Big Dog Hydrogeology Pty Ltd
135 Burgoyne Road Albany WA 6330
simon@bigdoghydrogeology.com.au
+61408230235

NEWMONT BODDINGTON GOLD 2025 ASSESSMENT OF MINING INFLUENCES ON GROUNDWATER

Report Status

Revision	Date	Signature
A (Draft)	May 2025	
0 (Final)	May 2025	S Barnett

EXECUTIVE SUMMARY

Newmont Boddington Gold Pty Ltd (NBG) operates the Boddington Gold Mine, located 17 km northwest of the town of Boddington, and around 100 km to the southeast of Perth in WA. The modern mining and processing operation was commissioned in 2009, and dewatering operations have been undertaken in the open pits throughout the construction and modern mining period. During modern mining, groundwater production bores have been constructed in deep bedrock in locations distant from the open pits and these bores are operated when necessary to supplement the water supply to the processing plant. Operation of the F1/F3 and R4 RDAs has resulted in significant changes in groundwater elevations and small changes in groundwater chemistry in the local area.

Groundwater monitoring data to 2025 have been reviewed to confirm whether the conceptual and numerical models of groundwater transmission remain valid and to update the understanding of the influences of the NBG mining operation of the receiving groundwater environment. The monitoring data continue to support the existing conceptual model in which:

- The Seasonal Shallow Groundwater System (SSGS) comprises shallow gravels and hardcap which locally act to transmit groundwater but are not saturated in all locations.
- Oxide underlies the SSGS, does not allow lateral transmission of groundwater, prevents vertical migration of groundwater in some locations and allows vertical migration of groundwater in other locations.
- The Weathered and Fractured Bedrock Groundwater System (WFBGS) comprising weathered and fractured zones at the upper bedrock surface is the dominant regional groundwater system and is the primary pathway for the migration of seepage from the mine facilities. The WFBGS is interpreted to be in hydraulic connection with the Hotham River and groundwater discharge supports the presence of pools in the river in summer.
- The Deep Fractured Bedrock Groundwater System (DFBGS) comprises discrete zones of fracturing in the unweathered bedrock at depth, which may be hydraulically connected to the open pits and to the groundwater production bores.

Open pit dewatering and production bore operation have caused local drawdown in the WFBGS. In some locations (such as Pillow, Round and Boomerang Swamps) this has had no effect on the SSGS, while in other locations (near the Westwood Borefield) drawdown in the SSGS has been observed. Mining related drawdown remains at least 1 km distant from the Hotham River in 2025. There is potential for mining related drawdown to cause harm to phreatophytic vegetation, and the Groundwater and Groundwater Dependent Vegetation Monitoring and Management Plan (GGDVMMP) has been designed to manage and mitigate this risk. Based on the data review presented in this document significant changes have been suggested for the groundwater monitoring components and groundwater triggers included in the GGDVMMP to account for the site specific conditions and risks at the BGM.

Seepage occurring during operation of the F1/F3 and R4 RDAs has caused groundwater mounding and small changes in groundwater hydrochemistry in the WFBGS, which have subsequently been transmitted into the SSGS. The maximum groundwater mounding (a shallowing of around 25 m in groundwater) has occurred close to the F1/F3 RDA embankment in the north and east. There is potential for groundwater mounding to cause harm to vegetation due to saturation of the root zone, and there is potential for mounding to drive cross catchment groundwater flow. These risks are managed and mitigated by the RDA Groundwater Management Plan (RDA GMP).

NBG are currently designing and permitting a second RDA in the Gringer Creek catchment referred to as RDA2. The updated characterisation of groundwater conditions in this document has been used to identify potential risks to the receiving surface water and groundwater environments associated with the planned operation of RDA2. These risks will be addressed and mitigated in the RDA2 designs and in the monitoring regime which is being designed in a separate document (BDH 2025).

Based on the results of the review of groundwater monitoring data to 2025 it is recommended that:

1. The monitoring bores included in the GGDVMMP to provide early warning of mining related drawdown should be reassessed. A summary of the suitability of the existing bores is provided in Table 1 and a suggested list of monitoring bores provided in Table 2.
2. The groundwater level triggers currently defined in the GGDVMMP which are based on the rate and annual magnitude of groundwater drawdown be replaced by trigger levels based on a minimum groundwater elevation. Potential trigger levels are suggested in Table 2. The suggested trigger levels have been developed taking account of long term and seasonal trends in groundwater elevations and the local hydraulic gradients acting towards the Hotham River.
3. The concurrent studies into baseline conditions and monitoring requirements at RDA2 should take account of the potential for 1) cross catchment flow to the northwest; 2) groundwater mounding influences on vegetation in the west; and 3) groundwater discharge influences on surface water in the east. It is also noted that the studies should consider the cumulative influences of the current seepage from the F1/F3 and R4 RDAs and potential future seepage from RDA2.
4. Once designs and monitoring requirements for RDA2 are fully defined the RDA GMP should be updated accordingly.

TABLE OF CONTENTS

1. Introduction

1.1 Background

Newmont Boddington Gold Pty Ltd (NBG) operates the Boddington Gold Mine, located 17 km northwest of the town of Boddington, and around 100 km to the southeast of Perth in WA. Open pit mining of an oxide gold resource was undertaken from 1987 to 2001, with stockpiled ore being processed until 2002 when the operation was placed in care and maintenance. Following definition of a gold resource within the deeper bedrock, construction of a large scale open pit mining operation was commenced by Newmont in 2006. The mining and processing operation was commissioned in 2009, and dewatering operations have been undertaken in the open pits throughout the construction and modern mining period. During modern mining, groundwater production bores have been constructed in deep bedrock in locations distant from the open pits and these bores are operated when necessary to supplement the water supply to the processing plant.

The potential for pit dewatering to influence the regional groundwater system was investigated in a large number of studies completed during the permitting and early mining period. Most recently the potential combined influences of open pit dewatering and production bore operation were assessed using a regional numerical model of groundwater flow (Golder, 2019). This regional model was calibrated to the observed changes in groundwater elevations during mining from 2009 to 2018.

NBG are required by Clause 7 of Ministerial Statement MS971 to develop and implement a Groundwater and Groundwater Dependent Vegetation Monitoring and Management Plan (referred to as the GGDVMMP, Umwelt 2021). The GGDVMMP is required to identify and manage the potential effects of groundwater drawdown on the receiving environment. The GGDVMMP was developed between 2018 and 2021 (Umwelt, 2021), utilising inputs from various stakeholders including the Department of Water and Environmental Regulation (DWER). Subsequent attempts to implement the GGDVMMP have identified that the recommended groundwater monitoring and triggers may be difficult to practically apply for the site specific conditions at the Boddington Gold Mine. NBG have requested that Big Dog Hydrogeology Pty Ltd (BDH) provide an updated assessment of groundwater conditions and provide recommendations for a simplified groundwater monitoring and groundwater trigger regime for potential incorporation to an updated GGDVMMP. This document provides the requested recommendations.

Operation of the F1/F3 RDA for the storage of tailings has resulted in significant changes in groundwater elevations and small changes in groundwater chemistry in the local area. Shallowing of groundwater has the potential to impact on local vegetation. The influences of the F1/F3 RDA were assessed in detail in a separate study (BDH 2023), and vegetation near the RDA is protected by the RDA Groundwater Management Plan (RDA GMP, BDH 2024). Key conclusions from these studies are reproduced in this report so that it forms a comprehensive assessment of mining influences on groundwater.

The existing influences of mining operations on groundwater in this report has also been used to develop recommendations for the management of groundwater during design studies for a new RDA referred to as RDA2.

1.2 Objectives

In consultation with Newmont, the objectives for the 2025 assessment of mining influences on groundwater were defined to be:

- To update the conceptualisation of the regional groundwater system using investigations and monitoring data collected to 2025.

- To determine whether the model predictions of future drawdown extent (Golder 2019) remain valid, or whether the predictions underestimate or overestimate regional drawdown.
- To develop simplified groundwater monitoring triggers which can easily and routinely be applied to three monthly groundwater monitoring results by NBG staff in the GGDVMMP.
- To ensure that the triggers nominated for use in the GGDVMMP are suitably protective of the receiving environment, while not being prone to false triggering due to natural seasonal and background trends.
- To outline the investigations which would be required to be undertaken if triggered by the groundwater monitoring undertaken as part of the GGDVMMP.
- To provide a complete description of mining influences on groundwater using all monitoring data collected to 2025.
- To outline the potential influences of RDA2 on groundwater to guide the design studies for this facility.

1.3 Summary of groundwater concepts in current GGDVMMP

The GGDVMMP describes that groundwater monitoring required to protect potentially groundwater dependent vegetation was developed by:

- Identifying areas where groundwater was naturally within 10 m of surface in 2006 prior to commencement of the modern mining operations. These areas were estimated using regional topographic data and monitoring results from a large number of standpipe monitoring bores (BDH 2018).
- Investigating the types of vegetation present in those areas and their potential to be dependent on permanent saturation associated with the local groundwater systems.
- Identifying the areas where mining drawdown will potentially occur using the results of the numerical groundwater modelling (Golder 2019).
- Nominating groundwater monitoring bores interpreted to be suitable to provide advance warning of mining related drawdown occurring in the identified groundwater systems.
- Measuring groundwater depths in nominated bores at three monthly intervals and quantifying the risk of groundwater depth changes impacting vegetation, using tables based on both the rate of change in groundwater depth and the absolute change in groundwater depth from a published study (Fround and Loomes 2004).

A total of 34 standpipe monitoring bores and four Vibrating Wire Piezometer (VWP) installations were included for monitoring in Table 3 of the GGDVMMP. The standpipe monitoring bores have screens of varying lengths and reflect the groundwater elevation in the most transmissive formation within the screen. The VWP sensors are grouted in place and measure the groundwater elevation at the depth of the sensor, with multiple sensors included at different depths in each installation. The bores and VWP installations nominated in the GGDVMMP were described as being either:

1. In locations where groundwater dependent vegetation may be present.
2. In locations between sources of drawdown and potential locations of groundwater dependent vegetation.
3. In locations distant from sources of drawdown and intended to define background regional trends.

1.4 Relevant studies

Other groundwater studies which have contributed to the assessment of groundwater conditions presented in this report comprise:

1. Groundwater Management Plan (BDH 2018). Compiled in 2018, this hydrogeological investigation included the installation of VWP sensors, geological and hydrological mapping of the Hotham River and a review of all monitoring data for the area between the pits and the Hotham River. The influences of both open pit dewatering and production bore operation on groundwater elevations were assessed. A map of regional groundwater depth below surface was compiled for the year 2006 (after recovery from the oxide mining period and prior to commencement of the modern hard rock mining period). The plan concluded that routine three monthly monitoring of all available standpipe bores was appropriate for the management of groundwater.
2. Groundwater model (Golder 2019). A regional numerical model of groundwater flow covering the locations of the RDAs, the open pits, the production bores and the Hotham River was updated and recalibrated using monitoring data collected to 2018. The model simulated the modern mining period and provided simulations of the total groundwater inflow to the open pits, groundwater drawdown at the open pits and groundwater mounding at the RDAs. The predictions for 2018 were a good match to the observed groundwater conditions (120 L/s groundwater inflow to the open pits on average). The model was then run in predictive mode from 2018 to 2032 to estimate future rates of groundwater inflow to the open pits and the extent of groundwater drawdown around the open pits. Predictive Scenario 1 assumed pit dewatering only at an average rate of around 140 L/s. Predictive Scenario 2 assumed pit dewatering at an average rate of around 140 L/s plus continuous operation of the eleven production bores at an average total rate of 129 L/s.
3. Production bore operating strategy (NBG 2018). NBG developed a strategy to manage potential drawdown from the Westwood Borefield which included:
    a. Three monthly measurement of groundwater depths in bores in the area as required by the Groundwater Management Plan.
    b. Increasing monitoring frequency near the borefield to monthly during operating periods for the production bores.
    c. Setting triggers at nominated bores for the rate of drawdown in m/month. Exceeding these triggers prompts an assessment of vegetation health in the vicinity.
    d. Setting triggers at nominated bores for the lowest allowable groundwater elevation. Exceeding these triggers prompts an assessment of whether the production bores should continue to be operated.
4. Review of groundwater conditions at the RDAs (BDH 2023). This report summarised groundwater elevations, groundwater chemistry and RDA hydrochemistry in the areas of the F1/F3 RDA and the R4 RDA using data collected to early 2023. The extent and fate of seepage influences in groundwater were discussed. Key conclusions from the study are summarised in this document.

5. RDA GMP (BDH 2024). This report provided a detailed investigation into groundwater mounding occurring around the F1/F3 and R4 RDAs, identified the mounding mechanisms, and investigated the influence of shallow groundwater mounding on vegetation health. A plan for the management of seepage influences at both the existing RDAs and any future RDAs (including the planned RDA2) was developed incorporating triggered actions based on both groundwater and vegetation monitoring. The RDA GMP is kept separate to the GGDVMMP because 1) groundwater mounding is localised to the RDAs and does not overlap with the drawdown influence of the open pits; and 2) the mechanism of potential environmental harm at the RDAs (damage to potentially all vegetation by permanent root saturation) is different to that at the open pits (damage to groundwater dependent vegetation by lowering groundwater below the root zone). Some results from the RDA GMP are summarised in this document, to avoid re-presenting all of the monitoring data from the RDAs.

1.5 Scope of groundwater updates for GGDVMMP

In consultation with NBG and Umwelt, the scope for updating groundwater components of the GGDVMMP in this report was agreed to be as follows:

1. There are no new monitoring data defining groundwater conditions in 2006, and there are no new data defining surface topography in 2006. The assessment of areas where groundwater naturally occurred within 10 m of surface in 2006 (BDH 2018) therefore remains valid and will not be updated in the GGDVMMP.
2. The groundwater model (Golder 2019) has not been updated since 2019, and the existing predictions of future mining related drawdown remain the best source for input to the GGDVMMP. However, monitoring data collected to 2025 have been assessed to determine whether the existing predictions are indicated to under or over predict mining related drawdown.
3. Since compilation of the GGDVMMP in 2021 construction of groundwater monitoring bores has been restricted to replacing decommissioned monitoring bores, with most of these bores located near the existing RDAs, or to constructing bores near the planned RDA2. Therefore, there are no new bores in critical drawdown locations which could be added to the GGDVMMP.
4. However, the scope included reviewing monitoring data for all bores included in the GGDVMMP, identifying any existing bores which are not suitable for use in the GGDVMMP, and identifying any existing bores which should be added to the GGDVMMP.
5. The scope included reviewing the updated monitoring data to confirm the degree of connection between the different groundwater systems and hence the appropriateness of bores completed at particular depths in monitoring mining related drawdown.
6. For bores included in the GGDVMMP, the scope included the development of proposed groundwater triggers which can easily be applied in practice by NBG to replace the risk tables included in the GGDVMMP.

2. Hydrogeological setting and mining driven changes

2.1 Facilities, topography and surface drainage

The layout of the Boddington mine is illustrated in Figure 1. The F1/F3 RDA, R4 RDA, North Pit, South Pit and the Waste Rock Storage Facilities have all been constructed within the surface water catchments of 34 Mile Brook, Boggy Brook and House Brook, all of which eventually report to the Hotham River. RDA2 is proposed to be constructed in the catchment of Gringer Creek, which eventually flows to the Hotham River. Natural topography slopes from around 340 m above Australian Height Datum (mAHD) to the north of the RDAs down to 200 mAHD at the Hotham River in the south and is dominated by a prominent ridge to the west of the RDAs which reaches 540 mAHD.

All of the surface water systems in the mine area, including Gringer Creek, 34 Mile Brook and the Hotham River, flow only during the winter period. The Hotham River retains pools during the summer period, and the regional groundwater investigations indicate these pools are supported by local groundwater discharge.

2.2 Sources of data

The description of hydrogeological conditions in the following sections has been compiled from extensive investigations which have resulted in the construction of the monitoring points described in Figure 2. These investigations included:

1. The installation of 24 standpipe regional monitoring bores under the supervision of Golder and Associates in January and February of 2007 (Golder 2007).
2. The construction of 54 standpipe monitoring bores at the F1/F3 RDA in 2009 (KP 2009).
3. The construction of eleven replacement standpipe monitoring bores at the F1/F3 RDA in 2009 (Aquaterra 2009).
4. The installation of 34 standpipe regional monitoring bores under the supervision of Golder and Associates in April and May of 2010 (Golder 2010).
5. The installation of 17 standpipe regional monitoring bores under the supervision of SWS between January and November of 2012 (SWS 2013).
6. Construction of two deep VWP installations in 2015 under the supervision of BDH (DeepVWP01 and DeepVWP02) along strike from the open pits to investigate drawdown trends and vertical hydraulic gradients.
7. Construction of a shallow VWP installation near the Hotham River in 2015 (HRVWP01).
8. Geological mapping and topographic surveys of the Hotham River in April 2015.
9. Construction of VWP installations HFVWP01 and HFVWP02 in 2018. These were located between the production bores in the Westwood Borefield and the Hotham River to measure drawdown at various depths.
10. Construction of standpipe regional monitoring bores HFBR10, HFBR11 and HFBR12 in 2017 to monitor groundwater conditions at 34 Mile Brook.
11. Construction of a second VWP installation to monitor groundwater conditions at the Hotham River in 2017 (HRVWP02).
12. Conversion of ten deep pilot holes drilled during exploration for production bores to function as standpipe regional monitoring bores.
13. Construction of 26 regional standpipe monitoring bores in the Gringer Creek catchment from 2020 to 2024.

The locations of the monitoring bores are presented in Figure 2 and construction details compiled from various reports are re-produced for all standpipes and VWP installations in Appendix A for ease of reference.

2.3 Climate

The Boddington mine experiences strong seasonal patterns in precipitation and evaporation. January and February are typically the warmest months, and evaporation in this period reaches 250 mm/month to 300 mm/month, while the cooler month of July experiences evaporation at around 50 mm/month to 60 mm/month. Annual total evaporation is typically 1,600 mm to 1,800 mm. Long term average annual precipitation for the Boddington mine has been reported to be 653 mm. However various studies have identified that a long term shift in precipitation patterns has occurred, with annual average precipitation prior to 1968 being 711 mm, and average annual precipitation after 1968 being 589 mm. On an annual basis, potential evaporation significantly exceeds annual precipitation. However, on a monthly basis precipitation typically exceeds evaporation in the winter months.

2.4 Conceptual hydrogeological model

2.4.1 Background

Geological records from mineral exploration drilling and from open pit mining, and observations from drilling at the 264 monitoring locations illustrated in Figure 2 provide good definition of the groundwater transmitting systems at the Boddington Gold Mine which are described in the following sections. The relationship between the geological logging units used by NBG and used by Golder for the numerical model of groundwater flow, and the groundwater units defined below is schematically illustrated in Figure 3.

2.4.2 Seasonal shallow groundwater system (SSGS)

The SSGS occurs at surface and comprises a mix of clays with some laterite gravel, laterite gravels, cemented laterite hardcap, cemented hardcap containing solution cavities, or in low elevation locations near 34 Mile Brook and the Hotham River alluvial gravels and sands. Of the 138 monitoring locations where shallow logging data are available, this unit was absent in four locations, and was present in all other locations, although in many of these locations it was not saturated. Typically, the shallow unit was 3 m to 5 m thick, on average extending to 5.5 m Below Ground Level (mBGL), with a maximum depth of 54 mBGL at HFVWP01 which represents an isolated outlier for the thickness of the SSGS.

These observations confirm that the SSGS occurs as discrete, isolated lenses and is not regionally continuous or consistently saturated. Large changes in thickness may occur between adjacent bores as was observed at HFBR8 and HRVWP02 in the low elevation area adjacent to the Hotham River. Although the SSGS has been identified more often in the areas southeast and northeast of the open pits, it may occur anywhere in the regional system.

In upper elevation areas the SSGS is periodically dry in most locations, and it appears that infiltration from significant precipitation events potentially saturates this zone in some locations and becomes perched above the underlying oxide clays. Perched groundwater moving through the lateritic gravel material potentially discharges downslope, is removed via evapotranspiration, or infiltrates and saturates the underlying oxide as has been observed at DeepVWP02. Many of the monitoring bores screened in this formation are dry in summer and contain water for some portions of the winter months. In nearly all monitoring locations in the higher elevation areas near the pits, the groundwater elevation in the laterite gravels is higher than in the underlying weathered and fractured bedrock. In lower elevation areas, near 34 Mile Brook and the Hotham River, the SSGS is permanently saturated.

2.4.3 Oxide

The oxide unit comprises highly weathered bedrock material (saprolite) which occurs in the zone beneath the SSGS and above the interface with the weathered and fractured bedrock groundwater system (WFBGS). Although the oxide is not interpreted to act as a regional groundwater transmitting unit, it is interpreted to store groundwater and has been thought to act as a control on the vertical movement of recharge and groundwater within the regional system.

Based on the logging data available from the drilling programmes:

- The oxide unit is present across nearly all of the site and was encountered in all 111 drillholes with logging data except at HRVWP02 adjacent to the Hotham River, where the oxide is absent, and alluvial gravels overlie fresh basalt bedrock.
- The thickness of the oxide layer ranged from 0 m at HRVWP02 and 6 m at HFVWP01, to 100 m at WD7BR3, and averaged 28 m over all drillholes.
- Logging descriptions for the oxide indicate it to have a massive clay nature, with variable amounts of relict structural features or chips of less weathered material.
- The oxide zone is present in nearly all locations across the Boddington site and was partially saturated at the open pits prior to mining. In high elevation locations near the open pits, the oxide appears to be at least partly unsaturated and to act as a barrier to significant rates of groundwater movement, resulting in the SSGS at Round, Boomerang and Pillow Swamps being perched. These responses are consistent with observations in similar deep weathering environments in southwest WA and in the Eastern Goldfields of WA.
- In the locations of the F1/F3 RDA and the R4 RDA, the oxide was unsaturated prior to mining but has subsequently been saturated by seepage from the overlying RDAs. This has allowed the oxide to transmit seepage into the underlying groundwater systems (BDH 2023 and BDH 2024).
- In the areas of 34 Mile Brook and the Hotham River, the oxide is saturated and can allow groundwater drawdown to be vertically transmitted. This is illustrated at monitoring bore HFBR5, where 65 m of oxide is present, but operating the Westwood Borefield from below the oxide caused drawdown in the SSGS above the oxide.
- On a regional basis across the Boddington mine, some hydraulic connection through the oxide appears to be present, given that the underlying groundwater systems typically demonstrate responses to precipitation.

2.4.4 Weathered and fractured bedrock system (WFBGS)

The WFBGS has been identified as the major regional groundwater system at Boddington (due to it being regionally extensive), and it occurs at the interface at the base of the oxide material as schematically illustrated in Figure 3, where the weathered bedrock retains sufficient structure to allow some groundwater transmission along with fracture zones at the surface of the unweathered bedrock. Logging data from the drilling programmes indicate that:

- Typically, the transition from weathered bedrock to fresh bedrock is relatively rapid with depth at Boddington. The logged thickness of this weathered interval ranges from 0 m at HRVWP01, to 24 m at WD9BR1.
- The average thickness of the WFBGS across all of the drilling locations was 6.5 m.
- The depth to the top of the WFBGS is highly variable, ranging 13 mBGL to 100 mBGL, but is typically more than 25 mBGL in most locations.
- Logging descriptions confirm that the WFBGS comprises highly to slightly weathered bedrock, including varying degrees of fracturing, veining, mineralisation and alteration.

- Most of the regional standpipe monitoring bores installed at Boddington have targeted the WFBGS. In all cases records were maintained of airlift flows during development of the completed bores. Airlift flow rates typically ranged from nil to less than 0.5 L/s, consistent with a moderate to low hydraulic conductivity for this system. Higher airlift flows were noted at WD7BR12 (0.6 L/s), HFBR7 (0.7 L/s) and at HFBR8 (1.2 L/s).
- Analyses of recovery from airlifting indicated hydraulic conductivity to range from 0.0003 m/day to 0.04 m/day, with an average of 0.003 m/day, confirming a relatively low hydraulic conductivity.
- The WFBGS is the groundwater unit which has the greatest extent across the Boddington site. Although on a regional basis it has been observed to act and respond as a relatively continuous and connected hydraulic system, on a localised basis the groundwater transmitting properties are highly variable. The primary storage and transmission of groundwater has been inferred to occur in the saprock zone at the interface with the upper bedrock surface.
- Groundwater flow occurs downslope in response to the prevailing hydraulic gradients, and also as vertical leakage into the underlying deep fractured bedrock system (the vertical gradients defined by the VWP sensors generally act downwards). In many locations the monitoring data define a source of seasonal recharge to this unit, with these locations including areas close to the pits, and areas distant from the pits.

2.4.5 Deep fractured bedrock groundwater system (DFBGS)

The DFBGS comprises zones of open fracturing occurring at depths of 100 mBGL to 200 mBGL in the bedrock. In the area of the open pits, the deep bedrock forms part of the regional greenstone unit striking to the north-northwest as outlined in Figure 1. Outside of the greenstone boundary (as marked in Figure 1) the regional geology comprises granitoids, with dolerite dike intrusions.

Locally, groundwater transmission and storage in the DFBGS is controlled by the intensity and openness of the fracture zones present in the unweathered bedrock. Regionally, groundwater transmission is controlled more by the degree of regional connection of these fracture zones, and the presence of any compartmentalising structures. On a regional basis, the DFBGS acts as a continuous unit.

Responses to seasonal recharge occur in the DFBGS, in some cases with very rapid responses to daily precipitation events, the sources of which have not been defined but may be related to drillholes and sumps in the mine area.

Previously the hydrogeological model suggested that significant groundwater transmitting fracture zones were present only in the greenstone, with limited fracturing expected in the surrounding granitoids. However, the groundwater supply investigations have identified that regionally connected fracture zones suitable for exploitation for water supply are present in the granitoids, and that drawdown associated with pit dewatering is likely to extend across strike beyond the limits of the greenstone unit. The eleven production bores identified in Figure 2 all intersect the DFBGS, extend to between 120 mBGL and 370 mBGL, and can sustain short term operation at rates between 3 L/s and 22 L/s.

Distant from the open pits, on a regional basis, vertical hydraulic gradients in the DFBGS are indicated to be small, and groundwater elevations in the DFBGS are interpreted to be similar to the WFBGS. However, in the zone within 2 km to 3 km of the open pits, spot measurements of groundwater elevations measured in the DFBGS identify significantly lower values than in the overlying WFBGS. Similarly, near the Westwood Borefield, operation of the production bores has a much larger influence on the DFBGS than on the overlying WFBGS. Drawdown associated with mine dewatering and production bore operation is interpreted to have a much larger magnitude and extent in the DFBGS, compared to the overlying WFBGS, however it is noted that the DFBGS occurs at depths which are too great to directly affect vegetation. The risk posed to vegetation by pit dewatering and production bore operation is therefore primarily controlled by the degree of vertical hydraulic connection between the groundwater units.

2.4.6 Hotham River

Mapping and drilling investigations have identified that the oxide is present in some locations below the Hotham River, while in other locations it is absent and there is direct contact between the river and the WFBGS (bedrock outcrop was identified in the riverbed in five locations between HRBR8 and HFBR1 in Figure 2). Pathways are therefore present for the exchange of surface water in the river and groundwater in the underlying systems.

Figure 4 provides an east west hydrogeological cross section through the Hotham River at the location of HRVWP01. In this area the drilling indicates the oxide is present with a thickness of around 20 m, however the seasonal trends in measured groundwater elevations in the different groundwater systems indicate vertical hydraulic connection is present through the oxide. The hydraulic gradients identify that groundwater flows from the west (from the area of the mine facilities) into the Hotham River both in the SSGS and in the WFBGS. The remnant pools in the Hotham River present in the summer are indicated to be supported by groundwater discharge. This conclusion is supported by the calibrated numerical model of groundwater flow which simulates discharge of groundwater to the river (Golder, 2019). The model predictions identified that if groundwater drawdown occurs near the Hotham River, there would be no influence on winter flow rates, but there would potentially be a reduction in the elevation and duration of remnant pools in summer.

2.5 Open pit dewatering

North Pit and South Pit are largely dewatered using sump pumping systems which remove a combination of groundwater inflow and surface water runoff (passive groundwater dewatering). For some periods, dewatering bores have also been operated in critical locations within the pit slopes (active groundwater dewatering). Figure 5 summarises dewatering rates provided by NBG from 2017 to 2024 and illustrates that variations in pumping rates largely relate to periods when lakes have been allowed to form in the pits followed by periods when the lakes have been pumped out. Monitoring and water balance modelling undertaken by NBG identifies that the total rate of groundwater flow into the open pits has been relatively constant at around 140 L/s during mining, regardless of whether the inflows are intercepted by bores or controlled by sumps (Ohashi 2024). The groundwater model predictions of total pit dewatering at 140 L/s from 2019 to end of mine life are therefore validated.

2.6 Production bore operation

The production bores illustrated in Figure 2 are typically operated for short periods when there is a shortfall from the multiple other sources of water used for the mining and processing operations, which include pumping from the Hotham River in winter, open pit dewatering and return of water from the RDAs. Figure 6 plots average weekly or monthly rates of pumping from the production bores. The bores were operated at up to 50 L/s in 2015 and 2016, at up to 70 L/s in 2017, at up to 70 L/s from 2020 to 2022 and at up to 30 L/s in 2024. The bores were not operated in 2018 and 2023. From 2019 to 2025 the average total pumping rate was 19 L/s. The assumptions applied in predictive Scenario 2 for the groundwater model (continuous operation of production bores from 2019 to end of mine life at 129 L/s) are therefore identified to be overly conservative.

2.7 Potential for mining drawdown to cause environmental harm

Both open pit dewatering and the operation of production bores will cause drawdown to occur within the DFBGS. This system occurs well below the root zone for vegetation and there are no environmental receptors directly in contact with the DFBGS. Based on the conceptual hydrogeological model described above, mechanisms for environmental harm to potentially occur due to mining related groundwater drawdown are identified to be:

- Hydraulic connection is known to be present between the DFBGS and the WFBGS. Pumping from the DFBGS will cause some groundwater drawdown to occur in the WFBGS. If the WFBGS occurs at shallow enough depths to be within the root zone, and groundwater dependent vegetation is present, there is potential for drawdown to cause harm to the vegetation.
- In some locations the oxide unit is known to provide hydraulic connection between the WFBGS and the SSGS. Drawdown in the SSGS could cause groundwater to fall below the root zone of groundwater dependent vegetation, or could cause Round, Boomerang or Pillow Swamp to dry out.
- If groundwater drawdown should reach the Hotham River, there would be a reduction in groundwater contribution to pools in the river in summer, and the pools could potentially be drained into the groundwater system.

The updated GGDVMMP and associated groundwater monitoring have been structured to provide the earliest possible warning of the occurrence of these potential mechanisms. Section 3 investigates where these mechanisms are currently occurring based on monitoring data collected to 2025.

2.8 RDA operation

The R4 RDA (located as marked in Figure 1) and the F3 RDA (located below the eastern part of the F1/F3 RDA in Figure 1) were utilised for tailings storage in the oxide mining period. During the current mining operations tailings have been stored in the F1/F3 RDA, and the R4 RDA has been operated for water transfers.

Measures included in the F1/F3 RDA design to mitigate potential seepage comprised:

- A HDPE liner was installed in the southern part of the F1 RDA (1.5 mm HDPE placed on 300 mm of compacted clay) and was designed to include all of the extent of the decant pond during operations.
- Construction of a gravel layer below the HDPE liner, with drainage reporting to the LCRS to intercept any seepage through the liner or any groundwater entering the facility from below.
- Installation of toe drains immediately upstream of critical portions of the embankments, reporting to toe wells, which were designed to be pumped to reduce hydraulic heads at the embankments.

Measures implemented at the F1 RDA during operations to further manage pore pressures and seepage comprise:

- Beach drains were installed within the tailings near the embankments at elevations between 335 mAHD and 345 mAHD and intercept supernatant water within the upper part of the settled tailings, which is removed by gravity drainage to a common flow monitoring point.
- Construction of perimeter sumps at the toe of the RDA embankment to collect pooled seepage and installation of pumping equipment to maintain the water levels in the sumps as low as possible. The sumps have been pumped since 2019.

Despite the seepage mitigation measures, operation of the F1/F3 RDA and the R4 RDA has caused mounding within the WFBGS in the local area. Figure 7 summarises the shallowing of groundwater from 2009 (start of tailings deposition in the F1/F3 RDA) to 2019 and Figure 8 summarises the further shallowing from 2019 to 2023 (both reproduced from the detailed investigations in BDH 2023). In 2019 groundwater had shallowed by up to 25 m immediately adjacent to the F1/F3 RDA in the north and east. In these areas little additional mounding is measured from 2019 to 2023 due to groundwater reaching surface and being controlled by the interception sumps.

Despite the large changes in groundwater elevations, changes in groundwater chemistry in the WFBGS have been relatively small. This is because the hydrochemistry of seepage lies in a similar range to the background groundwater hydrochemistry for many parameters, and because of geochemical attenuation for other parameters such as cyanide. Potential influences of the RDAs on the receiving environment are therefore controlled by the groundwater elevation responses, and have been identified to be:

- The presence of permanently shallow groundwater immediately adjacent to the RDA has potential to impact on vegetation which is not adapted to permanent saturation of the root zone.
- Groundwater from the WFBGS rising into the SSGS may cause significant increases in TDS concentrations which may affect vegetation.
- Groundwater mounding in the WFBGS may drive groundwater flow across the natural catchment boundaries. Figure 9 illustrates the currently interpreted groundwater flow directions and the potential fate of seepage and includes a component of cross catchment flow into the South Dandanup catchment.

These potential mechanisms for environmental harm associated with RDA seepage are mitigated and managed by the Boddington RDA GMP.

2.9 Boddington RDA GMP

The potential for environmental harm to occur associated with seepage from the RDAs is managed via the Boddington RDA GMP (BDH 2024). The RDA GMP specifies the monitoring of groundwater conditions and vegetation health around the current RDA and around any future RDAs (including RDA2). The required monitoring was defined based on observations of groundwater changes during current operations and the observed associated changes in vegetation health and is therefore adapted to the specific groundwater units and vegetation types occurring at the BGM. Commitments in the RDA GMP included:

- Quarterly groundwater depth monitoring at 108 active monitoring bores.
- Quarterly groundwater chemistry sampling at 27 bores included in Prescribed Premises Licence L2306/2008/3.
- Quarterly groundwater chemistry sampling at 79 bores which are not included in L2306/2008/3.

- Annual Plant Cell Density (PCD) assessment of vegetation health around the margins of the R4 and F1/F3 RDAs, regardless of groundwater monitoring results, including field review of grid blocks of PCD decline
- Three monthly field visual inspection including photographic points of vegetation adjacent to the RDAs to determine if small areas of decline become evident.
- Transition from the operational vegetation monitoring regime to the closure vegetation monitoring described in the F1 RDA rehabilitation plan.
- Annual interpretation and reporting of monitoring data.

3. Updated review of regional groundwater drawdown data

3.1 Background

Groundwater elevation monitoring data from regional standpipe bores and from VWP installations are reviewed in the following sections to confirm that the conceptual hydrogeological model described in Section 2 remains valid, and to identify the current influences of mining drawdown. Monitoring data from bores are plotted in groups, to allow common trends to be correlated and identified. Monthly precipitation data are included in the plots to allow groundwater responses to recharge events to be identified. Where relevant average pumping rates for nearby production bores are included to help identify drawdown associated with bore operation. Key dates for open pit dewatering are also included (the date when the lakes accumulated in the care and maintenance period were pumped out and the date when mining operations and pit dewatering commenced). For bores close to a gauging station on the Hotham River, the river elevation is included, which allows a direct comparison to determine whether hydraulic gradients act from groundwater into the river or from the river into groundwater. Although a few bores have monitoring data extending back to the 1990s, most of the bores were installed after 2010, and so most of the plots present grouped data from 2010 onwards.

The monitoring data are presented as groundwater elevations to allow hydraulic gradients to be identified by comparing responses at adjacent bores. Given that the primary mechanism for environmental harm is groundwater drawdown occurring in the root zone of groundwater dependent vegetation, the plots are also re-presented as groundwater depth where possible.

Construction details for all standpipe bores are summarised in Appendix A. Appendix A also lists the Figure in the report where groundwater elevations are plotted for that bore. Note that for the monitoring bores at the RDAs, which are not plotted in this report and are subject to groundwater mounding, plots were presented in the 2023 RDA review (BDH 2023).

3.2 Long term regional trends

Long term groundwater elevations measured in regional standpipe bores are plotted in Figure 10, and equivalent data are plotted as depths in Figure 11. In most of these regional bores, no drawdown response is present during dewatering of the Jarrah Decline in the oxide mining period, or during pit dewatering and production bore operation in the current mining period. However, WHBR1 located southeast of the open pits indicates around 10 m of mine related drawdown has occurred since 2010. All of the regional bores demonstrate long term declines in groundwater elevation of around 0.5 m/year which is attributed to long term reductions in precipitation as indicated by the four year average annual precipitation data plotted in Figure 10.

3.3 DeepVWP01 and DeepVWP02

Groundwater elevations measured in the five VWP sensors at each of these monitoring points are plotted in Figures 12 and 13. Data from nearby standpipe monitoring bores are included for reference. There are significant data gaps for all VWP sensors which NBG are currently working to resolve. Daily precipitation data are plotted to compare against the continuous monitoring data from the VWPs.

At both DeepVWP01 and DeepVWP02 the deep bedrock sensors show drawdown due to pit dewatering and possibly due to the operation of production bore Roberts 1. The sensors in weathered and fractured bedrock and in oxide display lower amounts of mine related drawdown, and the oxide sensors show strong recharge responses and higher groundwater elevations, indicating groundwater may be perched in the oxide and not fully connected to the underlying groundwater systems in these locations near the open pits. Comparing the VWP data with the three monthly readings from standpipe bores confirms that long term trends are captured in the standpipe bores, but the detail of localised recharge events may not be captured.

3.4 Pit area

Figures 14 to 29 present monitoring data for bores near the open pits and in the greater region, presented both as elevations and depths. Observations from these plots are:

- Many of the readings in October 2024 are clearly anomalous and have been disregarded.
- All of the groundwater depths calculated from the sensor in WHVWP01 in 2019 and 2020 are erroneous and have been disregarded (Figures 18 and 19).
- Most bores display seasonal rises and falls in groundwater elevation of up to 5 m which correlate with precipitation conditions.
- Many bores display long term declining groundwater elevations, at rates higher than the background declines illustrated in Figure 10, which are attributed to the influence of pit dewatering. The largest mine dewatering influences are identified at WD7BR13 (Figure 18), WD9BR1 (Figure 28), WTBR2 (Figure 15) and HGPZ32 (Figure 16). These indicate that a maximum drawdown of around 20 m has occurred in the WFBGS since open pit dewatering commenced.
- At several bores screened in the WFBGS, long term rising trends are evident in groundwater elevations, despite being located close to the open pits. These bores include SPBR1D (Figure 20), WD8BR4 (Figure 22), WD8BR6 (Figure 24), WD8BR2 (Figure 26) and WD7BR6 (Figure 28). All of the bores displaying these responses are located near waste rock storage facilities or containment ponds. In these locations it is interpreted that localised groundwater mounding is occurring due to seepage and preferential recharge associated with the mine facilities and drainage systems. Although the DFBGS has been depressurised in these locations due to pit dewatering, it appears that downward seepage from the WFBGS into the DFBGS occurs at lower rates than seepage and recharge from surface travelling downward through the oxide and entering the WFBGS.
- WD7BR1D located relatively close to South Pit appears to show both groundwater mounding from the adjacent waste rock storage facility (from 2010 to 2019 in Figure 20) and groundwater drawdown from pit dewatering (from 2020 to 2024 in Figure 20). This would suggest that in this location in the WFBGS, the balance between downward leakage into the DFBGS, and seepage through the oxide from surface has changed.

3.5 Swamps

Figures 30 to 39 plot groundwater elevations and groundwater depths measured in Boomerang Swamp, Round Swamp and Pillow Swamp which are located northeast of the open pits as marked in Figure 2. Where relevant the elevation of the base of the bore is also plotted to help identify periods when the bore is actually dry. For these figures, database readings listed as “dry” have been replaced with the depth of the bore, to better define the periods when the bores have been saturated.

Observations for Boomerang Swamp are:

- Q2PZ1A located near the swamp and screened in the WFBGS displayed strong responses to open pit dewatering in 2009 (Figure 32). Subsequently the water level has been static at 5 m above the reported base of casing, which indicates the lower part of the casing is blocked, the bore is actually dry, and mining drawdown is continuing to occur. However, BMSWPZ1A screened in the WFBGS has not responded to dewatering. A potential cause of the anomalous responses in BMSWPZ1A is that this standpipe was installed in the same drillhole as BMSWPZ1B, with a bentonite seal placed from 15 mBGL to 16 mBGL. If this seal failed it would explain the similar responses between BMSWPZ1A and BMSWPZ1B.
- Bores screened in the SSGS are either consistently dry (BMSWPZ3), sporadically dry (BMSWPZ2), or permanently saturated (BMSWPZ1B). None of these bores indicate any drawdown associated with pit dewatering has occurred.

Observations for Round Swamp are:

- The combined data from LPBR1 and replacement bore LPBR1A, and the data from K3PZ1A, ESBR1D and RNSWPZ3A in Figure 36 confirm that significant drawdown has occurred in the WFBGS in this area due to pit dewatering.
- Monitoring of bores RNSWPZ3B, RNSWPZ1 and RNSWPZ2 in Figure 34 identifies that the SSGS is largely dry but re-saturates every two to three years driven by winter precipitation. This behaviour has continued throughout the pit dewatering period, and the SSGS is not being underdrained by the deeper drawdown.

Observations for Pillow Swamp are:

- PISWPZ3A screened in the WFBGS measures drawdown due to pit dewatering, at rates consistent with data from K3PZ1A and Q2PZ1A (Figure 38).
- Monitoring of bores PISWPZ2 and PISWPZ1 in Figure 35 identifies that the SSGS is largely dry but re-saturates every two to three years driven by winter precipitation, while PISWPZ3A appears to be permanently dry. These behaviours have continued throughout the pit dewatering period, and the SSGS is not being underdrained by the deeper drawdown.

In combination, the groundwater elevations plotted in Figures 30 to 39 identify that drawdown related to pit dewatering is occurring in the WFBGS in the area of the swamps, but that the oxide has acted to prevent drawdown influencing the SSGS during the 17 years of pit dewatering which have been undertaken to date. These conclusions are consistent with an assessment of exploration drilling data which identified that between 20 m and 30 m of oxide is consistently present beneath the swamps, and that much of the oxide is unsaturated (BDH 2021).

3.6 Westwood Borefield

The Westwood Borefield comprises production bores Westwood 1, Westwood 3, Westwood 4, Westwood 5 and Westwood 8 located near 34 Mile Brook as marked in Figure 2. VWP installations HFVWP01 and HFVWP02 were installed specifically to monitor potential drawdown occurring between the borefield and 34 Mile Brook, and between the borefield and the Hotham River. Monitoring data from the VWP installations and standpipe bores are plotted in Figures 40 to 45. Pumping rates from the Westwood Borefield are included in the plots where relevant.

Background groundwater conditions in the general region of the Westwood Borefield are examined using data from distant standpipe monitoring bores in Figure 40. These identify that groundwater elevations have been stable on average during the operation of the Westwood Borefield, and in most bores seasonal recharge and discharge results in transient changes in groundwater elevations of up to 5 m. Exceptions to these trends are:

1. HFBR3D which indicates a long term decline potentially due to a combination of background trends and pit dewatering.
2. HFBR1D which shows small (drawdown of around 5 m) responses to Westwood Borefield operation in 2021.
3. HFBR2D which displays rising groundwater elevations from 2017 which is attributed to seepage from the adjacent reservoir.

Groundwater elevations calculated for bores near the Westwood Borefield are plotted in Figure 40 and are compared against the elevation of the base of the bore casing. Although groundwater depths have been measured in HFBR1S and HFBR6S, on nearly all occasions the calculated elevation is similar to the elevation of the base of the bore casing. These measurements reflect a small pocket of water trapped above the endcap, and these bores were in fact dry. Groundwater elevations calculated from these depths measured in HFBR1S and HFBR6S do not reflect groundwater conditions in the SSGS. Figure 40 identifies that:

- At HFBR5S, the SSGS has been saturated in some monitoring events, but it is clear that from 2015 to 2017, in 2020, in 2021 and in 2024 the bore was dry, with these periods corresponding to the operation of the Westwood Borefield.
- HFBR13 is an abandoned production bore pilot hole which extends to 261 m depth in bedrock. On some occasions groundwater depth has been measured as 9 mBGL, while on other occasions the water level has been beyond the longest available 200 m dipper. The comparison in Figure 43 identifies that these large changes in groundwater elevation in the DFBGS are real, and correlate with pumping rates from the Westwood Borefield, taking account that pumping rates for the borefield are available as monthly averages.
- HFBR15 is an abandoned production bore pilot hole which extends to 350 m depth in bedrock. Drawdown of up to 10 m is evident during operation of the Westwood Borefield.
- HFBR12 is screened in the SSGS near 34 Mile Brook and is located around 900 m from the nearest production bore. Drawdown due to borefield operation has not occurred in the shallow strata in this portion of 34 Mile Brook to date.
- All of HFBR5S, HFBR5D and HFBR10 are located within 0.5 km to 1 km of individual production bores and respond to Westwood Borefield operation with steep drawdown occurring in 2016, from April to June in 2020 and from January to May in 2021. Ongoing intermittent operation of the borefield from 2021 to 2025 has caused only minor drawdown in these bores.

In combination the monitoring data for the Westwood Borefield plotted in Figures 40 to 43 indicate that:

- In most of the bores near the Westwood Borefield which are screened in the SSGS and in the WFBGS, groundwater depths are less than 20 mBGL and there is potential for interactions between groundwater and the root zone of local vegetation.
- Operation of the Westwood Borefield to draw groundwater at up to 50 L/s from the DFBGS causes drawdown of up to 200 m to occur within the DFBGS.
- In the overlying WFBGS the drawdown from borefield operation has been a maximum of 10 m, indicating limited connection to the underlying deep fractured bedrock, but sufficient connection to potentially present a risk to vegetation.

- In the SSGS at the location of HFBR5, the drawdown during borefield operation occurred at a similar rate to the underlying WFBGS, indicating strong hydraulic connection through the intervening oxide unit.
- Comparison with the risk rankings presented in the current version of the GGDVMMP identifies that the magnitude of Westwood Borefield drawdown (up to 15 m) and the rate of drawdown (more than 5 m/year) would potentially pose a severe risk to vegetation dependent on either the SSGS or the WFBGS if pumping were to continue for significant periods. Monitoring and management of the Westwood Borefield is therefore a key component for the updated GGDVMMP.

VWP monitoring installations HFVWP01 and HFVWP02 were installed specifically to monitor potential drawdown from the Westwood Borefield migrating towards the Hotham River. Continuous monitoring data are plotted in Figures 44 and 45 and illustrate that:

- As a result of poor construction of the drillholes, damage occurred to many sensors during installation and grouting. Five sensors were installed in each bore, with three sensors now providing useful data in HFVWP01 and two sensors now providing reliable data in HFVWP02. In HFVWP01 the sensor installed in the WFBGS is operating (HFVWP01V3), while at HFVWP02 data are only available from a sensor above this unit in oxide and a sensor below this unit in bedrock.
- In each case groundwater elevation responses have been compared against HFBR6D where no drawdown is evident, and against HFBR15 where significant drawdown has occurred during operation of the Westwood Borefield. All of the VWP sensors display seasonal responses to recharge and discharge, which are consistent with the trends at HFBR6D, and are not consistent with the trends at HFBR15. To date, the operation of the Westwood Borefield has not caused drawdown to occur in these locations.
- Comparison of the continuous VWP readings with the manually collected standpipe depths confirms that manual monitoring defines the long term trends but may not fully define short term recharge events.

3.7 Responses at the Hotham River

Monitoring data for standpipe bores located near the Hotham River are plotted in Figures 46 and 47. Data from VWP installations HRVWP01 and HRVWP02 which were installed to identify any potential mine related drawdown at the Hotham River are plotted in Figures 48 and 49. Where relevant, the gauged height of the Hotham River or the surveyed elevation of pools or the bed in the Hotham River adjacent to each monitoring point are included in the plots.

- All standpipe bores display seasonal changes in groundwater elevation of 2 m to 3 m caused by winter recharge. Long term groundwater elevations have been stable on average since 2011 and there is no evidence of any drawdown near the Hotham River associated with pit dewatering or operation of the Westwood Borefield.
- In all cases, groundwater elevations are nearly always higher than in the adjacent Hotham River, confirming gradients act to cause discharge of groundwater to the river. This conclusion is based on Figure 48 which compares:
    - HRBR8 screened in the WFBGS with the elevation of the adjacent bed of the Hotham River which was surveyed in 2015.

  - HRBR1S screened in the SSGS, HRBR1D screened in the WFBGS and gauging data from the adjacent Hotham River gauging station. These identify that groundwater elevations are typically 1 m to 2 m higher than the river elevation, including throughout every summer no flow period from 2010 to 2024. However there have been very brief periods during winter swiftflow conditions when the river has peaked slightly higher than the groundwater elevation, which may have caused hydraulic gradients to be briefly reversed.
  - HFBR8S screened in the SSGS, HRBR8D screened in the WFBGS, gauging data for the Hotham River at the adjacent Pump Station 2, and the elevation of the pool that was present in the adjacent Hotham River when surveyed in 2015. These confirm that groundwater elevations have been 2 m to 4 m higher than the river elevation including during every summer no flow period from 2013 to 2024.
- As a result of poor construction of the drillholes, damage occurred to many sensors during installation and grouting at HRVWP01 and HRVWP02. Five sensors were installed in each bore, with two sensors now providing useful data in HRVWP01 and one sensor now providing reliable data in HRVWP02. In HRVWP02 the sensor installed in the WFBGS is operating (HRVWP02V3), while at HRVWP01 data are only available from a sensor above this unit in oxide and a sensor below this unit in bedrock. There are also significant data gaps for HRVWP01 (no data after April 2021) which NBG are working to resolve.
- Comparing the continuous monitoring data from the operating VWP sensors with adjacent gauging stations in the Hotham River confirms that groundwater elevations in all groundwater systems are higher than the water level in the adjacent river, including through the summer no flow periods from 2015. However, there may have been very brief periods during winter swiftflow conditions when the river has peaked slightly higher than the groundwater elevation, causing hydraulic gradients to be briefly reversed.
- The continuous monitoring data from the VWP sensors validate the reliability of the manual measurements made in adjacent standpipe bores. Long term trends are consistent between the standpipe bores and the VWP sensors. However, it is noted that some transient peaks in groundwater elevations, such as those measured at HRVWP01 in August 2017 and August 2018 may not be captured in the standpipe data.

In combination the monitoring data for the Hotham River plotted in Figures 46 to 49 indicate that:

- In most of the bores near the Hotham River which are screened in the SSGS and in the WFBGS, groundwater depths are less than 14 mBGL and there is potential for interactions between groundwater and the root zone of local vegetation.
- To date there has been no drawdown at the Hotham River due to pit dewatering or due to operation of the Westwood Borefield. If mining drawdown did reach this location, groundwater drawdown would likely be smaller and would occur at lower rates than in other locations, because the groundwater system would be supported by inflows from the Hotham River.
- In the event that mining drawdown was observed, the reduced presence of pools in the river in summer may be a larger risk to the environment than the potential for influences on groundwater dependent vegetation.
- Therefore, while protection of the Hotham River needs to be included in the GGDVMMP, the risk is expected to be lower than that posed to vegetation near 34 Mile Brook by operation of Westwood Borefield.

3.8 Gringer Creek catchment

NBG are currently designing and permitting a planned new RDA, referred to as RDA2 and located as illustrated in Figure 2. Groundwater monitoring has therefore been extended into the catchment of Gringer Creek and comprises the standpipe monitoring bores marked in Figure 2. Groundwater monitoring data for these bores are plotted in Figures 50 to 53 and are discussed as follows:

- There is limited period of monitoring data for all bores and longer term monitoring will be required to define baseline trends in the absence of influences of operating RDA2.
- Seasonal changes in groundwater elevation of 2 m to 3 m occur in most bores, driven by winter recharge, consistent with monitoring in all other catchments at the BGM.
- There is no indication of groundwater drawdown in this area driven by pit dewatering or production bore operation.
- There are no trends which can be attributed to groundwater mounding from the existing F1/F3 RDA. While BH01 demonstrates a rising trend, this bore is distant from the existing RDAs, and there are other standpipe bores between the RDAs and BH01 which show no groundwater mounding.
- Groundwater depths are predominantly less than 20 mBGL in the Gringer Creek catchment and are less than 5 mBGL in the lower elevation locations near Gringer Creek. There will be pathways for interaction between any potential seepage, groundwater and vegetation or surface water. These pathways have been recognised during the RDA2 design studies, and monitoring and mitigation which is recommended to be incorporated into the designs is discussed in Section 4. The RDA GMP includes groundwater monitoring and the development of triggers to be applied at RDA2 to protect vegetation once constructed (BDH 2024). Protection of vegetation in the Gringer Creek catchment is therefore not required to be addressed in the updated GGDVMMP which targets the influences of groundwater drawdown.

3.9 Groundwater elevations, flow directions and depths in the WFBGS in 2025

Groundwater elevations measured in the WFBGS in the summer of 2025 are contoured in Figure 54. Details of the contouring are as follows:

- Groundwater elevations have been calculated using groundwater depths measured in late 2024 and early 2025 in conjunction with the surveyed elevation of the top of the bore casing. The contoured surface reflects summer conditions although in a few bores if summer groundwater depths are not available other dates have been used.
- Regional groundwater elevations around the Gringer Creek catchment have been approximately defined using groundwater elevations for ten bores presented in a draft report describing an investigation undertaken for South32 (CDM Smith 2024).
- Mostly only bores screened in the WFBGS have been used. However, in some areas where few bores are available, bores completed in oxide or in deep bedrock have been included if the calculated elevations appear consistent with the weathered and fractured bedrock.
- At North Pit and South Pit, groundwater elevations have been taken from an NBG interpretation of monitoring data collected from multiple VWP sensors installed in the pit slopes (Ohashi 2024)
- At the D1 Reservoir, the F1/F3 RDA, Wattle Pit and the R4 RDA the groundwater elevation has been set at the surveyed pond elevation.
- At the end of December 2024, the Westwood Borefield was not operating, and the contours therefore largely reflect undisturbed conditions near 34 Mile Brook.
- Indicative groundwater flow direction arrows are included in Figure 54, which have been automatically contoured from the contours.

Features of the groundwater elevations contoured in Figure 54 include:

- A groundwater mound centred around the F1/F3 RDA and the R4 RDA driven by seepage. This results in local groundwater flow directions being radially away from the RDAs. To the northwest of the F1/F3 RDA groundwater flow directions have been reversed from pre-mining and groundwater flows from the 34 Mile Brook catchment into the South Dandanup catchment.
- In the Gringer Creek catchment where RDA2 is proposed to be bult, groundwater flow is generally to the east and southeast, consistent with surface water flow directions in Gringer Creek and its tributaries.
- The lowest groundwater elevations are around -150 mAHD, centred on South Pit.
- An area of mining related depressurisation and groundwater capture is centred on the open pits and extends preferentially to the northwest and northeast. Close to the open pits all groundwater flow is towards the pits, including the areas below some of the footprints of the waste rock storage areas.
- Steep hydraulic gradients are present at the margins of the depressurisation centred on the pits.
- Outside the pit area, on a regional basis groundwater flow at the existing mine facilities is generally to the southeast, consistent with surface water drainage directions defined in 34 Mile Brook, Boggy Brook and House Brook. Locally the contours define naturally higher groundwater elevations at WD7BR12 which is located on the northern flank of a local hill, and these localised groundwater elevations potentially act as a hydraulic barrier preventing direct groundwater flow from the pits to the Hotham River in this location. However, groundwater flow pathways are illustrated to be present from the pits towards the Hotham River along 34 Mile Brook, and from the current RDAs to Hotham River along House Brook and Boggy Brook.
- Groundwater flow directions are towards and along the Hotham River to the south of the mining operations.

Inferred depth to the groundwater elevation in summer 2025 in the WFBGS is contoured in Figure 55. Inferred groundwater depths have been calculated by subtracting the groundwater elevation surface in Figure 54 from the ground surface as defined by a Digital Terrain Model (DTM). Interpolating groundwater depth in this manner has the advantage that it accurately reflects surface topography (if a local hill is present, inferred groundwater depth will be correspondingly deeper). However, the DTM has been compiled from a combination of high resolution LiDAR mapping and low resolution regional SRTM data and in locations distant from the mine facilities the interpolated depths should be considered indicative only and may not exactly match the groundwater depth measured at individual bores.

The current groundwater depths in Figure 55 identify that:

- Groundwater is close to surface along the north and east of the F1/F3 RDA where sumps operate to intercept groundwater and seepage. This reflects the influence of groundwater mounding driven by seepage.
- Groundwater is naturally close to surface along much of Gringer Creek, and in eastern portions of the proposed RDA2. Along the western boundary of RDA2 groundwater depths are typically 20 mBGL to 40 mBGL.
- Groundwater is naturally very deep to the west of the F1/F3 RDA below Mt Wels (up to 200 mBGL).
- Groundwater is relatively deep close to the open pits which reflects the influences of mine dewatering.
- Groundwater is naturally close to surface along 34 Mile Brook, House Brook, Wattle Hollow Brook and the Hotham River and may support phreatophytic vegetation, as discussed and quantified in the GGDVMMP.

3.10 Mine influences on groundwater elevations in 2025

Figure 56 summarises the current extent of mine influences on groundwater elevations at the BGM. The boundaries have been based on estimating locations where groundwater mounding or groundwater drawdown of more than 2 m was present in 2025. The analysis was based on the estimated or measured groundwater elevations in 2006 prior to the modern mining operations, compared to the groundwater elevations in 2025 as presented in Figures 10 to 53. In the area of the existing F1/F3 and R4 RDAs, the analysis was based on groundwater elevations and contouring presented in the 2023 review (BDH 2023) and reproduced in Figures 7 and 8. 2 m is considered the minimum change that can be discerned, given that background seasonal variation is greater than this in most locations, and due to the difficulty in resolving long term background declining trends from mining drawdown influences. For the Westwood Borefield, which was not operating in 2025, the maximum observed influence of drawdown over the entire operating period was estimated using the monitoring data plotted in Figures 40 to 45.

The interpretation in Figure 56 indicates that:

- Groundwater mounding around the F1/F3 and R4 RDA, groundwater drawdown around the open pits, and the maximum extent to date of drawdown around the Westwood Borefield form three discrete areas which do not significantly overlap in 2025. Between the open pits and the RDAs this may be controlled to some extent by the D1 Reservoir which is interpreted to stabilise the local groundwater elevations. The separate nature of the influences confirms that the current approach of separately managing groundwater drawdown via the GGDVMMP (Umwelt 2021) and managing groundwater mounding via the RDA GMP (BDH 2024) as indicated in Figure 56 remains valid.
- In the southern part of the R4 RDA, and the southwest of the F1/F3 RDA, mounding extends less than 500 m from the facility. This results from the R4 RDA not being used for tailings deposition, and from the presence of the HDPE liner in the southwest portion of the F1/F3 RDA. In the northern and northeastern area of the F1/F3 RDA groundwater mounding extends around 1 km from the facility, which is attributed to the absence of a liner in these areas.
- Groundwater drawdown around the open pits extends preferentially to the northeast following the trend of geological and structural features known to run through the pit area. After 17 years of pumping down the pit lakes and continuous dewatering of the open pits, currently drawdown extends around 2 km from South Pit towards the Hotham River and remains at least 3 km from the river. However, the drawdown influence does include a portion of 34 Mile Brook close to the waste rock storage areas.
- Bores where localised mounding is occurring associated with waste rock storage or surface drainage features are highlighted in Figure 56. Nearly all of these bores are within the zone of pit dewatering influence. Within that zone there may be locations subject to drawdown, and locations subject to mounding, depending on the degree of vertical connection between the local groundwater systems. In these locations there may be some potential for rising groundwater elevations to affect vegetation by waterlogging, which is not captured by the groundwater monitoring in the GGDVMMP which is designed to detect drawdown. However, waterlogging effects will be detected by monitoring of vegetation in these locations, which is included in the GGDVMMP because drawdown trends in other bores in nearby locations has triggered monitoring due to drawdown.
- The maximum drawdown area associated with the Westwood Borefield extends less than 1 km from the individual production bores and includes a portion of 34 Mile Brook around 2 km long. The maximum influence remains 1 km distant from the Hotham River, as confirmed by HFBR12, HFVWP01 and HFVWP02 which were installed for the purpose of defining the extent of drawdown and have not been influenced by Westwood Borefield operation to date.

3.11 Review of groundwater model predictions

Figure 57 compares:

- The interpreted extent of mining drawdown more than 2 m around the open pits as assessed in 2018 (sourced from BDH 2018).
- The interpreted extent of mining drawdown more than 2 m around the open pits in 2025 as assessed in Figure 56.
- The model predicted extent of mining drawdown in 2026 (Golder 2019) for Scenario 1 (pit dewatering) and for Scenario 2 (pit dewatering plus continuous production bore operation).
- The model predicted extent of mining drawdown at the end of mining in 2032 (Golder 2019) for Scenario 1 (pit dewatering) and for Scenario 2 (pit dewatering plus continuous production bore operation).

As discussed in Sections 2.5 and 2.6, the actual rate of open pit dewatering to 2025 is comparable to the rates predicted by the groundwater model (around 140 L/s), while total abstraction from production bores has averaged 19 L/s from 2019 to 2025 compared to an assumption of 129 L/s in the model. Figure 57 confirms that the Scenario 1 model predictions for 2026 are a relatively good fit to the observed extent in 2025, while the Scenario 2 predictions greatly over estimate the drawdown extent.

Under the current regime, where production bores are operated intermittently during periods of high demand, the most appropriate means of defining areas at risk of mining drawdown over the remaining mine life for input to the GGDVMMP would be to use a combination of:

1. The model predicted drawdown extent in 2032 for Scenario 1.
2. The maximum observed influence of the Westwood Borefield presented in Figure 56.
3. A 1 km radius around production bores Roberts 1, Heharo 1, and Deewon 2 (production bores Coleman 1, Coleman 2 and Coleman 3 are already within the model predicted pit dewatering drawdown area).

4. Recommended management of groundwater for the GGDVMMP and RDA2

4.1 Specific requirements of the current GGDVMMP

Section 3.2.1 of the GGDVMMP describes that bores nominated for use in the GGDVMMP will be monitored three monthly from April to October and monthly from November to March. The nominated bores are detailed in Table 3 of the GGDVMMP and are linked to and are intended to be protective of an Applicable GDV Area in each case. Interpretation, triggered investigations and triggered mitigation for the monitoring data from the bores are discussed in Table 2, Chart 1 and Chart 2 of the GGDVMMP.

Table 1 reproduces all the bores included in the GGDVMMP, along with construction details and the nominated Applicable GDV area. Based on the monitoring data presented and interpreted in Section 3, Table 1 includes notes on the responses at each bore. Many of the bores completed in the SSGS are dry for some or all of the time. Several of the bores completed in the WFBGS demonstrate significant drawdown associated with pit dewatering or with the Westwood Borefield, and three of those bores have gone dry due to mining drawdown. The suitability for inclusion in the GGDVMMP is discussed individually for each bore in Section 4.3.

Table 1: Details for bores nominated in the GGDVMMP

Applicable GDV Area	Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted	Groundwater Depth (mBGL)	Notes
Round Swamp	RNSWPZ1	2.8	2.8	0.8	3.43	SSGS	Figure 34	4	Dry, occasionally re-saturates
	RNSWPZ2	3.6	3.2	0.7	3.93	SSGS	Figure 34	4	Dry, occasionally re-saturates
	RNSWPZ3A	44	44	32	44.43	WFBGS	Figure 34	15	Shows pit drawdown
	RNSWPZ3B	3	3	1	3.86	SSGS	Figure 34	4	Dry, occasionally re-saturates
	ESBR1D	46.5	46.5	34	47.1	WFBGS	Figure 36	30	Shows pit drawdown
	ESBR1S		6.5	2.5	5.08	SSGS	Figure 36	5	Dry, occasionally re-saturates
Pillow Swamp	PISWPZ1	3.5	3	1	3.67	SSGS	Figure 38	3	Dry, frequently re-saturates
	PISWPZ2	3	2.4	0.9	3.14	SSGS	Figure 38	3	Dry, occasionally re-saturates
	PISWPZ3A	35	35	23	34.03	WFBGS	Figure 38	23	Dry since 2018, shows pit drawdown
	Q2PZ1A	39	39	21	39.63	WFBGS	Figure 32	38	Dry since 2010, shows pit drawdown
	Q2PZ1B		9	3	9.52	SSGS	Figure 32		Dry
Boomerang Swamp	BMSWPZ1A	30	29.5	17.5	29.97	WFBGS	Figure 30	3	No drawdown, suspect bentonite seal
	BMSWPZ1B		5	2	5.73	SSGS	Figure 30	3	Saturated
	BMSWPZ2	6	4	1	4.78	SSGS	Figure 30	5	Dry, occasionally re-saturates
	34BR8				14.53	Unknown	Figure 32	12	No drawdown despite being within drawdown zone defined by Q2PZ1A
House Brook;	HBBR2	30.4	30.4	18.4	30.56	WFBGS	Figure 28	15	No drawdown
Hotham River									
Boggy Brook	HBBR1	41	41	29	41.57	WFBGS	Figure 20	41	Shows pit drawdown
34 Mile Brook	HFBR5D	84.5	84.5	67	84.96	WFBGS	Figure 42	5	Shows Westwood Borefield drawdown
	HFBR5S	4.5	4.5	1.5	4.61	SSGS	Figure 42	5	Goes dry
Wattle Hollow Brook	WD7BR4	44.3	38.6	26.6	39.12	WFBGS	Figure 24	5	No drawdown
Hotham River	HRBR1D	33.5	32.9	21.5	34.06	WFBGS	Figure 46	7	No drawdown
	HRBR1S	16	15.4	8	16.55	SSGS	Figure 46	7	No drawdown
	HFBR8D	57.5	57.5	45	57.62	WFBGS	Figure 46	6	No drawdown
	HFBR8S	17.5	17.5	2	17.68	SSGS	Figure 46	6	No drawdown
	HFBR6D	41	41	29	41.63	WFBGS	Figure 40	10	No drawdown
	HFBR6S	4.5	4.5	1.5	4.72	SSGS	Figure 40		Dry
	HFBR15					DFBGS	Figure 42	30	Shows Westwood Borefield drawdown
	HFBR12	13.1	13.1	2.1	13.1	SSGS	Figure 42	6	No drawdown
	WD7BR12	49.3	49.3	37	50.23	WFBGS	Figure 20	10	No drawdown
Western Perimeter GDV	MUBR3	17.6	17.6	5.5	17.6	WFBGS	Figure 20	15	Recent data potentially show pit drawdown
(pit dewatering)	WTBR1	34	34	22	35.72	WFBGS	Figure 15	17	Shows pit drawdown
	N4921-1A				43.06	Unknown	Figure 10	17	Shows pit drawdown
	WTBR2	44	44	32		WFBGS	Figure 15	44	Shows pit drawdown
	N5005-1A				12.15	Unknown	Figure 10	12	Shows pit drawdown, dry since 2012
Control Bores	HRBR8	24.5	24.5	8.5	20.7	WFBGS	Figure 46	4	No drawdown
	BUBR2				31	Unknown	Figure 10	15	Background declining trends
	HFBR14					DFBGS	Figure 22	14	No drawdown
	MUBR1	57.4	58	45.7	58.22	WFBGS	Figure 10	13	Background declining trends

Table 2: Suggested triggers for inclusion in the GGDVMMP

Applicable GDV Area	Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Trigger Plotted	Trigger Elevation (mAHD)	Trigger Depth (mBTOC)	Notes
Round Swamp	None									Pit drawdown already triggered
Pillow Swamp	None									Pit drawdown already triggered
Boomerang Swamp	None									Pit drawdown already triggered
House Brook; Hotham River	HBBR2	30.4	30.4	18.4	30.56	WFBGS	Figure 58	219.7	14.9	No drawdown
Boggy Brook	None									Pit drawdown already triggered
34 Mile Brook	HFBR5D	84.5	84.5	67	84.96	WFBGS	Figure 59	203	6.6	Shows Westwood Borefield drawdown
	HFBR10	11.1	11.1	5.1	11.1	SSGS	Figure 60	203	6.3	Shows Westwood Borefield drawdown
Wattle Hollow Brook	None									Assumes vegetation monitoring triggered by model
Hotham River	HRBR1D	33.5	32.9	21.5	34.06	WFBGS	Figure 58	194.7	7.7	No drawdown
	HRBR1S	16	15.4	8	16.55	SSGS	Figure 61	194.5	7.6	No drawdown
	HFBR8D	57.5	57.5	45	57.62	WFBGS	Figure 62	193.5	7.1	No drawdown
	HFBR8S	17.5	17.5	2	17.68	SSGS	Figure 61	193.5	7.1	No drawdown
	HFBR6D	41	41	29	41.63	WFBGS	Figure 59	229	11.8	No drawdown
	HFBR12	13.1	13.1	2.1	13.1	SSGS	Figure 63	198	7.0	No drawdown
	WD7BR12	49.3	49.3	37	50.23	WFBGS	Figure 62	None	None	Assumes vegetation monitoring triggered by model
Western Perimeter GDV (pit dewatering)	None									Pit drawdown already triggered
Control Bores	HRBR8	24.5	24.5	8.5	20.7	WFBGS		None	None	
	BUBR2				31	Unknown		None	None	
	MUBR1	57.4	58	45.7	58.22	WFBGS		None	None	

4.2 Suggested conceptual approach to monitoring and investigations for GGDVMMP

For the Applicable GDV Areas defined in the GGDVMMP which lie within the current and future predicted extent of drawdown associated with pit dewatering it is noted that:

- The monitoring data identify that within this area, groundwater elevations in the weathered and fractured bedrock have been lowered since 2007 due to pumping out the pit lakes and continuous dewatering during mining. The total magnitude of drawdown, and the long term rate of drawdown potentially would pose a severe risk to groundwater dependent vegetation based on Chart 1 and Chart 2 in the GGDVMMP.
- Where monitoring data are available in the SSGS, they identify that drawdown in the WFBGS has not caused drawdown in the SSGS. This is attributed to the presence of unsaturated oxide between these units.
- However, the available monitoring data do not fully define conditions in the SSGS due to the following:
    - Many of the bores are predominantly dry but sporadically re-saturate. If underdrainage were to occur it would potentially result in longer periods between saturation and would require years of monitoring to discern any statistically significant change in the durations of dry periods.
    - Outside of the swamps there are a limited number of bores in the SSGS.
    - There may be locations which are not currently monitored where there is either a natural connection through the oxide, or an artificial connection caused by ungrouted abandoned drillholes.
- It is therefore suggested that it should be assumed that any groundwater monitoring drawdown trigger in this region has already triggered, and that some form of vegetation monitoring in this area is warranted and should be routinely included in the GGDVMMP regardless of groundwater monitoring results. This area could comprise the current extent of pit drawdown, or preferably it would include all of the future predicted extent of pit drawdown for Scenario 1.
- The actual form of the vegetation monitoring triggered in the GGDVMMP should take account of the low risk posed to vegetation by pit dewatering, given that during the 17 year period over which the pit lakes have been pumped out and the pits have been dewatered:
    - Drawdown in the WFBGS has not caused any evident vegetation impairment.
    - Drawdown in the WFBGS has not been transmitted to SSGS due to the presence of an intervening layer of unsaturated oxide.
- A significant advantage of this approach is that monitoring of vegetation health will be required in the localised groundwater mounding locations near the waste rock storage facilities marked in Figure 56. Currently assessment of these locations is not triggered by the GGDVMMP which addresses drawdown and is not triggered by the RDA GMP which only addresses mounding near the RDAs.
- Although triggers are suggested not to be applied in the current and predicted pit drawdown area, three monthly monitoring of all standpipes as required in the Groundwater Management Plan should be continued, and the data can be used to investigate the cause of any impairment identified from vegetation monitoring.
- It is therefore suggested that in the current and future area of influence of pit dewatering the GGDVMMP should use vegetation monitoring to trigger groundwater investigations, rather than use groundwater monitoring to trigger vegetation investigations.

For locations outside of the current extent of drawdown associated with pit dewatering, and for locations near the intermittently operated production bores, groundwater drawdown monitoring triggers will be required. It is proposed that these triggers should be practical and easy to be applied by NBG environmental staff. Once triggered, the management actions should potentially allow for more detailed investigations to be undertaken by external specialists as required, and these follow up investigations could potentially reference Chart 1 and Chart 2 in the GGDVMMP as required

The application of Chart 1 and Chart 2 in the GGDVMMP as routine triggers for site use is not recommended as:

1. The risk ratings as described in Fround and Loomes do not appear to be designed for application to routine monthly and three monthly monitoring data, but rather reflect risks associated with long term trends.
2. The ratings do not account for any reduction in risk associated with subsequent rises in groundwater elevations, as occur rapidly following operation of the Westwood Borefield. (In theory the risk to vegetation should be a function of the total magnitude of drawdown, the rate of drawdown, and also the duration of drawdown).
3. The regional background trends in groundwater elevations (declines of around 0.5 m/year) would trigger a severe risk classification in the absence of any mine influences.
4. The magnitude and rate of seasonal changes in groundwater elevations which occur naturally at Boddington would falsely trigger severe risk classifications if not accurately accounted for.

Given that there is a significant period of monitoring data under a range of seasonal conditions available for all bores, it is suggested that routine triggers applied at site be based on a lowest groundwater elevation limit which would be designed to trigger if a drawdown influence over, and above typical seasonal trends is present.

It is suggested that no VWP sensors should be included as routine monitoring triggers in the GGDVMMP. This is because:

1. VWP sensors do not measure groundwater elevations, they measure a vibration frequency and a temperature. Conversion to groundwater elevations requires the correct application of calibration data, the installed sensor elevation and a quality controlled approach to the calculations which are best reviewed by external experts.
2. As a result of poor drilling practice during installation many VWP sensors have failed and determining whether ongoing VWP readings remain valid requires an experienced reviewer.
3. NBG have found that maintaining continuous monitoring and exports of VWP data is problematic, and committing to monthly measurements would be prone to non compliance.
4. The continuous monitoring data from the VWPs sometimes define very steep changes in groundwater elevations over very short periods (transient changes in groundwater level) which would be prone to false triggering of GGDVMMP limits.

It is suggested that conceptually in the GGDVMMP an exceedance of a groundwater trigger during routine monitoring should prompt some or a combination of the following actions:

- Re-measurement by NBG to confirm the result.
- Plumbing the bore by NBG to confirm that it remains open to the screen, has not collapsed and has not been subject to sedimentation.
- Review of pumping records and precipitation records by NBG to identify whether mining operations are a potential cause and whether conditions have been unusually dry.

- Review of other groundwater monitoring data by either NBG or an external specialist to:
  - Identify whether similar trends are present in distant background bores defined in the GGDVMMP and also multiple other background bores monitored in the Groundwater Management Plan.
  - Identify whether similar trends are evident in other bores in the area including reference to the groundwater system intersected by each bore.
  - Review continuous monitoring data from VWP sensors to identify potential mechanisms for transmission of drawdown.
  - Compare gauging data from the Hotham River if applicable to determine any interactions between groundwater and the river flows.
- If mining related drawdown is concluded to be the source, review the rate and magnitude of drawdown, potential risks to vegetation, and trigger appropriate vegetation monitoring as necessary.
- If vegetation impairment is identified investigate mitigation by terminating pumping from pumping bores or other measures.

4.3 Suggested triggers for each GGDVMMP protection area

The suggested approach to groundwater monitoring is discussed following for each of the Applicable GDV Areas defined in Table 3 of the GGDVMMP.

Round Swamp

- All these bores lie within the current and predicted future extent of drawdown associated with pit dewatering and it is assumed that some form of vegetation monitoring has already been triggered.
- No bores are suggested for inclusion in the GGDVMMP.
- Three monthly monitoring of all bores in this area should be undertaken as required by the Groundwater Management Plan, these data should be reviewed if impairment of vegetation is identified through the GGDVMMP.

Pillow Swamp

- All these bores lie within the current and predicted future extent of drawdown associated with pit dewatering and it is assumed that some form of vegetation monitoring has already been triggered.
- No bores are suggested for inclusion in the GGDVMMP.
- Three monthly monitoring of all bores in this area should be undertaken as required by the Groundwater Management Plan, these data should be reviewed if impairment of vegetation is identified through the GGDVMMP.

Boomerang Swamp

- All these bores lie within the current and predicted future extent of drawdown associated with pit dewatering and it is assumed that some form of vegetation monitoring has already been triggered.
- No bores are suggested for inclusion in the GGDVMMP.
- Three monthly monitoring of all bores in this area should be undertaken as required by the Groundwater Management Plan, these data should be reviewed if impairment of vegetation is identified through the GGDVMMP.

House Brook; Hotham River

- HBBR2 is suitably constructed to monitor the WFBGS and is located outside the predicted future extent of mining drawdown, although it is noted that groundwater is relatively deep at 15 mBGL.
- Based on the data presented in Figure 58, a trigger of 219.7 mAHD is suggested. It is noted this trigger would have been breached in July 2024, but it is expected that remeasurement would have found the depth to be erroneous.

Boggy Brook

- HBBR1 lies within the current and predicted future extent of drawdown associated with pit dewatering, groundwater depth elevations have been lowered by 4 m, and it is assumed that some form of vegetation monitoring has already been triggered.
- No bores are suggested for inclusion in the GGDVMMP.
- Three monthly monitoring of HBBR1 should be undertaken as required by the Groundwater Management Plan, these data should be reviewed if impairment of vegetation is identified through the GGDVMMP.

34 Mile Brook

- It is noted that some bores listed in Table 3 of the GGDVMMP as being appropriate to protection of Applicable GDV Area Hotham River may be closer to and better described as being protective of 34 Mile Brook.
- Or it may be appropriate to define an Applicable GDV Area of Westwood Borefield which is the highest risk to be managed under the GGDVMMP. Note that the NBG Production Bore Operating Strategy groups HFBR10, HFBR5D, HFBR6D, HFBR7D and HFBR12 as being protective for the Westwood Borefield.
- For the purposes of the current assessment the grouping in Table 3 of the GGDVMMP is retained.
- HFBR5S screened in the SSGS is not appropriate for monitoring in the GGDVMMP as it goes dry during borefield operation and may also go dry due to background seasonal conditions. HFBR5D demonstrates very similar trends to HFBR5S but can be monitored to lower elevations so provides suitable protection for this location in the absence of HFBR5S in the GGDVMMP.
- HFBR5D screened in the WFBGS is suitably located and constructed to act as a trigger bore and groundwater depths are around 5 mBGL. Based on the background and borefield responses plotted in Figure 59 a trigger of 203 mAHD is suggested. The trigger would have been breached:
    - In June 2013, but it is expected that remeasurement would have identified the depth to be incorrectly measured.
    - In 2016 and 2021, which is appropriate as in these periods the Westwood Borefield was causing a large enough drawdown in this location to potentially affect vegetation near 34 Mile Brook.
- HFBR10 is not included in the GGDVMMP as a bore to be used for the protection of 34 Mile Brook. The bore was constructed in the SSGS for this specific purpose, responded to borefield operation in 2021 and should be added to Table 3 of the GGDVMMP. Based on the trends plotted in Figure 60 a trigger of 203 mAHD is suggested. It is noted that this trigger would have been breached:
    - In November 2019, but it is expected that remeasurement would have identified the depth to be incorrectly measured.
    - In 2021 and 2022 which is appropriate as in these periods the Westwood Borefield was causing a large enough drawdown in this location to potentially affect vegetation near 34 Mile Brook.

Wattle Hollow Brook

- WD7BR4 is screened in the WFBGS, has groundwater depths around 5 mBGL and is suitable for monitoring vegetation near Wattle Hollow Brook. It has not shown drawdown in response to pit dewatering to date but lies immediately outside the current zone of influence and is within the predicted future zone of influence. The preferred option would be to trigger vegetation monitoring over all of the future predicted drawdown extent, and therefore not include a groundwater monitoring trigger for this bore. If required, Figure 63 indicates that a trigger of 230 mAHD would allow for seasonal variation while triggering when future pit dewatering drawdown occurs as expected.

Hotham River

- HRBR1S screened in the SSGS is cased to 16 mBGL and has a groundwater depth around 7 mBGL so is unlikely to go dry and is suitable for use as a trigger bore. Comparing against the adjacent Hotham River in Figure 61 indicates a trigger of 194.5 mAHD would ensure that the groundwater elevation is higher than the river in most flow conditions.
- HRBR1D screened in the WFBGS displays similar responses to HFBR1S and is suitable for use in the GGDVMMP with a trigger of 194.5 mAHD. It is noted this trigger would have been breached in October 2010 (Figure 58), but it is expected that rechecking the depth would have identified it to be incorrectly measured.
- HFBR8S is screened in the SSGS, is cased to 18 mBGL, and has a groundwater depth around 6 mBGL so is unlikely to go dry and is suitable for use as a trigger bore. Comparing against the adjacent Hotham River in Figure 61 indicates a trigger of 193.5 mAHD would ensure that the groundwater elevation is higher than the river in most flow conditions. It is noted this trigger would have been breached in 2013 and 2014, but it is expected that rechecking these depths would have identified them to be incorrectly measured.
- HFBR8D screened in the WFBGS displays similar responses to HFBR8S and is suitable for use in the GGDVMMP with a trigger of 193.5 mAHD (Figure 62). It is noted this trigger would have been breached in December 2013, but it is expected that rechecking the depth would have identified it to be incorrectly measured.
- While HFBR6S is correctly screened in the SSGS it is consistently dry and is not suitable for use in the GGDVMMP.
- Monitoring bore HFBR6D is screened in the WFBGS, has a groundwater depth around 10 mBGL, is located upgradient of the Hotham River, is located outside the predicted future influence of pit dewatering, and is suitable for use in the GGDVMMP. Figure 59 indicates that a trigger of 229 mAHD would be appropriate. This trigger was close to being breached in 2016 and 2024, which is appropriate as a small amount of drawdown from the Westwood Borefield may have been present at these times.
- HFBR15 is open to all of the groundwater systems but is interpreted to respond to the DFBGS at around 200 mBGL. Using this bore as a trigger in the GGDVMMP is considered overly conservative as the responses are not indicative of groundwater conditions in the root zone, while HFBR12 in this area was constructed to monitor the root zone near 34 Mile Brook.
- Monitoring bore HFBR12 is screened in the SSGS, is cased to 13 mBGL, has a groundwater depth around 7 mBGL and is located close to 34 Mile Brook. This bore is suitable for use in the GGDVMMP and Figure 63 indicates that a trigger of 198 mAHD would account for typical seasonal trends and would trigger in the event of drawdown from the Westwood Borefield.

- Standpipe bore WD7BR12 is screened in the WFBGS, is located between the open pits and the Hotham River, and has a groundwater depth of around 12 mBGL. It is located outside the current influence of pit dewatering but within the predicted future influence. While it could be used to monitor for pit dewatering drawdown, its location on a hill, and the groundwater flow directions in Figure 54 suggest it may not respond to dewatering. The preferred approach would be to assume vegetation monitoring has been triggered within the zone of predicted future pit dewatering drawdown, including the location of WD7BR12. If required Figure 62 indicates that a trigger of 254.7 mAHD would account for seasonal variation and potentially trigger in the event of mining drawdown.

Western perimeter GDV (pit dewatering)

- All these bores lie within the current and predicted future extent of drawdown associated with pit dewatering and it is assumed that some form of vegetation monitoring has already been triggered.
- N5005-1A has been dry since 2012.
- No bores are suggested for inclusion in the GGDVMMP.
- Three monthly monitoring of all bores in this area should be undertaken as required by the Groundwater Management Plan, these data should be reviewed if impairment of vegetation is identified through the GGDVMMP.

Control Bores

- HRBR8 completed in the WFBGS is suitably located to measure background conditions near the Hotham River. It is located outside the future predicted extent of pit dewatering drawdown. Groundwater depth is around 4 mBGL. No trigger is required.
- There are no geological or construction details available for BUBR2. The only information available is a plumbed depth of 31 mBGL, and the bore is therefore assumed to intersect the WFBGS. Groundwater depth is around 15 mBGL. The bore is considered suitable for monitoring background conditions and has a long period of monitoring data, although it is noted that the inferred screened formation can't be proven. No trigger is required.
- HFBR14 is a converted deep pilot hole open to all systems including the DFBGS. It is unsuitable for defining background conditions. HDBR01 located nearby is also a converted deep pilot hole and is also unsuitable. There are no bores in this location which would be suitable for monitoring background conditions.
- MUBR1 is screened in the WFBGS and is located outside the predicted future extent of pit dewatering drawdown. Groundwater depth is around 12 mBGL. This bore is suitable for monitoring background conditions. No trigger is required.

4.4 Summary of groundwater monitoring suggested for GGDVMMP

It is suggested that:

- The GGDVMMP should refer to the Groundwater Management Plan which requires groundwater depths to be measured three monthly in all accessible standpipe monitoring bores. These data should be described as being available to investigate the sources of any trends identified in bores linked to the GGDVMMP or changes in vegetation health.
- The GGDVMMP should refer to continuous monitoring data being collected from active sensors in the VWP installations. These data should be described as being available to investigate the sources of any trends identified in bores linked to the GGDVMMP or changes in vegetation health.
- Standpipe monitoring bores linked to the GGDVMMP should be those in Table 2 and no VWP sensors should be linked to the GGDVMMP.

- The bores in Table 2 should be monitored at three monthly intervals, but bores near the Westwood Borefield should be monitored monthly when it is in operation. These bores are HFBR5D, HFBR10 and HFBR12.
- Triggers suggested to be applied by NBG during routine three monthly and monthly monitoring of the bores in Table 2 are included as groundwater elevation and groundwater depth from top of casing in Table 2.

4.5 Groundwater management at RDA2

A second tailings storage facility is currently being designed and permitted at the location of RDA2 as marked in Figure 1. Based on the updated characterisation of groundwater conditions and the observed responses to operation of the existing RDAs discussed in this document it is identified that potential influences of the facility on groundwater could include:

- RDA2 lies at least 5 km from the current zone and the maximum modelled zone of drawdown associated with pit dewatering (Figure 57) and impacts on groundwater dependent vegetation due to dewatering drawdown are highly unlikely.
- RDA2 is at least 5 km distant from the nearest groundwater production bore (Deewon 2 in Figure 57) and impacts on groundwater dependent vegetation due to production bore drawdown are highly unlikely.
- The southwest portion of RDA2 overlaps with the existing mounding at the F1/F3 RDA (Figure 56). If seepage from RDA2 should occur there is potential for interactions between mounding at the F1/F3 RDA and mounding at RDA2. Modelling, management and monitoring of seepage influences should therefore be designed to account for the cumulative influences of both facilities.
- Based on the inferred groundwater depths in Figure 55, there is potential for seepage driven groundwater mounding to cause harm to vegetation if present in the area to the west of RDA2, as has been observed in discrete locations adjacent to the F1/F3 RDA. To the east of RDA2 groundwater mounding is unlikely to affect vegetation, as groundwater is naturally shallow, and vegetation in this area is expected to be adapted to saturated conditions. The RDA GMP will need to be updated to ensure vegetation and groundwater are monitored accordingly.
- Groundwater is close to surface near Gringer Creek and in some tributaries, and there is potential for groundwater to naturally discharge to the surface water system. If so, any changes in groundwater chemistry driven by seepage from RDA2 has the potential to affect the surface water receiving environment.

Aspects of the design and management of RDA2 which address these potential influences on the receiving environment are:

- RDA2 is planned to be constructed with an HDPE liner across the entire facility to minimise the potential for seepage. An underdrainage will be installed above the liner to minimise the head acting on the liner, and a collection system will be installed below the liner to recover local groundwater or any seepage.
- A baseline hydrological assessment has been compiled for RDA2 (BDH, 2025) which interprets surface water hydrochemistry, surface water flow rates, groundwater elevations and groundwater chemistry into a conceptual model of surface water and groundwater conditions. The assessment provides recommendations for a monitoring regime which has been designed to address the risks to the receiving environment identified above.

5. Conclusions and recommendations

5.1 Conclusions

Groundwater monitoring data to 2025 have been reviewed to confirm whether the conceptual and numerical models of groundwater transmission remain valid and to update the understanding of the influences of the NBG mining operation of the receiving groundwater environment. The monitoring data continue to support the existing conceptual model in which:

- The Seasonal Shallow Groundwater System (SSGS) comprises shallow gravels and hardcap which locally act to transmit groundwater but are not saturated in all locations.
- Oxide underlies the SSGS, does not allow lateral transmission of groundwater, prevents vertical migration of groundwater in some locations and allows vertical migration of groundwater in other locations.
- The Weathered and Fractured Bedrock Groundwater System (WFBGS) comprising weathered and fractured zones at the upper bedrock surface is the dominant regional groundwater system and is the primary pathway for the migration of seepage from the mine facilities. The WFBGS is interpreted to be in hydraulic connection with the Hotham River and groundwater discharge supports the presence of pools in the river in summer.
- The Deep Fractured Bedrock Groundwater System (DFBGS) comprises discrete zones of fracturing in the unweathered bedrock at depth, which may be hydraulically connected to the open pits and to the groundwater production bores.

Open pit dewatering and production bore operation have caused local drawdown in the WFBGS. In some locations (such as Pillow, Round and Boomerang Swamps) this has had no effect on the SSGS, while in other locations (near the Westwood Borefield) drawdown in the SSGS has been observed. Mining related drawdown remains at least 1 km distant from the Hotham River in 2025. There is potential for mining related drawdown to cause harm to phreatophytic vegetation, and the Groundwater and Groundwater Dependent Vegetation Monitoring and Management Plan (GGDVMMP) has been designed to manage and mitigate this risk. Based on the data review presented in this document significant changes have been suggested for the groundwater monitoring components and groundwater triggers included in the GGDVMMP to account for the site specific conditions and risks at the BGM.

Seepage occurring during operation of the F1/F3 and R4 RDAs has caused groundwater mounding and small changes in groundwater hydrochemistry in the WFBGS, which have subsequently been transmitted into the SSGS. The maximum groundwater mounding (a shallowing of around 25 m in groundwater) has occurred close to the F1/F3 RDA embankment in the north and east. There is potential for groundwater mounding to cause harm to vegetation due to saturation of the root zone, and there is potential for mounding to drive cross catchment groundwater flow. These risks are managed and mitigated by the RDA Groundwater Management Plan (RDA GMP).

NBG are currently designing and permitting a second RDA in the Gringer Creek catchment referred to as RDA2. The updated characterisation of groundwater conditions in this document has been used to identify potential risks to the receiving surface water and groundwater environments associated with the planned operation of RDA2. These risks will be addressed and mitigated in the RDA2 designs and in the monitoring regime which is being designed in a separate document (BDH 2025).

5.2 Recommendations

It is recommended that:

1. The monitoring bores included in the GGDVMMP to provide early warning of mining related drawdown should be reassessed. A summary of the suitability of the existing bores is provided in Table 1 and a suggested list of monitoring bores provided in Table 2.
2. The groundwater level triggers currently defined in the GGDVMMP which are based on the rate and annual magnitude of groundwater drawdown be replaced by trigger levels based on a minimum groundwater elevation. Potential trigger levels are suggested in Table 2. The suggested trigger levels have been developed taking account of long term and seasonal trends in groundwater elevations and the local hydraulic gradients acting towards the Hotham River.
3. The concurrent studies into baseline conditions and monitoring requirements at RDA2 should take account of the potential for 1) cross catchment flow to the northwest; 2) groundwater mounding influences on vegetation in the west; and 3) groundwater discharge influences on surface water in the east. It is also noted that the studies should consider the cumulative influences of the current seepage from the F1/F3 and R4 RDAs and potential future seepage from RDA2.
4. Once designs and monitoring requirements for RDA2 are fully defined the RDA GMP should be updated accordingly.

References

Aquaterra 2009. *F1 RDA Drilling of Replacement Shallow Monitoring Bores, Technical Memorandum to M Durack of NBG by S Strong of Aquaterra,* Aquaterra Water and Environment.

BDH 2018. *Newmont Boddington Gold, 2018 Update of Groundwater Conditions and Regional Groundwater Management Plan*, Big Dog Hydrogeology Pty Ltd.

BDH 2021. *Re Boddington Groundwater and Groundwater Dependent Vegetation Monitoring and Management Plan*, letter from S Barrett of BDH to Ben Walley of NBG.

BDH 2023. *Boddington Gold Mine, 2023 RDA Groundwater Revie*w, Big Dog Hydrogeology Pty Ltd.

BDH 2024. *Boddington Gold Mine, RDA Groundwater Management Plan*, Big Dog Hydrogeology Pty Ltd.

BDH 2025 (in prep). *Boddington Gold Mine, RDA2 Hydrological Baseline Assessment*, Big Dog Hydrogeology Pty Ltd.

CDM Smith 2024, *Phase 1 Drilling Construction and Conceptualisation – Hotham North and Quaindanning, Prepared for South 32 Worsley Alumina Pty Ltd,* CDM Smith Australia.

Fround, R and Loomes, R 2004. *Approach to Determination of Ecological Water Requirements of Groundwater Dependent Ecosystems in Western Australia*, A Report to the Department of Environment, Edith Cowan University Perth.

Golder 2007. *Shallow Monitoring Bore Installation, Boddington Gold Mine Expansion, Report 06641337-R02,* Golder and Associates.

Golder 2010. *Summary of Boddington Groundwater Drilling Programme, 22 April to 28 May 2010, Letter report to Mr Graeme Reynolds of Newmont from Greg Hookey of Golder,* Golder and Associates.

Golder 2019. *Boddington Hydrogeological Investigation, Numerical Groundwater Flow Model Update*, Golder and Associates.

KP 2009. *Boddington Expansion Project, RDA – Stage 2, Monitoring Bore Installation*, Knight Piesold Pty Ltd.

NBG 2018. *Proposed Production Bore Operating Strategy*, memo from Steph Myles of NBG to Rynhard Kok of NBG.

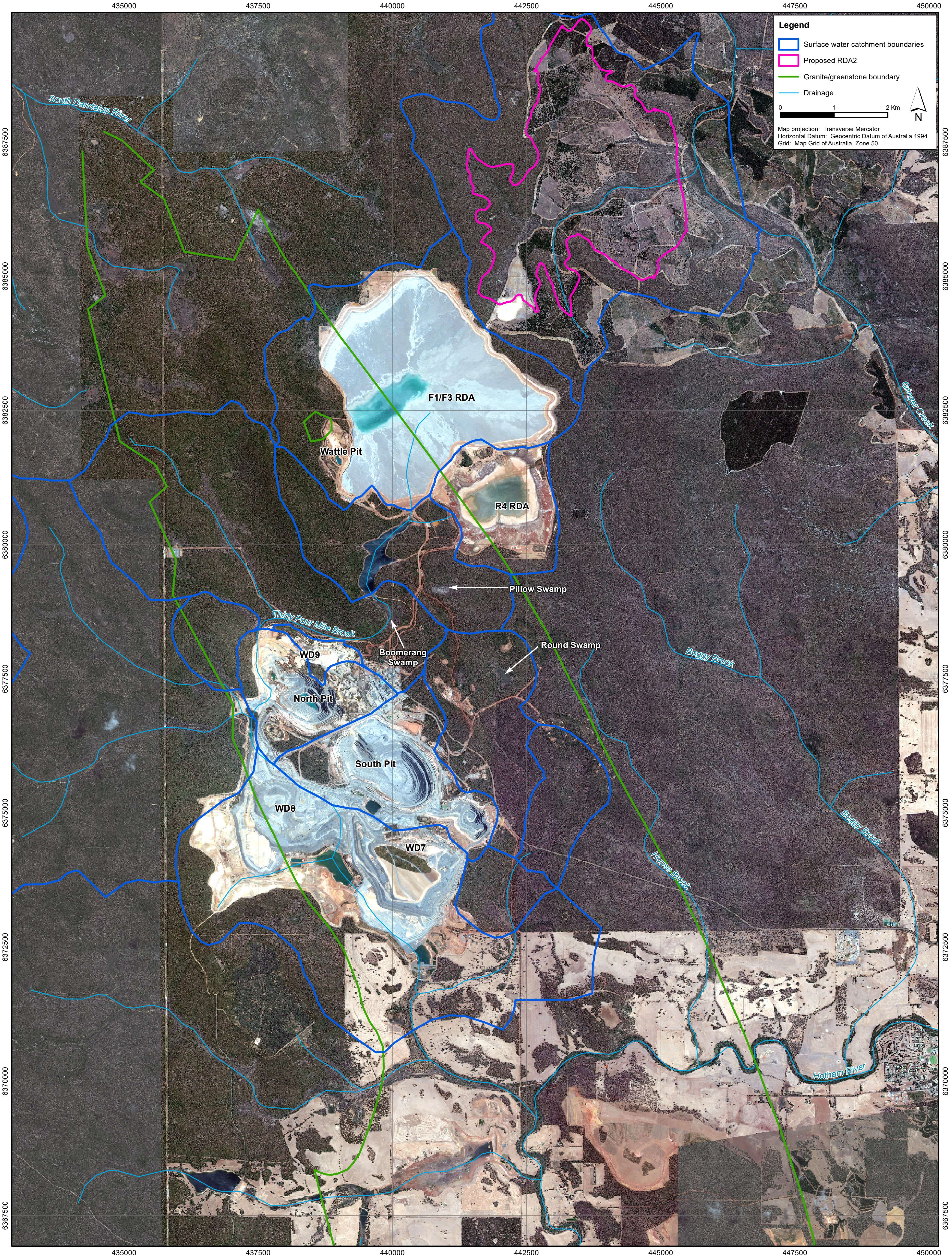
Ohashi 2024. *Q2 2024 NBG Pits Hydrogeology*, Technical Memo by Junji Ohashi of NBG.

SWS 2013. *Regional Monitoring Drilling Programme Summary, 9th January to 30th November 2012, Technical memorandum to Mr Ben Walley of Newmont, from Jorge Rodriguez of SWS,* Schlumberger Water Services.

Umwelt 2021. *Newmont Boddington Gold Mine, Groundwater and Groundwater Dependent Vegetation Monitoring and Management Plan,* Umwelt Environmental and Social Consultants.

List of Figures

Figures



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

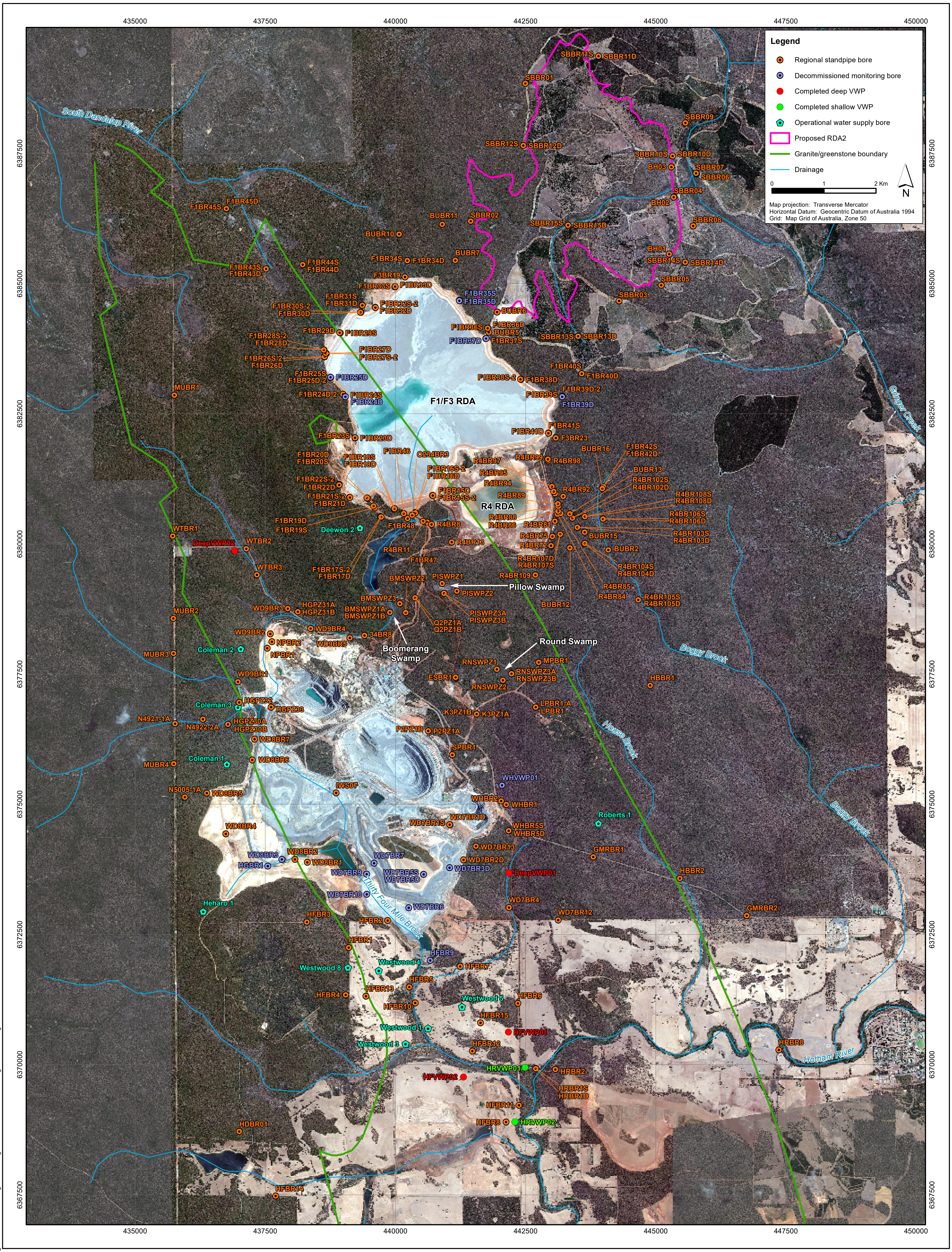
BIG DOG HYDROGEOLOGY

Hydrological setting

Figure 1

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



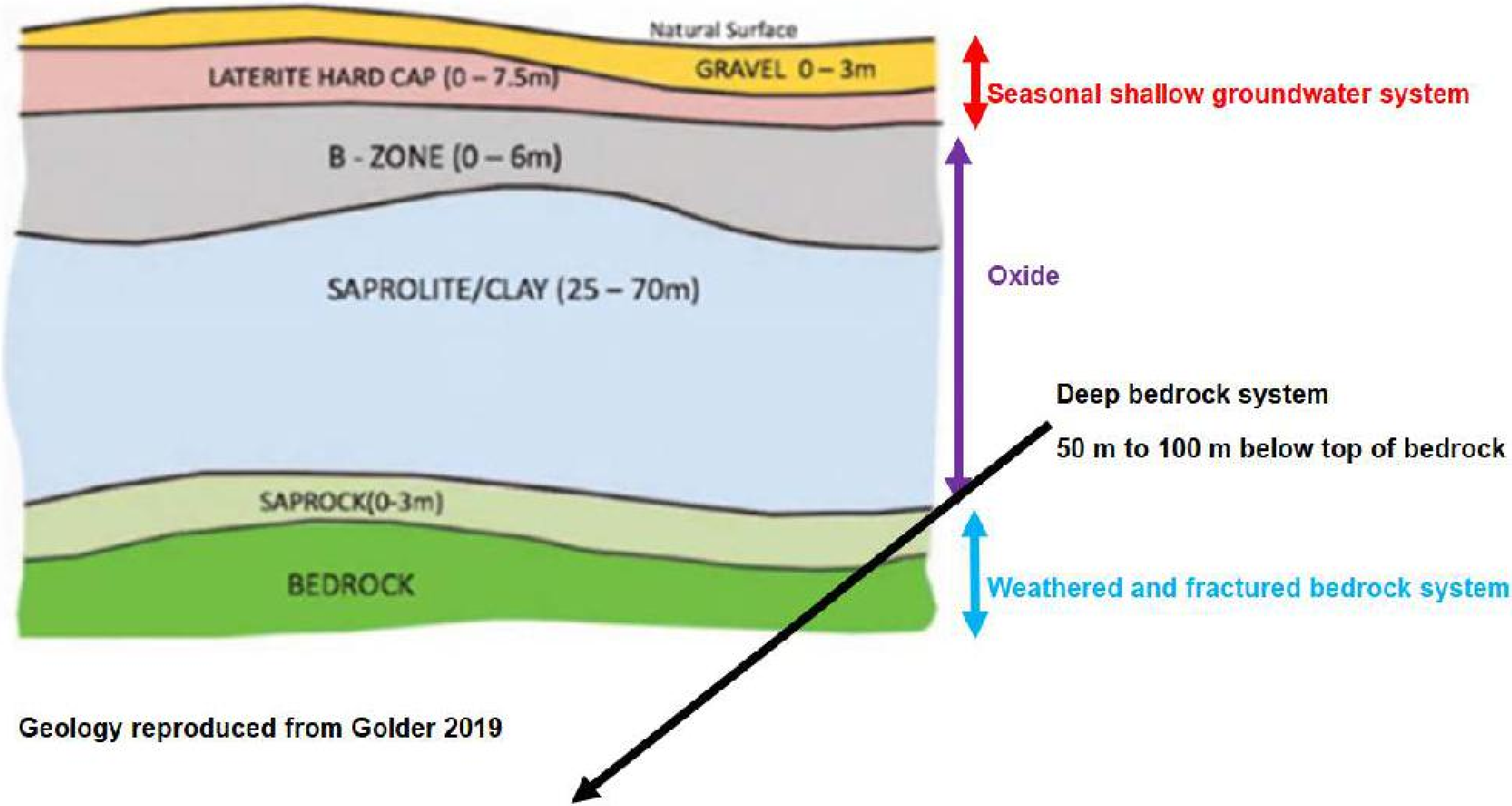
BIG DOG HYDROGEOLOGY

Monitoring locations

Figure 2

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



Geology reproduced from Golder 2019

D:\Documents\BDH Projects\Boddington\Boddington mining influences

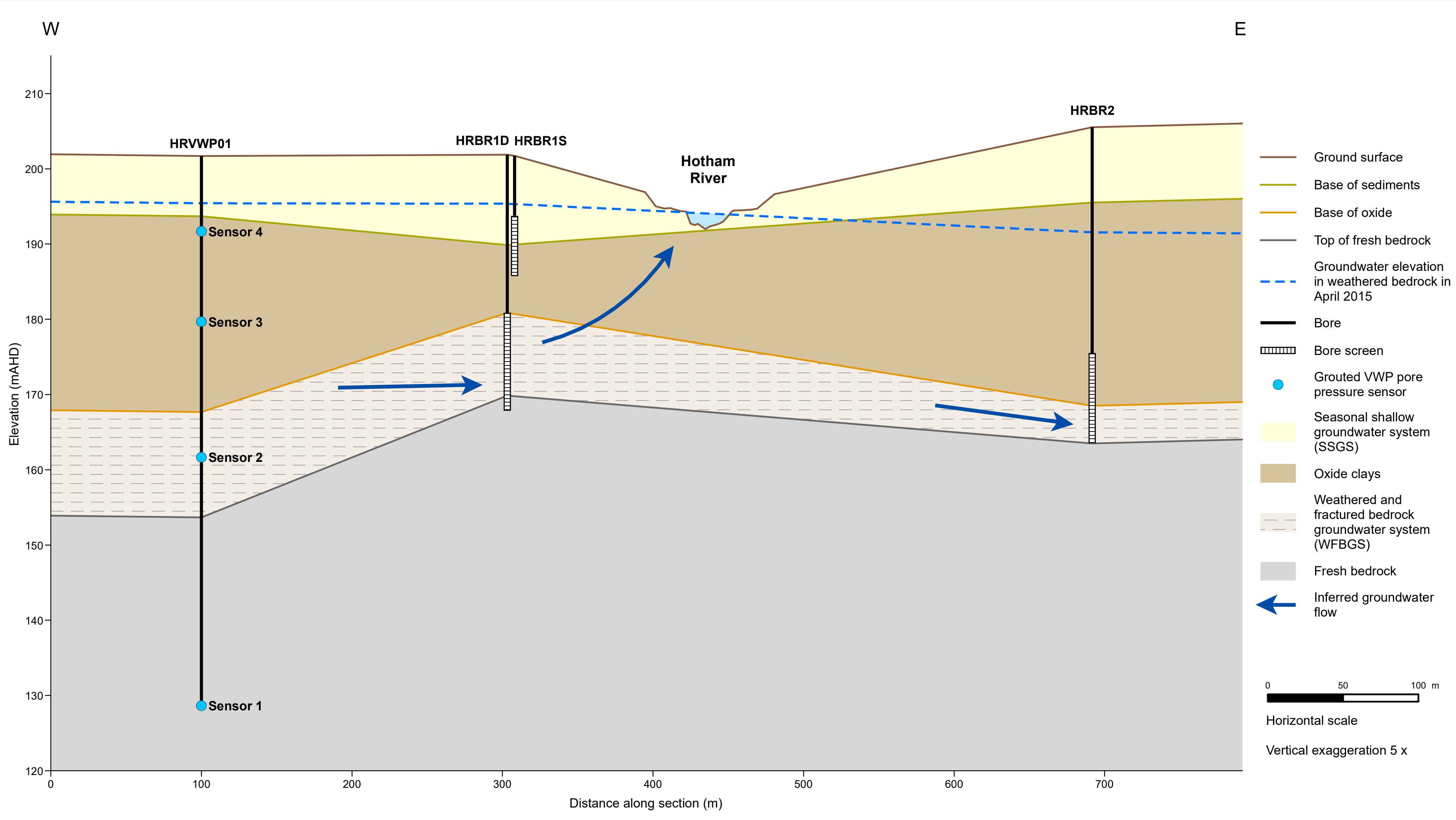
BIG DOG HYDROGEOLOGY

Schematic geological and hydrogeological section

Figure 3

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

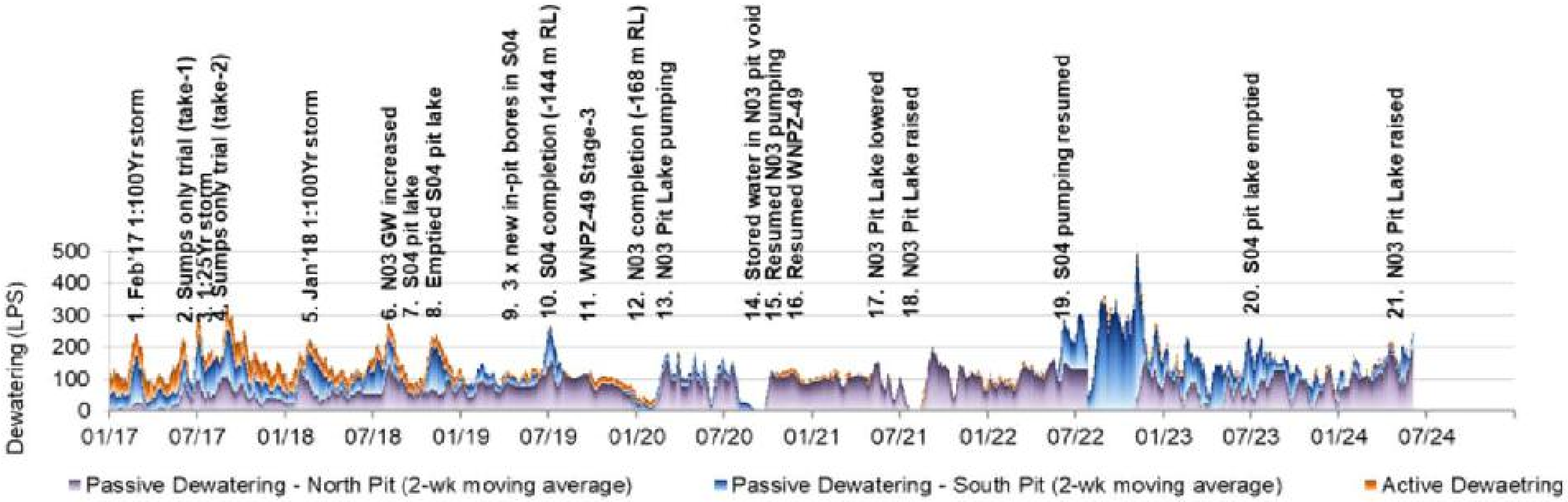
BIG DOG HYDROGEOLOGY

Hotham River hydrogeological section

Figure 4

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



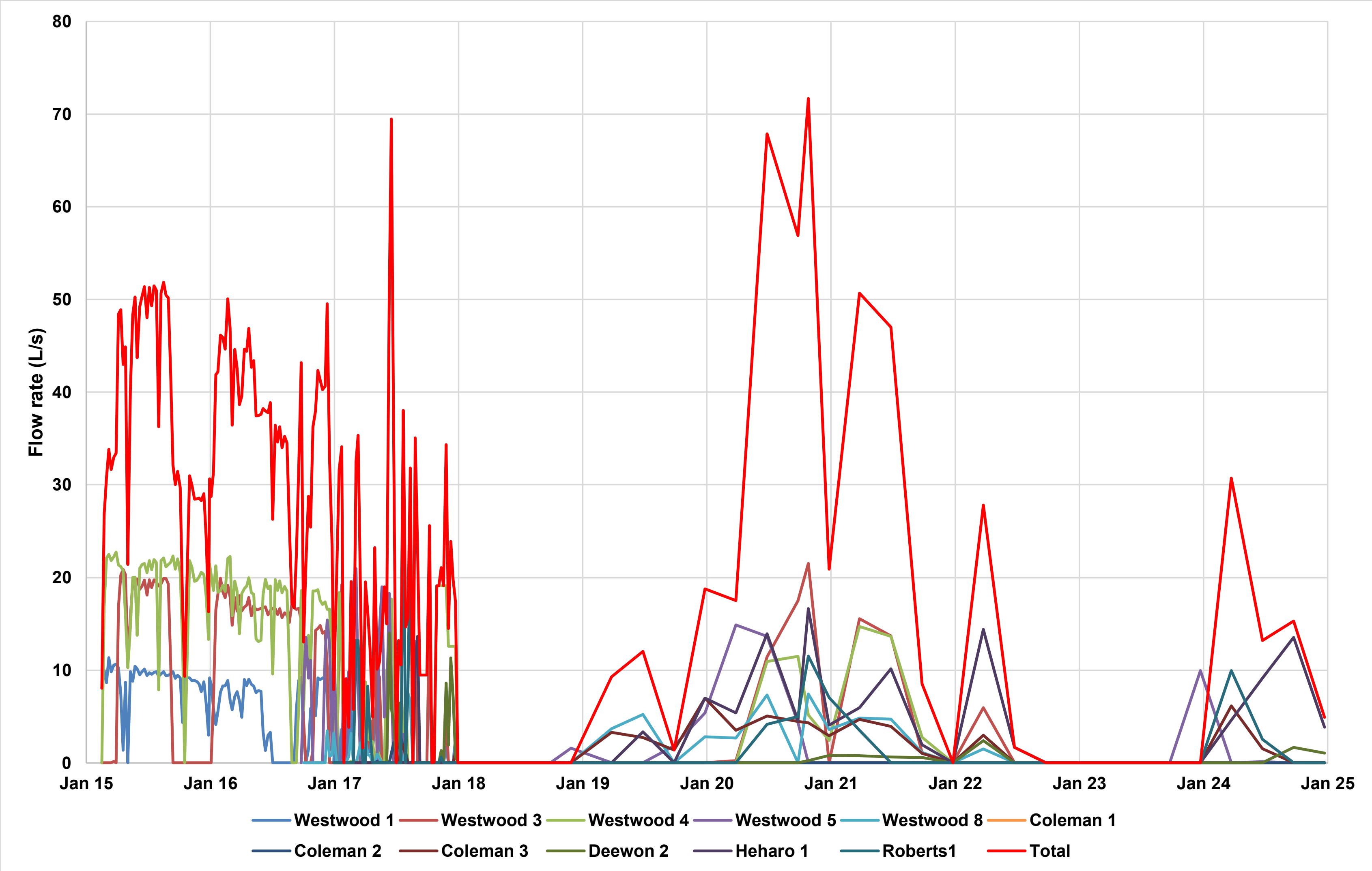
Note: Reproduced from Ohashi 2024

Pit dewatering rates

Figure 5

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



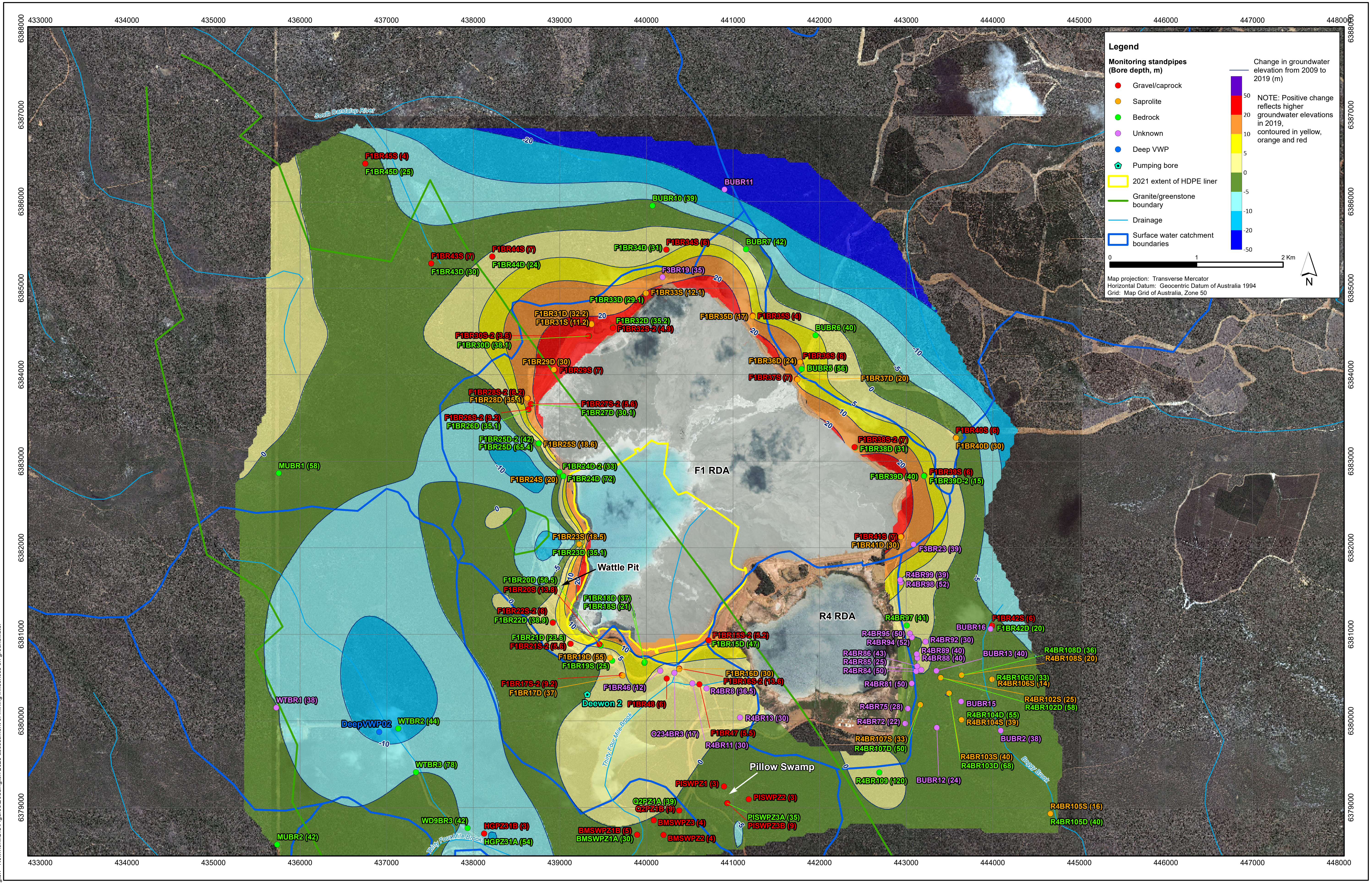
BIG DOG HYDROGEOLOGY

Rates of production bore operation

Figure 6

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



BIG DOG HYDROGEOLOGY

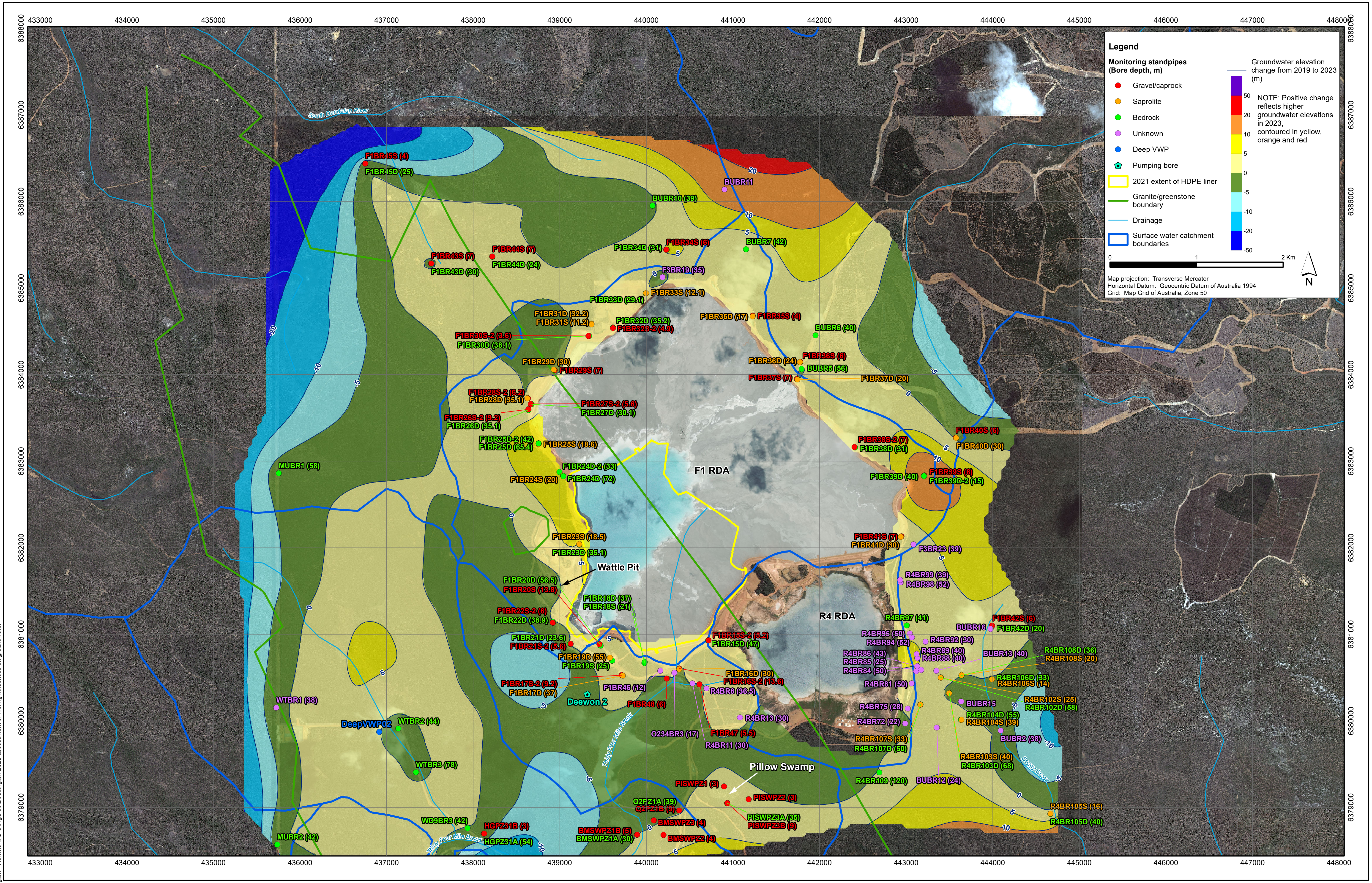
F1/F3 and R4 RDA change in groundwater elevations from 2009 to 2019

Figure 7

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater

G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

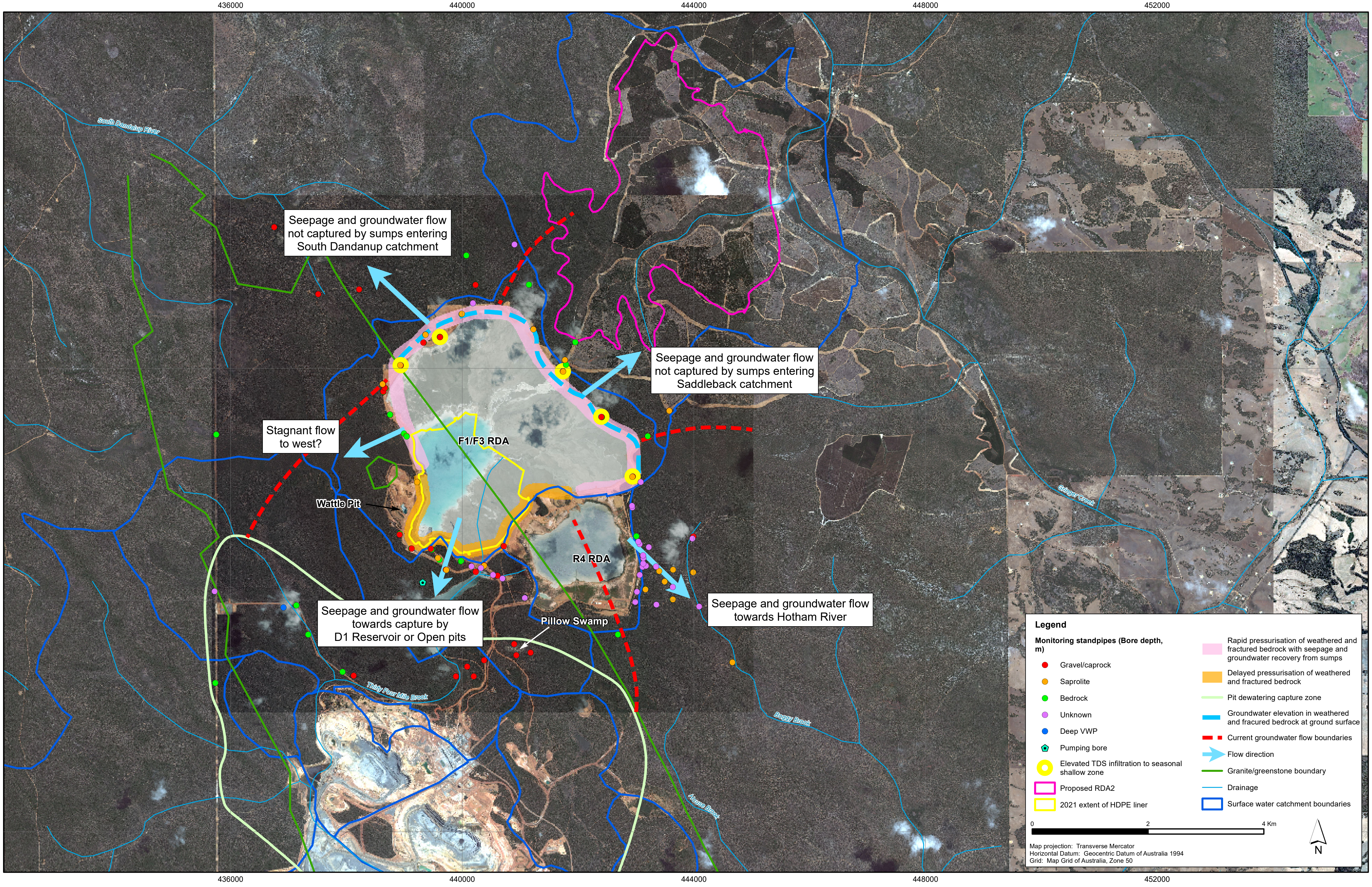
BIG DOG HYDROGEOLOGY

F1/F3 and R4 RDA change in groundwater elevations from 2019 to 2023

Figure 8

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

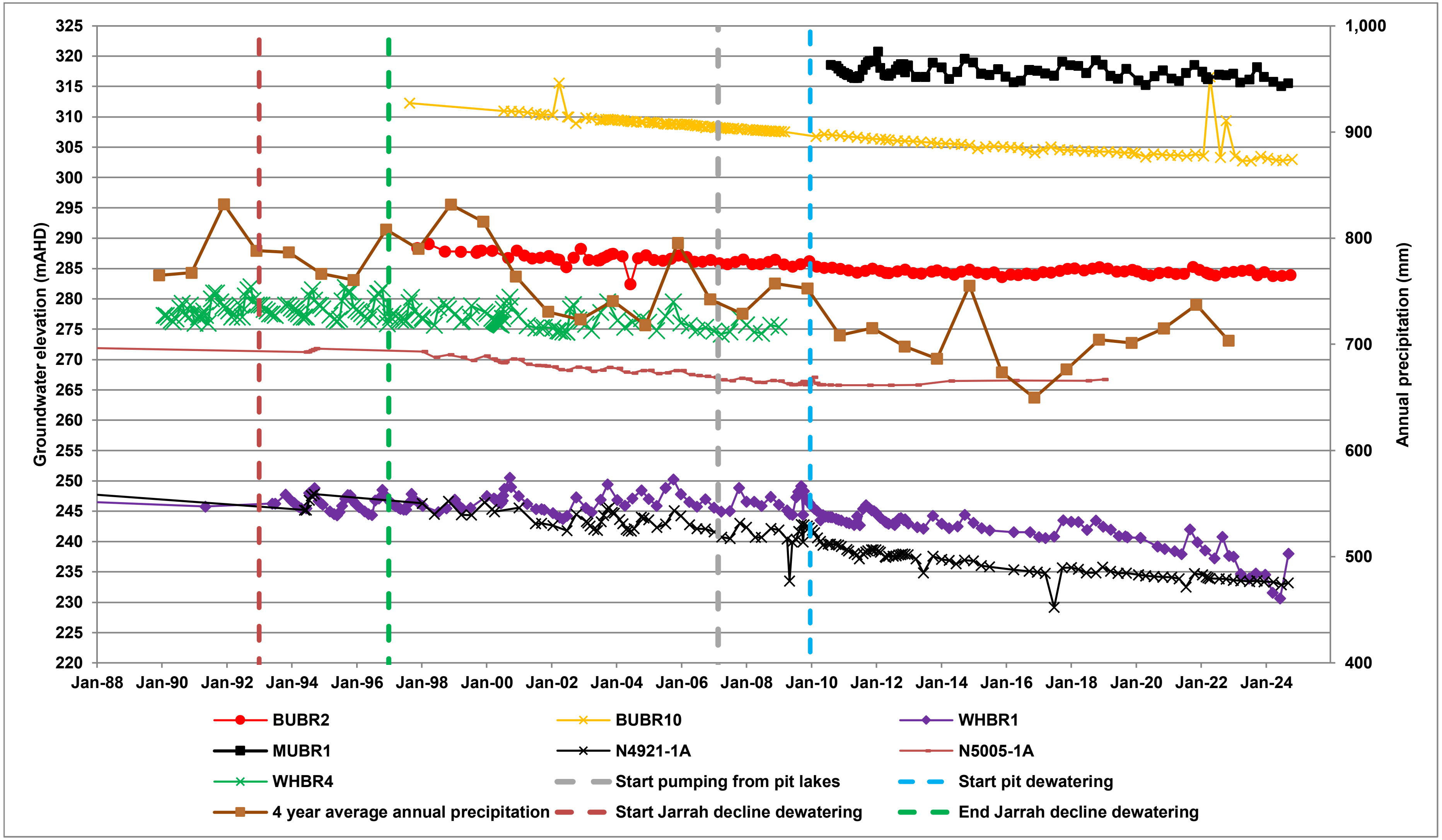
BIGDOG HYDROGEOLOGY

Current RDA seepage influences on groundwater

Figure 9

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

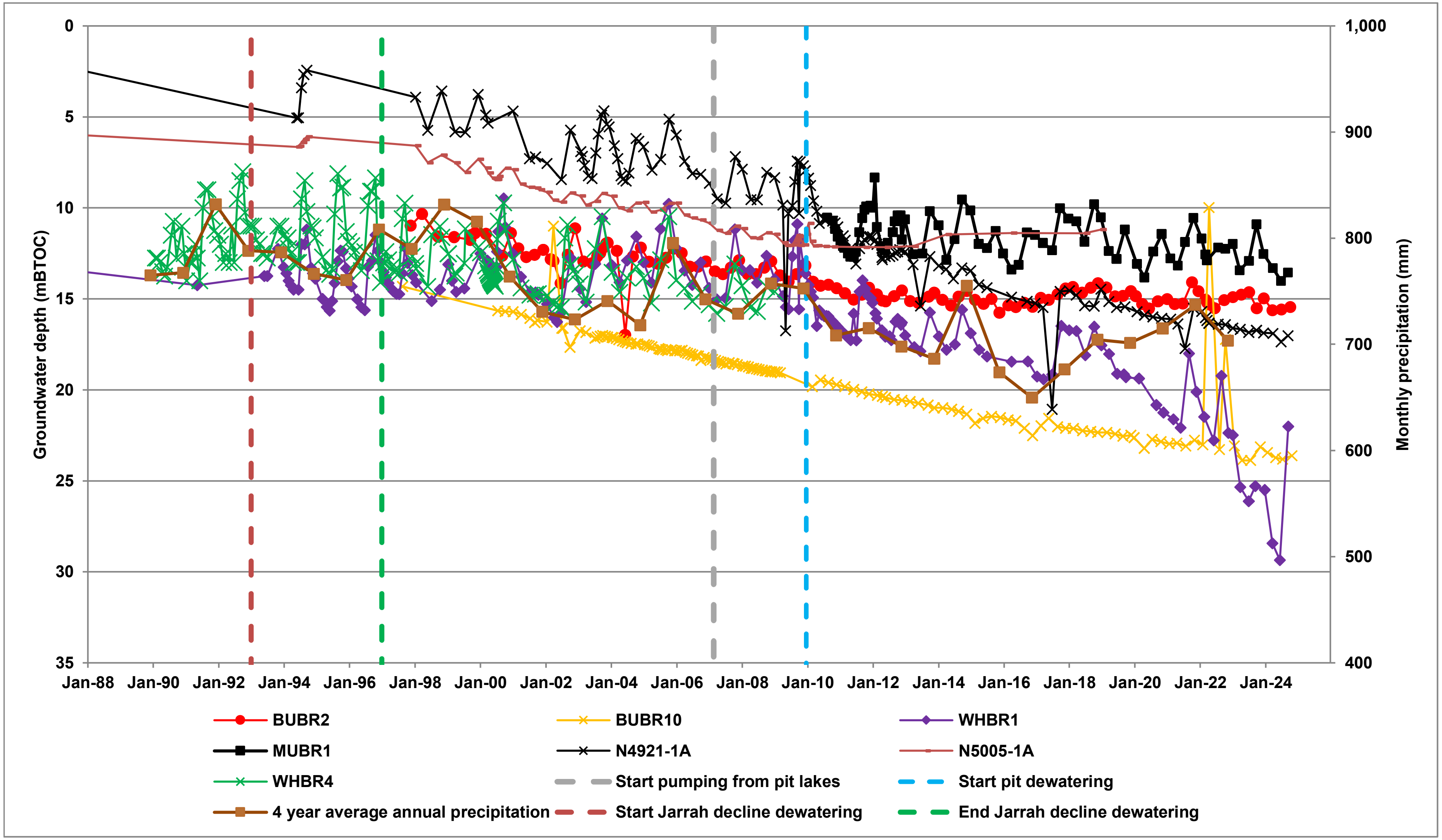
BIG DOG HYDROGEOLOGY

Groundwater elevations - long term

Figure 10

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

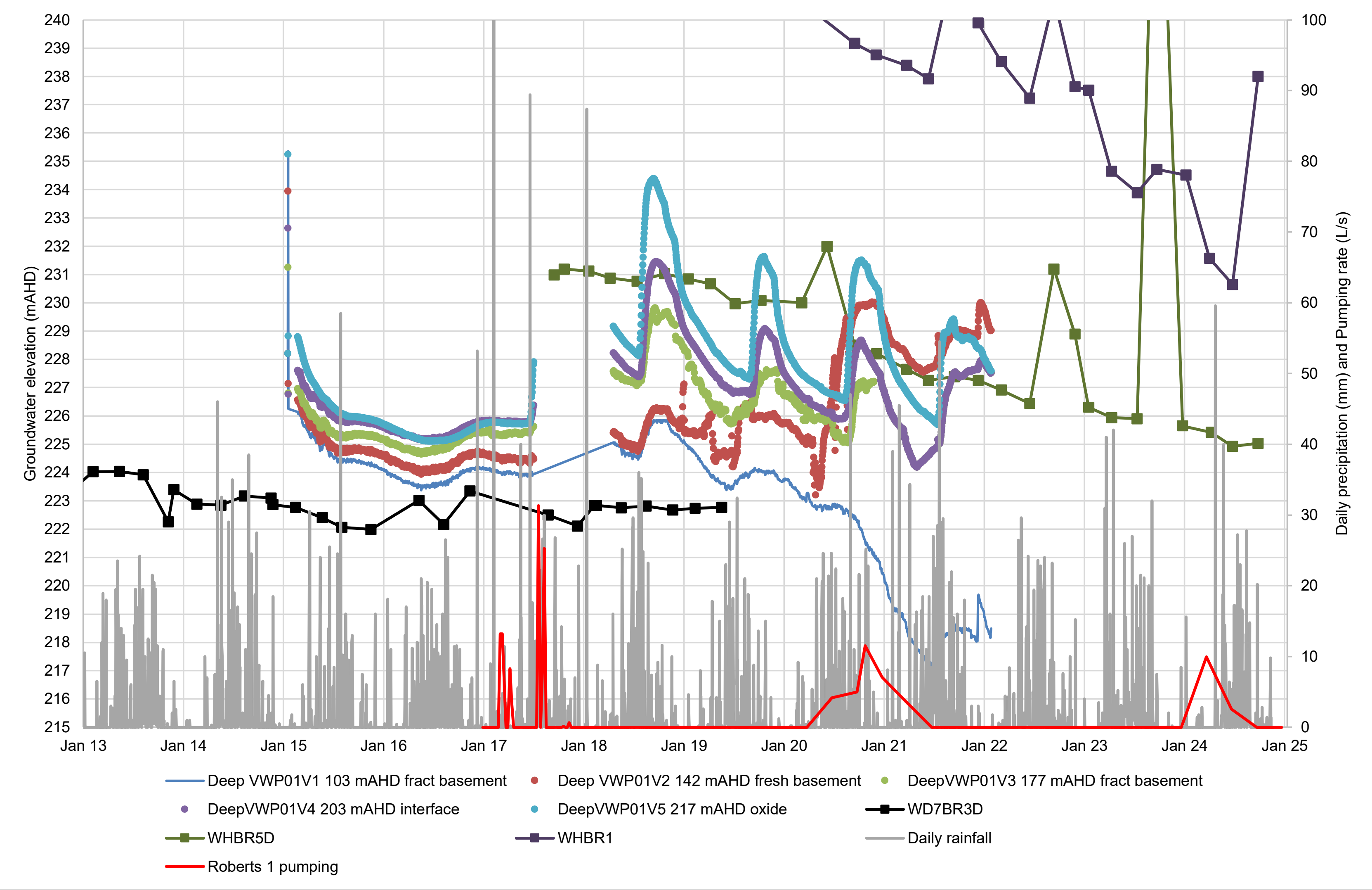
BIG DOG HYDROGEOLOGY

Groundwater depths - long term

Figure 11

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



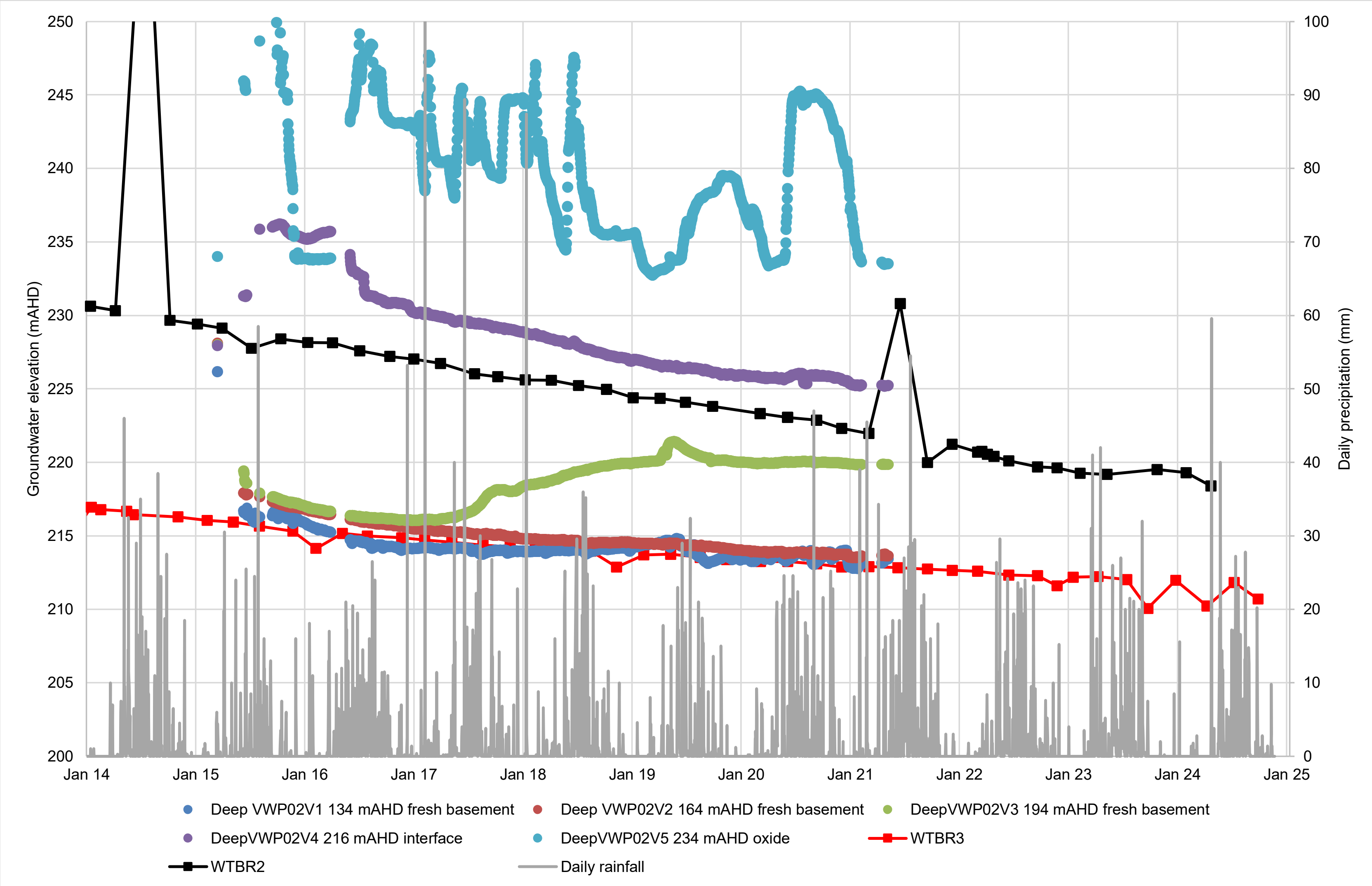
BIG DOG HYDROGEOLOGY

Groundwater elevations - DeepVWP01

Figure 12

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



BIG DOG HYDROGEOLOGY

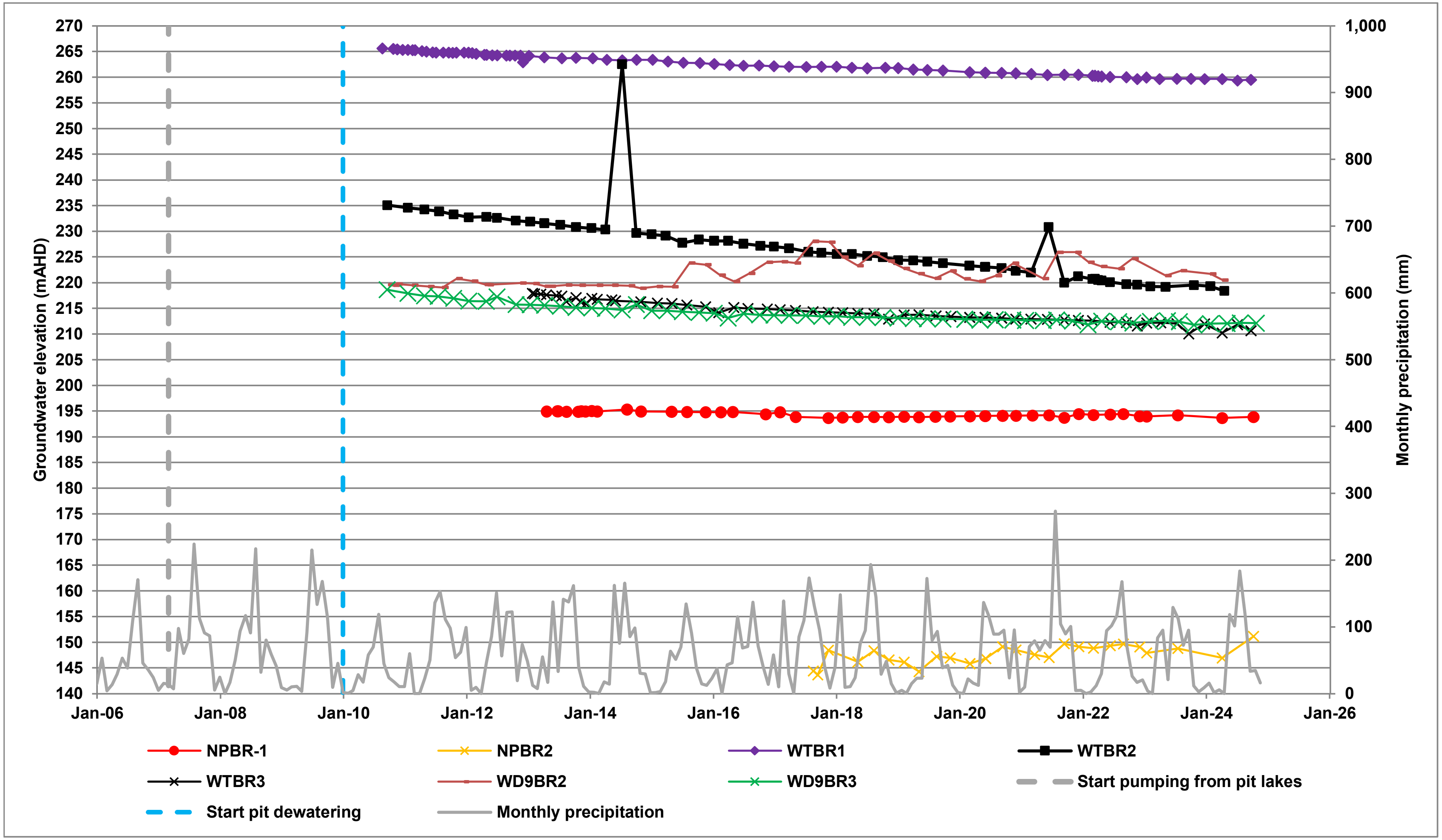
Groundwater elevations - DeepVWP02

Figure 13

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater

D:\Documents\BDH Projects\Boddington\Boddington mining influences



D:\Documents\BDH Projects\Boddington\Boddington mining influences

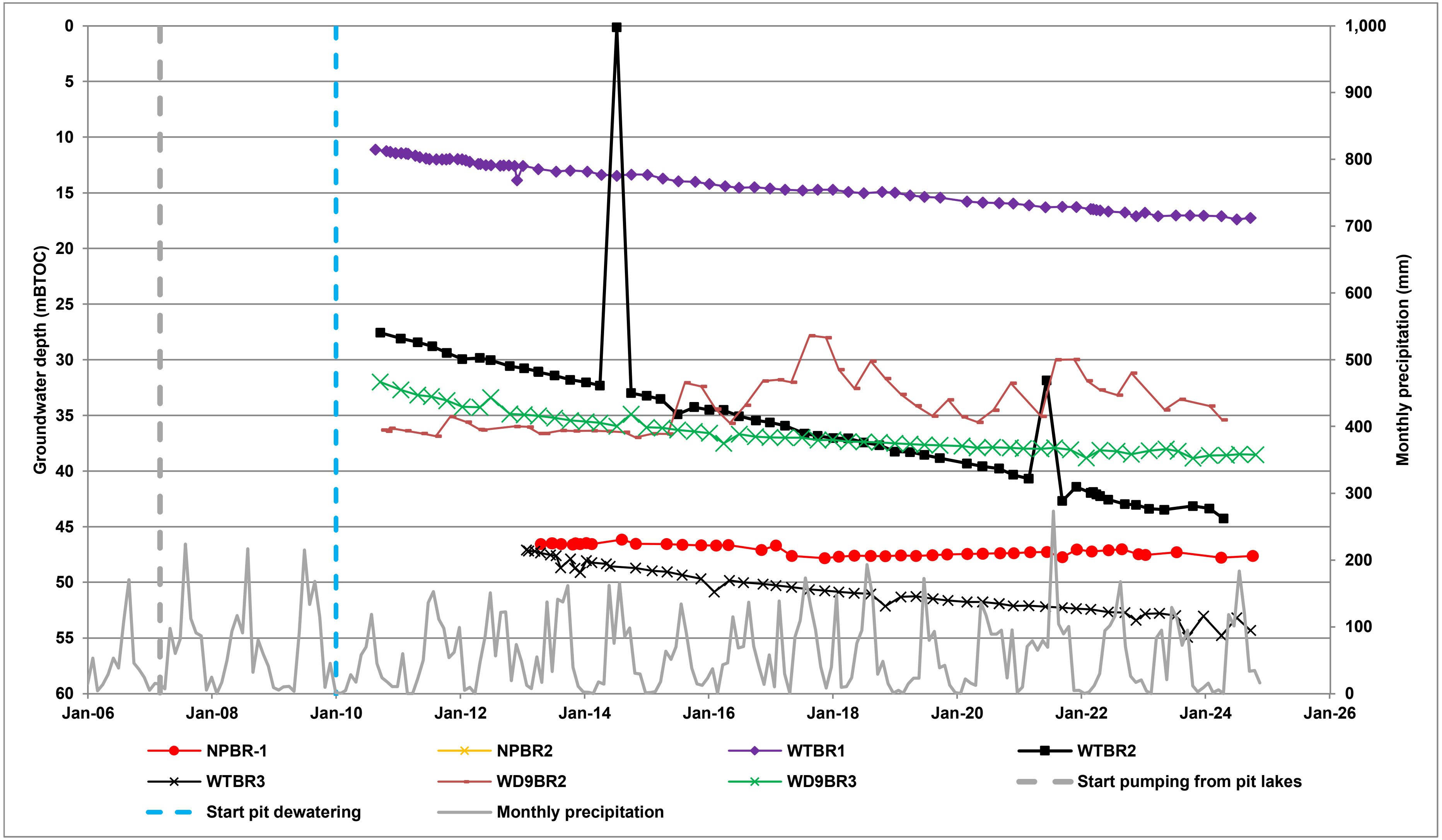
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 1

Figure 14

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

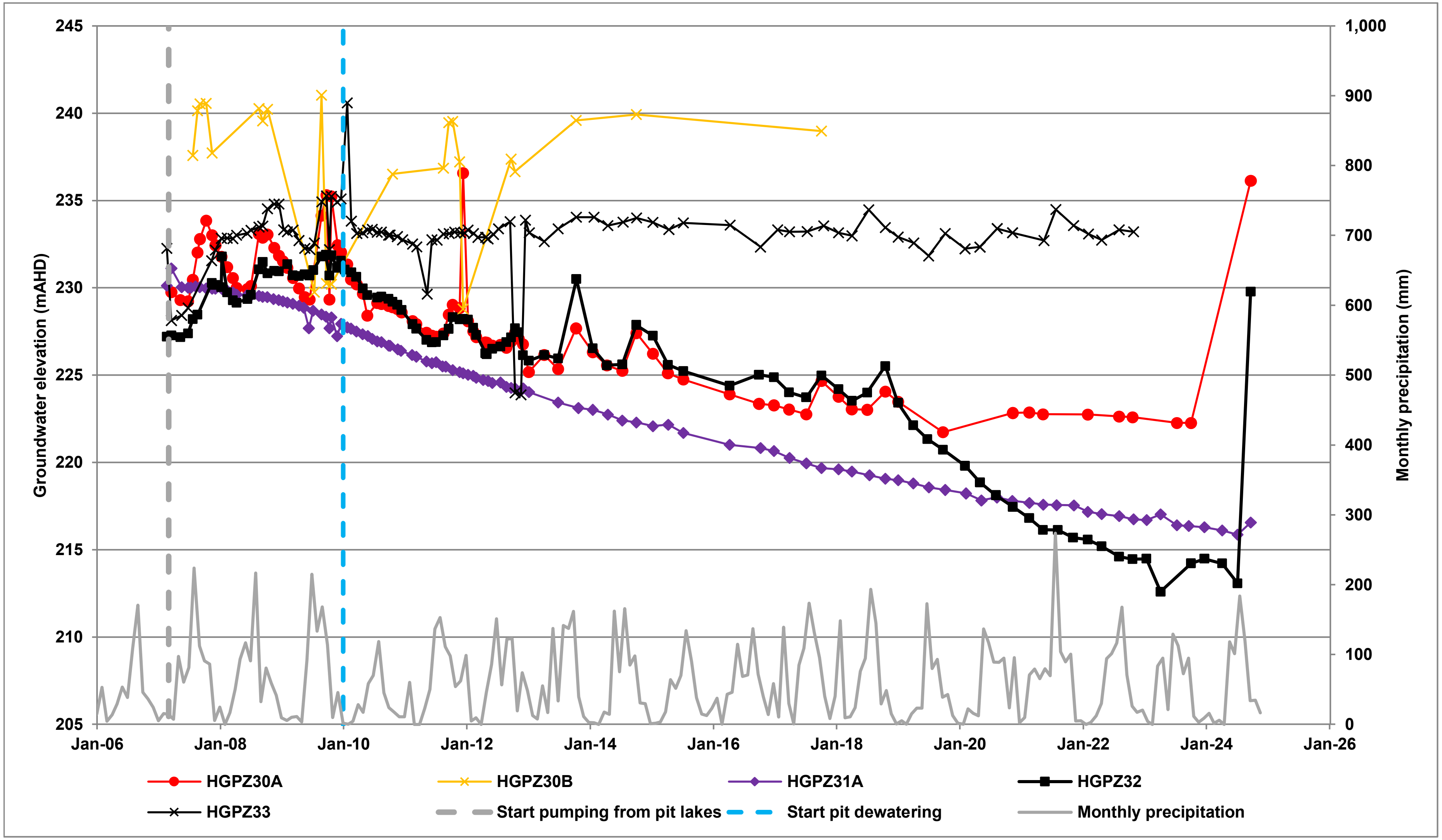
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 1

Figure 15

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

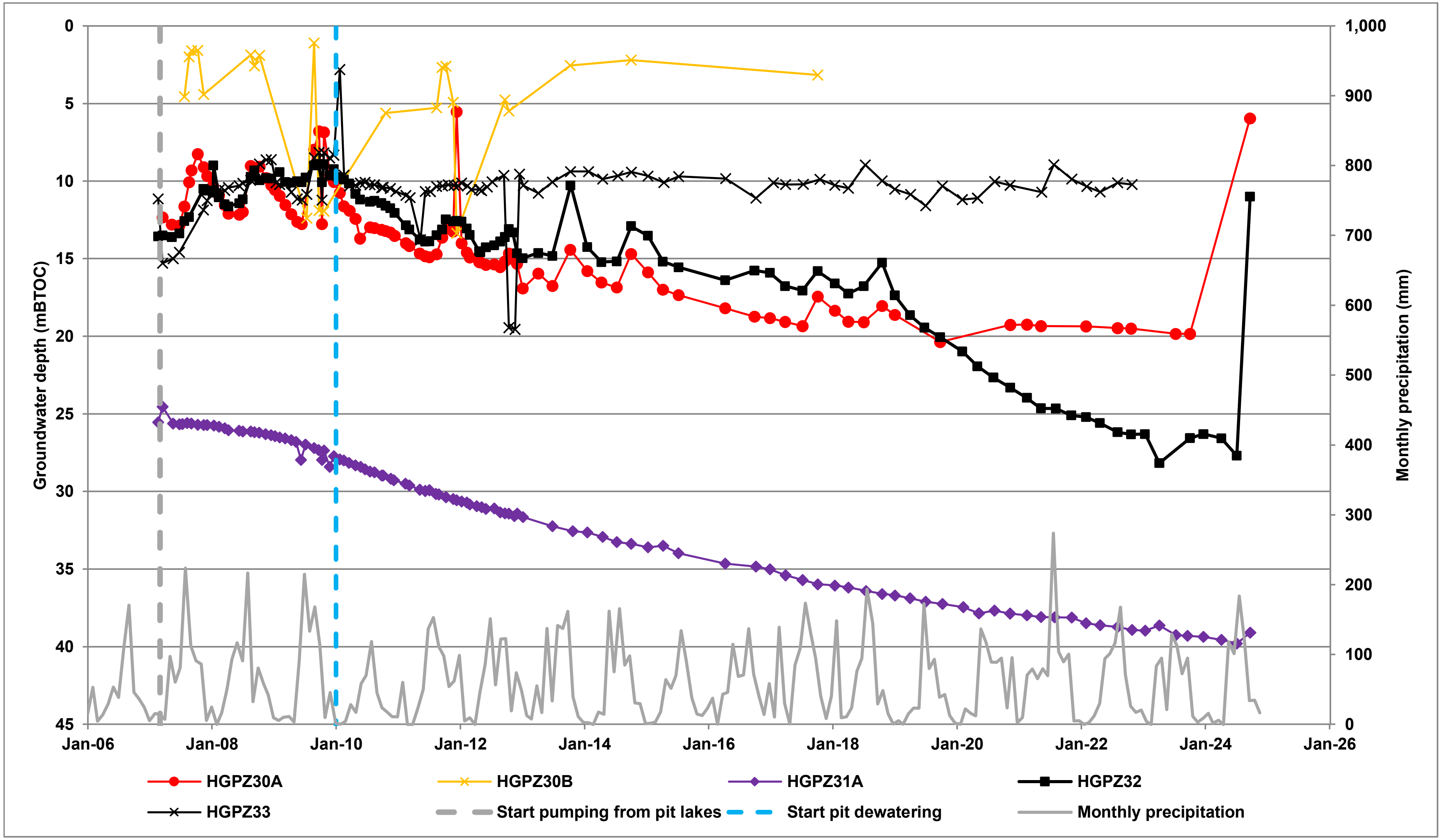
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 2

Figure 16

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

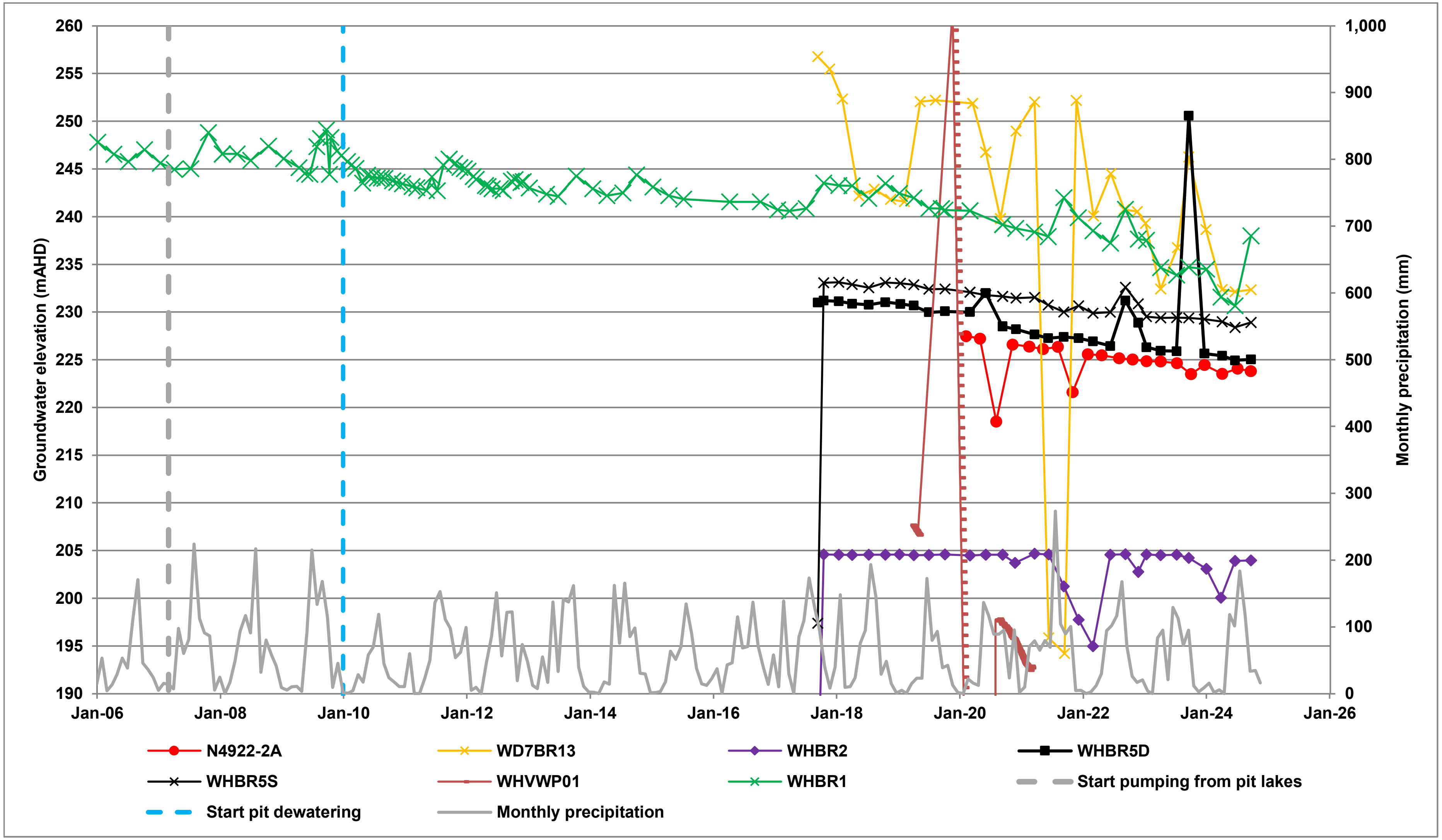
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 2

Figure 17

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

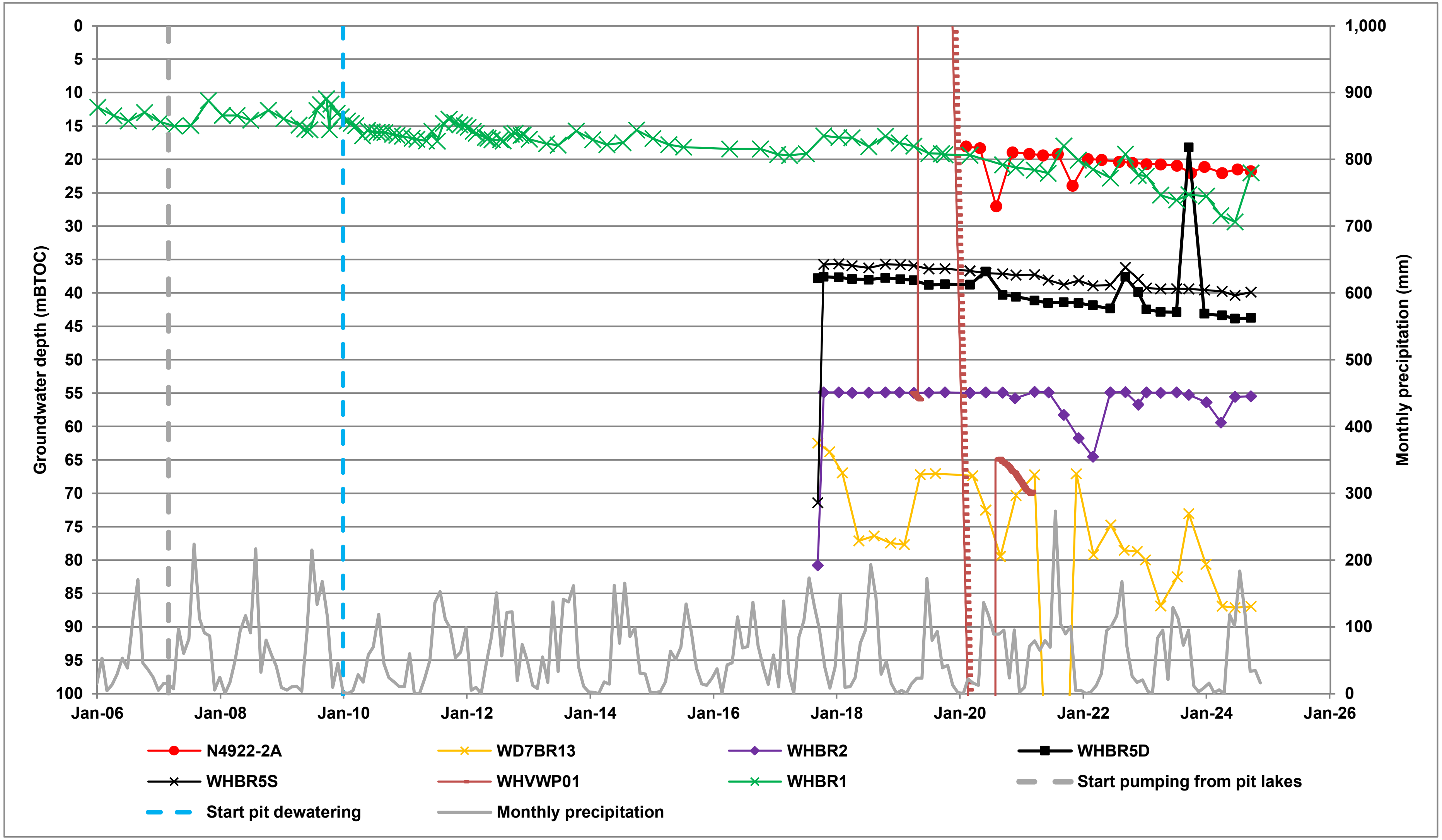
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 3

Figure 18

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

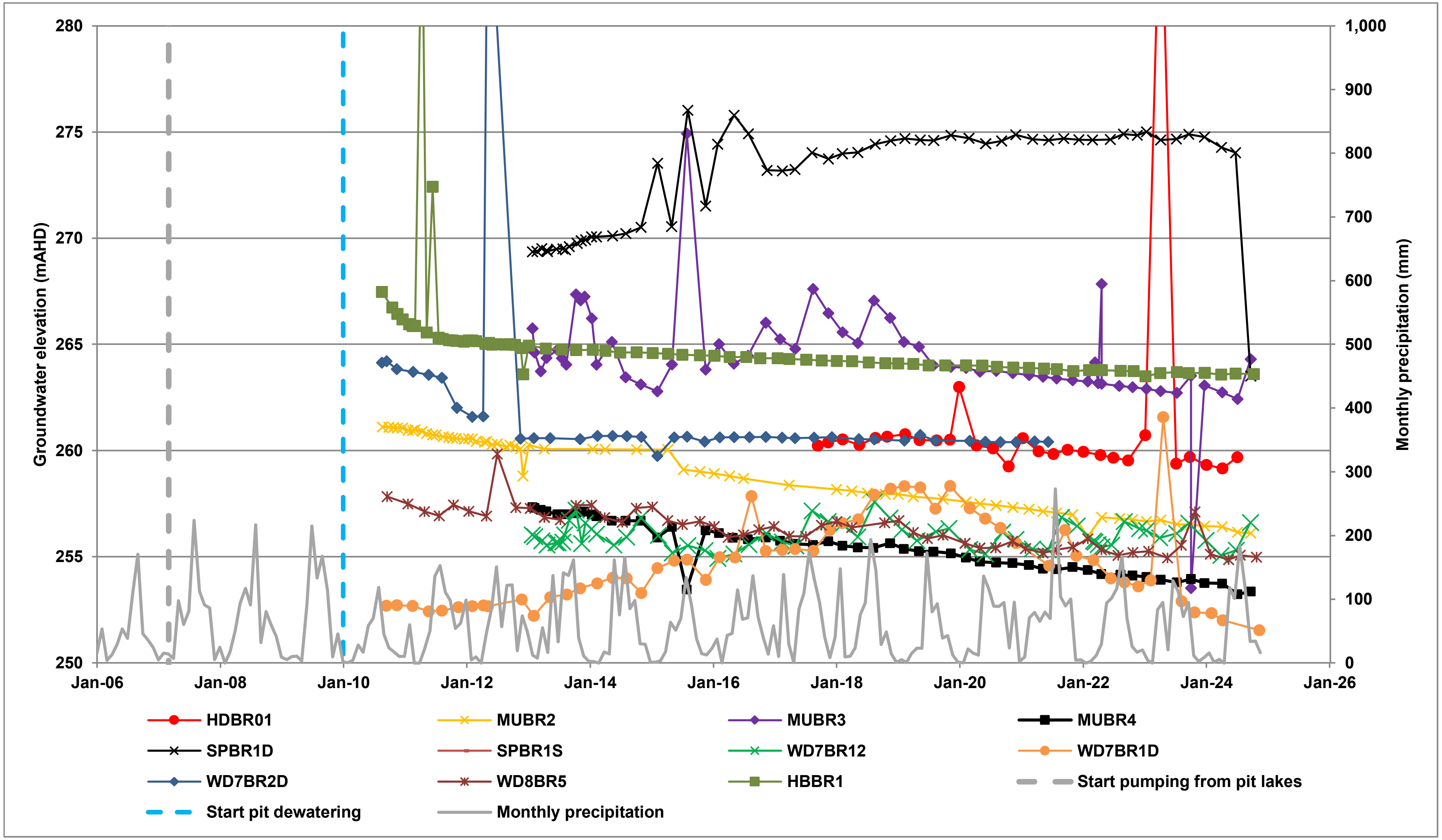
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 3

Figure 19

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

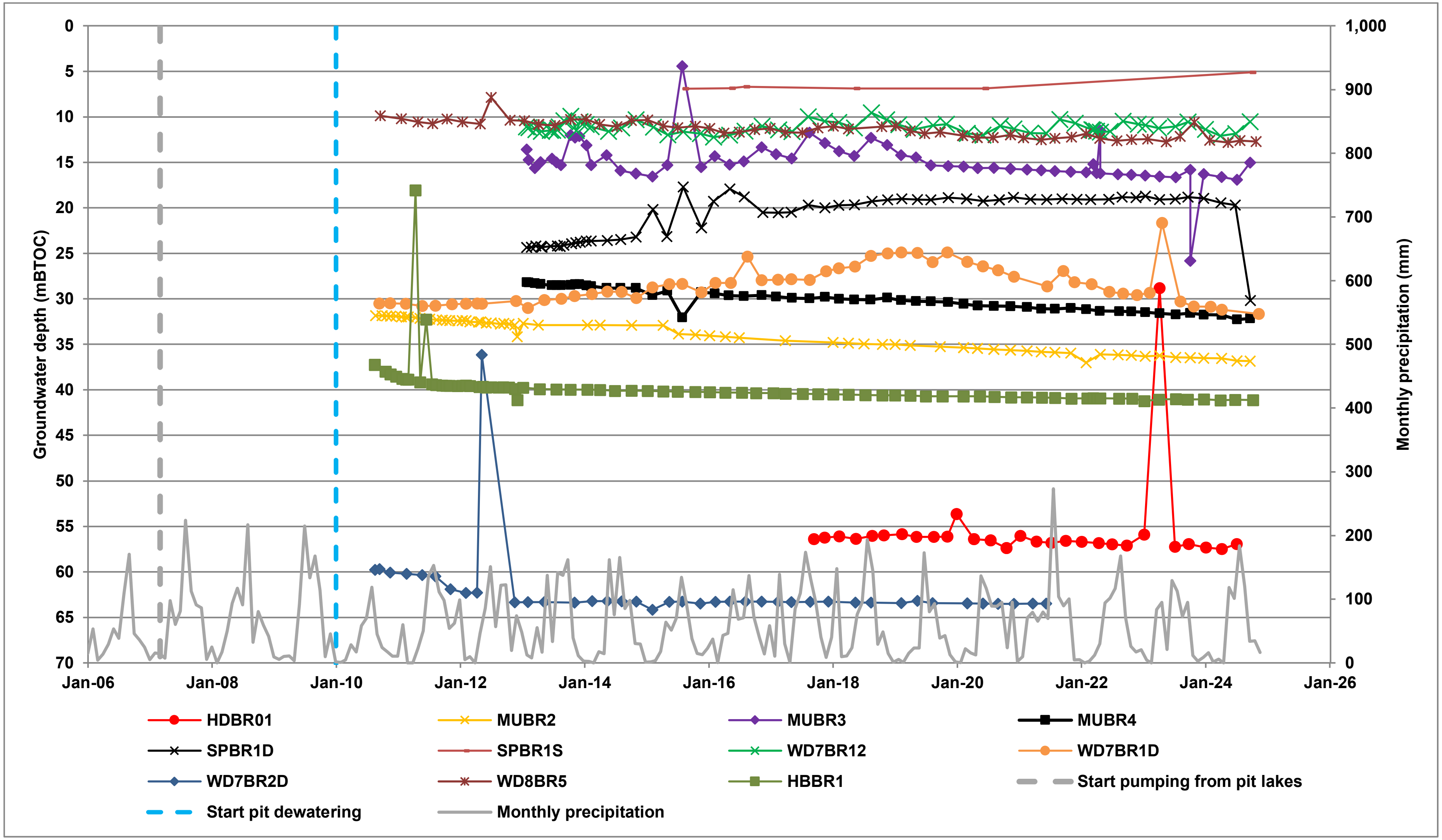
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 4

Figure 20

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

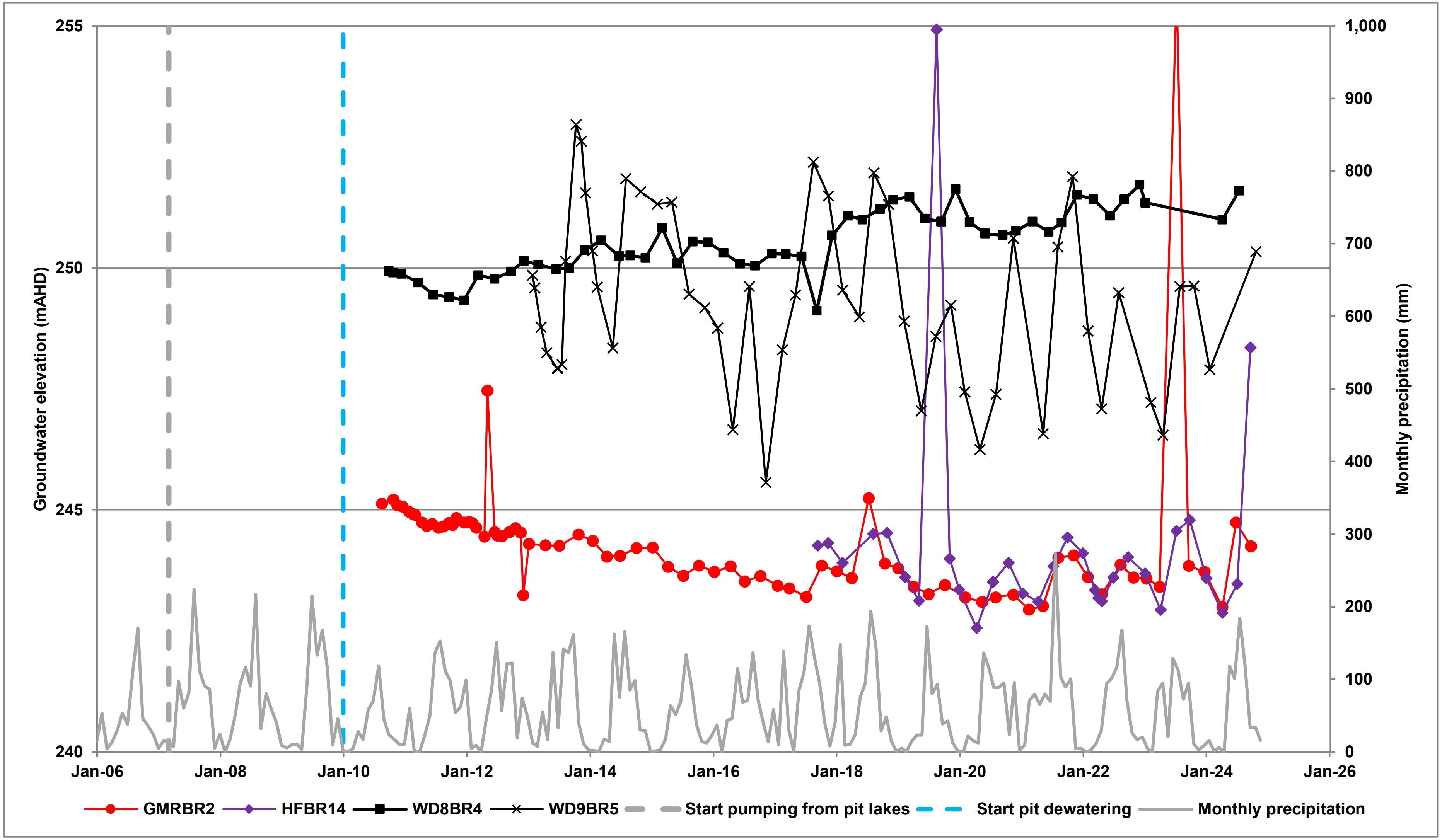
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 4

Figure 21

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

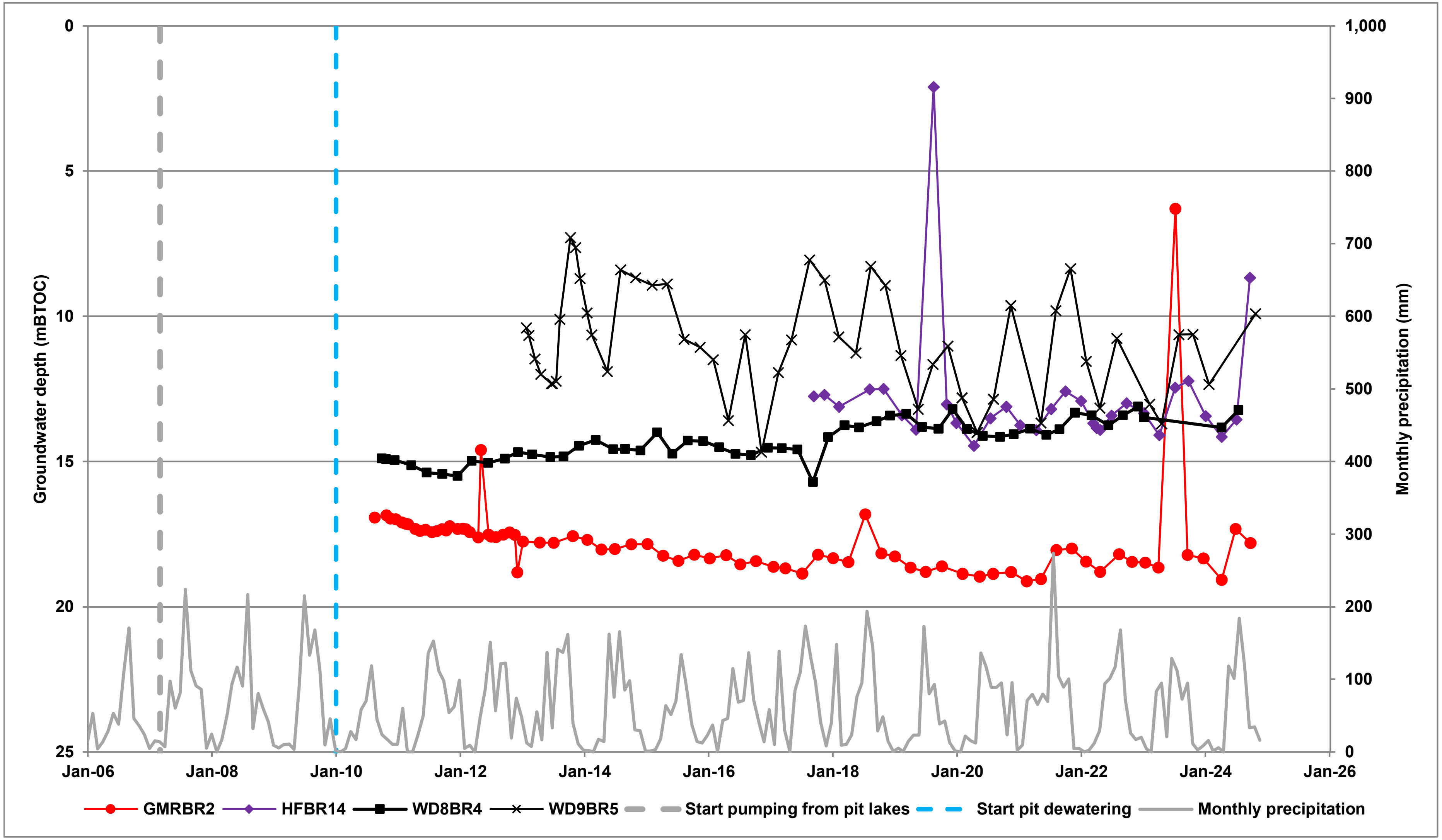
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 5

Figure 22

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



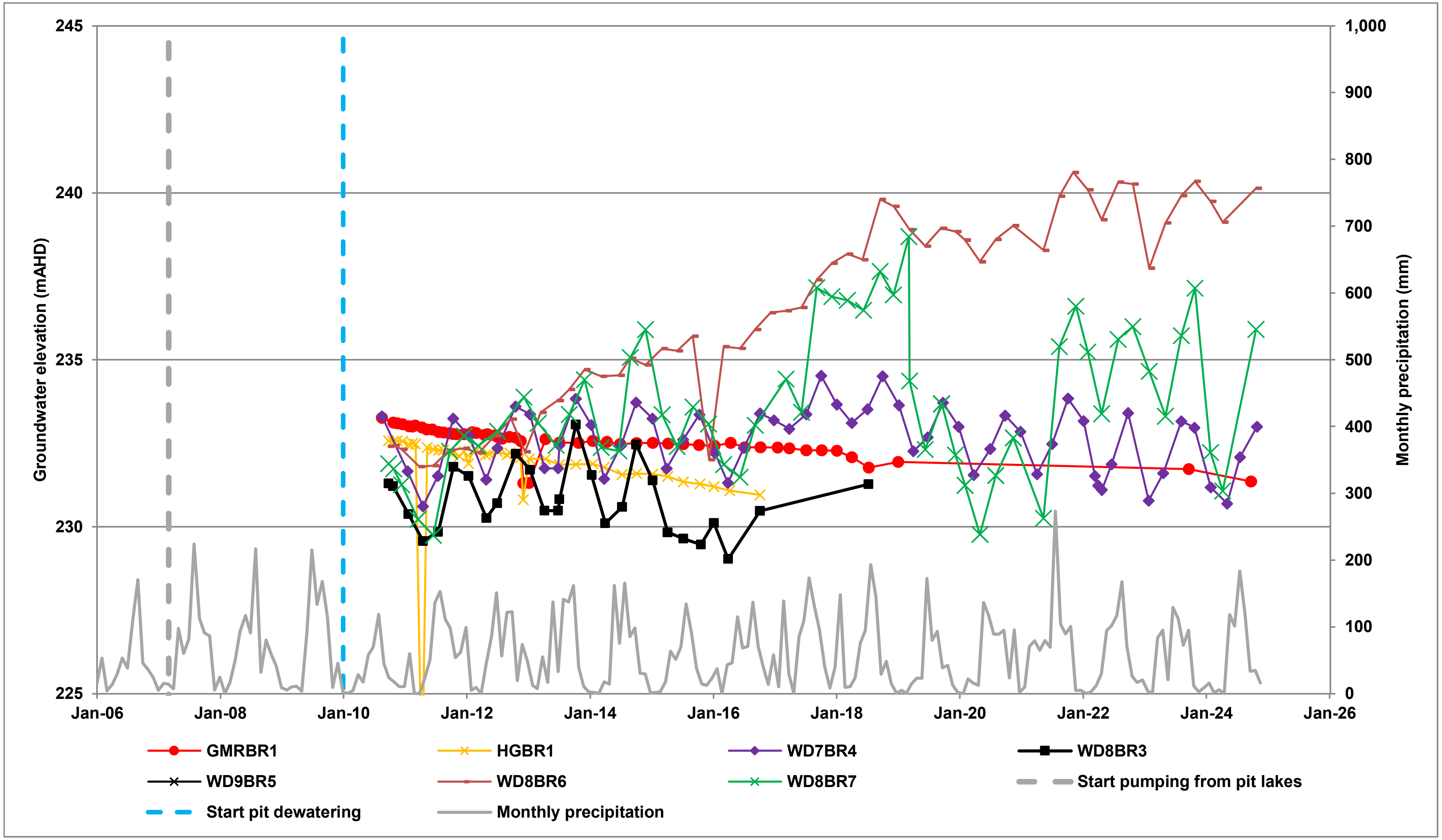
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 5

Figure 23

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

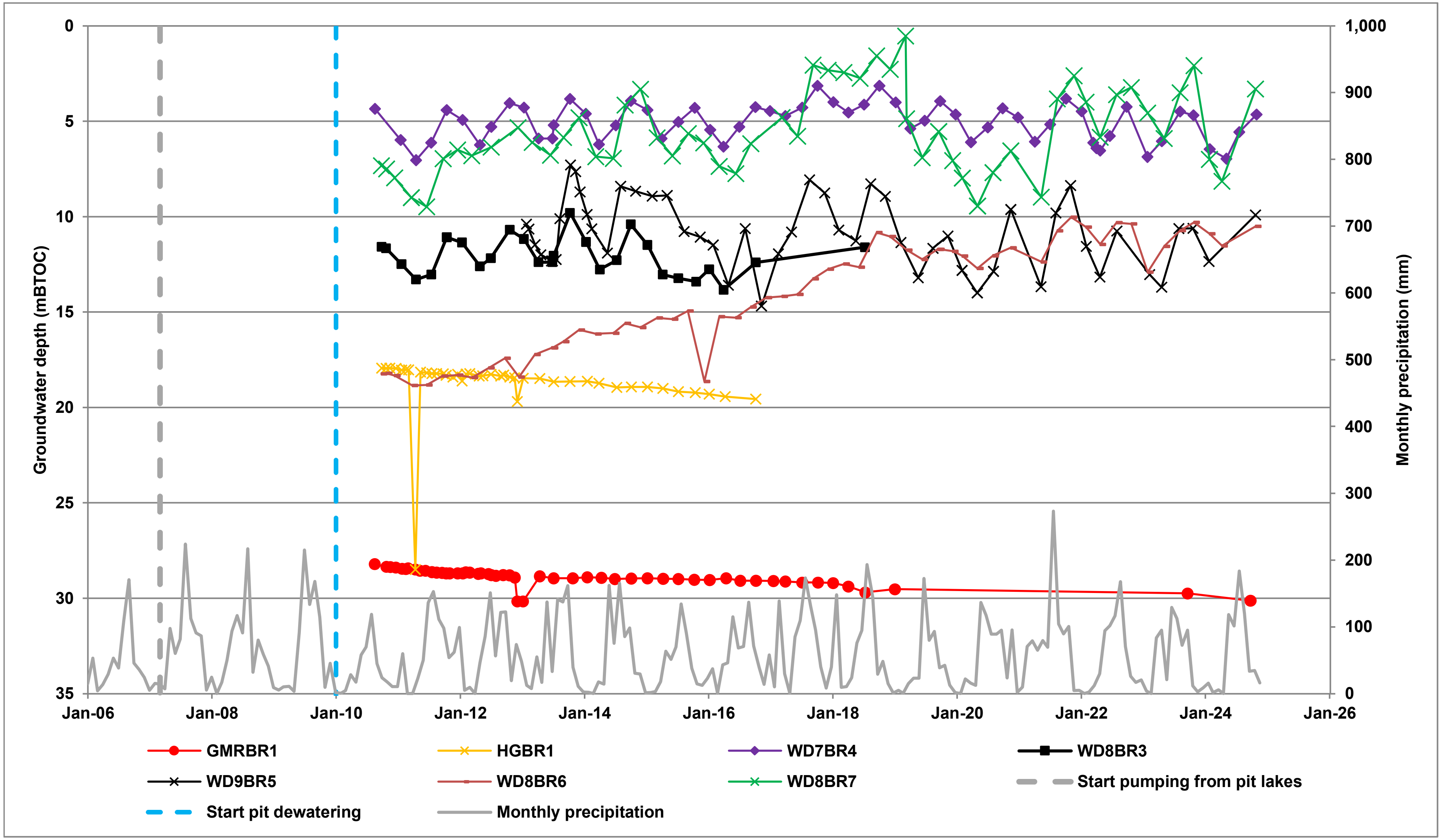
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 6

Figure 24

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

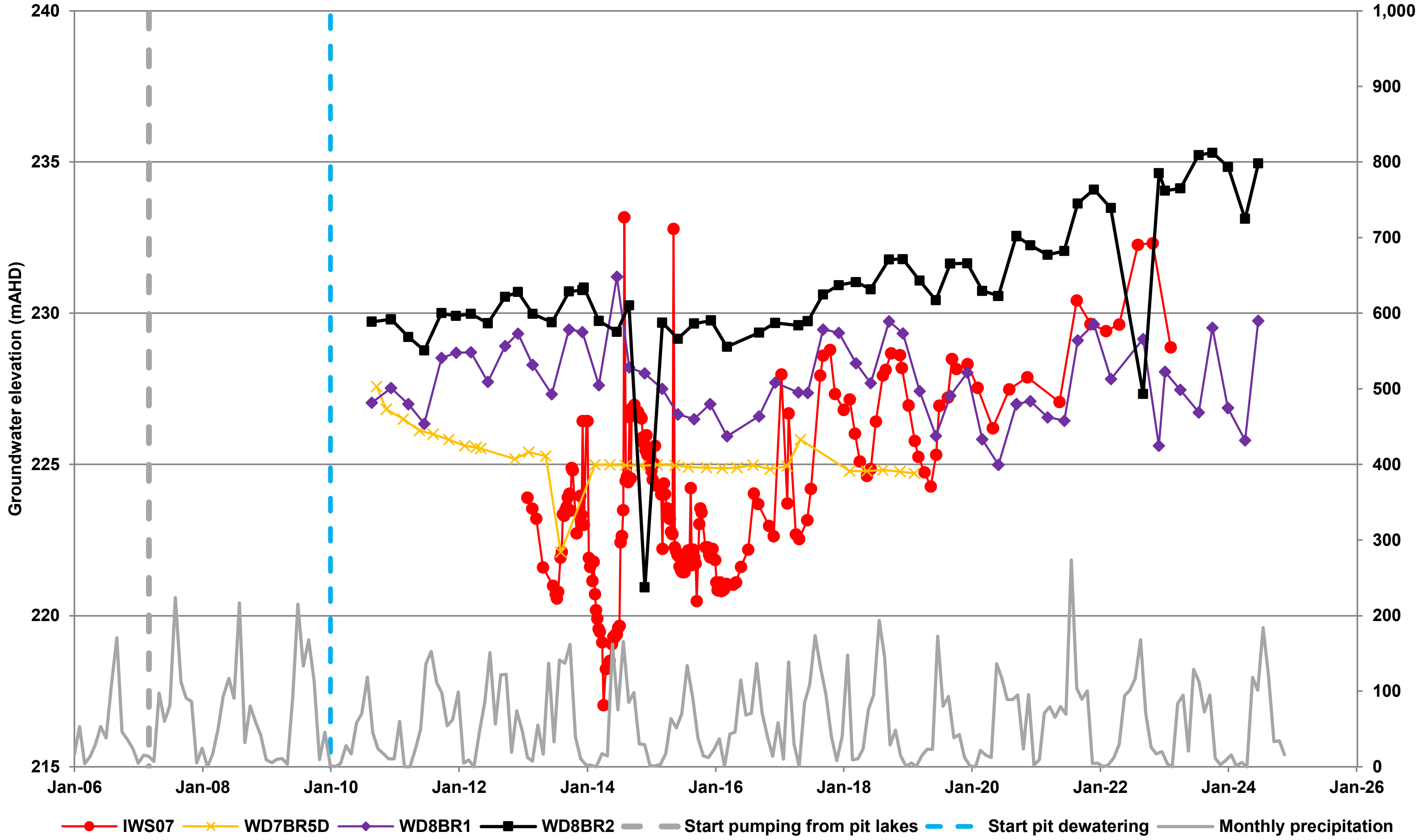
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 6

Figure 25

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

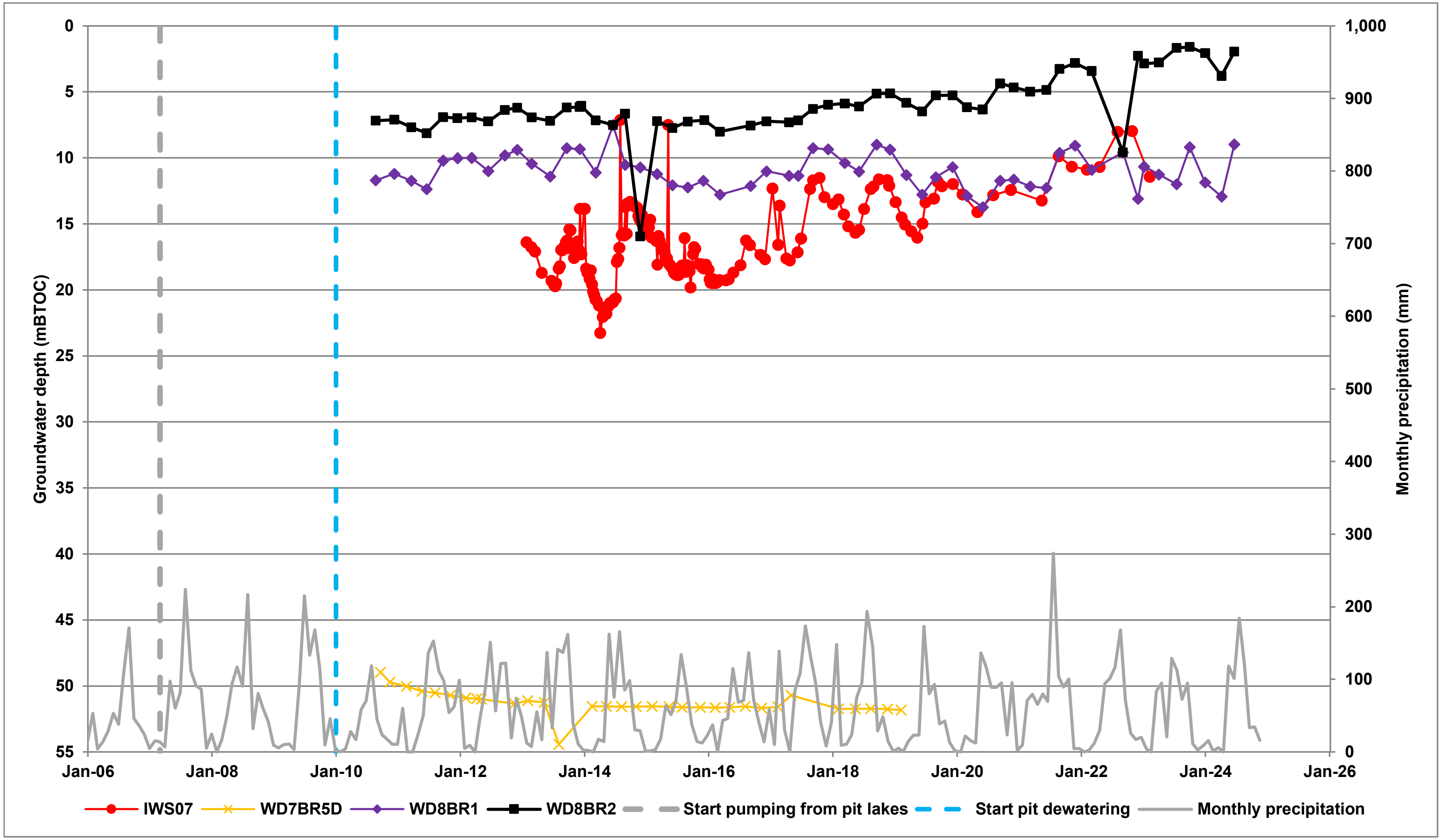
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 7

Figure 26

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



BIG DOG HYDROGEOLOGY

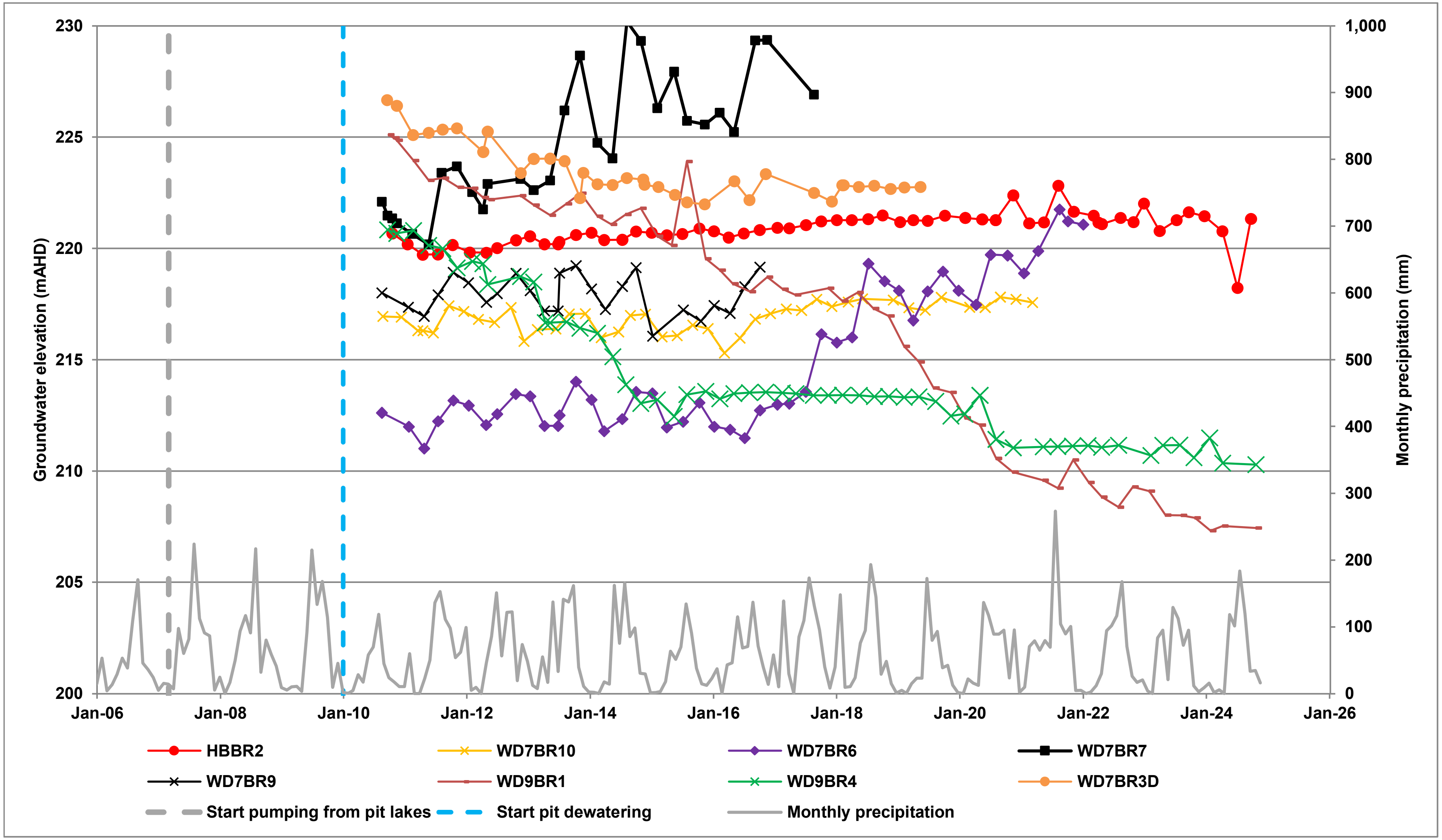
Groundwater depths - pit area part 7

Figure 27

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater

D:\Documents\BDH Projects\Boddington\Boddington mining influences



D:\Documents\BDH Projects\Boddington\Boddington mining influences

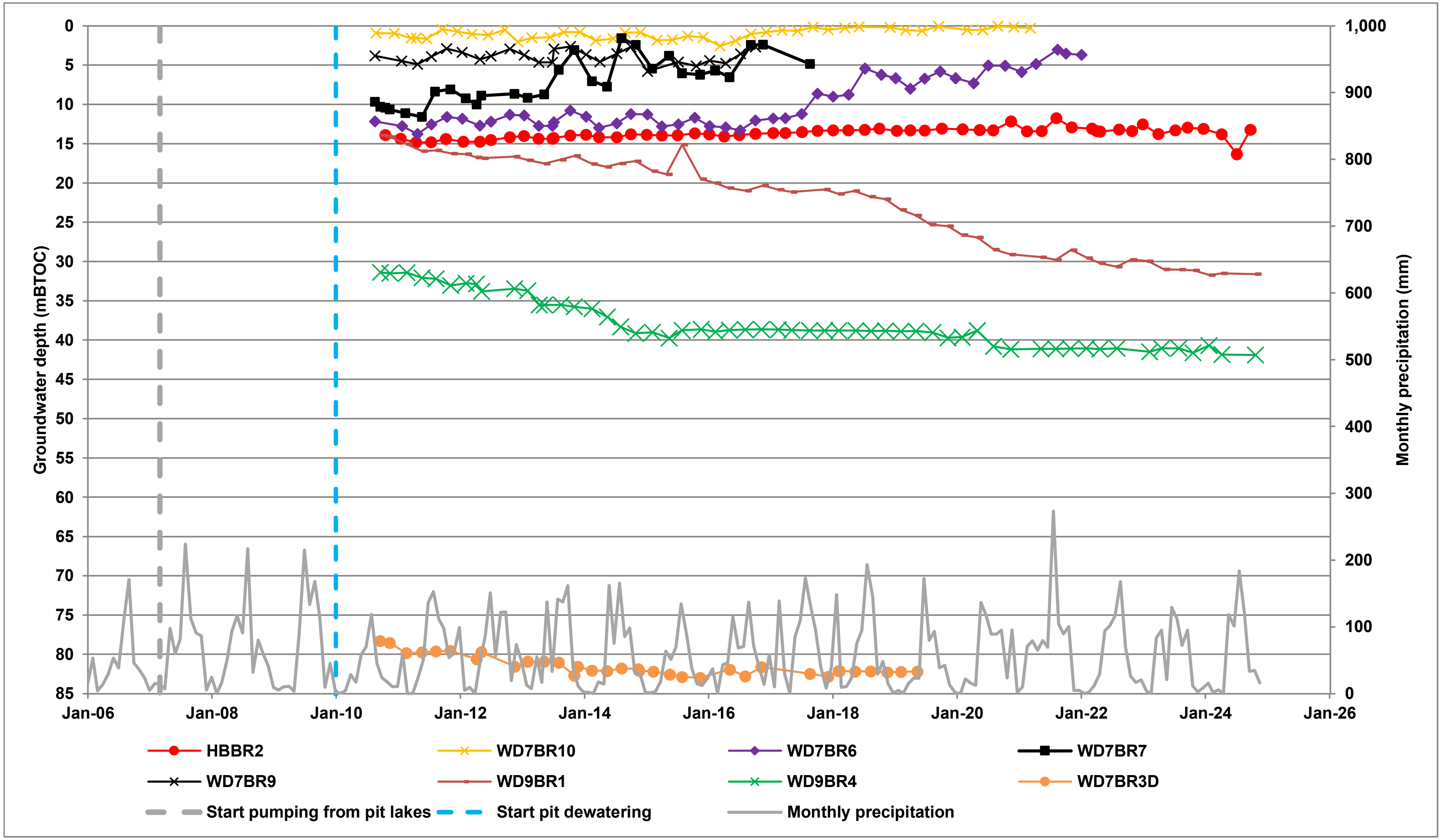
BIG DOG HYDROGEOLOGY

Groundwater elevations - pit area part 8

Figure 28

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

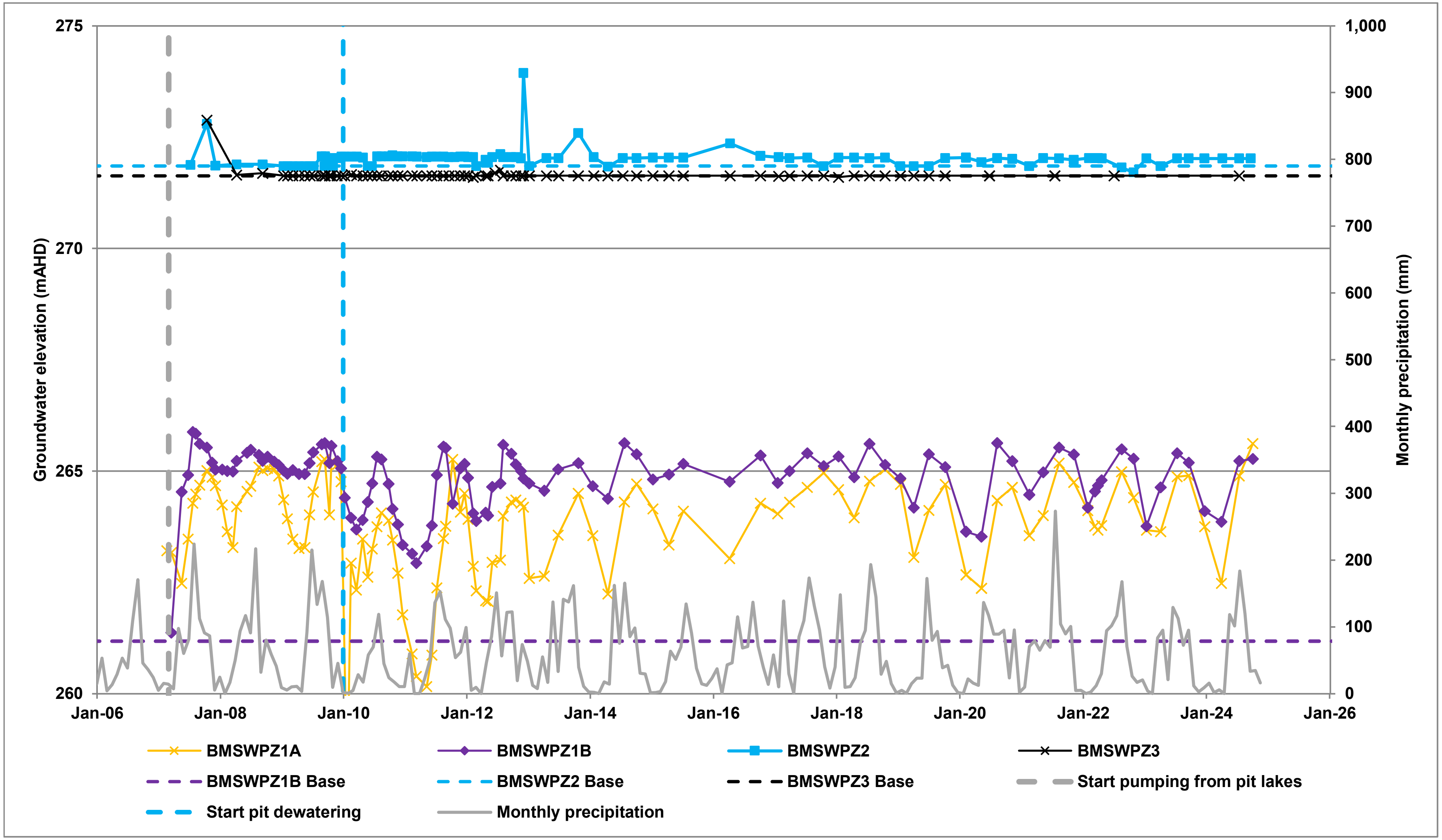
BIG DOG HYDROGEOLOGY

Groundwater depths - pit area part 8

Figure 29

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

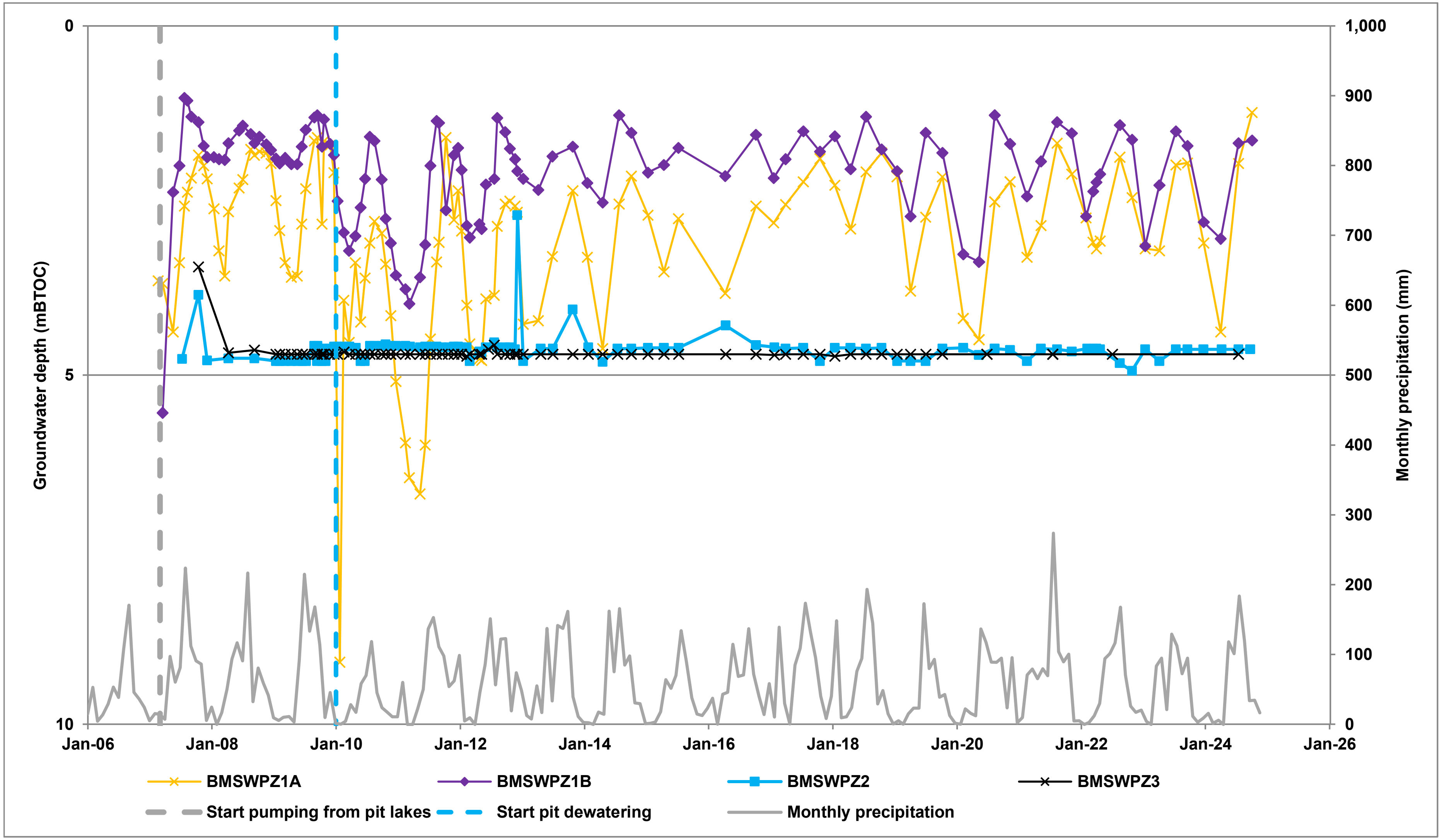
BIG DOG HYDROGEOLOGY

Groundwater elevations - Boomerang Swamp part 1

Figure 30

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

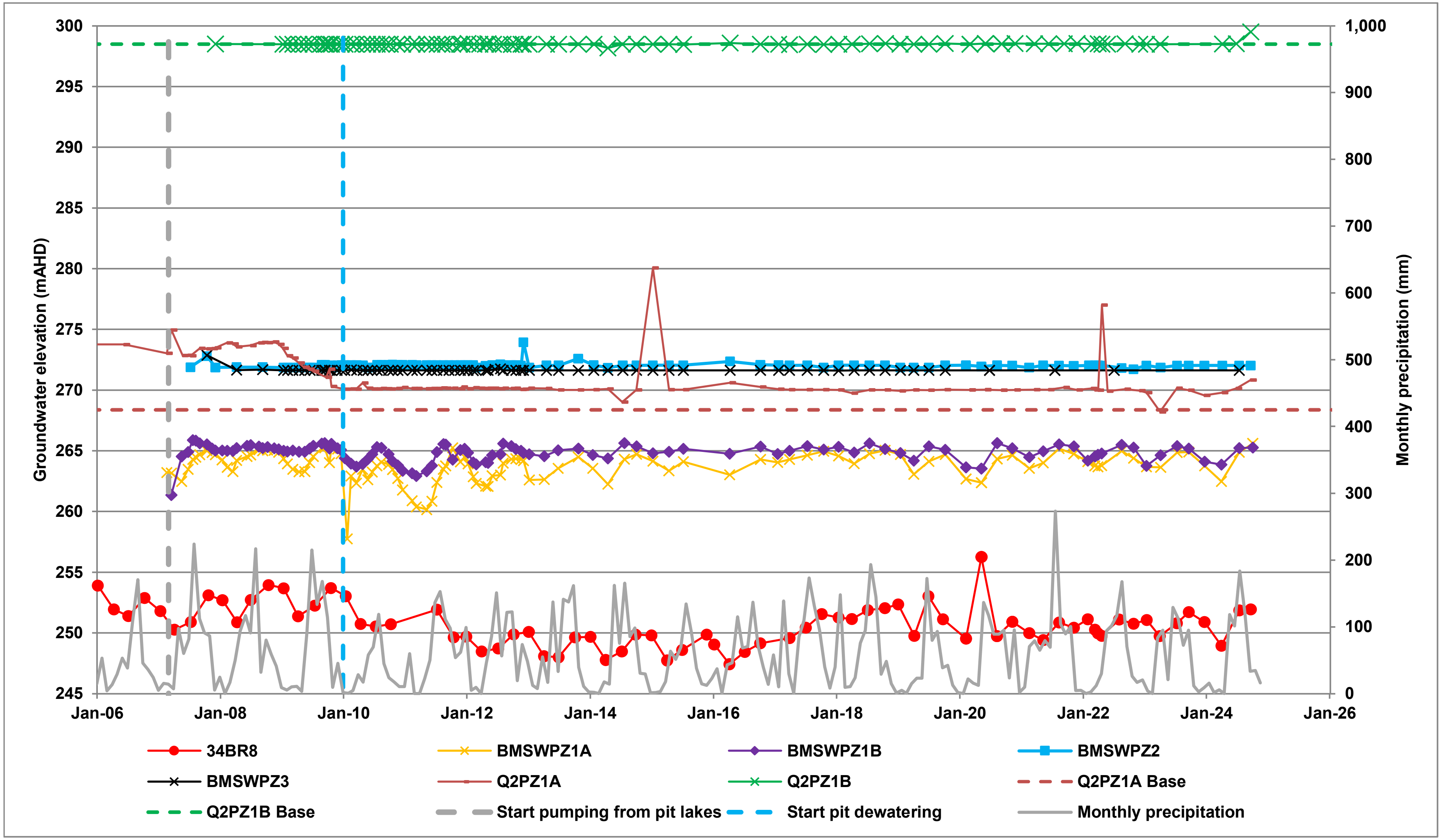
BIG DOG HYDROGEOLOGY

Groundwater depths - Boomerang Swamp part 1

Figure 31

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

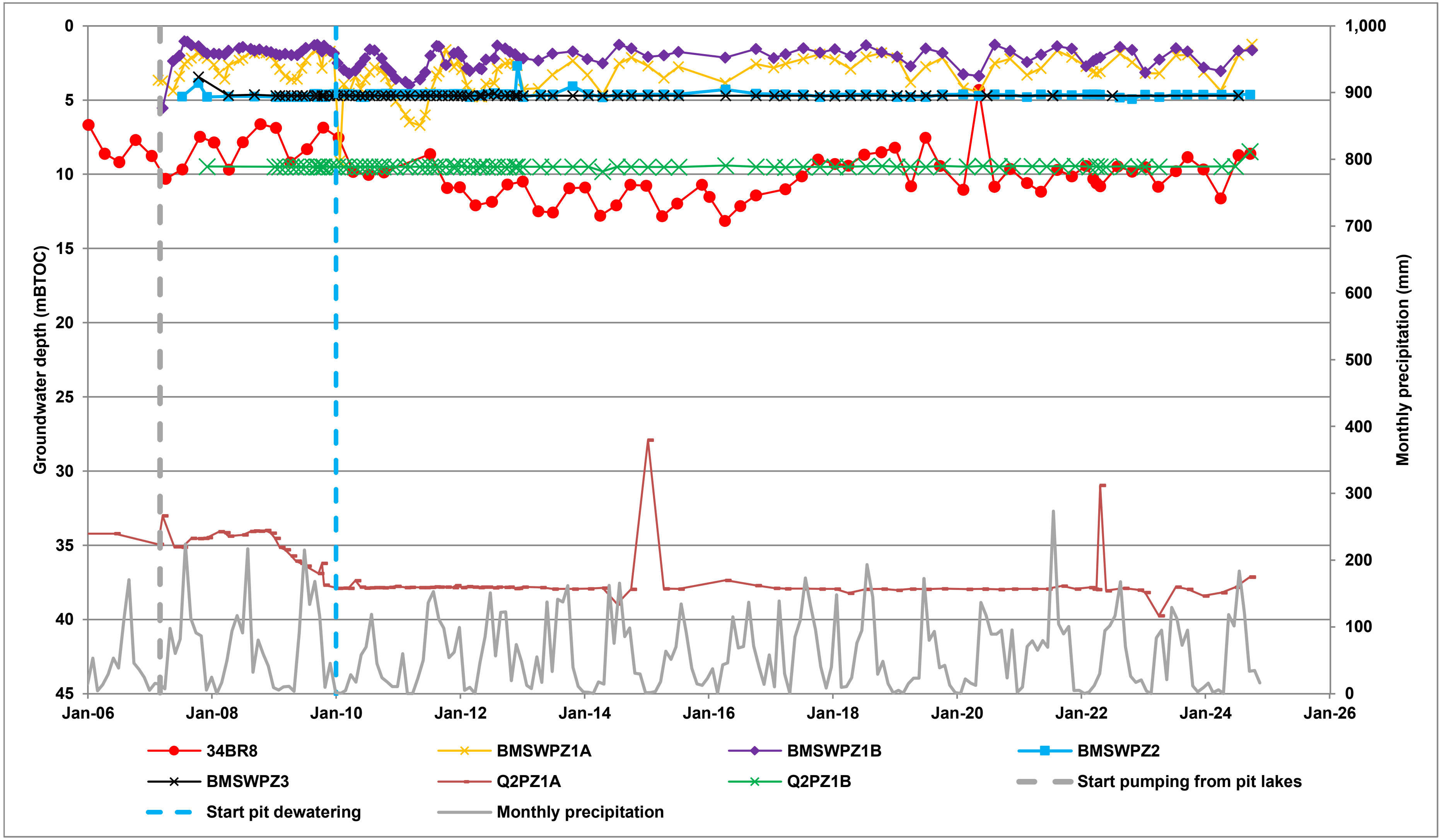
BIG DOG HYDROGEOLOGY

Groundwater elevations - Boomerang Swamp part 2

Figure 32

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

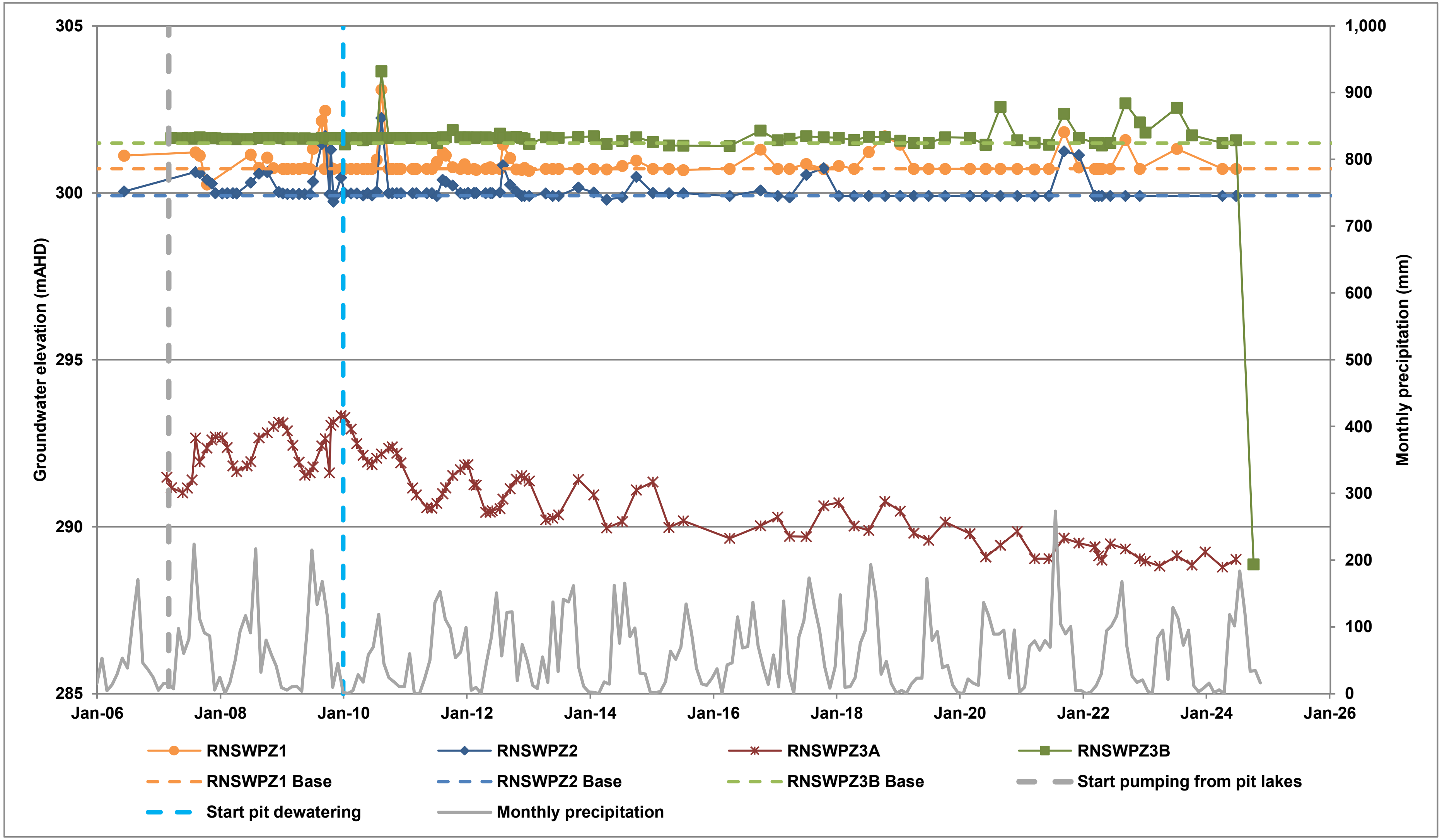
BIG DOG HYDROGEOLOGY

Groundwater depths - Boomerang Swamp part 2

Figure 33

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

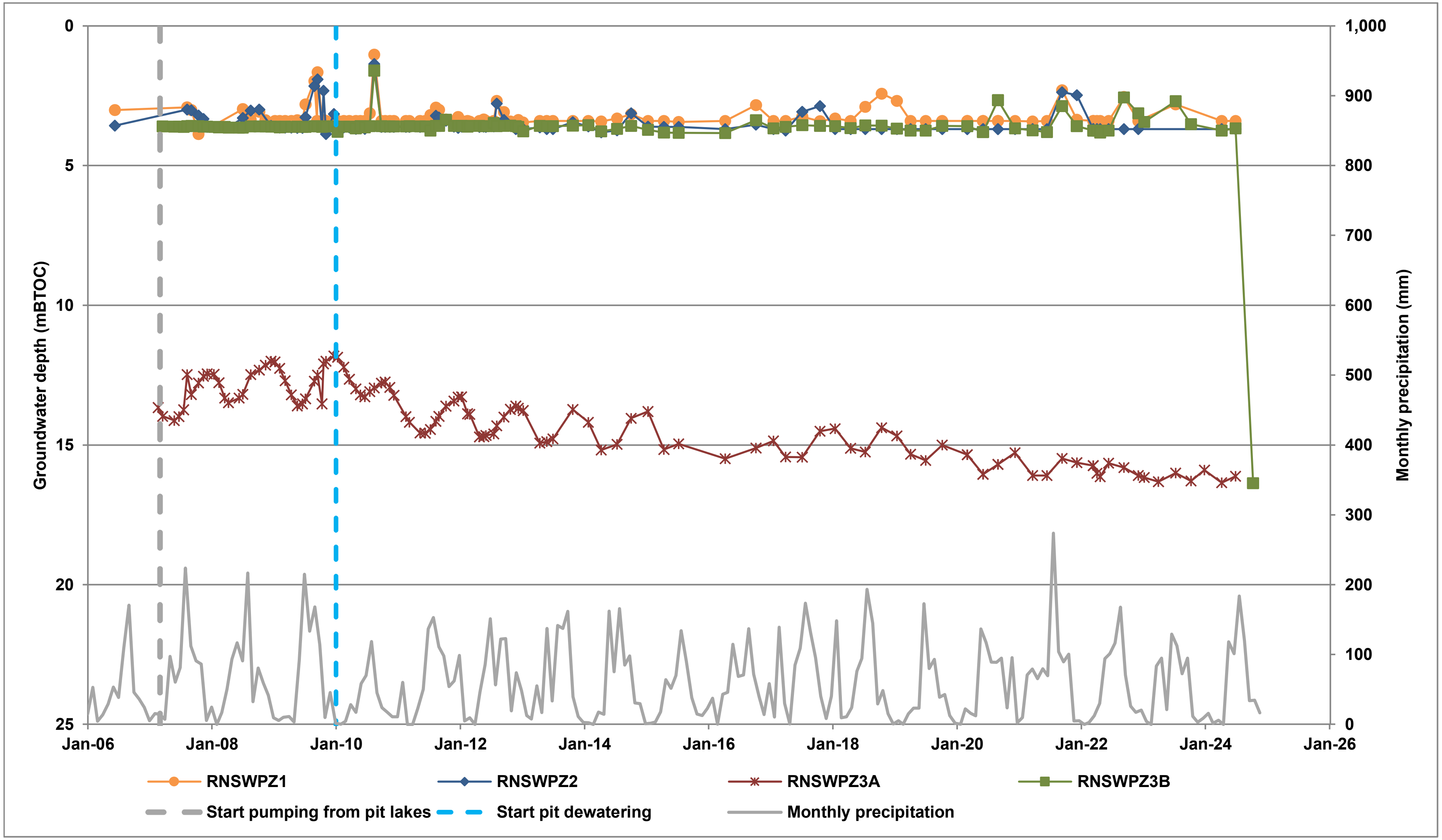
BIG DOG HYDROGEOLOGY

Groundwater elevations - Round Swamp part 1

Figure 34

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

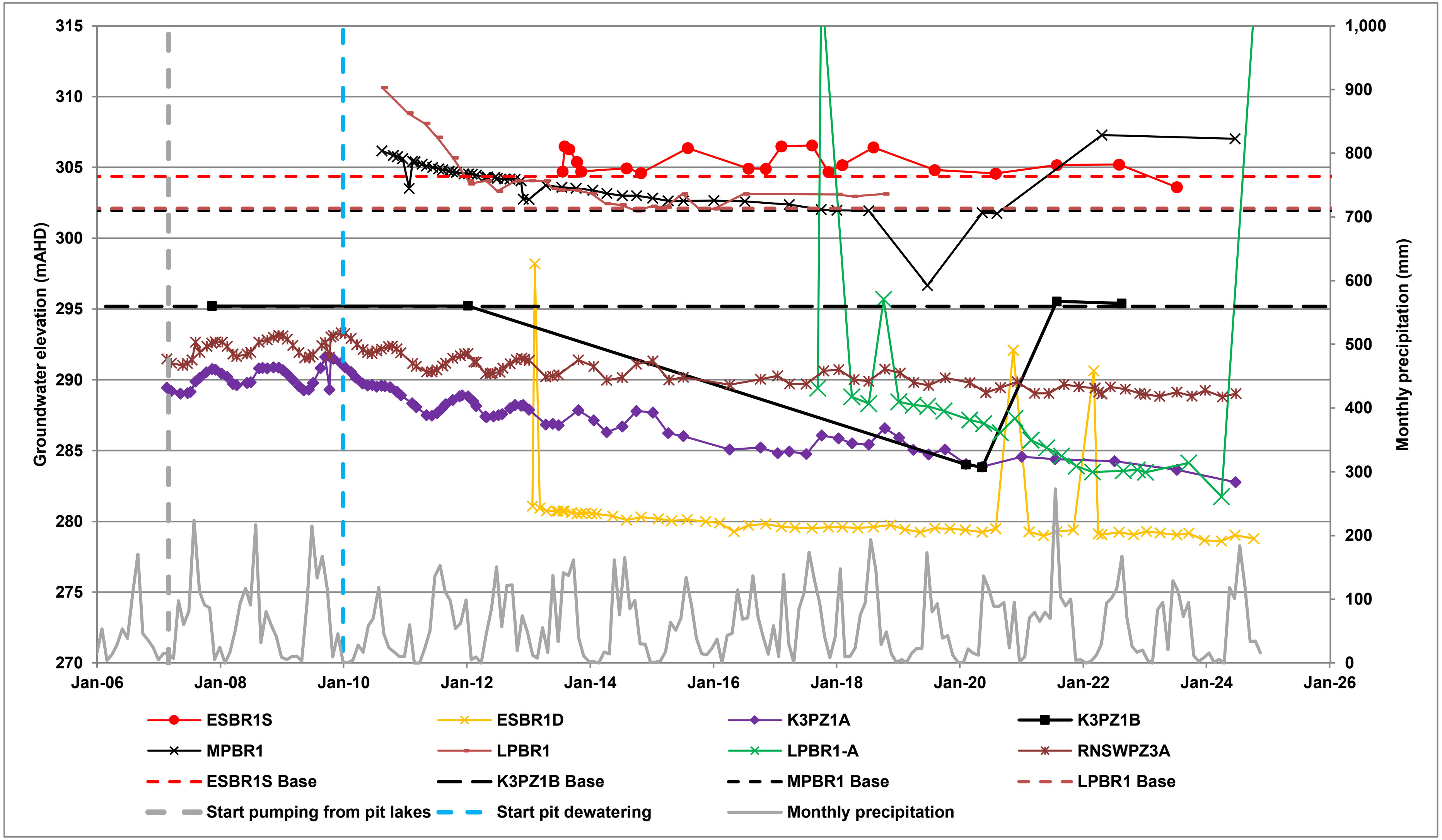
BIG DOG HYDROGEOLOGY

Groundwater depths - Round Swamp part 1

Figure 35

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

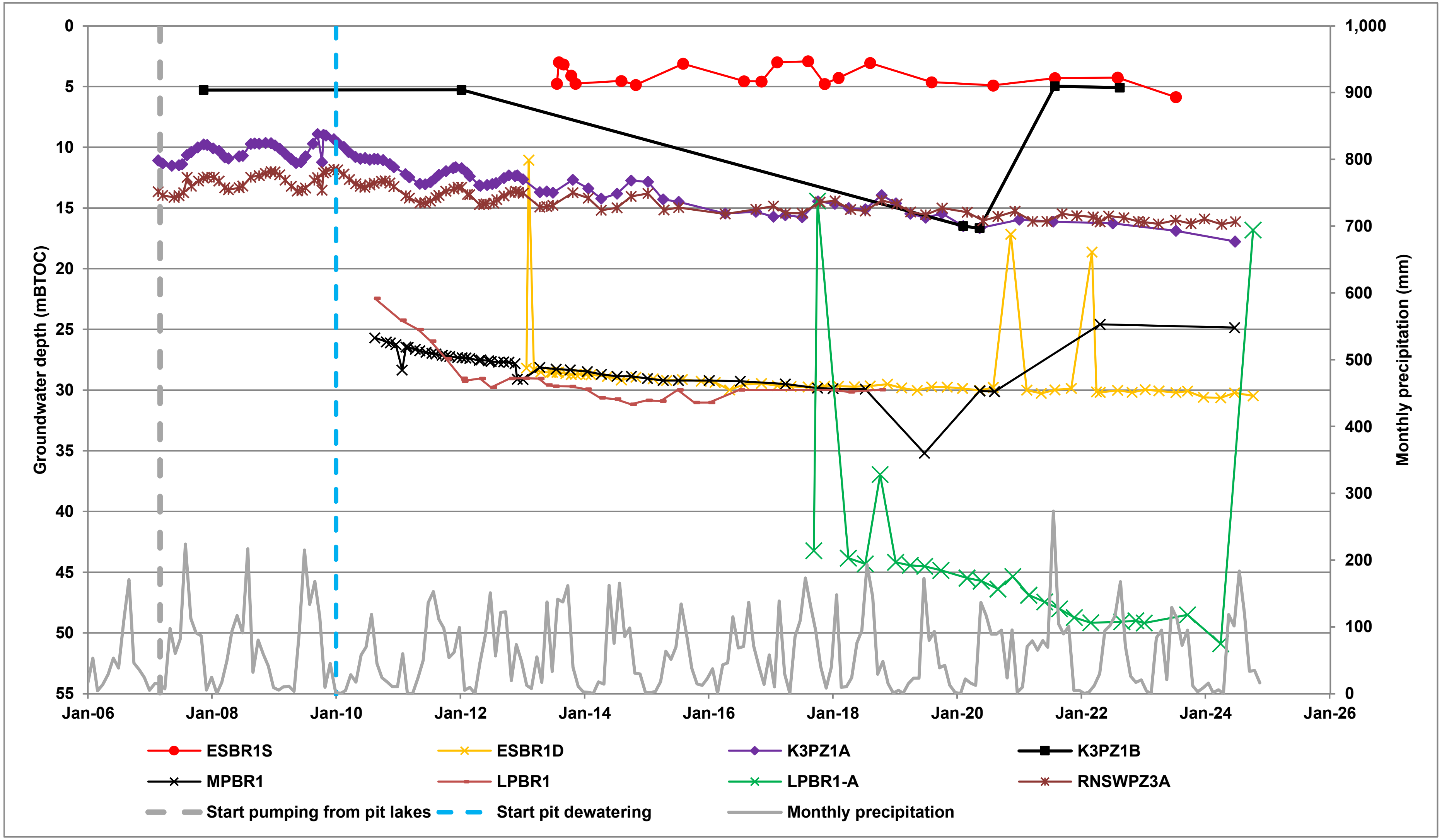
BIG DOG HYDROGEOLOGY

Groundwater elevations - Round Swamp part 2

Figure 36

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

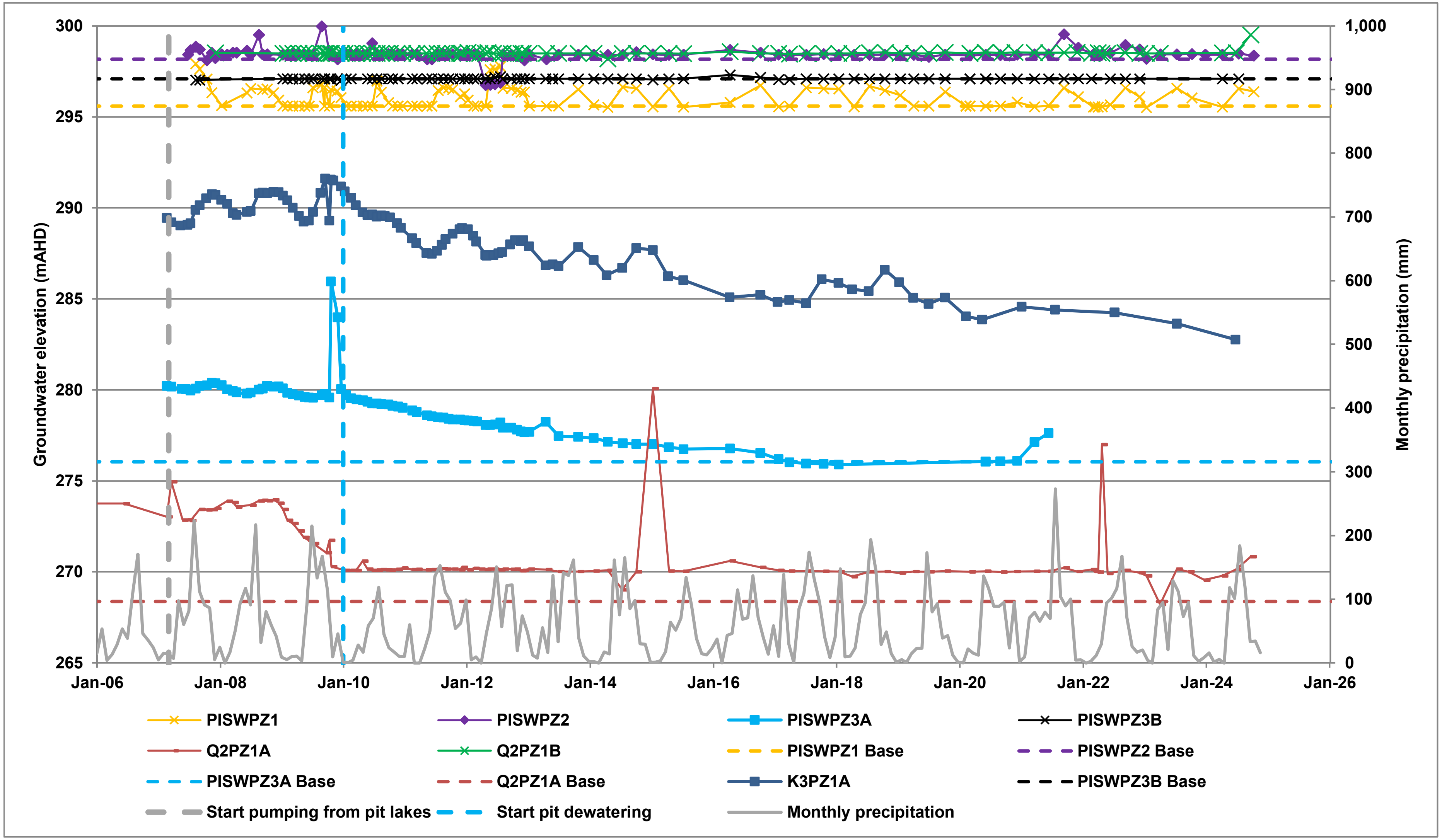
BIG DOG HYDROGEOLOGY

Groundwater depths - Round Swamp part 2

Figure 37

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

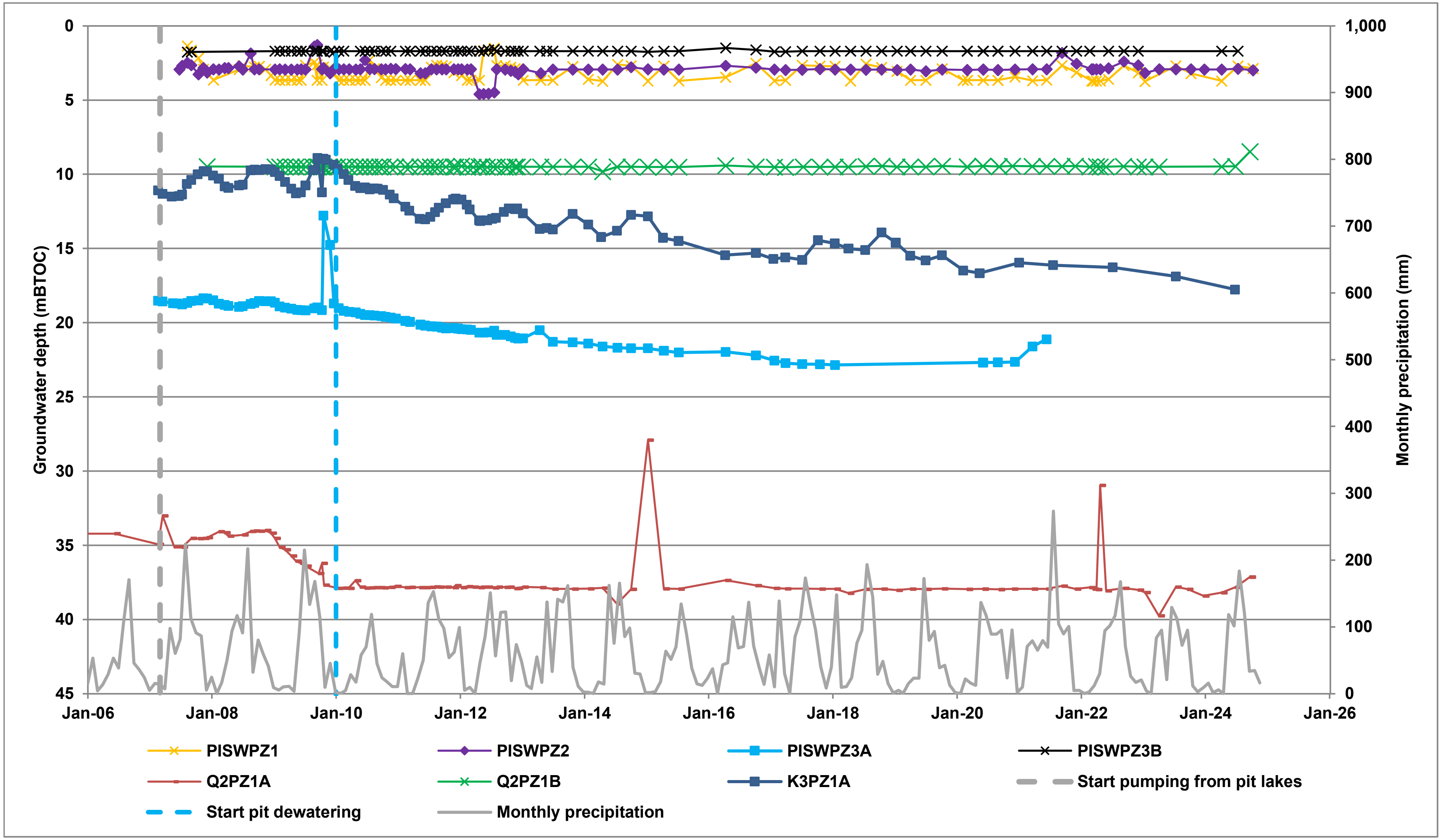
BIG DOG HYDROGEOLOGY

Groundwater elevations - Pillow Swamp

Figure 38

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

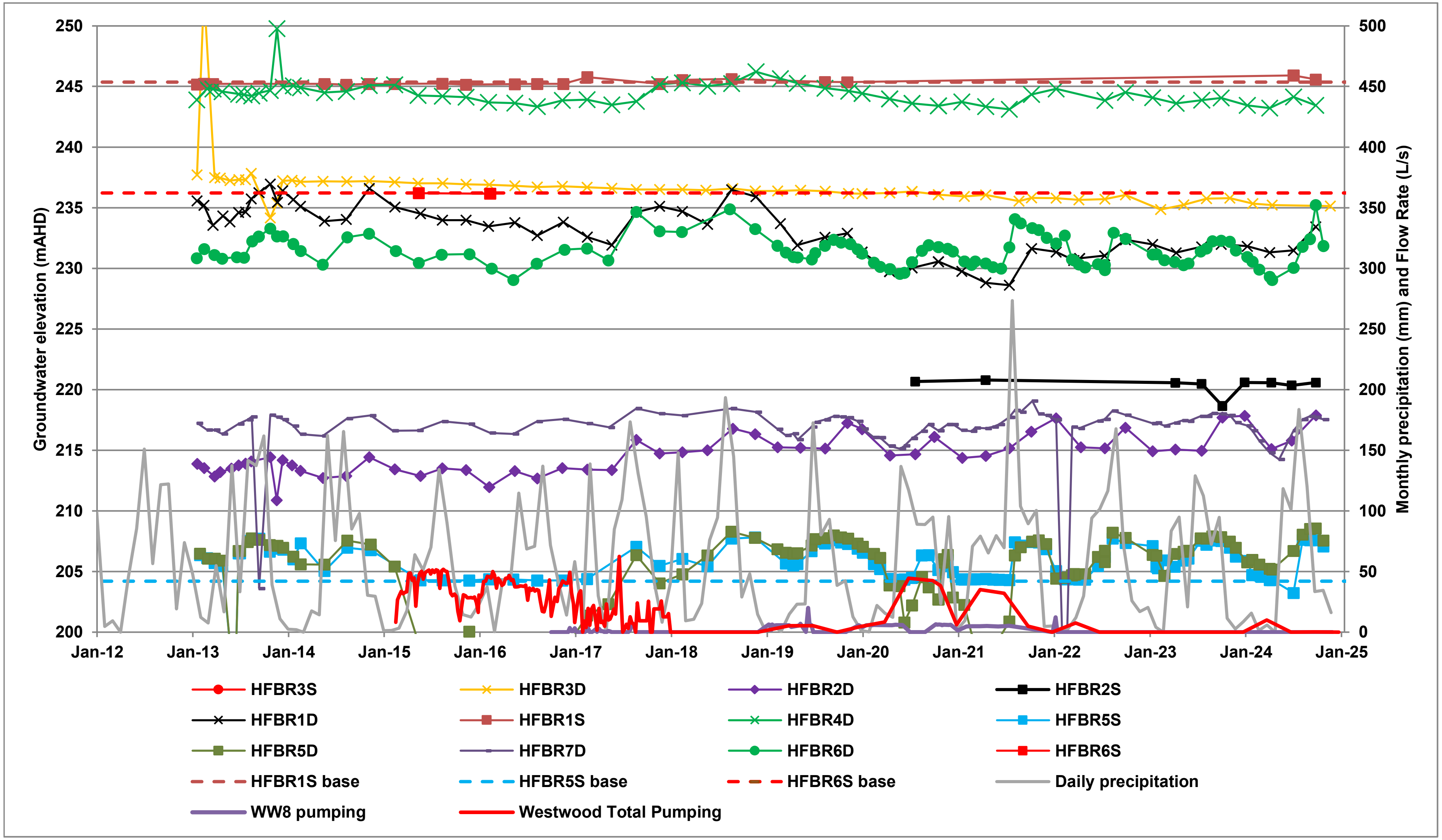
BIG DOG HYDROGEOLOGY

Groundwater depths - Pillow Swamp

Figure 39

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

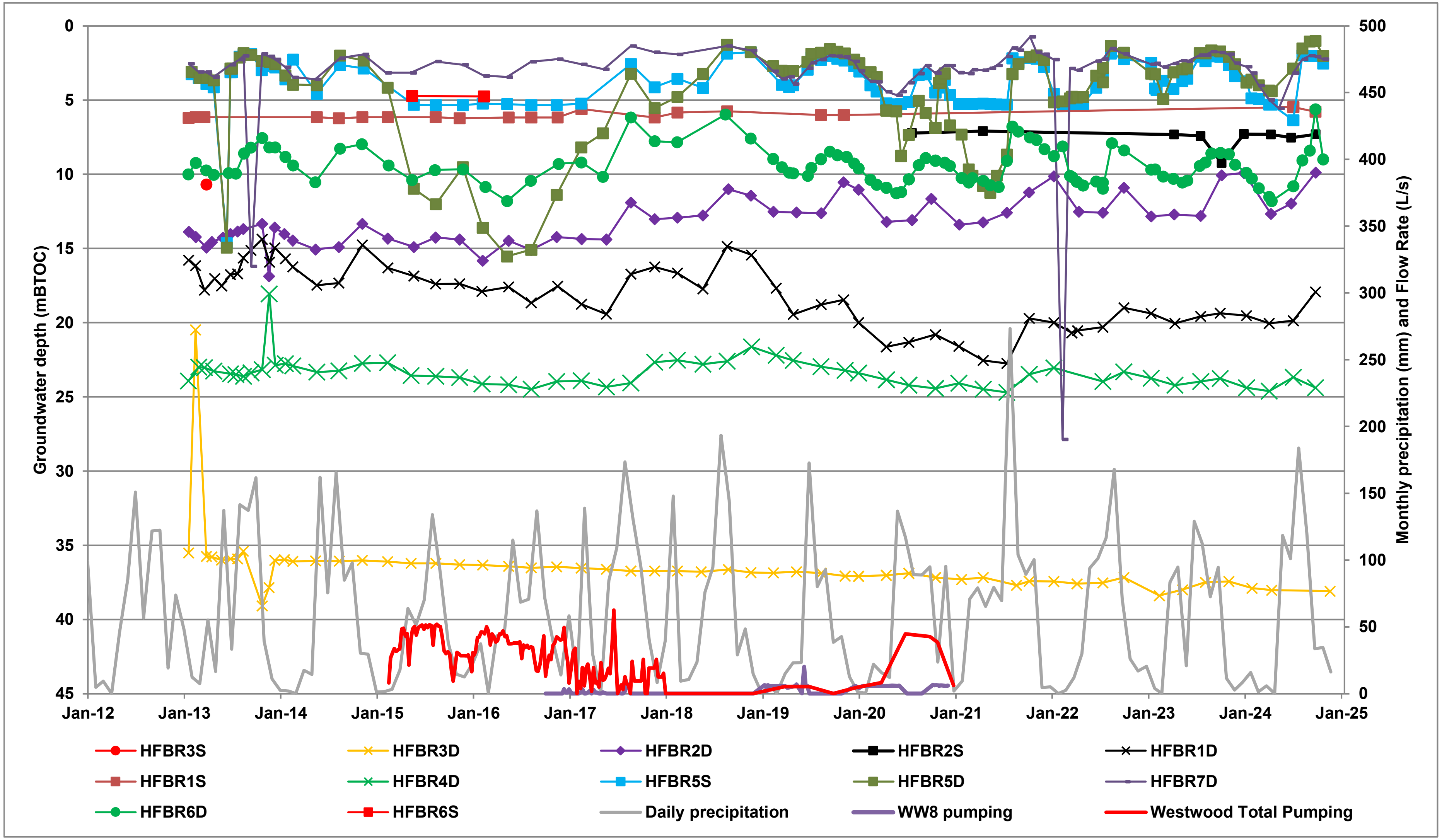
BIG DOG HYDROGEOLOGY

Groundwater elevations - Westwood Borefield part 1

Figure 40

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

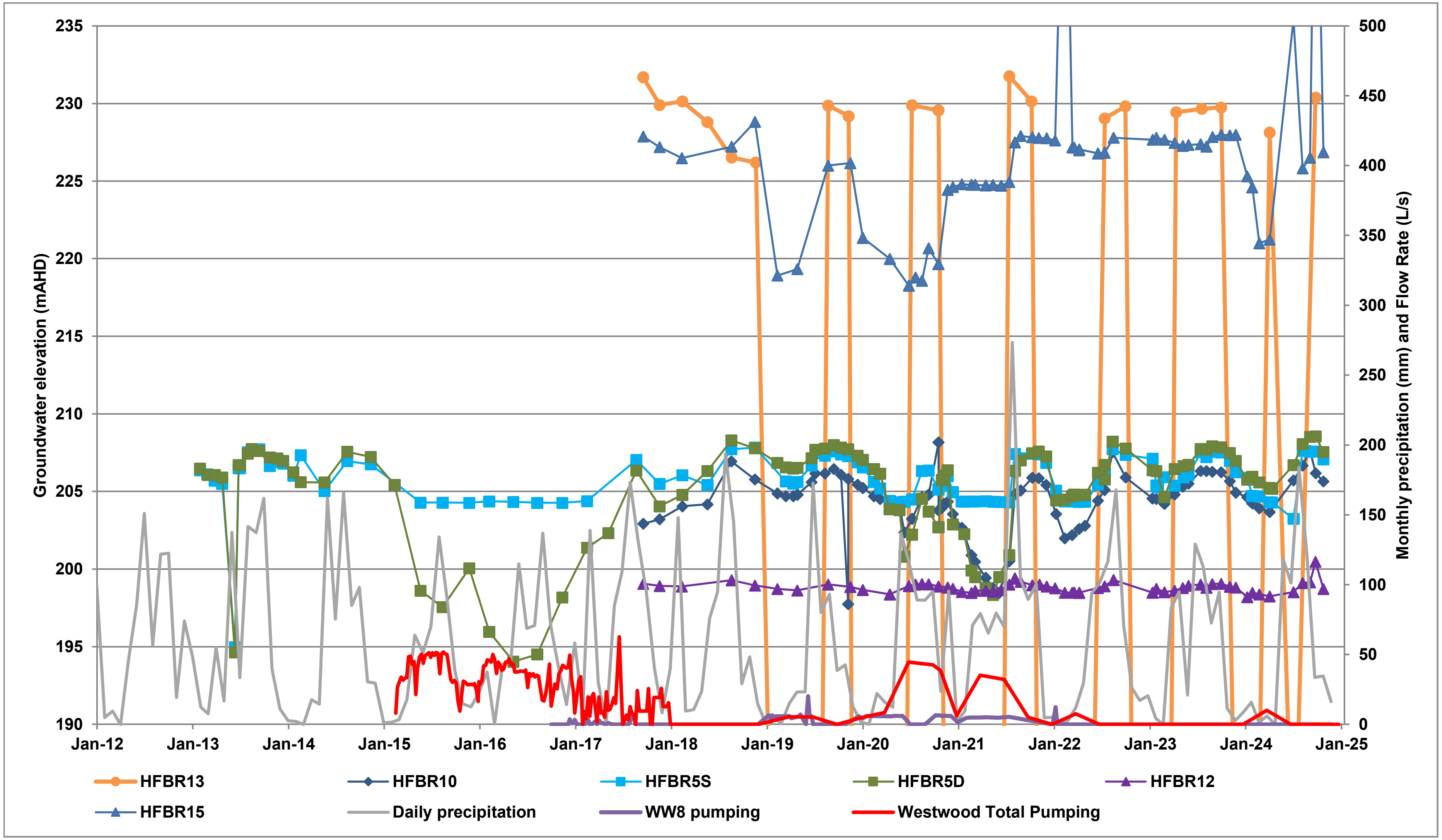
BIG DOG HYDROGEOLOGY

Groundwater depths - Westwood Borefield part 1

Figure 41

Date:
May 2025

Report:
Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

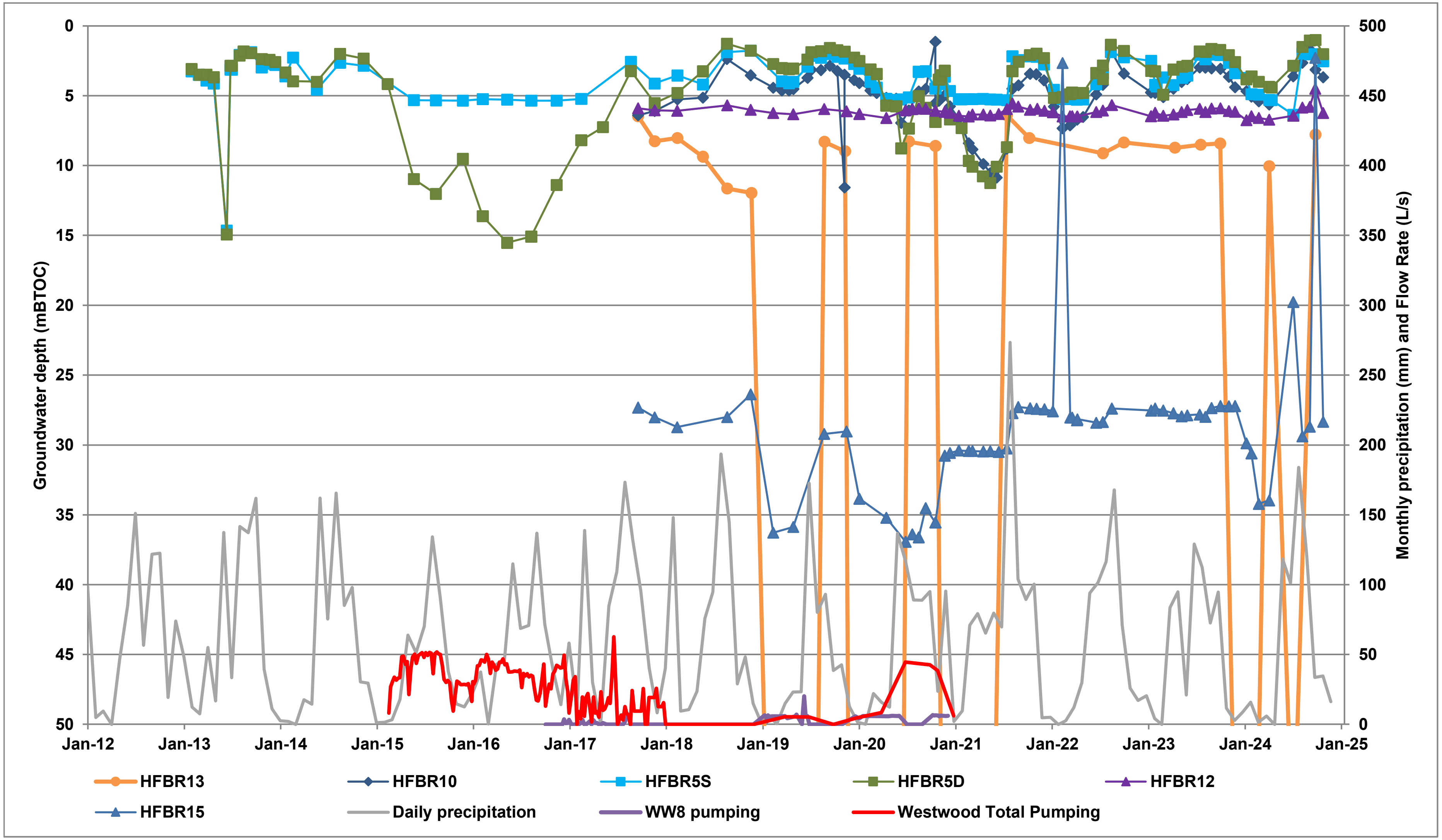
BIG DOG HYDROGEOLOGY

Groundwater elevations - Westwood Borefield part 2

Figure 42

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

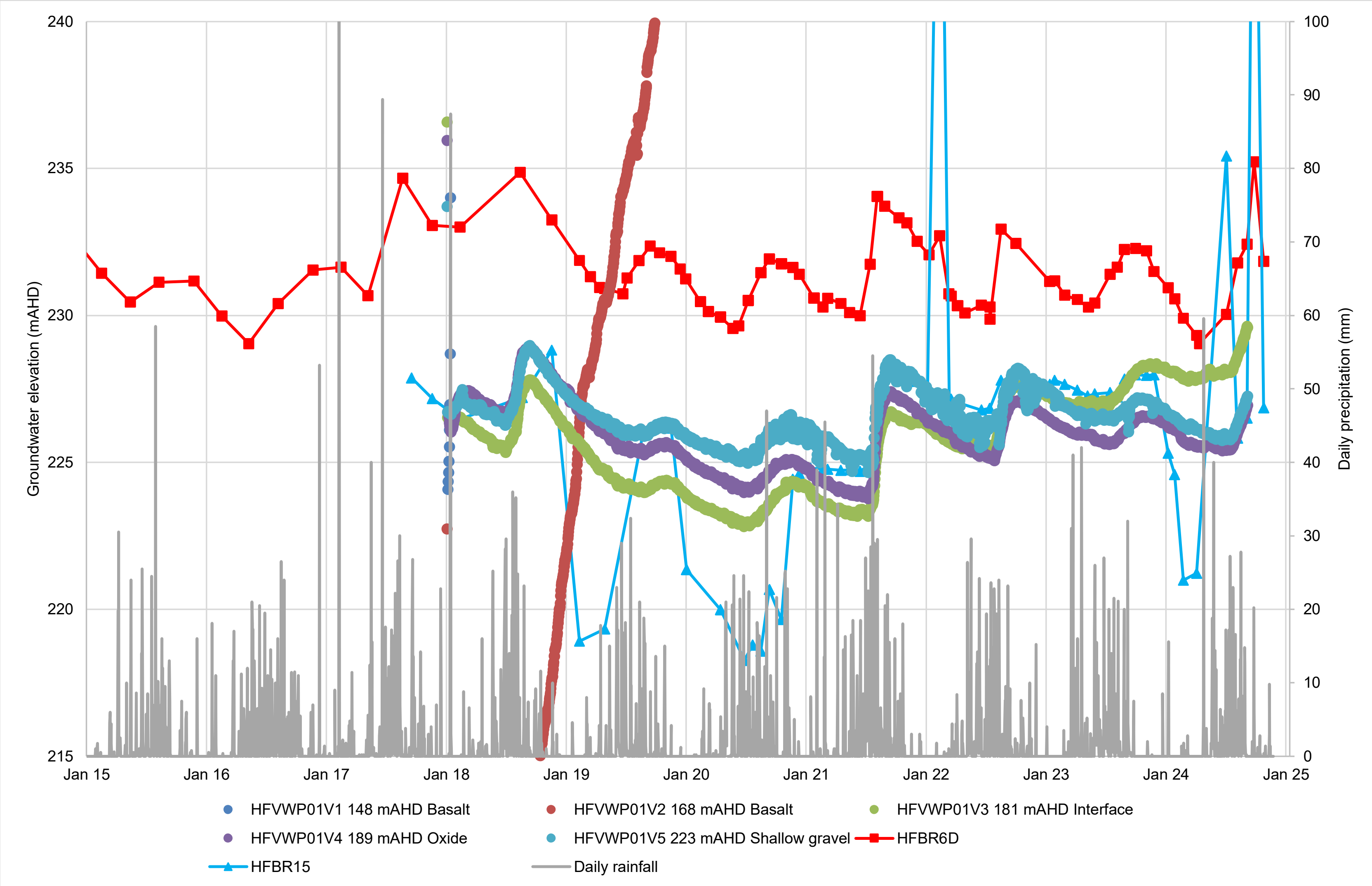
BIG DOG HYDROGEOLOGY

Groundwater depths - Westwood Borefield part 2

Figure 43

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

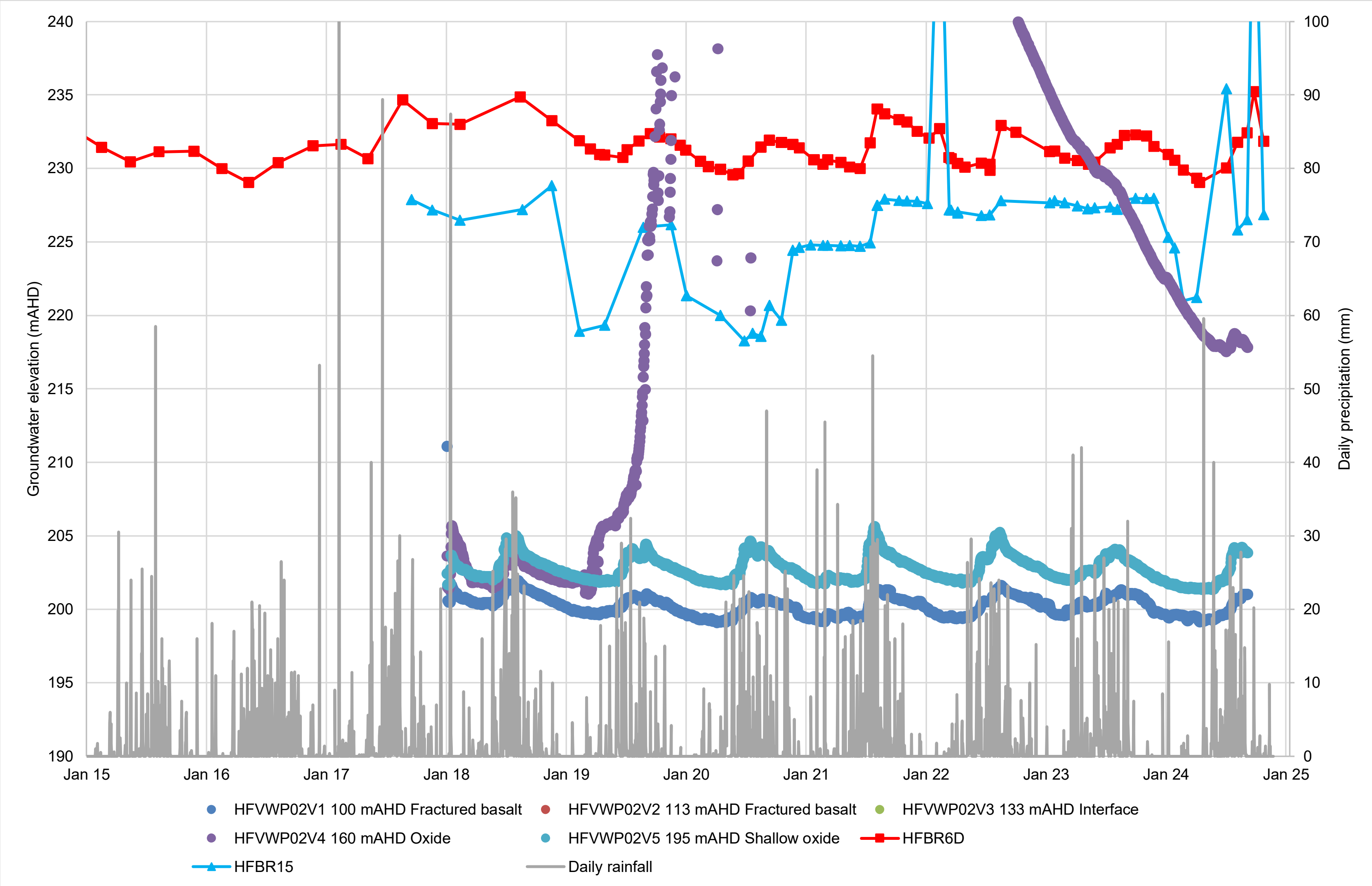
BIG DOG HYDROGEOLOGY

Groundwater elevations - HFVWP01

Figure 44

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

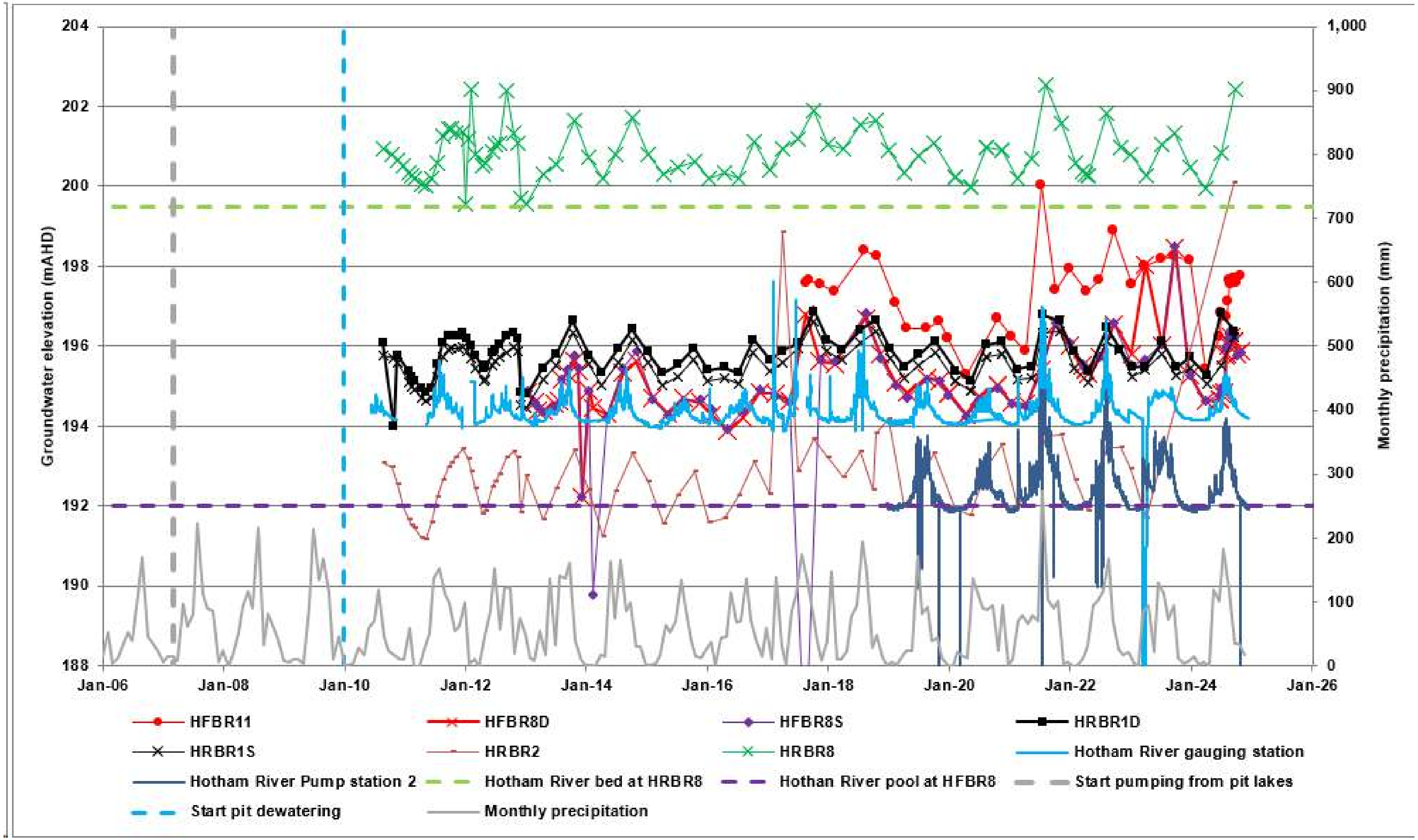
BIG DOG HYDROGEOLOGY

Groundwater elevations - HFVWP02

Figure 45

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

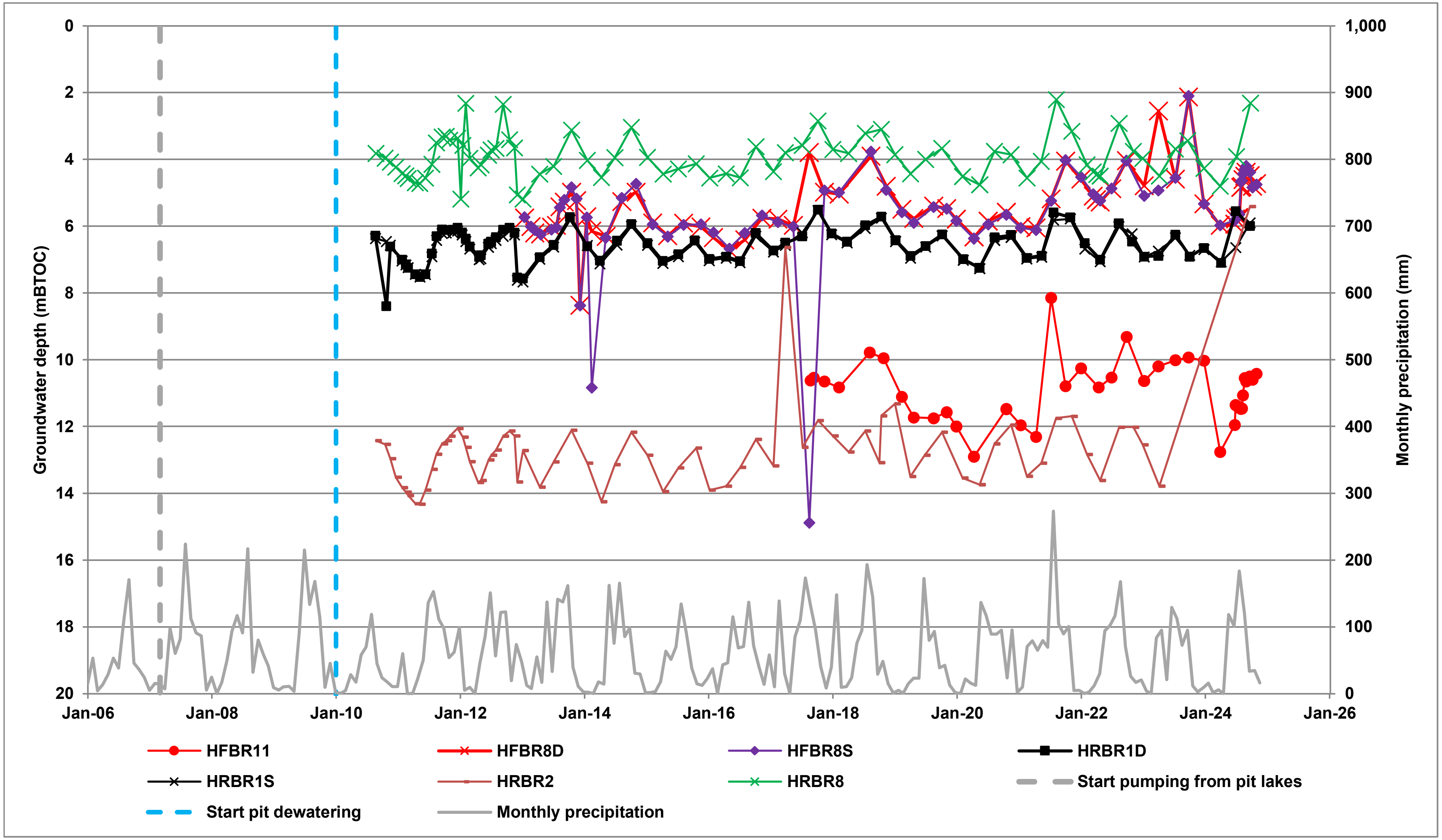
BIG DOG HYDROGEOLOGY

Groundwater elevations - Hotham River

Figure 46

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

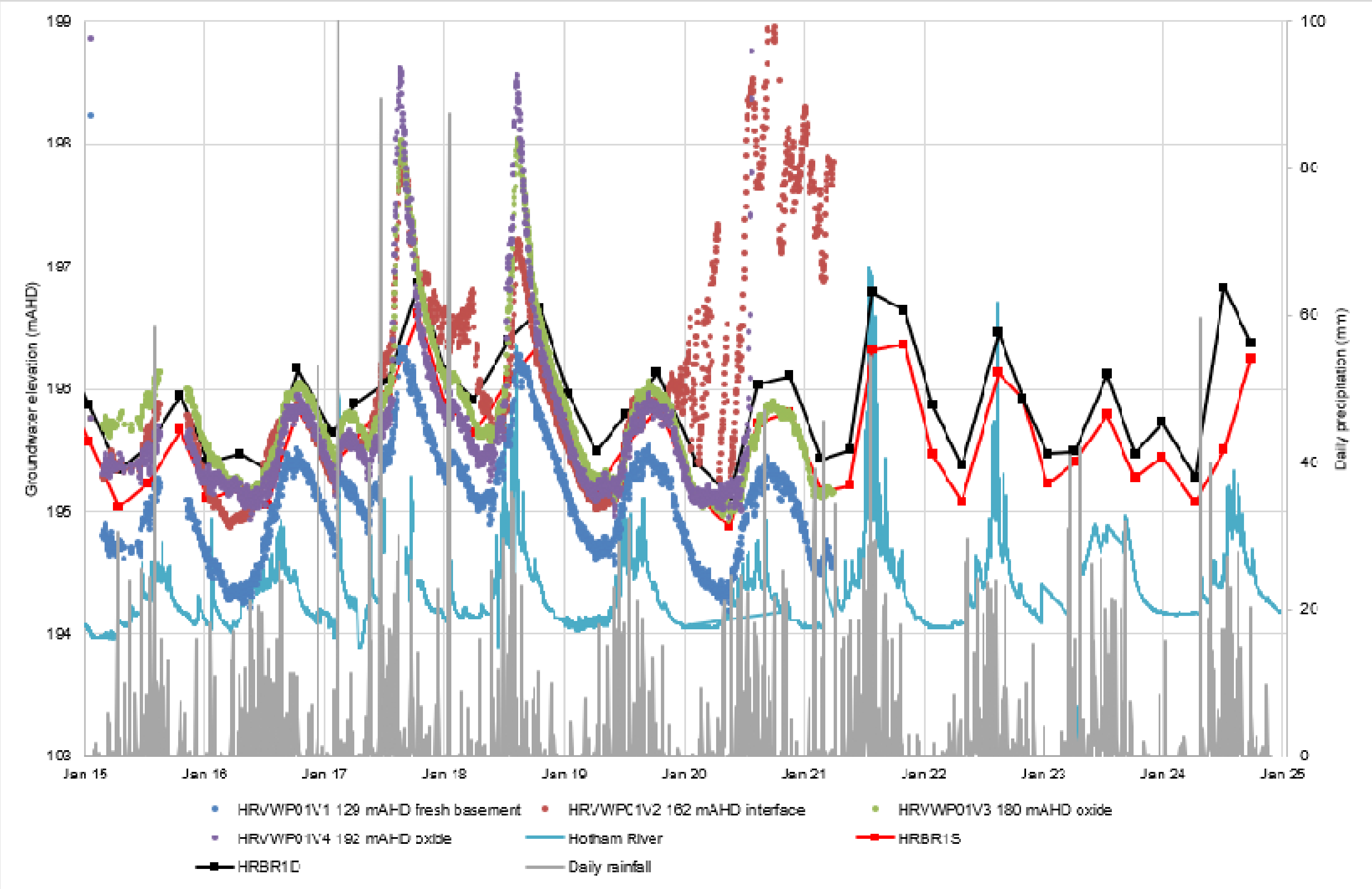
BIG DOG HYDROGEOLOGY

Groundwater depths - Hotham River

Figure 47

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

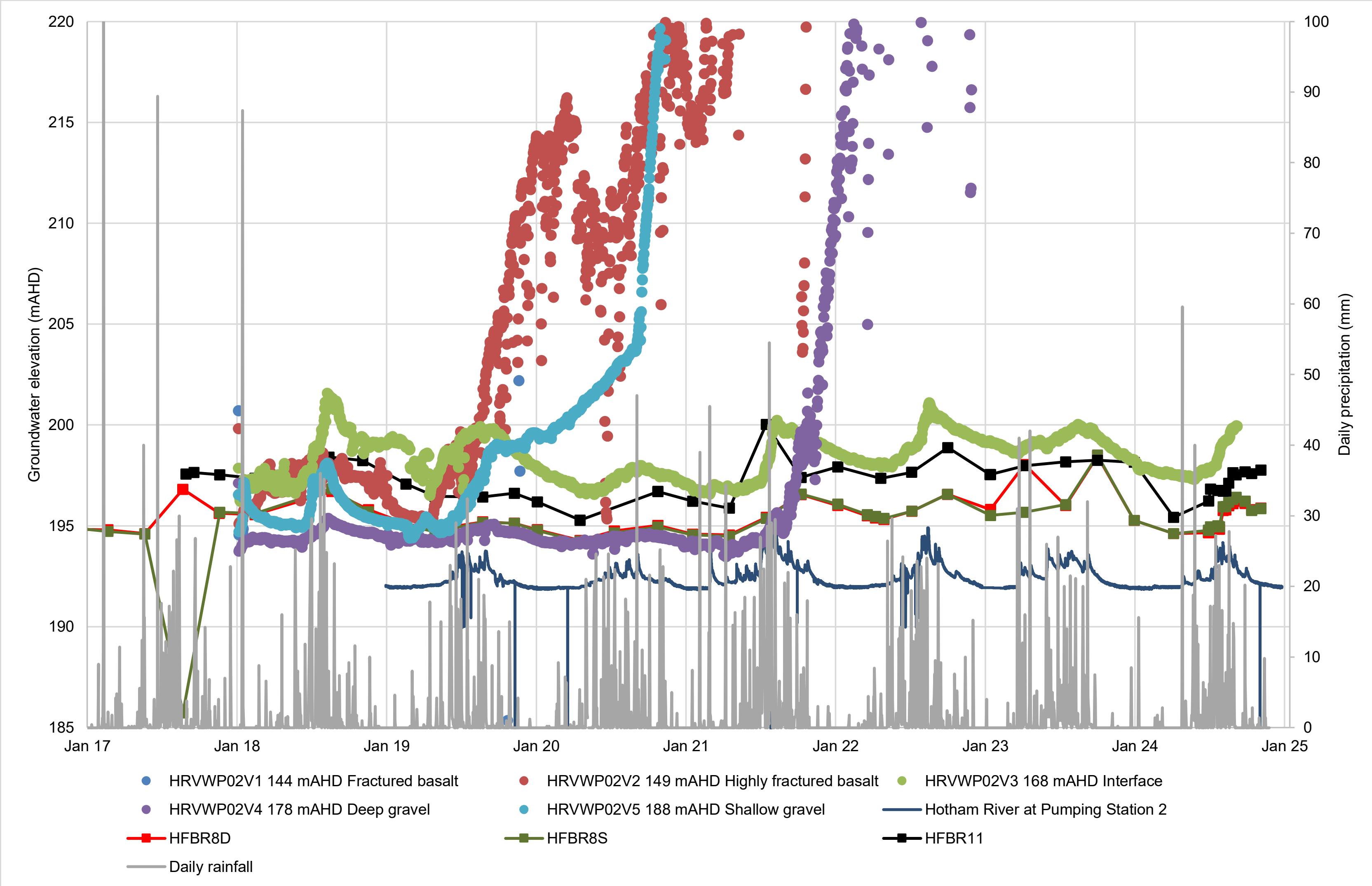
BIG DOG HYDROGEOLOGY

Groundwater elevations HRVWP01

Figure 48

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

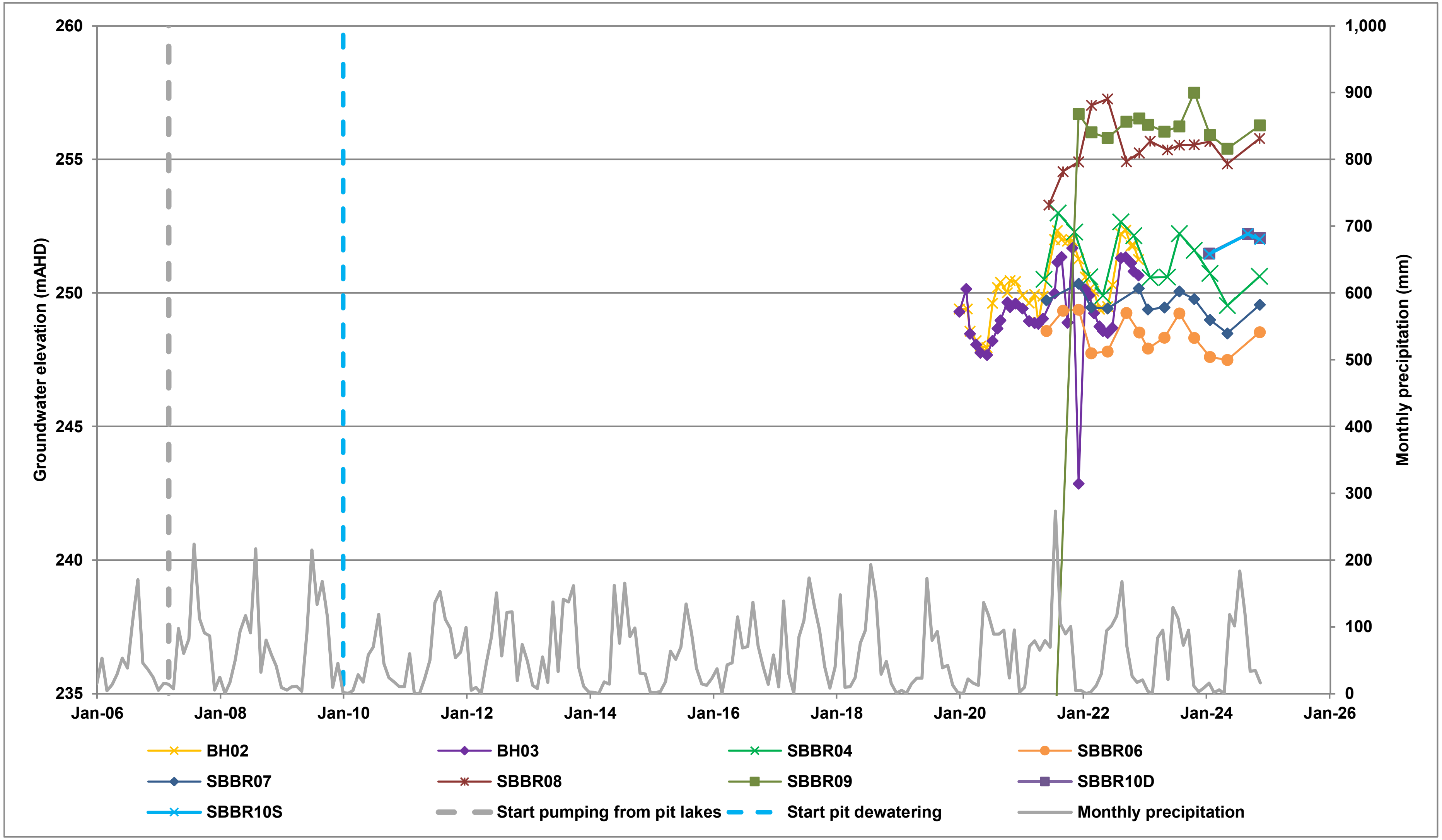
BIG DOG HYDROGEOLOGY

Groundwater elevations HRVWP02

Figure 49

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

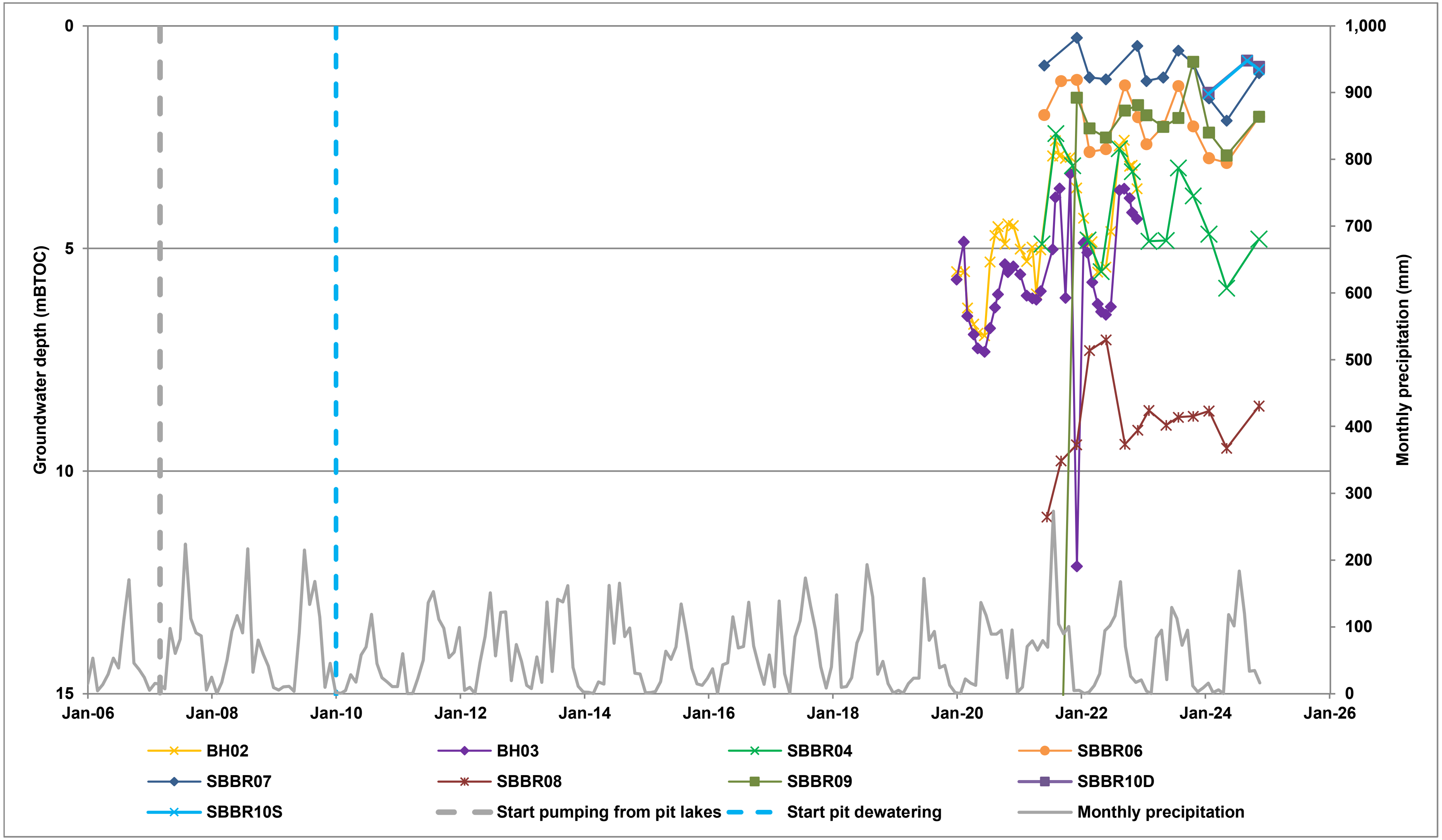
BIG DOG HYDROGEOLOGY

Groundwater elevations - Gringer Creek part 1

Figure 50

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

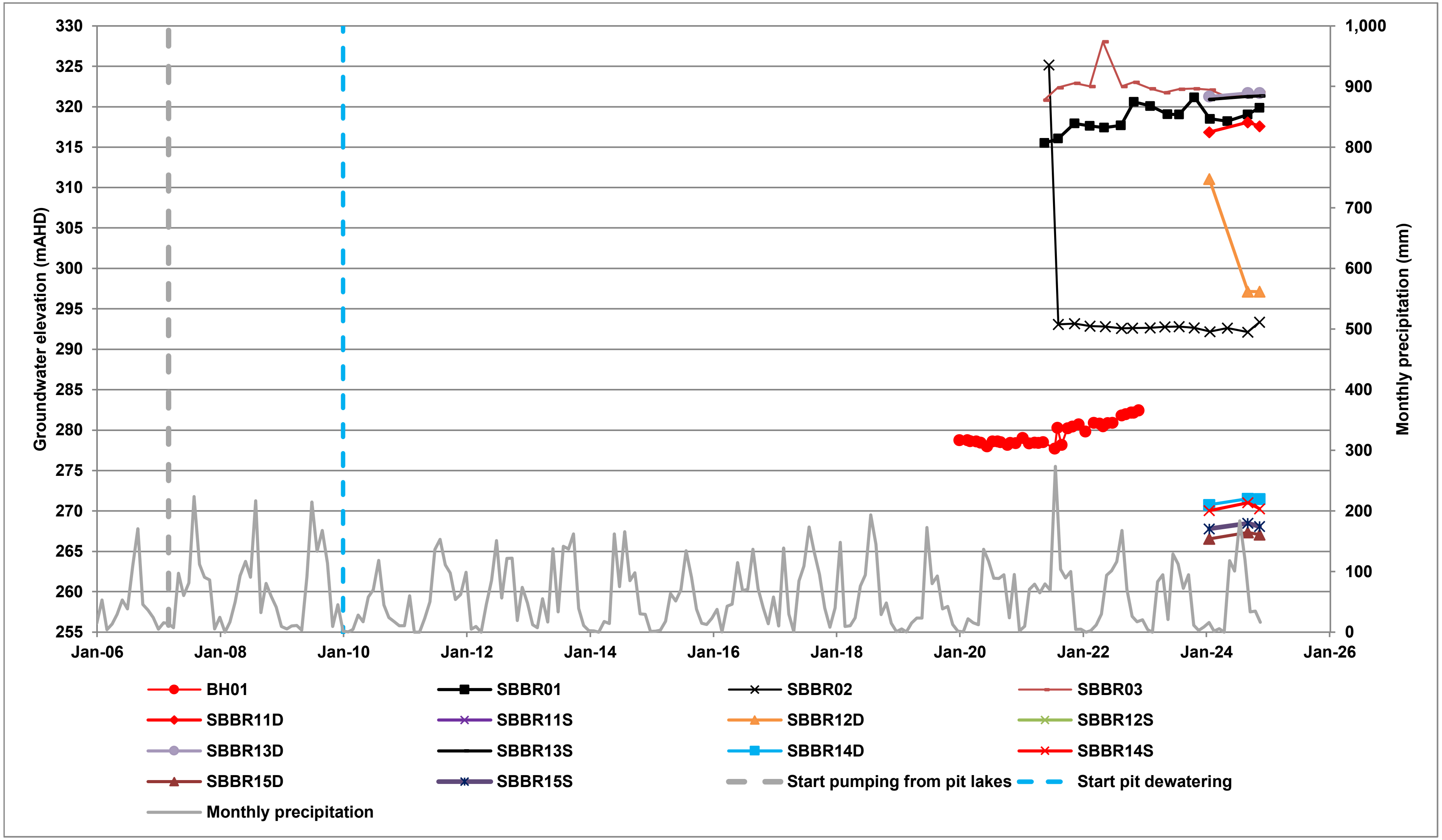
BIG DOG HYDROGEOLOGY

Groundwater depths - Gringer Creek part 1

Figure 51

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

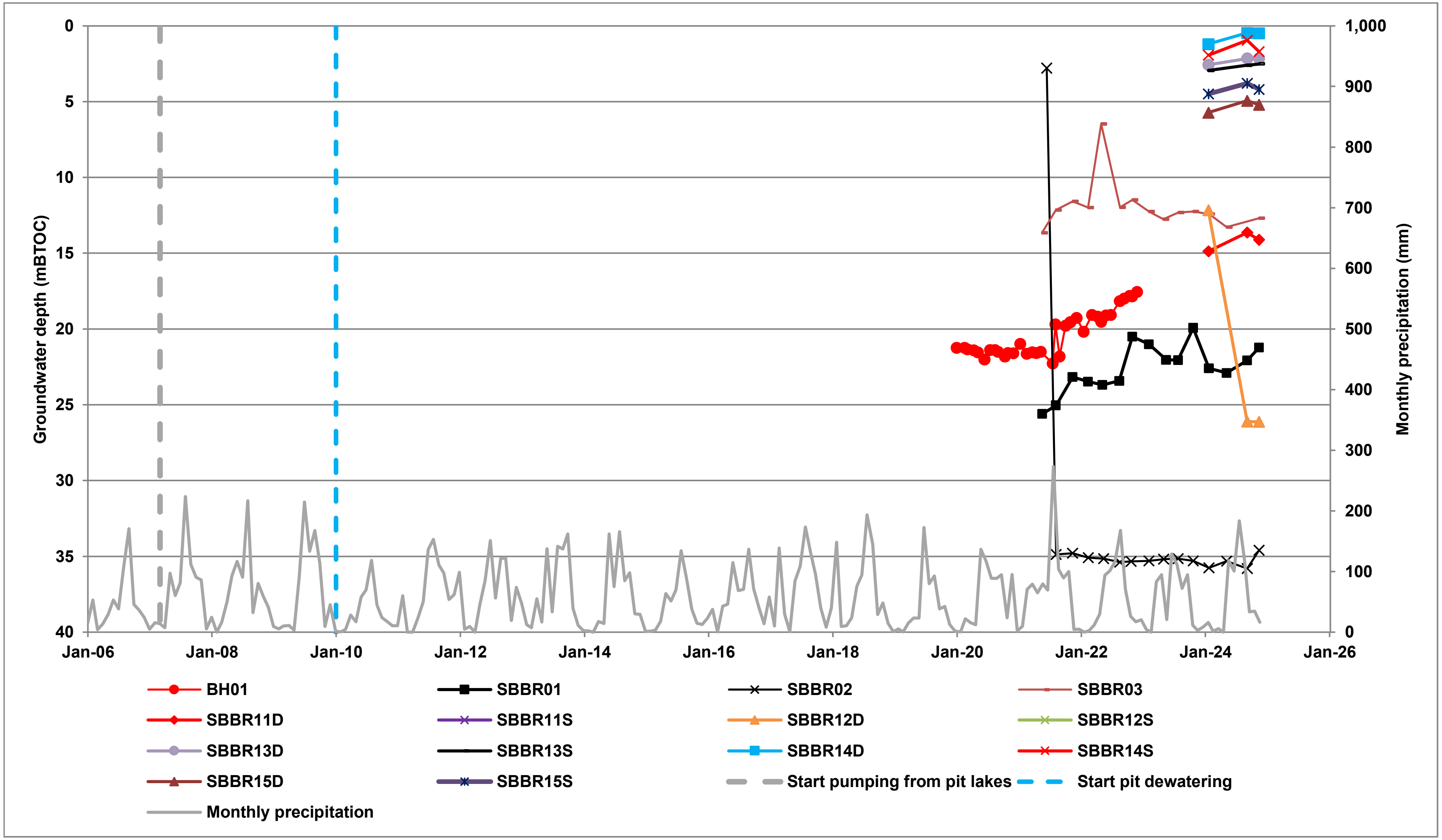
BIG DOG HYDROGEOLOGY

Groundwater elevations - Gringer Creek part 2

Figure 52

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

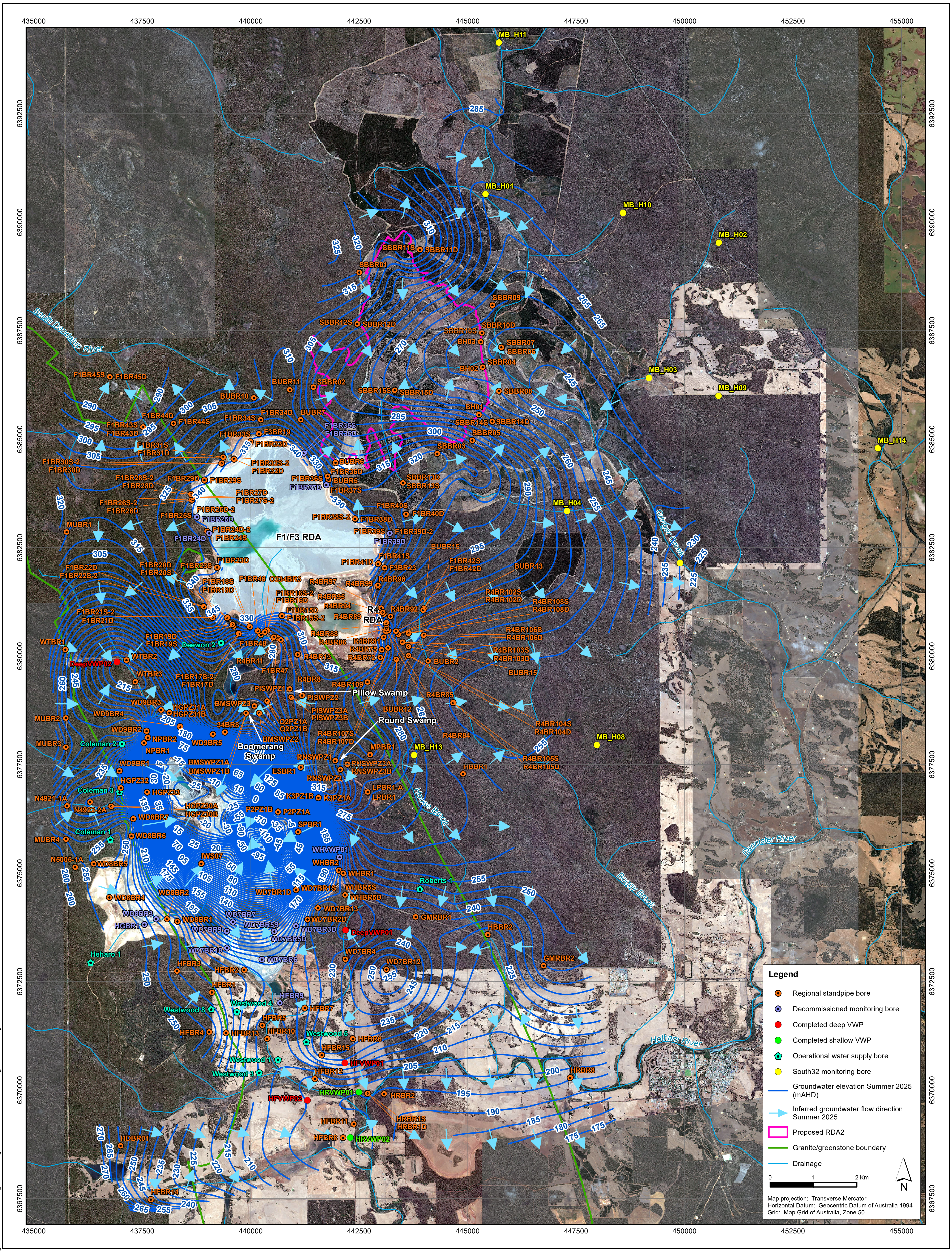
BIG DOG HYDROGEOLOGY

Groundwater depths - Gringer Creek part 2

Figure 53

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

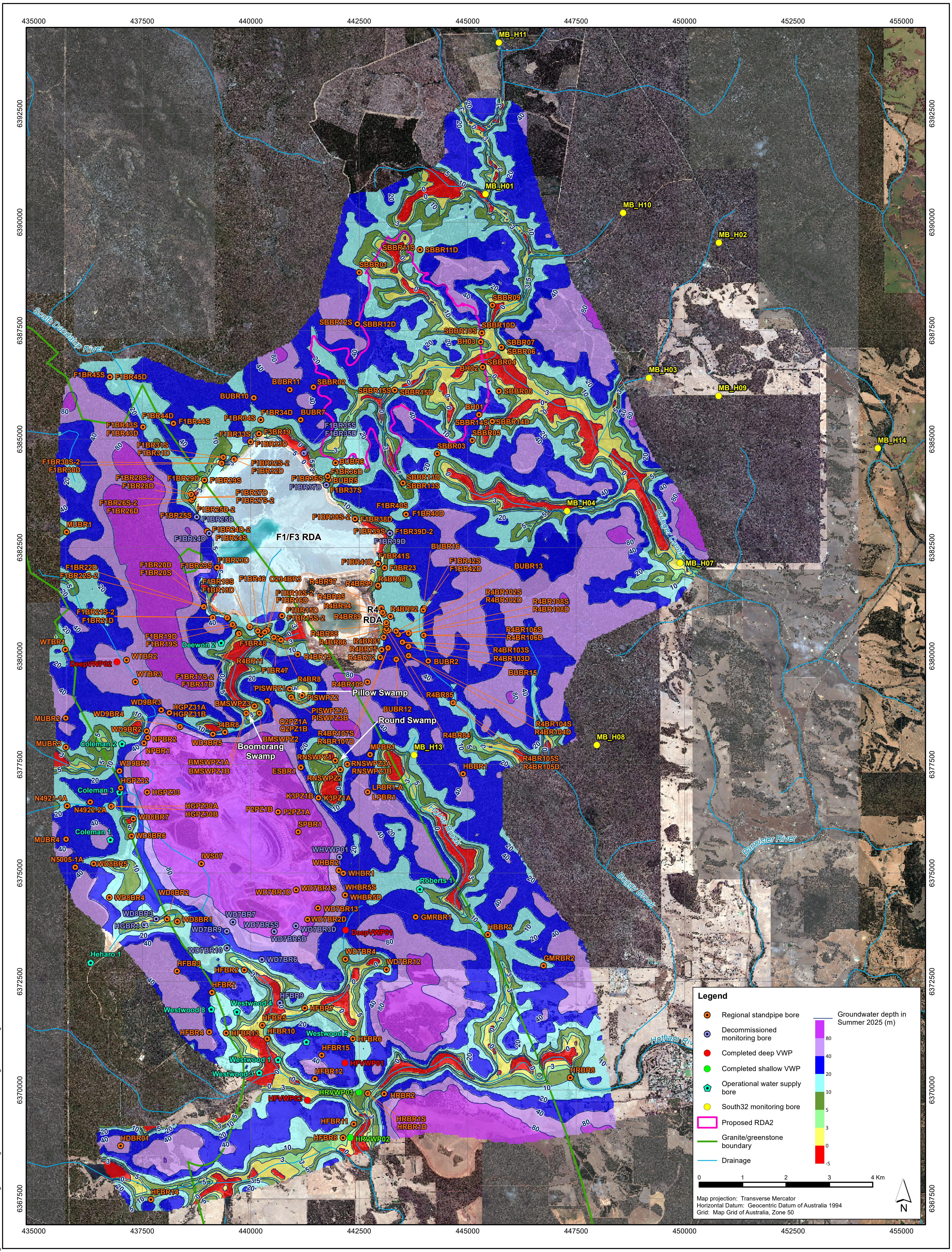
BIG DOG HYDROGEOLOGY

Groundwater elevations and flow directions in summer 2025

Figure 54

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

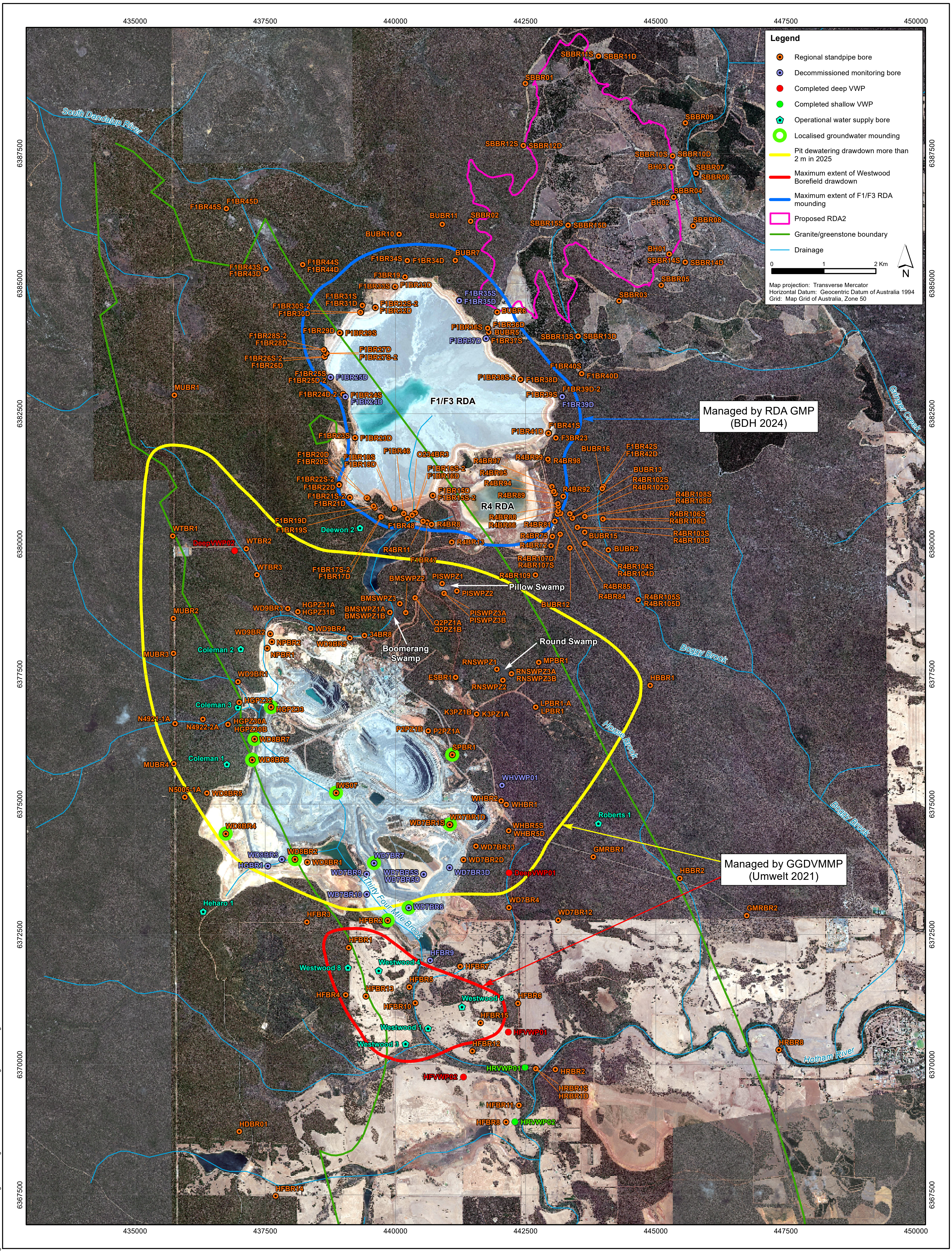
BIG DOG HYDROGEOLOGY

Groundwater depths in summer 2025

Figure 55

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



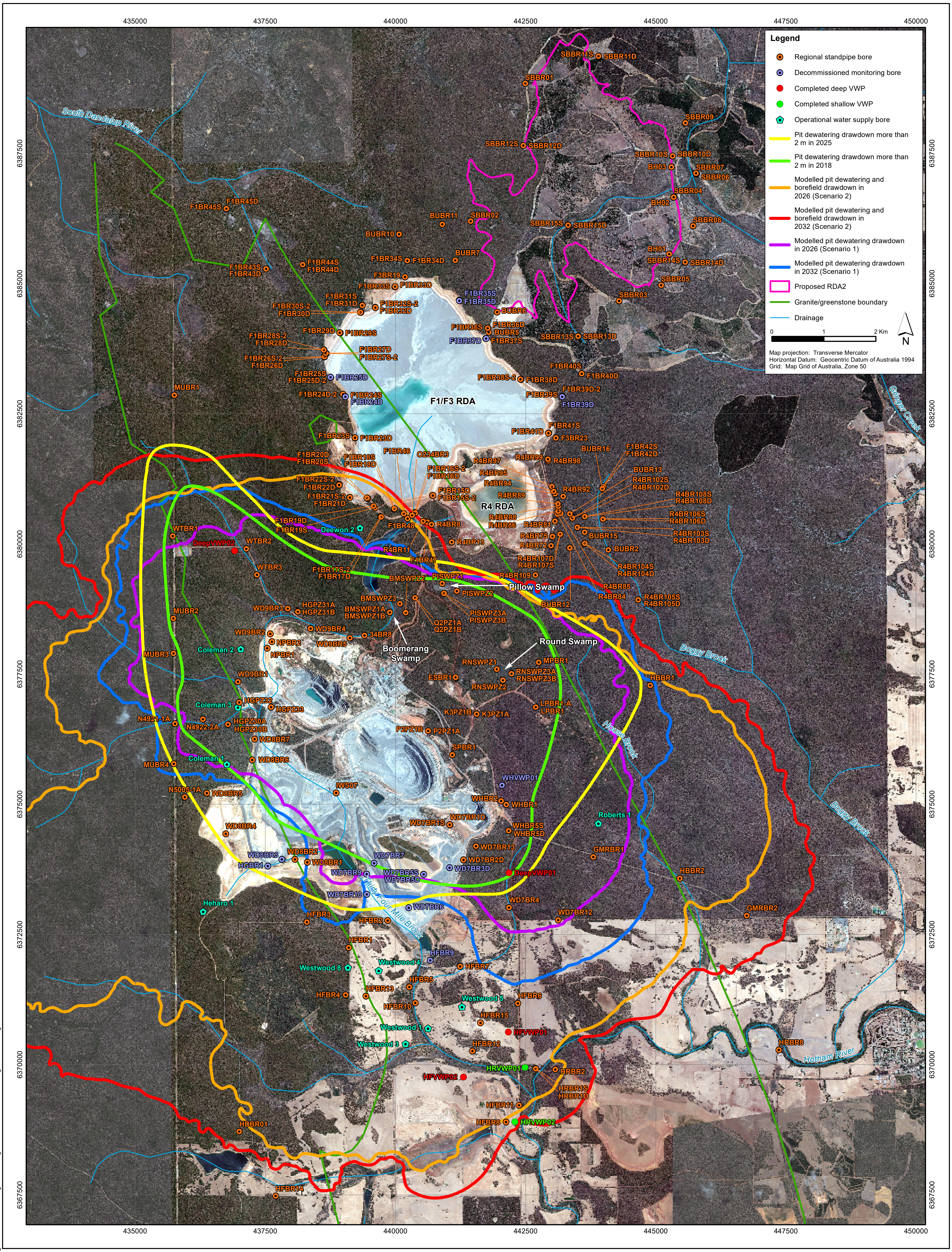
BIG DOG HYDROGEOLOGY

Mine influences on groundwater elevations in 2025

Figure 56

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



G:\Projects\BDH Projects\Boddington - Newmont\GIS\Figures\Boddington 2025 assessment of mining influences on groundwater

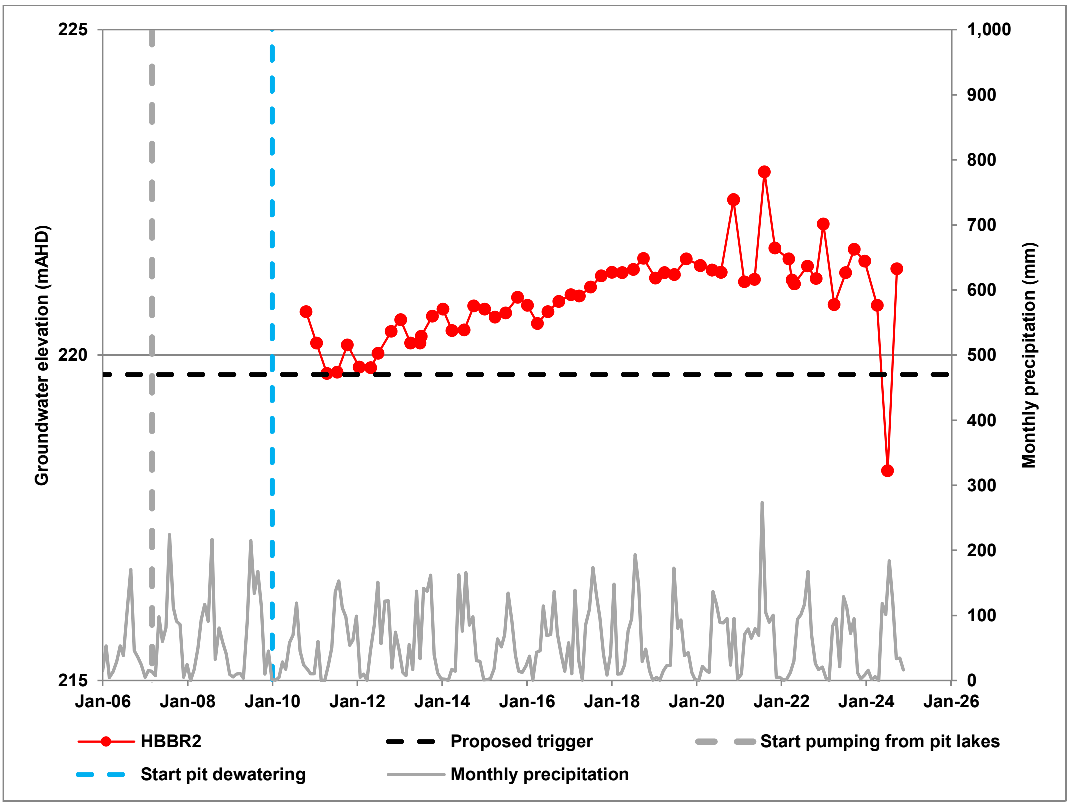
BIG DOG HYDROGEOLOGY

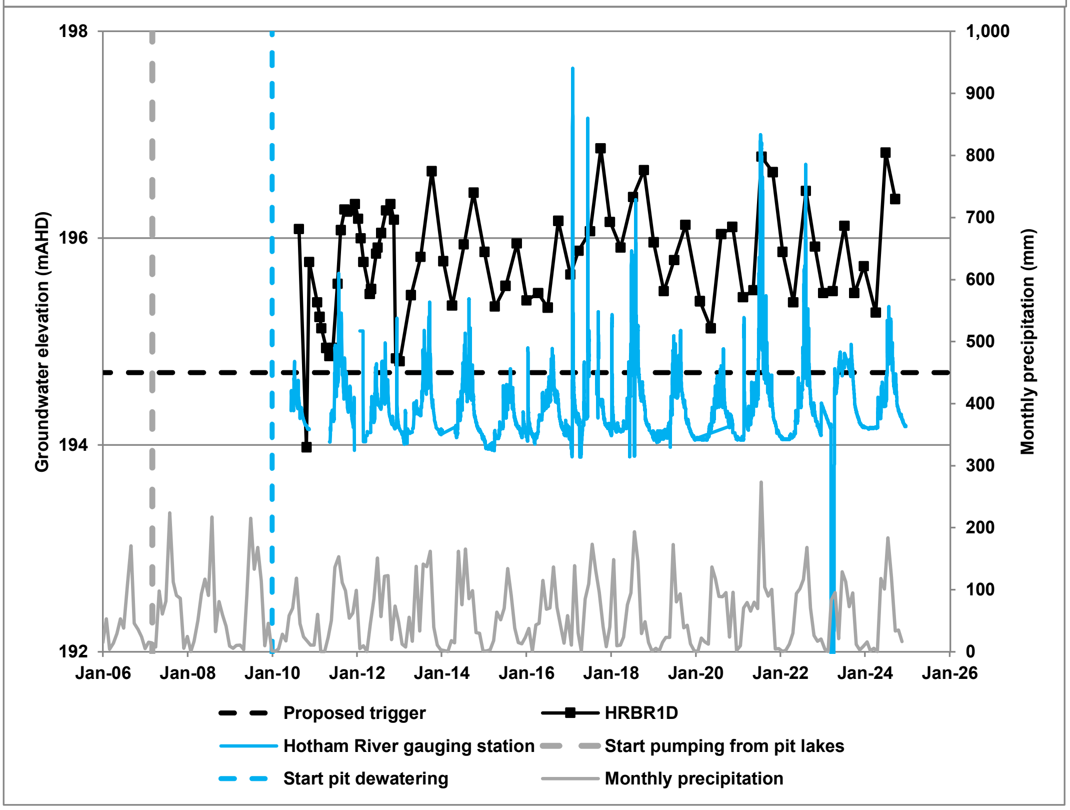
Long term pit dewatering drawdown

Figure 57

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater





D:\Documents\BDH Projects\Boddington\Boddington mining influences

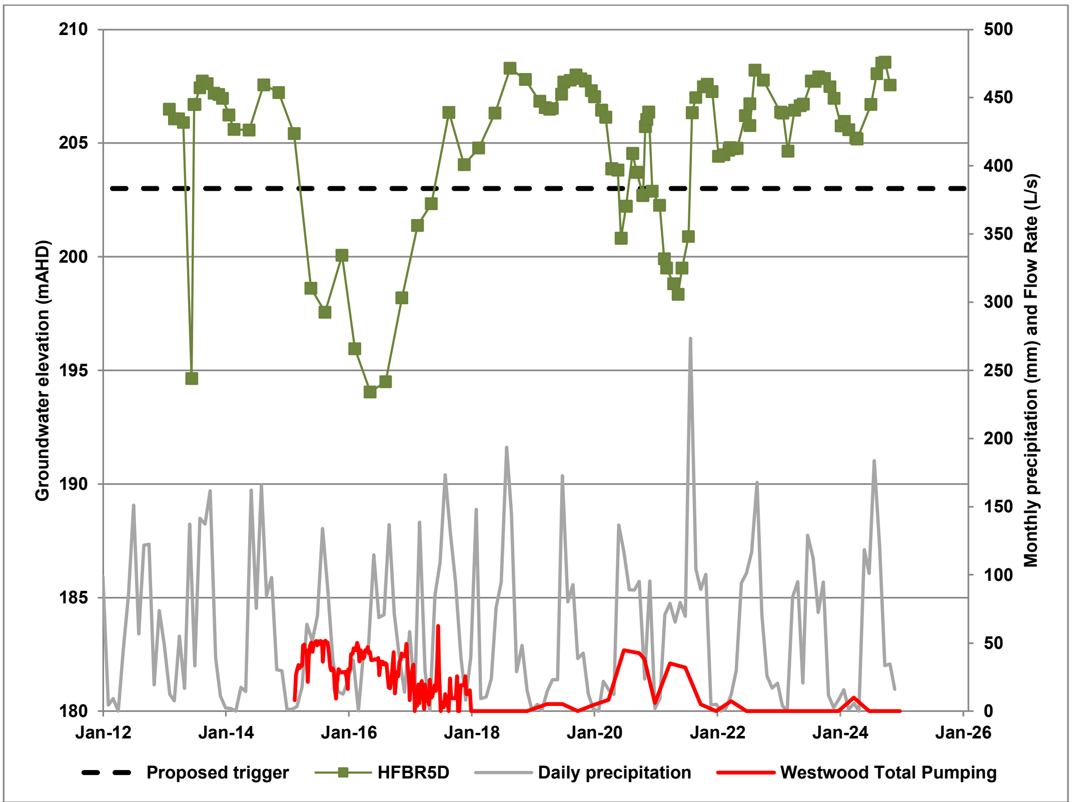
BIG DOG HYDROGEOLOGY

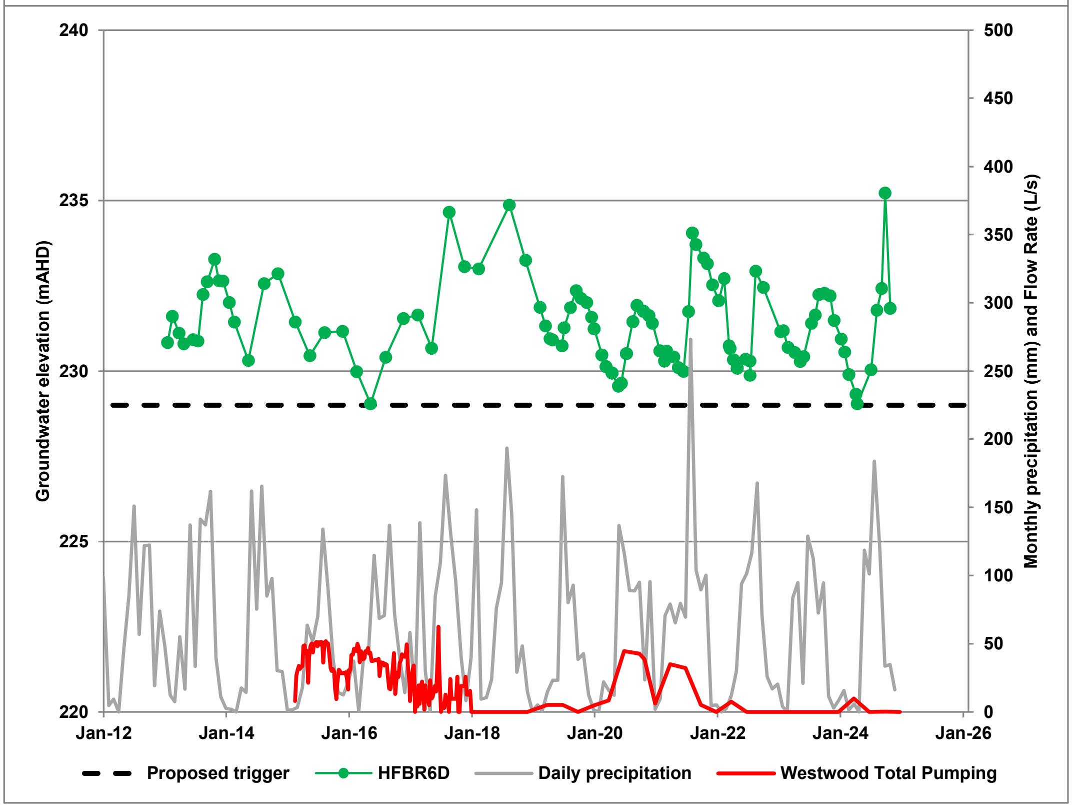
Groundwater elevation triggers part 1

Figure 58

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater





D:\Documents\BDH Projects\Boddington\Boddington mining influences

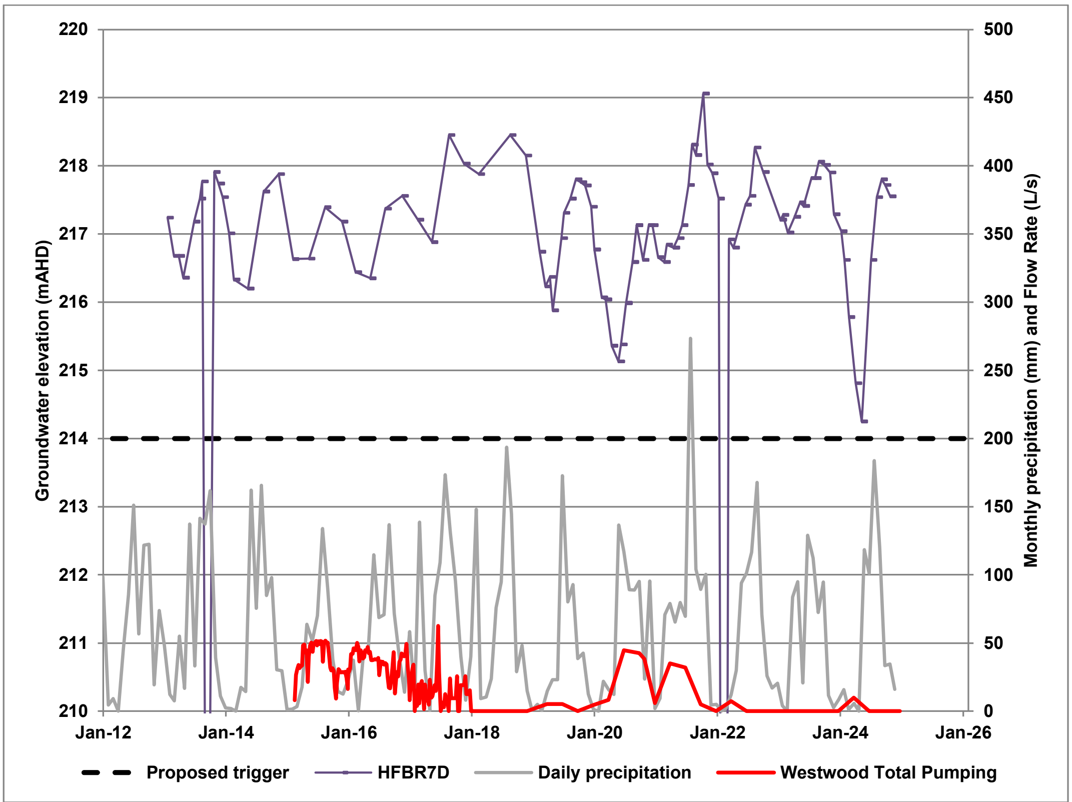
BIG DOG HYDROGEOLOGY

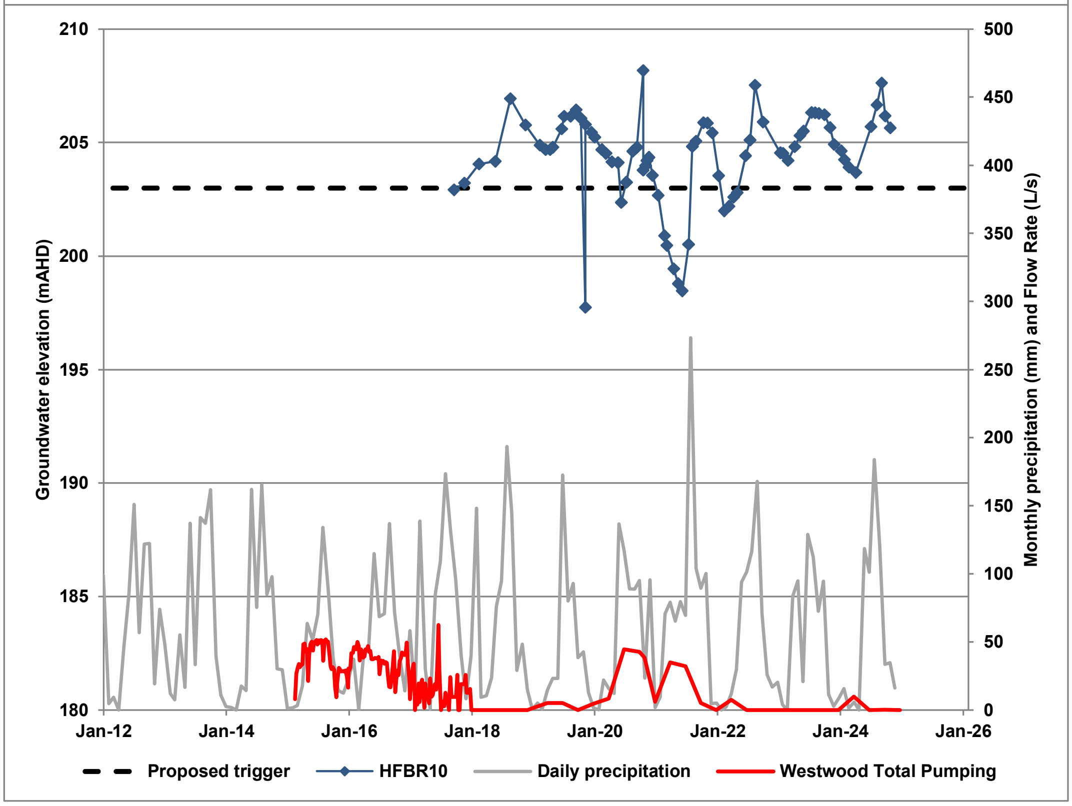
Groundwater elevation triggers part 2

Figure 58

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater





D:\Documents\BDH Projects\Boddington\Boddington mining influences

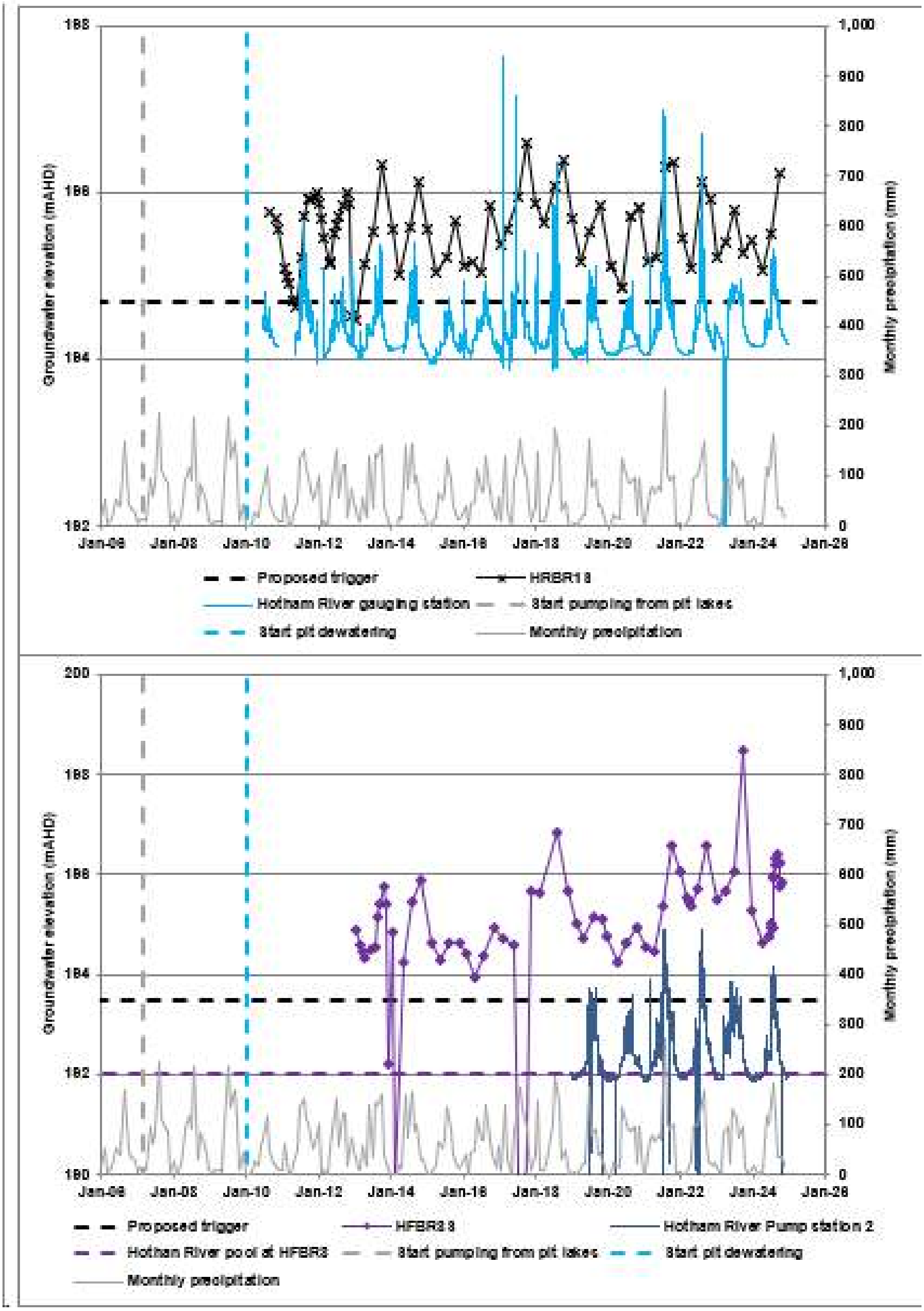
BIG DOG HYDROGEOLOGY

Groundwater elevation triggers part 3

Figure 60

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater



D:\Documents\BDH Projects\Boddington\Boddington mining influences

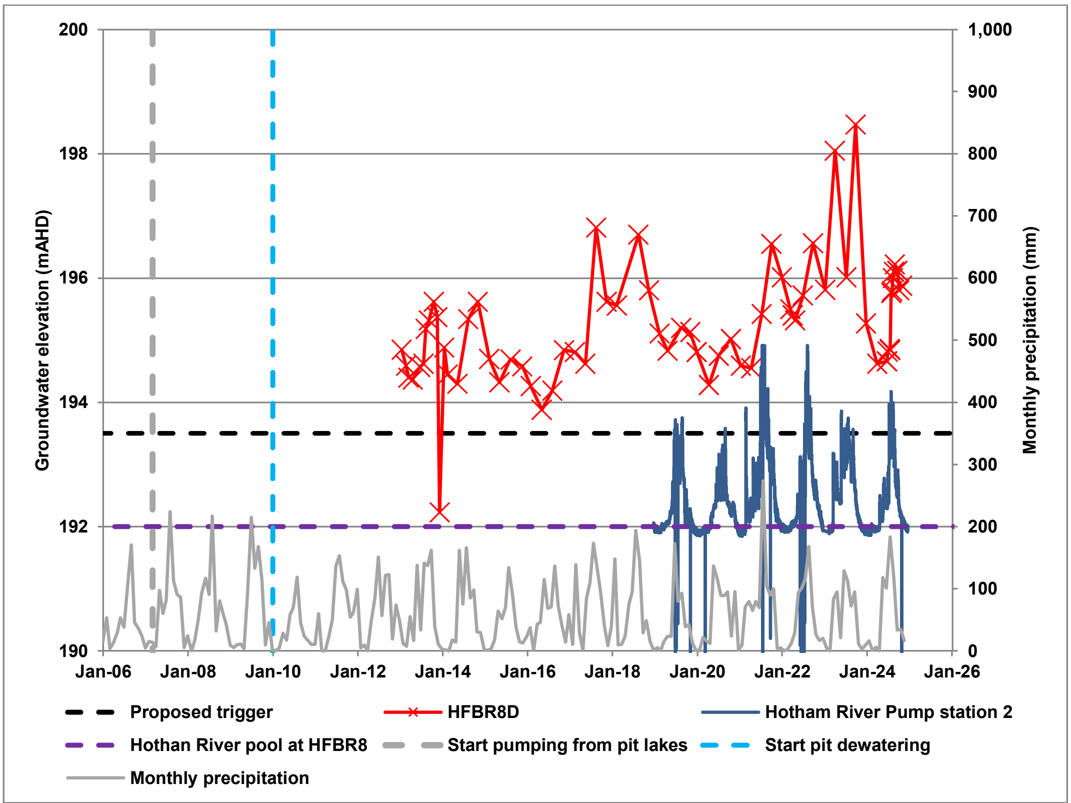
BIG DOG HYDROGEOLOGY

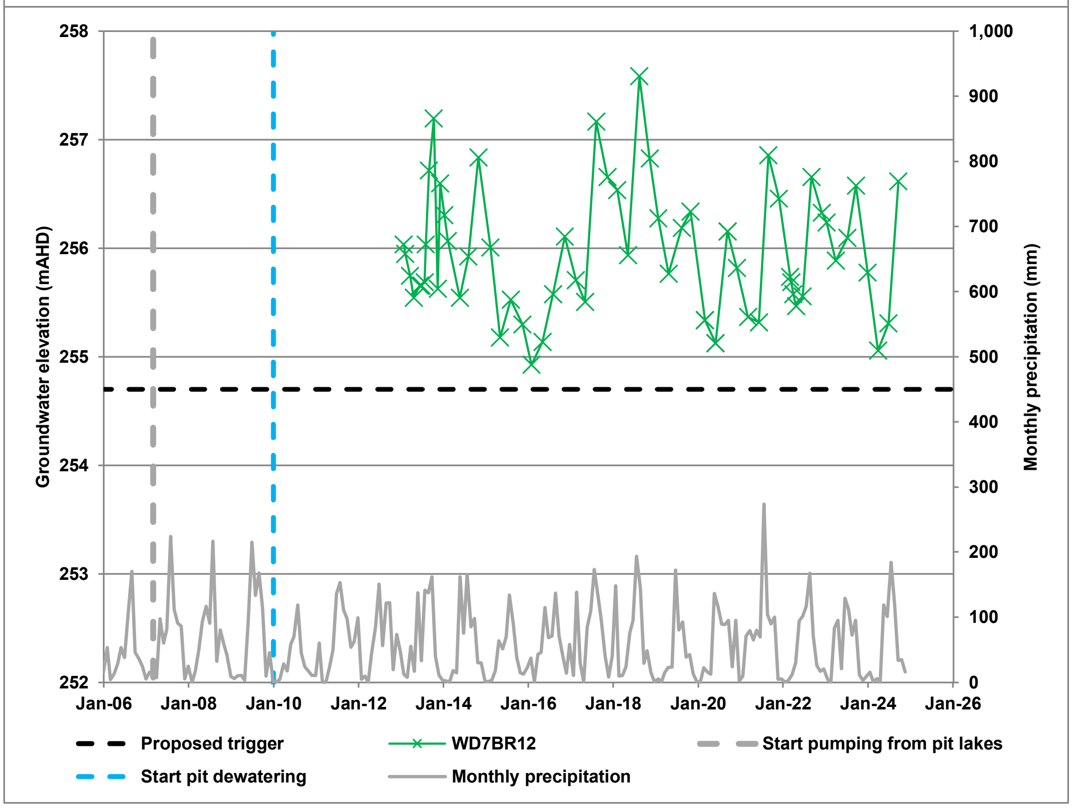
Groundwater elevation triggers part 4

Figure 61

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater





D:\Documents\BDH Projects\Boddington\Boddington mining influences

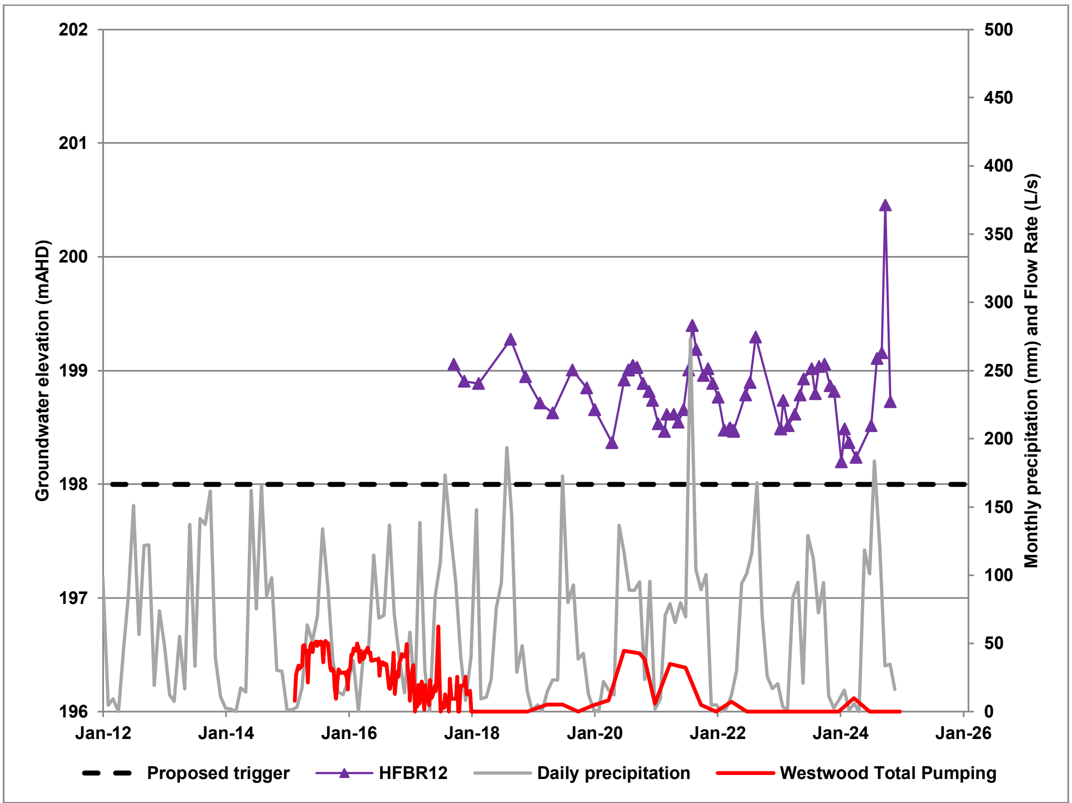
BIG DOG HYDROGEOLOGY

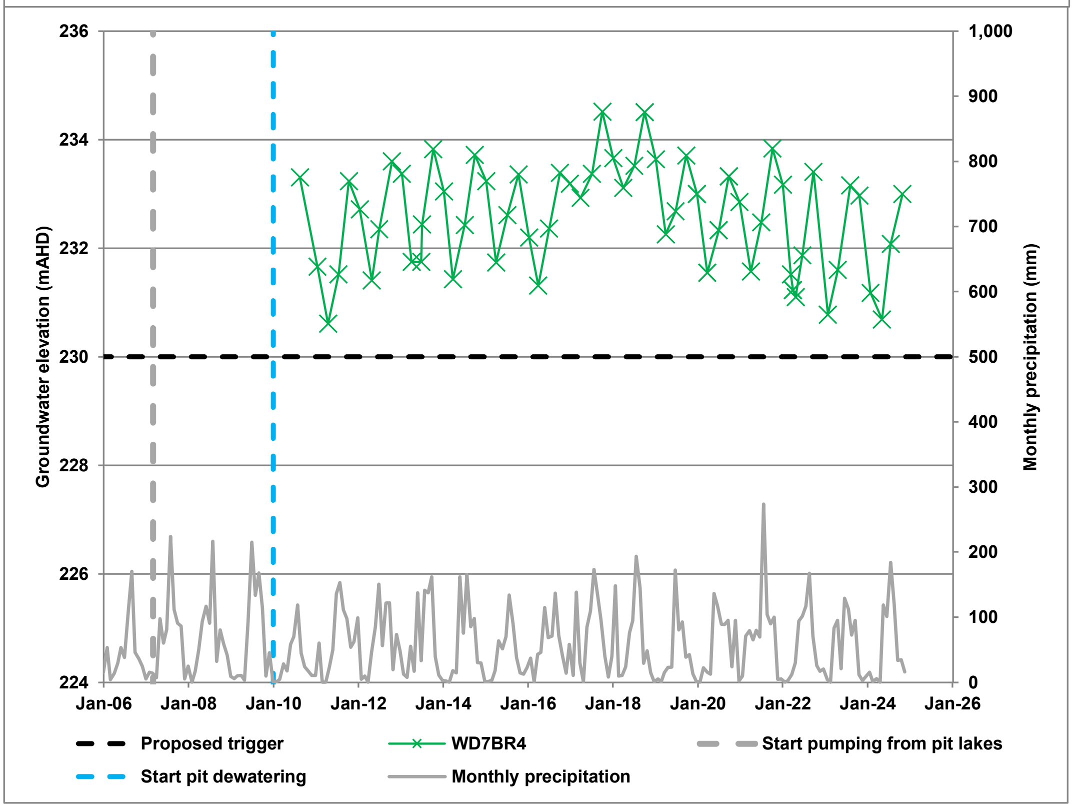
Groundwater elevation triggers part 5

Figure 62

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater





D:\Documents\BDH Projects\Boddington\Boddington mining influences

BIG DOG HYDROGEOLOGY

Groundwater elevation triggers part 6

Figure 63

Date: May 2025

Report: Boddington 2025 assessment of mining influences on groundwater

Appendix A
Monitoring Bore Construction Details

Table A: Bore construction details (part 1)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
34BR8				14.53	Unknown	Figure 32
BH01				19.27	Unknown	Figure 52
BH02					Unknown	Figure 50
BH03					Unknown	Figure 50
BMSWPZ1A	30	29.5	17.5	29.97	WFBGS	Figure 30
BMSWPZ1B		5	2	5.73	SSGS	Figure 30
BMSWPZ2	6	4	1	4.78	SSGS	Figure 30
BMSWPZ3	6	4	1	4.66	SSGS	Figure 30
BUBR10		39	21	38	WFBGS	Figure 10
BUBR11				27	Unknown	BDH 2023
BUBR12		24	12	23	Unknown	BDH 2023
BUBR13		40	28	24	Unknown	BDH 2023
BUBR15				40	Unknown	BDH 2023
BUBR16					Unknown	BDH 2023
BUBR2				31	Unknown	Figure 10
BUBR5	56	56	5	55	WFBGS	BDH 2023
BUBR6		40	10	40	WFBGS	BDH 2023
BUBR7		42	10	52	WFBGS	BDH 2023
Coleman 1	199				DFBGS	
Coleman 2	203.5				DFBGS	
Coleman 3					DFBGS	
DeepVWP01						Figure 12
DeepVWP02						Figure 13
Deewon 2	200				DFBGS	
ESBR1D	46.5	46.5	34	47.1	WFBGS	Figure 36
ESBR1S		6.5	2.5	5.08	SSGS	Figure 36
F1BR15D		46	43	17	WFBGS	BDH 2023
F1BR15S-2		5.2	1.7	6	SSGS	BDH 2023
F1BR16D		29	25		Oxide/WFBGS	BDH 2023
F1BR16S-2		13	7	14	SSGS	BDH 2023
F1BR17D		35	31		Oxide/WFBGS	BDH 2023
F1BR17S-2		9.2	5	10	SSGS	BDH 2023
F1BR18D		36	32		WFBGS	BDH 2023
F1BR18S		20	17	21	WFBGS	BDH 2023
F1BR19D		52	49	55	WFBGS	BDH 2023
F1BR19S		23	19	25	Oxide/WFBGS	BDH 2023
F1BR20D		56.5	44.5	57	WFBGS	BDH 2023
F1BR20S		13.8	10.8	14	SSGS	BDH 2023
F1BR21D		23.6	17.6	25	WFBGS	BDH 2023
F1BR21S-2		5.6	1.8	6	SSGS	BDH 2023
F1BR22D		38.9	32.9	40	WFBGS	BDH 2023
F1BR22S-2		6	3	6	SSGS	BDH 2023
F1BR23D		35.1	29.1	35	WFBGS	BDH 2023
F1BR23S		18.5	12.5	19	Oxide/WFBGS	BDH 2023
F1BR24D		62	56	64	DFBGS	BDH 2023
F1BR24D-2					WFBGS	BDH 2023
F1BR24S		20.1	14.1	21	Oxide/WFBGS	BDH 2023
F1BR25D		65.4	59.4	38	DFBGS	BDH 2023
F1BR25D-2		40.35	34.35		WFBGS	BDH 2023
F1BR25S		18.6	12.6	19	Oxide/WFBGS	BDH 2023

Table A: Bore construction details (part 2)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
F1BR26D		35	29	36	WFBGS	BDH 2023
F1BR26S-2		9.2	4.2	6	SSGS	BDH 2023
F1BR27D		30	24	32	WFBGS	BDH 2023
F1BR27S-2		5	2	7	SSGS	BDH 2023
F1BR28D		35	29	34	Oxide/WFBGS	BDH 2023
F1BR28S-2		5.9	2.9	6	SSGS	BDH 2023
F1BR29D		30	27	30	Oxide/WFBGS	BDH 2023
F1BR29S		7	4	7	SSGS	BDH 2023
F1BR30D		38.1	32.1	39	WFBGS	BDH 2023
F1BR30S-2		3.6	1.2	5	SSGS	BDH 2023
F1BR31D		32.2	26.2	32	Oxide/WFBGS	BDH 2023
F1BR31S		11.2	5.2	12	Oxide/WFBGS	BDH 2023
F1BR32D		35	29	35	WFBGS	BDH 2023
F1BR32S-2		4.9	1.6	5	SSGS	BDH 2023
F1BR33D		29.1	23.1	30	WFBGS	BDH 2023
F1BR33S		12.1	6.1	13	Oxide/WFBGS	BDH 2023
F1BR34D		31	25		WFBGS	BDH 2023
F1BR34S		6	3	6	SSGS	BDH 2023
F1BR35D		17	14	18	Oxide/WFBGS	BDH 2023
F1BR35S		4	1	5	SSGS	BDH 2023
F1BR36D		24	21	24	Oxide/WFBGS	BDH 2023
F1BR36S		6	3	7	SSGS	BDH 2023
F1BR37D		20	15	17	Oxide/WFBGS	BDH 2023
F1BR37S		7	4	8	SSGS	BDH 2023
F1BR38D		31	28	32	WFBGS	BDH 2023
F1BR38S-2		5.8	1.8	6	SSGS	BDH 2023
F1BR39D		39	35	40	WFBGS	BDH 2023
F1BR39D-2		15.1	9.1		WFBGS	BDH 2023
F1BR39S		6	3	5	SSGS	BDH 2023
F1BR40D		30	27	30	Oxide/WFBGS	BDH 2023
F1BR40S		6	3	6	SSGS	BDH 2023
F1BR41D		29	25	30	Oxide/WFBGS	BDH 2023
F1BR41S		6	3	7	SSGS	BDH 2023
F1BR42D		20	17	20	WFBGS	BDH 2023
F1BR42S		6	3	7	SSGS	BDH 2023
F1BR43D		30	18		WFBGS	BDH 2023
F1BR43S		7	1	7	SSGS	BDH 2023
F1BR44D		23	17	24	WFBGS	BDH 2023
F1BR44S		7	4	7	SSGS	BDH 2023
F1BR45D		25	19		WFBGS	BDH 2023
F1BR45S		4	2	5	SSGS	BDH 2023
F1BR46				12	Unknown	BDH 2023
F1BR47		5.5	0.5	6	SSGS	BDH 2023
F1BR48		6	0	7	SSGS	BDH 2023
F3BR19				35	Unknown	BDH 2023
F3BR23				39	Unknown	BDH 2023
GMRBR1	30.4	30.4	18.4	31.1	WFBGS	Figure 24
GMRBR2	45.5	45.5	33.5	45.95	WFBGS	Figure 22
HBBR1	41	41	29	41.57	WFBGS	Figure 20
HBBR2	30.4	30.4	18.4	30.56	WFBGS	Figure 28
HDBR01					DFBGS	Figure 20

Table A: Bore construction details (part 3)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
Heharo 1	264				DFBGS	
HFBR1D	47.6	47.6	35	47.86	WFBGS	Figure 40
HFBR1S	5.5	5.5	2.5	6.22	SSGS	Figure 40
HFBR10	11.1	11.1	5.1	11.1	SSGS	Figure 42
HFBR11	18.1	18.1	5.1	18.1	SSGS	Figure 46
HFBR12	13.1	13.1	2.1	13.1	SSGS	Figure 42
HFBR13					DFBGS	Figure 42
HFBR14					DFBGS	Figure 22
HFBR15					DFBGS	Figure 42
HFBR16	25	18.3	3.3		SSGS	
HFBR2D	57.3	57.3	45	57.13	WFBGS	Figure 40
HFBR2S	7	7	3	7.6	SSGS	Figure 40
HFBR3D	62.5	62.5	50	62.73	WFBGS	Figure 40
HFBR3S	10	10	4	10.68	SSGS	Figure 40
HFBR4D	44	44	32	44.09	WFBGS	Figure 40
HFBR5D	84.5	84.5	67	84.96	WFBGS	Figure 42
HFBR5S	4.5	4.5	1.5	4.61	SSGS	Figure 42
HFBR6D	41	41	29	41.63	WFBGS	Figure 40
HFBR6S	4.5	4.5	1.5	4.72	SSGS	Figure 40
HFBR7D	50	50	37	50.14	WFBGS	Figure 40
HFBR8D	57.5	57.5	45	57.62	WFBGS	Figure 46
HFBR8S	17.5	17.5	2	17.68	SSGS	Figure 46
HFBR9	7				SSGS	
HFVWP01						Figure 44
HFVWP02						Figure 45
HGBR1	30.4	30.4	18.4	30.82	WFBGS	Figure 24
HGPZ30A	26.8	26.8	13	27.35	WFBGS	Figure 16
HGPZ30B		6	4	5.7	SSGS	Figure 16
HGPZ31A	57.5	54	42	54.82	WFBGS	Figure 16
HGPZ31B		3	2	3.23	SSGS	
HGPZ32	75	72.5	54.5	73.62	WFBGS	Figure 16
HGPZ33	20	20	14	22.86	WFBGS	Figure 16
HRBR1D	33.5	32.9	21.5	34.06	WFBGS	Figure 46
HRBR1S	16	15.4	8	16.55	SSGS	Figure 46
HRBR2	42.5	42.5	30.5	42.93	WFBGS	Figure 46
HRBR8	24.5	24.5	8.5	20.7	WFBGS	Figure 46
HRVWP01						Figure 48
HRVWP02						Figure 49
IWS07	59.7	59.7	9	56.89	WFBGS	Figure 26
K3PZ1A	33	33	21	33.7	WFBGS	Figure 36
K3PZ1B		5	2	5.28	SSGS	Figure 36
LPBR1	30.4	30.4	12.4	31.02	WFBGS	Figure 36
LPBR1-A	65	65	18		WFBGS	Figure 36
MPBR1	30	30	18	30.44	WFBGS	Figure 36
MUBR1	57.4	58	45.7	58.22	WFBGS	Figure 10
MUBR2	42.1	42.1	32.1	42.76	WFBGS	Figure 20
MUBR3	17.6	17.6	5.5	17.6	WFBGS	Figure 20
MUBR4	57	57	44		WFBGS	Figure 20
N4921-1A				43.06	Unknown	Figure 10
N4922-2A					Unknown	Figure 18
N5005-1A				12.15	Unknown	Figure 10

Table A: Bore construction details (part 4)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
NPBR-1	53	53	41	54.06	WFBGS	Figure 14
NPBR2					DFBGS	Figure 14
O234BR3				17	Unknown	BDH 2023
P2PZ1A					Unknown	
P2PZ1B					Unknown	
PISWPZ1	3.5	3	1	3.67	SSGS	Figure 38
PISWPZ2	3	2.4	0.9	3.14	SSGS	Figure 38
PISWPZ3A	35	35	23	34.03	WFBGS	Figure 38
PISWPZ3B		9	3	1.7	SSGS	Figure 38
Q2PZ1A	39	39	21	39.63	WFBGS	Figure 32
Q2PZ1B		9	3	9.52	SSGS	Figure 32
R4BR102D	58	58	46	59	WFBGS	BDH 2023
R4BR102S		25	13	25	Oxide/WFBGS	BDH 2023
R4BR103D	68	68	56	69	WFBGS	BDH 2023
R4BR103S		40	28	40	Oxide/WFBGS	BDH 2023
R4BR104D	55	55	43	55	WFBGS	BDH 2023
R4BR104S		39	27	40	Oxide/WFBGS	BDH 2023
R4BR105D	40	40	28	40	WFBGS	BDH 2023
R4BR105S		16	4	16	Oxide/WFBGS	BDH 2023
R4BR106D	33	33	21	34	WFBGS	BDH 2023
R4BR106S		14	8	14	Oxide/WFBGS	BDH 2023
R4BR107D	50	50	38	50	WFBGS	BDH 2023
R4BR107S		33	21	30	Oxide/WFBGS	BDH 2023
R4BR108D	36	36	24	36	WFBGS	BDH 2023
R4BR108S		20	8	20	Oxide/WFBGS	BDH 2023
R4BR109		120	108		DFBGS	BDH 2023
R4BR11		30	24	22	Unknown	BDH 2023
R4BR13				30	Unknown	BDH 2023
R4BR72				23	Unknown	BDH 2023
R4BR75				28	Unknown	BDH 2023
R4BR8		36.5	6	35	Unknown	BDH 2023
R4BR81				50	Unknown	BDH 2023
R4BR84				50	Unknown	BDH 2023
R4BR85		25	24	30	Unknown	BDH 2023
R4BR86				41	Unknown	BDH 2023
R4BR88				33	Unknown	BDH 2023
R4BR89				39	Unknown	BDH 2023
R4BR92				30	Unknown	BDH 2023
R4BR94				56	Unknown	BDH 2023
R4BR95				37	Unknown	BDH 2023
R4BR97		41	10	38	WFBGS	BDH 2023
R4BR98				19	Unknown	BDH 2023
R4BR99		39	32	42	Unknown	BDH 2023
RNSWPZ1	2.8	2.8	0.8	3.43	SSGS	Figure 34
RNSWPZ2	3.6	3.2	0.7	3.93	SSGS	Figure 34
RNSWPZ3A	44	44	32	44.43	WFBGS	Figure 34
RNSWPZ3B	3	3	1	3.86	SSGS	Figure 34
Roberts 1					DFBGS	
SBBR01	30	30.2	24.2		WFBGS	Figure 52
SBBR02	45	45	39		Oxide/WFBGS	Figure 52
SBBR03	23	23	17		Oxide/WFBGS	Figure 52

Table A: Bore construction details (part 5)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
SBBR04	22	22	16		WFBGS	Figure 50
SBBR05	30	30	24		Oxide/WFBGS	
SBBR06	6	6	0.2		SSGS	Figure 50
SBBR07	21.5	21.5	15.5		Oxide/WFBGS	Figure 50
SBBR08	24	24	18		WFBGS	Figure 50
SBBR09	17	16.3	10.3		Oxide/WFBGS	Figure 52
SBBR10D	23	22	16		WFBGS	Figure 50
SBBR10S	6	6	3		SSGS	Figure 50
SBBR11D	35	34	28		WFBGS	Figure 52
SBBR11S	9	9	5		Oxide/WFBGS	Figure 52
SBBR12D	53	53	47		WFBGS	Figure 52
SBBR12S	10	10	7		Oxide/WFBGS	Figure 52
SBBR13D	18.5	18.5	12.5		WFBGS	Figure 52
SBBR13S	9	9	6		Oxide/WFBGS	Figure 52
SBBR14D	12	12	6		Oxide/WFBGS	Figure 52
SBBR14S		4	1		SSGS	Figure 52
SBBR15D	29	29	23		WFBGS	Figure 52
SBBR15S		6	3		SSGS	Figure 52
SPBR1D	34.9	34.9	23	35.46	WFBGS	Figure 20
SPBR1S	6.2	6.2	2.2	6.9	SSGS	Figure 20
WD7BR10	22.4	21.7	13.7	22.23	WFBGS	Figure 28
WD7BR12	49.3	49.3	37	50.23	WFBGS	Figure 20
WD7BR13					DFBGS	Figure 18
WD7BR1D	52.9	52.9	40.9	52.21	WFBGS	Figure 20
WD7BR1S	12.4	12.4	7.4	13.1	Oxide/WFBGS	
WD7BR2D	64.4	64.4	52.4	64.33	WFBGS	Figure 20
WD7BR2S	6.4	6.4	2.4	6.86	SSGS	
WD7BR3D	111.4	111.4	103.4	110.5	WFBGS	Figure 28
WD7BR3S	7.9	7.9	1.9	8.43	Oxide/WFBGS	
WD7BR4	44.3	38.6	26.6	39.12	WFBGS	Figure 24
WD7BR5D	51.4	51.4	41.4	51.5	WFBGS	Figure 26
WD7BR5S	9.4	9.4	7	10	Oxide/WFBGS	
WD7BR6	54.4	54.4	42.4	54.64	WFBGS	Figure 28
WD7BR7	29	29	17	29.16	WFBGS	Figure 28
WD7BR9	60.4	60.4	48.4	60.89	WFBGS	Figure 28
WD8BR1	29	28.5	16.5	29.25	WFBGS	Figure 26
WD8BR2	27.5	27.5	15.5	28.1	WFBGS	Figure 26
WD8BR3	32	28	16	28.36	WFBGS	Figure 24
WD8BR4	30.3	30.3	18.3	30.98	WFBGS	Figure 22
WD8BR5	31.5	31.5	19.5	31.13	WFBGS	Figure 20
WD8BR6	66.5	66.5	54.5	66.78	WFBGS	Figure 24
WD8BR7	30.2	30.2	18.2	30.75	WFBGS	Figure 24
WD9BR1	56	56.2	20.2	56.18	WFBGS	Figure 28
WD9BR2	37.9	37.4	25.4	37.4	WFBGS	Figure 14
WD9BR3	42.4	42.4	30.4	42.93	WFBGS	Figure 14
WD9BR4	40.9	41	29	41.1	WFBGS	Figure 28
WD9BR5	37	37	21		WFBGS	Figure 22
Westwood 1	152				DFBGS	
Westwood 3	208				DFBGS	
Westwood 4	270				DFBGS	
Westwood 5	195				DFBGS	

Table A: Bore construction details (part 6)

Monitoring Site	Drilled Depth (mBGL)	Base Screen (mBGL)	Top Screen (mBGL)	Plumbed Depth (mBGL)	Groundwater System	Data Plotted
Westwood 8	184				DFBGS	
WHBR1				38.54	Unknown	Figure 18
WHBR2					DFBGS	Figure 18
WHBR3					Unknown	
WHBR4					Unknown	Figure 10
WHBR5D					DFBGS	Figure 18
WHBR5S					DFBGS	Figure 18
WHVWP01					DFBGS	Figure 18
WTBR1	34	34	22	35.72	WFBGS	Figure 15
WTBR2	44	44	32		WFBGS	Figure 15
WTBR3	78.5	78.5	67	78.43	WFBGS	Figure 15