

PF Formation Pty Ltd

Annual Groundwater Report 2021 - 2022 Hitchcock Road Site, Maroota, NSW

Report E2W-0224 R004 (v2)

19 October 2022

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[1] *Unable to access logger- CWD dam levels too high*
[2] *Logger cable submerged under water and unable to find/retrieve*

1 INTRODUCTION

Earth2Water Pty Ltd (E2W) was engaged by PF Formation Pty Ltd (PFF) to provide the Annual Groundwater Report (2021-2022) for Hitchcock Road Site, Maroota (Figure 1). The groundwater and surface water sampling [3] and downloading of data loggers (6) was conducted in consultation and Joshua Graham (PFF) on 15 & 16 September 2022. The ongoing quarterly monitoring of creeks and monthly gauging of groundwater levels was undertaken by Melissa Mass of South East Environmental Pty Ltd (SEE). URS Australia Pty Ltd (URS) was previously (up to 2013) retained by PFF to prepare the groundwater component of the report.

PF Formation Pty Ltd (PFF) is required under the "Project Approval 06_0104 MOD1" conditions set for the Maroota Hitchcock Road property area (Figure 2) to prepare an Annual Review report to Department of Planning and Environment (DPE). This annual groundwater report is prepared to complete the Groundwater and Surface water aspects for the Annual Review in accordance with Condition 5 of Schedule 5 of the Project Approval, and to present the annual monitoring and analytical data to show compliance with the approved Water management Plan (WMP).

E2W provided updated WMP (8 January 2018, 23 November 2020, & 11 April 2022) which included a detailed assessment of the hydrogeology, site survey, pit depths and installation of additional wells and data loggers.

This annual groundwater report by E2W includes the monitoring data collected from 1996 to July/September 2022 for the Hitchcock Road and Portion 198 sites. Additional monitoring data was obtained from the 2018 to 2022 period which included water testing and data logger results and the new deep onsite wells (PF167MW-3D, PF167MW-4D). Due to the high rainfall and dam levels, the data loggers at the clean water dam (CWD), and Por 167 Dam were unable to be retrieved (i.e. logger download planned for 2023).

The monthly water monitoring and annual sampling has also continued from the adjacent new site (i.e. 4378 Old Northern Rd @ PF-1, PF-2, PF-3) and new wells [4] (8) installed at Pits 8 & 13 during August/September 2020 (Figure 1B).

The monthly water levels [5] were continued to be undertaken at available monitoring wells at the Hitchcock Road site and pumping bore (PB-1 [6]) at Lot 198 (Figures 1 & 5, Appendix D).

[3] Sampling locations (17) include: PF214MW-1, PFL2HitchMW-1, PF167MW-1, PF166MW-1, Lot198PB-1, and new locations: PF166MW-2D, PF166MW-2s, PF167MW-3D, PF167MW-4D, PF167MW-4s, and PFPit8MW-6D, PFPit13MW-7D and PF: 1,2, &3. The two water storage dams include: CWD & Por167spring. The two creeks (Lot 198, Hitchcock Rd) were sampled by Melissa Mass on 21 September 2021, 20 December 2021, and 22 March 2022 (no access for June 2022).

[4] PFPit8MW-8A, PFPit8MW-8B, PFPit8MW-8C, PFPit8MW-8D, PFPit8MW-8E, PFPit8MW-6s, PFPit8MW-6D, PFPit13MW-7D. Several of the wells were not gauged during 2021/2022 due to high rainfall/flooding at Pit 8 and Hitchcock Rd site (i.e. wells not accessible).

[5] Measurements conducted by Melissa Mass of South East Environmental Pty Ltd using an acoustic water level probe.

[6] The pumping bores (PB-2 & PB-3) are no longer used due to high iron, and not sampled in 2022.

2 GROUNDWATER AND SURFACE WATER MONITORING NETWORK

During May 2017, six additional monitoring wells were installed to improve the site characterisation of the Hawkesbury Sandstone (i.e. PF166MW-2D, PF167MW-3D, PF167MW-4D, PF167MW-5D) and Maroota Sand Aquifer (PF166MW-2s, PF167MW-4s). Refer to Figure 1B. The 6 monitoring wells were drilled by TerraTest Pty Ltd under E2W (Dino Parisotto) supervision to further assess groundwater levels and to guide the pit extraction depths (Tables 3A & 3B).

The existing wells (PF214MW-1, PFL2HitchMW-1, PF167MW-1 and PF166MW-1) and new wells (PF166MW-2D/2s, PF167MW-3D, PF167MW-4D/4s, PF167MW-5D) were subsequently surveyed to enable reduction of groundwater levels to the Australian Height Datum (mAHD). The aerial survey provided an updated aerial photographic plan showing pit excavation works and site topographic contours in 2017 (Figure 2). The monitoring wells were surveyed by a registered surveyor (Mathew Freeburn Pty Ltd, May 2017). Refer to Table 2A.

During 2018, PFF acquired a new site (4378 Old Northern Rd, Maroota) which is adjacent to the Hitchcock Road sand extraction area (Figure 1B). Three existing monitoring wells identified as PF-1, PF-2, & PF-3 are situated on the new site. Melissa Mass from SEE has monitored the water levels on monthly basis since December 2018 (Graph HG-11).

During August/September 2020, an additional 8 monitoring wells (PFPit8MW-8A, PFPit8MW-8B, PFPit8MW-8C, PFPit8MW-8D, PFPit8MW-8E, PFPit8MW-6s, PFPit8MW-6D, & PFPit13MW-7D) were installed by Ultradrilling Pty Ltd and E2W at Pits 8 & 13 to assess groundwater levels and the flow regime (appendix D, Figure 1B, Graph HG-11B). The groundwater levels are monitored monthly by SEE as part of assessing the maximum pit extraction depths.

At the Hitchcock Road site, groundwater was monitored at existing and new locations on 15 & 16 September 2022 by E2W (download of loggers, annual groundwater sampling, water level gauging and measuring field chemistry). Monthly gauging of groundwater levels and quarterly creek sampling was undertaken by Melissa Mass (SEE) during 2021-2022. The details of monitoring at the existing and new wells are presented in Tables; 2B, 3A, 3B, 3C and appendix D.

Groundwater Sampling of Existing Wells (September 2022)

1. Monitoring bore PF167MW-1 is located at Portion 167 and sampled on 15 September 2022 by E2W (note: data logger was removed in 2018).
2. Monitoring bore PF166MW-1 is located at Portion 166 and sampled on 15 September 2022 by E2W.
3. Monitoring bore PFL2HitchMW-1 is located at Lot 2 and has data logger results available from September 2021 to September 2022. The well was sampled on 15 September 2022 by E2W.
4. Monitoring bore PFP214MW-1 is located at Portion 214 and has data logger results available for the past year. Sampled on 15 September 2022 by E2W. A new logger was reinstated in the well (PFP214MW-1) during July 2021 (note: logger was shifted from CWD).

5. Production Bores PF198PB-1/PF198PB-2[7] and PF198PB-3 are located at Portion 198. One production bore (PB-1) was sampled on 16 September 2022 by E2W (Figure 5).

The pumping records are available from the water supply dams (clean water dam, Por167spring in Portion 167, and by-wash dam in Lot 198) for 2021 to 2022. Refer to Figure 1.

Significant changes to the landform occurred during 2018 to 2019 in the vicinity of PF167MW-5D and PFP214MW-1 which is now covered by a bund wall, raised ground and tailings ponds. A large clay bund wall and holding/tailing pond are located on the southern boundary and alongside the boundary monitoring well (PFP214MW-1).

The altered landforms (bund walls, dams) on the southern boundary are used for water storages and stormwater control. Water circulating in the new tailing dam are interpreted to artificially raise the local groundwater levels at PFP214MW-1. Seepages were not observed in the downslope area of well (PFP214MW-1) during E2W site inspection with PFF (Josh Graham) on 24 July 2021 and 15 September 2022.

Groundwater Sampling of New Wells (September 2022)

6. Monitoring bore PF166MW-2D is located at Portion 166 and sampled on 15 September 2022 by E2W.
7. Monitoring bore PF166MW-2s is the nested shallow well adjacent to the deep well (PF166MW-2D) in Portion 166. The well was sampled on 15 September 2022 by E2W.
8. Monitoring bore PF167MW-3D is located at Portion 167 and has data logger results available. Sampled on 16 September 2022 by E2W.
9. Monitoring bore PF167MW-4D is located at Portion 167 and has data logger results available. Sampled on 15 September 2022 by E2W.
10. Monitoring bore PF167MW-4s is the nested shallow well adjacent to the deep well (PF167MW-4D) and at Portion 167. Sampled on 15 September 2022 by E2W.
11. Monitoring bore PF167MW-5D was formerly located in Portion 167 and subsequently decommissioned in 2017 due to the construction of bund walls**.**
12. The three wells (PF-1, PF-2, PF-3) located at the new site were sampled by E2W on 16 September 2022. Well construction logs are not available for the 3 wells.

- Only two (2) of five available new monitoring bores installed at Pits 8 & 13 were sampled on 15 September 2022 by E2W (i.e. PFPit13MW-7D, PFPit8MW-6D). The pit 8 area was flooded preventing access to the wells (PFPit8MW-8A to 8G). The shallow well outside of Pit 8 was dry and not sampled (PFPit8MW-6s).

Collection of water samples for the September 2022 monitoring period and in previous months has been difficult at the site due to the heavy rains and muddy site conditions. The high rainfall in March 2022 (581 mm) has caused high dam levels and inaccessible access roads. Some data gaps exists in the past year due to flooding and difficult site access.

The additional new wells (14) installed in 2017 (6) and 2021 (8) were aimed to better characterise the groundwater flow regime in the central and northern portion of the site (i.e. PF166MW-2D & PF167MW-3D). The 8 new wells at Pit 8 & 13 and PF-1,2,3 improves mapping of the groundwater flow pattern east of the Hitchcock Rd site (Figure 2). The

[7] *PF198PB-2 was not operational during 2019-2020 (clogging issues). A new bore (PB-3) was installed in October 2019 at Lot 198 wash plant to replace the blocked bore (PF198PB-2), however is currently capped off due to clogging issues (Note: no water samples from PB-2 or PB-3).*

groundwater flow regime at Pit 8 is complex due to the flooding and variable geology causing variable recharge patterns.

The groundwater data and site topography indicate the presence of a groundwater divide near the highest part of the site which separates the flows to the north and south (RL ~240 m AHD at trig station, Figures 2 & 4).

Groundwater pumping and chemical analyses were also collected from the one water supply bores in Portion 198 (i.e. PF198PB-1). The bores PB-2/PB-3 are both clogged with iron-floc and not sampled. The replacement bore (PB-3) was installed in October 2019. The chemical treatment ceased at PB-2 in December 2016, however the bore is constantly clogged due to high iron levels in the water. The same issues occurred with the new bore (PB-3) which is capped off.

Groundwater monitoring has been carried out at the sites since 1996. Initially, water levels in bores PF166MW-1 and PF167MW-1 were measured manually at weekly intervals together with chemical field parameters such as pH and Electrical Conductivity (EC). The manual measurements continued until December 1998. In January 1999, the two bores were equipped with Dataflow Systems automatic data loggers (i.e. PF166MW-1; data logger was removed in 2017).

Data loggers have been downloaded quarterly between January 1999 and June 2000. Since June 2000, the dataloggers have been downloaded biannually. In January 2006, the old-style Dataflow dataloggers were replaced with Solinst Levelogger 3001 units, capable of storing 40,000 readings in the memory, with a battery life span of around 10 years. The Solinst dataloggers allow the data for annual downloading, a monitoring interval (once daily) started on July 2006. E2W downloaded the aged data loggers on 17 July 2017, however the data was only recorded from one (PF167MW-1) out of the four loggers (*note*. No data was not able to be downloaded from loggers at PFL2HitchMW-1, PFP214MW-1, PF166MW-1 in the 2016 to 2017 period).

Data logger information was retrieved from PF167MW-1 for the 2017 to 2018 period, including the two loggers (PFL2HitchMW-1, PFP214MW-1). The loggers from the two wells (PF166MW-1 in 2018, and PF167MW-1 in 2019) were not able to be programmed and subsequently decommissioned. In August 2021, the loggers from the two wells (PF214MW-1 and PFL2HitchMW-1) were not able to be downloaded and subsequently decommissioned. Solinst level data loggers were reinstated in the two wells (PF214MW-1 @ July 2021, and PFL2HitchMW-1 @ September 2021).

Groundwater level information at all available wells was also collected using an acoustic water level probe on monthly basis (August 2017 to 2022) by Melissa Mass of South East Environmental Pty Ltd (SEE). The monthly water level measurements (& creek sampling) are conducted at new and existing wells by SEE, whilst training, assessment and the annual gauging and download of loggers is conducted by E2W (Dino Parisotto).

Solinst data loggers (4) were installed at four locations (Por 167 dam, clean water dam, PF167MW-3D, PF167MW-4D) on 9 August 2017 to assist with the groundwater management and guiding of pit extraction depths. Two loggers (MW-3D, MW-4D) were downloaded on 15 September 2022 as part of this annual groundwater report. The data loggers in the CWD and Por167spring were not able to be collected due to high water levels. The logger data from CWD and Por167spring would be retrieved once dam levels are lower.

Field chemistry (EC, PH, T, DO, Redox) was measured using a calibrated field meter hired from ETS Pty Ltd (Geologic YSI professional series) at the 14 groundwater monitoring wells (PF167MW-1, PF166MW-1, PFPFL2HitchMW-1, PFP214MW-1, PF167MW-4D/4s, PF167MW-2D/2s, Lot 198PB-1), and 3 wells (PF-1,2,3) at 4378 Old Northern Rd, and two wells at Pits 13 (PFPit13MW-7D, PFPit8MW-6D) on 15 & 16 September 2022 by E2W.

Surface water sampling[8] was conducted at the 2 dams (CWD, Por167 Dam) on 16 September 2022 by E2W. All water samples were submitted for chemical analyses under Chain of Custody procedures to Australian Laboratory Services Pty Ltd (ALS, NATA accredited).

Samples were collected from a total of 14 bores and 2 dams;

- Existing/original Wells: PFL2HitchMW-1, PFP214MW-1, PF167MW-1, PF166MW-1, Lot198PB-1.
- New Wells (2017): PF167MW-3D, PF167MW-4D, PF167MW-4s, PF167MW-2D, PF167MW-2s.
- 4378 Old Northern Rd existing wells; PF-1, PF-2, and PF-3.
- New Wells (2020). PFPit13MW-7D, and PFPit8MW-6D (dry well: PFPit8MW-6s). No access due to flooding at Pit 8 (no samples from; PFPit8MW-8A, PFPit8MW-8B, PFPit8MW-8C, PFPit8MW-8D, PFPit8MW-8E, PFPit8MW-8F, PFPit8MW-8G due to flooding at Pit8).
- Water storage dams (CWD & Por167 Spring[9]).

Water sample collected from the bore PF198PB-1 is from a water supply/pumping bore.

The laboratory reports are presented in Appendix B-1. The analytical results have been plotted on individual graphs that are updated annually to assess trends over time (Graphs 1 to 6, and Appendix C).

The analytical list for all bores, which was discussed and agreed upon with the DLWC (now DPIE Water) has included:

- pH, Electrical Conductivity and Total Dissolved Solids;
- Calcium, Magnesium, Sodium and Potassium;
- Chloride, Sulphate, Bicarbonate; and
- Oil & Grease.

2.1 Surface Water Monitoring

The updated Water Management Plan for the site outlines the surface water monitoring requirements. The surface water monitoring program was undertaken in compliance with Condition 19 of Schedule 3 of the Project Approval. Surface water quality monitoring was monitored on a quarterly basis (except June 2022) when the creek sample locations were flowing (& accessible).

Surface water samples were taken from a creek below the Hitchcock Rd site (Figure 1) and also from a creek below Lot 198 DP752025 (Figure 5). Refer to Appendix B-2 (field/laboratory reports), and Table 3-13 (tabulated laboratory results).

[8] Sampling of creeks at Hithcock Road and Lot 198 is undertaken on quaterly basis by SEE (Sept 2021, December 2021, March 2022, but not in June/July 2022 due to access constraints and heavy rain).
[9] Portion 167 Spring also referenced previously as the Portion 167 Dam.

The safe access to creek sample locations in June /July 2022 were prevented by heavy rains and muddy site conditions.

Condition 19.

The Surface Water Monitoring Program shall include:

(a) detailed baseline data on surface water flows and quality in downstream water courses that could be affected by the project;
(b) surface water quality and stream health assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts; and
(c) a program to monitor:
• surface water flows, quality, and impacts on water users;
• stream health; and
• channel stability.

Monitoring of channel stability will be based on visual inspections undertaken at the same time. The assessment will include analysis applying to the following trigger levels:

• pH;	+/-1 unit from background
• Electrical conductivity (EC);	<1,500 uS/cm
• Total suspended solids (TSS);	<50 mg/L
• Oil and grease.	<10 mg/L

Note: Exceedance of trigger levels would trigger an investigation into the cause will be undertaken immediately so action can be taken to return levels to within average range. No additional investigations or follow up on storm and/or erosion issues were conducted after the monitoring undertaken on 3 dates (September 2021, December 2021, March 2022, no access in June/July 2022) due to the satisfactory water testing results and site observations. Refer to Tables 3-9A, 3-9B, and Appendix B-2.

Samples were taken and analysed following heavy rain events and any incidents on Lot 198 DP752025 which could have an impact on water quality. Sample location is presented in Figure 5, with the field and laboratory reports presented in Appendix B-2.

Surface water monitoring was undertaken by Melissa Mass (SEE) at two locations on the Hitchcock Road site (i.e. Lot 198 creek, and Little Catai Creek/Hitchcock Rd). Creek water samples were obtained and analysed on a quarterly basis; 21 September 2020, 20 December 2021, and 22 March 2022. Access to creek locations was not possible on 24 June 2022/or July 2022 (Appendix B-2).

2.2 Monitoring Bore PF167MW1

Groundwater monitoring at bore PF167MW-1 commenced in March 1996. The data between March 1996 and December 1998 (manual collection) have been plotted in the graph of Figure 2, together with EC and rainfall records collected by PFF (Appendix C). An automated weather station has been installed by PFF in 2010 and in early 2017 (including barometric pressure).

The Figure HG-2 (2013-2018, & after 2019 is not available due to a logger fault) presents the combined Solinst datalogger records for bore PF167MW-1 (previous records are in Appendix C). The monthly water level gauging data and graphs is presented in Figure HG-8, and Appendix D.

Previous minor data gaps exist and a slight difference between the manual data and the start of the automatic recording is evident in the previous data, which are due to the time intervening between the end of the manual and start of the automatic recording methods (Appendix C, URS, 2013).

2.3 Monitoring Bore PF166MW1

Groundwater monitoring at bore PF166MW-1 (Figure HG-3 shows 2013 to 2016 monitoring data) commenced in March 1998 in the same manner as for bore PF167MW-1. The data between March 1998 and December 1998 (manual collection) have been plotted in the graph of Figure 4 in Appendix C, together with EC and rainfall records collected by PFF.

Refer to Table 2A for water level gauging results. Logger data is not available for 2016-2017 (logger now decommissioned due to age >10 yrs). The monthly water level gauging graph is presented in Figure HG-8A/8B (2017 to 2021), and Appendix D (Table F-1). The well was previously dry (2019) due to the drought, but was sampled during 2020, 2021 and 2022.

2.4 Monitoring Bore PFP214MW1

Bore PFP214MW-1 was installed in March 2009 as part of an extended groundwater monitoring network following the Development Approval for Portion 214, located at the southern boundary of the Hitchcock Road site.

A datalogger was installed in the bore in early April 2009 (Solinst Levelogger Gold 3001, serial no. 51040540). Refer to Table 2A for the recent water level gauging results.

Bore PFP214MW-1 hydrograph is presented in Figure HG-4 (showing data collection from 2013 to 2020, and 2021 to 2022). Logger data is not available for 2016-2017, and for 2020-2021 due to technical issues with the aged logger. The monthly water level gauging graph is presented in Figure HG-4, and Appendix D (Table F-1).

The monthly water level gauging graph is presented in Figure HG-8A & HG-8B (2017 to 2022), and Appendix D.

2.5 Monitoring Bore PFL2HitchMW1

Bore PFL2HitchMW-1 was also installed in March 2009. This bore is located midway along the eastern boundary of the Hitchcock Site and monitors the full sequence of the Maroota Sand. A datalogger was installed in the bore in early April 2009 (Solinst Levelogger Gold 3001, serial no. 510405840). Refer to Table 2A for water level gauging results. A new level logger (Solinst serial no. 2139431) was installed in the well on 23 September 2021 and downloaded in September 2022.

Bore PFL2HitchMW-1 hydrograph is presented in Figures HG-5, HG-8A/8B (2017 to 2021, and 2021 to 2022) and Appendix D (Table F-1).

2.6 New Monitoring Bores (2017-2022)

A summary of the existing and new bores is presented in Tables 3A, 3B and 3C.

Seven new monitoring wells (PF167MW-3D, PF167MW-4D, PF167MW-4s, PF167MW-2D, PF167MW-2s, PF167MW-5D[10]) were installed at the site in 2017 to assist with the hydrogeological assessment of the sandstone and Maroota Sands aquifer.

Data loggers were installed in August 2017 at two deep wells (PF167MW-4D, PF167MW-3D, refer to Figures HG-6 and HG-7) to assist with the pit extraction depths. Results for the new wells are in presented in Table 3-9A, Figure HG-8A/8B, and Appendix D (Table F-1).

The four existing wells (PFL2HitchMW-1, PFP214MW-1, PF167MW-1, PF166MW-1) were sampled on 15 September 2022 to assist with the groundwater study at the site. The new wells (2 out 5) at Pits 8 & 13 (PFPit13MW-7D, PFPit8MW-6D), and three bores (PF-1,2,3) on the adjacent property were included with the monitoring program (i.e. monthly monitoring and annual sampling in September 2022).

Access was not possible to all monitoring wells at Pit 8 (quarry floor) due to flooding from recent heavy rain (wells are underwater; PFPit8MW-8A, PFPit8MW-8B, PFPit8MW-8C, PFPit8MW-8D).

2.7 Portion 167 Spring

At the early stages of the site development, an excavation (PF167 Spring[11]) was carried out to the top of the Hawkesbury Sandstone to an approximate level of 178m AHD. The excavation collects groundwater and surface water run-off and was eventually licensed by the DLWC (No.10BL157308) as part of the water supply of the operation. Water levels measured against surveyed pegs have been collected at the dam since September 1996 and pumpage records kept since January 1997.

Water quality in the dam is generally not monitored because the dam collects incident rainfall, run-off and groundwater and, as a result, water quality would vary according to the proportion of each component at the time of measurement.

Due to high rainfall in 2014-2015 (1321.5 mm) no monitoring or pumping was required from the Portion 167 Dam. Pumping was undertaken by PFF from Portion 167 Spring during the 2019 to 2020 monitoring period (Total of 28.448 ML) due to the prevailing drought.

Pumping was undertaken by PFF from Portion 167 Spring during 2020 to 2021 (42.865 ML) and for the 2021 to 2022 (2.256 ML) monitoring period and summarised in Table 3-7.

Pumpage occurred even though rainfall was adequate (1633.5 mm during 2021-2022, and 1264.4 mm for 2020-2021) but also to meet the requirements for sand extraction and processing.

Water level monitoring is not required in the license conditions, however a data logger was installed in August 2017 to assist with the site water balance and assessment. (*Note: the logger could not be downloaded due to high dam levels in July/August/September 2021 and*

[10] PF167MW-5D was decommissioned in early 2018 during the construction of the tailings dam.
[11] The Portion 167 Spring is also referred to as the Portion 167Dam.

July/August/September 2022. The two dams CWD and P167 spring had merged during the heavy rainfall in 2022).

Water samples and field chemistry were collected on 16 September 2022 for the site water balance and assessment (Figure HG-10 and Table 3-9B).

The previous data logger readings are provided as raw data in Figure HG-10 (*note: logger data requires adjustment with barometric pressure, evaporation and pumping influences. To be provided in separate documentation*).

2.8 Clean Water Dam (Portion 167)

Water quality in the dam is not previously monitored because the dam collects incident rainfall, run-off and recycled water from the wash plant and tailings.

Water level monitoring is not required in the license conditions, however a data logger was installed in August 2017 to assist with the site water balance. Water samples and field chemistry were collected on 16 September 2022 by E2W to assist with the site water balance and assessment (Figure HG-9 and Table 3-9B). The data logger was not retrieved due to high dam levels which prevented access. Previous logger data is presented in Figure HG-9 (*note: logger data requires adjustment with barometric pressure, evaporation and pumping influences. To be provided in separate documentation*).

2.9 Portion 198 Water Supply Bores

The two water supply bores in Portion 198 (PF198PB-1 and PF198PB-2) have been monitored manually since their installation in March 1998. Groundwater samples have been collected quarterly for the last four quarters to March 2000, biannually up to July 2006 and annually since then. Pumpage records are collected and totalised weekly. (*Note: Pump in bore PF198PB1 was out of service for most of 2012-2013, and PF198PB-2 was replaced in 2019 by PF198PB-3*).

Water quality data have been plotted for selected parameters and the graphs (5 & 6) and the laboratory reports in Appendix B-1. Monthly water levels were measured during the 2017 - 2022 period by South East Environmental (Melissa Mass, Figure HG-1).

The bore was operational and sampling from PF198PB-1 (note: PF198PB-2/3 are decommissioned) discharge outlet occurred in September 2021. A water sample was collected from PF198PB-1 for the chemical assessment and field chemistry by E2W (Tables 3-5 & 3-6).

Note: Chemical treatment for clogging (Fe-floc) at PF198PB-2 ceased in December 2016, however the bore has been clogged/not sampled for the past few years and replaced by PB-3 in 2019. The clogging issues has occurred at new bore (PB-3).

3 GROUNDWATER DATA ASSESSMENT

The groundwater assessment for the site has been conducted by E2W in collaboration with PFF (Josh Graham) and Melissa Mass (South East Environmental Pty Ltd, SEE). The analytical reports by ALS Environmental Pty Ltd (NATA laboratory) are presented in Appendix B-1, whilst the monthly water level measurements by SEE are included in Appendix D.

Additional monitoring locations are included in the 2020 to 2021 and 2021 to 2022 (where access was possible) operating period due to the installation of 8 new wells (Pits 8 & 13 in Aug/Sept 2020), six new wells (May 2017), inclusion of 3 new wells (PF-1,2,3) on the adjacent property (Figure HG-11), assessment of the clean water dam (CWD) and Por 167 dam (Figures; 1, 1A, 1B). The additional testing locations relate to the revised water management plans (January 2018, November 2020, April 2022).

The quarterly surface water testing (September 2021, December 2021, March 2022) has been included at two locations (Lot 198, and Little Catai Creek) in the annual water monitoring program (Figures 1 & 5, Table 3-13, and Appendix B-2). No exceedances of the guidelines are reported for the 2021 to 2022 monitoring period.

This annual groundwater report contains the available monitoring data and updates the analytical data from water monitoring (incl field chemistry) collected annually. The Water Management Plan (WMP) for the site outlines the sample locations, parameters and guidelines in which test results are assessed, together with the associated trigger limits.

3.1 New Monitoring Wells

During May 2017, six additional monitoring wells were installed to improve site coverage and better assess water levels in the Hawkesbury Sandstone (PF166MW-2D, PF167MW-3D, PF167MW-4D, PF167MW-5D) and Maroota Sand Aquifers (PF166MW-2s, PF167MW-4s Figures 1 & 2, Tables; 2, 3A & 3B). The 6 monitoring wells were drilled by TerraTest Pty Ltd under E2W (Dino Parisotto) supervision and testing (Table 3B).

Eight (8) additional wells were installed at Pits 8 & 13 in 2020 to assist with guiding the pit extraction depths above the 2m buffer zone above the high groundwater level. Refer to the WMP (2022).

The inferred hydrogeological cross sections for the site are presented in Figures 3 & 4. The new monitoring wells and recent survey (aerial and well RL details) were used to better assess the pit extraction depths (i.e. 2 m buffer zone).

E2W note that the previous URS water contour maps (2013) were based on a limited well network comprising three monitoring wells over the 100 ha site. The additional new wells (14) installed at the site in 2017 and 2020 provide a better depiction of the groundwater flow regime, particularly in the north (e.g. PF166MW-2D).

The additional three wells (PF-1,2,3) available on the adjacent new property (4378 Old Northern Rd) also improve characterisation of the flow regime on the eastern site boundary (Appendix D & Table F-3, Figure 1B).

The groundwater data and site topography indicate the presence of a groundwater divide at the highest point of the site (RL ~240 mAHD at former trig station located near PF166MW-3D and PFL2HitchMW-1). Refer to Figures 1 to 4.

A decline in groundwater levels was evident across the site in 2019-2020 due to the drought (i.e. rainfall =559 mm during 2019-2020), however water levels have risen in the past 2 years (2020-2022) due to the above average annual rainfall (2021-2022= 1,633.5 mm, and 2020-2021= 1,264.4 mm). Refer to graphs HG-8A & 8B.

3.2 Groundwater Levels

Groundwater levels in the Hawkesbury Sandstone and Maroota Sand aquifers indicate the presence of perched and regional water tables (Tables; 2A, 3A & 3B).

The plots of bore PF167MW-1, which taps the full saturated thickness of the Maroota Sand, and bore PF166MW-1, which taps an unconfined aquifer (Maroota Sand) perched at a higher elevation, indicate a general rapid response to periods of sustained rainfall (Appendix C). Records for the two monitoring bores (PF214MW-1 and PFL2HitchMW-1) indicate a subdued and moderate response to rainfall. The water levels at bore (PF214MW-1) were recently influenced and mounded by the artificial recharge linked to recent dam and tailings constructions (2019).

The yearly rainfall for the year 2010 (1015.1mm), for the year 2011 (1115.4 mm) and for the year 2012 (984 mm) have been considerably above the long term average of 910.3 mm (to June 2013). Rainfall for the year July 2013-June 2014 has been just 595.5 mm, indicating that the rainfall for year is below the yearly long term average (*Note: These rainfall data are reported from the BOM weather station No. 67014 located on Old Telegraph Road*).

Rainfall for July 2014 to June 2015 was 1321.5 mm and above the annual average. The above average rainfall for 2014-2015 and high monthly rainfall during April 2015 (422 mm) has stabilised water levels associated with the previous year of low rainfall and subsequently caused a rising of the water table in all bores. Rainfall for July 2015 to June 2016 was 1176 mm and above the annual average.

The average rainfall for July 2016 to June 2017 was 957.4 mm, with a substantial 276.8 mm occurring in the month of March 2017. The groundwater table rose approximately 1m in the sandstone aquifer (PF167MW-1) following March 2017.

The rainfall for July 2017 to June 2018 was 473 mm, July 2018 to June 2019 was 557.4 mm, and 559 mm for the July 2019 to June 2020 reporting period. The rainfall in 2018/2019 were below the annual average and indicate drought conditions. All deep wells and shallow wells show a general decline and/or stabilisation of groundwater levels reflecting the prevailing low rainfall.

The rainfall for July 2020 to June 2021 was 1264.4 mm, and 1633.5 mm from July 2021 to June 2022. The rainfall in the past 2 years indicate a return to above average rainfall conditions (& site flooding) after several years of drought. Groundwater levels in shallow wells responded well to heavy rainfall during February 2020 (243 mm) and March 2021 (229.8mm), whilst only subtle changes in the deep wells. Intense rainfall occurred during February 2022 (250.6 mm) and March 2022 (581.2mm) causing obvious water level rises in both shallow and deep aquifers at the site.

3.3 Bore PF167MW1

After a significant rain event in June 2007, the water level rose by 4.5 m and similar to highest recorded value in mid-2000 (Figure HG-2, and Appendix C).

Since June 2011 to 2014, after a period of variable and a slow decline, the water level in this bore has been rising steadily following the above average rainfall up to 2013 (2014 is below annual average). The level from rainfall in 2014-2015 is similar in the year 2000. Water levels

were stable in 2014 and then rose sharply (approximately 1.5 m, 183.8 m AHD) after the high recharge event of April 2015 (rainfall 422 mm, Figure HG-2).

Following the April 2015 rainfall event other recharges occurred in early and middle of 2016 causing groundwater levels to rise between 183 and 184 m AHD (June 2016 ~ 183.4 m AHD).

Water levels were approximately 183.5 AHD during July 2017 and ranged from ~182.5 to 184 m AHD during 2016-2017. Spikes in water levels relate to storm events, such as the high rainfall in March 2017 (Figure HG-2). The groundwater table rose approximately 1 m in the sandstone aquifer (PF167MW-1) following the March 2017 rainfall.

The water levels manually measured from August 2016 to August 2018 ranged from 183.12 m AHD to 181.1 m AHD (August 2018), and a gradual lowering (approximately 1m) to August 2019 (180.24 m AHD). The water levels during 2020 to 2021 rose due to the higher rainfall and ranged from 181.95 mAHD (August 2020) to approximately 183.96 m AHD (May 2021).

Water levels responded substantially to the high rainfall in February and March 2022 (250.6 mm, 581.2 mm) causing levels to rise substantially (~2.3m) to July 2022 (185.85 mAHD). The September 2022 groundwater levels are the highest recorded to date (since 2013).

Refer to Table 2A, Appendix D (Table F-1) and Figures HG-8A/8B & HG-2.

3.4 Bore PF166MW1

Since March 2011, the water level in this bore has been rising steadily, although it shows a slight fall during a low rainfall period in the second half of 2012, followed by a rise due to the high rainfall at the beginning of 2013. Bore PF166MW-1 taps a perched aquifer with variable responses to major and sustained rainfall events and periods (Figure 3 in Appendix C).

The water level declines during 2014 and then rises steadily in 2015 due to the above average rainfall and high April 2015 rainfall (422 mm, Figure 3). Following the April 2015 rainfall event other recharge events occurred in early 2016 causing groundwater levels to rise and peak at approximately 200.8 m AHD in April 2016 (Figure HG-3).

The water levels manually measured from August 2016 to August 2018 ranged from 199.55 m AHD to below 199 m AHD in May 2018 (Figure HG-8A/8B). The well has been dry from 2018 to August 2020 (BOH=11.8 m bgl). The groundwater rose quickly (1m) following heavy rains in May 2020 and was measured at 199.20 mAHD on 24 July 2020 (Figure HG-8A).

During 2020 to 2021, water levels rose gradually due to the higher rainfall, and ranged from 199.33 mAHD (August 2020) to approximately 199.85 m AHD (August 2021). The water levels continued to rise (1.69 m) during late 2021 through to September 2022 (201.54 mAHD).

The water levels in the Maroota Sand are generally perched above the sandstone aquifer and have recently risen due to the high annual rainfall in 2020-2021 (1264.4 mm) and particularly during 2021-2022 (1633.5 mm).

3.5 Bore PFP214MW1

Bore PFP214MW-1 taps the full thickness of the Maroota Sand at the southern edge of the quarry area. Since its installation in March 2009, the water level has shown a slow declining

trend up to end of February 2011. Since that time, the water level has risen in response to the above average rainfall (Figure 4 in Appendix C).

Water levels fluctuated slightly (<1m) during 2014 (181.6 m to 180.3 AHD) and then rises slightly and stabilises (180.3 to 181.2 m AHD) with minor fluctuations during 2015 and 2016. Water levels also showed minor fluctuation during 2017 to 2018 with an overall decline. Water levels ranged from approximately 180.2 to 179.5 m AHD (August 2018, Figure HG-4).

The water levels manually measured from August 2016 to August 2018, ranged from 179.41 m AHD to 179.54 mA HD (August 2018). The water levels continued to fluctuate during 2018 to 2019 (178.06 to 179.69 m AHD), reflecting nearby water storages, and bund wall constructions. The groundwater has risen by almost 2 m since early 2019 to July 2020 due to the nearby new water storages/tailing dam (Figure HG-8A/8B). The groundwater level was manually measured at 180.41m AHD on 24 July 2020 which corresponds to the logger levels (Figure HG-4).

During 2020 to 2021, water levels continued to rise gradually to approximately April 2021 and then stabilised with slight decline. The groundwater levels ranged from 179.72 mAHD (August 2020) to approximately 181.19 m AHD (May 2021).

The groundwater levels have remained relatedly stable during late 2021 to middle of 2022 (22-3-2022 @ 181.26 mAHD, and 181.25 @ 15-9-22).

Refer to Table 2A and Figure HG-8A/8B which presents the water levels trends over time (2013 to 2022).

Note: PFF conducted a survey of new and existing wells (Freeburn Surveying Pty Ltd) in May 2017 as part of updating the well network. An adjustment (1.16m elevation) of the well casing RL at PF214MW-1.

3.6 Bore PFL2HitchMW1

Bore PFL2HitchMW-1 is the deepest bore in the Hitchcock Road site, as it in the vicinity of the former trigonometric station, which is the highest elevation on the site and taps the full thickness of the Maroota Sand aquifer.

The hydrograph shows that after an initial settlement period after drilling, the water level stabilised at an RL level of 189.6 m AHD without any significant response to the rainfall events until September 2012, after which time it shows a steady rise in response to the above average rainfall (Figure HG-5, and Appendix C).

Since 2013, the water level shows a slight consistent decline to approximately December 2014, followed by a stable to gently rising water table after April 2015 to middle of 2016 where it stabilises at approximately 189.95 m AHD (Figure HG-5). The water levels decline gently from August 2017 to August 2018, ranging from approximately 189.7 to 189.4 m AHD, respectively. The water levels from August 2018 to July 2019 show a relatively stable and decreasing water level (189.85 to 189.5 m AHD) reflecting the below average rainfall.

The water levels manually measured from August 2016 to August 2018 ranged from 189.6 m AHD to 189.85 m AHD (Figure HG-8A/8B). The water levels from September 2018 to July 2020 show a relatively stable depth between 189 to 190 m AHD.

The groundwater level was manually measured on 24 July 2020 (189.36 m AHD) and 22 July 2021 (190.28 mAHD) showing a stable and gentle rise (0.33m) from the higher rainfall of 2020-2021. The groundwater level continues to rise (1.77m) from late 2021 to July 2022 (191.70) and September 2022 (192.05 mAHD) due to high rainfall. Refer to Figure HG-5, and HG-8B.

3.7 Portion 167 Spring

Records of pump operation have been kept from Portion 167 Spring since January 1997. The Figure 7 (in Appendix C) shows the monthly summary of the pumpage from the dam. Due to the above average rainfall over previous years (2011-2013 and 2014-2015) no pumping has been necessary from this source, however below average rainfall has occurred in early 2014, and 2017-2018, with some pumping necessary. No pumping occurred from July 2014 to June 2015.

Pumpage occurred (46.829 ML) from Portion 167 Spring during 2015 to 2016. Pumpage occurred (38.407 ML) from Portion 167 Spring during 2016 to 2017, and 48.953 ML for 2017 to 2018. Pumpage (26.009 ML) occurred from Portion 167 Spring during 2018 to 2019, and from 2019 to 2020 (28.448 ML).

The new licensed limit for the Portion 167 spring is 44 ML/year which was not exceeded for any year. The annual pumpages are as follows; 2019 to 2020 period (28.448 ML), 2020 to 2021 (42.865 ML) and the current year 2021-2022 (2.256 ML).

The pumping records from 1997 to 2022 are provided in Table 3-7.

The rainfall recorded at the BOM station since 2010 has been above the long-term annual average of 910.3 mm. No water levels have been recorded at this site during the 2011 - 2013, 2014 - 2015 years, as the dam and the pump have been under water for most of the recording period due to the above average rainfall and resulting run-off experienced in the Maroota area during the 2011-2013 and, in particular, during the period May-June 2013 when the water level peaked briefly at 189 m AHD, returning to 180 m AHD at the end of June 2013.

The water level in the dam reduced by approximately 2 m (184.5 m to 182.5 mAHD) during the years (2017-2018) due to the low rainfall and high pumpage (48.953 ML/yr). During 2018 to 2019 levels were at low levels (30 July 2019 @ 183.63 mAHD) due to the drought conditions.

Dam water levels have been rising from 2020 to 2022 due to the above average rainfall. The water level was measured at 184.54 mAHD on 22 July 2021. The water levels in the dam during 2021-2022 are potentially the highest and estimated at 186 mAHD (September 2022), which caused a merge with the CWD. Refer to Figure HG-10.

The water levels in the dam are also affected by significant evaporation losses during summer and combined contributions from rainfall and groundwater recharge (Figure HG-10). The dam is hydraulically connected to the Maroota Sands aquifer and aquifer recharge patterns being closely linked to climate.

The quarry area is internally draining and, therefore, the dam collects all incident rainfall on the site. Although the dam levels are variable and affected by pumpage (i.e. dust suppression

and irrigation of rehabilitated areas and, more recently, for sand slurry), records show that water levels return rapidly to the average values, especially after rainfall and ceased pumping.

The data logger was installed in the dam during a period of high levels in August 2017 (Figure HG-10). Due to the low rainfall and declining water levels, the logger was shifted to a deeper part of the dam by 2.295m on 12 April 2018. The logger data indicates a lowered water table due to the drought conditions up to 2020. The higher rainfall period (2020-2022) and heavy rainfall in February 2021 (243 mm) and March 2022 (581 mm) has caused dam levels to rise (> 2 m) and cover the data logger/peg (i.e. not downloaded as submerged underwater).

The water level in Por167 Spring was measured at 184. 42 mAHD on 22 July 2021 by PFF using nearby surveyed benchmarks. Survey (2022) of the water levels in Por167spring has not been conducted due to heavy rains and muddy site conditions.

Previous records suggest that the Maroota Sand aquifer at the site can sustain the required pumpage even under the lower rainfall recharge conditions.

3.8 Clean Water Dam (CWD in Portion 167)

Water quality in the dam (1 Ha ~1.5m maximum depth) was not previously monitored because the dam collects incident rainfall, run-off and recycled water from the wash plant and tailings. The data logger was installed in the dam during a period of high levels in August 2017 (187.635 mAHD). The water levels have decreased by approximately 1m from 2017 to 2018 (186.5 mAHD) due to a lack of rainfall, summer evaporation losses and through operational activities. The water levels fluctuated by approximately 1 m from 2018 to 2019.

The water level on 22 July 2020 of 186.90 m AHD was slightly higher than the 30 July 2019 level (186.77 m AHD). Pumping records are provided in Table 3-12 whilst the logger results are presented in Figure HG-9. The water level was 0.315 m higher on 14 July 2021 (187.215 mAHD) relative to CWD level on 22 July 2020.

The collection of the data logger and survey was not possible from the CWD due to high dam levels and flooding at the site.

Water level monitoring is not required in the new license conditions, however a data logger was installed in August 2017 to assist with the site water balance. Water samples and field chemistry were collected on 16 September 2022 by E2W o assist with assessing and managing the surface water quality (Table 3-9B).

3.9 Water Supply Bores (PB1, PB2/PB3 at Lot 198)

Pumping records for the water supply bores (PB-1/PB-2 and PB-3) in Lot 198 for the year July 2021 to June 2022 are tabulated in Table 3-8 (i.e. combined usage of 20.201 ML). Groundwater usage is still significantly below the combined new annual allocation of 56 ML.

In previous years, during 2014-2015 pumpage was 21.8 ML, whilst during 2013-2014 the total pumpage was 33.6 ML. During 2015 to 2016 and given the above average rainfall the available pumping records (PB-1 & PB-2) indicate a usage of 16.841 ML. Pumpage from 2016 to 2017 from PB-1/PB-2 indicate a combined usage of 16.507 ML. The pumpage during 2017 to 2018 (13.622 ML), and from 2018 to 2019 at PB-1 (9.947 ML) are well below the 60 ML allocation.

The replacement bore (PB-3) was installed and commissioned in October 2019 due to the ongoing clogging/high iron levels of PB-2 (i.e. PB-2 is no longer used and replaced by PB-3, which was also decommissioned in 2022 due to clogging). Refer to Table 3-8 & Figure HG-1.

3.10 Water Quality

The water quality obtained from all available monitoring wells and dams are presented in the hydrochemical diagrams (i.e. Piper trilinear & expanded Durov in Appendix E) and time series graphs (Graphs 1 to 6).

Water quality in bores PF167MW-1 and PF166MW-1 has been monitored for pH and EC since monitoring started. Since June 1999, groundwater quality has been analysed for a range of analytical parameters and for Oil & Grease to obtain background data.

Since July 2009, groundwater quality data have also become available from the newly installed monitoring bores, PFP214MW-1 and PFL2HitchMW-1. Historical and recent analytical results for the other samples from the monitoring sites are summarised in Tables 3-1 to 3-6 and have been plotted in the graphs (1 to 6). The laboratory reports are presented in Appendix B-1.

The graphs (1 & 2) show EC time series trends with water levels and rainfall for the initial monitoring period (March 1996 to January 1999 for bore PF167MW-1 and March 1998 to January 1999 for bore PF166MW-1), before the installation of the dataloggers. Refer to Appendix C for previous graphs presented in URS 2013. The EC graphs show a sympathetic variation with rainfall, indicating the effects of dilution generated by recharge (decrease in EC) and by a lower water table. In the latter case, the improved EC is interpreted as the effect of aquifer recharge by fresher water.

The graphs (1 to 6) confirm the dependence of the aquifer upon rainfall to maintain storage and supply. Analysis was not previously carried out of the water from the Portion 167 Dam because of extraneous influences, such as direct rainfall and run-off, make the water in the dam not representative of the groundwater at that site.

Groundwater quality has also been monitored at bores PF198PB-1 (Graph-5) and PF198PB-2/PB-3 (Graph-6), the processing plant water supply bores[12]. The water in these bores is derived from the Hawkesbury Sandstone aquifer. Water quality records are summarised in Tables 3-5 and 3-6 and have been graphed (Refer to Graphs 1 to 6, and previously by URS (2013) in Appendix C). The groundwater levels in the production bores (PF198PB-1 & PB-2/PB-3) are presented in Table 3-8.

The waters in the Maroota Sand aquifer monitoring bores are similar and have a characteristic rain composition, with low pH (acidic), low TDS and a Sodium-Chloride water type. The samples were also analysed for Oil&Grease to monitor the possible effect of the sand extraction operations. Concentrations of Oil & Grease were not detected in all bores for the September 2022, 2021, 2019, 2018, and previous four monitoring events (2017, 2016, 2015, 2014). Some anomalous Oil&Grease results were reported from water samples from two locations (CWD and P166MW-1) on 5 August 2020, however were “not detected” with re-sampling on 19 August 2020 by E2W. The initial anomalous Oil & Grease results are interpreted to result from potential cross contamination (i.e. skin contact).

[12] PB-2 was replaced by PB-3 (since October 2019, refer to Table 3A).The two bores (PB-2/PB-3) are no longer in use due to Fe/clogging issues.

The deep Hawkesbury Sandstone pumping bores groundwater display a slightly different character from that in the shallow Maroota Sand aquifer in the Hitchcock Road area and from the shallow Hawkesbury Sandstone aquifer in other areas of Maroota. The deeper groundwater has a slightly higher TDS, pH and Bicarbonate content (PF198PB-1& 2) than the shallower Maroota Sand groundwater; however, its overall low salinity content and sodium-chloride rain composition indicate a dynamic groundwater regime with regular and rapid rainfall recharge.

An increasing EC/TDS trend was evident in two bores (PFL2HitchMW-1, PF214MW-1) from 2013 to 2017, and inferred to relate to variable aquifer characteristics and rainfall recharge patterns. The EC/TDS trends at the two bores (PFL2HitchMW-1, PF214MW-1) have stabilised in the past 4 years (2017-2022). The previously increasing TDS/EC trend at both bores (PFL2HitchMW-1, PF214MW-1) has declined based on the 2021 and 2022 results.

The boundary bore (PF214MW-1) had a rising water table up to middle of 2021 due to the nearby water storages/tailings dams. Ongoing monitoring is required at PF214MW-1 to address potential mounding of the water table from nearby water storages. Seepages were not observed by E2W at the base of the bund walls next to PF214MW-1 on 15 September 2022.

The water quality of the deep new bores (MW-3D, MW-4D, MW-2D) within the Hawkesbury Sandstone are like the existing bores. The water quality in the dams (CWD and Por167 spring) are similar to the shallow bores (MW-4s) situated within the Maroota Sands aquifer. The deeper bores (MW-4D) are similar in major ion composition (Na-Cl rich) to shallower bores and dams, however have slightly higher TDS (Appendix E, Piper trilinear & Durov diagrams).

The new wells at Pits 8 & 13 also target the sandstone and Maroota sands aquifer (i.e. sandstone bores: PFPit13MW-7D, PFPit8MW-6D and Maroota Sand wells: PFPit8MW-8A PFPit8MW-8B, PFPit8MW-8C, PFPit8MW-8D, PFPit8MW-8E and PFPit8MW-6s).

The groundwater samples and pond 8 from Pit 8 is not available due to flooding of the site. The available well sampling, water analyses and the hydrochemistry are presented in Table 3-14 and in appendix E.

The water monitoring results at Pits 8 & 13 and at wells (PF-1,2,3, Table 3-10) indicate similar water quality characteristics (Na-Cl, low TDS, acidic pH) to the Hitchcock Road bores. The deep bore (PFPit13MW-7D) has a higher TDS as it encountered siltstone/shale bedrock at depth (lower permeability formation), whilst the Pond8 pond is relatively fresh indicating a stormwater runoff source (not groundwater).

The groundwater bores at Pits 8 & 13, and PF-1,2,3 indicate minor variations in the water quality due to variations in the geology of the Maroota Sand and sandstone (e.g. ironstone layers, shell grit, pebbles, shale/siltstone layers).

Overall, all the site monitoring bores in both the Hawkesbury Sandstone and in the Maroota Sand show minor variation in Total Dissolved Solids over time, with the deeper bores showing a more constant character. The general groundwater flow regime with the sandstone aquifer is shown in Figures 2 to 4.

3.11 Laboratory Quality Control

The laboratory quality control samples (ALS laboratory duplicates, procedure blanks and control spikes) returned results within the required limits and acceptance criteria. The quality

control data generated by the laboratory are presented with the laboratory certificates in Appendix B-1 & B-2.

ALS Environmental is NATA accredited for the analyses performed. Based on the evaluation of the data, it is assessed that the accuracy and precision of the analytical data generated in the sampling round, as reported by the analytical laboratory, are acceptable as a basis for interpretation. The short holding time for laboratory PH measurements is supplemented with field readings using a calibrated field chemistry meter (YSI professional series).

4 CONCLUSIONS

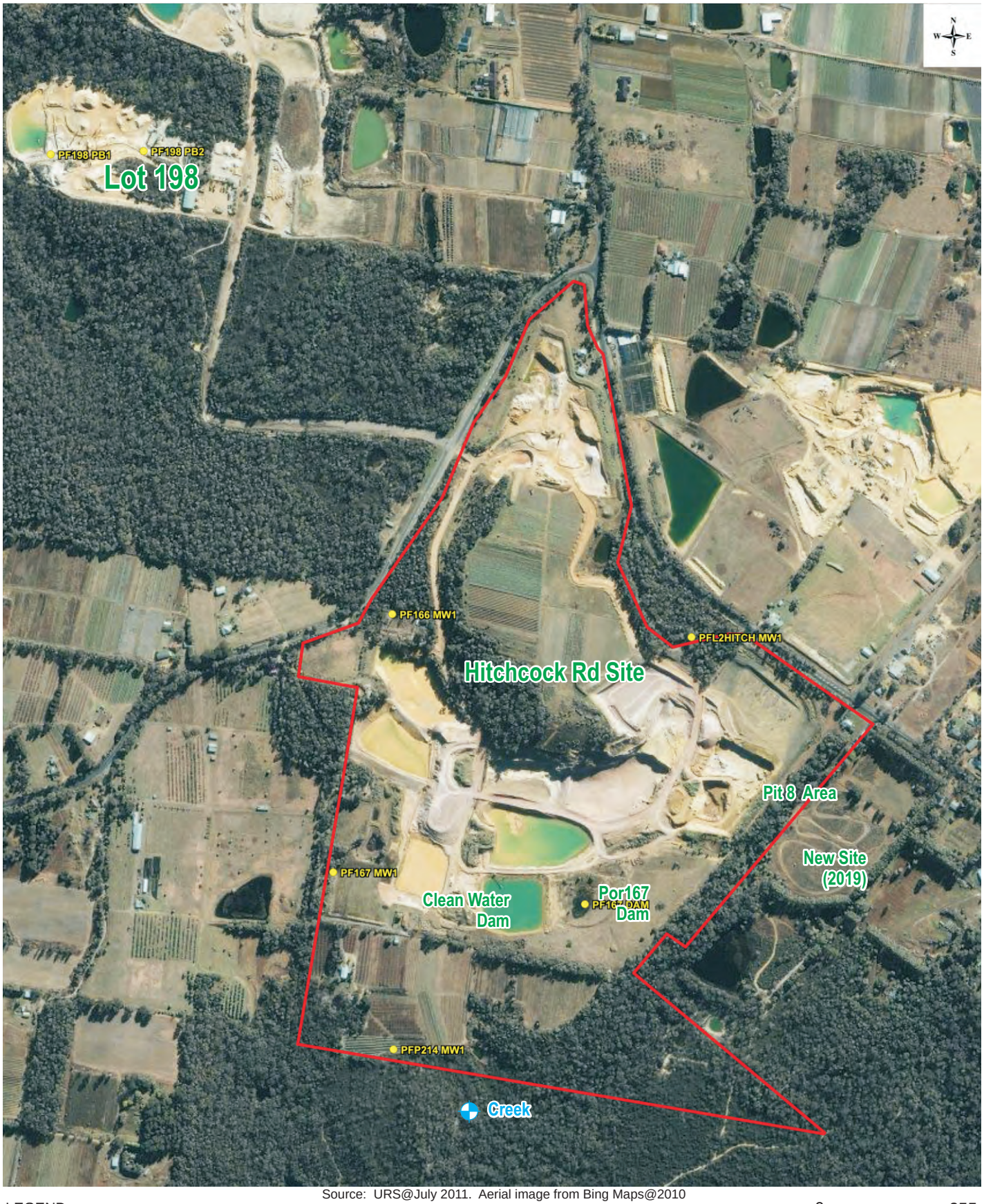
The assessment of the data collected on the groundwater levels and quality in the Maroota Hitchcock Road site, some of which represent the oldest data available to the groundwater study carried out by the DLWC (now Office of Water) indicate the following:

- Water levels in the Maroota Sand aquifer generally respond to the rainfall pattern. The rainfall in the past two years (2020-2021 @ 1264.4 mm, and 2021-2022 @ 1633.5 mm) were substantially above the annual average.
- Water quality in the Maroota Sand aquifer varies with rainfall recharge due to variations in aquifer characteristics and rainfall from 2013 to 2022. The recent 2021-2022 sampling indicates a stabilisation of the EC/TDS trend in PFL2HitchMW-1 and PF214MW-1. The previous water level rises at PF214MW-1 and stabilisation in 2021-2022 relate to the construction of nearby water storages.
- Water was pumped from the Portion 167 Spring (2.256 ML) and was below the PFF allocation (44 ML).
- Previous pumpage records for the two production bores (PF198PB1=12.027 ML, and PF198PB2=1.595 ML) in 2017-2018 was 13.622 ML, whilst during the 2018-2019 period was 9.947 ML (PB-1 only). During 2019-2020, the existing production bore (PB-1) and a new bore (PB-3, replacing PB-2) recorded 26.745 ML. The combined pumpages from PB-1/PB-3 during 2020 to 2021 was 14.248 ML. The pumpage during 2021-2022 period was 20.201 ML (PB-1 only). Groundwater pumpage has remained substantially below the allocation of 56 ML/year (i.e. combined PB-1 & PB-2/PB-3). The two bores (PB-2/PB-3) have been decommissioned due to high Fe and clogging.
- The chemical composition of the groundwater in the deep aquifer of the Hawkesbury Sandstone (water supply bores in Portion 198) has an overall character that indicates that rainfall recharge occurs readily.
- The new monitoring wells (6) installed in 2017, three additional wells at the new site (PF-1, PF-2, PF-3), and 8 new wells (2020) at Pits 8 & 13 were used to better assess groundwater levels, the flow regime and pit extraction depths. E2W understand that two previous pit extraction areas (locations near PF167MW-3D and PF167MW-5D) were backfilled in 2017-2019 to meet the required groundwater buffer zone (i.e. >2m above the high water table).
- The current sand extraction operations in the Hitchcock Road area operate in a manner that does not appear to have an adverse impact upon the groundwater sustainability and meets the DA Approval Conditions.

The data collected during the year are available to Water NSW for their continued study in the area.

FIGURES

earth2water Pty Ltd
Environmental & Groundwater Consulting



Source: URS@July 2011. Aerial image from Bing Maps@2010

LEGEND
- Site Boundary
- Groundwater Monitoring Location
- Creek Sample Location

0 255
Approx Scale - metres

SITE LOCATION- Hitchcock Rd & Lot 198 (2022)

Date: *19 October 2022*

Reference: *E2W_224_07.cdr*

PF FORMATION - Hitchcock Road, Maroota

Figure 1

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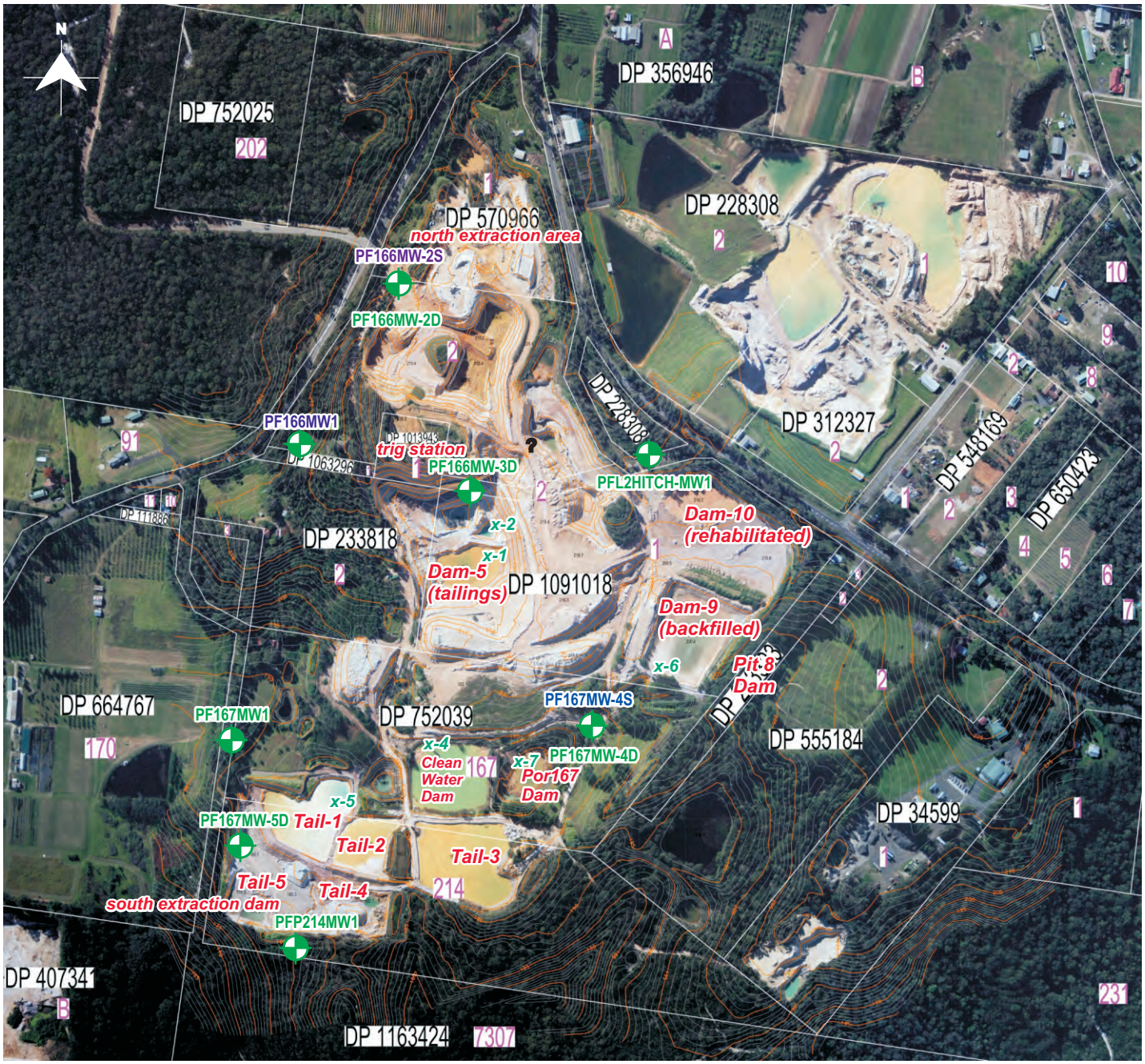


0 100 200 300 m
Scale

Base source: Landair Surveys 2017

Landair Pty Ltd; May 2017 Topography Shown

Note:Frequent changes to land from 2017 to 2022 sand extraction & backfilling

LEGEND

PF167MW-4S	Well location (Maroota Sands)
PF167MW-4D	Well location (Sandstone aquifer)
x-5	Water sample location (E2W; 20 April 2017)
Tail-2	Tailing dam (active settlement)
Dam-9	Dam (former extraction pit, undergoing rehabilitation)

Pit 8 Dam; from 2019
Tail: 4 & 5 from 2019 (former backfilled extraction areas)

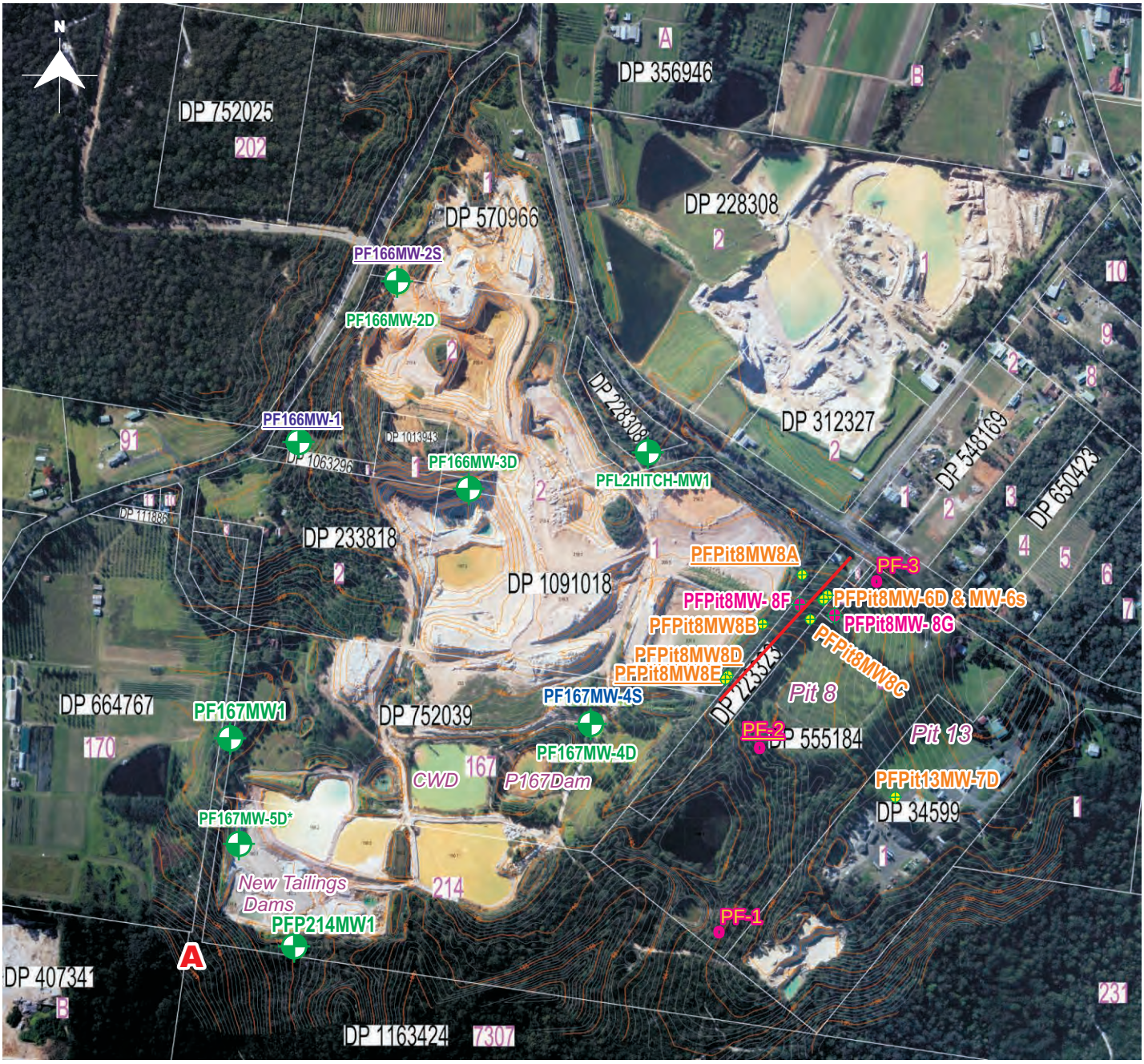
Site Layout & Water Storages (2022)

Date: 19 Oct 2022

Reference: E2W_224_15.cdr

MAROOTA - HITCHCOCK ROAD SITE

Figure 1 A



LEGEND

PF167MW-4S	Well location (Maroota Sands)
PF167MW-4D	Well location (Sandstone aquifer)
PF-1	Well Location (2019)
PFPit13MW-7D	New Wells; Pits 8 & 13 (Aug/Sept 2020)
PFPit8MW- 8F	New Wells; Pit 8 (22 Sept 2021)

Note:

Perched Water Table (Maroota Tertiary Sand):

PF166MW-2s, PF167MW-4s, PF166MW-1, PF-2

PFPit8MW-8A, PFPit8MW-8D, PFPit8MW-8E

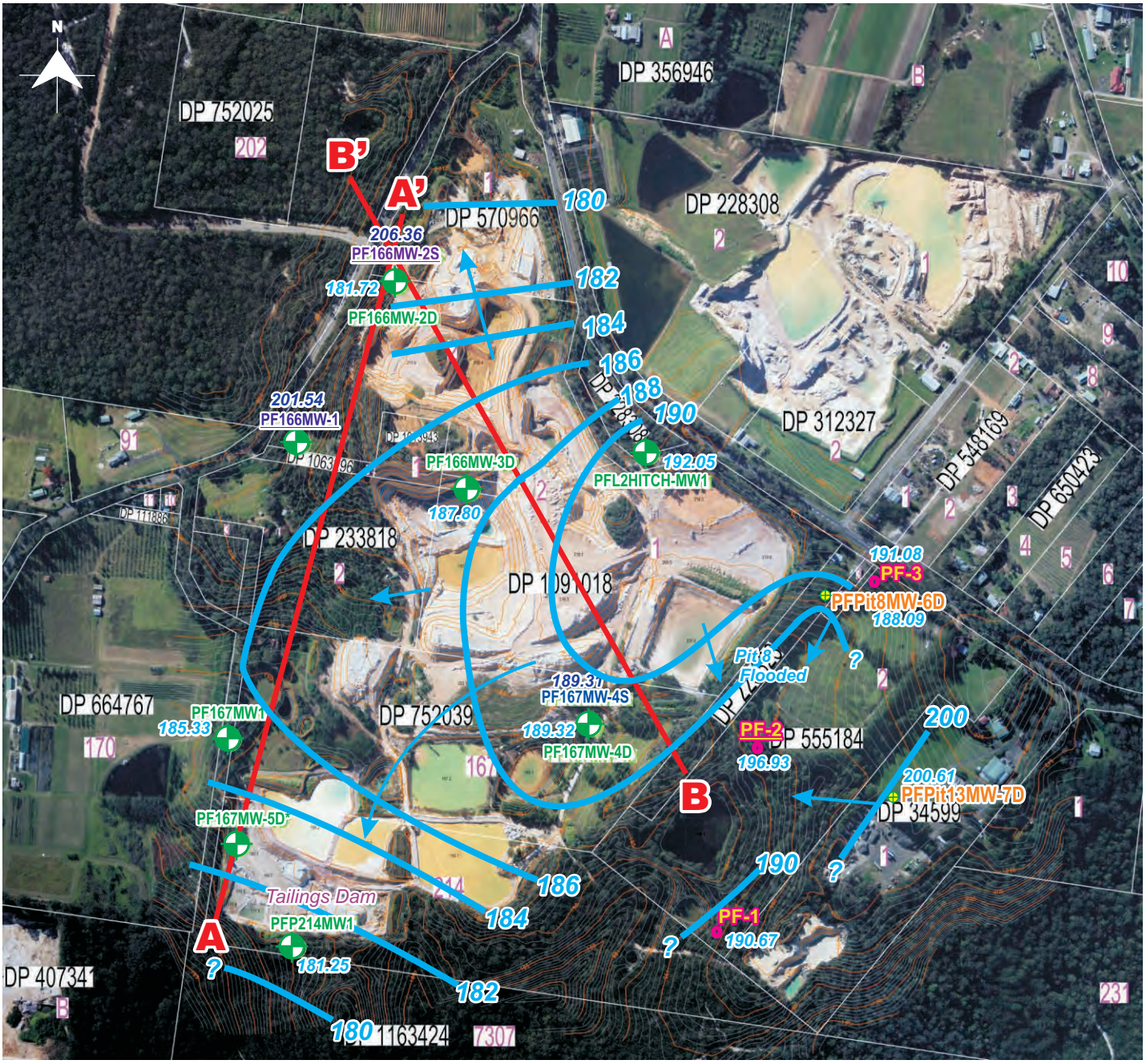
Site Layout & Groundwater Monitoring Well Network (2022)

MAROOTA- HITCHCOCK ROAD SITE

Date: *3 Oct 2022*

Reference: *E2W_224_15.cdr*

Figure 1B



Base source: Landair Surveys

0 100 200 300 m
Scale

LEGEND

PFPit13MW-7D
New Wells (Aug/Sept 2020)at Pits 8 & 13
(Wells at Pit8;MW-8A to 8E; not shown due to mounded water levels)

Note:

Perched Water Table (Maroota Sand):
PFMW-2s, PFMW-4s, PF166MW-1, PF-2

PF167MW-4S — Well location (Maroota Sands)
PF167MW-4D — Well location (Sandstone aquifer)
179.41 — SWL (mAHD)- Sandstone (Sept 2022)
Inferred groundwater flow (sandstone)
Inferred groundwater flow contour (sandstone @ 15& 16 Sept 2022)
A-A' — Line of cross section
PF-1 — Well Location (new site,acquired 2019)

Site Plan & Inferred Groundwater Flow Regime (15 & 16 September 2022)

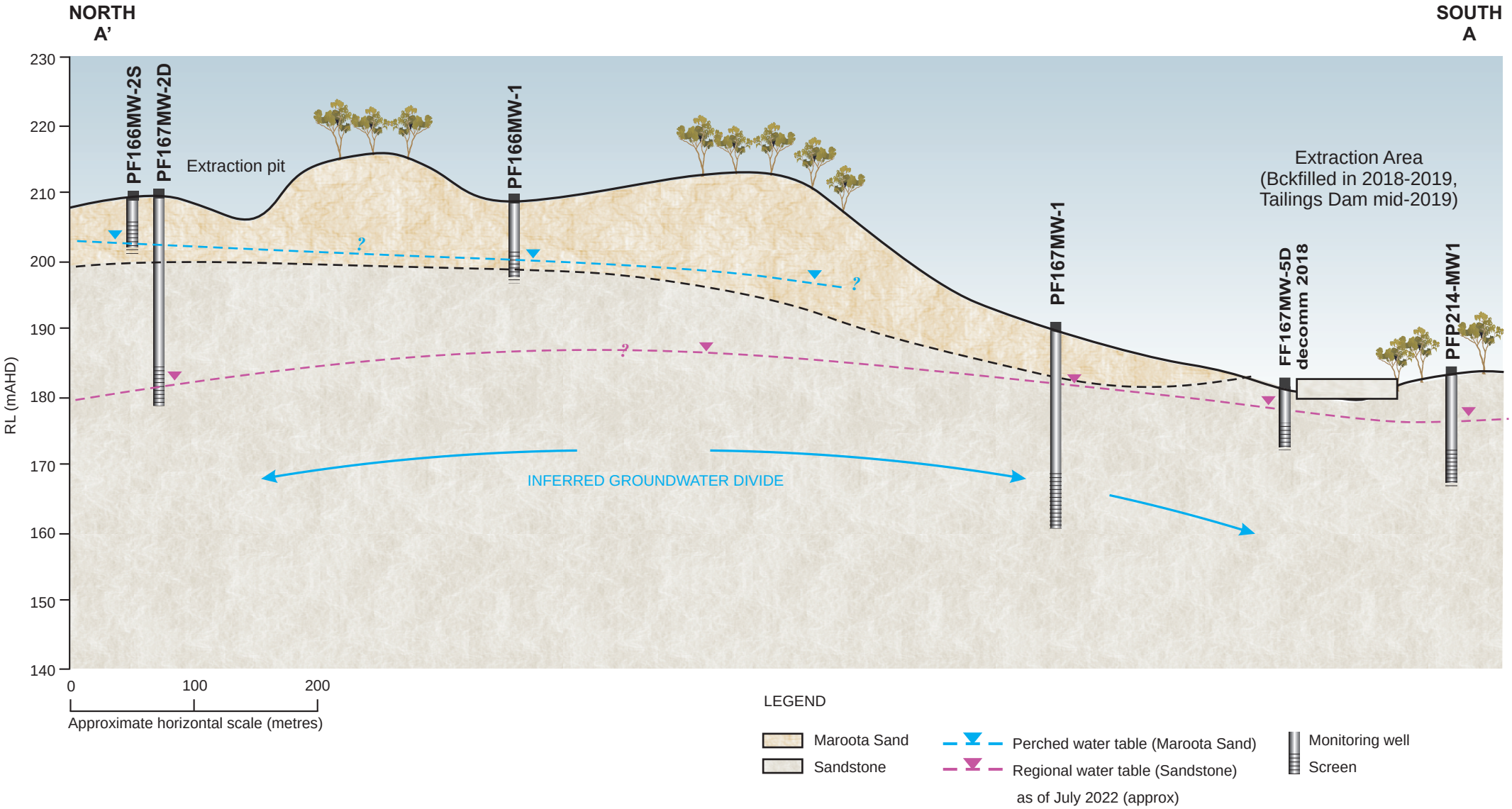
Date: 23 Sept 2022

MAROOTA - HITCHCOCK ROAD SITE

Reference: E2W_224_15.cdr

Figure 2

earth2water Pty Ltd
Environmental & Groundwater Consulting



INFERRED HYDROGEOLOGICAL SECTION (N-S)

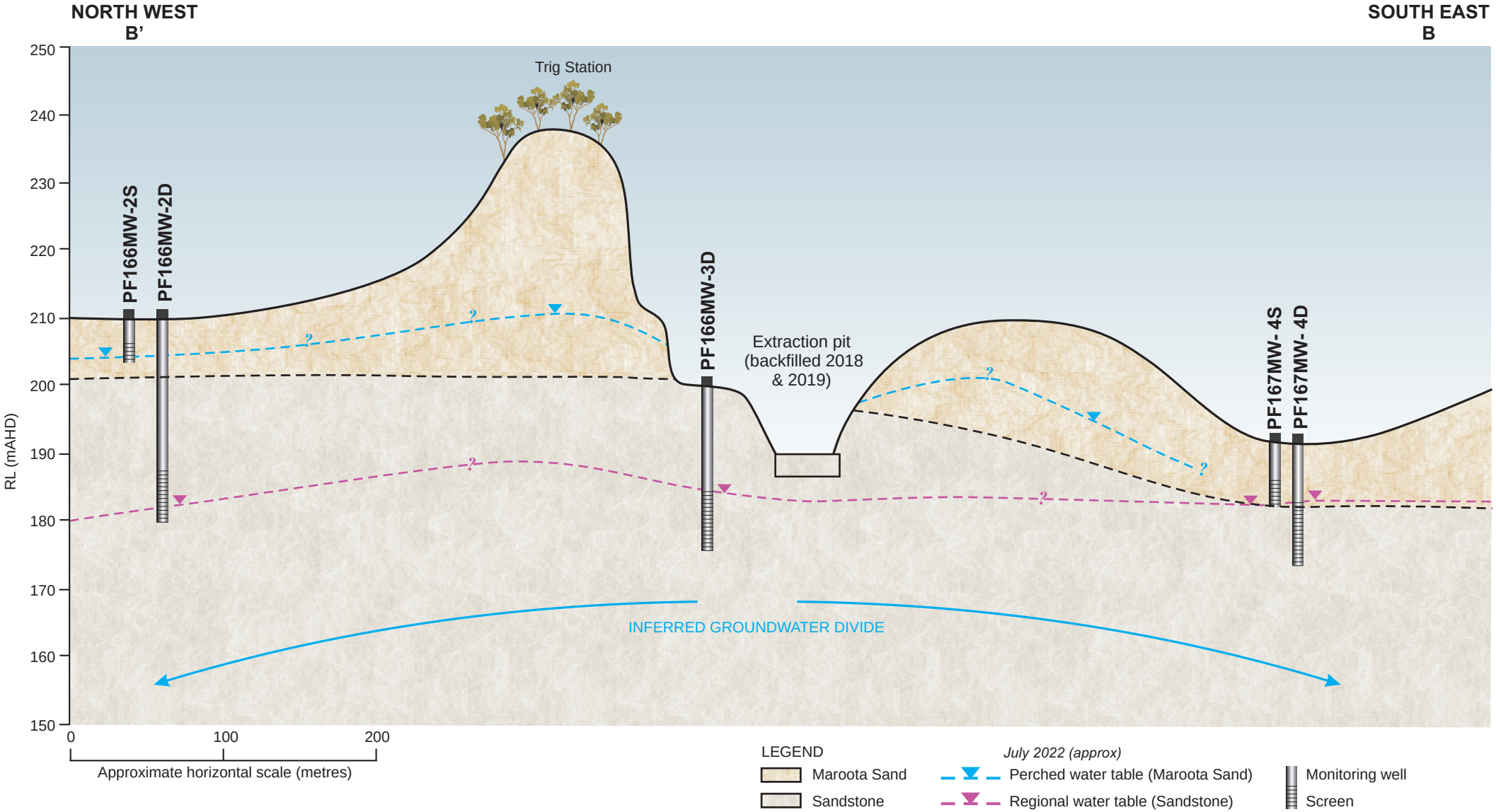
Date: 6-9-2022

Reference: E2W_224_17.cdr

MAROOTA - HITCHCOCK ROAD SITE

Figure 3

earth2water Pty Ltd
Environmental & Groundwater Consulting



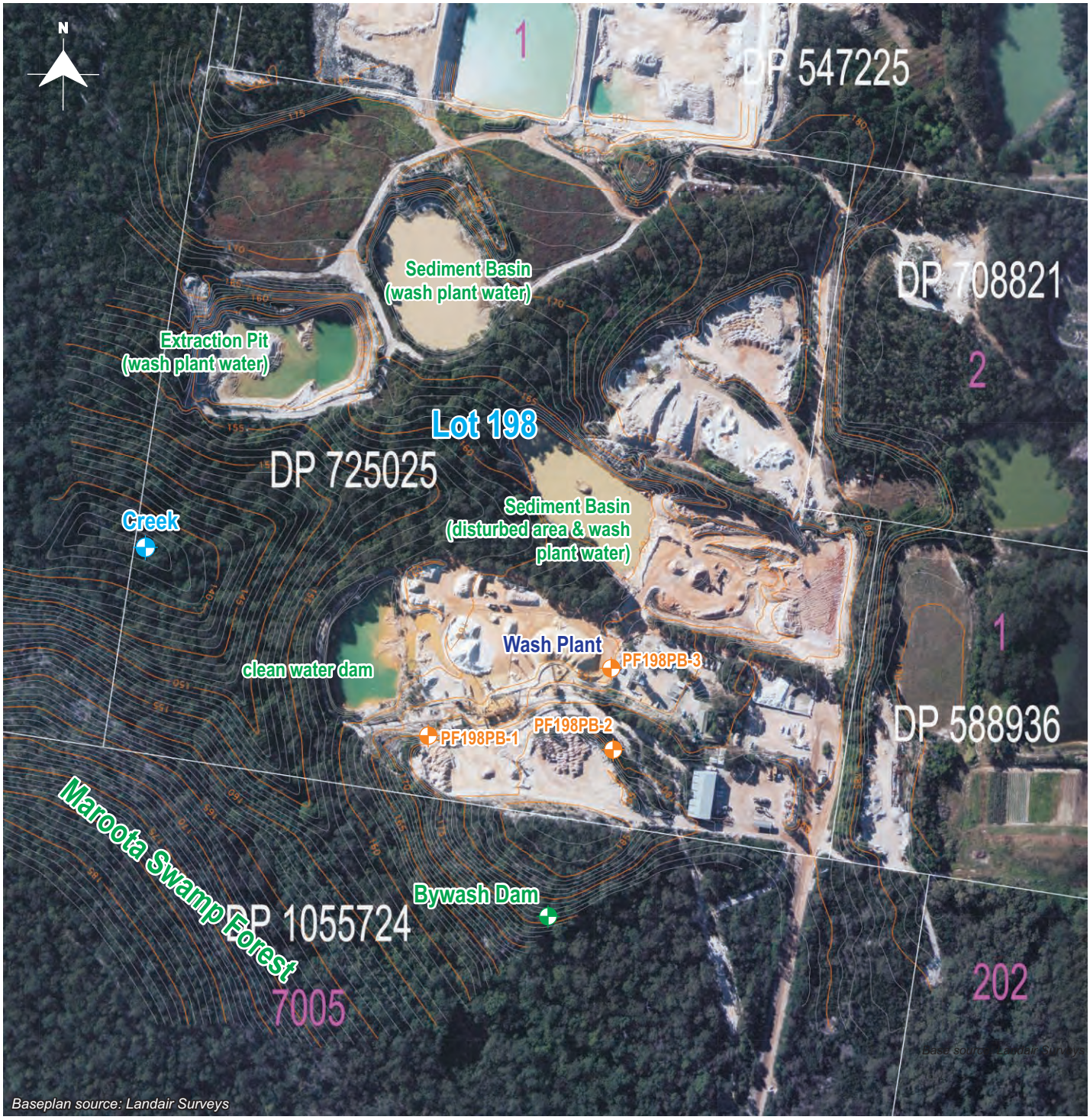
INFERRED HYDROGEOLOGICAL SECTION (NW-SE)

Date: *August 2022*

Reference: *E2W_224_16.cdr*

MAROOTA - HITCHCOCK ROAD SITE

Figure 4



0 30 60 90 120 150
Scale (metres)

LEGEND

PF198PB-1 Production Bore (sandstone aquifer)
PF198PB-3 installed in 2019 to replace PF198PB-2

Creek Creek Sample Location

Site Layout for Lot 198 (2022)

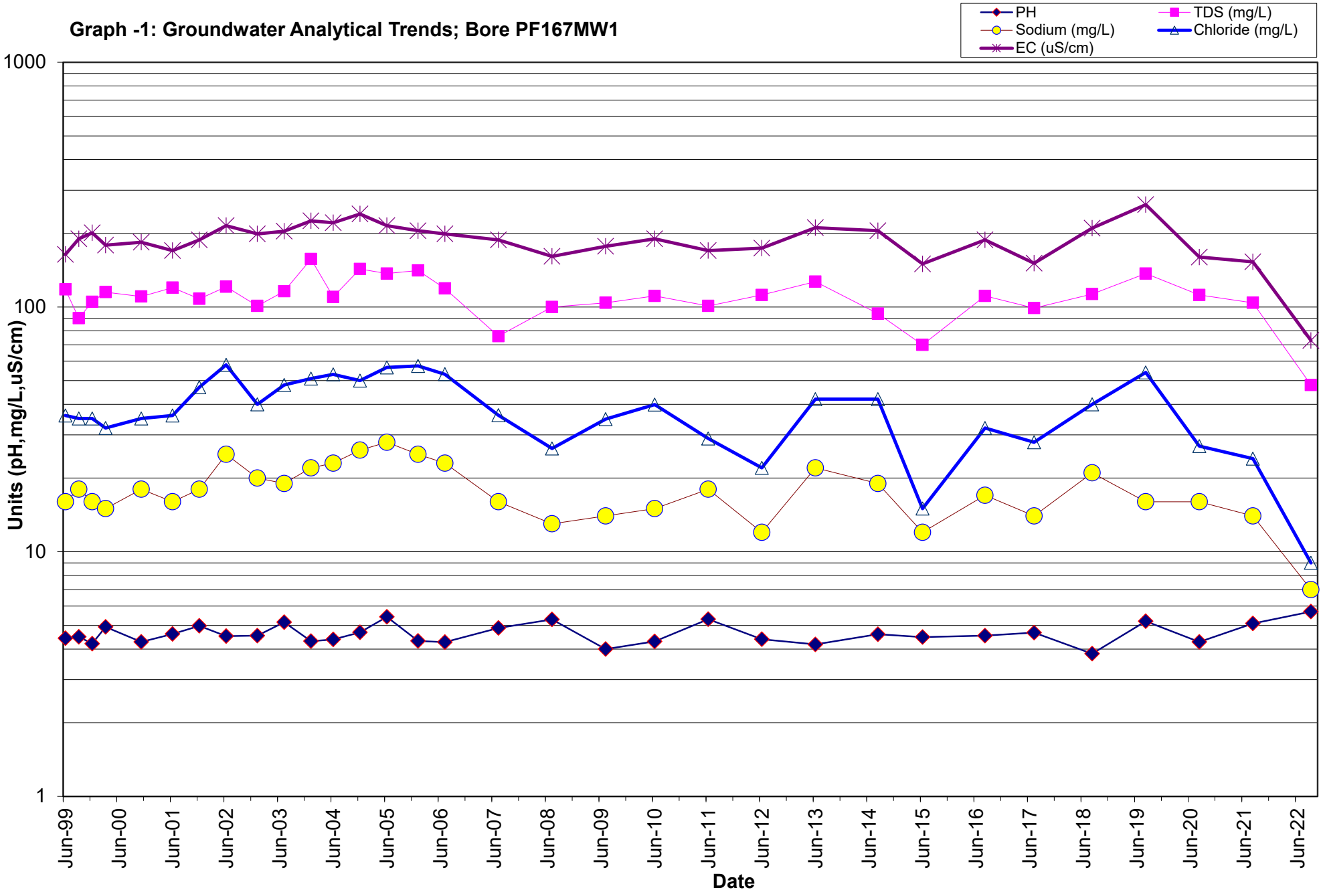
Date: *August 2022*

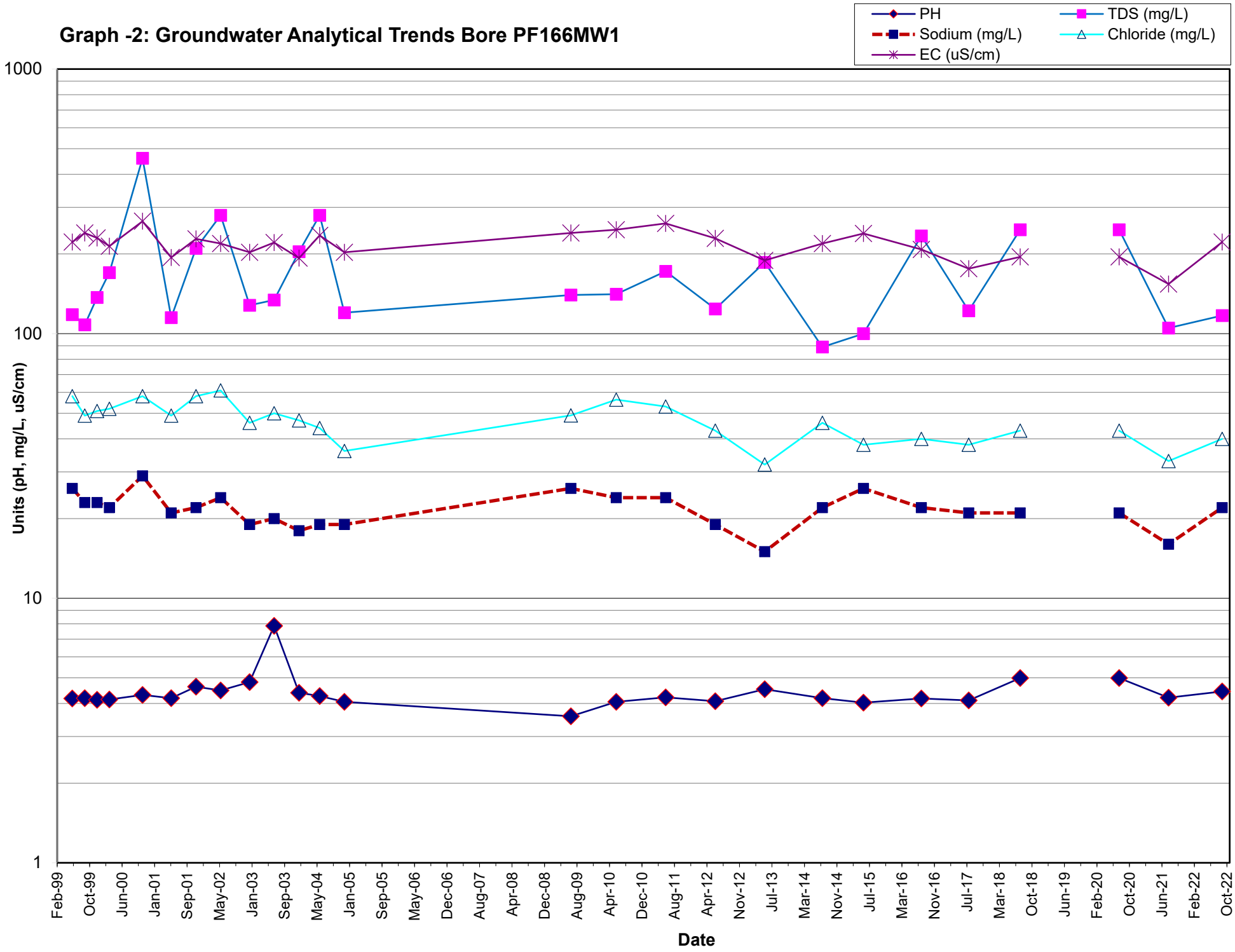
Reference: *E2W_224_22.cdr*

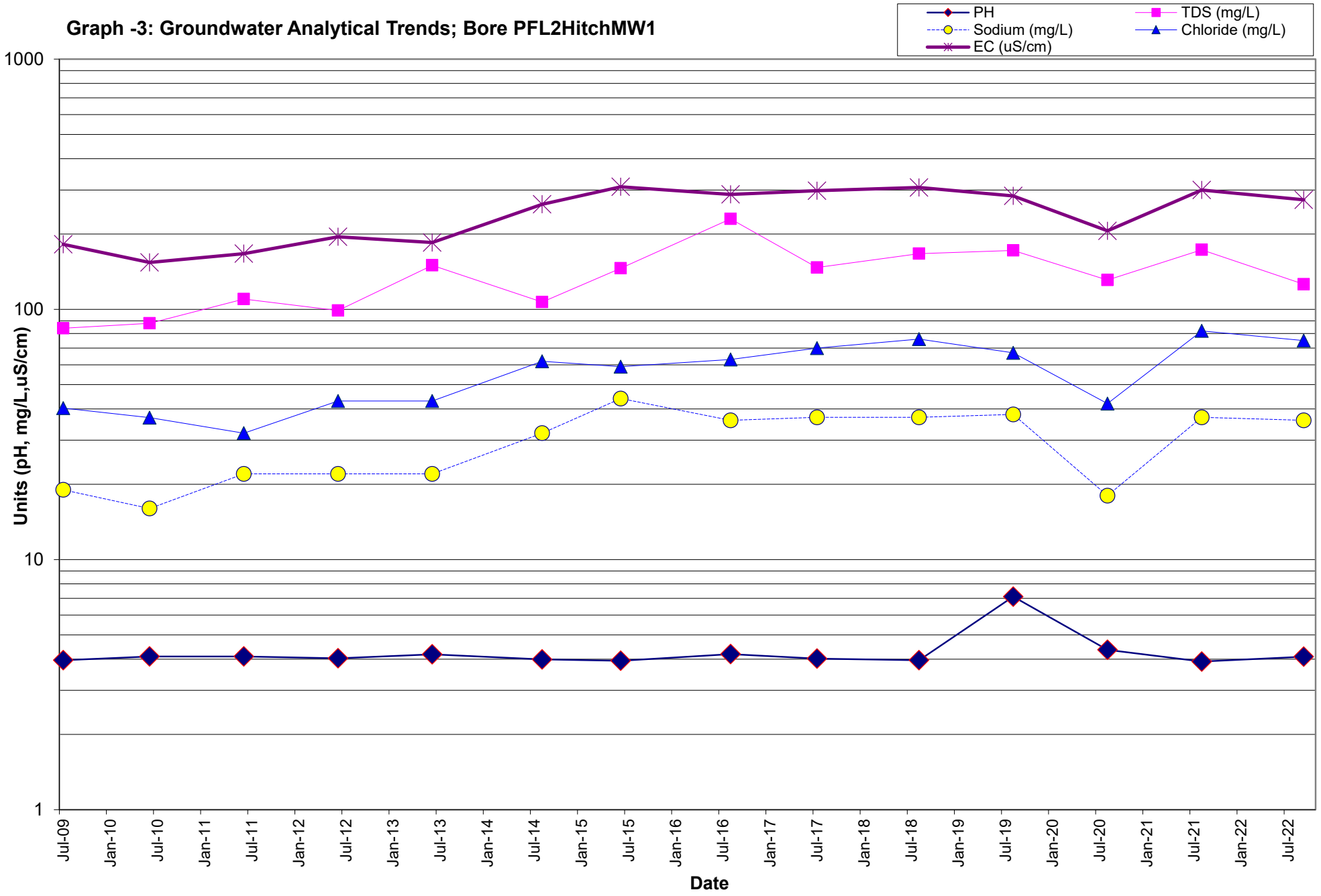
PF Formation: Maroota Lot 198 Site

Figure 5

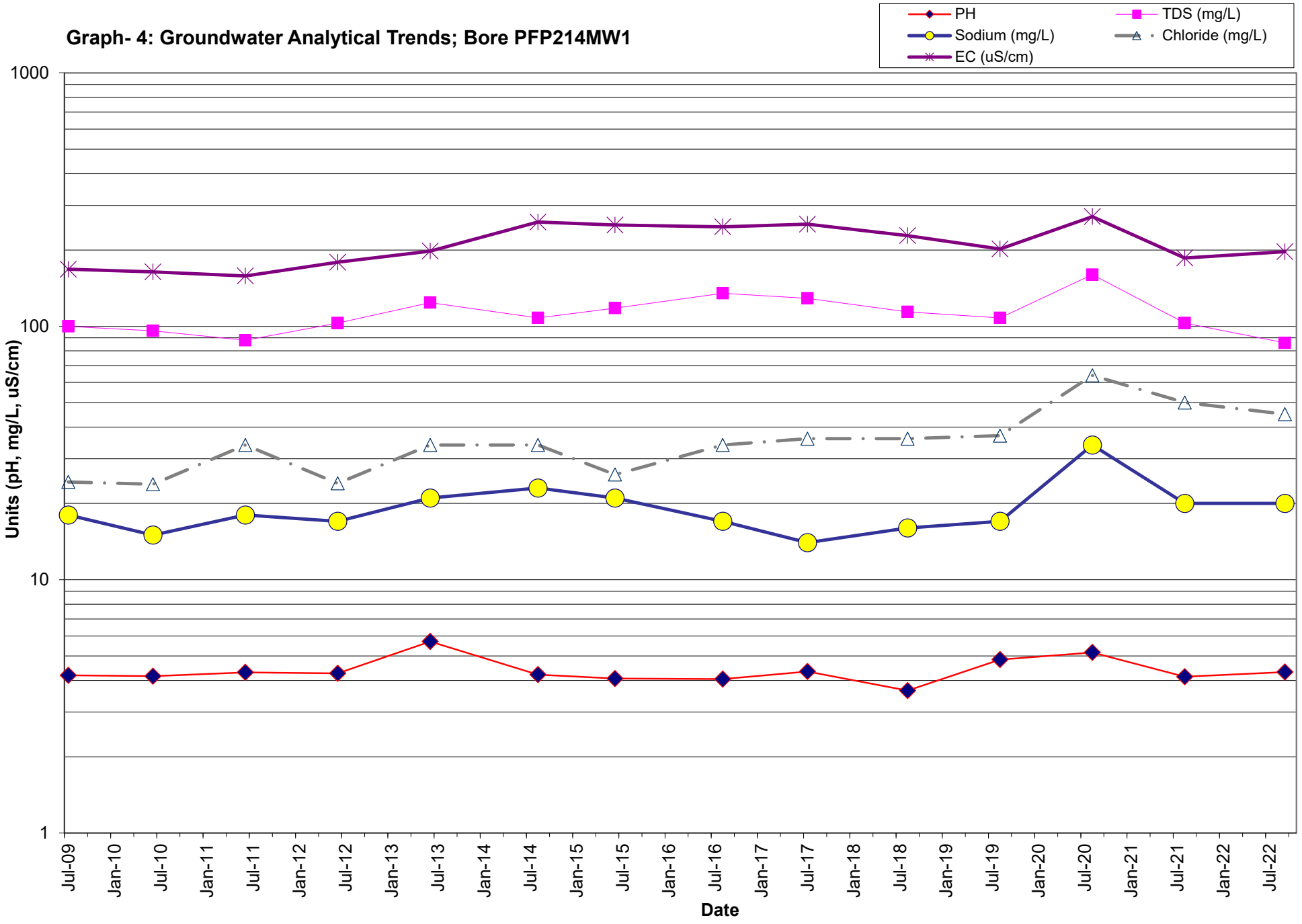
HYDRO-CHEMICAL GRAPHS

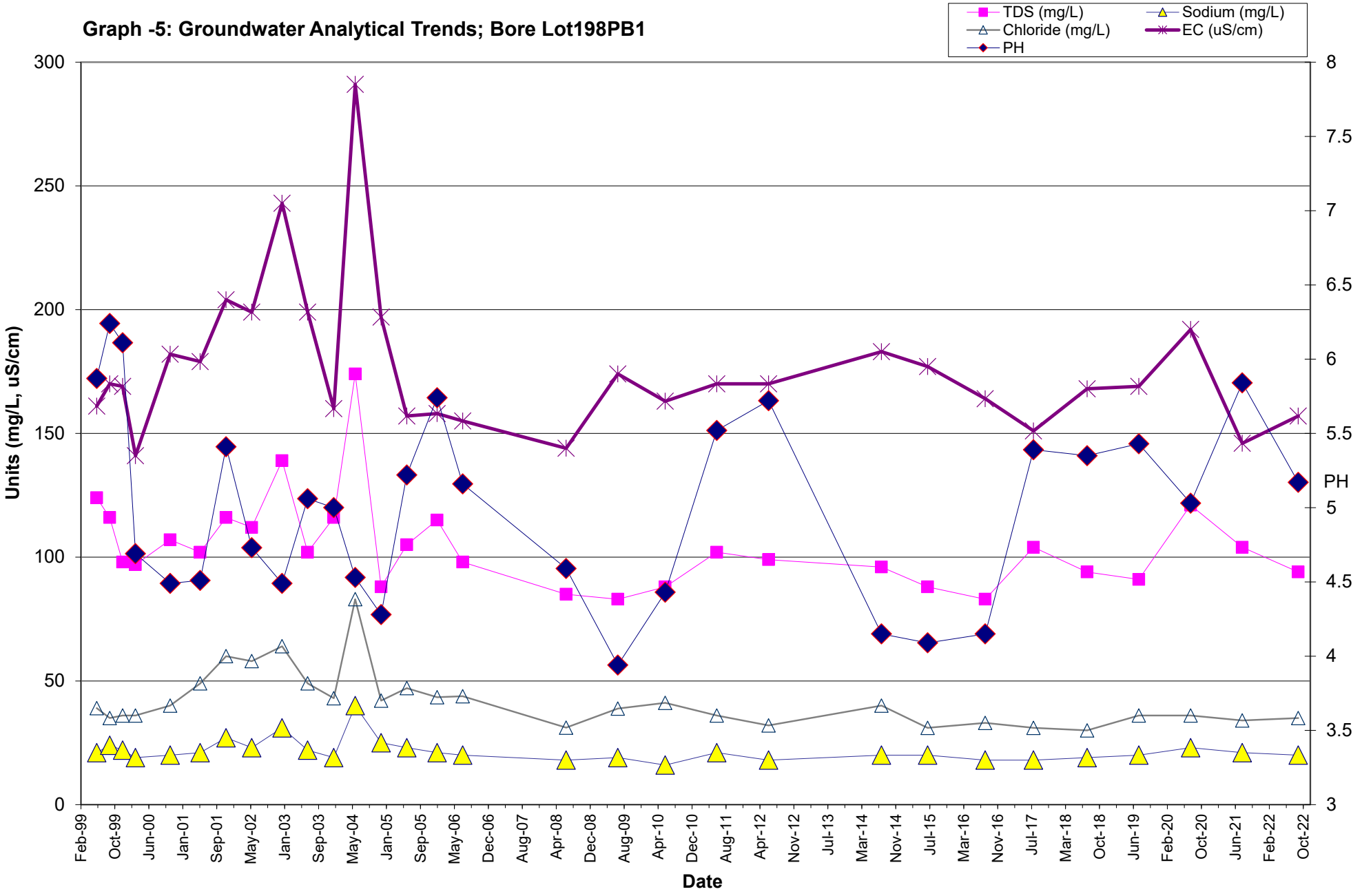

Graph -1: Groundwater Analytical Trends; Bore PF167MW1
PH
TDS (mg/L)
Sodium (mg/L)
Chloride (mg/L)
EC (uS/cm)
1000
100
10
1
Units (pH,mg/L,uS/cm)
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Jun-05
Jun-06
Jun-07
Jun-08
Jun-09
Jun-10
Jun-11
Jun-12
Jun-13
Jun-14
Jun-15
Jun-16
Jun-17
Jun-18
Jun-19
Jun-20
Jun-21
Jun-22
Date

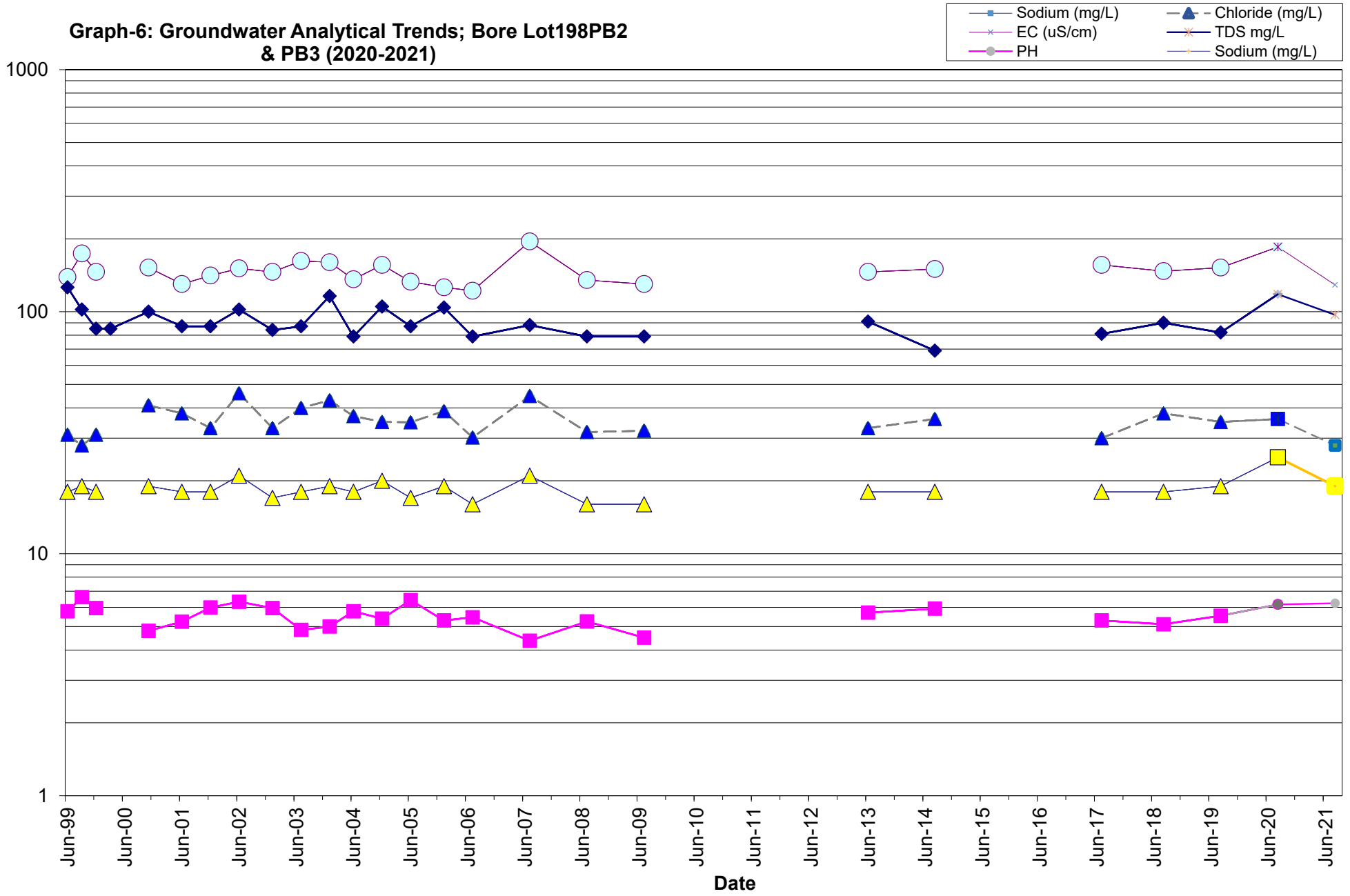

Graph -2: Groundwater Analytical Trends Bore PF166MW1
PH
TDS (mg/L)
Sodium (mg/L)
Chloride (mg/L)
EC (uS/cm)
1000
100
10
1
Units (pH, mg/L, uS/cm)
Feb-99
Oct-99
Jun-00
Jan-01
Sep-01
May-02
Jan-03
Sep-03
May-04
Jan-05
Sep-05
May-06
Dec-06
Aug-07
Apr-08
Dec-08
Aug-09
Apr-10
Dec-10
Aug-11
Apr-12
Nov-12
Jul-13
Mar-14
Nov-14
Jul-15
Mar-16
Nov-16
Jul-17
Mar-18
Oct-18
Jun-19
Feb-20
Oct-20
Jun-21
Feb-22
Oct-22
Date


Graph -3: Groundwater Analytical Trends; Bore PFL2HitchMW1
PH
TDS (mg/L)
Sodium (mg/L)
Chloride (mg/L)
EC (uS/cm)
1000
100
10
1
Units (pH, mg/L,uS/cm)
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Date

Graph- 4: Groundwater Analytical Trends; Bore PFP214MW1




Graph -5: Groundwater Analytical Trends; Bore Lot198PB1
TDS (mg/L)
Sodium (mg/L)
Chloride (mg/L)
EC (uS/cm)
PH
Units (mg/L, uS/cm)
PH
Date
300
250
200
150
100
50
0
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
Feb-99
Oct-99
Jun-00
Jan-01
Sep-01
May-02
Jan-03
Sep-03
May-04
Jan-05
Sep-05
May-06
Dec-06
Aug-07
Apr-08
Dec-08
Aug-09
Apr-10
Dec-10
Aug-11
Apr-12
Nov-12
Jul-13
Mar-14
Nov-14
Jul-15
Mar-16
Nov-16
Jul-17
Mar-18
Oct-18
Jun-19
Feb-20
Oct-20
Jun-21
Feb-22
Oct-22


Graph-6: Groundwater Analytical Trends; Bore Lot198PB2 & PB3 (2020-2021)
Sodium (mg/L)
Chloride (mg/L)
EC (uS/cm)
TDS mg/L
PH
Sodium (mg/L)
1000
100
10
1
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Jun-05
Jun-06
Jun-07
Jun-08
Jun-09
Jun-10
Jun-11
Jun-12
Jun-13
Jun-14
Jun-15
Jun-16
Jun-17
Jun-18
Jun-19
Jun-20
Jun-21
Date

HYDRO-GRAPHS

Figure HG-1: Manual Water Level Gauging at Lot 198 Wells (PB1, PB2, PB3), 2017 to 2022

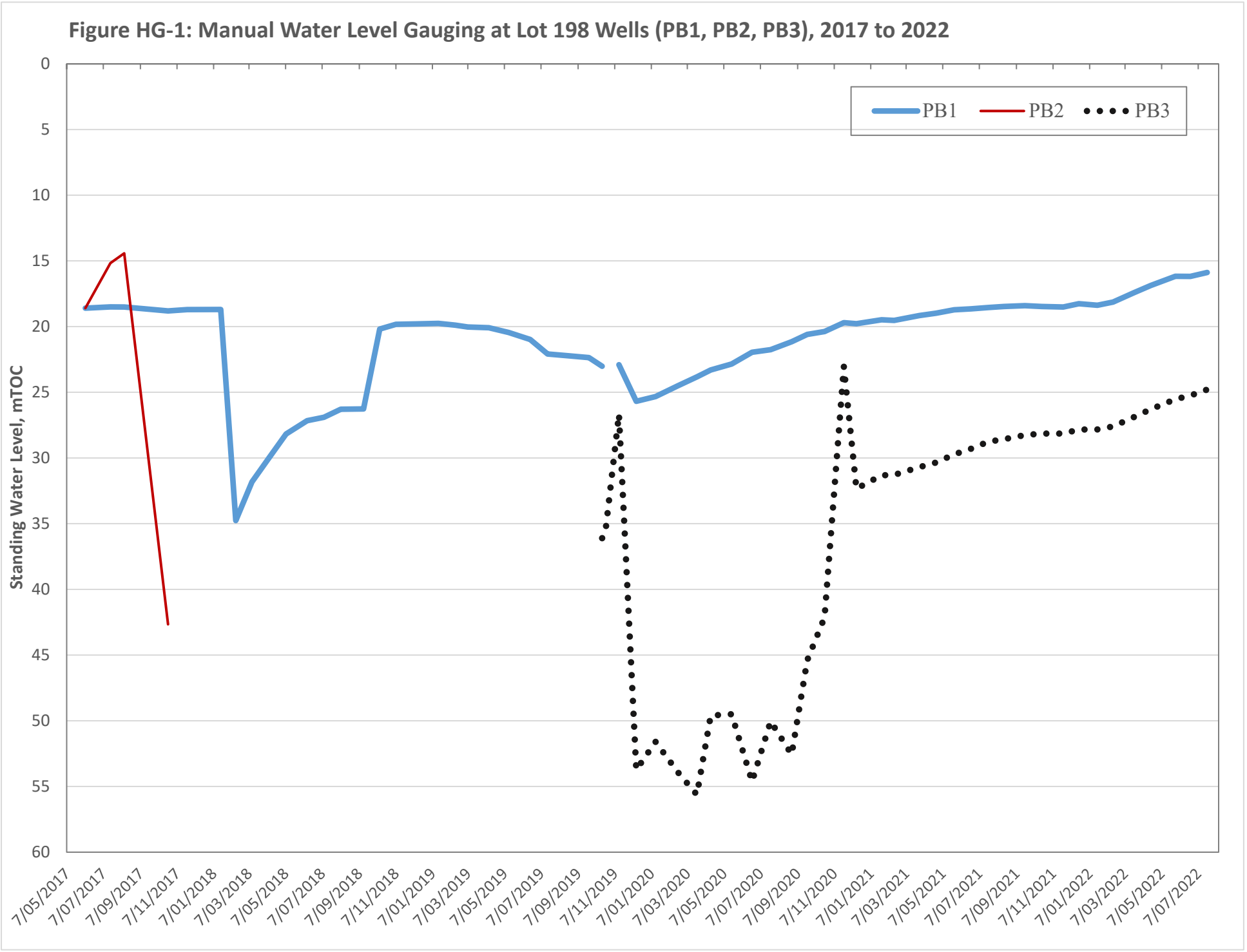


Figure HG-2: Monitoring Data at Bore PF167MW1 (2013-2018)

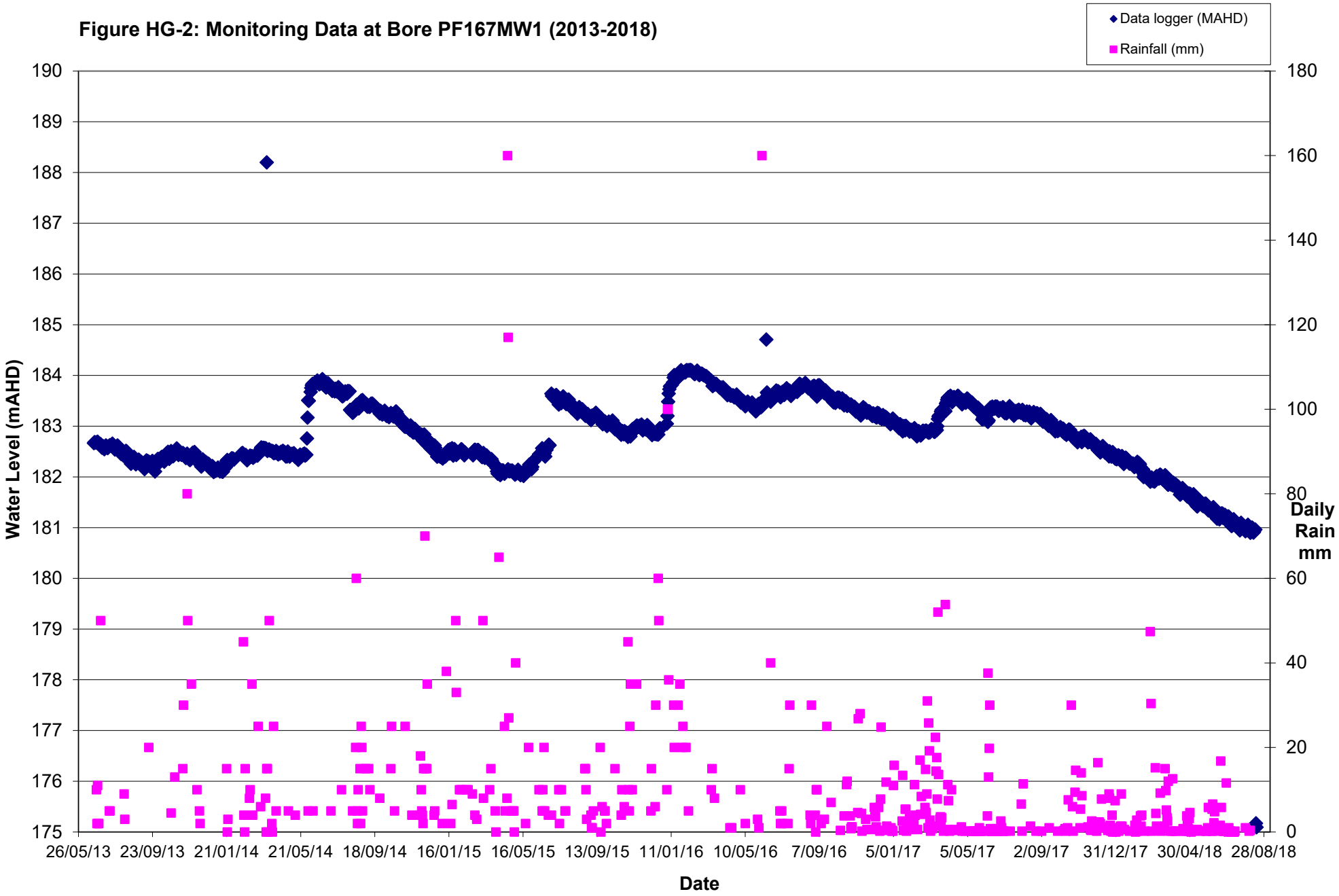


Figure HG-3: Monitoring Data at Bore PF166MW1 (2013-2016)

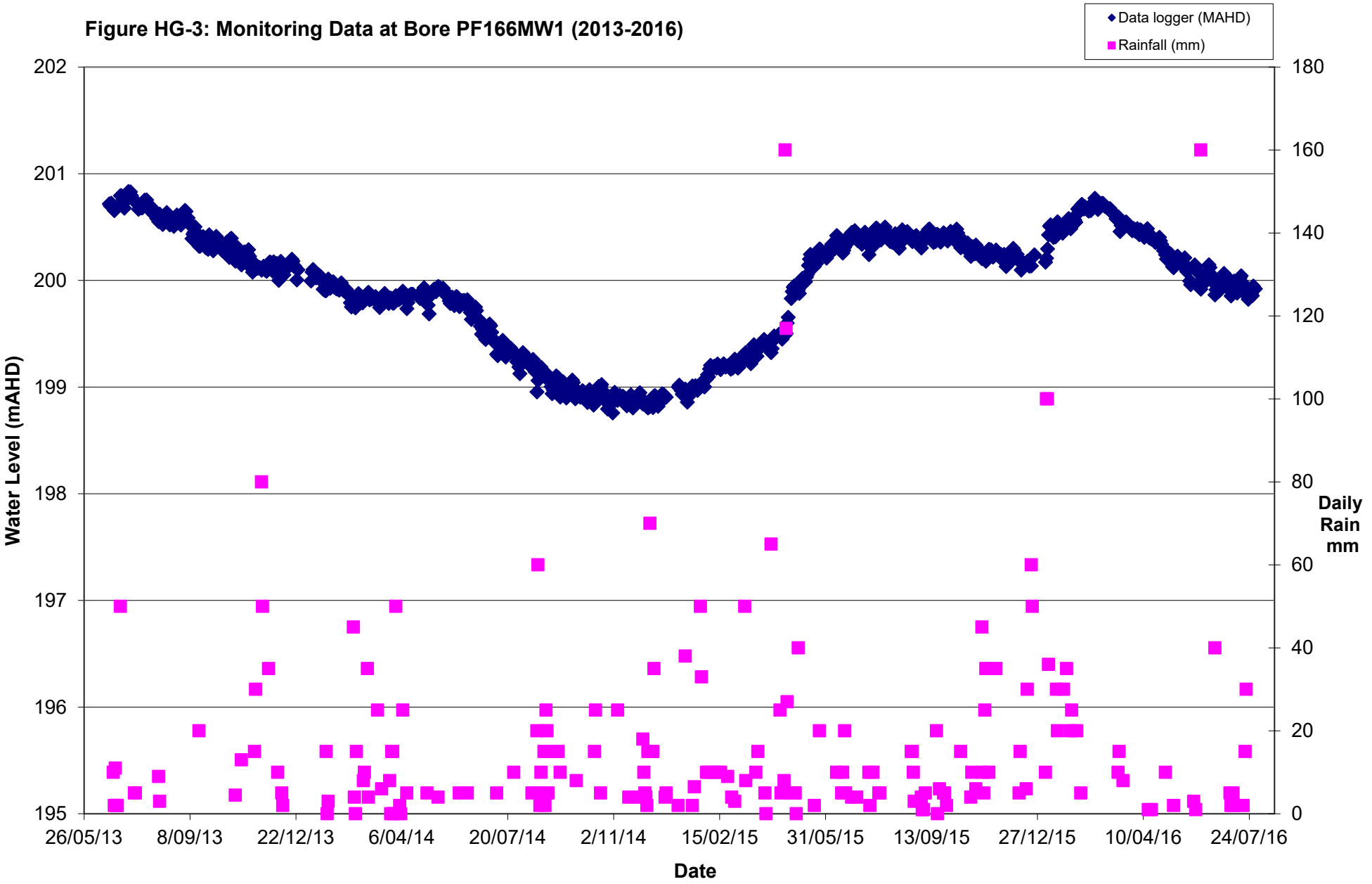


Figure HG-4: Monitoring Data at Bore PF214MW1 (2013-2022)

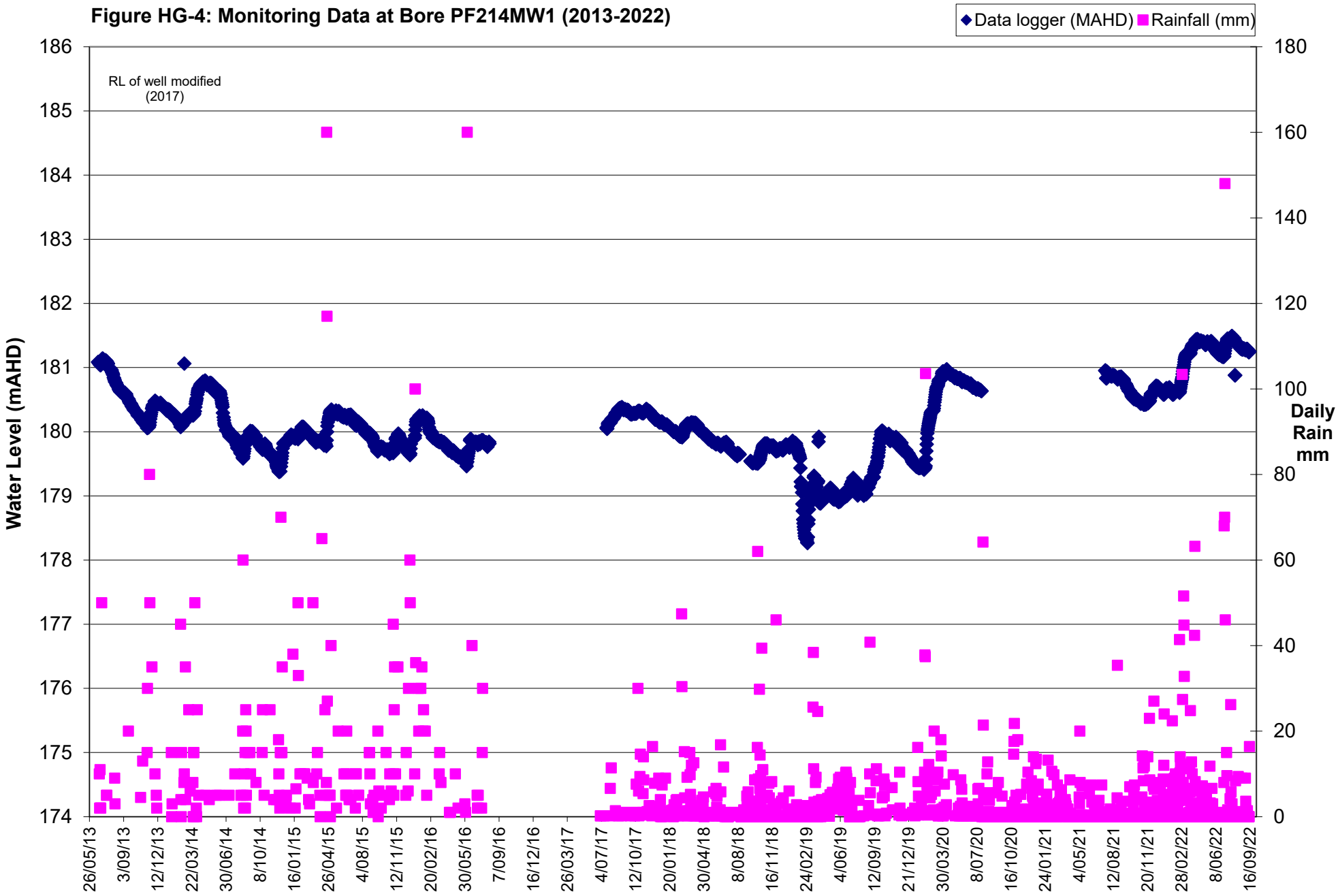


Figure HG-5: Monitoring Data Bore PFL2HitchMW1 (2013-2022)

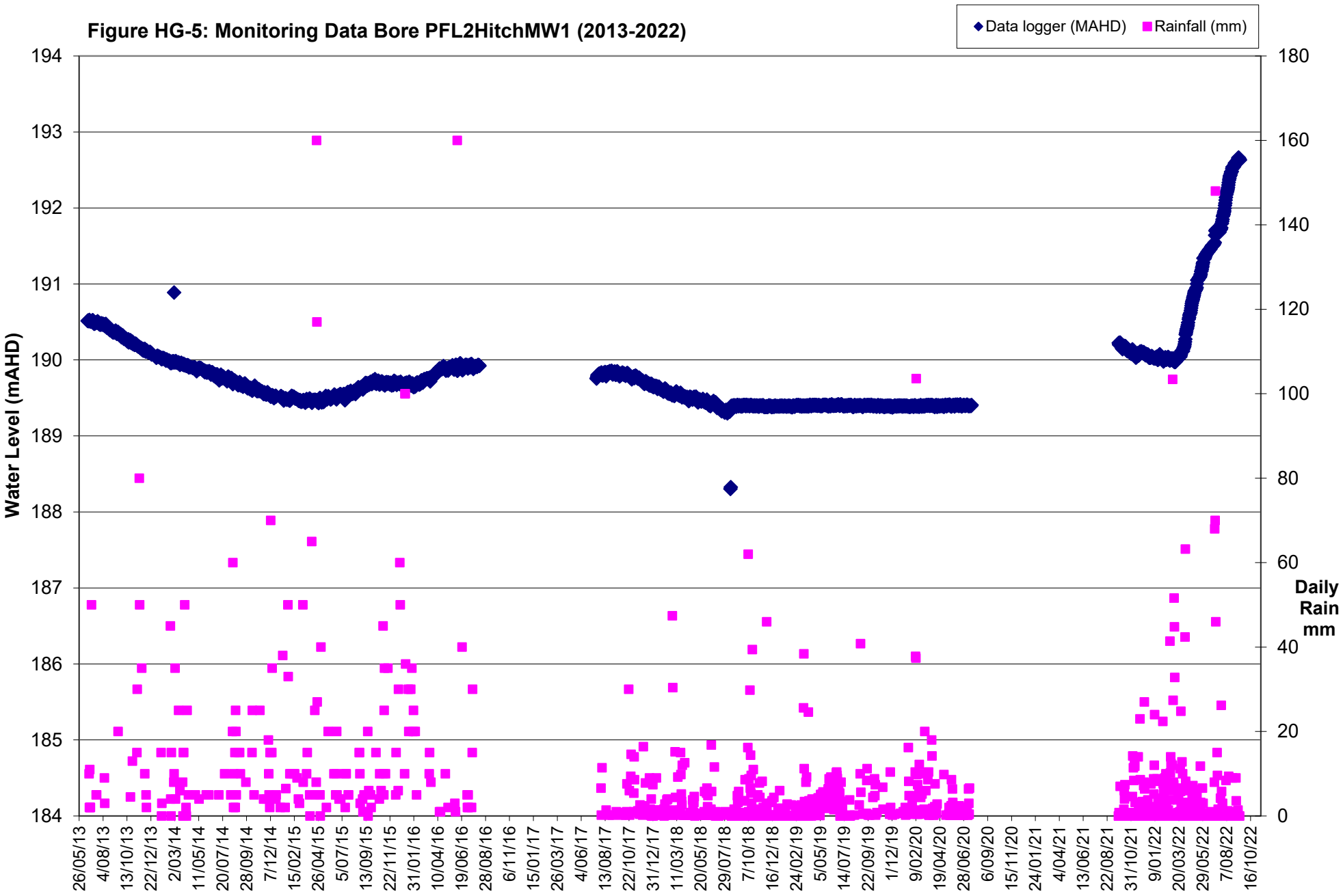


Figure HG-6: Monitoring Data Bore PF167MW3D (2017-2022, New bore)

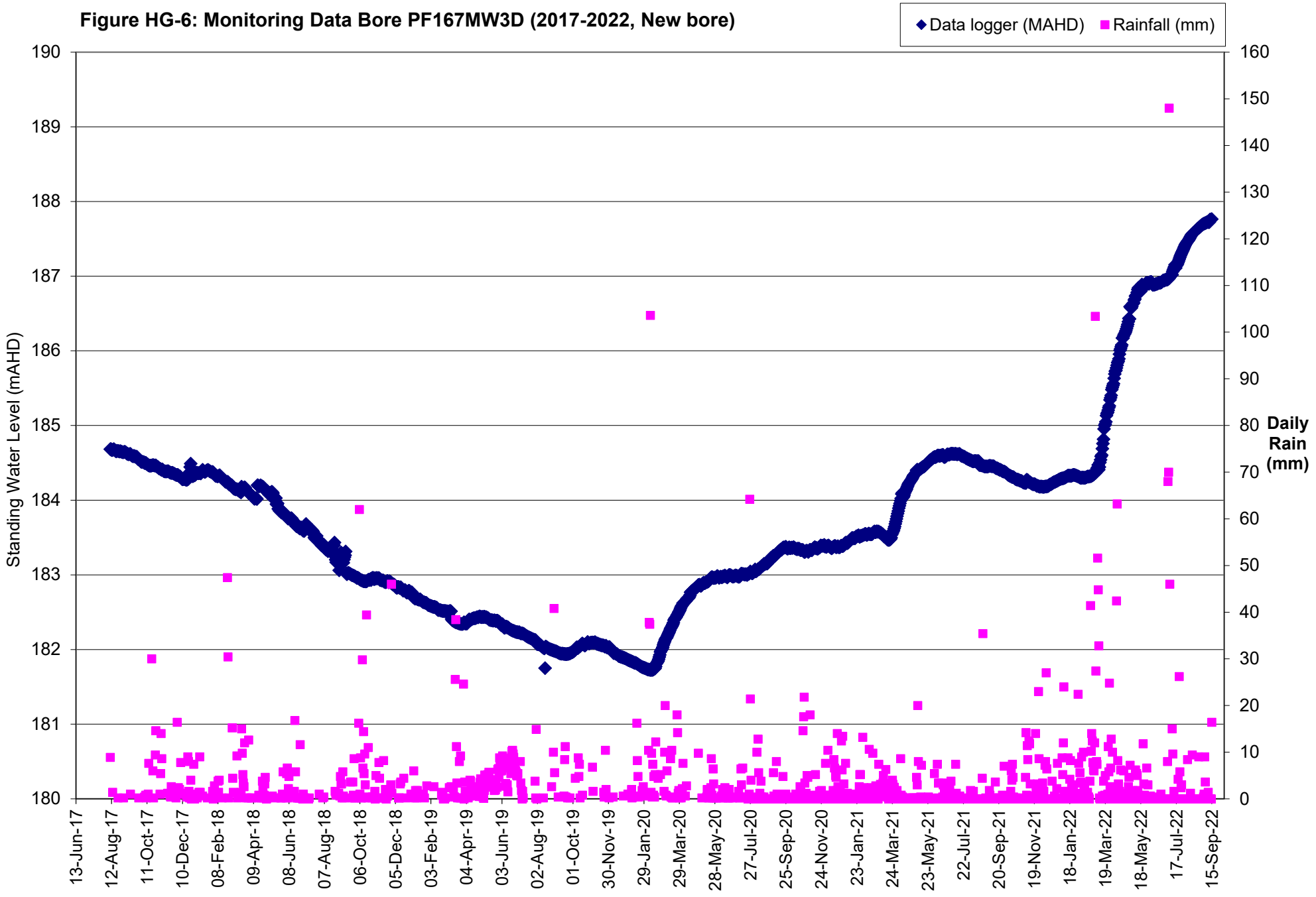
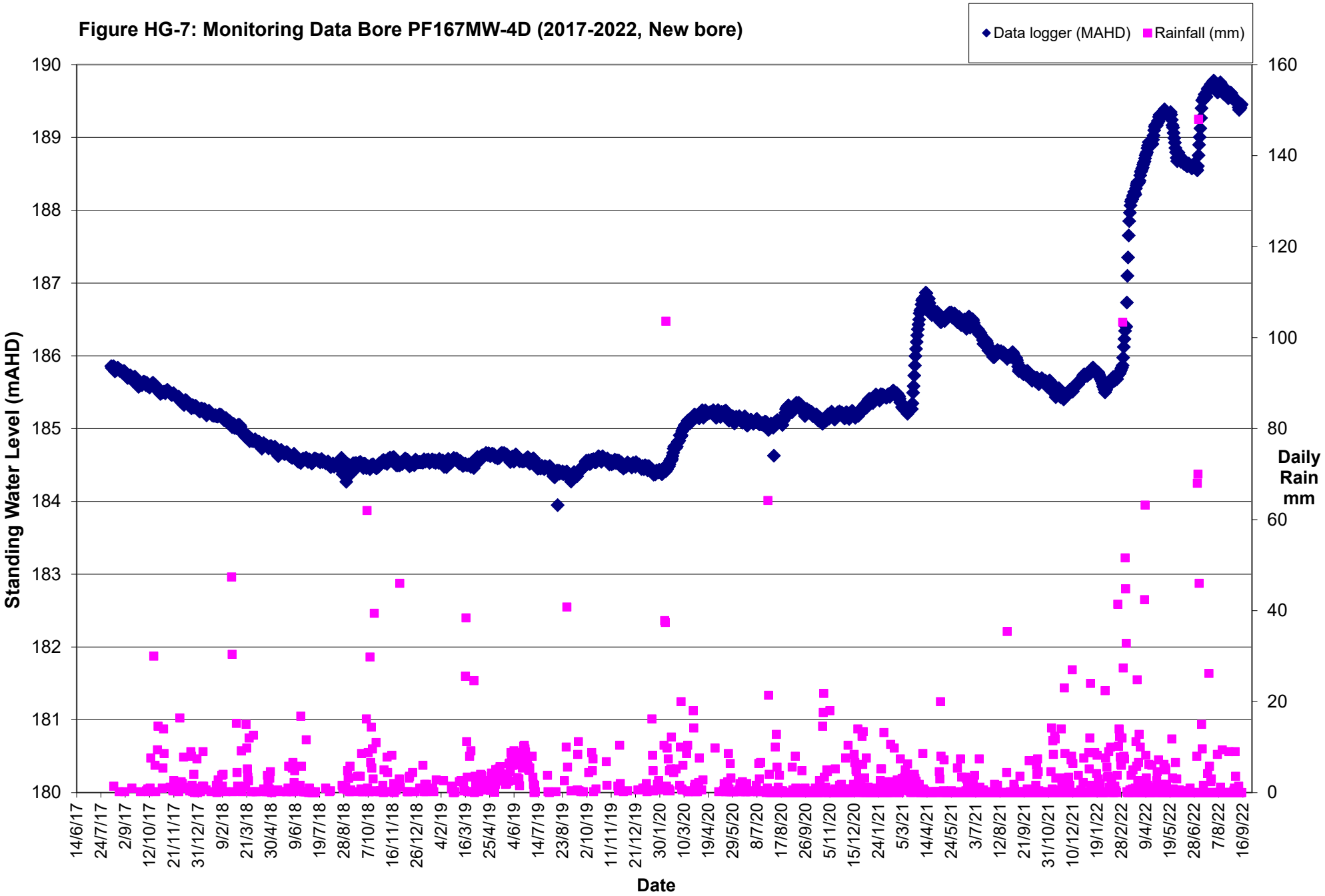


Figure HG-7: Monitoring Data Bore PF167MW-4D (2017-2022, New bore)



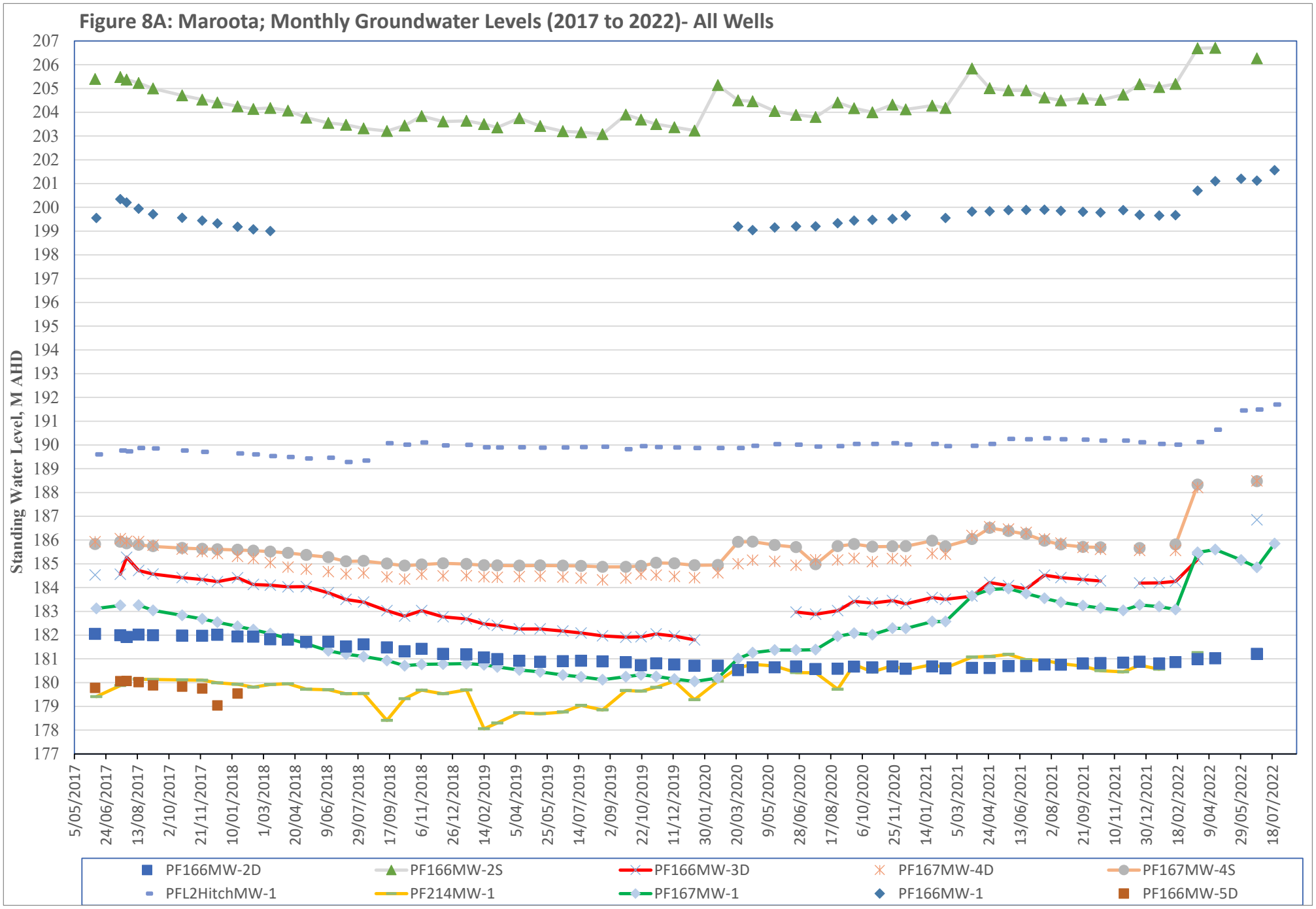


Figure 8A: Maroota; Monthly Groundwater Levels (2017 to 2022)- All Wells
Standing Water Level, M AHD
207
206
205
204
203
202
201
200
199
198
197
196
195
194
193
192
191
190
189
188
187
186
185
184
183
182
181
180
179
178
177
5/05/2017
24/06/2017
13/08/2017
2/10/2017
21/11/2017
10/01/2018
1/03/2018
20/04/2018
9/06/2018
29/07/2018
17/09/2018
6/11/2018
26/12/2018
14/02/2019
5/04/2019
25/05/2019
14/07/2019
2/09/2019
22/10/2019
11/12/2019
30/01/2020
20/03/2020
9/05/2020
28/06/2020
17/08/2020
6/10/2020
25/11/2020
14/01/2021
5/03/2021
24/04/2021
13/06/2021
2/08/2021
21/09/2021
10/11/2021
30/12/2021
18/02/2022
9/04/2022
29/05/2022
18/07/2022
PF166MW-2D
PF166MW-2S
PF166MW-3D
PF167MW-4D
PF167MW-4S
PFL2HitchMW-1
PF214MW-1
PF167MW-1
PF166MW-1
PF166MW-5D

Figure 8B: Maroota; Monthly Groundwater Levels (2017 to 2022)- Selected Wells

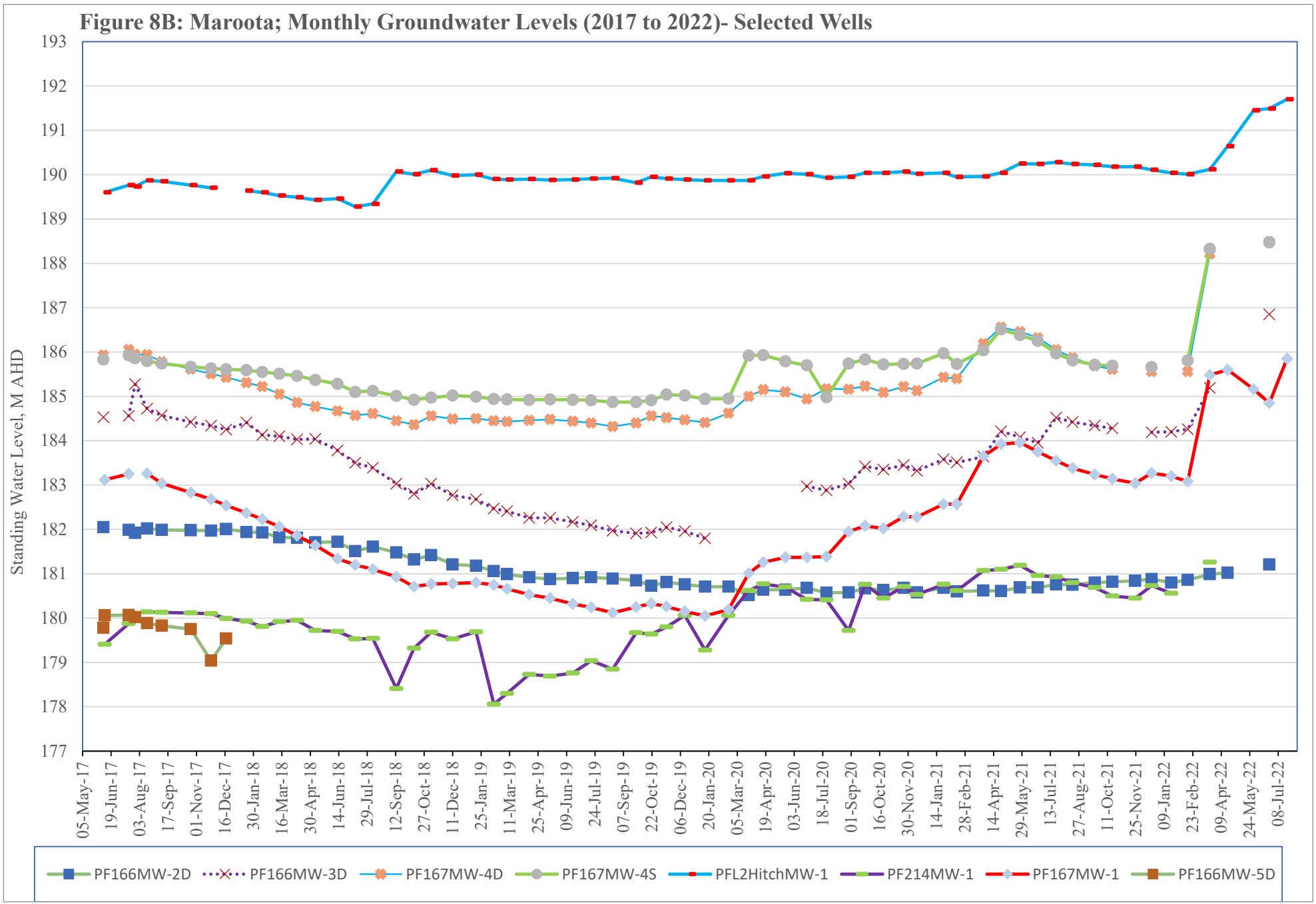


Figure HG-9: Preliminary Logger Data; Hitchcock Rd Clean Water Dam (2017-2021)

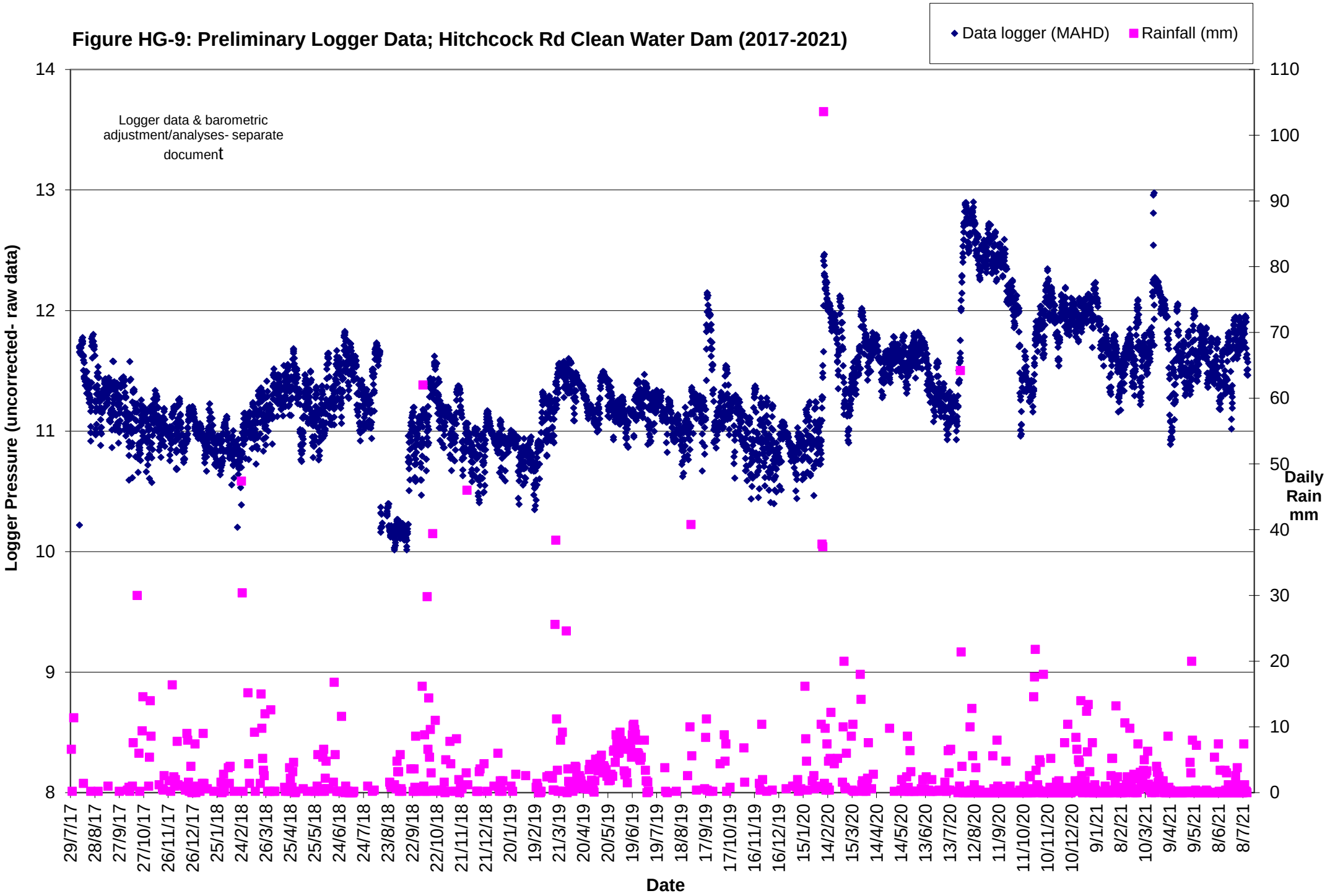


Figure HG-10: Preliminary Logger Data; Por167 Dam (2017-2020)

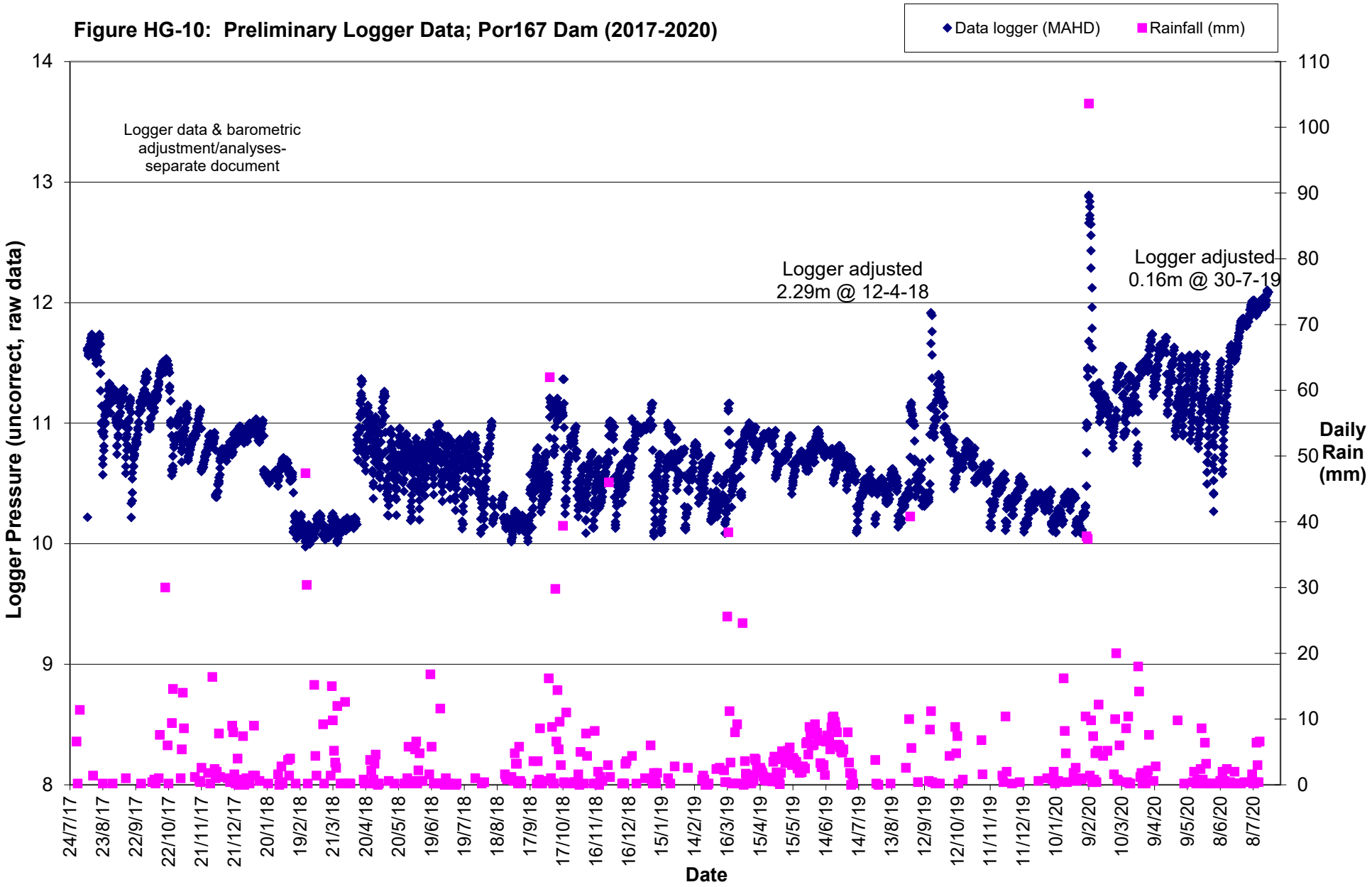


Figure HG-11: Maroota; Monthly Groundwater Levels at PF-1,2,3 (2017 to 2022)
4378 ON Rd

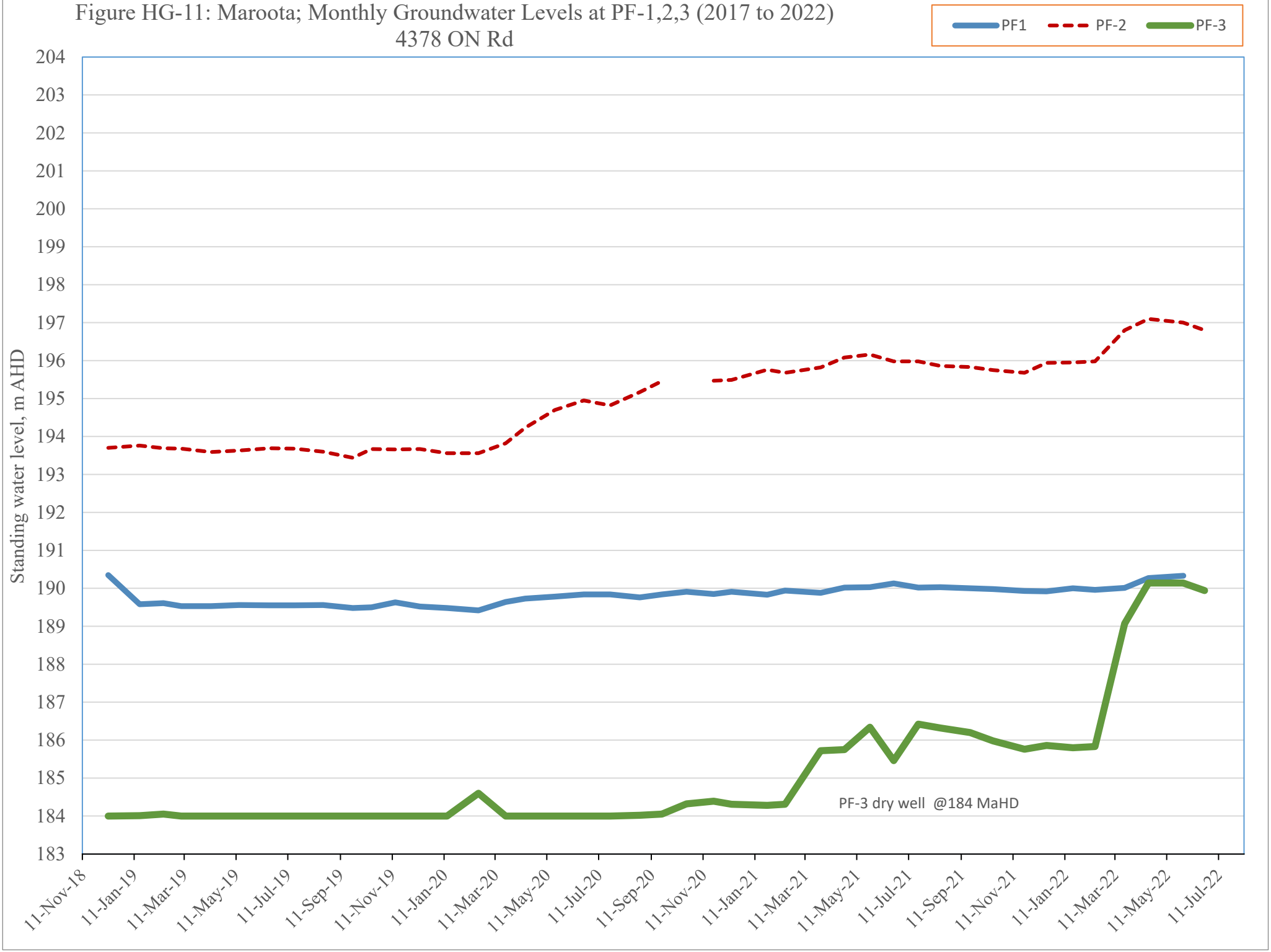


Figure HG-11A: Maroota; Monthly Groundwater Levels- Pits 8 & 13, & 4378 ONRd (2017 to 2022)

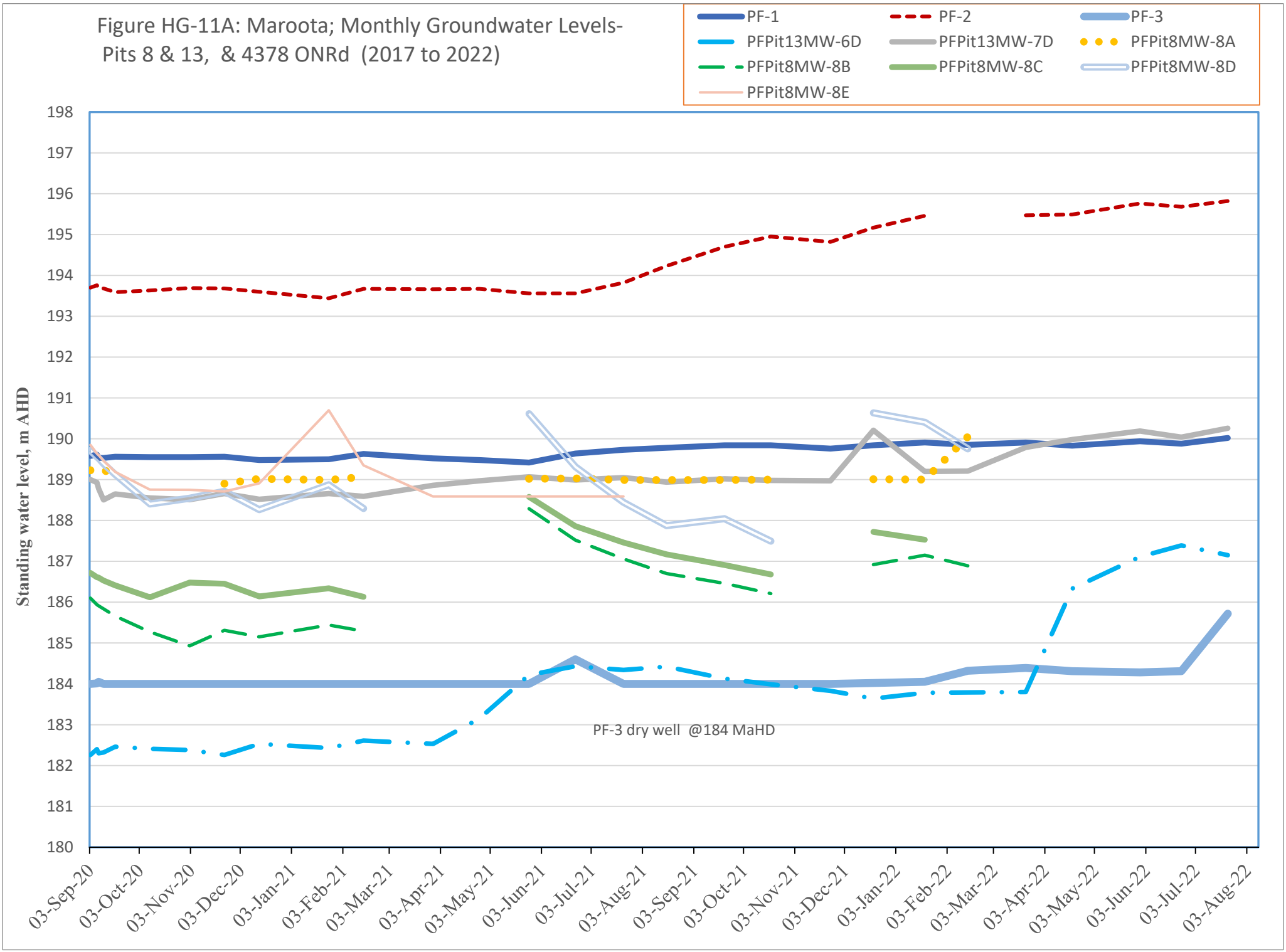
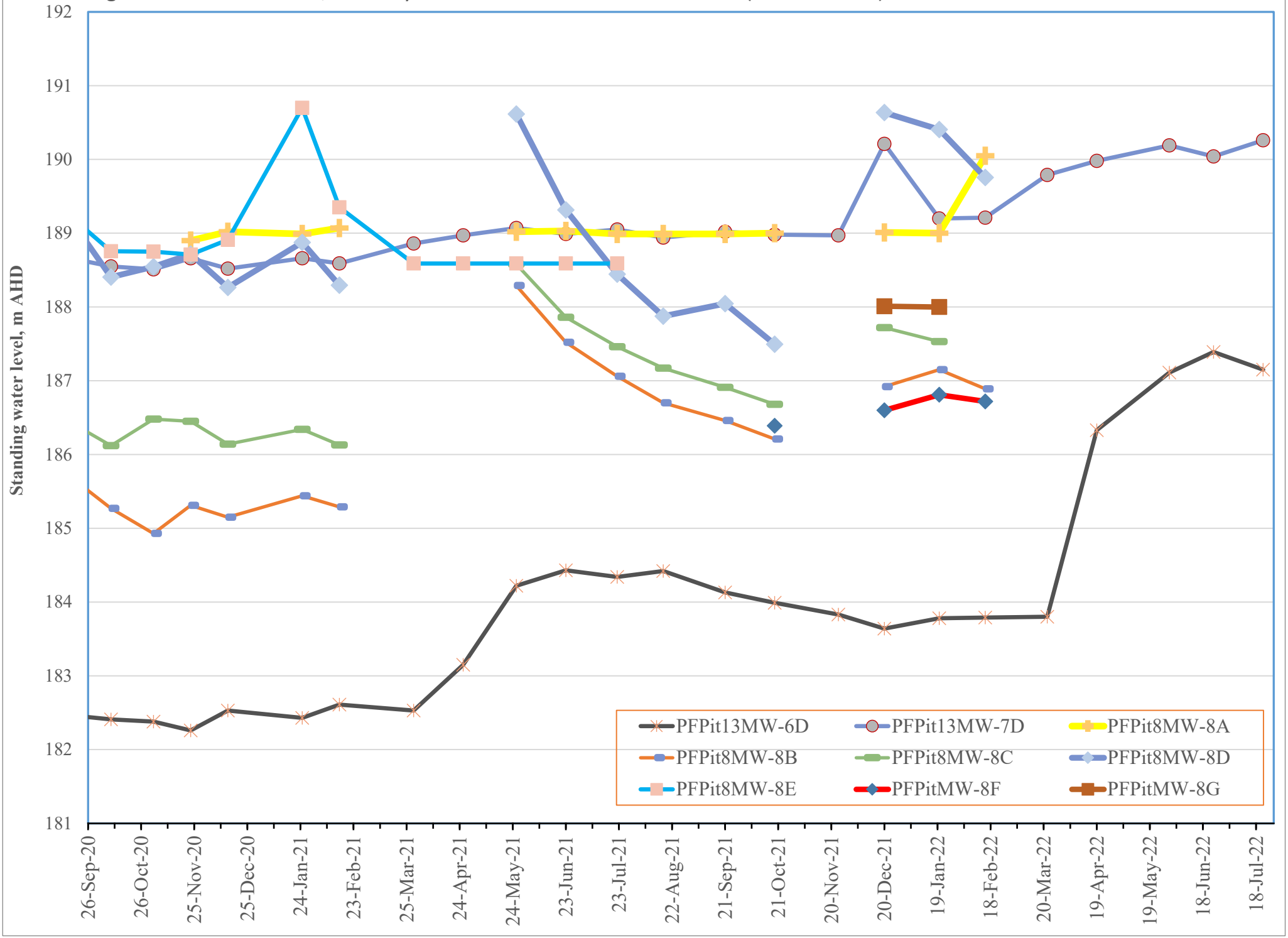


Figure HG-11B: Maroota; Monthly Groundwater Levels- Pits 8 & 13 (2017 to 2022)



TABLES

Table 1: Maroota Climate (2021-2022)

Month	PFF Rainfall (mm, monthly)	BOM Maroota Rainfall (mm, monthly)
July '2021	14	30.4
August	43.4	66.4
September	15.4	23
October	24.6	47.4
November	123.4	183.6
December	69.6	129.3
January	83.4	112
February	171.8	250.6
March	373.2	581.2
April	151.4	115.8
May	52.5	87.6
June '2022	2.6	6.2
Total (yr)	1125.3	1633.5

Note:
Data source: PFF Weather station
BOM (Station ID: 067014 Old Telegraph Road)

Table 2A: Monitoring Wells, Water Level Gauging & Chemistry (15 & 16 September 2022)

Maroota - Hitchcock Road

Sample ID	SWL (m btoc) 15 & 16 Sept-2022	PVC Stickup	BOH (mbgl)	Ground RL	RL (TOC) *	Reduced SWL (mAHD) 15 & 16 Sept 2022	Co-ordinates	pH	EC (uS/cm)	DO (%)	DO (mg/L)	Redox (mV)	Temp (°C)	Aquifer
Existing Wells (new site)														
PF-1	12.23	0.93	19	201.97	202.9	190.67	313919.48 & 6294505.13	4.31	222	41	3.9	182	18.5	deep sandstone
PF-2	4.07	0.9	13.28	200.1	201	196.93	313950.78 & 6294789.93	6.48	199	7	0.68	282	16.3	maroota sand
PF-3	28.12	0.75	32.2	218.45	219.2	191.08	314159.95 & 6295046.84	4.01	137	17	1.65	132	17.5	deep sandstone
Existing Monitoring Wells														
PF214MW-1	4.01	0.8	18	184.45	185.26	181.25	313286.41 & 6294508.34	4.09	217	36	3.6	221	15.2	deep sandstone
PF167MW-1	2.62	0.3	23.8	187.85	187.95	185.33	313190.79 & 6294816.05	4.7	86	30	3.1	204	13.2	deep sandstone
PF166MW-1	8.81	0.55	11.8	209.78	210.35	201.54	313293.61 & 6295256.65	4.06	234	49	4.6	230	17	maroota sand
PFL2HitchMW-1 (note 1)	33.25	-0.02	43.5	225.13	225.3	192.05	313810.71 & 6295241.46	4.02	323	56	5.3	112	17.2	deep sandstone
New Monitoring Wells (May 2017)														
PF167 MW-2D	28.18	0.6	29.4	209.28	209.9	181.72	313438.92 & 6295492.65	4.66	173	52	5.09	193	17.2	deep sandstone
PF167 MW-2s	3.64	0.7	5.1	209.3	210.00	206.36	313439.64 & 6295494.49	4.36	227	60	6.06	249	14.8	maroota sand
PF167 MW-3D	10.87	0.75	23	197.93	198.67	187.80	313545.67 & 6295186.86	4.21	94.1	65	6.5	294	15.6	deep sandstone
PF166 MW-4D	4.07	0.5	15.5	192.93	193.39	189.32	313727.56 & 6294836.89	4.69	134	42	4.4	102	15.5	deep sandstone
PF166 MW-4s	4.13	0.5	8	192.93	193.44	189.31	313725.86 & 6294836.93	4.6	128	50	5.12	165	15.5	maroota sand

Notes:

SWl= standing water level — Water level gauging undertaken by D.Parisotto (E2W) using an acoustic water level probe Note 1: PVC stickup of well cut short by 0.55m due to damage (2019)

BOH= bottom of well — *TOC= top of 50mm PVC casing (reference point for water level gauging)

E2W Field parameters measured by D.Parisotto on 15 & 16 Sept 2022 during water sampling (pH, EC, DO, Eh and temperature using YSI professional series hired from ETS)

Redox (Eh mV, based on Ag/AgCl electrode) and conversion from Orp (mv) to Redox by adding 200 MV

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Table 2B: Monitoring Well Details & Water Table Gauging at Pits 8 & 13 (15 & 16 September 2022)

Maroota - Hitchcock Road & Pits 8 & 13 Area

Sample ID	SWL (m btoc) 15 & 16 Sept 2022	PVC Stickup *	BOH (mbgl)	RL (mTOC) m AHD	Reduced SWL (mAHD) 15 & 16 Sept 2022	pH	EC (mS/cm)	DO (%)	DO (mg/L)	Redox (mV)	Temp (°C)	Aquifer	Comments
New Wells at Pit 8 Floor in September 2020													
PFPIT8MW-8A	No Access	1.15	7.7	196.64								Maroota Sand	Area Flooded
PFPIT8MW-8B	No Access	1.15	10.3	193.77								Maroota Sand	Area Flooded
PFPIT8MW-8C	No Access	1.28	8.8	194.5								Maroota Sand	Area Flooded
PFPIT8MW-8D	No Access	1	7.3	184.45								Maroota Sand	Area Flooded
PFPIT8MW-8E	No Access	0.95	4.5	187.85								Maroota Sand	Area Flooded
New Wells installed outside of Pits 8 & 13 in Aug 2020													
Sample ID	**SWL (btoc) 15 & 16 Sept 2022**	**PVC Stickup m**	**BOH (mbgl)**	**RL (TOC)**	**Reduced SWL (mAHD) 15 & 16 Sept 2022**	**pH**	**EC (mS/cm)**	**DO (%)**	**DO (mg/L)**	**Redox (mV)**	**Temp (°C)**	**Aquifer**	**Comments**
PFPIT8MW-6D	21.69	0.52	38.8	209.78	188.09	4.35	162	68	6.7	267	16.3	deep sandstone	clear water
PFPIT8MW-6s	dry	0.42	10.8	225.13	NA							Maroota Sand	dry well
PFPIT13MW-7D	24.52	0.5	42.5	225.13	200.61	4.22	457	40	3.8	106	17.5	deep sandstone	cloudy brown water

Notes:
NA= not available
SWl= standing water level
BOH= bottom of well
E2W Field parameters measured by D.Parisotto on 15 & 16 Sept 2022 during water sampling (pH, EC, DO, Eh and temperature using YSI professional series hired from ETS)
Redox (Eh mV, based on Ag/AgCl electrode) and conversion from Orp (mv) to Redox by adding 200 MV

Table 3A: Summary of Existing Monitoring Wells (Hitchcock Road, 2022)

PF Formation at Maroota

	PF167MW1	PF166MW1	PFL2HitchMW1	PFP214MW1	Lot 198PB1	Lot 198PB3	Lot 198PB2	Por 167 Spring
Ground Elevation (mAHD)	**187.64**	**209.94**	**226**	**186.5**				**184**
Lot & DP	Lot 167 DP 752039	Lot 2 DP570933	Lot 1 DP109 1018	Lot 167 DP 752039	Lot 198 DP 752025	Lot 198 DP 752025	Lot 198 DP 752025	Lot 167 DP 752039
License No	GW100649	GW104410	GW110746	GW110747	10AL109354	10WA109355	10WAL1093550	GW104614
Alocation (ML/yr)					Combined 56 ML /yr			44 ML/year
Approval Number					GW101528	as PB-2	GW101527	10WA114809
Groundwater Resource	Sydney Central Sandstone	Maroota Tertiary Sand	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Maroota Tertiary Sand
Date Installed	1996	**1998**	**2009**	**2009**	**1998**	**October 2019**	**1998**	**1995**
Drilled Depth (m bgl)	23.8	11.8	43.5	18	150	150	138	4
Well Screen Interval (mbgl)	20-23 ?	4.9-10.9	31- 43	11.5- 17.5	23.4 - 140	50 to 150 (open hole)	35.5-140	
Aquifer Permeability (K m/day)	0.1 L/sec	NA	0.1 L/sec	0.1 L/sec	0.5 L/sec	1.6 L/sec	2.6 L/sec	10 L/sec
Water Levels (mbgl)	4	10.57	36	5.6	20.58	48	35.36	(~4 m) 180 MAHD
Water Type	Na-Cl	Na-SO4	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	
PH	4.5	4	4	4.1	4.1		5	
Total Dissolved Solids, TDS	100	100	140	120	100		150	
Data Logger	Yes	Yes	Yes	Yes	No	No	No	No
Water Bearing Zones (mbgl)	6 to 8m	Na	Na-Cl	11.5-12	15.5-18.5m , 26-27m, 108 -114.5m, 188.5-121m	101 to 102m, 145 to 146m	56.5-57.2m, 74-75.55m	
Geology	0-2m Sand 2-10m Wet gravel 10-23.8 m Weathered Sandstone	0- 0.7m Sand 0.7-6.5m Sandy Clay 6.5- 11.5m Sand 11.5 -11.8m weathered sandstone	0- 18.5m Clay Sandy 18.5- 24.5m qtz gravel 24- 34m Clay & gravel 34 -43.5m weathered sandstone & clay	0- 0.5m Sandy 0.5- 18m sandstone - soft with clay	0-150 m Sandstone. Some interbedded Shale; 44-45m, 51-53.5m, 114.5-188.5m, 134.4-135m	Sandstone: 0-31 m, & 62-150m Shale; 31-62m	0-138 m Sandstone. Some interbedded Ironstone; 48.5-49m, Shale; 49-50.5m, 58.5-60m	Inferred sand/gravels (Maroota)
Comments	located on south west boundary	located on west boundary	located on east boundary	located on south boundary	Allocation is Under utilised. Pumping bore and supply to sand wash plant	Cased to 50m, open hole below 50 to 150m	Pumping bore and supply to sand wash plant. Treated for Fe floc- not sampled for 2 yrs. Bore replaced bhy PB-3 at concrete wash plant	Allocation is Under utilised. Former agricultural use- spring & unlined dam. Previous data logging (URS, 1996-2012) of pond levels

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Table 3B: Summary of New Monitoring Wells (Hitchcock Road; 2022)

PF Formation at Maroota

	PF166MW-2S	PF166MW-2D	PF166MW-3D	PF167MW-4D	PF167MW-4S	PF167MW-5D #
Ground Elevation (mAHD)	**210**	**210.09**	**198.67**	**193.39**	**193.44**	181.54
Lot & DP	Lot 1 DP 570966	Lot 1 DP 570966	Lot 1 DP1013943	Lot 167 DP 752039	Lot 167 DP 752039	Lot 214 DP 752039
Groundwater Resource	Maroota Tertiary Sand	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Maroota Tertiary Sand	Sydney Central Sandstone
Date Installed	**May-17**	**May-17**	**May-17**	**May-17**	**May-17**	1/05/2017 (#Feb 2018)
Drilled Depth (m bgl)	8.5 m	29.4 m	23 m	15.5 m	8 m	9.5 m
Well Screen Interval (mbgl)	4.9 -7.9 m	26.4 -29.4 m	20 -23 m	11.5 -15.5 m	5 -8 m	6.4 -9.4 m
Aquifer Permeability (K m/day)	6.9 * E-01 m/sec	Na	4.57 * E-02 m/sec	1.6 * E-01 m/sec	7.18 * E-02 m/sec	4.95 * E-02 m/sec
Water Levels (mbgl)	4	25	14	8.5	7	2
Water Type	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Ca-SO4	K-Cl
PH	5.39	6.99	5.63	5.85	5.85	5.82
Total Dissolved Solids, TDS	384	549	346	2170	736	1140
Water Bearing Zones (mbgl)	4 to 5.5m	4 to 5.5m	Na	7 to 8 m	7 to 8 m	Na
Geology	0-4m: Sandy Clay 4- 5.5m: Sand 5.5 -8.5m: Sandy Clay	0-4m: Sandy Clay 4-5.5m: Sand 5.5 -8.5m: Sandy Clay 8.5 -29.4m: Sandstone	0-23m: Sandstone	0- 7.1m: Sandy Silt & Clay 7.1 -15.5m: Sandstone	0- 7.1m: Sandy Silt & Clay 7.1 -8m: Sandstone	0 -9.5m: Sandstone
Comments	located on site entrance	located on site entrance	located next to extraction pit	located near Por 167 Dam	located near Por 167 Dam	located on southern extraction area

Legend:

P167MW-5D # Decommissioned in 2018 (covered by bunding)

New wells installed in May 2017

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Table 3C: Summary of New Monitoring Wells at Hitchcock Road- Pits 8 & 13 (2022)

PF Formation- Pit 8 Assessment of Extraction Depths

	PFPit8 MW-6D	PFPit8 MW-6s	PFPit13 MW-7D	PFPit8 MW-8A	PFPit8 MW-8B	PFPit8 MW-8C	PFPit8 MW-8D	PFPit8 MW-8E	PFPit8 MW-8F	PFPit8 MW-8G
Date Well Installed	**Aug-20**	**Aug-20**	**Aug-20**	**Sep-20**	**Sep-20**	**Sep-20**	**Sep-20**	**Sep-20**	**Sep-21**	**Sep-21**
Ground Elevation (mAHD)	**209.53**	**209.63**	**213.48**	**196.64**	**193.75**	**194.53**	**192.82**	**192.84**	**195.61**	**196.12**
Base of Bore (m AHD)	**169.53**	**197.13**	**170.98**	**188.94**	**182.75**	**185.03**	**184.62**	**187.84**	**185.41**	**188.02**
Borehole Status	Groundwater Intersected	Dry Well (Above SWL)	Groundwater Intersected	Dry or Perched	Groundwater Intersected	Groundwater Intersected	Dry or Perched	Dry or Perched	Groundwater Intersected	Dry or Perched
Pit 8 Extraction Guide	**Yes**	NA	**Yes**	NA	**Yes**	**Yes**	NA	NA	**Yes**	NA
Lot & DP	Lot 2 DP223323	Lot 2 DP223323	Lot 1 DP34599	Lot 1 DP223323	Lot 1 DP223323	Lot 1 DP223323	Lot 1 DP223323	Lot 1 DP223323	Lot 1 DP223323	Lot 1 DP223323
Groundwater Resource	Sydney Central Sandstone	Maroota Tertiary Sand	Sydney Central Sandstone	Maroota Tertiary Sand	Maroota Tertiary Sand	Maroota Tertiary Sand	Maroota Tertiary Sand	Maroota Tertiary Sand	Maroota Tertiary Sand	Maroota Tertiary Sand
Aquifer Characteristics	Regional	Regional	Regional	Perched- spillway	Regional	Regional	Perched- near Dam	Perched- near Dam	Regional	Regional
Drilled Depth (m bgl)	40	12.5	42.5	7.7	11	9.5	8.2	5	10.2	8.1
Well Screen Interval (mbgl)	32.8 -38.8m	4.8 - 10.8m	36.5 - 42.5 m	4.7 - 7.7 m	7.3 - 10.3 m	5.8 - 8.8 m	5.8 - 7.3 m	3.1 - 4.6 m	7.2 - 10.2 m	5.1 - 8.1 m
Permeability or Yield	Low (<0.2 L/sec)	NA	Low (<0.2 L/sec)	Low-moderate	Low-moderate	Low-moderate	Low-moderate	Low-moderate	Low-moderate	Low-moderate
Initial Water Levels (mbgl)	27	dry	25	7.7	8	8	4	3	9	dry
Water Bearing Zones (mbgl)	32 m & 38 m	NA, dry	40 m	7 - 7.7 m	8- 11 m	8- 9 m	4- 6.5 m	3 -5 m	2.5 - 10.2 m	2.5 - 8.1 m
Local Geology	0- 28m: Interbedded Sand, silt, gravel, & clay-brown. 28-40m: Sandstone, brown. weathered some pebbles & ironstone	0- 12.3 m: Interbedded Sand, silt, gravel, brown 12.3m hard layer (sandstone, Fe)	0-1m: Clayey Silt, brown. 1- 42.5m: Interbedded Sandstone, Siltstone & Shale- brown to grey	0-0.5m: Sandy Clay, brown 0.5- 7.1m: Interbedded Sands, Silt & Clay, brown	0- 0.7m: Sandy Clay, brown 0.7 -11m: Interbedded Sand,Silt & Gravel, minor clay & ironstone, brown	0- 9.2m: Interbedded Sand, Silt & Gravel, minor clay 9.2m: Sandstone, hard	0- 6.5m: Interbedded Sand, Silt & Gravel, minor clay 6.5 -8.2m: Sandstone, brown & weathered	0- 5m: Interbedded Sand, Silt & Gravel, minor clay, brown	0- 10.2m: Interbedded Sand, Silt & Gravel, minor clay, brown	0- 8.1m: Interbedded Sand, Silt & Gravel, minor clay, red/brown with multiple hard ironstone layers
Comments	Located rear of firestation & residence	Located rear of firestation & residence	Located rear of commercial property/aggregate supplier	Located on floor of Pit 8-north end	Located on floor of Pit 8-north	Located on floor of Pit 8-north east corner	Located on floor of Pit 8-south end near pond	Located on floor of Pit 8-south end near pond	Located on floor of Pit 8-north end near MW-8a	Located on floor of Pit 8-north end near MW-6s. Difficult drilling to ironstone layers

Legend:

New groundwater monitoring wells installed in August & September 2020 to guide the Pit Shell Plan.

Additional groundwater monitoring wells (2) installed on 22 Sept 2021 to assess gw flow patterns & verify regional WLs

NA **Shallow well used to verify high water levels/buffer zone and to identify perched water system**

Refer to borelog/well cvonstruction records for details of geology and well construction

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Tables 3-1 to 3-2: Maroota Hitchcock Road- Water Analyses (1999 to 2022)

Table 3-1 **Bore PF167MW1 Chemical Analyses Summary**

Date		2.6.99	8.9.99	21.12.99	9.3.00	28.11.00	21.6.01	19.12.01	26.6.02	23.1.03	9.7.03	30.1.04	29.6.04	15.12.04	22.6.05	19.1.06	6.7.06
pH		4.43	4.49	4.21	4.93	4.28	4.61	4.98	4.52	4.54	5.15	4.31	4.38	4.68	5.42	4.32	4.27
Electrical Conductivity, EC	uS/cm	164	190	201	179	184	170	188	215	199	204	225	221	240	215	205	199
Total Dissolved Solids, TDS	mg/L	118	90	105	115	207	120	108	121	101	116	157	110	143	137	141	119
Calcium, Ca	mg/L	3	3	5	6	3	6	6	5	3	4	4	5	5	5	4	4
Magnesium, Mg	mg/i.	5	4	4	4	4	4	5	4	4	3	4	4	4	4	4	4
Sodium, Na	mg/L	16	18	16	15	18	16	18	25	20	19	22	23	26	28	25	23
Potassium, K	mg/L	2	2	3	3	3	5	4	5	2	2	2	3	3	3	3	3
Bicarbonate, HCO3	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	2	1	<1
Sulphate, SO4	mgIL	9	11	35	32	16	15	15	14	9	13	12	10	13	13	10	6
Chloride, Cl	mg/L	36	11	35	32	35	36	47	58	4	48	51	53	50	56.6	57.4	53.1
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5

Table 3-1 (Con't) **Bore PF167MW1 Chemical Analyses Summary**

Date		5.7.07	3.7.08	3.7.09	16.6.10	22.6.11	20.6.12	19.6.13	8.8.14	30.6.15	10.8.16	17.7.17	14.8.18	2.9.19	5.8.20	17.8.21	15.9.2022
pH		4.88	5.29	4	4.3	5.3	4.39	4.18	4.6	4.48	4.54	4.67	3.83	5.2	4.28	5.09	5.69
Electrical Conductivity, EC	uS/cm	188	161	177	190	170	174	211	205	150	188	151	210	262	160	153	73
Total Dissolved Solids, TDS	mg/L	76	100	104	111	101	112		94	70	111	99	113	137	112	104	48
Calcium, Ca	mg/L	2	6	5	3	4	7	<1	5	5	5	4	4	2	3	5	1
Magnesium, Mg	mg/i.	3	5	4	3	4	4	4	4	3	4	4	4	3	3	5	2
Sodium, Na	mg/L	16	13	14	15	18	12	22	19	12	17	14	21	16	16	14	7
Potassium, K	mg/L	2	4	4	2	4	4	2	3	2	3	3	4	22	3	4	3
Bicarbonate, HCO3	mg/L	<1	<1	<1	2	2.4	<1	<1	<1	<1	<1	<1	<1	4	<1	<1	4
Sulphate, SO4	mgIL	10	30	22.6	17.1	18	28	1	19	30	22	24	17	10	21	27	16
Chloride, Cl	mg/L	36.1	26.4	34.8	39.9	29	22	42	42	15	32	28	40	54	27	24	9
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<8	<5

Table 3-2 **Bore PF166MW1 Chemical Analyses Summary**

Date		1.6.99	8.9.99	21.12.99	9.3.00	29.11.00	21.6.01	19.12.01	26.6.02	23.1.03	9.7.03	30.1.04	29.6.04	15.12.04	22.6.05	19.1 .06	6.7.06
pH		4.18	4.19	4.13	4.14	4.31	4.19	4.63	4.48	4.82	7.86	4.39	4.27	4.06			
Electrical Conductivity, EC	uS/cm	222	240	230	214	266	194	228	219	203	221	193	235	203	DRY	DRY	DRY
Total Dissolved Solids, TDS	mg/L	118	108	137	170	460	115	210	280	128	134	204	280	120			
Calcium, Ca	mg/L	1	1	1	1	1	1	1	2	1	1	<1	1	1			
Magnesium, Mg	mg/L	6	6	6	5	6	5	6	6	5	4	5	5	4			
Sodium, Na	mg/L	26	23	23	22	29	21	22	24	19	20	18	19	19			
Potassium, K	mg/L	<1	<1	1	1	1	1	2	1	<1	<1	<1	1	1			
Bicarbonate, HCO3	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1			
Sulphate, SO4	mgIL	1	7	1	1	16	2	1	2	<1	<1	2	<1	2			
Chloride, Cl	mg/L	58	49	51	52	58	49	58	61	46	50	47	44	36			
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	6	<5	<5	5	<5			

Table 3-2 (con't) **Bore PF166MW1 Chemical Analyses Summary**

Date		5.7.07	3.7.08	3.7.09	16.6.10	22.6.11	20.6.12	19.6.13	8.8.14	30.6.15	10.8.16	17.7.17	14.8.18	15.8.19	5.8.20	17.8.21	15.9.2022
pH		4.76		3.58	4.06	4.22	4.08	4.53	4.19	4.03	4.18	4.11	dry	dry	4.99	4.21	4.44
Electrical Conductivity, EC	uS/cm	163	NA	240	247	261	229	189	219	239	208	176			195	154	222
Total Dissolved Solids, TDS	mg/L	98		140	141	172	124	186	89	100	234	122			247	105	117
Calcium, Ca	mg/L			<1	<1	1	1	6	1	<1	1	<1			<1	1	1
Magnesium, Mg	mg/L			4	4	6	5	4	5	6	5	5			5	5	7
Sodium, Na	mg/L			26	24	24	19	15	22	26	22	21			21	16	22
Potassium, K	mg/L			2	2	3	3	4	1	1	2	2			2	2	3
Bicarbonate, HCO3	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1			2	<1	<1
Sulphate, SO4	mgIL			2.21	1.77	1	1	21	2	1	2	2			2	1	2
Chloride, Cl	mg/L			49.1	56.3	53	43	32	46	38	40	38			43	33	40
Oil and Grease	mg/L			<5	<5	<5	<5	<5	<5	<5	<5	<5			(13#) <5	<5	<5

Note:
Groundwater samples collected by Melissa Mass of SE Environmental Pt Ltd on 17 August 2021 & Earth2Water Pty Ltd (15-9-22)
(13#) & <5 = Initial (anomalous) and resampling results of Oil/Grease on 5 & 28 August 2020, respectively

Tables 3-3 to 3-4: Maroota Hitchcock Road- Water Analyses (2009 to 2022)

Table 3-3 **Bore PFL2HitchMW1 Chemical Analyses Summary**

Date		3.7.2009	16.6.2010	22.6.2011	20.6.2012	20.6.2012	19.6.2013	8.08.2014	30.06.2015	10.8.2016	17.7.2017	14.8.2018	15.8.2019	5.8.2020	17.8.2021	15.9.2022
pH		3.96	4.1	4.1	4.03	4.03	4.18	3.99	3.94	4.19	4.02	3.96	7.11	5.16	3.91	4.09
Electrical Conductivity, EC	uS/cm	182	154	167	195	195	185	263	309	288	298	307	284	271	300	274
Total Dissolved Solids, TDS	mg/L	84	88	110	99	99	150	107	146	230	147	167	172	160	173	126
Calcium, Ca	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1
Magnesium, Mg	mg/L	2	2	2	2	2	2	3	3	3	4	4	4	4	4	3
Sodium, Na	mg/L	19	16	22	22	22	22	32	44	36	37	37	38	34	37	36
Potassium, K	mg/L	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate, HCO3	mgIL	<1	<	<1	<1	<1	<1	<1	<1	<1	<1	<1	9	2	<1	<1
Sulphate, SO4	mg/L	7.88	4.06	5	1	1	4	6	6	6	5	6	6	5	5	5
Chloride, Cl	mg/L	40.3	36.9	32	43	43	43	62	59	63	70	76	67	64	82	75
Oil and Grease	mgJL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Table 3-4 **Bore PFP214MW1 Chemical Analyses Summary**

Date		3.7.2009	16.6.2010	22.6.2011	20.6.2012	19.6.2013	8.08.2014	30.06.2015	10.8.2016	17.7.2017	14.8.2018	15.8.2019	5.8.2020	17.8.2021	15.9.2022
pH		4.19	4.16	4.31	4.27	5.7	4.22	4.07	4.05	4.34	3.65	4.84	4.36	4.14	4.32
Electrical Conductivity, EC	uS/cm	168	164	158	179	198	258	251	247	253	228	202	206	186	197
Total Dissolved Solids, TDS	mg/L	100	96	88	103	124	108	118	135	129	114	108	131	103	86
Calcium, Ca	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium, Mg	mg/L	6	5	4	6	7	10	11	10	8	9	6	7	6	6
Sodium, Na	mg/L	18	15	18	17	21	23	21	17	14	16	17	18	20	20
Potassium. K	mg/L	1	<1	1	<1	2	<1	<1	1	1	2	<1	1	1	1
Bicarbonate, HCO3	mg/L	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate, SO4	mg/L	1.9	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Chloride, Cl	mg/L	24.3	23.8	34	24	34	34	26	34	36	36	37	42	50	45
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Groundwater samples collected by Melissa Mass of SE Environmental Pty Ltd and Earth2Water Pty Ltd (15& 16-9-22)

Tables 3-5 to 3-6: Maroota Hitchcock Road- Water Analyses (1999 to 2022)

Table 3-5 **Bore L198PB1 Chemical Analyses Summary (1999-2022)**

Date		1.6.99	8.9.99	21.12.99	9.3.00	28.11.00	21.6.01	19.12.01	26.6.02	23.1.03	9.7.03	30.1.04	29.6.04	15.12.04	22.6.05	19.1.06	6.7.06	5.7.07	3.7.08	3.7.09	16.6.10	22.6.11	20.6.12	19.6.13	8.08.14	30.06.15	10.08.16	17.7.17	14.8.18	15.8.19	5.8.20	17.8.21	16.9.2022
pH		5.87	6.24	6.11	4.69	4.49	4.51	5.41	4.73	4.49	5.06	5	4.53	4.28	5.22	5.74	5.16	NA	4.59	3.94	4.43	5.52	5.72	NA	4.15	4.09	4.15	5.39	5.35	5.43	5.03	5.84	5.17
E Conductivity, EC	uS/cm	161	170	169	141	182	179	204	199	243	199	160	291	197	157	158	155		144	174	163	170	170		183	177	164	151	168	169	192	146	157
Total Dissolved Solids, TDS	mg/l	124	116	98	97	107	102	116	112	139	102	116	174	88	105	115	98		85	83	88	102	99		96	88	83	104	94	91	121	104	94
Calcium, Ca	mg/L	1	<1	1	1	3	2	2	4	3	2	2	4	1	1	2	1		<1	1	<1	2	2		1	1	1	2	2	1	2	2	2
Magnesium, Mg	mg/L	4	6	5	3	3	4	4	4	4	3	2	5	2	2	4	3		2	2	2	4	3		2	2	2	3	3	3	3	3	3
Sodium, Na	mg/L	21	24	22	19	20	21	27	23	31	22	19	40	25	23	21	20		18	19	16	21	18		20	20	18	18	19	20	23	21	20
Potassium, K	mg/L	1	<1	1	1	2	5	5	3	3	2	2	3	2	2	2	2		1	2	1	2	2		2	1	2	2	1	1	2	2	2
Bicarbonate, HCO3	mg/l	13	29	22	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	12	5		<1	<1	<1	3.7	9.8		<1	<1	<1	3	7	5	<1	3	1
Sulphate, SO4	mg/L	4	4	4	2	8	8	3	7	4	8	6	9	8	8	6	2		10	9.31	6.89	6	6		9	7	8	6	9	8	8	7	9
Chloride, Cl	mg/l	39	35	36	36	40	49	60	58	64	49	43	83	42	47.1	43.4	43.8		31.1	38.8	41.1	36	32		40	31	33	31	30	36	36	34	35
Oil and Grease	mg/l	<5	<5	<5	<5	<5	<5	<5	<5	6	<5	<5	<5	<5	<5	5	<5		<5	<5	<5	<5	<5		<5	<5	<5	<5	<5	<5	<5	<8	<5

Table 3-6A **Bore L198PB2 Chemical Analyses Summary (1999-2022)**

Date		1.6.99	8.9.99	21.12.99	9.3.00	29.11.00	21.6.01	19.12.01	26.6.02	23.1.03	9.7.03	30.1.04	29.6.04	15.12.04	22.6.05	19.1.06	6.7.06	5.7.07	3.7.08	3.7.09	16.6.10	22.6.11	20.6.12	19.6.13	8.08.14	30.6.15	10.8.16	17.7.17	14.8.18	15.8.19	5.8.20	17.8.21	16.9.2022
pH		5.78	6.61	5.96	NA	4.8	5.24	5.99	6.33	5.96	4.84	5	5.78	5.39	6.43	5.3	5.46	4.37	5.25	4.5	no sample			5.71	5.93	**no sample**		5.3	5.11	5.54	No sample		No sample
E Conductivity, EC	uS/cm	139	174	146	NA	152	130	141	151	146	162	160	136	156	133	126	122	195	135	130				146	150	(note 1)	(note 1)	156	147	152			
Total Dissolved Solids, TDS	mg/L	126	102	85	NA	100	87	87	102	84	87	116	79	105	87	104	79	88	79	79				91	69			81	90	82			
Calcium, Ca	mgIL	1	2	2	NA	<1	<1	<1	1	<1	<1	2	1	1	<1	<1	1	<1	1	<1				<1	<1			<1	<1	<1			
Magnesium, Mg	mg/L	5	5	5	NA	4	3	4	4	4	2	2	4	2	4	3	4	3	5	3				3	4			3	3	3			
Sodium, Na	mg/L	18	19	18	NA	19	18	18	21	17	18	19	18	20	17	19	16	21	16	16				18	18			18	18	19			
Potassium, K	mg/L	2	2	2	NA	1	1	2	2	1	<1	2	1	2	2	1	2	1	2	2				2	2			1	1	<1			
Bicarbonate, HCO3	mg/L	23	33	19	NA	4	3	13	8	16	<1	<1	9	2	14	7	24	<1	24.4	9.2				9	10			6	6	5			
Sulphate, 804	mg/L	3	3	2	NA	1	1	3	2	<1	<1	6	1	4	4	1	1	4	2	2.78				2	4			6	3	3			
Chloride, Cl	mg/l	31	28	31	NA	41	38	33	46	33	40	43	37	35	34.9	38.8	30.2	44.8	31.8	32.2				33	36			30	38	35			
Oil and Grease	mg/L	<5	<5	<5	-	NA	<5	<5	11	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5				<5	<5			<5	<5	<5			

Note 1= Bore clogging (Iron floc) and chemicals added to unclogg (unrepresentative water)

Table 3-6B **Bore L198PB3 Chemical Analyses Summary (2020-2022)**

Date		5.8.20	17.8.21	16.9.22
pH		6.17	6.24	No sample
E Conductivity, EC	uS/cm	185	129	
Total Dissolved Solids, TDS	mg/L	118	97	
Calcium, Ca	mgIL	2	2	
Magnesium, Mg	mg/L	5	5	
Sodium, Na	mg/L	25	19	
Potassium, K	mg/L	2	2	
Bicarbonate, HCO3	mg/L	17	17	
Sulphate, 804	mg/L	4	5	
Chloride, Cl	mg/l	36	28	
Oil and Grease	mg/L	<5	<5	

Note: New bore L198PB3 was installed in October 2019 to replace L198PB-2 (Fe clogging). Well capped off in 2022 due to high Fe in water
Groundwater samples collected by Melissa Mass of SE Environmental Pty Ltd & Earth2Water Pty Ltd (16-9-22)

Prepared by: Earth2Water Pty Ltd
Checked By: DParisotto

Table 3-7: Pumping Logbook POR 167 - Spring (2021-2022)

DATE START	TIME START	METER READING START	DATE FINISH	TIME FINISH	METER READING FINISH	M3 PUMPED	Approval No: 10WA114809 WAL number: 24156
2/09/21	14	0	44442	15	199	199	
5/10/21	14.45	199	44475	16.3	435	236	
20/10/21	16.2	435	44490	16.2	657	222	
27/10/21	16.3	657	44498	11.3	918	261	
3/11/21	16.3	918	44505	16.45	1417	499	
16/11/21	8.1	1417	44522	8	2256	839	Lost prime

TOTAL (m3)	**2256**
TOTAL (ML)	**2.256**

Note: information provided by PFF in August 2022

Prepared by: Earth2Water Pty Ltd
Checked By: DP

Table 3-8: Pumping Records - Lot 198 PB01
(2021-2022)

DATE	TIME START	METER READING START	METER READING FINISH	M3 PUMPED	Approval No. 10WA109355 WAL number: 42252
1/07/21		45529	52542	7013	
18/11/21		52542	52592	50	
19/11/21		52592	52797	205	
23/11/21		52797	52849	52	
24/11/21		52849	52901	52	
25/11/21		52901	52954	53	
26/11/21		52954	53117	163	
29/11/21		53117	53168	51	
30/11/21		53168	53224	56	
1/12/21		53224	53280	56	
2/12/21		53280	53340	60	
3/12/21		53340	53497	157	
6/12/21		53497	53551	54	
7/12/21		53551	53604	53	
8/12/21		53604	53659	55	
9/12/21		53659	53875	216	
13/12/21		53875	53933	58	
14/12/21		53933	53987	54	
15/12/21		53987	54046	59	
16/12/21		54046	54096	50	
17/12/21		54096	54202	106	
20/12/21		54202	54318	116	
22/12/21		54318	54370	52	
23/12/21		54370	55341	971	
10/01/22		55341	55455	114	
12/01/22		55455	55505	50	
13/01/22		55505	55650	145	
14/01/22		55650	55854	204	
19/01/22		55854	56537	683	
1/02/22		56537	56588	51	
2/02/22		56588	56656	68	
3/02/22	13.1	56656	56796	140	
4/02/22	6.55	56796	56856	60	
7/02/22	6	56856	56910	54	
8/02/22	6.5	56910	57019	109	
10/02/22	8.22	57019	57058	39	
11/02/22	6.5	57058	57228	170	
14/02/22	6.4	57228	57283	55	
15/02/22	7	57283	57346	63	
16/02/22	7	57346	57401	55	
18/02/22	7.3	57401	57744	343	
24/02/22	6.5	57744	58050	306	
1/03/22	10.1	58050	58099	49	
2/03/22	7.05	58099	58701	602	
14/03/22	9	58701	58765	64	
15/03/22	7	58765	58831	66	
16/03/22	7.15	58831	58902	71	
17/03/22	10.2	58902	59134	232	
21/03/22	7.45	59134	59218	84	
22/03/22	7.3	59218	59283	65	
23/03/22	6.55	59283	59347	64	
24/03/22	6.4	59347	60192	845	
6/04/22	7.2	60192	60255	63	
7/04/22	6.31	60255	60318	63	
8/04/22	9	60318	60517	199	
11/01/22	6.3	60517	60584	67	
12/04/22	6.55	60584	60650	66	
13/04/22	7	60650	60745	95	
14/04/22	6.4	60745	60944	199	
19/04/22	6.27	60944	61112	168	
20/04/22	6.4	61112	61133	21	
21/04/22	6.4	61133	61242	109	
22/04/22	6.26	61242	61507	265	
26/04/22	6.25	61507	61575	68	
27/04/22	6.35	61575	61643	68	
28/04/22	6	61643	61708	65	
29/04/22	7.05	61708	61926	218	
3/05/22	7.2	61926	62041	115	
4/05/22	11.3	62041	62095	54	
5/06/22	6.5	62095	62158	63	
6/06/22	6.3	62158	62415	257	
10/05/22	6.4	62415	62480	65	
11/05/22	6.53	62480	62545	65	
12/05/22	9.45	62545	62806	261	
16/05/22	7.37	62806	62870	64	
17/05/22	6.57	62870	63073	203	
20/05/22	11.3	63073	63123	50	
21/05/22	7	63123	63166	43	
24/05/22	6.55	63166	63402	236	
25/05/22	2.14	63402	63445	43	
26/05/22	6.45	63445	63515	70	
27/05/22	8.3	63515	63575	60	
28/05/22	7	63575	63705	130	
30/05/22	6.55	63705	63760	55	
31/05/22	2	63760	63803	43	
1/06/22	6.35	63803	63868	65	
2/06/22	6.5	63868	63930	62	
3/06/22	6.3	63930	64123	193	
6/06/22	6.55	64123	64193	70	
7/06/22	6.45	64193	64257	64	
8/06/22	6.35	64257	64385	128	
10/06/22	6.45	64385	64645	260	
14/06/22	6.55	64645	64708	63	
15/06/22	6.45	64708	64774	66	
16/06/22	7	64774	64837	63	
17/06/22	6.46	64837	65025	188	
20/06/22	6.55	65025	65086	61	
21/06/22	6.35	65086	65123	37	
22/06/22	6.43	65123	65422	299	
27/06/22	7.4	65422	65442	20	
28/06/22	6.55	65442	65443	1	
29/06/22	6.3	65443	65506	63	
30/06/22	6.3	65506	65730	224	

Note: information provided by PFF in August 2022

TOTAL (m3)	**20201**
TOTAL (ML)	**20.201**

Table 3-9A: Maroota Hitchcock Road- Water Analyses for New Wells (2017 to 2022)

New Wells & Dams		MW-2S	MW-2S	MW-2S	MW-2S	MW-2S	MW-2S	MW-2S	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-4S	MW-4S	MW-4S	MW-4S	MW-4S	MW-4S	MW-4D	MW-4D	MW-4D	MW-4D	MW-4D	MW-4D	MW-5D
Date		17/07/17	18/05/17	14/08/18	15/08/19	5/08/20	17/08/21	15/09/22	18/05/17	14/08/18	2/09/19	5/08/20	17/08/21	15/09/22	18/05/17	1/08/18	15/08/19	5/08/20	17/08/21	15/09/22	18/05/17	14/08/18	15/08/19	5/08/20	17/08/21	15/09/22	18/05/17	14/08/18	15/08/19	5/08/20	17/08/21	15/09/22	18/05/17
pH	units	4.58	5.39	5.5	6.15	4.77	5.03	4.57	6.99	5.5	5.44	5.18	5.73	5.22	5.63	4.02	4.98	4.75	4.27	4.46	6.03	4.48	insufficient	5.65	5.56	5.3	5.85	5.47	5.65	5.73	6.11	5.41	5.82
Electrical Conductivity	uS/cm	166	211	128	168	67	129	221	307	128	152	137	120	172	278	306	250	164	143	87	129	76	water	76	74	126	274	158	149	152	136	125	190
Total Dissolved Solids	mg/L	114	384	84	----	66	102	124	549	84	77	96	78	79	346	159	130	103	90	61	169	----		60	48	64	736	95	92	110	112	73	1140
Calcium, Ca	mg/L	3	5	2	3	1	2	4	9	2	3	2	2	3	2	1	1	<1	<1	<1	7	1		<1	2	3	3	2	2	3	4	3	<1
Magnesium, Mg	mg/L	4	3	2	3	1	3	5	3	2	2	2	2	4	1	7	4	2	2	1	3	1		2	3	4	1	2	2	3	2	5	<1
Sodium, Na	mg/L	18	20	15	18	8	17	26	40	15	18	18	19	20	32	36	31	21	21	10	8	11		8	8	13	37	22	21	21	21	11	13
Potassium, K	mg/L	2	2	1	2	<1	2	2	3	1	1	1	1	2	11	<1	<1	<1	<1	<1	3	1		1	<1	<1	8	<1	<1	<1	1	<1	26
Bicarbonate, HCO3	mgIL	<1	2	8	4	<1	<1	<1	35	8	8	3	5	3	2	<1	<1	<1	<1	<1	12	<1		8	<1	6	8	13	7	11	7	3	3
Sulphate, SO4	mg/L	6	8	3	3	2	5	6	12	3	1	1	2	4	3	2	2	2	2	3	20	4		7	12	16	32	7	3	2	7	19	<1
Chloride, Cl	mg/L	38	37	30	36	15	31	58	40	30	32	31	28	41	56	68	57	36	33	18	12	17		12	11	22	34	18	9	19	18	16	36
Oil& Grease	mg/L	<5			<5	<5	<5	<5			<5	<5	<5	<5		<5	<5	<5	<8	<5		<5		<5	<5	<5		<5	<5	<5	<5	<5	

Note: Analyses by ALS
Re-analyses conducted on TDS- filtering of samples conducted due to TDS values exceeding EC (turbidity & silica issues)
bold- TDS results are considered anomalous (re-analyses conducted after filtering samples, i.e. TDS higher than EC, possibly silica in water)
--- (no TDS available- matrix interference)
MW-2D sample on 15 Aug 2019 was turbid and not representative. MW-2D resampled on 2 Sept 2019 by Melissa Mass
CWD= Clean Water Dam. The new wells (MW-2D) have the prefix PF166 or PF167 (PFF166MW-2D)

Table 3-9B: Maroota Hitchcock Road- Water Analyses for Dams (2018 to 2022)

Existing Site Dams		CWD	CWD	CWD	CWD	CWD	Por167 Dam	Por167 Dam	Por167 Dam	Por167 Dam	Por167 Dam
Date		14/08/18	2/09/19	5/08/20	17/08/21	16/09/22	14/08/18	2/09/19	5/08/20	17/08/21	16/09/22
pH	units	4.62	5.26	5.43	4.72	5.09	4.15	5.52	5.38	5.02	6.31
Electrical Conductivity	uS/cm	222	86	113	161	159	201	222	176	94	103
Total Dissolved Solids	mg/L	125	----	76	113	90	108	----	119	74	68
Calcium, Ca	mg/L	5	1	3	8	7	2	6	2	4	8
Magnesium, Mg	mg/L	3	2	2	2	2	3	3	4	2	1
Sodium, Na	mg/L	25	9	13	18	16	22	24	22	11	9
Potassium, K	mg/L	3	2	3	3	4	2	5	3	2	2
Bicarbonate, HCO3	mgIL	<1	<1	<1	<1	<1	<1	4	<1	<1	8
Sulphate, SO4	mg/L	5	4	8	20	30	7	20	8	13	16
Chloride, Cl	mg/L	45	20	21	31	24	38	44	36	21	14
Oil& Grease	mg/L	<5	<5	(10 #) <5	<5	<5	<5	<5	<5	<5	<5

Note:
Groundwater and surface water samples collected by Melissa Mass of SE Environmental Pty Ltd on 17 Aug 2021 & Earth2Water Pty Ltd (15 & 16-9-22)
CWD= Clean Water Dam on Por 167 site
(10#) & <5 = Initial (anomalous) and resampling results of Oil/Grease on 5 & 19 August 2020, respectively

Table 3-10: Maroota - Water Analyses for Existing Wells at 4378 ON Rd (2019 -2022)

Site; 4378 Old Northern Rd, Maroota

Maroota New Wells	units	4378ONR PF1	4378ONR PF1	4378ONR PF1	4378ONR PF1	4378ONR PF2	4378ONR PF2	4378ONR PF2	4378ONR PF2	4378ONR PF3	4378ONR PF3	4378ONR PF3	4378ONR PF3
Date		15/8/2019	5/08/2020	17/08/2021	16/09/2022	15/8/2019	5/08/2020	17/08/2021	16/09/2022	15/8/2019	5/08/2020	17/08/2021	16/09/2022
pH		5.76	4.79	4.80	3.87	5.84	4.90	7.36	7.47	dry	4.29	4.08	4.47
Electrical Conductivity, EC	uS/cm	156	64	149	130	72	55	206	198		221	632	226
Total Dissolved Solids (ALS)	mg/L	79	28	96	99	38	57	116	50		191	347	107
Calcium, Ca	mg/L	<1	1	1	2	1	<1	<1	<1		2	4	1
Magnesium, Mg	mg/L	2	<1	2	2	<1	<1	<1	<1		4	11	3
Sodium, Na	mg/L	16	5	23	9	8	8	9	8		26	83	29
Potassium, K	mg/L	2	1	2	<1	<1	<1	3	3		<1	<1	1
Bicarbonate, HCO3	mgIL	12	<1	<1	<1	11	<1	79	68		<1	<1	<1
Sulphate, SO4	mg/L	2	<1	3	14	3	3	7	5		9	8	4
Chloride, Cl	mg/L	32	11	39	21	9	9	11	14		51	178	64
Oil& Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5		<5	<5	<5

Note:
Groundwater samples collected by Melissa Mass of SE Environmental Pty Ltd on 17 August 2021 & Earth2Water Pty Ltd on 16 September 2022
Samples analysed by ALS Environmental (NATA accredited)

Table 3-11: Pumping Log book Lot 198 - Bywash Dam (2021-2022)

DATE	TIME START	METER READING START	TIME FINISH	METER READING FINISH	M3 PUMPED	Approval No: 10WA105415 WAL number : 26168
1/07/21		12732	13/07/21 8.40	12875	143	
13/07/21	8.4	12875	17	12930	55	
20/07/21	8	12930	21/07/21 8.30	13090	160	
27/07/21	7.3	13090	18.15	13160	70	
5/08/21	8	13160	16.45	13189	29	
23/08/21	7.3	13189	24/08/21 08.15	13351	162	
27/09/21	12.55	13351	28/09/21 6.30	13468	117	
12/10/21	6.3	13468	12/10/21 16.30	13534	66	
22/10/21	7.15	13534	4.25	13544	10	
28/10/21	7	13544	16.3	13805	261	
17/11/21	7	13805	18/11/21 16.30	13865	60	
20/11/21	7	13865	16.15	13897	32	
25/11/21	16.3	13897	26/11/21 07.30	13993	96	
5/01/22	11	13993		14006	13	
6/01/22	10	14006		14078	72	

TOTAL (m3)	1346
TOTAL (ML)	1.346

Note: information provided by PFF in August 2022

Table 3-12A: Pumping Records for POR 167 Clean Water Dam (2021-2022)

DATE	METER READING START	METER READING FINISH	HOURS PUMPED (METER)	M3 PUMPED	Approval No: 10WA114809 WAL: 24156
1/07/21	9662	9679	17	16269	
1/07/21	9679	9696	17	16269	
5/07/21	9696	9713	17	16269	
6/07/21	9713	9730	17	16269	
7/07/21	9730	9746	16	15312	
8/07/21	9746	9763	17	16269	
9/07/21	9763	9779	16	15312	
12/07/21	9779	9798	19	18183	
13/07/21	9798	9816	18	17226	
14/07/21	9816	9834	18	17226	
16/07/21	9834	9850	16	15312	
19/07/21	9850	9867	17	16269	
20/07/21	9867	9885	18	17226	
21/07/21	9885	9898	13	12441	
22/07/21	9898	9905	7	6699	
23/07/21	9905	9918	13	12441	
26/07/21	9918	9931	13	12441	
27/07/21	9931	9945	14	13398	
28/07/21	9945	9962	17	16269	
29/07/21	9962	9976	14	13398	
30/07/21	9976	9989	13	12441	
2/08/21	9989	10000	11	10527	
3/08/21	10000	10010	10	9570	
4/08/21	10010	10016	6	5742	
6/08/21	10016	10023	7	6699	
9/08/21	10023	10034	11	10527	
10/08/21	10034	10043	9	8613	
11/08/21	10043	10052	9	8613	
12/08/21	10052	10060	8	7656	
19/08/21	10060	10070	10	9570	
20/08/21	10070	10079	9	8613	
23/04/21	10079	10088	9	8613	
24/04/21	10088	10097	9	8613	
25/04/21	10097	10105	8	7656	
26/04/21	10105	10135	30	28710	
30/08/21	10135	10143	8	7656	
31/08/21	10143	10149	6	5742	
1/09/21	10149	10156	7	6699	
2/09/21	10156	10163	7	6699	
3/09/21	10163	10170	7	6699	
6/09/21	10170	10180	10	9570	
7/09/21	10180	10190	10	9570	
8/09/21	10190	10213	23	22011	
9/09/21	10213	10225	12	11484	
10/09/21	10225	10231	6	5742	
13/09/21	10231	10241	10	9570	
14/09/21	10241	10251	10	9570	
15/09/21	10251	10257	6	5742	
16/09/21	10257	10267	10	9570	
17/09/21	10267	10277	10	9570	
20/09/21	10277	10287	10	9570	
21/09/21	10287	10297	10	9570	
22/09/21	10297	10308	11	10527	
23/09/21	10308	10318	10	9570	
24/09/21	10318	10328	10	9570	
27/09/21	10328	10338	10	9570	
28/09/21	10338	10348	10	9570	
29/09/21	10348	10358	10	9570	
30/09/21	10358	10368	10	9570	
1/10/21	10368	10379	11	10527	
5/10/21	10379	10390	11	10527	
6/10/21	10390	10398	8	7656	
7/10/21	10398	10408	10	9570	
8/10/21	10408	10418	10	9570	
11/10/21	10418	10428	10	9570	
12/10/21	10428	10435	7	6699	
13/10/21	10435	10443	8	7656	
14/10/21	10443	10453	10	9570	
15/10/21	10453	10463	10	9570	
18/10/21	10463	10473	10	9570	
19/10/21	10473	10479	6	5742	
20/10/21	10479	10490	11	10527	
21/10/21	10490	10500	10	9570	
22/10/21	10500	10510	10	9570	
25/10/21	10510	10520	10	9570	
26/10/21	10520	10529	9	8613	
27/10/21	10529	10536	7	6699	
28/10/21	10536	10546	10	9570	
1/11/21	10546	10569	23	22011	
3/11/21	10569	10579	10	9570	
4/11/21	10579	10583	4	3828	
5/11/21	10583	10593	10	9570	
8/11/21	10593	10603	10	9570	
9/11/21	10603	10613	10	9570	
10/11/21	10613	10623	10	9570	
11/11/21	10623	10633	10	9570	
12/11/21	10633	10643	10	9570	
15/11/21	10643	10653	10	9570	
16/11/21	10653	10661	8	7656	
17/11/21	10661	10666	5	4785	
18/11/21	10666	10673	7	6699	
19/11/21	10673	10688	15	14355	
23/11/21	10688	10697	9	8613	
24/11/21	10697	10707	10	9570	
25/11/21	10707	10719	12	11484	
26/11/21	10719	10729	10	9570	
29/11/21	10729	10738	9	8613	
30/11/21	10738	10748	10	9570	
1/12/21	10748	10758	10	9570	
2/12/21	10758	10776	18	17226	
6/12/21	10776	10787	11	10527	
7/12/21	10787	10797	10	9570	
8/12/21	10797	10808	11	10527	
9/12/21	10808	10829	21	20097	
13/12/21	10829	10839	10	9570	
14/12/21	10839	10851	12	11484	
15/12/21	10851	10862	11	10527	
16/12/21	10862	10870	8	7656	
17/12/21	10870	10880	10	9570	
20/12/21	10880	10893	13	12441	
22/12/21	10893	10913	20	19140	
10/01/22	10913	10923	10	9570	
11/01/22	10923	10933	10	9570	
12/01/22	10933	10941	8	7656	
13/01/22	10941	10951	10	9570	
14/01/22	10951	10960	9	8613	
17/01/22	10960	10969	9	8613	
18/01/22	10969	10978	9	8613	
19/01/22	10978	10987	9	8613	
20/01/22	10987	11046	59	56463	
25/01/22	11046	11053	7	6699	
28/01/22	11053	11062	9	8613	
1/02/22	11062	11079	17	16269	
2/02/22	11079	11082	3	2871	
3/02/22	11082	11089	7	6699	
4/02/22	11089	11098	9	8613	
7/02/22	11098	11108	10	9570	
8/02/22	11108	11117	9	8613	
10/02/22	11117	11126	9	8613	
11/02/22	11126	11134	8	7656	
14/02/22	11134	11144	10	9570	
15/02/22	11144	11153	9	8613	
16/02/22	11153	11163	10	9570	
18/02/22	11163	11171	8	7656	
21/02/22	11171	11180	9	8613	
22/02/22	11180	11184	4	3828	
1/03/22	11184	11200	16	15312	
14/03/22	11200	11217	17	16269	
16/03/22	11217	11248	31	29667	
23/03/22	11248	11257	9	8613	
24/03/22	11257	11320	63	60291	
19/04/22	11320	11328	8	7656	
20/04/22	11328	11337	9	8613	
21/04/22	11337	11347	10	9570	
22/04/22	11347	11357	10	9570	
26/04/22	11357	11366	9	8613	
27/04/22	11366	11375	9	8613	
28/04/22	11375	11384	9	8613	
29/04/22	11384	11425	41	39237	
6/05/22	11425	11491	66	63162	
20/05/22	11491	11499	8	7656	
21/05/22	11499	11510	11	10527	
23/05/22	11510	11524	14	13398	
24/05/22	11524	11534	10	9570	
25/05/22	11534	11542	8	7656	
26/05/22	11542	11559	17	16269	
27/05/22	11559	11574	15	14355	
28/05/22	11574	11579	5	4785	
30/05/22	11579	11599	20	19140	
31/05/22	11599	11604	5	4785	
1/06/22	11604	11616	12	11484	
2/06/22	11616	11628	12	11484	
3/06/22	11628	11640	12	11484	
6/06/22	11640	11652	12	11484	
7/06/22	11652	11665	13	12441	
8/06/22	11665	11688	23	22011	
10/06/22	11688	11701	13	12441	
14/06/22	11701	11714	13	12441	
15/06/22	11714	11725	11	10527	
16/06/22	11725	11736	11	10527	
17/06/22	11736	11748	12	11484	
20/06/22	11748	11761	13	12441	
21/06/22	11761	11774	13	12441	
22/06/22	11774	11798	24	22968	
27/06/22	11786	11811	25	23925	
28/06/22	11798	11824	26	24882	
29/06/22	11811	11824	13	12441	
30/06/22	11824	11840	16	15312	

Note: information provided by PFF in August 2022

TOTAL (m3)	2120712
TOTAL (ML)	2120.712

Table 3-13: Maroota Hitchcock Road & Lot 198- Surface Water Analyses for Creeks (2018 - 2022)
Sites: Lot 198 & Hitchcock Rd

Water Sample ID		Guideline Limits	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Lot 198	Downstream Lot 198	Hitchcock Tailings	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd Crk	Hitchcock Rd	Hitchcock Rd Crk	Hitchcock Rd	Hitchcock Rd- Little Catai Crk
Date	Units		22/3/22	20/12/21	21/9/21	23/6/21	14/12/20	23/9/20	30/6/20	23/3/20	13/12/19	2/9/19	5/12/18	11/4/19	3/9/18	23/9/20	22/3/22	20/12/21	21/9/21	23/6/21	14/12/20	23/9/20	30/6/20	23/3/20	13/12/19	2/9/19	5/12/18	11/4/19	1/9/18
pH		=+/- 1 (BG)	6.37	5.76	6.75	5.75	6.04	5.85	5.91	6.24	5.60	5.86	5.35	6.72	5.7	5.52	6.53	6.85	5.84	5.73	5.6	5.36	5.24	5.54	5.02	5.04	4.4	5.22	4.4
Electrical Conductivity, EC	uS/cm	<1500	107	212	200	205	194	193	182	221	210	224	291	225	201	129	170	139	151	148	187	173	179	225	193	282	236	241	187
Suspended Solids (SS)	mg/L	<50	24	7	<5	<5	<5	<5	NA	NA	NA	18	<5	8	4.5	9	<5	11	<5	<5	<5	<5	NA	NA	NA	9	<5	5	6.5
Turbidity	NTU	<50							NA	6	<5	NA	1.5	10.5	1.5								NA	<5	<5	9	0.3	0.3	1.1
Oil& Grease	mg/L	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.1	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.1
Total Dissolved Solids	mg/L				130			136	124						108	96			114			130	110						95
Major Ions																													
Calcium	mg/L		4			3	2	3	4		3	6				3	3			1	<1	<1	<1		<1	2			
Magnesium	mg/L		2			6	4	4	4		4	4				3	5			4	4	4	5		4	7			
Sodium	mg/L		13			29	25	29	30		30	25				16	21			21	23	26	28		22	33			
Potassium	mg/L		3			2	1	2	2		2	2				3	4			3	2	2	2		<1	2			
Bicarbonate	mg/L		13			2	6	4	8		4	8				2	8			4	2	2	4		2	<1			
Total Alkalinity	mg/L		13			2	6	4	8		4	8				2	8			4	2	2	4		2	<1			
Sulphate	mg/L		16			24	6	14	6		9	16				9	7			4	2	6	4		2	6			
Chloride	mg/L		20			43	46	45	48		53	46				30	40			40	46	45	48		46	68			

Notes:
Water samples collected by Melissa Mass of SE Environmental Pty Ltd
Note 1: Analyses by Boral Laboratory in Sept 2019
Note 2: Analyses by ALS Laboratory in Dec 2018, April /May 2019 to 2021
BG= background. Sample locations shown on Figure 1

Laboratory reports by ALS are provided in separate documentation. Summary results table provided for future reference

No Site Access- June 2022 (too wet)

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Table 3-14: Water Analyses for New Wells at Pits 8 & 13 (November 2020, August 2021 & September 2022)

Site; 4378 Old Northern Rd, Maroota

Maroota New Wells	units		PFPit8MW 6D	PFPit8MW 6D	PFPit8MW 6D	PFPit13MW 7D	PFPit13MW 7D	PFPitMW 8B	PFPitMW 8B	PFPit8MW 8C	PFPit8MW 8C	PFPit8MW 8D	PFPit8MW 8D	Pit 8 Pond	Pit 8 Pond
			Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Tertiary Sands	Tertiary Sands	Tertiary Sands	Tertiary Sands	Tertiary Sands	Tertiary Sands	Stormwater Pond	Stormwater Pond
Date			15/9/2022	17/8/2021	02/11/2020	15/9/2022	17/8/2021	02/11/2020	17/8/2021	02/11/2020	17/8/2021	02/11/2020	17/8/2021	02/11/2020	17/8/2021
pH			5.63	5.39	5.63	4.06	4.09	6.37	4.76	6.13	4.44	6.22	4.82	5.61	5.34
Electrical Conductivity, EC	uS/cm		69	97	118	435	438	78	49	143	100	87	57	47	54
Total Dissolved Solids (ALS)	mg/L		38	61	62	226	254	79	32	216	65	56	49	31	35
Calcium, Ca	mg/L		1	<1	2	<1	1	6	<1	6	<1	3	1	<1	<1
Magnesium, Mg	mg/L		2	4	3	8	8	1	1	3	4	1	1	<1	1
Sodium, Na	mg/L		8	10	12	57	58	7	5	13	12	9	7	6	8
Potassium, K	mg/L		1	2	3	1	1	1	<1	1	1	4	2	1	2
Bicarbonate, HCO3	mgIL		4	<1	3	<1	<1	10	<1	6	<1	4	<1	2	<1
Sulphate, SO4	mg/L		2	<1	4	4	3	6	1	8	<1	12	4	4	6
Chloride, Cl	mg/L		13	19	19	127	126	12	10	23	21	13	11	8	14
Oil& Grease	mg/L		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Note:
Groundwater samples collected by Melissa Mass of SE Environmental Pty Ltd
Samples analysed by ALS Environmental
Note: No access to Pit 8 wells- area flooded

Prepared By: Earth2Water Pty Ltd
CHecked By: DParisotto

APPENDIX A

LIMITATIONS

Earth2Water Pty Ltd has prepared this report for the use of PF Formation Pty Ltd (PFF) in accordance with the standard terms and conditions of the consulting profession. This report is prepared in accordance with a generalised scope of work. The methodology adopted and sources of information used by E2W are outlined in this report. Information for the groundwater and surface water study were also provided by Melissa Mass of SE Environmental Pty Ltd.

This report was prepared from September 2022 to October 2022 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report, and our experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

APPENDIX B-1

Analytical Laboratory Certificates (ALS, 2022) - Groundwater Wells

CHAIN OF CUSTODY DOCUMENTATION- EARTH2WATER PTY LTD

CLIENT: Earth2Water Pty Ltd		LABORATORY BATCH NO.:	ALS Environmental
POSTAL ADDRESS: 175 Fern St, Gerringong NSW		SAMPLERS: Melissa Mass	
SEND REPORT TO: D.Parisotto	SEND INVOICE TO: JOSh Graham	PHONE: 0422 334102 E-MAIL: dino@earth2water.com.au	Smithfield
DATA NEEDED BY: 5 day turnaround	REPORT NEEDED BY: 5 day turnaround (important)	REPORT FORMAT: HARD: Yes FAX:Yes DISK: ☐ BULLETIN BOARD: ☐ E-MAIL: yes	
Site: Maroota	QUOTE NO.:	QC LEVEL: QCS1:☐ QCS2:☐ QCS3 Yes QCS4:☐	
P.O. NO.: E2W-224A	COMMENTS/SPECIAL HANDLING/STORAGE OR DIPOSAL:	ANALYSIS REQUIRED	
INVOICE to: PF Formation Josh Graham josh@pfformation.com.au	Ratain samples for 3 weeks prior to disposal	1 2 3 4	Laboratory Analyses 1 Oil & Grease 1 Ph, EC, TDS, 1 Ca, Mg, Na, K, Cl, HCO3, SO4

	SAMPLE DATA				ALS Containers			
	SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.		
1	PF 167 MW-1	gwater	15.9.22		2 containers		YES	
2	PF 166 MW1	gwater	15.9.22		↓		YES	
3	PF L2 Hicth MW1	gwater	15.9.22		↓		YES	
4	PF P214 MW1	gwater	15.9.22		↓		YES	
5	MW-7D	water	15.9.22		↓		Yes	
6	PF 198 PB3	gwater	"		"		[illegible]	
7	PF 198 PB1	gwater					[illegible]	
8	MW-6D	water	15.9.22		2 containers		Yes	
9	PF167MW-2D	gwater	15.9.22		2 containers		YES	
10	PF167MW-2S	gwater	↓		↓		YES	
11	PF167MW-3D	gwater					YES	
12	PF167MW-4D	gwater					YES	
13	PF167MW-4S	gwater	↓		↓		YES	
14	PF-1	gwater					[illegible]	
15	PF-2	gwater					[illegible]	
16	PF-3	gwater					[illegible]	
17	CWD	swater					[illegible]	
18	Por167 Dam	swater					[illegible]	

Environmental Division
Sydney
Work Order Reference
ES2233335

Telephone : +61-2-8784 8555

Email lab reports & COC to 3 recipients
dino@earth2water.com.au
josh@pfformation.com.au
mmass@southeastenvironmental.com.au

Notes
water sample not filtered

RELINQUISHED BY:		RECEIVED BY	
NAME : Dino Parisotto	DATE:	NAME : [illegible]	DATE: 16/9/22
OF: Earth2Water	TIME:	OF: AC	TIME: 15:00
NAME :	DATE:	NAME :	DATE:
OF:	TIME:	OF:	TIME:

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2233335**	Page	: 1 of 5
Client	: **PF FORMATION**	Laboratory	: Environmental Division Sydney
Contact	: Dino Parisotto	Contact	: Customer Services ES
Address	: 1 Patrica Fay Drive MAROOTA 2756	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 0422 334 102	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 16-Sep-2022 15:00
Order number	: E2W-224A	Date Analysis Commenced	: 19-Sep-2022
C-O-C number	: ----	Issue Date	: 27-Sep-2022 18:06
Sampler	: Melissa Mass		
Site	: Maroota		
Quote number	: EN/333		
No. of samples received	: 11		
No. of samples analysed	: 11		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- EN055: Ionic Balance out of acceptable limits for sample ES2233335-#002 due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	PF 167 MW-1	PF 166 MW1	PF L2 Hitch MW1	PF P214 MW1	MW-7D
			Sampling date / time	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00
Compound	CAS Number	LOR	Unit	ES2233335-001	ES2233335-002	ES2233335-003	ES2233335-004	ES2233335-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.69	4.44	4.09	4.32	4.06
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	73	222	274	197	435
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	48	117	126	86	226
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	4	<1	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L	4	<1	<1	<1	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	16	2	5	1	4
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	9	40	75	45	127
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	1	1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	2	7	3	6	8
Sodium	7440-23-5	1	mg/L	7	22	36	20	57
Potassium	7440-09-7	1	mg/L	3	3	<1	1	1
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	0.67	1.17	2.22	1.29	3.66
ø Total Cations	----	0.01	meq/L	----	----	1.98	----	3.39
ø Total Cations	----	0.01	meq/L	0.60	1.66	----	1.39	----
ø Ionic Balance	----	0.01	%	----	----	----	----	3.86
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW-6D	MW-2D	MW-2S	MW-3D	MW-4D
			Sampling date / time	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00	15-Sep-2022 00:00
Compound	CAS Number	LOR	Unit	ES2233335-006	ES2233335-007	ES2233335-008	ES2233335-009	ES2233335-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.63	5.22	4.57	4.46	5.41
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	69	172	221	87	125
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	38	79	124	61	73
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	4	3	<1	<1	3
Total Alkalinity as CaCO3	----	1	mg/L	4	3	<1	<1	3
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	4	6	3	19
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	13	41	58	18	16
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	1	3	4	<1	3
Magnesium	7439-95-4	1	mg/L	2	4	5	1	5
Sodium	7440-23-5	1	mg/L	8	20	26	10	11
Potassium	7440-09-7	1	mg/L	1	2	2	<1	<1
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	0.49	1.30	1.76	0.57	0.91
ø Total Cations	----	0.01	meq/L	0.59	1.40	1.79	0.52	1.04
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW-4S	----	----	----	----
			Sampling date / time	15-Sep-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2233335-011	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.30**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**126**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**64**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**6**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**6**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**16**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**22**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**4**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**13**	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**1.07**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**1.04**	----	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	----	----	----	----

CHAIN OF CUSTODY DOCUMENTATION- EARTH2WATER PTY LTD

CLIENT: Earth2Water Pty Ltd
POSTAL ADDRESS: 175 Fern St, Gerringong NSW
SEND REPORT TO: D.Parisotto — SEND INVOICE TO: Josh Graham
DATA NEEDED BY: 5 day turnaround — REPORT NEEDED BY: 5 day turnaround (important)
Site: Maroota — QUOTE NO.: E2W
P.O. NO.: E2W-224A — COMMENTS/SPECIAL HANDLING/STORAGE OR DIPOSAL:

INVOICE to:
PF Formation
Josh Graham

josh@pfformation.com.au

Retain samples for 3 weeks prior to disposal

LABORATORY BATCH NO.
SAMPLERS: Melissa Mass
PHONE: 0422 334102 E-MAIL: dino@earth2water.com.au
REPORT FORMAT: HARD: Yes FAX:Yes DISK: ☐ BULLETIN BOARD: ☐ E-MAIL: yes
QC LEVEL: QCS1:☐ QCS2:☐ QCS3 Yes QCS4:☐

ALS Environmental
Smithfield

ANALYSIS REQUIRED

SAMPLE DATA				ALS Containers		1	2	3	4
SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.				
PF Pit8 MW8A	gwater					YES			
PF Pit8 MW8B	gwater					YES			
PF Pit8 MW8C	gwater					YES			
PF Pit8 MW8D	gwater					YES			
PF Pit8 MW8E	gwater					YES			
1 Lot198 PB-1	wate	16.9.22		2 containers		Yes			
~~PFPitMW6s~~	gwater					YES			
~~PFPit8MW6D~~	gwater					YES			
2 Por 167 Dam	wate	16/9/22		2 containers		Yes			
3 CWD ~~Pit 8 dam~~	swater	16/9/22		2 containers		YES			
~~PFPit13MW7D~~	gwater					YES			
4 PF-1	wate	16/9/22		2 containers		Yes			
5 PF-2	|	↓		↓		Yes			
6 PF-3	|	↓		↓		Yes			

Environmental Division
Sydney
Work Order Reference
ES2233397

Telephone : +61-2-8784 8555

Laboratory Analyses

1 **Oil & Grease**
1 **Ph, EC, TDS,**
1 **Ca, Mg, Na, K, Cl, HCO3, SO4**

(2 bottles for gw)

PB-3 hold only

Notes

water sample not filtered

Email lab reports & COC to 3 recipients
dino@earth2water.com.au
josh@pfformation.com.au
mmass@southeastenvironmental.com.au

RELINQUISHED BY:		RECEIVED BY	
NAME: Dino Parisotto	DATE: DP 16/9/22	NAME:	DATE: 16/9/22
OF: Earth2Water	TIME:	OF: AN	TIME: 1750
NAME:	DATE:	NAME:	DATE:
OF:	TIME:	OF:	TIME:

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2233397**	Page	: 1 of 4
Client	: **EARTH2WATER PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR DINO PARISOTTO	Contact	: Customer Services ES
Address	: 175 FERN ST GERRINGONG NSW 2534	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 16-Sep-2022 17:50
Order number	: E2W-224A	Date Analysis Commenced	: 16-Sep-2022
C-O-C number	: ----	Issue Date	: 23-Sep-2022 18:56
Sampler	: M MASS		
Site	: Maroota		
Quote number	: SYBQ/408/21		
No. of samples received	: 7		
No. of samples analysed	: 6		

Accreditation No. 825
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ISO/IEC 17025 - Testing

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This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- TDS by method EA-015 may bias high for sample 5 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- EN055: Ionic Balance out of acceptable limits for sample ES2233397-#005 due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Lot 198 PB-1	Por 167 Dam	CWD	PF-1	PF-2
			Sampling date / time	16-Sep-2022 00:00	16-Sep-2022 00:00	16-Sep-2022 00:00	16-Sep-2022 00:00	16-Sep-2022 00:00
Compound	CAS Number	LOR	Unit	ES2233397-001	ES2233397-002	ES2233397-003	ES2233397-004	ES2233397-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.17	6.31	5.09	3.87	7.47
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	157	103	159	130	198
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	94	68	90	99	50
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	8	<1	<1	68
Total Alkalinity as CaCO3	----	1	mg/L	1	8	<1	<1	68
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	16	30	14	5
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	35	14	24	21	14
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	2	8	7	2	<1
Magnesium	7439-95-4	1	mg/L	3	1	2	2	<1
Sodium	7440-23-5	1	mg/L	20	9	16	9	8
Potassium	7440-09-7	1	mg/L	2	2	4	<1	3
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	1.19	0.89	1.30	0.88	1.86
ø Total Cations	----	0.01	meq/L	1.27	0.92	1.31	0.66	0.42
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	PF-3	----	----	----	----
			Sampling date / time	16-Sep-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2233397-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**4.47**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**226**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**107**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**64**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**3**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**29**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**1**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**1.89**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**1.58**	----	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	----	----	----	----

APPENDIX B-2

Creek Monitoring Results
SEE & Laboratory Reports (21 September 2021, 20 December 2021, 22 March 2022)

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Hitchcocks Road

Time of collection (date/time)	21/09/2021 2.00pm	**Weather conditions** (hot/cold/dry/windy/raining)	Cool, calm, Slightly cloudy
Stream bank (rocky/sandy/muddy)	Peat/Sand/Soil	**Climate 3mths preceeding** (rainfall/drought/extremes)	Near normal
Water flow rate (fast/slow/none)	Moderate	**Stream depth** (mm, cm or m)	1cm - 40cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	40cm - 2m
Stream condition (erosion, polutants)	Vegetated/mossy	**Other observations**	

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	6.27	0.17mS	90ppm	12.9

Site photo

Sample collected by - Melissa Mass/South East Environmental
Signed *Melissa Mass*

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Lot 198

Time of collection (date/time)	21/09/2021 10.00am	**Weather conditions** (hot/cold/dry/windy/raining)	Cool, calm, clear
Stream bank (rocky/sandy/muddy)	Sandy	**Climate 3mths preceeding** (rainfall/drought/extremes)	Near normal
Water flow rate (fast/slow/none)	Slow	**Stream depth** (mm, cm or m)	20cm-40cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	1m - 3m
Stream condition (erosion, polutants)	Vegetated on banks	**Other observations**	Frogs calling

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	5.54	0.20mS	100ppm	12.6

Site photo

Sample collected by - Melissa Mass/South East Environmental
Signed *Melissa Mass*

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2134082**	Page	: 1 of 3
Client	: **PF FORMATION**	Laboratory	: Environmental Division Sydney
Contact	: Josh Graham	Contact	: Customer Services ES
Address	: 1 Patrica Fay Drive Maroota 2756	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 21-Sep-2021 16:00
Order number	: ----	Date Analysis Commenced	: 22-Sep-2021
C-O-C number	: ----	Issue Date	: 27-Sep-2021 13:18
Sampler	: Melissa Mass		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 5		
No. of samples analysed	: 5		

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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- TDS by method EA-015 may bias high for sample 3 and 4 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**Lot 198**	**Pit 4**	**Hitchcock Rd**	**Dam 1**	**Dam 2**
			Sampling date / time	21-Sep-2021 10:00	21-Sep-2021 11:55	21-Sep-2021 14:05	21-Sep-2021 13:00	21-Sep-2021 13:05
Compound	*CAS Number*	*LOR*	*Unit*	**ES2134082-001**	**ES2134082-002**	**ES2134082-003**	**ES2134082-004**	**ES2134082-005**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.75**	**6.73**	**5.84**	**5.39**	**6.77**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**200**	**259**	**151**	**88**	**260**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**130**	**162**	**114**	**79**	**174**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	**14**	**34**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**----**	**----**	**----**	**0.02**	**0.79**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**----**	**----**	**----**	**0.2**	**4.4**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**----**	**----**	**----**	**0.2**	**5.2**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**----**	**----**	**----**	**0.03**	**0.99**
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	<5	<5	<5

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Hitchcock Road

Time of collection (date/time)	20/12/2021 10.20am	**Weather conditions** (hot/cold/dry/windy/raining)	Warm, partly cloudy, still
Stream bank (rocky/sandy/muddy)	Sand	**Climate 3mths preceeding** (rainfall/drought/extremes)	Average rain
Water flow rate (fast/slow/none)	Moderate	**Stream depth** (mm, cm or m)	1cm - 30cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	0.3 - 1.5m
Stream condition (erosion, polutants)	Vegetated, moss	**Other observations**	

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	7.51	0.12mS	60ppm	19.2

Site photo

Unable to upload photo file

Sample collected by -
Melissa Mass/South East Environmental
Signed *Melissa Mass*

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Lot 198

Time of collection (date/time)	20/12/2021 8am	**Weather conditions** (hot/cold/dry/windy/raining)	Warm, partly cloudy, still
Stream bank (rocky/sandy/muddy)	Sand	**Climate 3mths preceeding** (rainfall/drought/extremes)	Average rain
Water flow rate (fast/slow/none)	Slow	**Stream depth** (mm, cm or m)	10cm - 30cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	0.8-1.5m
Stream condition (erosion, polutants)	Vegetated	**Other observations**	

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	6.42	0.15mS	80ppm	18.7

Site photo

Sample collected by -
Melissa Mass/South East Environmental
Signed *Melissa Mass*

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2146658**	Page	: 1 of 4
Client	: **EARTH2WATER PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR DINO PARISOTTO	Contact	: Customer Services ES
Address	: 175 FERN ST GERRINGONG NSW 2534	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 21-Dec-2021 09:50
Order number	: ----	Date Analysis Commenced	: 21-Dec-2021
C-O-C number	: ----	Issue Date	: 31-Dec-2021 13:17
Sampler	: Melissa Mass		
Site	: ----		
Quote number	: SYBQ/408/21		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
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- Analytical Results

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

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Where moisture determination has been performed, results are reported on a dry weight basis.

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When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	Lot 198	Pit 5	Pit 4	Hitchcock Road	Maroota Lodge Dam 1
				Sampling date / time	20-Dec-2021 08:00	20-Dec-2021 08:30	20-Dec-2021 09:00	20-Dec-2021 10:20	20-Dec-2021 09:40
Compound	CAS Number	LOR	Unit		ES2146658-001	ES2146658-002	ES2146658-003	ES2146658-004	ES2146658-005
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		5.76	6.70	6.60	6.85	6.72
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		212	100	260	139	64
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		7	18	7	11	15
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		----	----	----	----	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		----	----	----	----	0.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		----	----	----	----	0.6
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		----	----	----	----	0.06
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	Maroota Lodge Dam 2	----	----	----	----
				Sampling date / time	20-Dec-2021 09:45	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2146658-006	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.19**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**249**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**8**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.2**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.59**	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Hitchcocks Road

Time of collection (date/time)	22/03/2022 12.25pm	**Weather conditions** (hot/cold/dry/windy/raining)	Humid/sunny/calm
Stream bank (rocky/sandy/muddy)	Sand/Peat	**Climate 3mths preceeding** (rainfall/drought/extremes)	Rainfall - <300mm during March
Water flow rate (fast/slow/none)	Fast	**Stream depth** (mm, cm or m)	3cm - 40cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	0.8m-2m
Stream condition (erosion, polutants)	Vegetated/mossy	**Other observations**	

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	6.7	0.13mS	70ppm	20.3

Site photo

Sample collected by - Melissa Mass/South East Environmental

Signed *Melissa Mass*

Surface Water Monitoring

PF Formation - Maroota Quarries

1 Patricia Fay Drive Ph 45668314
Maroota NSW 2756

Location - Lot 198

Time of collection (date/time)	22/03/2022 8.20am	**Weather conditions** (hot/cold/dry/windy/raining)	Clear/cool/calm
Stream bank (rocky/sandy/muddy)	Rock/sand	**Climate 3mths preceeding** (rainfall/drought/extremes)	Rainfall - <300mm during March
Water flow rate (fast/slow/none)	Fast	**Stream depth** (mm, cm or m)	3cm-30cm
Water clarity (turbidity, sheen)	Clear	**Stream width** (mm, cm or m)	3m
Stream condition (erosion, polutants)	Vegetated on banks	**Other observations**	Recent localised flooding has gouged the creek bed

Field tests	**pH**	**EC**	**TDS**	**Temp C°**
	6.34	0.07mS	40ppm	20.3

Site photo

Sample collected by - Melissa Mass/South East Environmental

Signed *Melissa Mass*

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2210025**	Page	: 1 of 5
Client	: **PF FORMATION**	Laboratory	: Environmental Division Sydney
Contact	: Josh Graham	Contact	: Customer Services ES
Address	: 1 Patrica Fay Drive MAROOTA 2756	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 22-Mar-2022 14:30
Order number	: ----	Date Analysis Commenced	: 23-Mar-2022
C-O-C number	: ----	Issue Date	: 29-Mar-2022 13:39
Sampler	: Melissa Mass		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Lot 198	Pit 5	Pit 5 Received as Pit 4	Hitchcock Rd	Maroota Lodge Dam 1
			Sampling date / time	22-Mar-2022 08:20	22-Mar-2022 09:20	22-Mar-2022 09:55	22-Mar-2022 12:25	22-Mar-2022 11:20
Compound	CAS Number	LOR	Unit	ES2210025-001	ES2210025-002	ES2210025-003	ES2210025-004	ES2210025-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.37	6.52	6.86	6.53	6.95
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	107	63	82	170	172
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	24	33	214	<5	6
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	13	12	19	8	39
Total Alkalinity as CaCO3	----	1	mg/L	13	12	19	8	39
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	16	5	10	7	37
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	20	12	11	40	11
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	2	4	3	19
Magnesium	7439-95-4	1	mg/L	2	1	2	5	4
Sodium	7440-23-5	1	mg/L	13	8	8	21	12
Potassium	7440-09-7	1	mg/L	3	3	3	4	3
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	----	----	----	----	0.03
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	----	----	----	----	0.5
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	----	----	----	----	0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	----	----	----	----	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	1.16	0.68	0.90	1.43	1.86
ø Total Cations	----	0.01	meq/L	1.01	0.61	0.79	1.58	1.88
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	Maroota Lodge Dam 2	----	----	----	----
				Sampling date / time	22-Mar-2022 11:30	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2210025-006	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.15	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		184	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		19	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		49	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		49	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		31	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		13	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		19	----	----	----	----
Magnesium	7439-95-4	1	mg/L		4	----	----	----	----
Sodium	7440-23-5	1	mg/L		10	----	----	----	----
Potassium	7440-09-7	1	mg/L		8	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		0.75	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.6	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		3.4	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.91	----	----	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		1.99	----	----	----	----
ø Total Cations	----	0.01	meq/L		1.92	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

APPENDIX C

Previous Bore Hydrographs (URS, 2013)

URS

P.F.FORMATION
Bore PF167MW1 Groundwater Monitoring Data

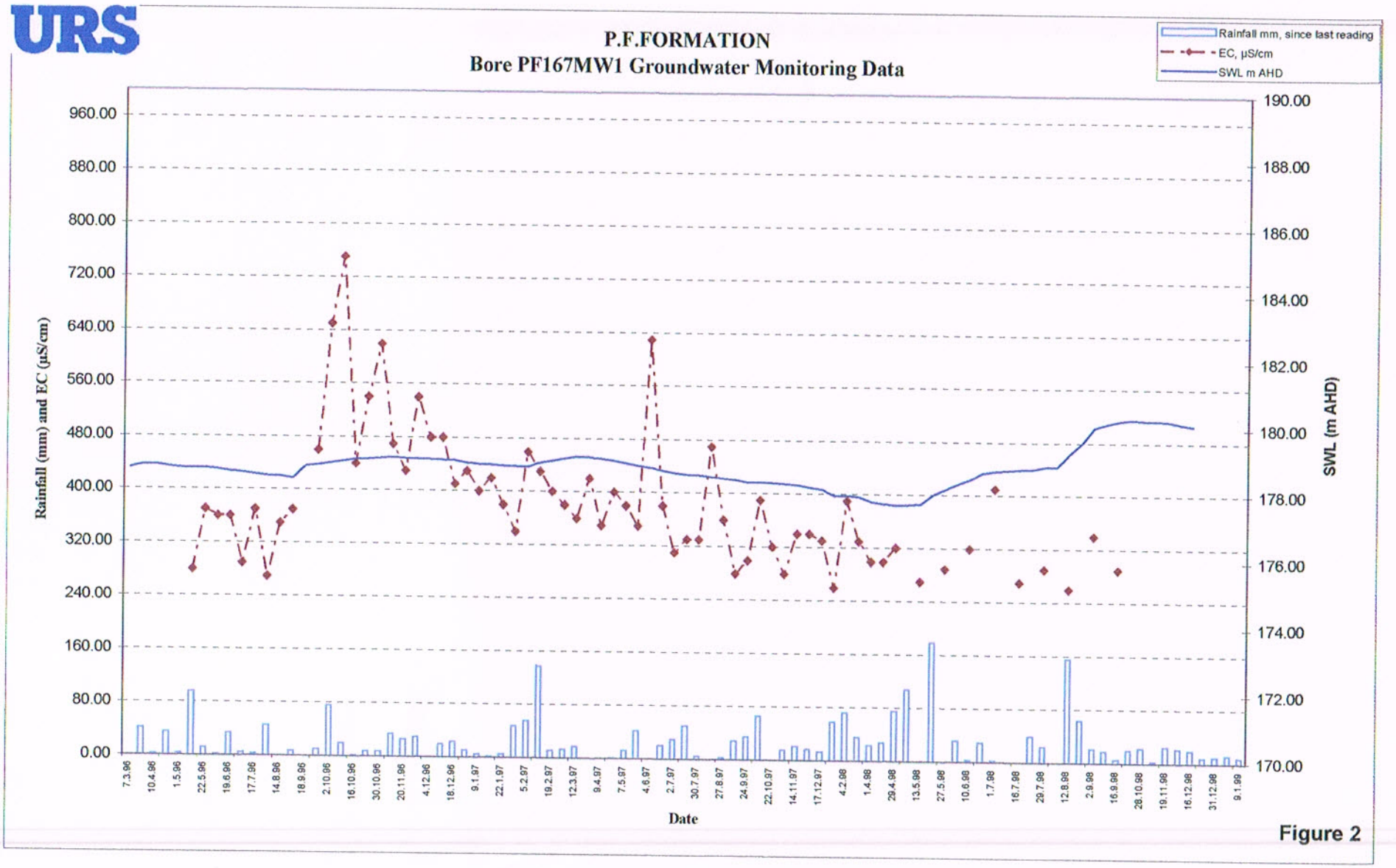


Figure 2

URS

PF FORMATION
Bore PF167MW1 Groundwater Monitoring Data

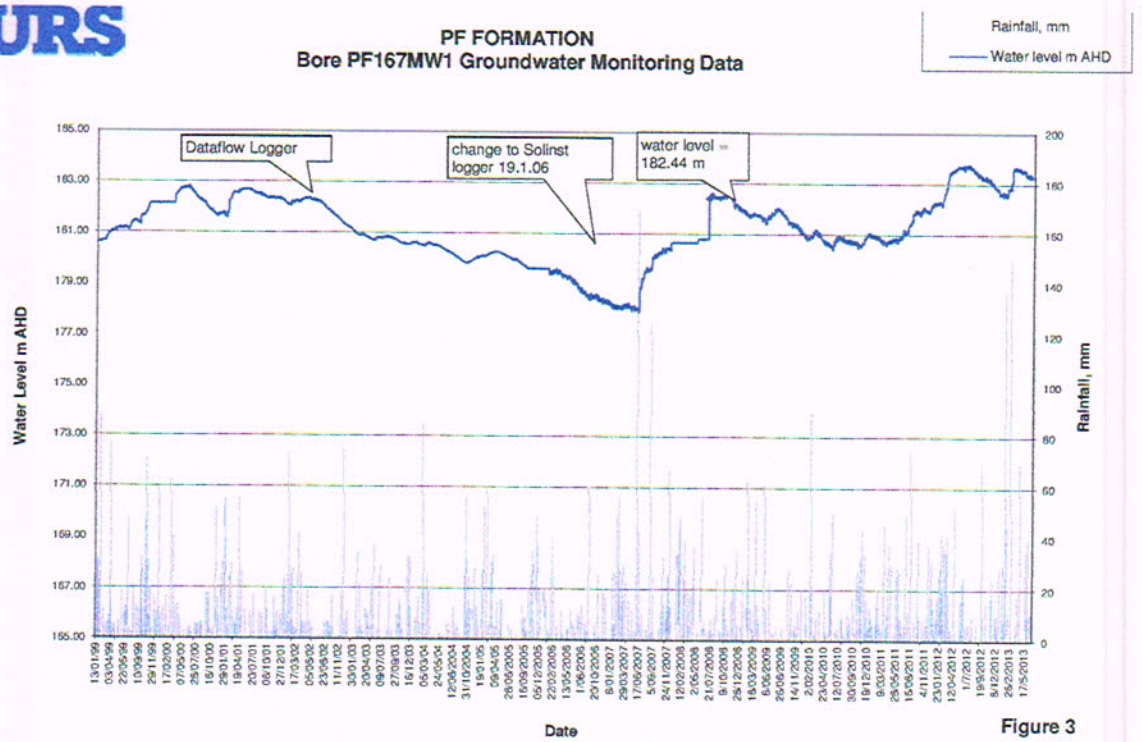


Figure 3

URS

PF FORMATION
PF166MW1 Groundwater Monitoring Data

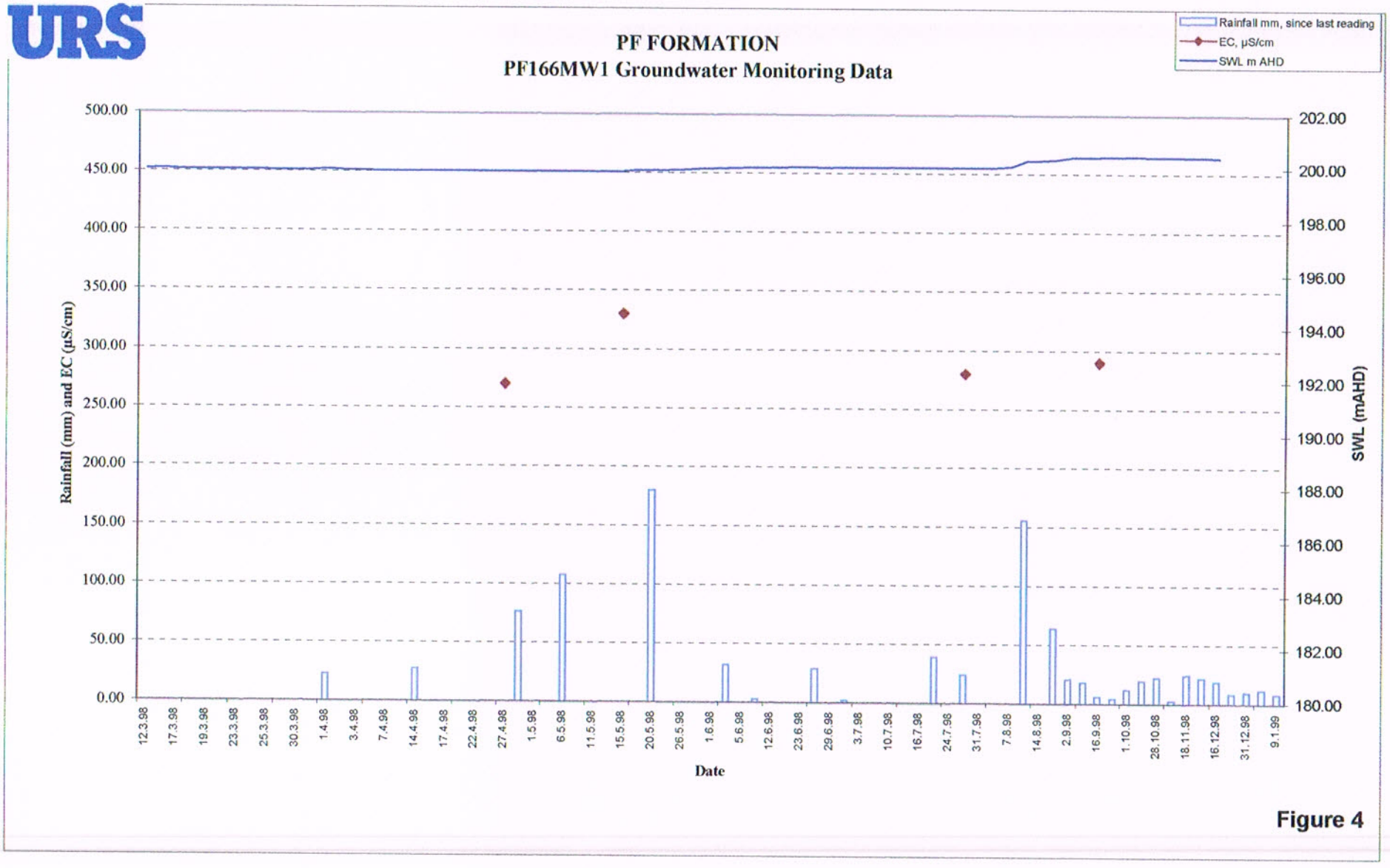


Figure 4

URS

PF FORMATION
Bore PF166MW1 Groundwater Monitoring Data

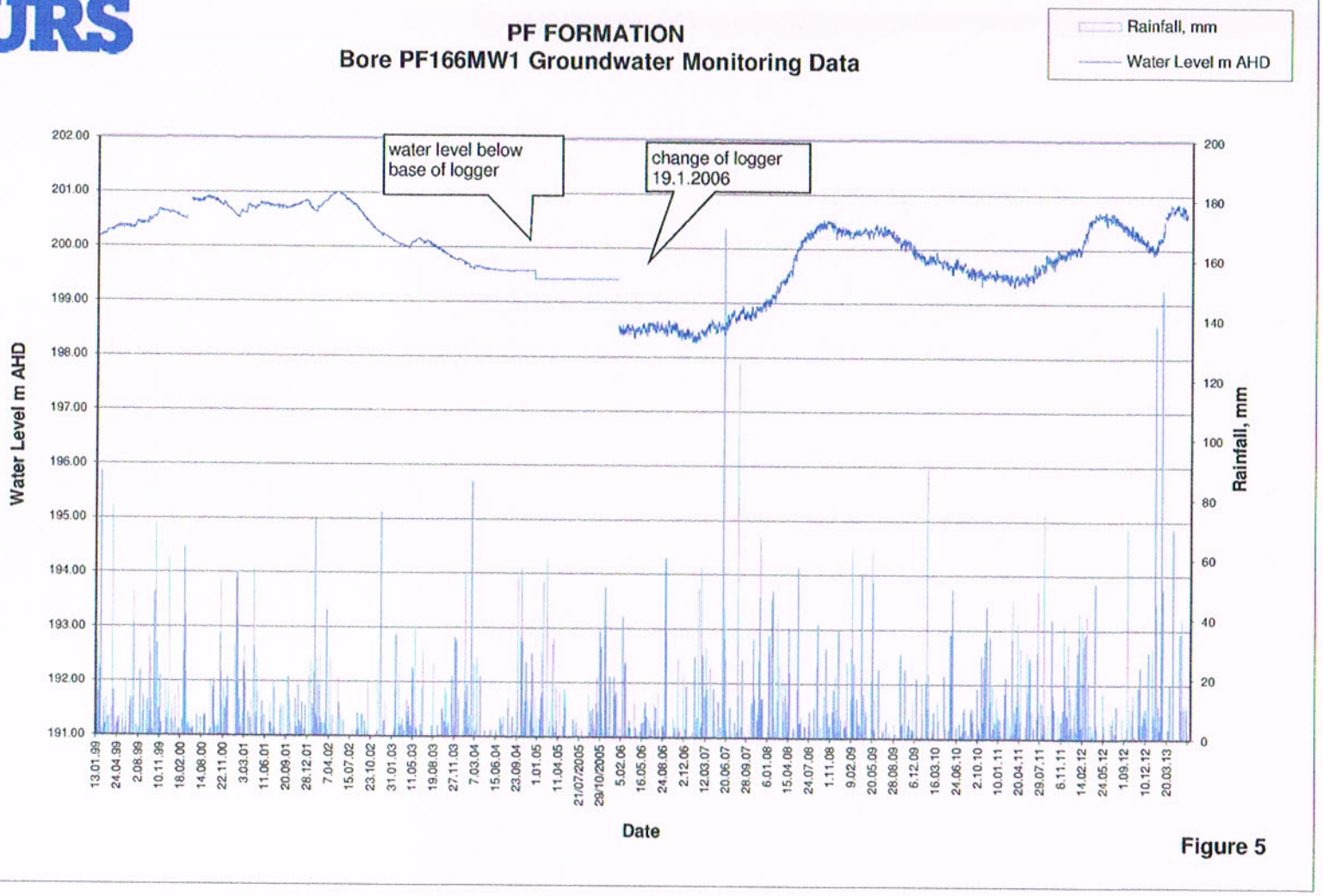


Figure 5

URS

PF FORMATION
Bore PFP214MW1 Groundwater Monitoring Data

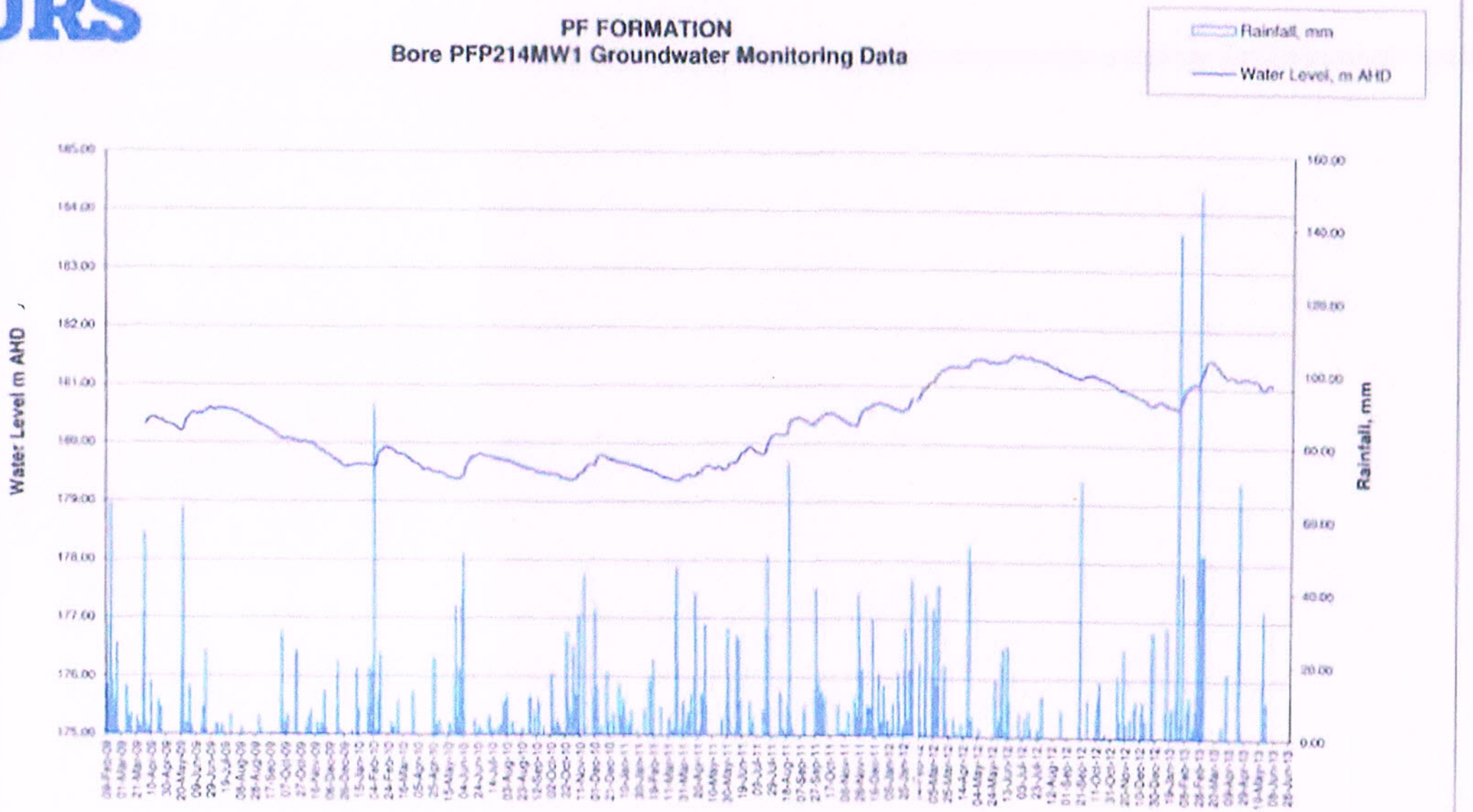


Figure 6

URS

PF FORMATION
Bore PFL2HitchMW1 Groundwater Monitoring Data

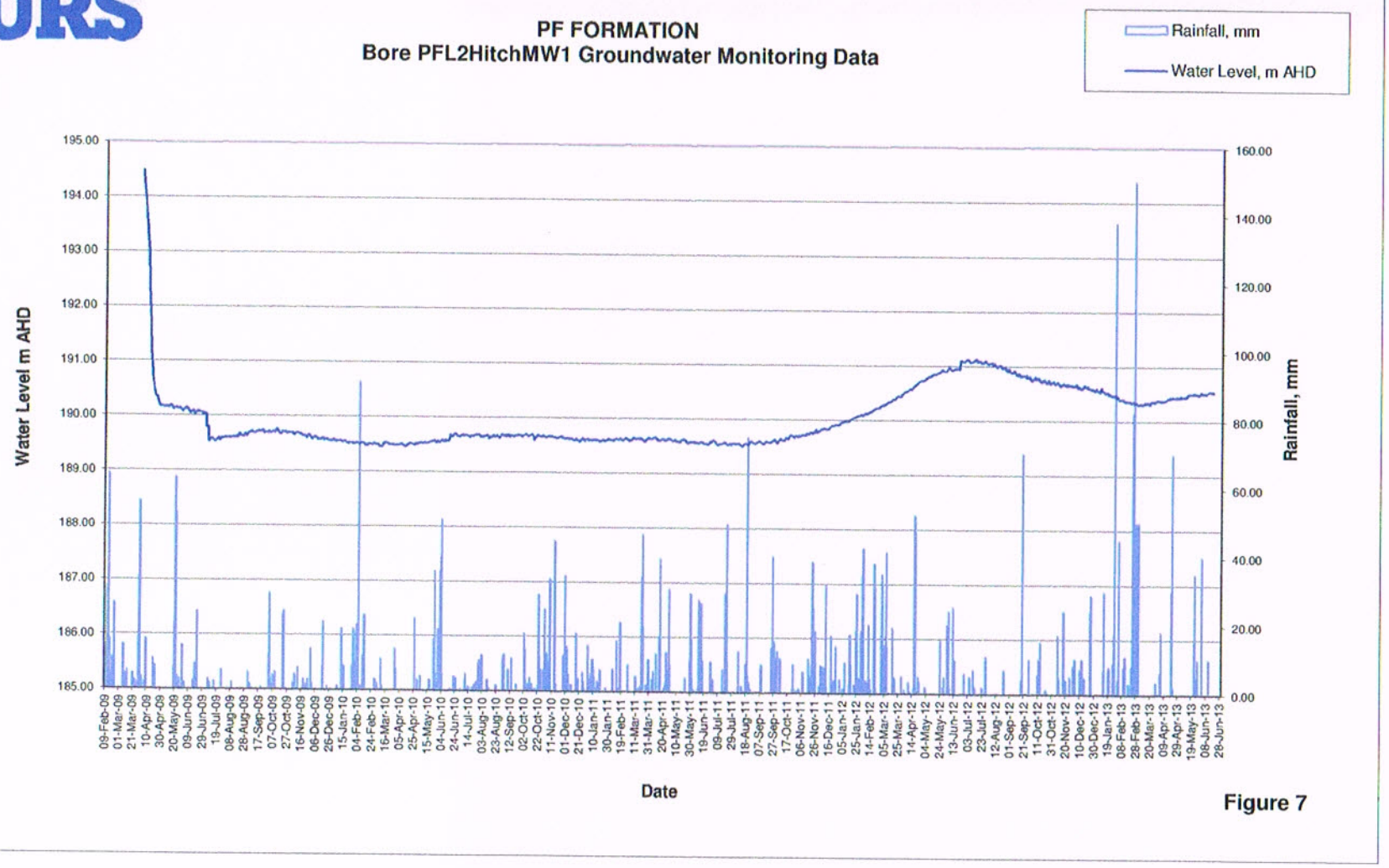


Figure 7

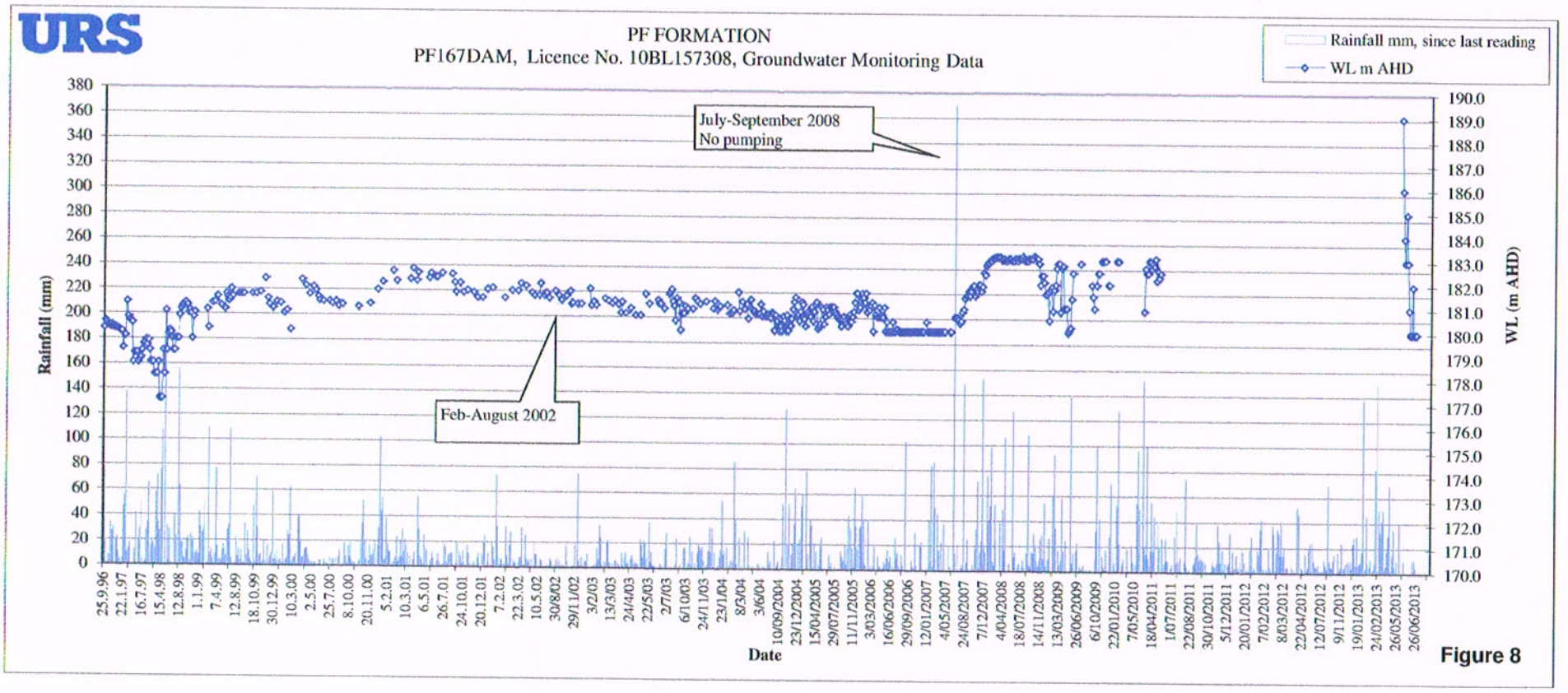

URS
PF FORMATION
PF167DAM, Licence No. 10BL157308, Groundwater Monitoring Data
Rainfall mm, since last reading
WL m AHD
July-September 2008
No pumping
Feb-August 2002
Rainfall (mm)
WL (m AHD)
Date

Figure 8

URS

PF FORMATION
PF167DAM Monthly Pumpage Records

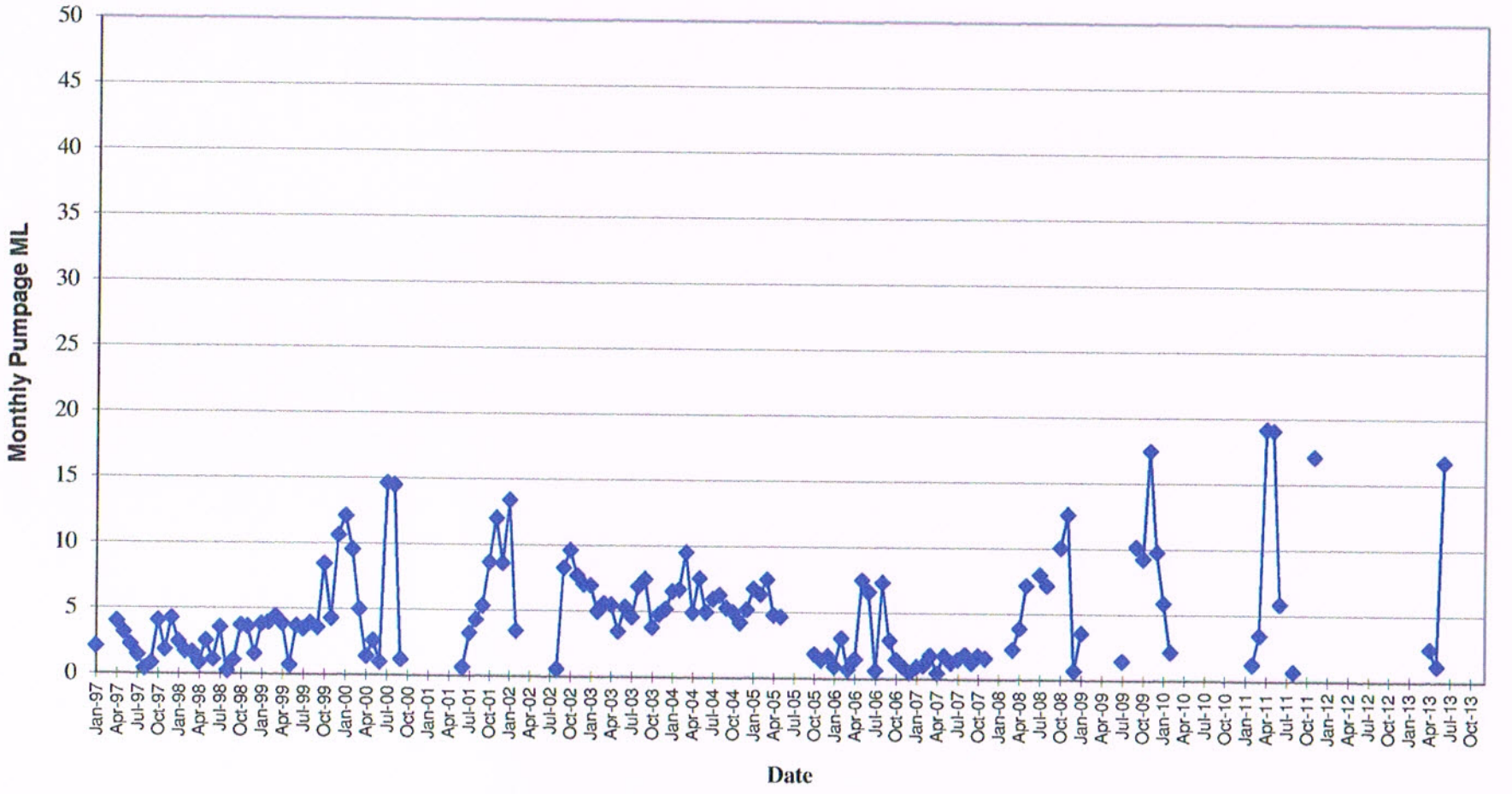


Figure 9

APPENDIX D

Monthly Water Level Monitoring (2017 to 2022 @ SEE Pty Ltd)
Hitchcock Road Wells @Table F1-SWL, New Wells at Pits 8 & 13 @ Table F-2,
and Existing wells PF-1,2,3 @ Table F-3.

Table F1-SWL: Summary of Monthly Bore Water Monitoring (2017 - 2022)
Hitchcock Road & Lot 198

Date	PF166MW -2D	PF166MW -2S	PF166MW -3D	PF166MW 4D	PF166MW - 4s	PF166MW1	PF167MW1	PF214MW1	PFL2Hitch MW-1	PF167MW-5D
7/06/2017	182.05	205.4	184.53	185.93	185.83					179.78
9/06/2017						199.55	183.12	179.41	189.6	
17/07/2017	181.99	205.48	184.56	186.055	185.925	200.34	1/07/1900	179.875	189.765	180.06
27/07/2017	181.92	205.375	185.275	185.945	185.86	200.2			189.73	180.07
15/08/2017	182.02	205.23	184.72	185.94	185.795	199.94	183.26	180.14	189.87	180.02
7/09/2017	181.99	205	184.57	185.78	185.74	199.71	183.04	180.13	189.85	179.885
23/10/2017	181.98	204.71	184.42	185.615	185.665	199.56	182.83	180.114	189.765	179.83
24/11/2017	181.97	204.53	184.34	185.51	185.63	199.44	182.68	180.1	189.705	179.75
18/12/2017	182.01	204.41	184.25	185.43	185.61	199.32	182.54	179.99		179.04
19/01/2018	181.94	204.25	184.41	185.31	185.59	199.18	182.37	179.93	189.64	179.54
13/02/2018	181.93	204.14	184.13	185.22	185.55	199.07	182.23	179.81	189.6	
12/03/2018	181.82	204.18	184.1	185.05	185.51	199	182.06	179.92	189.53	
9/04/2018	181.81	204.07	184.03	184.86	185.46	dry	181.86	179.95	189.49	
8/05/2018	181.71	203.77	184.04	184.77	185.37		181.64	179.72	189.43	
12/06/2018	181.72	203.55	183.78	184.67	185.28		181.34	179.7	189.46	
10/07/2018	181.51	203.47	183.5	184.57	185.1		181.2	179.53	189.28	
7/08/2018	181.61	203.32	183.39	184.61	185.12		181.1	179.54	189.34	
13/09/2018	181.48	203.21	183.03	184.45	185.01		180.93	178.41	190.07	
11/10/2018	181.32	203.44	182.8	184.36	184.92		180.71	179.32	190.01	
7/11/2018	181.42	203.84	183.03	184.56	184.97		180.77	179.68	190.1	
11/12/2018	181.21	203.61	182.77	184.49	185.02		180.78	179.53	189.98	
17/01/2019	181.18	203.64	182.68	184.5	184.99		180.8	179.69	190	
14/02/2019	181.06	203.5	182.47	184.45	184.94		180.75	178.06	189.9	
7/03/2019	180.99	203.36	182.41	184.43	184.93		180.66	178.3	189.89	
11/04/2019	180.92	203.75	182.26	184.46	184.92		180.53	178.73	189.9	
14/05/2019	180.88	203.42	182.26	184.48	184.93		180.45	178.69	189.88	
19/06/2019	180.9	203.2	182.17	184.44	184.92		180.32	178.76	189.89	
18/07/2019	180.92	203.16	182.09	184.4	184.91		180.24	179.04	189.91	
21/08/2019	180.89	203.08	181.97	184.32	184.87		180.12	178.85	189.92	
27/09/2019	180.85	203.9	181.91	184.4	184.87		180.25	179.67	189.82	
21/10/2019	180.73	203.69	181.93	184.56	184.91		180.33	179.64	189.95	
14/11/2019	180.81	203.5	182.05	184.52	185.04		180.26	179.8	189.91	
13/12/2019	180.76	203.37	181.96	184.47	185.02		180.15	180.06	189.89	
14/01/2020	180.71	203.23	181.8	184.41	184.94		180.05	179.28	189.87	
20/02/2020	180.71	205.14		184.62	184.95		180.19	180.06	189.87	
23/03/2020	180.52	204.5		185	185.92	199.19	181.01	180.62	189.87	
15/04/2020	180.64	204.46		185.15	185.93	199.04	181.26	180.77	189.96	
20/05/2020	180.64	204.05		185.1	185.79	199.15	181.37	180.7	190.03	
23/06/2020	180.68	203.89	182.97	184.94	185.7	199.2	181.37	180.42	190.01	
24/07/2020	180.57	203.8	182.88	185.17	184.98	199.2	181.39	180.41	189.93	
28/08/2020	180.58	204.41	183.03	185.16	185.74	199.33	181.95	179.72	189.95	
23/09/2020	180.67	204.17	183.42	185.23	185.83	199.44	182.08	180.76	190.04	
22/10/2020	180.63	204	183.35	185.09	185.72	199.47	182.02	180.45	190.04	
23/11/2020	180.68	204.32	183.45	185.22	185.73	199.51	182.29	180.71	190.07	
14/12/2020	180.58	204.12	183.32	185.13	185.74	199.65	182.28	180.53	190.02	
25/01/2021	180.68	204.28	183.58	185.43	185.97		182.57	180.76	190.04	
15/02/2021	180.6	204.18	183.51	185.4	185.73	199.55	182.57	180.62	189.95	
29/03/2021	180.62	205.84	183.64	186.19	186.04	199.82	183.65	181.07	189.96	
26/04/2021	180.61	205.01	184.21	186.56	186.51	199.83	183.92	181.1	190.04	
26/05/2021	180.69	204.92		186.46	186.38	199.88	183.96	181.19	190.25	
23/062021	180.69	204.92	183.95	186.32	186.25	199.89	183.75	180.96	190.24	
22/07/2021	180.76	204.62	184.52	186.05	185.97	199.9	183.55	180.93	190.28	
17/08/2021	180.75	204.5	184.42	185.87	185.81	199.85	183.38	180.8	190.24	
21/09/2021	180.8	204.58	184.34	185.69	185.71	199.81	183.24	180.69	190.22	
19/10/2021	180.82	204.52	184.28	185.61	185.69	199.78	183.14	180.5	190.18	
24/11/2021	180.84	204.74				199.88	183.04	180.45	190.18	
20/12/2021	180.88	205.18	184.19	185.56	185.66	199.68	183.27	180.73	190.11	
20/01/2022	180.8	205.06	184.2			199.65	183.2	180.56	190.04	
15/02/2022	180.86	205.19	184.26	185.56	185.81	199.67	183.08		190.01	
22/03/2022	180.99	206.69	185.19	188.21	188.33	200.7	185.48	181.26	190.12	
19/04/2022	181.02	206.71				201.1	185.6		190.64	
30/05/2022						201.2	185.16		191.45	
24/06/2022	181.21	206.27	186.85	188.49	188.47	201.12	184.85		191.49	
22/07/2022						201.56	185.85		191.7	

Note: no data= area not accessible due to flooding
SWLs measured by M.Mass of SE Environmental

Prepated By: Earth2Water Pty Ltd
Checked By: DP

Table F1: Summary of Monthly Borewater Monitoring (2017-2022)
Hitchcock Road & Lot 198

Concrete Plant

Date	PB-3 SWL (m,toc)	PB-2 SWL (mtoc)	PB-1 SWL (mtoc)
7/06/2017		18.6	18.6
19/07/2017		15.17	18.5
11/08/2017		14.42	18.51
23/10/2017		42.66	18.805
24/11/2017			18.705
19/01/2018			18.7
13/02/2018			34.76
12/03/2018			31.82
9/04/2018			30.02
8/05/2018			28.17
12/06/2018			27.16
10/07/2018			26.9
7/08/2018			26.29
14/09/2018			26.27
11/10/2018			20.19
7/11/2018			19.83
11/12/2018			19.8
17/01/2019			19.76
14/02/2019			19.89
7/03/2019			20.03
11/04/2019			20.09
14/05/2019			20.45
19/06/2019			20.98
18/07/2019			22.09
21/08/2019			22.22
25/09/2019			22.36
17/10/2019	36.1		23.02
23/10/2019	35.39		
14/11/2019	26.67		22.9
13/12/2019	53.74		25.69
14/01/2020	51.6		25.33
20/02/2020	53.9		24.51
23/03/2020	55.62		23.83
15/04/2020	49.6		23.3
20/05/2020	49.5		22.85
23/06/2020	54.62		21.95
24/07/2020	50.04		21.76
28/08/2020	52.57		21.15
23/09/2020	45.4		20.6
22/10/2020	42.13		20.38
23/11/2020	23.03		19.7
14/12/2020	32.34		19.78
25/01/2021	31.32		19.48
15/02/2021	31.29		19.53
29/03/2021	30.7		19.16
26/04/2021	30.35		18.98
26/05/2021	29.73		18.72
23/06/2021	29.3		18.65
22/07/2021	28.76		18.55
17/08/2021	28.57		18.47
21/09/2021	28.26		18.41
19/10/2021	28.14		18.47
24/11/2021	28.14		18.51
20/12/2021	27.84		18.26
20/01/2022	27.83		18.38
15/02/2022	27.6		18.13
22/03/2022	26.89		17.42
19/04/2022	26.29		16.87
30/05/2022	25.53		16.17
24/06/2022	25.25		16.18
22/07/2022	24.79		15.88

Notes:
Monitoring conducted by Melissa Mass (SEE Pty Ltd) for PF Formation
using an acoustic water level probe

Table F2: Summary of Monthly Borewater Monitoring (2017-2022)
Pits 8 & 13: 4378 Old Northern Road Maroota

Date	Pit8MW8A (SWL mAHD)	Pit8MW-8B (SWL mAHD)	Pit8MW-8C (SWL mAHD)	Pit8MW-8D (SWL mAHD)	Pit8MW-8E (SWL mAHD)	Pit8MW-8F (SWL mAHD)	Pit8MW-8G (SWL mAHD)	Pit13 MW-7D (SWL mAHD)	Pit13 MW-6D (SWL mAHD)
3/08/2020	189.23	186.1	186.715	189.715	189.85				
7/09/2020	189.24	185.94	186.61	189.555	189.64				
8/09/2020	189.23	185.91	186.6	189.52	189.6			188.78	
11/09/2020	189.24	185.835	186.53	189.39	189.46				182.3
18/09/2020	189.09	185.66	186.41	189.125	189.19				182.32
9/10/2020		185.27	186.12	188.405	188.755			188.55	182.41
2/11/2020		184.93	186.48	188.545					182.26
23/11/2020	188.9	185.31	186.45	188.715	188.75			188.66	182.53
14/12/2020	189.02	185.15	186.14	188.265	188.71			188.52	182.43
25/01/2021	188.99	185.44	186.34	188.875	188.91			188.66	182.61
15/02/2021	189.07	185.29	186.13	188.295				188.59	182.53
29/03/2021								188.86	183.15
26/04/2021								188.97	184.22
26/05/2021	189.02	188.29	188.58	190.615	190.7			189.07	184.43
23/06/2021	189.03	187.52	187.86	189.315	189.35			188.99	184.34
22/07/2021	188.99	187.06	187.46	188.445	188.59			189.05	184.42
17/08/2021	188.99	186.7	187.17	187.875	188.59			188.94	184.13
21/09/2021	188.99	186.46	186.91	188.045				189.02	183.99
19/10/2021	189	186.21	186.68	187.495		186.39		188.98	183.83
24/11/2021								188.97	183.64
20/12/2021	189.01	186.92	187.72	190.635	188.59	186.6	188.01	190.21	183.78
20/01/2022	189	187.15	187.53	190.405	188.59	186.81	188.00	189.2	183.79
15/02/2022	190.05	186.89		189.755	188.59	186.72		189.21	183.8
22/03/2022								189.79	186.33
19/04/2022								189.98	187.11
30/05/2022								190.19	187.39
24/06/2022								190.04	187.15
22/07/2022								190.26	188.12

Note: no data= area not accessible due to flooding at Pit 8 due to high rainfall
SWLs measured by M.Mass of SE Environmental using an acoustic water level probe

Prepared By: Earth2Water Pty Ltd
Checked By: DP

Table F3: Summary of Monthly Borewater Monitoring (2017-2022)

4378 Old Northern Road Maroota

Date	PF-1 SWL (mAHD)	PF-2 SWL (mAHD)	PF-3 SWL (mAHD)
11/12/2018	189.58	193.7	184
17/01/2019	189.61	193.76	184.01
14/02/2019	189.53	193.69	184.05
7/03/2019	189.53	193.68	184
11/04/2019	189.56	193.59	184
14/05/2019	189.55	193.63	184
19/06/2019	189.55	193.69	184
18/07/2019	189.56	193.68	184
21/08/2019	189.48	193.6	184
25/09/2019	189.5	193.44	184
17/10/2019	189.63	193.67	184
14/11/2019	189.52	193.66	184
13/12/2019	189.48	193.67	184
14/01/2020	189.42	193.56	184
20/02/2020	189.64	193.56	184.6
23/03/2020	189.73	193.82	184
15/04/2020	189.78	194.23	184
20/05/2020	189.84	194.7	184
23/06/2020	189.84	194.95	184
24/07/2020	189.76	194.82	184
28/08/2020	189.84	195.17	184.02
23/09/2020	189.91	195.46	184.05
22/10/2020	189.85		184.32
23/11/2020	189.91	195.47	184.39
14/12/2020	189.83	195.49	184.31
25/01/2021	189.94	195.76	184.28
15/02/2021	189.88	195.68	184.31
29/03/2021	190.02	195.82	185.72
26/04/2021	190.03	196.08	185.75
26/05/2021	190.13	196.16	186.34
23/06/2021	190.02	195.98	185.46
22/07/2021	190.03	195.98	186.42
17/08/2021	190	195.86	186.32
21/09/2021	189.98	195.83	186.2
18/10/2021	189.93	195.75	185.98
24/11/2021	189.92	195.68	185.76
20/12/2021	190	195.94	185.86
20/01/2022	189.96	195.95	185.8
15/02/2022	190.01	195.98	185.83
22/03/2022	190.27	196.8	189.07
19/04/2022	190.33	197.1	190.14
30/05/2022		197	190.14
24/06/2022	190.35	196.8	189.94
22/07/2022			

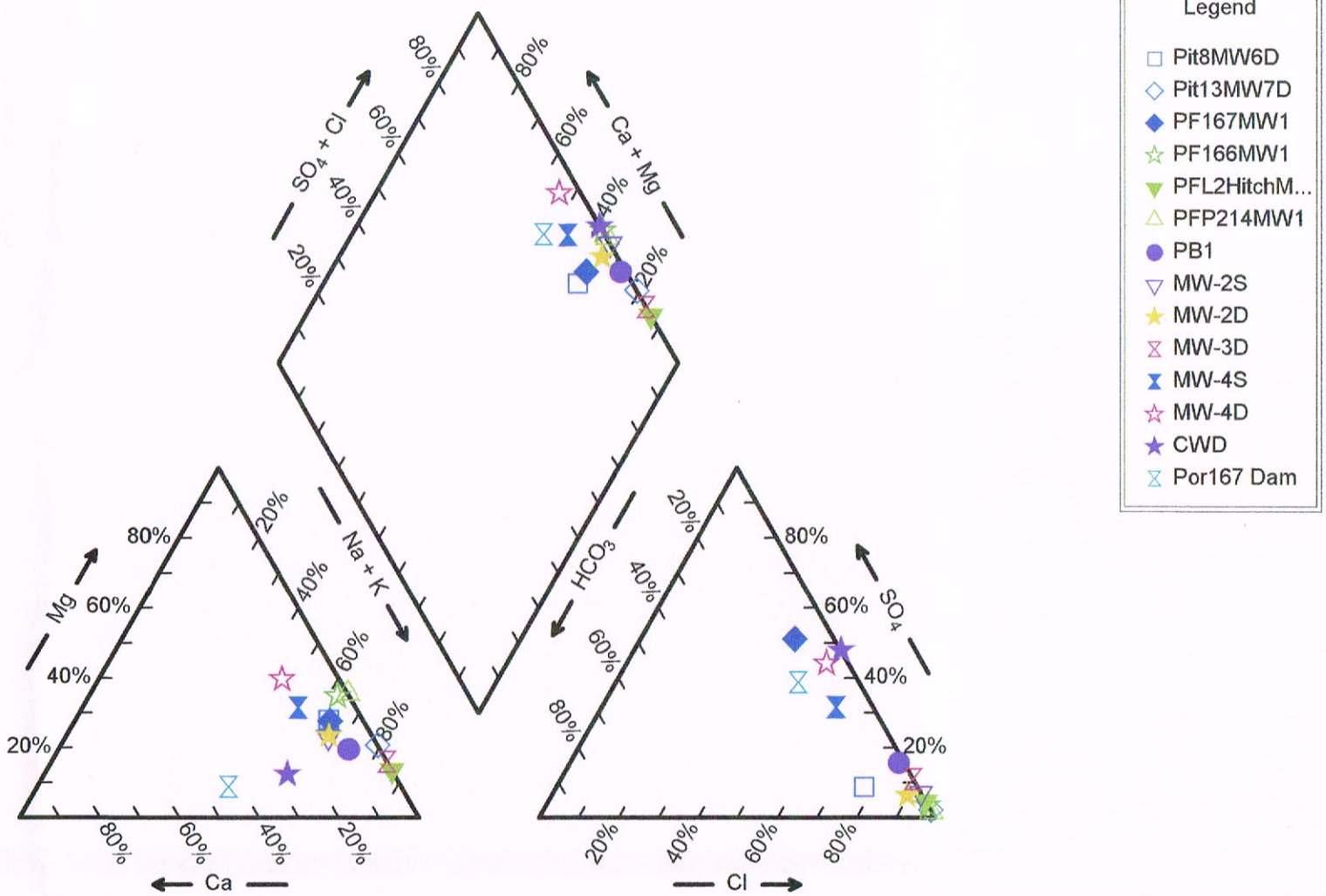
Note: no data= area not accessible due to flooding

SWLs measured by M.Mass of SE Environmental

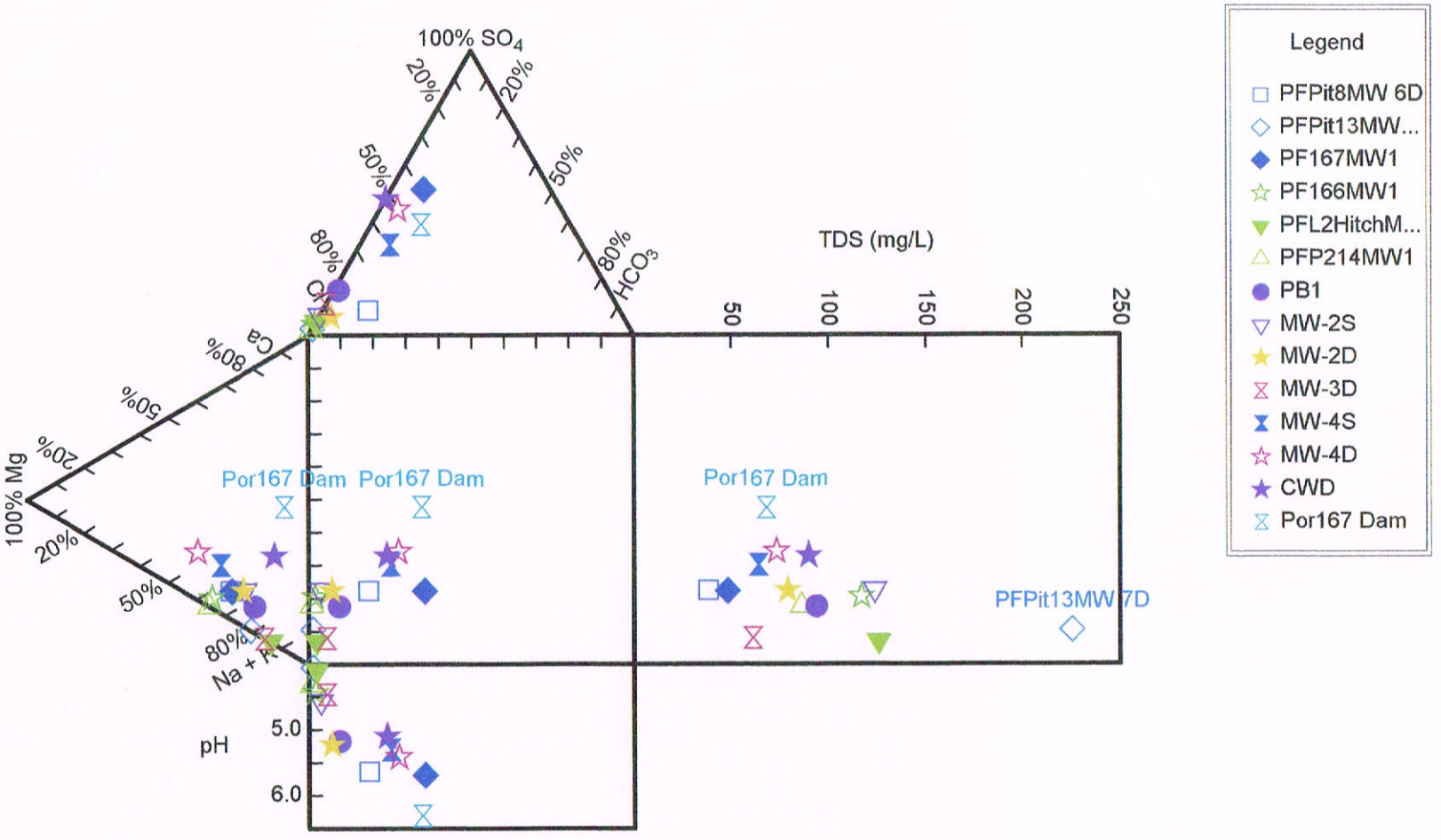
APPENDIX E

Piper Trilinear & expanded Durov Hydrochemical Diagrams (September 2022)

Piper1= Maroota Sept 2022



Durov Diagram 1 = Sept 2022



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Thank you for the opportunity to work with your organisation.

Your feedback is welcomed regarding Earth2Water Pty Ltd professional services.

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Environmental & Groundwater Consulting