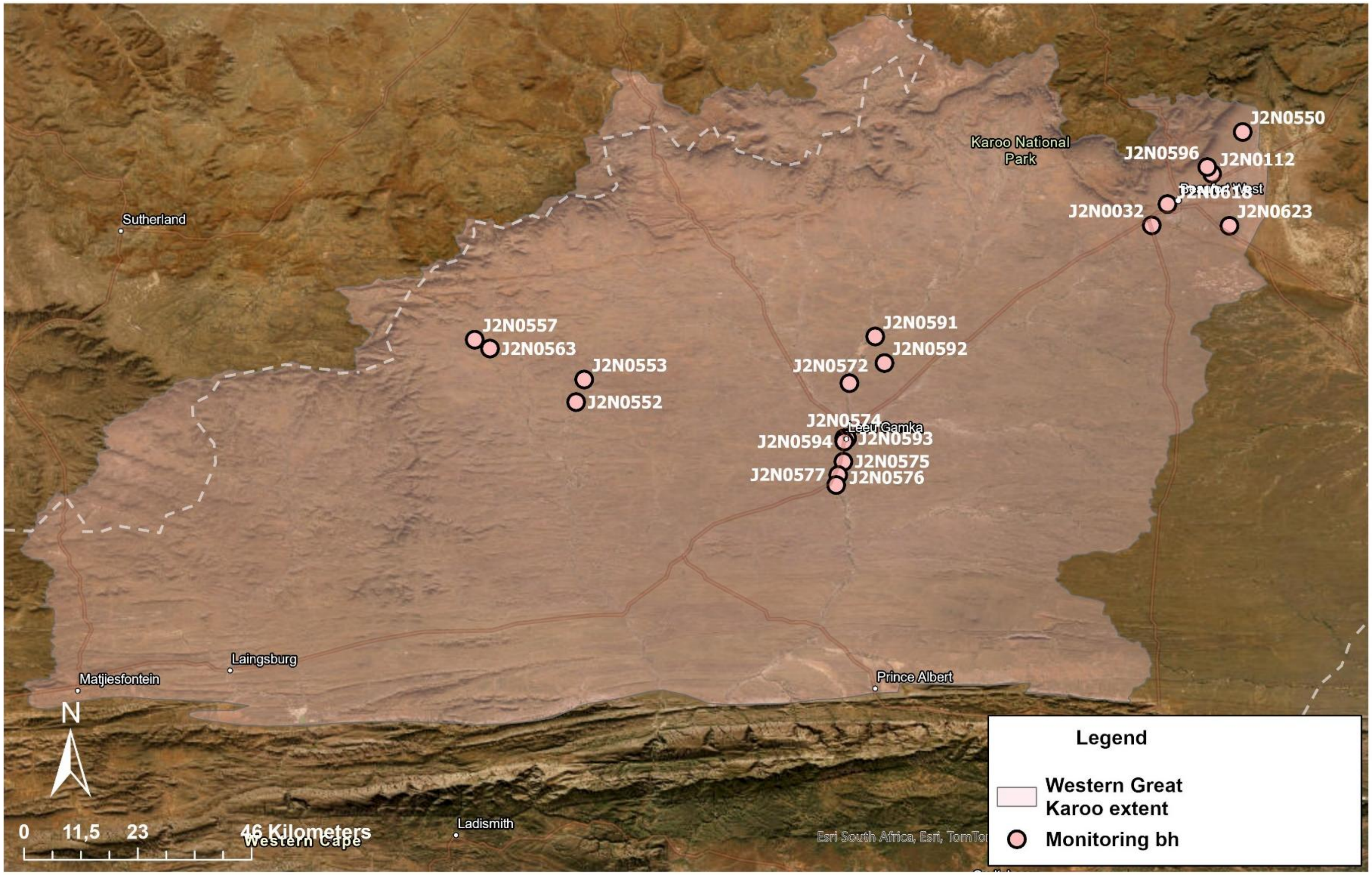


Figure 25: The extent of the Western Great Karoo Hydrogeological Region and its monitoring boreholes

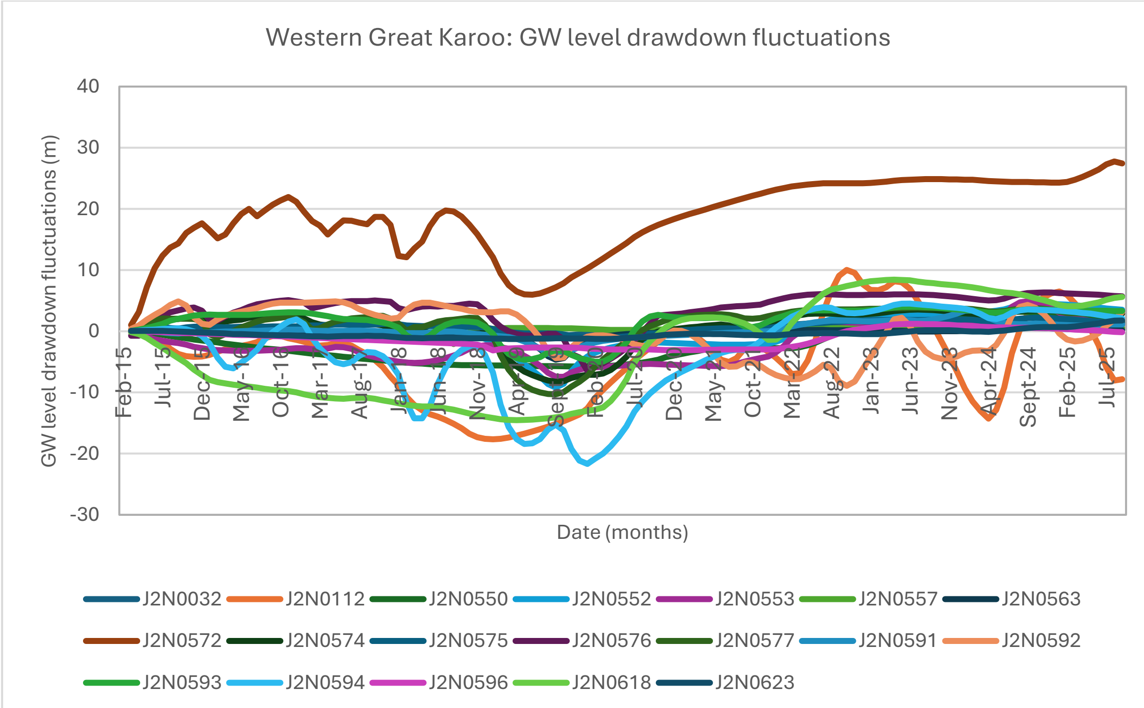


Figure 26: Groundwater level drawdown fluctuations from the Western Great Karoo monitoring boreholes

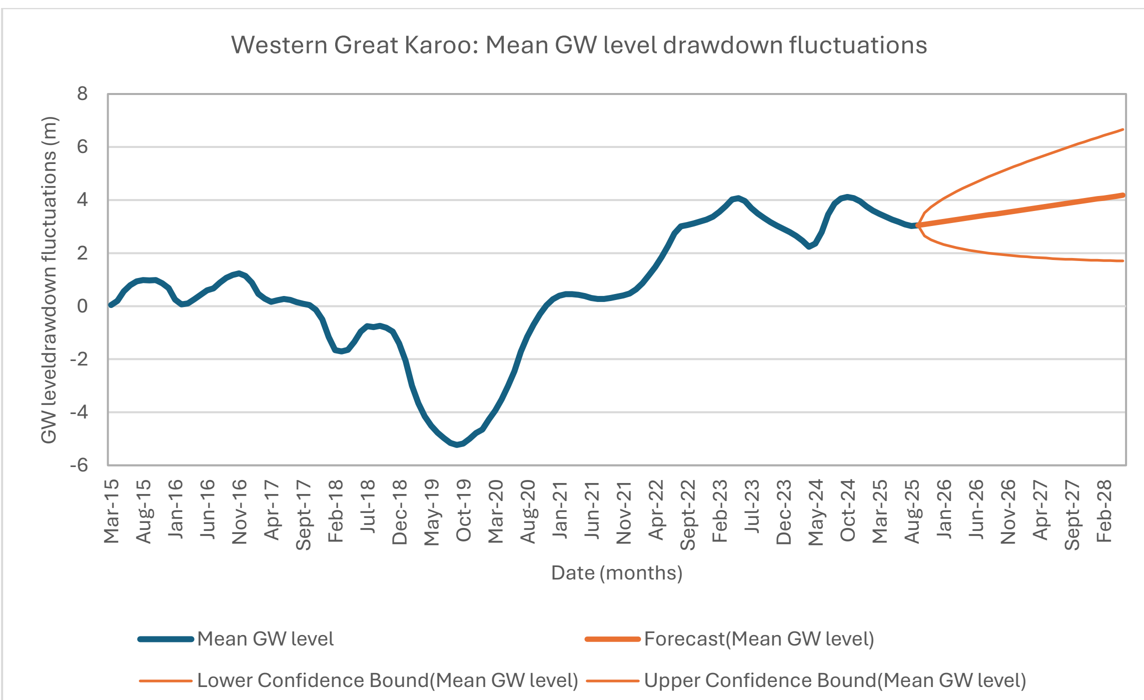


Figure 27: The mean groundwater level drawdown for the Western Great Karoo Hydrogeological Region

3.9 The Intermontane Tulbagh-Ashton Valley Hydrogeological Region

The Intermontane Tulbagh-Ashton Valley Hydrogeological Region is crammed in a valley from Tulbagh on the northwestern side, through Worcester, centrally, up to Ashton on southeast (Figure 29). This valley, bound to the north and south by the Cape Fold Belt, marks the presence of Obiqua Mountains, Winterhoek Mountains, Witzenberg Mountains, Langeberg Range and the Hex River Mountains further south, as landform-features making this region.

Also presented in Figure 29 are the monitoring boreholes for this region. The distribution is focused on the central part of the hydrogeological region, leaving the northwestern side and the eastern underrepresented. The monitoring programme for this hydrogeological region needs to be augmented to close the gaps.

The rainfall trends for the Intermontane Tulbagh-Ashton Valley Hydrogeological Region were derived from the average of monitoring districts 7 and 8 of the SAWS rainfall monitoring stations. Figure 28 indicates the rainfall trends with a marked increase in rainfall intensity from the beginning of 2020, marking the end of a relatively drier period observed since September 2015.

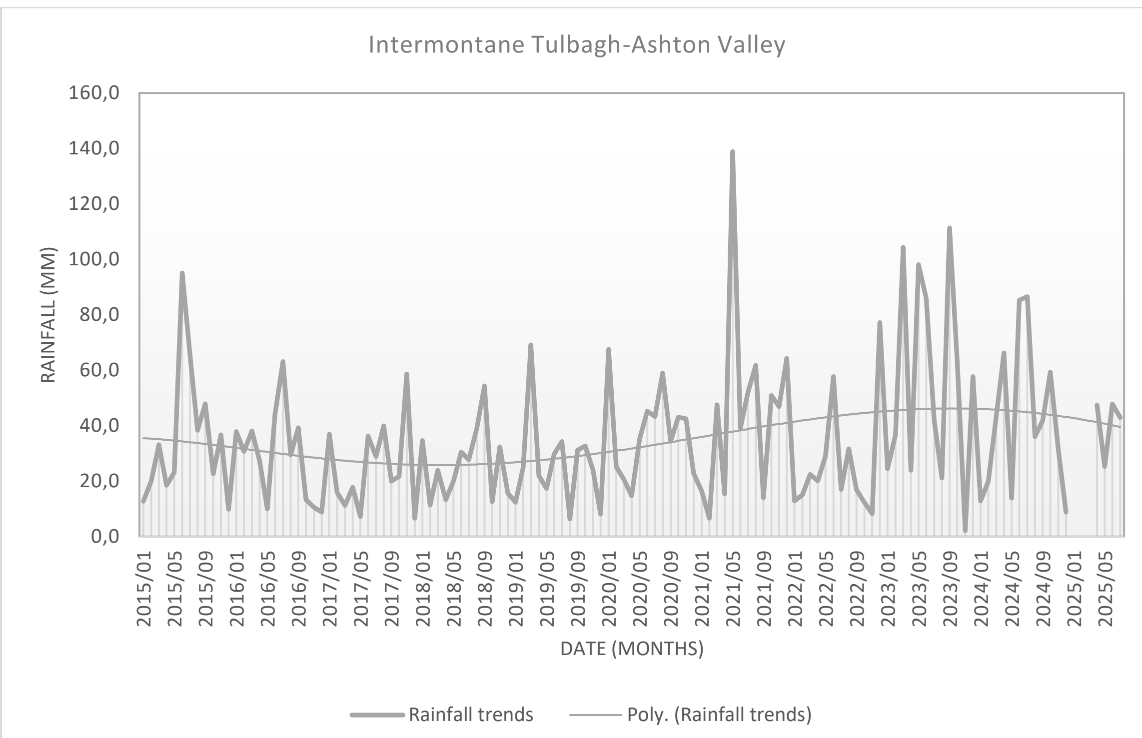


Figure 28: Rainfall trends for the Intermontane Tulbagh-Ashton Valley Hydrogeological Region

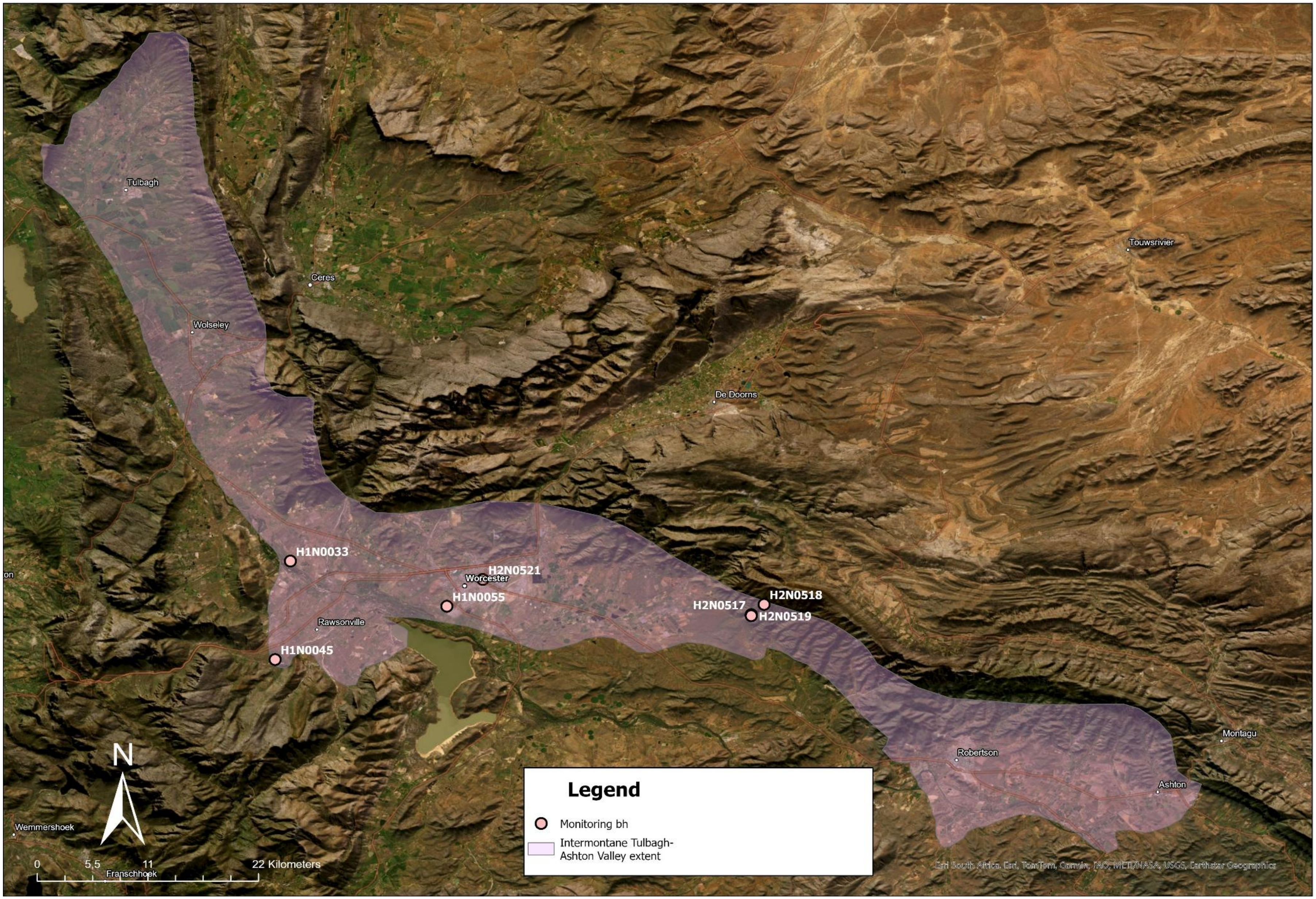


Figure 29: The extent of the Intermontane Tulbagh-Ashton Valley Hydrogeological Region and its monitoring boreholes

The groundwater level drawdown for the monitoring boreholes in Intermontane Tulbagh-Ashton Valley Hydrogeological Region responded to the drier period observed post 2015 to 2020. This is the period where water level decline in the order of 2-8m was recorded (Figure 30). With the onset of the above-average rainfall in the beginning of 2020, the groundwater level drawdown trends indicated an inflection point, though it took a while to finally show an upward trend which became clearer in 2022-2023. The latest information (post 2023) indicates positive recovery to the levels last seen around 2015. However, this is not the case with borehole H2N0521, which is still climbing gradually but still below its initial groundwater level. The period of environmental stressors to the groundwater resource of this region is clearly shown in Figure 31. Though it took long for full recovery, the groundwater level drawdown for this region is now indicated to be horizontally fluctuating above initial water levels. Given this status, there is no immediate intervention recommended for management of groundwater (quantity) for this region.

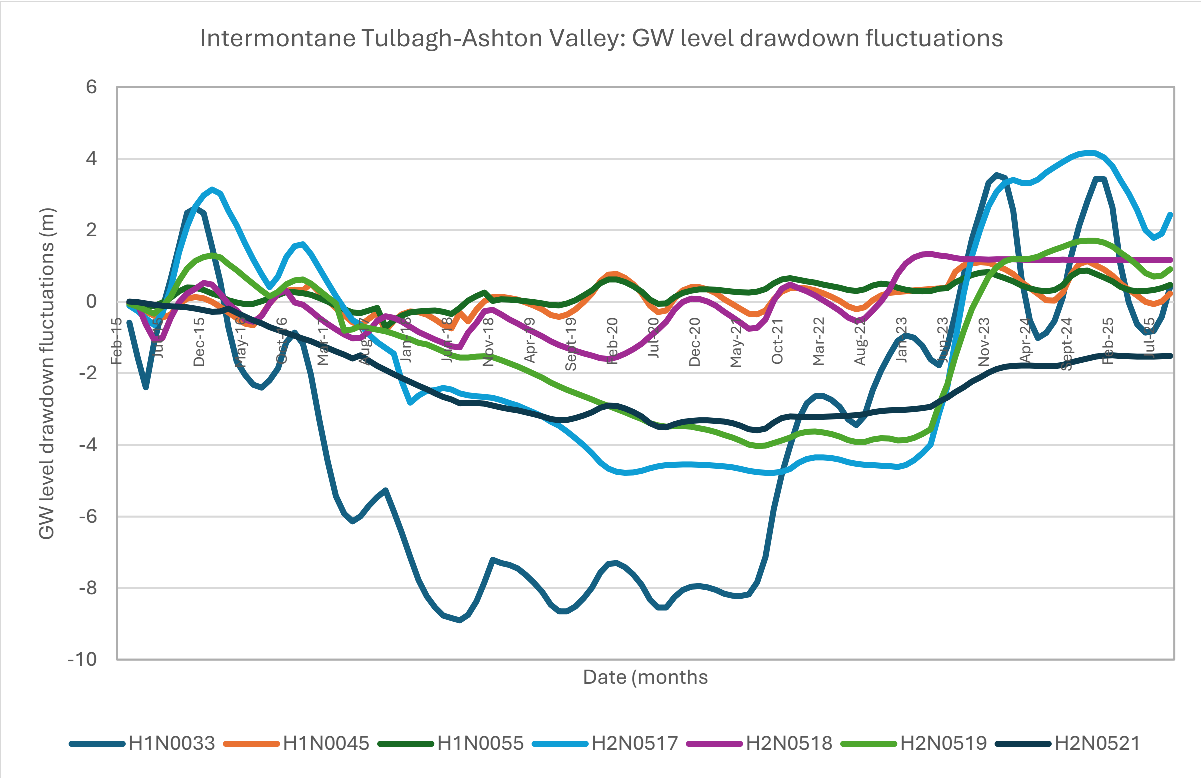


Figure 30: Groundwater level drawdown fluctuations for the Intermontane Tulbagh-Ashton Valley Hydrogeological Region monitoring boreholes

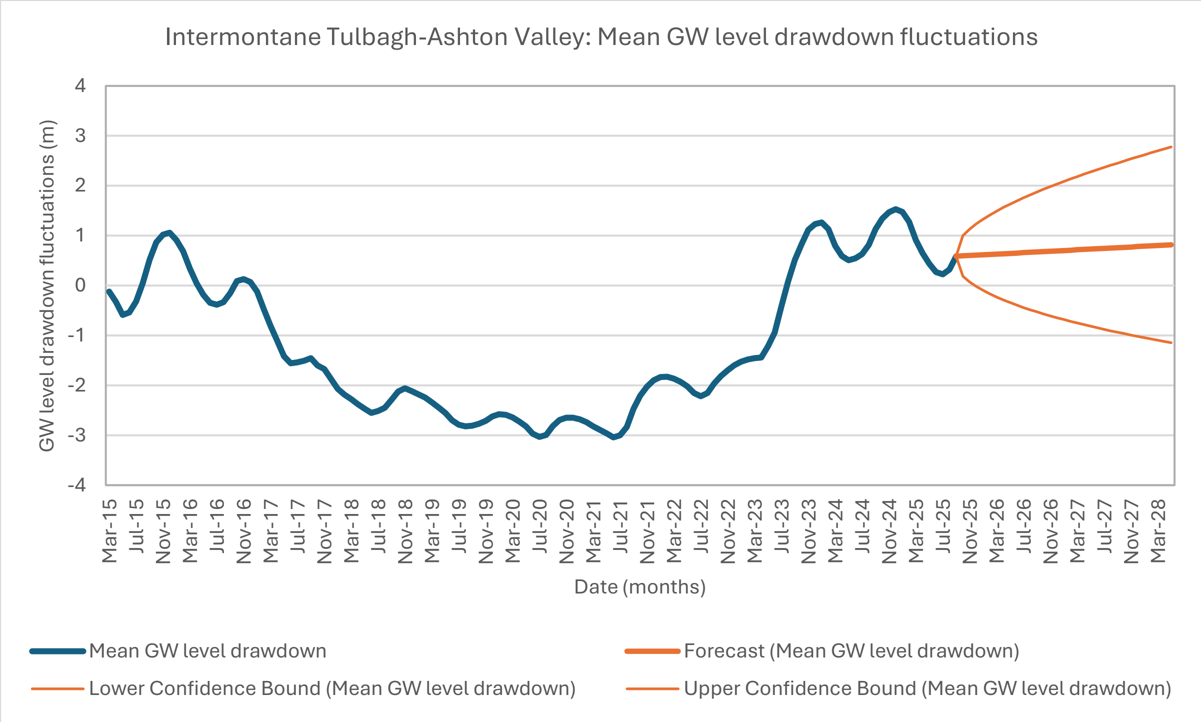


Figure 31: Mean groundwater level drawdown fluctuations for the Intermontane Tulbagh-Ashton Valley Hydrogeological Region

3.10 The Swartland Hydrogeological Region

The Swartland Hydrogeological Region stretches from the northeast, near Citrusdal, to the south where Grabouw lies, and covers the coastal side, inclusive of the outskirts of Cape Town, and up north towards the West Coast National Park (Figure 32). The distribution of monitoring is added in Figure 32 as well, with the coverage/ distribution satisfactory.

The rainfall trends for this region are represented by two SAWS rainfall districts i.e. District 3 and 4. The mean rainfall from these districts is depicted in Figure 33. Unlike other regions in the Western Cape, the Swartland region seems to have enjoyed good rain throughout, marking no deficit in rains. Post 2023, the region experienced higher than average rain.

With regards to groundwater level drawdown for the boreholes of this region, fluctuations were observed, varying from -1m to -60m in some cases (Figure 34). These water level drawdown drops were noted to be temporary and would easily recover to initial levels, suggesting anthropogenic effects rather than environmental impacts. Some boreholes responded well to rains, rising from the initially recorded levels. In general, the groundwater resource seems to be in its vital state, showing a steady fluctuating rise. Isolated cases of over-abstraction are suggested by the dataset if water level drawdowns of some boreholes are considered. This affects the mean groundwater levels of the region as seen in Figure 35. Nevertheless, there are no immediate management actions recommended for this groundwater system, given its current status.

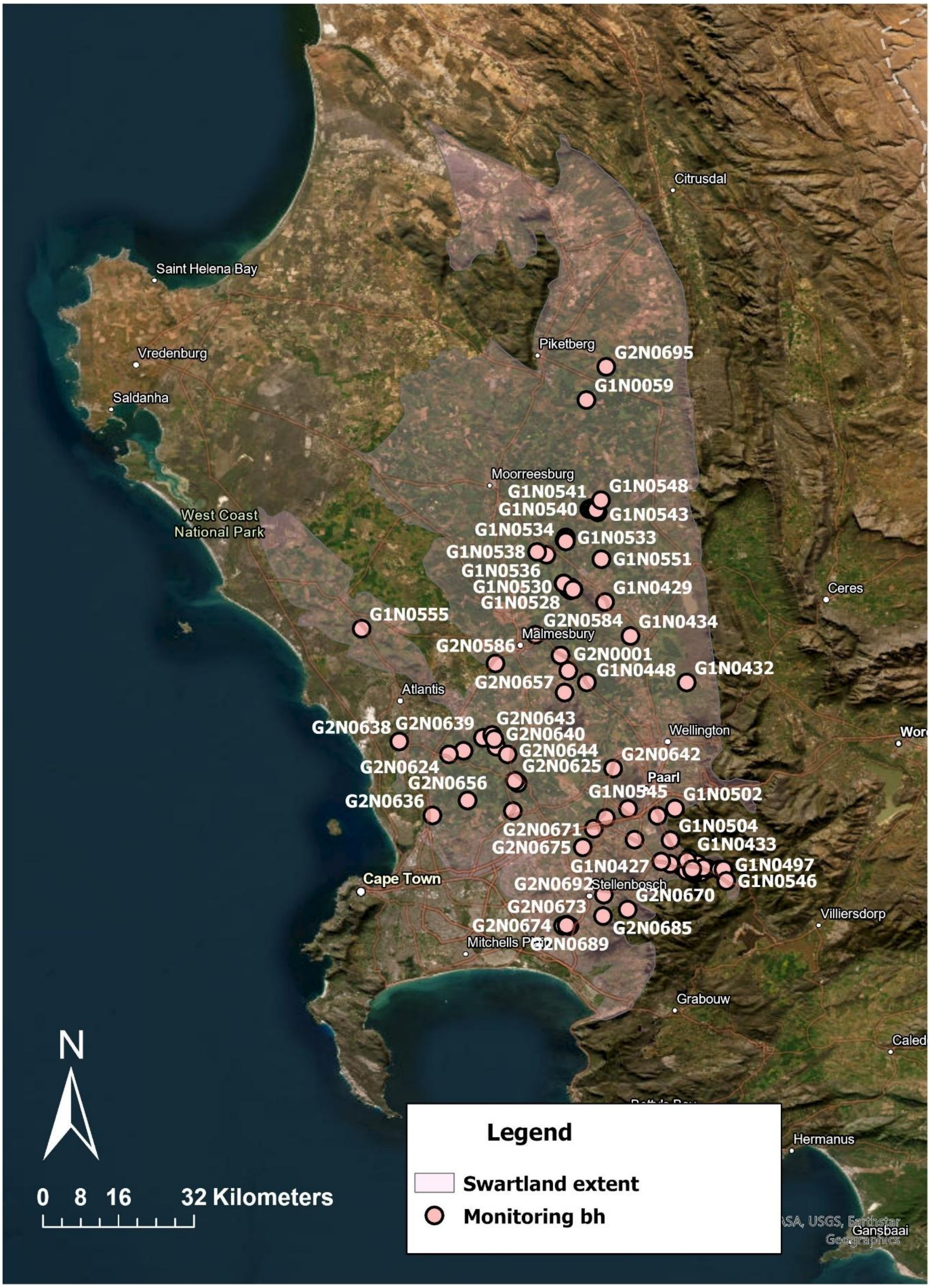


Figure 32: Locality of the Swartland Hydrogeological Region and its monitoring boreholes

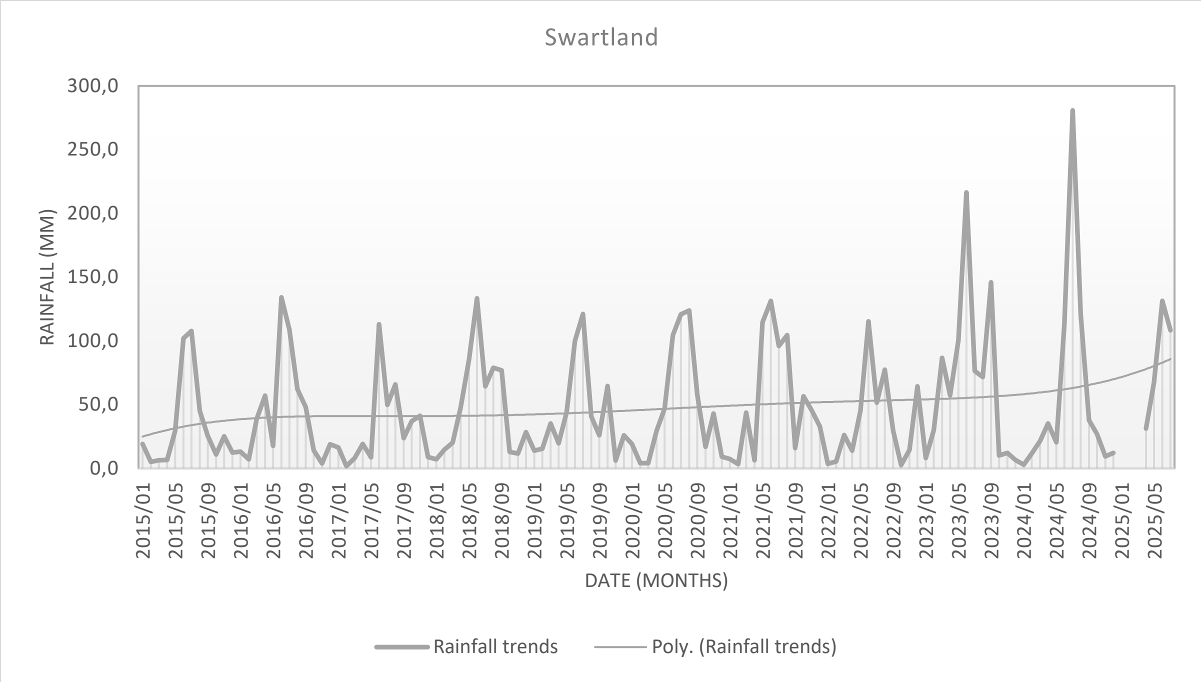


Figure 33: Rainfall trends for the Swartland Hydrogeological Region

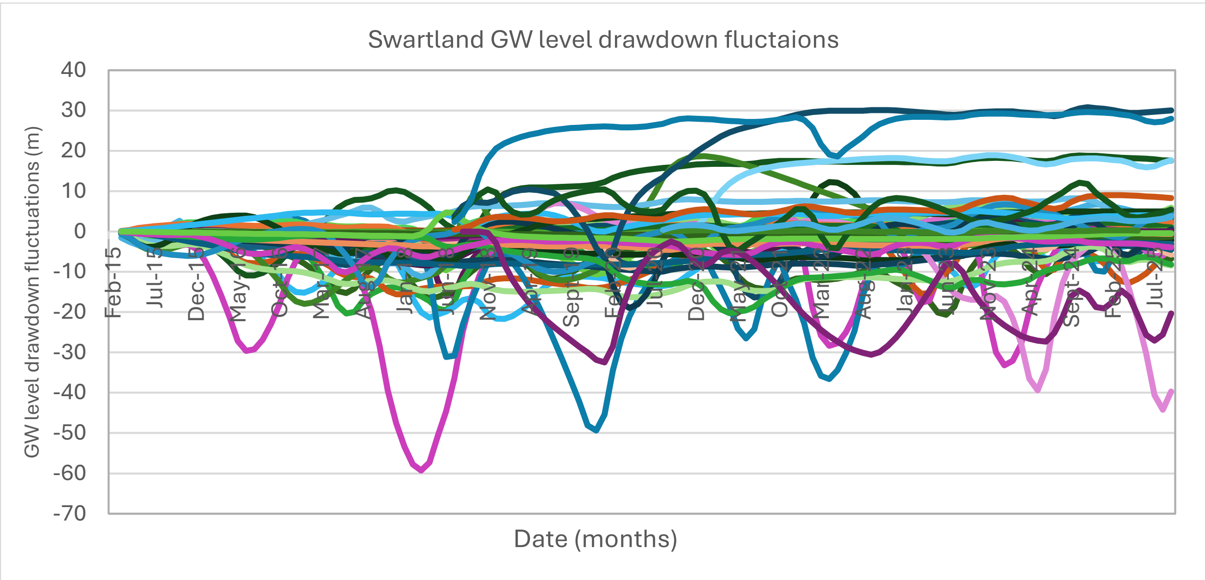


Figure 34: Groundwater level drawdown fluctuation trends for the Swartland Hydrogeological Region

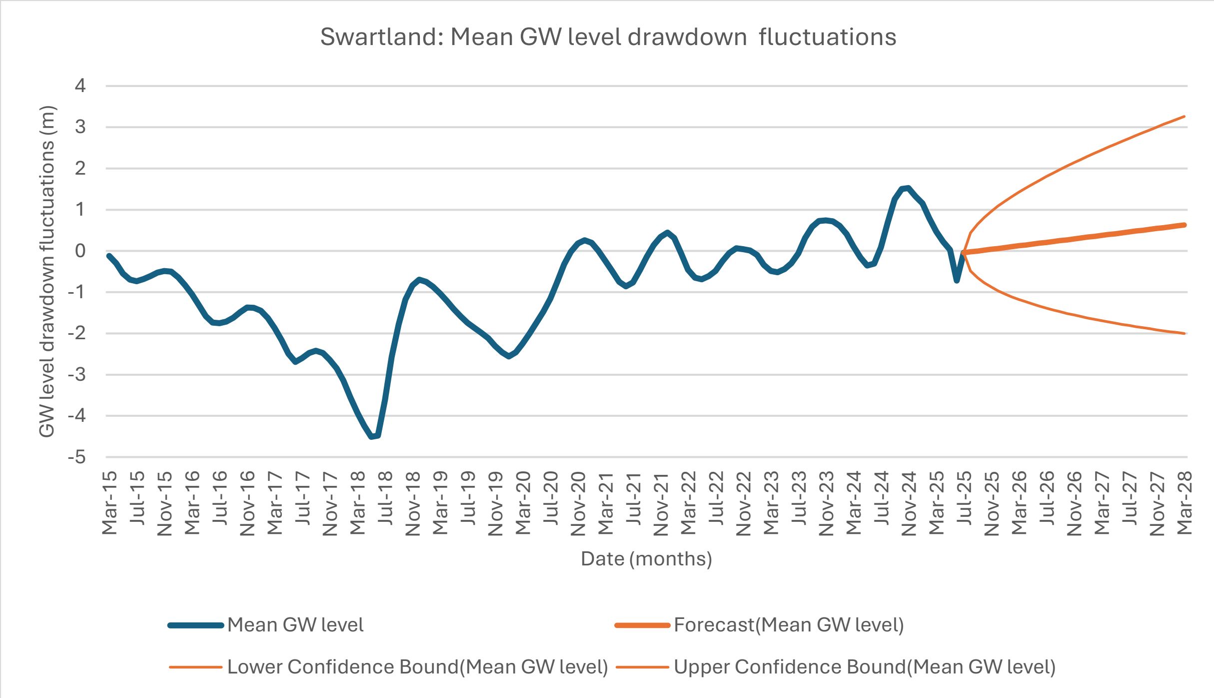


Figure 35: The mean groundwater level drawdown fluctuations for the Swartland Hydrogeological Region

3.11 The Southwestern Coastal Sandveld Hydrogeological Region

The Southwestern Coastal Sandveld Hydrogeological Region occupies the shoreline of the Western Cape from the Silvermine National Park, inclusive of Cape Flats, up north, extending more inland to Malmesbury and finally north of St Helena Bay (Figure 36). It is an over-represented hydrogeological region with regards to groundwater monitoring, with borehole distribution covering the southern, central and northern sections of the region. The region could benefit from groundwater monitoring optimization as most boreholes are too clustered.

The Southwestern Coastal Sandveld Hydrogeological Region shares the same SAWS rainfall districts as Swartland i.e. region 3 and 4. Therefore, for interpretation, the Swartland Region is referenced.

With regards to groundwater level drawdown from the boreholes of this region, only trends are included for demonstration, the legend is not included due to the high number of boreholes assessed (which was making the figure too cluttered). The groundwater level drawdown fluctuations for all the observed boreholes remained in the range of +/-5m. An exception to this holds for boreholes G1N0119 and G1N0118 (green and orange lines with very high and very low drawdown in Figure 37, respectively) whose drawdown trends showed a rise and decline of more than 5m respectively (Figure 37). These boreholes are located close to each other (about 90m apart). It appears as a coincidence that the water level from one borehole would drop while the other is rising, with a mirror image of the trends. An ongoing experimental work/ investigation pertaining to artificial recharge is strongly suspected to be the cause of the observed trends.

The overall groundwater level drawdown trends for the hydrogeological region suggest a fluctuating upward trend from the horizontal trends that dominated from 2017 to late 2024

(Figure 38). The forecasts are that these trends can still rise to initial groundwater levels of the region or settle about 0,2m below the initial levels.

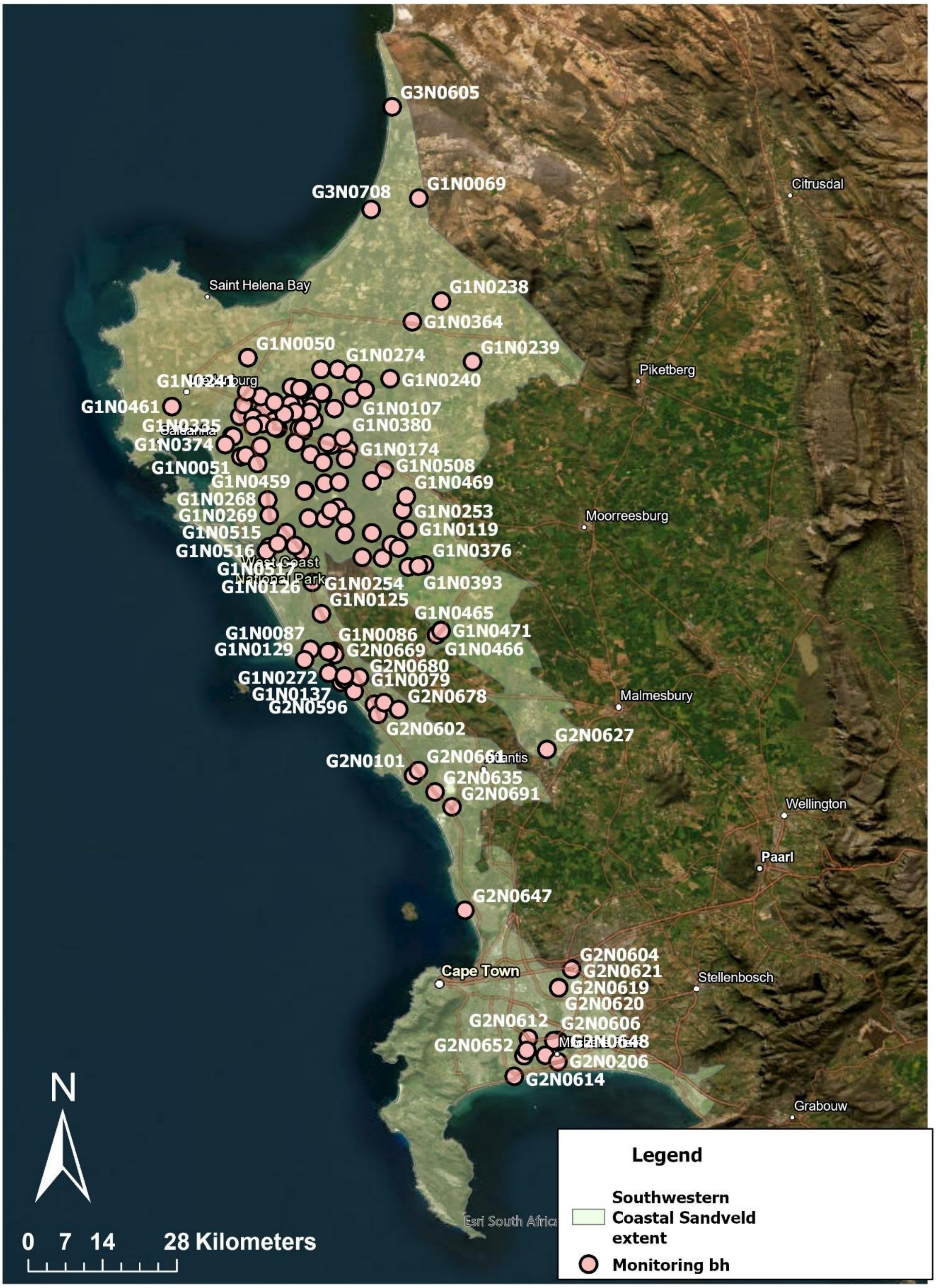


Figure 36: Locality of the Southwestern Coastal Sandveld Hydrogeological Region

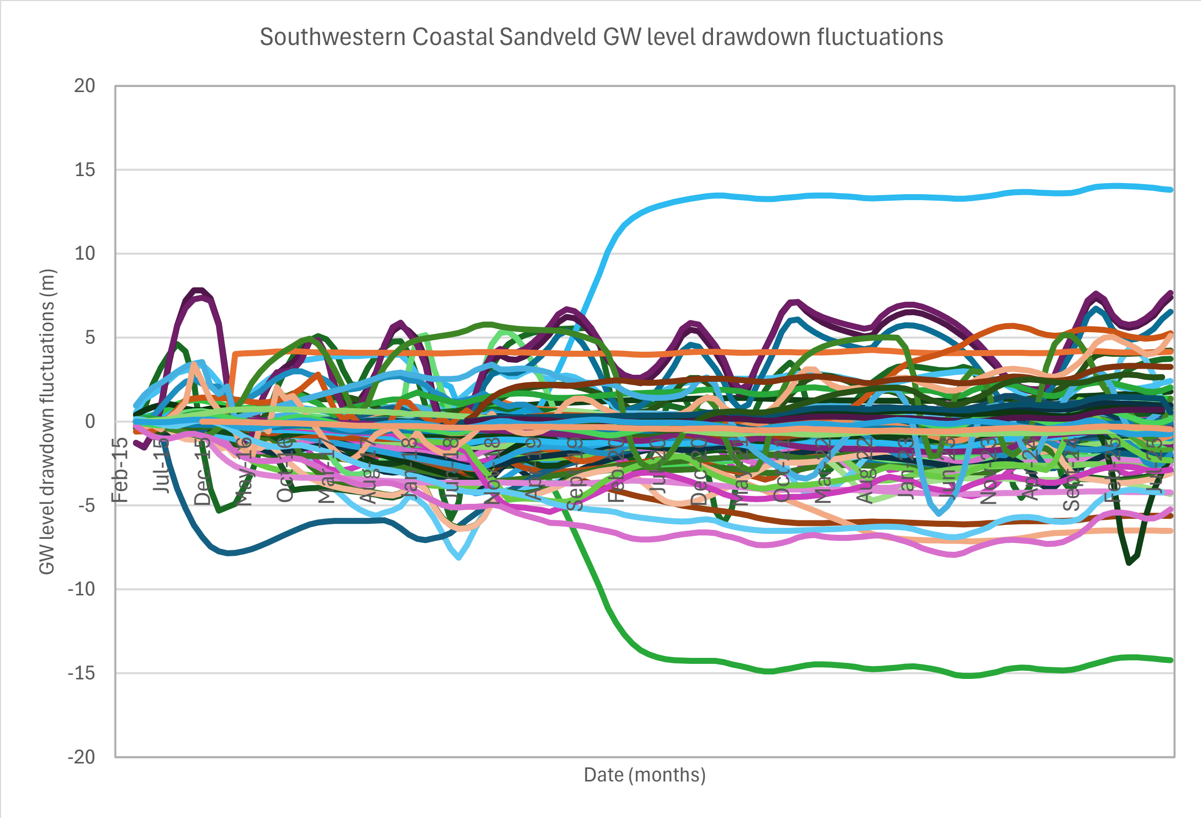


Figure 37: Groundwater level drawdown fluctuations for the Southwestern Coastal Sandveld boreholes

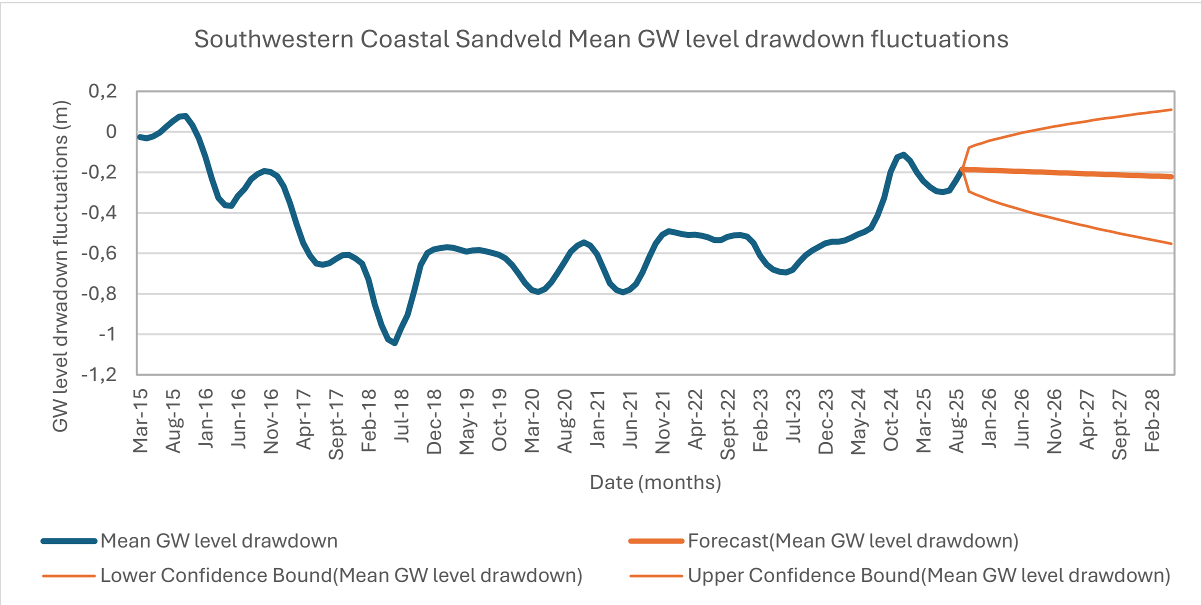


Figure 38: Mean groundwater level drawdown fluctuation for the Sandveld Hydrogeological Region

3.12 The Northwestern Cape Ranges Hydrogeological Region

The Northwestern Cape Ranges Hydrogeological Region stretches from Ceres, northwards along the northwestern mountain ranges, extending westwards to Piketberg and includes the shoreline of Lamberts Bay. To the north it is bound by the Olifants River where it distributes its water to the Atlantic Ocean (Figure 40). The monitoring boreholes are spread across the region satisfactorily to represent the groundwater conditions of the entire region (Figure 40).

The rainfall records for this region were obtained from the SAWS District 3 and 2. The average rainfall data from 2015 is indicated in Figure 39. The rainfall records indicated that the region enjoyed relatively higher rainfall from 2023 to date compared to the previous years (i.e. since 2015).

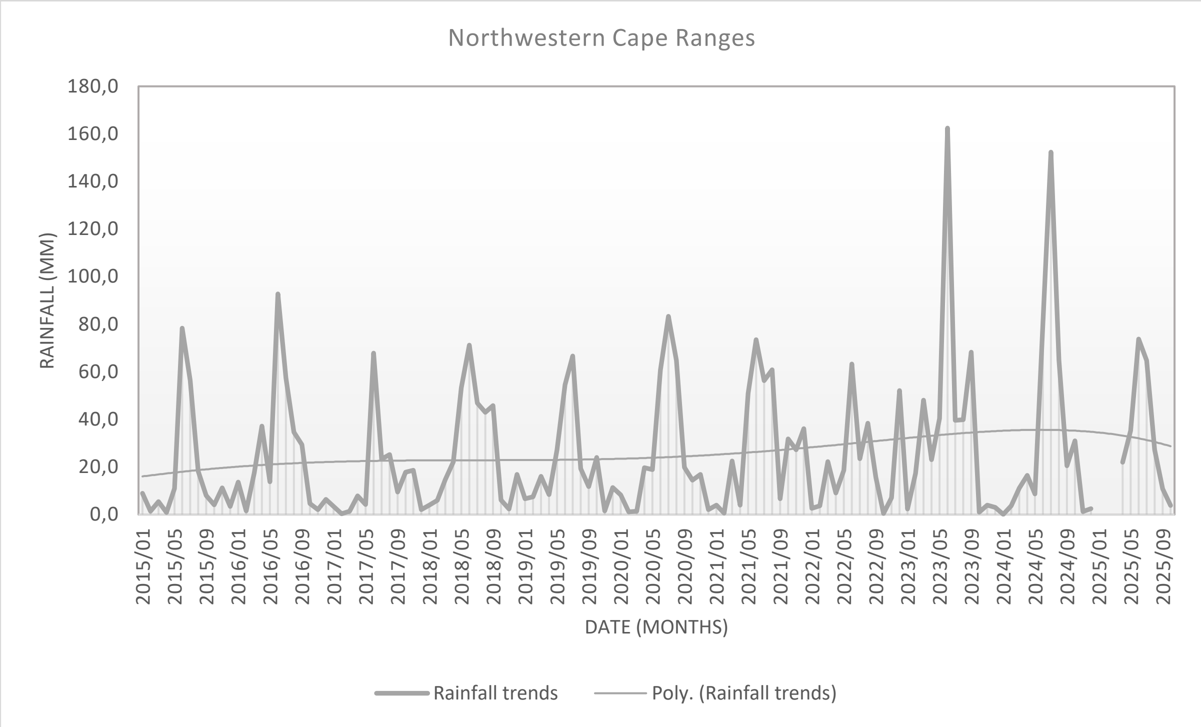


Figure 39: Rainfall trends for the Northwestern Cape Ranges

The groundwater level drawdown trends showed both strong positive and negative fluctuations over the observation period (Figure 41). Prominent fluctuating trends up to -40m could be observed (Figure 41) but these easily recovered within a short period. The water level drawdown decline was evident around 2017-2018. Since then, the groundwater system has been in a consistent fluctuating rise till today. The mean groundwater level drawdown for the entire region, depicted in Figure 42, represents this well, showing rising groundwater level drawdown trends and a dynamic groundwater system.

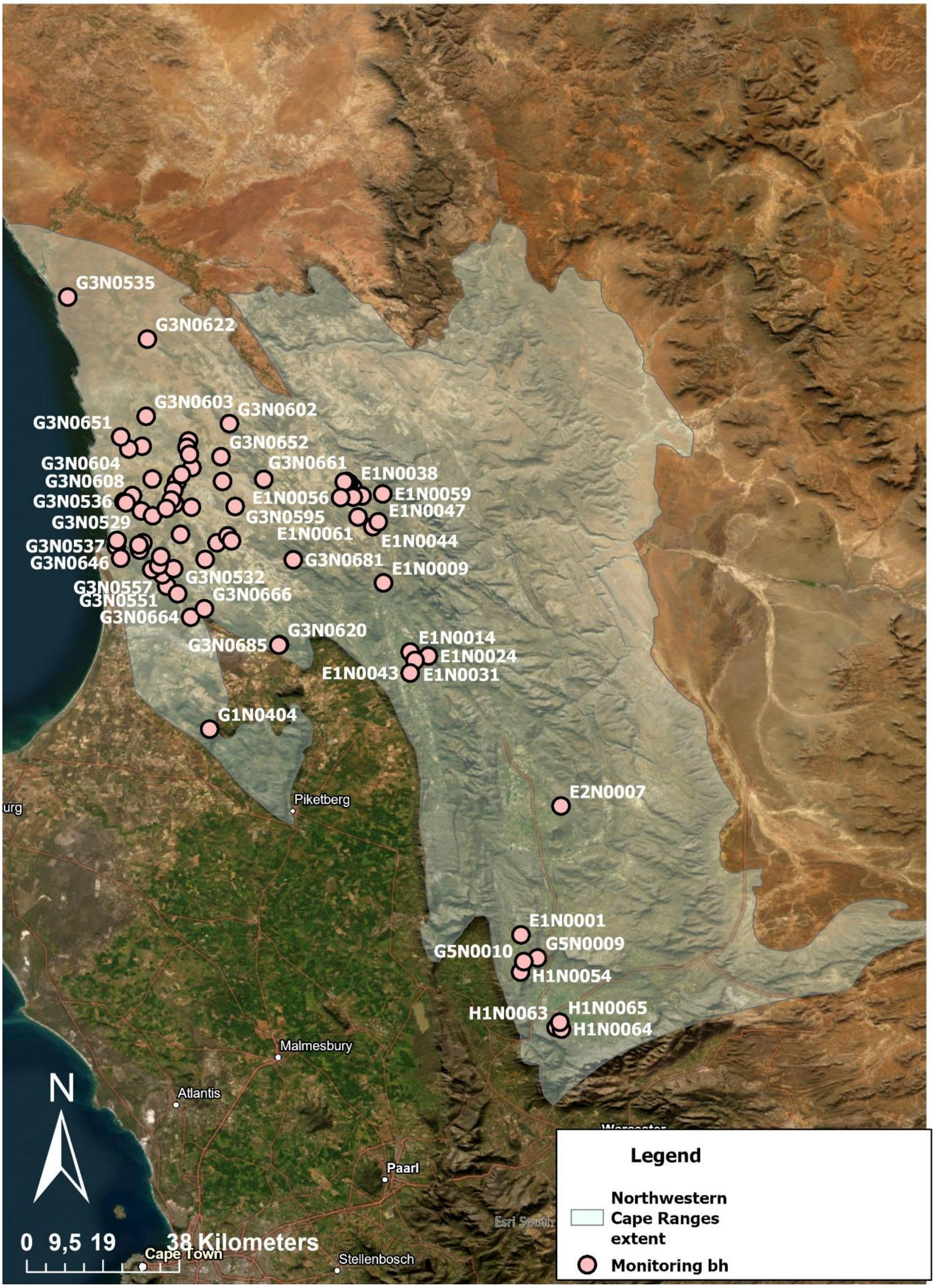


Figure 40: Monitoring borehole distribution and the extent of the Northwestern Cape Ranges Hydrogeological Region

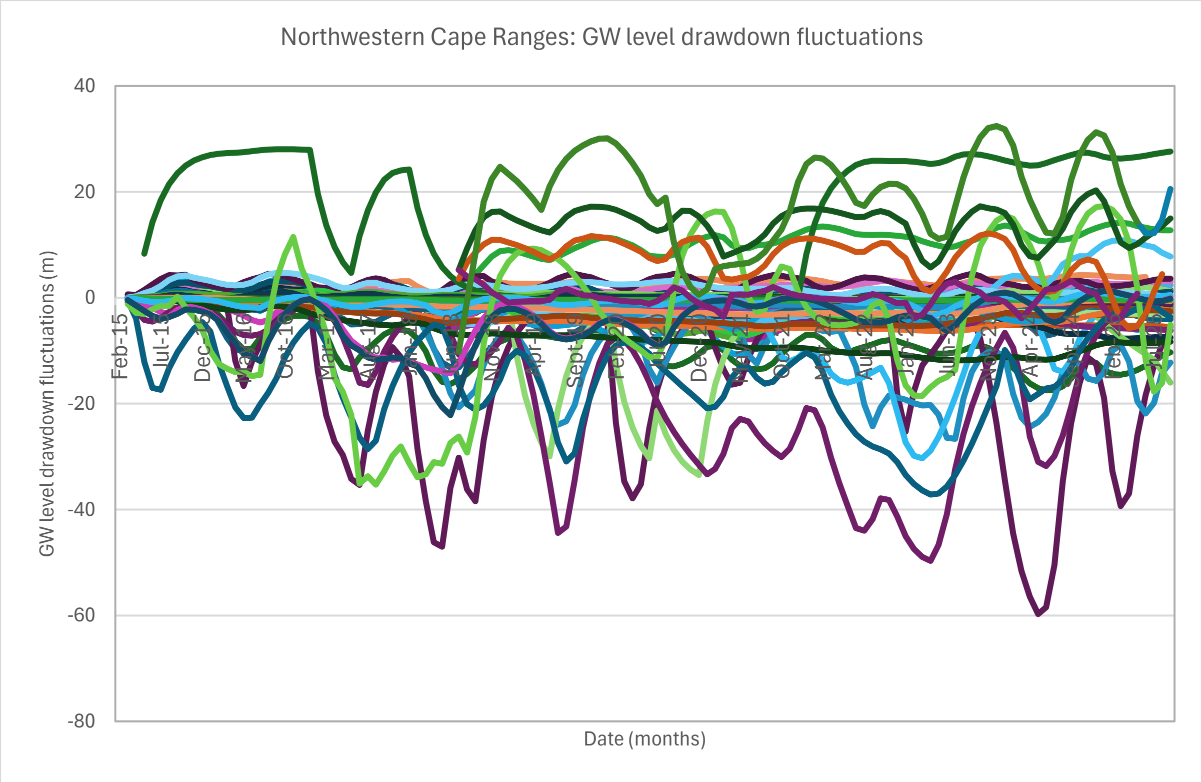


Figure 41: Groundwater level fluctuations for the Northwestern Cape Ranges boreholes

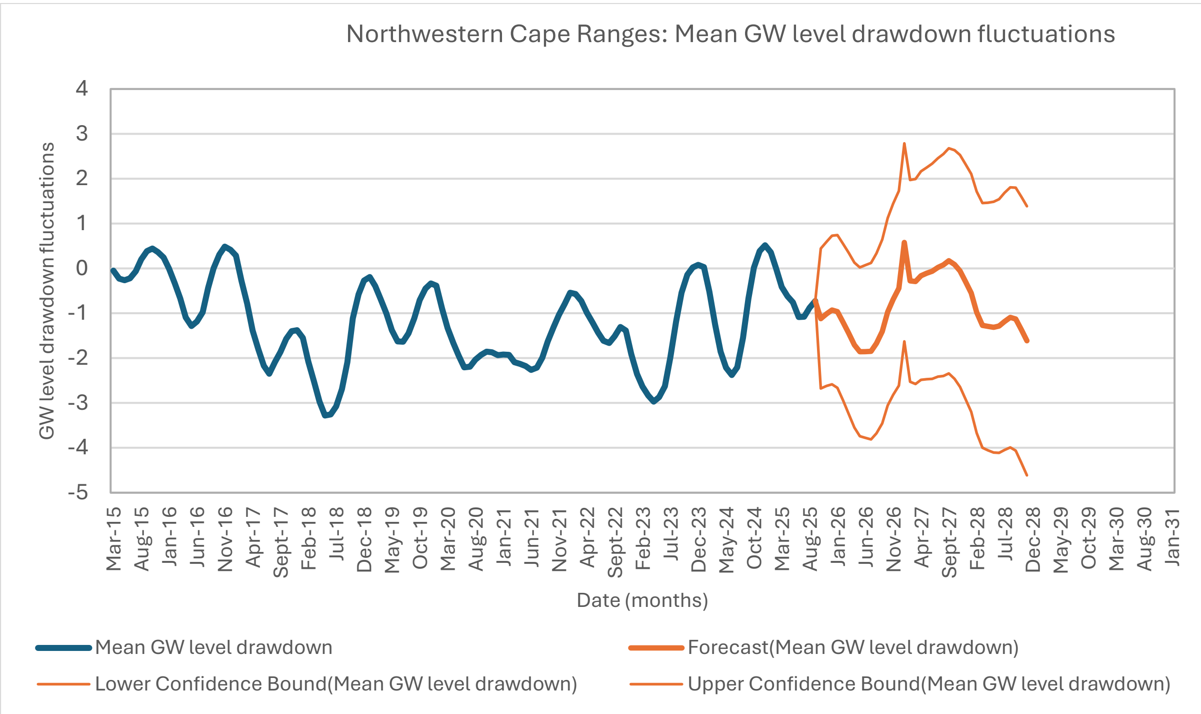


Figure 42: The mean groundwater level drawdown fluctuations for the Northwestern Cape Ranges

3.14 The Knersvlakte Hydrogeological Region

The Knersvlate Hydrogeological Region lies in the northernmost part of the Western Cape Province. The small town of Bitterfontein forms the northern border for the region, while to the south, Klawer and the surroundings of Strandfontein serve to form a boundary. To the east, the surrounds of the small town/ village of Nieuwoudtville serve as the border (Figure 43).

The monitoring borehole distribution for this region is mostly clustered to the south, with just about 2 boreholes existing or representing the northern side of the hydrogeological region (Figure 43). An upgrade of the monitoring programme for this region is required so that the central, the eastern and the western sides are represented as well.

The rainfall pattern over a 10-yr monitoring period resembles what has been observed with other regions i.e. low rainfall between 2015 and 2021 and significantly wetter years from mid 2021up to date (Figure 44). Such dry and wet years would significantly impact groundwater levels for region.

The above is evident in Figure 45 where a consistent and significant decline in water level drawdown trend of this region was observed from most observed boreholes until February 2023. The year 2023 is when an inflection point was recorded, with upward fluctuations noted. This, however, still indicated no improvement in the groundwater reservoir for the region as most water levels still recorded an overall negative trend. This is represented clearly in Figure 46 which shows the average groundwater level fluctuations (which are below the initial water level) for the region and further downward water level drawdown trend projections**. A close monitoring of the groundwater levels and water usage in this region needs to be done to avoid long-term impact on groundwater availability**.

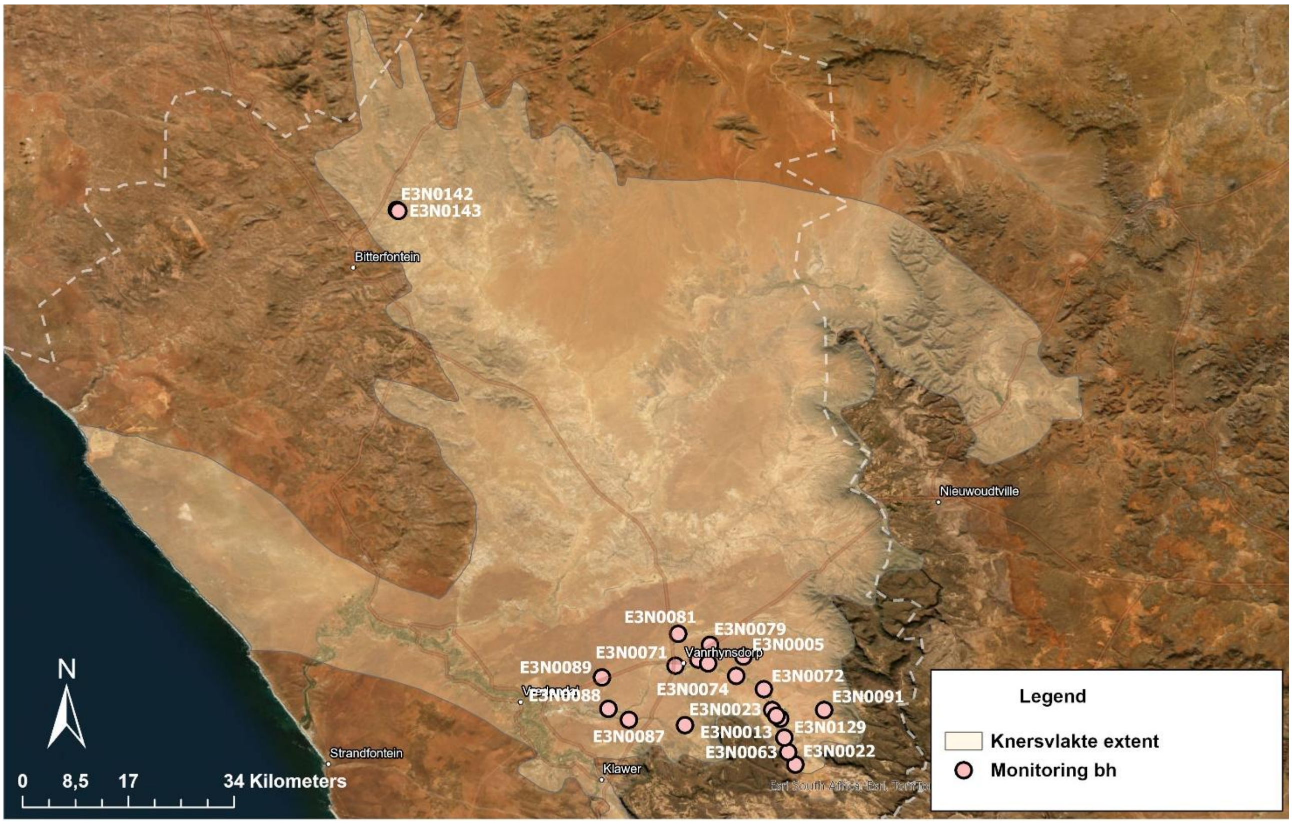


Figure 43: An extent of the Knersvlate Hydrogeological Region and its monitoring boreholes

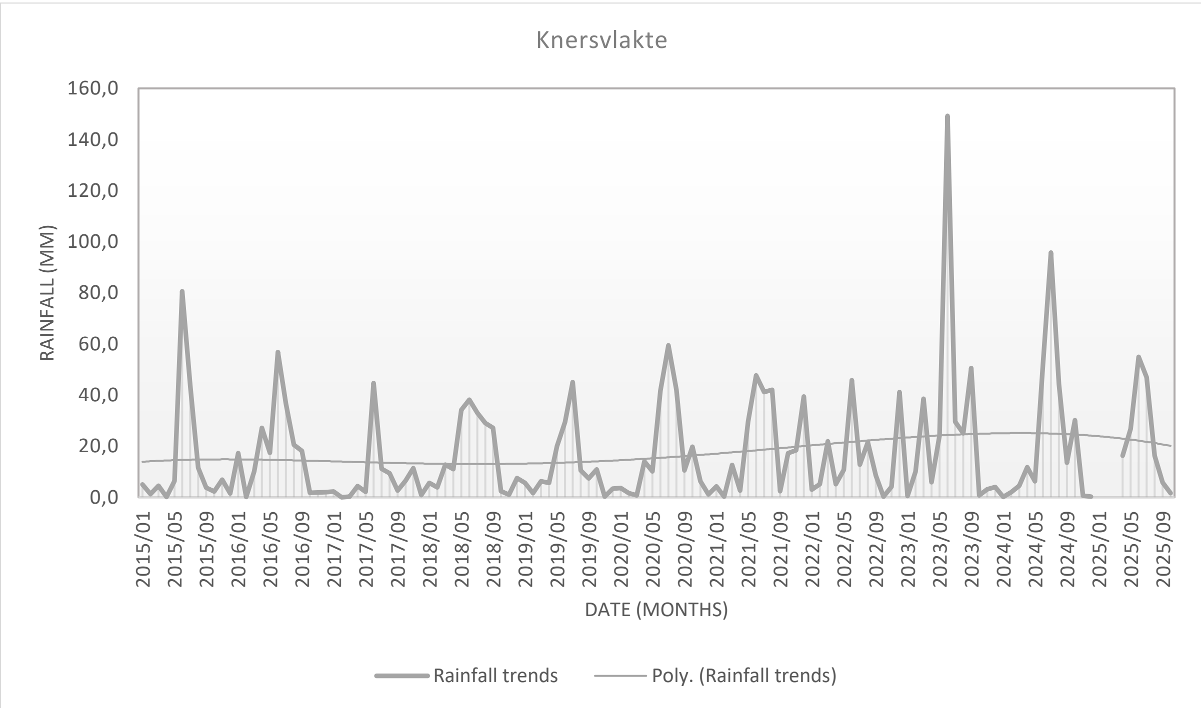


Figure 44: Rainfall trends for the Knersvlakte Hydrogeological Region

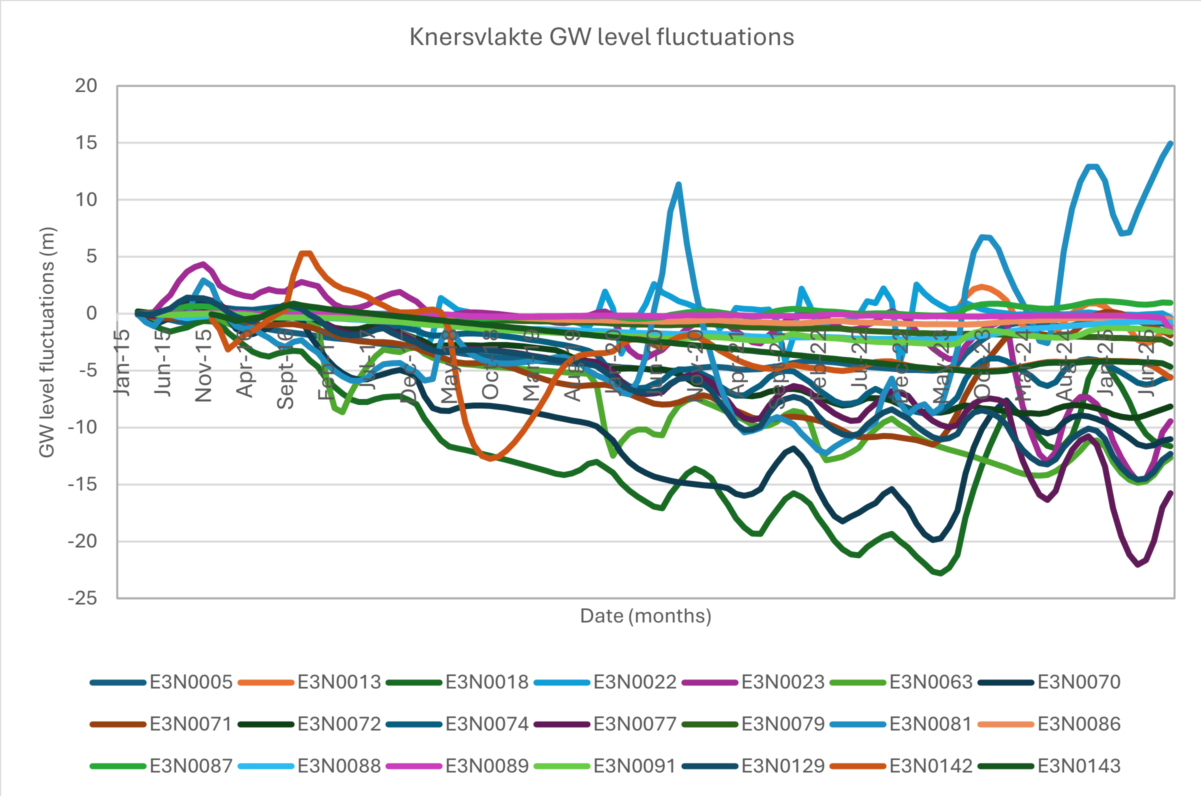


Figure 45: Groundwater level drawdown fluctuations for the Knersvlakte boreholes

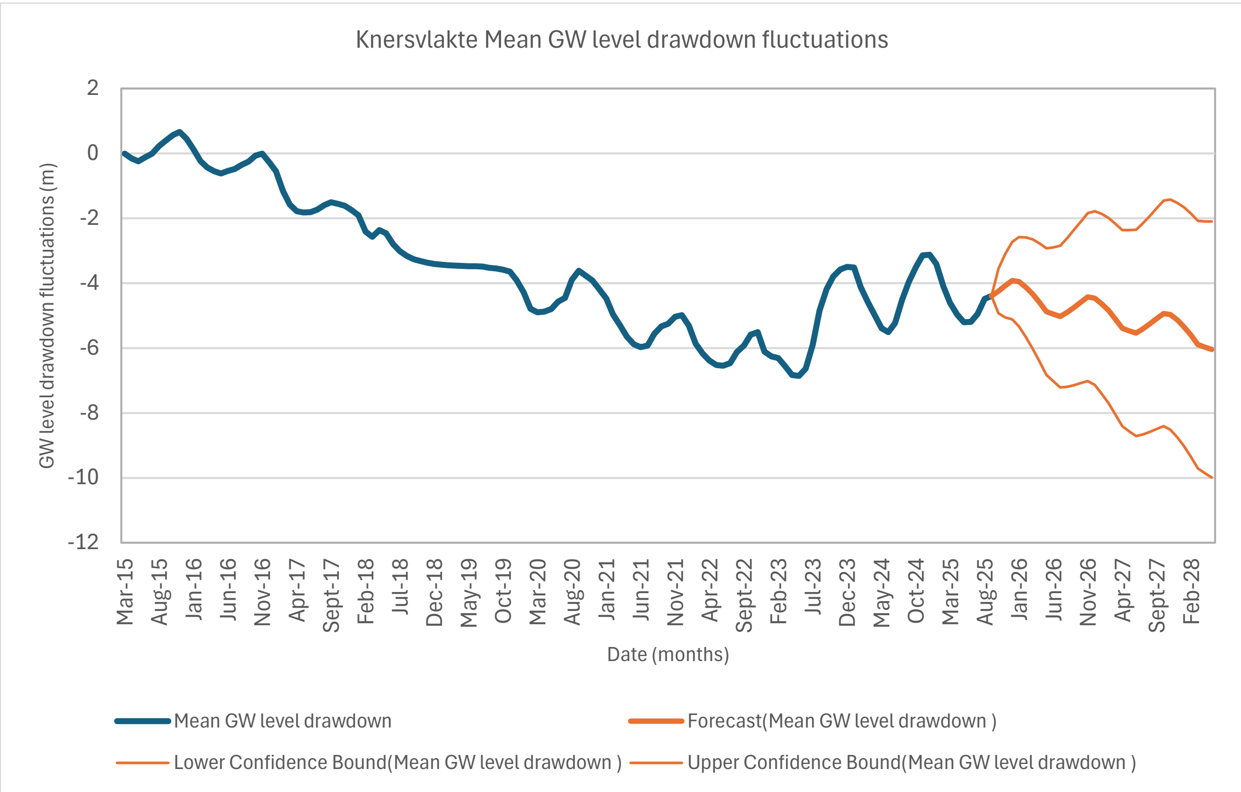


Figure 46: The mean groundwater level drawdown fluctuations for the Knersvlakte Hydrogeological Region

3.15 The Namaqualand Hydrogeological Region

The Namaqualand Hydrogeological region largely falls in the Northern Cape Province, with its southern parts feature in the Western Cape Province. It stretches along the west coast from Bitterfontein up north to the Namibian border (Figure 47).

The monitoring boreholes are evenly spread across the region offering a good representation of groundwater conditions (Figure 47). **Despite this, the consistency in monitoring is lacking; as a result, there are many data gaps with groundwater dataset for the Namaqualand region. This needs to be given much attention by the monitoring team.**

The rainfall trends suggest increasing intensity observed from April 2020 to date compared to the previous years, dating back to 2015 (

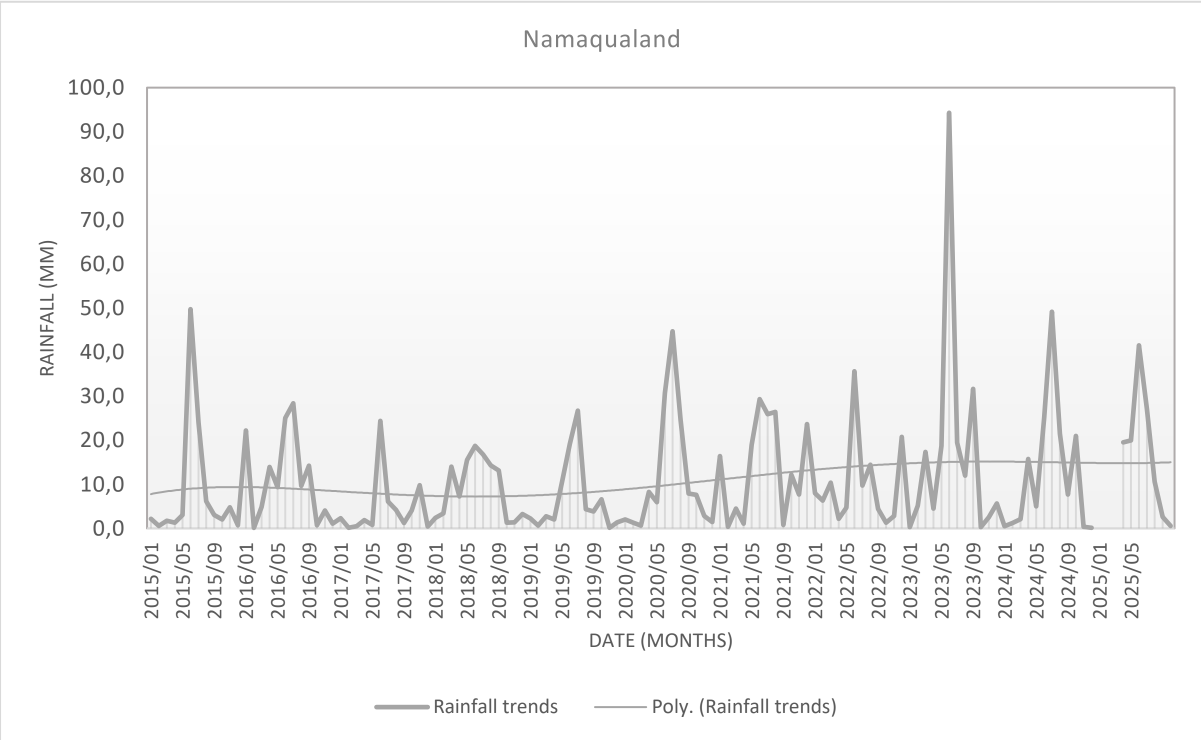


Figure 48). This significance of the experienced rains in the region is observed with groundwater level response from July 2022 where a positive response to groundwater level drawdown is observed from most of the boreholes (Figure 49 and Figure 50). Prior to this period, boreholes F5N0509 and F5N0512 experienced a significant downward water level drawdown in the range of 10-20m. This could be a response to a combination of low rainfall and human-induced factors. Notwithstanding the observed historic decline in drawdown trends, the groundwater resource fully recovered and serves as a vital source of water supply for this region (Figure 50).

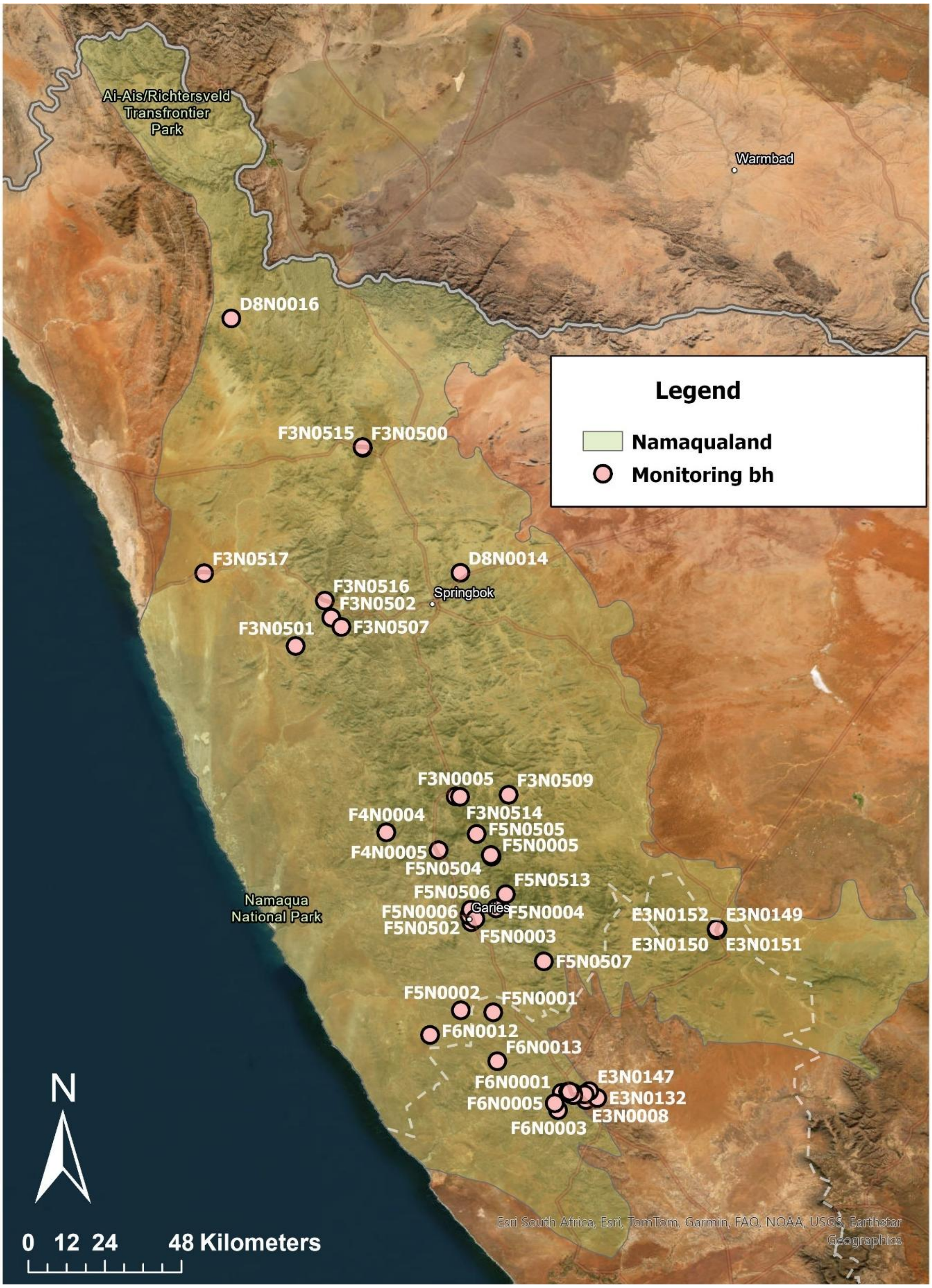


Figure 47: The Namaqualand Hydrogeological Region and its monitoring boreholes

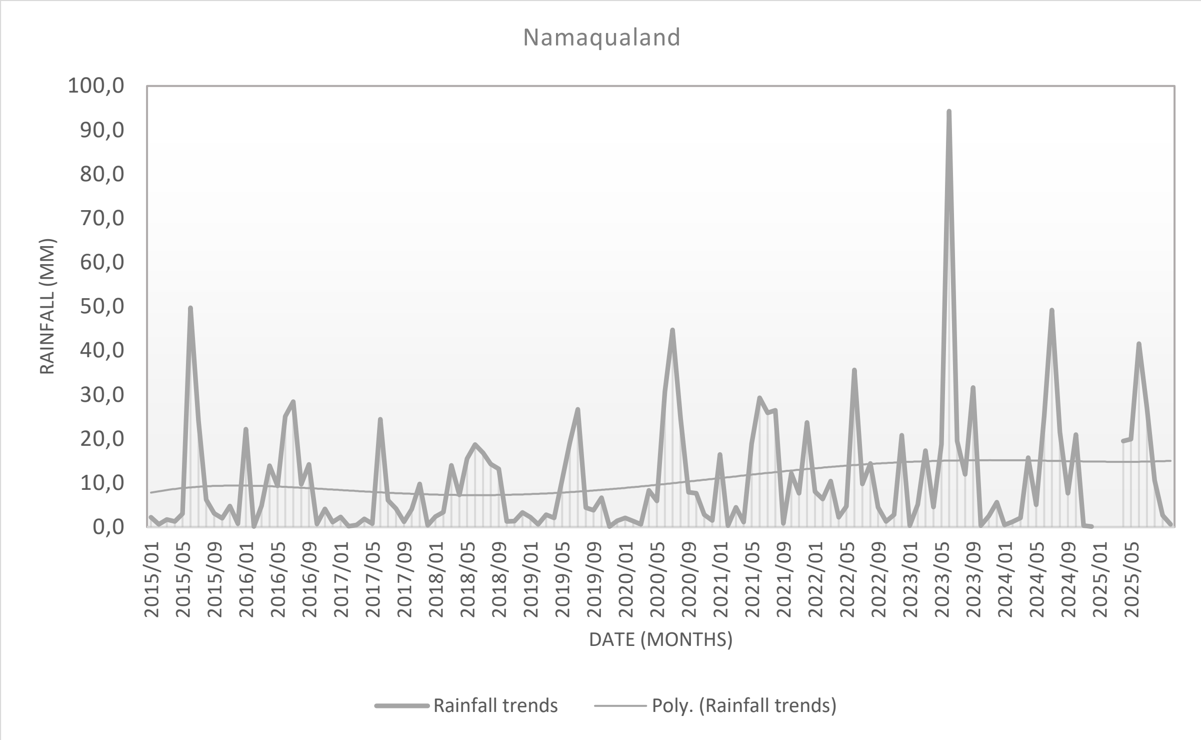


Figure 48: Rainfall trends for the Namaqualand Region

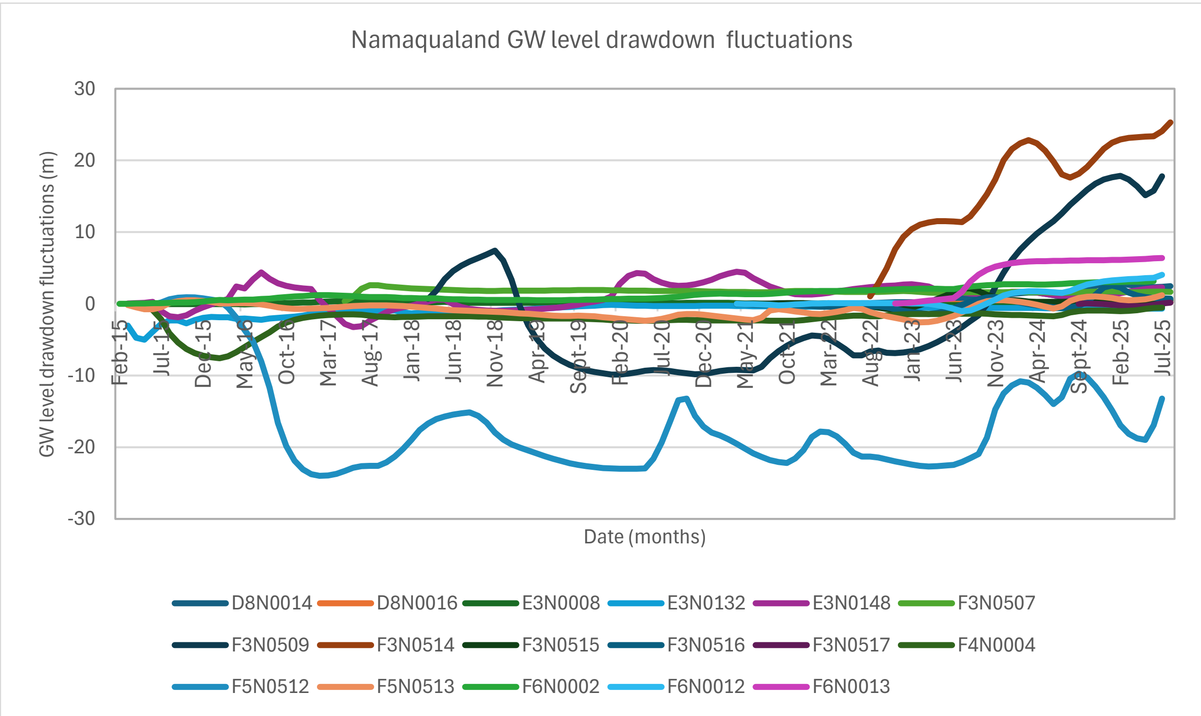


Figure 49: Groundwater level drawdown fluctuations for the Namaqualand Region

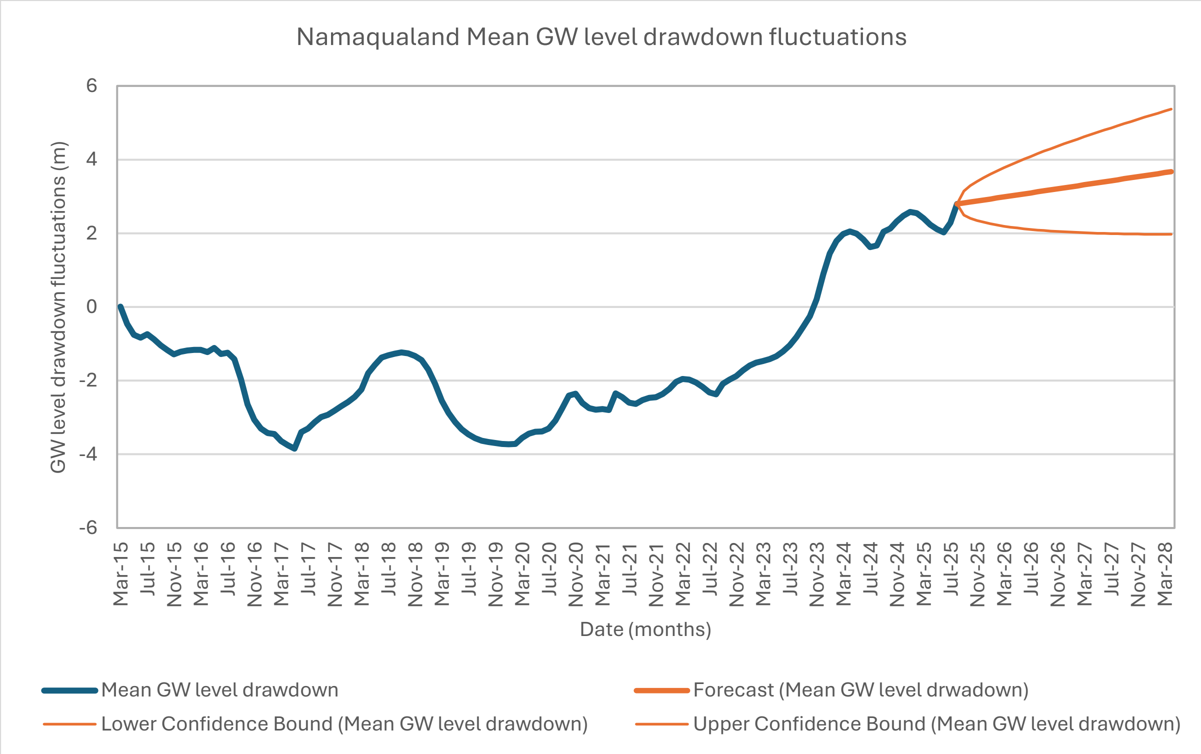


Figure 50: The mean groundwater level drawdown fluctuations for the Namaqualand Hydrogeological Region

3.16 The Richtersveld Hydrogeological Region

The extent of Richsterveld hydrogeological region is shown in Figure 51. It stretches along west coast from Kleinzee to Alexander Bay in the north. The Orange River serves as its northern border while the eastern side is made up of the western border of Namaqualand Hydrogeological Region presented in section 3.16 (Figure 51). This hydrogeological region is represented by three monitoring boreholes. No meaningful assessment can be made based on this limited information. The monitoring programme for this region needs to be reviewed and expanded to ensure full representation of groundwater conditions.

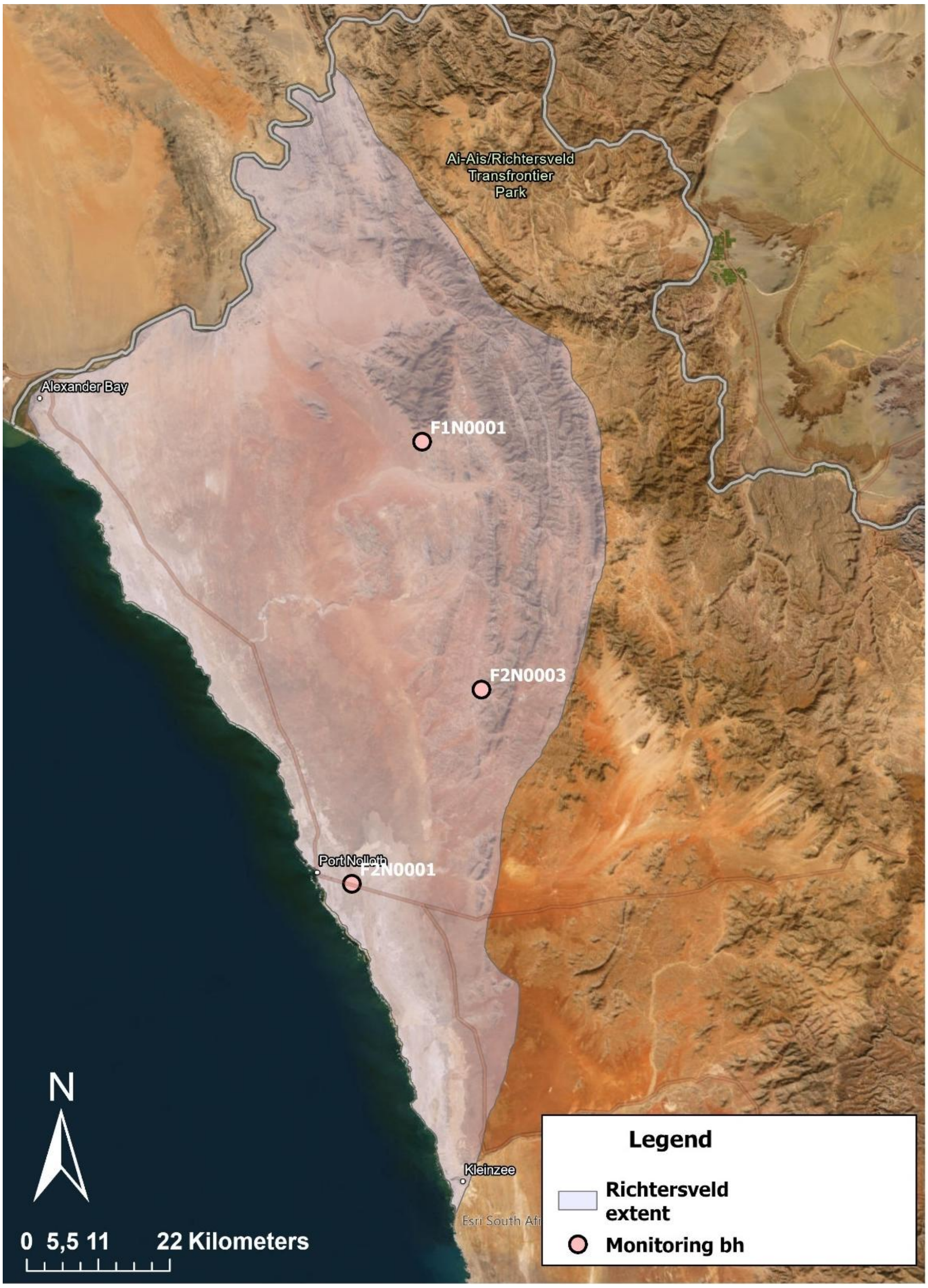


Figure 51: The extent of the Richtersveld Hydrogeological Regions and its monitoring boreholes.

3.17 The Hantam Hydrogeological Region

Located just north of the Tankwa National Park is the Hantam Hydrogeological Region. It houses the town of Calvinia and Niewoudtville to the southeast and southwest respectively, and Lorriesfontein to the east. The monitoring borehole distribution for this region isn't spectacular. Few boreholes are clustered in the towns of Calvinia and Niewoudtville, and two centrally. A review and optimization of the monitoring programme is needed for this region.

The rainfall trends indicated a downward trend in intensity from 2015 to 2019 September thereafter the region has been enjoying a relatively higher rainfall up to date (Figure 52).

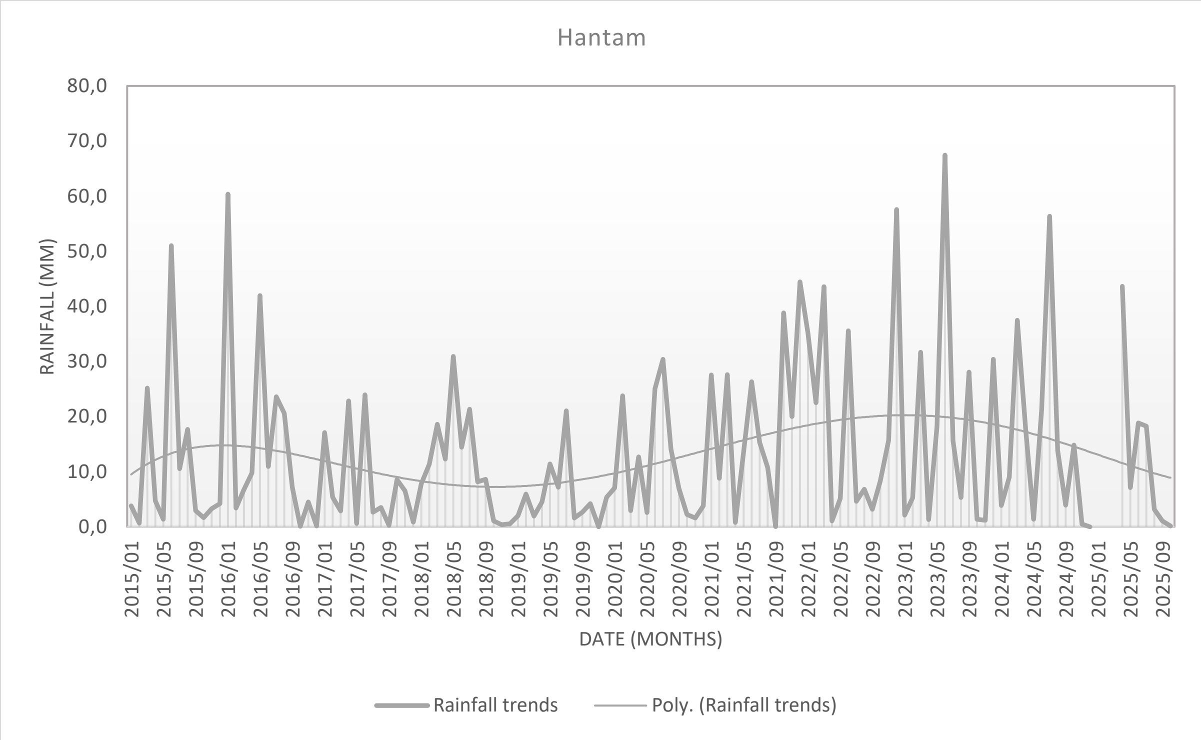


Figure 52: Rainfall trends for the Hantam Hydrogeological Region

The groundwater levels for this region have generally responded to rainfall patterns. Several boreholes indicated declining / negative water level drawdown fluctuation since the beginning of the observation period (2015) (Figure 54). This continued until mid-2021 when an inflection point was observed, in response to rainfall recharge. This periodic decline and rise in water level drawdown trends is clearly depicted in Figure 55 which shows the mean groundwater level drawdown for the region. In essence the groundwater status for this region can be said to be in its recovering state. Management of abstraction is needed when drier periods are experienced.

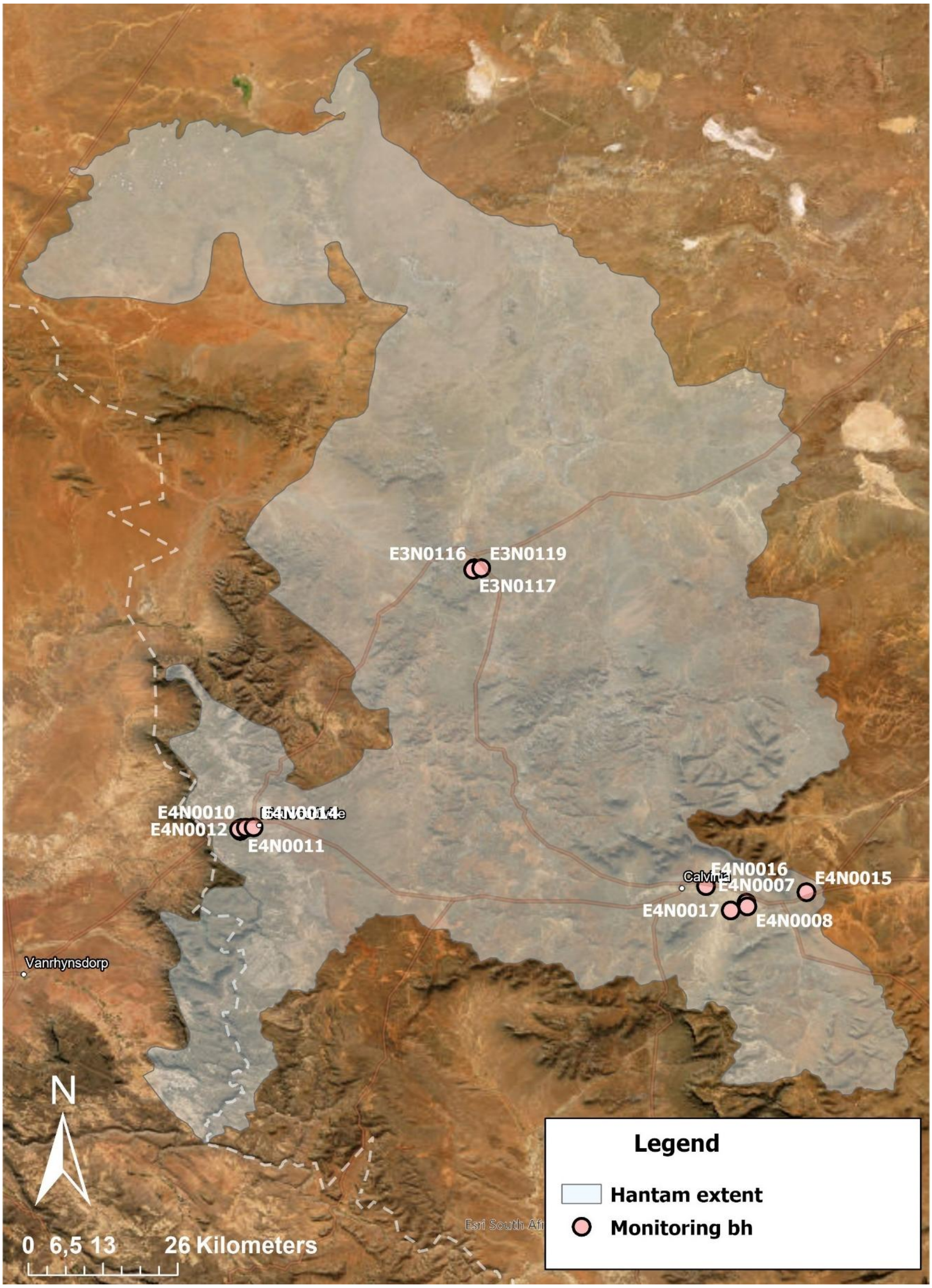


Figure 53: An extent of the Hantam Hydrogeological Region and its monitoring boreholes

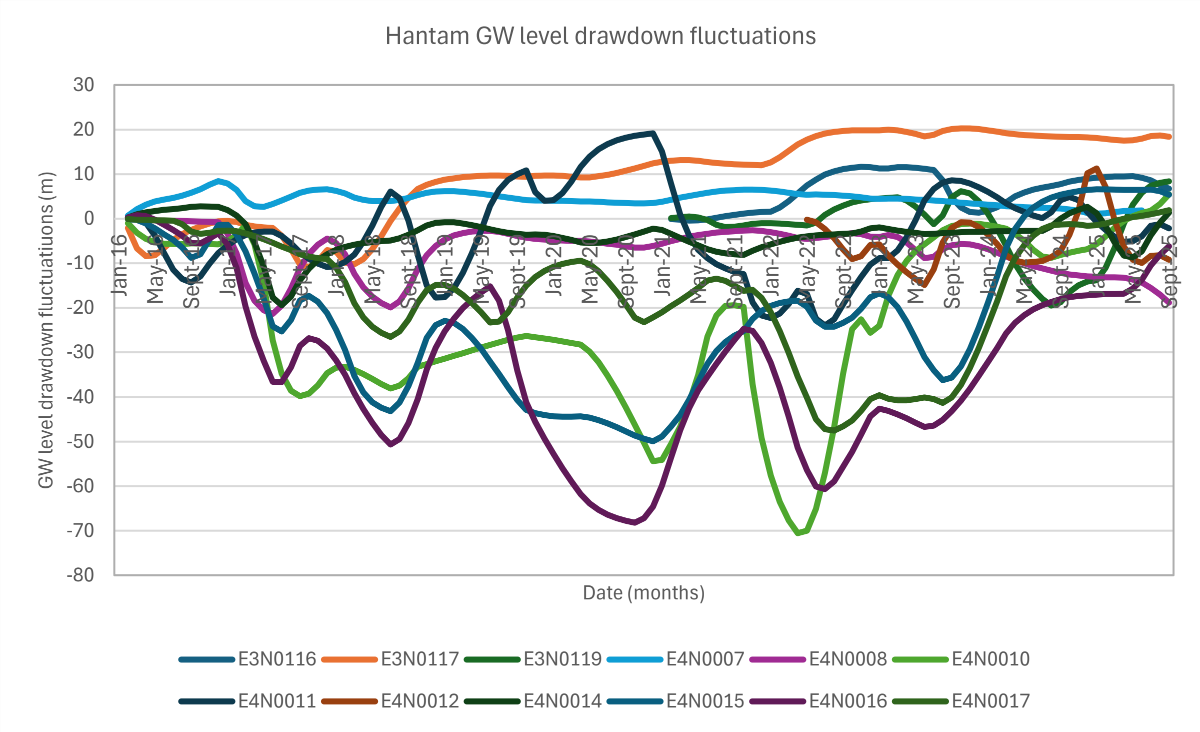


Figure 54: Groundwater level drawdown fluctuations for the Hantam Region boreholes

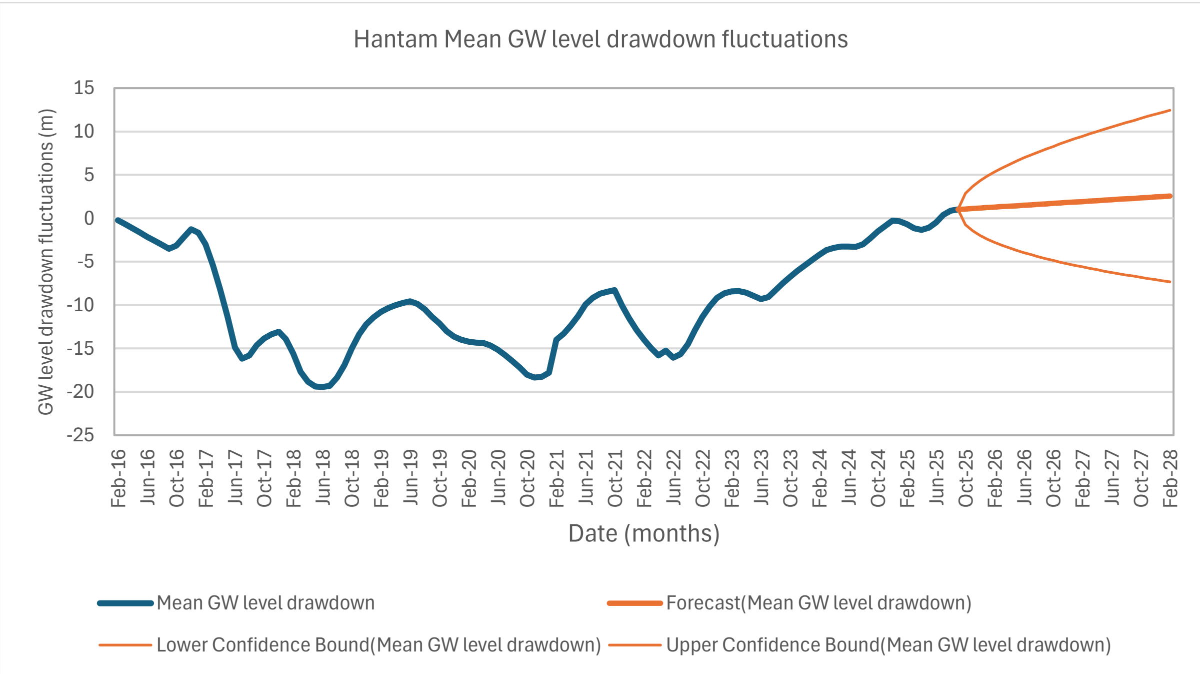


Figure 55: The mean groundwater level drawdown for the Hantam Hydrogeological Region

3.18 The Western Upper Karoo Hydrogeological Region

The Western Upper Karoo Hydrogeological Region lies northwest of Beaufort West. To the north the small towns of Carmovon and Williston border the region while to west Calvinia lies (Figure 56). The monitoring boreholes for the Western Upper Karoo region seem to be located along the routes bisecting this region (Figure 56). As a result, certain areas are left underrepresented. It's unclear whether other areas are not accessible to have monitoring boreholes. The monitoring programme needs to be optimized so that a good distribution can be achieved.

The rainfall patterns showed a dip/ decline around 2017- to 2019, suggesting lower rainfall experienced in the region at the time (Figure 57). This was followed by relatively higher rainfall until 2023, with latter part of 2023 suggesting another cycle of rainfall decline. The groundwater level drawn down trends of the boreholes for this region responded to these cycles (although with a delayed response, as expected). The period of higher rainfall also saw a rise in trends unlike the period between June 2018 to February 2022 (Figure 58). This holds true for all the observed boreholes except for borehole D5N0597 which had remained with positive levels over the periods of less rainfall and started showing decline in June 2024. This could possibly mean that this borehole is tapping water from a different aquifer system (possibly deep aquifer) than the rest of the boreholes, hence the delayed response to groundwater stressors. The mentioned cycles of groundwater level drawdown rise and decline (in response to rainfall recharge) are clearly indicated in Figure 59 which shows the average groundwater level drawdown fluctuations for the region. In essence, the groundwater level trends for the Western Upper Karoo are mostly influenced by environmental stressors more than the anthropogenic activities. The latest trends revealed a downward trend for the region, achieving stabilization just above the initial water levels (Figure 59). No immediate interventions are recommended for this groundwater region.

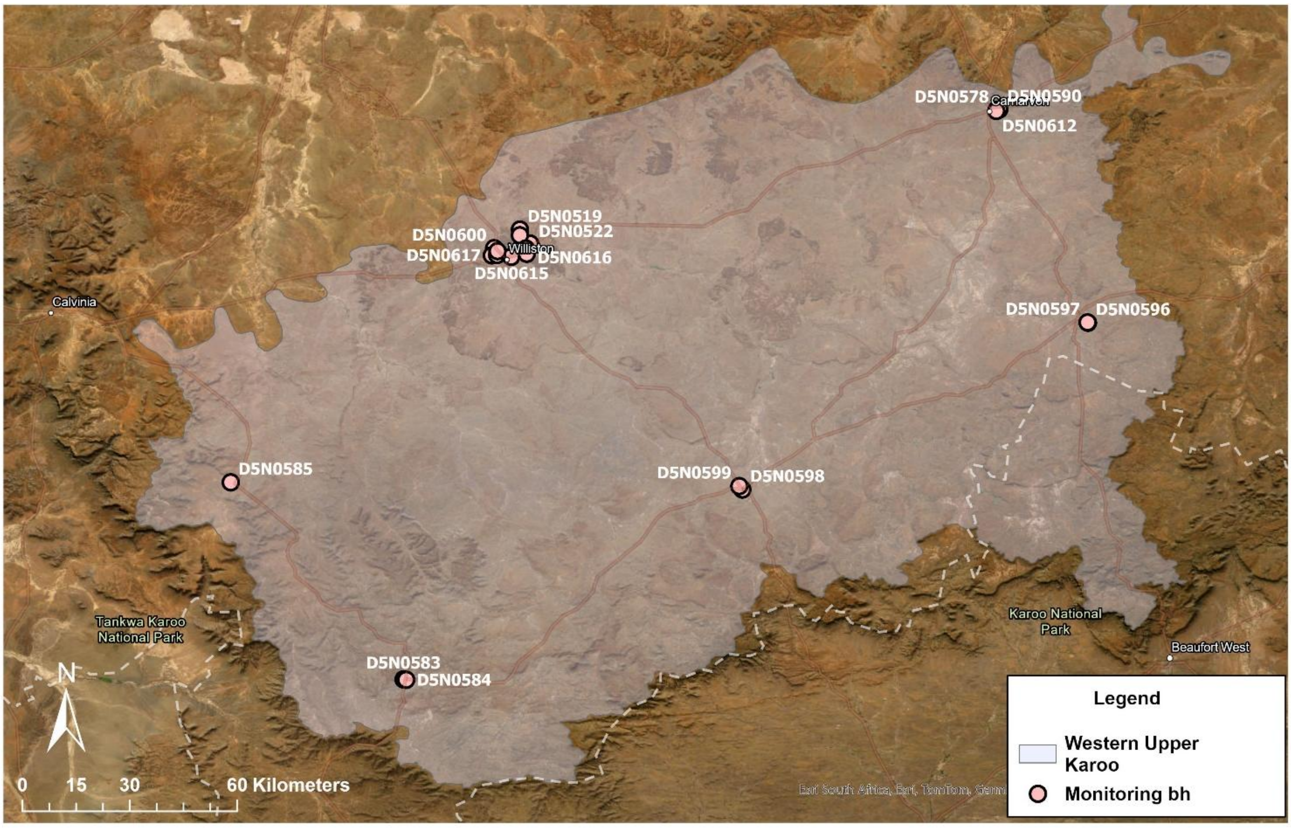


Figure 56: The Western Upper Karoo Hydrogeological Region extent and its monitoring boreholes

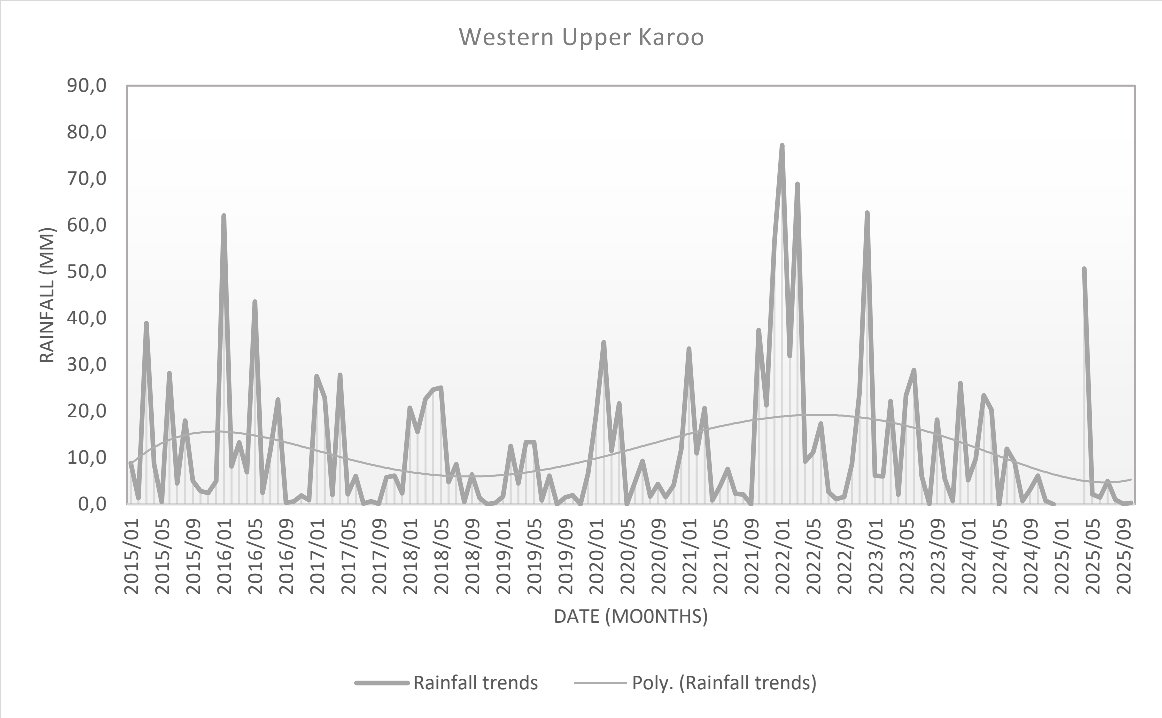


Figure 57: Rainfall trends for the Western Upper Karoo Hydrogeological Region

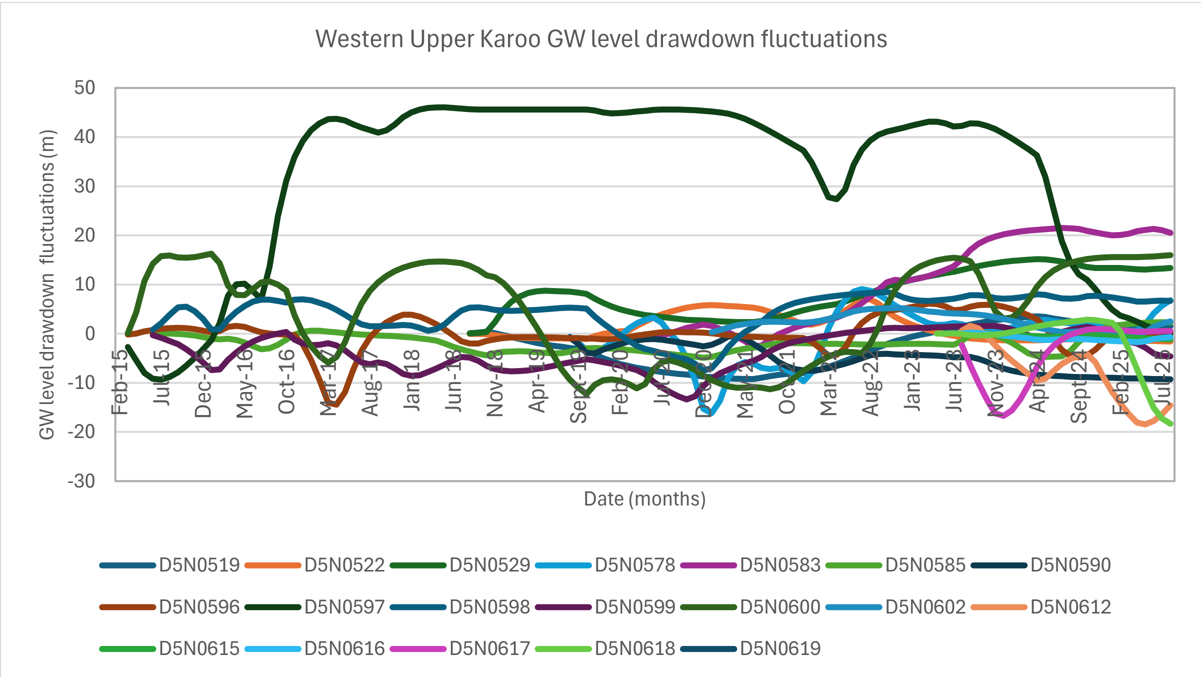


Figure 58: Groundwater level drawdown fluctuations for the Western upper Karoo Hydrogeological Region boreholes

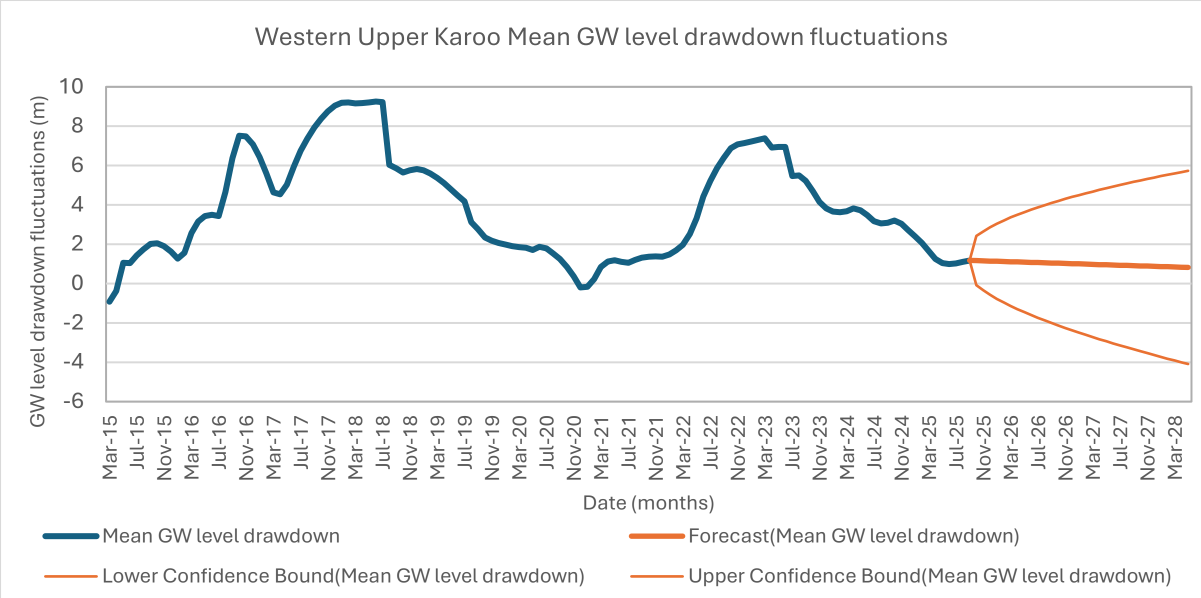


Figure 59: Mean groundwater level drawdown fluctuations for the Western Karoo Hydrogeological Region

3.19 The Bushmaland Pan Belt Hydrogeological Region

The Bushmanland Pan Belt Hydrogeological Region lies just north of Calvinia and Williston and stretches further up north to just south of Pofadder (Figure 60). Its monitoring boreholes are clustered to the south and eastern side, leaving the northern and western side underrepresented. The monitoring programme for this region needs to be reviewed and improved.

The rainfall patterns resemble the Upper Western Karoo with significant rainfall experienced between early 2020 and early to mid-2024. It is the same time that some boreholes e.g. D5N0592 and D5N0607 started showing upward groundwater drawdown fluctuations, rising to initial water levels. This phenomenon is also demonstrated by the mean groundwater levels depicted in Figure 62. Borehole D5N0607 didn't remain with rising groundwater level drawdown trends for long as it showed decline from September 2023 to date. Overall, the latest groundwater level drawdown for this region has reached a steady state below the initial water levels (Figure 62). Monitoring needs to continue to observe the response of this groundwater system.

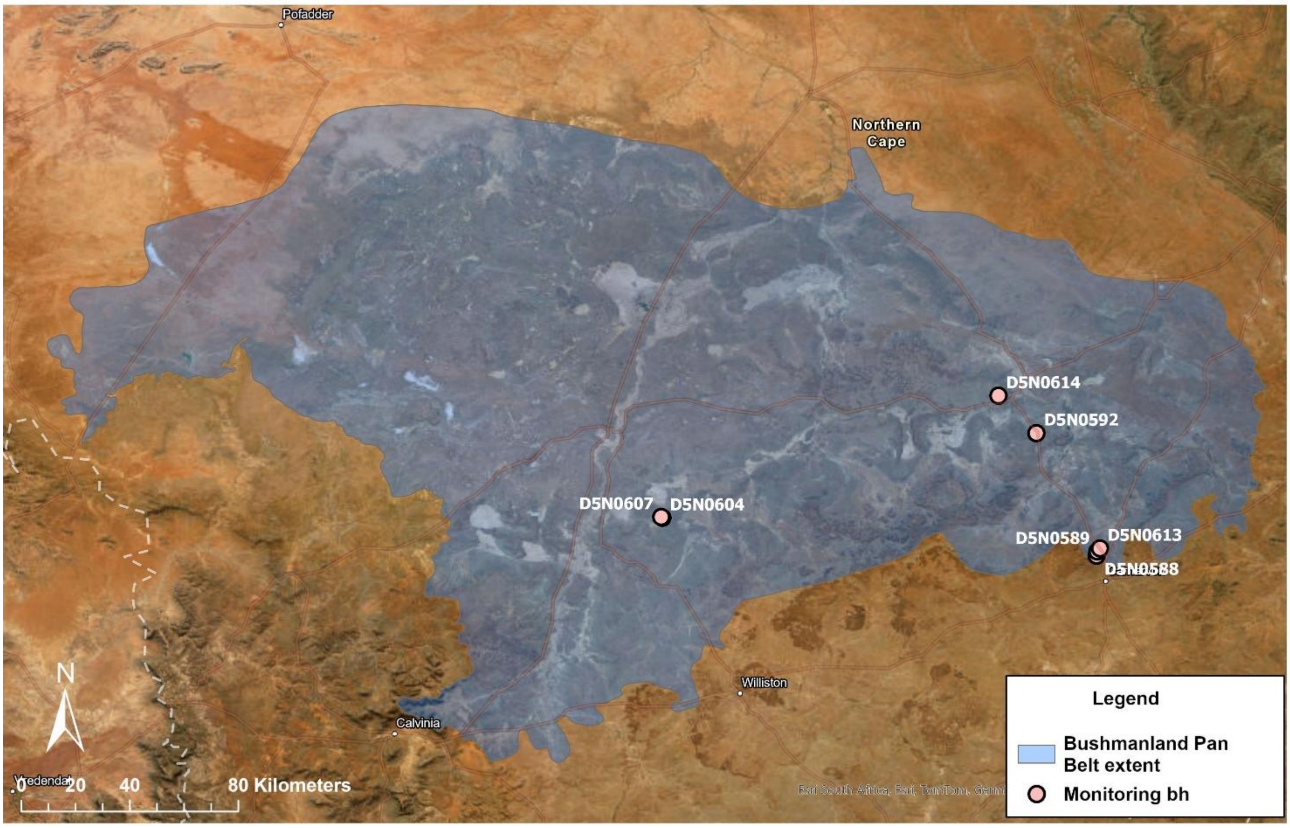
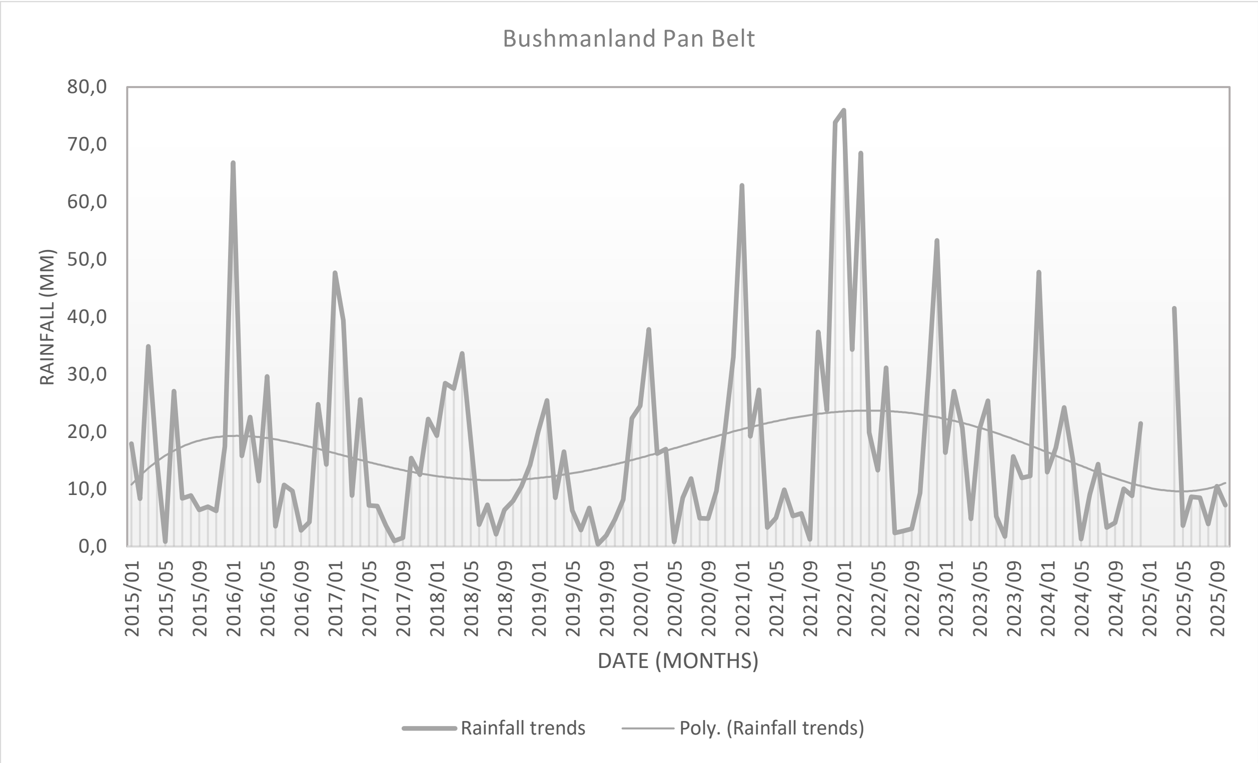


Figure 60: An extent of the Bushmanland Pan Belt Hydrogeological Region and its monitoring boreholes



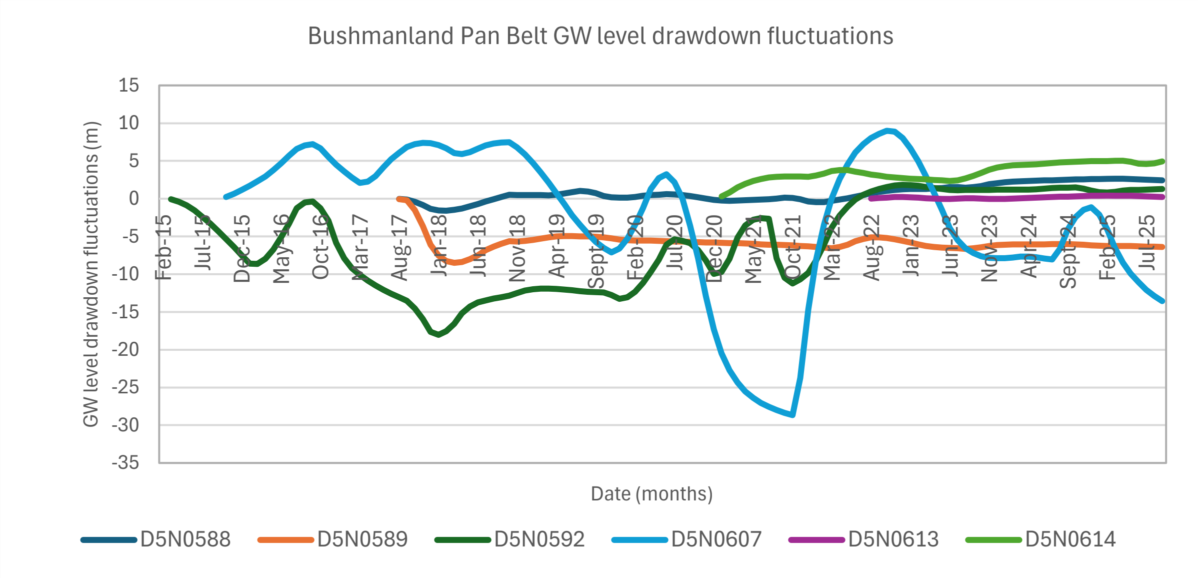


Figure 61: Groundwater level drawdown fluctuations for Bushmanland Pan Belt Hydrogeological Region boreholes

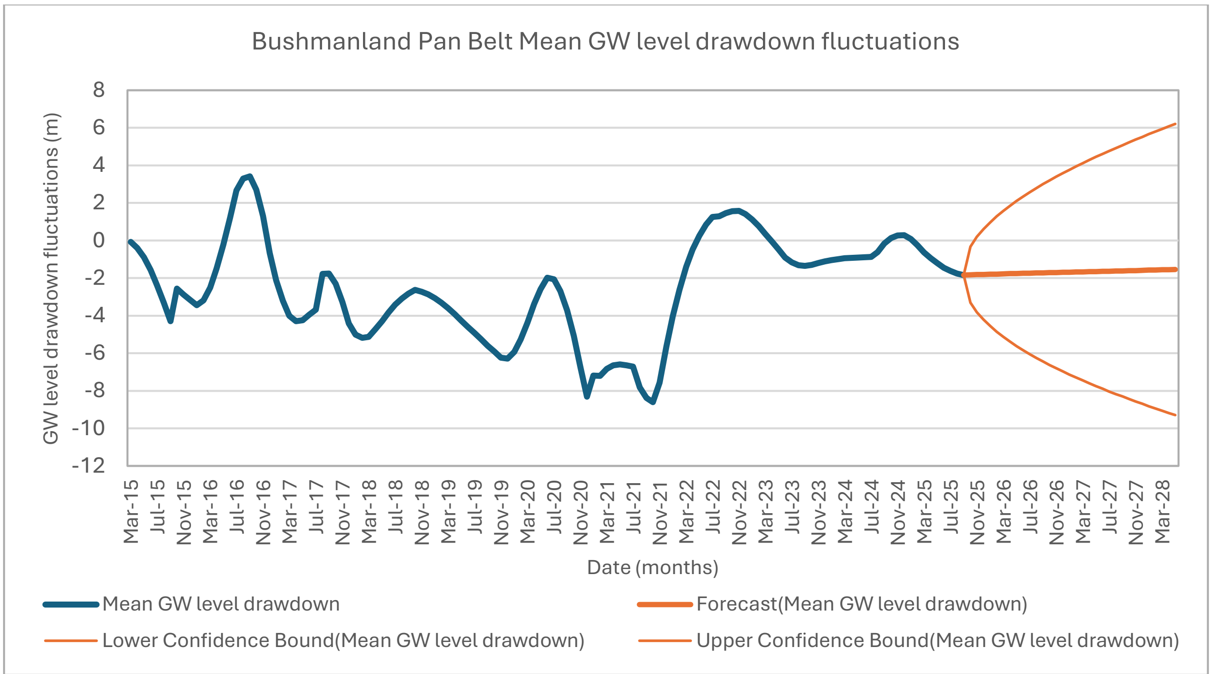


Figure 62: Mean groundwater level drawdown fluctuations for the Bushmanland Pan Belt Hydrogeological Region

3.20 The Bushmanland Hydrogeological Region

The Bushmanland Hydrogeological Region lies along the Namibia/ South Africa national border on the northwestern side and extends from the surrounds of Springbok on the western side to Prieska in the east whilst Upington and Grobblershoop border it to the north and northeast (Figure 63). There are not many monitoring boreholes for this region. It would benefit to a review so that there is representation to the far west, south and northeast (Figure 63).

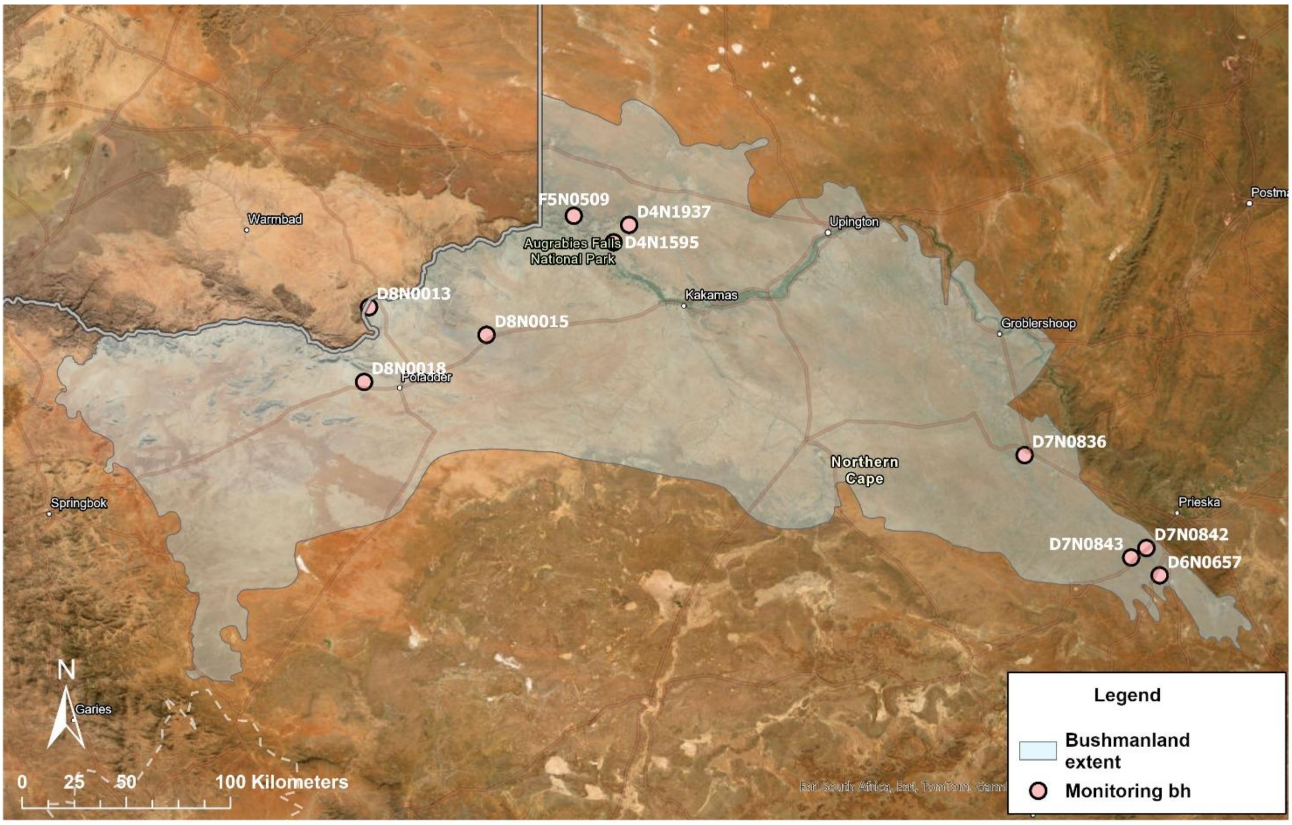


Figure 63: Monitoring borehole distribution for the Bushmanland Hydrogeological Region and its extent

The rainfall trends for the region indicated a reasonable amount of rainfall experienced from 2015 to May 2017 whereafter a dip in intensity of rainfall was observed until early 2020 (Figure 64). This period of less rainfall is evident with groundwater level drawdown trends where a slight decline was observed until June 2020 (from boreholes D4N1937 and F5N0507) which were the only boreholes monitored at the time (Figure 65). Thereafter, more boreholes were introduced in the monitoring programme. These boreholes maintained a slight increase to horizontal trends. An exception was noted with D4N1937 and D4N1595, the two neighbouring boreholes whose water levels declined sharply from June 2022 to February 2023, though good rains were experienced at the time (Figure 65). Anthropogenic impacts are attributed to the observed decline in water levels of these boreholes. Borehole D4N1937 managed to recover while D4N1595 maintained a downward trend with about 25m water level loss (Figure 65).

The mean groundwater level drawdown for the region in Figure 66 shows a declining trend in response to lower rainfall prevalent since 2023 to date. Closer monitoring needs to be done for the groundwater levels of this region as the prevailing drawdown trends are downward.

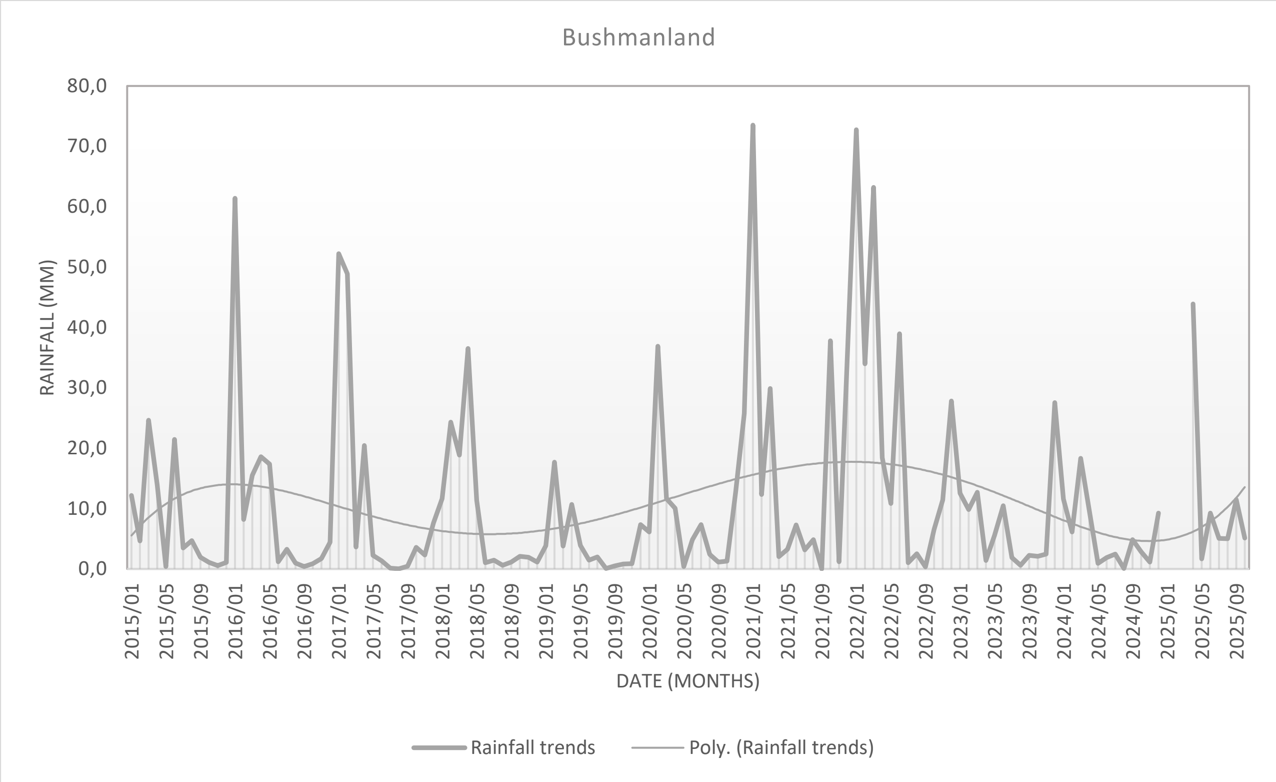


Figure 64: Rainfall trends for the Bushmanland Hydrogeological Region

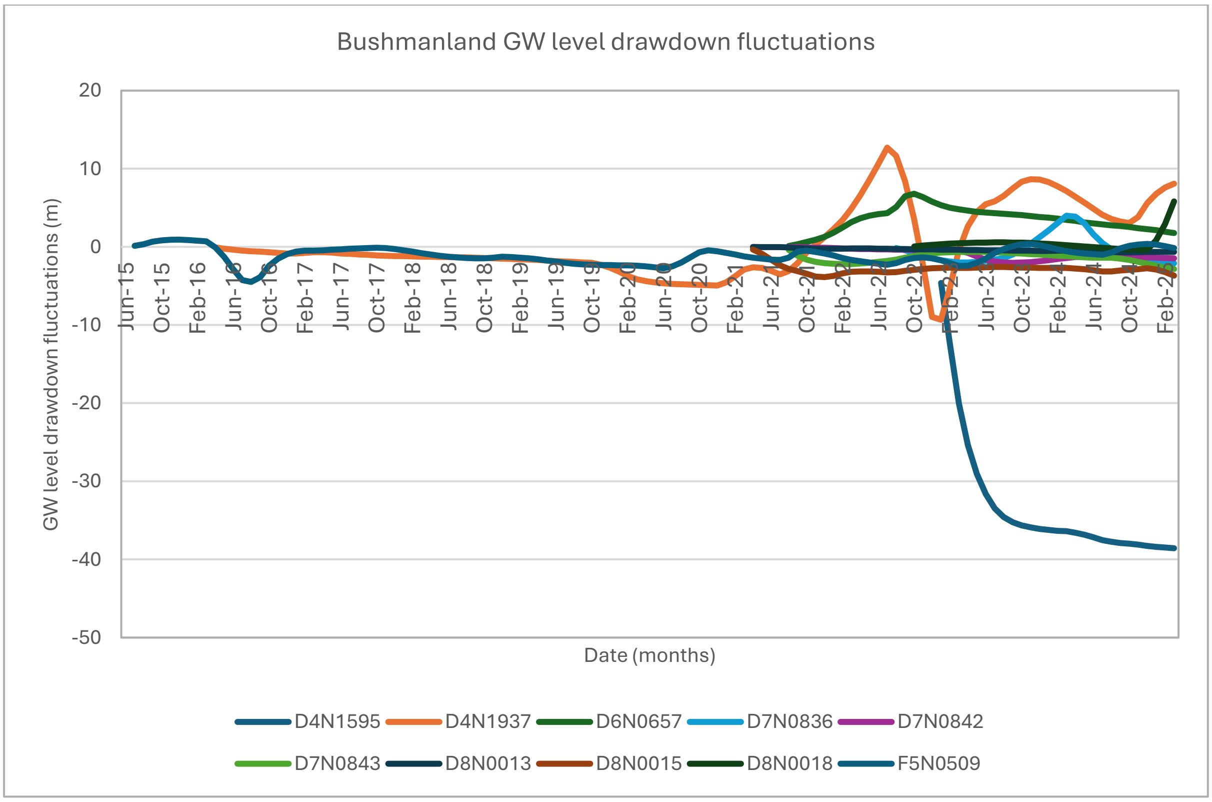


Figure 65: Groundwater level drawdown fluctuations for the Bushmanland Hydrogeological Region boreholes

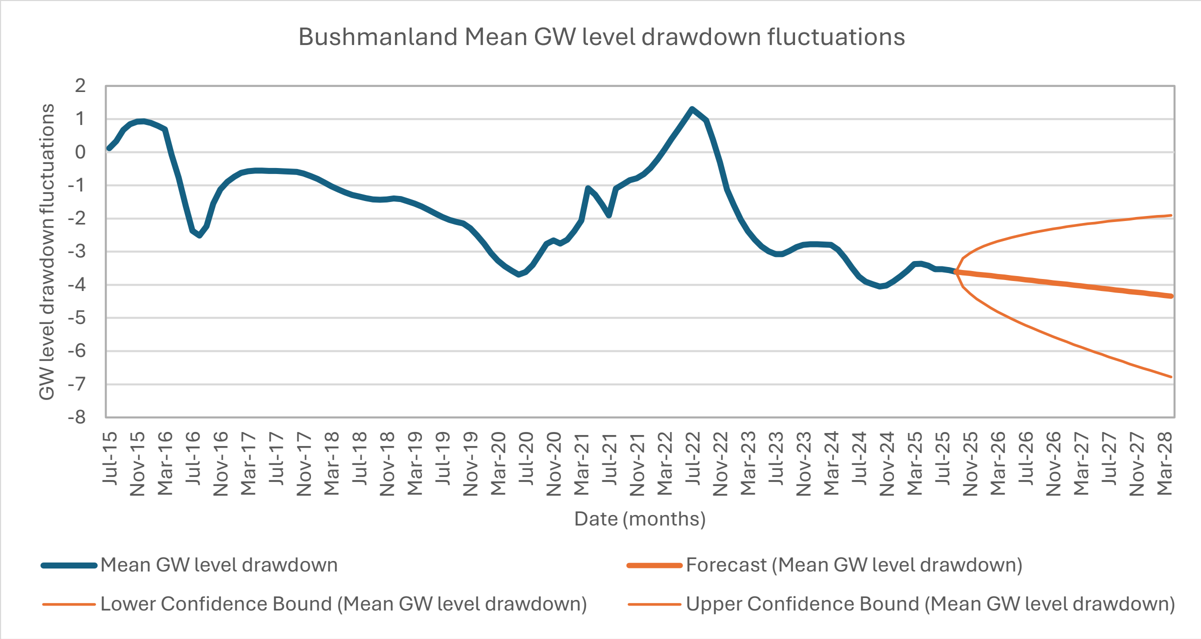


Figure 66: Mean groundwater drawdown levels for the Bushmanland Hydrogeological Region

3.21 The Western Kalahari Hydrogeological Region

The Western Kalahari Hydrogeological Region lies north of the Orange River, bordered on the south eastern side by Upington and Groblershoop, the Olifantshoek mountains to the east, the South Africa/ Namibian national border on the west and the Molopo River on its northern extremities (Figure 67). The borehole distribution is spread across the entire area. However, centrally and to the east, the region could benefit with additional monitoring boreholes (Figure 67).

Although a fair number of monitoring boreholes exist in this region, the monitoring consistency is far below standard. As a result, there are too many data gaps with the existing information to produce any water level trends. Thus far, the information that could be used dates a year back (2024). Therefore, no assessment of water level was done for this region.

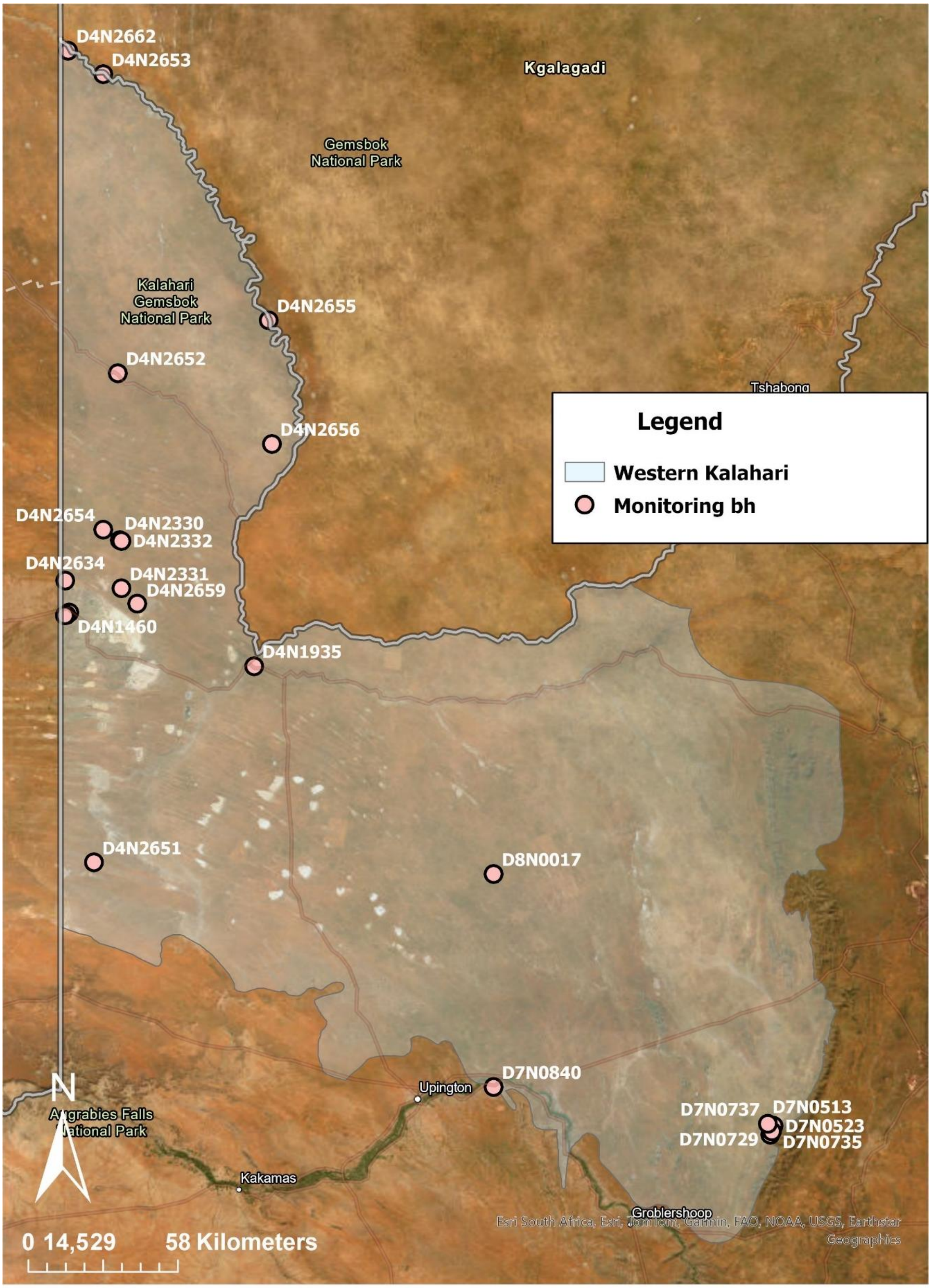


Figure 67: The extent of the Western Kalahari Hydrogeological Region and its monitoring boreholes

3.22 The Eastern Upper Karoo Hydrogeological Region

Just like Northeastern Upper Karoo Hydrogeological Region, the Eastern Upper Karoo Hydrogeological Region lies largely in the Northern Cape Province, although its portions extend to the Eastern Cape and Free State Provinces. Its extent covers the towns such as De Aar, Noupoort and Springfontein to the north (Figure 68).

About 23 boreholes were used for analyses and interpretation of water level data from the boreholes located in the astern Upper Karoo Hydrogeological Region (Figure 68).

Like the other hydrogeological regions, the Eastern Upper Karoo experienced higher rains from 2020, peaking in 2022 before it declined from mid-2023 onwards (Figure 69). The groundwater level assessment will therefore be analyzed from this basis.

Due to data unavailability/ inconsistency, groundwater level analyses could be considered for dataset dating back to 2017. Generally, the groundwater level drawdown trends for the boreholes of Eastern Upper Karoo Hydrogeological region have responded to rainfall cycles with positive fluctuations, above the initial water levels, marking a consistent fluctuating rise with time. Since February 2022, a consistent rise has been maintained observed all in response to rainfall experienced in this region (Figure 70). These trends are supported by the consistently rising mean groundwater level drawdown fluctuations for the region, cementing that the groundwater levels for this area are replenished well (Figure 71). Given the latest information, there are no immediate interventions needed to manage the groundwater resource for this region.

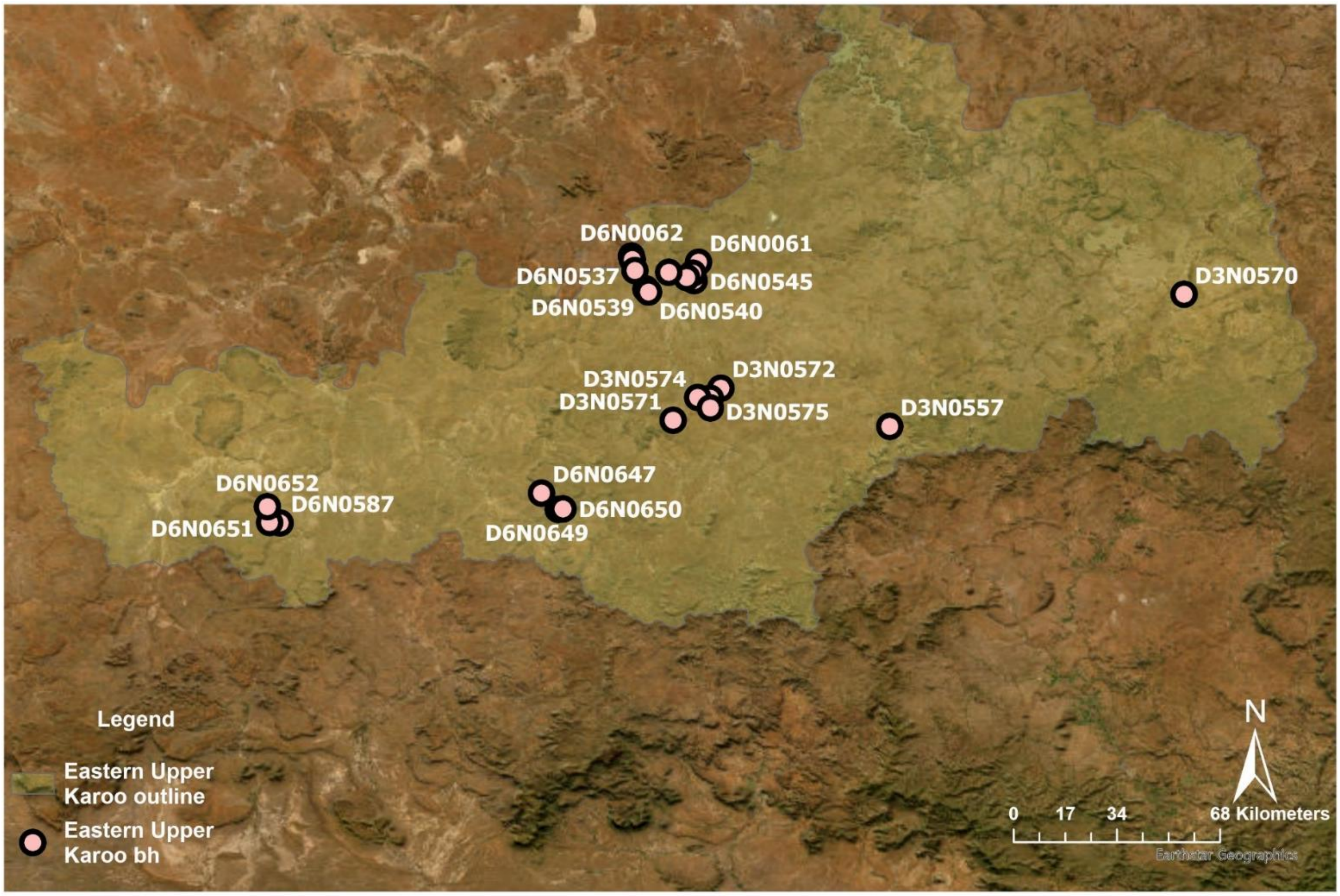


Figure 68: Monitoring borehole distribution and the extent of the Eastern Upper Karoo Hydrogeological Region

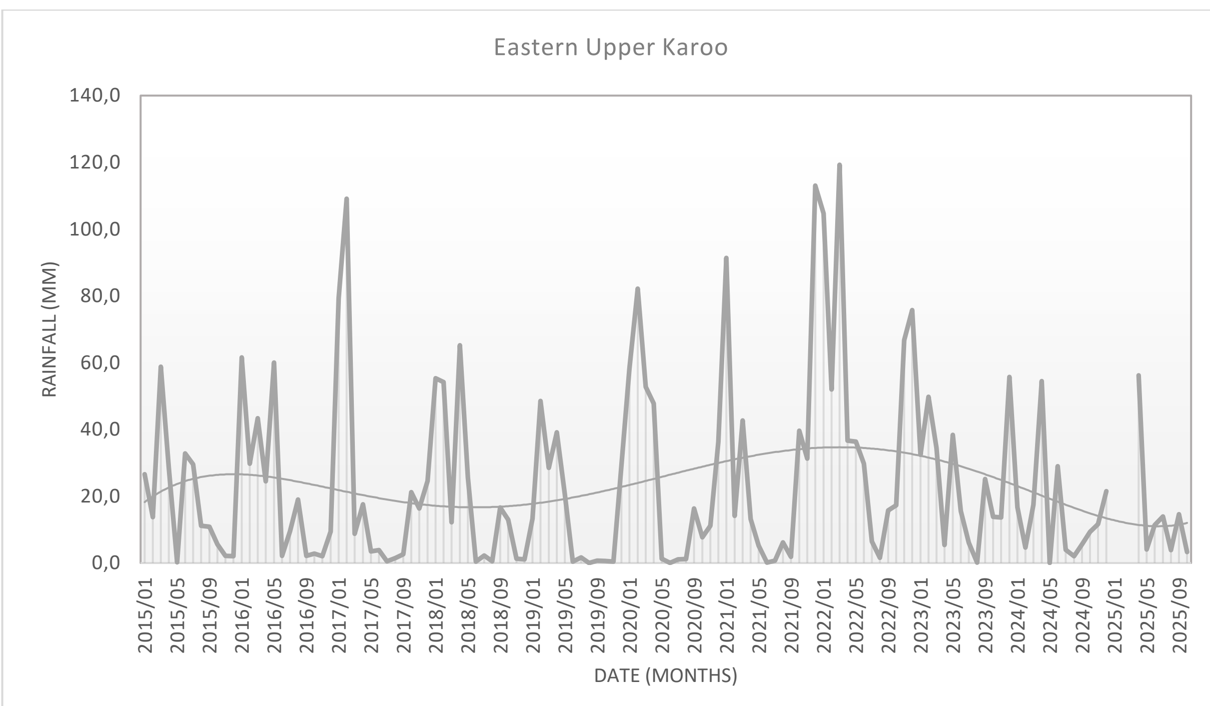


Figure 69: rainfall trends for the Eastern Upper Karoo Hydrogeological Region

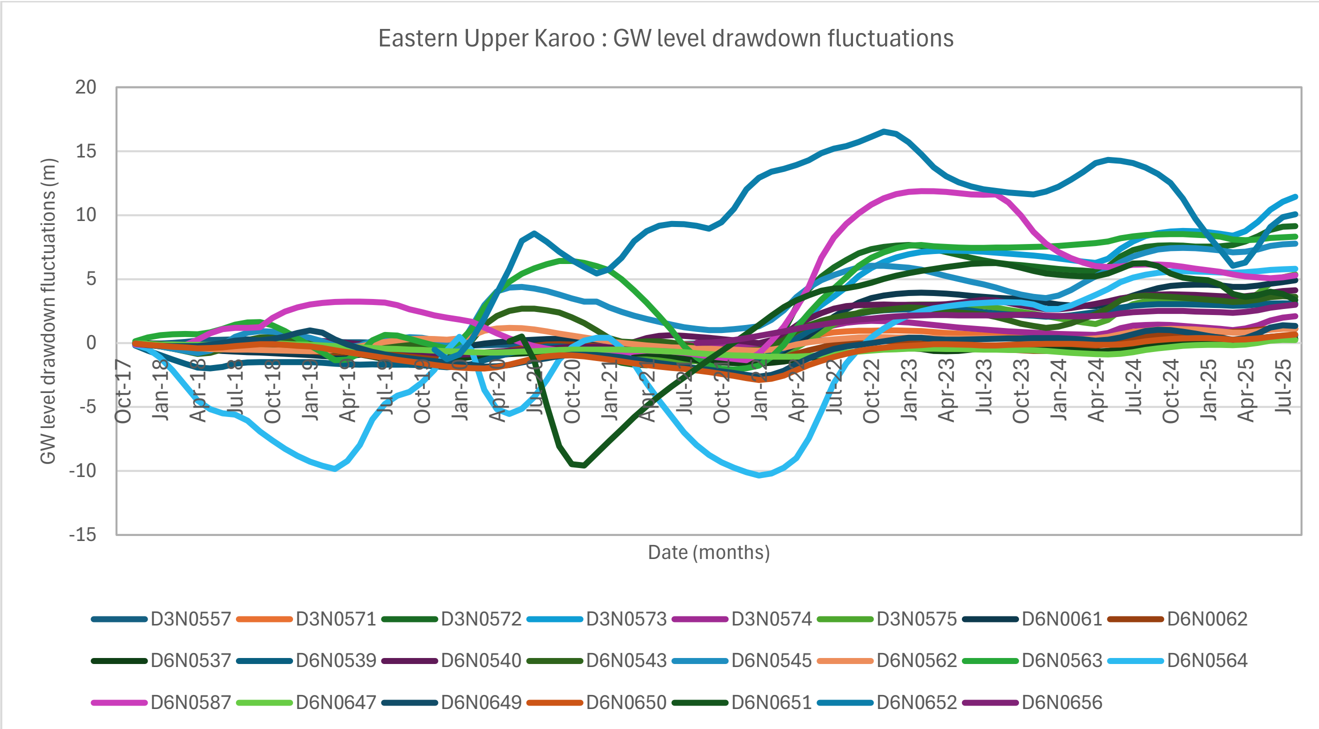


Figure 70: Groundwater level drawdown fluctuations: Eastern Upper Karoo Hydrogeological Region

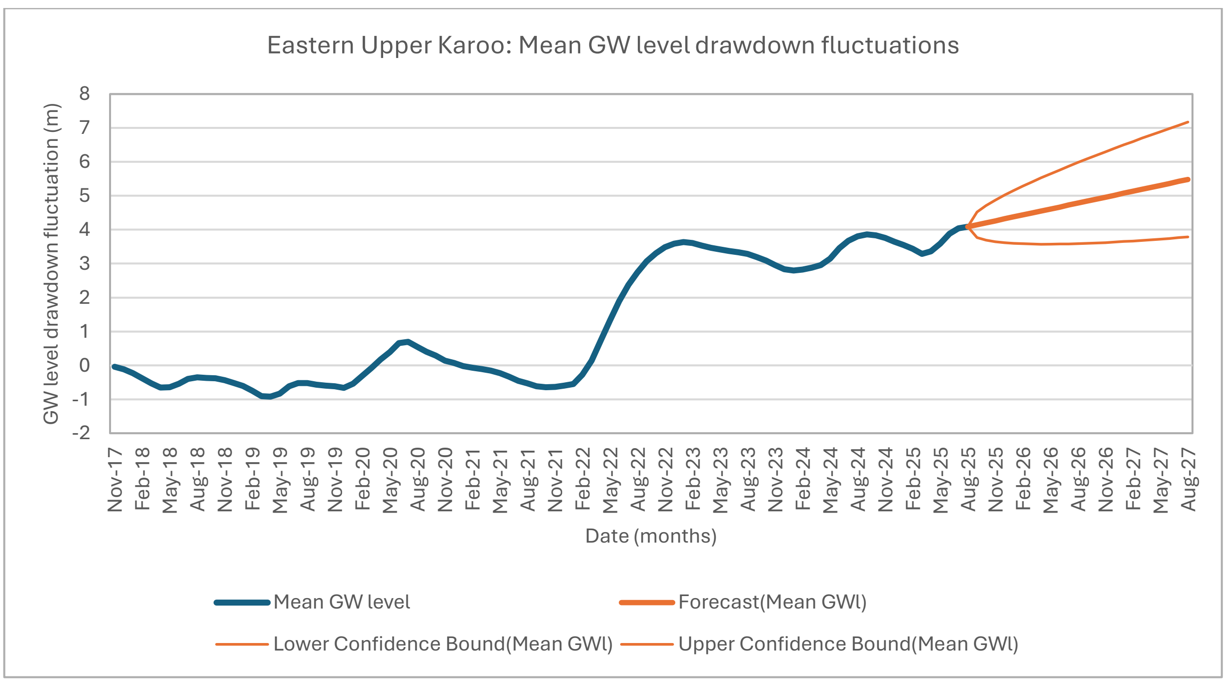


Figure 71: Mean groundwater level drawdown fluctuations for the Eastern Upper Karoo Hydrogeological Region

3.23 The Central Pan Belt Hydrogeological Region

The Central Pan Belt Hydrogeological Region is bisected by the provincial border of the Free State/ Northern Cape Provinces. To the northwest, Kimberly exists while the northeastern side is bordered by Bloemfontein. More to the southwest, the town of Vorsburg and its surrounds borders the region (Figure 72).

The borehole distribution is rather clustered in the north and south, leaving the central part of the region underrepresented. More boreholes are needed towards the provincial border/ central zone of the hydrogeological region.

The rainfall trends for the region have revealed a consistent increase with time, with more rainfall observed from September 2020 onwards. However, the latest part of the graph indicates a gradual decline (reflective of the lower rainfall observed in 2025). The increased rainfall (in 2020 till early 2024) is reflected by groundwater level drawdown trends which took a positive inflection point since January 2021 reflecting a time lag in groundwater recharge. This is also reflected by the mean groundwater level drawdown trends of the region as depicted in Figure 75. The groundwater level drawdown for this region in currently in its healthy state, forecasting a further rise.

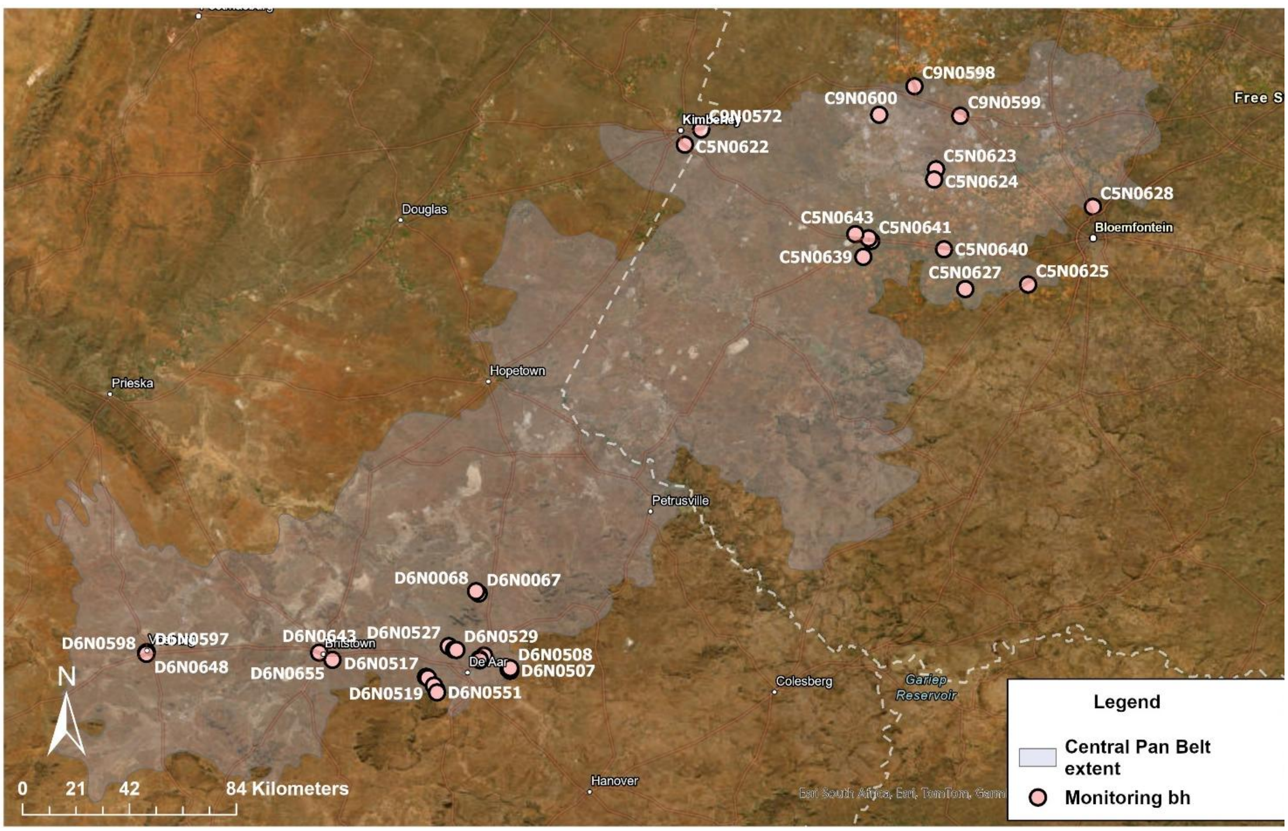


Figure 72: The Central Pan Belt extent and its monitoring boreholes

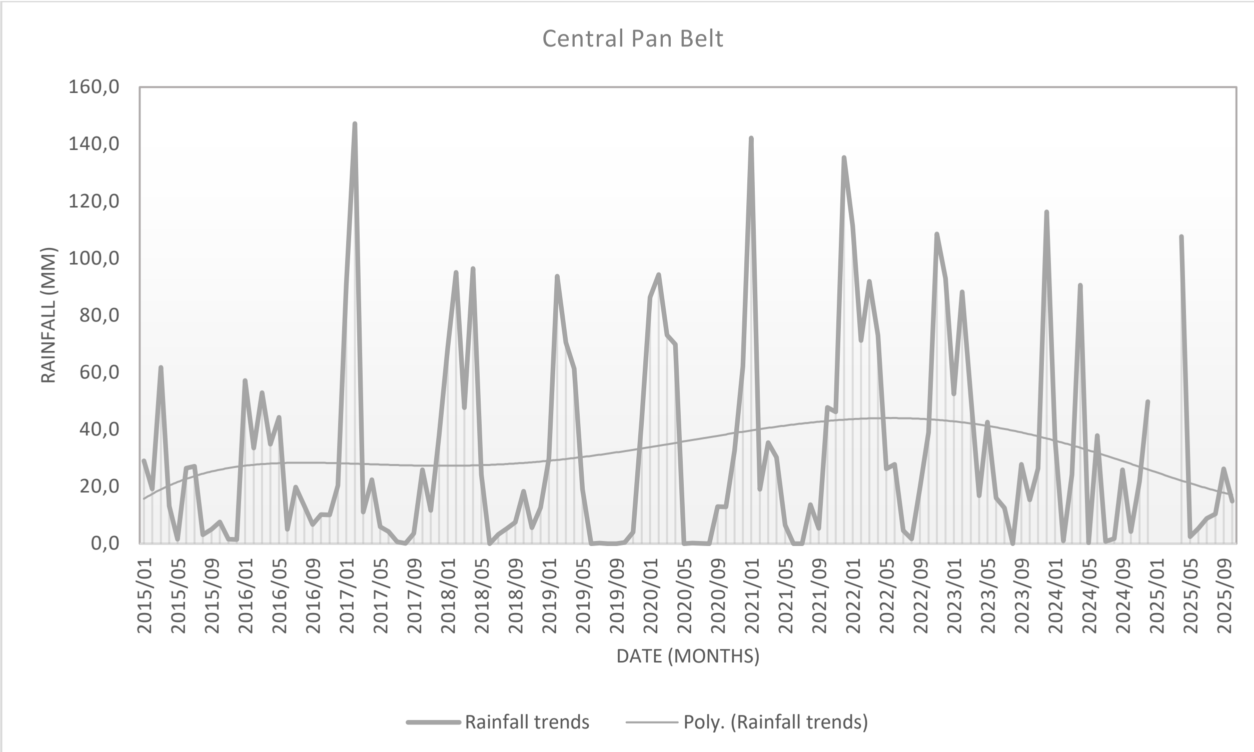


Figure 73: Rainfall trends for the Pan Belt Hydrogeological Region

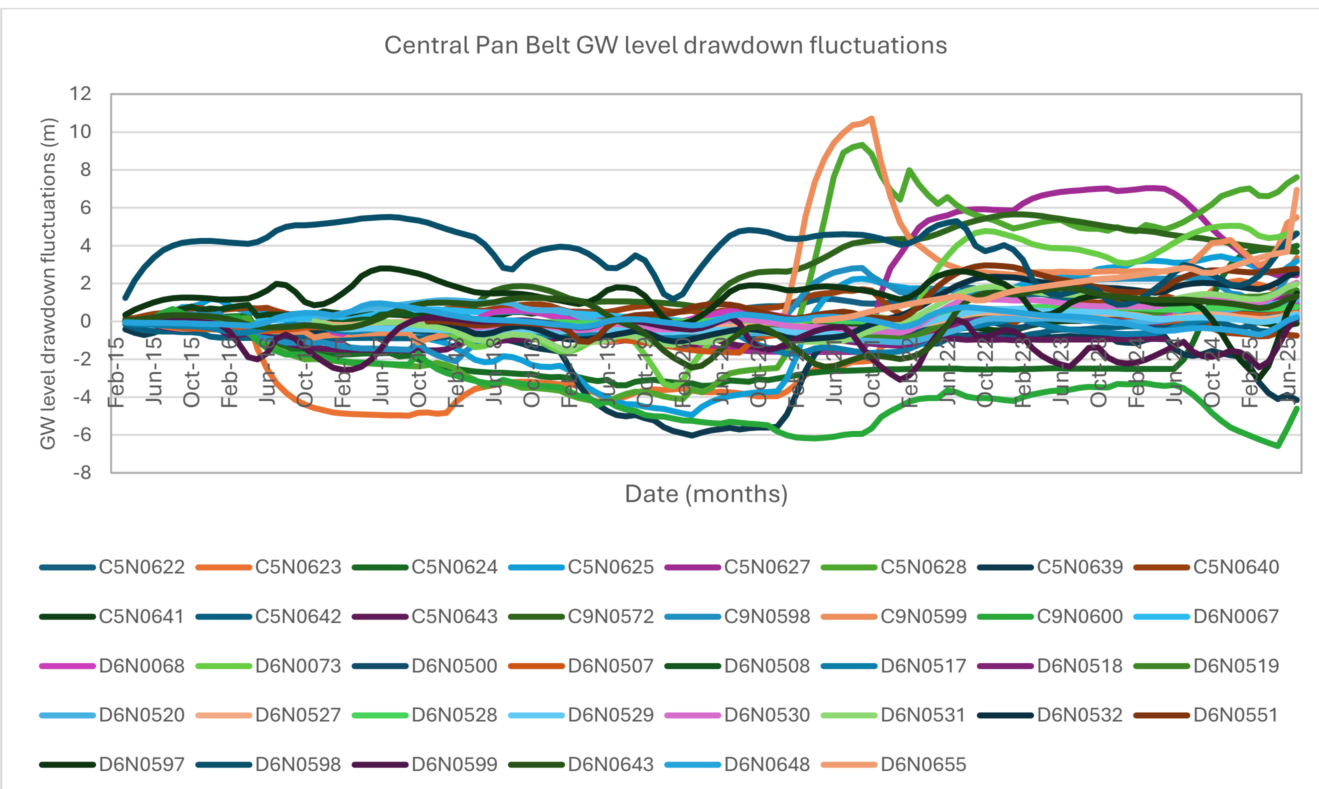


Figure 74: Groundwater level drawdown fluctuations for the Central Pan Blet Hydrogeological Region

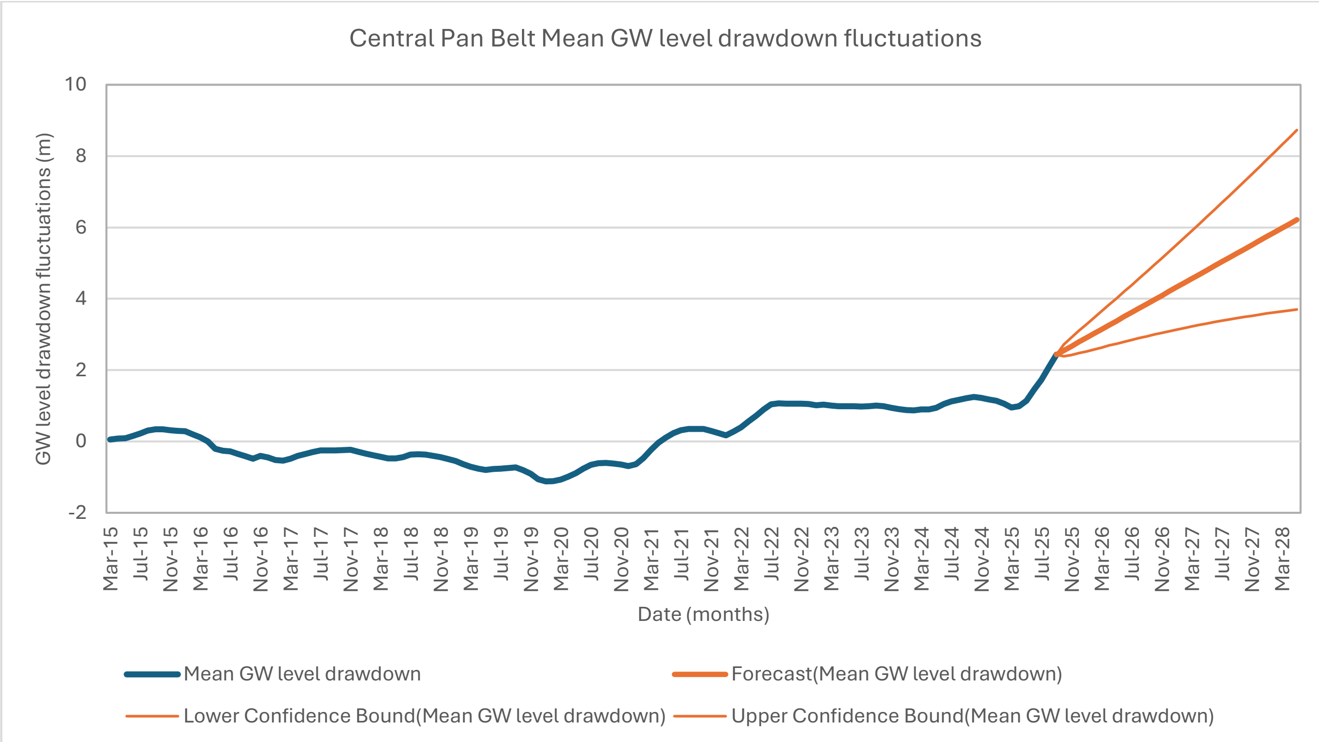


Figure 75: Mean groundwater level drawdown fluctuations for the Central Pan Belt Hydrogeological Region

3.24 The Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region

The Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region stretches from Vryburg down to Prieska in a linear direction along the N18 route. The eastern extent is bordered by Hopetown, southwards, and Jan Kempdorp in the northeast (Figure 76). The borehole representation isn't remarkable, with most boreholes clustered to the south and a few in Vryburg. The monitoring programme for this region needs to be reviewed and optimized.

Incremental rain over the 10-year observation period (2015-2025) has been experienced in the region since the beginning of time (Figure 77). However, since 2024, a downward trend has been noted, marking a period of lower rainfall going into 2025.

The groundwater level drawdown trends for the region have responded well to the rains mentioned (albeit the delayed response), with positive groundwater fluctuation trends recorded since 2017 (Figure 78). Even borehole C3N0064 finally climbed to the initial water level mark after 7yrs of reporting negative fluctuations. This is almost the same time that C3N0075 showed a downward trend. Given the proximity of these boreholes, it is suspected that they are used interchangeably and influence each other. The overall gradual rise in groundwater levels is depicted clearly in Figure 79, which shows the mean groundwater level drawdown of the region.

Generally, the groundwater availability in this region is in an intact state with insignificant environmental stressors or human induced impacts.

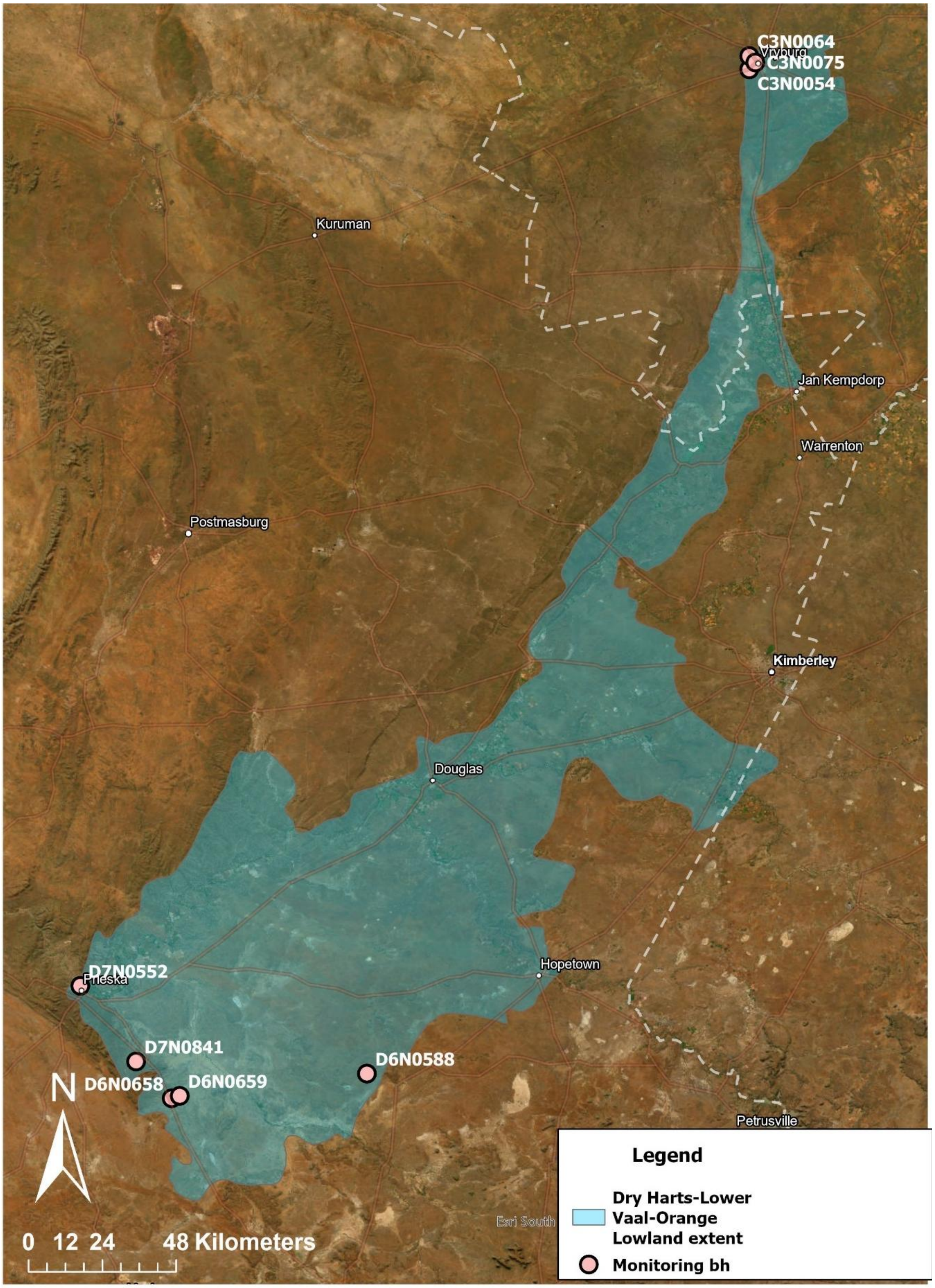


Figure 76: The extent of Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region and its monitoring boreholes

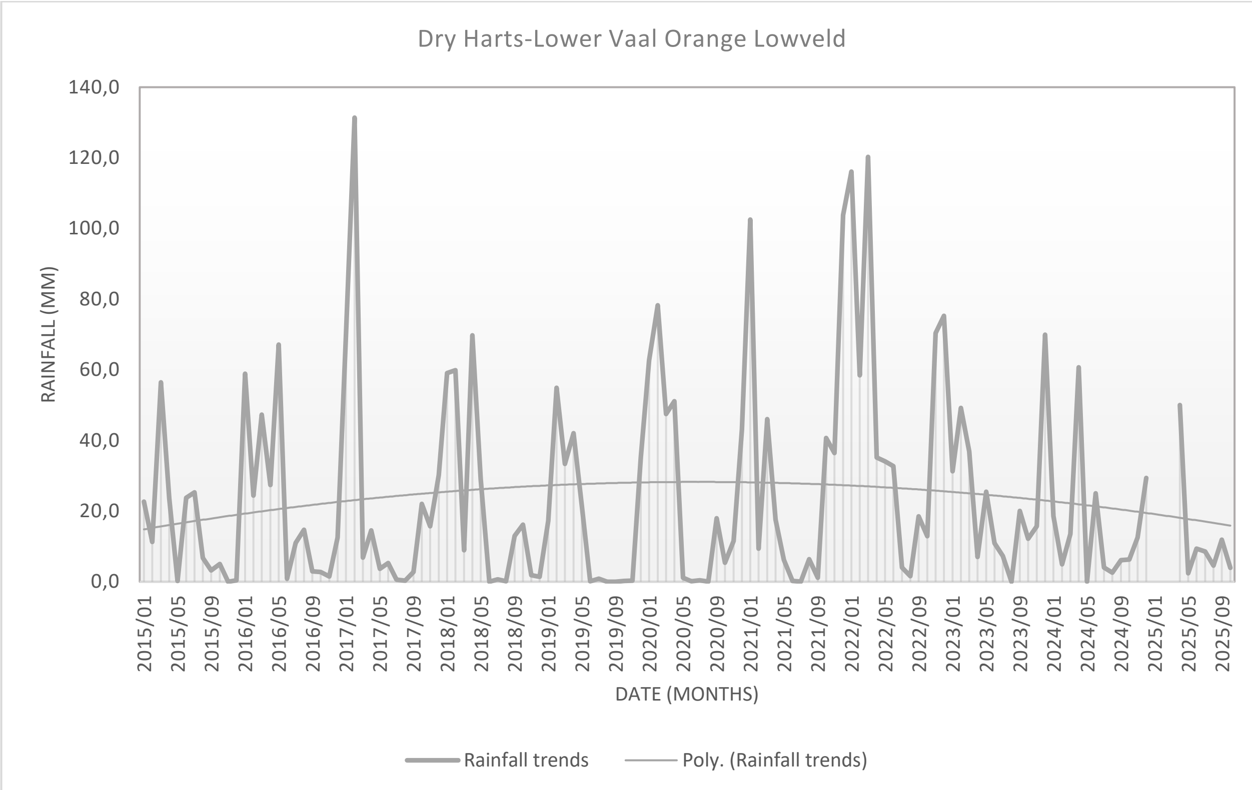


Figure 77: Rainfall trends for the Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region

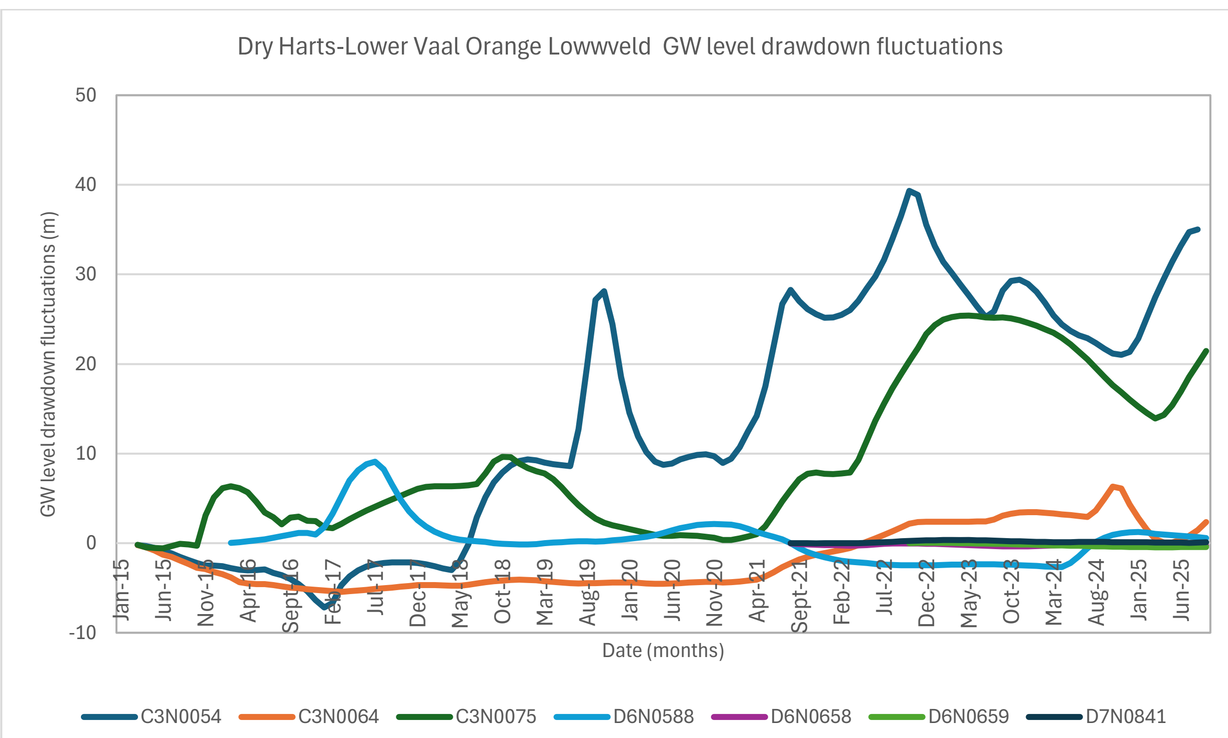


Figure 78: Groundwater level drawdown fluctuations for the Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region boreholes

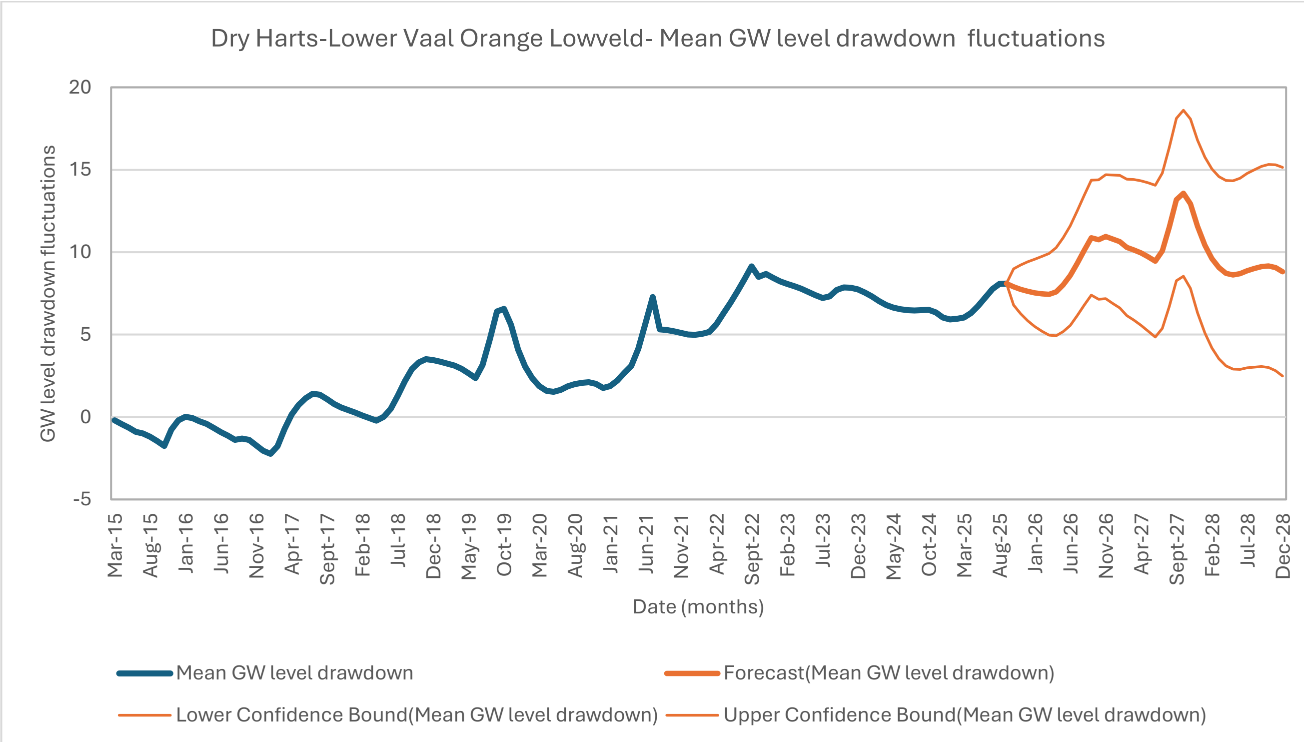


Figure 79: The mean groundwater level drawdown for the Dry Harts-Lower Vaal Orange Lowveld Hydrogeological Region

3.25 The West Griqualand Hydrogeological Region

To the north and south, the West Griqualand Hydrogeological Region is bounded by Kuruman and Prieska respectively. To the east, the coverage of this hydrogeological region stretches to Campbell while the Olifantshoek mountain range forms the western border (Figure 80).

The monitoring borehole distribution for the region is clustered to the north, with just about 2 boreholes to the south and no representation in the central parts. The monitoring programme for this region needs to be upgraded.

The rainfall patterns revealed intense rain that was experienced in the region from January 2019 declining gradually from the beginning of 2023. This period preceded with a relatively lower rainfall between 2017 and 2018 (Figure 81).

The groundwater level drawdown from the boreholes of this region reflected a response to rainfall with rise in levels from October/ November 2020, indicating period of groundwater recharge. From 2024, the gradual declining trends were noted, responding to the declining rainfall for the region (Figure 82). The latest data though, has reflected a change from this decline, with most borehole water levels indicating an upward trend. This is clearly depicted in Figure 83 where the average groundwater level drawdown trends for the entire region are shown. The groundwater levels are in a good state, way above the initial water levels. Given this status there are no immediate management actions recommended for implementation.

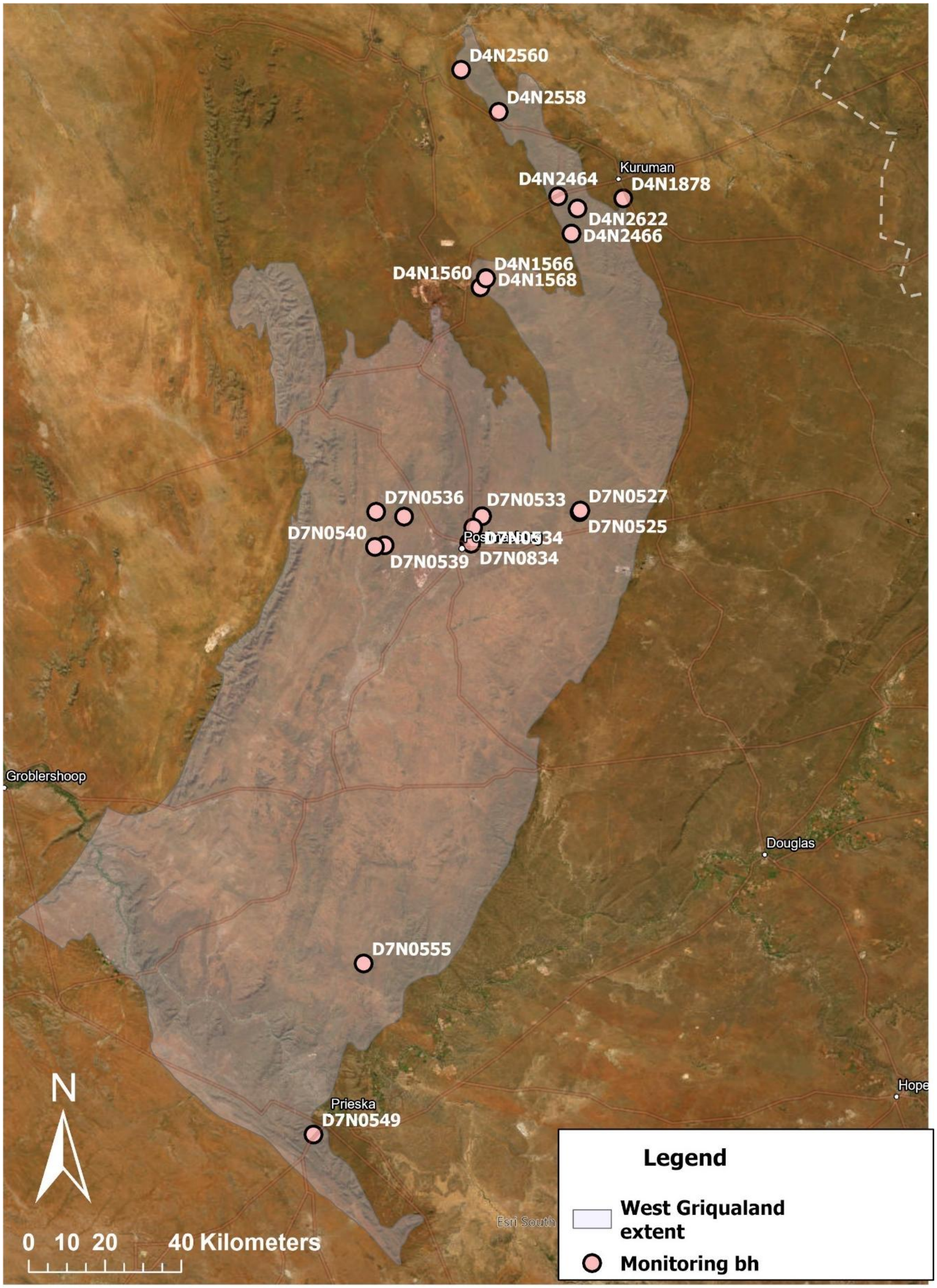


Figure 80: The West Griqualand Hydrogeological Region extent and its monitoring boreholes

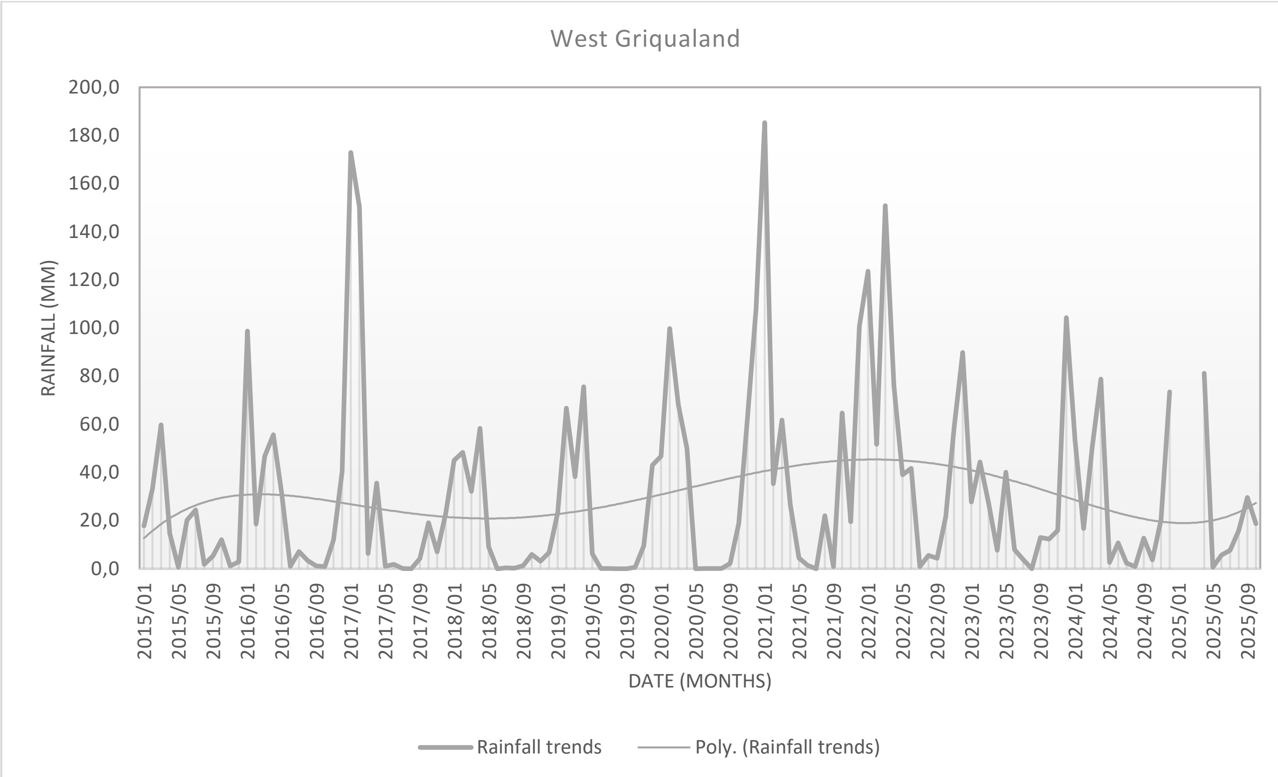


Figure 81: Rainfall trends for the West Griqualand Region

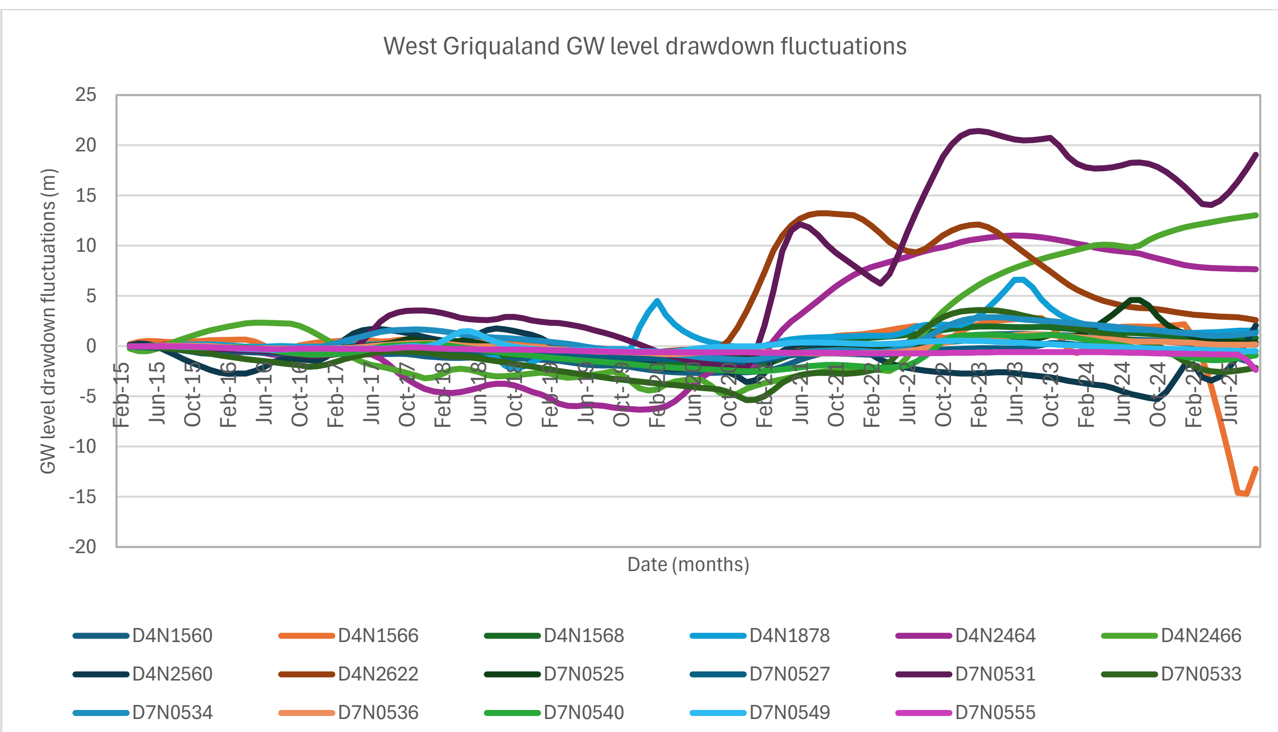


Figure 82: Groundwater level drawdown fluctuations for the West Griqualand Region

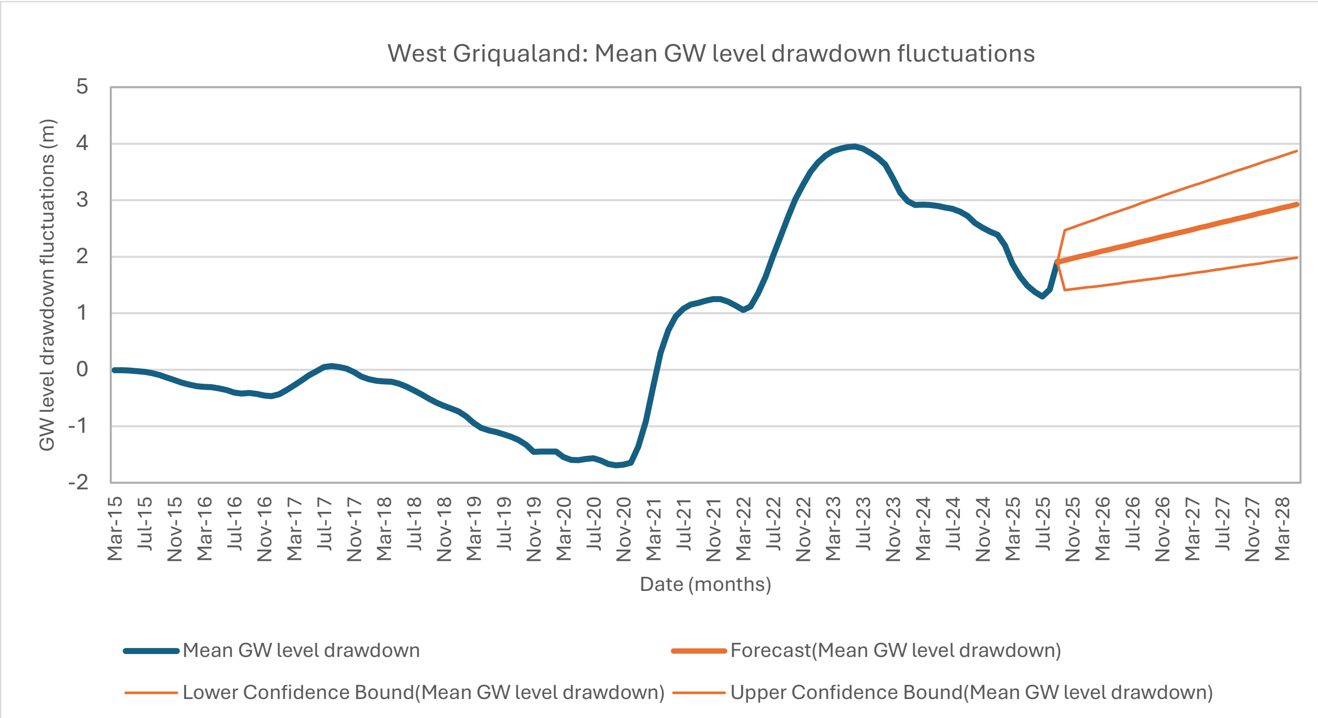


Figure 83: The West Griqualand mean groundwater level drawdown fluctuations

3.26 The Ghaap Plateau Hydrogeological Region

The Ghaap Plateau Hydrogeological Region covers the area from Vryburg in the north to Campbel and its surroundings, to the south. The hydrogeological region is bisected by the Northern Cape/ Northwest provincial border. The Vall River flows on the eastern side of the region, and in some instances overlaps with the region (Figure 84).

The monitoring borehole distribution shows that the boreholes are scanty in the eastern and southern side of the hydrogeological region, while the northern section is well represented (Figure 84). Given this, a review and optimization of the monitoring programme might benefit this region.

The rainfall trends showed 2yearly to 2,5 yearly cycles of low and relatively high rainfall (Figure 85). This is clear from the graph from 2015-2017, then 2020- 2022 where higher rains were recorded.

The impact of the significant rains observed in 2020 is noticed with rise in water level drawdown in October/ November 2020 (Figure 86). These water levels have remained with positive horizontal trends with a slight decline until February 2025 when an upward rise has been recorded to date. This is clearly shown in Figure 87. Generally, the groundwater for this region is in its viable state, way above the initial water levels.

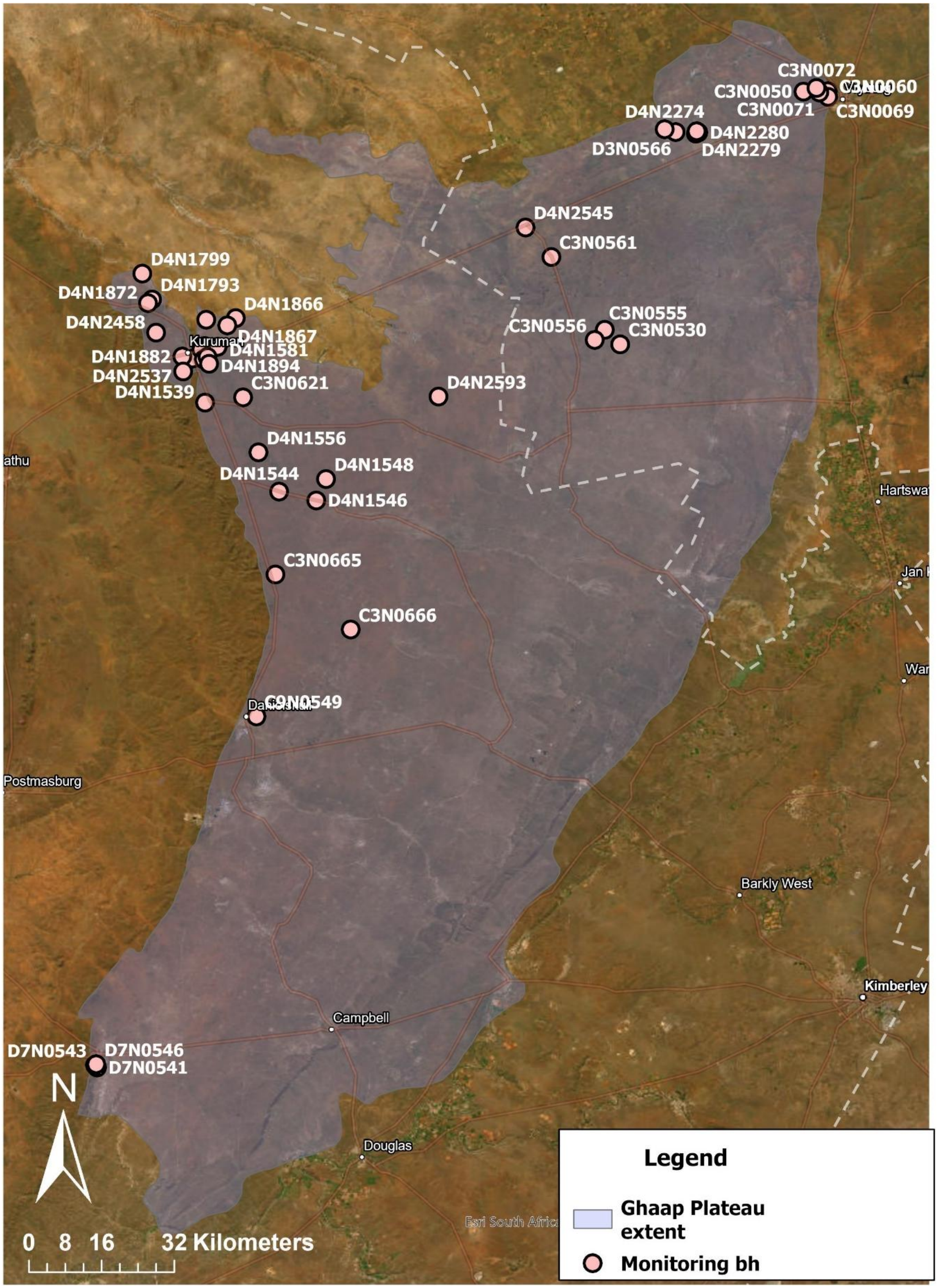


Figure 84: The extent of the Ghaap Plateau and its monitoring boreholes

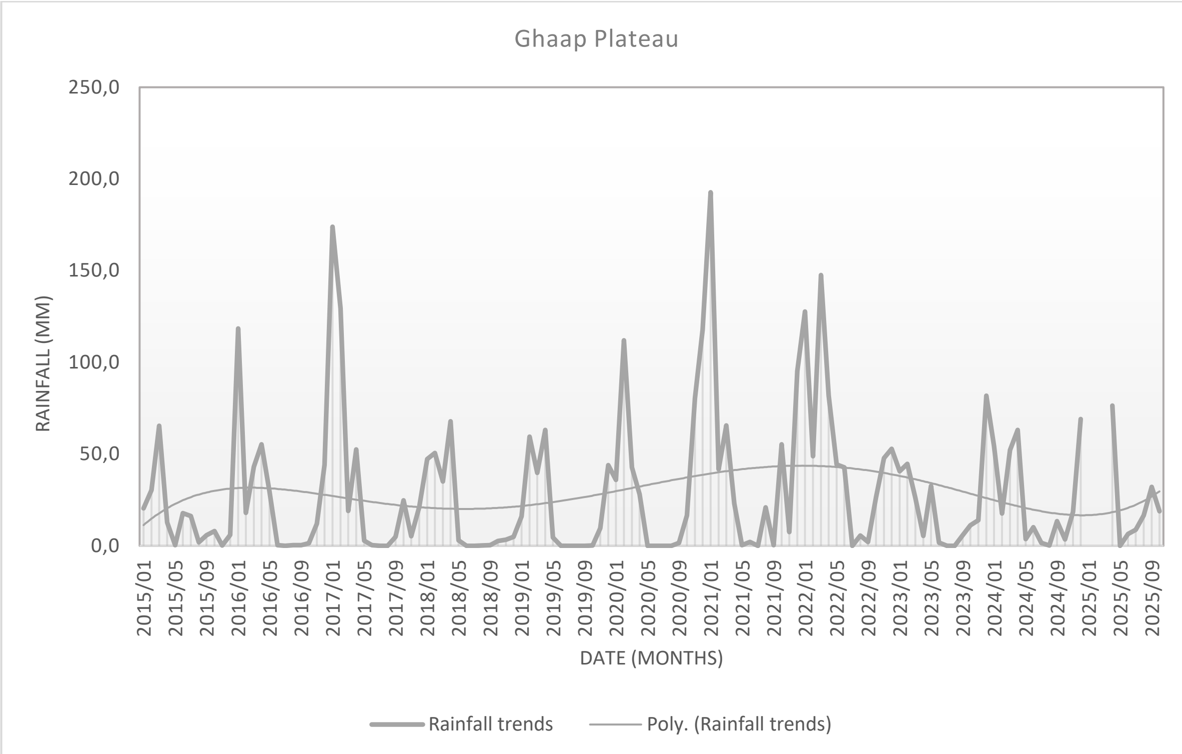


Figure 85: Rainfall trends for the Ghaap Plateau hydrogeological Region

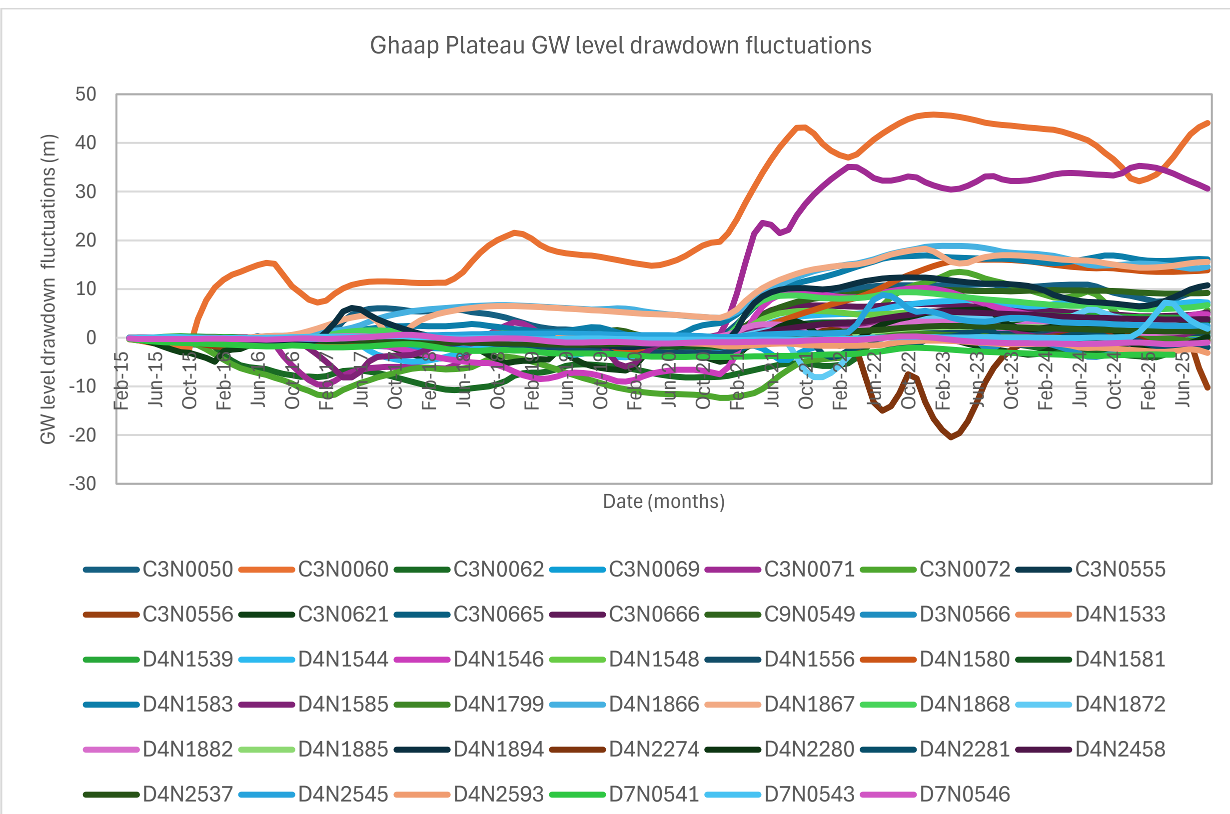


Figure 86: Groundwater level drawdown trends for the Ghaap Plateau boreholes

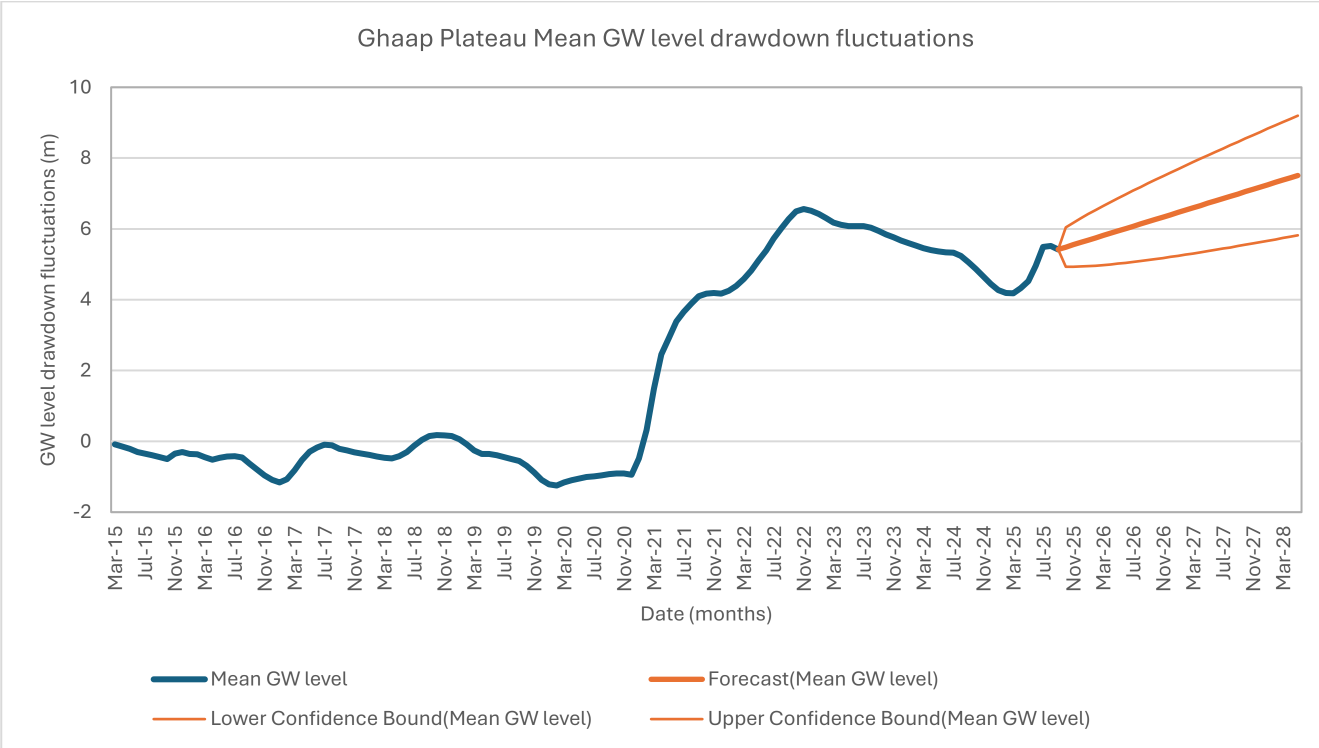


Figure 87: Mean groundwater level drawdown for the Ghaap Plateau Hydrogeological Region

3.27 The Eastern Kalahari Hydrogeological Region

The Eastern Kalahari Hydrogeological Region is bordered from the west and north by Molopo River. To the northeast, the town of Mahikeng serves as the boundary while to the south, the region stretches to Kuruman, Olifantshoek and its mountain range to the west (Figure 88).

The monitoring boreholes are more than enough but clustered to the southeast and north leaving the western and central side without representation (Figure 88). The monitoring boreholes where they are clustered (in the south, east and north) should be reduced and introduce groundwater monitoring in areas without representation.

The rainfall patterns revealed a gradually increasing rainfall from the beginning of 2019, peaking in 2022 and gradually declining from 2023 onwards (Figure 89).

The increased rainfall between 2019 and 2023 saw groundwater level drawdown response in July 2019, where most boreholes indicated a positive fluctuation in water levels (Figure 90). Some boreholes responded later though, especially those that were already below the initial water levels. This gradual rise and decline in water level drawdown in response to rainfall recharge is clearly shown in Figure 91. The latest trends for the region are indicative of a rise, clearly shown in Figure 91. Given the current water level status (i.e. positive water level fluctuations above initial water levels), no immediate interventions to the groundwater resource are recommended.

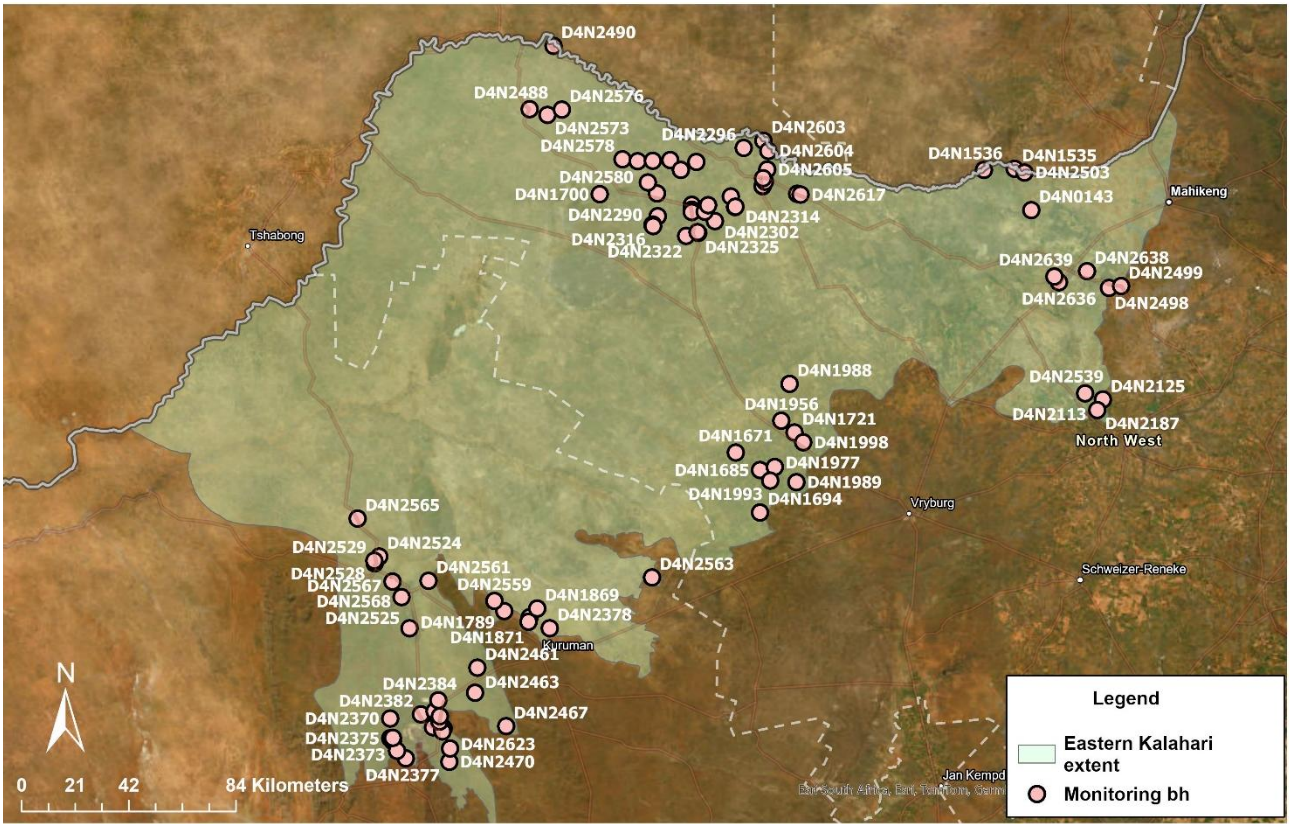


Figure 88: The Eastern Kalahari Hydrogeological Region extent and its monitoring boreholes

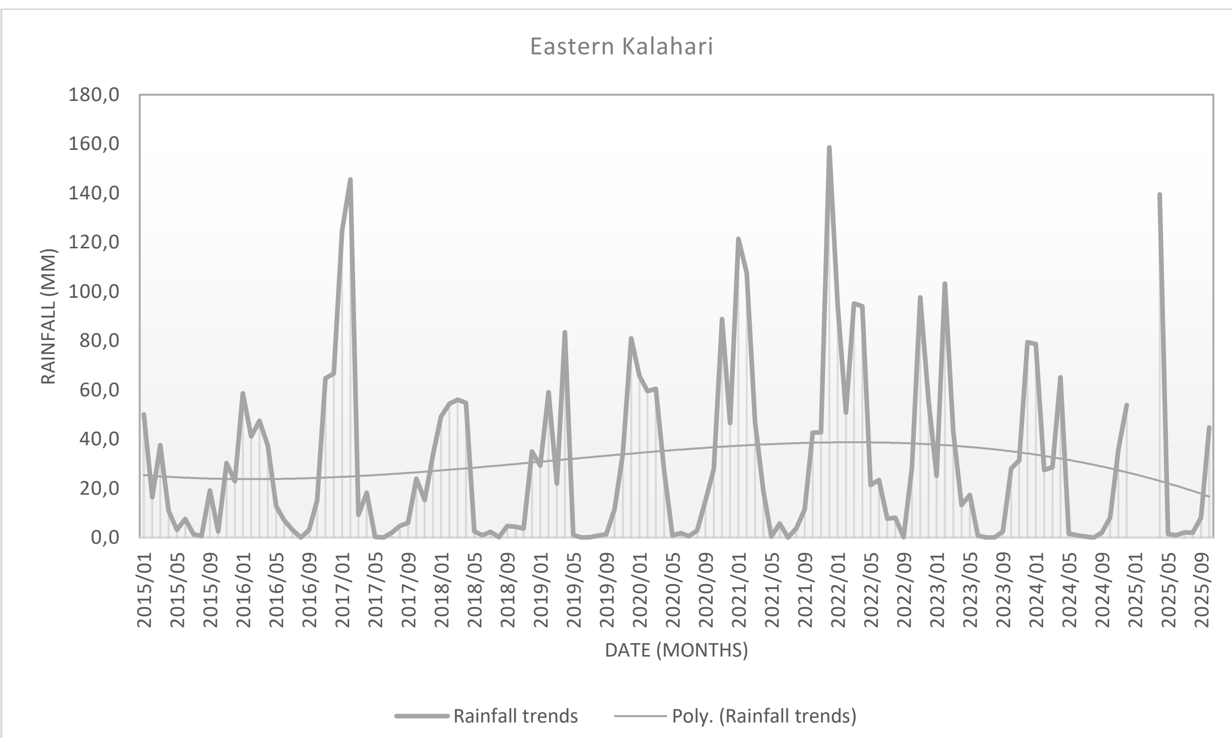


Figure 89: Rainfall trends for the Eastern Kalahari Hydrogeological Region

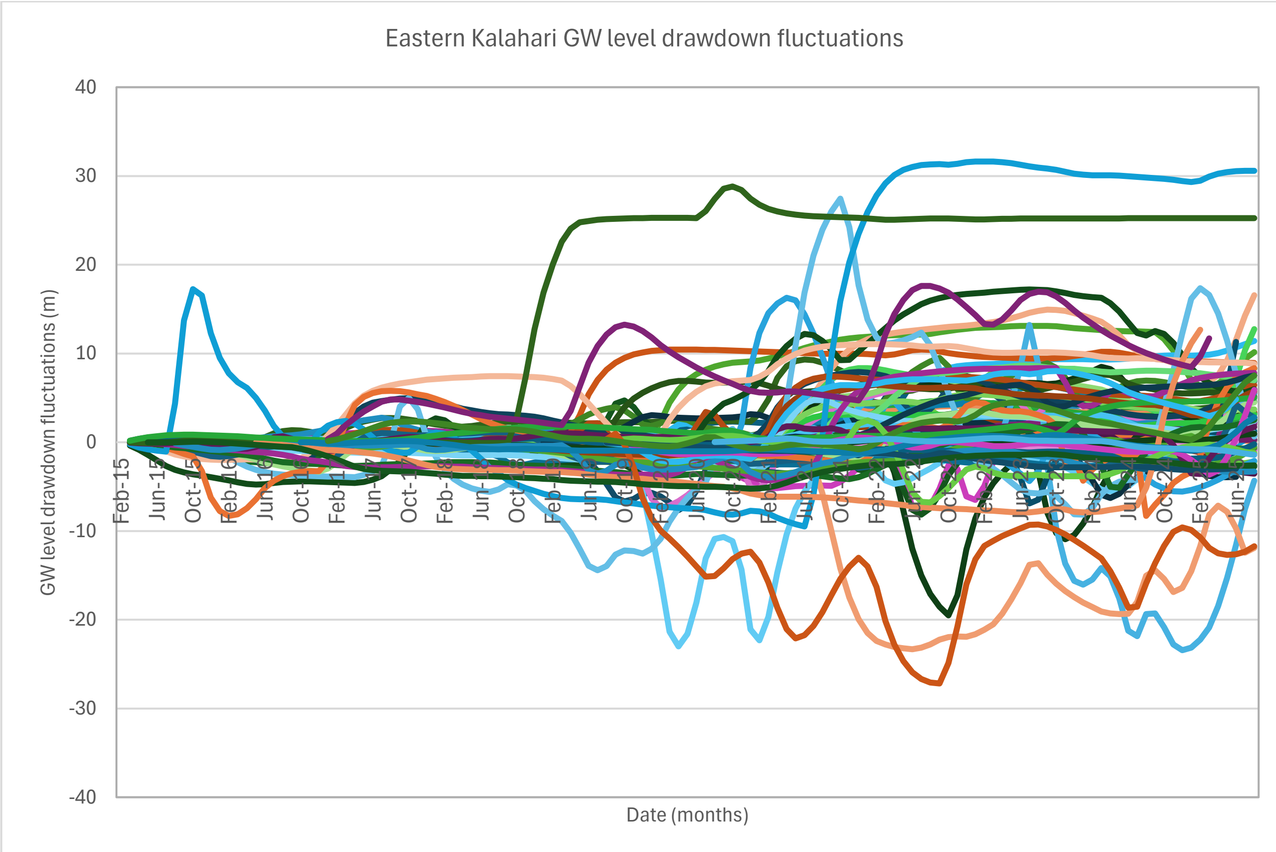


Figure 90: Groundwater level drawdown fluctuation for the Eastern Kahari boreholes

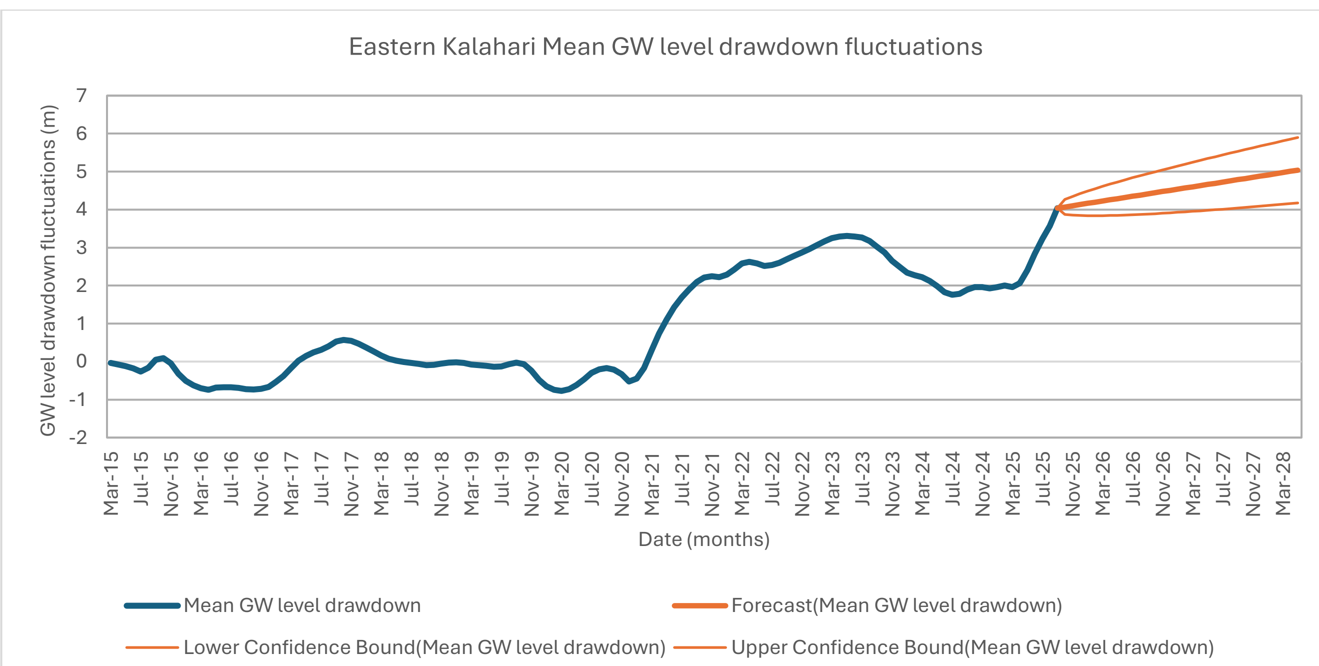


Figure 91: The Eastern Kalahari Hydrogeological Region mean groundwater level drawdown

3.28 The Northeastern Upper Karoo Hydrogeological Region

The Northeastern Upper Karoo Hydrogeological Region lies, largely, in the Free state, with a small portion falling in the Eastern Cape. Its eastern side borderd by Lesotho while the southern side is formed by the town of Molteno. To the north, the major town of Bloemfontein serves to border the region.

Four boreholes are currently monitored for this region (Figure 92) and their monitoring data is limited to make a meaningful analysis of water levels for the entire region. It is recommended that the monitoring programme be expanded for this region to understand the status quo of groundwater and its impacts and ultimately better management of groundwater as a resource.

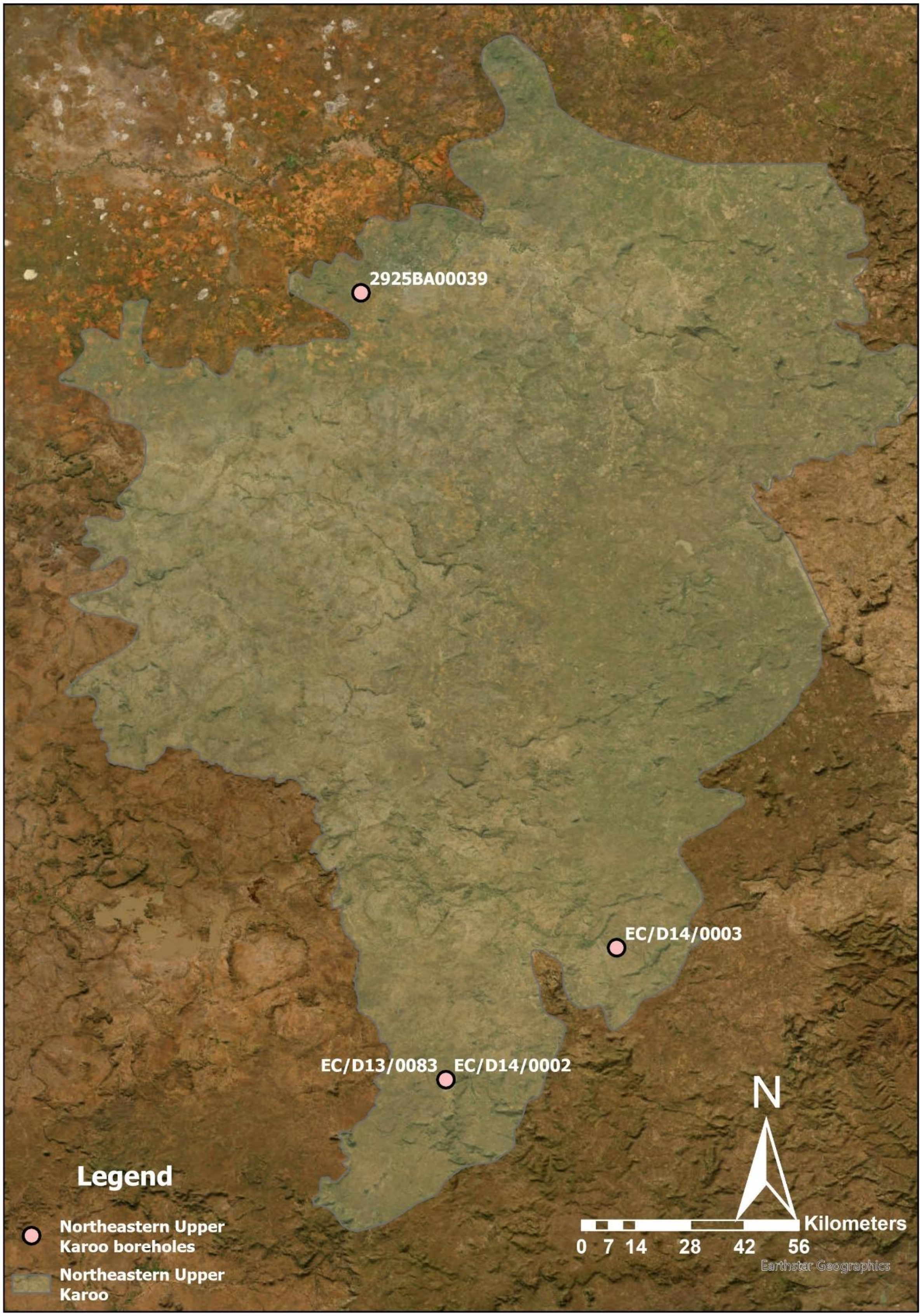


Figure 92: Monitoring boreholes and the extent of the Northeastern Upper Karoo Hydrogeological Region

3.29 The Northeastern Pan Belt Hydrogeological Region

The Northeastern Pan Belt Hydrogeological Region stretches from Kimberly in the south, in a northeasterly direction, up north to Orkney. The towns of Welkom and Kroonstad serve as the eastern boundary while Warrenton and Bloemhof border the western side (Figure 93).

The monitoring borehole distribution is focused on the north, with just about two boreholes in the extreme south of this region. There is no representation centrally and to the southeast (Figure 93). Boreholes in these areas should be added in the monitoring programme for better evaluation of the groundwater status for the region.

The rainfall trends indicate that the region generally enjoys relatively higher monthly rainfall, save for the drier months of the year. However, between early 2015 and September 2016, the region experienced lower rainfall than usual whilst consistent good rains were recorded 2020 and 2024, with peak rains in September 2021-and May 2022 (Figure 94).

The same period (peak rain period) saw most boreholes water level drawdown responding positively to rainfall recharge until mid-2024, where a slight decline was observed and was prevalent until early 2025. The latest trends/ status shows a rise in drawdown levels to date (Figure 95). Over this period, boreholes C2N1158 and C2N1155 were an exception where they revealed a downward trend from October 2022 and continued until May 2024 and March 2025 respectively. The mean groundwater level drawdown trends showed the fluctuations as explained above including the decline observed in 2014, which was followed by horizontal trends with a slight water level rise (Figure 96). The groundwater levels for the region reflect positive fluctuations, above the initial water levels for the region, therefore no immediate actions for groundwater management are recommended.

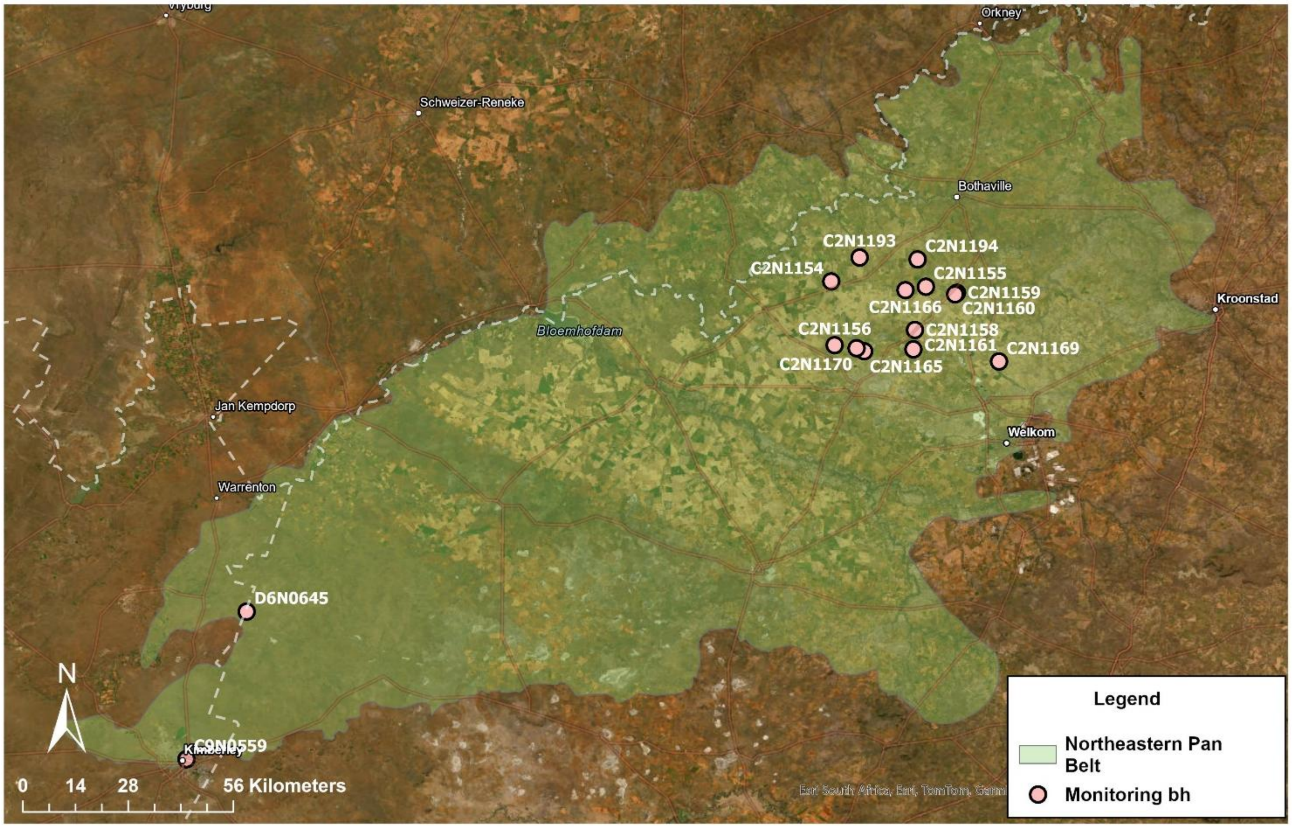


Figure 93: The Northeastern Pan Belt extent and its monitoring boreholes

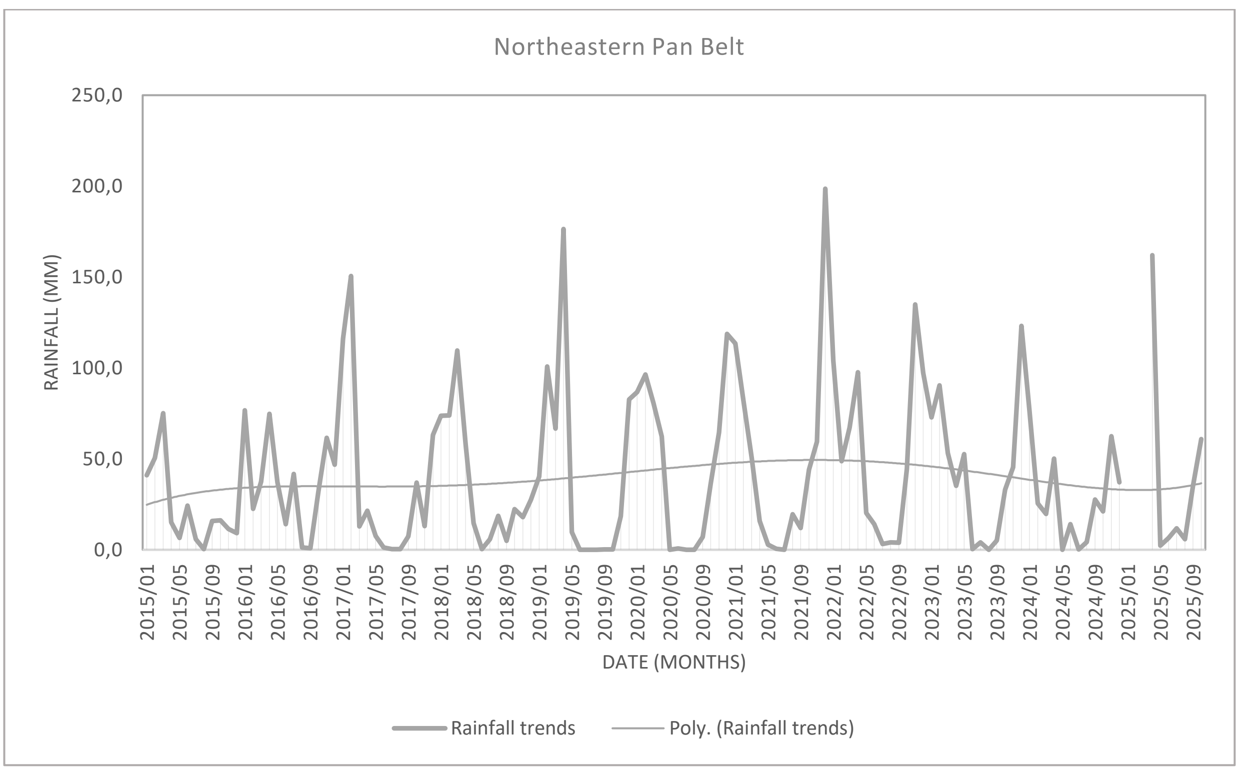


Figure 94: Rainfall trends for the Northeastern Pan Belt Hydrogeological Region

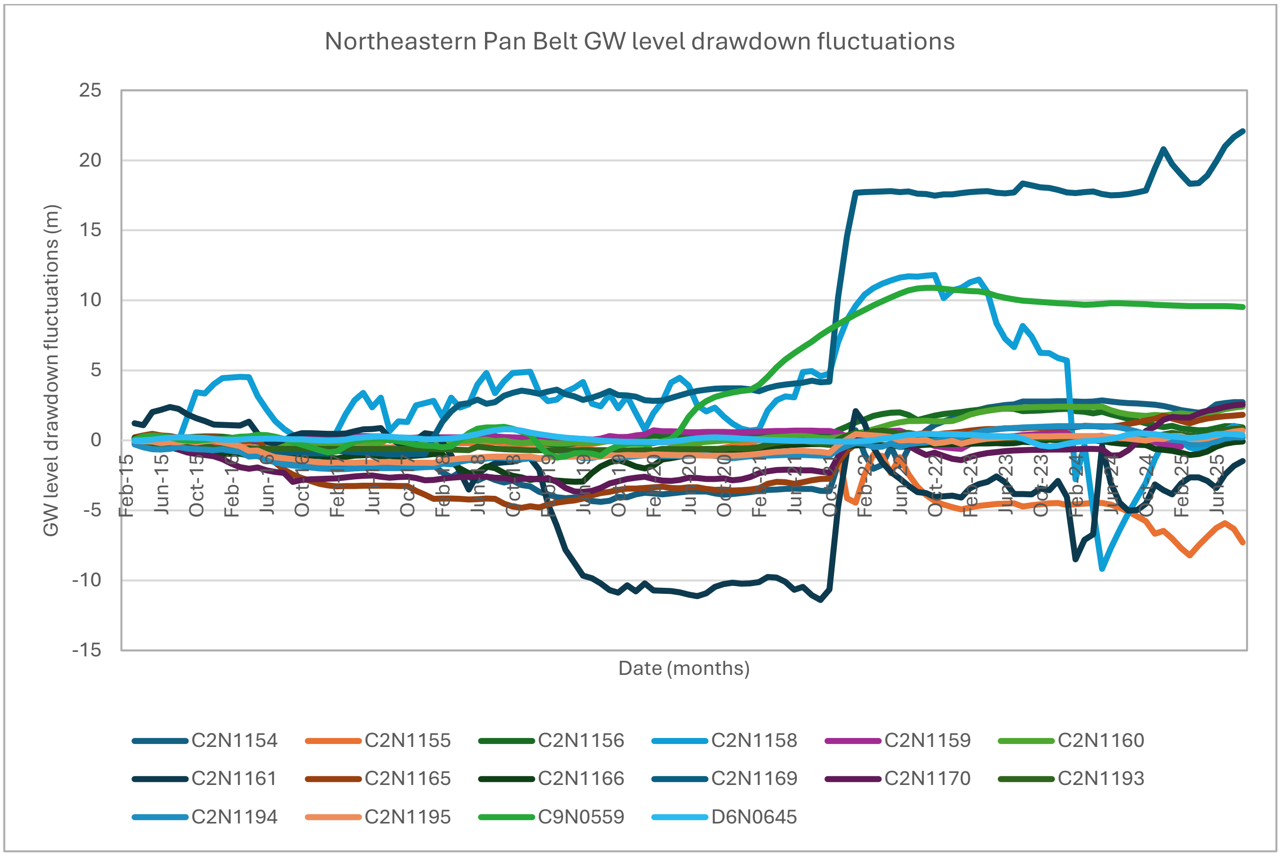


Figure 95: Groundwater level drawdown fluctuations for the Northeastern Pan Belt monitoring boreholes

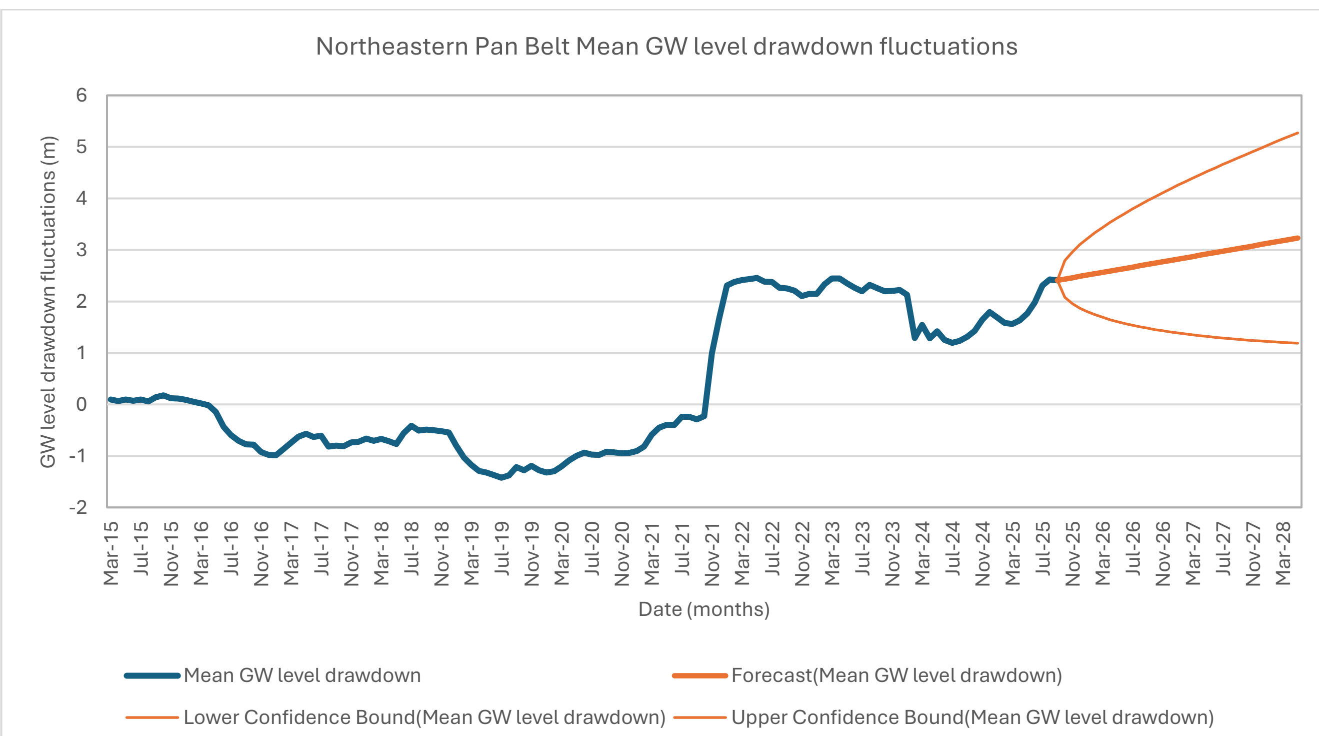


Figure 96: Mean groundwater level drawdown fluctuations for the Northeastern Pan Belt.

3.30 The Eastern Highveld Hydrogeological Region

The Eastern Highveld Hydrogeological Region is bisected in half by the provincial border of Free State and Mpumalanga. To the north, the bordering towns include Middleburg and Carolina, to the west, Johannesburg; to the southwest and south Kroonstad and Bethlehem, respectively, exist. On the eastern side Volksrust serves as the border (Figure 97).

Regarding groundwater monitoring, only the northern half falling in Mpumalanga is monitored. There are no monitoring boreholes in the Free State portion (Figure 97). This needs to be rectified as soon as possible. At this stage the water level assessment for the region is rather focused on a portion of the hydrogeological region and purports to be for the entire region.

The Eastern Highveld Hydrogeological Region has enjoyed good rains for almost the entire observation period (2015-2025). A bit of lower rainfall was noticed though between 2015 and mid-2016 and late 2023 to date (Figure 99).

The rains have maintained positive groundwater level drawdown fluctuations for most of the observation period, save for the period from early 2024 to early 2025, where negative trends were recorded for some boreholes. Anthropogenic activities are attributed to the decline in water levels for some of these boreholes. The decline in rainfall was not severe to cause a change that could not be observed prior to mid-2016 rains. The prevailing trends are of rising water levels from the observed boreholes. These changes are depicted clearly in Figure 100, including the latest upward level rise. Given the status of groundwater in this region, no groundwater management immediate interventions are recommended for this region.

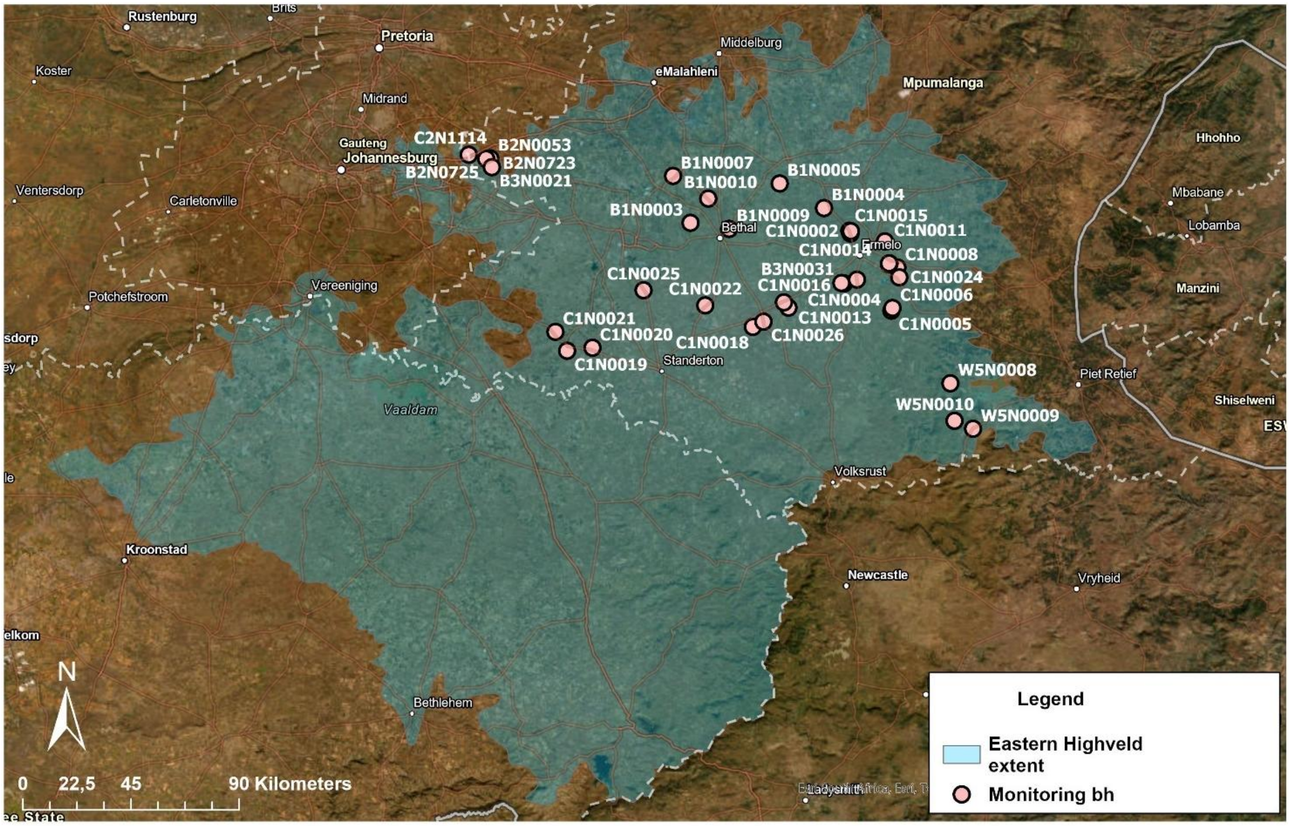


Figure 97: Layout of the Eastern Highveld Hydrogeological Region and its monitoring boreholes

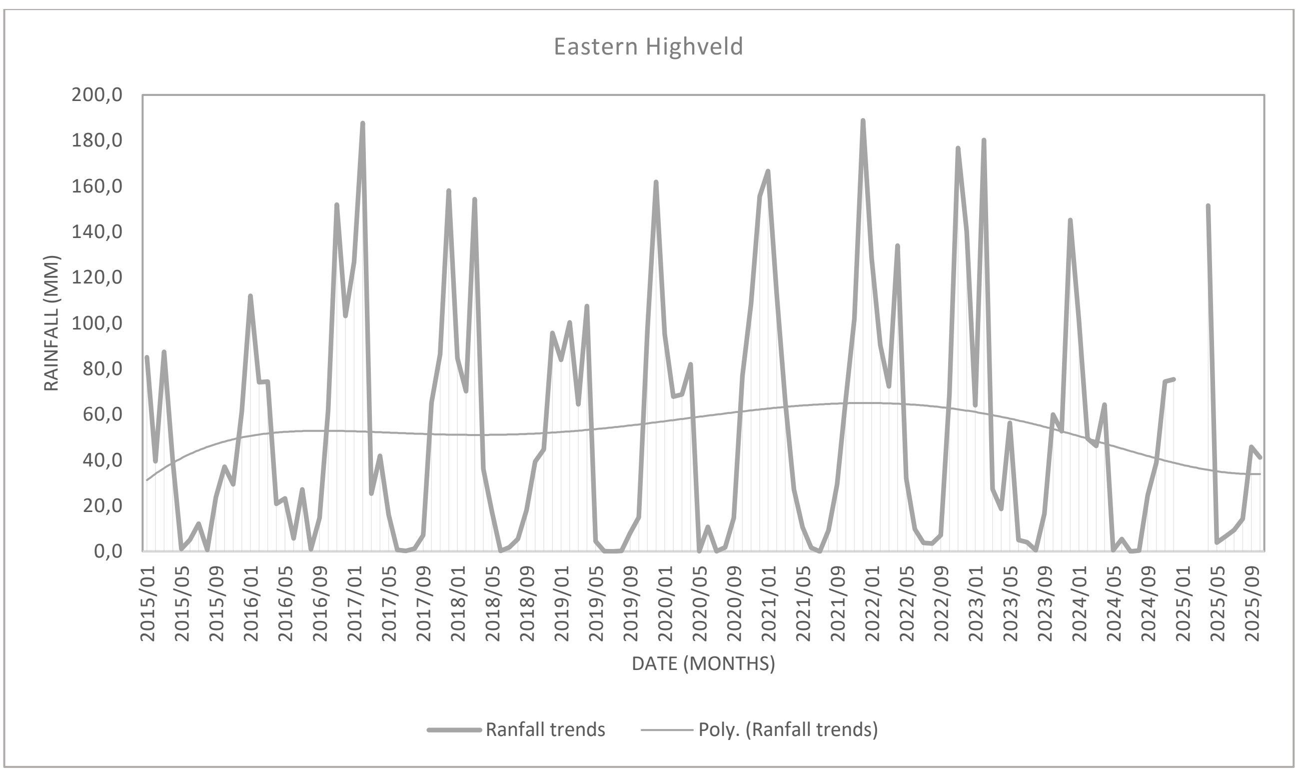


Figure 98: Rainfall trends for the Eastern Highveld.

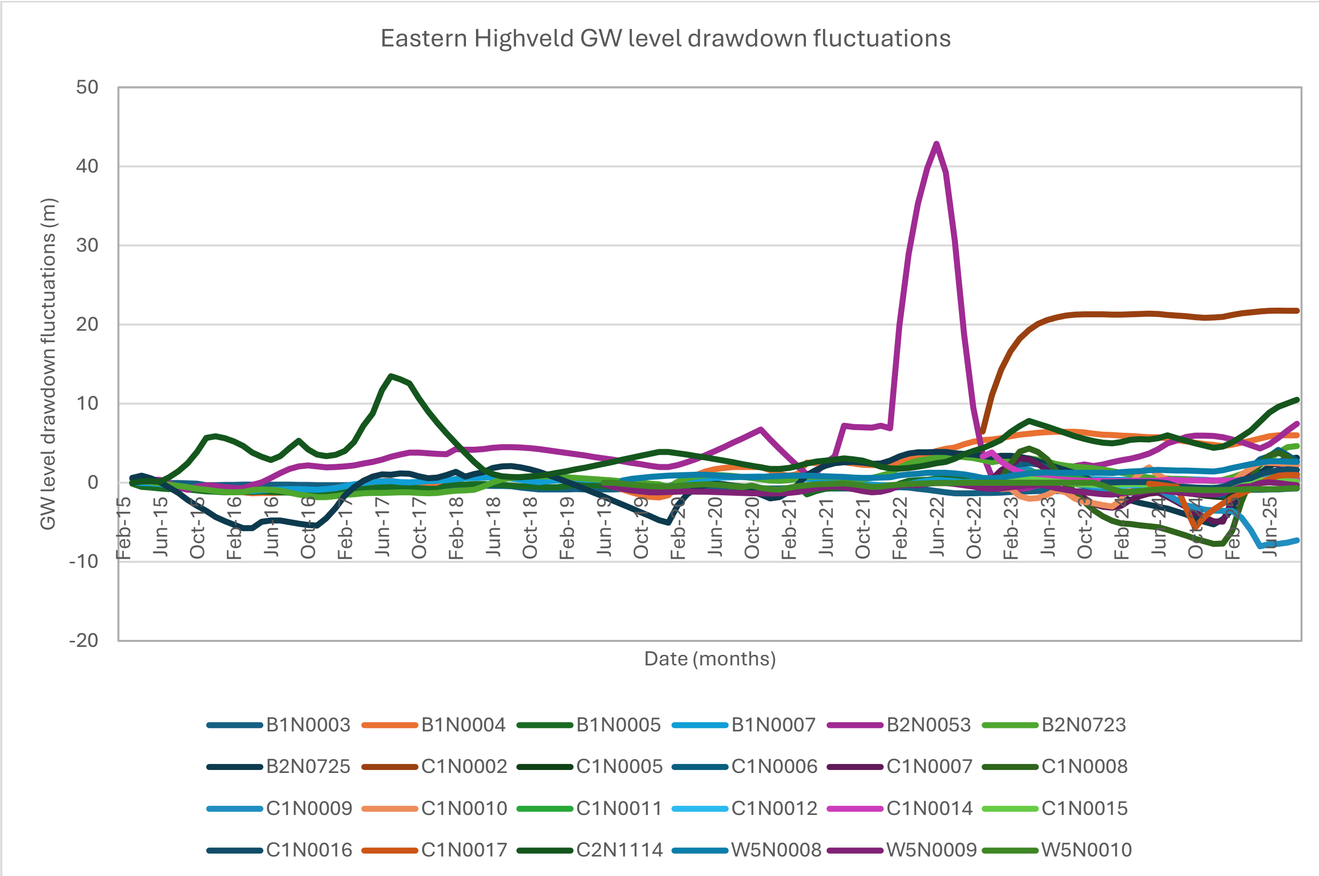


Figure 99: Groundwater level drawdown fluctuations for the Eastern Highveld boreholes.

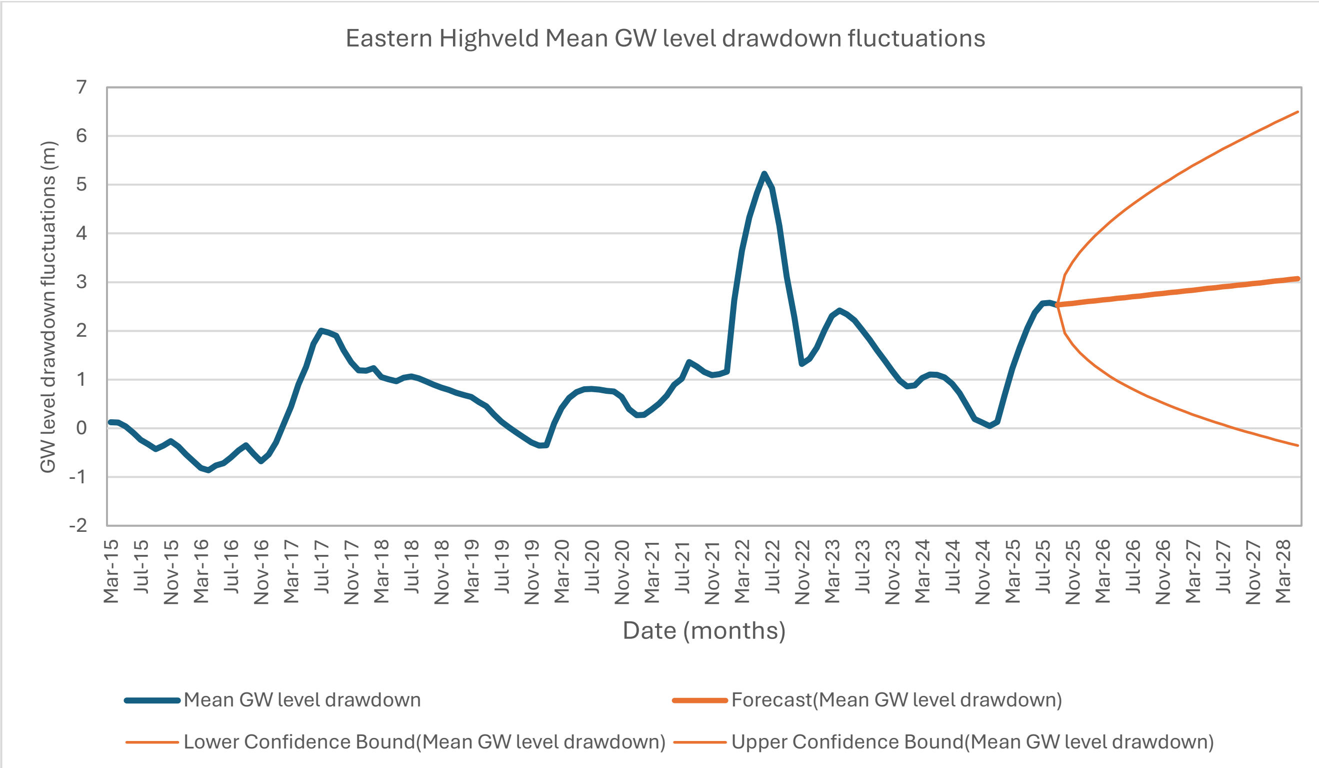


Figure 100: Mean Groundwater level drawdown fluctuations for the Eastern Highveld Hydrogeological Region

Summary of groundwater level status for the Western Cape, Northern Cape and Free State hydrogeological regions

The mean groundwater level drawdown trends for the Western Cape hydrogeological regions are presented in Figure 101. Water level declines were recorded over the observation period, marking a period of low rainfall. Few regions such as Oudtshoorn Basin and the Southwestern Cape Ranges were not as impacted as others. These two maintained positive trends for the most part of the observation period while other regions reported downward trends of up to 8m decline. It was until late 2021 that groundwater level drawdown for all these regions had a fluctuating upward trend in response to rainfall recharge. This is the prevailing trend to date. The water level rebound in the Knersvlakte region has been slow compared to other regions, but its latest information shows that it is gradually improving, catching up with other regions. Although the latest rains for the regions have shown a reduction in intensity, the groundwater levels still reflect an upward trend indicating a delayed response to rainfall recharge.

For the Northern Cape and Free State Provinces (Figure 102) the hydrogeological regions that were most affected by historic groundwater level drawdown declines are Hantam and the Bushmanland Pan Belt (both in the Northern Cape). Other regions maintained horizontal, slightly upward trends until late 2021 where a prominent rise was observed (including the groundwater level drawdown trends for the two regions Hantam and the Bushmanland Pan Belt, which were impacted severely previously), lasting until early 2024. Thereafter, a gradual decline lasted until March 2025. The latest water levels are marked by upward trends for most regions save for Bushmanland and Bushmanland Pan Belt.

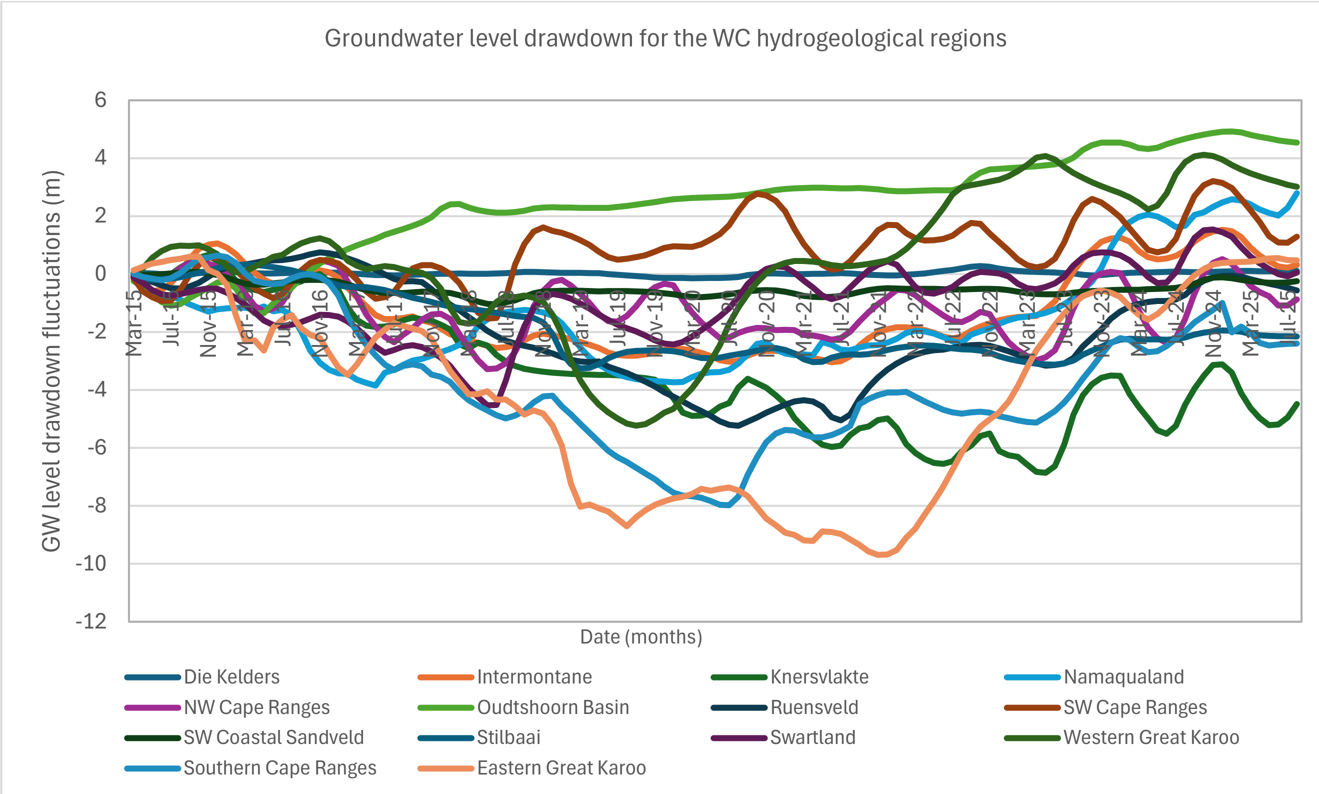


Figure 101: Groundwater level drawdown for the hydrogeological regions in the Western Cape

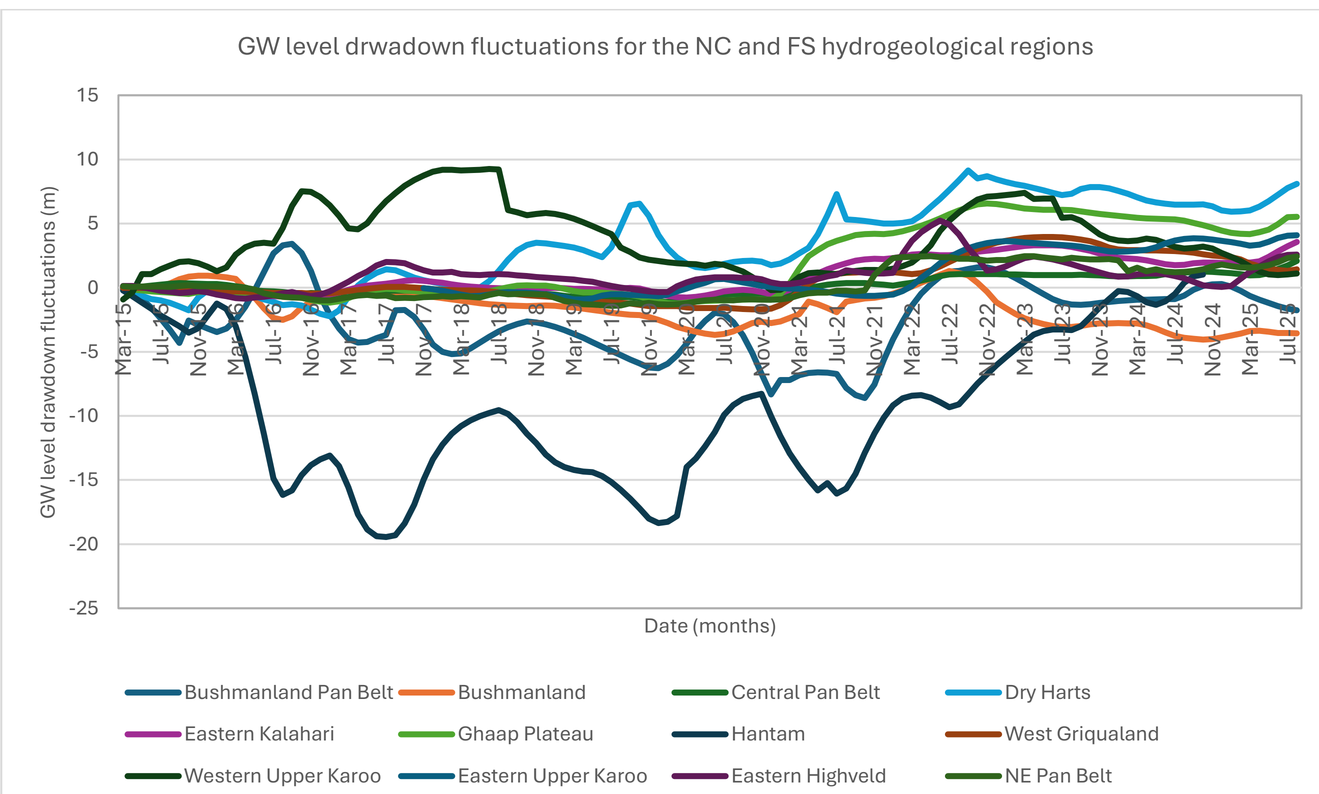


Figure 102: Groundwater level drawdown for the hydrogeological regions in the Northern Cape and Free State Provinces

4. Conclusions

An assessment of groundwater level status for the Western Cape, Northen Cape and Free State hydrogeological regions was conducted to ascertain whether the groundwater resource for these two provinces could be under threat from natural or anthropogenic impacts. This was done based on assessing natural groundwater level drawdown and recovery over a 10-year period. Thirty-eight (38) hydrogeological regions were assessed with meaningful historic datasets varying from 2015 to 2025. Of these 38 regions, two regions in the Free State (i.e. Southern Highveld and Northern Highveld) had no data i.e. no monitoring is conducted. The same was noted with the Tanqua Karoo region in the Northen Cape/ Western Cape and Bredasdorp in Western Cape. The Outenikwa Coastal Foreland, Stillbaai, Richtersveld, Western Kalahari and the Northeastern Upper Karoo recorded limited boreholes, for an assessment to be conducted. Generally, the monitoring programme for most of the regions needs to be reviewed to close the gaps and have a better representation of the monitoring programme. The Namaqualand and western Kalahari Hydrogeological Regions revealed monitoring inconsistencies although there is better borehole representation. Emphasis needs to be placed on the actual monitoring/ data gathering in these regions.

With regards to the overall assessment, all the regions' water level drawdowns respond well to rainfall recharge. This was noted when correlated with rainfall observed over the same period of assessment. Periods of water level decline could be associated with low rainfall (with lag period of rainfall and water level replenishment considered). Periods associated with low rainfall were mostly from 2016-2020. The groundwater levels responded to such for most regions. The later years (2020-2024) saw a replenishment period, which has been followed by the low rainfall cycle to date. The groundwater levels, for most regions have revealed to be in healthy state and have recovered from the significant water level decline (drought effects) observed between 2017 and 2020. Close observation/ monitoring (as another low rainfall cycle commencing) is recommended for those regions that didn't fully recover to initial water levels e.g. Knersvlakte and the Southern Cape Ranges. There is no immediate management intervention required for the assessed regions.

Included in the assessments are the forecasts of water level trends for the given years as indicative of future water levels; they are based on historic information and should be treated purely as basic indicators/ forecasts and not detailed modelling.

With regards to understanding of aquifer behaviour, the depths of the boreholes will need to be incorporated into the analysis. This will give an understating of the groundwater system unto which the boreholes tap water from. This will also allow the sorting and analysis of data based on groundwater systems rather than just geographically or purely from an elevation viewpoint.