





# Groundwater and Spring Monitoring 2025, Mt Shamrock Quarry

## Annual monitoring review

Holcim (Australia) Pty Ltd

17 February 2026



<b>Project name</b>		Mt Shamrock Quarry Groundwater & Spring annual monitoring review 2025-2026					
<b>Document title</b>		Groundwater and Spring Monitoring 2025, Mt Shamrock Quarry   Annual monitoring review					
<b>Project number</b>		12670738					
<b>File name</b>		12670738-RPT-A-Mt Shamrock Pakenham Quarry Reporting 2025.docx					
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	A. Wilson	J. Morgan		J. Morgan		2/2/26
S4	0	A. Wilson	J. Morgan		J. Morgan		13/2/26
S4	1	A. Wilson	J. Morgan		J. Morgan		17/2/26

**GHD Pty Ltd | ABN 39 008 488 373**

180 Lonsdale Street, Level 9

Melbourne, Victoria 3000, Australia

T +61 3 8687 8000 | F +61 3 8732 7046 | E melmail@ghd.com | [ghd.com](http://ghd.com)

© GHD 2026

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

# Disclaimer

*This report has been prepared by GHD for Holcim (Australia) Pty Ltd and may only be used and relied on by Holcim (Australia) Pty Ltd for the purpose agreed between GHD and Holcim (Australia) Pty Ltd as set out in section 1.3 of this report.*

*GHD otherwise disclaims responsibility to any person other than Holcim (Australia) Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.*

*The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.*

*The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.*

*The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.*

*The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.*

*Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.*

*Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.*

*GHD has prepared this report on the basis of information provided by Holcim (Australia) Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.*

# Contents

<b>Disclaimer</b>	<b>i</b>
<b>1. Introduction</b>	<b>1</b>
1.1 Overview	1
1.2 Scope of work	1
1.3 Purpose of this report	1
1.4 Previous reports	2
1.5 Data sources	2
<b>2. Background information</b>	<b>3</b>
2.1 Site location	3
2.2 Topography	3
2.3 Monitoring objectives	3
2.3.1 Environmental Management Plan requirements	3
2.4 Summary quarry mining activities	4
2.4.1 2025 mining activities	4
<b>3. Groundwater characterisation</b>	<b>6</b>
3.1 Regional groundwater characterisation	6
3.2 Neighbouring groundwater use	7
3.3 Regional groundwater level trends	8
3.4 Aquifer hydraulic parameters	9
<b>4. Groundwater and spring monitoring network</b>	<b>11</b>
4.1 Groundwater monitoring bore network	11
4.1.1 Site monitoring bores	11
4.1.2 State Observation Network bore	11
4.2 Spring monitoring locations	11
<b>5. Groundwater and spring monitoring</b>	<b>16</b>
5.1 2025 monitoring	16
5.1.1 Groundwater level monitoring	16
5.1.2 Spring monitoring	16
5.1.3 Quarry dam water levels	21
<b>6. Discussion of results - groundwater levels</b>	<b>22</b>
6.1 External influences on groundwater levels	22
6.1.1 Rainfall	22
6.2 Groundwater level monitoring results	23
6.2.1 SON bore 84032	23
6.2.2 Site monitoring bores	23
Monitoring bores MB01 and MB06	23
Nested monitoring bores MB02 and MB04	24
Nested monitoring bores MB03 and MB05	24
Monitoring bore MB07	24
6.2.3 Dam water levels	25
6.3 Summary	25
<b>7. Classification of Groundwater and Protected Environmental Values</b>	<b>26</b>

7.1	Classification of groundwater	26
7.1.1	Regulatory instruments	26
7.1.2	Groundwater quality indicators and objectives	27
7.1.3	Identified groundwater segment	28
7.1.4	Protected Environmental Values	28
<b>8.</b>	<b>Discussion of results – springs</b>	<b>30</b>
8.1	Spring monitoring results	30
8.1.1	Electrical Conductivity	30
8.1.2	Spring flows	30
	2025 monitoring	30
	Spring flow meters	31
8.1.3	Spring and groundwater level comparison	34
8.2	Summary	34
<b>9.</b>	<b>Bore maintenance</b>	<b>35</b>
<b>10.</b>	<b>Conclusions and recommendations</b>	<b>36</b>
10.1	Conclusions	36
10.2	Recommendations	37
<b>11.</b>	<b>References</b>	<b>38</b>

## Table index

Table 1	Site management measures	3
Table 2	Site monitoring schedule	4
Table 3	Regional groundwater characterisation summary	6
Table 4	Neighbouring bore summary	8
Table 5	Summary Wandin Yallock GMA/ WSPA groundwater level trends	9
Table 6	Summary Koo Wee Rup WSPA groundwater level trends	9
Table 7	Summary of slug test results, bores MB01 – MB06	10
Table 8	Summary of Holcim site monitoring bores	12
Table 9	Summary of springs	13
Table 10	Groundwater level monitoring - 2025	16
Table 11	Spring inspection results, December 2025	17
Table 12	Monthly rainfall, 2025. Dandenong (086224) climate station	22
Table 13	Summary of monitoring bore groundwater levels	25
Table 14	Protected environmental values and groundwater segments	26
Table 15	Groundwater indicators and objectives	27
Table 16	Relevant protected environmental values	29
Table 17	Spring EC, 2024 and 2025	30
Table 18	Summary of spring flows, 2025	31
Table 19	Summary of spring flows, SP01 to SP03	32
Table 20	Spring and groundwater elevations	34
Table 21	Monitoring bore condition, December 2025	35
Table 22	Conclusions	36
Table 23	Recommendations	37

## Figure index

Figure 1	Site location	4
Figure 2	Holcim quarry heatmap, dated January 2026	5
Figure 3	Mount Shamrock quarry monitoring bore and spring location plan	15
Figure 4	Spring flows, SP01 to SP03 and daily rainfall	33
Figure 5	Spring flows SP01 (datalogger)	33

## Appendices

Appendix A	EPA licence OL000000544
Appendix B	Summary of neighbouring bores
Appendix C	Summary of groundwater level trends (source: DEECA)
Appendix D	Monitoring bore construction and lithology logs
Appendix E	Tabulated groundwater levels
Appendix F	Monitoring bore hydrographs (manual water level monitoring)
Appendix G	Monitoring bore hydrographs, bores MB01, MB06 and SON 84032 (datalogger)
Appendix H	Mt Shamrock spring monitoring data
Appendix I	Mt Shamrock spring rainfall and EC
Appendix J	Spring and monitoring bore photographic record, December 2025
Appendix K	Field equipment calibration certificates – December 2025 monitoring
Appendix L	Tabulated dam water levels

# 1. Introduction

## 1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Holcim (Australia) (Holcim) to undertake an annual hydrogeological review for their Mt Shamrock Quarry in Pakenham, Victoria.

The Pakenham (Mt Shamrock) Quarry Environmental Management Plan (v3, July 2021) requires a groundwater monitoring program to ensure that water discharged from the Quarry minimises any potential impact on receiving waters, does not affect the environmental values of the receiving waters and assesses any long term trends in groundwater levels.

The following requirements to meet these objectives include:

- Ongoing groundwater level monitoring
- Annual visual inspection of identified springs at/surrounding the quarry
- Completion of an annual assessment to understand if quarry operations are potentially impacting on groundwater levels

The objective of this report is to provide a consolidated review, and interpretation of the groundwater level and quality results collected during 2025. Reference to and incorporation of earlier monitoring data collected by others as part of the site's groundwater monitoring has also been completed.

## 1.2 Scope of work

Holcim engaged GHD to undertake an annual groundwater monitoring review for their Mt Shamrock Quarry in Pakenham (site) for 2025. GHD's scope of work included:

- Conducting groundwater and spring monitoring in accordance with the relevant environmental management plan requirements
- Review and summarise quarry mining activity for the year
- Groundwater monitoring:
  - Annual groundwater level monitoring from the site groundwater monitoring bore network and a field inspection of the groundwater monitoring bores to assess bore condition
  - Collation of groundwater monitoring data recorded by Holcim
  - Compilation of photographic record for each bore
- Spring monitoring:
  - An annual field inspection of the nominated springs at the site to assess current condition and comparison with previous inspections
  - Compilation of photographic record for each spring
  - Collection of field water quality parameters from each spring
- Preparation of a concise interpretive report (this report) documenting the results of the above, including the addition of other field data collected by Holcim and its contractors during 2025

## 1.3 Purpose of this report

The purpose of this report is to:

- Document the results of the groundwater and spring monitoring completed by Holcim at their site in 2025.
- Assess the potential impacts of quarry operations on identified environmental values pertinent to groundwater
- If required, provide recommendations to expand, rationalise or improve the monitoring to meet the objectives of the Environmental Management Plan (EMP) pertinent to groundwater

## 1.4 Previous reports

A number of reports and studies have been undertaken for this site which contain information on monitoring bore drilling and installation, groundwater sampling, geotechnical and hydrogeological conditions. These reports have been referenced in Section 11 along with other documents referenced throughout this report.

## 1.5 Data sources

This report has relied on a number of data sources which have been assumed to be accurate and up to date. These include:

- Published geological and hydrogeological mapping
- State drilling records: GEDIS (Geological, Exploration and Development Information System), WMIS (Water Management Information System)
- Government produced literature including water accounting, land use planning information, meteorological, and topographical data
- Holcim supplied information including historical monitoring bore records (onsite drilling, bore construction, water levels and quality), elevation information, etc

These data sources have been referenced, where relevant, throughout this report. A complete list of references is provided in Section 11 of this report.

## 2. Background information

### 2.1 Site location

The site is located approximately 4 km north of Pakenham and immediately west of the Healesville – Koo Wee Rup Road. The quarry has been in operation since 1974, i.e. just over 50 years, with basalt (Older Volcanics) quarried for use as rail ballast, aggregates and road bases.

The site location is shown in Figure 1.

### 2.2 Topography

The site forms a high point in the landscape (Mount Shamrock) with an elevation of approximately 220 m Australian Height Datum (AHD). This high point forms a perimeter around the current quarry operations with generally a steep drop off to the surrounding farmland. Elevations near surrounding roads are typically around 100 m AHD.

### 2.3 Monitoring objectives

The objective of the groundwater monitoring program during 2025 has been to continue with the collection of groundwater level data and inspect selected springs to meet the compliance and conformance targets outlined in the EMP.

#### 2.3.1 Environmental Management Plan requirements

Section 2.4 of the EMP documents management measures and a monitoring schedule for surface water, drainage and groundwater. Those pertinent to groundwater have been summarised in Table 1 and Table 2.

In addition to the groundwater level monitoring summarised in Table 1, Holcim have deployed automated dataloggers (dataloggers) in bores MB01, MB06, MB07 and SON 84032. These dataloggers have been programmed to collect water level data every six hours, i.e. more frequently than that collected manually.

Visual inspection of springs at the site is undertaken as per section 2.5.4 of the EMP.

Table 1 Site management measures

Management measure	Description	Timing
Groundwater level gauging (external)	Water level gauging will be conducted quarterly, and an annual evaluation undertaken, to determine how the groundwater levels respond to the following: <ul style="list-style-type: none"><li>– Seasonal rainfall changes</li><li>– Extension of the quarry</li><li>– Revegetation to parts of the plateau surface</li><li>– Progressive rehabilitation of quarry</li></ul>	Quarterly
Groundwater Level Gauging (internal)	Monthly water level gauging (MB01 – MB06) will be conducted by site personnel	Monthly
Groundwater Beneficial Use Assessment	Properties surrounding the quarry will be regularly assessed to confirm that the assessed beneficial uses of groundwater in accordance with section 15 of the SEPP (Waters) on the properties is supported by actual practices	Annual
Notes: Source: EMP v3, July 2021 The SEPP (Waters) has since been replaced by the Environmental Reference Standard (ERS) Items listed pertinent to groundwater only		

Table 2 Site monitoring schedule

Item/ location	Test	Frequency	Assessment methodology	Acceptance criteria
Monitoring bores MB01 to MB06	Level Gauging (Standing Water Height)	Quarterly (January, April, July, October)	AS5667.11:1998 or similar	Plot trends and any significant changes in groundwater levels, report in Site Environmental Management Program
Monitoring bores MB01 to MB06	Level Gauging (Standing Water Height)	Monthly	Direct observation	N/A

Notes:  
 Source: EMP v3, July 2021  
 Items listed pertinent to groundwater only

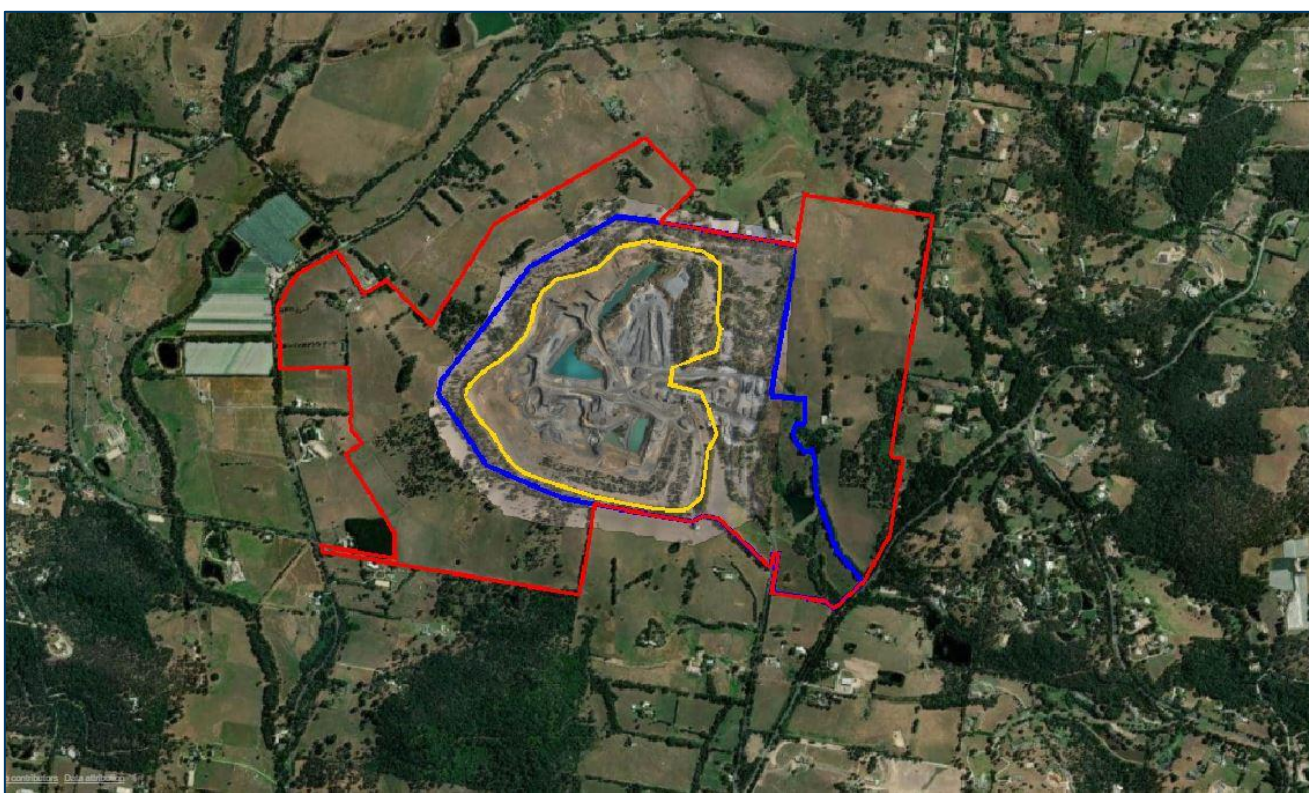


Figure 1 Site location

Source: Holcim

## 2.4 Summary quarry mining activities

### 2.4.1 2025 mining activities

Based on information provided by Holcim to GHD, it is understood that mining activities in 2025 were similar to that completed in 2024:

- No significant stripping (rocky overburden and clay removal) or reclamation works undertaken
- The northern mining areas focussed on the upper benches. Mining was undertaken to an elevation of approximately Relative Level (RL) 173 m

- The southern mining areas focussed on lower benches. Mining was undertaken to an elevation of approximately RL162 m

The 2025 quarry work areas are shown in Figure 2, which has been supplied by Holcim to GHD. The closet bores to the northern and southern areas are nested bores MB03B/ MB05B and nested bores MB02C/MB04C (refer Figure 3).



Figure 2 Holcim quarry heatmap, dated January 2026

Source: Holcim

# 3. Groundwater characterisation

## 3.1 Regional groundwater characterisation

A review of available groundwater information neighbouring the quarry has been completed to characterise the groundwater system, and potential influences on water quality and water levels. This information is summarised in Table 3.

Table 3 Regional groundwater characterisation summary

Item	Description
Geology	<p>A summary the geological profile at the site, from youngest to oldest, includes:</p> <ul style="list-style-type: none"> <li>– Quaternary aged alluvium consisting of silty sands and clays, primarily deposited in the Toomuc Creek Valley</li> <li>– Tertiary aged Older Volcanics which consist of dense, blue/black, olivine basalt. This is the resource quarried at the site and has a maximum thickness of 70 m with a varied weathered profile of up to 26 m, but generally in the order of 10 m. It is hypothesised that this basalt flow was in a generally north-south trending ancient valley which forms the current ridge line, as the surrounding sediments have been eroded over time geologically by more recent drainage lines.</li> <li>– Tertiary aged Werribee Formation consisting of clay, poorly consolidated clay with some organic material</li> <li>– Palaeozoic aged bedrock consisting of either Devonian aged granite or Silurian aged siltstone and sandstone</li> </ul>
Groundwater use	Groundwater use close to the quarry has been summarised in Section 3.2.
Surrounding land use	<p>The site use comprises a mix of farmland, currently used for cattle grazing, and remnant indigenous vegetation.</p> <p>A pony club has been identified immediately to the north of the quarry, and some light industry has been identified adjacent neighbouring roads. Scattered residential properties are present in the area associated with the farming and light industry.</p> <p>More intensive urban development is present approximately 2.5 km south of the site. This urban development forms the outskirts of the Pakenham suburb.</p>
Aquifer developed	<p>The quarry is located upon Tertiary age Older Volcanics which consist of basalt. Where saturated, the basalt forms the water table aquifer.</p> <p>The Werribee Formation underlies the basalt. GHD (2023) reported that URS (2005) conceptualised the springs to be groundwater discharge from outcropping Werribee Formation aquifer at the base of the basalt. GHD consider, to the north particularly, that the springs are more likely to be groundwater discharge directly from the Older Volcanics aquifer, where it overlies Werribee Formation which was logged as being fine grained</p>
Potential contamination sources	<p>Victoria Unearthed was interrogated to identify potential contamination sources close to the site. The quarry has been identified as an EPA licensed area operating under EPA licence OL00000544. This licence has been attached as Appendix A.</p> <p>Several EPA audit areas and points were identified on either side of the Princes Highway near Pakenham. These sites are more than approximately 3 km south of the quarry. Given the distance from the site (and lower elevation), these are deemed a low risk to the groundwater environment at the site.</p> <p>The area is used for grazing and pony clubs have been identified close to the site. Grazing of livestock can result in faecal contamination and changes in nutrient (e.g., nitrate, phosphorous) concentrations in groundwater. Given the low density of grazing and depth to groundwater at the site, livestock grazing is deemed pose a low risk to groundwater quality.</p> <p>In addition, the farming land may have been subject to the application of fertilisers, weedicide/herbicide as well as fuel and oil leaks from farm machinery.</p>

Item	Description
Regional groundwater quality	<p>The Department of Energy, Environment and Climate Action (DEECA) SAFE datasets indicate regional groundwater salinity for the majority of the site to be between 500 mg/L and 1,000 mg/L Total Dissolved Solids (TDS). Groundwater salinity south and north of the site is interpreted to be between 1,000 mg/L and 3500 mg/L TDS and less than 500 mg/L TDS, respectively.</p> <p>There is limited groundwater quality information available for nearby bores (refer Section 3.2). In the available data within 3 km of the site, 10 bores had laboratory Electrical Conductivity (EC) information. EC for these 10 bores ranged from 720 <math>\mu\text{S}/\text{cm}</math> to 5,800 <math>\mu\text{S}/\text{cm}</math> with an average of approximately 2,075 <math>\mu\text{S}/\text{cm}</math>. Most of the bores reported an EC less than 2,500 <math>\mu\text{S}/\text{cm}</math>. Based on a conversion factor of 0.6, this suggests a groundwater salinity of between approximately 430 mg/L and 3,500 mg/L TDS with an average of approximately 1,250 mg/L TDS.</p>
Groundwater management	<p>The site does not fall within a designated Groundwater Management Area (GMA) and thus is not subject to specific plans and rules regarding the development of groundwater. It is noted however that the regulating authority, Southern Rural Water (SRW), may require a technical hydrogeological assessment to support any proposed groundwater development.</p>
State Observation Bores	<p>State Observation Network (SON) bore 84032 is located approximately 10 km south of the site and is screened in the Older Volcanics. Whilst the bore has not been actively monitored by the State since 2016, Holcim commenced monitoring water levels from this bore in November 2024 as part of their groundwater monitoring program.</p> <p>The results of groundwater monitoring from this bore are discussed in Section 6.2.1.</p>
Groundwater Dependant Ecosystems	<p>Local creeks and drainage lines near the site have been identified as potential aquatic Groundwater Dependent Ecosystems (GDEs) and include Toomuc Creek (west) and Kennedy and Pakenham Creeks (south). These have been identified as high potential GDEs.</p> <p>Scattered potential terrestrial GDEs have been identified near the site but predominantly to the west. These have been identified as both low to high potential terrestrial GDEs.</p>

## 3.2 Neighbouring groundwater use

DEECA's Visualising Victorias Groundwater (VVG) was interrogated to identify groundwater bores in the area and characterise groundwater use near the site.

The following comments are made regarding the VVG data:

- Bores installed prior to the proclamation of the original *Water Act* (1969) may not be registered as there was no mandatory requirement to licence bores prior to this date
- VVG does not provide information regarding the operation status of the bores
- Bores installed without a bore construction licence are unlikely to be registered on VVG (unless detected by later audits)
- Many bores have not been surveyed for location. Bore locations registered were often those initially proposed on the bore construction licence application. In many instances drilling contractors could not gain access to these sites and final locations often have a positional accuracy greater than 250 m
- The information registered on the VVG is subject to the accuracy of the bore completion reports submitted by drilling contractors
- Information registered on VVG is subject to change since the completion of the bore e.g. water level information, pump setting depth, groundwater quality
- Some information is not available on VVG e.g. pump setting depth and bore ownership

The search identified 31 bores within an approximate 3 km radial search from the centre of the site, and a summary is provided in Table 4. Neighbouring bores have been tabulated in Appendix B.

There is no change in neighbouring groundwater use from the 2024 reporting period.

Of the 10 observation bores, two of these, bores WRK082149 and WRK082152 were identified on bore decommissioning licence WLE067411, supplied to GHD by Holcim, i.e. these were Holcim monitoring bores.

Table 4 Neighbouring bore summary

Bore Use	Number of bores	Depth range (m)
Stock/ domestic	16	15 - 103
Observation	10	1.5 – 12.2
Irrigation	1	14.7
Unknown	3	30.5 - 88
Not listed	1	25
Note: Source - VVG		

### 3.3 Regional groundwater level trends

Groundwater monitoring from SON bore 84032, located approximately 10 km south of the quarry (refer Table 3) is discussed in Section 6.2.1.

To further understand regional groundwater level trends, available long term monitoring data, collated by DEECA, from the Wandin Yallock GMA/ Water Supply Protection Area (WSPA) and the Koo Wee Rup WSPA were reviewed and summarised.

At their closest points, the Wandin Yallock GMA/ WSPA is located approximately 6 km north of the quarry and the Koo Wee Rup WSPA is located approximately 4.5 km south of the quarry. It is noted that SON bore 84032 is located in the Koo Wee Rup WSPA.

A summary of the groundwater level trends has been included in Table 5 and Table 6. All available data has been summarised in Appendix C.

At this stage, summary groundwater level monitoring data is only available to June 2024 for both WSPAs. The available information for each WSPA indicates that:

- In general, groundwater levels in the Wandin Yallock WSPA were rising (June 2024)
- In general, groundwater levels in the Koo Wee Rup WSPA were stable or rising (June 2024)

Whilst this information may be useful to identify broad trends in regional groundwater levels there is some attached uncertainty:

- The timing of information collation and publication by DEECA lags behind that of the Holcim monitoring program, i.e. in this case the DEECA does not present the information to the end of the 2025 quarry monitoring period
- The information available from DEECA is aggregated and does not represent specific sites
- Groundwater level trends in the WSPAs are likely to be influenced by a combination of the prevailing climate, groundwater extraction, e.g. irrigation, and other land uses
- The magnitude of groundwater levels change (rising or falling), is not documented by DEECA.

As such, it is recommended that the up to date groundwater level trends from SON bore 84032 continue to be used to characterise groundwater level trends remote from the quarry (refer Section 6.2.1), rather than the above regional data.

**Table 5** Summary Wandin Yallock GMA/ WSPA groundwater level trends

<b>Year</b>	<b>Groundwater level trend</b>
2017 – March 2018	Falling
June 2018	Stable
September 2018 – June 2020	Falling
September – December 2020	Rising
March 2021	Falling
September – December 2021	Stable
June – September 2021	Stable
December 2021 – March 2024	Rising
June 2024	Stable
Notes: Data available from 2017 to 2024 Source: DEECA	

**Table 6** Summary Koo Wee Rup WSPA groundwater level trends

<b>Year</b>	<b>Groundwater level trend</b>
2017 – March 2020	Falling
June – December 2020	Stable
March – June 2021	Falling
September 2021 – September 2022	Stable
December 2022 – September 2023	Rising
December 2023 – March 2024	Stable
June 2024	Rising
Notes: Data available from 2017 to 2024 Source: DEECA	

### 3.4 Aquifer hydraulic parameters

Slug testing has been completed at the site by AECOM (AECOM, 2024) and the results of the testing have been provided to GHD by Holcim. A summary of the results is presented in Table 7.

Table 7 Summary of slug test results, bores MB01 – MB06

Bore ID	Average hydraulic conductivity (m/sec)	Calculated average hydraulic conductivity (m/day)	Interpreted lithology	Bore depth (m)	Interpreted hydraulic conductivity category
MB01	9.9 x 10 <sup>-7</sup>	0.09	Silty CLAY (Werribee)	71.9	Very low
MB02C	2.0 x 10 <sup>-6</sup>	0.17	Sandy CLAY (Werribee)	36.7	Low
MB03B	5.7 x 10 <sup>-7</sup>	0.05	Silty CLAY (Werribee)	52.9	Very low
MB04C	3.8 x 10 <sup>-5</sup>	3.28	Basalt (Older Volcanics)	30.8	Moderate
MB05B	5.3 x 10 <sup>-6</sup>	0.46	Basalt (Older Volcanics)	47	Low
MB06	6.4 x 10 <sup>-6</sup>	0.55	Basalt (Older Volcanics)	50.5	Low

Notes:

Source: AECOM (2024) report provided to GHD by Holcim

AECOM (2024) present the average hydraulic conductivity in m/sec. Average hydraulic conductivity in m/day calculated by GHD

Interpreted lithology and hydraulic conductivity category from AECOM (2024)

## 4. Groundwater and spring monitoring network

### 4.1 Groundwater monitoring bore network

#### 4.1.1 Site monitoring bores

Six bores, MB01 to MB06, were installed in 2001 and formed the original monitoring bore network. Bores were installed in both the basalt of the Older Volcanics and the underlying Werribee Formation.

Bores MB01 and MB06 have remained operation since their installation in 2001. Over time, with quarry development however, some of the remaining original bores have been lost or damaged. Where lost or damaged, these bores have been replaced.

It is noted that Holcim have indicated that current bores MB02c and MB4c, located on the quarry floor, have been installed in overburden material. AECOM (2017) however indicates that these bores were installed in the Werribee Formation (bore MB02c) and basalt (bore MB04c). Review of the bore construction and lithology logs for these bores indicates that:

- Bore MB02c was installed in what has been logged as clay, sand and silt between approximately 33.5 m and 36.5 m depth (and below material logged as basalt)
- Bore MB04c was installed in what has been logged as basalt between approximately 30 m and 31 m depth

In addition to bores MB01 to MB06, bore MB07 was installed in 2024 at a location to the north east of the quarry. Bore MB07 was installed to support future quarry expansion activities in this area.

A summary of the monitoring bores at the site is provided in Table 8. Bores shaded blue in Table 8 are operational and currently monitored.

Monitoring bores at the site are shown on Figure 3. Available monitoring bore logs, provided by Holcim, are included in Appendix D.

#### 4.1.2 State Observation Network bore

As noted previously State Observation Network (SON) bore 84032 is located approximately 10 km south of site, adjacent Burke Road. This bore screens the Older Volcanics between 48 m and 60 m depth. Summary details of this bore have been included in Table 8. Given the distance of the bore from the site it has not been shown on Figure 3.

The bore has not been actively monitored by the State since 2016 however Holcim have monitored water levels from the bore since November 2024 to aid in identifying groundwater level variations away from their site.

GHD understands that Holcim's approval to access and monitor water levels from SON bore 84032 has been provided by DEECA.

## 4.2 Spring monitoring locations

Eleven springs surrounding the quarry, SP01 to SP11, have been monitored to assess potential changes in spring function (flow, level, quality) that may be impacted by quarry operation. Each monitoring event has included a walkover and visual inspection at each spring location and measurement of field water quality parameters including Electrical Conductivity (EC), pH, temperature, Oxidation Reduction Potential (ORP) and Dissolved Oxygen (DO). It is noted that:

- Springs SP09 and SP10 have since been reclassified with spring SP10 classified as a seep
- A new spring, SP11, was identified by Holcim in 2023 on the western side of the quarry.

A summary of the springs at the site has been provided in Table 9.

Table 8 Summary of Holcim site monitoring bores

Bore ID	Installation date	MGA Z55 Coordinates		Elevation (m AHD)	Screened interval (m)	Screened aquifer	Status
		Easting	Northing				
MB01	7-Mar-01	366135.13	5789516	216.518	67.0 – 72.5	Werribee Formation	Operational
MB02a	13-Mar-09	N/A	N/A	N/A	14 – 17	Werribee Formation	Destroyed
MB02b	22-Oct-14	366344.3	5790135.03	174.64	8.8 – 11.8	Werribee Formation	Decommissioned
MB02c	17-Jan-17	366232.07	5790211.78	191.68	33.77 – 36.77	Werribee Formation/ Overburden	Operational
MB03	6-Mar-01	365817.18	5789879.64	229.69	71 – 77	Werribee Formation	Destroyed
MB03b	24-Oct-14	365739.25	5790087.04	209.9	49 – 52	Werribee Formation	Operational
MB04a	13-Mar-09	N/A	N/A		8.7 – 11.7	Basalt (Older Volcanics)	Destroyed
MB04b	22-Oct-14	366342.72	5790133.59	174.7	1 – 1.5	Basalt (Older Volcanics)	Decommissioned
MB4c	17-Jan-17	366233.33	5790213.41	191.84	30.4 – 30.9	Basalt/ Overburden	Operational
MB05	6-Mar-01	365820.83	5789879.07	229.84	51 – 57	Basalt (Older Volcanics)	Decommissioned
MB05b	27-Oct-14	365736.94	5790087.88	209.55	40 – 46	Basalt (Older Volcanics)	Operational
MB06	13-Mar-01	366321.06	5790488.4	219.84	44 – 50	Basalt (Older Volcanics)	Operational
MB07	March 2024	366948	5790593	242.84	64 - 70	Basalt (Older Volcanics)	Operational

Notes:  
Source: AECOM (2024) and Holcim  
MGA – Map Grid of Australia  
m AHD – metres Australian Height Datum  
All bores comprise 50 mm internal diameter PVC  
Bores shaded blue are operational and currently monitored.

Table 9 Summary of springs

Spring ID	MGA Z55 Coordinates		Elevation (m AHD)	Location relative to quarry	Classification/ general comment
	Easting	Northing			
SP01	365525.204	5790017.447	155.628	South west	Spring. This spring provides irrigation and stock water to a number of properties in the local area Adjacent general current quarrying area. Magflow meter (HydroMace) installed by Holcim. Meter volume also recorded approximately weekly by Holcim
SP02	365660.221	5789766.116	145.731	South west	Spring Water emanating from the spring terminates at small dam. The dam catchment would include both surface water run-off and groundwater (spring flow). Adjacent general current quarrying area. Mechanical flow meter installed by Holcim. Meter volume recorded approximately weekly by Holcim
SP03	365785.971	5790429.762	160.522	West	Spring Spring flows towards small dam Adjacent general current quarrying area. Mechanical flow meter installed by Holcim. Meter volume recorded approximately weekly by Holcim
SP04	366197.271	5790751.129	166.851	North west	Spring Pooled water, but historically dry or damp seep with healthy vegetation.
SP05	365805	5789730	161	South	Spring Spring area is historically observed to be dry with healthy vegetation Adjacent general current quarrying area
SP06	366655.043	5790924.065	165.962	North	Spring. Flow into a dam. The spring is accessible by livestock
SP07	Not accessible		-	North	Seep. Downslope and down catchment from SP06. Reclassified as seep only in 2005, and not monitored
SP08	366883.083	5791019.567	171.744	North	Spring. In an adjacent creek line to SP06. On private property Spring flow into a dam/ small wetland.
SP09	366961	5790092	-	East	Spring. Flow into wetlands.
SP10	366890	5790147	166	East	Seep. Reclassified as a seep only in 2005.
SP11	365896	5790542	179	West	Spring. Damp to dry
Notes:					

Spring ID	MGA Z55 Coordinates	MGA Z55 Coordinates	Elevation (m AHD)	Location relative to quarry	Classification/ general comment
	Easting	Northing			
<p>Surveyed coordinates and elevations for springs SP01 – SP04, SP06 and SP08 provided by Holcim. Elevation taken at the top of stake at each spring</p> <p>Handheld GPS coordinates for springs SP05, SP10 and SP11 collected by GHD in December 2024</p> <p>Approximate elevations for springs SP05, SP10 and SP11 collected with handheld GPS by GHD in December 2024</p> <p>Approximate location for spring SP09 provided based on GIS mapping</p>					



- Legend**
- Spring Location (EC  $\mu$ S/cm) Dec 2025
  - Operational bore - Werribee Formation
  - Operational bore - Basalt
  - Lost/destroyed
  - Stream
  - Drain/Channel/Other
  - Watercourse
  - ▭ Mining Tenement

**Data Disclaimer**

© 2026. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A3

0 50 100 150 200  
Meters

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 55



Holcim (Australia) Pty Ltd  
Holcim Pakenham Quarry 2025  
Groundwater Monitoring Review

**Mount Shamrock Quarry Monitoring  
Bore and Spring Location Plan**

Project No. 12670738  
Revision No. A  
Date 28/01/2026

**FIGURE 3**

<LINK>g:\gdw\g\h\AU\Melbourne\Projects\3112670738\GIS\Maps\Deliverables\12670738\_Figures\12670738\_Figures.aprx<LINK>  
12670738\_003\_Bore&Spring\_LocationPlan\_revA  
Print date: 28 Jan 2026 - 10:19

Data source: GHD; Site location and samples (2026); VICMAP; Roads, Cadastre, Waterways (2026); Nearmap WMS Server; Imagery (Date Extracted: 23/01/2026). Created by: ejan

# 5. Groundwater and spring monitoring

## 5.1 2025 monitoring

### 5.1.1 Groundwater level monitoring

During 2025, groundwater level monitoring was completed monthly from bores MB01 to MB06. Groundwater levels in bore MB07 were measured in December 2025. Groundwater level monitoring from SON bore 84032 (refer Section 4.1.2) has also been completed monthly.

Groundwater level monitoring was completed by AECOM, Holcim and GHD as summarised in Table 10.

Table 10 Groundwater level monitoring - 2025

Month	Monitoring completed by
January – November 2025	Holcim
December 2025	GHD

As indicated in Section 2.3.1, dataloggers have been deployed in bores MB01, MB06, MB07 and SON84032 and collect water level data every six hours.

Groundwater level data has been provided to GHD by Holcim. Tabulated manual groundwater levels are included in Appendix E. Monitoring bore hydrographs have been prepared for each bore. In constructing the hydrographs, the following rules were applied:

- Consistent range on the (reduced) water level (y-axis/ordinate axis), where possible
- Consistent range on the time (x-axis/abscissa), where possible
- Reduced water level trends (to metres above Australian Height Datum) shown

The monitoring bore hydrographs for the monthly monitoring are presented in Appendix F. Monitoring bore hydrographs for those bores with dataloggers (bores MB01, MB06, MB07 and SON84032) are presented in Appendix G. Water levels collected using the dataloggers are shown in metres below top of casing (m btoc).

### 5.1.2 Spring monitoring

A GHD hydrogeologist, along with a Holcim representative, completed a survey of the springs on 15 December 2025. The survey included:

- An inspection of each spring to assess the current condition, so it can be compared to previous inspections
- Where possible, collection of field water quality parameters from each spring, including Electrical Conductivity (EC), pH, temperature, Oxygen Reduction Potential (ORP) and Dissolved Oxygen (DO)
- Where possible, estimate spring flows
- Compilation of a photographic record

A summary of the spring monitoring in December 2025 is presented in Table 11. A summary of the spring observations is included as Appendix H.

In addition, GHDs summary of spring monitoring (GHD, 2023) has been updated and included in Appendix H.

Spring EC and rainfall for the period 2001 to 2025 has been shown graphically in Appendix I. A photographic record of the springs for the December 2025 inspection has also been included in Appendix J.

Calibration certificates for water level and water quality meters used during the December 2025 inspection are included as Appendix K.

EC recorded at each spring in December 2025 is also shown on Figure 3.

Table 11 Spring inspection results, December 2025

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2025	Water level height (m AHD)	EC (µS/cm)	Flow meter reading (m³) Dec 24	Flow meter reading (m³) 2025	Estimated flow rate (m³/day) Dec-25	Observation
SP01	South west	Bucket and flow meter. Measuring tape	155.628	0.17	155.458	704	262	3,403	8.6	<p>Water flows into bin. Due to location of bin, not all water captured in bin.</p> <p>Flow meter installed November 2024 at tank below spring.</p> <p>Flow meter reading in December 2024 was 262 m³. Assuming 365 days between meter reads, this suggests an approximate daily flow rate of 8.6 m³/day.</p> <p>Measurement of flow rate using bucket indicates flows of approximately 5 L/minute, i.e. approximately 7.2 m³/day</p>
SP02	South west	Bucket and flow meter Measuring tape	145.731	0.26	145.471	1705	10	1,113	3.0	<p>Spring is fenced. Increase in vegetation/ weeds from 2024 inspection</p> <p>Flow meter installed between spring and water tank on 4 December 2024. Flow meter reading in December 2024 was 10 m³. Assuming 365 days between meter reads, this suggests an approximate flow rate of 3 m³/day</p> <p>Measurement of flow rate using bucket indicates flows of approximately 1 L/minute, i.e. approximately 1.5 m³/day</p>

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2025	Water level height (m AHD)	EC (µS/cm)	Flow meter reading (m³) Dec 24	Flow meter reading (m³) 2025	Estimated flow rate (m³/day) Dec-25	Observation
SP03	West	Bucket Measuring tape	160.522	0.485	160.037	524		210.5	2.2	Spring is fenced. Overgrown with weeds and grasses Water flows into wheelie bin. Small drainage line upslope of spring. Flow meter has been installed however Holcim indicates it does not always record low flow conditions. Measurement of flow rate using bucket indicates flows of approximately 1.5 L/minute, i.e. approximately 2.2 m³/day
SP04	North west	-	166.903	-	-	Dry			NR	Heavy weed growth including blackberries and thistles at spring. Spring appears to have been historically fenced but evidence of livestock at spring now observed. Spring currently dry, but flows have been historically reported.
SP05	South	-	161	-	-	Dry			NR	Location dry, but areas of healthy vegetation observed. Holcim indicates this location was historically wet but has remained largely dry for at least five years. Incorrectly labelled as SP01

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2025	Water level height (m AHD)	EC (µS/cm)	Flow meter reading (m³) Dec 24	Flow meter reading (m³) 2025	Estimated flow rate (m³/day) Dec-25	Observation
SP06	North	Measuring tape	165.962	0.43	165.532	249.2			-	Spring not fenced. Accessible by livestock. Landowner has historically damned the spring. Holcim report that historic flows of approximately 40 L/day have been indicated Potential seepage through dam wall into local gully. Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water.
SP07	North	-	No access							Spring no longer observed.
SP08	North	Bucket	171.744	N/A	171.595	395.5			2.9 - 4.3	Flow rate measured from small culvert where spring overflows. Measurement of flow rate using bucket indicates flows of between approximately 2 L and 3 L/minute, i.e. approximately 2.9 to 4.3 m³/day Measuring stake now covered by vegetation and needs to be relocated. Water level height surveyed by Holcim
SP09	East	-	N/A	166.035	-	642			1.3	Spring located on Holcim land. No access for livestock. Large spring, heavily vegetated. Holcim indicates area is always wet. Measurement of spring flow rate at culvert using bucket indicates a flow rate of

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2025	Water level height (m AHD)	EC (µS/cm)	Flow meter reading (m³) Dec 24	Flow meter reading (m³) 2025	Estimated flow rate (m³/day) Dec-25	Observation
										approximately 0.9 L/min, i.e. approximately 1.3 m³/day. No survey stake for water level measurement. Water level height surveyed by Holcim
SP10	East	-	166		-	Insufficient water			NR	AECOM (2024) indicated that this has been reclassified as a seep and no longer observed. In December 2025 only a trace of damp ground was identified adjacent gate.
SP11	West	-	179	-	-	Insufficient water			Not flowing	Identified in 2023 by landholder as a wet patch and lush vegetation in an otherwise dry area. Not fenced. Extensive weeds in area in 2025. Trace moisture only
<p>Notes:</p> <p>Water level at spring measured on survey peg. Measurement is from top of survey peg to water level.</p> <p>NR – not recorded</p> <p>December 2025 monitoring completed on 15 December. This includes water level heights, water quality and flow rates.</p>										

In 2024 and 2025, Holcim installed flow meters on springs SP01, SP02 and SP03 in order to provide an understanding of long term flow rates from these springs. A summary of the flow meter information from these springs is included in Section 8.1.2.

### 5.1.3 Quarry dam water levels

Water level data is also recorded by Holcim from their northern and southern dams located within the quarry. These dam water levels are collected in order to allow comparison to groundwater levels at the site.

Tabulated water levels in site dams are provided in Appendix L. Water level information, provided by Holcim, is available between October 2020 and December 2025.

## 6. Discussion of results - groundwater levels

### 6.1 External influences on groundwater levels

#### 6.1.1 Rainfall

To assess the influence of rainfall on water levels, rainfall information was obtained from the Bureau of Meteorology (BOM). To maintain consistency with previous reporting, rainfall information has been obtained from the Dandenong BOM climate station 086224.

Monthly rainfall received during 2025 has been summarised in Table 12. During 2025, the data indicates that rainfall at Dandenong during 2025 was approximately 234 mm below the long-term average.

Table 12 Monthly rainfall, 2025. Dandenong (086224) climate station

Month	Rainfall (mm) as recorded at Dandenong Climate Station (2025)	Long Term Average Monthly Rainfall (mm)
		Dandenong
January	46.4	49.5
February	21.8	52.2
March	37.8	48.9
April	1	73.1
May	18.9	62.6
June	77.5	68.7
July	56.8	67
August	33.7	68.5
September	38.3	64.1
October	63.4	73.5
November	109.7	88.4
December	45.8	68.9
<b>Annual Total</b>	<b>551.1</b>	<b>785.4</b>

Note:  
 BOM station 086224. Lat – 37.98 S, Long – 145.22E, Elevation – 54 m.  
 December 2025 rainfall data not available for station 086224 (Dandenong). Monthly rainfall for December 2025 obtained from BOM station 086299 (Berwick)  
 Average monthly rainfall calculated using data from January 2002 to December 2025, i.e. period of monitoring from data obtained from BOM.

Cumulative deviation from the mean monthly rainfall plots have been generated for the period 2002 to 2025. These have been included with the hydrographs (refer Appendix F) to characterise the influence of rainfall on groundwater levels. The absolute value of the residual mass curve is not important, but rather the slope:

- A positive slope indicates a wetter than average period
- A negative slope indicates a drier than average period
- A section of both negative and positive indicates a period of generally average rainfall
- The grade of the slope indicates how much wetter or drier than average the climate is

## 6.2 Groundwater level monitoring results

### 6.2.1 SON bore 84032

The regional groundwater level response has been characterised using SON bore 84032 which screens the Older Volcanics. The bore has not been actively monitored by the State since 2016, however Holcim are monitoring water levels from this bore as part of their groundwater monitoring program.

A hydrograph for SON bore 84032 has been included in Appendix F. Groundwater levels from 2002 until the State ceased monitoring in 2016 are shown, along with water levels recorded by Holcim from November 2024 until December 2025.

Between approximately 2006 and mid 2010 there was a fall in water levels, coincident with the Millennium drought conditions experienced across the State. Water levels began to recover in 2010, consistent with increasing rainfall, and by 2012 had recovered to levels pre-drought conditions. A gradual fall in water levels is also noted between 2014 to when monitoring ceased in 2016, which is also consistent with below average rainfall.

Water levels measured by Holcim in November and December 2024 were reported at approximately 11 m AHD, broadly consistent with previous monitoring, although this is following a number of wetter than average years post around 2020.

Since December 2024 water levels in the bore have steadily fallen, consistent with the below average rainfall recorded during 2025 (refer Table 12). Water levels have fallen by approximately 1.8 m between December 2024 and December 2025.

Based on the available data, the water level response from SON bore 84032 appears to be influenced by climatic conditions, i.e. rainfall.

Ongoing monitoring by Holcim is recommended to confirm trends in regional groundwater levels, i.e. away from the site, and to support future reviews.

### 6.2.2 Site monitoring bores

Groundwater level monitoring is completed from site bores in order to meet the requirements of the EMP (refer Section 2.3.1) and groundwater levels are available from 2022 to the present, except for a period between 2005 and 2008.

Tabulated groundwater level data is presented in Appendix E and hydrographs are included in Appendix F. A discussion of water level responses in the bores is included below.

#### Monitoring bores MB01 and MB06

Monitoring bores MB01 (Werribee Formation) and MB06 (Older Volcanics) are located at the south and north of the quarry, respectively.

- Based on the available water level data between 2002 and 2005, water levels in both bores showed an obvious response to the prevailing rainfall trends, falling during periods of below average rainfall and rising during periods of above average rainfall
- Following a break in the monitoring between early 2005 and 2008, water levels were observed to have fallen significantly, more than 8 m, coincident with a period of below average rainfall
- Water levels continued to fall in bore MB06 (Older Volcanics) until 2010 whereas water levels in bore MB01 (Werribee Formation) rose during the period of below average rainfall (which is thought to be related to the stripping of overburden/vegetation removal during this time)
- Following a break in the monitoring in 2014, the water level response in both bores appears to have been largely driven by the prevailing climate with water levels rising and falling in response to rainfall. The most obvious responses are:
  - A period in late 2022/ early 2023 when generally water levels in the bores rose as rainfall totals increased. The rise in water levels is more pronounced in bore MB06 (Older Volcanics) and peaked around December 2022

- From mid 2023 when water levels in the bores have steadily fallen. The fall in water levels is consistent with a longer term fall in rainfall totals
- Except for a period between 2008 and 2011, water levels in bore MB06 (Older Volcanics) have been higher than in bore MB01 (Werribee Formation). Since 2023, an approximate average head difference of approximately 3.6 m has been recorded

The available data from the dataloggers from these bores, from November 2024 to the end of 2025, are shown in Appendix G. The datalogger information also shows a consistent fall in water levels during 2025. Available manual water level measurements are also shown on these hydrographs and indicate that the dataloggers are recording water levels in the bores correctly.

### **Nested monitoring bores MB02 and MB04**

Nested monitoring bores MB02 (Werribee Formation) and MB04 (Older Volcanics) are located on the quarry floor however Holcim has indicated that the more recent bores replacement monitoring bores may be installed in overburden material (refer Section 4.1.1).

- Based on the available data, water levels in the bores did not appear to fall during a long period of below average rainfall between 2006 and 2010
- Following a break in the monitoring between mid-2008 and mid-2009, water levels were observed to rise significantly, more than 10 m, coincident with a period of above average rainfall
- During another break in the monitoring between early 2011 and early 2015, water levels were observed to have fallen significantly, approximately 10 m, coincident with a period of average/below average rainfall. Water levels continued to fall steadily until approximately early 2019
- Whilst rainfall has generally increased since 2020, water levels in the bores has remained relatively stable until approximately mid 2024. Since then, water levels in both bores have steadily fallen by small amounts, consistent with below average rainfall. The groundwater level in MB04 (older Volcanics) appears to strongly correspond with the northern dam level
- Historically, water levels in bore MB02 (Werribee Formation) have been higher than in bore MB04 (Older Volcanics). More recently however, since 2020, water levels have been higher in bore MB04. An approximate average head difference of 1.3 m is noted during this more recent period

### **Nested monitoring bores MB03 and MB05**

Nested monitoring bores MB03 (Werribee Formation) and MB05 (Older Volcanics) are located on to the south west of the site, near the quarry crest.

- Based on the available water level data between 2002 and 2011, water levels in both bores showed an obvious response to the prevailing rainfall trends, falling during periods of below average rainfall and rising during periods of above average rainfall
- During a break in the monitoring between early 2011 and early 2015, water levels were observed to have fallen significantly, more than 10 m, coincident with a period of average/below average rainfall. Water levels continued to fall until approximately mid 2016
- Above average rainfall has been observed between early 2020 and late 2022 however the water level response has not been as pronounced as during previous above and below average rainfall periods
- Water levels in the bores fell sharply between November 2022 and March 2023. AECOM (2024) indicate that this fall was in response to quarrying from Area 2. Whilst water levels initially recovered, they have since continued to generally fall slightly in response to reduced rainfall
- Historically, water levels in bore MB05 (Older Volcanics) have been higher than in bore MB03 (Werribee Formation), sometimes up to 2 m. Since 2023 however, the approximate average head difference has fallen to 0.2 m

### **Monitoring bore MB07**

Groundwater levels in bore MB07 in December 2025 were reported at 203 m AHD. Ongoing monitoring from this bore will aid in determining any trends in groundwater levels in the basalt aquifer at this location.

## 6.2.3 Dam water levels

Dam water levels, provided by Holcim, have been included on the hydrographs. Based on the data between late 2020 and December 2025, the northern dam averages a pit water level of approximately 172.5 m AHD and the Southern Dam approximately 165.5 m AHD. This is consistent to that reported by AECOM (2024).

During 2025 water levels in the northern dam have varied by approximately 1 m whereas water levels in the southern dam have varied by only approximately 0.3 m.

The water level in the northern dam broadly corresponds with water levels recorded from bore MB04 (Older Volcanics) located on the quarry floor. Water levels in the southern dam are lower than groundwater levels recorded from all bores.

## 6.3 Summary

A summary of the groundwater levels in the bores is included in Table 13. Overall, and particularly in the last decade, the groundwater levels observed in monitoring bores tend to reflect a response of the groundwater system to the prevailing climate, i.e. rainfall trends.

Groundwater level falls in bores MB03 and MB05 in late 2022 are likely related to quarry deepening in 2022/2023 adjacent the bores, however recent falls in groundwater level observed in most other bores over the last 2 years appear to be related predominately to climate influence (i.e. below average rainfall years).

**Table 13** Summary of monitoring bore groundwater levels

Bore ID	Aquifer	Summary
SON 84032	Older Volcanics	Bore SON84032 is remote from site. Based on the available data, the water level response from the bore appears to be influenced by climatic conditions, i.e. rainfall. Recent water level monitoring completed by Holcim indicates falling water levels in the bore, consistent with below average rainfall.
MB01 and MB06 (nested)	Werribee Formation and Older Volcanics	Based on the available data, the water level response from the bores appears to be influenced by climatic conditions, i.e. rainfall. Monitoring in 2025 indicates falling water levels, consistent with below average rainfall.
MB02 and MB04	Werribee Formation and Older Volcanics (overburden)	Since approximately 2024 water levels in the bores have fallen steadily by small amounts, consistent with below average rainfall.
MB03 and MB05 (nested)	Werribee Formation and Older Volcanics	Obvious response to prevailing rainfall trends between 2002 and 2011 Obvious fall in water levels in the bores between November 2022 and March, reportedly in response to quarrying from Area 2. Whilst water levels initially recovered, they have since continued to fall slightly in response to reduced rainfall.
MB07	Older Volcanics	Ongoing monitoring is required to confirm any responses to the prevailing climate and/ or quarry operation.

# 7. Classification of Groundwater and Protected Environmental Values

This section has been included in order to allow for reviewing the classification of the local ground water (refer Section 7.1.3) to identify the protected environmental values specific to this site.

## 7.1 Classification of groundwater

### 7.1.1 Regulatory instruments

The *Environment Protection Act (2017)* specifies objectives of the EPA. The Act requires a prevention based approach, rather than preventing waste and pollution impacts and managing these after they have occurred. Central to the Act is the general environmental duty (GED) which requires Victorians to reduce the risk of their activities potentially harming the environment or human health through waste and pollution.

The Act introduces two subordinate instruments:

- Environment Protection Regulations (EPR)
- Environment Reference Standard (ERS)

The ERS is used to assess and report on the environmental conditions throughout Victoria, as it:

- Identifies environmental values (human health and the environment) to be achieved or maintained in Victoria
- Specifies indicators and objectives used to measure, determine, or assess whether those environmental values are being achieved, maintained, or threatened

The ERS is not meant to represent a compliance standard but rather has a primary function to provide an environmental assessment and reporting benchmark. The ERS contains environmental values for each element of the environment in separate parts, i.e. air, land, water (surface and groundwater), however, the different elements of the environment can impact each other and the interactions between them need to be considered.

The ERS (2021) provides that groundwater is categorised into segments, with each segment having particular identified values. The segments and their environmental values are summarised in Table 14.

**Table 14** Protected environmental values and groundwater segments

Environmental value	Segment (TDS mg/l)						
	A1 (0-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial use	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓

Environmental value	Segment (TDS mg/l)						
	A1 (0-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓
Note: TDS – Total Dissolved Solids (mg/L). Source ERS (2021).							

## 7.1.2 Groundwater quality indicators and objectives

The indicators and objectives for groundwater, for each environmental value have been summarised in Table 15. The environmental values may not apply to groundwater if:

- There is insufficient aquifer yield to sustain the environmental value, having regard to variations within the aquifer and reasonable bore development techniques to improve yield; or
- The application of that groundwater, such as for irrigation, may be a risk to the environmental values of land or the broader environment due to the soil properties; or
- The background water quality level exceeds (or is less than, in the case of indicators such as pH, dissolved oxygen and many biological indicators) the relevant objective specified in Table 15 and as a result the environmental value cannot be achieved

Table 15 Groundwater indicators and objectives

Environmental value	Indicators	Objectives
Water dependent ecosystems and species (in surface waters)	For groundwater that discharges to surface water, the indicators are the indicators applicable to the relevant surface water as specified in Division 3 of Part 5 of this ERS	The level that ensures the groundwater does not affect receiving waters to the extent that the level of any indicator in the receiving waters: <ul style="list-style-type: none"> <li>– Exceeds the level of that indicator (if specified as an upper limit); or</li> <li>– Is less than the level of that indicator (if specified as a lower limit),</li> <li>– Specified for surface water in Division 3 of Part 5 of this ERS.</li> </ul>
Water dependent ecosystems and species (in subterranean waters with a hydrogeological setting conducive to the presence of troglofauna and stygofauna)	Indicators that are relevant to the subterranean species of troglofauna and stygofauna, which may include TSS, salinity, toxicants in water, toxicants in sediment and dissolved oxygen	The level that ensures the groundwater quality does not adversely affect the troglofauna and stygofauna that depend on the groundwater.
Potable water supply	Indicators specified in the ADWG	Health-related guideline value for each indicator specified in the ADWG. Aesthetic guideline value for each indicator specified in the ADWG.
Potable mineral water supply	Indicators specified in the ADWG	Health guideline values for each indicator specified in the ADWG. Aesthetic guideline values for each indicator set out in the ADWG.
Agriculture and irrigation (irrigation)	Indicators specified for irrigation and water for general on-farm use in the ANZG	Level of that indicator specified in the ANZG
Agriculture and irrigation (stock watering)	Indicators specified for livestock drinking water quality in the ANZG	Level of that indicator specified in the ANZG

Environmental value	Indicators	Objectives
Industrial and commercial	Indicators specific to the particular industrial or commercial activity and their use of water	Groundwater quality that is suitable for its industrial or commercial use
Water-based recreation	E. coli	10 E. coli/100mL (if no human faecal contamination sources identified) 0 E. coli/100mL (if human faecal contamination sources identified)
	Chemical hazards, aesthetic effects	Level of indicators (where specified) and descriptions in applicable guidance, in the Recreational Water Guidelines
Buildings and structures	pH, sulphate, chloride, redox potential, salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures	Groundwater that is not corrosive to or otherwise adversely affecting structures or building
Geothermal	Temperature between 30°C and 70°C.	Geothermal properties of groundwater to be maintained for current and future users of the resource

Note: ANZG - means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)

The background water quality level is the objective for an indicator if:

- The objective is not able to be attained due to the background water quality level of that indicator; or
- The background water quality level better protects the environmental values than the objective specified in Table 15

The ERS (2021) requires that occupational health and safety, odour and amenity also be considered, due to the fact that vapours sourced from impacted groundwater may present a potential risk to workers, and that odours or discolouration may result in degradation of overall environmental values of groundwater.

### 7.1.3 Identified groundwater segment

In identifying the relevant groundwater segment, several sources of data were reviewed:

- Field water quality monitoring from the springs over the entire dataset indicate that salinity ranges from 149 mg/L TDS (SP09, February 2002) to 2,808 mg/L TDS (SP02, January 2003) with an average of approximately 778 mg/L TDS
  - Water quality monitoring in December 2025 indicated that salinity ranged from 150 mg/L TDS (SP06) to 1,029 mg/L TDS (SP02) with an average of approximately 422 mg/L TDS
- Regional salinity information (refer Section 3.1) indicates that the groundwater salinity at the site is between 500 mg/L and 1,000 mg/L TDS but higher groundwater salinity, 1,000 mg/L to 3500 mg/L TDS is interpreted south of the site
- Historical site monitoring bore salinity data taken during bore development ranges from approximately 1,140 mg/L TDS to approximately 2,320 mg/L TDS

The historical monitoring bore salinity results are considered the most representative of local groundwater salinity. It is acknowledged that the water at the springs may not be a true representative of groundwater quality as the springs are likely to capture rainfall, either directly or as runoff leading to dilution and reduction of salinity. As such, and using site specific monitoring bore data, groundwater at the site, Segment B (i.e. 1,201 mg/L to 3,100 mg/L TDS) has been adopted. The distinctly high salinity from spring SP02, relative to other springs, is a strong indicator that this spring may be predominately recharged by the groundwater system.

### 7.1.4 Protected Environmental Values

Segment B groundwater quality needs to be maintained to protect the following environmental values:

Table 16 Relevant protected environmental values

Environmental value	Existing use	Relevance
Water dependent ecosystems and species	Yes	<b>Relevant</b> Groundwater quality must be maintained to protect aquatic ecosystems at the point of groundwater discharge. Based upon the ERS, the site falls within the Central Foothills and Coastal Plains segment which is a slightly to moderately modified water dependent ecosystem.
Potable mineral water supply	Onsite – no Offsite - no	<b>Not relevant</b> The groundwater is not within a recognised mineral water province and is not known to display properties desirable in a mineral water e.g. spritzig or effervescence. There is a limited likelihood of groundwater being used for this purpose in this area.
Agriculture and irrigation (irrigation)	Onsite – No Offsite – yes	<b>Relevant</b> Bores within irrigation use have been identified and therefore this is a relevant environmental value that requires protection.
Agriculture and irrigation (stock watering)	Onsite – no Offsite - yes	<b>Relevant</b> There are stock bores neighbouring the site. The salinity of the groundwater is acceptable to a wide range of livestock species. This is a relevant environmental value that requires protection.
Industrial and commercial	Onsite – no Offsite - yes	<b>Relevant</b> There are no nearby bores with a commercial or industrial licence and the neighbouring land use is predominantly farming. Whilst development of groundwater for such abstractive benefit seems unlikely, protection of this environmental value is reasonable.
Water-based recreation (primary contact recreation)	Onsite – no Offsite - potentially	<b>Relevant</b> Whilst local waterways are likely to be too small to support water based recreation, neighbouring bores may be used for such purpose, e.g. swimming pool top up.
Traditional Owner cultural values	Yes	<b>Relevant</b> No engagement has been undertaken as part of this commission. In the absence of specific engagement with the local traditional owners (that GHD know of), it has been assumed that protection of groundwater that discharges into local waterways is required to maintain traditional owner cultural values
Cultural and spiritual values	Yes	<b>Relevant</b> This environmental value may include traditional aquaculture, fishing, harvesting, cultivation of freshwater and marine foods, fish, grasses, medicines and filtration of water holes. There are no objectives specified in the ERS. In the absence of site-specific criteria, the objectives for other environmental values of water dependent ecosystems and species have been adopted.
Buildings and structures	Not on site. Neighbouring residential properties (likely shallow foundations)	<b>Not relevant</b> There are some buildings, including residential properties, located remote from the quarry. It is noted that most water levels tend to be greater than 20 m depth and therefore the buildings would need to have basements and/or foundation structures that penetrate below this depth.
Geothermal properties	No	<b>Not relevant</b> The groundwater is too shallow to have an elevated temperature and therefore this value is not considered relevant to the assessment.

## 8. Discussion of results – springs

### 8.1 Spring monitoring results

#### 8.1.1 Electrical Conductivity

Where there was sufficient water, field measurements of EC for the springs were recorded during the December 2025 inspection and these have been recorded in Table 11 and Appendix H.

At all springs EC was observed to have fallen slightly between the December 2024 and December 2025 monitoring with falls in EC varying from 33  $\mu\text{S}/\text{cm}$  (SP03) to 282  $\mu\text{S}/\text{cm}$  (SP09) (refer Table 17).

Table 17 Spring EC, 2024 and 2025

Spring ID	Field Electrical Conductivity ( $\mu\text{S}/\text{cm}$ )	
	December 2024	December 2025
SP01	758	724
SP02	1922	1705
SP03	557	524
SP06	493	249.2
SP08	596	395.5
SP09	924	642

Note: All other springs dry/ insufficient water to measure field parameters

Long term rainfall and spring EC has been presented graphically in Appendix I.

The data indicates that spring SP02, located south west of the quarry, has consistently reported the highest EC, usually between 2,000  $\mu\text{S}/\text{cm}$  and 2,500  $\mu\text{S}/\text{cm}$ , and as noted previously is likely to be predominantly groundwater fed. Since 2016 however, the EC of the water from the spring has been slowly falling, from just above 3,000  $\mu\text{S}/\text{cm}$  to 1,705  $\mu\text{S}/\text{cm}$  in December 2025.

Whilst the falls in EC from late 2019 to late 2024 are broadly consistent with a longer term rise and average rainfall in the region, EC from spring SP02 continued to fall despite a reduction in rainfall during 2025. It is noted however that above average rainfall was received in November 2025, prior to the December 2025 monitoring.

The long term record for spring SP02 indicates that the salinity has varied between approximately 957 mg/L TDS and 2,808 mg/L TDS with an average of approximately 1,610 mg/L TDS. Whilst the average water salinity from this spring is consistent with Segment B groundwater, as noted above recent monitoring has identified a falling salinity trend, potentially reflecting an increasing portion of recharge from local rainfall (and related interflow).

#### 8.1.2 Spring flows

##### 2025 monitoring

A summary of the flows recorded at each spring in both December 2024, and December 2025 is provided in Table 18. There is some small variation in spring flows between December 2024 and December 2025 with spring flows increasing slightly in SP01, SP02 and SP09. Flows in springs SP03 and SP08 have fallen slightly.

Table 18 Summary of spring flows, 2025

Spring ID	Location relative to quarry	Estimated flow rate (m <sup>3</sup> /day)			Flow meter reading m <sup>3</sup>	Comment
		Dec-24	Dec-25	Average calculated from flow meter, December 2025		
SP01	South west	4.7	≈ 7.2	8.6	3,403	Spring flows have risen since previous inspection
SP02	South west	1.3	1	3	1,113	Spring flows have remained similar to previous inspection however flow meter reading is slightly higher than instantaneous reading
SP03	West	2.5	2.2	0.9	210.5	Spring flows have fallen since previous inspection
SP04	North west	NR	NR	N/A – no flow meter		Spring currently dry- no change.
SP05	South	NR	NR	N/A – no flow meter		Spring currently dry-no change.
SP06	North	-	-	N/A – no flow meter		Wet on upslope of dam, no visible flow out of the dam
SP07	North	Spring no longer observed.				
SP08	North	7.9	2.9 – 4.3	N/A – no flow meter		Spring flows have fallen since previous inspection
SP09	East	NR	1.3	N/A – no flow meter		Spring flows have risen slightly since previous inspection
SP10	East	NR	NR	N/A – no flow meter		N/A – trace moisture only
SP11	West	Not flowing	Not flowing	N/A – no flow meter		No change since previous inspection
Notes. GHD 2025 inspection completed on 15 December 2025						

## Spring flow meters

Whilst instantaneous estimates of flow rates are made from the springs, flow meters have been installed at springs SP01, SP02 and SP03 (refer Table 9) to provide more accurate long term measurements of spring flows.

Holcim have installed flow meters on springs SP01, SP02 and SP03 in order to provide an understanding of long term flow rates from these springs. Flow meter volumes are recorded approximately weekly. In addition to weekly measurement of volumes, Holcim have installed a HydroMace datalogger at spring SP01 to collect more frequent measurements of flow rates.

A summary of the flow meter information from these springs is included in Table 19. Average weekly rates for springs SP01 to SP03 over the monitoring period are shown in graphically in Figure 4, along with daily rainfall. Average daily flow rates from spring SP01 are shown in Figure 5.

The information from the flow meters indicates that:

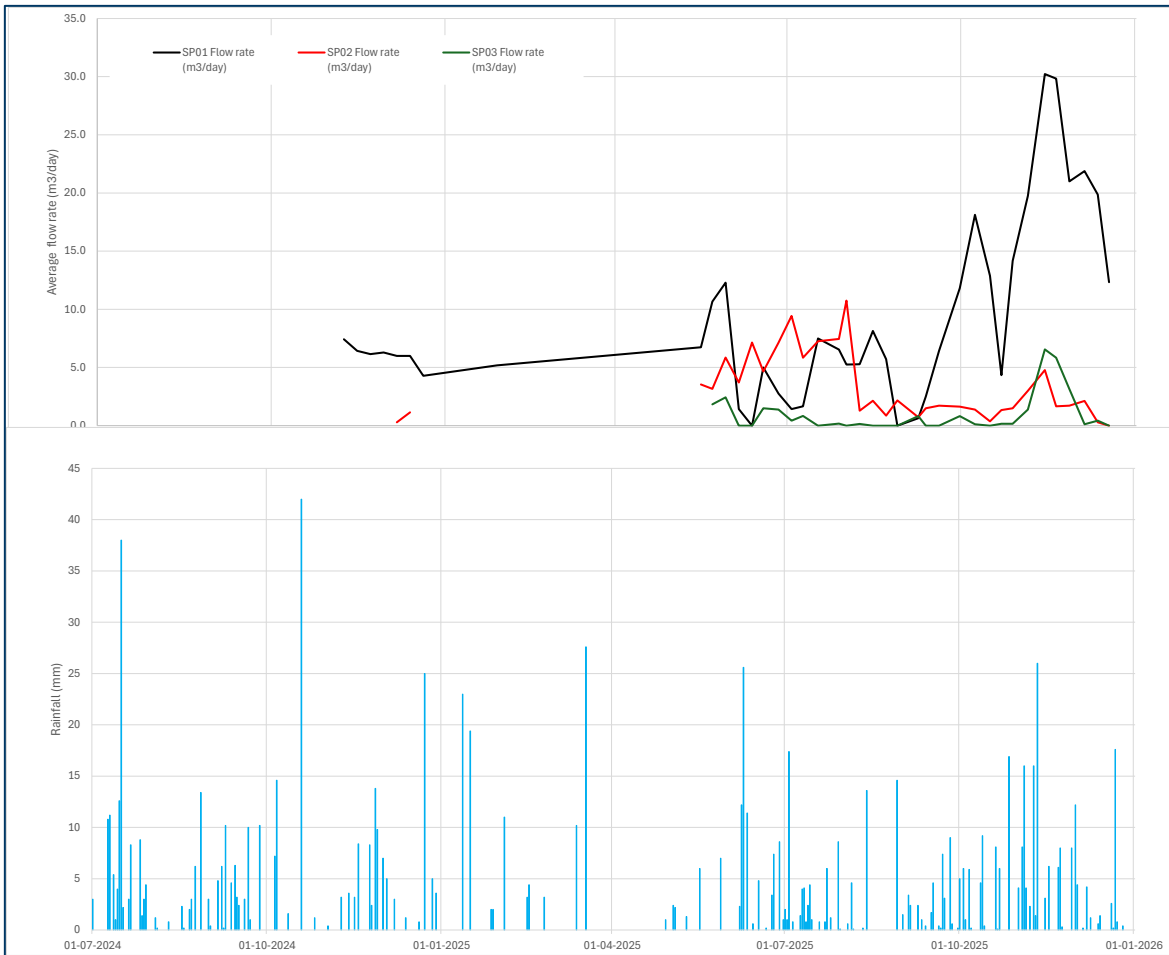
- The available spring flow data collected from the flow meters indicates that spring SP01 has the highest flow rate, on average more than three times that of springs SP02 and SP03
- The flow rates measured during the field inspection in December 2025 (refer Table 11) fall towards the lower end of the longer term range documented in Table 19
- Spring flow rates from all springs increased significantly in November 2025. This increase in flow rate correlates to the above average rainfall totals received during this month (refer Table 12)

- Calculated flow rates from spring SP01 for the weekly meter reads and HydroMace datalogger are comparable

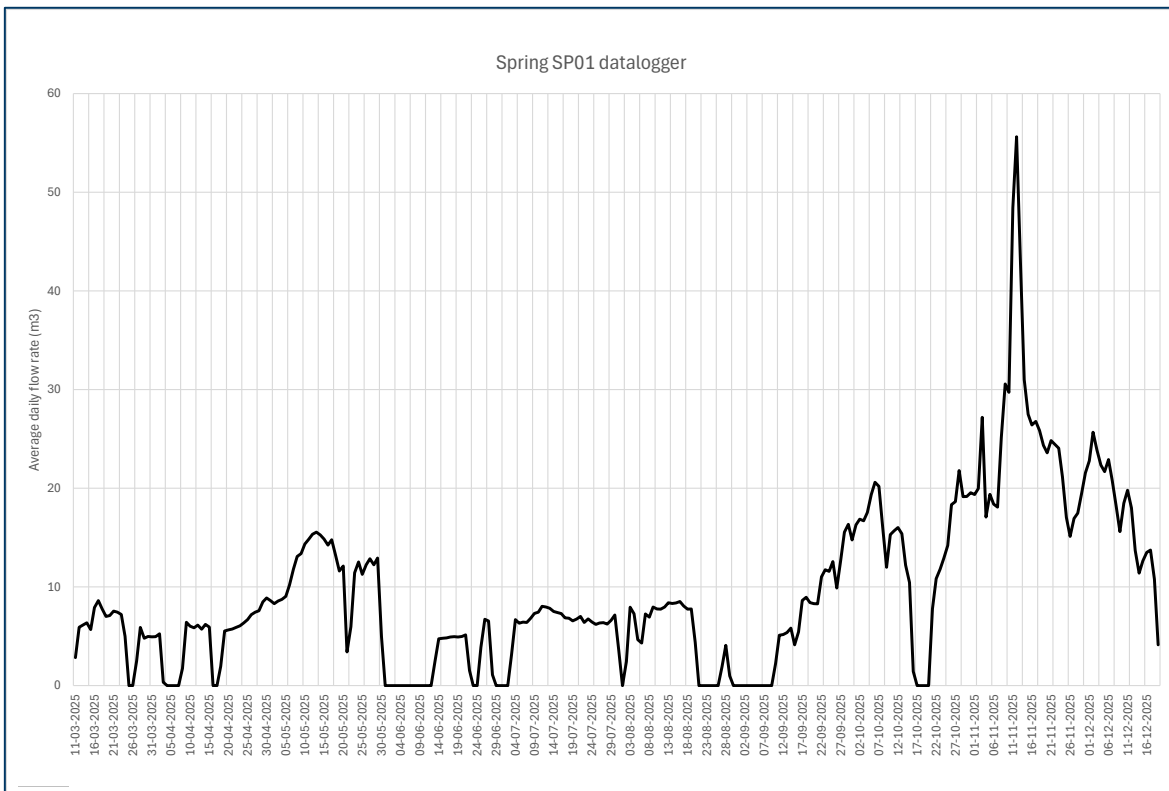
On-going monitoring from these three springs will eventually allow climate and level /flow results to be plotted to provide a more complete picture of the spring flow/level trends.

**Table 19** Summary of spring flows, SP01 to SP03

Spring ID	Monitoring period	Total volume recorded (m <sup>3</sup> ) for monitoring period	Minimum flow rate (m <sup>3</sup> /day)	Minimum flow rate (m <sup>3</sup> /day)	Average flow rate (m <sup>3</sup> /day)	Comment
SP01	1/11/2024 – 8/12/2025	3,442	0.6	30.2	9	Data from ≈ weekly records of meter volumes
	11/03/2025 – 19/12/2025	2,694.7	0	55.61	9.5	Data from HydroMace logger
SP02	8/11/2024 - 8/12/2025	1,113	0.3	10.8	3.3	Data from ≈ weekly records of meter volumes
SP03	15/05/2025 - 8/12/2025	211	0.1	6.6	1.4	Data from ≈ weekly records of meter volumes
<p>Notes:</p> <p>Source – Holcim</p> <p>Flow meter volumes recorded manually approximately weekly</p> <p>Average flow rate in m<sup>3</sup>/day calculated from weekly records (for manual measurement of flow meters)</p> <p>Flow meter volumes recorded every 10 minutes (HydroMace logging)</p>						



**Figure 4** Spring flows, SP01 to SP03 and daily rainfall



**Figure 5** Spring flows SP01 (datalogger)

### 8.1.3 Spring and groundwater level comparison

During the December 2025 inspection, water levels were measured at the springs where there was sufficient water. These water levels have been summarised in Table 20, along with measured groundwater levels in nearby monitoring bores.

Based on the available data for December 2025, the groundwater elevation at the bores is generally greater, i.e. higher, than that recorded from the springs. This is consistent with the findings of previous reviews (GHD, 2025, AECOM, 2024).

**Table 20** Spring and groundwater elevations

Spring ID	Location relative to quarry	Elevation (m AHD)	Measured spring water level (m)	Spring water level height (m AHD)	Nearest monitoring bore(s)	Groundwater elevation (m AHD)
SP01	South west	155.628	0.17	155.458	MB03, MB05	168.12 (MB03) 168.45 (MB05)
SP02	South west	145.731	0.26	145.471	MB03, MB05	168.12 (MB03) 168.45 (MB05)
SP03	West	160.522	0.485	160.037	MB03, MB05	168.12 (MB03) 168.45 (MB05)
SP06	North	165.962	0.43	165.532	MB06	172.5 (MB06)
SP08	North	171.744	-	171.595	MB06 MB07	172.5 (MB06) 203.06 (MB07)
SP09	East	166	-	166.035	MB07	203.06 (MB07)
Notes: Water levels for springs SP08 and SP09 surveyed by Holcim Groundwater elevations recorded in December 2025						

## 8.2 Summary

There is no obvious indication that quarry operations are impacting on the springs. As shown by the installed flow meters, recorded flows from the springs primarily reflect the response to rainfall, i.e. increased spring flows in response to increased rainfall, and long term results will be required to attempt to assess if the quarry operation influences these flows. The one off daily flow measurements, compared to the previous year, indicated most springs remained stable, while three springs had an increase in flow, and two had a decrease in flow (recognising these measurements are also influenced by recent rainfall before the inspection).

Installation of flow meters at springs SP01, SP02 and SP03 will allow for a greater understanding of spring flows longer term and seasonally, assuming flow volumes are recorded at regular intervals. The annual inspection at the other spring sites will continue to build a up a record of flow statistics over time, which can also help identify any long term trends.

## 9. Bore maintenance

Table 21 summarises the monitoring bore condition observed in December 2025, along with recommended maintenance actions. A photographic record of the bore headworks in December 2025 has been included as Appendix J.

Whilst most bores are in good condition, recommendations have been made to further secure and maintain selected bores.

**Table 21** *Monitoring bore condition, December 2025*

<b>Bore ID</b>	<b>Condition</b>	<b>Comment</b>
MB01	Bore located on steep slope above quarry area. Safe access to bore from track behind (south of) bore. Concrete headworks have been exposed slightly on quarry side and there is slight movement in steel headworks. Otherwise bore in good condition.	Continue accessing the bore from the to avoid field staff traversing steep, loose slope.
MB02C/ MB04C	Nested monitoring bore site on quarry floor. Good condition. Spoil piles around the bore provide some protection from mobile plant.	-
MB03B/ MB05B	Nested monitoring bore site south west of quarry. Bores in good condition and grass near bores has been slashed to avoid obscuring bores	Slash grass as required to avoid bores becoming obscured by grass.
MB06	Bore in good condition. Headworks have been recently painted (high visibility yellow) Grass near bore has been slashed to avoid obscuring bores	Slash grass as required to avoid bores becoming obscured by grass.
MB07	Bore in good condition and easily located Small bund in front of bore provide some protection from vehicles.	-
SON 84032	Bore in good condition and easily located however long grass has started to grow near bore (in road reserve)	This bore is managed by DEECA and the roadside managed by the local council
General	Bores have been labelled. Bores outside quarry grounds have been secured (locked).	-

# 10. Conclusions and recommendations

## 10.1 Conclusions

Based on the groundwater and spring review, Table 22 summarises the conclusions from the groundwater monitoring completed at the site in 2025.

Table 22 Conclusions

Item	Comment
Groundwater levels	<p>Baseline groundwater level monitoring required as part of the EMP is currently undertaken monthly by Holcim.</p> <p>Holcim have also monitors groundwater levels from SON bore 84032, south of the site, to further understand regional groundwater levels and to inform future reviews.</p> <p>The water level response geographically across the site monitoring bore network was variable, but generally consistent ranges are observed within individual bores.</p> <p>Overall, and particularly in the last decade, the groundwater levels observed in monitoring bores tend to reflect a response of the groundwater system to the prevailing climate, i.e. rainfall trends. Groundwater level declines in bores MB03 and MB05 in late 2022 are likely related to quarry deepening in 2022/2023 adjacent the bores, however recent declines in groundwater level observed in most other bores over the last 2 years appear to be related predominately to climate influence (i.e. below average rainfall years).</p>
Dam water levels	<p>During 2025, water levels in the northern dam varied by approximately 1 m whilst water levels in the southern dam varied by approximately 0.3 m. This variation is similar to than in 2024 but less than in 2023 when water levels in the northern dam varied by 2 m and by 1 m in the southern dam. Groundwater levels in bore MB04 strongly correlate with the northern pit surface water levels.</p>
Spring monitoring	<p>Eleven springs are monitored at the site however spring SP10 has been reclassified as a seep. There was some small variation in spring flows between the 2024 and 2025 monitoring with flows in three springs increasing slightly and flows in two springs falling slightly. The spring flows recorded in December 2025 were generally within the historical range.</p> <p>Flow meters have been installed by Holcim at SP01, SP02 and SP03 in order understand spring flows longer term and seasonally. High spring flows recorded by the flow meters in November 2025 may be due to the above average rainfall received during this month.</p> <p>Spring EC at SP02 is consistently the highest, more than 2,000 <math>\mu\text{S}/\text{cm}</math>, though a long term falling trend is noted. EC in the remaining springs is less than 1,000 <math>\mu\text{S}/\text{cm}</math> with EC reported in December 2025 slightly less than in December 2024.</p> <p>Based on this assessment, there is no obvious indication that quarry operations are impacting on the springs.</p> <p>Minor improvements to the spring monitoring network have been made, and ongoing monitoring will continue to improve the understanding of spring flow trends, and the potential for any impacts from the quarry.</p>
Identified environmental values	<p>This assessment has classified the groundwater at site as falling within Segment B, consistent with the previous review. Based on this assessment, there is no obvious indication that quarry operations are impacting on identified groundwater environmental values.</p>
Monitoring bore maintenance	<p>Bores need to be maintained in a functional condition to ensure that quality, defensible monitoring data (water level and water quality) can be obtained from the installations. This enables the potential impacts of mining to be assessed.</p> <p>All bores are deemed to be in good condition and accessible for monitoring. Minor ongoing works have been recommended to maintain ongoing access to some of the bores.</p>
<p>Note: EC – Electrical Conductivity</p>	

## 10.2 Recommendations

This report makes the following recommendations (Table 23):

Table 23 Recommendations

Recommendation	Comment
Continue with groundwater and spring monitoring as per the approved EMP.	To ensure compliance with the EMP.
Correctly label spring SP05	To enable accurate identification of spring during field inspections
Clear poly pipe at spring SP08	To enable ongoing accurate estimates of spring flow
Install new survey peg at springs SP08 and SP09. Existing stake locations are overgrown with vegetation	To enable ongoing accurate measurement of water levels, i.e. surveyor not required to measure water levels
Continue to undertake regular measurements of the flow meters at springs SP01, SP02 and SP03	To understand spring flows longer term and seasonally and to compare to annual instantaneous measurements. To compare spring flow to rainfall trends. Measurements to be taken weekly during 2026 to better understand spring flow response to rainfall.
Continue with groundwater monitoring from SON bore 84032.	Further understand regional groundwater levels and to inform future reviews. As Holcim have deployed a datalogger in the bore, manual water level measurements can be completed at a minimum quarterly frequency (along with datalogger download at the same time).
Continue to measure pit water levels	For comparison to groundwater levels.
Complete ongoing inspection and maintenance of the monitoring bore headworks (for all monitoring bores). Contact DEECA/ Council if access to SON bore 84032 becomes difficult due to encroaching grasses/ overgrown vegetation in road reserve.	Complete at a minimum quarterly frequency. To ensure monitoring network integrity

# 11. References

- Bureau of Meteorology, Climate data online. <http://www.bom.gov.au/climate/data/>. Accessed January 2025
- AECOM, 2024. Pakenham Quarry Hydraulic Conductivity Testing. Ltr Pakenham Quarry Hydraulic Conductivity Testing v2, dated 12 January 2024. Prepared for Holcim
- DEECA. Victoria Unearthed. <https://mapshare.vic.gov.au/victoriaunearthed/>. Accessed January 2026
- DEECA. Visualising Victorias Groundwater. <https://www.vvg.org.au/>. Accessed January 2026
- DEECA. Victorian Water Accounts. Wandin Yallock and Koo Wee Rup WSPAs: <https://accounts.water.vic.gov.au/2024/local-water-reports/groundwater-by-area/wandin-yallock-gma/> and <https://accounts.water.vic.gov.au/2024/local-water-reports/groundwater-by-area/koo-wee-rup-wspa/>. Accessed January 2026
- GHD, 2023. *Pakenham Quarry. Hydrogeological Review*. GHD report 12598748-REP-0-Pakenham Quarry Hydrogeological Review-A\_1, prepared for Holcim, dated June 2023
- GHD, 2025. *Groundwater and spring monitoring, Mt Shamrock Quarry. Annual monitoring review*. GHD report 12643509-RPT-0-Mt Shamrock Pakenham Quarry Reporting, prepared for Holcim, dated February 2025

# Appendices

# **Appendix A**

**EPA licence OL000000544**

# Operating licence

*Environment Protection Act 2017*

---

Licence number	OL000000544
Issue date	23 November 1979
Last amended	25 November 2022
Expiry date	31 December 9999
Licence holder	HOLCIM (AUSTRALIA) PTY LTD
ACN	099732297
Activity site(s)	95 Shamrock Rd, Pakenham, VIC, 3810, AU
Prescribed permission activities	C01 (Extractive industry and mining)

---

Issued under section 74(1)(a) of the *Environment Protection Act 2017* (the Act).



---

Margaret Green  
Team Leader, Licensing  
Delegate of Environment Protection Authority Victoria (EPA)

[epa.vic.gov.au](http://epa.vic.gov.au)

Environment Protection Authority Victoria  
GPO BOX 4395 Melbourne VIC 3001  
1300 372 842

# Operating licence

*Environment Protection Act 2017*

## Context

Environment Protection Authority Victoria (EPA) is Victoria's environmental regulator acting in accordance with the *Environment Protection Act 2017* (the Act). Our regulatory role is to work with community, industry and business to prevent and reduce the harmful effects of pollution and waste on Victoria's environment and people.

### **Why we issue operating licences**

A range of operating activity types are prescribed in the Environment Protection Regulations 2021 (the Regulations) because they give rise to risks of harm to human health or the environment. We issue operating licences so applicants can lawfully undertake prescribed operating activities. Section 45 of the Act provides that a person must not engage in a prescribed operating activity except as authorised by an operating licence in respect of that activity.

### **When we issue operating licences**

EPA can issue an operating licence under section 74(1) of the Act. When issuing an operating licence, EPA takes into account a number of factors, including the measures an applicant has taken or proposes to take in order to comply with the Act when engaging in the prescribed permission activity.

EPA can amend, suspend or revoke a licence for a range of reasons. This can include in response to changes in activities, risks or licence holder performance. All operating licence details are publicly accessible via the EPA Public Register.

## Key information and obligations

### **Interpretation**

For the purposes of this operating licence "You" means the "licence holder" identified on the first page. Unless a contrary intention appears, words or terms used in the conditions of your licence have the same meaning as in the Act, and in any regulations made pursuant to the Act.

### **Compliance**

Your licence is subject to conditions. These conditions confer legal obligations on you as the licence holder. Some of these are general in nature, while others require you to do (or not to do) specific things. The requirements of these conditions do not detract from each other in any way, nor do they affect any other duties or obligations with which you are required to comply by law. You must fulfil all duties and perform all obligations set out in this licence or otherwise required by law.

Strict penalties apply for non-compliance with any part of your .

You must comply with the Act and regulations administered by EPA. This includes, but is not limited to, compliance with the general environmental duty (GED).

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

## **Duties under the Act**

Under the Act, you have legal obligations in relation to your prescribed and non-prescribed activities. These legal obligations exist to minimise risks of harm to human health and the environment from pollution and waste.

You may be committing an offence and be liable to a penalty under the Act if your actions or omissions constitute a breach of these legal obligations.

## **General environmental duty**

The Act places the onus on you to understand the risks associated with your operation or activity and requires you to minimise the risk of harm. This is called the general environmental duty (GED).

Sections 6 and 25 of the Act provide the legal basis for the GED. These sections state that a person engaging in an activity which may give rise to risks of harm to human health or the environment from pollution or waste must eliminate or minimise those risks, as far as reasonably practicable.

## **Duty to notify EPA of notifiable incidents**

A notifiable incident is a pollution incident that causes or threatens to cause material harm to human health or the environment or is a prescribed notifiable incident. Under section 32 of the Act, you have an obligation to notify EPA of a notifiable incident as soon as practicable after you become aware of the incident.

## **Duty to take action to respond to harm caused by pollution incident**

Under section 31 of the Act, if a pollution incident has occurred as a result of an activity (whether by act or omission) and the pollution incident causes or is likely to cause harm to human health or the environment, a person who is engaging in that activity must, so far as reasonably practicable, restore the affected area to the state it was in before the pollution incident occurred.

## **Duty to notify of contaminated land**

Under section 40(1) of the Act, a person in management or control of land must notify EPA if the land has been contaminated by notifiable contamination as soon as practicable after the person becomes aware of the notifiable contamination.

Notifiable contamination means contamination which is prescribed in the Regulations, or contamination for which the cost of action to remediate the land is likely to exceed \$50,000, or any other prescribed amount.

## **Duties relating to industrial waste, priority wastes and reportable priority wastes**

Under parts 6.4 and 6.5 of the Act, a person has obligations in relation to the generation, receiving, recording, managing, transporting, and disposal of industrial, priority wastes and reportable priority wastes. These duties include:

- Duties of persons depositing industrial waste.

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

- Duties of persons receiving industrial waste.
- Duty of persons involved in transporting industrial waste.
- Duties of persons managing priority waste.
- Duty to investigate alternatives to waste disposal.
- Duty to notify of transaction in reportable priority waste.
- Duty of persons transporting reportable priority waste.

For further information on waste classifications see schedule 5 of the Regulations.

## **Further information and resources**

To aid compliance with the Act and the Regulations, Environment Reference Standards (ERS), Compliance Codes, Position Statements and Guidelines have been developed to address a range of environmental objectives, permitted and non-permitted activities and risks.

You should understand how the Victorian environment protection framework applies to you and your activity, operation or business by making yourself familiar with the Act, Regulations, Compliance Codes and other relevant guidance material.

To assist you with understanding your obligations refer to [www.epa.vic.gov.au](http://www.epa.vic.gov.au).

## **Amendment**

You can apply at any time to EPA for an amendment to your licence under section 57 of the Act. EPA may also decide to amend a licence under its own initiative according to section 58 of the Act.

## **Transfer**

A person may apply to EPA for the transfer of this licence to a new licence holder pursuant to section 56 of the Act.

## **Duration of licence**

This operating licence is subject to the expiry date identified on the first page. It will remain in force until that time unless it is first surrendered by the licence holder (with consent from EPA), or it is suspended or revoked by EPA.

## **Operating licence structure**

Your operating licence has multiple parts:

- Conditions
- Appendix 1 – locality plan
- Appendix 2 – activity plan
- Appendix 3 – contour plan
- Appendix 4 – waste acceptance table
- Appendix 5 – air discharge table
- Appendix 6 – water discharge table

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

- Appendix 7 – landfill cell table

Licence number: OL000000544

Page 5



# Operating licence

Environment Protection Act 2017

## Conditions

### General conditions

OL_G1	A copy of this licence must be kept at the activity site and be easily accessible to persons who are engaging in an activity conducted at the activity site. Information regarding the requirements of the licence and the Act duties must be included in site induction and training information.
OL_G2	You must immediately notify the Authority by calling 1300 EPA VIC (1300 372 842) in the event of: a) A discharge, emission or deposit which gives rise to, or may give rise to, actual or potential harm to human health or the environment; b) A malfunction, breakdown or failure of risk control measures at the activity site which could reasonably be expected to give rise to actual or potential harm to human health or the environment; or c) Any breach of the licence.
OL_G3	You must notify the Authority within 48 hours of the occurrence of any the following: (a) Any change to your name or address (including your registered address and activity site as applicable); (b) You become, or are likely to become, an insolvent under administration; (c) You become, or are likely to become, an externally administered company under the Corporations Act; or (d) A change to an officer (as defined in the Act). You must update your information in the EPA Interaction Portal if any other relevant administrative details for your business change.
OL_G4a	You must provide to the Authority with a Permission Information and Performance Statement (PIPS) in the form determined by the Authority within 2 months of receiving notification in writing from the Authority. The PIPS may be released to the public (in whole or in part).
OL_G4b	Information and monitoring records used for the preparation of, inclusion in, or support of, any reporting or notification that is required of you by the Authority (including data reporting, performance reporting, documents evidencing any risk and monitoring program) must be: a) retained for five years; and b) made available to the Authority on request.
OL_G5	1. You must develop a risk management and monitoring program for your activities which: (a) identifies all the risks of harm to human health and the environment which may arise from the activities you are engaging in at your activity site; (b) clearly defines your environmental performance objectives; (c) clearly defines your risk control performance objectives; (d) describes how the environmental and risk control performance objectives are being achieved; (e) identifies and describes how you will continue to eliminate or minimise the risks in 1(a) (above) so far as reasonably practicable (SFARP); and (f) describes how the information collated in compliance with this clause, is or will be disseminated, used or otherwise considered by you or any other entity. 2. The risk management and monitoring program must be: (a) documented in writing; (b) signed by a duly authorised officer of the licensed entity; and (c) made available to the Authority on request.

Licence number: OL000000544

# Operating licence

Environment Protection Act 2017

---

OL_G7	You must: (a) develop and maintain a decommissioning plan that is in accordance with the current decommissioning guidelines published by the Authority; (b) provide the decommissioning plan to the Authority upon request; (c) supply to the Authority an updated detailed decommissioning plan 40 business days prior to commencement of decommissioning, if you propose to divest a section of the licensed site, cease part or all of the licensed activity or reduce the basis upon which the licence was granted to a point where licensing is no longer required; and (d) decommission the licensed site in accordance with the detailed decommissioning plan, to the satisfaction of the Authority and within any reasonable timeframe which may be specified by the Authority.
-------	---

---

## Standard conditions

---

OL_WM14	All plant and equipment must be maintained and operated in proper working condition, in accordance with the manufacturer's specifications.
---------	--

---

## Specific conditions

---

OL_DW2	Discharge of waste to surface waters must be in accordance with Appendix 6.
OL_WM13	Notwithstanding the discharge limits set out in this licence, the licence holder's risk management and monitoring program must address: (a) Causes of short-term variation in emissions (which may include equipment or process failures and replacement of components); (b) Opportunities to reduce long term and event-driven emissions through practices or controls; and (c) Key indicators of emission variation including process and system indicators.

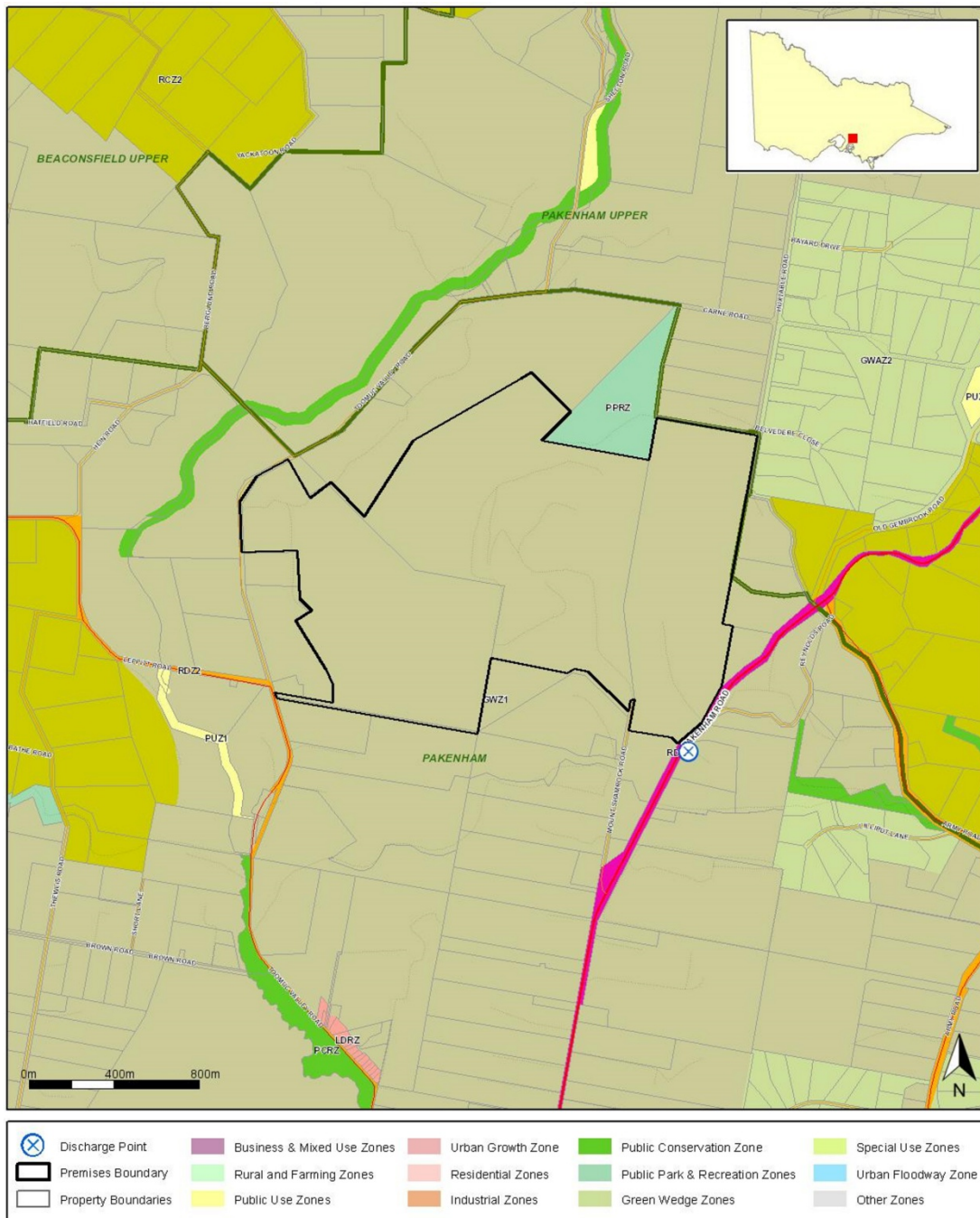
---

# Operating licence

Environment Protection Act 2017

## Appendices

### Appendix 1 – locality plan



Before relying on the information in this map, carefully evaluate its accuracy, currency, completeness and relevance. Obtain appropriate professional advice before using this information.

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

Licence number: OL000000544

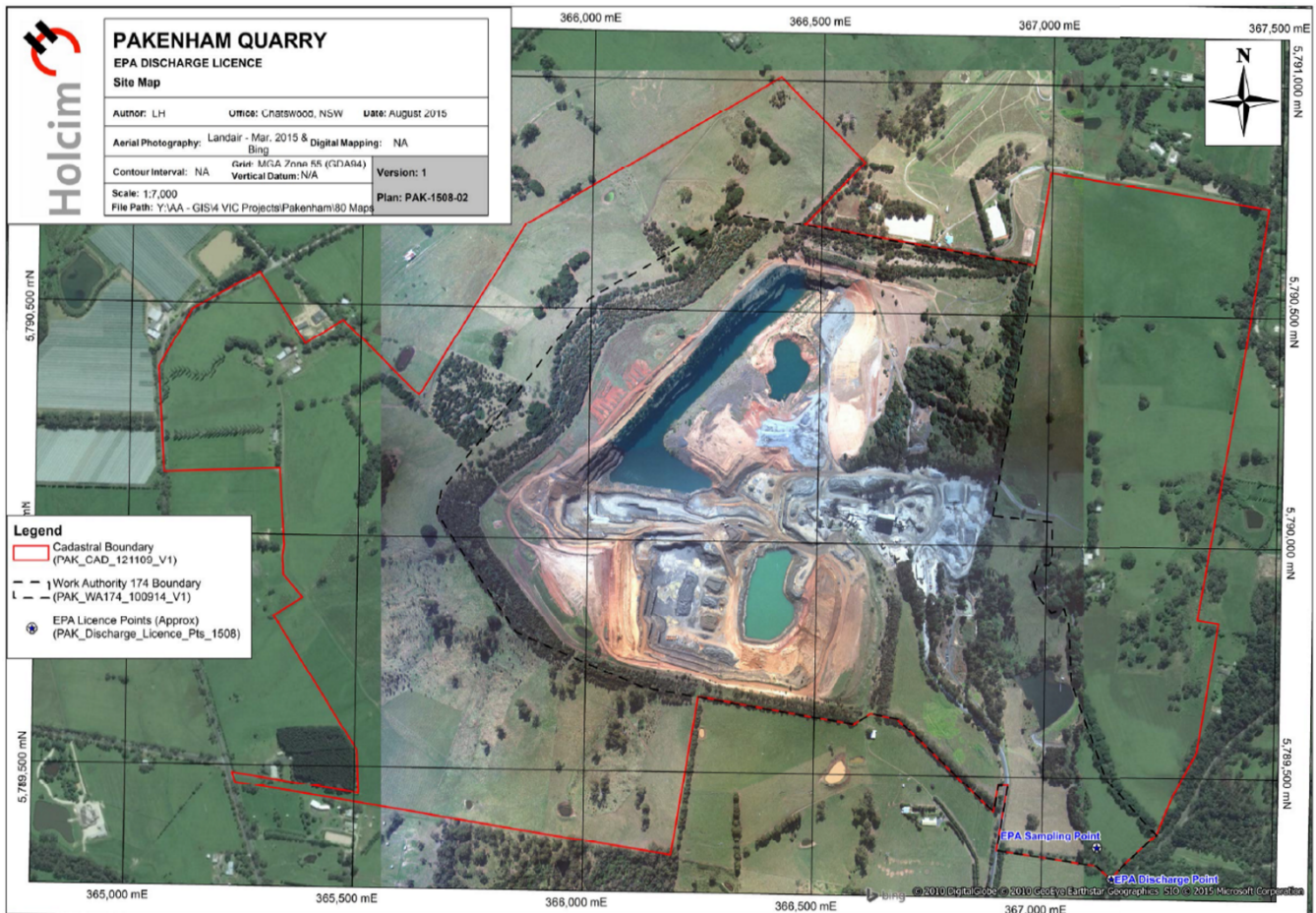
Page 9



# Operating licence

Environment Protection Act 2017

## Appendix 2 – activity plan



Before relying on the information in this map, carefully evaluate its accuracy, currency, completeness and relevance. Obtain appropriate professional advice before using this information.

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

## **Appendix 3 – contour plan**

*There is no contour plan for this licence.*

# Operating licence

*Environment Protection Act 2017*

## **Appendix 4 - waste acceptance table**

*There is no waste acceptance for this licence.*

# Operating licence

*Environment Protection Act 2017*

## **Appendix 5 – air discharge table**

*There are no air discharge points for this licence.*

# Operating licence

Environment Protection Act 2017

## Appendix 6 –water discharge table

Discharge Point ID	Discharge Point Name	Indicator	Limit Type	Unit	Discharge Limit
1	Discharge to tributary of Pakenham Creek	Flow Rate	Mean	ML/day	0.84000
1	Discharge to tributary of Pakenham Creek	Turbidity	Annual median	Ntu	15.00000
1	Discharge to tributary of Pakenham Creek	pH	Minimum	pH	6.00000
1	Discharge to tributary of Pakenham Creek	Turbidity	Maximum	Ntu	30.00000
1	Discharge to tributary of Pakenham Creek	Electrical conductivity	Annual median	µS/cm	1000.00000
1	Discharge to tributary of Pakenham Creek	pH	Maximum	pH	9.00000
1	Discharge to tributary of Pakenham Creek	Electrical conductivity	Maximum	µS/cm	1200.00000

ML/d = megalitres per day

mg/L = milligrams per litre

Licence number: OL000000544

# Operating licence

*Environment Protection Act 2017*

$\mu\text{g/L}$  = micrograms per litre

$\mu\text{S/cm}$  = microsiemens per centimetre

pH = pH Units

Org/mL = organisms per 100 millilitre

pg/L = picograms per litre

Ntu = Nephelometric Turbidity Units

% sat = percent saturation

pcu = Platinum-Cobalt Units

ADMI = American Dye Manufacturers' Institute

# Operating licence

*Environment Protection Act 2017*

## **Appendix 7 – landfill cells**

*There are no landfill cells for this licence.*

# **Appendix B**

**Summary of neighbouring bores**

Bore ID	Easting (MGA)	Northing (MGA)	Map zone	Constructed date	Constructed depth (m)	Uses
64195	367562.2	5792514.1	55	9/02/1980 0:00	48.8	DM, ST
64201	367573.2	5791904.1	55	23/12/1985 0:00	57.3	DM, ST
64210	367873.2	5792584.1	55	30/04/1990 0:00	83.6	DM, ST
64216	365333.2	5792884.1	55	10/01/1987 0:00	51.8	DM, ST
84069	367574.2	5790282.1	55	14/04/1977 0:00	55	DM, ST
84072	366413.2	5790004.1	55	23/08/1977 0:00	58	NKN
84073	366533.2	5790044.1	55	25/08/1977 0:00	30.5	NKN
84074	366833.2	5789704.1	55	31/08/1977 0:00	88	NKN
84082	368653.2	5788264.1	55	31/03/1981 0:00	14.7	IR
84096	365413.2	5788084.1	55	9/03/1984 0:00	17.65	DM, ST
84100	366343.2	5787704.1	55	7/03/1985 0:00	20.45	DM, ST
84106	367583.2	5790874.1	55	30/04/1990 0:00	14.9	DM, ST
112797	365853.2	5787424.1	55	24/02/1992 0:00	16	DM, ST
114867	367733.2	5790544.1	55	10/04/1992 0:00	103	DM, ST
114934	367683.2	5790894.1	55	24/10/1992 0:00	65.5	DS
115444	367873.2	5791609.1	55	12/03/1993 0:00	79	DM, ST
121918	367813.2	5791364.1	55	24/11/1992 0:00	74	DM, ST
124394	367873.2	5791609.1	55	20/03/1995 0:00	38.5	ST
132497	368233.2	5791044.1	55	10/11/1997 0:00	91	DM
WRK057121	367874	5789936	55	19/05/2010 0:00	5	OB
WRK057122	367883	5789950	55	19/05/2010 0:00	5	OB
WRK057123	367871	5789955	55	19/05/2010 0:00	5	OB
WRK069238	365481	5787583	55	10/05/2012 0:00	10	OB
WRK069239	365480	5787585	55	9/05/2012 0:00	10	OB
WRK069240	365485	5787585	55	14/05/2012 0:00	9	OB
WRK070147	365489	5787583	55	15/05/2012 0:00	12.2	OB
WRK070148	365485	5787583	55	18/05/2012 0:00	7	OB
WRK082149	366344	5790134	55	22/10/2014 0:00	12	OB
WRK082152	366342	5790133	55	22/10/2014 0:00	1.5	OB
WRK960359	367903	5792649	55	27/02/2002 0:00	99	DM
WRK990207	366258	5790107	55	N/A	25	N/A

Notes:

Source: VVG

Bores within a 3 km radial distance from the centre of site

Bores WRK082149 and WRK082152 (shaded blue) identified on bore decommissioning licence WLE067411, supplied to GHD by Holcim, i.e. these were Holcim monitoring bores (refer Section 3.2).

# **Appendix C**

**Summary of groundwater level trends  
(source: DEECA)**

**Wandin Yallock WSPA**

Heading	Entity	Column	Report line item	Water year	Value/ groundwater level trend
Groundwater management area	Wandin Yallock GMA	Jun-17	Wandin Yallock	2017-18	Declining
Groundwater management area	Wandin Yallock GMA	Dec-17	Wandin Yallock	2017-18	Declining
Groundwater management area	Wandin Yallock GMA	Mar-18	Wandin Yallock	2017-18	Declining
Groundwater management area	Wandin Yallock GMA	Jun-18	Wandin Yallock	2017-18	Stable
Groundwater management area	Wandin Yallock GMA	Sep-18	Wandin Yallock	2018-19	Declining
Groundwater management area	Wandin Yallock GMA	Dec-18	Wandin Yallock	2018-19	Declining
Groundwater management area	Wandin Yallock GMA	Mar-19	Wandin Yallock	2018-19	Declining
Groundwater management area	Wandin Yallock GMA	Jun-19	Wandin Yallock	2018-19	Declining
Groundwater management area	Wandin Yallock GMA	Sep-19	Wandin Yallock	2019-20	Declining
Groundwater management area	Wandin Yallock GMA	Dec-19	Wandin Yallock	2019-20	Declining
Groundwater management area	Wandin Yallock GMA	Mar-20	Wandin Yallock	2019-20	Declining
Groundwater management area	Wandin Yallock GMA	Jun-20	Wandin Yallock	2019-20	Declining
Groundwater management area	Wandin Yallock GMA	Sep-20	Wandin Yallock	2020-21	Rising
Groundwater management area	Wandin Yallock GMA	Dec-20	Wandin Yallock	2020-21	Rising
Groundwater management area	Wandin Yallock GMA	Mar-21	Wandin Yallock	2020-21	Declining
Groundwater management area	Wandin Yallock GMA	Jun-21	Wandin Yallock	2020-21	Stable
Groundwater management area	Wandin Yallock GMA	Sep-21	Wandin Yallock	2021-22	Stable

Heading	Entity	Column	Report line item	Water year	Value/ groundwater level trend
Groundwater management area	Wandin Yallock GMA	Dec-21	Wandin Yallock	2021-22	Rising
Groundwater management area	Wandin Yallock GMA	Mar-22	Wandin Yallock	2021-22	Rising
Groundwater management area	Wandin Yallock GMA	Jun-22	Wandin Yallock	2021-22	Rising
Groundwater management area	Wandin Yallock GMA	Sep-22	Wandin Yallock	2022-23	Rising
Groundwater management area	Wandin Yallock GMA	Dec-22	Wandin Yallock	2022-23	Rising
Groundwater management area	Wandin Yallock GMA	Mar-23	Wandin Yallock	2022-23	Rising
Groundwater management area	Wandin Yallock GMA	Jun-23	Wandin Yallock	2022-23	Rising
Groundwater management area	Wandin Yallock GMA	Sep-23	Wandin Yallock	2023-24	Rising
Groundwater management area	Wandin Yallock GMA	Dec-23	Wandin Yallock	2023-24	Rising
Groundwater management area	Wandin Yallock GMA	Mar-24	Wandin Yallock	2023-24	Rising
Groundwater management area	Wandin Yallock GMA	Jun-24	Wandin Yallock	2023-24	Rising

### Koo Wee Rup WSPA

Heading	Entity	Column	Report line item	Water year	Value/ groundwater level trend
Water supply protection area	Koo Wee Rup WSPA	Jun-17	Koo Wee Rup	2017-18	Declining
Water supply protection area	Koo Wee Rup WSPA	Dec-17	Koo Wee Rup	2017-18	Declining
Water supply protection area	Koo Wee Rup WSPA	Mar-18	Koo Wee Rup	2017-18	Declining
Water supply protection area	Koo Wee Rup WSPA	Jun-18	Koo Wee Rup	2017-18	Declining
Water supply protection area	Koo Wee Rup WSPA	Sep-18	Koo Wee Rup	2018-19	Declining
Water supply protection area	Koo Wee Rup WSPA	Dec-18	Koo Wee Rup	2018-19	Declining

Heading	Entity	Column	Report line item	Water year	Value/ groundwater level trend
Water supply protection area	Koo Wee Rup WSPA	Mar-19	Koo Wee Rup	2018-19	Declining
Water supply protection area	Koo Wee Rup WSPA	Jun-19	Koo Wee Rup	2018-19	Declining
Water supply protection area	Koo Wee Rup WSPA	Sep-19	Koo Wee Rup	2019-20	Declining
Water supply protection area	Koo Wee Rup WSPA	Dec-19	Koo Wee Rup	2019-20	Declining
Water supply protection area	Koo Wee Rup WSPA	Mar-20	Koo Wee Rup	2019-20	Declining
Water supply protection area	Koo Wee Rup WSPA	Jun-20	Koo Wee Rup	2019-20	Stable
Water supply protection area	Koo Wee Rup WSPA	Sep-20	Koo Wee Rup	2020-21	Stable
Water supply protection area	Koo Wee Rup WSPA	Dec-20	Koo Wee Rup	2020-21	Stable
Water supply protection area	Koo Wee Rup WSPA	Mar-21	Koo Wee Rup	2020-21	Declining
Water supply protection area	Koo Wee Rup WSPA	Jun-21	Koo Wee Rup	2020-21	Declining
Water supply protection area	Koo Wee Rup WSPA	Sep-21	Koo Wee Rup	2021-22	Stable
Water supply protection area	Koo Wee Rup WSPA	Dec-21	Koo Wee Rup	2021-22	Stable
Water supply protection area	Koo Wee Rup WSPA	Mar-22	Koo Wee Rup	2021-22	Stable
Water supply protection area	Koo Wee Rup WSPA	Jun-22	Koo Wee Rup	2021-22	Stable
Water supply protection area	Koo Wee Rup WSPA	Sep-22	Koo Wee Rup	2022-23	Stable
Water supply protection area	Koo Wee Rup WSPA	Dec-22	Koo Wee Rup	2022-23	Rising
Water supply protection area	Koo Wee Rup WSPA	Mar-23	Koo Wee Rup	2022-23	Rising
Water supply protection area	Koo Wee Rup WSPA	Jun-23	Koo Wee Rup	2022-23	Rising
Water supply protection area	Koo Wee Rup WSPA	Sep-23	Koo Wee Rup	2023-24	Rising
Water supply protection area	Koo Wee Rup WSPA	Dec-23	Koo Wee Rup	2023-24	Stable
Water supply protection area	Koo Wee Rup WSPA	Mar-24	Koo Wee Rup	2023-24	Stable
Water supply protection area	Koo Wee Rup WSPA	Jun-24	Koo Wee Rup	2023-24	Rising

# **Appendix D**

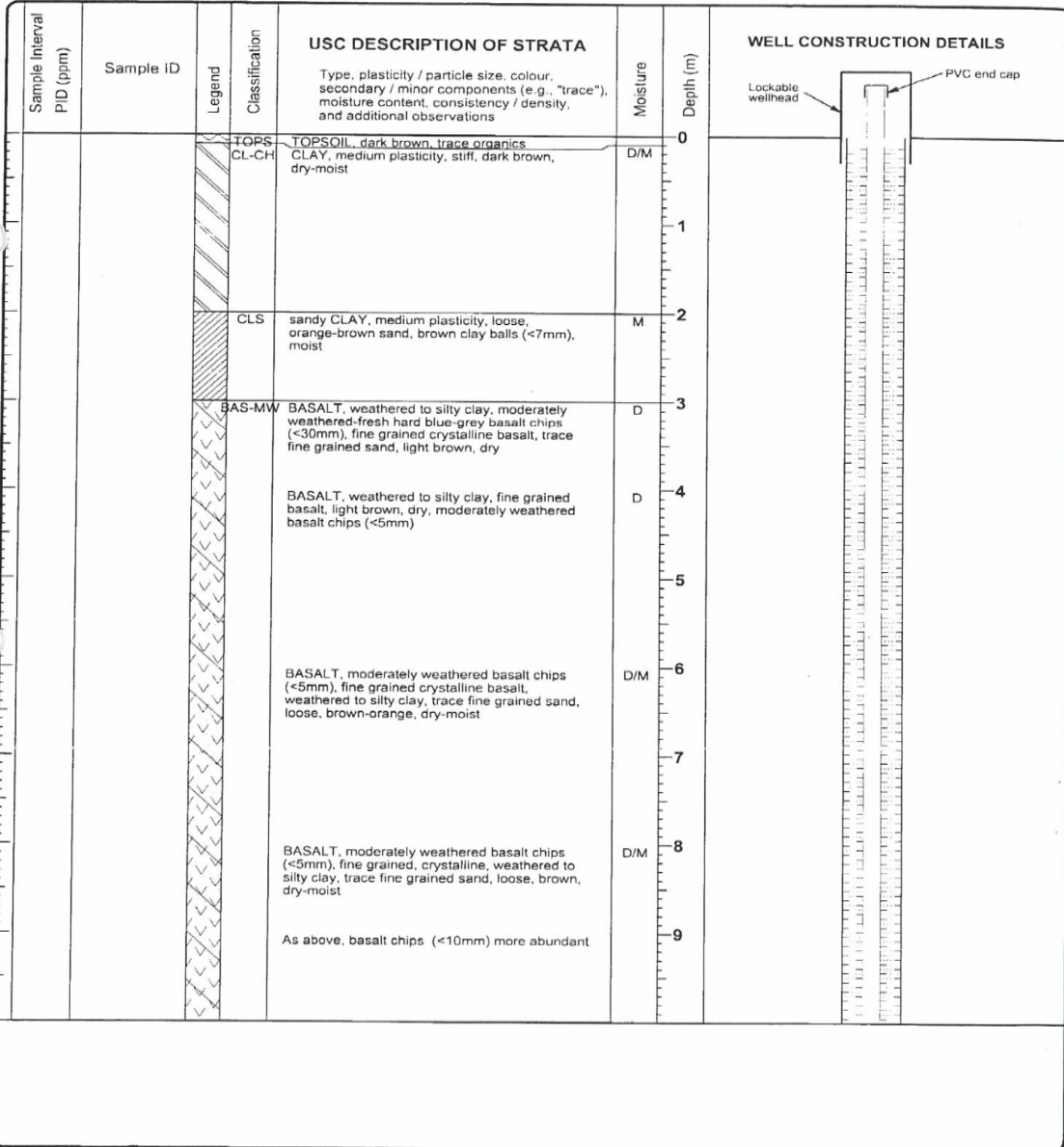
**Monitoring bore construction and  
lithology logs**

# URS

## MONITORING WELL MB01

Sheet 1 of 7

URS Australia Ltd Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Phone 8699 7500 Fax 8699 7550		Project Reference: <b>Pakenham Quarry Groundwater Investigation</b> Project No.: <b>46053-010-5050</b>	Client: <b>CSR Construction Materials Pty Ltd</b> Location: <b>Mt Shamrock Rd, Pakenham, VIC</b>
Drilling Contractor: <b>KH ADAMS &amp; SONS</b>		Relative Level: <b>216.54 mRL</b> Coordinates: <b>5789516.00 mN</b> <b>366135.15 mE</b> Permit No.: <b>57815 / 01</b>	Drill Type: <b>Down hole hammer</b> Drill Model: <b>Edson 6000</b> Drill Fluid: <b>AIR</b>
Logged By: <b>AL</b> Checked By: <b>BC</b> Date Started: <b>03-07-01</b> Date Finished: <b>03-07-01</b>	Bore Size: <b>120 mm</b> Total Depth: <b>72.50 m</b> Casing Size: <b>50 mm</b>		



WELL MB0055 GPJ WCC AUS.GDT 04/10/04

URS Australia Ltd Phone 8699 7500 Project 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550 No.:

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g. "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						10	
				As above, less basalt chips (<5mm)		11	
						12	
			BAS-HW	BASALT, highly weathered to clay with moderately weathered chips (<15mm), light grey, hard, dry	D	13	50mm diameter PVC pipe
						14	
			BAS-MW	BASALT, moderately weathered-fresh, large chips (<60mm), larger chips weathered to orange-brown clay, hard, dry	D	15	
						16	
				BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry		17	
						18	Backfill
				BASALT, moderately weathered-fresh, crystalline, fine grained, light grey, hard, dry		19	
						20	
			BAS-FR	BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry	D	21	

WELL MBLOGS.GPJ WCC\_AUS\_GDT 04/10/04

URS Australia Ltd Phone 8699 7500 Project No.: 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						22	
						23	
						24	
			BAS-MW	BASALT, moderately weathered-fresh, light grey, hard, dry	D	25	
						26	
				BASALT, with brown clay, moderately weathered, chips (<20mm), hard, dry		27	
				BASALT, moderately weathered-fresh, light grey, hard, dry		28	
				BASALT, fresh, chips (<30mm), blue-grey, hard, dry		29	
				BASALT, some weathered to brown clay, moderately weathered, fine grained, crystalline, chips (<20mm), hard, dry		30	
			BAS-FR	BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry	D	31	
						32	
						33	

WELL MBLOGS.GPJ WCC\_AUS.GDT 04/10/04

URS Australia Ltd Phone 8699 7500 Project 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550 No.:

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g. "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						34	
						35	
						36	
						37	
						38	
			BAS-MW	BASALT, moderately weathered, crystalline, fine grained, grey, hard, dry	D	39	
						40	
			BAS-FR	BASALT, fresh, blue-grey, hard, dry	D	41	
						42	Grout
						43	
				Fracture zone		44	
			BAS-HW	BASALT, with weathered brown clay, highly weathered, crystalline, fine grained, dark grey, hard, dry	D	45	
							SWL @ 40.70 mTOC (30/3/01)

WELL MBLOGS:GFJ WCC AUS GDT 04/10/04

## MONITORING WELL MB01

URS Australia Ltd Phone 8699 7500 Project No. 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
			CL-ML	silty CLAY, trace fine grained sand, black, soft, dry-moist	D	46	<p>Bentonite</p>
				silty CLAY, trace fine grained sand, yellow-green-grey, soft, dry-moist		47	
				silty CLAY, trace fine grained sand, blue-grey, soft, dry-moist		48	
				silty CLAY, low plasticity, grey-green, soft, moist	M	49	
				silty CLAY, low plasticity, light grey, soft, dry	D	50	
				silty CLAY, low plasticity, grey-green, soft, moist-dry	D/M	51	
				silty CLAY, low plasticity, grey, soft, dry-moist		52	
				As above, more clay, darker grey		53	
				Rig refusal, started drilling with water		54	
						55	
						56	
						57	

WELL\_MBLOGS.GPJ WCC\_AUS\_GDT 04/10/04

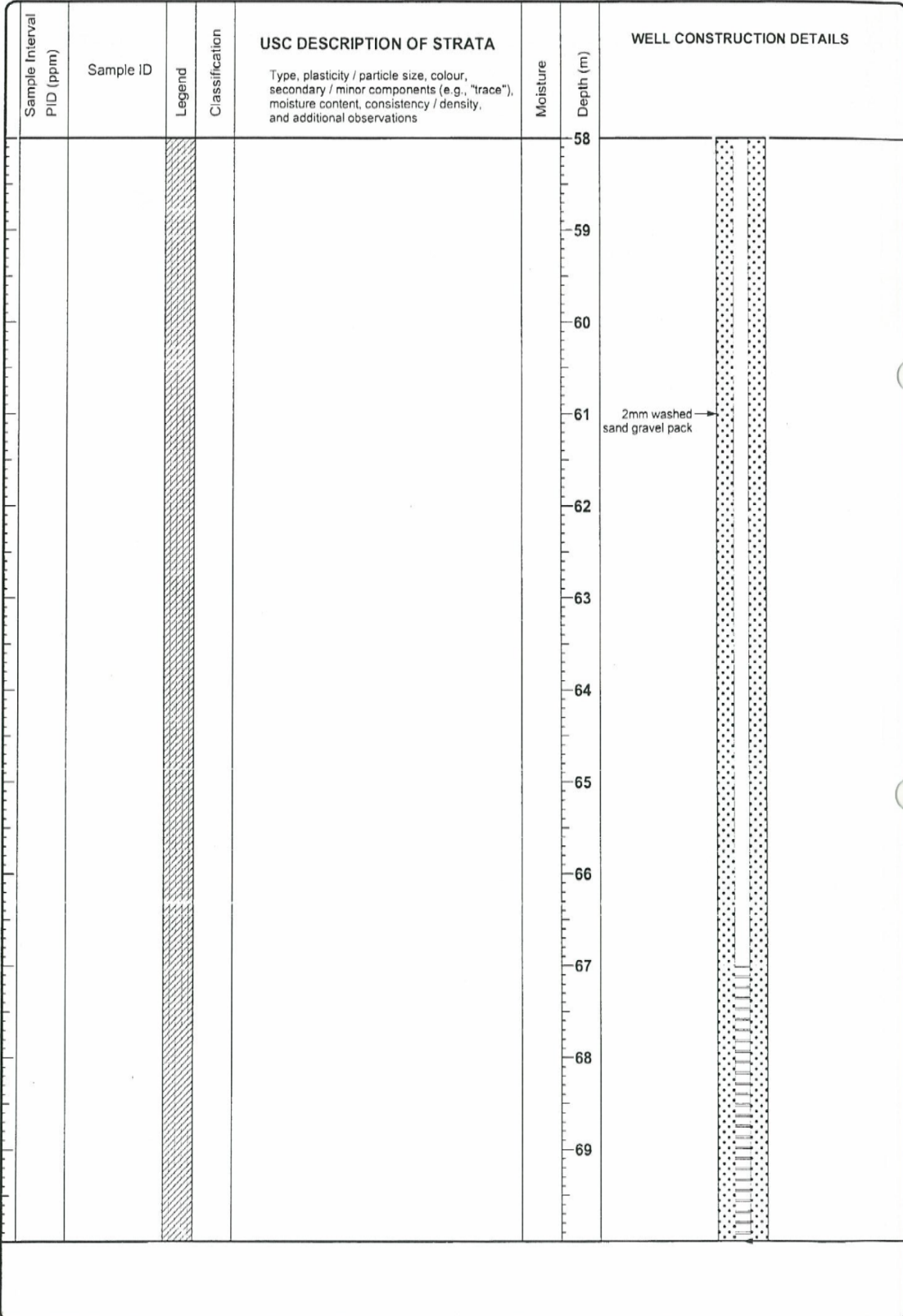
## MONITORING WELL MB01

URS Australia Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

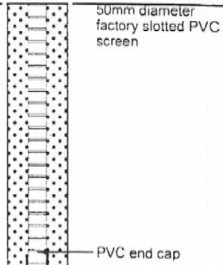
Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation



WELL\_MIBLOGS.GPJ WCC\_AUS.GDT 04/10/04

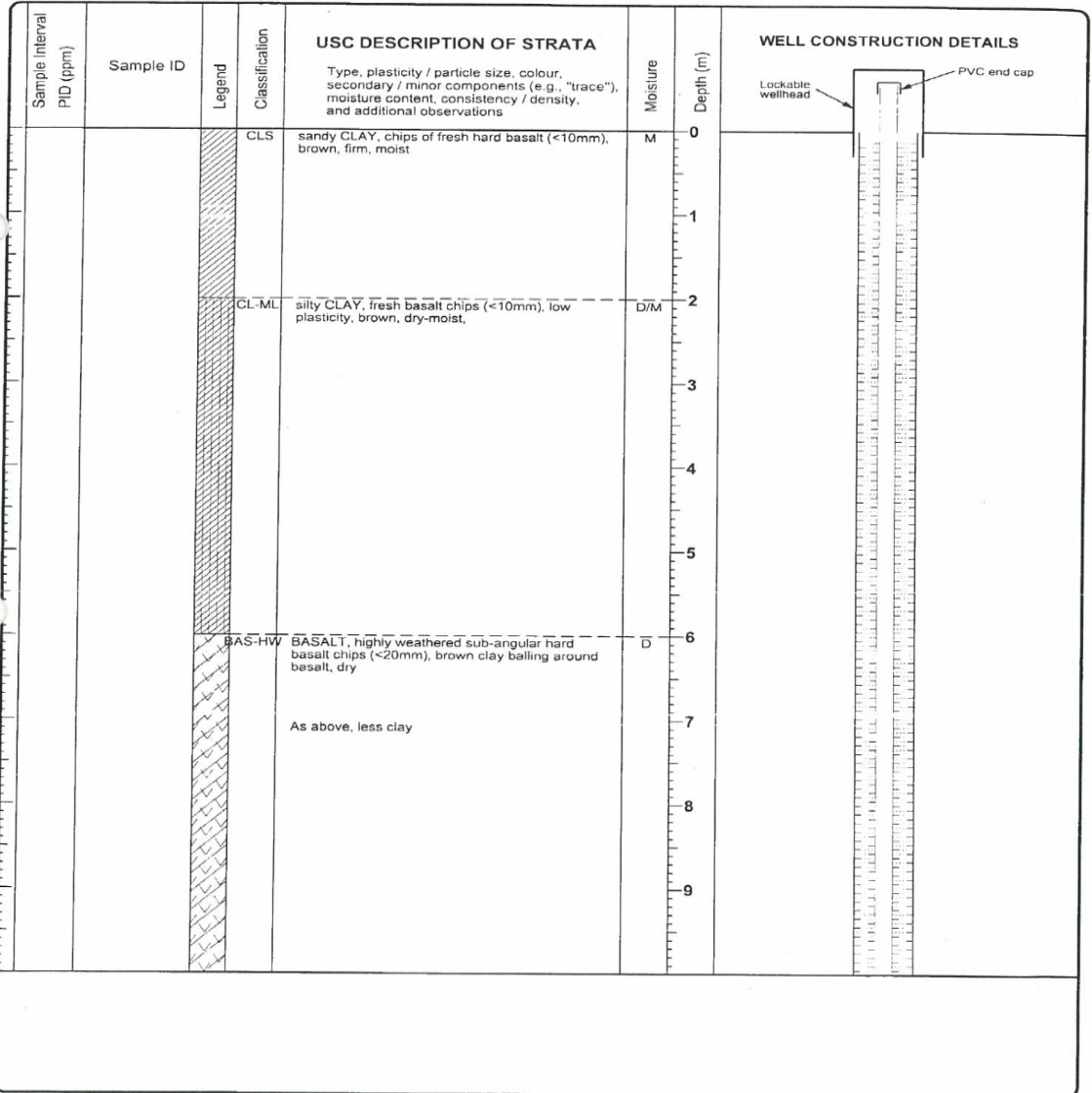
URS Australia Ltd Phone 8699 7500 Project 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550 No.:

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g. "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
				trace white granite specks (<2mm), hard		70	 <p>50mm diameter factory slotted PVC screen</p> <p>PVC end cap</p>
						71	
						72	
				End of hole @ 72.5m Unsure if groundwater encountered during drilling as drilling with water		73	
						74	
						75	
						76	
						77	
						78	
						79	
						80	
						81	

WELL MB01 GSG GPJ WCC\_AUS GDT D4/10/04

MB06 - still in use

<b>URS</b>		Sheet 1 of 5	
URS Australia Ltd Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Phone 8699 7500 Fax 8699 7550		Project Reference: <b>Pakenham Quarry Groundwater Investigation</b> Project No.: <b>46053-010-5050</b>	Client: <b>CSR Construction Materials Pty Ltd</b> Location: <b>Mt Shamrock Rd, Pakenham, VIC</b>
Drilling Contractor: <b>KH ADAMS &amp; SONS</b>		Bore Size: 120 mm Total Depth: 50.00 m Casing Size: 50 mm	Relative Level: <b>219.56 mRL</b> Coordinates: <b>5790488.40 mN</b> <b>366321.06 mE</b> Permit No: <b>57815 / 06</b>
Logged By: <b>AL</b> Checked By: <b>BC</b> Date Started: <b>01-03-13</b> Date Finished: <b>01-03-14</b>	Bore Size: 120 mm Total Depth: 50.00 m Casing Size: 50 mm	Drill Type: <b>Down hole hammer</b> Drill Model: <b>Edson 6000</b> Drill Fluid: <b>AIR</b>	



URS Australia Ltd Phone 8699 7500 Project 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550 No.:

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						10	
			BAS-MW	BASALT, highly to moderately weathered, crystalline, fine grained, minor weathered clay, light grey, hard, dry	D	11	
			BAS-HW	BASALT, weathered to brown low plasticity clay, highly weathered basalt chips (<5mm), hard, dry	D	13	
			BAS-MW	BASALT, moderately to highly weathered, crystalline, fine grained, chips (<20mm), minor clay, light grey, hard, dry	D	16	
				As above, trace clay		17	
				As above, chips (<30mm)		20	
				BASALT, moderately weathered, crystalline, fine grained, chips (<10mm), blue-grey, hard, dry		21	

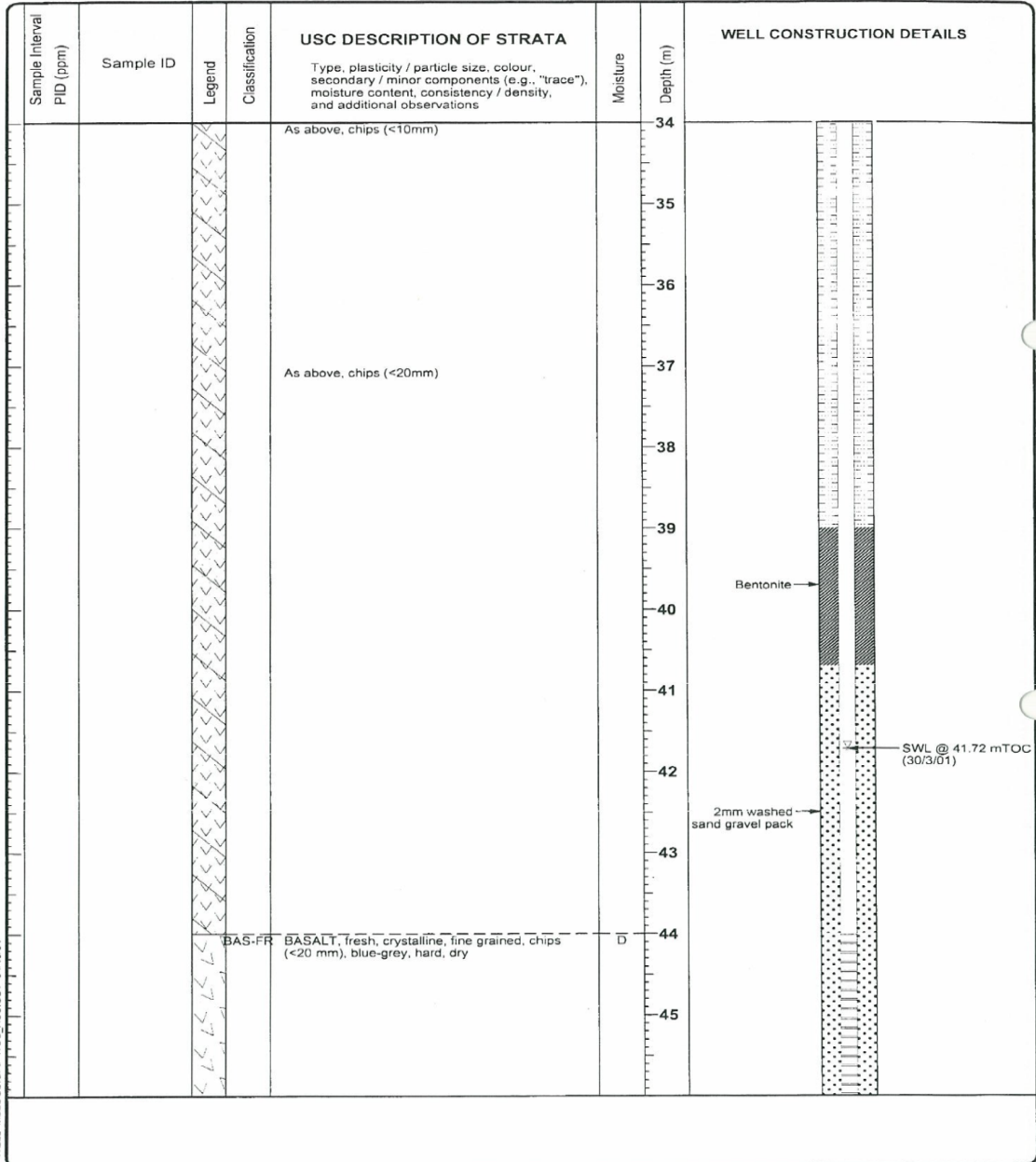
50mm diameter PVC pipe

WELL\_MBL06S.GPJ WCC\_AUS.GDT 04/10/04

URS Australia Ltd Phone 8699 7500 Project No. 46053-010-5050 Project Reference: Pakenham Quarry Groundwater Investigation  
 Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Fax 8699 7550

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						22	<p>Backfill</p>
				As above, chips (<20mm)		23	
						24	
						25	
				BASALT, moderately weathered to fresh, crystalline, fine grained, chips (<40mm), blue-grey, hard, dry		26	
				BASALT, moderately weathered, chips (<20mm), trace clay, blue-grey, hard, dry		27	
						28	
				BASALT, moderately weathered to fresh, chips (<30mm), blue-grey, hard, dry		29	
						30	
				BASALT, moderately weathered, chips (<20mm), trace clay, light grey, hard, dry		31	
						32	
				BASALT, moderately weathered to fresh, crystalline, fine grained, chips (<40mm), blue-grey, hard, dry Fracture zone		33	

WELL MB06SS GPJ WCC AUS GDT 04/10/04



# URS

## MONITORING WELL MB06

Sheet 5 of 5

URS Australia Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006 Phone 8699 7500 Fax 8699 7550

Project No.: 46053-010-5050

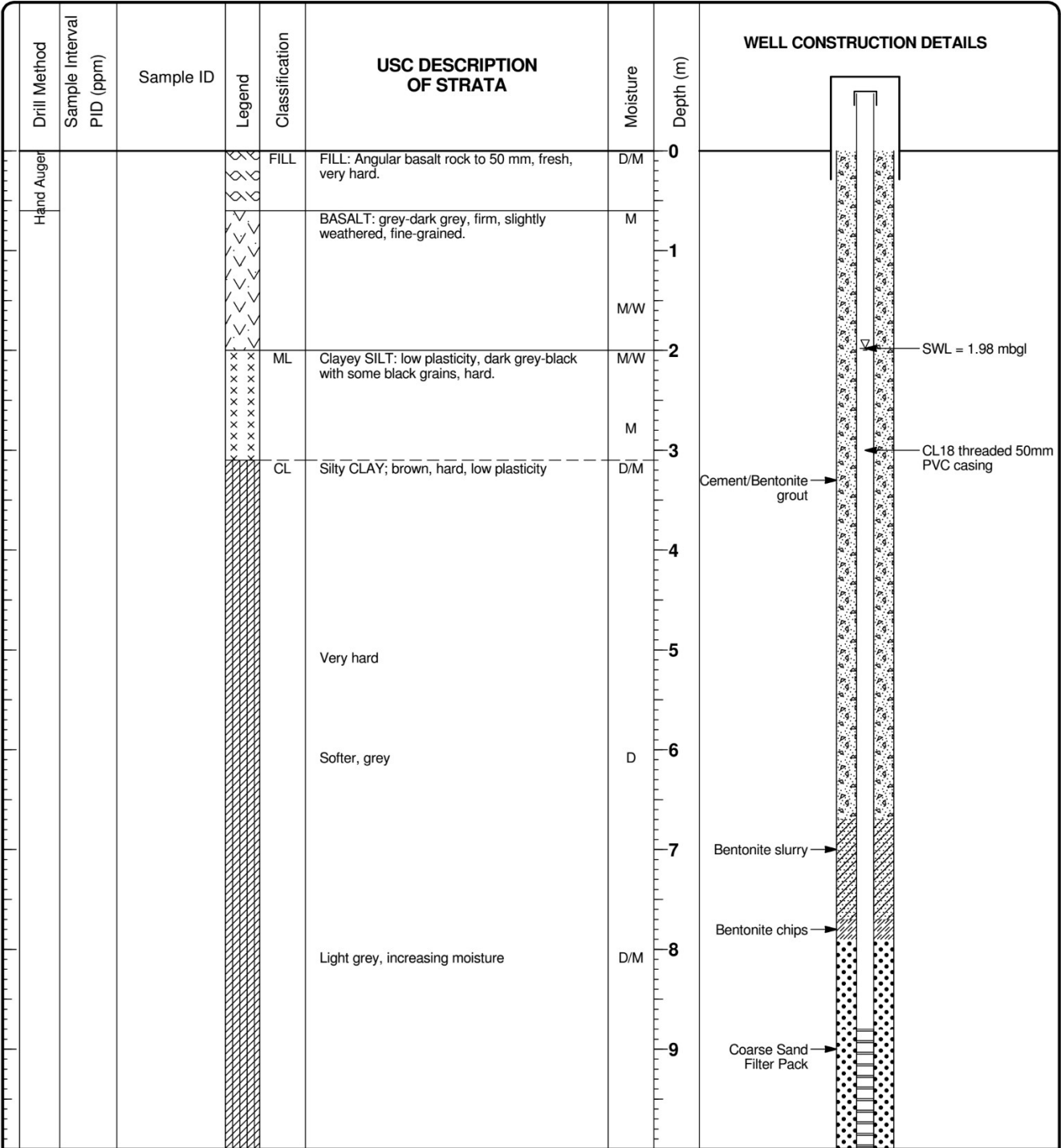
Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						46	<p>50mm diameter factory slotted PVC screen</p> <p>PVC end cap</p>
						47	
						48	
						49	
						50	
				End of Hole @ 50 m Groundwater not encountered during drilling		51	
						52	
						53	
						54	
						55	
						56	
						57	

WELL: MB0605.GPJ WCC-AUS.GDT 04/10/04

## MONITORING WELL MB02b

URS Australia Pty Ltd Level 6, 1 Southbank Boulevard, Southbank VIC 3006		Phone 8699 7500 Fax 8699 7550	Project Name: <b>Holcim Drilling</b>	Client: <b>Holcim (Australia) Pty Ltd</b>
Drilling Contractor: <b>South Western Drilling</b>			Project No.: <b>43283807</b>	Location: <b>Mt. Shamrock Quarry, Pakenham</b>
Logged By: <b>MR</b>	Bore Size: <b>125 mm</b>	Relative Level (PVC): <b>mRL</b>	Drill Type: <b>Air Hammer</b>	
Checked By: <b>AC</b>	Total Depth: <b>11.80 m</b>	Coordinates: <b>mN</b>	Drill Model: <b>DB520</b>	
Date Started: <b>22-10-14</b>	Casing Size: <b>50 mm</b>	<b>mE</b>	Drill Fluid: <b>Air</b>	
Date Finished: <b>22-10-14</b>		Permit No: <b>WRK082149</b>		



Remarks: Bentonite slurry used, as chips were bridging at surface.

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14


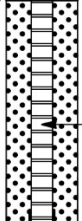
## MONITORING WELL MB02b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

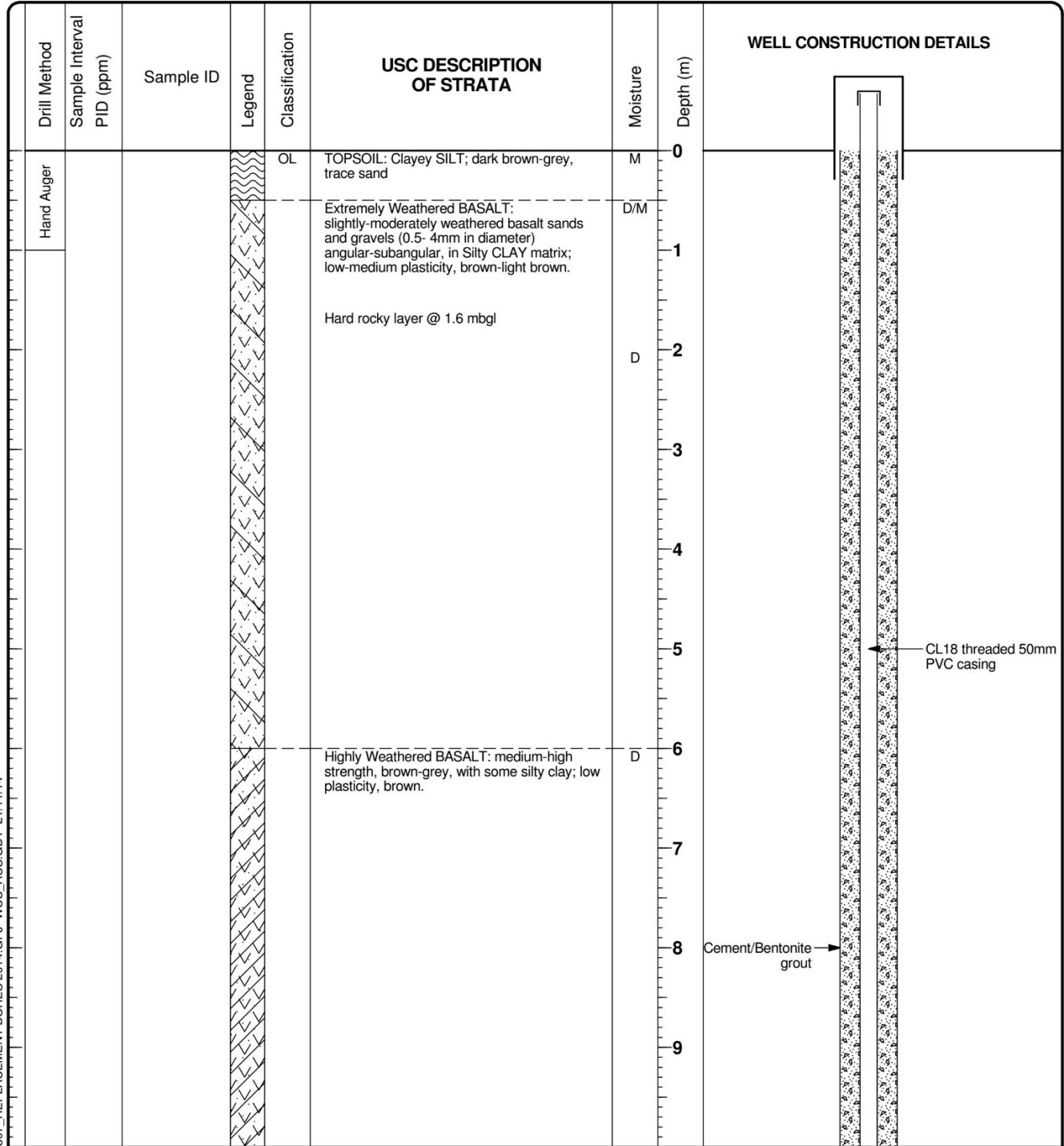
Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Air Hammer						M	10 11	 CL18 threaded 50mm PVC screen
					EOH @ 11.8 m		12 13 14 15 16 17 18 19 20 21	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

## MONITORING WELL MB03b

URS Australia Pty Ltd Level 6, 1 Southbank Boulevard, Southbank VIC 3006		Phone 8699 7500 Fax 8699 7550	Project Name: <b>Holcim Drilling</b>	Client: <b>Holcim (Australia) Pty Ltd</b>
Drilling Contractor: <b>South Western Drilling</b>			Project No.: <b>43283807</b>	Location: <b>Mt. Shamrock Quarry, Pakenham</b>
Logged By: <b>MR</b>	Bore Size: <b>125 mm</b>	Relative Level (PVC): <b>mRL</b>	Drill Type: <b>Air Hammer</b>	
Checked By: <b>AC</b>	Total Depth: <b>60.00 m</b>	Coordinates: <b>mN</b>	Drill Model: <b>DB520</b>	
Date Started: <b>22-10-14</b>	Casing Size: <b>50 mm</b>	<b>mE</b>	Drill Fluid: <b>Air</b>	
Date Finished: <b>24-10-14</b>		Permit No: <b>WRK082150</b>		



WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14













## MONITORING WELL MB03b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					Reducing silty CLAY and increasing strength		10	
					Moderately Weathered BASALT: high strength, grey, very fine grained	D	11	
					Very hard band @ 13.3-13.4 mbgl		13	
					Very hard band @ 13.7-13.9 mbgl		14	
					Slightly Weathered BASALT: high-very high strength, blue-grey, fine grained, with some light brown-light grey weathered surfaces.	D	14	
					Soft layer @ 16 mbgl		16	
					Fresh-Slightly Weathered BASALT: very high strength, blue-grey, fine grained, trace light grey weathered surfaces.	D	17	
							18	
							19	
							20	
							21	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14


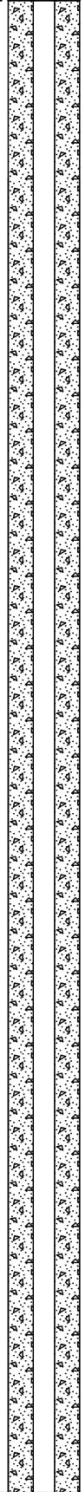
## MONITORING WELL MB03b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS	
							22		
							23		
							24		
							25		
							26		
							27		
					Fractured zone @ 27.5-28 mbgl		28		
					Very fractured @ 29-30 mbgl		29		
					Some fracturing		30		
							31		
							32		
							33		

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

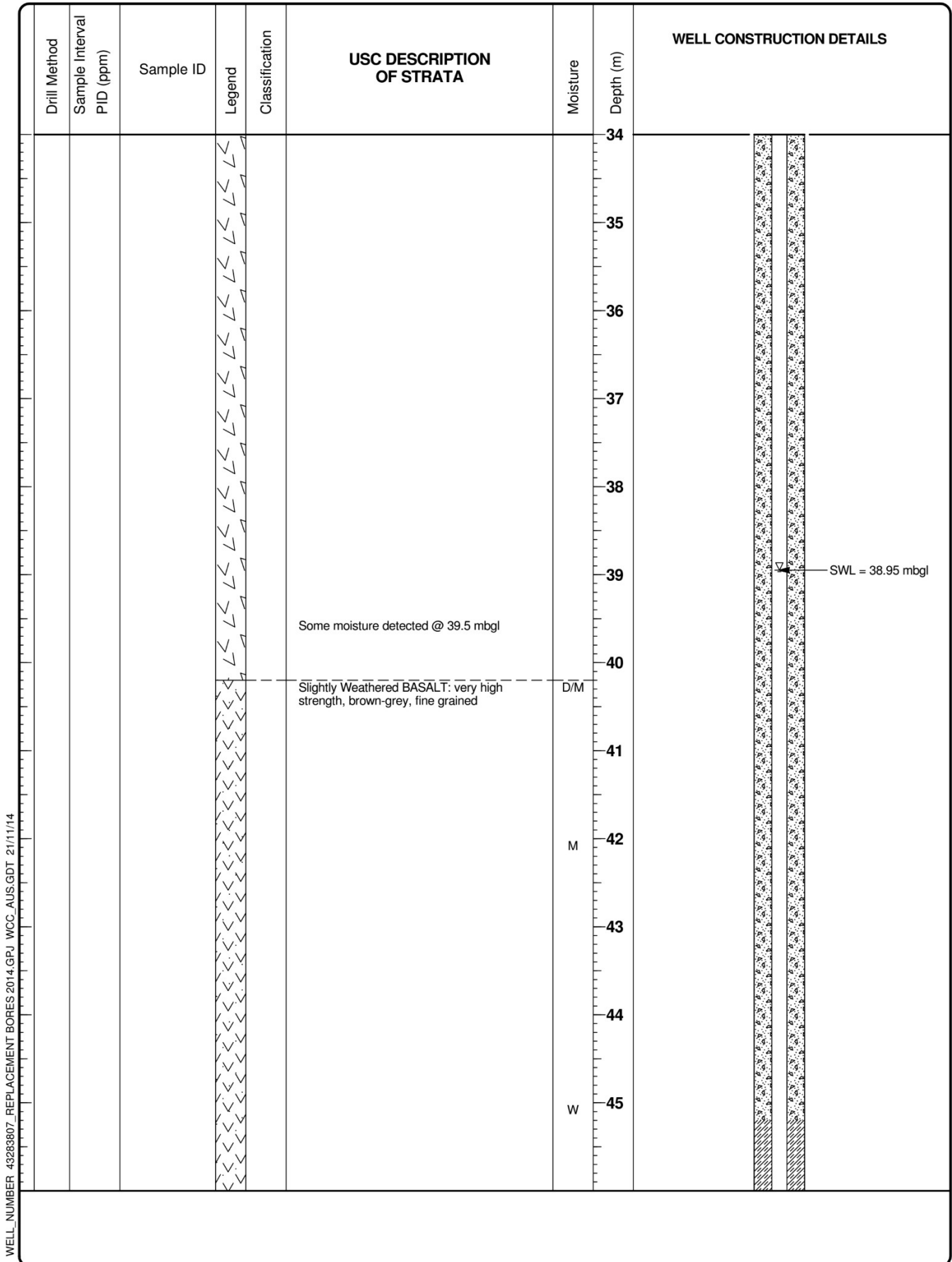
## MONITORING WELL MB03b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**



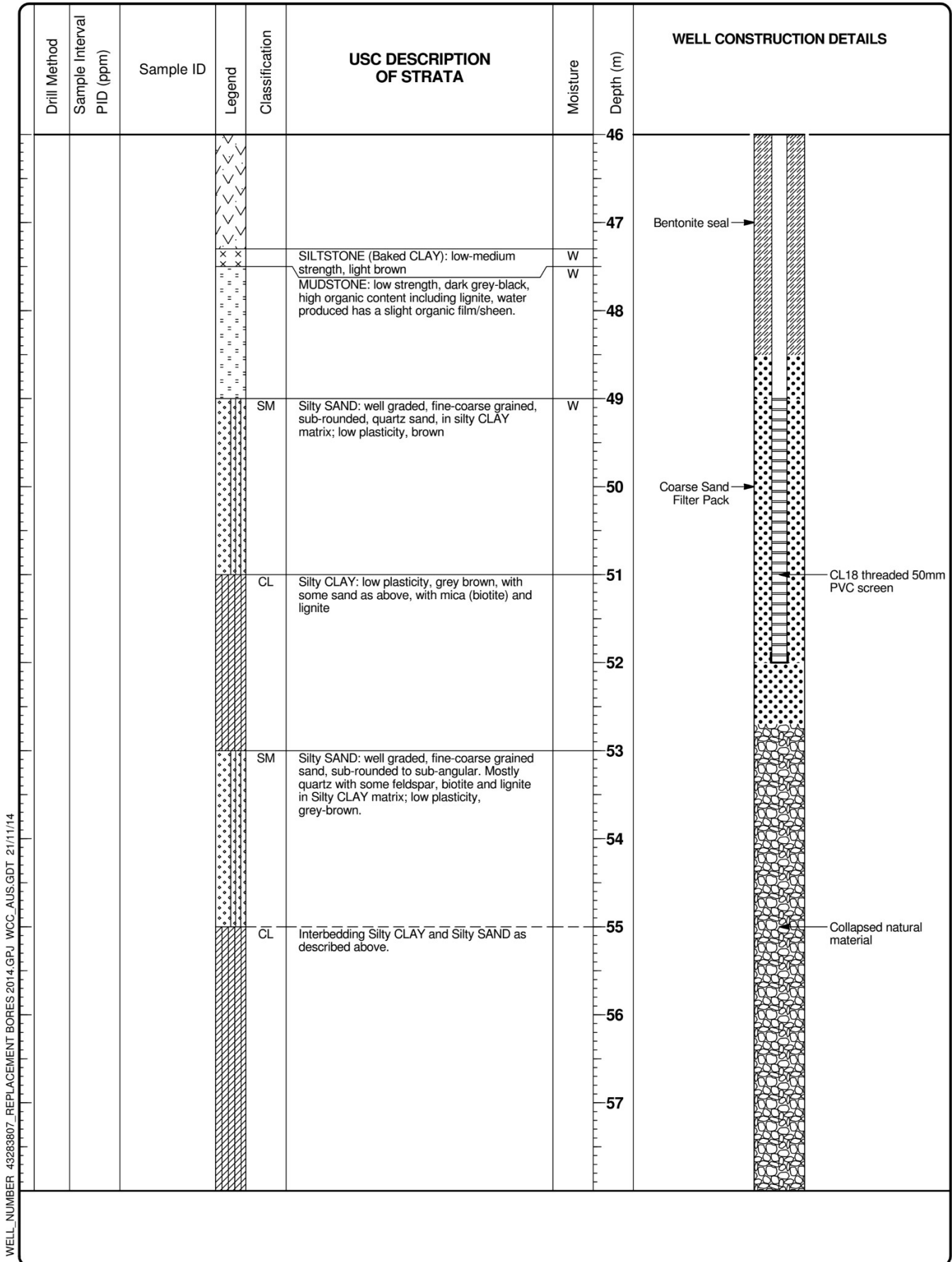
WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**



WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14



## MONITORING WELL MB03b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Air Hammer							58 59 60	
					EOH @ 60 mbgl. Target depth reached.		61 62 63 64 65 66 67 68 69	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

## MONITORING WELL MB04b

URS Australia Pty Ltd Level 6, 1 Southbank Boulevard, Southbank VIC 3006		Phone 8699 7500 Fax 8699 7550	Project Name: <b>Holcim Drilling</b>	Client: <b>Holcim (Australia) Pty Ltd</b>
Drilling Contractor: <b>South Western Drilling</b>			Project No.: <b>43283807</b>	Location: <b>Mt. Shamrock Quarry, Pakenham</b>
Logged By: <b>MR</b>	Bore Size: <b>125 mm</b>	Relative Level (PVC): <b>mRL</b>	Drill Type: <b>Air Hammer</b>	
Checked By: <b>AC</b>	Total Depth: <b>1.50 m</b>	Coordinates: <b>mN</b>	Drill Model: <b>DB520</b>	
Date Started: <b>22-10-14</b>	Casing Size: <b>50 mm</b>	<b>mE</b>	Drill Fluid: <b>Air</b>	
Date Finished: <b>22-10-14</b>		Permit No: <b>WRK082152</b>		

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Air Hammer				FILL	FILL: Basalt rocks, angular, 50 mm in diameter, very high strength, fresh	D	0	
				BASALT	BASALT: high strength, fresh-slightly weathered, fine grained, blue-grey	D/M	1	
				M	Becoming dark grey, increasing moisture EOH @ 1.5 mbgl	M	2	
							3	
							4	
							5	
							6	
							7	
							8	
							9	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

## MONITORING WELL MB05b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project Name: **Holcim Drilling**

Client: **Holcim (Australia) Pty Ltd**

Drilling Contractor: **South Western Drilling**

Project No.: **43283807**

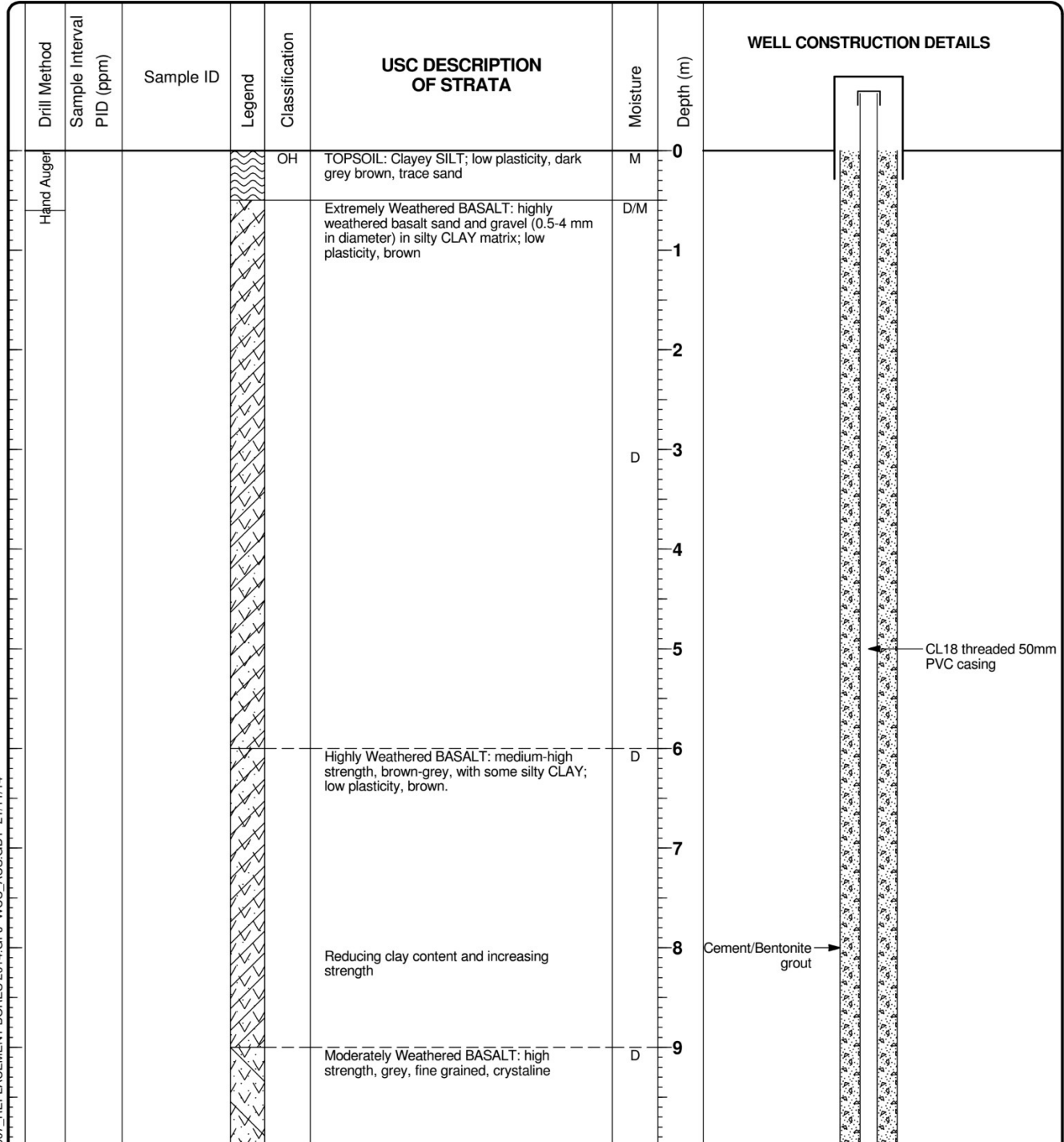
Location: **Mt. Shamrock Quarry, Pakenham**

Logged By: **MR**  
Checked By: **AC**  
Date Started: **24-10-14**  
Date Finished: **27-10-14**

Bore Size: **125 mm**  
Total Depth: **46.00 m**  
Casing Size: **50 mm**

Relative Level (PVC): **mRL**  
Coordinates: **mN**  
**mE**  
Permit No: **WRK082153**

Drill Type: **Air Hammer**  
Drill Model: **DB520**  
Drill Fluid: **Air**



WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14



## MONITORING WELL MB05b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							10	
							11	
							12	
							13	
					Slightly Weathered BASALT: high-very high strength, blue-grey, with some light brown-light grey weathered surfaces	D	14	
							15	
					Some fracturing @ 17.5 mbgl		17	
					Fresh-Slightly Weathered BASALT: very high strength, blue-grey with trace pale grey weathered surfaces.		18	
							19	
					Increased fracturing @ 21 mbgl, appearing to gradually increase with depth.		21	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

## MONITORING WELL MB05b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							22	
							23	
							24	
							25	
							26	
							27	
							28	
							29	
							30	
							31	
					Extremely hard @ 31.8-32.1 mbgl		32	
							33	

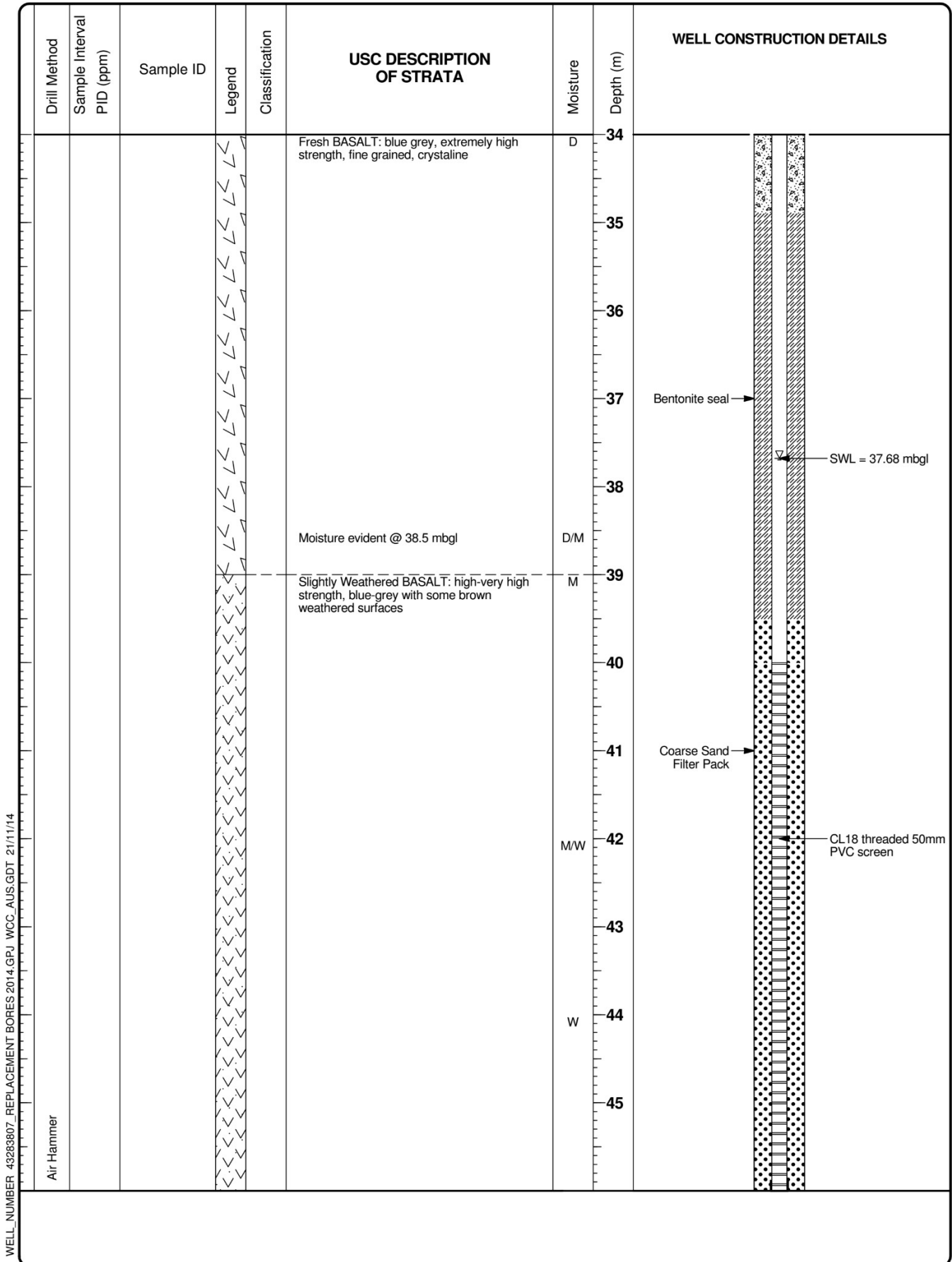
WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**



WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14

## MONITORING WELL MB05b

URS Australia Pty Ltd  
Level 6, 1 Southbank Boulevard, Southbank VIC 3006

Phone 8699 7500  
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					EOH. Target depth reached @ 46 mbgl		46 47 48 49 50 51 52 53 54 55 56 57	

WELL\_NUMBER 43283807 REPLACEMENT BORES 2014.GPJ WCC\_AUS.GDT 21/11/14



# MONITORING WELL MB02C

Project Name: **Holcim Pakenham**

Client: **Holcim Australia**

Drilling Contractor: **South Western Drilling**

Project No: **60451395**

Location: **Mt Shamrock Quarry**

Logged By: **SW** Bore Size: **125mm mm** Top of Casing: **mRL**

Drill Type: **Sonic/percussion**

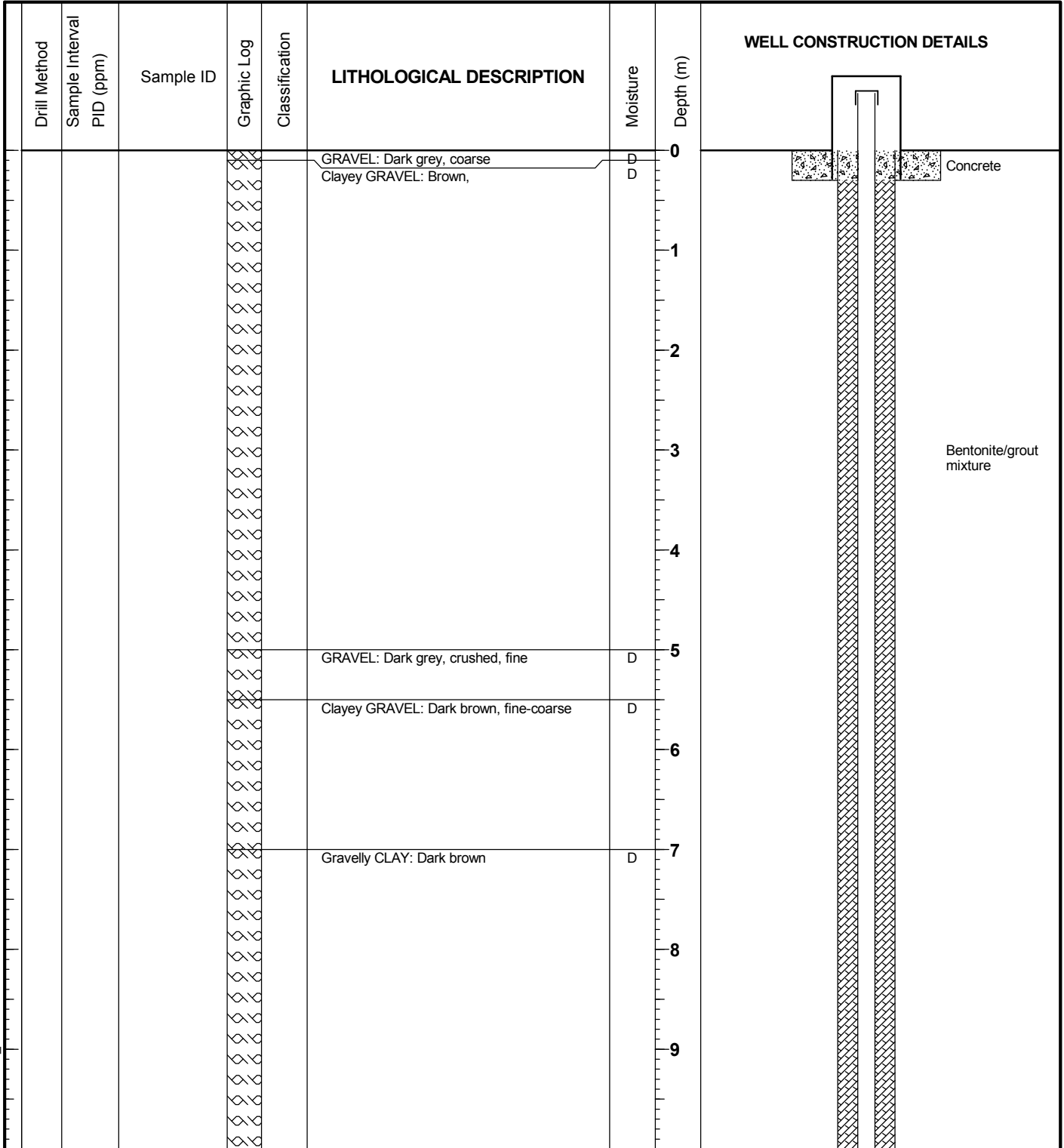
Checked By: **SW** Total Depth: **36.77 m** Coordinates: **mE**

Drill Model:

Date Started: **16/01/2017** Casing Size: **mm** **mN**

Drill Fluid: **Water**

Date Finished: **17/01/2017** Permit No: **WLI605348**





# MONITORING WELL MB02C

Project No.: 60451395

Project Reference: Holcim Pakenham

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS	
							10	<p>CL18 threaded 50mm PVC casing</p>	
					Less gravel	D	11		
					GRAVEL: Dark grey, crushed, medium-fine grained	D	12		
					Very coarse		13		
					Minor clay		14		
					No returns		15		
					Gravelly CLAY: Red/brown,	M	16		
							17		
							18		
							19		
							20		
							21		

01: WELL MB02C AND MB04.GPJ WCC\_AUS.GDT 14/2/17



# MONITORING WELL MB02C

Project No.: 60451395

Project Reference: Holcim Pakenham

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS	
					Dark red/brown		22		Bentonite/grout mixture
					Dark brown		23		
							24		
							25		
							26		
							27		
							28		
					FRESH: BASALT: Dark grey, fractured	M	29		
							30		
							31		
					CLAY with minor silt: Black, organic	M	32		
							33		Bentonite plug
					CLAY: Dark grey	M			

01: WELL MB02C AND MB04.GPJ WCC\_AUS.GDT 14/2/17



# MONITORING WELL MB02C

Project No.: 60451395

Project Reference: Holcim Pakenham

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Sonic/percussion					Clayey SAND: Dark grey, sand fine grained	M	34	<p>50mm slotted pvc in sand screen</p>
					SAND: Dark grey, fine grained	M	35	
					Silty CLAY: Dark grey	M	36	
					Bore terminated at 36.77m		37	
							38	
							39	
							40	
							41	
							42	
							43	
							44	
							45	



# MONITORING WELL MB04C

Project Name: **Holcim Pakenham**

Client: **Holcim Australia**

Drilling Contractor: **South Western Drilling**

Project No: **60451395**

Location: **Mt Shamrock Quarry**

Logged By: **SW** Bore Size: **125mm mm** Top of Casing: **mRL**

Drill Type: **Sonic/percussion**

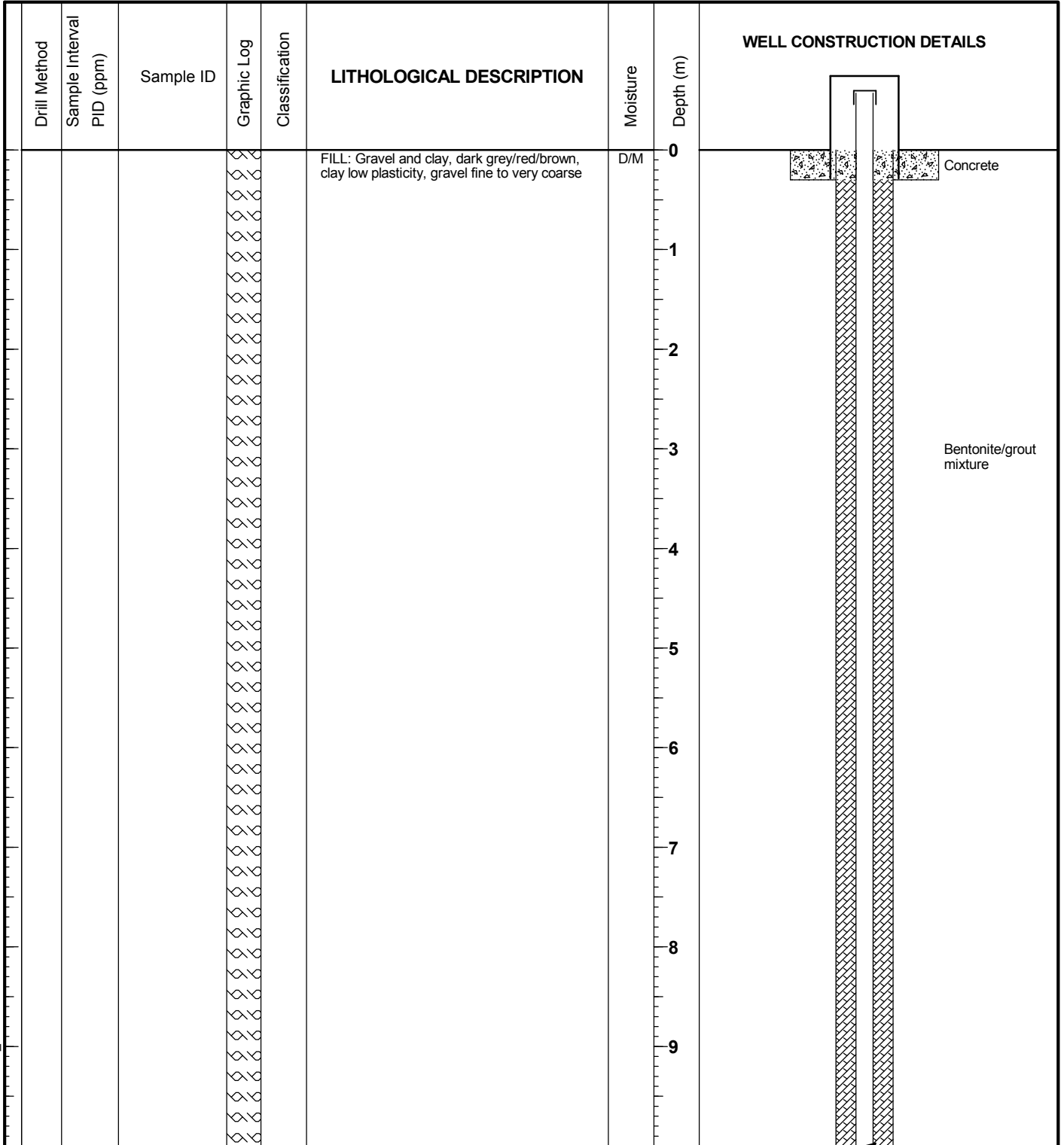
Checked By: **SW** Total Depth: **30.90 m** Coordinates: **mE**

Drill Model:

Date Started: **17/01/2017** Casing Size: **mm** **mN**

Drill Fluid: **Water**

Date Finished: **17/01/2017** Permit No: **WLI605348**





# MONITORING WELL MB04C

Project No.: 60451395

Project Reference: Holcim Pakenham

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS	
							10		CL18 threaded 50mm PVC casing
							11		
							12		
							13		
							14		
							15		
							16		
							17		
							18		
							19		
							20		Bentonite/grout mixture
							21		

01. WELL MB04C AND MB04.GPJ WCC\_AUS.GDT 14/2/17



# MONITORING WELL MB04C

Project No.: 60451395

Project Reference: Holcim Pakenham

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Sonic/percussion							22	<p>Bentonite plug</p> <p>50mm slotted pvc in sand screen</p>
					FRESH: BASALT: Dark grey, fractured	M	29	
					Bore terminated at 30.9m		31	
							32	
							33	

01: WELL MB02C AND MB04: GPJ WCC\_AUS\_GDT\_14/2/17



**Statewide Geotechnical**  
Geotechnical Engineers

8<sup>th</sup> May, 2024

Holcim Australia Pty Ltd  
Attention: Matt Dodd  
[Matt.dodd@holcim.com](mailto:Matt.dodd@holcim.com)

Re: Groundwater Bore – Pakenham Quarry

Matt,

Attached is a schematic (not to scale) of the construction details for MB1 at Pakenham Quarry.

The installation was overseen by licensed driller Phil Burgess from our Ringwood office. Class 1 water well licence number 0838.

Please don't hesitate to contact me directly if you require any additional information or have any other queries.

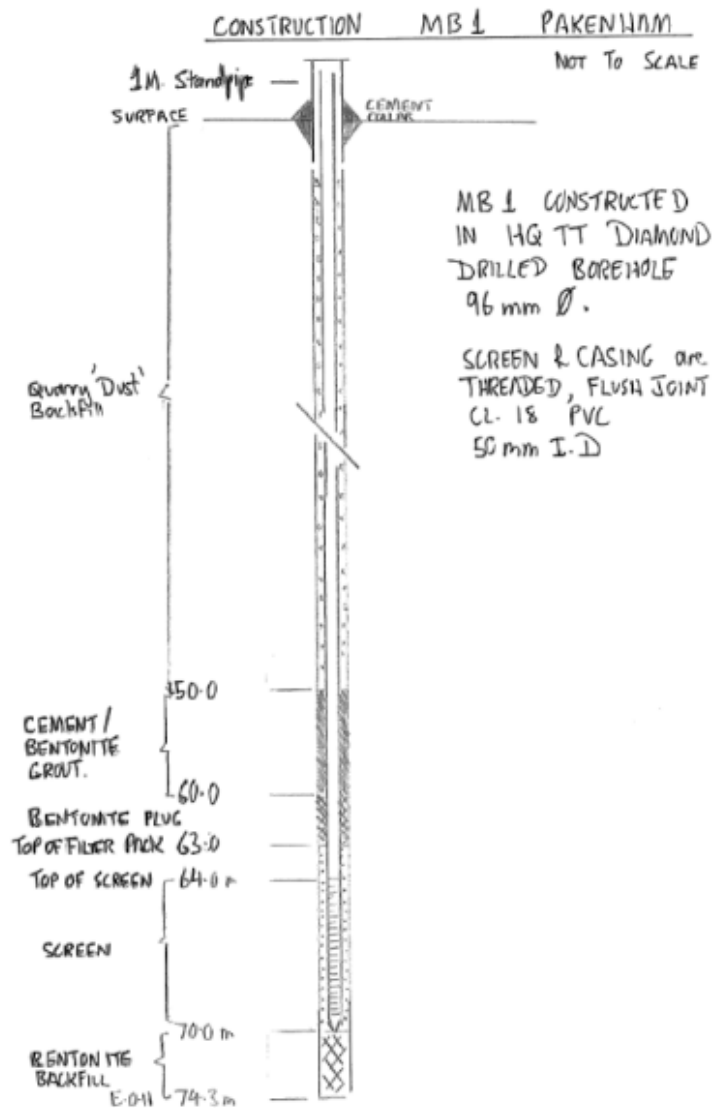
For and on behalf of  
**Statewide Geotechnical (Aust) Pty Ltd**

**David Alkemade** B.Eng (Geo), MSc  
Engineering Manager

---

**Statewide Geotechnical (Aust) Pty Ltd**

17-20 Summer Lane, Ringwood 3134  
Phone: 03 9879 2999 Fax: 03 9879 6226 Email: [geo@statewidedrilling.com.au](mailto:geo@statewidedrilling.com.au)  
ABN: 73 113 017 799 ACN: 113 017 799



# Diamond Log

Client **Holcim**  
 Project **Pakenham Quarry**  
 Logged By **Liesl Cristanelli**  
 Co-ords **366948E 5790593N**  
 Collar RL **241.9m (A.H.D.)**  
 Hole Depth **74.3m**

Drilled By **Statewide Drilling**  
 MGA Zone55  
 Local (Non Earth) 0E 0N  
 Collar Confidence **Good**

Bore No. **D24-MB1**

Date Drilled **21-Mar-24**  
 Project No. **R02\_107**  
 Drill Type **Diamond**  
 Hole Attitude **Vertical**  
 Hole Size **HQ**

Measured Water Level

AHD (m)	Interval m		MATERIAL	TEXTURE	COLOUR	Alter.	ROCK CONDITION	Downhole Depth m	Core Loss	FRACTURE	SMC	Deg (%)	LA (%)	PD ssd (t/m3)	Comments	Assigned Quality
	from	to														
	0.0	0.2	TOPSOIL		bn/rd											
	0.2	5.4	CLAY/BASALT		Dk rd											
241																
240																
239					Dk rd, wh											
238																
237																
236	5.4	70.2	BASALT		Dk or, wh											
235																
234																
233																
232																
231					Dk or/bn, wh											
230																
229																
228					Dk or/rd											
227					Dk or/bn, wh											
226																
225																
224																
223																
222																
221																
220																
219																
218					Dk bn, wh											
217																
216																
215																
214																
213					Lt bn/or, wh											
212																
211																
210																
209				f-m grained, compact	bn/rd											
208																
207																
206					bn/gy											
205					bn											
204					gy/bn											
203					bn											

COMMENTS/ABBREVIATIONS

Data Reliability:-

F Fresh  
 SW Slightly Weathered  
 MW Moderately Weathered  
 HW Highly Weathered  
 XW Extremely Weathered

Rock shows no sign of decomposition  
 Rock is slightly discoloured but generally shows no change from fresh rock  
 Rock is moderately discoloured, generally showing noticeable change from fresh rock  
 Rock strength visible altered by weathering  
 Rock weathered to such an extent that it has soil properties

RQD = Rock Quality Description

RQD(%)  $\frac{\text{Sum of core pieces} > 100\text{mm in Length of core run}}{\text{Length of core run}}$

# Diamond Log

Bore No. **D24-MB1**

Client **Holcim**  
 Project **Pakenham Quarry**  
 Logged By **Liesl Cristanelli**  
 Co-ords **366948E 5790593N**  
 Collar RL **241.9m (A.H.D.)**  
 Hole Depth **74.3m**

Drilled By **Statewide Drilling**  
 MGA Zone **55**  
 Local (Non Earth) **0E 0N**  
 Collar Confidence **Good**

Date Drilled **21-Mar-24**  
 Project No. **R02\_107**  
 Drill Type **Diamond**  
 Hole Attitude **Vertical**  
 Hole Size **HQ**

Measured Water Level

AHD (m)	Interval m		MATERIAL	TEXTURE	COLOUR	Alter.	ROCK CONDITION					Downhole Depth m	Core Loss	FRACTURE	SMC	Deg (%)	LA (%)	PD ssd (t/m3)	Comments	Assigned Quality	
	from	to					F	SW	MW	HW	XW										
201	5.4	70.2	<b>BASALT</b>	f-m grained, compact	bn gy/bn	S/Al													v. fractured		
200						bn															
199						bn															
198						bn/gy															
197						bn															
196						bn															
195						gy/bn															
194						gy/bn															
193						gy/bn															
192						gy															
191						gy															
190						gy															
189						gy/bn															
188						gy															
187						gy															
186						gy															
185						gy, bn															
184					gy																
183																					
182																					
181																					
180																					
179																					
178																					
177																					
176																					
175																					
174																					
173																					
172																					
171	70.2	73.6	<b>GRANITE</b>	v. clayey	Lt gy																
170																					
169																					
168	73.6	74.3	<b>core loss</b>																		
167																					
166																					
165																					
164																					
163																					
162																					

COMMENTS/ABBREVIATIONS

Data Reliability:-

F Fresh  
 SW Slightly Weathered  
 MW Moderately Weathered  
 HW Highly Weathered  
 XW Extremely Weathered

Rock shows no sign of decomposition  
 Rock is slightly discoloured but generally shows no change from fresh rock  
 Rock is moderately discoloured, generally showing noticeable change from fresh rock  
 Rock strength visible altered by weathering  
 Rock weathered to such an extent that it has soil properties

RQD = Rock Quality Description  
 RQD(%)  $\frac{\text{Sum of core pieces} > 100\text{mm in}}{\text{Length of core run}}$

# Bore Core Photograph - Rock

BORE No. **D24-MB1**

Project: **Holcim, Pakenham, Vic**

Project No.: R02-107

Date Drilled: 21 - March - 2024

From **0.0** to **74.3** (Metres)



# Bore Core Photograph - Rock

BORE No. **D24-MB1**

Project: **Holcim, Pakenham, Vic**

Project No.: R02-107

Date Drilled: 21 - March - 2024

From **0.0** to **74.3** (Metres)



# Bore Core Photograph - Rock

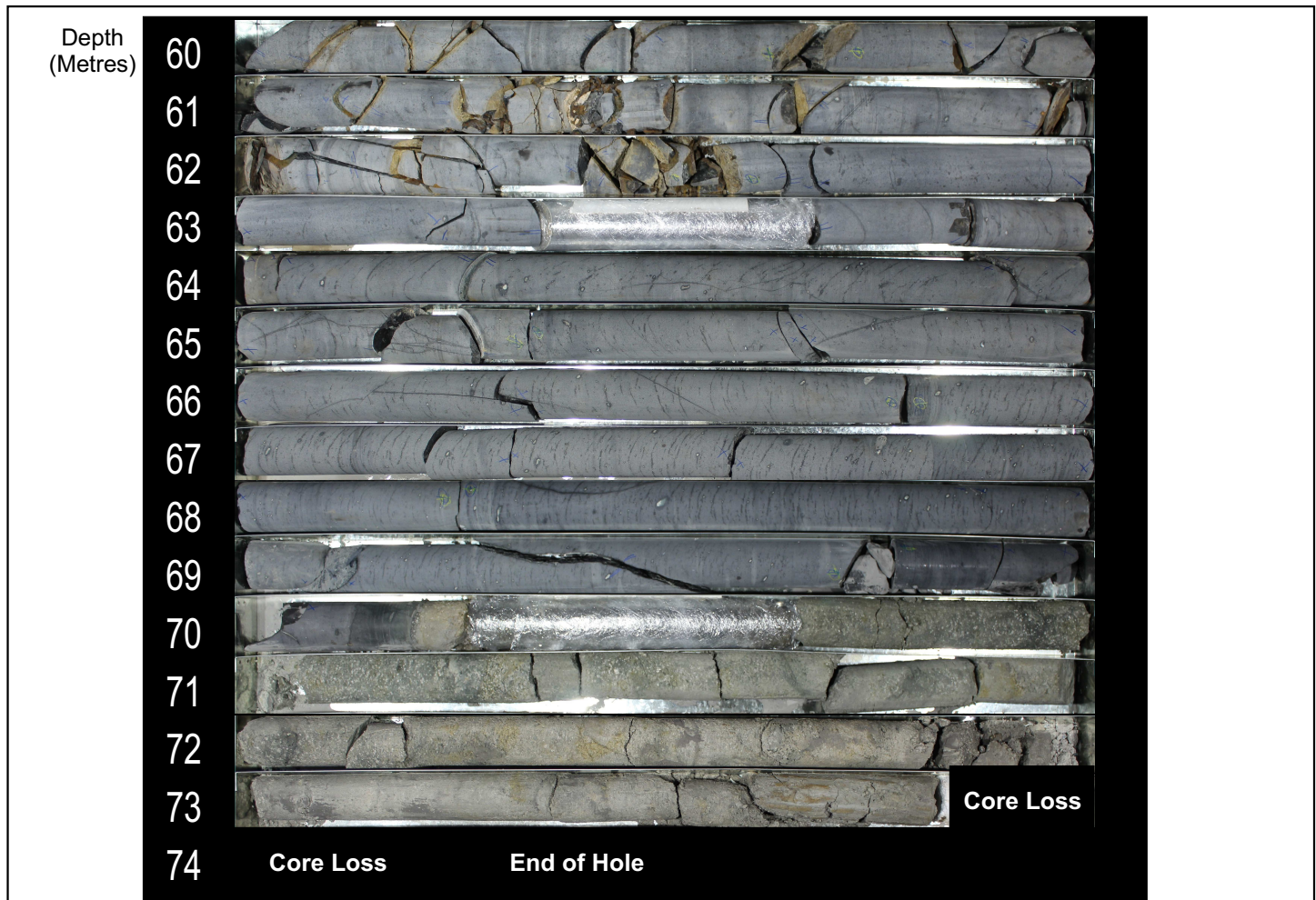
BORE No. **D24-MB1**

Project: **Holcim, Pakenham, Vic**

Project No.: R02-107

Date Drilled: 21 - March - 2024

From **0.0** to **74.3** (Metres)



# **Appendix E**

**Tabulated groundwater levels**

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
30/3/01	175.84	163.35	180.16	163.55	183.76	177.84
6/4/01		163.35		163.39		
7/5/01	175.75	163.63	180.26	163.56	183.55	177.21
24/5/01	175.94	163.67	180.40	163.55	183.46	177.00
31/5/01	175.92	163.62	180.32	163.57	183.36	176.87
7/6/01	175.96	163.63	180.33	163.50	183.34	176.87
14/6/01	176.04	163.70	180.32	163.75	183.30	176.77
21/6/01	176.01	163.87	180.25	163.68	183.23	176.78
28/6/01	175.95	163.75	180.18	163.51	183.04	176.62
5/7/01	176.00	163.73	180.23	163.48	183.13	176.61
12/7/01	175.96	163.73	180.14	163.59	183.02	176.56
19/7/01	175.95	163.75	180.11	163.56	182.95	176.52
26/7/01	175.95	163.74	5789879.07	163.45	182.87	176.54
2/8/01	175.93	163.76	180.02	163.63	182.85	176.52
9/8/01	175.94	163.75	180.05	163.48	182.84	176.46
16/8/01	175.91	163.57	180.00	163.45	182.75	176.51
23/8/01	175.86	163.85	179.94	163.77	182.68	176.33
30/8/01	175.86	163.78	179.91	163.60	182.60	176.38
6/9/01	175.74	163.82	179.94	163.53	182.53	176.38
13/9/01	175.91	163.89	179.82	163.53	182.55	176.36
20/9/01	175.89	163.87	179.75	163.46	182.50	176.51
27/9/01	175.89	163.75	179.70	163.54	182.55	176.56
4/10/01	175.89	163.64	179.78	163.53	182.65	176.68
11/10/01	175.93	163.63	179.80	163.55	182.69	176.78
18/10/2001	175.94	163.60	179.82	163.60	182.75	176.79
25/10/2001	175.95	163.66	179.82	163.61	182.79	176.80
1/11/2001	175.93	163.99	179.75	163.55	182.77	176.74
8/11/2001	175.93	163.92	179.72	163.53	182.76	176.71
15/11/2001	175.93	163.95	179.70	163.57	182.73	176.69
22/11/2001	175.98	164.00	179.74	163.50	182.78	176.70
30/11/2001	176.03	163.89	179.74	163.44	182.77	176.71
7/12/2001	176.00	163.79	179.94	163.58	182.79	176.65
20/12/2001	176.01	163.66	179.63	163.06	182.70	176.67
11/01/2002	176.00	163.47	179.48	163.03	182.56	176.61
18/01/2002	175.99	163.46	179.47	163.03	182.54	176.62
25/01/2002	175.96	163.42	178.99	163.37	182.44	176.50

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
1/02/2002	175.97	163.41	179.29	163.02	182.41	176.46
11/02/2002	175.94	163.59	179.20	163.43	182.35	176.32
20/02/2002	175.85	163.52	179.17	163.40	182.27	176.29
28/02/2002	175.81	163.32	179.11	163.08	182.14	176.17
11/06/2002	175.61	163.13	178.41	162.54	180.94	
16/10/2002	175.33	163.32	177.60	163.20	179.77	175.02
30/01/2003	175.02	162.79	176.81	162.14	178.77	174.59
27/06/2003	174.54	163.06	175.75	162.65	177.55	174.06
9/07/2003	174.44	163.08	175.54	162.44	177.44	174.00
11/09/2003	174.77	163.40	175.28	162.71	177.06	174.04
1/11/2003		162.93	175.06	162.87	177.10	176.52
27/02/2004	174.64	162.37	175.51	162.66	177.99	175.87
19/05/2004	174.51	162.98	175.90	162.76	178.74	175.01
21/07/2004	175.00	163.55	177.20	162.89	178.85	175.02
3/09/2004	175.22	163.70	176.72	163.11	180.55	176.44
10/11/2004	176.32	163.60	179.57	163.32	187.29	179.90
13/01/2005	177.30	163.49	181.33	162.89	188.74	179.78
20/03/2008	170.70	164.01	174.59	163.46	177.18	172.31
18/07/2008	169.00	164.52	174.04	163.53	176.59	172.35
29/09/2008	171.77	164.62	173.59	163.53	174.92	172.26
22/12/2008	173.10	Bore Destroyed	173.29	Bore Destroyed	175.50	171.81
2/04/2009	173.54	MB2a commences	172.59	MB4a commences	174.14	171.56
18/06/2009	174.04	178.60	172.99	177.00	174.84	171.56
18/08/2009	174.94	178.60	173.09	177.70	174.84	171.56
29/09/2009	175.54	178.80	172.99	178.66	174.74	171.46
13/12/2009	176.10	178.84	173.29	179.00	174.94	170.86
11/03/2010	176.05	179.14	173.31	179.15	173.92	171.44
15/06/2010	176.19	179.03	173.35	179.53	174.89	171.46
3/08/2010	176.34	179.31	173.51	180.10	175.02	171.43
25/11/2010	177.34	180.57	175.27	181.58	178.79	172.36
26/01/2011	177.24	182.38	178.07	181.30	177.54	173.46
1/03/2011	178.31	180.40	176.49	183.60	182.49	173.92
14/06/2011	178.25	Bore Destroyed	179.91	Bore Destroyed	184.35	174.85
8/09/2011	176.44		Bore Destroyed		Bore Destroyed	174.76

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
14/12/2011	173.64					
14/01/2012	173.74					176.56
29/02/2012	174.74					176.28
12/04/2012	175.44					175.81
10/05/2012	175.34					175.66
9/07/2012	174.94					175.83
3/08/2012	172.84					175.81
12/09/2012	174.94					175.86
10/10/2012	175.04					175.96
14/02/2013	175.19					176.06
12/03/2013	175.08					176.30
8/04/2013	175.04					175.81
4/06/2013	174.89					176.06
2/07/2013	174.54					175.81
5/08/2013	172.79					177.91
9/09/2013	175.04					175.81
7/10/2013	175.04					175.81
12/11/2013	172.47					177.41
10/12/2013	174.29					175.44
13/01/2014	175.04					175.91
11/02/2014	175.04					178.11
10/03/2014	176.04					176.96
8/04/2014	174.04					175.32
15/05/2014	174.39					175.46
10/06/2014	175.04	MB2b commences	MB3b commences	MB4b commences	MB5b commences	176.23
19/02/2015	No access	No access	170.92	No access	171.28	
28/03/2015	172.51	173.15	170.61	173.09	170.98	174.88
25/05/2015	172.52	173.29	170.17	173.08	170.52	174.34
23/06/2015	172.69	173.29	170.20	173.37	170.56	174.30
23/07/2015	172.46	173.29	170.08	173.21	170.42	174.12
31/08/2015	172.25	173.45	169.92	173.26	170.26	173.84
29/09/2015	172.12	173.48	169.98	173.32	170.32	173.77
30/10/2015	171.86	173.30	170.04	173.20	170.39	173.71
27/11/2015	171.56	173.21	169.92	173.11	170.26	173.59
17/12/2015	171.47	173.10	169.87	173.03	170.22	173.53
26/02/2016	173.23	172.70	169.46	172.85	169.78	173.11

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
17/06/2016	171.14	173.24	169.22	Dry, bore damaged	169.54	172.78
28/09/2016	171.16	173.24	170.36	172.66	170.79	172.83
15/12/2016	171.22		170.78	172.28	171.21	173.41
16/01/2017		MB02C commences		MB04C commences		
8/05/2017	171.86	172.08	170.10	171.96	170.50	173.29
9/08/2017	171.74	171.62	170.24	171.46	170.69	172.90
9/10/2017	171.49	171.52	170.92	171.26	171.44	171.75
8/12/2017	171.27	171.18	170.69	170.97	171.16	172.61
12/04/2018	170.78	171.32	170.26	170.82	170.70	172.36
3/07/2018	170.04	171.10	170.92	170.89	171.52	172.11
9/10/2018	169.88	171.17	171.71	170.99	172.31	171.95
8/01/2019	169.78	171.24	172.03	171.00	172.57	171.81
5/04/2019	169.35	170.39	170.39	170.30	170.82	171.67
18/07/2019	168.93	170.64	171.58	170.70	172.14	171.38
16/12/2019	169.33	171.69	172.52	171.81	173.04	171.71
31/03/2020	169.39	171.68	172.54	171.94	173.08	171.86
14/08/2020	169.81	172.46	172.01	172.90	172.47	172.67
24/09/2020	169.66	172.30	172.20	172.84	172.59	172.68
30/10/2020	170.89	172.62	172.81	173.24	173.28	174.23
6/11/2020	170.13	172.65	172.99	173.22	173.53	174.35
21/12/2020	170.2	172.36	172.54	172.79	172.99	174.89
10/03/2021	170.36	171.86	171.54	172.21	172.00	174.59
19/04/2021*	169.96	171.76	171.29	172.38	171.7	174.6
25/05/2021*	170.81	171.82	171.27	172.54	171.7	174.3
17/06/2021	170.29	172.01	171.44	172.71	171.92	173.87
28/07/2021*	170.04	172.13	171.35	172.85	171.79	173.71
27/08/2021*	169.96	172.01	171.24	172.69	171.66	173.285
14/09/2021	170.34	172.23	171.48	171.88	172.01	173.29
27/10/2021*	170	172.46	172.3	173.18	172.8	173.52
23/11/2021*	170.30		172.95	173.17	173.50	173.03
20/12/2021	170.89	172.46	172.47	173.06	172.94	173.90
21/01/2022*	170.68	172.07	171.37	172.65	171.70	174.31
21/02/2022*	170.68	171.77	170.78	172.32	171.10	174.44
22/03/2022*	170.58	171.58	170.54	172.16	170.65	173.76
26/04/2022	170.65	171.53	170.28	172.08	170.65	174.29
24/05/2022*	171.07	171.62	170.41	172.21	170.86	174.39

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
17/06/2022	170.50	171.87	170.50	172.49	170.98	174.22
20/07/2022*	170.49	171.84	170.47	172.66	170.89	174.03
24/08/2022*	170.56	171.98	170.19	172.85	170.45	173.91
12/09/2022	170.52	172.25	170.75	173.09	171.05	173.93
17/10/2022*	170.87	172.31	170.27	173.17	170.55	174.56
23/11/2022*	171.42	172.43	171.55	173.14	171.91	176.33
19/01/2023*	171.97	171.65	169.90	172.71	170.15	177.80
20/02/2023*	171.89	171.29	169.03	172.55	169.36	177.33
23/03/2023	171.65	171.05	167.32	172.36	167.58	176.93
6/04/2023*	172.37	171.20	168.19	172.45	168.39	176.82
18/05/2023*	171.47	171.60	168.49	172.52	168.47	176.16
22/06/2023	171.28	171.87	168.91	172.73	169.03	175.66
13/07/2023*	171.30	171.97	169.33	172.57	169.45	175.49
3/08/2023*	171.21	171.92	169.43	172.83	169.59	175.26
7/09/2023	171.09	171.77	169.42	172.67	169.57	174.91
25/10/2023*	170.97	171.93	169.53	172.84	169.67	174.54
20/11/2023*	170.92	171.88	169.45	172.68	169.62	174.38
13/12/2023	170.97	171.82	169.35	172.54	169.54	174.26
15/01/2024	170.52	172.05	169.32	173.02	169.47	174.10
Highest Elevation (whole dataset)	178.31	182.38	5789879.07	183.60	188.74	179.90
Lowest Elevation (whole dataset)	168.93	162.37	167.32	162.14	167.58	170.86
Highest Elevation since 2015	173.23	173.48	172.99	173.37	173.53	177.80
Lowest Elevation since 2015	168.93	170.39	167.32	170.30	167.58	171.38
Difference	4.30	3.09	5.66	3.07	5.95	6.42
Source: AECOM (2024)						

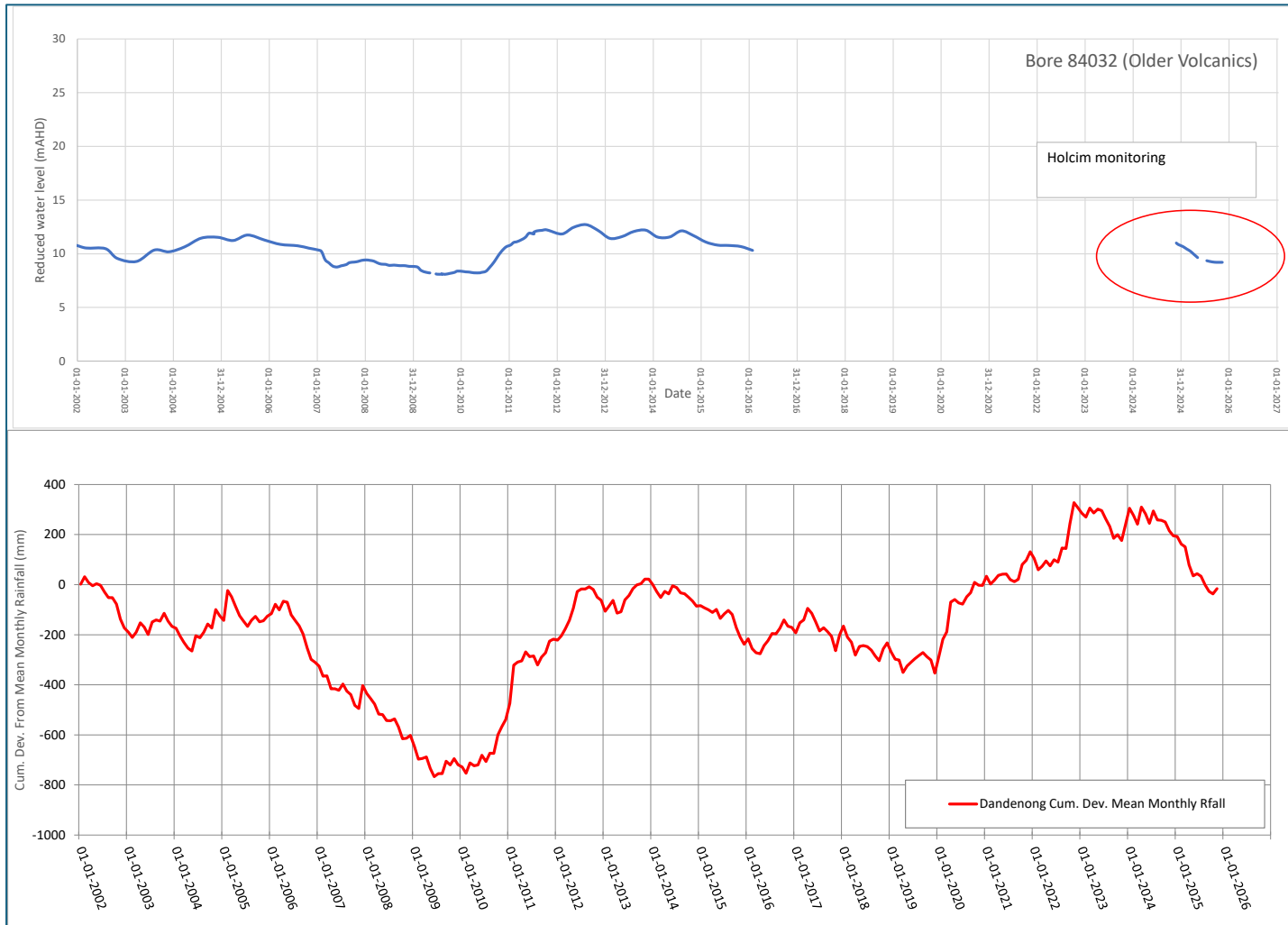
Date	Bore ID								Contractor
	MB01 (RLWL)	MB02C (RLWL)	MB03B (RLWL)	MB04C (RLWL)	MB05B (RLWL)	MB06 (RLWL)	MB07 (RLWL)	SON 84032 (RLWL)	
15/01/2024	170.52	172.05	169.32	173.02	169.47	174.10		-	AECOM
07/02/2024	170.92	171.77	169.37	172.53	169.53	174.10		-	J. Everitt
19/03/2024	170.82	171.29	169.16	172.04	169.36	174.07		-	J. Everitt
17/04/2024	170.67	171.32	169.04	172.29	169.23	173.94		-	J. Everitt
02/05/2024	170.63	171.33	169.02	172.26	169.30	173.90		-	J. Everitt
06/06/2024	170.52	171.01	168.91	172.41	169.13	173.88		-	J. Everitt
08/07/2024	170.30	171.05	168.76	172.41	168.98	173.72		-	J. Everitt
08/08/2024	170.42	171.14	168.85	172.99	169.08	173.66		-	J. Everitt
10/09/2024	170.39	170.65	168.80	172.64	169.07	173.67		-	J. Everitt
10/10/2024	170.34	170.57	168.69	172.42	168.95	173.64		-	J. Everitt
26/11/2024	170.21	170.24	168.54	172.38	168.82	173.59			J. Everitt
12/12/2024	170.17	170.03	168.45	172.37	168.75	173.56		10.94	GHD
15/01/2025	170.12	170.28	168.33	172.43	168.6	173.47		10.85	J. Everitt
13/02/2025	169.99	170.15	168.2	172.25	168.37	173.37		10.67	J. Everitt
12/03/2025	169.85	170.08	168.09	172.17	168.35	173.25		10.44	J. Everitt
08/04/2025	169.75	170.08	168	172.12	168.25	173.13		10.24	J. Everitt
07/05/2025	169.69	169.73	167.9	171.49	168.17	173.06		9.95	J. Everitt
05/06/2025	169.54	169.41	167.78	171.06	168.05	172.92		9.64	J. Everitt
16/07/2025	169.47	169.44	167.69	171.02	167.94	172.78		-	J. Everitt
08/08/2025	169.34	169.45	167.71	171.02	167.95	172.71		9.35	J. Everitt
12/09/2025	169.34	169.36	167.72	170.79	167.97	172.65		9.28	J. Everitt
09/10/2025	169.35	169.31	167.72	170.57	168.04	172.62		9.21	J. Everitt
11/11/2025	169.37	169.57	167.83	170.99	168.13	172.55		9.2	J. Everitt
15/12/2025	169.44	169.5	168.12	171.1	168.45	172.5	203.06	9.2	GHD

Source: Holcim

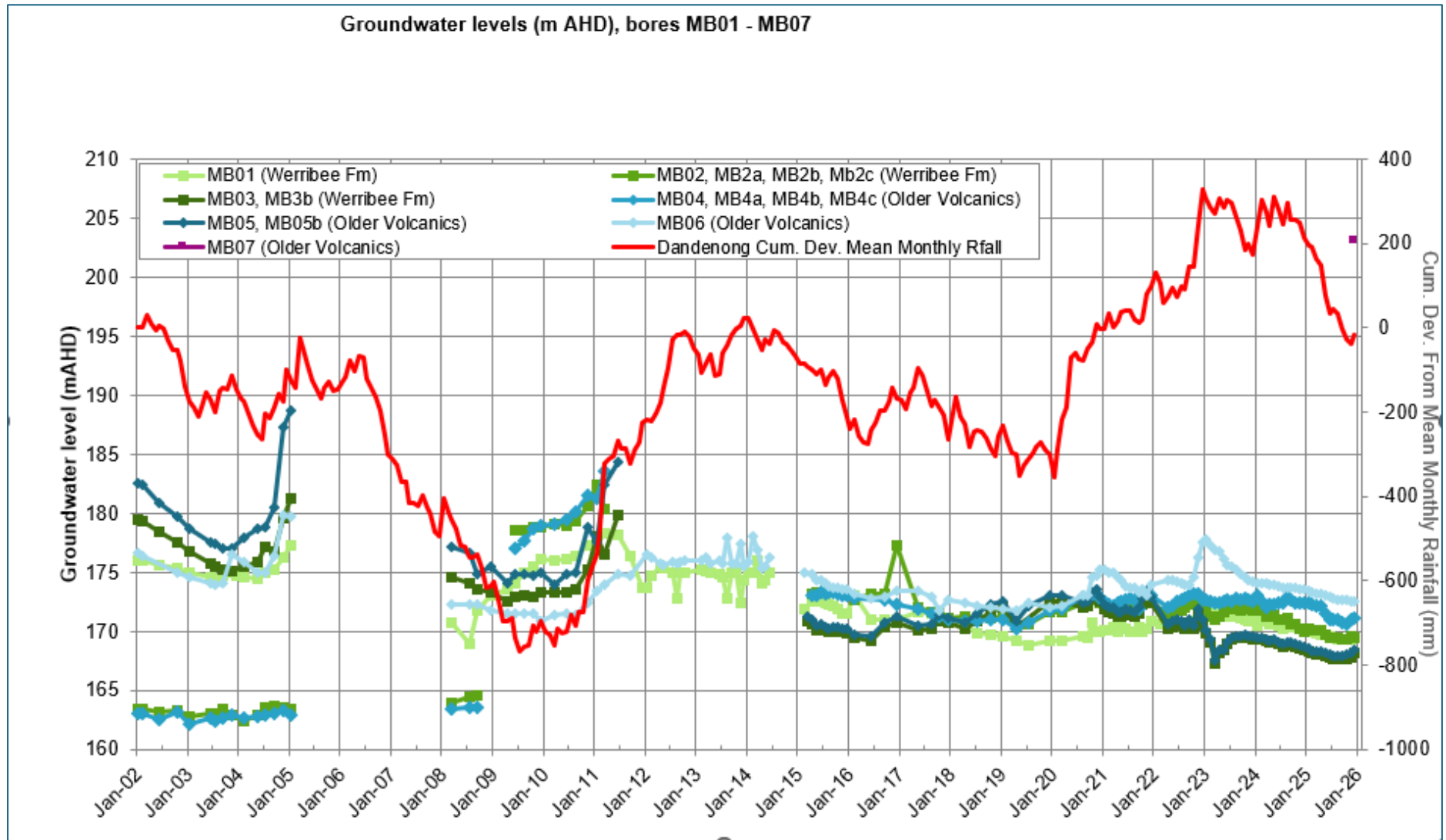
# **Appendix F**

**Monitoring bore hydrographs (manual  
water level monitoring)**

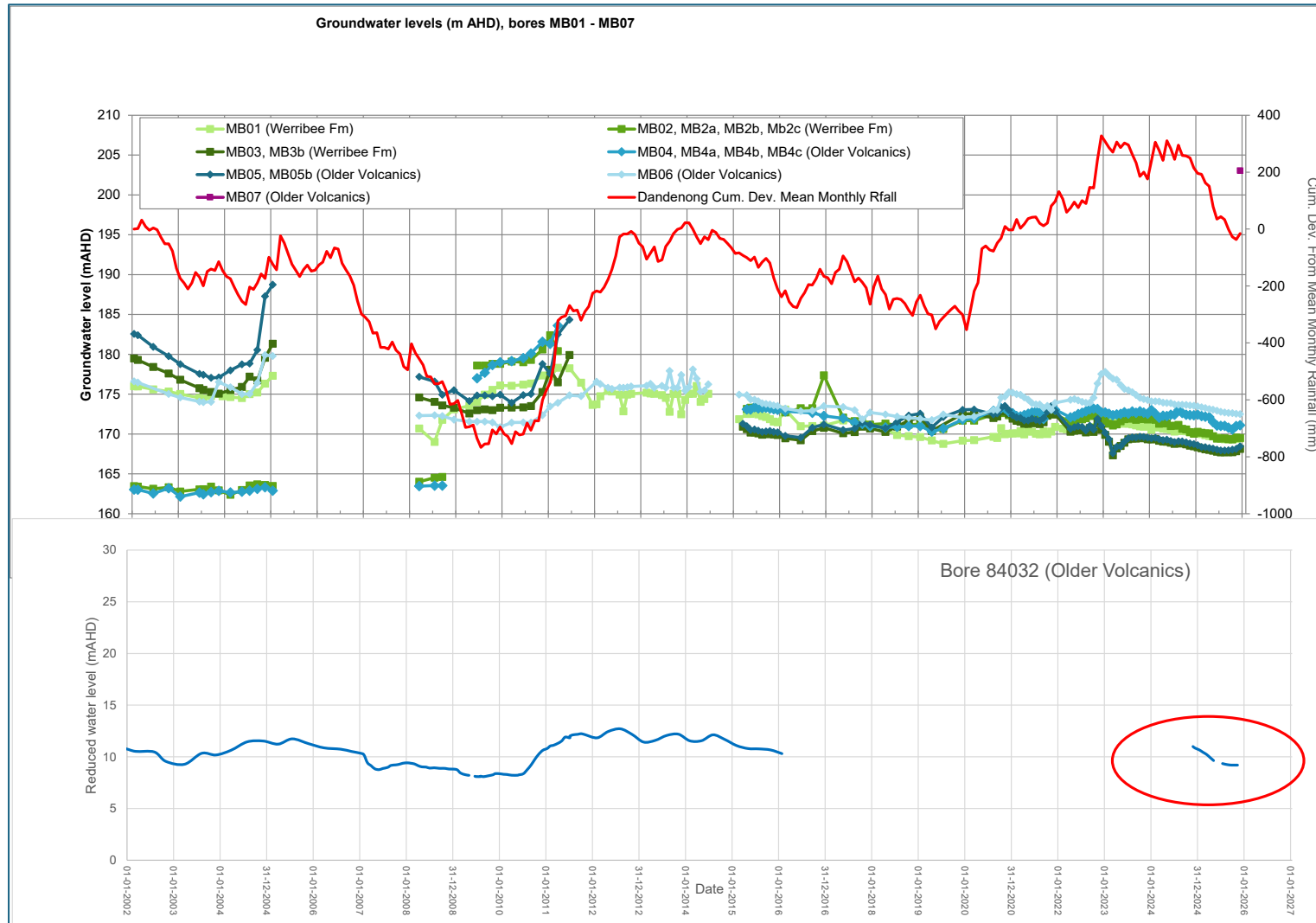
# Bore 84032 (Older Volcanics)



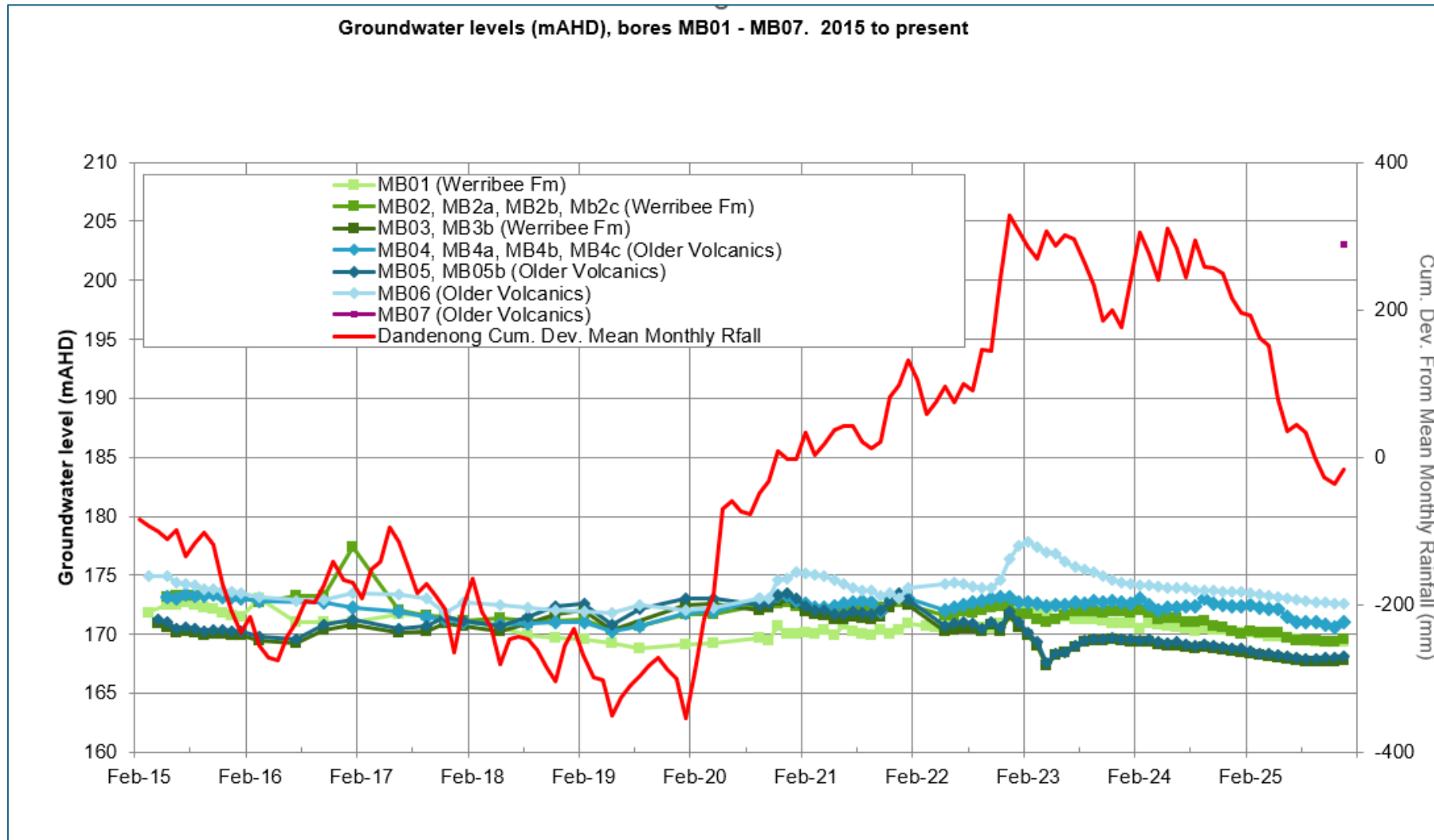
**Bores MB01 to MB07 – all data**



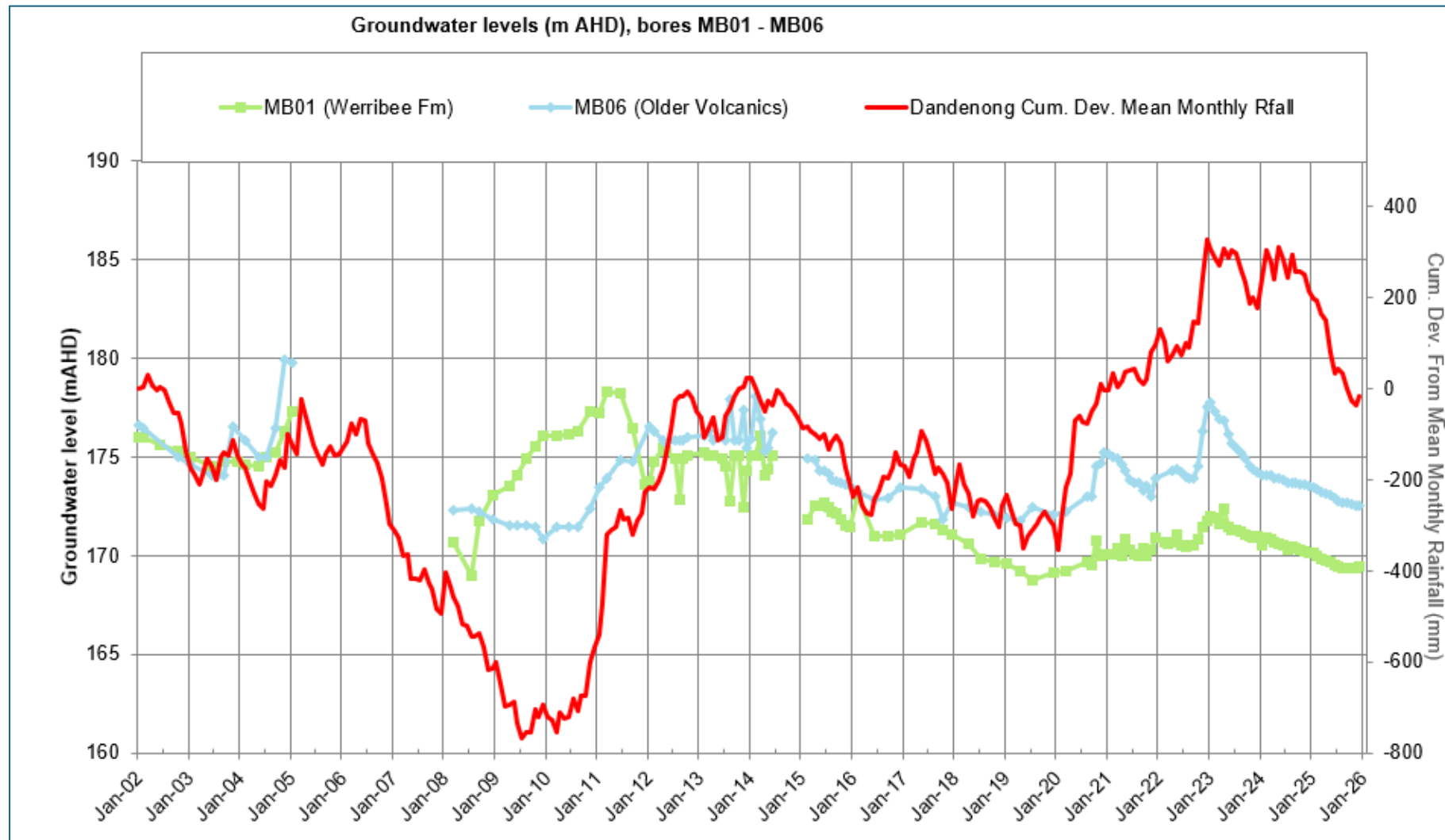
### SON bore 84032 and site bores MB01 – MB07; 2002 to present



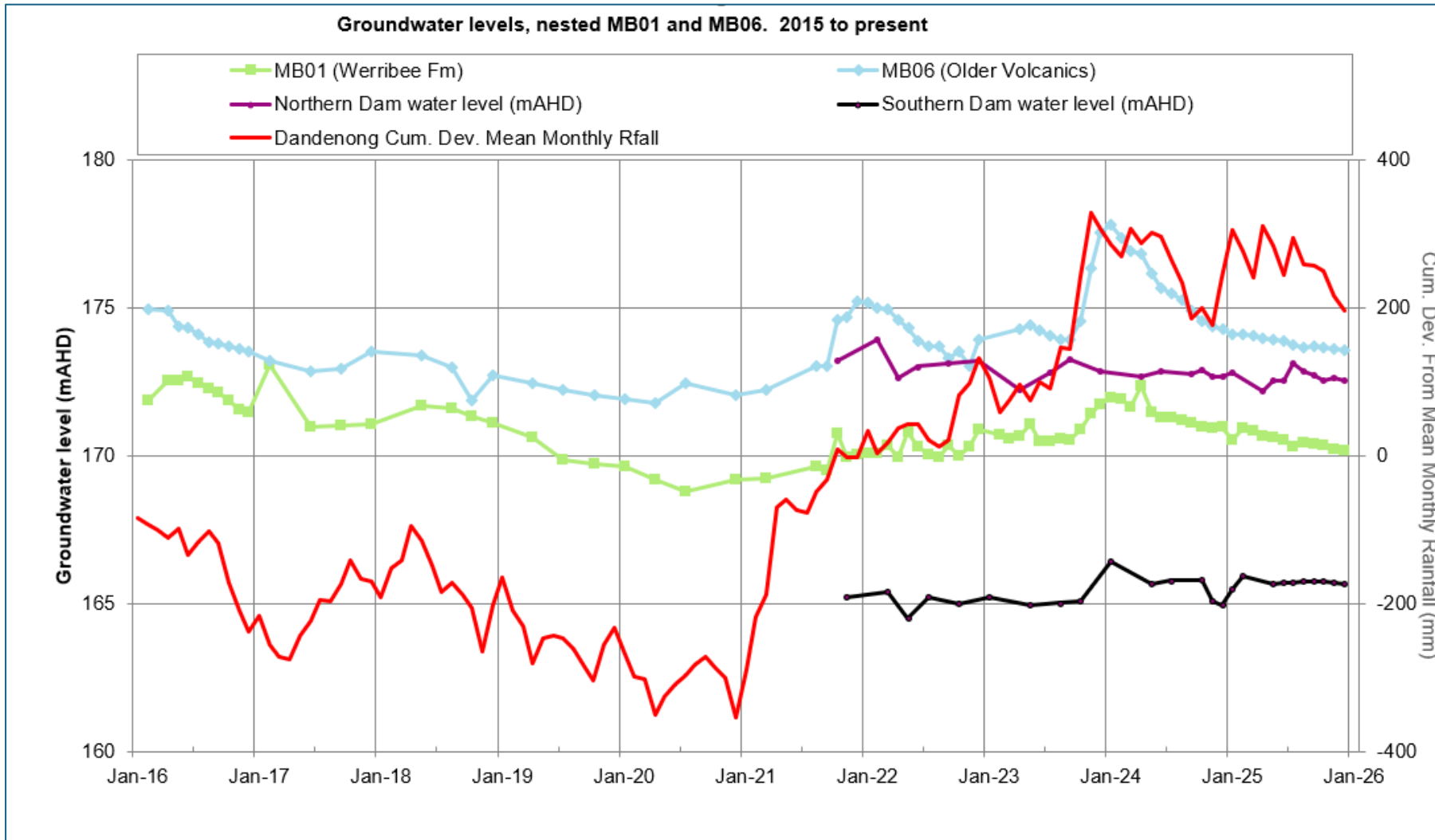
### Bores MB01 to MB07 – 2015 to present



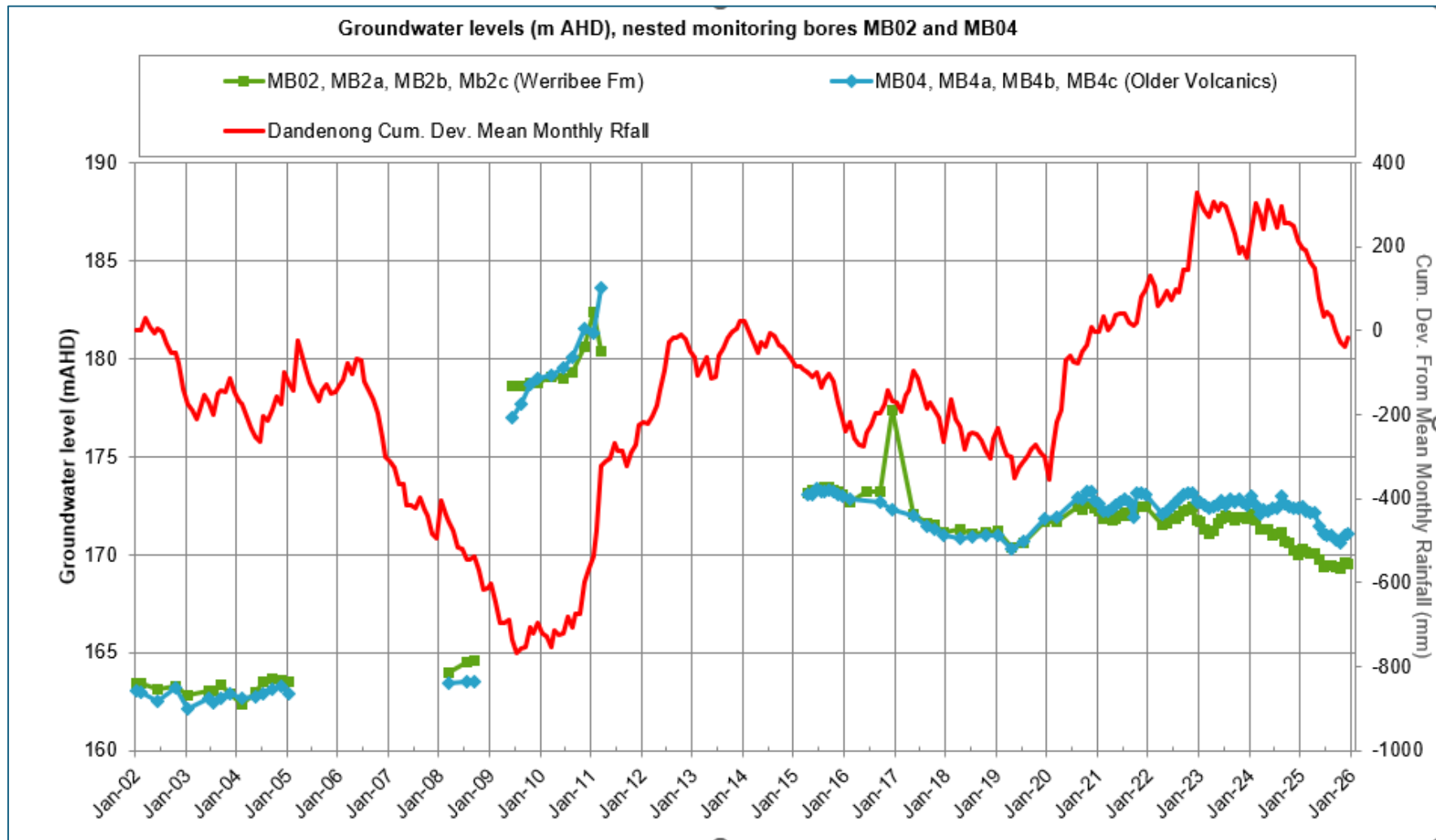
### Bores MB01 and MB06 – all data



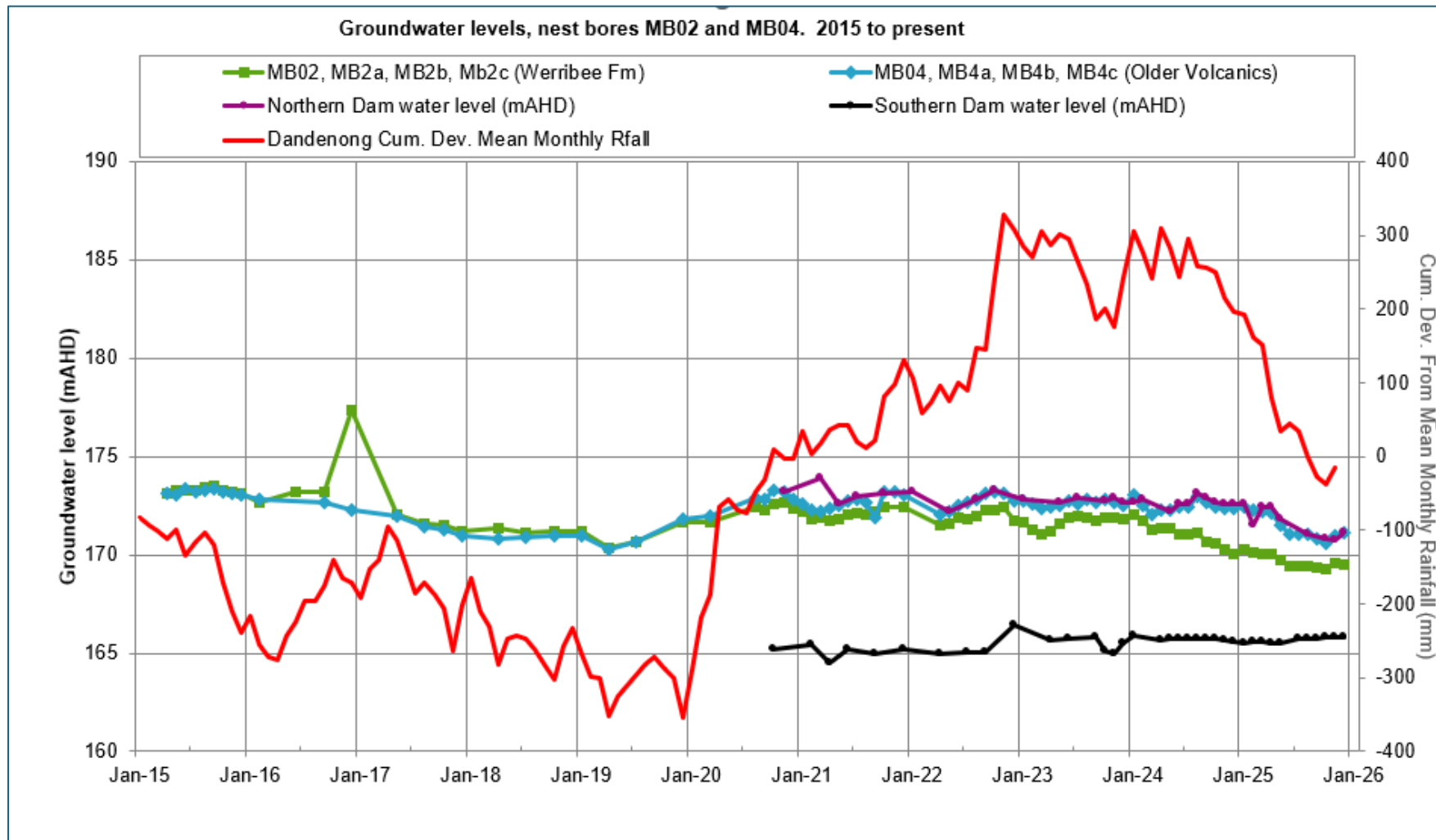
### Bores MB01 and MB06 – 2015 to present



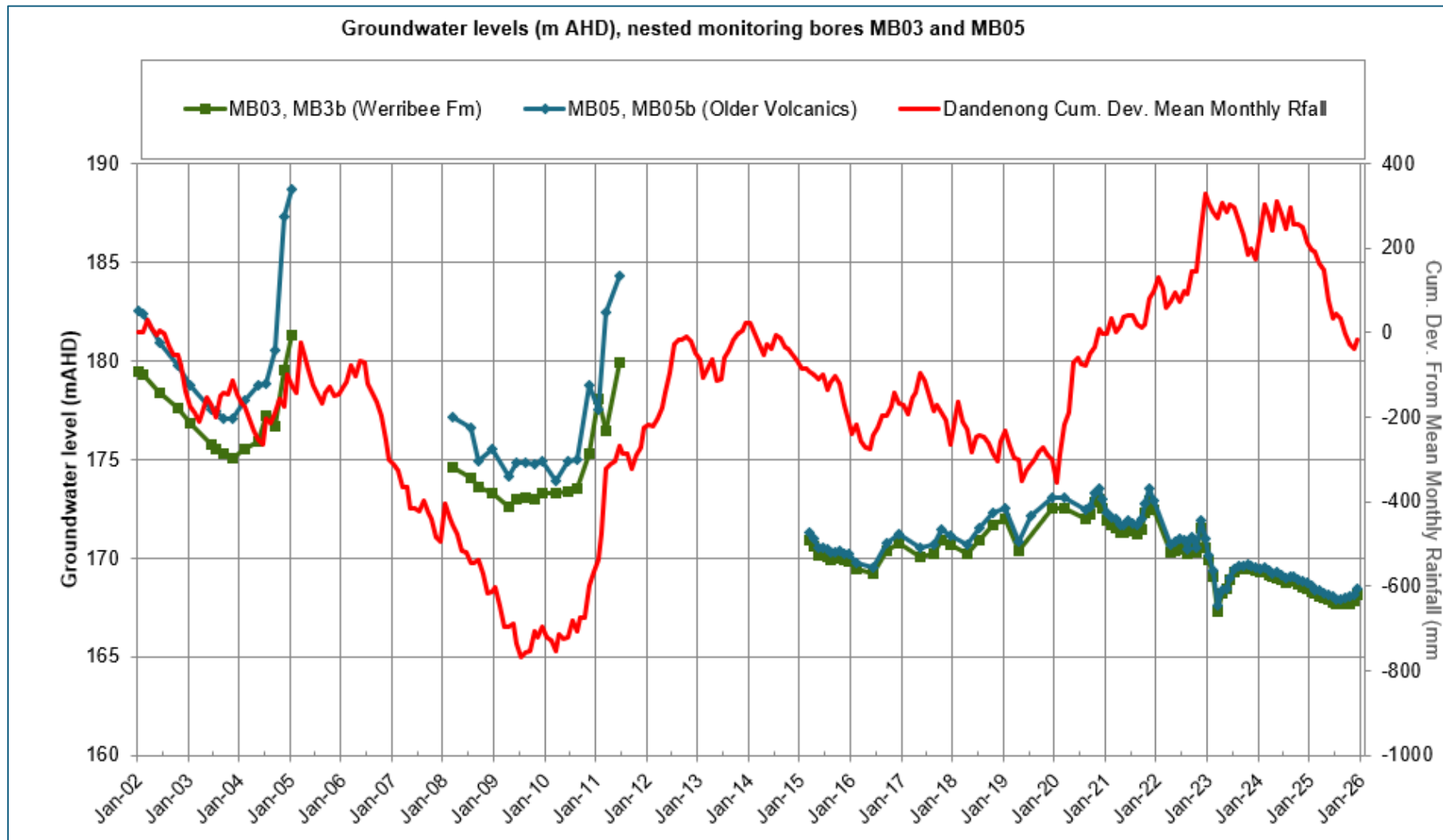
### Bores MB02 and MB04 – all data



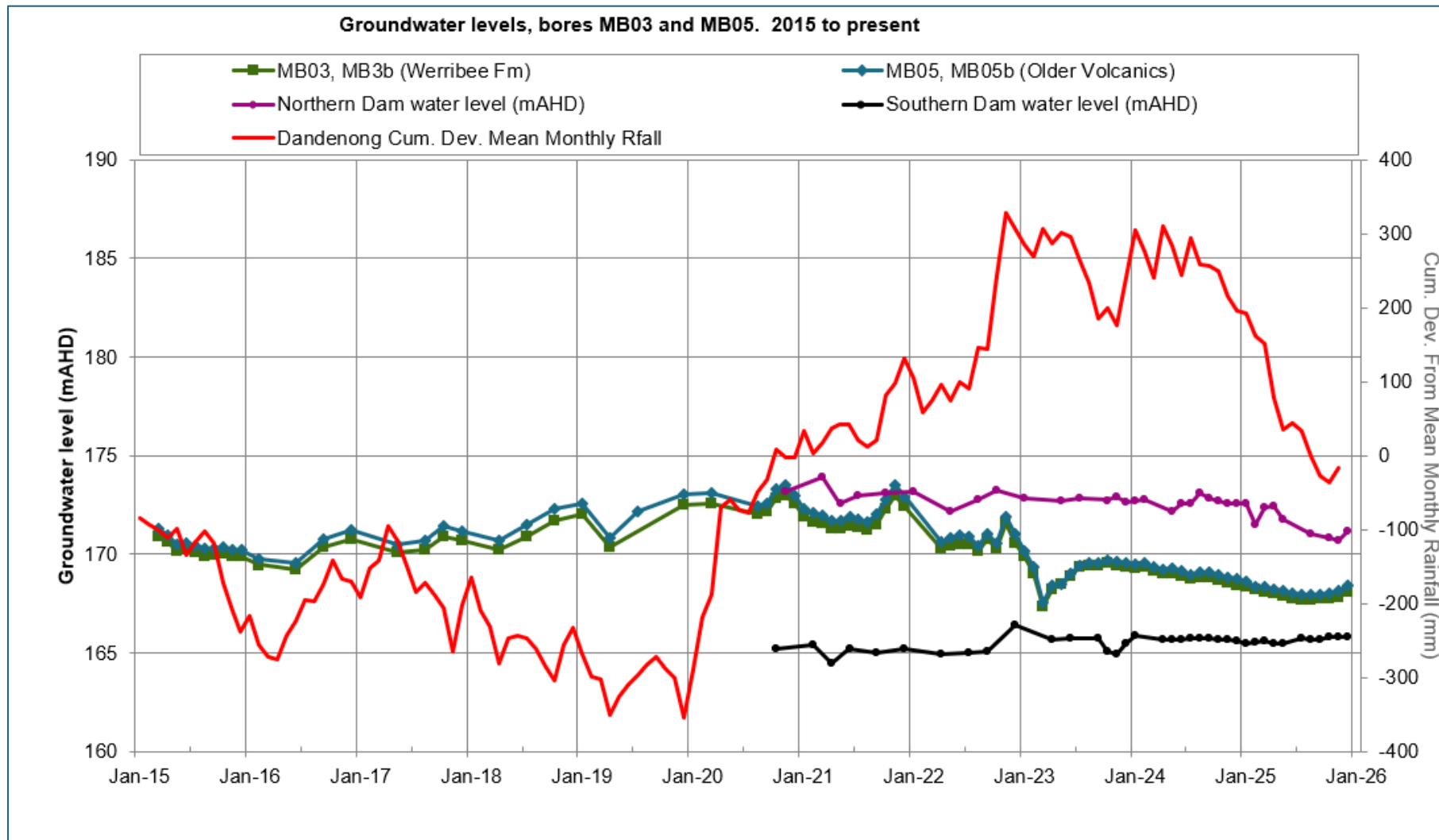
### Bores MB02 and MB04 – 2015 to present



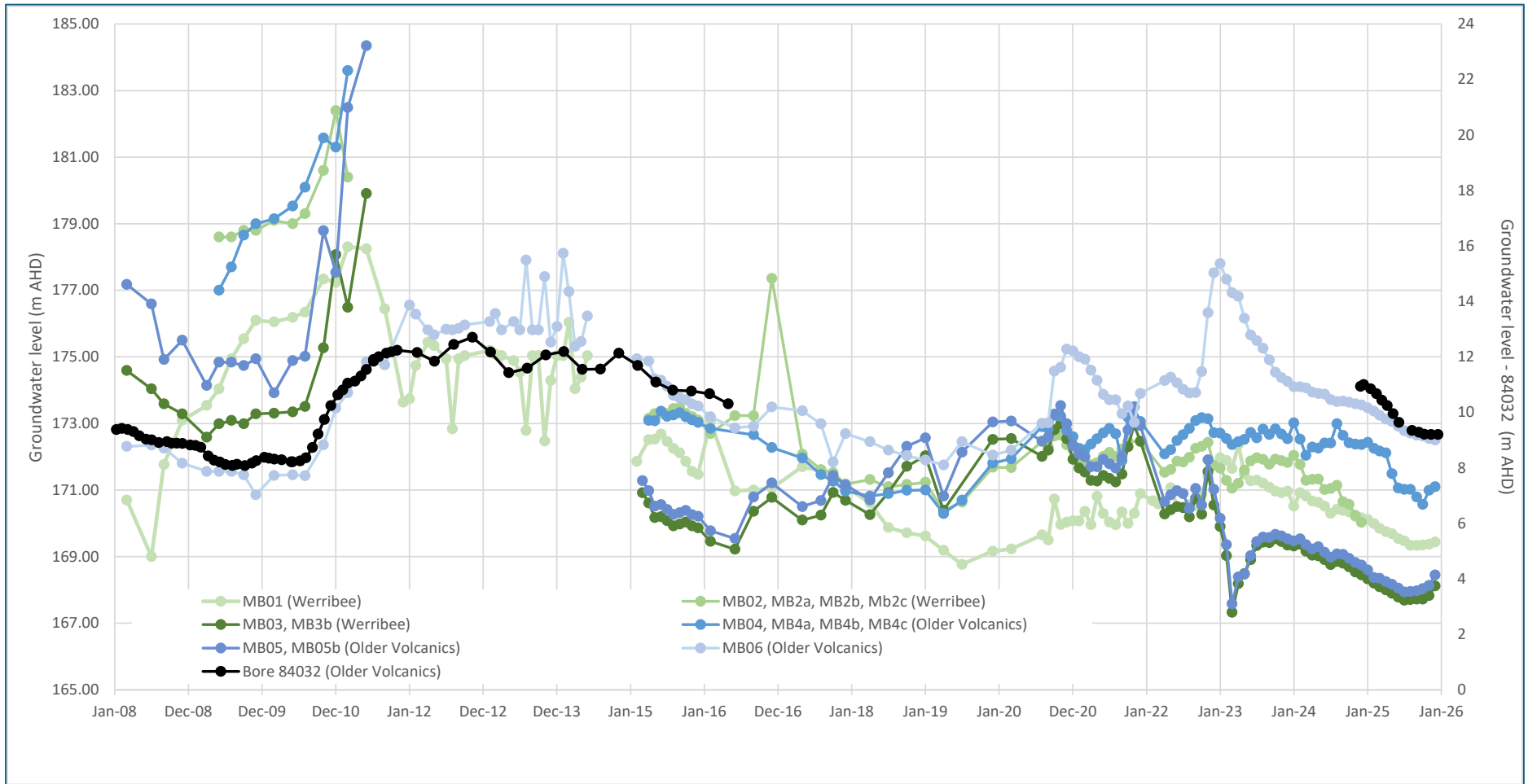
### Bores MB03 and MB05 – all data



### Bores MB03 and MB05 – 2015 to present



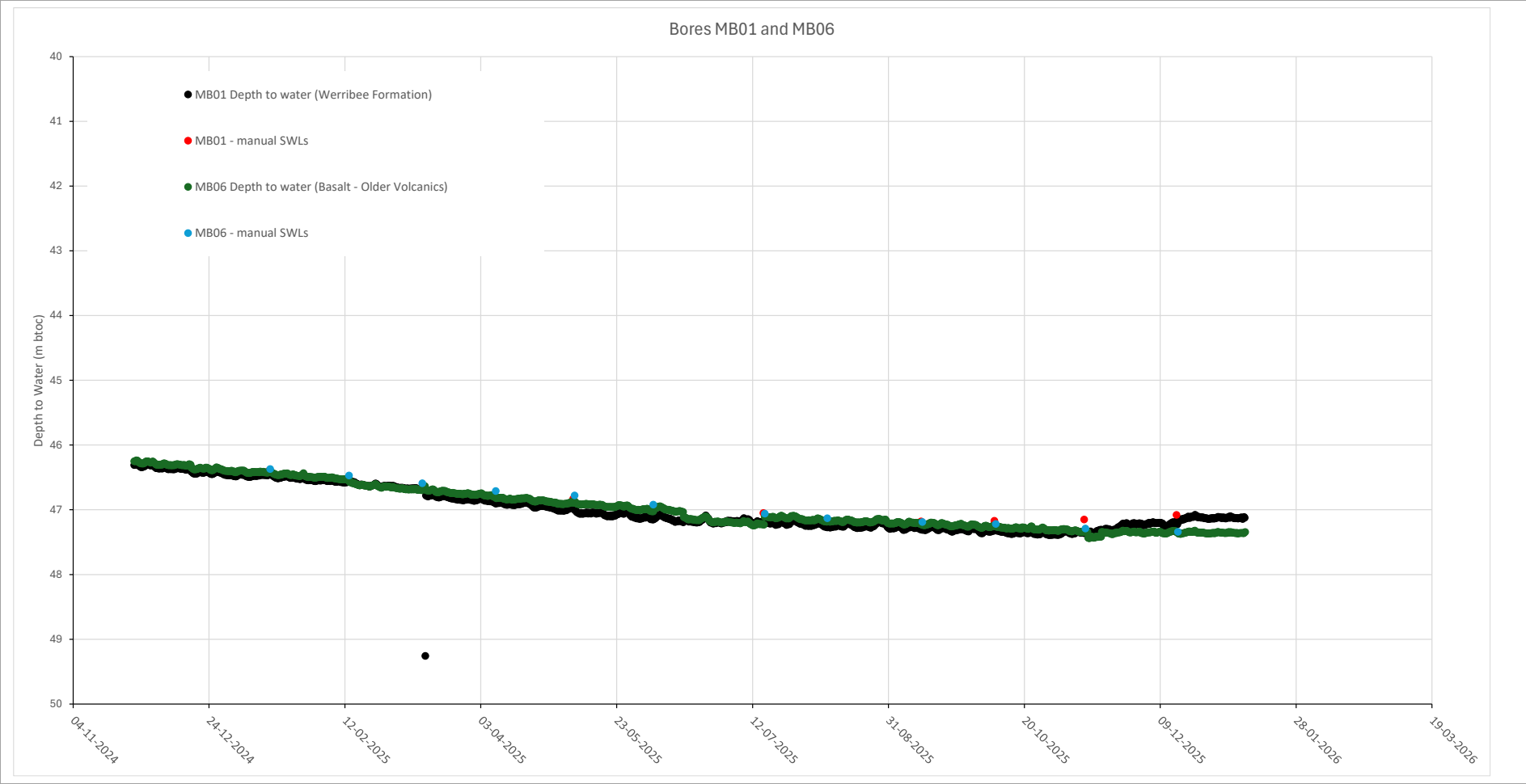
### Bores MB01 to MB06 and SON84032 – 2008 to present



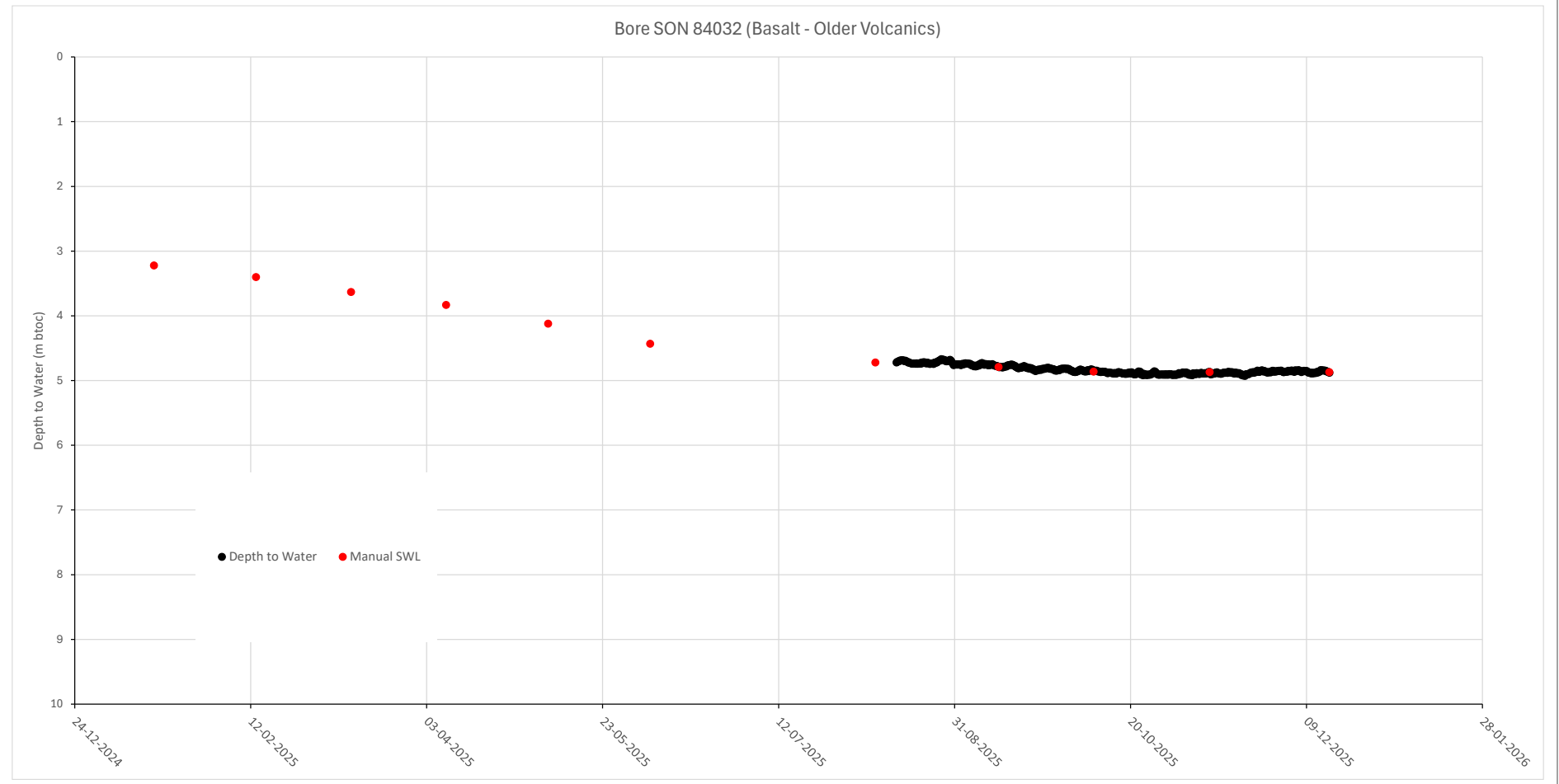
# **Appendix G**

**Monitoring bore hydrographs, bores  
MB01, MB06 and SON 84032 (datalogger)**

# Bores MB01 and MB06 – datalogger results



### Bore SON 84032 – datalogger results



# **Appendix H**

**Mt Shamrock spring monitoring data**

Field Parameters Recorded at Spring Locations

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations	
		µS/cm		mV	mg/L	°C	mg/L			
SP01	13-Feb-01	905	7.53	193	-	22.9	588			
	06-Apr-01	1013	6.65	240	1.03	18.4	658			
	07-May-01	1079	7.21	215	5.67	17.2	701			
	15-Jun-01	886	8.21	151	7.11	16.1	576			
	11-Jul-01	994	7.31	194	**	15.8	646			
	13-Aug-01	1104	7.25	189	8.07	17.0	718			
	17-Sep-01	958	7.16	203	5.91	17.0	623			
	04-Oct-01	1048	7.17	230	**	16.0	681			
	20-Nov-01	721	7.06	320	6.07	16.1	469			
	17-Dec-01	1025	7.16	190	9.78	18.8	666			
	22-Feb-02	1054	7.36	173	5.28	22.7	685			
	12-Jun-02	946	6.88	8	4.68	14.7	615			
	30-Jan-03	1260	7.21	43	5.98	19.7	819			
	27-Jun-03	1127	7.08	208	6.10	10.6	733			
	21-Jul-04	988	7.57	305	**	12.1	642			
	12-Mar-09	1140	7.11	-	-	-	741		Main irrigation spring, flow ~1.2L/min, sampled from tank inlet	
	25-Jun-10	1076	7.80	-	-	-	699		Parameters gauged at source, flow ~3 L/min	
	28-Mar-12	1049	***	-	-	-	19.3	682		
	25-Jun-13	947	7.58	79.9	10.39	14.4	616			
	15-May-14	1043	7.60	18	9.3	15.8	678			
									Clear, moderate flow	
									Clear, water flow into tank ~4L/s. Wheelie bin where water collects was half full of water	
									Clear, no odour. Water is collected in wheelie bin prior to discharge.	
		09-Oct-17	1120	6.99	167	6.16	14.9	728	2.0	Vegetation in area in very healthy condition, weeds growing over bin lid. Very boggy in area. Water had been extracted from the tank during the morning and therefore it was recharging. Flowing quickly into tank at approximately 250 mL / 10 seconds. Water clear with suspended solids.
		03-Jul-18	1470	7.01	197	5.70	12.3	956	5.0	Vegetation in area in very healthy condition. Very boggy in area. Flowing from Spring via pipe into tank quickly at approximately 250 mL / 4 seconds.
		08-Jan-19	1323	7.38	73.8	6.15	16.1	860		Grey, no odour, medium turbidity, very overgrown
		18-Jul-19	1218	7.44	71	7.15	12.9	792		Clear, low turbidity, no odour, moderate flow into tank.
		16-Dec-19	1200	7.54	37.2	7.37	15.3	780		Thick vegetation. Flowing water in bin.
		06-Nov-20	814	7.26	20.1	5.92	14.6	529		Overgrown. Flowing into bin. Sign at spring reads Spring 3.
		17-Jun-21	908	7.46	28.2	7.4	13.6	590		Overgrown. Water flowing into bin. Fence maintained. Sign reads Spring 3.
		20-Dec-21	755	7.63	23	5.7	14.8	491	9.0	~100mL/s flowing into bin. (8640 L/day)
		17-Jun-22	928	7.62	-26.4	5.94	14.4	603	10.0	113mL/s flowing from spring (9,792 L/day)
		21-Dec-22	753	7.84	12.8	7.88	13.7	489	19.0	Water flowing into bin, losing some water which misses the capture system. Flow rate = 10L/45 secs
		15-Jan-24	724	6.96	230.6	6.96	17.66	471	10.3	Water flowing into bin - losing some water which misses capture system
			758	6.98	48.2	66.70%	16	493	4.7	Water flows into bin. Due to location of bin, not all water captured in bin. Flow meter installed 1 November 2024 at tank below spring. Flow meter reading - 262 m3. Assuming an initial flow meter reading of 0 m3, this suggests an approximate daily flow rate of 6.4 m3
		12-Dec-24								
		15-Dec-25	724	6.72	48.2	66.70%	15.9	471	8.6	Water flows into bin. Due to location of bin, not all water captured in bin.
	SP02	13-Feb-01	3240	8.01	166	-	20.8	2106		
		06-Apr-01	3090	7.24	219	0.00	19.4	2009		
		07-May-01	3030	7.78	187	4.18	13.8	1970		
		15-Jun-01	2450	8.66	130	7.39	14.5	1593		
		11-Jul-01	2510	7.95	166	**	12.5	1632		
		13-Aug-01	2650	8.08	202	7.68	14.2	1723		
17-Sep-01		2600	8.38	135	8.03	16.4	1690			
04-Oct-01		2480	7.83	168	**	14.7	1612			
20-Nov-01		2630	8.32	139	6.14	18.1	1710			
17-Dec-01		2270	7.07	197	6.87	18.0	1476			
22-Feb-02		2660	7.04	191	2.02	21.9	1729			
12-Jun-02		1813	7.41	201	4.59	12.0	1178			
30-Jan-03		4320	7.15	-40	1.28	21.7	2808			
27-Jun-03		3230	7.63	183	7.68	10.3	2100			
21-Jul-04		1829	8.20	311	**	9.9	1189			
12-Mar-09		2990	7.56	-	-	-	1944		Low flow, sample taken from grassy pool / dam	
25-Jun-10		2209	8.15	-	-	-	1436		Low flow, parameters taken from dam	
28-Mar-12		2342	***	-	-	-	21	1522		
25-Jun-13		2029	8.09	106.3	11.09	12.5	1319			
15-May-14		2140	7.65	39	12.8	12.3	1391			No flow
										Clear-brown, strong flow with potential to break through wall. Water fed through pipes to trough down slope.
		26-Feb-16	3130	6.41	199	7.34	17.8	2035		Organic odour. Large pond; water levels managed to prevent bund from collapsing.
		18-Jan-17	2456	7.38	-18	2.26	20.2	1596		Organic odour. Large pond; water levels managed to prevent bund from collapsing.
		09-Oct-17	2405	7.02	52	2.72	15	1563		Organic odour. Large pond; water levels managed to prevent bund from collapsing. Pond surface. Troughs that are fed by the spring are full. Pond is deep, no flow
										Deep pond with large amount of duckweed. This Spring directly feeds into trough and a tank. The flow downhill into the tank was approx. 250ml / 3 sec until was reduced the flow to roughly 250ml / 6 sec
		03-Jul-18	2290	6.05	243	5.66	7.8	1489		
		08-Jan-19	2829	7.19	-107	6.11	17.5	1839		Black, organic odour, medium-high turbidity, overgrown
		18-Jul-19	2070	7.46	86.8	6.26	8.4	1346		No flow, brown, low turbidity, no odour
		16-Dec-19	2838	7.24	41.6	4.87	15.5	1845		Thick grass. Standing water within grass. No visible flow.
		06-Nov-20	2143	7.19	52	-	13.1	1393		Overgrown. Standing water.
										Fenced off, no cattle access evident. Vegetation healthy. Flow on slope above, no overflow observed.
		17-Jun-21	2259	7.48	-6.8	12.73	8.3	1468		
		20-Dec-21	2420	7.33	-3	0.36	14	1573		Thick vegetation. Standing water. No flow observed.
		17-Jun-22	1995	7.6	-55.1	8.93	10.3	1297	2.3	Thick vegetation. Flow measured at tank downhill - 27mL/s (2,333L/day)
		21-Dec-22	2265	7.23	-60.5	0.39	17.6	1472	2.5	Flow rate 5L/171 secs from second trough outflow, thick veg around spring
		15-Jan-24	1892	7.04	215.3	4.27	20.05	1230	15.1	Audible flow, healthy vegetation
										Spring is fenced. Lush healthy vegetation.
										Flow meter installed between spring and water tank on 4 December 2024. Flow meter reading -10 m3. Assuming an initial flow meter reading of 0 m3, this suggests an approximate daily flow rate of 0.9 m3
		12-Dec-24								
		15-Dec-25	1705	7.15	142.7	117.8	16.8	1108	3.0	Meter to be read weekly by Holcim.
										Spring is fenced. Lush healthy vegetation
		21-Nov-01	540	6.80	242	0.12	18.2	351		

Field Parameters Recorded at Spring Locations

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations	
		µS/cm		mV	mg/L	°C	mg/L			
SP03	17-Dec-01	696	7.32	177	5.01	17.9	452			
	22-Feb-02	592	7.38	187	2.38	22.6	385			
	12-Jun-02	696	7.55	192	2.42	12.7	452			
	30-Jan-03	758	8.57	153	6.28	20.7	493			
	27-Jun-03	727	6.85	203	7.82	12.3	473			
	21-Jul-04	713	7.86	295	**	11.9	463			
	12-Mar-09	899	7.16	-	-	-	584		Low flow, degraded/eroded by cattle, organic material	
	25-Jun-10	599	7.62	-	-	-	389		Parameters taken from dam below the discharge point	
	28-Mar-12	599	***	-	-	11.3	389			
	25-Jun-13	589	7.91	72.1	7.86	12.6	383			
	15-May-14	552	8.50	39.5	4.05	13.9	359		Low flow, cattle prints evident	
	26-Feb-16	1022	6.37	84	7.34	17.6	664		Large pool spilling down slope, duckweed, cow hoof imprints, water brown-clear	
	18-Jan-17	674	7.88	52	2.55	19.7	438		Large pool, no flow observed. Water pooled in cow hoof prints to half way down slope.	
	09-Oct-17	655	6.97	101	7.30	14.5	426		Vegetation and spring both appear very healthy as per last time. Large pool and boggy in area. Cattle trough full so no flow observed.	
	03-Jul-18	669	7.8	200	8.31	10.4	435		Large pool and boggy in area. Cattle trough full so no flow observed.	
	08-Jan-19	784	7.39	-430	5.10	18.2	510		Black/clear, no odour, low-medium turbidity	
	18-Jul-19	775	7.14	-40.1	1.33	9.8	504		Cow in Springs. No odour, grey, low turbidity	
	16-Dec-19	812	7.87	-17.1	2.36	14.5	528		Tall grass and floating vegetation. No flow.	
	06-Nov-20	697	7.79	-24.1	-	13.4	453		Standing water. Seeping down slope. Sign reads Spring 4	
	17-Jun-21	452	7.46	-25.3	6.20	9.5	294		Bin installed to manage overflow. Some flow into bin.	
	20-Dec-21	694	7.98	32.2	8.05	13.5	451		~100mL/s flowing out of bin	
	17-Jun-22	662	7.83	-79.4	5.93	12.8	430		Healthy vegetation. Sunken bin leading to only intermittent flow from spring. Unable to gauge during visit but trough filled from spring lower down slope full.	
	21-Dec-22	673	7.66	-3.1	4.58	17.6	437	3.0	Flow rate 5L in 142 Secs, healthy veg, flow into bin with some seepage	
	15-Jan-24	768	7.51	205.8	1.65	19.31	499	0.3	Water flowing around bin	
	12-Dec-24	557	-	50.6	0.91	16	362	2.5	Spring is fenced. Lush healthy vegetation. Water flows into wheelie bin. Small drainage line upslope of spring. Water also allowed to flow into small tank directly below spring. PVC pipe needs to be disconnected for some time to allow for surges in water to cease, i.e. prior to measuring flow rate.	
15-Dec-25	524	6.97	134.4	9.77	12.7		2.2	Spring is fenced. Overgrown with weeds and grasses. Water flows into wheelie bin. Small drainage line upslope of spring.		
SP04	17-Dec-01	1206	7.11	196	2.05	17.1	784			
	22-Feb-02	928	7.08	185	3.75	21.8	603			
	12-Jun-02	Could not find any signs of flow, ground wet in this area.								
	30-Jan-03	1359	7.58	145	6.08	18.1	883			
	27-Jun-03	1096	7.89	176	8.07	11.5	712			
	21-Jul-04	1031	8.84	296	**	11.6	670			
	12-Mar-09	1469	7.43	-	-	-	955		Northern discharge point, low to no flow	
12-Mar-09	1342	7.69	-	-	-	872		Southern discharge point, low flow		
SP04 (S)	25-Jun-10	1080	6.75	-	-	-	702		Low flow, parameters taken from groundwater discharge pooling in hoof impressions	
	28-Mar-12	1099	***	-	-	19.5	714			
	25-Jun-13	1414	7.39	15.5	0.00	14.9	919			
	15-May-14	875	7.43	-43	4.05	12.7	569		No measurable flow, stagnant	
	26-Feb-16	1078	6.80	97	1.24	17.8	701		Small puddle of water (<30cm <sup>2</sup> , and <5cm deep), wet, marshy grass, water clear	
	18-Jan-17	1004	7.92	65	4.33	20.3	653		Small puddle; clear, marshy, overgrown and boggy; around 30 cm <sup>2</sup> x 5 cm deep.	
	09-Oct-17	1498	6.89	232	3.33	14.5	974		Shallow pool (~5cm) and very boggy in area. Vegetation healthy.	
	03-Jul-18	Spring dry. Vegetation healthy.								Dry Spring, vegetation healthy
	08-Jan-19	Spring dry. Vegetation healthy.								Dry
	18-Jul-19	Spring dry. Vegetation healthy.								Dry Spring, vegetation healthy though overgrown
	16-Dec-19	Spring dry. Vegetation healthy.								Slightly damp seep observed.
	06-Nov-20	Spring dry. Vegetation healthy.								Thicker vegetation. Sign reads Spring 3
	17-Jun-21	Unable to be accessed.								
	20-Dec-21	Spring dry. Vegetation healthy.								
	17-Jun-22	Spring dry. Vegetation healthy.								
	21-Dec-22	1232	7	-102	4	18	801		Thick vegetation, clear water, algae, no flow from spring. Audible flow on bank above spring but not visible through vegetation.	
	15-Jan-24	1041	6.81	227.4	6.81	19.7	677		Audible flow upslope	
12-Dec-24	Spring dry								Heavy weed growth including blackberries and thistles at spring. Spring appears to have been historically fenced but evidence of livestock at spring now observed. Spring currently dry, but flows have been historically reported. Trace moisture at located immediately above spring.	
15-Dec-25	Spring dry								Heavy weed growth including blackberries and thistles at spring.	
SP05	21-Nov-01	434	6.93	107	5.04	16.6	282			
	17-Dec-01	2350	6.92	206	5.24	17.3	1528			
	22-Feb-02	487	6.76	207	1.77	22.0	317			
	12-Jun-02	Could not find any signs of flow, ground wet in this area.								
	30-Jan-03	No obvious water even with digging, but area green								
	27-Jun-03	612	7.85	212	6.01	10.2	398			
	21-Jul-04	280	7.34	280	**	9.9	182			
	12-Mar-09	Could not locate, no obvious flow								
	25-Jun-10	Could not locate, no obvious flow								No flow
	28-Mar-12	Could not find signs of flow								
	25-Jun-13	Could not be located								
	15-May-14	Spring dry								
	26-Feb-16	Spring dry								
	18-Jan-17	No parameters could be taken.								Muddy and minor water pooling in cow hoof prints.
	09-Oct-17	Spring dry								Very boggy in area, no large pool observed. Large boggy area with the only pooling in cattle hoof depressions. Unable to get a large enough pool to take reliable parameters.
	03-Jul-18	Spring dry. Vegetation healthy.								Dry Spring, vegetation healthy
	08-Jan-19	Spring dry. Vegetation healthy.								Dry
18-Jul-19	Spring dry. Vegetation healthy.								Dry Spring, vegetation healthy though overgrown	
16-Dec-19	Spring dry. Vegetation healthy.								Tall vegetation. No damp ground observed.	

Field Parameters Recorded at Spring Locations

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations
		µS/cm		mV	mg/L	°C	mg/L		
	06-Nov-20			Spring dry. Vegetation healthy.					Thicker vegetation. Sign reads Spring 1.
	17-Jun-21			Spring dry. Vegetation healthy.					Vegetation healthy. Sign reads Spring 1.
	20-Dec-21			Spring dry. Vegetation healthy.					Vegetation healthy. Sign reads Spring 1.
	17-Jun-22			Spring dry. Vegetation healthy.					Vegetation healthy. Sign reads Spring 1.
	21-Dec-22			Spring dry. Vegetation healthy.					Vegetation healthy. Confirmed with Holcim that all signs has been fixed
	15-Jan-24			Spring dry. Vegetation healthy.					Spring dry, wet ground, water present on upper bank
	12-Dec-24			Spring dry					Location dry, but areas of healthy vegetation observed. Holcim indicates this location was historically wet but has remained largely dry for at least four years
	15-Dec-25			Spring dry					Location dry, but areas of healthy vegetation observed. Incorrectly labelled as SP01
SP06	04-Oct-01	574	7.65	174	**	16.5	373		
	21-Nov-01	477	7.19	135	6.39	20.9	310		
	17-Dec-01	638	7.04	195	3.22	21.5	415		
	22-Feb-02	701	7.41	170	2.17	24.3	456		
	30-Jan-03	720	8.01	103	5.75	17.0	468		
	27-Jun-03	785	6.54	234	5.86	10.5	510		
	21-Jul-04	463	8.01	315	**	11.7	301		
	12-Mar-09			No flow					Dry, some subsurface flow assumed
	25-Jun-10	660	7.07	-	-	-	429		
	28-Mar-12			No flow					
	25-Jun-13	388	7.12	51.9	5.30	16.6	252		
	15-May-14	527	7.58	-40.5	13.00	13.6	343		No measurable flow, stagnant
	26-Feb-16	846	6.98	143.0	3.86	22.2	550		Pool of water, 10x5m, duckweed, water clear to moderate turbidity
	18-Jan-17	457	8.29	58	8.70	25.4	297		Pool of water, 10 x 5 m, with duckweed.
	09-Oct-17			Not able to be accessed					
	03-Jul-18	543	7.32	222	8.52	9.8	353		Stagnate water, very boggy and pool approx. 15-20m2 and 0.5 deepest point.
	08-Jan-19	592	8.1	38.7	10.62	22.3	385		Brown, no odour, low-medium turbidity
	18-Jul-19	417.9	7.68	36.1	9.01	9.4	272		Brown, no odour, low turbidity, boggy
	16-Dec-19	437.5	7.88	49.3	7.64	17.5	284		Standing water. Livestock pugging evident.
	06-Nov-20	386	7.67	18.3	-	15	251		Standing water. Livestock pugging evident.
	17-Jun-21	512	7.42	-34.4	4.88	9.5	333		Water light brown. Cows entering water.
	20-Dec-21	668	7.85	-25.3	1.51	16.3	434		Brown water, medium turbidity. No outflow.
	17-Jun-22	444	8.22	-16.6	11.53	12	288		Brown, medium turbidity. Cattle pugging evident. No outflow visible.
21-Dec-22	474.8	7.52	-67.8	3.7	21.3	309		Light brown, medium turbidity, healthy veg. Standing water with audible slope flow beneath spring, not visible through vegetation.	
15-Jan-24	397	6.55	185.7	3.35	23.5	258.05		Heavily vegetated, ground below spring saturated	
	493	7.69	41.3	96.40%	20.9	320.45		Spring not fenced. Accessible by livestock. Landowner has historically dammed the spring. Potential seepage through dam wall into local gully. Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water. Water level lower than that recorded in January 2024	
12-Dec-24								Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water.	
15-Dec-25	249.2	6.76	272.83	8210.00%	17.1	161.98			
SP07	04-Oct-01	758	7.74	166	**	15.4	493		
	21-Nov-01	406	7.05	110	7.03	21.1	264		
	12-Jun-02	627	7.04	218	3.45	13.2	408		
	12-Mar-09			No flow					Dry, some subsurface flow assumed
	25-Jun-10	493	6.14	-	-	-	320		Significant pooling in valley floor
	28-Mar-12	831	***	-	-	16.4	540		
	25-Jun-13	251	7.56	98.9	10.55	14.6	163		
	15-May-14			No flow					No flow, very shallow/small ponds, parameters not possible
	26-Feb-16			Dry					
	18-Jan-17			Dry					
	09-Oct-17			Not able to be accessed					
	03-Jul-18			Not able to be accessed					
	08-Jan-19			Not able to be accessed					
	18-Jul-19			Dry					Dry and no sign of water in valley going towards dam. Large amounts of blackberry plants and some dumped rubbish in valley.
	16-Dec-19			Dry / Not identified					No damp ground observed.
	06-Nov-20			Dry / Not identified					Damp patches. No spring positively identified.
	17-Jun-21			Unable to be accessed.					
	20-Dec-21			Dry / Not identified					
	17-Jun-22			Dry / Not identified					
	21-Dec-22			Reclassified as seep					
	12-Dec-24			No access					
	15-Dec-25			No access					
	SP08	21-Nov-01	1748	7.12	118	4.60	17.9	1136	
17-Dec-01		642	7.11	194	2.95	19.2	417		
22-Feb-02		611	7.81	131	7.83	25.2	397		
12-Jun-02		731	7.36	201	3.61	12.6	475		
30-Jan-03		880	7.60	122	4.76	18.4	572		
27-Jun-03		1103	6.73	232	6.98	9.6	717		
21-Jul-04		572	8.02	323	**	11.7	372		
12-Mar-09				No flow					Dry, no indication of recent flow
25-Jun-10				No flow					No flow
28-Mar-12		706	***	-	-	16.4	459		
25-Jun-13		457	7.57	100.3	10.42	14.6	297		
15-May-14		606	7.88	32	13	13	394		No measurable flow, stagnant. Cattle prints evident
26-Feb-16		1369	6.29	116	4.7	22.1	890		Hoof indentations, area marshy.
18-Jan-17		675	7.82	64	6.16	25.4			Water pooling in dozens of small locations, with minor flow in parts.
09-Oct-17				Not able to be accessed					
03-Jul-18		504	6.62	222	5.76	8.6	328		Large wetland with a lot of reeds, clear/orange tinge, water, no odour and suspended solids.
08-Jan-19		1103	7.79	86.2	6.98	21.7	717		Overgrown, brown/clear, no odour, low-medium turbidity
18-Jul-19		396.4	7.36	42.1	8.31	10.3	258		Reeds, no odour, low turbidity, clear
16-Dec-19		631	7.94	46.9	9.61	16.9	410		Standing water in pond. Low flow down slope. Oxidised iron apparent in stream.
06-Nov-20		655	7.51	-54.7	-	14	426	8.6	Flowing approx. 0.1-0.2L/s. Standing water.
17-Jun-21		692	7.64	-106.3	3.8	6.9	450		Water clear and flowing. Cattle entry to stream evident.

**Field Parameters Recorded at Spring Locations**

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations	
		µS/cm		mV	mg/L	°C	mg/L			
SP09	20-Dec-21	612.5	8.02	60.8	7.75	14.2	398	26.0	Extensive cattle pugging in former channel. Parameters measured over fence in riding club grounds where flowing water (200-300 mL/s) was present	
	17-Jun-22	612	8.14	16.4	9.45	12.3	398	9.0	Measured in riding club grounds. Water flowing diffusely, unable to gauge accurately. 100-200 mL/s estimated.	
	21-Dec-22	640	8.21	41.5	8.22	14.7	416	9.0	1L/10sec. consistent flow. Healthy vegetation. Recommendation to install means of measuring flow such as v-notch or elevated pipe.	
	15-Jan-24	431	6.92	177.5	8.22	14.7	280	13.0	Healthy vegetation, medium turbidity.	
	12-Dec-24	596	7.95	44.8	87.30%	20.3	387	7.9	Located on private property. Lush vegetation, including reeds surrounding large pool of water. Flow rate measured from small culvert where spring overflows. Holcim indicates that water level in spring remains reasonably consistent over time but flow rates in drainage line respond to rainfall events.	
	15-Dec-25	395.5	6.74	135.6	88.7	15.1	257	2.9 - 4.3	Measuring stake now covered by vegetation and needs to be relocated.	
	22-Feb-02	229	6.90	198	6.90	23.3	149			
	12-Jun-02	Could not find any signs of flow, ground wet in this area.								
	30-Jan-03	Could not find any signs of flow, area green.								
	27-Jun-03	759	6.40	142	8.23	10.6	493			
	21-Jul-04	909	7.04	254	4.52	8.9	591			
	12-Mar-09	No flow								
	25-Jun-10	550	6.66	-	-	-	358		Low to moderate flow with ponding below at the break of slope, parameters from discharge zone	
	28-Mar-12	676	***	-	-	20	439			
	25-Jun-13	899	8.56	133.7	10.06	15.9	584			
15-May-14	1053	6.68	-40	1.7	15.4	684		Very low flow, doesn't now appear to be a spring		
26-Feb-16	1798	6.40	-22	0.26	22.2	1169		Measurement collected at large pond with reeds, clear. Unlikely that the pond is reflective of seepage only. Will be collecting rainfall and run off also.		
18-Jan-17	860	8.36	65	12.23	22.2	559		Large pond. Spring area cannot be observed.		
09-Oct-17	1185	7.33	85	4.44	16.4	770		Former spring 9 is now a small wetland. Wetland full with water. Highest water level observed in the area. Vegetation very healthy and wildlife.		
03-Jul-18	1169	5.16	199	6.47	10.8	760		Small wetland full of water. Vegetation very healthy due to large amount of water		
08-Jan-19	1163	7.63	86.7	6.58	21.5	756		Black/clear, no odour, low-medium turbidity		
18-Jul-19	780	7.53	-8.8	10.24	9.4	507		Large pond, cloudy/grey no-odour, low turbidity		
16-Dec-19	1231	7.59	-2	6.81	18.4	800		Wetland. Reeds and other vegetation healthy.		
06-Nov-20	556	6.96	-2	8.26	14.2	361		Vegetated wetland. Standing water. Sign reads Spring 10		
17-Jun-21	675	7.53	59.7	13.74	8.1	439		Wetland.		
20-Dec-21	957	7.8	55.9	6.32	18.2	622		Wetland.		
17-Jun-22	770	7.72	-119.3	2.33	11.2	501	26.0	Wetland. Reeds and other vegetation healthy. Outflow at pipe measured at 0.311 L/s. Signed has been replaced to read Spring 9		
21-Dec-22	776	8.03	-18	2.67	17.3	504	1.2	2.5L/3min. Thick veg, clear water		
15-Jan-24	457	7.06	205.3	1.28	20.46	297	21.6	Healthy vegetation, many frogs		
12-Dec-24	924	6.89	33.8	45.20%	18.5	601	-	Spring located on Holcim land. No access for livestock. Large spring, heavily vegetated. Trickle of water only in overflow/ discharge pipe. Insufficient to accurately measure flows. Holcim indicates area is always wet.		
15-Dec-25	642	6.57	12.5	101.4	16.4	417	1.3	Large spring, heavily vegetated. No stake for water level measurement		
SP10	19-Apr-02	2819	6.15	260	9.52	17.4	1832			
	12-Jun-02	2640	6.80	230	7.20	10.6	1716			
	30-Jan-03	2292	7.43	43	6.15	24.6	1490			
	27-Jun-03	1167	6.52	137	8.63	10.6	759			
	21-Jul-04	374	7.71	282	9.13	9.2	243			
	12-Mar-09	No flow								
	25-Jun-10	790	7.03	-	-	-	514		Spring dry, sample taken from dam fed by spring	
	28-Mar-12	1207	***	-	-	19.8	785		Low flow, parameters from discharge pooling in cattle hoof impression	
	25-Jun-13	578	7.37	29.8	6.99	11.3	376			
	15-May-14	Spring dry								
	26-Feb-16	1616	6.34	73	8.48	19.7	1050		Hoof indentations with water pooling in them- about 5cm deep, water clear.	
	18-Jan-17	Spring dry								
	09-Oct-17	Water as per SP09								Boggy area that feeds the wetland at the location of former Spring 9. Vegetation healthy and very wet and boggy. No parameters taken and water only pooled in small amounts and the same water feeds spring 9 wetland.
	03-Jul-18	No parameters could be taken.								Boggy area that feeds the wetland at the location of former Spring 9. Vegetation healthy and very wet and boggy. No parameters taken and water only pooled in small amounts and the same water feeds spring 9 wetland
	08-Jan-19	Spring dry								
	18-Jul-19	Spring dry								
	16-Dec-19	Spring dry								
	06-Nov-20	Spring dry								
	17-Jun-21	Spring dry								
	20-Dec-21	Spring dry								
	17-Jun-22	Spring dry								
	21-Dec-22	Spring dry								
	21-Dec-22	Spring dry								
	12-Dec-24	Spring dry								
	15-Dec-25	Spring dry								
SP11	15-Jan-24	Spring dry								Insufficient water to allow parameters to be taken
	12-Dec-24	Minor seepage only								Identified in 2023 by landholder as a wet patch and lush vegetation in an otherwise dry area. Insufficient water to sample
	12-Dec-24	Spring dry								Not fenced. Damp/ soft ground. Water pooling where disturbed by livestock. Extensive weeds in area in 2025. Trace moisture only
Max	4320	9	323	118	25	2808				
Min	229	5	-430	0	7	149				
* TDS estimated by electrical conductivity x 0.65 **Dissolved Oxygen not recorded as probe malfunctioning ***pH readings not reported due to probe error Data to January 2024 recorded by AECOM. Data thereafter recorded by GHD										



Spring no.	Date	EC (µS/cm)	pH	ORP (mV)	DO (%)	Temp (°C)	Turbidity (NTU)	Salinity as TDS	Flow meter reading (m³)	Flow rate (m³/day)	Observations
SP01	12-12-2024	758	6.98	48.2	66.7	16		591.5	262	4.7	Flow meter installed November 2024 at tank below spring.
	15-12-2025	724	6.72	142	142	15.9		470.6	3403	8.6	Water flows into bin. Due to location of bin, not all water captured in bin.
SP02	12-12-2024	1922	7.44	17.5	43.4	17.2		1649	10	1.3	Lush healthy vegetation
	15-12-2025	1705	7.15	142.7	117.8	16.8	143	1108.25	1113	3	Spring is fenced. Increase in vegetation/ weeds from 2024 inspection
SP03	12-12-2024	557	7.63	49.2	108	16.4		442	-	2.5	Spring is fenced. Lush healthy vegetation
	15-12-2025	524	6.97	134.4	9.77	12.7		340.6	210.5	2.2	Spring is fenced. Overgrown with weeds and grasses Water flows into wheelie bin. Small drainage line upslope of spring.
SP04	12-12-2024	Spring dry									Spring appears to have been historically fenced but evidence of livestock at spring now observed. Spring currently dry, but flows have been historically reported. Trace moisture located immediately above spring.
	15-12-2025	Spring dry									Heavy weed growth including blackberries and thistles at spring.
SP05	12-12-2024	Spring dry									Location dry but Holcim indicates this location was historically wet but has remained largely dry for at least four years
	15-12-2025	Spring dry									Location dry, but areas of healthy vegetation observed. Incorrectly labelled as SP01
SP06	12-12-2024	493	7.69	41.3	94.6	20.9		349			Spring not fenced. Accessible by livestock. Landowner has historically dammed the spring.
	15-12-2025	249.2	6.76	272.83	82.1	17.1		161.98			Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water.
SP07	12-12-2024	No access									

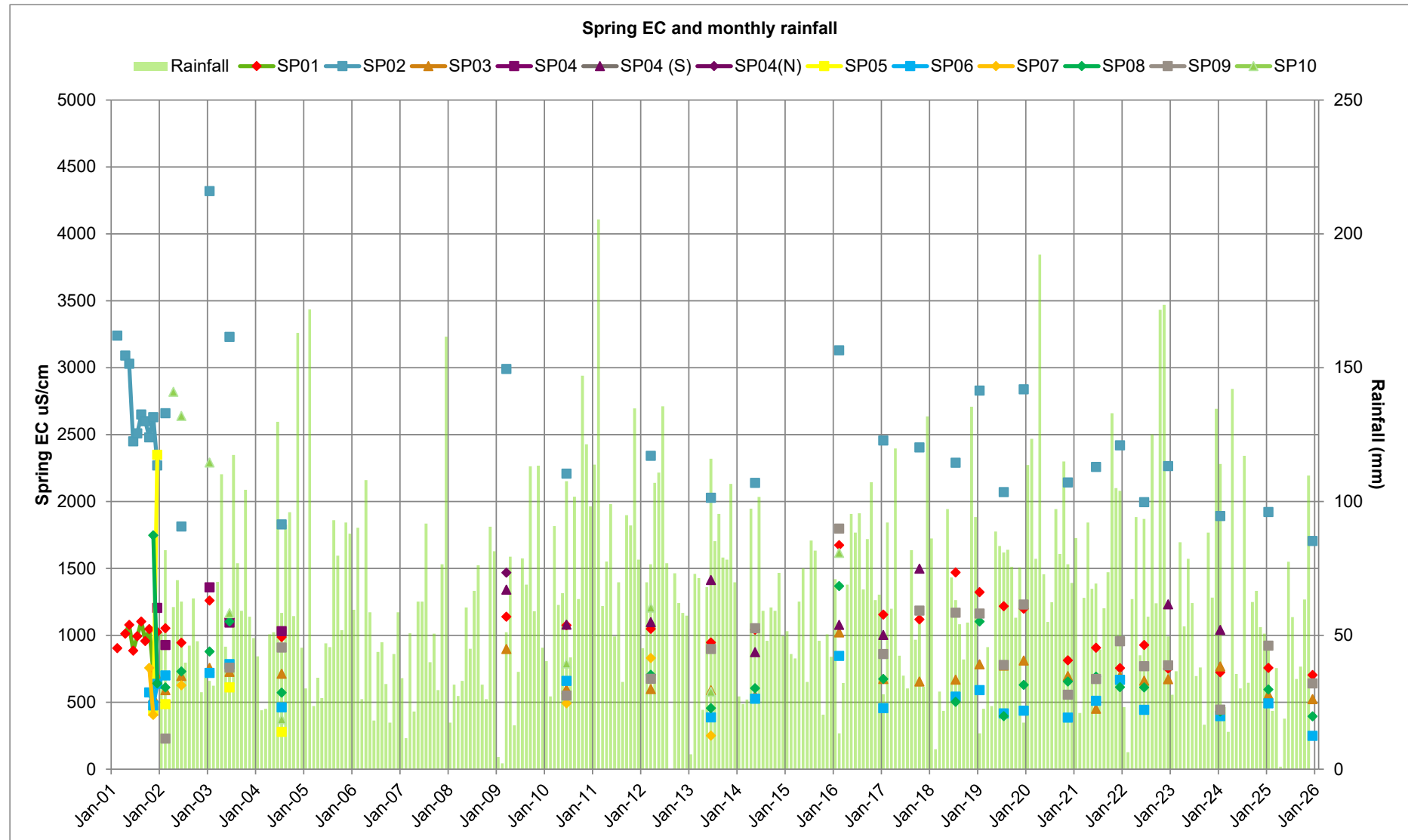
Spring no.	Date	EC (µS/cm)	pH	ORP (mV)	DO (%)	Temp (°C)	Turbidity (NTU)	Salinity as TDS	Flow meter reading (m³)	Flow rate (m³/day)	Observations
	15-12-2025	No access									
SP08	12-12-2024	596	7.94	44.8	87.3	20.3		429		7.9	Located on private property. Lush vegetation, including reeds surrounding large pool of water.
	15-12-2025	395.5	6.74	135.6	88.7	15.1	94.7			2.9 - 4.3	Measuring stake now covered by vegetation and needs to be relocated.
SP09	12-12-2024	924	6.89	33.8	45.2	18.5		682.5		Trickle only	Large spring, heavily vegetated. Trickle of water only in overflow/discharge pipe. Insufficient to accurately measure flows.
	15-12-2025	642	6.57	12.5	101.4	16.4	394				Large spring, heavily vegetated. No stake for water level measurement
SP10	12-12-2024	Minor seepage only									Minor seepage identified adjacent gate.
	15-12-2025	Spring dry									Only a trace of damp ground was identified adjacent gate.
SP11	12-12-2024	Minor seepage only									Damp/ soft ground. Water pooling where disturbed by livestock.
	15-12-2025	Spring dry									Extensive weeds in area in 2025. Trace moisture only
<p>Notes:</p> <p>EC – Electrical Conductivity</p> <p>ORP – Oxygen Reduction Potential</p> <p>DO – Dissolved Oxygen</p> <p>Temp - Temperature</p>											

# **Appendix I**

**Mt Shamrock spring rainfall and EC**

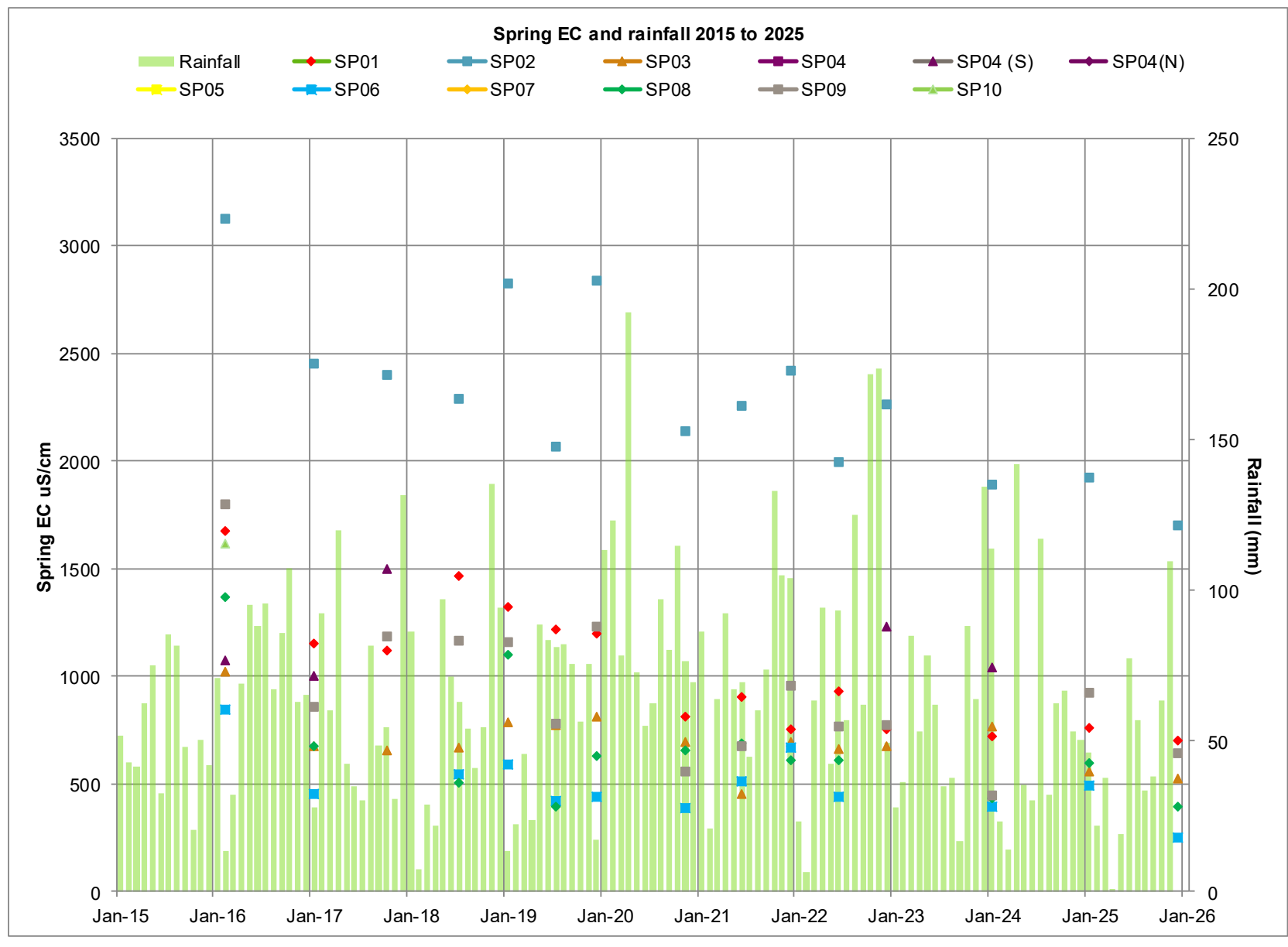
## Spring EC and rainfall records

Spring EC and rainfall, 2002 - 2025



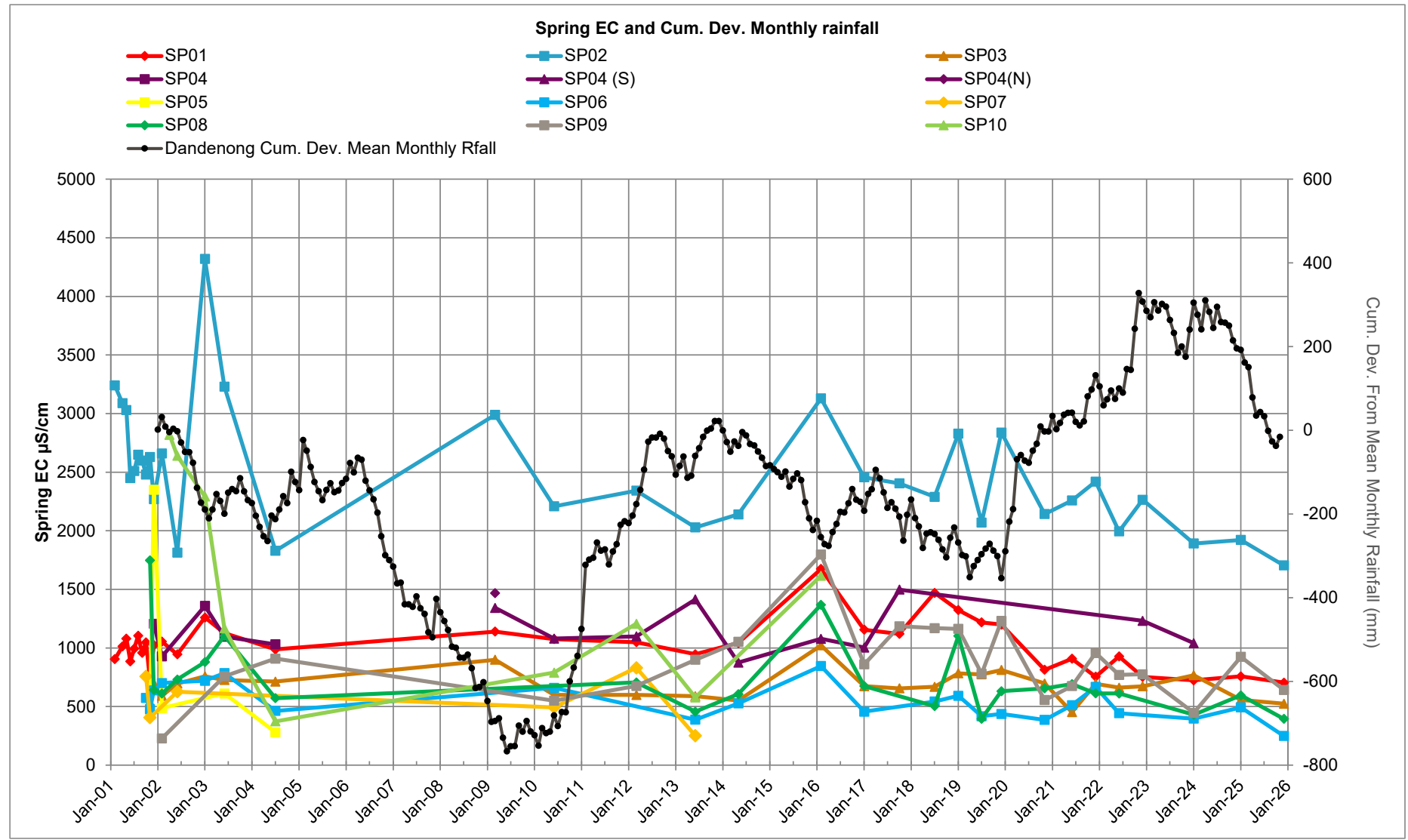
Spring EC and rainfall, 2015 - 2024

**Spring EC and rainfall records**



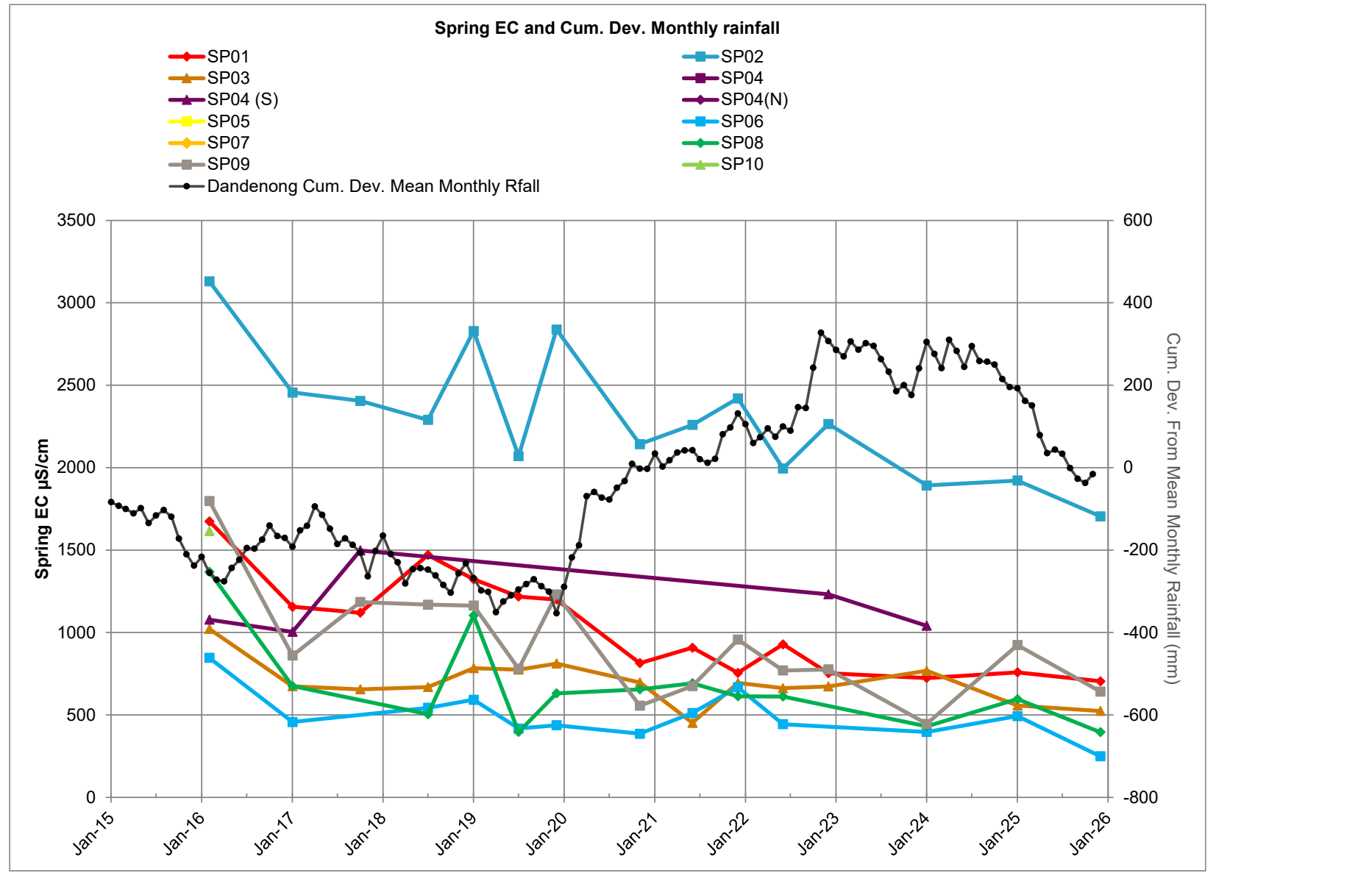
## Spring EC and rainfall records

Spring EC and Cum. Dev. Monthly rainfall, 2002 - 2025



## Spring EC and rainfall records

Spring EC and Cum. Dev. Monthly rainfall, 2015 - 2022



# **Appendix J**

**Spring and monitoring bore photographic  
record, December 2025**

December 2025 Spring photographic record

<p>15 December 2025 10:54</p>	<p>15 December 2025 10:49</p>
<p>SP01</p>	<p>SP01 with bin in centre of spring</p>
<p>15 December 2025 10:36</p>	<p>15 December 2025 10:45</p>
<p>SP01. Flow meter reading of 3,403 m<sup>3</sup></p>	<p>SP01 – measuring field water quality</p>
<p>15 December 2025 11:21</p>	<p>15 December 2025 11:25</p>
<p>SP02</p>	<p>SP02</p>



SP02 – measuring field water quality



SP02. Flow meter reading of 1,113 m³



SP03



SP03 – bin in spring.



SP03. Flow meter reading of 210.5 m³



SP03 – small drainage adjacent spring



SP04 – dry in December 2025



SP04 – measuring stake



SP05 – dry in December 2025



SP05 – dry in December 2025



SP06. Spring dammed by landholder



SP06. Spring dammed by landholder



SP08. Surrounded by reeds



SP08. Surrounded by reeds



SP08. Surrounded by reeds



SP08. Culvert and PVC pipe



SP09. Large spring in Holcim land



SP09. Large spring in Holcim land



SP09 with culvert



SP09 – measuring flow and field water quality



SP10. Reclassified as a seep. Trace moisture in base of drainage line.



SP10. Reclassified as a seep. Trace moisture in base of drainage line adjacent gate



SP11 under fallen tree. Weed growth extensive compared to 2024 inspection



SP11. Trace moisture

**December 2025 monitoring bore photographic record**



Bore MB01 located at top of steep slope. Slight movement in monument cover noted



Bores MB02 and MB04 on quarry floor



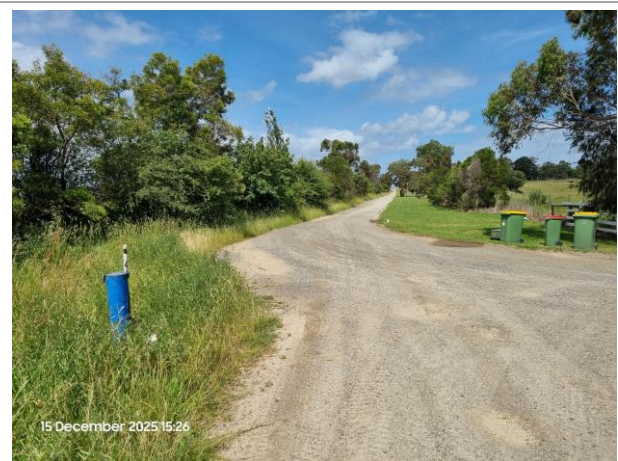
Bores MB03 and MB05. Grass surrounding bore has been slashed to aid access.



Bore MB06. Steel casing has been repainted. Grass surrounding bore has been slashed to aid access.



Bore MB07 with quarry fence (boundary) in background



Bore SON84032 (Burke Road).

# **Appendix K**

**Field equipment calibration certificates –  
December 2025 monitoring**

## EQUIPMENT QUALITY REPORT

### Water Level Meter:

**Equipment Code: MWL-8749      Serial number 378749**

The following equipment has been issued as follows:

- ✓ Equipment is clean and mechanically undamaged.

Calibration Results		
Parameter	Standard	Result
Water	Constant Beep	✓
Battery	9.0 V	9.4 V

Date: 11/12/2025

Calibrated by: Erin Joy

Please check that the following items are received and all items are returned. Please clean equipment before retuning. **A minimum \$20 service/repair charge applies to any unclean or damaged items.**

Items	HT Id No.	Sent	Returned
Solinst Water Level	<b>MWL-8749</b>	✓	
Instruction leaflet	N/A	✓	
Tape Guide	N/A	✓	
Spare 9V battery. Qty 1 - Voltage    v	N/A	✓	
Carry Case	N/A	✓	
Instrument Tested and passed	N/A	✓	

Date: 11/12/2025

Calibrated by: Erin Joy

HT JOB NO:    25237

CLIENTS REF: P/O No:    12670738

RETURN DATE:    /    /	TIME:	CONDITION ON RETURN:
------------------------	-------	----------------------

## EQUIPMENT QUALITY REPORT

### Water Quality Meter:

**Equipment Code: MWQ-5504      Serial Number: 21G105504**

The following equipment has been issued as follows:

- Equipment is clean
  Impeller and probe check

Calibration Results											
Parameter	Solution Brand and Batch no.			Standard			Error Range		Result		
Temperature (°C)	-			25°C			-		25°C		
pH				7.01	4.00		± 0.2		7.01	4.00	
Sp. Conductivity (µS/cm)				12880			± 20		12898		
DO (%)				0	100		± 3		0.3	101.6	
Redox (mV)				229			± 10		228.3		
Turbidity (NTU/FNU)				0	20	1000	± 2		0.64	20.51	1000.71
Chlorophyll							± 2				

Date: 11/12/2025

Calibrated by: Erin Joy

**Please check that the following items are received and all items are returned. Please clean equipment before retuning. A minimum \$20 service/repair charge applies to any unclean or damaged items.**

Item	HT Id No.	Sent	Returned
Water Quality Meter	MWQ-5504	✓	
Manual	N/A	✓	
Probe Cluster	N/A	✓	
In situ monitoring cage	N/A	✓	
Storage cup	N/A	✓	
Flow through Cell	N/A	✓	
Calibration cup and lid	N/A	✓	
Spare Batteries / Screwdriver	N/A	✓	
Test and Tag	N/A	✓	

- Equipment voltage
  Pre-Delivery Calibration Confirmation Test

Date: 11/12/2025

Calibrated by: Erin Joy

HT JOB NO: 25237      CLIENTS REF: P/O No: 12670738

RETURN DATE: / /	TIME:	CONDITION ON RETURN:
------------------	-------	----------------------

# **Appendix L**

**Tabulated dam water levels**

Date	Northern Dam	Southern Dam	Difference
October 2020	173.2	165.2	8.0
February 2021	173.9	165.4	8.5
April 2021	172.6	164.5	8.1
June 2021	173.0	165.2	7.8
Sept 2021	173.1	165.0	8.1
Dec 2021	173.2	165.2	8.0
Apr 2022	172.2	165.0	7.2
July 2022	172.8	165.0	7.8
September 2022	173.2	165.1	8.2
December 2022	172.8	166.4	6.4
April 2023	172.7	165.7	7.0
June 2023	172.9	165.8	7.1
September 2023	172.7	165.8	7.0
October 2023	172.9	165.1	7.8
November 2023	172.7	164.9	7.7
December 2023	172.7	165.5	7.2
Max	173.9	166.4	8.5
Min	172.2	164.5	6.4
Average	172.9	165.3	7.6
Source: AECOM (2024)			

Month of Survey	Northern dam water level (m AHD)	Southern dam water level (m AHD)	Contractor
January 2024	172.8	165.9	J. Everitt
February 2024		165.6	J. Everitt
April 2024	172.2	165.7	Stegg Civil
May 2024	172.6	165.7	J. Everitt
June 2024	172.6	165.7	J. Everitt
July 2024	173.1	165.8	J. Everitt
August 2024	172.9	165.7	J. Everitt
September 2024	172.7	165.8	J. Everitt
October 2024	172.6	165.7	J. Everitt
November 2024	172.6	165.7	J. Everitt
December 2024	172.6	165.6	J. Everitt
January 2025	171.5	165.5	J. Everitt
February 2025	172.4	165.6	J. Everitt
March 2025	172.5	165.6	J. Everitt
April 2025	171.8	165.5	J. Everitt

Month of Survey	Northern dam water level (m AHD)	Southern dam water level (m AHD)	Contractor
May 2025	NR	165.5	J. Everitt
June 2025	NR	NR	J. Everitt
July 2025	171.0	165.8	J. Everitt
August 2025	NR	165.7	J. Everitt
September 2025	170.8	165.7	J. Everitt
October 2025	170.7	165.8	J. Everitt
November 2025	171.2	165.8	J. Everitt
December 2025	171.2	165.8	J. Everitt
Notes: Source – Holcim NR – Not Recorded			



[ghd.com](http://ghd.com)

→ **The Power of Commitment**