Australasian Groundwater & Environmental Consultants

Report on

# Mangoola Mine – Annual Groundwater Review Report for 2024

Prepared for
Mangoola Coal Operations Pty Limited

Project No. MAN5035.001
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**ageconsultants.com.au**

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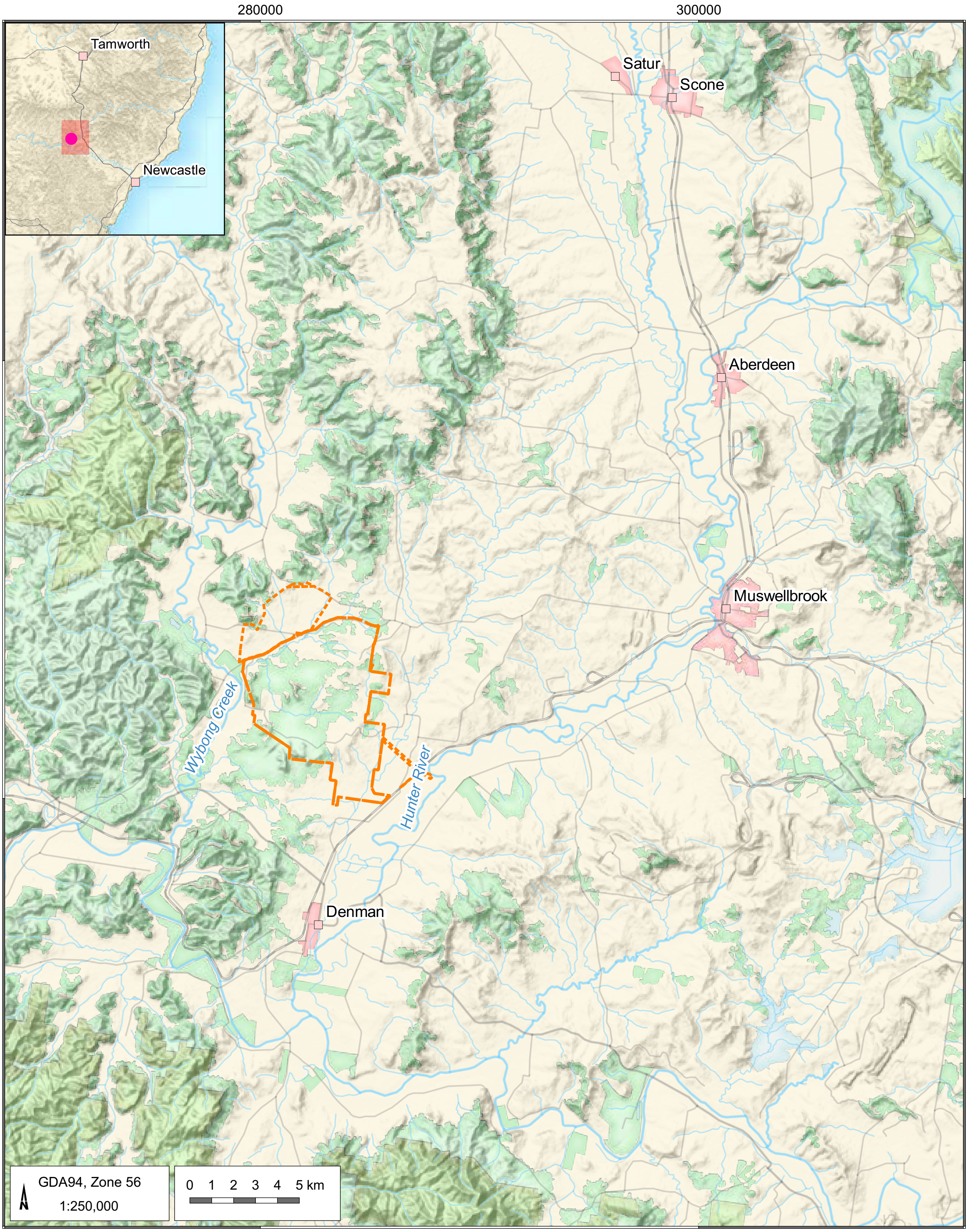
# Mangoola Mine – Annual Groundwater Review Report for 2024

## 1 Introduction

Mangoola Open Cut (Mangoola) is owned and operated by Mangoola Coal Operations Pty Ltd (Mangoola Coal), which is a Glencore managed operation. Mangoola is located near Wybong, New South Wales (NSW), approximately 20 kilometres (km) west of Muswellbrook and approximately 10 km north of Denman in the Muswellbrook Local Government Area (LGA). A locality plan is presented in Figure 1.1. Project Approval 06_0014 was granted in June 2007 for the construction of the open cut coal mine and associated infrastructure, with mining commencing in September 2010. In April 2021, State significant development (SSD) consent SSD 8642 was granted for the Mangoola Coal Continued Operations (MCCO) Project. On 21 November 2022, Mangoola surrendered MP 06_0014 in accordance with Schedule 2, Condition A15 of SSD-8642.

Routine groundwater monitoring is undertaken at Mangoola as required by Condition B50 of SSD8642. The groundwater monitoring program is outlined in the Mangoola Groundwater Management Plan (GWMP) that was last updated in December 2022 (Glencore, 2022) and implemented in Q2 of 2023.

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) was commissioned by Mangoola Coal to prepare the Mangoola Annual Groundwater Review in 2023 which formed as an appendix to the 2023 Annual Review (a requirement under Condition D11 of SSD8642). AGE was commissioned by Mangoola Coal to prepare the groundwater section which is intended to be incorporated within the Mangoola Annual Review in 2024 (this report). The annual groundwater review has been prepared to address the reporting requirements in the GWMP and conditions of SSD8642.




LEGEND

- Populated place
- Study area location
- Mining lease
- Built up area
- Water area
- Reserve
- Vegetation
- Road
- Road major
- Rail
- Watercourse major
- Watercourse

Mangoola 2024 Annual GW Review (MAN5035.001)

**Project location**

AGE

DATE 26/03/2025

FIGURE No: 1.1


Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
\\AGE-SRV-DC01\shared\Projects\MAN5035.001 Mangoola 2024 AGMR\3_GIS\Workspaces\001_Deliverable1\01.01_MAN5035_Project location.qgz

# 2 Objectives and scope of work

The GWMP describes a program of groundwater monitoring to address the conditions of approval for Mangoola. This includes monitoring within the mining lease and at bores located off site and on adjacent private properties. Monitoring tasks undertaken over the 2024 calendar year period included:

- manual measurement of groundwater levels in the monitoring network;
- downloading of electronic water level loggers; and
- collection of groundwater samples for field and laboratory analysis.

This report provides a review and analysis of the groundwater monitoring data collected over the 2024 calendar year as required by the Environment Protection Licence (EPL) 12894 and SSD8642 conditions.

# 3 Environmental management

Mangoola monitors groundwater quality and levels within and surrounding the site in accordance with the Groundwater Monitoring Plan (GWMP). This was consolidated with the Groundwater Response Plan and last updated and approved by DPHI in December 2022 in accordance with Condition B50 of the MCCO Development Consent (SSD-8642). The new GWMP (dated 2022) was implemented in Q2 of 2023, and subsequently in place for 2024 forming the basis of this chapter in the Annual Review.

The 2022 and approved GWMP was reviewed in 2024 and an updated version (January 2025) is currently in its final review stages and it is planned to replace the 2022 version sometime in 2025.

As stated in the approved GWMP (2022) the validity of the groundwater model predictions will be independently reviewed every three years against water level and mine inflow data to determine if the model is providing useful predictions (Condition B50(v)(#8) of SSD-8642). The currently approved GWMP was reviewed and updated (AGE, 2024e) in response to a review and recalibration of the numerical groundwater flow model which was completed in 2024 to satisfy Condition B50( e) (v) of SSD8642 and Section 9.4 of the GWMP. This updated GWMP was submitted for approval (via the DPHI portal) in December 2024. Once approved, this will replace the 2022 GWMP.

## 3.1 Summary of the Groundwater Regime

The regional groundwater regime is comprised of; a shallow unconfined aquifer associated with alluvial deposits along the main drainages of Wybong Creek and Sandy Creek, a shallow colluvial and weathered zone minor aquifer along Big Flat Creek, and a deeper confined system primarily associated with the coal seams. The wider coal measures strata provide limited groundwater storage and transmission capacity, and the interburden and overburden lithologies possess very low hydraulic conductivities.

Groundwater recharge to the Permian strata occurs via rainfall to the ground surface infiltrating into the formations through the soil cover and weathered profile. The alluvial and colluvial sediments are also recharged by seepage through creek beds when these are flowing. Groundwater-surface water interactions occur along Wybong Creek and Sandy Creek, but not along Big Flat Creek where the water table is below the bed of the creeks and the colluvium is largely unsaturated occurring as a surficial capping of limited thickness (AGE, 2019a). Groundwater flow directions prior to mining were a subdued reflection of topography and aligned with the major drainage lines in the area.

Groundwater is typically brackish to saline in quality in all areas except within the alluvium along Wybong Creek and Sandy Creek. The salinity is the main constraint to beneficial use of groundwater in the region with all bedrock geological units having a water quality that is often unsuitable for aquatic ecosystems, irrigation, or potable consumption (AGE 2019a).

## 3.2 Summary of the Monitoring Network

A network of uPVC (standpipe) groundwater monitoring bores and vibrating wire piezometers (VWPs) have been installed at Mangoola to monitor the influence of approved mining activities on the groundwater regime. The number of monitoring bores utilised at the site changes over time as new monitoring bores are installed to collect data in future mining areas, and sites within the approved mining footprint go dry, and/or are gradually removed as mining passes through.

Currently groundwater monitoring is undertaken at 65 monitoring locations where Figure 3.1 shows the location of the monitoring sites in context of the mine. The monitoring frequency adopted is:

- daily recording at nine VWPs sites that record pore pressures using data loggers – these sites have the prefix “VW”;
- monthly measurement of water level at 10 sites;
- bi-monthly (every two months) measurement at 49 sites of water levels and field water quality parameters of pH, and EC;

- half yearly measurement at 17 sites of water level, field parameters and laboratory analysis of major ions;
- quarterly private bore groundwater level logger downloads; and
- annual measurement at 7 sites of water level, field parameters and a full laboratory analysis of major ions and metal.

### 3.2.1 Additional Monitoring Sites

The groundwater impact assessment prepared for MCCO concluded that a number of additional groundwater monitoring locations should be added to the monitoring network to assess baseline conditions as per the MCCO EIS (Umwelt 2019a). The locations of the newly installed groundwater monitoring sites are shown in Figure 3.1 with a summary of the construction details for each site provided in Table 3.1. Due to excessive wet weather posing safety during the installation period, these bores were installed between late 2022 and mid 2023. No monitoring bores were installed in 2024.

Table 3.1 Additional monitoring bores installed between late 2022 and mid 2023 and added to the groundwater monitoring program

| Bore ID | Easting (m) | Northing (m) | Target geology | Nominal Depth (m) |
|---|---|---|---|---|
| Wybong1a * | 278777 | 6425143 | Alluvium | 20 |
| Wybong1b * | 278777 | 6425143 | Unweathered conglomerate | 40 |
| Wybong1c * | 278777 | 6425143 | Great Northern Seam | 50 |
| Sandy 1a * | 286099 | 6422280 | Alluvium | 20 |
| Sandy 1b * | 286099 | 6422280 | Permian non-coal inter-burden | 70 |
| GWMP1a | 277913 | 6422707 | Alluvium | 20 |
| GWMP1b | 277913 | 6422707 | Great Northern Seam | 30 |
| GWMP2 | 278509 | 6428191 | Great Northern Seam | 140 |
| GWMP3 | 279259 | 6425580 | Great Northern Seam | 69 |
| GW26A ** | 277367 | 6426593 | Weathered rock or alluvium | 25 |
| NGW01_D ** | 278062 | 6427044 | Conglomerate | 33 |
| NGW01_E ** | 278060 | 6427042 | Conglomerate | 112 |

**Notes:** Coordinates GDA94/MGA Zone 56.
* Groundwater level trigger and quality triggers derived for these bores.
** The additional sites above (GW26A and NGW01_D and NGW01_E) have been added to ensure the monitoring network provides sufficient data to determine if the project performance measures are being met.

### 3.2.2 Private groundwater users

The majority of registered bores and wells within the predicted groundwater impact zone are situated on Mangoola Coal landholdings. There are a small number of water supply bores located on private properties at the locations on Figure 3.1.

In addition to the monitoring above, Mangoola also installed the following bores to further verify drawdown impacts;

- one standpipe cluster (three individual bores, Wybong 1a, b and c) in the Wybong Creek alluvial and shallow coal measures; and
- one standpipe cluster (two individual bores, Sandy 1a and b) into Sandy Creek alluvium and underlying coal measures.

Water levels in these bores have been monitored on a monthly basis since early 2023 to collect baseline data before transitioning to a bimonthly frequency.

Condition B39 of SSD 8642 requires that prior to commencing construction of the MCCO Project, the owners of the private water supply bores listed in Table 3.2 may request Mangoola Coal monitor the groundwater level within their bore to determine if there are any impacts from mining activities over time. If monitoring records drawdown of more than 2 m as a result of mining, Mangoola Coal must provide compensatory water in accordance with SSD 8642 conditions B41 to B45.

On 17 May 2021 Mangoola Coal offered monitoring to owners of the bores listed in Table 3.2 in accordance with the requirements of SSD 8642. Quarterly bore-specific monitoring plans have been developed according to the time frames provided in Table 3.2. Groundwater level loggers have been installed at three of the six landholder bores where landholders approved the installation of measuring infrastructure to continuous monitoring levels and to download the data quarterly. The landholder of Bore 2 responded in March 2025 and will be incorporated into the 2025 monitoring program pending the installation of the necessary infrastructure for logger installation.

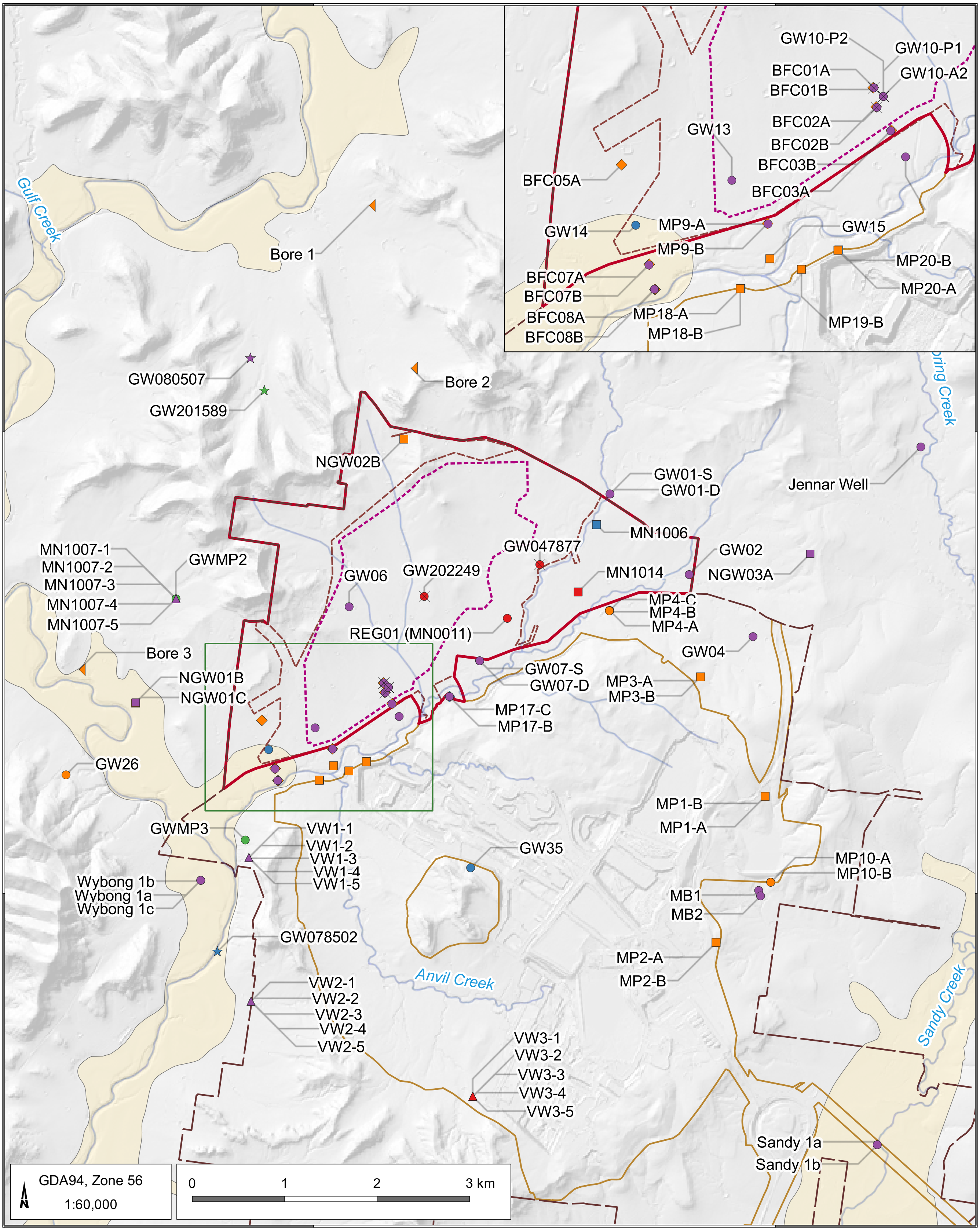
Table 3.2 List of potentially impacted private groundwater bores

| Bore ID* | Receiver ID* | Predicted Groundwater Drawdown (m)# | Bore inspected and monitoring plan developed ** |
|---|---|---|---|
| Bore 1 | R261 | 0.3 | Non-responsive landholder. |
| Bore 2 | R157 | 5.9 | Landholder response in March 2025. |
| Bore 3 | R130 | 1.5 | Yes, Aug 2021. |
| GW080507 | R144 | 0.05 | Yes, May 2022. |
| GW201589 | R144 | 0.1 | Yes, May 2022. |
| GW078502 | R83 | 24.1 | Non-responsive landholder. |

**Notes:** * The receiver IDs and bore locations are presented in SSD 8642 Appendix 3.

# Originally outlined in the MCCO Project EIS (Umwelt 2019a) and as updated in the MCCO Project RTS (Umwelt 2019b). The drawdown predictions were updated after the 3-year model calibration in 2024 (AGE, 2024b).

** As per SSD 8642.




**Shallow strata**
- Multi VWP
- Standpipe
- Standpipe + logger
- Private registered bore
- Standpipe-Decommissioned

**Unweathered Conglomerate**
- Multi VWP
- Single VWP
- Standpipe
- Standpipe + logger
- Other landholder bore

**Deeper Coal Measures**
- Multi VWP
- Standpipe
- Standpipe + logger
- Standpipe + logger-Decommissioned

**Fassifern and Pilot Seams**
- Multi VWP
- Single VWP
- Standpipe
- Standpipe + logger
- Private registered bore
- Standpipe-Decommissioned

**Great Northern Seam and Awaba Tuff**
- Multi VWP
- Standpipe
- Private registered bore
- Standpipe-Decommissioned

- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mine Disturbance Area
- Approved Mangoola Coal Mining Area
- Approved additional Mining Area
- Alluvium
- Drainage

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**Groundwater monitoring locations**

AGE

DATE 26/03/2025

FIGURE No: **3.1**


Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
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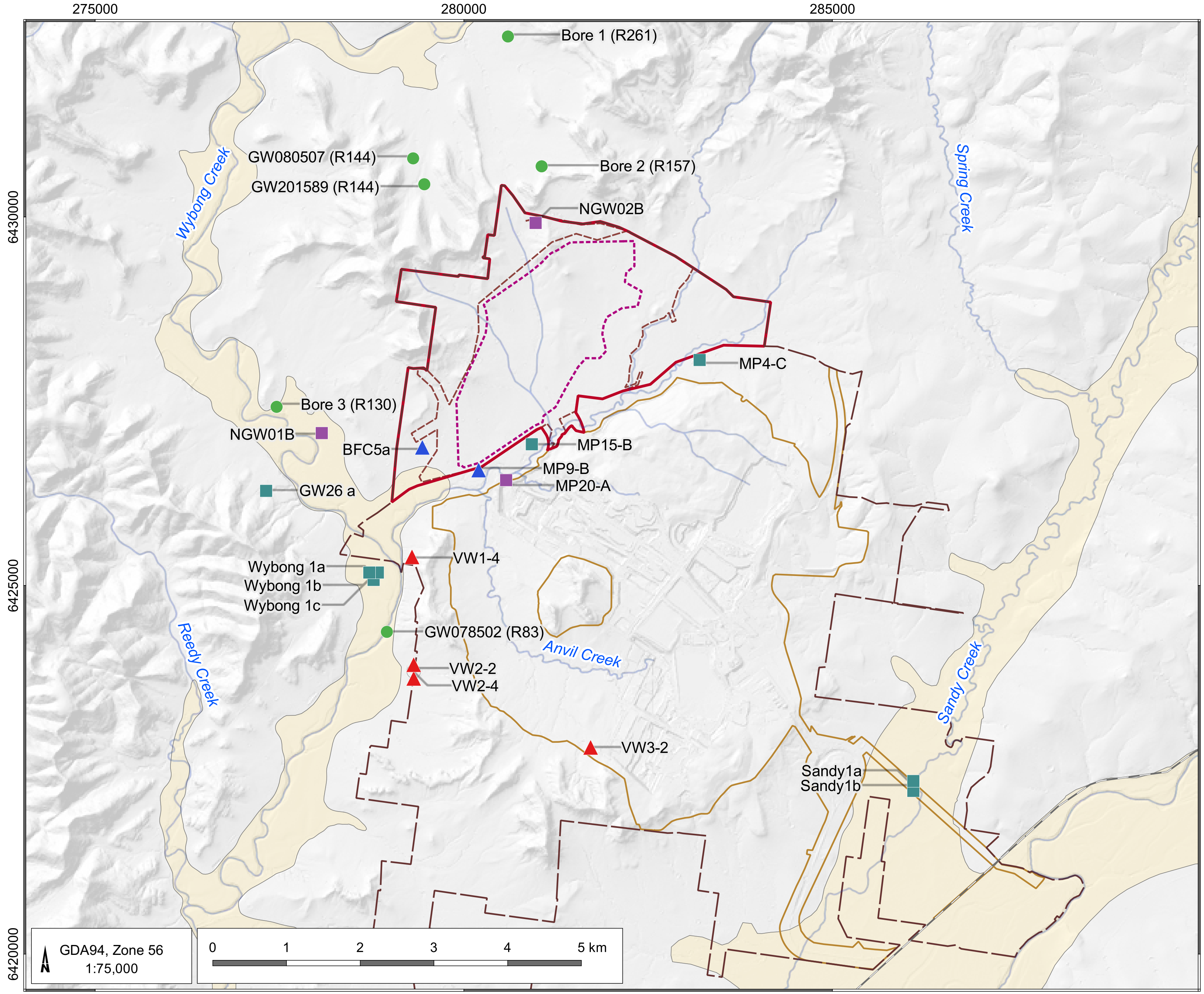
## 3.3 Groundwater triggers values

### 3.3.1 Groundwater level triggers

The GWMP provides groundwater level thresholds for selected bores that trigger further review and investigation of monitoring datasets. The GWMP describes two tiers of triggers for groundwater levels being the Lower Available Limit (LAL) and the Lower Cut-off Level (LCL). The Lower Available Limit (LAL), or the Tier 1 threshold is based on the 5$^{th}$ percentile of all groundwater level data collected until January 2022. When water levels are below the Tier 1 threshold for three consecutive measurements, it indicates a declining trend in groundwater levels that must be internally reviewed. The Lower Cut-off Level (LCL) is the Tier 2 threshold and based on maximum drawdown predicted by the most recent groundwater modelling. The trigger level is set at 2 m below the predicted maximum drawdown at identified locations to account for uncertainty in model predictions as well as climatic variability. According to the TARP (Glencore, 2022) a detailed investigation is required for three consecutive exceedances of the LCL.

Figure 3.2 shows the locations of the bores with groundwater level trigger thresholds. The water level trigger values are provided in Table 3.3.




LEGEND

- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mine Disturbance Area
- Approved Mangoola Coal Mining Area
- Approved additional Mining Area
- Alluvium
- Drainage

**Groundwater Level Trigger bores**

- Private production bore
- Standpipe
- Standpipe + logger
- Single VWP
- Multi VWP

Mangoola 2024 Annual GW Review (MAN5035.001)

**Groundwater level trigger bore locations**

AGE

DATE
26/03/2025

FIGURE No:
**3.2**


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Table 3.3 Mangoola GWMP groundwater level triggers

| Monitoring Location | Easting | Northing | Geology | Tier 1 Trigger Limit (mAHD) | Tier 2 Trigger Limit (mAHD) |
|---|---|---|---|---|---|
| MP15-B | 280924.5 | 6426917 | Shallow Strata / Weathered Conglomerate | 135.4 | 133.4 |
| NGW01B | 278073 | 6427068 | Shallow Strata / Weathered Conglomerate | 130.6 | 129.2 |
| BFC05A | 279438 | 6426875 | Unweathered Conglomerate | 135.3 | 113 |
| GW26 | 277318 | 6426284 | Unweathered Conglomerate | 144.1 | 144 |
| MP4-C | 283200 | 6428060 | Unweathered Conglomerate | 163.4 | 162 |
| MP9-B | 280202 | 6426567 | Unweathered Conglomerate | 113.6 | 103.1 |
| NGW02B | 280975 | 6429919 | Unweathered Conglomerate | 208.5 | 203.4 |
| VW1-4 | 279298 | 6425390 | Unweathered Conglomerate | 108.3 | 101.9 |
| VW2-4 | 279321 | 6423834 | Unweathered Conglomerate | 122.9 | 104.6 |
| MP20-A | 280574 | 6426429 | Fassifern and Pilot Seams | 111.7 | 102.5 |
| VW2-2 | 279321 | 6423834 | Fassifern and Pilot Seams | 132 | 113.9 |
| VW3-2 | 281721 | 6422804 | Deeper Coal Measures | 134.7 | 133.1 |
| Sandy 1a | 286099 | 6422280 | Shallow strata / Weathered conglomerate | tbd | - |
| Sandy 1b | 286099 | 6422280 | Unweathered Conglomerate | tbd | - |
| Wybong 1a | 278777 | 6425143 | Shallow strata / Weathered conglomerate | tbd | - |
| Wybong 1b | 278777 | 6425143 | Unweathered Conglomerate | tbd | - |
| Wybong 1c | 278777 | 6425143 | Great Northern Seam and Awaba Tuff | tbd | - |
| Bore 1 | 280599 | 6432450 | Unweathered Conglomerate | tbd | 2m drawdown[1] |
| Bore 2 | 281056 | 6430688 | Unweathered Conglomerate | tbd | 2m drawdown[1] |
| Bore 3 | 277461 | 6427424 | Unweathered Conglomerate | tbd | 2m drawdown[1] |
| GW080507 | 279313 | 6430796 | Shallow strata / Weathered conglomerate | tbd | 2m drawdown[1] |
| GW078502 | 278957 | 6424371 | Fassifern and Pilot Seams | tbd | 2m drawdown[1] |
| GW201589 | 279464 | 6430445 | Great Northern Seam and Awaba Tuff | tbd | 2m drawdown[2] |

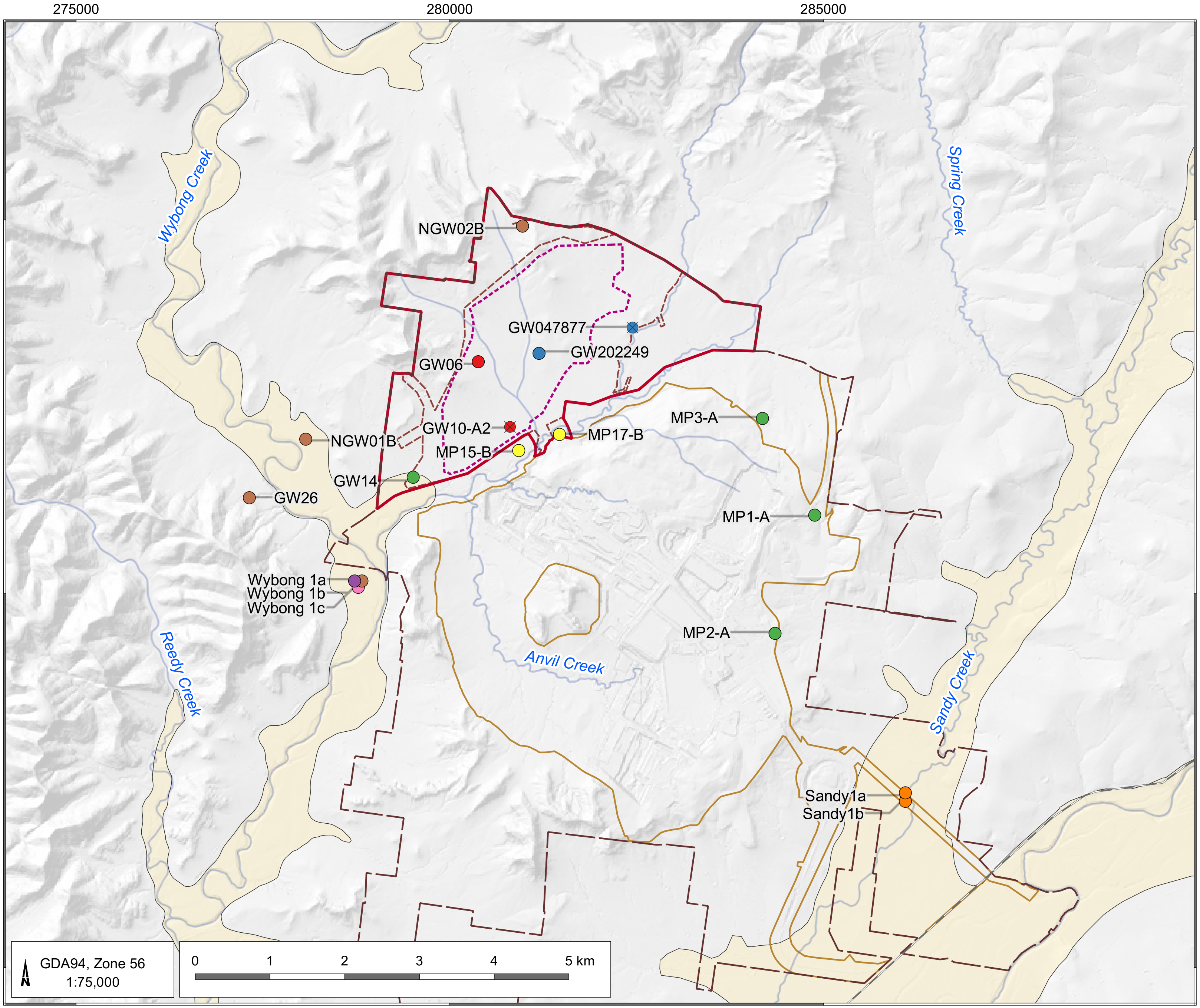
**Notes:** Tbd = to be determined following 12 months of monitoring data. This occurred within 2024 and as such triggers have been added to the updated GWMP currently submitted to DPHI for review and approval.
[1] Predicted drawdown is less than 2m at these private bores: trigger set at 2m drawdown.
[2] Predicted drawdown is 7.5m at this bore: trigger set at 2m drawdown, consistent with performance criteria.

### 3.3.2 Groundwater quality triggers

Similar to groundwater levels, the GWMP outlines a two-tier approach for groundwater quality trigger thresholds. The Upper Allowable Limit (UAL) or the Tier 1 trigger is based on the 95$^{th}$ percentile for electrical conductivity (EC) for all groundwater quality data collected until December 2021. The UAL indicates a potential trend towards higher salinity, but potentially not a reduction in environmental value or beneficial use. According to the TARP (Glencore, 2022) an internal review is required for three consecutive exceedances to overcome unnecessary duplication of analysis and graphing. A Tier 1 trigger threshold was not calculated for pH since pH levels are generally within and very close to the Tier 2 thresholds of pH 6 to pH 9.

The Upper Cut-off Limit (UCL) or Tier 2 limit is the beef cattle guideline limit of 7,500 uS/cm for EC and pH is pH 6 to pH 9. Again, a detailed investigation is required for three consecutive exceedances of Tier 2. Four of the selected trigger bores yield groundwater with high salinity that naturally exceeds the beef cattle guideline value and, in this case, only the Tier 1 trigger value is applied.

Figure 3.3 shows the locations of the bores selected for groundwater quality trigger thresholds. The trigger thresholds are summarised in Table 3.4.




LEGEND

- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mine Disturbance Area
- Approved Mangoola Coal Mining Area
- Approved additional Mining Area
- Alluvium
- Drainage

**Groundwater quality Trigger Bores**

- Big Flat Creek area coverage
- Shallow Strata/ weathered conglomerate
- Unweathered conglomerate
- Fassifern and Pilot seams
- Great northern seam
- Permian non-coal interburden
- Deeper coal measures
- Wybong Creek alluvium
- Deeper coal measures-decommissioned
- Shallow Strata/ weathered conglomerate-decommissioned

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**Groundwater quality trigger bore locations**

DATE
26/03/2025

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FIGURE No:
**3.3**


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Table 3.4 Mangoola GWMP groundwater quality triggers

| Monitoring Location | Easting | Northing | Geology | Tier 1 pH trigger | Tier 2 pH trigger | Tier 1 EC trigger | Tier 2 EC trigger |
|---|---|---|---|---|---|---|---|
| GW06 | 280383 | 6428105 | Shallow Strata / Weathered Conglomerate | 6 | 9 | 333 | 7500 |
| MP15-B | 280924.5 | 6426917 | Shallow Strata / Weathered Conglomerate | 6 | 9 | 16887 | - |
| MP17-B | 281469.7 | 6427132.6 | Shallow Strata / Weathered Conglomerate | 6 | 9 | 22797 | - |
| NGW01B | 278073.8 | 6427068.6 | Shallow Strata / Weathered Conglomerate | 6 | 9 | 5356 | 7500 |
| GW26 | 277318.8 | 6426284.9 | Unweathered Conglomerate | 6 | 9 | 2742 | 7500 |
| NGW02B | 280975.3 | 6429919.9 | Unweathered Conglomerate | 6 | 9 | 5584 | 7500 |
| GW14 | 279512 | 6426559 | Fassifern and Pilot Seams | 6 | 9 | 6712 | 7500 |
| MP1-A | 284886.2 | 6426052.2 | Fassifern and Pilot Seams | 6 | 9 | 6716 | 7500 |
| MP2-A | 284354.8 | 6424470.2 | Fassifern and Pilot Seams | 6 | 9 | 17596 | - |
| MP3-A | 284186.8 | 6427346.1 | Fassifern and Pilot Seams | 6 | 9 | 10540 | - |
| Sandy 1a | 286099 | 6422280 | Shallow strata / Weathered conglomerate | 6 | 9 | - | 7500 |
| Sandy 1b | 286099 | 6422280 | Unweathered Conglomerate | 6 | 9 | - | 7500 |
| Wybong 1a | 278777 | 6425143 | Shallow strata / Weathered conglomerate | 6 | 9 | - | 7500 |
| Wybong 1b | 278777 | 6425143 | Unweathered Conglomerate | 6 | 9 | - | 7500 |
| Wybong 1c | 278777 | 6425143 | Great Northern Seam and Awaba Tuff | 6 | 9 | - | 7500 |

# 4 Results from the monitoring period

## 4.1 Groundwater levels

Natural fluctuations in groundwater levels occur in response to a range of stresses. These stresses can range from short term events, such as rainfall recharge events, or long-term events, such as multi-year drought. To capture the range of stresses, groundwater levels/pressures are measured both manually over longer time frames, and automatically over shorter time frames with pressure transducers and data loggers.

### 4.1.1 Rainfall

Monthly patched point rainfall data was obtained from the Long Paddock website on 22 Jan 2025 (DES, 2025) for a point adjacent to the mine (longitude 150.70° latitude -32.30°). The SILO data interpolates rainfall and evaporation records from available stations to the selected location. The cumulative rainfall departure (CRD) from the monthly mean was calculated and illustrates wetter or dryer periods compared to long-term average rainfall. Figure 4.1 shows both monthly rainfall and the CRD. Wetter than average periods are indicated by increasing slopes, and dryer periods shown as declining slopes. Notable recent features shown on Figure 4.1 are the short but intense drought period from March 2017 to February 2020, followed by above average rainfall and La Nina periods from 2020 to 2022. Between 2022 and early 2024 rainfall has been below average. For the reporting period (2024) rainfall was generally above average. At the time of writing the NSW Department of Primary Industries (DPI) classifies the area as being 'non-drought affected' (NSW DPI, February 2025).

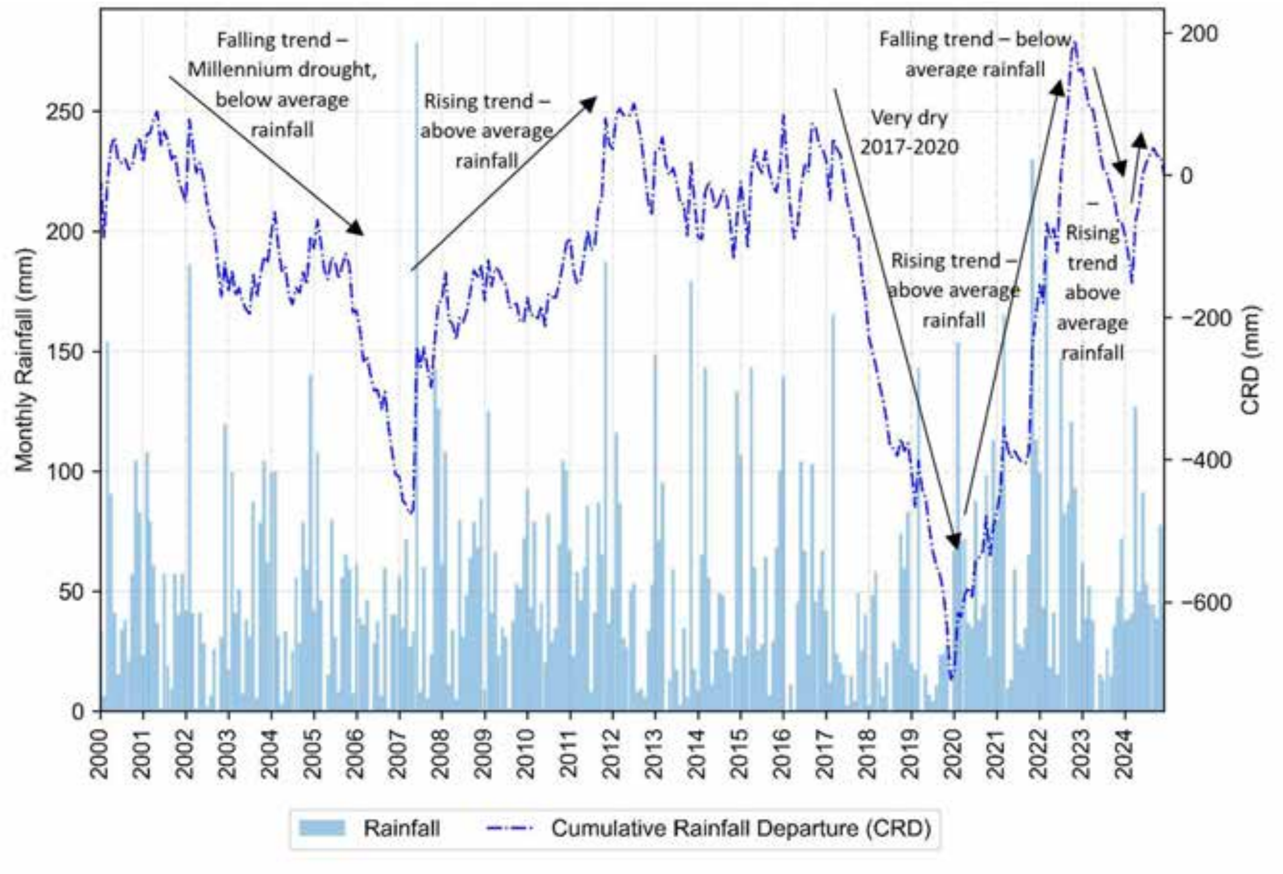


Figure 4.1 Monthly SILO rainfall and CRD

### 4.1.2 Hydrostratigraphic unit monitoring and mapping

Groundwater levels recorded in the monitoring bore network were plotted against time for each hydrostratigraphic unit present at Mangoola presented in Appendix A. The groundwater levels are also plotted along with the CRD to indicate where water level trends are correlated with climate, and where other factors such as mining may be influencing groundwater levels. Groundwater level data were used to prepare contour maps for May 2024 conditions, covering each hydrostratigraphic unit that had at least one water level measurement per bore within that unit. These maps are included with Appendix B.

#### 4.1.2.1 Shallow Strata / Weathered Conglomerate

Groundwater levels recorded within the monitoring bores screened in the shallow strata/weathered conglomerate are presented in Figure A 1. Generally, groundwater levels demonstrate that fluctuations reflect climatic conditions and rainfall. During the 2024 reporting period groundwater levels have increased in most of the monitoring bores as a result of an above average rainfall phase experienced in 2024.

Consistent with previous reporting periods,

Figure B 1 shows that groundwater levels remain a general reflection of topography, with no significant influence evident due to mining activities.

#### 4.1.2.2 Unweathered Conglomerate

Figure A 2 shows the deeper unweathered conglomerate groundwater levels tend to be less influenced by climatic conditions. Groundwater appears to flow generally north to south with the monitoring bores at the northernmost and southeasternmost extents, NGW02B and Sandy 1b, recording the lowest and highest water levels, respectively. This pattern follows a stepped southward groundwater gradient that mirrors the region's topography. The monitoring bores GW15, and historically MP18-B, MP19-B and MP20-B, which are located close to the mine footprint (Table 3.1), show a potential mining activity impact. VW1-4, located 1.4 km southwest of the bore cluster, has shown the most significant potential response to regional climatic and rainfall conditions, recharging 18.96 m between December 2023 and December 2024. Groundwater levels here have returned to levels last recorded in 2016, following a consistent drawdown since November 2015. Groundwater levels at monitoring bore GW26, which is located approximately 3.5 km west of the mining lease, continues to record a slow decline since July 2016 indicating a potential mining impact.

Figure B 2 illustrates an area of drawdown influencing groundwater levels west of the Main Pit.

#### 4.1.2.3 Great Northern Seam and Awaba Tuff

The Great Northern Seam and Awaba Tuff groundwater level time series are shown in Figure A 3. The majority of the bores were installed in the first quarter of 2023, resulting in limited time series data. Initial observations indicate some alignment with regional CRD dynamics during this period, but additional data is needed to validate these patterns. The lack of sufficient spatial data did not allow meaningful groundwater contours to be produced.

#### 4.1.2.4 Fassifern and Pilot Seams

Similar to the deeper unweathered conglomerate groundwater system, the Fassifern and Pilot Seams groundwater levels tend to be less influenced by climatic conditions. As expected, some monitoring bores within the coal seams which are located close to the Main Pit West area (i.e. GW14, MP18-A and MP20-A), have recorded a decline in groundwater levels attributed to mining as shown in Figure A 4 and in

Figure B 3. The groundwater levels in these monitoring bores have stabilised since the last reporting period.

#### 4.1.2.5 Deeper Coal Measures

Monitoring bores recording groundwater levels within the deeper coal measures have recorded a relatively stable trend within mining influence from climatic conditions, as shown in Figure A 5. The lack of sufficient spatial data did not allow groundwater contours to be prepared.

#### 4.1.2.6 Water level results from reporting period

Table 4.1 presents the 2024 groundwater monitoring results of depth to groundwater at selected monitoring bores to provide insight into the groundwater dynamics of the monitored sites for the year 2024. The table summarises the minimum, average, and maximum values measured against the Tier 1 and Tier 2 triggers when applicable to assess groundwater level variations throughout the monitoring period.

Table 4.1 2024 Groundwater Monitoring Results - Groundwater Level

| Monitoring Bores | Depth to Groundwater Results (mBGL) | | | Tier 1 | Tier 2 |
|---|---|---|---|---|---|
| | Min | Ave | Max | | |
| BFC05 | 14.94 | 15.18 | 15.54 | 14.9[1] | 16.9 |
| Bore 3 (R130) | 12.98 | 13.81 | 13.93 | tbd | 2m drawdown |
| GW02 | 3.66 | 3.87 | 4.33 | - | - |
| GW04 | 11.47 | 11.50 | 11.53 | - | - |
| GW06 | 0.59 | 0.82 | 1.32 | - | - |
| GW13 | 0.95 | 1.96 | 4.39 | - | - |
| GW14 | 33.93 | 34.15 | 34.37 | - | - |
| GW15 | 20.5 | 20.53 | 20.55 | - | - |
| GW26 | 18.05 | 18.16 | 18.31 | 17.4 | 17.5[2] |
| GW080507 (R144) | 0.75 | 1.40 | 2.38 | tbd | 2m drawdown |
| GW201589 (R144) | 6.64 | 13.36 | 28.23 | tbd | 2m drawdown |
| MP1-A | 9.22 | 9.32 | 9.46 | - | - |
| MP1-B | 12.45 | 13.04 | 13.42 | - | - |
| MP9-A | 12.55 | 13.00 | 13.32 | - | - |
| MP10-A | 16.12 | 16.66 | 17.3 | - | - |
| MP10-B | 9.18 | 9.54 | 9.80 | - | - |
| MP15-B | No data | No data | No data | - | - |
| MP16-B | 10.82 | 11.51 | 11.86 | - | - |
| MP17-B | 3.2 | 4.22 | 5.24 | - | - |
| MP18-A | 48.44 | 48.46 | 48.48 | - | - |
| MP19-A | 42.81 | 43.02 | 43.36 | - | - |
| MP2-A | 37.29 | 37.86 | 38.28 | - | - |
| MP2-B | 21.85 | 21.93 | 22.04 | - | - |
| MP20-A | 33.29 | 33.74 | 37.45 | 34* | 43.2 |
| MP3-A | 28.05 | 28.24 | 28.41 | - | - |
| MP3-B | 25.66 | 25.73 | 25.81 | - | - |
| MP4-A | 0.46 | 0.83 | 1.14 | - | - |
| MP4-B | 1.61 | 1.88 | 2.05 | - | - |
| MP4-C | 3.78 | 4.06 | 4.46 | 5.2 | 6.6 |
| MP9-B | 25.54 | 28.02 | 30.49 | 29.9* | 40.4 |

| Monitoring Bores | Depth to Groundwater Results (mBGL) | | | Tier 1 | Tier 2 |
|---|---|---|---|---|---|
| | Min | Ave | Max | | |
| NGW01B | 14.2 | 14.25 | 14.31 | 15.4 | 16.8 |
| NGW02B | 6.56 | 6.91 | 7.18 | 7.8 | 12.9 |
| Sandy 1a | 7.15 | 15.65 | 18.81 | tbd | tbd |
| Sandy 1b | 15.54 | 15.78 | 16.04 | tbd | tbd |
| VW1-4 | 9.82 | 26.36 | 35.83 | 37.7 | 44.1 |
| VW2-2 | 18.22 | 19.17 | 21.75 | 13.1[1] | 31.2 |
| VW2-4 | 22.64 | 23.32 | 24.12 | 22.2[1] | 40.5 |
| VW3-2 | 60.55 | 61.02 | 61.60 | 65.1 | 66.7 |
| Wybong 1a | 13.01 | 13.15 | 13.25 | tbd | tbd |
| Wybong 1b | 17.80 | 18.08 | 19.20 | tbd | tbd |
| Wybong 1c | 19.20 | 19.84 | 20.12 | tbd | tbd |

**Notes:** Tbd = to be determined following 12 months of monitoring data. This occurred within 2024 and as such triggers have been added to the updated GWMP currently submitted to DPHI for review and approval.

[1] Tier 1 trigger exceedance and investigation was undertaken (AGE, 2023a; AGE, 2023b; AGE, 2023c; AGE, 2024a; AGE, 2024c).

[2] Tier 2 trigger exceedance and investigation was undertaken (AGE, 2023a; AGE, 2023b; AGE, 2023c; AGE, 2024a; AGE, 2024c).

[*] Recorded a single exceedance that did not involve three consecutive events and thus did not trigger a TARP as per GWMP (2022).

### 4.1.3 Groundwater level assessment against triggers

As outlined in Table 3.4, the GWMP provides two tiers of trigger threshold for groundwater levels.

During the 2023 monitoring period Tier 1 trigger events occurred at piezometers BFC05, VW2-2 and VW2-4, and a Tier 2 trigger exceedance at monitoring bore GW26, requiring TARP assessment per the GWMP (2022). These triggers, originally established based on the 2019 model's predictions (AGE, 2019b), were evaluated through investigations (AGE, 2023a; AGE, 2023b; AGE, 2023c; AGE, 2024a; AGE, 2024c), which attributed declining groundwater levels to mining induced groundwater depressurisation. Following the model recalibration, the updated triggers and predictions will be incorporated within the framework of the updated GWMP, which was submitted for review and approval to DPHI in December 2024.

In contrast, the 2024 monitoring results indicate that the above-mentioned monitoring points – BFC05, VW2-2, VW2-4, and GW26 – continued to exceed the trigger levels established in the 2022 GWMP. Appendix C contains hydrographs of the groundwater level trigger bores and groundwater trigger levels which demonstrates that groundwater levels have stabilised or improved relative to the 2023 observations for the majority of these monitoring bores, where the water level recorded in GW26 continues to decline at a consistent rate. This maintains consistency with the earlier conclusion that there is no significant environmental risk associated with these boreholes. Continued monitoring is recommended to ensure long-term stability and to validate the ongoing influence of mining-induced depressurisation on regional groundwater dynamics. Particularly, the numerical groundwater model, recalibrated in 2023/2024 (AGE, 2024e), adjusted GW26's trigger, which will be reflected in the updated GWMP and unlikely to be exceeded.

The data displayed in Appendix D for the Mangoola site plot two different datasets: the Environmental Monitoring Database (EMD), which is available online, and a historical dataset held by AGE, which is a spreadsheet used for previous annual groundwater review reports and contains data only for a limited subset of monitoring bores. Due to some slight differences between these two datasets, charts in Appendix D show both.

### 4.1.4 Private bores monitoring

Figure C 1, Figure C 2 and Figure C 3 show groundwater levels monitored by Mangoola at Bore 3, GW080507 and GW201589 respectively through 2024. The observed declines at GW080507 and GW201589 are likely due to below average rainfall and local abstraction, and no clear mining impacts are identified. Bore 3 shows minor recharge fluctuations correlated closely to localised rainfall events with fast recoveries (AGE, 2023d; AGE, 2023e; AGE, 2024b; AGE, 2024f; AGE, 2024g; AGE, 2024h; AGE, 2024i; AGE, 2025a; AGE, 2025b). Ongoing monitoring will refine these trends as the database expands throughout 2025.

## 4.2 Groundwater quality and monitoring

### 4.2.1 Quality monitoring overview

Groundwater samples collected from the Mangoola monitoring network are analysed for:

- pH;
- Electrical Conductivity (EC);
- Total Dissolved Solids (TDS);
- major ions; and
- dissolved metals.

#### 4.2.1.1 pH and electrical conductivity (EC)

Table 4.2 presents the 2024 groundwater monitoring results for pH and electrical conductivity (EC) at selected monitoring bores to provide insight into the overall hydrochemical characteristics of the monitored sites for the reporting period. The table summarises the minimum, average, and maximum values for each parameter measured against Tier 1 and Tier 2 triggers where appropriate, to provide insight into groundwater quality variations throughout the monitoring period.

Table 4.2 2024 Groundwater Monitoring Results - pH, EC

| Monitoring Bores | pH Results | | | | | EC Results (µS/cm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Ave | Max | Tier 1 | Tier 2 | Min | Ave | Max | Tier 1 | Tier 2 |
| GW02 | 7.00 | 7.98 | 9.18 | - | - | 13,100 | 18,440 | 23,500 | - | - |
| GW04 | 7.09 | 7.18 | 7.37 | - | - | 6,840 | 7,366 | 7,520 | - | - |
| GW06 | 6.55 | 7.51 | 8.00 | 6 | 9 | 191 | 235 | 261 | 333 | 7,500 |
| GW13 | 7.32 | 7.64 | 7.89 | - | - | 172 | 248 | 312 | - | - |
| GW14 | 7.06 | 7.15 | 7.27 | - | - | 5,660 | 6,194 | 6,650 | 6,712 | 7,500 |
| GW15 | 6.83 | 6.97 | 7.13 | - | - | 12,200 | 13,940 | 15,100 | 11,483 | - |
| GW26 | 7.06 | 7.24 | 7.42 | 6 | 9 | 1,350 | 1,497 | 1,634 | 2,742 | 7,500 |
| GW080507 (R144) | 5.86 | 6.25 | 7.31 | tbd | tbd | 147 | 189 | 247 | tbd | tbd |
| GW201589 (R144) | 6.41 | 6.69 | 7.36 | tbd | tbd | 160 | 194 | 227 | tbd | tbd |
| MP1-A | 7.73 | 7.83 | 7.97 | 6 | 9 | 4,810 | 5,160 | 5,380 | 6,716 | 7,500 |
| MP1-B | 8.24 | 8.30 | 8.41 | - | - | 5,850 | 5,966 | 6,140 | - | - |
| MP9-A | 6.62 | 6.76 | 6.92 | - | - | 10,300 | 12,433 | 14,100 | - | - |
| MP10-A | 7.69 | 7.80 | 7.93 | - | - | 5,510 | 5,584 | 5,730 | - | - |
| MP10-B | 11.09 | 11.22 | 11.49 | - | - | 12,500 | 12,900 | 13,200 | - | - |

| Monitoring Bores | pH Results | | | | | EC Results (µS/cm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Ave | Max | Tier 1 | Tier 2 | Min | Ave | Max | Tier 1 | Tier 2 |
| MP15-B | No data | - | - | 6 | 9 | No data | - | - | 16,887 | - |
| MP16-B | 6.86 | 6.99 | 7.11 | - | - | 12,270 | 14,067 | 15,500 | - | - |
| MP17-B | 6.36 | 6.62 | 6.88 | 6 | 9 | 1,686 | 2,155 | 2,625 | 22,797 | - |
| MP18-A | 7.06 | 7.18 | 7.52 | - | - | 7,670 | 8,022 | 8,270 | - | - |
| MP19-A | 6.76 | 6.83 | 6.94 | - | - | 9,490 | 9,756 | 10,000 | - | - |
| MP2-A | 7.43 | 7.49 | 7.62 | 6 | 9 | 13,500 | 16,560 | 16,600 | 17,596 | - |
| MP2-B | 6.81 | 6.94 | 7.2 | - | - | 18,100 | 18,400 | 18,800 | - | - |
| MP3-A | 7.66 | 7.74 | 7.8 | 6 | 9 | 7,140 | 7,425 | 7,860 | 10,540 | - |
| MP3-B | 7.16 | 7.24 | 7.38 | - | - | 10,200 | 10,540 | 10,900 | - | - |
| MP4-A | 7.53 | 7.79 | 8.26 | - | - | 8.560 | 8,882 | 9,410 | - | - |
| MP4-B | 7.86 | 8.11 | 8.44 | - | - | 6,210 | 6,346 | 6,630 | - | - |
| MP4-C | 6.61 | 6.83 | 7.12 | - | - | 20,280 | 23,322 | 24,900 | - | - |
| NGW01B | 7.48 | 7.79 | 8.07 | 6 | 9 | 3,360 | 3,476 | 3,740 | 5,356 | 7,500 |
| NGW02B | 7.31 | 7.36 | 7.41 | 6 | 9 | 3,380 | 3,486 | 3,570 | 5,584 | 7,500 |
| Sandy 1a | 6.64 | 6.83 | 7.37 | 6 | 9 | 2,690 | 3,172 | 3,530 | - | 7,500 |
| Sandy 1b | 7.28 | 7.43 | 7.59 | 6 | 9 | 1,485 | 1,620 | 1,823 | - | 7,500 |
| Wybong 1a | 7.06 | 7.20 | 7.43 | 6 | 9 | 2,176 | 2,369 | 2,658 | - | 7,500 |
| Wybong 1b | 10.71 | 11.43 | 11.94 | 6 | 9[2] | 2,450 | 3,596 | 4,200 | - | 7,500 |
| Wybong 1c | 11.70 | 11.96 | 12.35 | 6 | 9[2] | 3,850 | 4,662 | 5,650 | - | 7,500 |

**Notes:** Tbd = to be determined following 12 months of monitoring data. This occurred within 2024 and as such triggers have been added to the updated GWMP currently submitted to DPHI for review and approval.

[2] Tier 2 trigger exceedance and investigation was undertaken (AGE, 2024d).

#### 4.2.1.2 Major ions

The ionic balance of all major ions analyses was received. All samples showed an ionic charge balance error[1] less than ± 10% (NSW DPI, 2012). The proportions of the major anions and cations were used to determine the hydro-chemical facies of the groundwaters sampled over the 2024 monitoring period. The results of these are displayed in both Table 4.3 and Table 4.4. The anion-cation composition for the 2024 samples are displayed in Piper diagrams in Appendix E in Figure E 1 and the entire EMD dataset including data from both 2023 and 2024 are shown on the Piper diagram in Figure E 2. In summary, the following predominant hydro-chemical facies characterised groundwater systems in the Mangoola area:

- Shallow Strata and Unweathered Conglomerate generally exhibit a Sodium/Potassium and Chloride type water; and
- Fassifern and Pilot Seams generally exhibits a Sodium/Potassium and Bicarbonate type water.

[1] Ionic charge-balance error (CBE). When all the major cations (such as Ca2+, Mg2+, Na+, K+) and anions (such as Cl-, SO42-, and HCO3 -) have been analysed carefully, the sum of cations in equivalents should equal the sum of anions in equivalents.

#### 4.2.1.3 Dissolved metals

Section 4.1 of the GWMP requires annual comprehensive water quality monitoring at ten sites for water level, field parameters and a full laboratory analysis of major ions and metals. Collection of the required annual samples was scheduled and completed in November 2024 by third party contractor: CBased Environmental (CBased). Two water samples were collected during 2024 from MP9a to satisfy Condition 19 of EPBC Approval 2018/8280 and Condition 10, Part D of SSD 8642. Two water samples were also collected from monitoring bores GW04, GW14 and MP19-A. Single samples were collected from GW02 and GW26. GW07-D could not be sampled throughout the year as it was either dry, too low, or muddy. Results from these analyses are displayed in Table 4.4.

Table 4.3 Annual Groundwater Major Ions Results 2024

| Parameter | Units | GW04 (May) | GW04 (Dec) | GW06 | MP10-A | MP10-B | MP18-A | MP2-A | MP2-B | MP3-A | MP4-C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TDS | mg/L | 4,600 | 4,760 | 132 | 3,630 | 9,440 | 5,270 | 9,480 | 12,600 | 4,960 | 16,900 |
| Hydroxide | mg/L | <1 | <1 | <1 | <1 | 3.74 | <1 | <1 | <1 | <1 | <1 |
| Carbonate | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate | mg/L | 1,854.4 | 1,634.8 | 68.32 | 1,915.4 | <1 | 2,171.6 | 2,867 | 1,549.4 | 2,086.2 | 1,184.62 |
| Sulfate | mg/L | <1 | 86 | 7 | 178 | 456 | <1 | <1 | 1,850 | 33 | 863 |
| Chloride | mg/L | 1,520 | 1,340 | 24 | 916 | 4,200 | 1,590 | 3,280 | 4,940 | 1,540 | 7,120 |
| Dissolved Calcium | mg/L | 45 | 33 | 6 | 15 | 1300 | 34 | 42 | 134 | 18 | 487 |
| Dissolved Magnesium | mg/L | 15 | 13 | 9 | 19 | 2 | 42 | 24 | 153 | 8 | 444 |
| Dissolved Sodium | mg/L | 1,840 | 1,760 | 19 | 1,350 | 1,580 | 1,840 | 3,100 | 4,210 | 1,970 | 4,810 |
| Dissolved Potassium | mg/L | 11 | 10 | 2 | 11 | 50 | 20 | 21 | 38 | 9 | 45 |
| Total Phosphorous | mg/L | 1.76 | 1.2 | - | 0.16 | 0.02 | 0.06 | 0.14 | 0.04 | 0.15 | - |

Table 4.4 Annual Groundwater Speciation Results 2024

| Parameter | Units | GW02 | GW26 | GW04 (May) | GW04 (Nov) | GW14 (May) | GW14 (Nov) | MP9-A (May) | MP9-A (Nov) | MP19-A (May) | MP19-A (Nov) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TDS | mg/L | 14,800 | 764 | 4,600 | 4,760 | 3,680 | 4,060 | 16,100 | 10,700 | 5,970 | 5,990 |
| Hydroxide | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Carbonate | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate | mg/L | 158.6 | 422.12 | 1,854.4 | 1634.8 | 824.72 | 761.28 | | 885.72 | 1,256.6 | 1,156.56 |

| Parameter | Units | GW02 | GW26 | GW04 (May) | GW04 (Nov) | GW14 (May) | GW14 (Nov) | MP9-A (May) | MP9-A (Nov) | MP19-A (May) | MP19-A (Nov) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | mg/L | 6 | 47 | <1 | 86 | 57 | 105 | 178 | 289 | 404 | 456 |
| Chloride | mg/L | 7,960 | 295 | 1,720 | 1,550 | 1,600 | 1,580 | 4,180 | 4,420 | 2,660 | 2,880 |
| Dissolved Calcium | mg/L | 66 | 28 | 45 | 33 | 111 | 106 | 200 | 130 | 121 | 131 |
| Dissolved Magnesium | mg/L | 379 | 62 | 15 | 13 | 191 | 201 | 556 | 676 | 244 | 243 |
| Dissolved Sodium | mg/L | 3,950 | 213 | 1,840 | 1,760 | 1,030 | 1,030 | 1,610 | 2,130 | 1,830 | 1,700 |
| Dissolved Potassium | mg/L | 49 | 12 | 11 | 10 | 27 | 28 | 49 | 84 | 29 | 28 |
| Total Phosphorous | mg/L | 0.1 | 0.18 | 1.76 | 1.2 | 0.51 | 0.34 | <0.2 | <0.1 | 0.84 | 0.25 |
| Dissolved Aluminum | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <10 | <10 |
| Dissolved Arsenic | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Dissolved Barium | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 238 | 228 |
| Dissolved Boron | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 190 | 240 |
| Dissolved Iron | mg/L | 12,000 | <50 | 50 | - | 50 | <1 | 13,800 | <50 | 60 | 270 |
| Dissolved Lithium | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 54 | 55 |
| Dissolved Manganese | mg/L | 989 | <1 | 80 | <1 | 377 | <1 | 172 | 147 | 333 | 307 |
| Dissolved Rubidium | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 55 | 50 |
| Dissolved Selenium | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <10 | <10 |
| Dissolved Silicon | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 8,460 | 9,340 |
| Dissolved Strontium | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 6,480 | 7,670 |
| Dissolved Zinc | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 16 | 11 |

## 4.3 Groundwater quality assessment against triggers

Groundwater quality monitoring data collected during 2024 was compared to trigger values outlined in Table 3.4. Monitoring sites Wybong 1b and Wybong 1c recorded groundwater pH trigger events in 2024. Monitoring sites Wybong 1b and Wybong 1c were installed in March 2023 as part of the additional groundwater monitoring sites to assess baseline conditions as per the MCCO EIS (Umwelt 2019). A summary of the construction details for each site is provided in Table 4.5.

Table 4.5 Construction details of Wybong 1b and Wybong 1c

| Bore ID | Easting (m) | Northing (m) | Target Geology | Depth (m) |
|---|---|---|---|---|
| Wybong 1b | 278777 | 6425143 | Unweathered conglomerate | 35 |
| Wybong 1c | 278777 | 6425143 | Great Northern Seam and Awaba Tuff | 65 |

The pH trigger exceedances required assessment against the TARP outlined in the GWMP (2022). The results of the investigation (AGE, 2024d) concluded the exceedances were associated with leakage of cement grout used to seal the annulus of the borehole, rather than related to mining operations.

Appendix F contains stacked charts displaying groundwater levels, pH and EC values for each groundwater quality trigger bore. As noted previously, two different datasets are available with some slight historical differences.

# 5 Mine Inflow and Comparison with Predictions

Engeny has developed a spoil seepage and pit water balance model that is used to provide quarterly estimates of groundwater inflow to Main Pit West, South Pit and Wybong Pit. The estimated hardrock and colluvial/alluvial ingress to Main Pit West, South Pit and Wybong Pit for each quarter in 2024 was approximately 31.1 ML/year (Engeny, 2024a; Engeny, 2024b; Engeny, 2024c; Engeny, 2025).

Groundwater modelling for the original Environmental Assessment was undertaken by Mackie Environmental Research (MER) in 2006 (Mackie, 2006). Since then, the progressive three yearly updates to the numerical groundwater model updates were completed by MER in 2010 (Mackie, 2010), 2013 (Mackie, 2013) and AGE in 2016 (AGE, 2016). The numerical groundwater model was further validated and recalibrated in 2024 (AGE, 2024) as part of the Mangoola Coal Continued Operations (MCCO) approval condition. Despite slight divergences between the observed and modelled datasets, groundwater inflow volumes estimated by AGE for the 2024 reporting period (i.e. 125 ML: AGE, 2024e) were in accordance with the groundwater inflows from quarterly reviews.

Engeny concluded that the estimate is not considered to be a significant inflow and is in line with model predictions, therefore does not trigger enactment of the trigger actions response plans (TARPs) outlined in the Mangoola GWMP (Engeny, 2025). The total cumulative estimated hardrock and colluvial ingress is significantly lower than Mangoola Coal's licensed annual take of 700 ML under WAL41561 (Converted in 2021 – previously 20BL172598).

# 6 Key Performance and Management Issues

Where the criteria were exceeded for three consecutive monitoring events, the response protocol was enacted as per measures prescribed in the trigger action response plans (TARPs) of the approved GWMP (2022). Following an exceedance, initial steps of the protocol require review of the results and an investigation to determine if an incident has occurred that could cause environmental harm. AGE was engaged to investigate the exceedances and report on findings. As per the TARPS, exceedances of trigger values are only reportable if an investigation determined that an incident had occurred. The AGE trigger level exceedance review reports concluded that the groundwater level exceedances posed low potential for material environmental harm, and therefore no incidents were considered to have occurred.

# 7 Proposed Improvements

As noted above, the three-yearly review of the numerical groundwater model (AGE 2024e) for Mangoola was completed during 2023 and finalised in 2024. The updated model has been calibrated with available groundwater monitoring data, in line with the GWMP. The revised findings on the magnitude and timing of groundwater impacts have been subsequently incorporated into the updated GWMP which was submitted for review and approval to DPHI in December 2024. The next validation and review of the groundwater model will be in 2026.

As also indicated earlier, additional monitoring bores have satisfied the criteria for establishing triggers and have been fully integrated into the monitoring system, with their locations and triggers included in the updated GWMP, submitted for review and approval to DPHI in December 2024.

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# Appendix A

# Hydrographs by geological unit

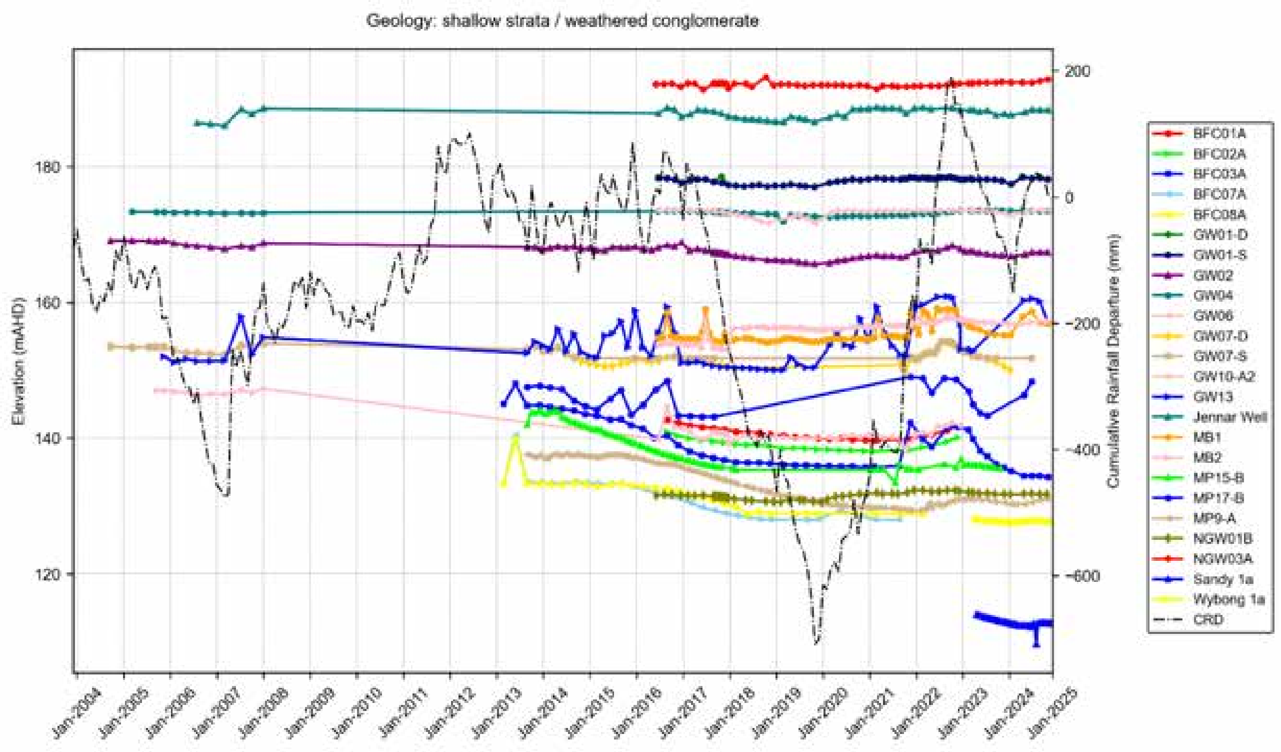


Figure A 1 Hydrographs of Shallow Strata / Weathered Conglomerate bores

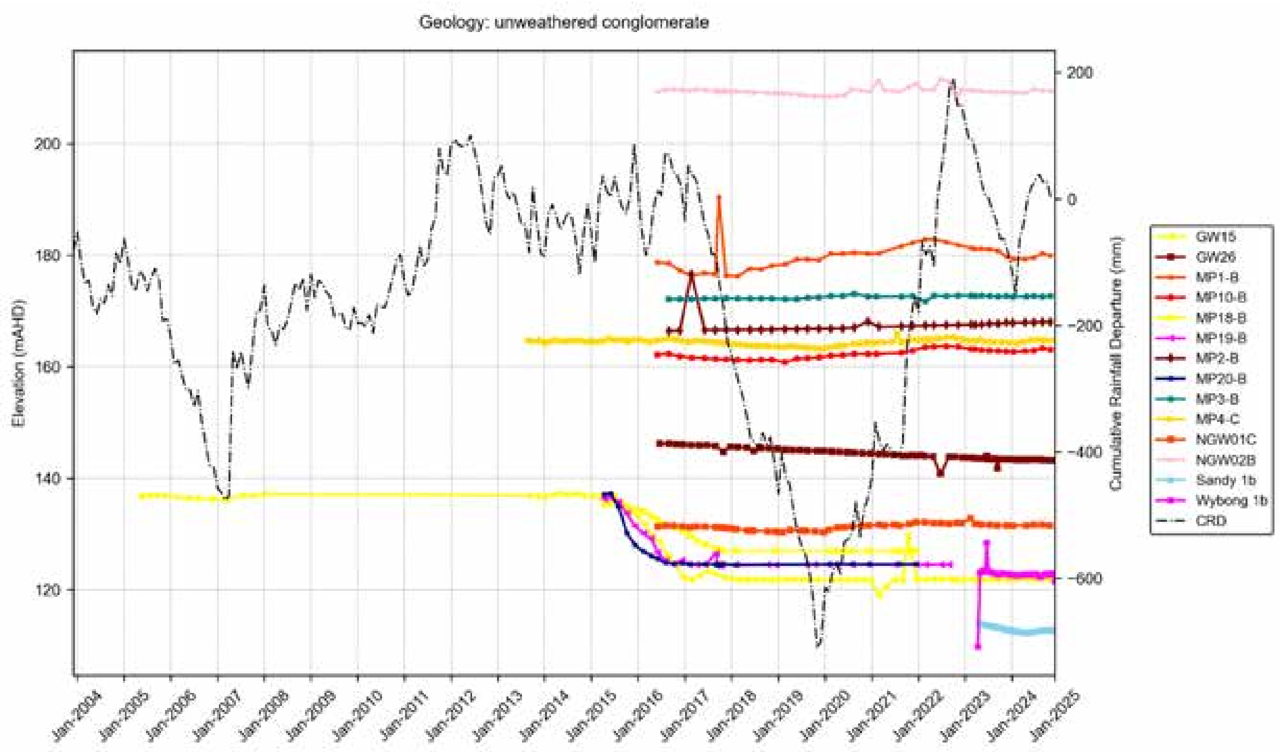


Figure A 2 Hydrographs of Unweathered Conglomerate bores

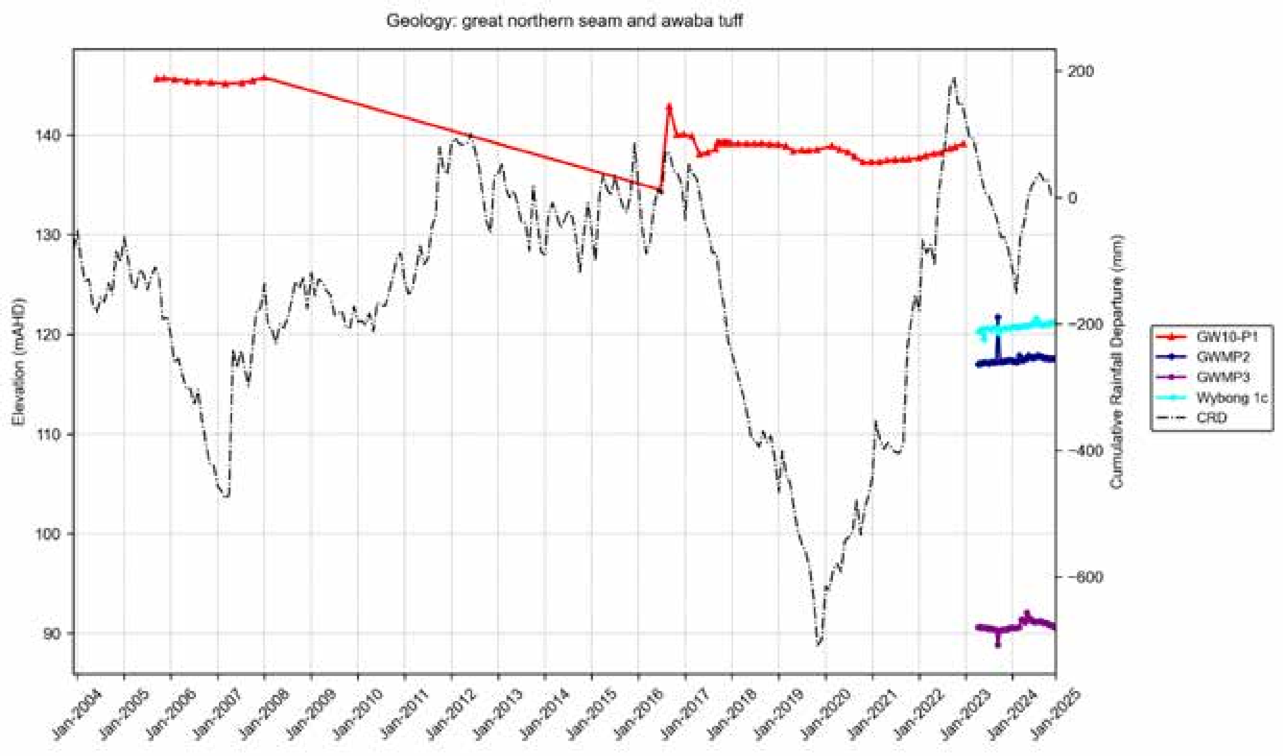


Figure A 3 Hydrographs of Great Northern Seam and Awaba Tuff bores

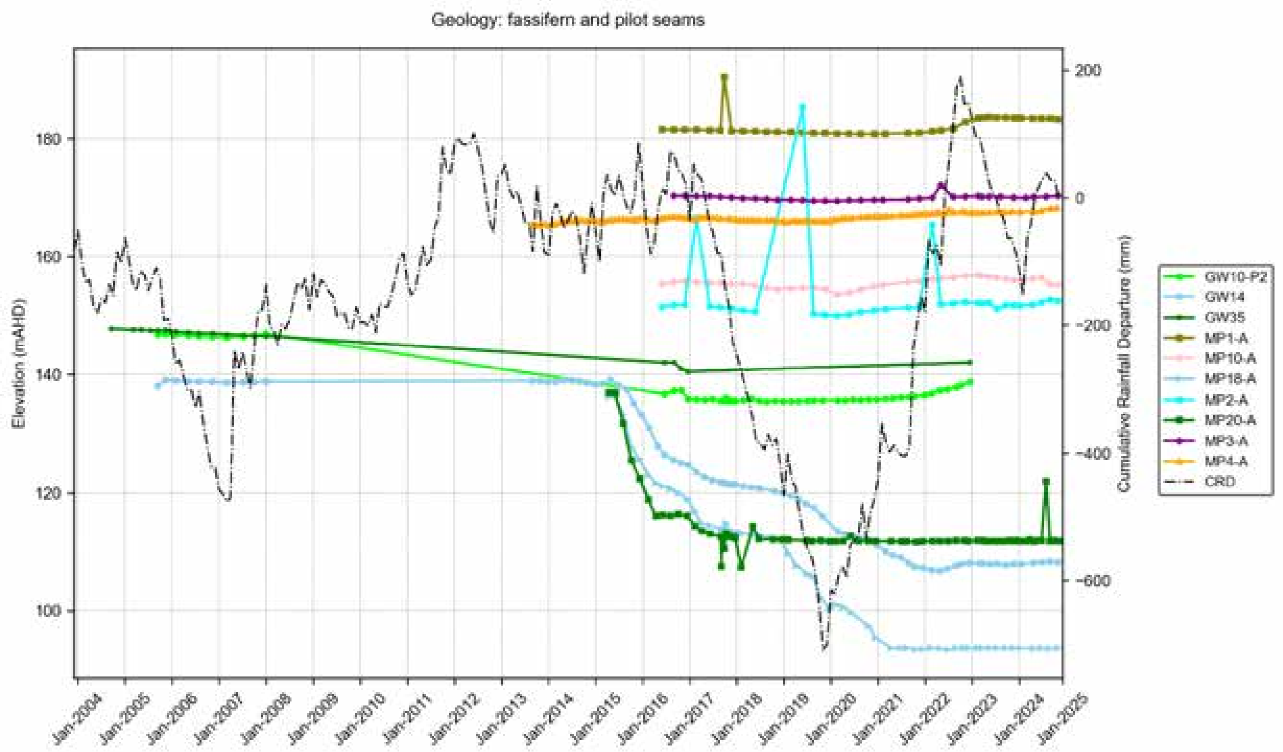


Figure A 4 Hydrographs of Fassifern and Pilot Seams bores

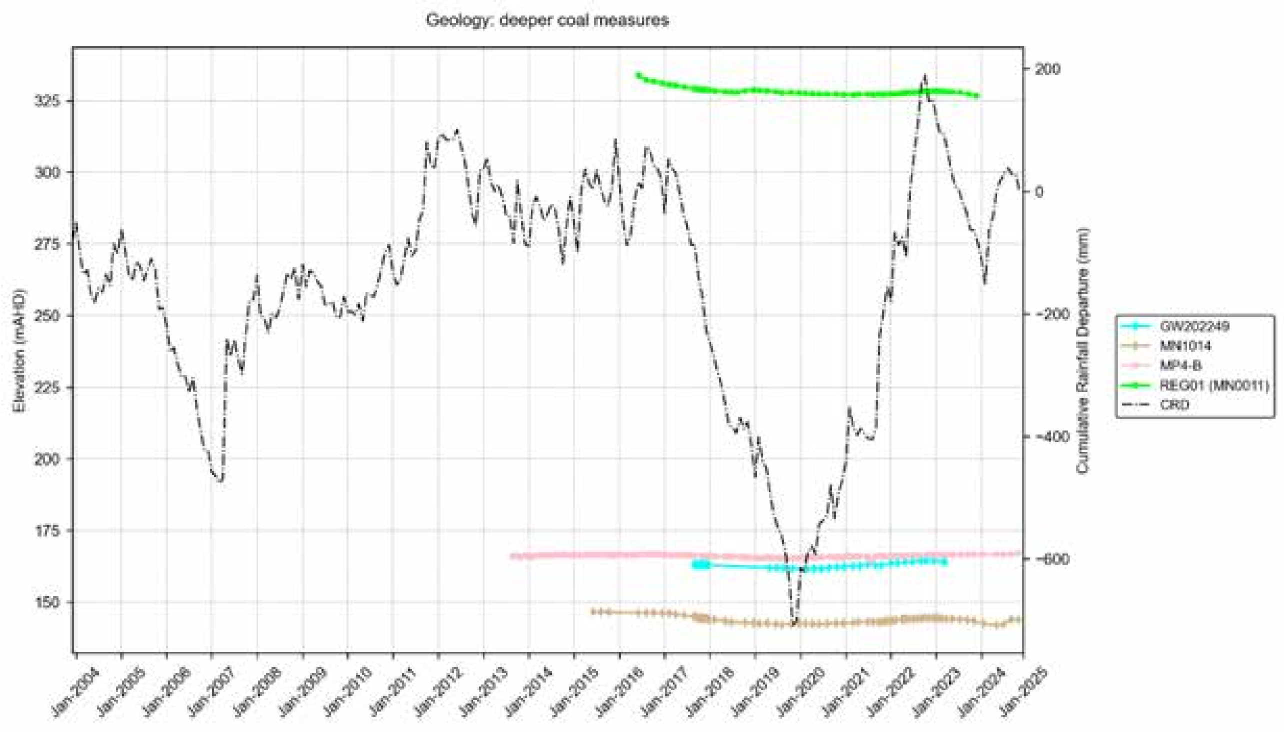


Figure A 5 Hydrographs of Deeper Coal Measures bores

Appendix B

# Groundwater contours – May 2024

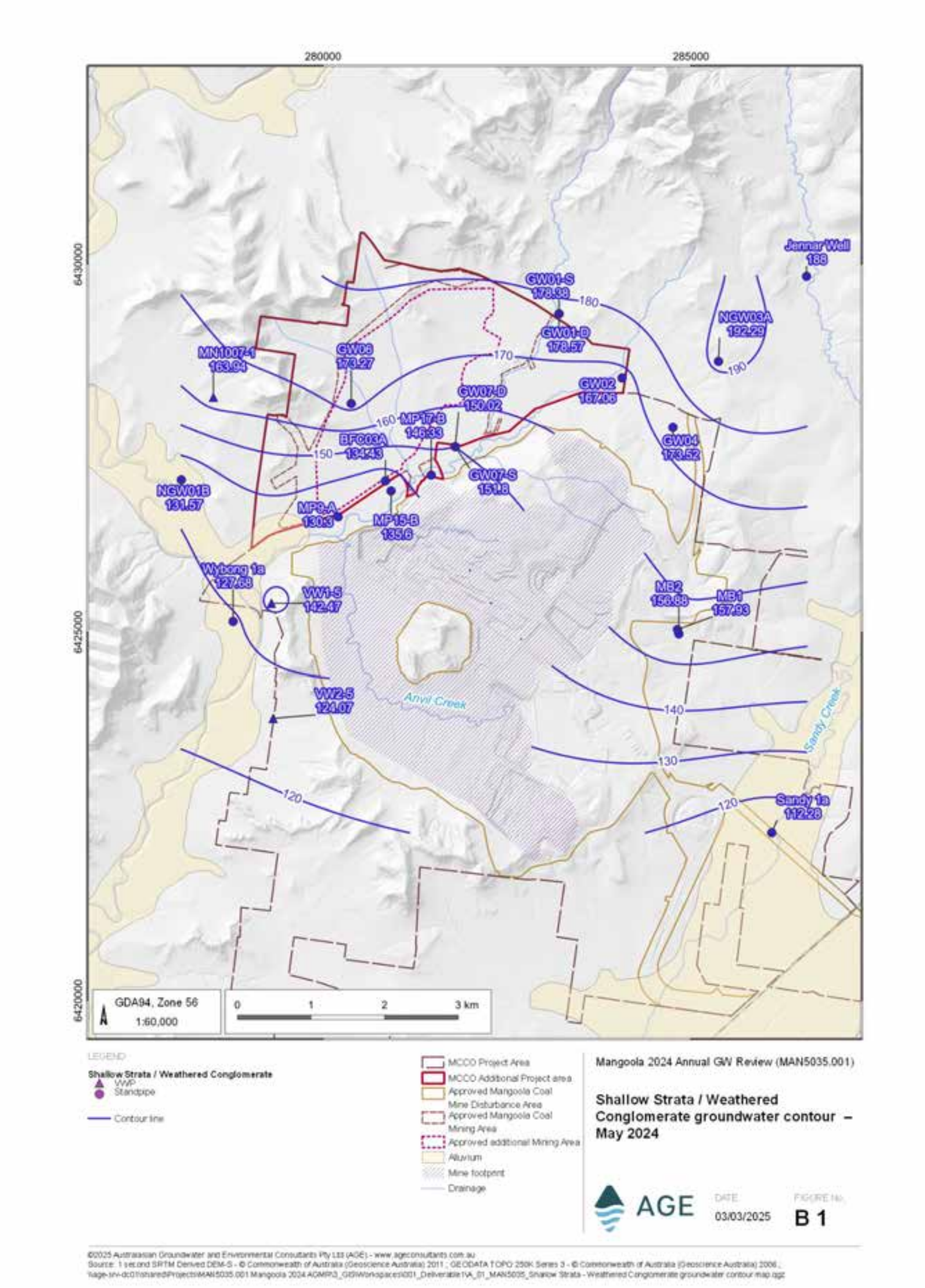


Figure B 1   Shallow Strata / Weathered Conglomerate groundwater contour – May 2024

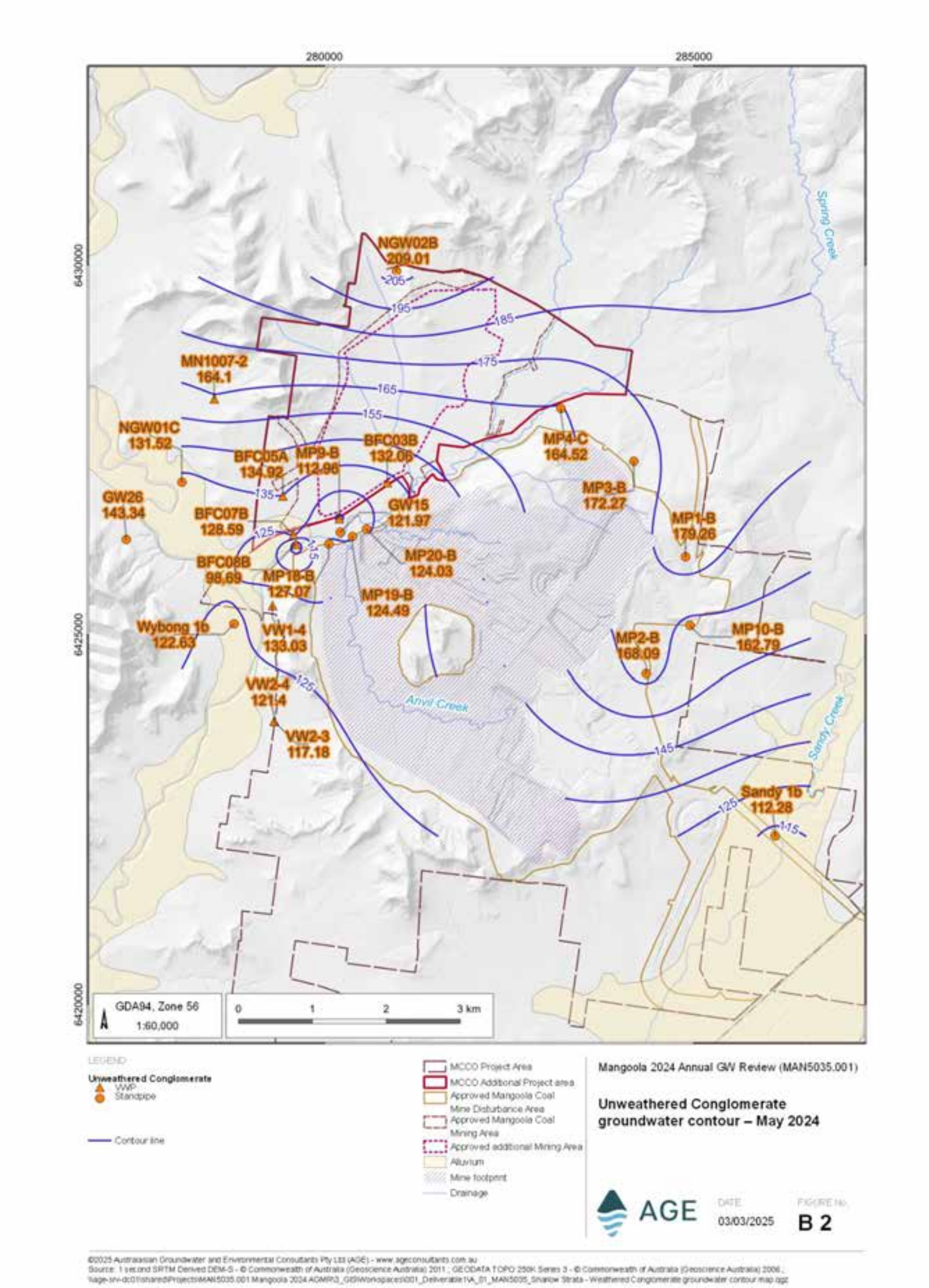


Figure B 2 Unweathered Conglomerate groundwater contour – May 2024

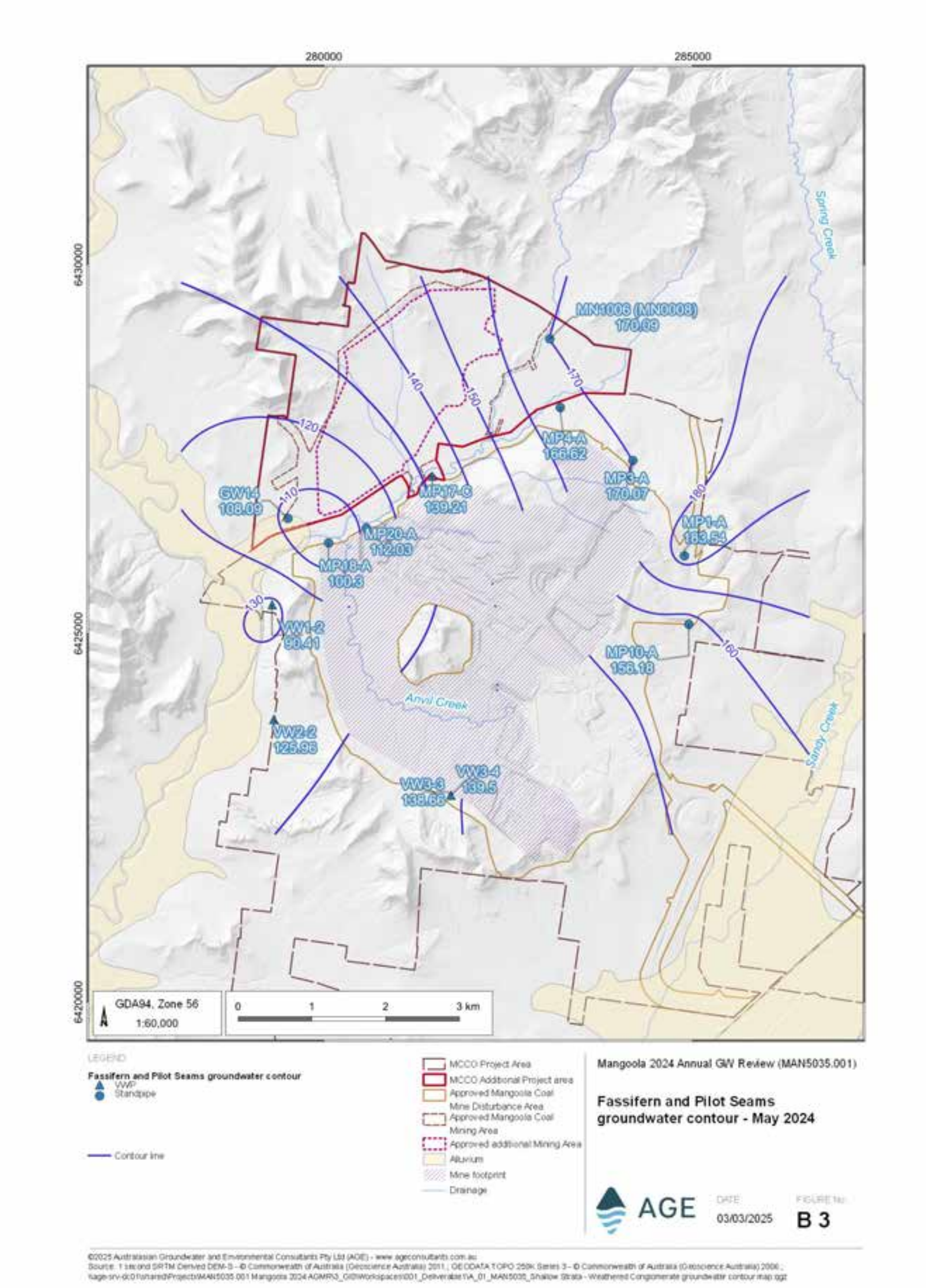


Figure B 3 Fassifern and Pilot Seams groundwater contour – May 2024

# Appendix C

# Private land owner monitoring bore hydrographs

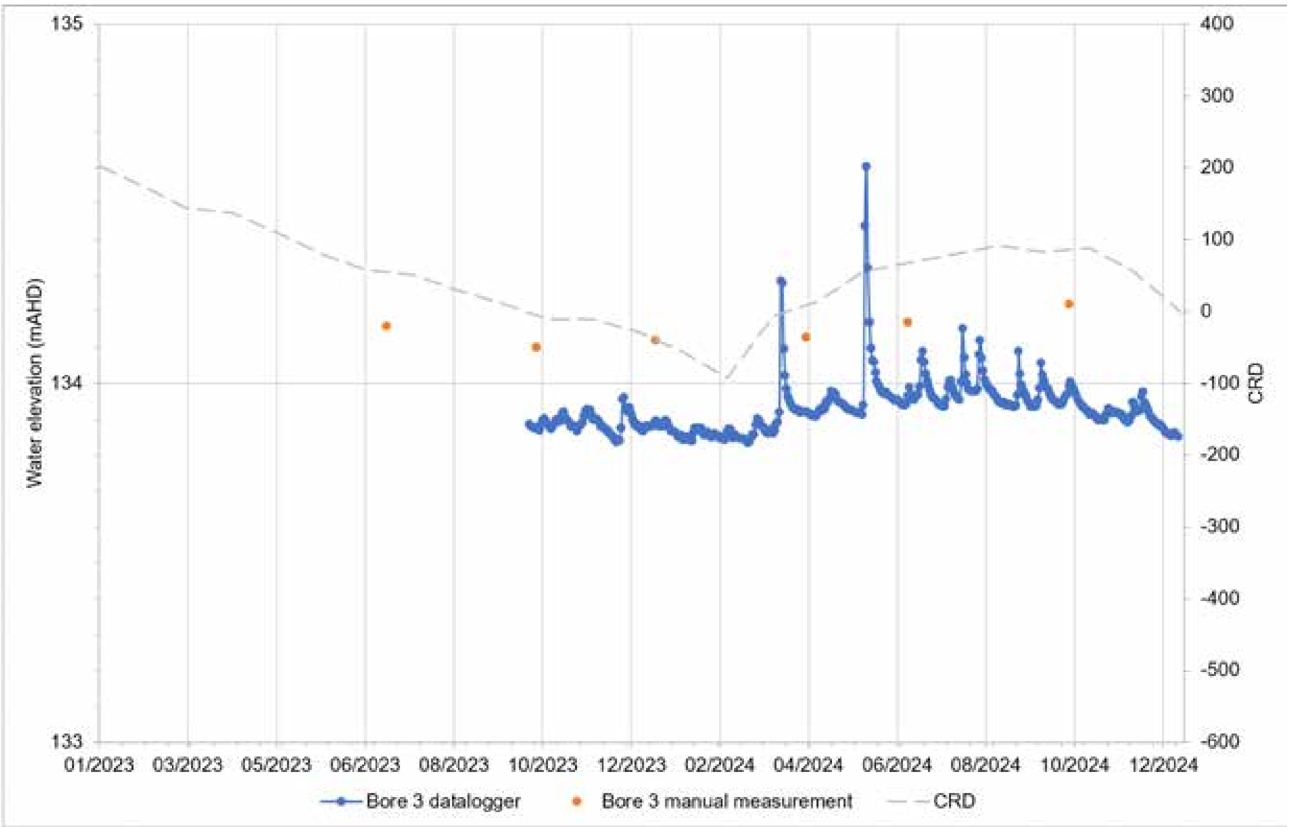


Figure C 1 Bore 3 hydrograph

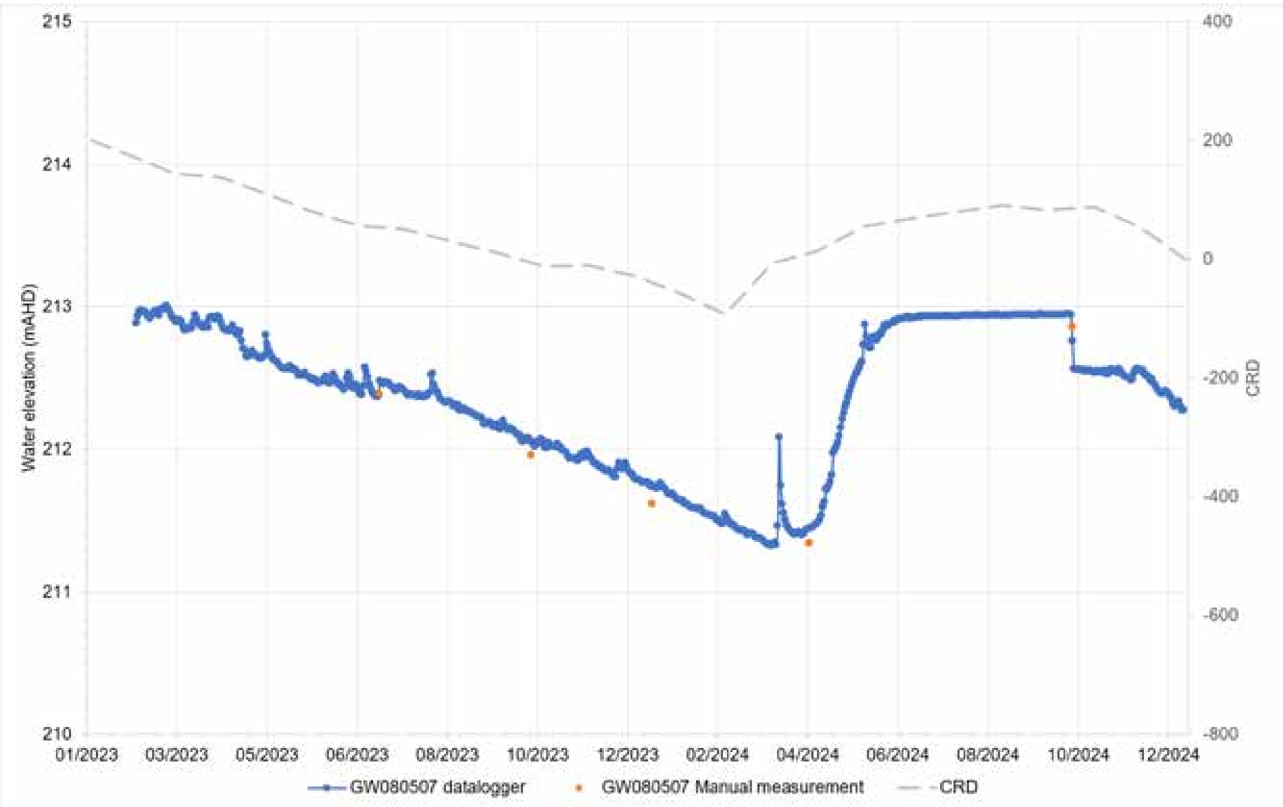


Figure C 2 GW080507 hydrograph

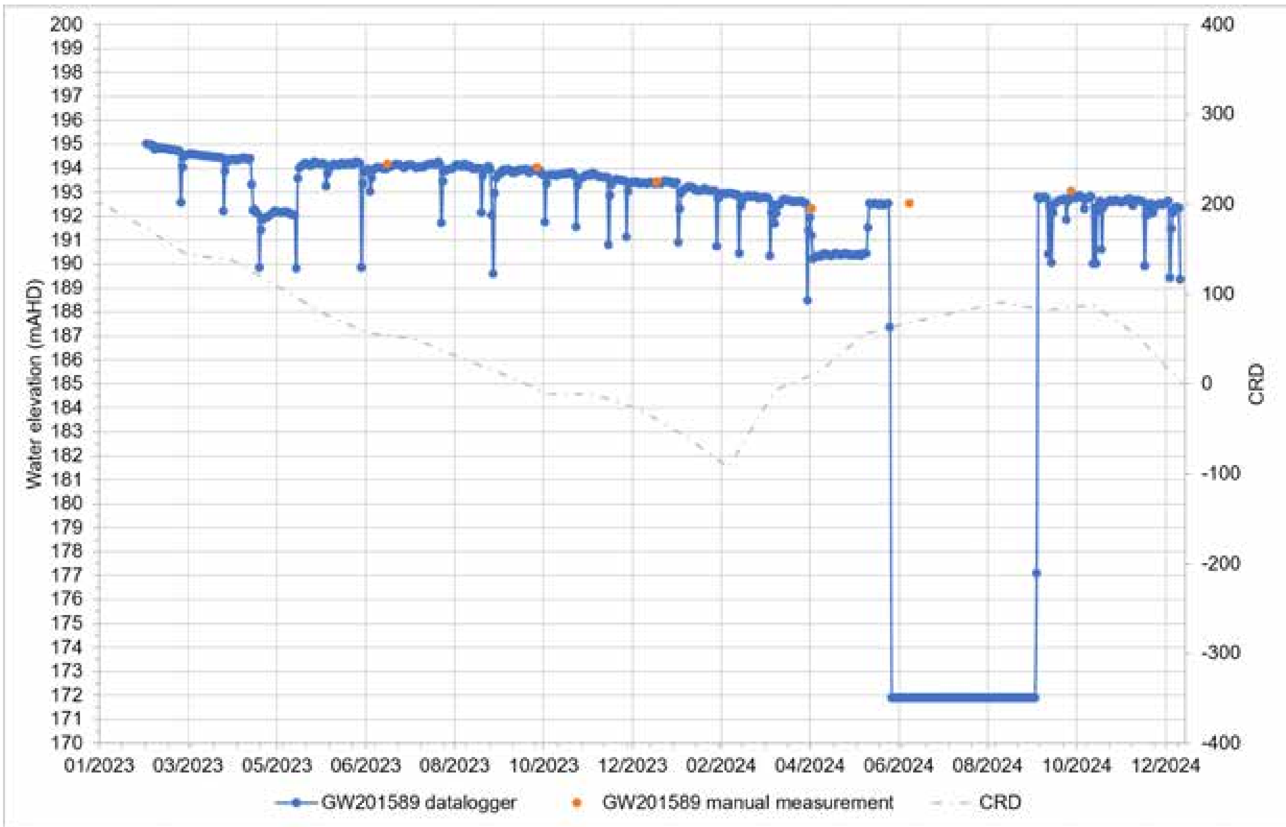


Figure C 3 GW201589 hydrograph

# Appendix D

# Groundwater level trigger bores – hydrographs with CRD and trigger values

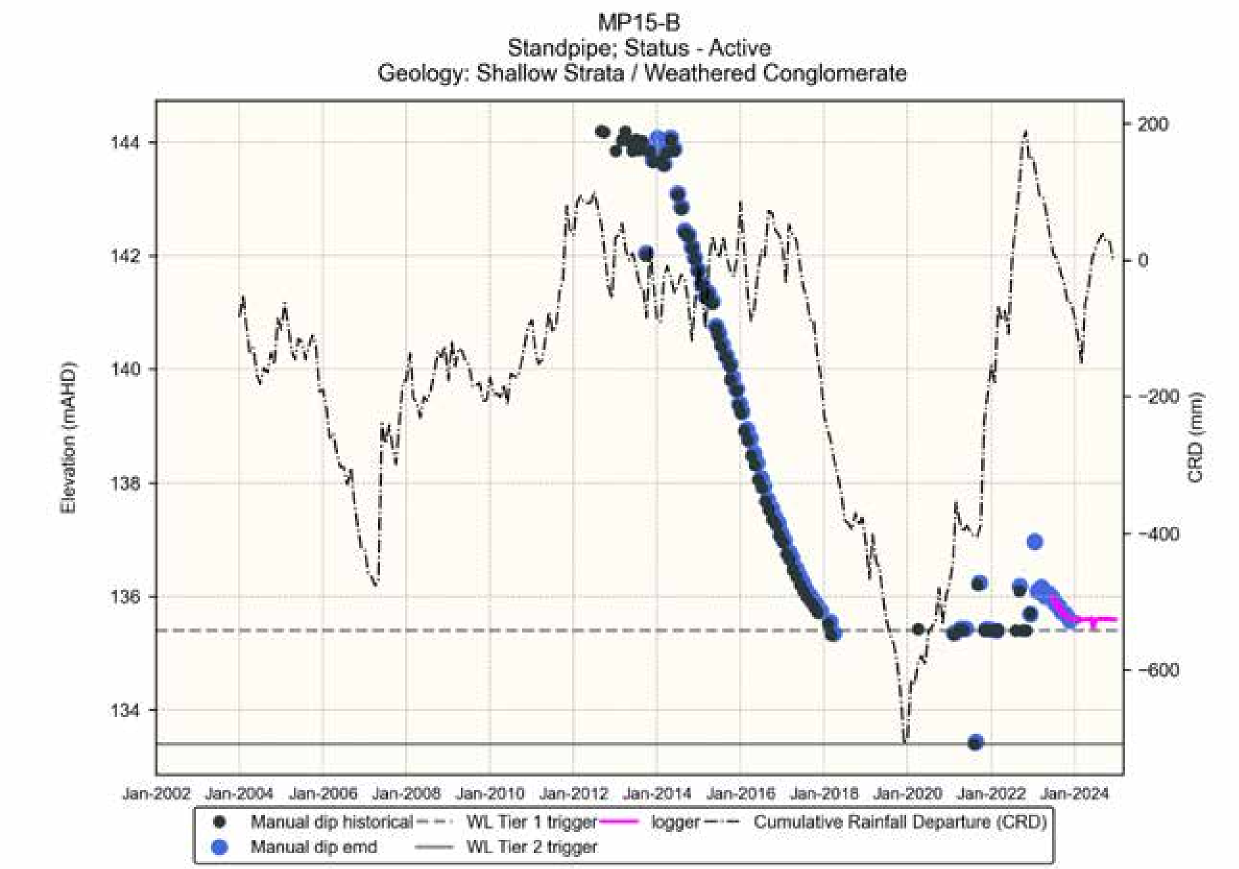


Figure D 1 MP15-B hydrograph

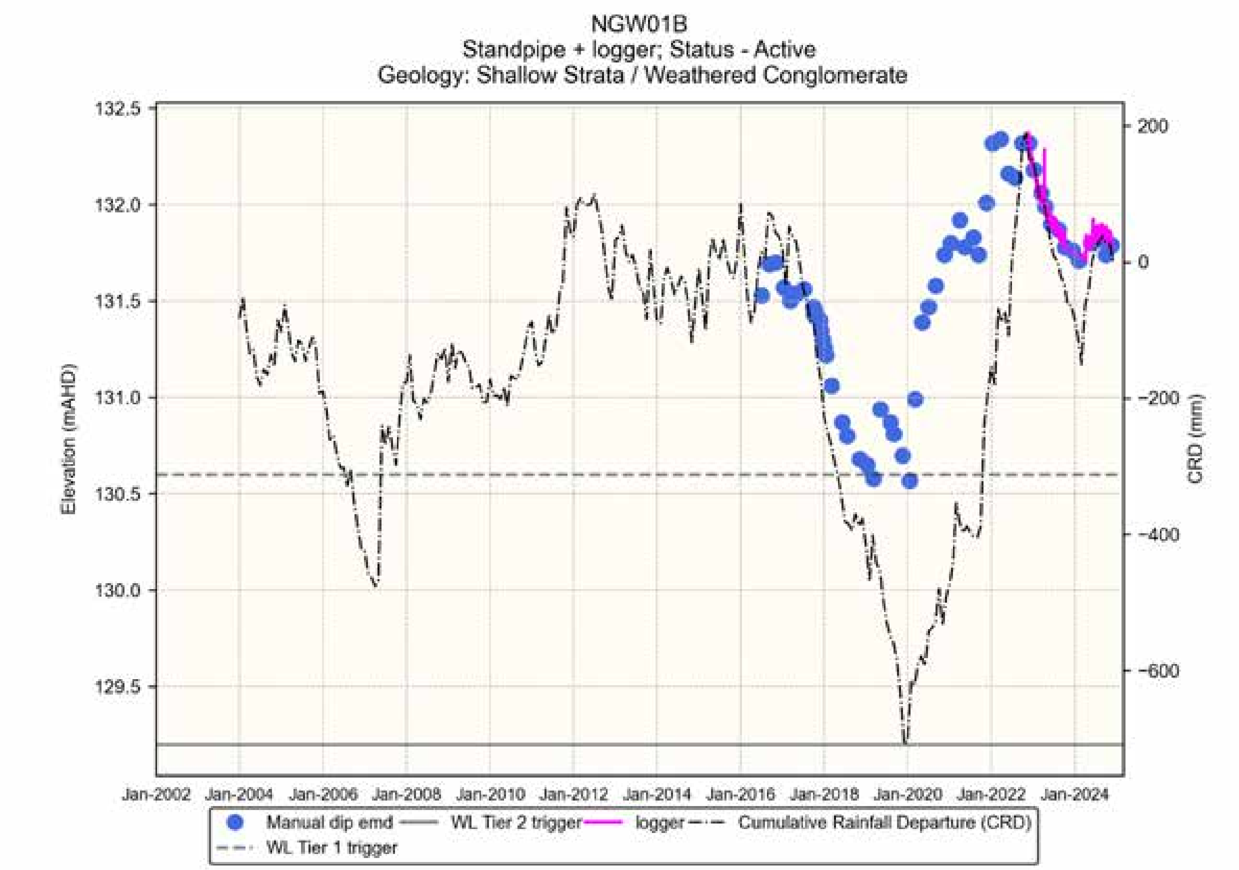


Figure D 2 NGW01B hydrograph

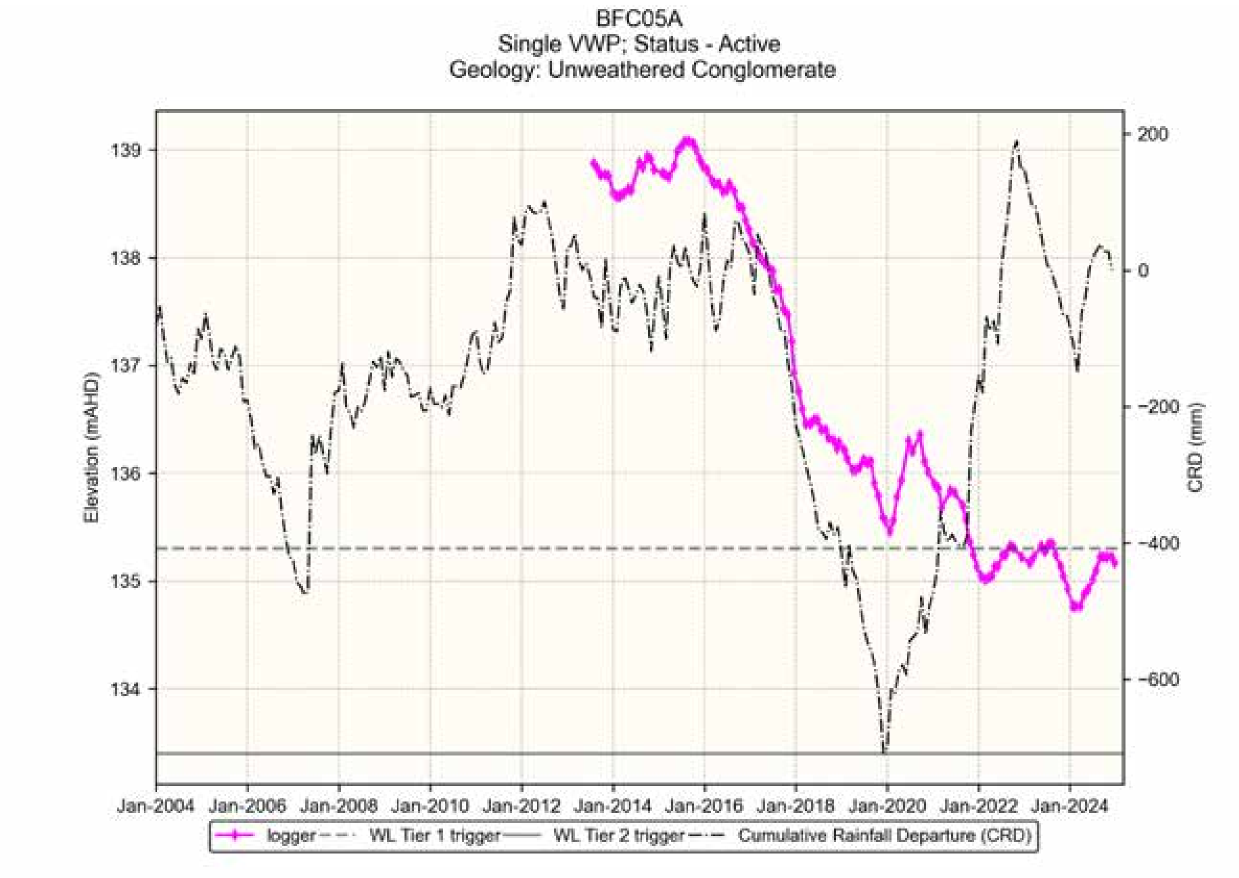


Figure D 3 BFC05A hydrograph

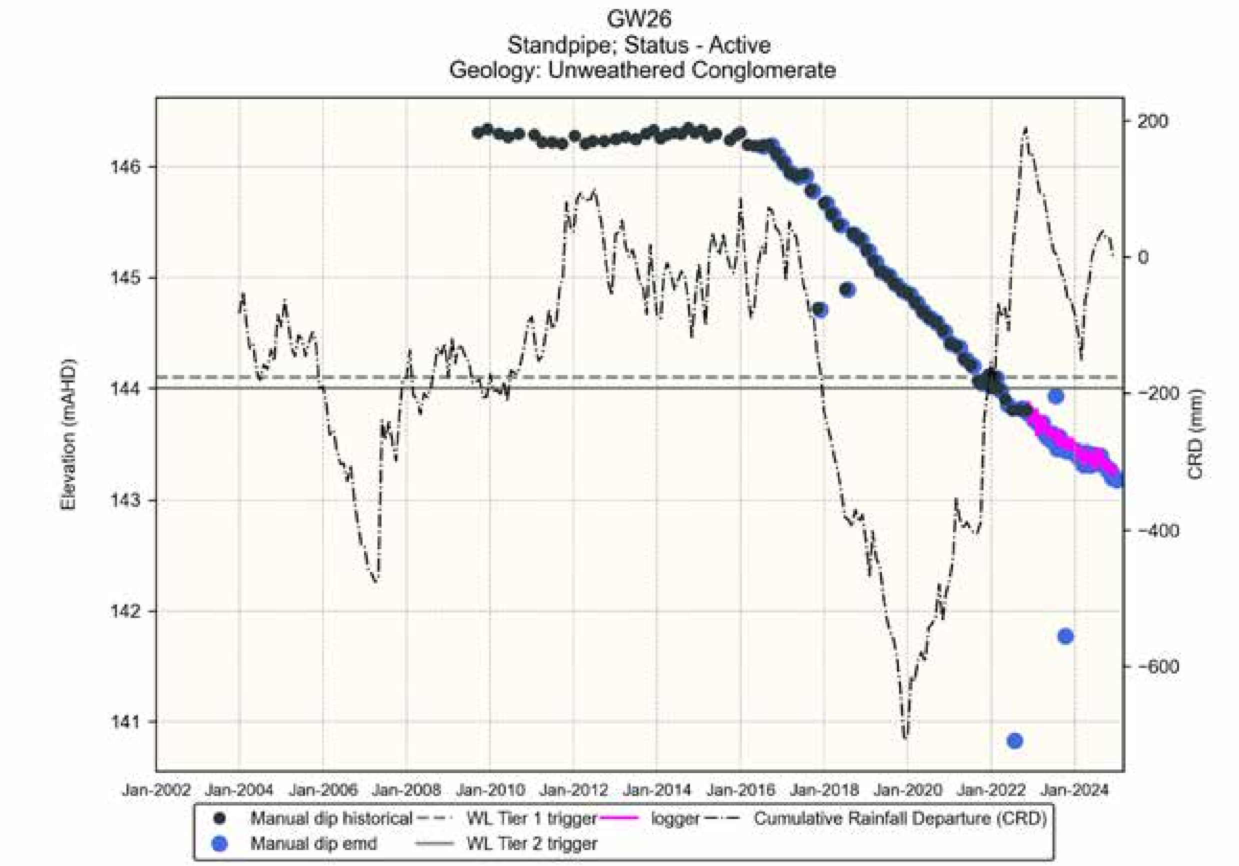


Figure D 4 GW26 hydrograph

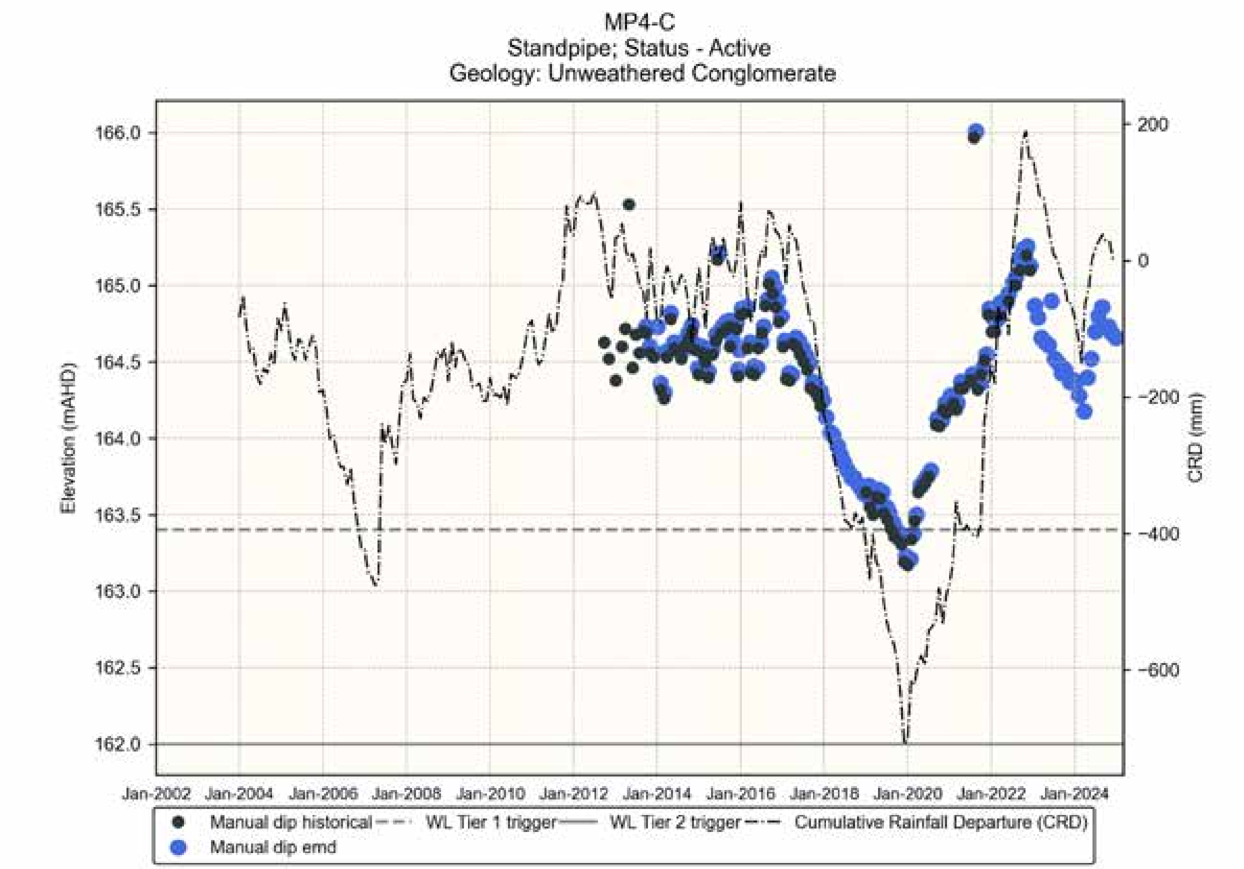


Figure D 5 MP4-C hydrograph

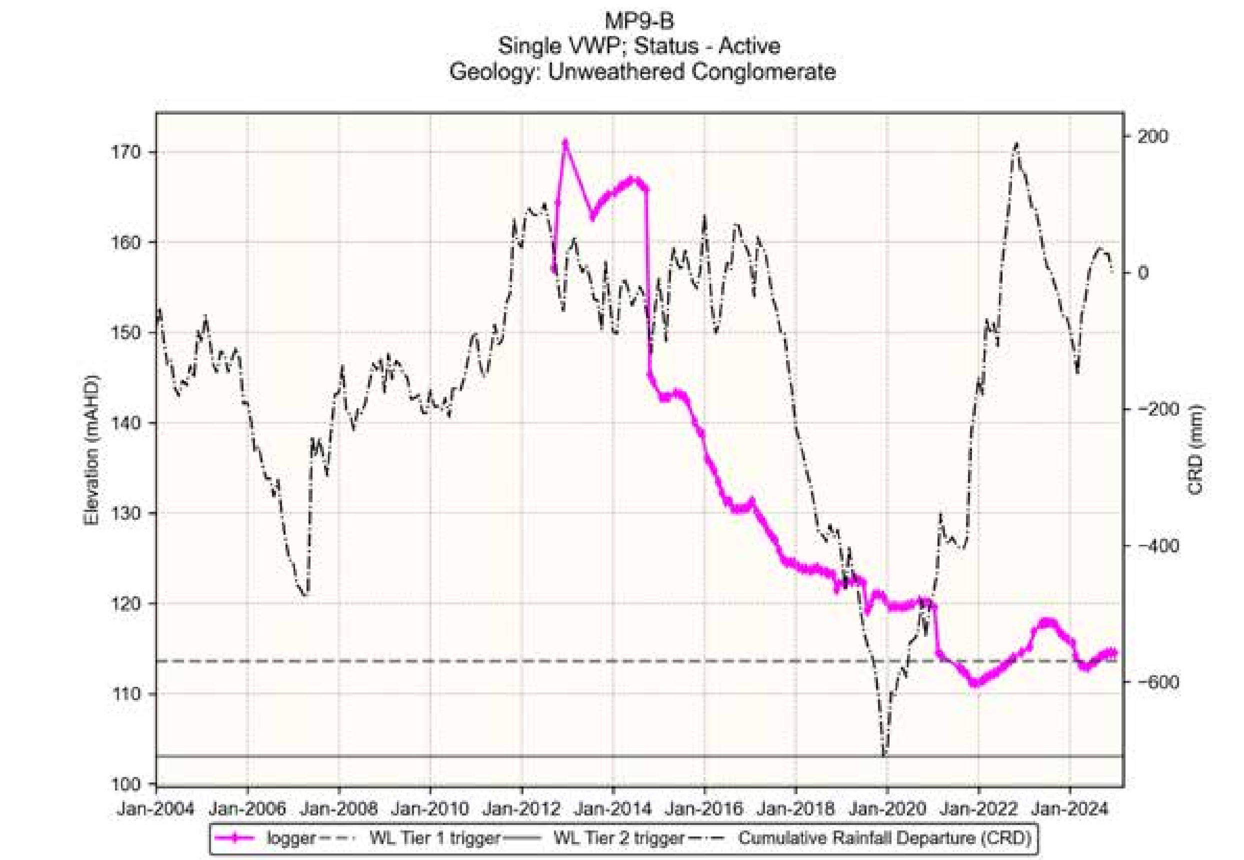


Figure D 6 MP9-B hydrograph

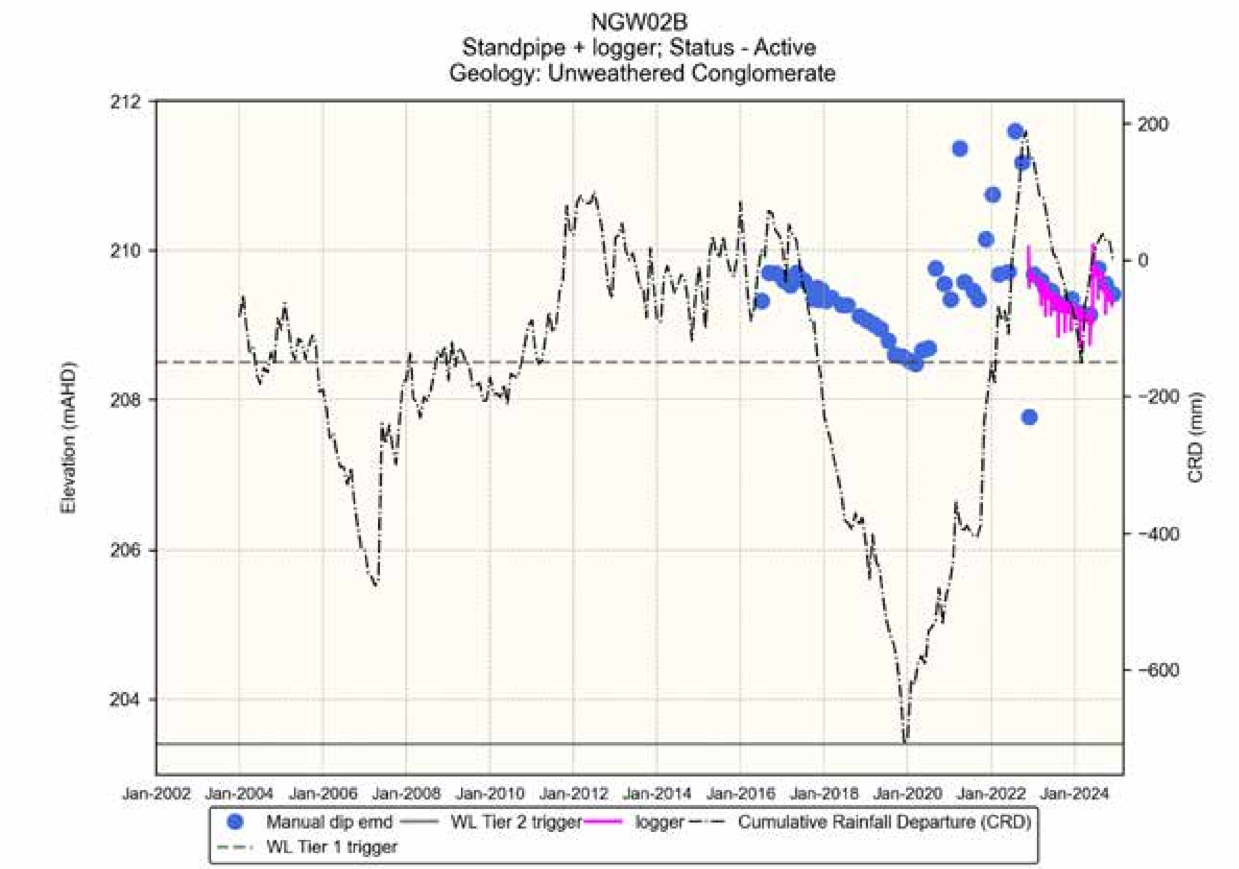


Figure D 7 NGW02B hydrograph

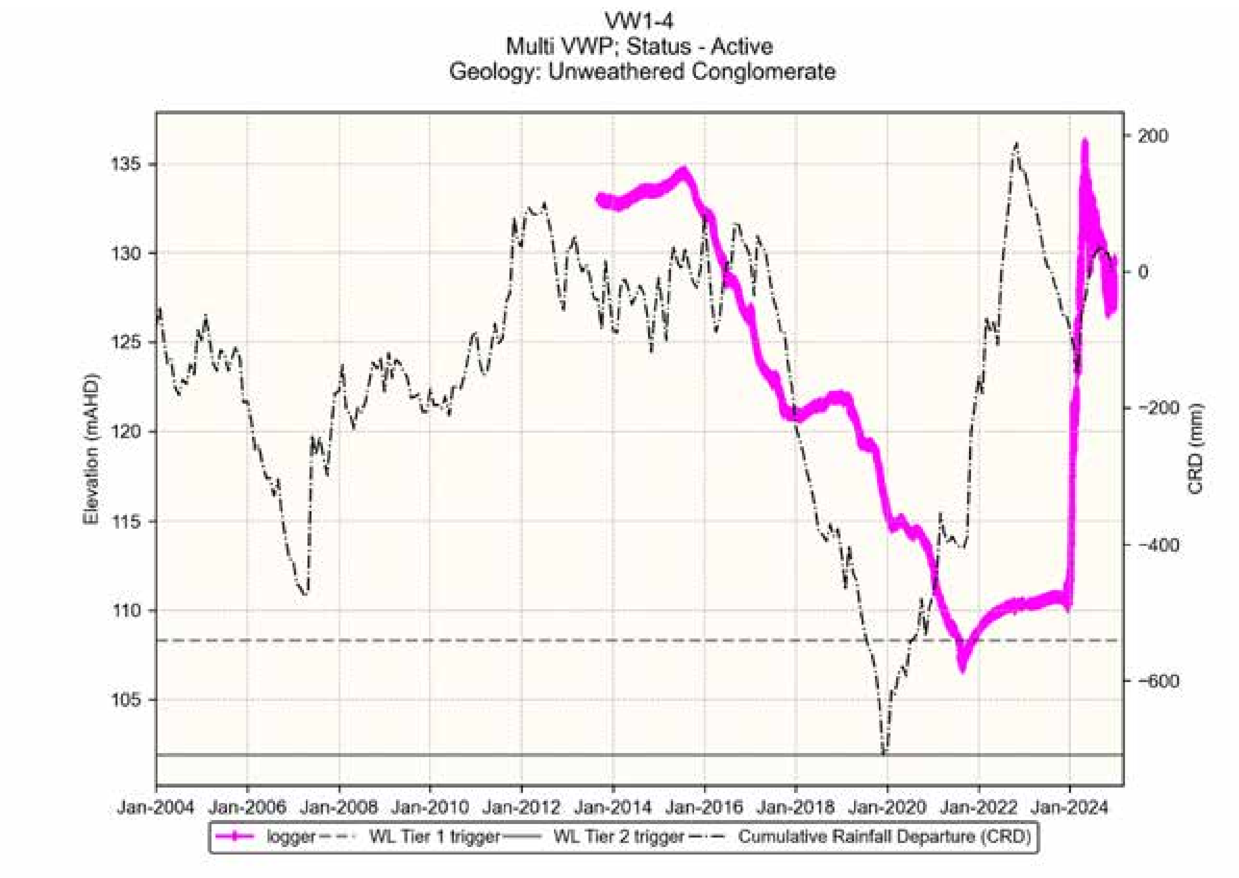


Figure D 8 VW1-4 hydrograph

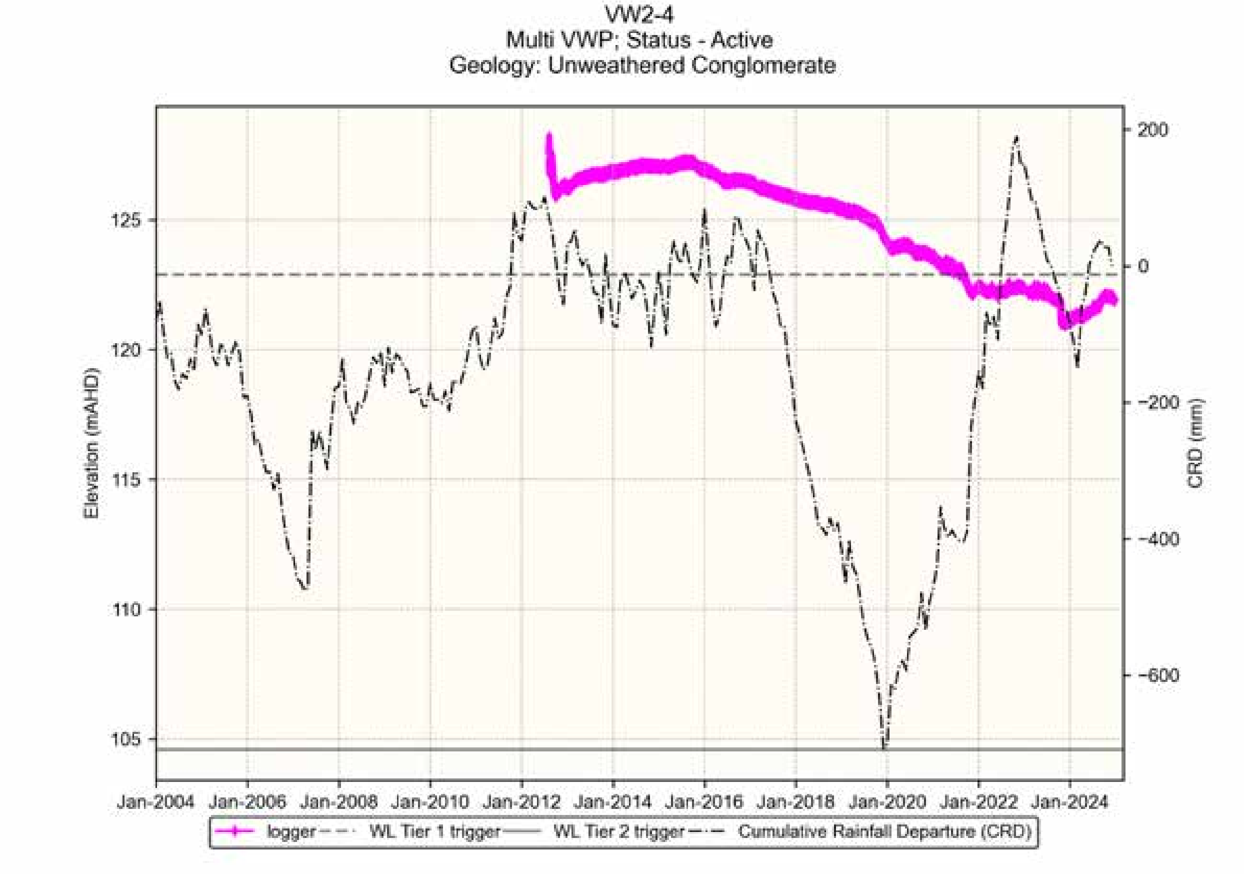


Figure D 9 VW2-4 hydrograph

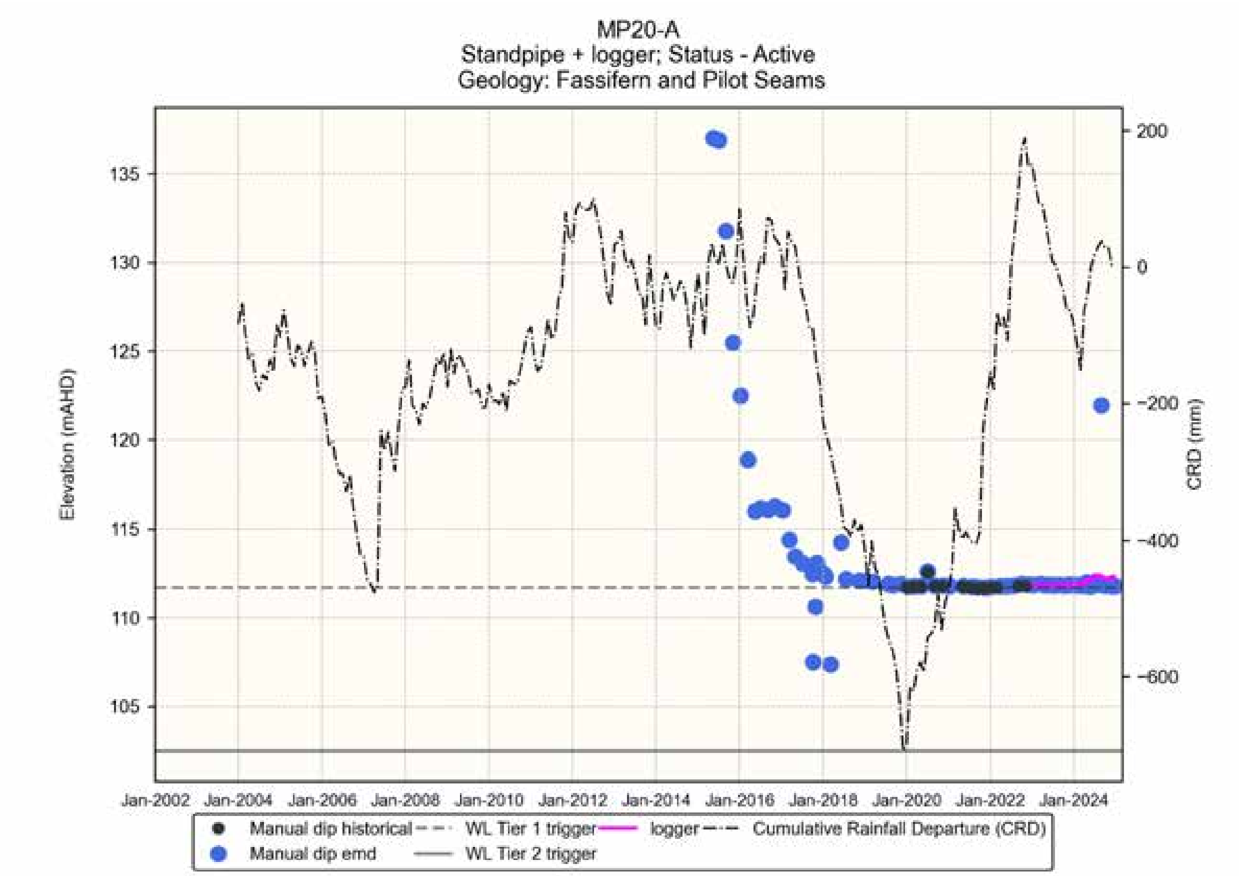


Figure D 10 MP20-A hydrograph

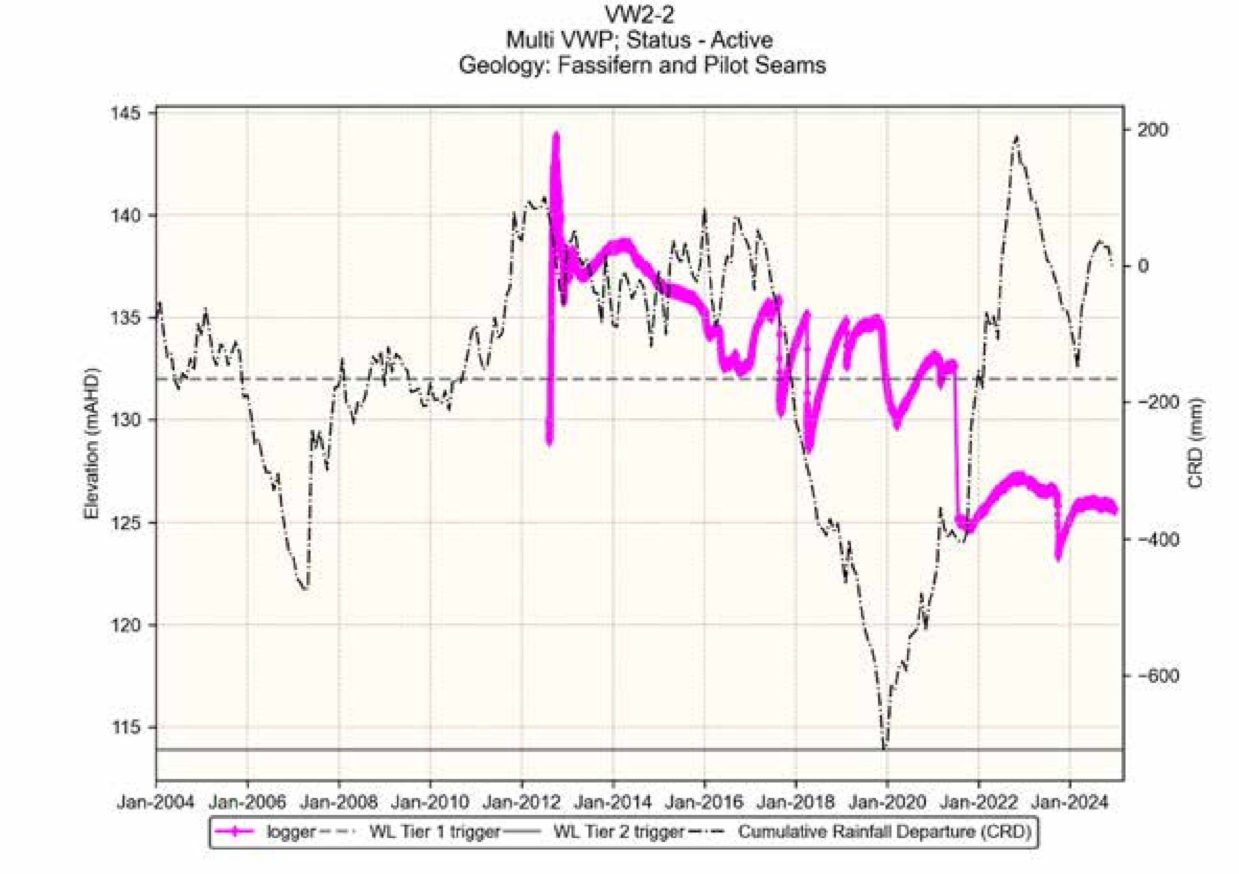


Figure D 11 VW2-2 hydrograph

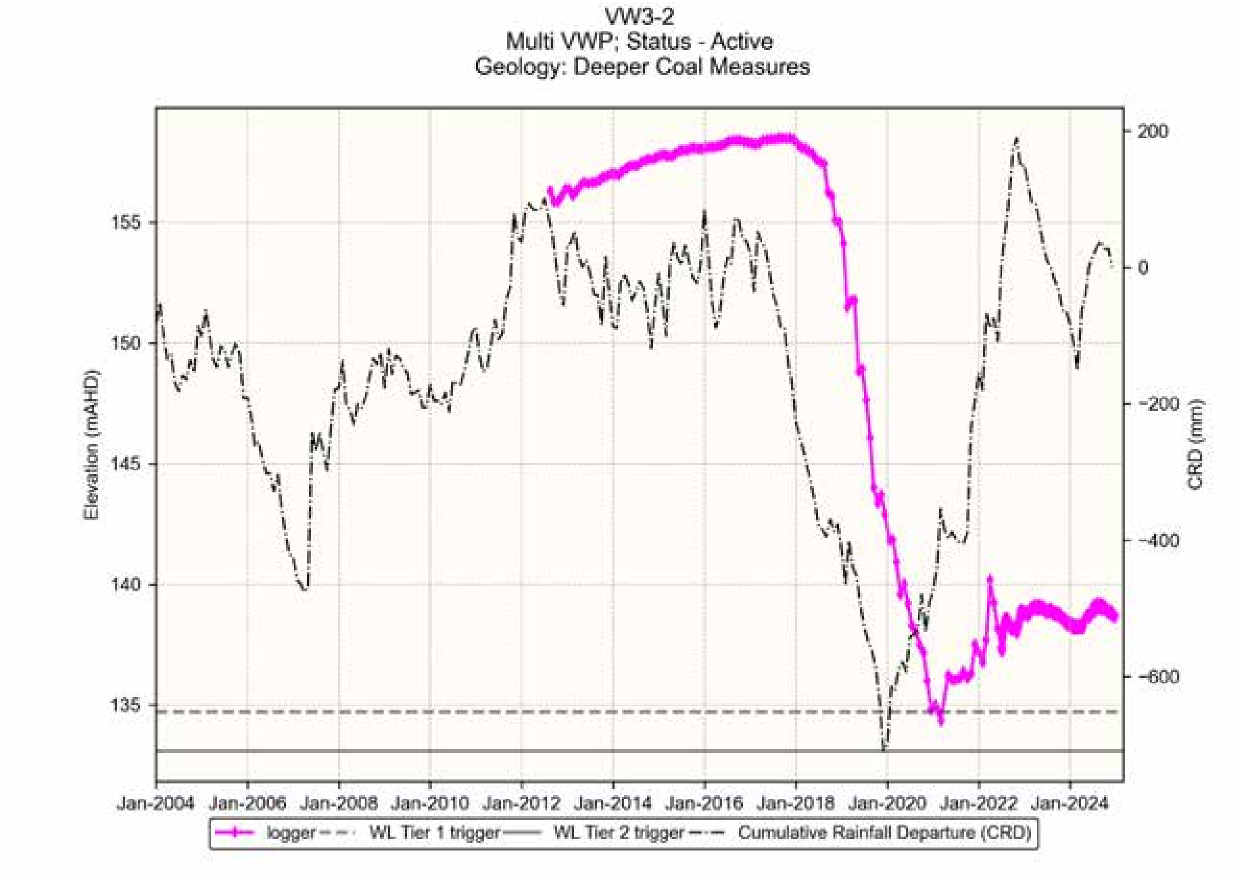


Figure D 12 VW3-2 hydrograph

Appendix E

# Groundwater quality – Piper plot

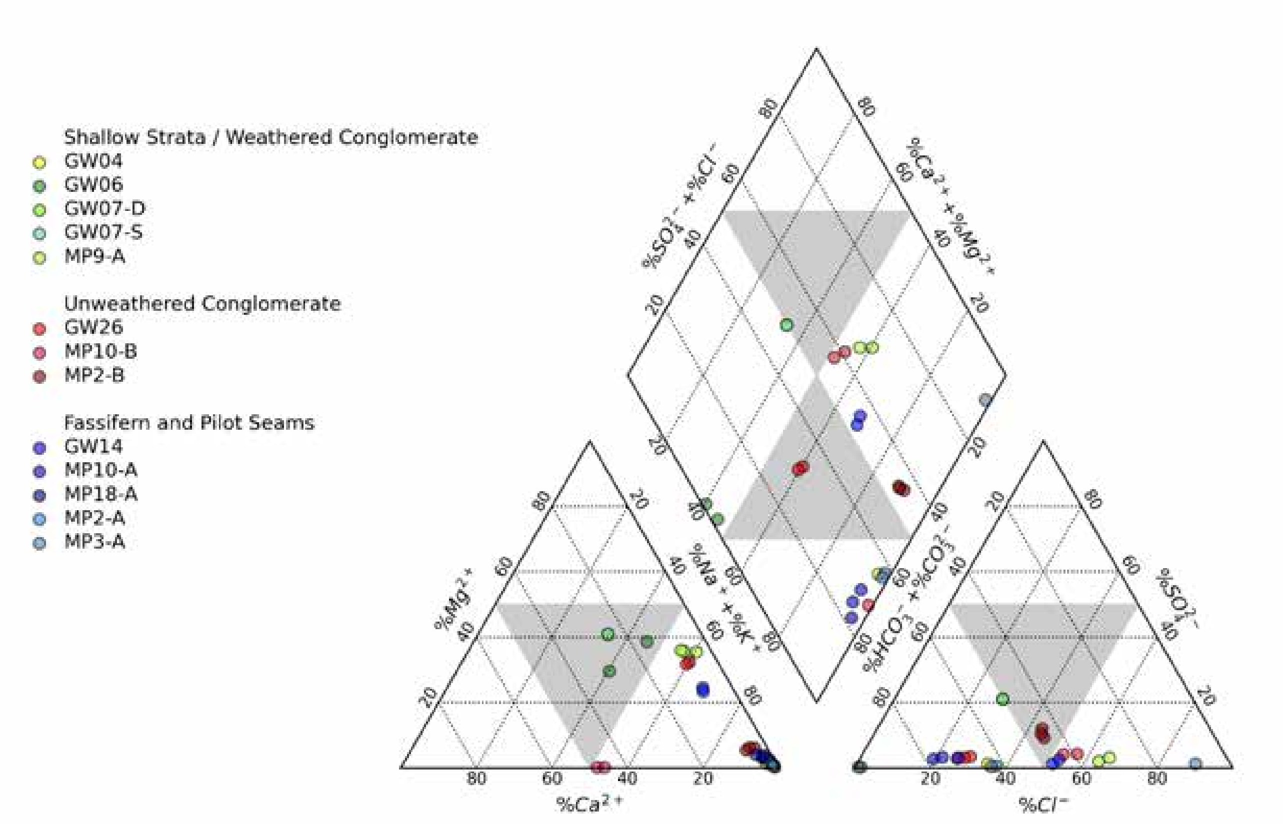


Figure E 1 Mangoola 2024 Piper Plot

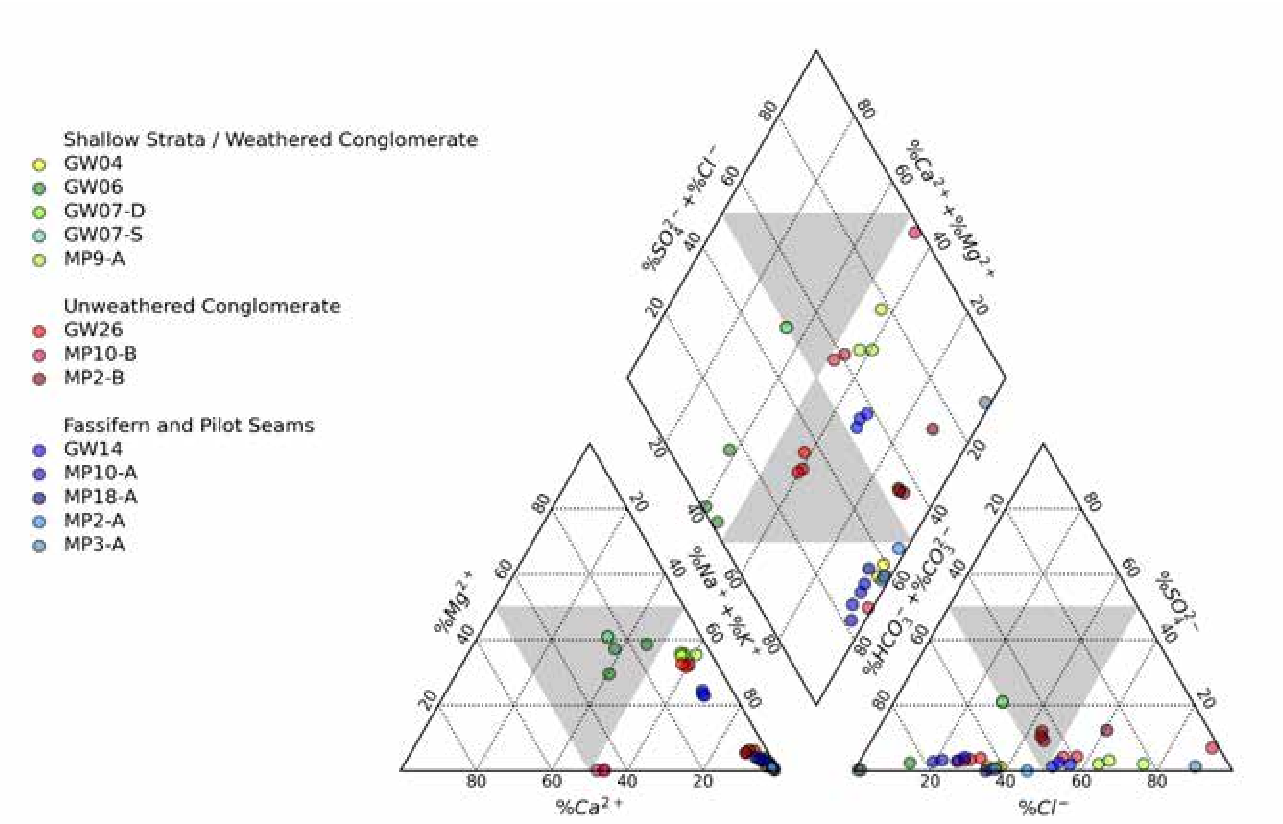


Figure E 2 Mangoola total EMD (2023-2024) Piper Plot

Appendix F

# Groundwater quality trigger bore – stacked charts

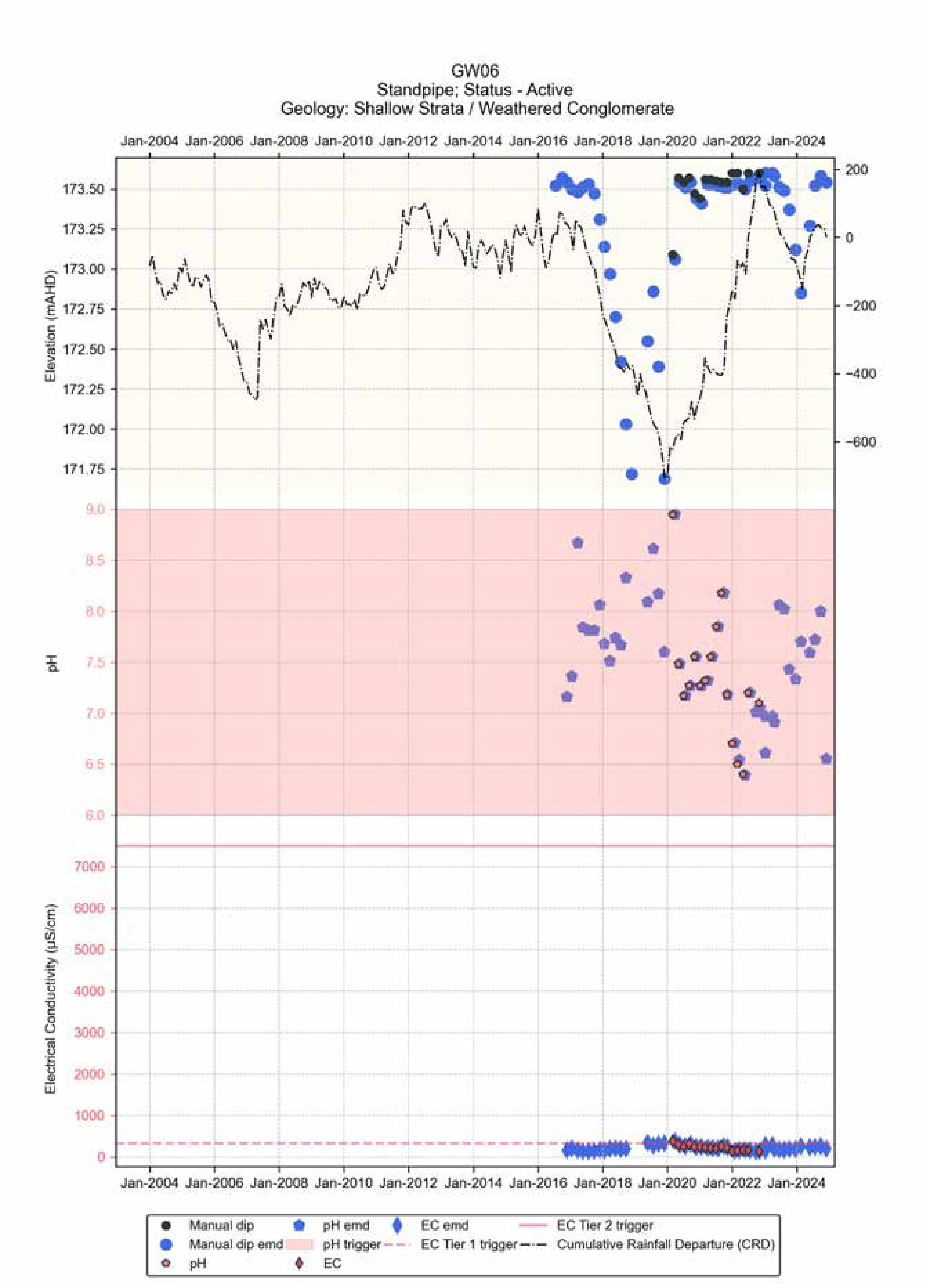


Figure F 1 GW06 groundwater quality triggers chart

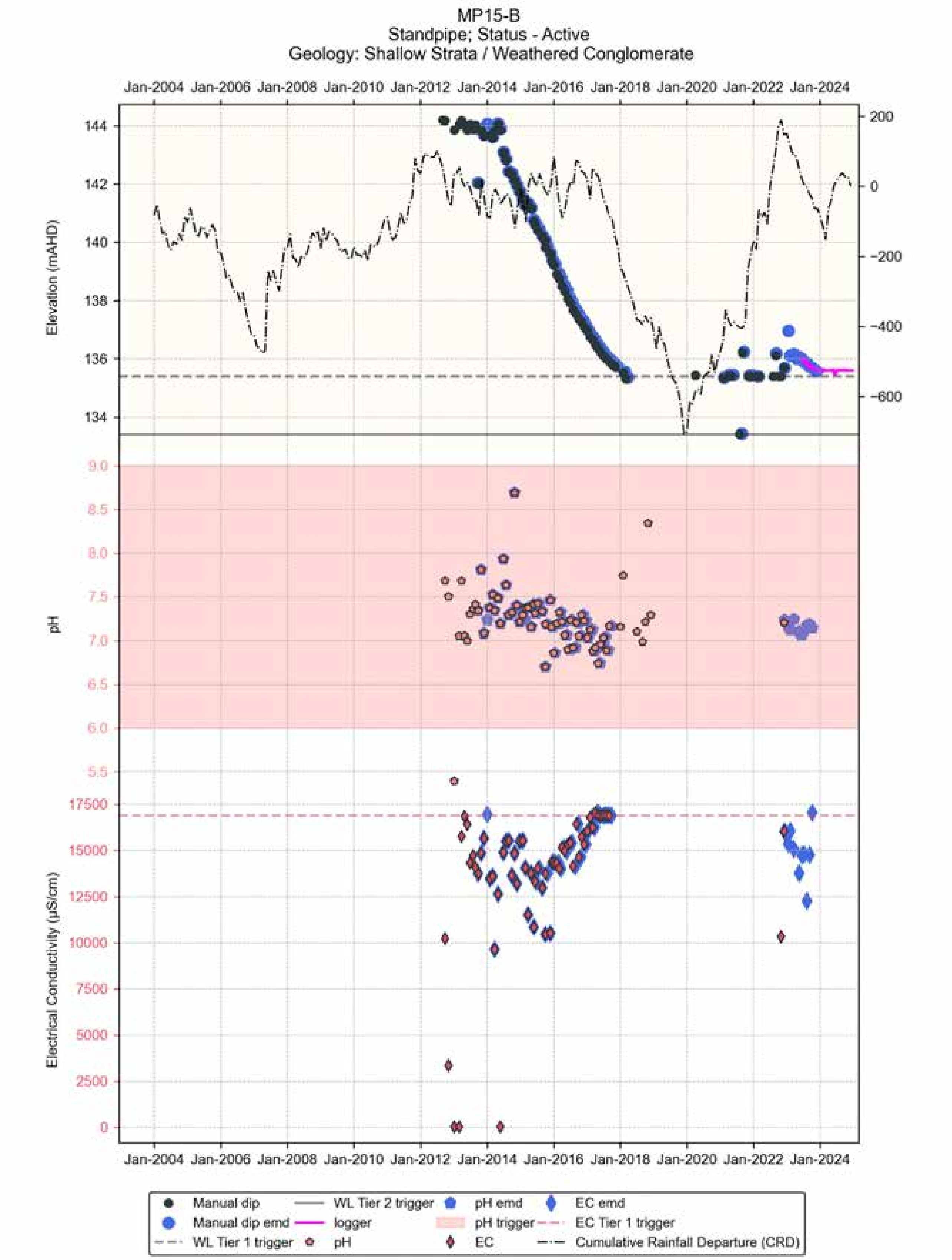


Figure F 2 MP15-B groundwater quality triggers chart

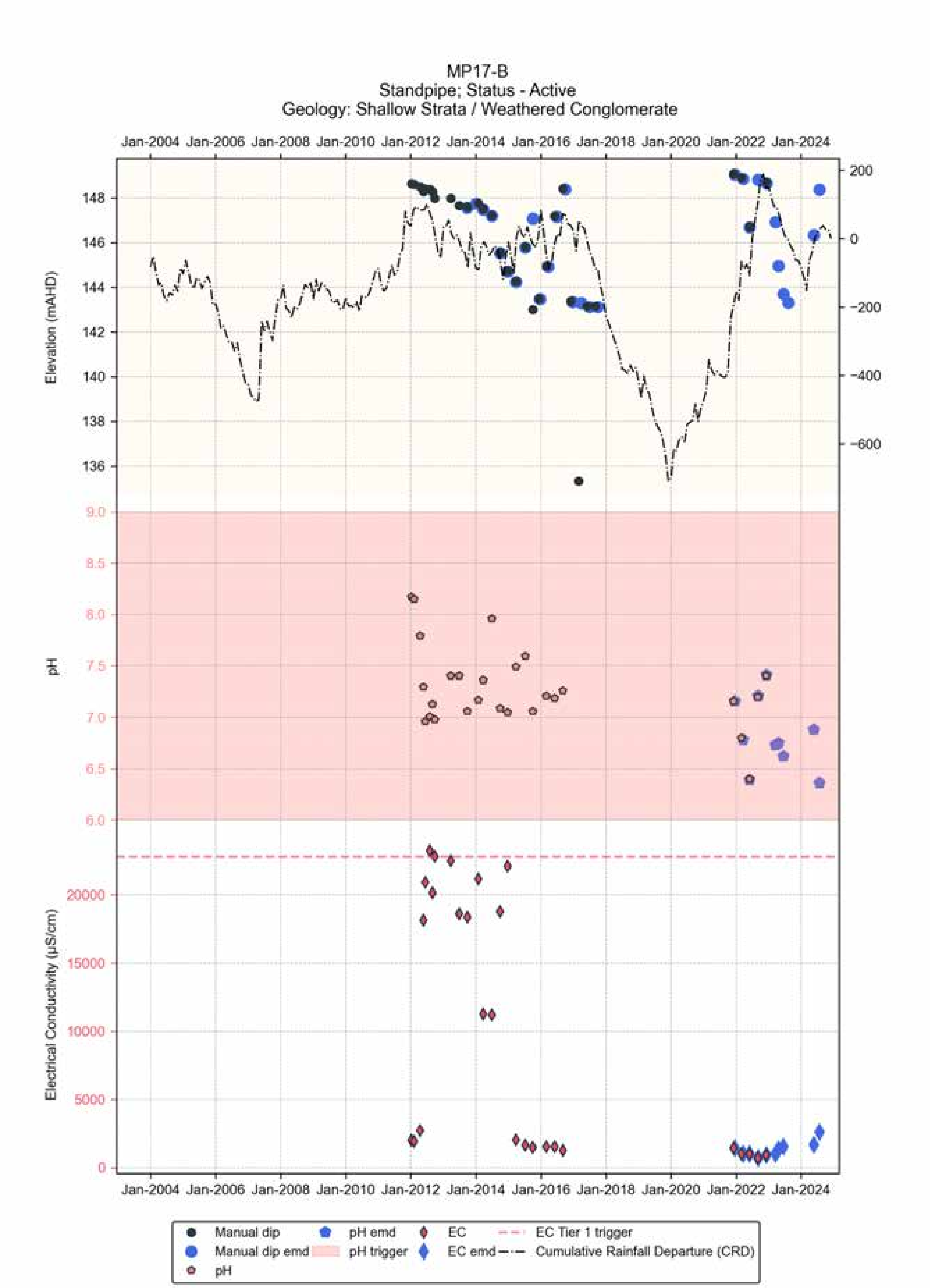


Figure F 3 MP17-B groundwater quality triggers chart

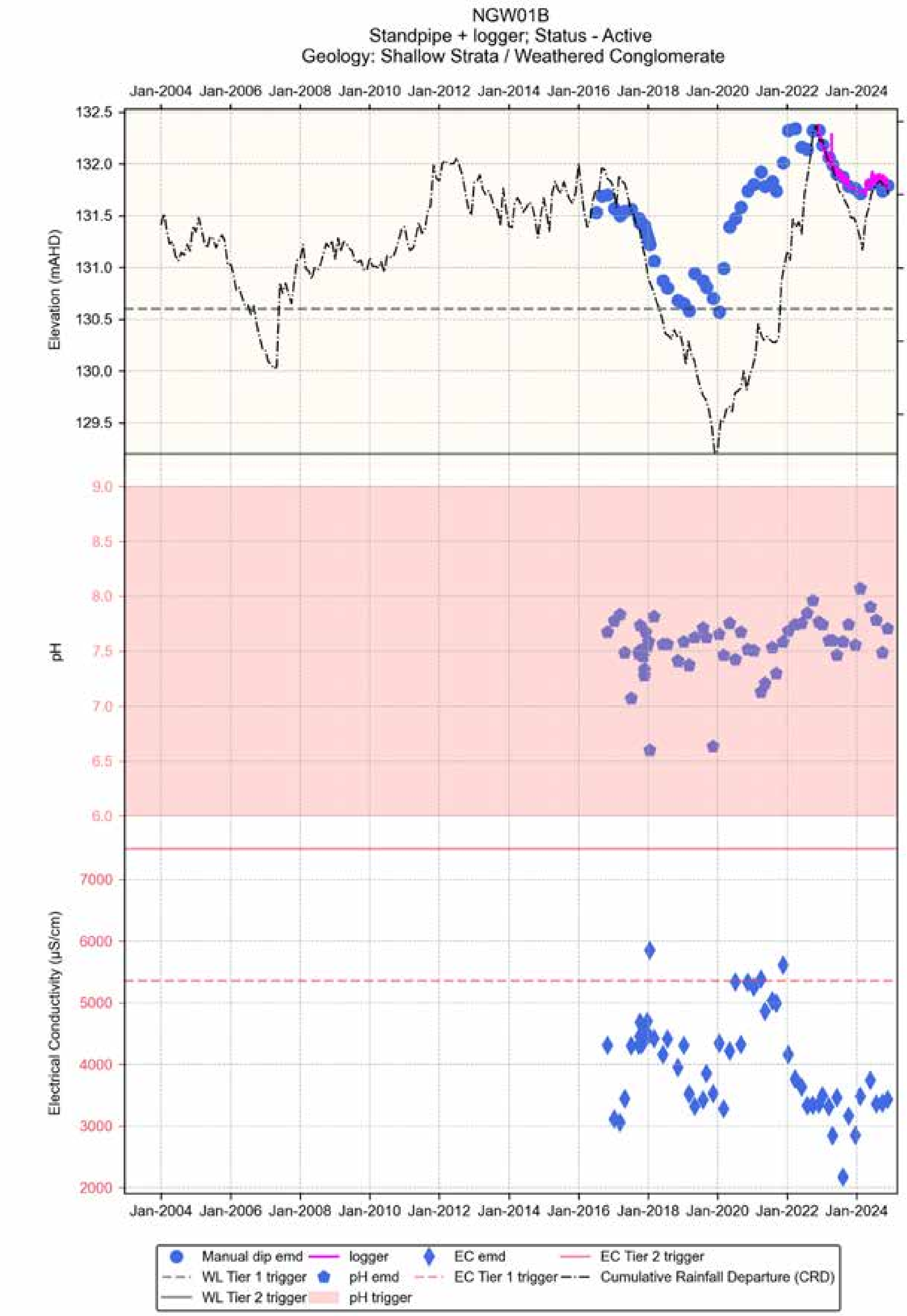


Figure F 4 NGW01B groundwater quality triggers chart

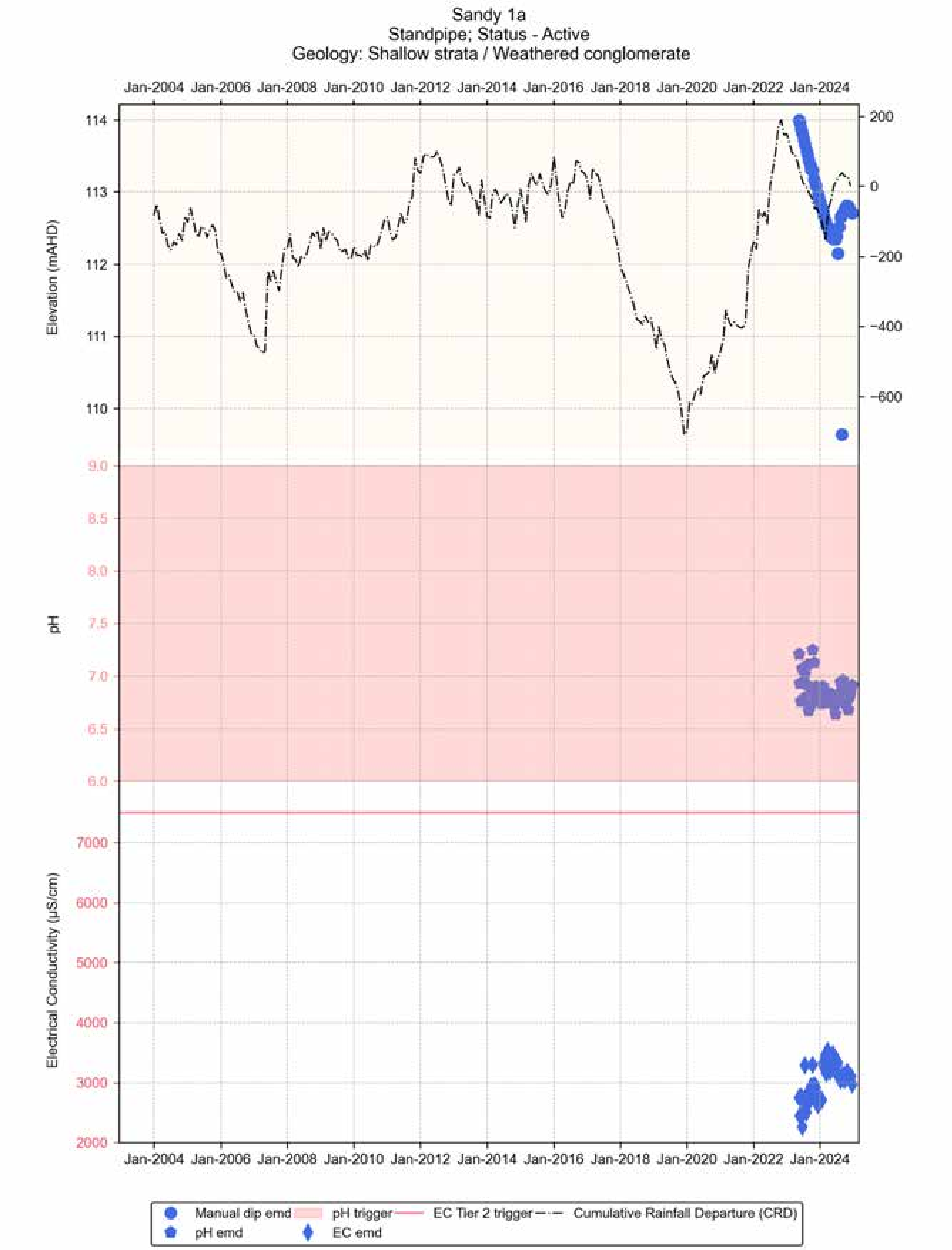


Figure F 5 Sandy 1a groundwater quality triggers chart

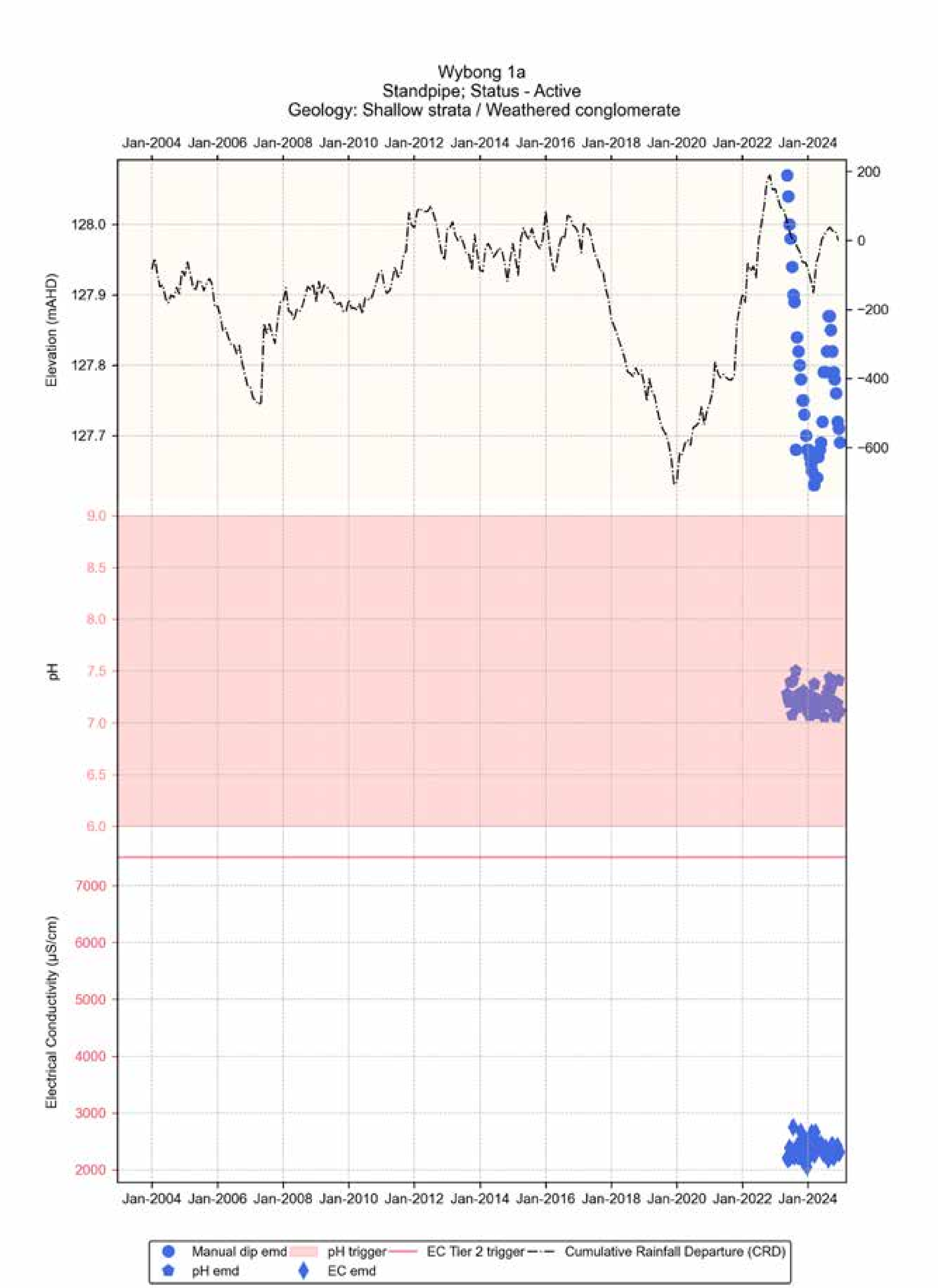


Figure F 6 Wybong 1a groundwater quality triggers chart

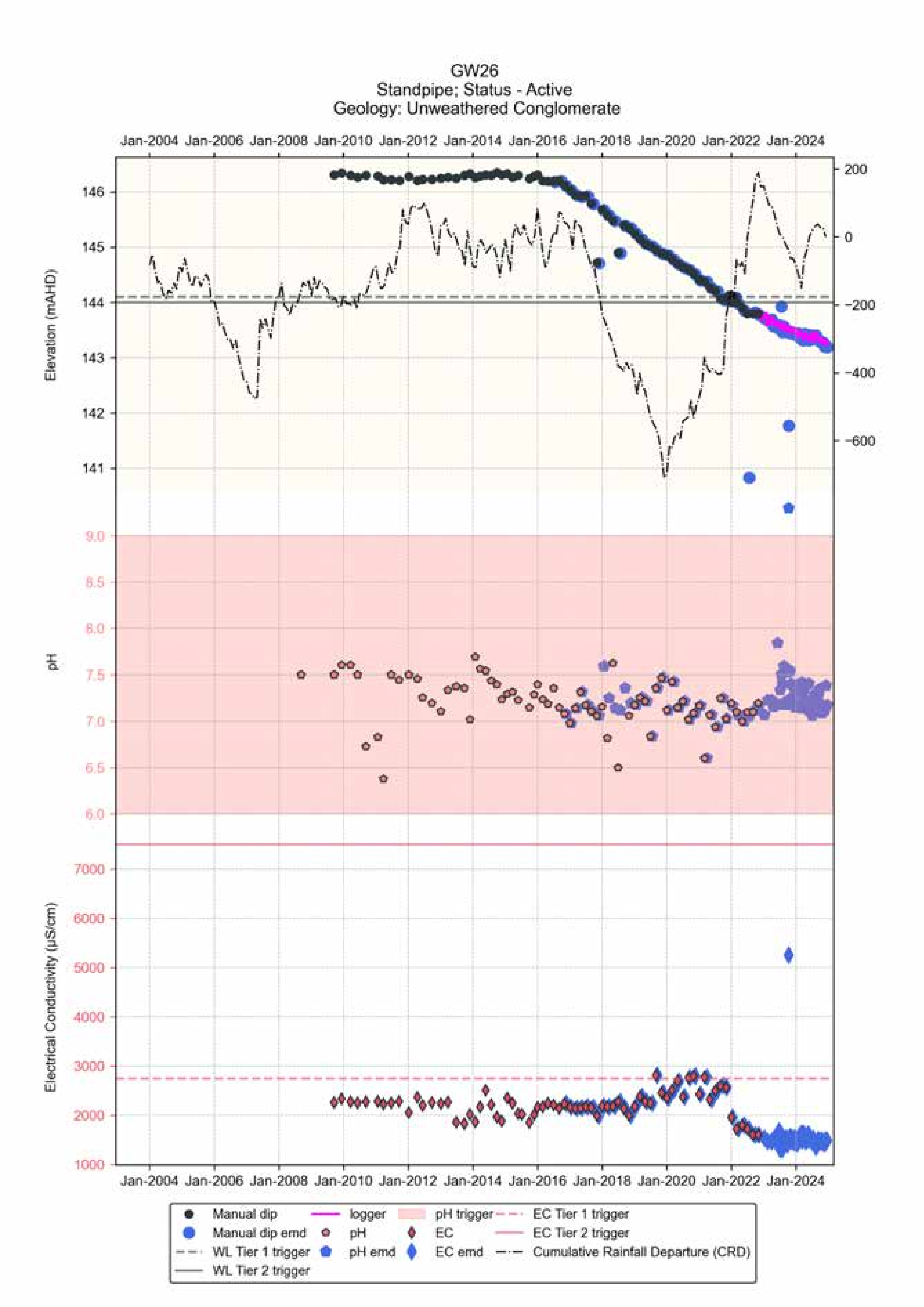


Figure F 7 GW26 groundwater quality triggers chart

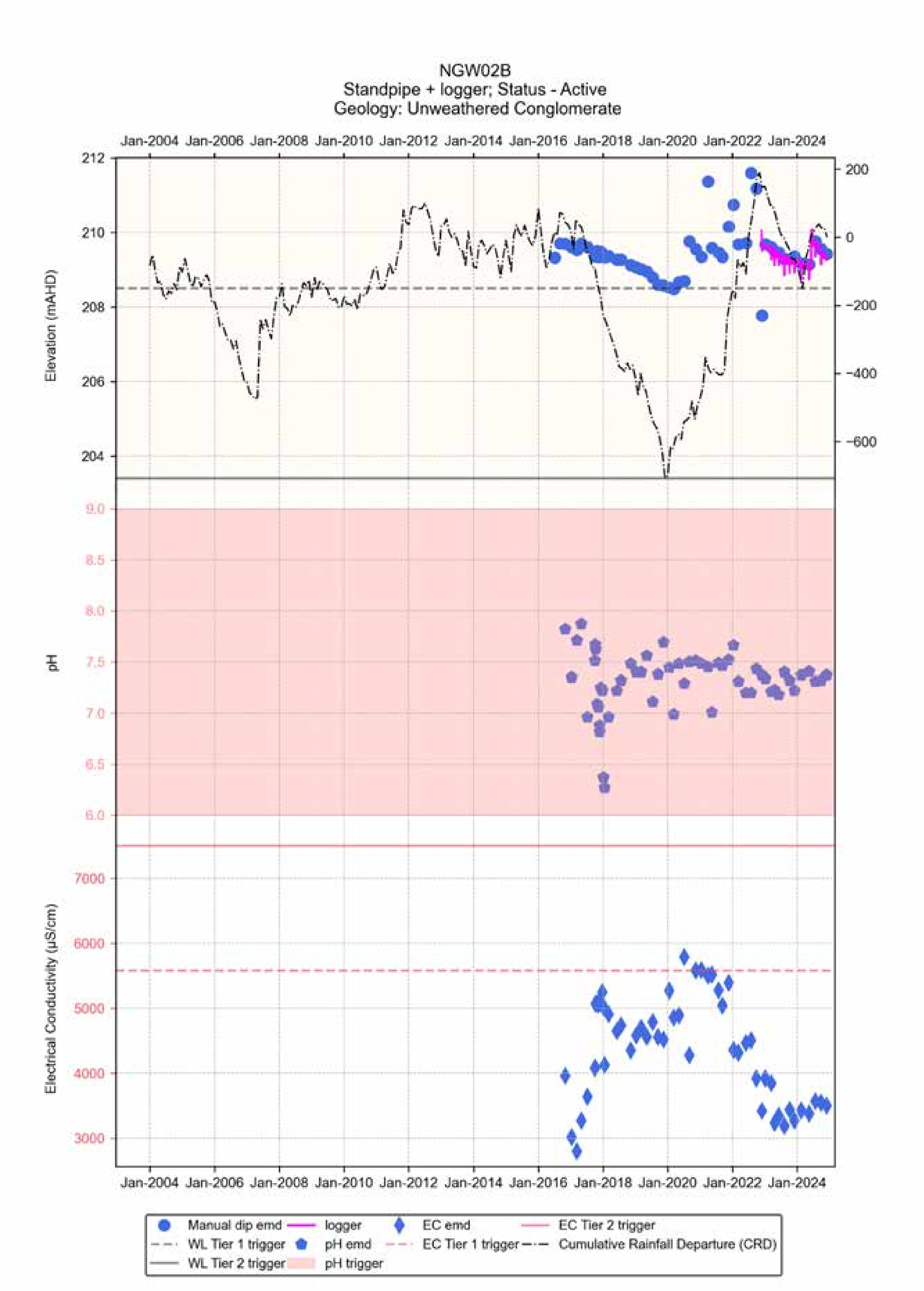


Figure F 8 NGW02B groundwater quality triggers chart

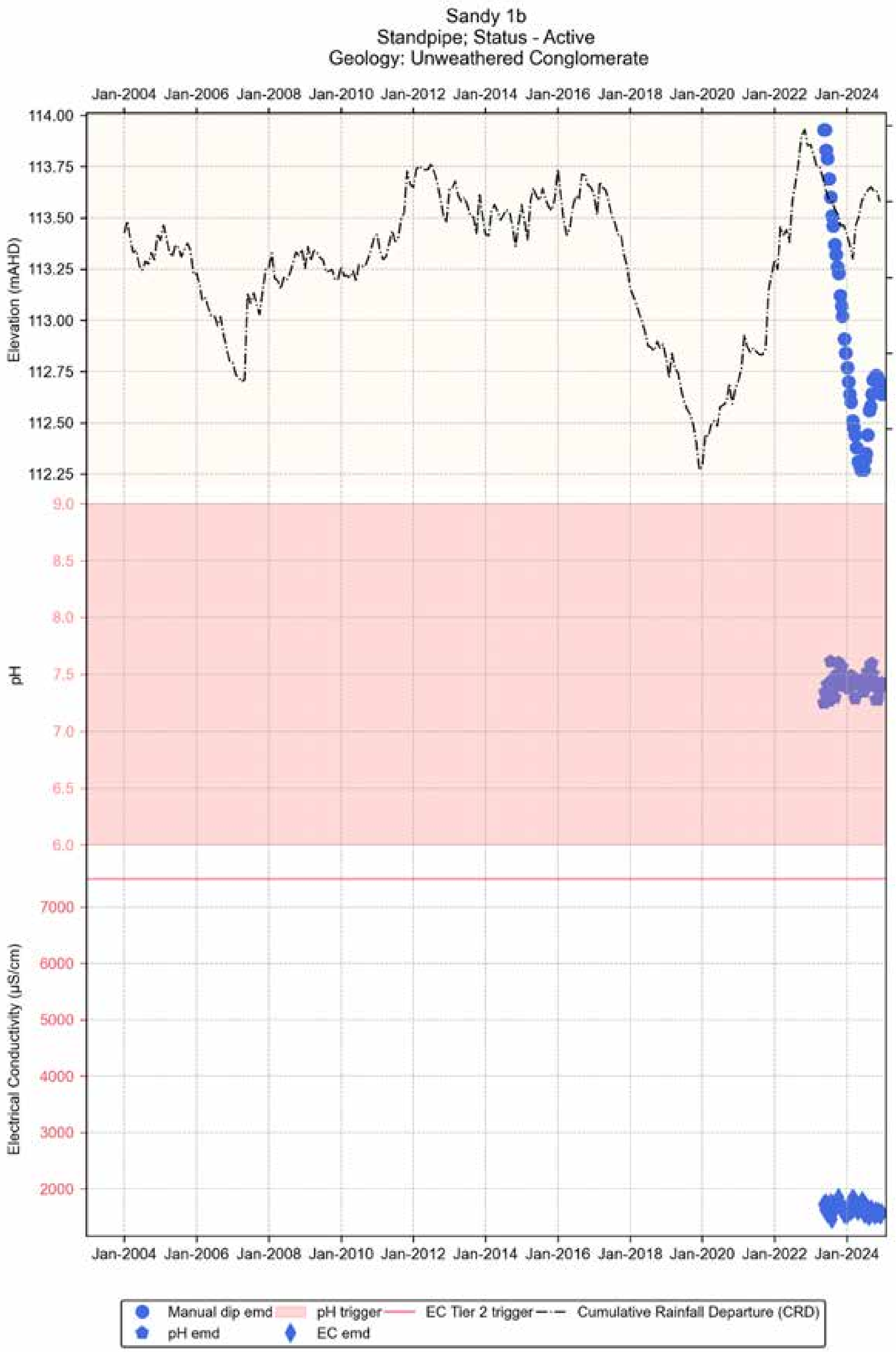


Figure F 9 Sandy 1b groundwater quality triggers chart

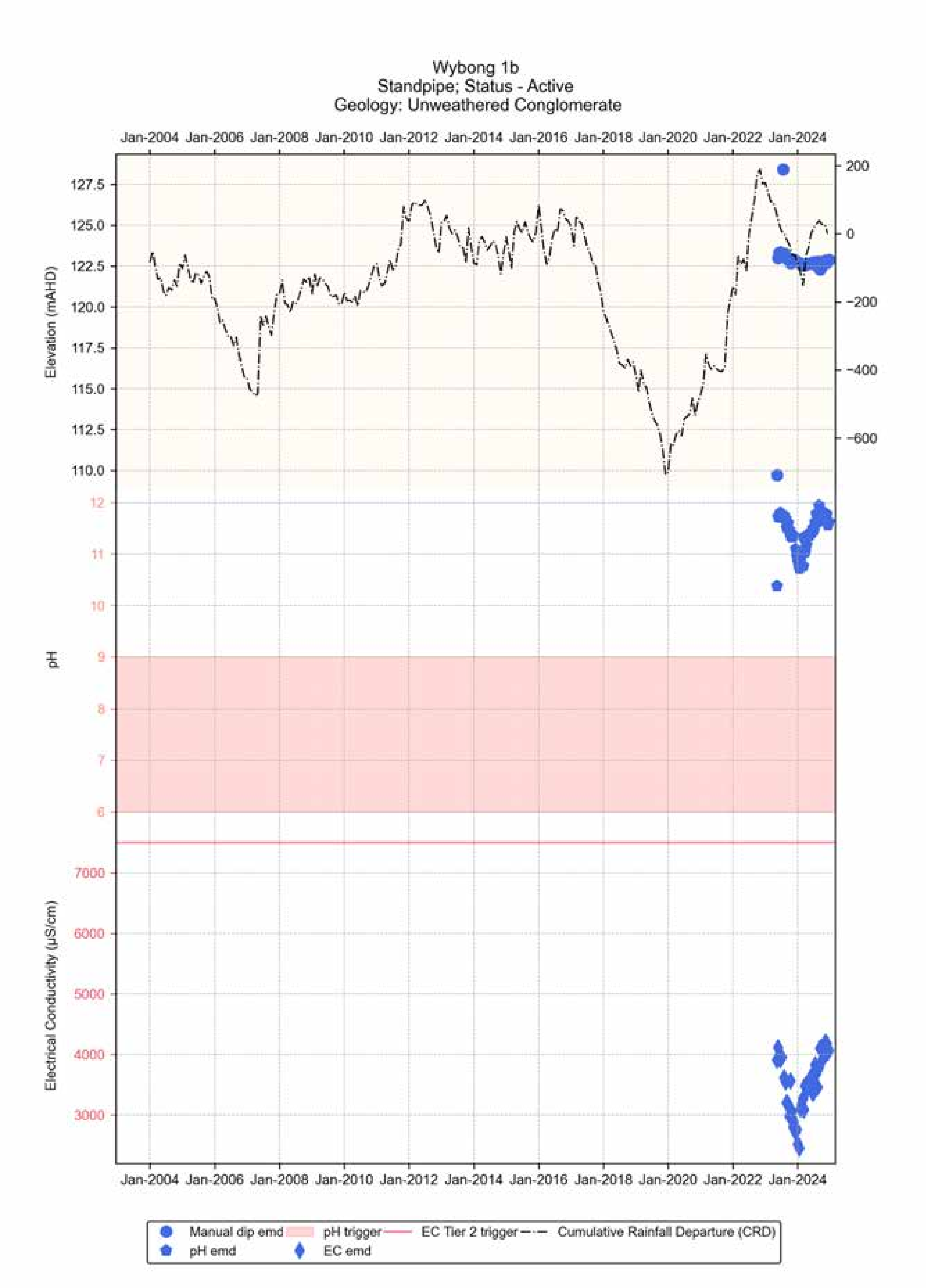


Figure F 10 Wybong 1b groundwater quality triggers chart

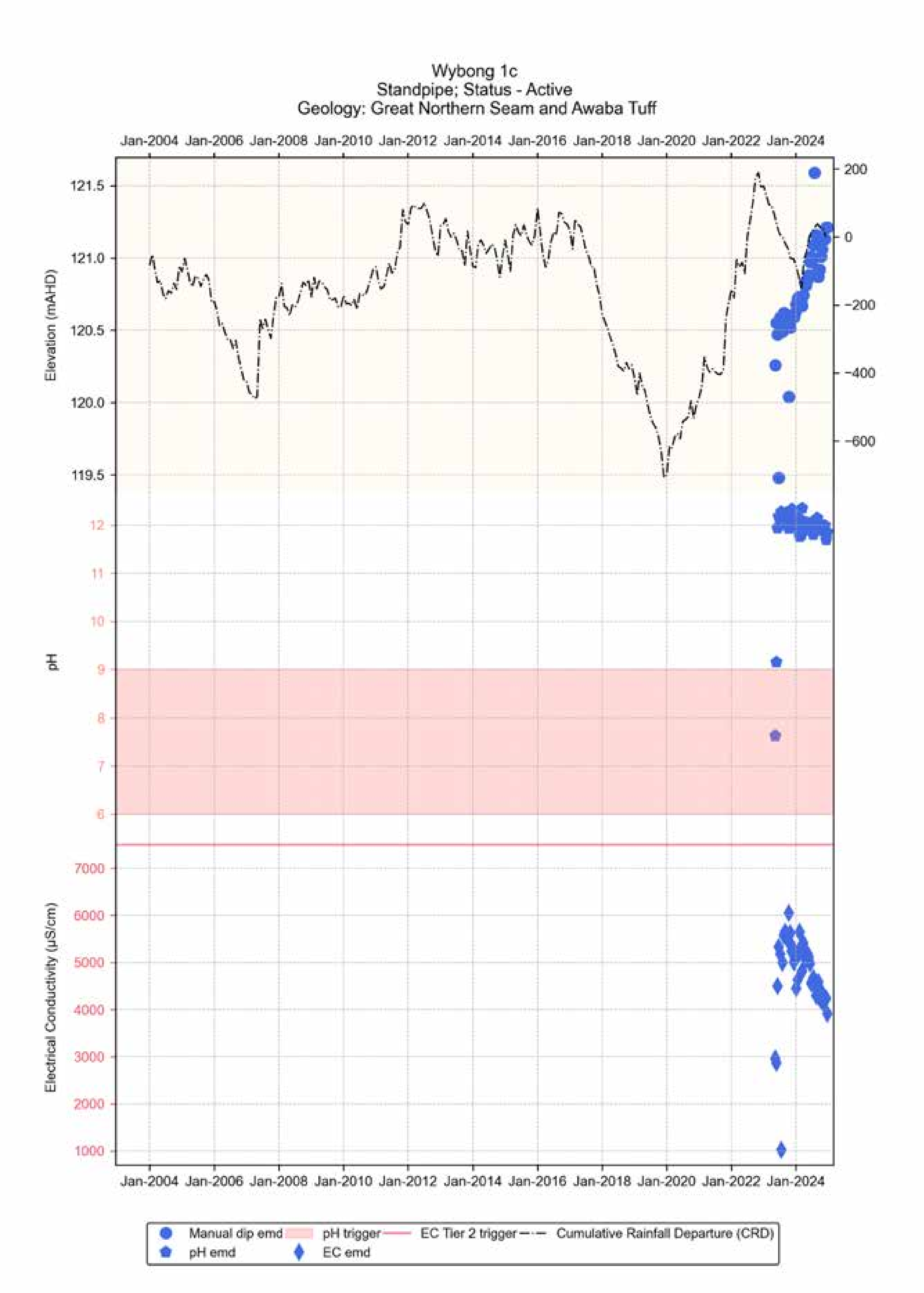


Figure F 11 Wybong 1c groundwater quality triggers chart

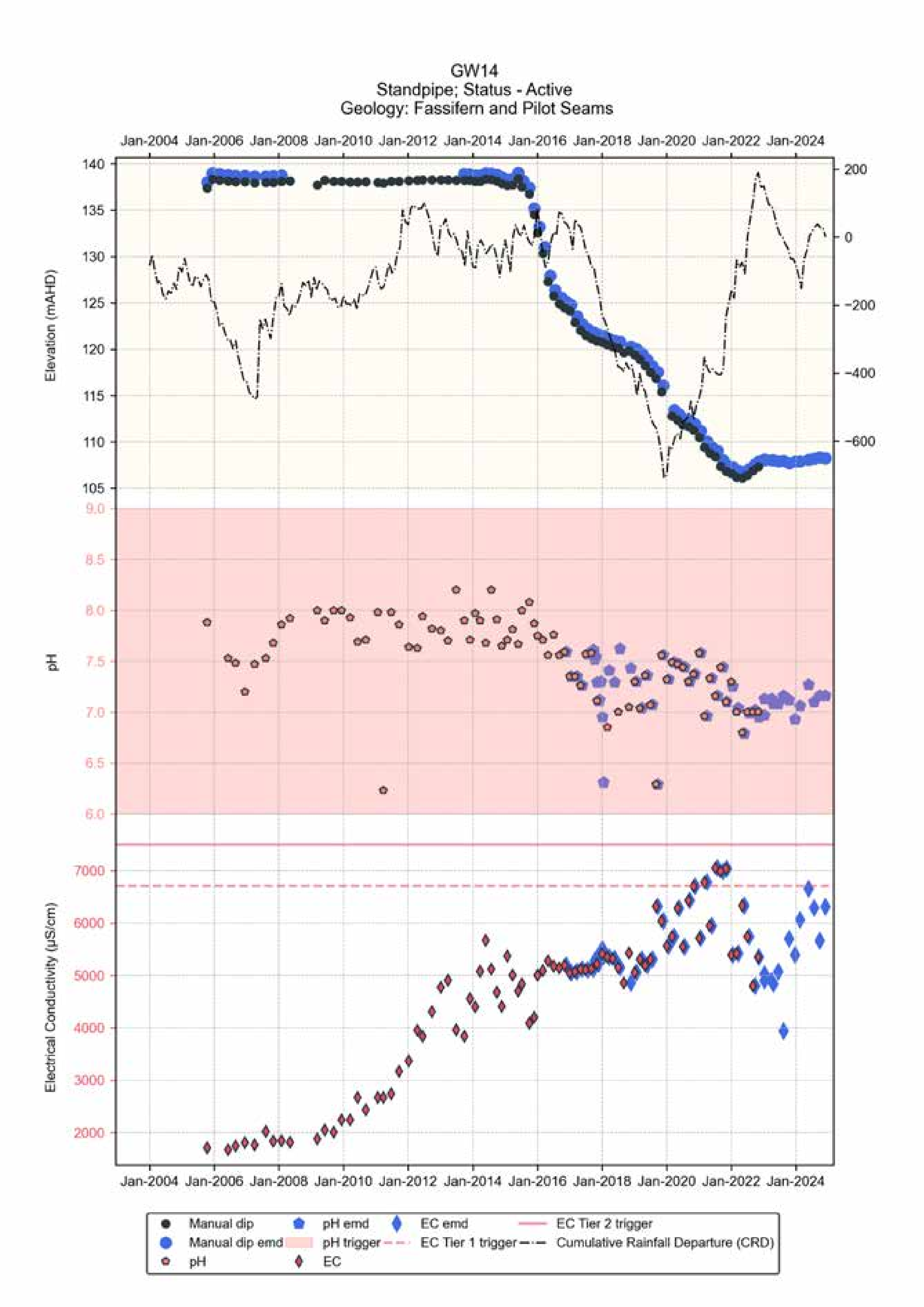


Figure F 12 GW14 groundwater quality triggers chart

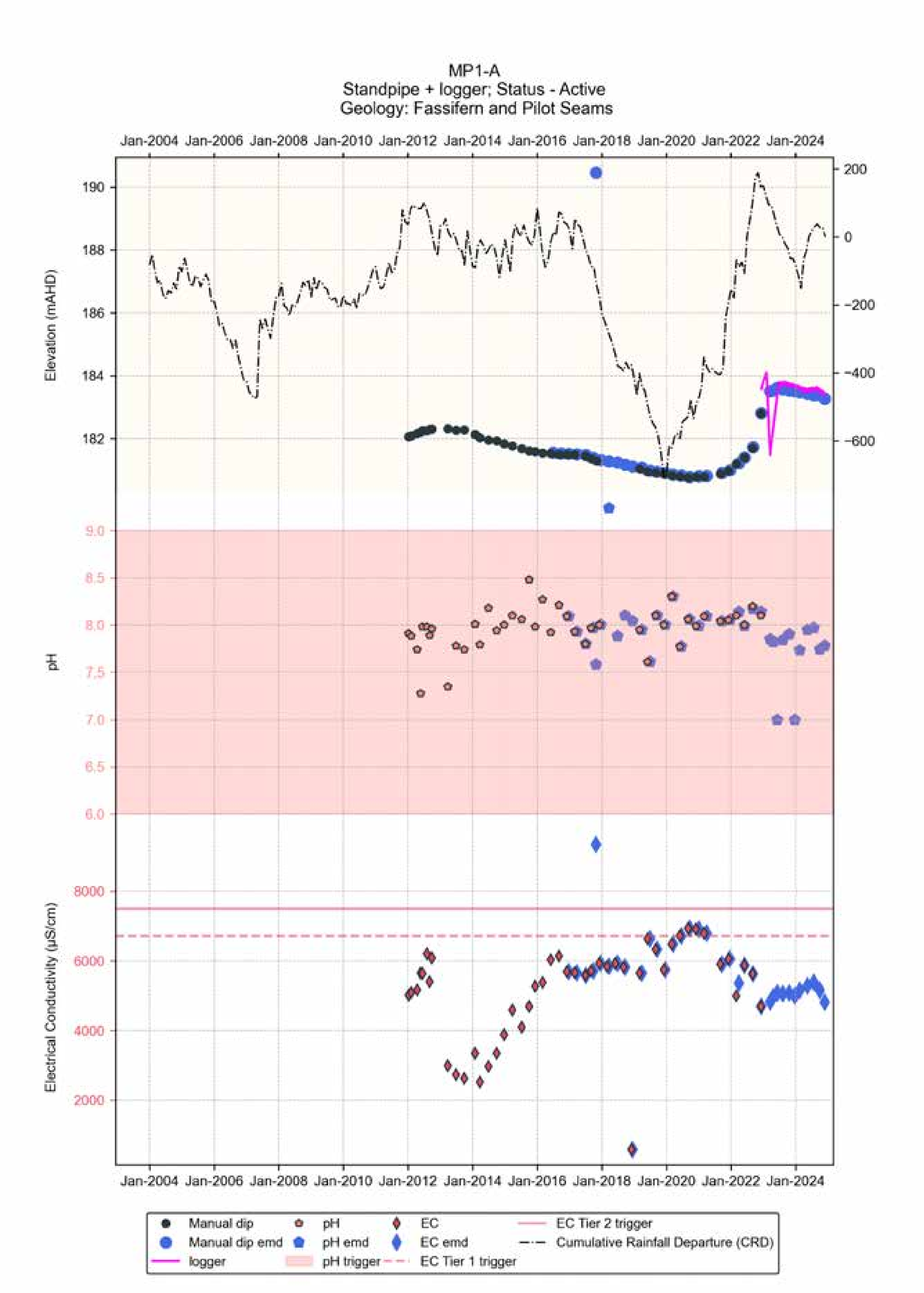


Figure F 13 MP1-A groundwater quality triggers chart

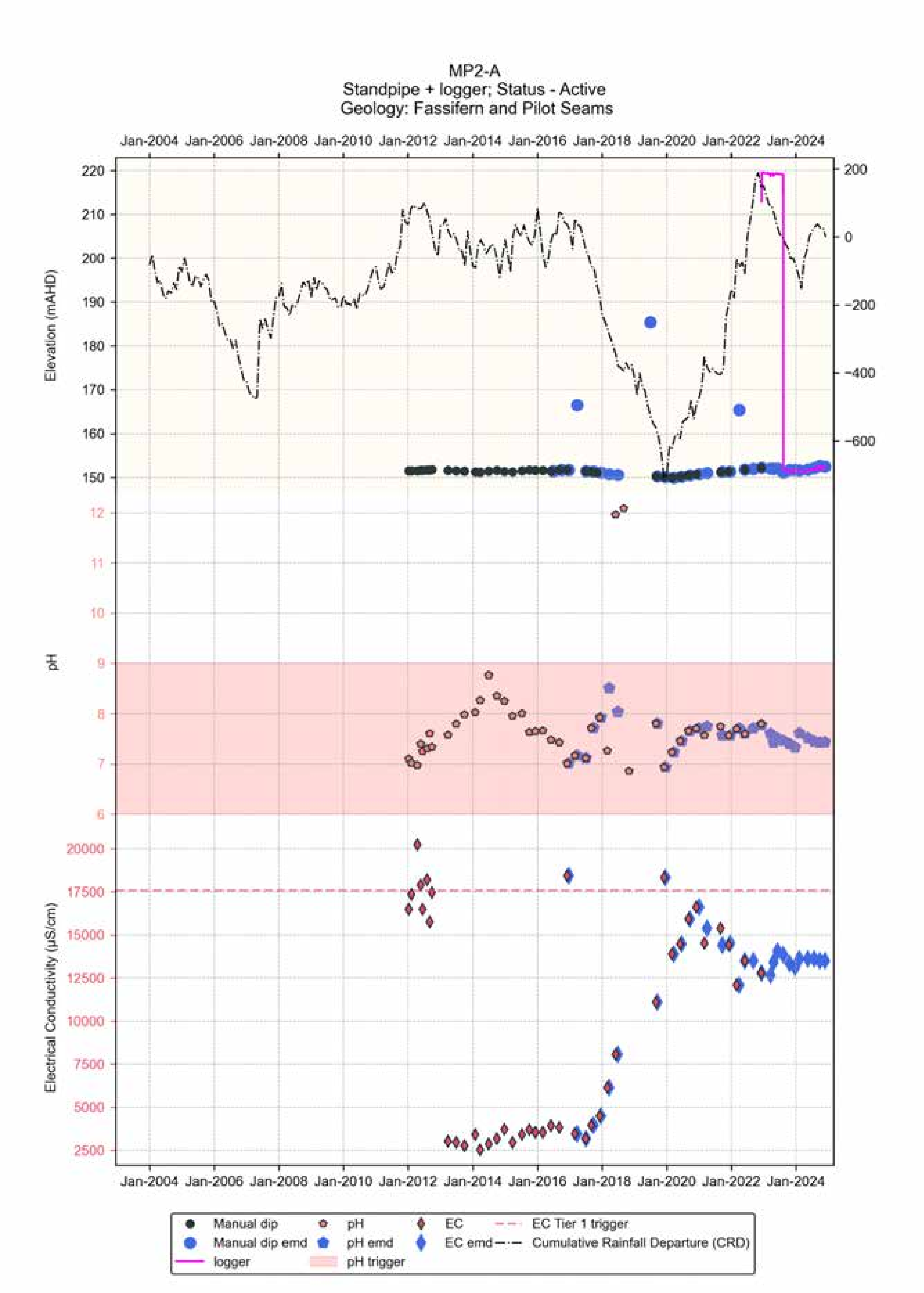


Figure F 14 MP2-A groundwater quality triggers chart