



PF Formation

# Groundwater Report: Hitchcock Road Site, Maroota, NSW Annual Groundwater Management Plan 2016-2017

Report E2W-0224 R003 (V1)

31 July 2017



Prepared by: Dino Parisotto (Director)  
BAppSc-Geology (Hons) MAppSc-Groundwater  
Phone: (02)42340829 E:dino@earth2water.com.au  
175 Fern Street, Gerrington, NSW , Australia, 2534

This document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. This document should not be used or copied without written permission from Earth2Water Pty Ltd.

**earth<sub>2</sub>water**  
Pty Ltd  
Environmental & Groundwater Consulting

**Client: PF Formation**

**Project: Groundwater Report  
Hitchcock Road Site, Maroota  
2015-2016 Annual Groundwater Management Plan**

Prepared for:  
Josh Graham  
**PF Formation**  
**1774 Wisemans Ferry Road**  
**Maroota, NSW, 2756**

Report: 31 July 2017  
Ref: E2W-224 R003 (V1)



Prepared By: Earth2Water Pty Ltd

A handwritten signature in blue ink, appearing to read 'D. Parisotto'.

**D. Parisotto (Managing Director)**  
*BAppSc; Geology. MAppSc; Groundwater. C3 Driller (DL1977)*  
*SCPA Certified Practitioner (17017); Site Assessment & Management*

Office: 175 Fern Street, Gerringong, NSW 2534  
Phone: (02) 4234 0829 Email: dino@earth2water.com.au

**Reports Distributed and Authorised for:**

PF Formation: report - electronic copy (pdf)

© Authorisation from Earth2Water Pty Ltd is required for third party use and distribution

## TABLE OF CONTENTS

<b>1</b>	<b>Introduction.....</b>	<b>4</b>
<b>2</b>	<b>Groundwater Monitoring Network.....</b>	<b>4</b>
2.1	Monitoring Bore PF167MW1 .....	6
2.2	Monitoring Bore PF166MW1 .....	6
2.3	Monitoring Bore PFP214MW1 .....	7
2.4	Monitoring Bore PFL2HitchMW1 .....	7
2.5	Portion 167 Dam .....	7
2.6	Portion 198 Water Supply Bores .....	8
<b>3</b>	<b>Groundwater Data Assessment .....</b>	<b>8</b>
3.1	New Wells and Pit Extraction Depths .....	8
3.2	Groundwater Levels .....	9
3.3	Bore PF167MW1 .....	9
3.4	Bore PF166MW1 .....	10
3.5	Bore PFP214MW1 .....	10
3.6	Bore PFL2HitchMW1 .....	10
3.7	PF167 Dam .....	11
3.8	Groundwater Quality .....	11
3.9	Quality Control .....	12
3.10	Portion 167 dam .....	13
3.11	Water Supply Bores, Portion 198 .....	13
<b>4</b>	<b>Conclusions.....</b>	<b>13</b>

### Figures

Figure 1	Site Location Plan & Inferred Groundwater flow regime (7 June 2017)
Figure 2	Inferred Groundwater flow regime (17 July 2017)
Figure 3	Inferred Hydrogeological Section (N-S)
Figure 4	Inferred Hydrogeological Section (NW-SE)
Figure 5	Site Location (PB1 & PB-2)
Figure 6	Bore PF167MW1 Groundwater Hydrograph (2013-2017)

### Tables

Table 1	Maroota Climate (July 2016 to June 2017)
Table 2	Monitoring Well Details & Water Table Gauging (2017)
Table 3A	Summary of Existing Monitoring Wells (Hitchcock Road, Maroota)
Table 3B	Summary of New Monitoring Wells (Hitchcock Road; May 2017)
Table 3-1	Bore PF167MW1 Chemical Analyses Summary
Table 3-2	Bore PF166 Chemical Analyses Summary
Table 3-3	Bore PFL2HitchMW1 Chemical Analyses Summary
Table 3-4	Bore PFP214MW1 Chemical Analyses Summary
Table 3-5	Bore 198PB1 Chemical Analyses Summary
Table 3-6	Bore 198PB2 Chemical Analyses Summary
Table 3-7	Portion 167 Dam Annual Pumpage Records
Table 3-8	Water Supply Bores Annual Pumpage Records
Table 3-8a	Water Supply Bores – Groundwater Levels (PB-1 & 2)

## **Graphs**

Graph-1	Monitoring Data at Bore PF167MW1 (2017)
Graph-2	Monitoring Data at Bore PF166MW1 (2017)
Graph-3	Monitoring Data at Bore PF214MW1 (2017)
Graph-4	Monitoring Data at Bore PFL2HitchMW1 (2017)
Graph-5	Monitoring Data at Bore 198PB1 (2017)
Graph-6	Monitoring Data at Bore 198PB2 (2017)

## **Appendices**

Appendix A:	Limitations
Appendix B:	Analytical Laboratory Certificates (ALS, July 2017)
Appendix C:	Previous Bore Hydrographs (URS, 2013)
Appendix D:	Hitchcock Road Water Table Contours (URS, June 2011)
Appendix E:	Borelogs/Well Construction Records (May 2017)
Appendix F:	Surveying of Wells
Appendix G:	Previous Groundwater Hydrographs (2013- 2016)
	Figure 3, Bore PF166MW1 Groundwater hydrograph (2013-2016)
	Figure 4, Bore PFP214MW1 Groundwater Hydrograph (2013-2016)
	Figure 5, Bore PFL2HitchMW1 Groundwater Hydrograph (2013-2016)

## 1 INTRODUCTION

Earth2Water Pty Ltd (E2W) was engaged by PF Formation (PFF) to provide the Groundwater Report (2016-2017 Annual Groundwater Management Plan) for Hitchcock Road Site, Maroota (Figure 1). The groundwater sampling<sup>1</sup> and downloading of loggers (4) was conducted in consultation with Joshua Graham (PFF) on 17 July 2017. URS Australia Pty Ltd (URS) was previously (up to 2013) retained by PFF to prepare the groundwater component of the report.

PF Formation (PFF) is required under the Development Approval conditions set for the Maroota Hitchcock Road property area (Figure 1) to prepare an annual Water Management Plan (WMP) report to the *Department of Planning and Environment* (DPE). The WMP is part of the overall Environmental Management Plan and addresses the surface water and groundwater aspects of the sand extraction operations at the site.

The WMP for the year July 2015 to June 2016 also includes the monitoring data collected from 1996 to 30 June 2017 for the Hitchcock Road site, and also for Portion 198.

## 2 GROUNDWATER MONITORING NETWORK

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

The existing wells (PF214MW-1, PFL2HitchMW-1, PF167MW-1 and PF166MW-1<sup>3</sup>) and new wells (PF166MW-2D, PF166MW-3D, PF167MW-4D, PF167MW-5D, PF167MW-2s, PF166MW-4s) were surveyed by Landair Survey Pty Ltd (May 2017). The aerial survey provided an updated aerial photographic plan showing current pit excavation works and site topographic contours (Figure 1). The new and existing monitoring wells were surveyed by a registered surveyor (Mathew Freeburn Pty Ltd) on 29 May 2017 to enable groundwater levels to be reduced to Australian Height Datum (mAHD, refer to Appendix F and Table 2).

At the Hitchcock Road site, groundwater was monitored at six existing and six new locations on 17 July 2017. The details of the existing and new wells are presented in Tables 3A and 3B.

### *Existing Wells (sampling 17 July 2017)*

1. Monitoring bore PF167MW1, located in Portion 167,
2. Monitoring bore PF166MW1, located in Portion 166,
3. Monitoring bore PFL2HitchMW1, located in Lot 2,
4. Monitoring bore PFP214MW1, located in Portion 214; and
5. Production Bores PF198PB1 and PF198PB2, located in Portion 198.

<sup>1</sup> Sampling locations (8) include: PF214MW-1, PFL2HitchMW-1, PF167MW-1 and PF166MW-1, PB-1 & PB-2, and new locations: PF166MW-2D, PF167MW-2s).

<sup>3</sup> The fourth well (PF166MW-1) is situated in the Maroota Sands Aquifer.



The pumping records are available from the water supply dam (PF167DAM in Portion 167) for 2016-2017.

### ***New Wells (May 2017)***

6. Monitoring bore PF166MW2D, located in Portion 166 (#, & sampling on 17-7-2017)
7. Monitoring bore PF166MW2S, located in Portion 166 (#, & sampling 17-7-2017)
8. Monitoring bore PF167MW3D, located in Portion 167 (#)
9. Monitoring bore PF167MW4D, located in Portion 167 (#)
10. Monitoring bore PF167MW4s, located in Portion 167 (#)
11. Monitoring bore PF167MW5D, located in Portion 167 (#).

*Note: # groundwater sampling conducted at the new wells on 18 May 2017.*

The previous water level contour map (URS June 2011, Appendix D) was based on a limited well network (3 wells) across a large site area (100 ha). The additional new wells (6) installed in May 2017 improve the groundwater flow depths and regime near the centre and north portion of the site (PF166MW-2D & PF166MW-3D). The groundwater data and site topography indicates the presence of a groundwater divide near the highest part of the site which separates the flows to the north and south (RL ~240 mAHD at trig station, Figures 3 & 4).

Groundwater pumping and chemical analyses were also collected from the two water supply bores in Portion 198 (i.e. PF198PB1 & PF198PB2). The bore PB2 was previously treated with iron-floc chemicals due to clogging and was not sampled in previous years (chemical treatment ceased in December 2016).

Groundwater monitoring has been carried out at the sites since 1996. Initially, water levels in bores PF166MW1 and PF167MW1 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.

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 Levellogger 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 loggers on 17 July 2017, however the data was only recorded from one (PF167MW1) out of the four loggers (*note*. loggers >10 yrs old).

Data logger information was retrieved from PF167MW-1 for the 2016 to 2017 period. The two loggers (PFL2HitchMW1, PFP214MW1) were re-inserted into the respective wells on 19 July 2017 for a further trial period and/or possible future replacement. The logger from well (PF166MW1) was not able to be programmed and decommissioned. Groundwater level information is scheduled to be undertaken using an acoustic water level probe on a monthly basis (August 2017 to 2018) to continue the groundwater assessment at new and existing wells.

New Solinst data loggers (4) are planned to be installed at four locations (Por 167 dam, clean water dam, PF166MW-3D, PF167MW-4D) in August 2017 to assist with the expansion of groundwater management and guiding the pit extraction depths.

Water levels from selected existing and new wells were measured on 27 & 18 July 2017, 7 & 9 & 26 June 2017, 18 May 2017 and 10 August 2016 using an acoustic water level probe (Table 2). Field chemistry (EC, PH, T, DO, Redox) was measured using a calibrated field meter (TPS 90 FLMV) at the 6 bores on 17 July 2017.

Water samples from six bores (PF167MW1, PF166MW1, PFL2HitchMW1, PFP214MW1 and PF166MW2S/PF166MW2D) were collected by E2W (Dino Parisotto) and PFF (Joshua Graham) on 17 July 2017. Samples were submitted for chemical analysis under Chain of Custody procedures to Australian Laboratory Services Pty Ltd (ASL-Sydney).

Samples from two bores (PF198PB1/PB2) were also collected by PFF (Josh Graham) on 25 July 2017 (PB1/PB2) under E2Ws advice (i.e. laboratory containers, E2W chain of custody, despatch/analyses at ALS). Groundwater samples from the production bores PF198PB1 & PB2 (25 July 2017) are from operational bores.

The laboratory reports are presented in Appendix B. The analytical results have been plotted on individual graphs that are continuously updated 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 the NSW Office of Water) has included:

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

## **2.1 Monitoring Bore PF167MW1**

Groundwater monitoring at bore PF167MW1 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 also in early 2017 (including barometric pressure). Occasionally missing data from this station were integrated with data from the BoM Maroota station No.67014 and also from the neighbouring Dixon Site

The Figure 6 (2013-2017) presents the combined Solinst datalogger records for bore PF167MW1 (previous records are presented in Appendix C).

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).

## **2.2 Monitoring Bore PF166MW1**

Groundwater monitoring at bore PF166MW1 (Appendix G; Figure 3 shows 2013 to 2016 monitoring data) commenced in March 1998 in the same manner as for bore PF167MW1. The data between March 1998 and December 1998 (manual collection) have been plotted in the graph of Figure 4 (Appendix C), together with EC and rainfall records collected by PFF. Refer

to Table 2 for water level gauging results. Logger data is not available for 2016-2017 (logger now decommissioned due to age >10 yrs).

### **2.3 Monitoring Bore PFP214MW1**

Bore PFP214MW1 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 Levellogger Gold 3001, serial no. 51040540). Refer to Table 2 for water level gauging results. Bore PFP214MW1 hydrograph is presented in Appendix G; Figure 4 (showing 2013 to 2016 monitoring data). Logger data is not available for 2016-2017 due to technical issues with the aged logger.

### **2.4 Monitoring Bore PFL2HitchMW1**

Bore PFL2HitchMW1 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 Levellogger Gold 3001, serial no. 510405840). Refer to Table 2 for water level gauging results.

Bore PFL2HitchMW1 hydrograph is presented in Appendix G- Figure 5 (including 2013 to 2016 monitoring data). Logger data is not available for 2016-2017 due to technical issues with the logger (aged).

### **2.5 Portion 167 Dam**

At the early stages of the site development, an excavation (PF167DAM) 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 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 Dam during the 2015-2016 and summarised in Table 3-7 (Total of 46.829 ML). The pumpage was due to the lower rainfall (1176 mm for 2015-2016) and high volume of sand extraction (note: water levels monitoring are not required, not in the new licence conditions).

Pumping was undertaken by PFF from Portion 167 Dam during the 2016-2017 and summarised in Table 3-7 (Total of 38.407 ML). The pumpage was due to the modest rainfall (957.4 mm for 2016-2017) and high volume of sand extraction. Water level monitoring is not required in the new license conditions, however a data logger is planned for installation in August 2017 to assist with the site water balance.



## 2.6 Portion 198 Water Supply Bores

The two water supply bores in Portion 198 (PF198PB1 and PF198PB2) 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 the year 2012-2013*).

Water quality data have been plotted for selected parameters and the graphs (5 & 6) and the laboratory reports in Appendix B.

The bores were operational and sampling from PF198PB1 & PF198PB2 discharge outlet occurred on 25 July 2017. A sample was collected from PF198PB2 as chemical treatment for clogging (Fe-floc) from this bore ceased in December 2016.

## 3 GROUNDWATER DATA ASSESSMENT

### 3.1 New Wells and Pit Extraction Depths

During May 2017, six additional monitoring wells were installed to improve site coverage and better assess water levels in the Hawkesbury Sandstone (PF166MW-4D, PF166MW-3D, PF167MW-4D, PF167MW-5D) and Maroota Sand Aquifers (PF167MW-2s, PF166MW-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, Appendix E).

The inferred hydrogeological cross sections for the site are presented in Figures 3 & 4. The new monitoring wells (6) and also recent survey (aerial and well RL details, Appendix F) were used to better assess the pit extraction depths and the groundwater buffer zone (2m requirement).

The previous water level contour map provided by URS (June 2011) is presented in Appendix D. E2W note that the URS water contour map is based on a limited well network comprising three monitoring wells over a 100 ha site. The additional new wells (6) installed at the site in May 2017 are considered to provide a better depiction of the groundwater flow regime (northern portion at PF166MW-2D). The groundwater data and site topography indicates the presence of a groundwater divide at the highest point of the site (RL ~240 mAHD at trig station located near PF166MW-3D and PFL2HitchMW-1). Refer to Figures 1 to 4.

The indicative extraction depths for the site are as follows:

- Northern extraction area (PF166MW-2D)= 204.3 mAHD
- Southern extraction area (PF167MW-5D)= 178 to 182 mAHD (#)
- Central extraction pit (PF167MW-3D)= 178 to 180 mAHD (#)

E2W understand that the two pit extraction areas (#, areas near PF166MW-3D and PF167MW-5D) require backfilling to meet the required groundwater buffer zone (2m, Figure 3 & 4).

### 3.2 Groundwater Levels

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

The plots of bore PF167MW1, which taps the full saturated thickness of the Maroota Sand, and bore PF166MW1, 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 new monitoring bores, PFP214MW1 and PFL2HitchMW1, indicate a subdued and moderate response to rainfall.

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.

### 3.3 Bore PF167MW1

After a significant rain event in June 2007, the water level rose by 4.5 m to a level similar to the highest recorded value in mid-2000 (Figure 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 current 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 mAHD) after the high recharge event of April 2015 (rainfall 422 mm, Figure 2).

Following the April 2015 rainfall event other recharge events occurred in early and mid 2016 causing groundwater levels to rise and vary between 183 and 184 mAHD (June 2016 is ~ 183.4 mAHD, Appendix G; Figure 2).

Water levels are approximately 183.5 AHD during July 2017, and ranged from ~182.5 to 184m mAHD during 2016-2017. Spikes in water levels relate to storm events, such as the high rainfall in March 2017 (Figure 6). The groundwater table rose approximately 1m in the sandstone aquifer (PF167MW-1) following March 2017 rainfall.

The water levels manually measured from August 2016 to July 2017 ranged from 183.25 mAHD to 183.58 mAHD and is similar to 2015 to 2016 (Table 2, Figure 6, and Appendix G, Figure 3).

### 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 as a result of the high rainfall at the beginning of 2013. Bore PF166MW1 taps a perched aquifer with variable responses to major and sustained rainfall events and periods (Figure 3, 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 mAHD in April 2016 (Figure 2).

The water levels manually measured from August 2016 to July 2017 ranged from 199.55 mAHD to 200.75 mAHD (Table 2) and similar to the 2015 to 2016 levels (Appendix G, Figure 3). The water levels in the Maroota Sand are perched above the sandstone aquifer.

### 3.5 Bore PFP214MW1

Bore PFP214MW1 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, 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 mAHD) with minor fluctuations during 2015 and 2016.

The water levels manually measured from August 2016 to July 2017, ranged from 179.41 mAHD to 179.41 mAHD (Table 2). The recent water levels (depth below ground) are similar to the previous 2016 levels (Appendix G, Figure 4).

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 was required and presented in Table 2, and Appendix F.

### 3.6 Bore PFL2HitchMW1

Bore PFL2HitchMW1 is the deepest bore in the Hitchcock Road site, as it is located 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 5, 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 mid 2016 where it stabilises at approximately 189.95 mAHD (Figure 5).

The water levels manually measured from August 2016 to July 2017 and ranged from 189.6 mAHD to 189.85 mAHD (Table 2). The recent water levels are similar to the previous 2015-2016 levels, showing a relatively stable water level over time (refer to *Appendix G, Figure 5*).

### 3.7 PF167 Dam

Water levels in the PF167DAM, which was originally excavated to the base of the Maroota Sand within the deep palaeochannel, have been kept above 180 m AHD over the year to June 2011 by regulating pumpage so as not to exceed this level (Figure 6 & 7, Appendix C). Due to the above average rainfall of the last three years there have been long periods when no water was extracted from this site.

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 2001-2013 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.

During July 2013 the water level peaked at 209 mAHD, however in October 2013 the level reached 188m AHD (low rainfall). Total pumpage from the dam (PF167) was 30.395 ML for the 2013-2014 operational period. No pumpage occurred during 2014-2015 which had above average rainfall (1321.5 mm). Total pumpage from the dam (PF167) was 46.829 ML for 2015-2016, and **38.407 ML** for the current 2016-2017 operational period.

It should be noted that the quarry area is internally draining and, therefore, collects all incident rainfall on the site.

Although water is pumped from the dam for a variety of purposes, such as dust suppression and irrigation of rehabilitated areas and, more recently, for sand slurring, records show that water levels return rapidly to the average values indicated above, even after higher levels are experienced after heavy rainfall and consequential run-off.

Figure 6 (appendix C) shows these combined effects upon the water level in the dam. The records suggest that the Maroota Sand aquifer at the site is capable of sustaining the required pumpage even under the lower rainfall recharge conditions and the additional demand posed upon it in the wider Maroota area by the many groundwater users.

### 3.8 Groundwater Quality

Water quality in bores PF167MW1 and PF166MW1 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 and Grease to obtain background data.

Since July 2009, groundwater quality data have also become available from the newly installed monitoring bores, PFP214MW1 and PFL2HitchMW1. 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 (1-6). The laboratory reports are presented in Appendix B.

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 PF167MW1 and March 1998 to

January 1999 for bore PF166MW1), 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 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. No analysis has been carried out of the water from the Portion 167 Dam because 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 PF198PB1 (Graph-5) and PF198PB2 (Graph-6), the two processing plant water supply bores. 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 also in Appendix C, URS 2013). The groundwater levels in the production bores (PF198PB1 & PB2) are presented in Table 3-8a.

The waters in the Maroota Sand aquifer monitoring bores are similar and have a characteristic rain composition, with low pH, low TDS and a Sodium-Chloride type. The samples were also analysed for Oil and Grease to monitor the possible effect of the sand extraction operations. Concentrations of Oil & Grease were not detected in all bores for the July 2017 or the previous 2016, 2015 and 2014 monitoring events (*Note: previous detections were considered anomalous by URS*).

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 (PF198PB1 & 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.

Increasing EC/TDS trend is evident in two bores (PFL2HitchMW1, PF214MW1) from 2013 to 2017, and inferred to relate to variable aquifer characteristics and rainfall recharge patterns.

Overall, all the site monitoring bores in both the Hawkesbury Sandstone and in the Maroota Sand show a marginal decrease in Total Dissolved Solids over time, the deeper bores showing a more constant character. The general groundwater flow regime with the sandstone is shown in Figures 1, 2, 3, 4, and also in Appendix D (URS, groundwater regime in 2011).

### 3.9 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.

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.



### 3.10 Portion 167 dam

Records of pump operation have been kept from PF167DAM since January 1997. The Figure 7 (in Appendix C) shows the monthly summary of the pumpage from the dam and Table 3-7 shows the annual totals. 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, with some pumping necessary. No pumping occurred from July 2014 to June 2015. Pumpage occurred (46.829 ML) from Portion 167 Dam during 2015 to 2016.

Pumpage occurred (38.407 ML) from Portion 167 Dam during 2016 to 2017 (Table 3-7). The licensed limit for the Portion 167 dam is 50 ML/year which are not exceeded for 2017.

### 3.11 Water Supply Bores, Portion 198

Pumping records for the two water supply bores in Portion 198 for the year July 2016 to June 2017 are tabulated in Table 3-8. In previous years, during 2014-2015 pumpage was 21.8 ML, whilst during 2013-2014 the total pumpage was 33.6 ML and still significantly below the combined annual allocation of 60 ML. This lower consumption rate is due to the non-operational status of bore PF198PB1 for part of the year 2013, and overall improved efficiency of the plant (including in 2014).

During 2015 to 2016 and given the above average rainfall the available pumping records (PB1 & 2) indicate a usage of 16.841 ML. Pumpage during 2016 to 2017 from PB1 & 2 indicate a combined usage of 16.507 ML.

Groundwater usage is below the combined annual allocation of 60 ML (Table 3-8).

## 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) in the area, indicate that:

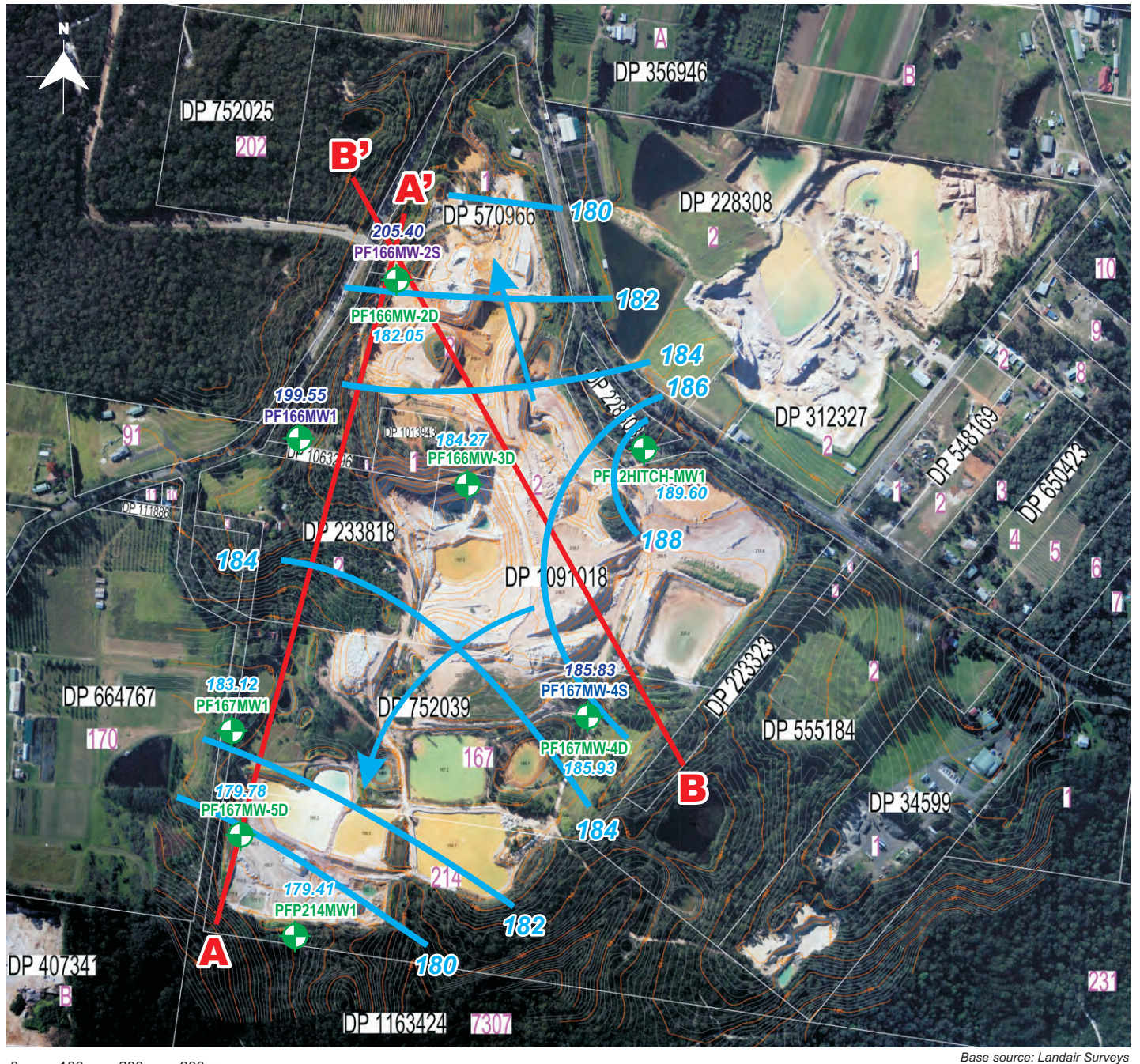
- Water levels in the Maroota Sand aquifer generally respond to the rainfall pattern. The rainfall during 2016/2017 was close to the annual average.
- Water quality in the Maroota Sand aquifer varies with rainfall recharge (slight increasing EC/TDS trends are visible in two deep bores (PFL2HitchMW1, PF214MW1) due to variations in aquifer characteristics and rainfall from 2013 to 2017.
- Water was pumped from the dam in Portion 167 (38.407 ML) and below the PFF allocation (50 ML).
- Groundwater pumpage occurred from the two deep water supply bores in Portion 198 (16.841 ML in 2015-2016, 21.8 ML in 2014-2015, 21.8 ML in 2014-2015). Pumpage records for the two production bores (PF198PB1=8.951 ML, and PF198PB2=7.556 ML) in 2016-2017 was 16.507 ML.
- 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 recharge occurs readily.

- The new monitoring wells (6) installed in May 2017 and recent survey (aerial and well RL details) were used to better assess groundwater levels and the maximum pit extraction depths. E2W understand that two pit extraction areas (locations near PF166MW-3D and PF167MW-5D) require backfilling 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 meet the DA Approval Conditions.

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

## FIGURES





Base source: Landair Surveys

0 100 200 300 m  
Scale

#### LEGEND

- PF167MW-4S Well location (Maroota Sands)
- PF167MW-4D Well location (Sandstone aquifer)
- 179.41 SWL (mAHD) - sandstone (7-6-2017)
- ← Inferred groundwater flow (sandstone)
- Inferred groundwater flow contour (sandstone @ 7-6-2017)
- A-A' Line of cross section

Perched Water Table ( Maroota Sand):  
PFMW-2s, PFMW-4s, PF166MW1

### Site Plan & Inferred Groundwater Flow Regime (7 June 2017)

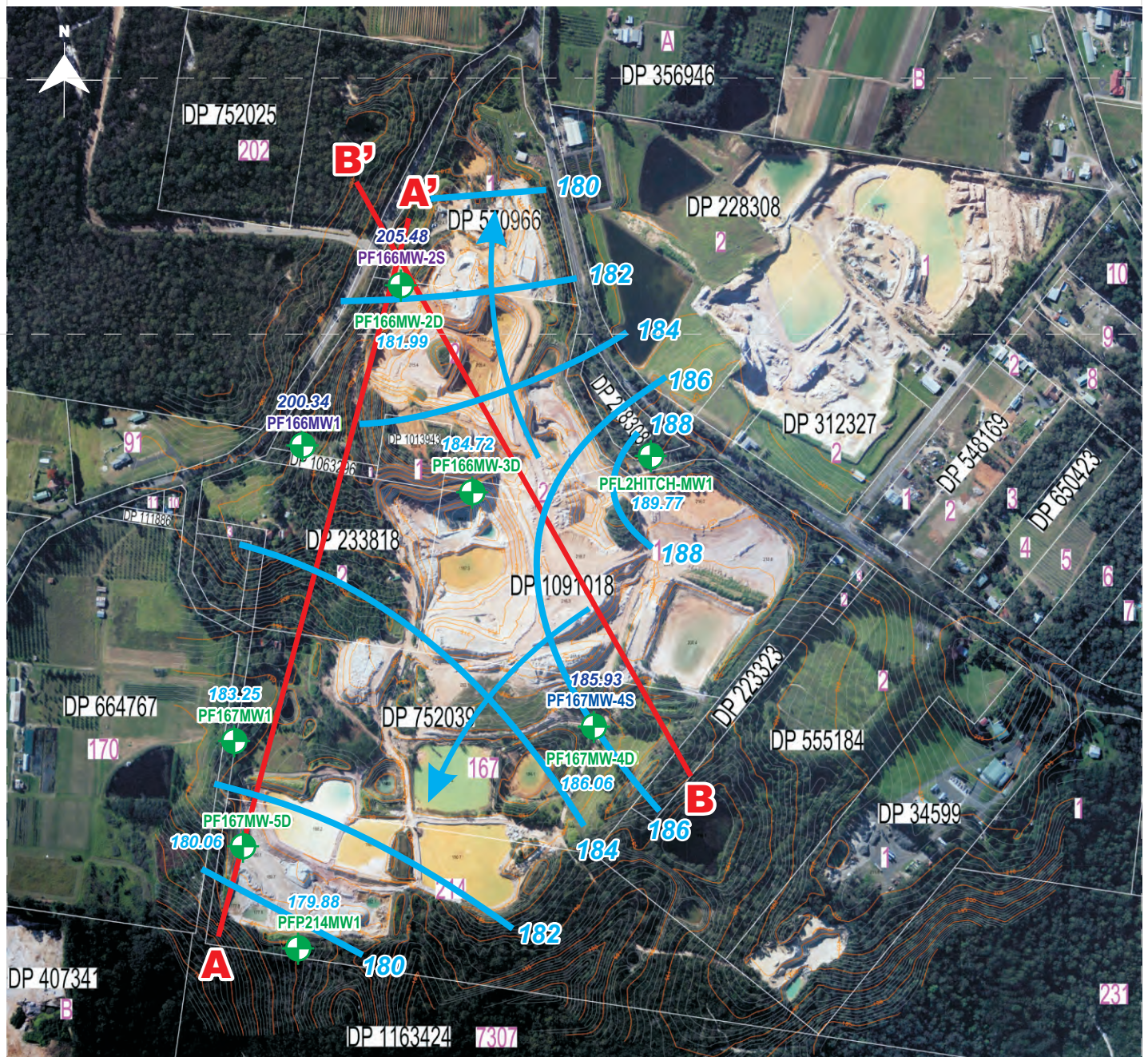
Date: 27 July 2017

Reference: E2W\_224\_15.cdr

MAROOTA - HITCHCOCK ROAD SITE

Figure 1





Base source: Landair Surveys

0 100 200 300 m  
Scale

Perched Water Table ( Maroota Sand):  
PFMW-2s, PFMW-4s, PF166MW1

#### LEGEND

- PF167MW-4S Well location (Maroota Sands)
- PF167MW-4D Well location (Sandstone aquifer)
- 179.41 SWL (mAHD) - sandstone (17-7-2017)
- Inferred groundwater flow direction
- Inferred groundwater contour (17-7-17)
- A-A' Line of cross section

### INFERRED GROUNDWATER FLOW REGIME- SANDSTONE (17 July 2017)

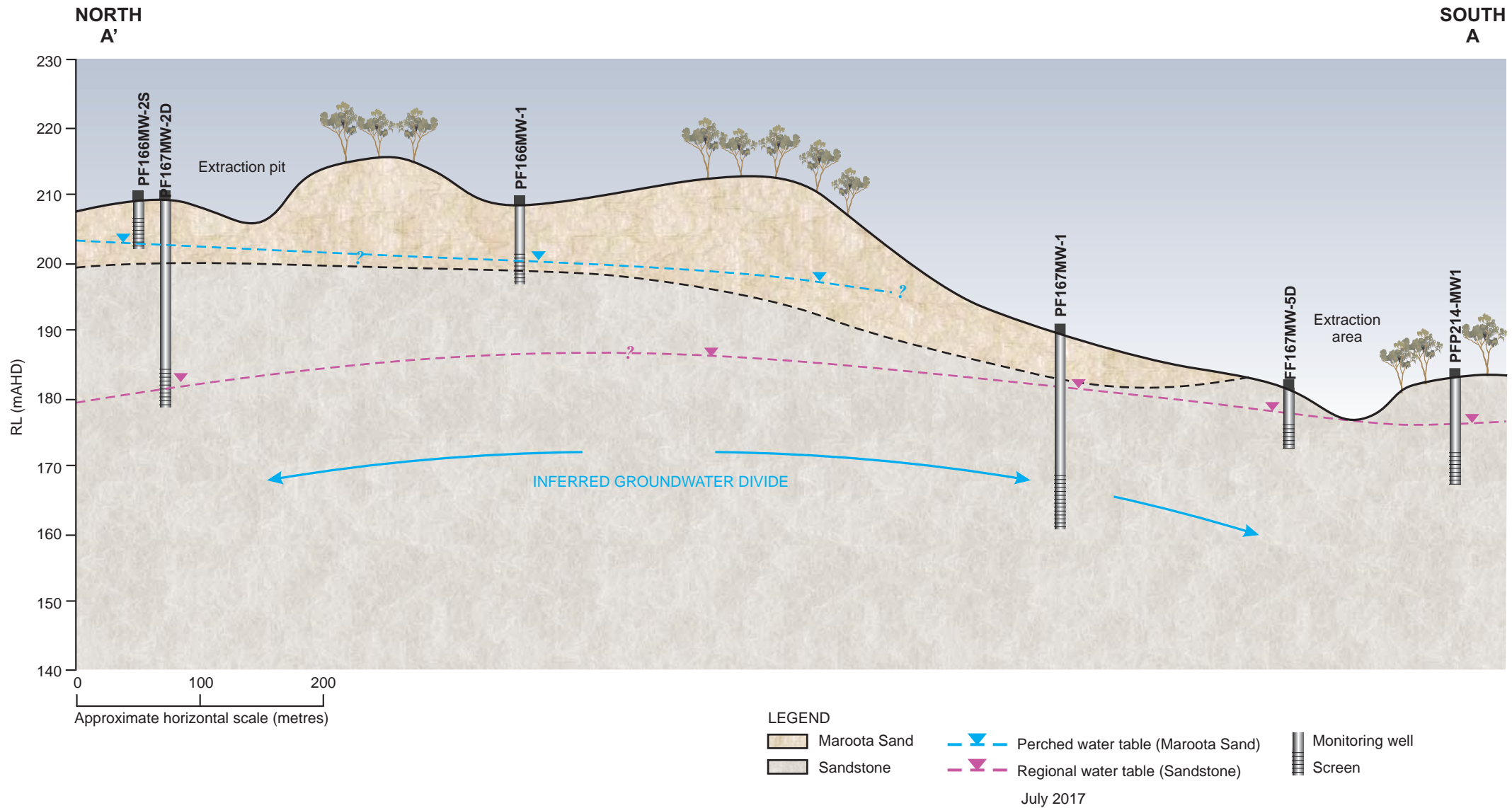
Date: 20 July 2017

Reference: E2W\_224\_15.cdr

MAROOTA - HITCHCOCK ROAD SITE

Figure 2





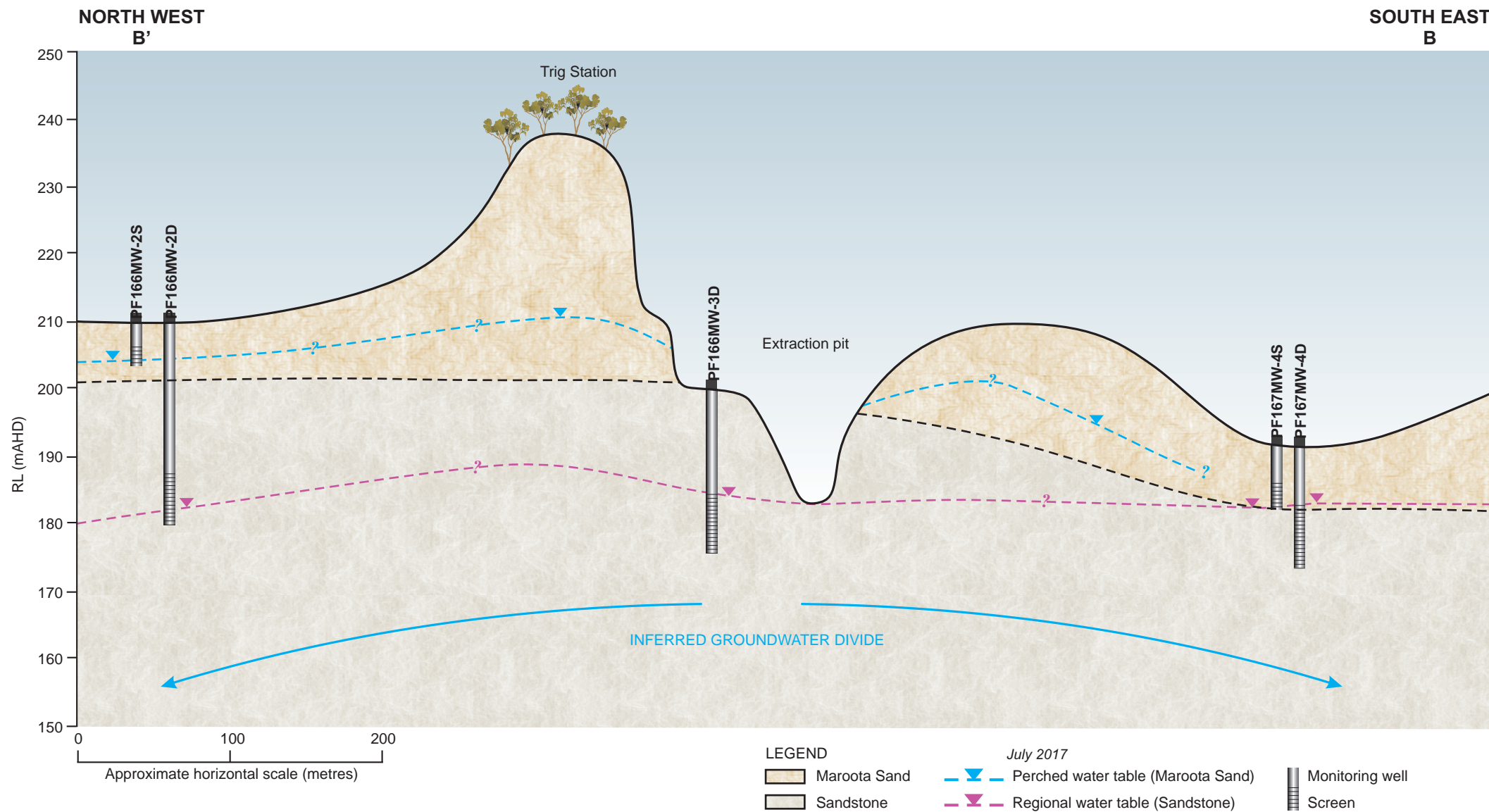
## INFERRED HYDROGEOLOGICAL SECTION (N-S)

Date: 28 July 2017

Reference: E2W\_224\_17.cdr

MARootA - HITCHCOCK ROAD SITE

Figure 3



## INFERRED HYDROGEOLOGICAL SECTION (NW-SE)

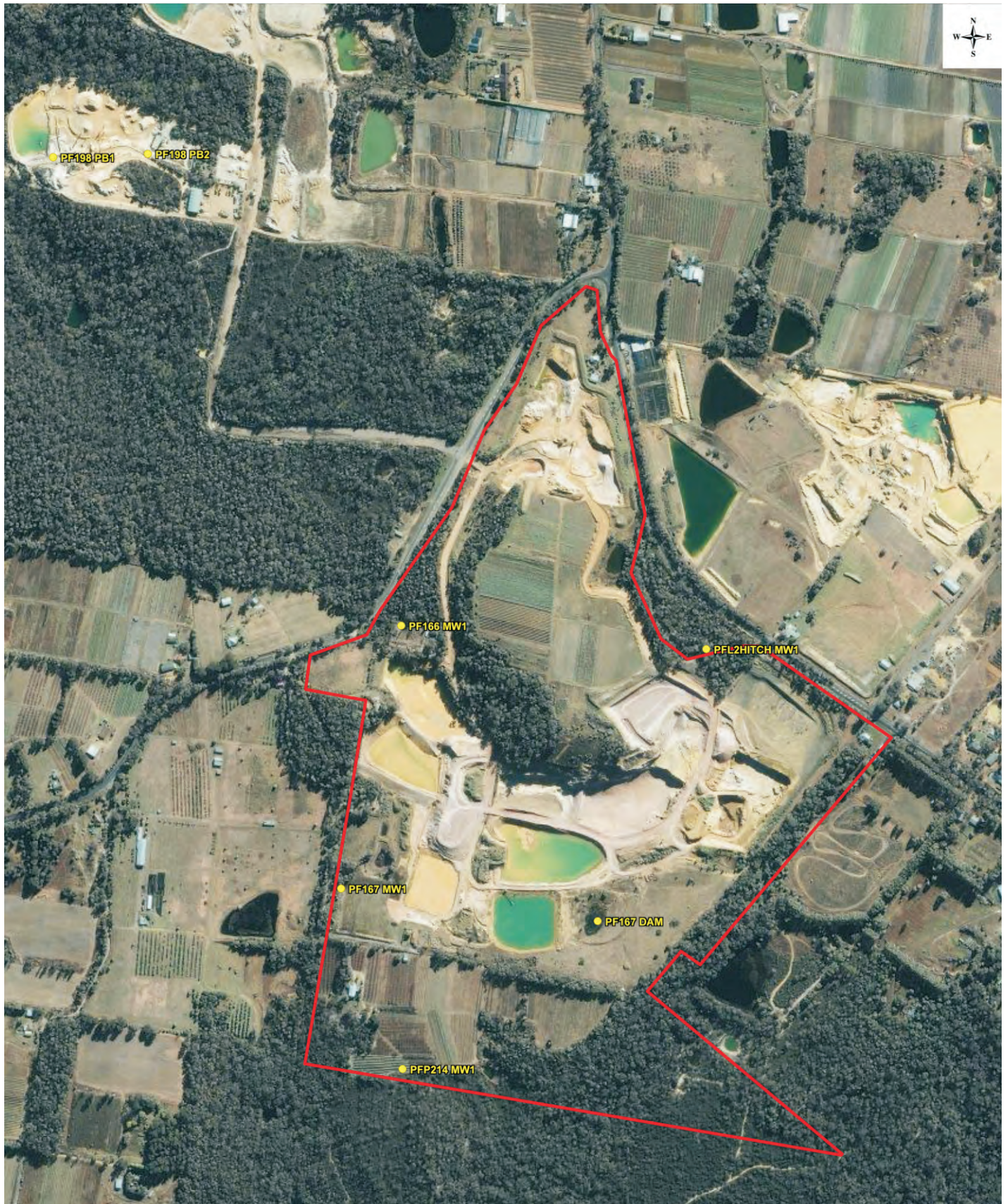
Date: 28 July 2017

Reference: E2W\_224\_16.cdr

MAROOTA - HITCHCOCK ROAD SITE

Figure 4





LEGEND

- Site Boundary
- Groundwater Monitoring Location

Source: URS

Date: July 2017

Reference: E2W\_224\_07.cdr

0 254.4  
metres

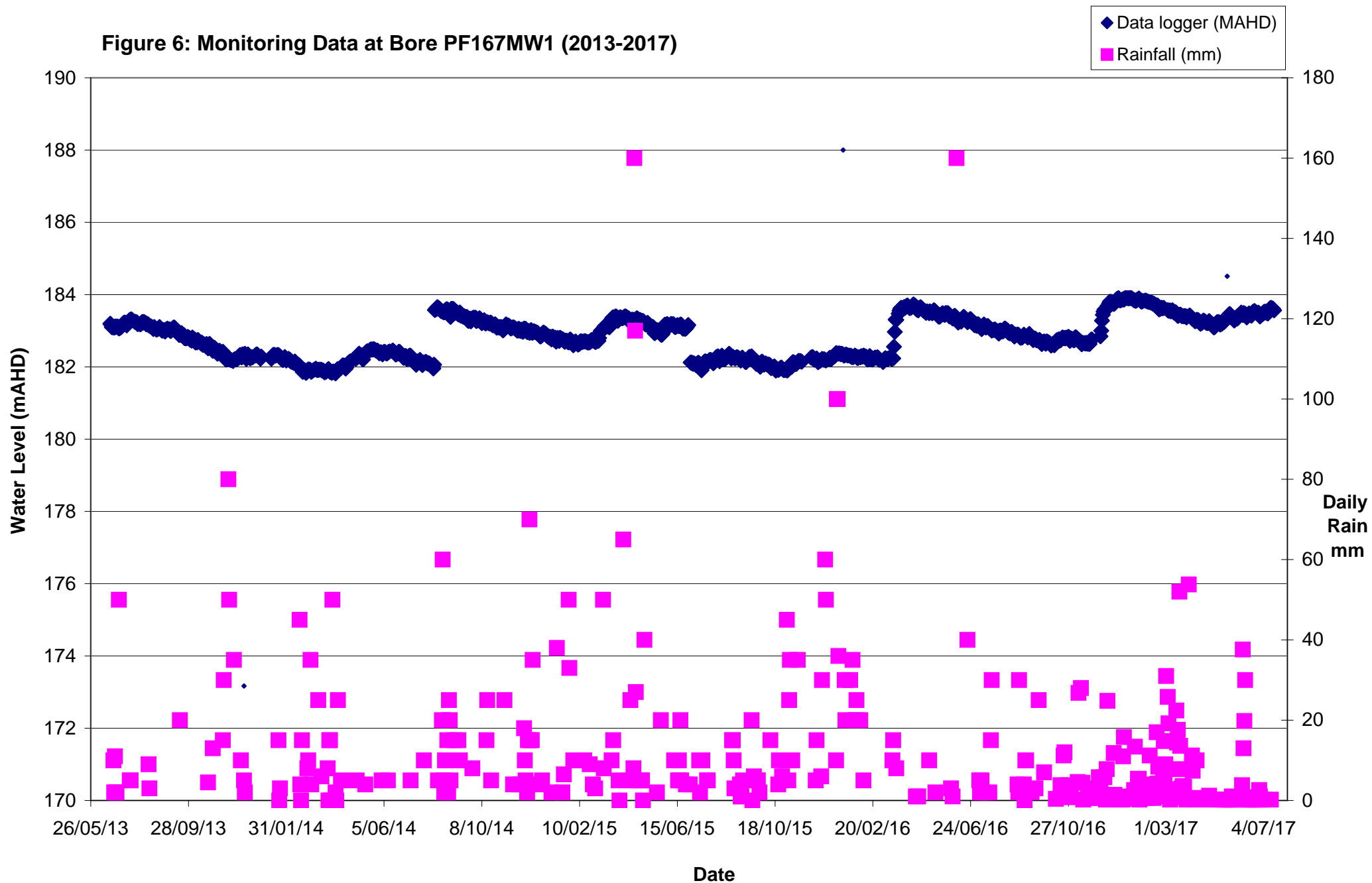
## SITE LOCATION (PB1 & PB2)

PF FORMATION - Hitchcock Road Site (GMP), Maroota

**Figure 5**



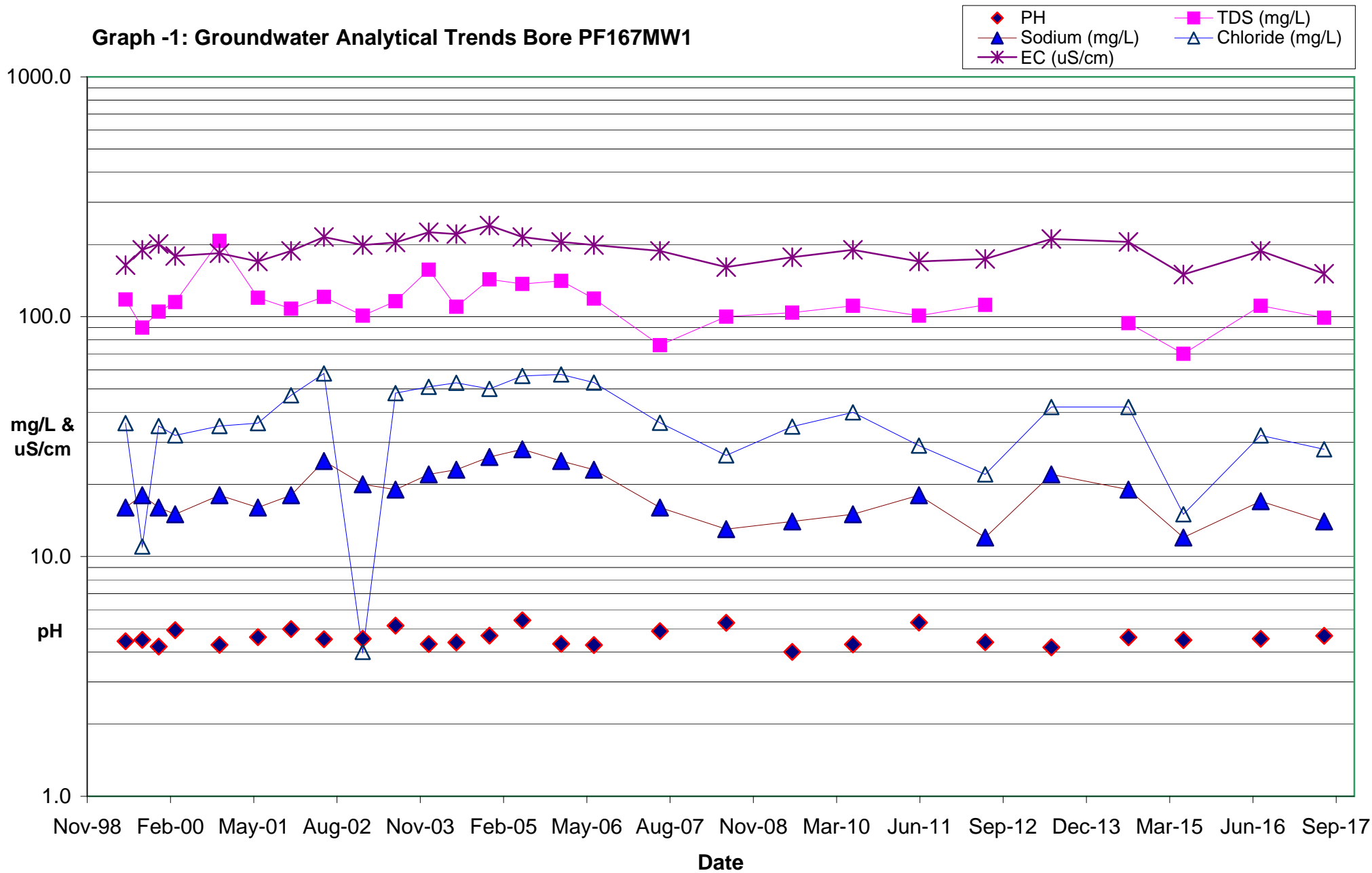
Figure 6: Monitoring Data at Bore PF167MW1 (2013-2017)



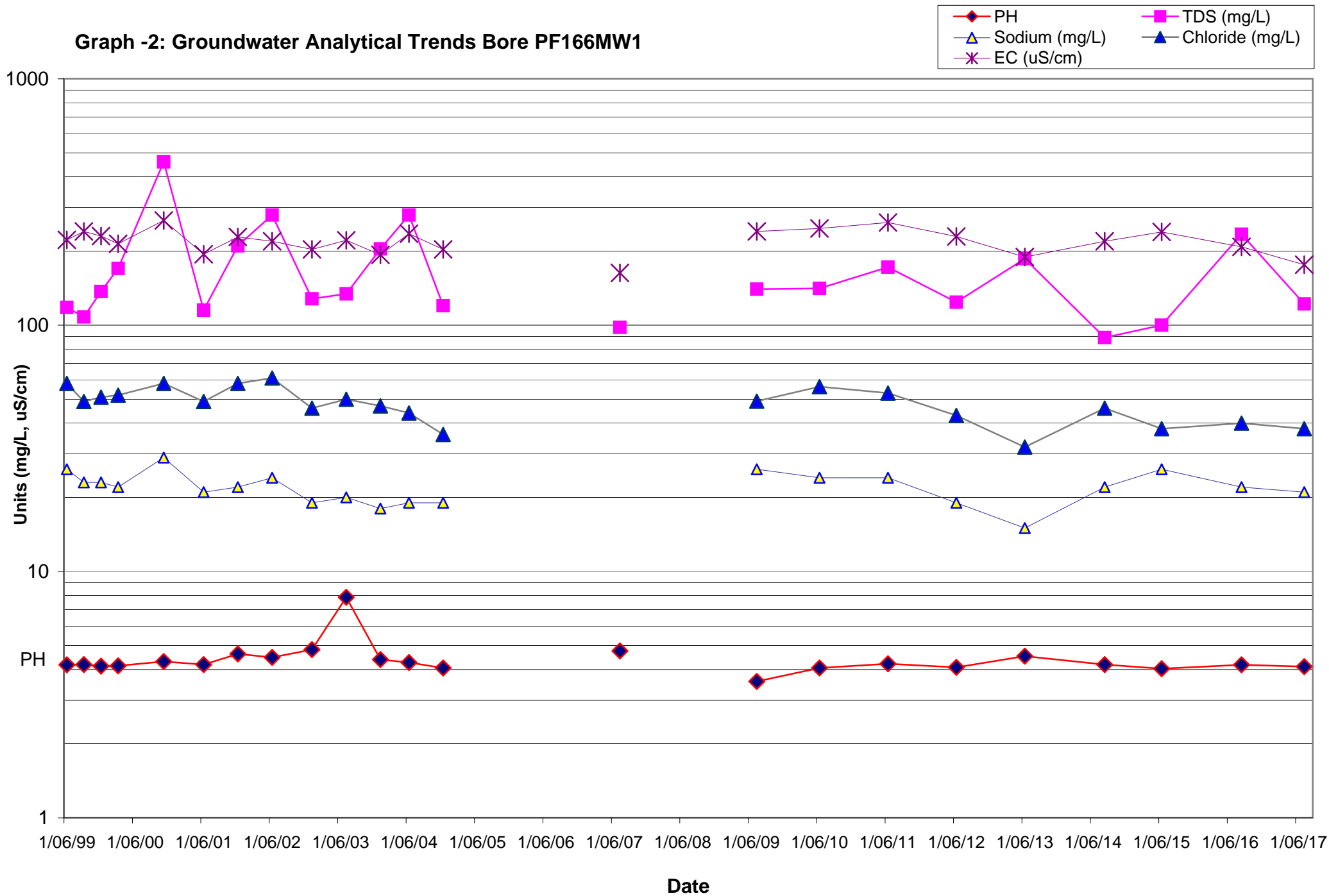
## GRAPHS



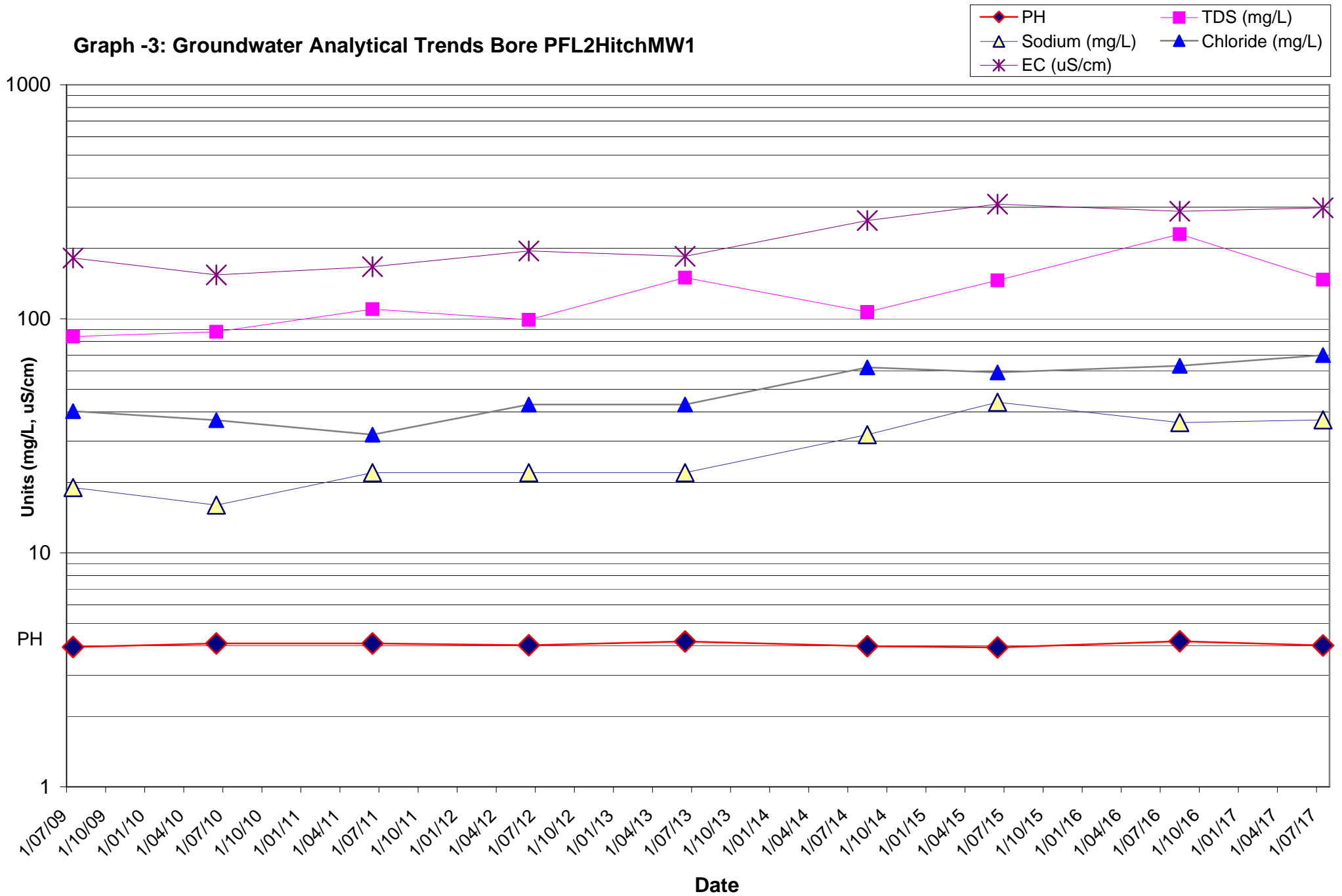
**Graph -1: Groundwater Analytical Trends Bore PF167MW1**



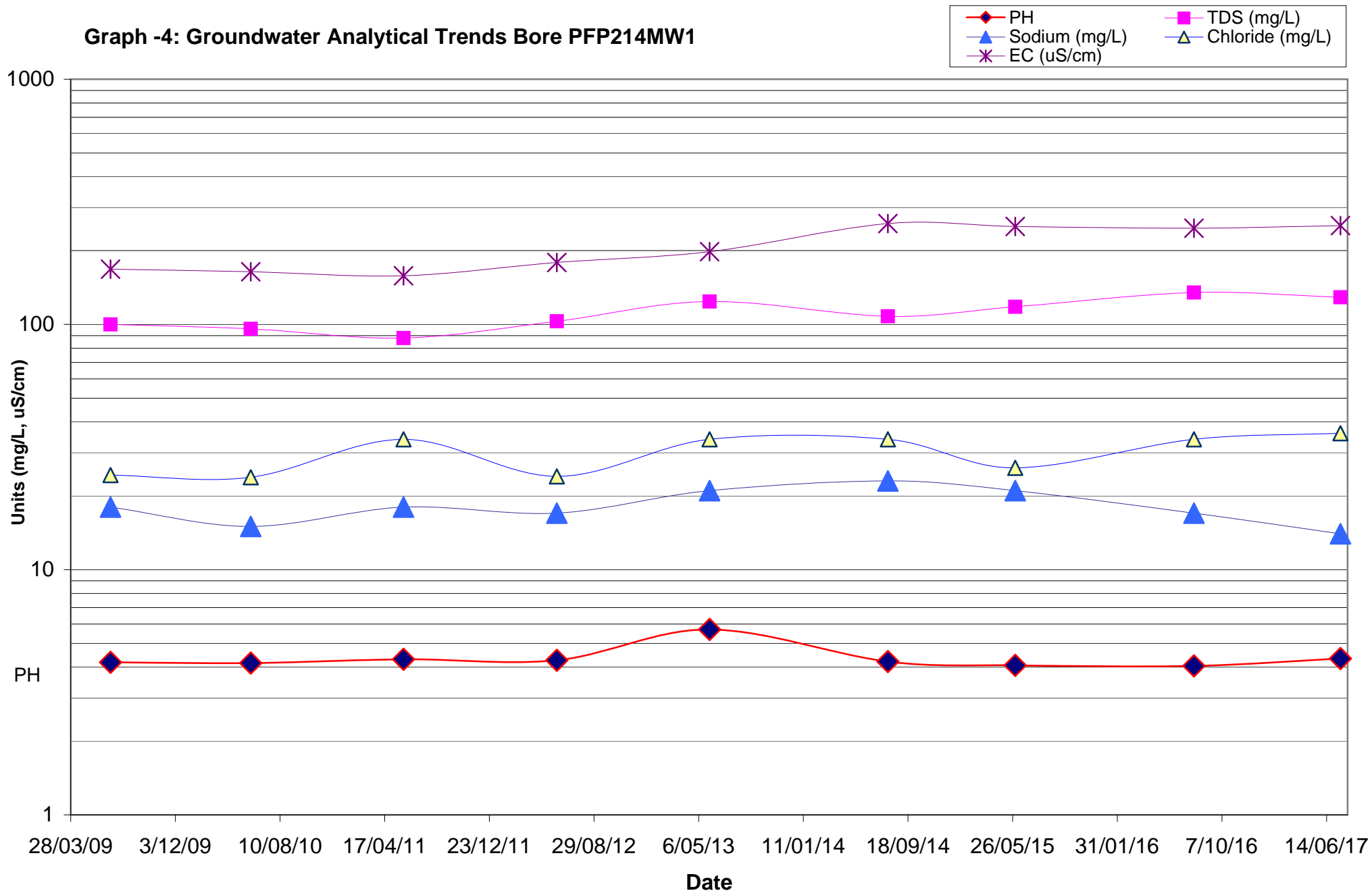
**Graph -2: Groundwater Analytical Trends Bore PF166MW1**



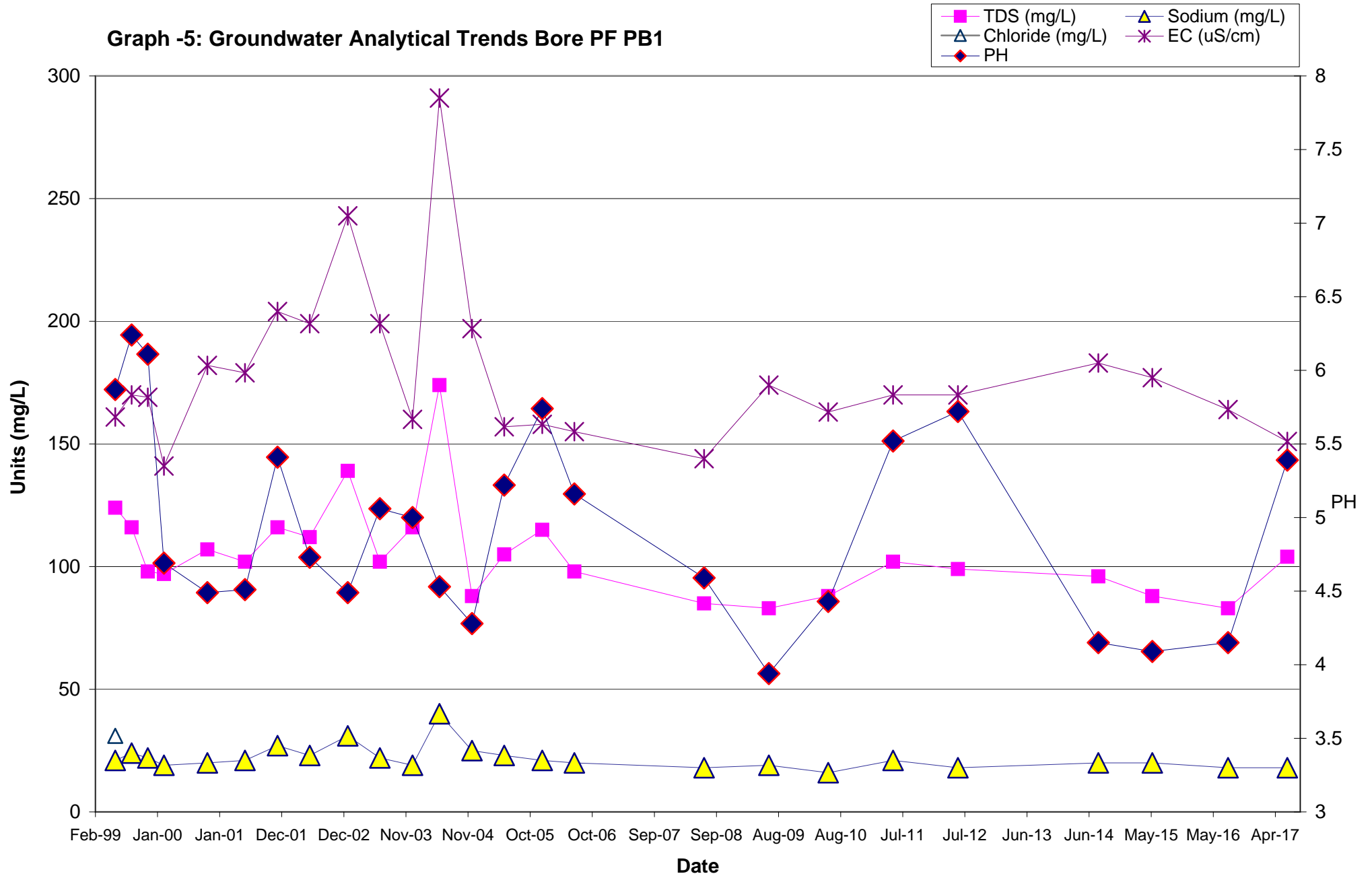
Graph -3: Groundwater Analytical Trends Bore PFL2HitchMW1



**Graph -4: Groundwater Analytical Trends Bore PFP214MW1**

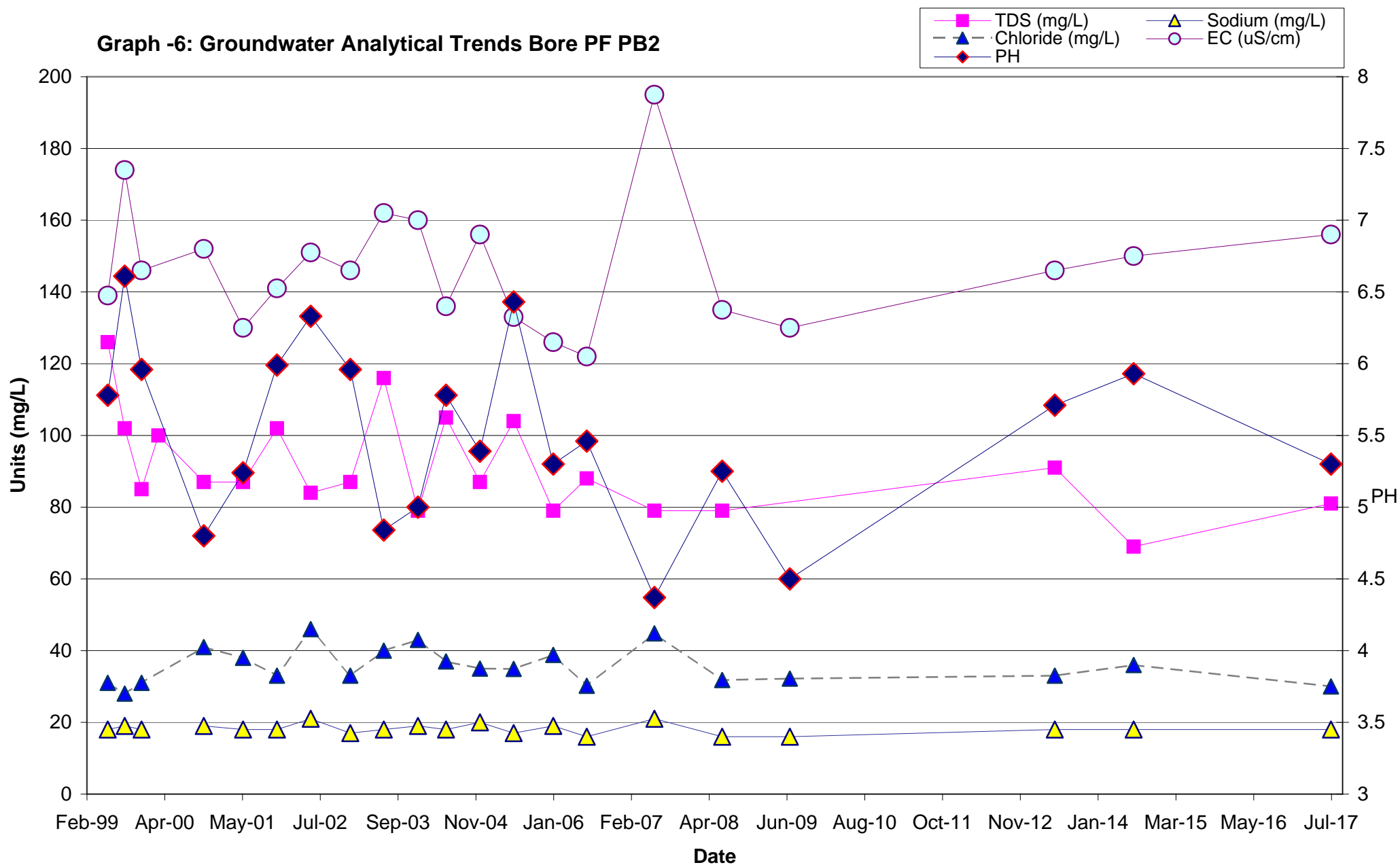


**Graph -5: Groundwater Analytical Trends Bore PF PB1**





**Graph -6: Groundwater Analytical Trends Bore PF PB2**



## TABLES

**Table 1: Maroota Climate Summary (2016-2017)**



<b>Date</b>	<b>Monthly Rainfall (mm)</b>
July (2016)	61
August	83
September	57
October	34.4
November	68.2
December	66.8
January	59.8
February (2017)	84.2
March	276.8
April	32.2
May	15.2
June	118.8
<b>Total (mm/yr)</b>	<b>957.4</b>

**Table 2: Monitoring Well Details & Water Table Gauging (2017)**  
Maroota -Hitchcock Road



Sample ID	SWL (m btoc) 27-7-2017	SWL (m btoc) 17-7-2017	SWL (m btoc) 9-6-2017	SWL (m btoc) 7-6-2017	SWL (m btoc) 18-5-2017	SWL (m btoc) 21-3-2017	SWL (m btoc) 10-8-2016	PVC Stickup *	BOH (mbgl)	Co-ordinates	Ground RL	RL (TOC) *	Reduced SWL (mAHD) 17-7-2017	Reduced SWL (mAHD) 7-6-2017	Aquifer
<b>Existing Monitoring Wells</b>															
PF214MW-1	NA	<b>5.39</b>	5.85	<b>5.85</b>	NA	NA	5.62	0.8	18	313286.41 & 6294508.34	184.45	185.26	179.88	179.41	deep sandstone
PF167MW-1	NA	<b>4.70</b>	4.83	<b>4.83</b>	NA	NA	4.37	0.3	23.8	313190.79 & 6294816.05	187.85	187.95	183.25	183.12	deep sandstone
PF166MW-1	NA	<b>10.01</b>	10.80	<b>10.8</b>	NA	NA	9.6	0.55	11.8	313293.61 & 6295256.65	209.78	210.35	200.34	199.55	maroota sand
PFL2HitchMW-1	36.14	<b>36.11</b>	36.27	<b>36.27</b>	NA	36.44	36.02	0.55	43.5	313810.71 & 6295241.46	225.13	225.87	189.77	189.6	deep sandstone
<b>New Monitoring Wells (May 2017)</b>															
PF167 MW-2D	27.98	<b>27.91</b>	NA	<b>27.85</b>	27.07	NA	NA	0.6	29.4	313438.92 & 6295492.65	209.28	209.9	181.99	182.05	deep sandstone
PF167 MW-2s	4.63	<b>4.52</b>	NA	<b>4.60</b>	4.54	NA	NA	0.7	5.1	313439.64 & 6295494.49	209.3	210.00	205.48	205.4	maroota sand
PF167 MW-3D	NA	<b>13.95</b>	NA	<b>14.40</b>	14.18	NA	NA	0.75	23	313545.67 & 6295186.86	197.93	198.67	184.72	184.27	deep sandstone
PF166 MW-4D	7.45	<b>7.34</b>	NA	<b>7.46</b>	8.32	NA	NA	0.5	15.5	313727.56 & 6294836.89	192.93	193.39	186.06	185.93	deep sandstone
PF166 MW-4s	7.58	<b>7.52</b>	NA	<b>7.61</b>	7.54	NA	NA	0.5	8	313725.86 & 6294836.93	192.93	193.44	185.93	185.83	maroota sand
PF167 MW-5D	NA	<b>1.48</b>	NA	<b>1.76</b>	3.19	NA	NA	0.5	9.5	313203.61 & 6294658.95	180.85	181.54	180.06	179.78	deep sandstone

Notes:  
NA= not available  
SWL= standing water level  
BOH= bottom of well  
\* Survey conducted in May 2017 by Freeborn Surveyors

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

PF Formation at Maroota



	PF167MW1	PF166MW1	PFL2HitchMW1	PFP214MW1	198PB1	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 167 DP 752039
License No	GW100649	GW104410	GW110746	GW110747	10AL109354	10WAL1093550	GW104614
Alocation (ML/yr)					Combined 60 ML /yr		50 ML/year
Approval Number					GW101528	GW101527	10WA114809
Groundwater Resource	Sydney Central Sandstone	Maroota Tertiary Sand	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Sydney Central Sandstone	Maroota Tertiary Sand
Date Installed	1996	1998	2009	2009	1998	1998	1995
Drilled Depth (m bgl)	23.8	11.8	43.5	18	150	138	4
Well Screen Interval (mbgl)	20-23 ?	4.9-10.9	31- 43	11.5- 17.5	23.4 - 140	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	2.6 L/sec	10 L/sec
Water Levels (mbgl)	4	10.57	36	5.6	20.58	35.36	(~4 m) 180 MAHD
Water Type	Na-Cl	Na-SO4	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
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	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	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	Pumping bore and supply to sand wash plant. Treated for Fe floc- not sampled for 2 yrs	Allocation is Under utilised. Former agricultural use- spring & unlined dam. Previous data logging (URS, 1996-2012) of pond levels

**Table 3B: Summary of New Monitoring Wells (Hitchcock Road; May 2017)**

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	May-17
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



## Tables 3.1 to 3.2: Maroota Hitchcock Road- Water Analyses (1999 to 2017)



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
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
Electrical Conductivity, EC	uS/cm	164	190	201	179	184	170	188	215	199	204	225	221	240
Total Dissolved Solids, TDS	mg/L	118	90	105	115	207	120	108	121	101	116	157	110	143
Calcium, Ca	mg/L	3	3	5	6	3	6	6	5	3	4	4	5	5
Magnesium, Mg	mg/L	5	4	4	4	4	4	5	4	4	3	4	4	4
Sodium, Na	mg/L	16	18	16	15	18	16	18	25	20	19	22	23	26
Potassium, K	mg/L	2	2	3	3	3	5	4	5	2	2	2	3	3
Bicarbonate, HCO <sub>3</sub>	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L	9	11	35	32	16	15	15	14	9	13	12	10	13
Chloride, Cl	mg/L	36	11	35	32	35	36	47	58	4	48	51	53	50
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

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

Date		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	8.8.14	30.6.15	10.8.2016	17.7.2017
pH		5.42	4.32	4.27	4.88	5.29	4	4.3	5.3	4.39	4.18	4.6	4.48	4.54	4.67
Electrical Conductivity, EC	uS/cm	215	205	199	188	161	177	190	170	174	211	205	150	188	151
Total Dissolved Solids, TDS	mg/L	137	141	119	76	100	104	111	101	112		94	70	111	99
Calcium, Ca	mg/L	5	4	4	2	6	5	3	4	7	<1	5	5	5	4
Magnesium, Mg	mg/L	4	4	4	3	5	4	3	4	4	4	4	3	4	4
Sodium, Na	mg/L	28	25	23	16	13	14	15	18	12	22	19	12	17	14
Potassium, K	mg/L	3	3	3	2	4	4	2	4	4	2	3	2	3	3
Bicarbonate, HCO <sub>3</sub>	mg/L	2	1	<1	<1	<1	<1	2	2.4	<1	<1	<1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L	13	10	6	10	30	22.6	17.1	18	28	1	19	30	22	24
Chloride, Cl	mg/L	56.6	57.4	53.1	36.1	26.4	34.8	39.9	29	22	42	42	15	32	28
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<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
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
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, HCO <sub>3</sub>	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L	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		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	8.8.14	30.6.15	10.8.2016	17.7.2017
pH					4.76		3.58	4.06	4.22	4.08	4.53	4.19	4.03	4.18	4.11
Electrical Conductivity, EC	uS/cm	DRY	DRY	DRY	163	NA	240	247	261	229	189	219	239	208	176
Total Dissolved Solids, TDS	mg/L				98		140	141	172	124	186	89	100	234	122
Calcium, Ca	mg/L						<1	<1	1	1	6	1	<1	1	<1
Magnesium, Mg	mg/L						4	4	6	5	4	5	6	5	5
Sodium, Na	mg/L						26	24	24	19	15	22	26	22	21
Potassium, K	mg/L						2	2	3	3	4	1	1	2	2
Bicarbonate, HCO <sub>3</sub>	mg/L						<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L						2.21	1.77	1	1	21	2	1	2	2
Chloride, Cl	mg/L						49.1	56.3	53	43	32	46	38	40	38
Oil and Grease	mg/L						<5	<5	<5	<5	<5	<5	<5	<5	<5



### Tables 3.3 to 3.4: Maroota Hitchcock Road- Water Analyses (1999 to 2017)

**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
pH		3.96	4.1	4.1	4.03	4.03	4.18	3.99	3.94	4.19	4.02
Electrical Conductivity, EC	uS/cm	182	154	167	195	195	185	263	309	288	298
Total Dissolved Solids, TDS	mg/L	84	88	110	99	99	150	107	146	230	147
Calcium, Ca	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium, Mg	mg/L	2	2	2	2	2	2	3	3	3	4
Sodium, Na	mg/L	19	16	22	22	22	22	32	44	36	37
Potassium, K	mg/L	2	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate, HCO <sub>3</sub>	mg/L	<1	<	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L	7.88	4.06	5	1	1	4	6	6	6	5
Chloride, Cl	mg/L	40.3	36.9	32	43	43	43	62	59	63	70
Oil and Grease	mg/L	<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
pH		4.19	4.16	4.31	4.27	5.7	4.22	4.07	4.05	4.34
Electrical Conductivity, EC	uS/cm	168	164	158	179	198	258	251	247	253
Total Dissolved Solids, TDS	mg/L	100	96	88	103	124	108	118	135	129
Calcium, Ca	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium, Mg	mg/L	6	5	4	6	7	10	11	10	8
Sodium, Na	mg/L	18	15	18	17	21	23	21	17	14
Potassium, K	mg/L	1	<1	1	<1	2	<1	<1	1	1
Bicarbonate, HCO <sub>3</sub>	mg/L	<1	<1	<1	<1	2	<1	<1	<1	<1
Sulphate, SO <sub>4</sub>	mg/L	1.9	<0.5	<1	<1	<1	<1	<1	<1	<1
Chloride, Cl	mg/L	24.3	23.8	34	24	34	34	26	34	36
Oil and Grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5

Tables 3.1 to 3.6: Maroota Hitchcock Road- Water Analyses (1999 to 2017)



Table 3-5 Bore 198PB1 Chemical Analyses Summary (1999-2017)

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	17.7.2017
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
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
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
Calcium, Ca	mg/L	1	<1	1	1	3	2	2	4	3	2	2	4	1	2	2	1		<1	1	<1	2	2		1	1	1	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
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
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
Bicarbonate, HCO <sub>3</sub>	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
Sulphate, SO <sub>4</sub>	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
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
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

Table 3-6 Bore198PB2 Chemical Analyses Summary (1999-2017)

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	30.06.15	10.08.16	17.7.2017
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	NA	NA	NA	5.71	5.93	no sample		5.3
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
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
Calcium, Ca	mg/L	1	2	2	NA	<1	<1	<1	1	<1	<1	2	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
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
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
Bicarbonate, HCO <sub>3</sub>	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
Sulphate, SO <sub>4</sub>	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
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
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

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

**Table 3-7: Portion 167 Dam Annual Pumpage Records**  
1997 to 2017



YEAR	TOTAL, ML
1997	24.56
1998	24.24
1999 to May	16.84
1 June 1999 - 30 June 2000	66.3
1 July 2000 - 5 September 2000	31.4
5 September 2000 - 25 June 2001	Not used
25 June 2001 - 30 June 2001	1
1 July 2001 - 8 February 2002	59.2
8 February 2002 - 30 June 2002	Not used
30 June 2002 - 29 August 2002	Not used
29 August 2002 - 30 June 2003	65.2
1 July 2003 - 29 June 2004	73.1
1 July 2004 - 3 May 2005	57.5
7 October 2005 - 30 June 2006	25.4
1 July 2006 - 30 June 2007	21.3
1 July 2007 - 30 June 2008	21.5
1 July 2008 - 30 June 2009	42.2
1 July 2009 - 30 June 2010	56.2
1 July 2010 - 30 June 2011	48.9
1 July 2011 - 30 June 2012	No pumpage
1 July 2012 - 30 June 2013	42.8
1 July 2013 - 30 June 2014	30.395
1 July 2014 - 30 June 2015	No pumpage
1 July 2015 - 30 June 2016	<b>46.829</b>
1 July 2016 - 30 June 2017	<b>38.407</b>

**Table 3-8: Water Supply Bores, Annual Pumping Records (PB1 &2)**  
2000 to 2017

Year	Bore	Total, ML
1 July 1999 - 30 June 2000	Bore PF1 98PB1	21.1
	PF198PB2	35.6
1 July 2000 - 30 June 2001	Bore PF198PB1	20.3
	Bore PF198PB2	29
1 July 2001 - 30 June 2002	Bore PF198PB1	25.1
	Bore PF198PB2	36
1 July 2002 - 30 June 2003	Bore PF198PB1	24.8
	Bore PF198PB2	47.8
1 July 2003 - 29 June 2004	Bore PF198PB1	22.9
	Bore PF198PB2	49.3
1 July 2004 - 29 June 2005	Bore PF1 98PB1	4.2
	Bore PF198PB2	18.7
5 July 2005 - 23 June 2006*	Bore PF198PB1	14.8
	Bore PF198PB2	8.9
24 June 2006 - 30 June 2007*	Bore PF198PB1	7.8
	Bore PF198PB2	19.9
1 July 2007 - 30 June 2008*	Bore PF198PB1	1.6
	Bore PF198PB2	22.9
1 July 2008 - 30 June 2009*	Bore PF198PB1	25.6
	Bore PF198PB2	16
1 July 2009 - 30 June 2010*	Bore PF198PB1	9.5
	Bore PF198PB2	8.1
1 July 2010 - 30 June 2011*	Bore PF198PB1	11.8
	Bore PF198PB2	NA
1 July 2011 - 30 June 2012*	Bore PF198PB1	9.8
	Bore PF198PB2	13.2
1 July 2012 - 30 June 2013	Bore PF198PB1	NA
	Bore PF198PB2	10.9
1 July 2013 - 30 June 2014	Bore PF198PB1	3.6
	Bore PF198PB2	30
1 July 2014 - 30 June 2015	Bore PF198PB1	6.1
	Bore PF198PB2	15.7
1 July 2015 - 30 June 2016	Bore PF198PB1	5.73
	Bore PF198PB2	11.111
1 July 2016 - 30 June 2017	Bore PF198PB1	<b>8.951</b>
	Bore PF198PB2	<b>7.556</b>
Combined PB1&2 per yr		<b>16.507</b>

\* Due to modifications carried out at the wash plant, these bores are no longer required for continuous water supply

**Table 3-8A: Water Supply Bores, Groundwater Levels (PB1 &2)**

Production Bore	Groundwater Levels	Comments
<b>PB-1</b>	7-6-2017 = 18.6m btoc 19-7-2017= 15.17 m btoc	
<b>PB-2</b>	7-6-2017 = 18.6m btoc 19-7-2017= 18.5 m btoc	Oxalic Acid used until Dec 2016

## APPENDIX A

### Limitations

Earth2Water Pty Ltd has prepared this report for the use of PF Formation in accordance with the standard terms and conditions of the consulting profession. This report is prepared in accordance with the scope of work and for the purpose outlined in the proposal. The methodology adopted and sources of information used by E2W are outlined in this report. Some technical issues arose from the downloading of the Solinst data loggers (2008/2009) and considered to reflect logger age).

This report was prepared during July and August 2017 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



## CERTIFICATE OF ANALYSIS

**Work Order** : **ES1717633**  
**Client** : **EARTH2WATER PTY LTD**  
**Contact** : **MR DINO PARISOTTO**  
**Address** : **175 FERN ST**  
**GERRINGONG NSW 2534**  
**Telephone** : **+61 4236 1334**  
**Project** : **----**  
**Order number** : **E2W-224A**  
**C-O-C number** : **----**  
**Sampler** : **DINO PARISOTTO, ELLEN SWANSON**  
**Site** : **Maroota-Pit 5**  
**Quote number** : **BQ 2015**  
**No. of samples received** : **7**  
**No. of samples analysed** : **7**

**Page** : 1 of 4  
**Laboratory** : Environmental Division Sydney  
**Contact** : Customer Services ES  
**Address** : 277-289 Woodpark Road Smithfield NSW Australia 2164  
**Telephone** : +61-2-8784 8555  
**Date Samples Received** : 18-Jul-2017 10:30  
**Date Analysis Commenced** : 18-Jul-2017  
**Issue Date** : 24-Jul-2017 13:00



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ashesh Patel	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by 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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

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)				Client sample ID	PFL3MW-2	PF166MW.1	PF167MW.1	PFL2Hitch MW.1	PFMW.2S
Client sampling date / time					17-Jul-2017 00:00	17-Jul-2017 00:00	17-Jul-2017 00:00	17-Jul-2017 00:00	17-Jul-2017 00:00
Compound	CAS Number	LOR	Unit		ES1717633-001	ES1717633-002	ES1717633-003	ES1717633-004	ES1717633-005
					Result	Result	Result	Result	Result
<b>EA005P: pH by PC Titrator</b>									
pH Value	----	0.01	pH Unit		4.11	4.11	4.67	4.02	4.58
<b>EA010P: Conductivity by PC Titrator</b>									
Electrical Conductivity @ 25°C	----	1	µS/cm		192	176	151	298	166
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		102	122	99	147	114
<b>ED037P: Alkalinity by PC Titrator</b>									
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	<1	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L		<1	<1	<1	<1	<1
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		2	2	24	5	6
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		49	38	28	70	38
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		2	<1	4	<1	3
Magnesium	7439-95-4	1	mg/L		8	5	4	4	4
Sodium	7440-23-5	1	mg/L		37	21	14	37	18
Potassium	7440-09-7	1	mg/L		<1	2	3	<1	2
<b>EN055: Ionic Balance</b>									
Total Anions	----	0.01	meq/L		1.42	1.11	1.29	2.08	1.20
Total Cations	----	0.01	meq/L		2.37	1.38	1.21	1.94	1.31
<b>EP020: Oil and Grease (O&amp;G)</b>									
Oil & Grease	----	5	mg/L		<5	<5	<5	<5	<5



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	PFMW.2D	PF214MW.1	----	----	----
Client sampling date / time					17-Jul-2017 00:00	17-Jul-2017 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1717633-006	ES1717633-007	-----	-----	-----
				Result	Result		----	----	----
<b>EA005P: pH by PC Titrator</b>									
pH Value	----	0.01	pH Unit		6.28	4.34	----	----	----
<b>EA010P: Conductivity by PC Titrator</b>									
Electrical Conductivity @ 25°C	----	1	µS/cm		140	253	----	----	----
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		70	129	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		11	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		11	<1	----	----	----
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		7	<1	----	----	----
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		32	36	----	----	----
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		4	<1	----	----	----
Magnesium	7439-95-4	1	mg/L		2	8	----	----	----
Sodium	7440-23-5	1	mg/L		18	14	----	----	----
Potassium	7440-09-7	1	mg/L		2	1	----	----	----
<b>EN055: Ionic Balance</b>									
Total Anions	----	0.01	meq/L		1.27	1.02	----	----	----
Total Cations	----	0.01	meq/L		1.20	1.29	----	----	----
<b>EP020: Oil and Grease (O&amp;G)</b>									
Oil & Grease	----	5	mg/L		<5	<5	----	----	----

## QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES1717633	Page	: 1 of 5
Client	: EARTH2WATER PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR DINO PARISOTTO	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 18-Jul-2017
Site	: Maroota-Pit 5	Issue Date	: 24-Jul-2017
Sampler	: DINO PARISOTTO, ELLEN SWANSON	No. of samples received	: 7
Order number	: E2W-224A	No. of samples analysed	: 7

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

### Summary of Outliers

#### Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

#### Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

#### Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.



## Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005P: pH by PC Titrator</b>						
<b>Clear Plastic Bottle - Natural</b> PFL3MW-2, PF167MW.1, PFMW.2S, PF166MW.1, PFL2Hitch MW.1, PFMW.2D	----	----	----	18-Jul-2017	17-Jul-2017	1
<b>Clear Plastic Bottle - Natural</b> PF214MW.1	----	----	----	19-Jul-2017	17-Jul-2017	2

## Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) PFL3MW-2, PF167MW.1, PFMW.2S, PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	17-Jul-2017	✘	
Clear Plastic Bottle - Natural (EA005-P) PF214MW.1	17-Jul-2017	----	----	----	19-Jul-2017	17-Jul-2017	✘	
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P) PFL3MW-2, PF167MW.1, PFMW.2S, PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	14-Aug-2017	✔	
Clear Plastic Bottle - Natural (EA010-P) PF214MW.1	17-Jul-2017	----	----	----	19-Jul-2017	14-Aug-2017	✔	





Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H) PFL3MW-2, PF167MW.1, PFMW.2S,	PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	19-Jul-2017	24-Jul-2017	✓
Clear Plastic Bottle - Natural (EA015H) PF214MW.1		17-Jul-2017	----	----	----	20-Jul-2017	24-Jul-2017	✓
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P) PFL3MW-2, PF167MW.1, PFMW.2S,	PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	31-Jul-2017	✓
Clear Plastic Bottle - Natural (ED037-P) PF214MW.1		17-Jul-2017	----	----	----	19-Jul-2017	31-Jul-2017	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) PFL3MW-2, PF167MW.1, PFMW.2S,	PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	14-Aug-2017	✓
Clear Plastic Bottle - Natural (ED041G) PF214MW.1		17-Jul-2017	----	----	----	19-Jul-2017	14-Aug-2017	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) PFL3MW-2, PF167MW.1, PFMW.2S,	PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	14-Aug-2017	✓
Clear Plastic Bottle - Natural (ED045G) PF214MW.1		17-Jul-2017	----	----	----	19-Jul-2017	14-Aug-2017	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F) PFL3MW-2, PF167MW.1, PFMW.2S,	PF166MW.1, PFL2Hitch MW.1, PFMW.2D	17-Jul-2017	----	----	----	18-Jul-2017	24-Jul-2017	✓
Clear Plastic Bottle - Natural (ED093F) PF214MW.1		17-Jul-2017	----	----	----	20-Jul-2017	24-Jul-2017	✓
EP020: Oil and Grease (O&G)								
Amber Jar - Sulfuric Acid or Sodium Bisulfate (EP020) PFL3MW-2, PF167MW.1, PFMW.2S, PF214MW.1	PF166MW.1, PFL2Hitch MW.1, PFMW.2D,	17-Jul-2017	----	----	----	20-Jul-2017	14-Aug-2017	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	6	58	10.34	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	23	17.39	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	4	33	12.12	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	27	14.81	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	5	43	11.63	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	3	58	5.17	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	23	8.70	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	33	6.06	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Oil and Grease	EP020	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	43	13.95	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	23	8.70	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	33	6.06	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Oil and Grease	EP020	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	43	6.98	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of 'filterable' residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)  Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3)  Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
Oil and Grease	EP020	WATER	In house: Referenced to APHA 5520 B. Oil & grease is a gravimetric procedure to determine the amount of oil & grease residue in an aqueous sample. The sample is serially extracted three times n-hexane. The resultant extracts are combined, dehydrated and concentrated prior to gravimetric determination. This method is compliant with NEPM (2013) Schedule B(3)

# CHAIN OF CUSTODY DOCUMENTATION- EARTH2WATER PTY LTD

<b>CLIENT:</b> Earth2Water Pty Ltd <b>POSTAL ADDRESS:</b> 175 Fern St, Gerrigong NSW <b>SEND REPORT TO:</b> D.Parisotto <b>DATA NEEDED BY:</b> 5 day turnaround <b>QUOTE NO.:</b> 2014 Quote <b>COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:</b> Retain samples for 3 weeks prior to disposal <b>INVOICE to:</b> Earth2Water				<b>ALS Environmental</b> <b>Smithfield</b> <b>REPORT FORMAT:</b> HARD: Yes FAX: Yes DISK: <input type="checkbox"/> BULLETIN BOARD: <input type="checkbox"/> E-MAIL: Yes <b>QC LEVEL:</b> QCS1: <input type="checkbox"/> QCS2: <input type="checkbox"/> QCS3: Yes QCS4: <input type="checkbox"/>						
<b>LABORATORY BATCH NO.</b> SAMPLES: Dino Parisotto/Ellen Swanson PHONE: 0422 334102 FAX: 4236 1824 E-MAIL: earthh2o@pg.com.au				<b>ANALYSIS REQUIRED</b> 1 Oil & Grease 1 Ph, EC, TDS, 1 Ca, Mg, Na, K, Cl, HCO3, SO4 water sample not filtered						
<b>SAMPLE DATA</b>				<b>ALS Containers</b>						
SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.					
PF 198 PB2	water	21/07/2017		3 bottles		1	2	3	4	
PF 198 PB1	water	21/07/2017		3 bottles						
<div style="text-align: center; font-size: 2em; font-weight: bold;">HIT</div>										

Environmental Division  
 Sydney  
 Work Order Reference  
**ES1718380**



Telephone : + 61-2-8794 8555

<b>RELINQUISHED BY:</b> NAME: Dino Parisotto OF: Earth2Water		<b>RECEIVED BY:</b> NAME: M Goud OF: ALS	
DATE: 21-7-2017	DATE: 25-7-14	TIME:	TIME: 14:00
NAME:	NAME:	OF:	OF:

## CERTIFICATE OF ANALYSIS

**Work Order** : **ES1718380**  
**Client** : **EARTH2WATER PTY LTD**  
**Contact** : **MR DINO PARISOTTO**  
**Address** : **175 FERN ST**  
**GERRINGONG NSW 2534**  
**Telephone** : **+61 4236 1334**  
**Project** : **----**  
**Order number** : **E2W-224A**  
**C-O-C number** : **----**  
**Sampler** : **DINO PARISOTTO, ELLEN SWANSON**  
**Site** : **Maroota**  
**Quote number** : **BQ 2015**  
**No. of samples received** : **2**  
**No. of samples analysed** : **2**

**Page** : 1 of 3  
**Laboratory** : Environmental Division Sydney  
**Contact** : Customer Services ES  
**Address** : 277-289 Woodpark Road Smithfield NSW Australia 2164  
**Telephone** : +61-2-8784 8555  
**Date Samples Received** : 25-Jul-2017 14:00  
**Date Analysis Commenced** : 26-Jul-2017  
**Issue Date** : 31-Jul-2017 09:28



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. 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
Ashesh Patel	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW





## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by 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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

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: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	PF 198 PB2	PF 198 PB1	----	----	----
Client sampling date / time					21-Jul-2017 09:45	21-Jul-2017 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1718380-001	ES1718380-002	-----	-----	-----
				Result	Result		----	----	----
<b>EA005P: pH by PC Titrator</b>									
pH Value	----	0.01	pH Unit		<b>5.30</b>	<b>5.39</b>	----	----	----
<b>EA010P: Conductivity by PC Titrator</b>									
Electrical Conductivity @ 25°C	----	1	µS/cm		<b>156</b>	<b>151</b>	----	----	----
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		<b>81</b>	<b>104</b>	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<b>6</b>	<b>3</b>	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		<b>6</b>	<b>3</b>	----	----	----
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<b>6</b>	<b>6</b>	----	----	----
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		<b>30</b>	<b>31</b>	----	----	----
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		<1	<b>2</b>	----	----	----
Magnesium	7439-95-4	1	mg/L		<b>3</b>	<b>3</b>	----	----	----
Sodium	7440-23-5	1	mg/L		<b>18</b>	<b>18</b>	----	----	----
Potassium	7440-09-7	1	mg/L		<b>1</b>	<b>2</b>	----	----	----
<b>EN055: Ionic Balance</b>									
Total Anions	----	0.01	meq/L		<b>1.09</b>	<b>1.06</b>	----	----	----
Total Cations	----	0.01	meq/L		<b>1.06</b>	<b>1.18</b>	----	----	----
<b>EP020: Oil and Grease (O&amp;G)</b>									
Oil & Grease	----	5	mg/L		<5	<5	----	----	----

## QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES1718380	Page	: 1 of 5
Client	: EARTH2WATER PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR DINO PARISOTTO	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 25-Jul-2017
Site	: Maroota	Issue Date	: 31-Jul-2017
Sampler	: DINO PARISOTTO, ELLEN SWANSON	No. of samples received	: 2
Order number	: E2W-224A	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

### Summary of Outliers

#### Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

#### Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

#### Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.



## Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005P: pH by PC Titrator</b>						
<b>Clear Plastic Bottle - Natural</b> PF 198 PB2, PF 198 PB1	----	----	----	26-Jul-2017	21-Jul-2017	5

## Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	21-Jul-2017	✖	
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	18-Aug-2017	✔	
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	27-Jul-2017	28-Jul-2017	✔	
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	04-Aug-2017	✔	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	18-Aug-2017	✔	
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	18-Aug-2017	✔	
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F) PF 198 PB2, PF 198 PB1	21-Jul-2017	----	----	----	26-Jul-2017	28-Jul-2017	✔	



Matrix: WATER

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP020: Oil and Grease (O&G)								
Amber Jar - Sulfuric Acid or Sodium Bisulfate (EP020) PF 198 PB2,	PF 198 PB1	21-Jul-2017	----	----	----	28-Jul-2017	18-Aug-2017	✓





## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	8	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Oil and Grease	EP020	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	8	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Oil and Grease	EP020	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard



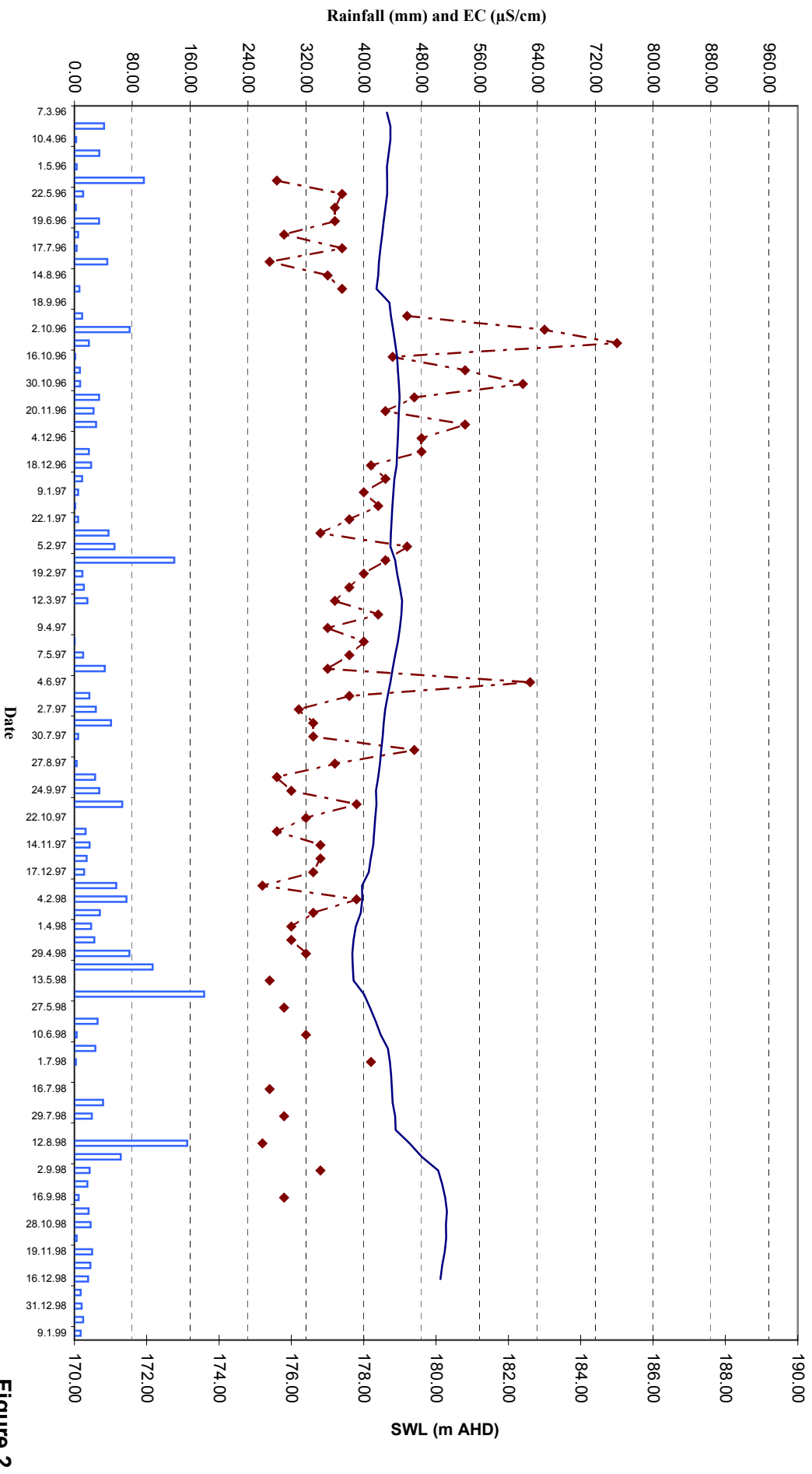
## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of 'filterable' residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)  Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3)  Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
Oil and Grease	EP020	WATER	In house: Referenced to APHA 5520 B. Oil & grease is a gravimetric procedure to determine the amount of oil & grease residue in an aqueous sample. The sample is serially extracted three times n-hexane. The resultant extracts are combined, dehydrated and concentrated prior to gravimetric determination. This method is compliant with NEPM (2013) Schedule B(3)

## APPENDIX C

**P.F.FORMATION**  
**Bore PF167MW1 Groundwater Monitoring Data**



**Figure 2**



**PF FORMATION**  
**Bore PF167MW1 Groundwater Monitoring Data**

— Rainfall, mm  
— Water level m AHD

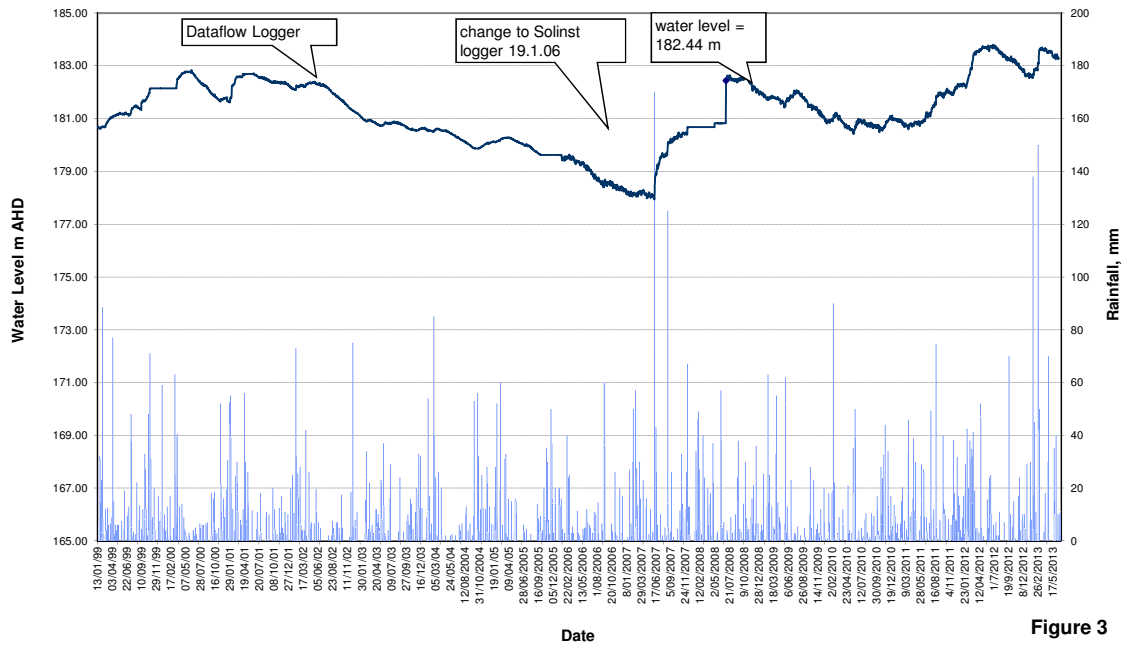


Figure 3

# PF FORMATION PF166MW1 Groundwater Monitoring Data

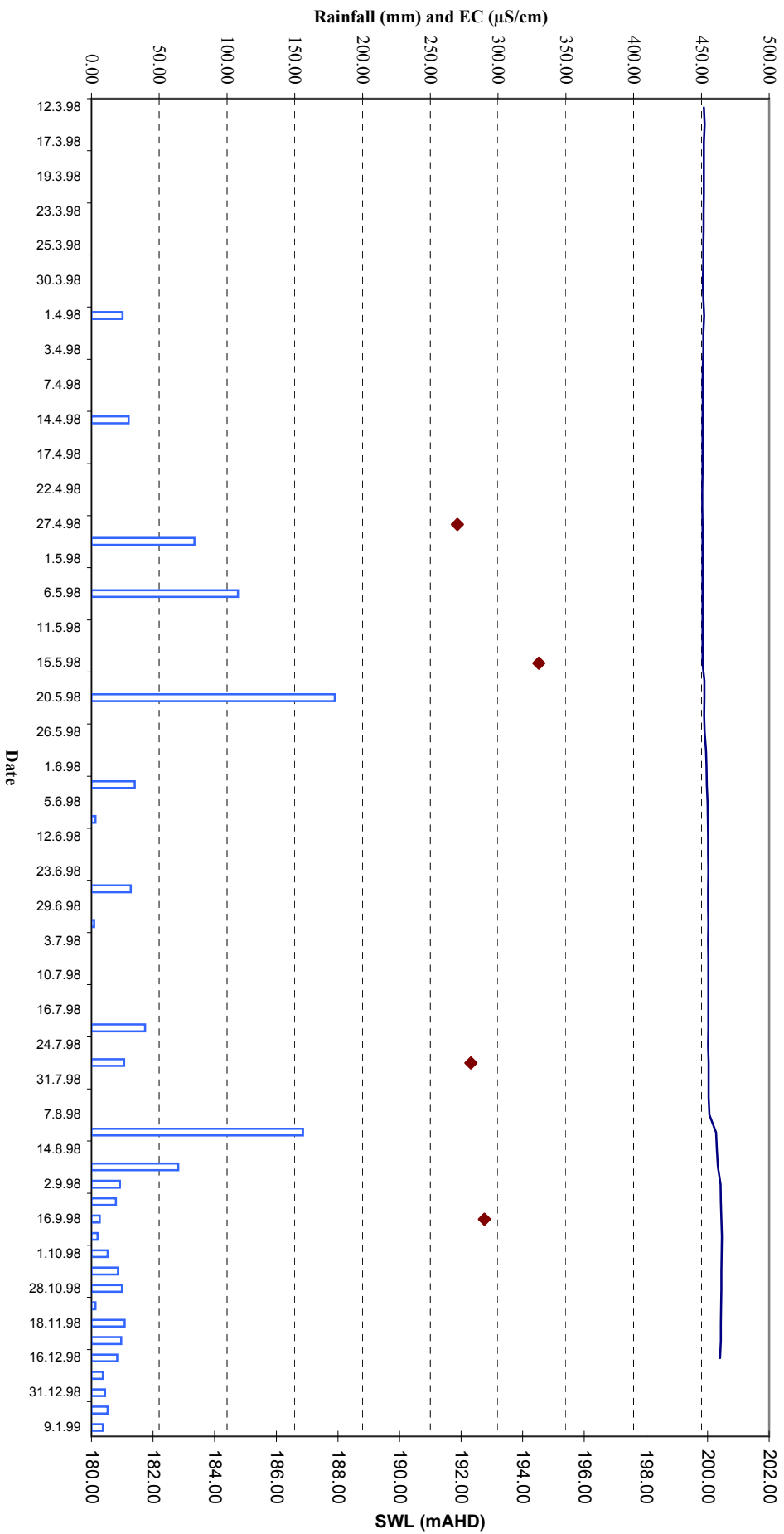


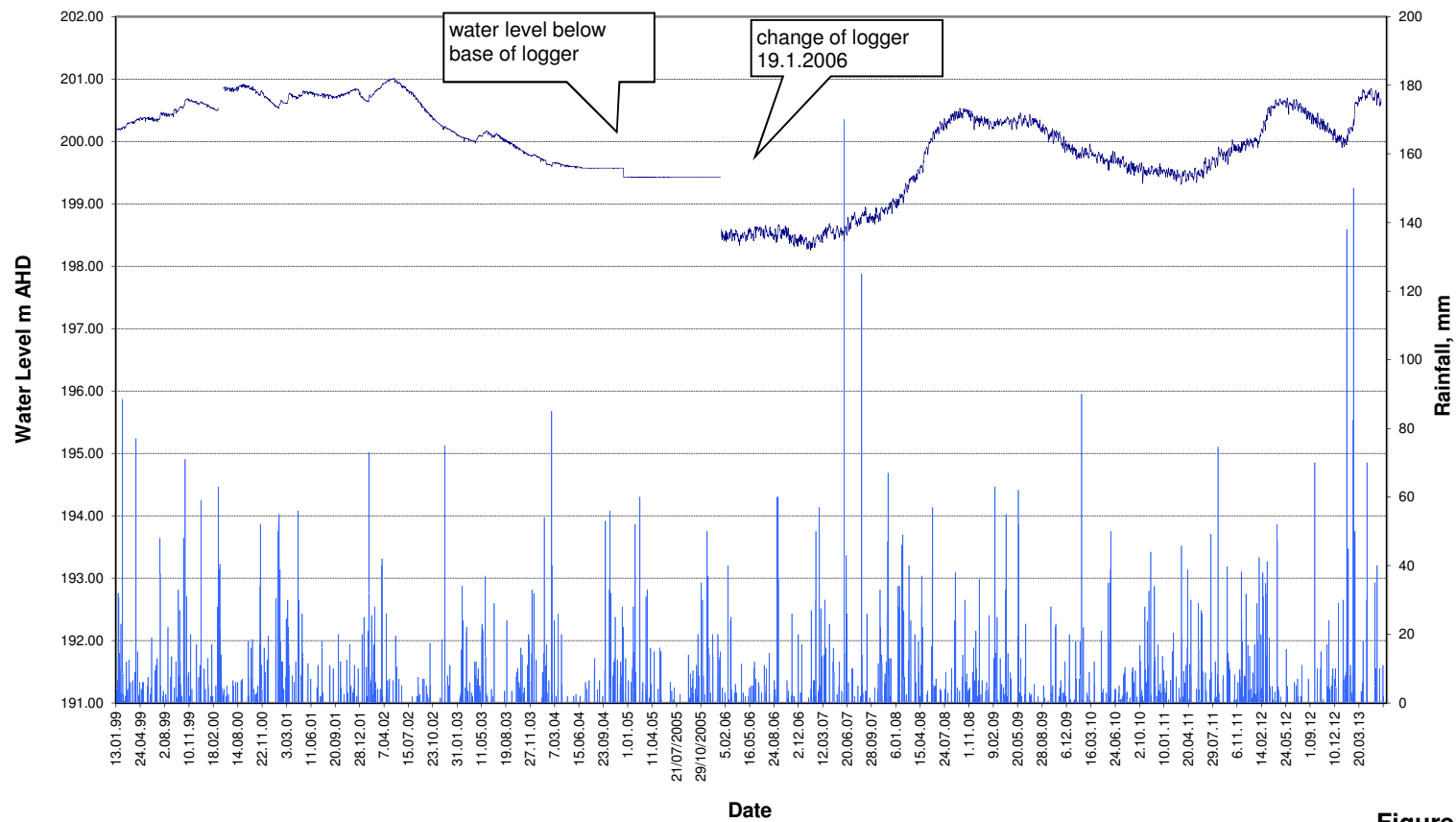
Figure 4





**PF FORMATION**  
**Bore PF166MW1 Groundwater Monitoring Data**

— Rainfall, mm  
— Water Level m AHD



**Figure 5**

# PF FORMATION Bore PFP214MW1 Groundwater Monitoring Data

▬ Rainfall, mm  
▬ Water Level, m AHD

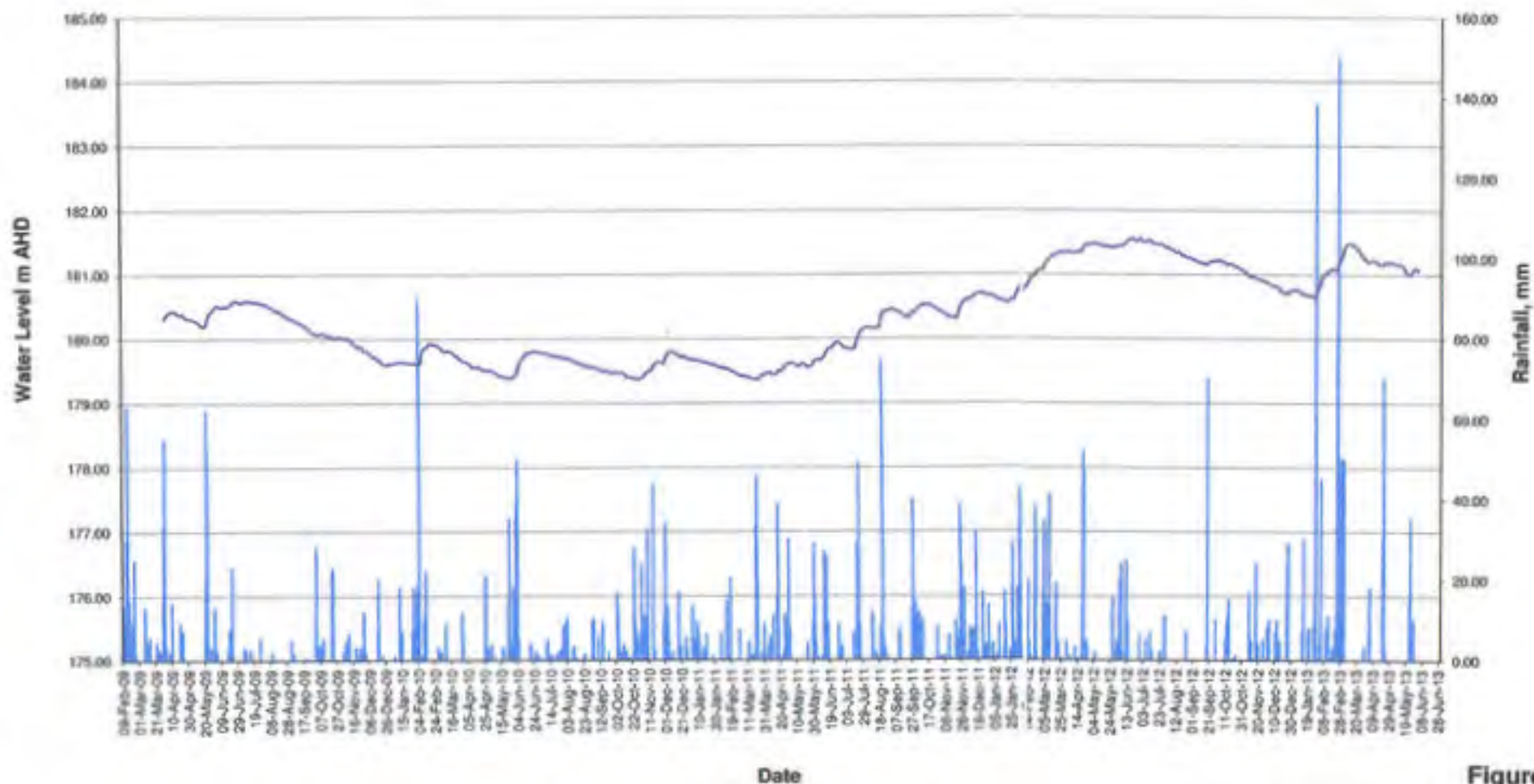
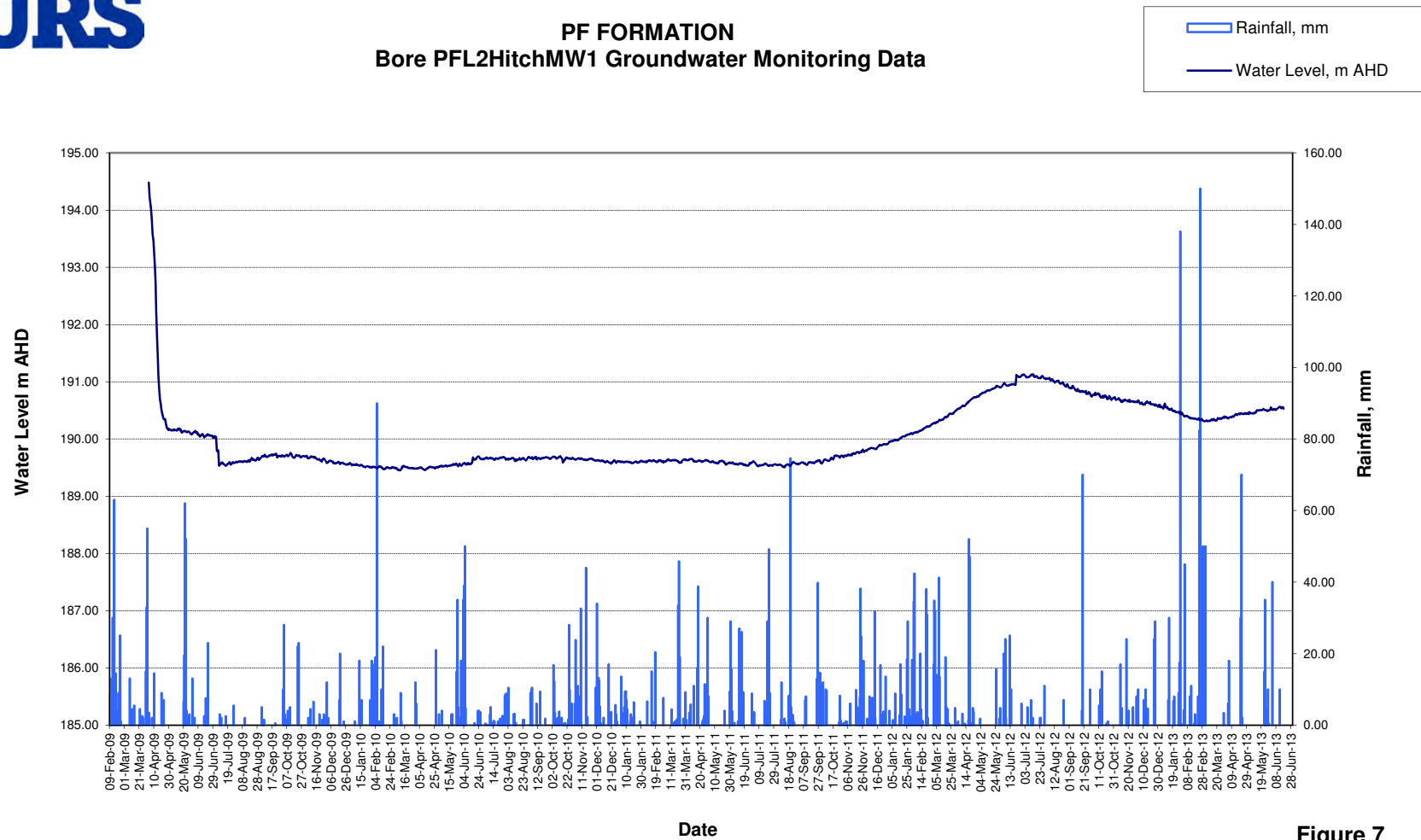


Figure 6



**PF FORMATION**  
**Bore PFL2HitchMW1 Groundwater Monitoring Data**



**Figure 7**



PF FORMATION  
PF167DAM, Licence No. 10BL157308, Groundwater Monitoring Data

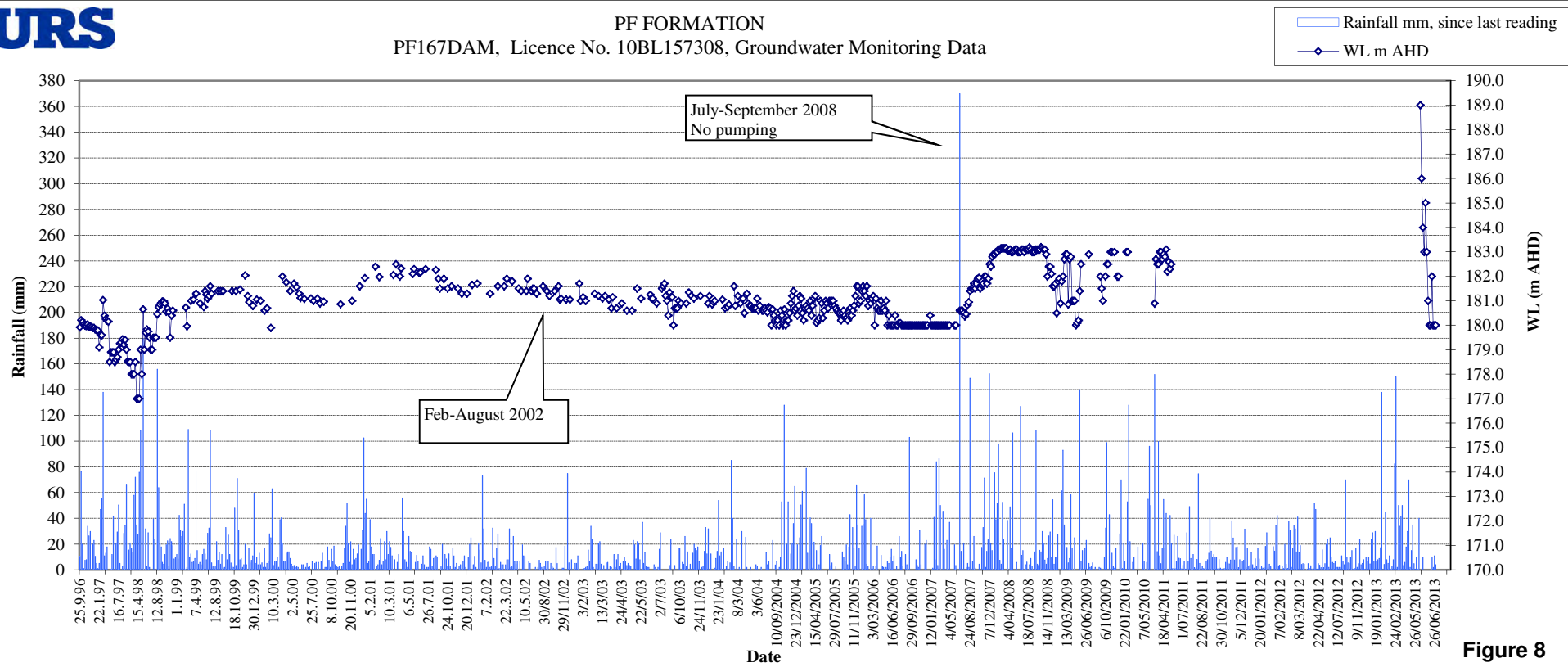


Figure 8



# PF FORMATION PF167DAM Monthly Pumpage Records

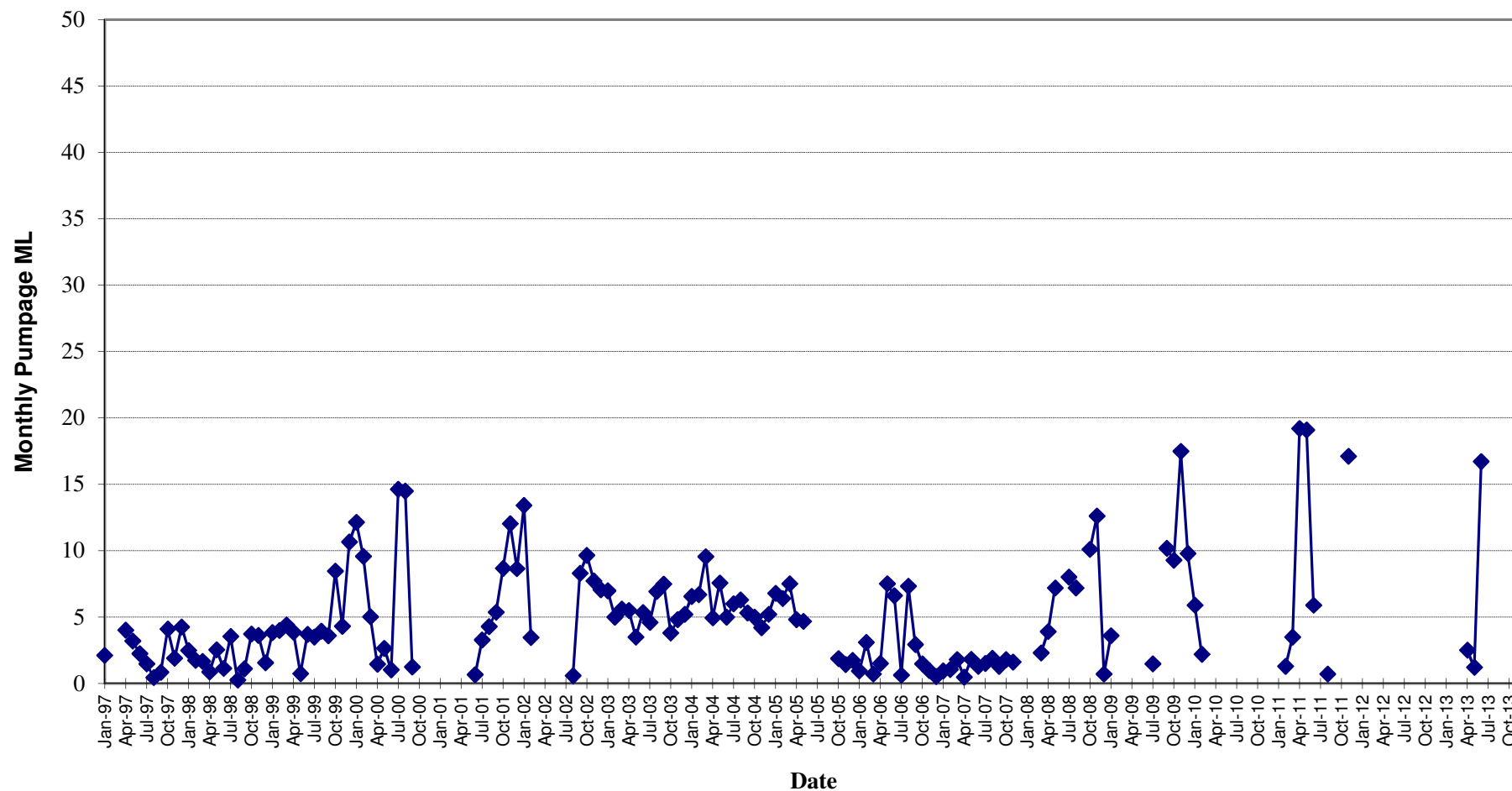
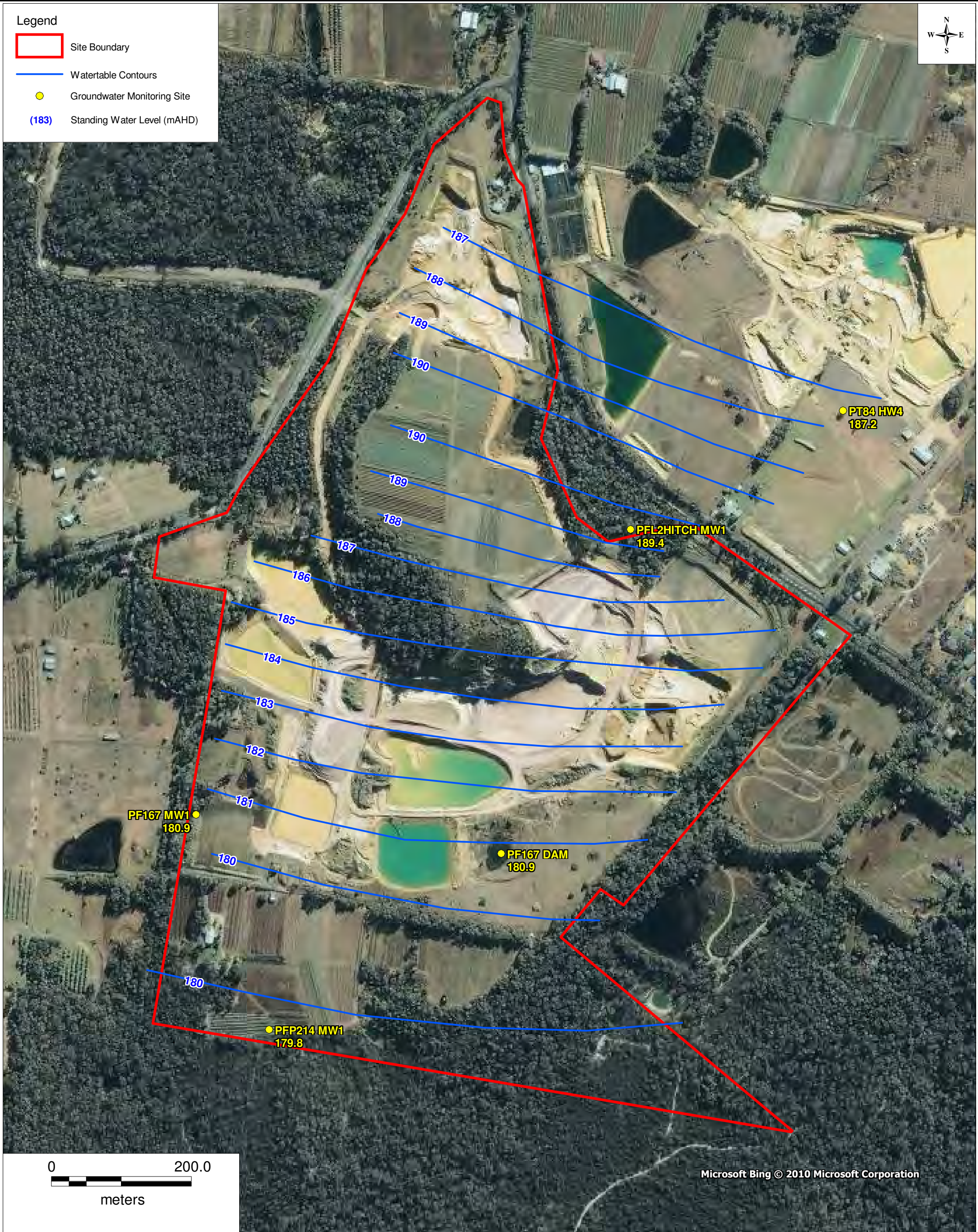


Figure 9

## APPENDIX D



This drawing is subject to COPYRIGHT.



Source: Aerial imagery from Bing Maps © 2010 Microsoft Corporation and its data suppliers.  
Whilst every care is taken by URS to ensure the accuracy of the digital data, URS makes no representation or warranties about its accuracy, reliability, completeness, suitability for any particular purpose and disclaims all responsibility and liability (including without limitation, liability in negligence) for any expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of data being inaccurate in any way for any reason. Electronic files are provided for information only. The data in these files is not controlled or subject to automatic updates for users outside of URS.

PF FORMATION

HITCHCOCK ROAD, SAND EXTRACTION  
AND REHABILITATION PROJECT

HITCHCOCK ROAD SITE  
WATERTABLE CONTOURS @ 22/06/2011



## APPENDIX E

## GROUNDWATER MONITORING WELL

<b>PROJECT :</b> Maroota- Hitchcock Rd		<b>JOB NO:</b> E2W-0238 Earth2Water Pty Ltd	
<b>LOCATION:</b> PF166MW-2s		<b>DATE STARTED:</b> 16/05/2017	
<b>SUPERVISOR:</b> Dino Parisotto (Lic DL1977)		<b>DATE COMPLETED:</b> 16/05/2017	
Contractor: TerraTest Pty Ltd		Method: SFA 125 mm diam	
Rig: Hydrapower Scout		Depth: 8.5 m	R.L. Ground (m):
Datum: Ground level		Water Level: approx 4 mbgl	R.L. WL (m):
<b>Well ID: MW-2s</b>			
Lithological Log	Comments	Depth (m)	Bore Construction Details
<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"> <p>Maroota Sands Outcrop- rehab area</p> <p>0 - 4 m Sandy Clay (fill): medium brown firm, moist, slightly plastic some quartz pebbles</p> <p>4- 5.5 m Sand: light grey, some silt &amp; granules, loose, saturated/wet (palaeochannel)</p> <p>5.5- 8.5m Sandy Clay: med brown, stiff plastic, moist</p> <p>8.5 m End of Borehole (target depth- sandy clay)</p> </div> <div style="width: 10%; text-align: center;"> <p>ingress</p> </div> <div style="width: 40%;"> <p>Monument- steel PVC/50mm stick-up (+0.65m)</p> <p>cement plug around PVC sleeve</p> <p>drill cuttings &amp; bentonite</p> <p>50mm PVC class 18 Casing ('+0.65m to 4.9m)</p> <p>Bentonite seal (2- 4.2m)</p> <p>4.2 - 8 m Gravel pack (2mm)</p> <p>4.9- 7.9m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling</p> <p>PVC end cap at 7.9 m</p> </div> </div>			
		0	
		1.0	
		2.0	
		3.0	
		4.0	
		5.0	
		6.0	
		7.0	
		8.0	
		9.0	
		10.0	
		11.0	



# GROUNDWATER MONITORING WELL

<b>PROJECT :</b>	Maroota- Hitchcock Rd	<b>JOB NO:</b>	E2W-0238 Earth2Water Pty Ltd
<b>LOCATION:</b>	PF166MW-2D	<b>DATE STARTED:</b>	16/05/2017
<b>SUPERVISOR:</b>	Dino Parisotto (Lic DL1977)	<b>DATE COMPLETED:</b>	17/05/2017
Contractor: TerraTest Pty Ltd	Method:	SFA 125 mm diam to 11m , RAB from 11-30m (100mm diam)	
Rig: Hydrapower Scout	Depth:	29.4 m	R.L. Ground (m):
Datum: Ground level	Water Level: approx 25 mbgl		R.L. WL (m):

**Well ID: MW-2D**

Lithological Log	Comments	Depth (m)	Bore Construction Details
Maroota Sands Outcrop- rehab area			Monument- steel PVC/50mm stick-up (+0.6m)
0 - 4 m Sandy Clay (fill): medium brown firm, moist, slightly plastic some quartz pebbles		0	cement plug around PVC sleeve
3.5- 5.7m Sand: light brown, some silt & granules, loose, saturated/wet (palaeochannel)	ingress	2.5	drill cuttings & bentonite
5.7-6.3 m Hard band (iron stone)		5.0	50mm PVC class 18 Casing ('+0.6m to 26.4m)
6.3- 9.5m Sandy Clay: med brown, stiff plastic, moist		7.5	
9.5-29.4m Sandstone/Siltstone (soft); light grey fine grained, clay matrix, moist weathered	11m RAB	10.0	
dusty drill cuttings- light grey		12.5	
moderately hard siltstone/sandstone		15.0	
		17.5	
moderately hard siltstone/sandstone		20.0	
light grey, clay matrix		22.5	Bentonite seal (23- 29.4m)
	minor ingress <0.01 L/sec	25.0	25 -29.4m Gravel pack (2mm)
		27.5	26.4- 29.4m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling
29.4 m End of Borehole (target depth- hard sandstone/siltstone)		30.0	PVC end cap at 29.4m



## GROUNDWATER MONITORING WELL

PROJECT :		Maroota- Hitchcock Rd		JOB NO:		E2W-0238 Earth2Water Pty Ltd	
LOCATION:		PF167MW-3D		DATE STARTED:		17/05/2017	
SUPERVISOR:		Dino Parisotto (Lic DL1977)		DATE COMPLETED:		17/05/2017	
Contractor: TerraTest Pty Ltd		Method:		SFA 125 mm diam to 3m , RAB from 3-23m (100mm diam)			
Rig: Hydrapower Scout		Depth:		23 m		R.L. Ground (m):	
Datum: Ground level		Water Level: approx 14 mbgl				R.L. WL (m):	
<div style="text-align: right;"> <b>Well ID: MW-3D</b> </div>							
Lithological Log		Comments	Depth (m)	Bore Construction Details			
Maroota Sands & Sandstone (extraction pit)							
0 to 23m	Sandstone/Siltstone (soft): light grey fine grained, weathered, clay matrix slight moisture	SFA	0	<div style="position: relative; height: 230px;"> <div style="position: absolute; top: 0; right: 0;">Monument- steel</div> <div style="position: absolute; top: 10px; right: 10px;">PVC/50mm stick-up (+0.75m)</div> <div style="position: absolute; top: 20px; right: 10px;">cement plug around PVC sleeve</div> <div style="position: absolute; top: 50px; right: 10px;">drill cuttings &amp; bentonite</div> <div style="position: absolute; top: 40px; right: 10px;">50mm PVC class 18 Casing (+0.75m to 20m)</div> <div style="position: absolute; top: 70px; right: 10px;">Bentonite seal (16- 18.6m)</div> <div style="position: absolute; top: 80px; right: 10px;">20 - 23 m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling</div> <div style="position: absolute; top: 85px; right: 10px;">18.6- 23m Gravel pack (2mm)</div> <div style="position: absolute; top: 90px; right: 10px;">PVC end cap at 23 m</div> </div>			
	hard light grey sandstone- dry	3m RAB	1.5				
			3.0				
	dusty drill cuttings- light grey		4.5				
			6.0				
			7.5				
			9.0				
			10.5				
			12.0				
	moderately hard siltstone/sandstone		13.5				
			15.0				
			16.5				
	dusty drill cuttings- light grey		18.0				
	moderately hard siltstone/sandstone		19.5				
			21.0				
	dusty drill cuttings- light grey		22.5				
		dry	24.0				
23 m	End of Borehole (target depth- moderate hard sandstone)		25.5				

## GROUNDWATER MONITORING WELL

<b>PROJECT :</b> Maroota- Hitchcock Rd		<b>JOB NO:</b> E2W-0238 Earth2Water Pty Ltd	
<b>LOCATION:</b> PF167MW-4s		<b>DATE STARTED:</b> 18/05/2017	
<b>SUPERVISOR:</b> Dino Parisotto (Lic DL1977)		<b>DATE COMPLETED:</b> 18/05/2017	
Contractor: TerraTest Pty Ltd		Method: SFA 125 mm diam	
Rig: Hydrapower Scout		Depth: 8 m	
Datum: Ground level		R.L. Ground (m):	
		R.L. WL (m):	
<b>Well ID: MW-4s</b>			
<b>Lithological Log</b>	<b>Comments</b>	<b>Depth (m)</b>	<b>Bore Construction Details</b>
			Monument- steel PVC/50mm stick-up (+0.5m)
Maroota Sands Outcrop- near Por167 Dam			
0 - 2 m	Sandy Silty Clay: medium brown firm, moist, uniform, slightly plastic	0	cement plug around PVC sleeve
		1.0	drill cuttings & bentonite
2- 3.5 m	Sandy Clay: med brown/red brown firm-stiff, moist, uniform, slightly plastic	2.0	50mm PVC class 18 Casing (+0.5m to 6.4m)
		3.0	
3.5-7.1m	Sandy Silt: med brown, some clay (10%) & minor pebbles, firm, moist.	4.0	Bentonite seal (2- 4m)
		5.0	
		6.0	4 - 8 m Gravel pack (2mm)
	minor ingress	7.0	5 - 8 m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling
7.1- 8 m	Sandstone/Siltstone (soft); light grey fine grained, clay matrix, moist weathered	8.0	PVC end cap at 8 m
8 m	End of Borehole (target depth- moderate hard sandstone)	9.0	
		10.0	
		11.0	



## GROUNDWATER MONITORING WELL

<b>PROJECT :</b> Maroota- Hitchcock Rd		<b>JOB NO:</b> E2W-0238 Earth2Water Pty Ltd	
<b>LOCATION:</b> PF167MW-4D		<b>DATE STARTED:</b> 18/05/2017	
<b>SUPERVISOR:</b> Dino Parisotto (Lic DL1977)		<b>DATE COMPLETED:</b> 18/05/2017	
Contractor: TerraTest Pty Ltd		Method: SFA 125 mm diam	
Rig: Hydrapower Scout		Depth: 15.5 m	
Datum: Ground level		R.L. Ground (m):	
		R.L. WL (m):	
<b>Well ID: MW-4D</b>			
<b>Lithological Log</b>	<b>Comments</b>	<b>Depth (m)</b>	<b>Bore Construction Details</b>
<div><div><div>Maroota Sands Outcrop- near Por167 Dam</div><div>0 - 2 m Sandy Silty Clay: medium brown firm, moist, uniform, slightly plastic</div><div>2- 3.5 m Sandy Clay: med brown/red brown firm-stiff, moist, uniform, slightly plastic</div><div>3.5-7.1m Sandy Silt: med brown, some clay (10%) &amp; minor pebbles, firm, moist.</div><div>7.1-15.5 m Sandstone/Siltstone (soft); light grey fine grained, clay matrix, moist weathered</div><div>muddy drill cutting returns</div><div>15.5 m End of Borehole (target depth- moderate hard sandstone)</div></div><div>minor ingress</div><div><div>0</div><div>1.0</div><div>2.0</div><div>3.0</div><div>4.0</div><div>5.0</div><div>6.0</div><div>7.0</div><div>8.0</div><div>9.0</div><div>10.0</div><div>11.0</div><div>12.0</div><div>13.0</div><div>14.0</div><div>15.0</div><div>16.0</div><div>17.0</div></div><div><div>Monument- steel PVC/50mm stick-up (+0.5m)</div><div>cement plug around PVC sleeve</div><div>drill cuttings &amp; bentonite</div><div>50mm PVC class 18 Casing ('+0.5m to 12.5m)</div><div>Bentonite seal (9.4- 11.4m)</div><div>12.5 - 15.5m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling</div><div>11.4-15.5m Gravel pack (2mm)</div><div>PVC end cap at 15.5 m</div></div></div>			

## GROUNDWATER MONITORING WELL

<b>PROJECT :</b> Maroota- Hitchcock Rd		<b>JOB NO:</b> E2W-0238 Earth2Water Pty Ltd	
<b>LOCATION:</b> PF166MW-5D		<b>DATE STARTED:</b> 18/05/2017	
<b>SUPERVISOR:</b> Dino Parisotto (Lic DL1977)		<b>DATE COMPLETED:</b> 18/05/2017	
Contractor: TerraTest Pty Ltd		Method: SFA 125 mm diam	
Rig: Hydrapower Scout		Depth: 9.5 m	
Datum: Ground level		R.L. Ground (m):	
		Water Level: approx 3 mbgl	
		R.L. WL (m):	
<b>Well ID: MW-5D</b>			
<b>Lithological Log</b>	<b>Comments</b>	<b>Depth (m)</b>	<b>Bore Construction Details</b>
Sandstone Outcrop- near Silt Pond			Monument- steel PVC/50mm stick-up (+0.5m)
0 to 9.5m Sandstone/Siltstone (soft): light grey fine grained, weathered, clay matrix moist		0	cement plug around PVC sleeve
		1.0	
		2.0	50mm PVC class 18 Casing (+0.5m to 6.4m)
		3.0	drill cuttings & bentonite
becoming very moist		4.0	
hardness increasing		5.0	Bentonite seal (3.5- 5.5m)
		6.0	
moderately hard siltstone/sandstone light grey, clay matrix muddy drill cutting returns	minor ingress	7.0	6.4 - 9.4 m, 50mm PVC cl 18 screen 0.45mm aperture, screw coupling
		8.0	
		9.0	5.5-9.4 m Gravel pack (2mm)
9.5m End of Borehole (target depth- moderate hard sandstone)		10.0	PVC end cap at 9.4 m
		11.0	



## APPENDIX F

### Mathew Freeburn Pty Ltd (survey information)

**From:** Clint [mailto:clint@freeburnsurveyors.com]  
**Sent:** Monday, 29 May 2017 3:50 PM  
**To:** 'Josh Graham' <josh@pfformation.com.au>  
**Subject:** Extraction Levels and Wells.

Hi Josh,

Below are the Coordinates and levels taken on concrete base, top of pipe and top of metal lid for new and existing monitoring wells.

(PFP214 MW1) E =313286.41 N = 6294508.34 RL 184.450 Concrete - RL 185.26 Pipe - RL 185.34 Lid  
(PF167MW-5D) E =313203.61 N = 6294658.95 RL 180.850 Concrete - RL 181.54 Pipe - RL 181.65 Lid  
(PF167 MW1) E =313190.79 N = 6294816.05 RL 187.850 Concrete - RL 187.95 Pipe  
(PF167MW-4S) E =313725.86 N =6294836.93 RL 192.930 Concrete - RL 193.44 Pipe - RL 193.57 Lid  
(PF167MW-4D) E =313727.56 N = 6294836.89 RL 192.930 Concrete - RL 193.39 Pipe - RL 193.193.52 Lid  
(PF166MW-3D) E =313545.67 N = 6295186.86 RL 197.930 Concrete - RL 198.67 Pipe - RL 198.81 Lid  
(PF166 MW1) E =313293.61 N = 6295256.65 RL 209.780 Concrete - RL 210.35 Pipe - RL 210.55 Lid  
(PF166MW-2D) E =313438.92 N = 6295492.65 RL 209.280 Concrete - RL 209.90 Pipe - RL 210.09 Lid  
(PF166MW-2S) E =313439.64 N = 6295494.49 RL 209.300 Concrete - RL 210.00 Pipe - RL 210.10 Lid  
(PFL2HITCH MW1) E =313810.71 N = 6295241.46 RL 225.130 Concrete - RL 225.87 Pipe - RL 226.01 Lid

Please also see attached PDF's showing levels taken at bottom of extraction.

I think this all you need for tomorrow if you need anything else please let me know.

Regards

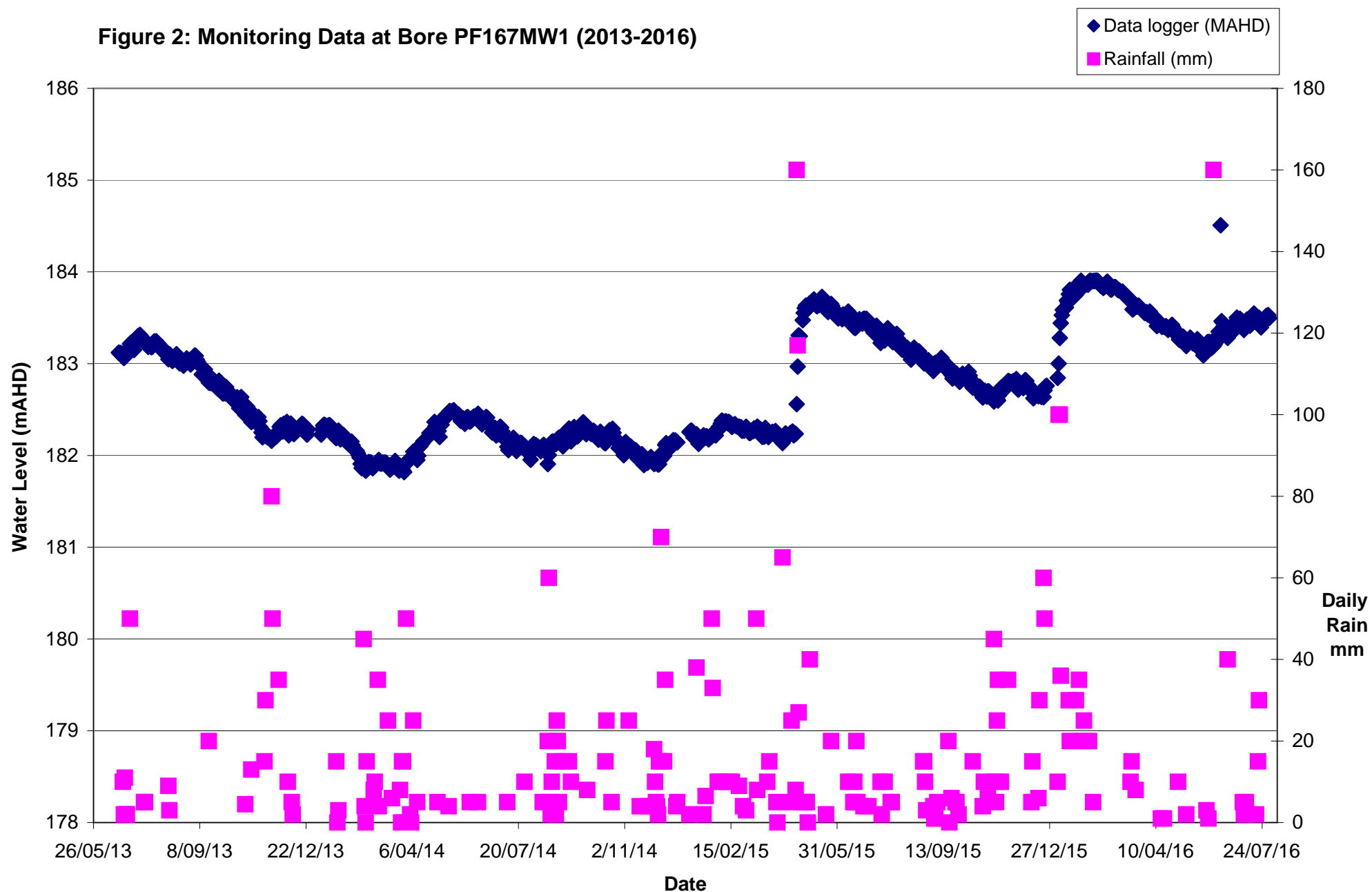
Clint Donnelly.  
0433121668

**FREEBURN SURVEYING**

PHONE: (02) 4721 2289 FAX: (02) 4721 5646  
SUITE 2, FIRST FLOOR "SURVEYOR HOUSE"  
2 CASTLEREAGH STREET, PENRITH NSW 2750

## APPENDIX G

**Figure 2: Monitoring Data at Bore PF167MW1 (2013-2016)**



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

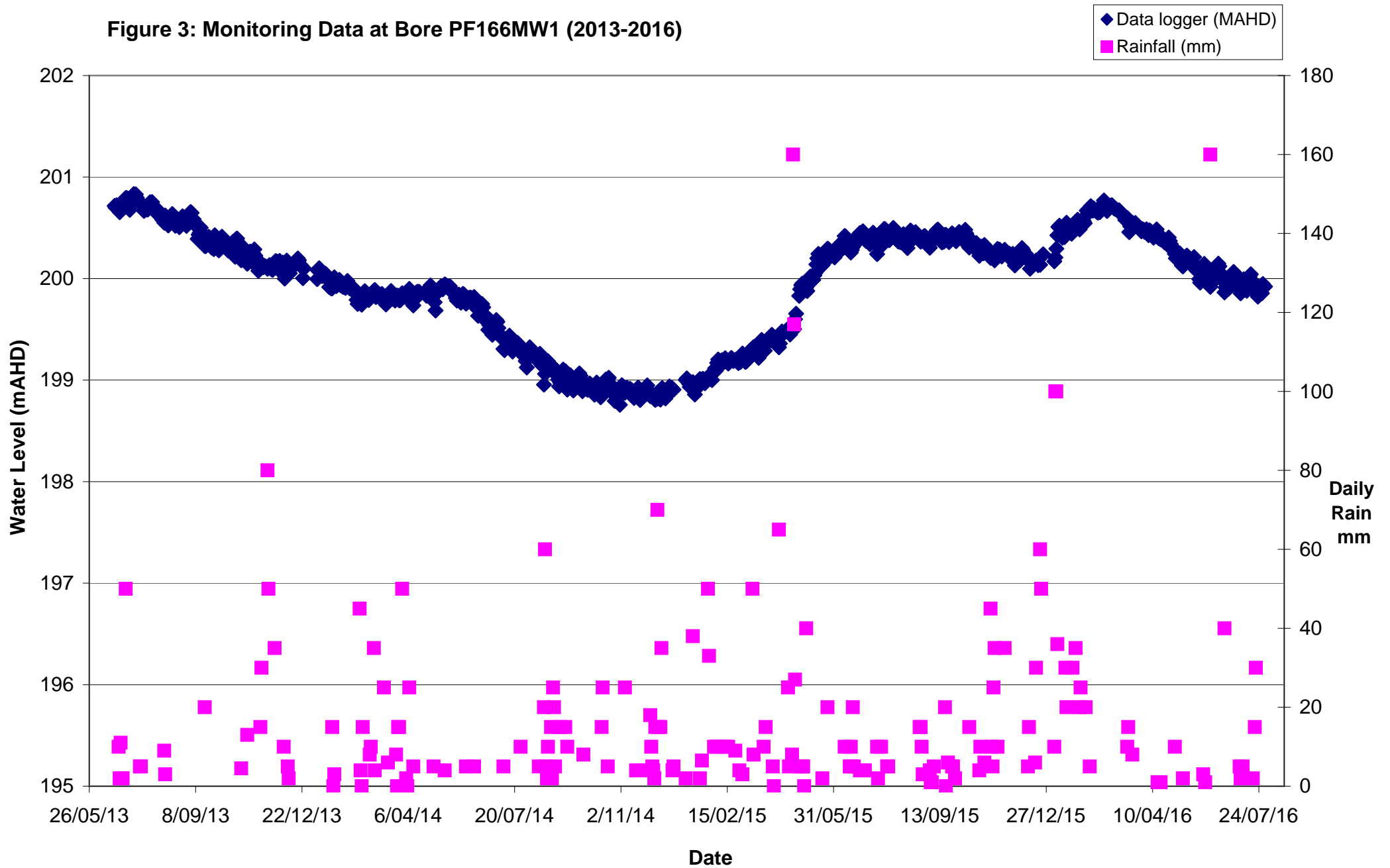




Figure 4: Monitoring Data at Bore PF214MW1 (2013-2016)

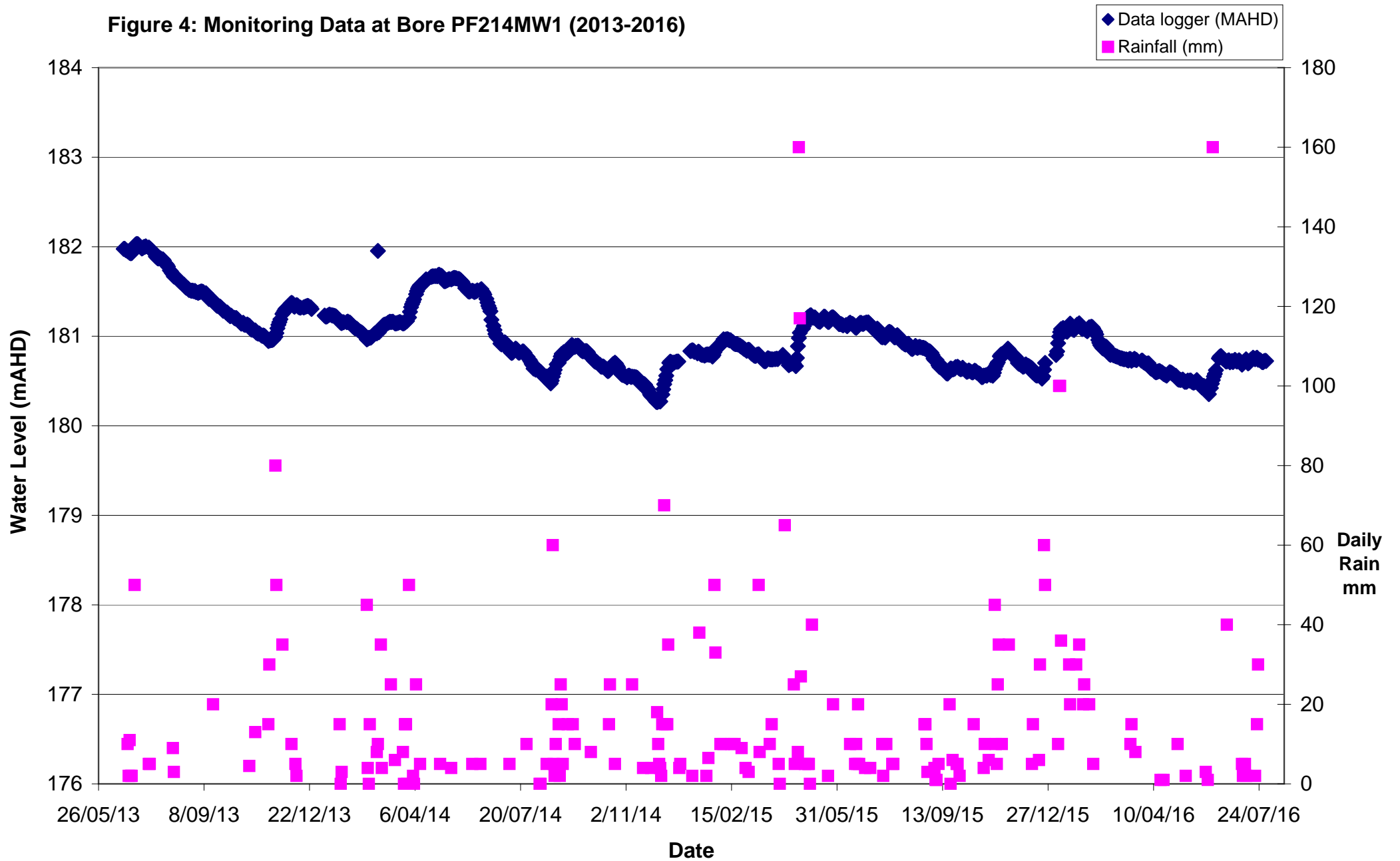
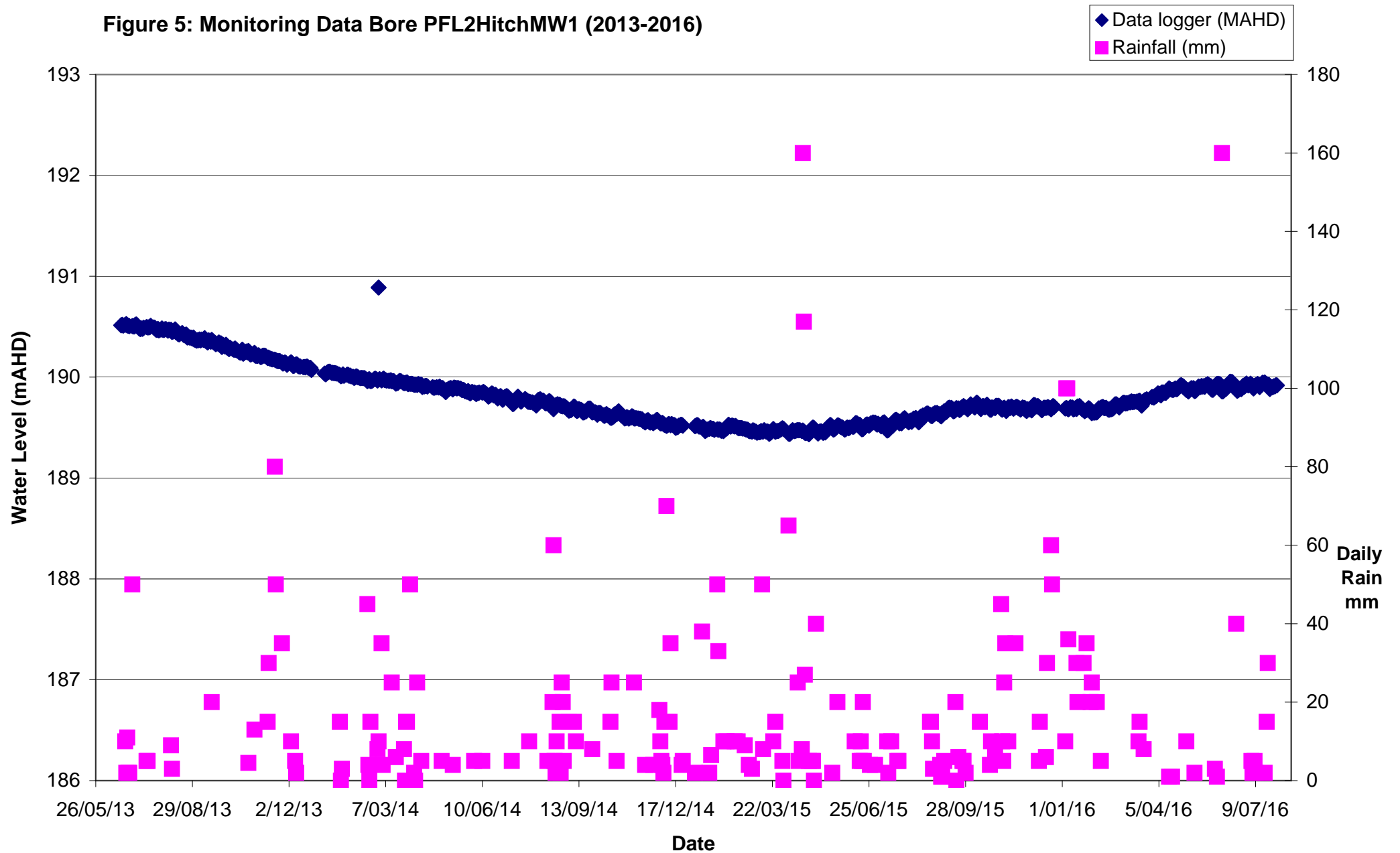


Figure 5: Monitoring Data Bore PFL2HitchMW1 (2013-2016)



LAST PAGE OF REPORT



*Thank you for the opportunity to work with  
PF Formation.*

Feedback is Welcomed at Earth2Water  
([dino@earth2water.com.au](mailto:dino@earth2water.com.au))

