

**Boundary Creek, Big  
Swamp and surrounding  
environment  
Remediation and  
Environmental Protection  
Plan**

**Annual Report 2019-2020**

# Executive summary

The Boundary Creek, Big Swamp and surrounding environment Remediation and Environmental Protection Plan (REPP) was submitted by Barwon Water and accepted by Southern Rural Water in late February 2020.

This Annual Report presents a summary of the work completed by Barwon Water for the Boundary Creek, Big Swamp and surrounding environment Remediation and Environmental Protection Plan (REPP) for the 2019-2020 year. It also includes the quarterly update for quarter 1 of the 2020/21 financial year which covers the period 1 July to 30 September 2020.

This Annual Report is the first for implementation of the REPP and includes information on:

- Implementation progress and upcoming actions
- Community engagement
- Progress against success targets

The Annual Report also provides a summary of the data captured this year which will inform implementation and detailed design. Key data summarised includes:

- Boundary Creek and Big Swamp groundwater levels, surface water flows and water quality.
- Groundwater levels and recovery trends in the Lower Tertiary Aquifer (LTA)
- Water quality and macroinvertebrate sampling for Boundary Creek and the Barwon River.
- Findings from the soil incubation study for Big Swamp

Key outcomes from the work completed and data gathered this year include:

- A continuing recovery trend of groundwater levels in the LTA.
- Autumn macro-invertebrate sampling in Boundary Creek and the Barwon River, which follows sampling undertaken in Spring last year, shows that impacts from Big Swamp were confined to Boundary Creek and the Barwon River immediately downstream of Boundary Creek.
- Findings from the soil Incubation study recommended that the swamp be maintained in a saturated state, consistent with the current remediation approach.

# Table of contents

Executive summary.....	2
Figures.....	4
Tables.....	5
1.0 Introduction.....	6
2.0 Implementation of the REPP.....	7
2.1 Remediation of Boundary Creek and Big Swamp .....	7
2.1.1 Implementation actions completed during 2019-2020 for the Boundary Creek and Big Swamp Remediation Plan.....	8
2.1.2 Quarterly update for the period 1 July to 30 September 2020 for the Boundary Creek and Big Swamp Remediation Plan.....	9
2.1.3 Upcoming implementation actions & milestones for the period 1 October 2020 to 30 September 2021 for the Boundary Creek and Big Swamp Remediation Plan (Annual Work Plan).....	10
2.2 Surrounding Environment Investigation.....	11
2.2.1 Implementation actions completed during 2019-2020 for the Surrounding Environment Investigation .....	12
2.2.2 Quarterly update for the period 1 July to 30 September 2020 for the Surrounding Environment Investigation .....	13
2.2.3 Upcoming implementation actions & milestones for the period 1 October 2020 to 30 September 2021 for the Surrounding Environment Investigation (Annual Work Plan).....	14
3.0 Issues register .....	15
4.0 Community engagement .....	15
5.0 Success targets.....	16
5.1 Recovery trend for LTA groundwater levels.....	18
5.2 Big Swamp Vegetation.....	20
5.3 Big Swamp groundwater levels targets .....	20
5.4 Surface water flow in Boundary Creek .....	22
5.5 Boundary Creek pH .....	25
6.0 Further Monitoring and Assessment.....	26
6.1 Big Swamp groundwater levels.....	26
6.2 Water quality .....	26
6.3 Soil incubation study.....	28
6.4 Barwon River macroinvertebrate survey .....	29
6.5 Flow in East Barwon River.....	30

6.6	Regional groundwater monitoring .....	31
6.6.1	Metering.....	31
6.6.2	Monitored area.....	31
6.6.3	Regional groundwater levels & hydrographs.....	32
6.6.4	Residual drawdown.....	32
6.6.5	Land subsidence.....	34
7.0	Contingency measures.....	34
8.0	REPP amendments.....	35
9.0	Progress report.....	35
10.0	Appendices .....	36
	Appendix A – Big Swamp Groundwater Hydrographs.....	36
	Appendix B – Surface Water flow in Boundary Creek.....	39
	Appendix C – Regional groundwater bore locations.....	41
	Appendix D – Regional groundwater bore levels .....	42
	Appendix E – Regional groundwater hydrographs .....	44
	Clifton .....	44
	Mepunga.....	45
	Dilwyn.....	46
	Pebble Point.....	48
	Appendix F – Contour Maps.....	49
	Appendix G – Progress Report.....	52

## Figures

Figure 1: Timeframes for implementation of the REPP.....	7
Figure 2: Process overview for the Surrounding Environment Investigation .....	11
Figure 3: Groundwater Level – Bore 64229 (G13) .....	18
Figure 4: Groundwater Level – Bore 64236 (G20) .....	18
Figure 5: Groundwater Level – Bore 82844 (M28) .....	19
Figure 6: Groundwater Level – Bore 109131 (YEO40) .....	19
Figure 7: Groundwater hydrograph and interim target at BH01 .....	21
Figure 8: Groundwater hydrograph and interim target at BH06 .....	21
Figure 9: Groundwater hydrograph and interim target at BH09 .....	21
Figure 10: Groundwater hydrograph and interim target at BH12.....	22
Figure 11: Groundwater hydrograph and interim target at BH15.....	22

Figure 12: Flows for Boundary Creek upstream of McDonalds Dam and supplementary flow releases for 2019/20.....	23
Figure 13: Flows for Boundary Creek downstream of McDonalds Dam and supplementary flow releases for 2019/20.....	23
Figure 14: Flows for Boundary Creek upstream of Big Swamp and supplementary flow releases for 2019/20.....	23
Figure 15: Flows for Boundary Creek downstream of Big Swamp and supplementary flow releases for 2019/20.....	24
Figure 16: Flows for Boundary Creek at Yeodene and supplementary flow releases for 2019/20.....	24

## Tables

Table 1: Completed actions for Implementation of the Boundary Creek and Big Swamp Remediation Plan during 2019/20 .....	8
Table 2: Quarterly update - Q1 2020/21 (1 July – 30 September 2020) – Boundary Creek and Big Swamp Remediation Plan .....	9
Table 3: Upcoming actions for the Boundary Creek and Big Swamp Remediation Plan for the period 1 October 2020 to 30 September 2021 .....	10
Table 4: Completed actions for Surrounding Environment Investigation during 2019/20.....	12
Table 5: Quarterly Update - Q1 2020/21 (July – September 2020) – Surrounding Environment Investigation .....	13
Table 6: Upcoming actions for the Surrounding Environment Investigation for the period 1 October 2020 to 30 September 2021 .....	14
Table 7: Issues register.....	15
Table 8: Remediation Success Targets as provided in the REPP .....	16
Table 9: Groundwater level targets (water level meters below ground level).....	20
Table 10: East Barwon flow measurements 2019-2020.....	30
Table 11: Observation Bore number and aquifer monitored .....	32
Table 12: Land Subsidence Monitoring – Variation from 2003 Readings .....	34
Table 13: Contingency measures to be implemented .....	34
Table 14: Amendments to the REPP .....	35

# 1.0 Introduction

In June 2017, Barwon Water acknowledged that historic management of groundwater pumping had an environmentally significant impact in the Boundary Creek catchment. Reductions in flows caused by groundwater extraction coupled with a drier climate and supplementary flows not reaching the intended area, all contributed to the drying out of Big Swamp. This resulted in the activation of acid sulfate soils and ongoing release of acidic water to the lower reach of Boundary Creek.

In May 2018, Barwon Water established a community and stakeholder working group to participate in the design of a remediation plan for Boundary Creek and Big Swamp. As part of this process, Barwon Water invited the working group to nominate their own technical experts to help support them in their discussions to shape the remediation plan.

In September 2018 Barwon Water's commitment to undertake remedial works was legally strengthened through the issuing of a Ministerial Notice under section 78 of the *Water Act, 1989*. This notice mandated the development and implementation of the Boundary Creek, Big Swamp and Surrounding Environment – Remediation and Environmental Protection Plan (REPP) by 01 March 2020.

The section 78 notice defined remediation to be the controls and actions that could be practicably carried out to achieve improved environmental outcomes. In order to align this with an accepted scientific definition for remediation, the REPP further expanded the definition to be *"the controls and actions that could be practicably carried out to improve the ecological condition and function of areas confirmed to have been impacted by historical management of groundwater pumping at Barwon Downs, noting that this is likely to be different to the original condition due to the extent of change since European settlement."*

In February 2020, Southern Rural Water (SRW) accepted Barwon Water's REPP, which will be delivered under two parallel work packages:

- The **Boundary Creek and Big Swamp Remediation Plan** to address remediation of confirmed impact in the Boundary Creek catchment resulting from historical management of groundwater extraction.
- The **Surrounding Environment Investigation** to investigate whether other areas within the regional groundwater system have been impacted by historical management of groundwater extraction.

A key requirement of the section 78 notice and the REPP is the provision of quarterly updates to Southern Rural Water to report on progress with implementation of the plan, as well as an Annual Report. The section 78 notice also stipulates that the Annual Report is required to be submitted to SRW and made publicly available by 30 September each year. The annual reports capture progress with implementation of the REPP for the preceeding financial year, an annual work plan for the next 12 months, and a quarterly update for the first quarter of the new financial year.

The 2019-2020 Annual Report is the first Annual Report issued in accordance with the REPP since it was accepted in February, 2020. This first annual report therefore outlines progress with implementation of the REPP since 1 March, 2020, with progress presented in a similar format to that of the quarterly updates. It also provides additional detail on outcomes from any further technical investigations, monitoring, the data collected, and tracking against the REPP success targets. The Annual Report also provides an outline of upcoming tasks for implementation for the next 12 months, which constitutes the annual workplan that will form the basis for tracking progress of implementation of the REPP in future quarterly updates.

This Annual Report also includes the quarterly update for the 2020-2021 Q1 period (i.e. 1 July to 30 September, 2020), with Table 1 and Table 5 highlighting the actions completed during Q1 2020/21 for the Boundary Creek & Big Swamp Remediation Plan and the Surrounding Environment Investigation respectively.

## 2.0 Implementation of the REPP

### 2.1 Remediation of Boundary Creek and Big Swamp

The REPP included the overview and timelines for remediation depicted in Figure 1. Barwon Water has been working to collect a full seasonal data set to allow updating of the groundwater-surface water and geochemical models in order to better inform the detailed design for the remediation of Boundary Creek and Big Swamp. Barwon Water has also engaged suitably qualified expertise from GHD to review, refine and update the groundwater-surface water modelling to inform detailed design. Other technical work completed during the first few months of REPP implementation has included finalisation of the Soil Incubation study and undertaking Autumn sampling for the Barwon River Macroinvertebrate Study.

A list of the specific actions that have been undertaken since implementation commenced on 1 March, 2020 is provided in Table 1.

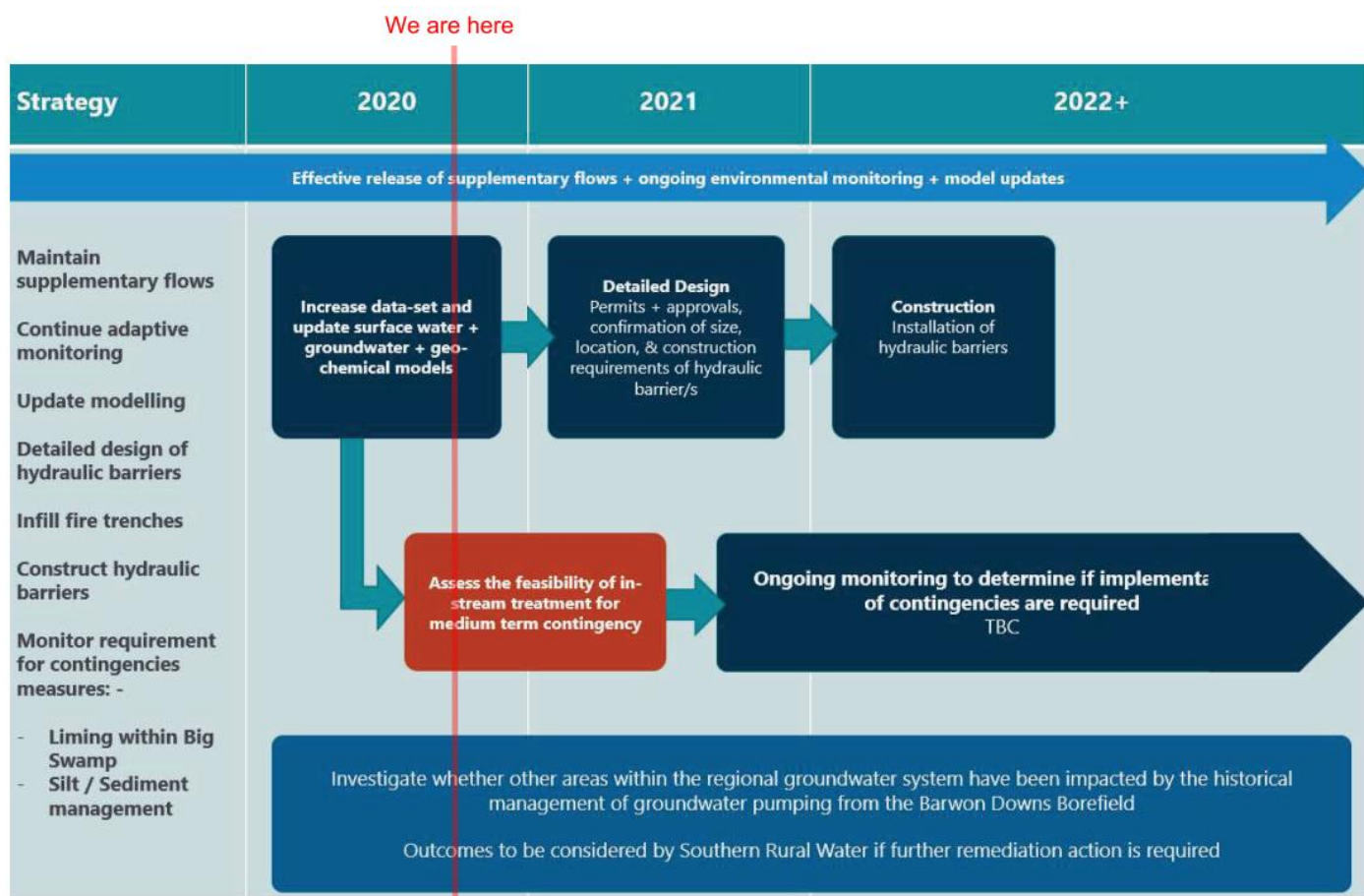


Figure 1: Timeframes for implementation of the REPP

## 2.1.1 Implementation actions completed during 2019-2020 for the Boundary Creek and Big Swamp Remediation Plan

Table 1: Completed actions for Implementation of the Boundary Creek and Big Swamp Remediation Plan during 2019/20

Completed actions - Remediation of Boundary Creek and Big Swamp	Comment / Link
Q1 2019/20 (1 July – 30 September 2019)	
N/A	
Q2 2019/20 (1 October – 31 December 2019)	
N/A	
Q3 2019/20 (1 January – 31 March 2020)	
Amended REPP accepted by SRW, 27 <sup>th</sup> February 2020	<a href="https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/137031">https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/137031</a>
Continuation of monitoring of groundwater levels and groundwater quality in Big Swamp, surface water flows and surface water quality in Boundary Creek and Big Swamp to enable data collection of a full seasonal cycle (i.e. minimum of 12 months of data) and surface water flows at Ten Mile Creek and Yahoo Creek.	
Q4 2019/20 (1 April – 30 June 2020)	
Continuation of monitoring of groundwater levels and groundwater quality in Big Swamp, surface water flows and surface water quality in Boundary Creek and Big Swamp to enable data collection of a full seasonal cycle (i.e. minimum of 12 months of data) and surface water flows at Ten Mile Creek and Yahoo Creek.	
Final register of REPP feedback provided by Southern Rural Water confirmed, 30 April 2020.	
Completion of the autumn macro-invertebrates survey of the Barwon River & Boundary Creek	<a href="https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173047">https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173047</a>
Appointment of a dedicated Project Manager	
Completion of soil incubation testing that was commenced during implementation of the scope of works	<a href="https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173046">https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173046</a>
Commenced preliminary assessment of the data collected through ongoing monitoring (anticipated for completion in December 2020)	
Commenced scoping of further technical work to be undertaken to inform detailed design (anticipated for completion in December 2020)	
Commenced development of the work plan detailing how Barwon Water will respond to the register of feedback,	



including prioritisation of actions, the timeframe for responding to each item and the process for reporting and closing out each item (due 31 July 2020)	
Commenced development of a communication and engagement plan (due 31 July 2020)	
Commenced development of the governance framework (due 31 July 2020)	
Two email updates provided to the Remediation Working Group in lieu of face to face meetings with feedback sought on future community engagement	
Quarterly update submitted to SRW, 30 June 2020 covering period 1 March 2020 to 30 June 2020	<a href="https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173049">https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/173049</a>

## 2.1.2 Quarterly update for the period 1 July to 30 September 2020 for the Boundary Creek and Big Swamp Remediation Plan

Table 2: Quarterly update - Q1 2020/21 (1 July – 30 September 2020) – Boundary Creek and Big Swamp Remediation Plan

Q1 2020/21 Update (1 July – 30 September 2020)	Comment / Link
Governance framework submitted to and accepted by Southern Rural Water, 31 July 2020	
Submission of the REPP feedback work plan to SRW which was accepted by SRW on 31 July 2020, detailing how Barwon Water will respond to the register of feedback including prioritisation of actions, the timeframe for responding to each item and the process for reporting and closing out each item	
Overview of Communication and Engagement Plan submitted to Southern Rural Water, 31 July 2020	
Submission of proposed REPP amendments addressing agreed actions in the REPP feedback work plan for SRW consideration	
Groundwater and Surface Water modelling contract awarded to GHD	
Preliminary assessment of data undertaken to help inform scoping of further technical work required and for inclusion in Annual Report	
Submission of annual report to SRW and report made publicly available, 30 September 2020	
Quarterly update for period 1 July to 30 September (Q1 2020/21) provided as a component of the Annual Report	

### 2.1.3 Upcoming implementation actions & milestones for the period 1 October 2020 to 30 September 2021 for the Boundary Creek and Big Swamp Remediation Plan (Annual Work Plan)

Table 3: Upcoming actions for the Boundary Creek and Big Swamp Remediation Plan for the period 1 October 2020 to 30 September 2021

Upcoming tasks – Remediation of Boundary Creek and Big Swamp	Due (if applicable)
<b>Q2 2020/21 (1 October – 31 December 2020)</b>	
Update groundwater-surface water model and geochemical model – Report from GHD SRW Independent Technical Review Panel (ITRP) feedback to be sought	31/12/2020
Confirm additional technical work packages required to inform detailed design and address REPP feedback register SRW ITRP feedback to be sought where required	31/12/2020
Confirm feasibility for installation of additional bore within Big Swamp to further assist with determining interaction between Lower Tertiary Aquifer (LTA) and swamp at the west end of the swamp	31/12/2020
Establish vegetation baseline monitoring for Boundary Creek and Big Swamp Remediation Plan	31/12/2020
Q2 Remediation Reference Group Meeting (first meeting) Draft agenda: terms of reference, annual report, REPP updates to SRW REPP feedback.	TBA
Submit quarterly update for the period 1 October to 31 December 2020 to SRW and publish to website	31/12/2020
<b>Q3 2020/21 (1 January – 31 March 2021)</b>	
Continue detailed design - specification to confirm size, location and construction requirements for hydraulic barriers SRW & ITRP feedback to be sought (as a part of detailed design consultation)	
Q3 Remediation Reference Group Meeting Draft agenda: Updated GW-SW model, bore and stream gauge installation	TBA
Submit quarterly update to SRW for the period 1 January to 30 March 2021 and publish to website	31/03/2021
<b>Q4 2020/21 (1 April – 30 June 2021)</b>	
Complete feasibility assessment for in-stream contingency measures SRW & ITRP feedback to be sought (as a part of detailed design consultation)	31/05/2021
Complete detailed design - specification to confirm size, location and construction requirements for hydraulic barriers SRW & ITRP feedback to be sought (as a part of detailed design consultation)	31/05/2021
Q4 Remediation Reference Group Meeting Draft agenda: Detailed design progress	TBA

Submit quarterly update to SRW for the period 1 April to 30 June, 2021 and publish to website	30/06/2021
<b>Q1 2021/22 (1 July – 30 September 2021)</b>	
Submission of detailed design of the hydraulic barriers outlining proposed controls or actions and any revisions to success measures/targets. SRW to accept the detailed design, including proposed actions, controls, and success measures/targets.  SRW & ITRP feedback to be sought (as a part of detailed design consultation)	31/07/2021
Q1 Remediation Reference Group Meeting  Draft agenda: Detailed design including any required contingencies	TBA
Commence approvals process for implementation of detailed design	
Submit 2020-2021 Annual report to SRW and publish to website  Annual report to incorporate the quarterly update to SRW for the period 1 July to 30 September 2021	30/09/2021

## 2.2 Surrounding Environment Investigation

Barwon Water has also begun work on the Surrounding Environment Investigation as summarised in Figure 2. Specific actions that have been completed are outlined below in Table 4. The focus to date has been the design and planning for installation of new site specific monitoring assets.

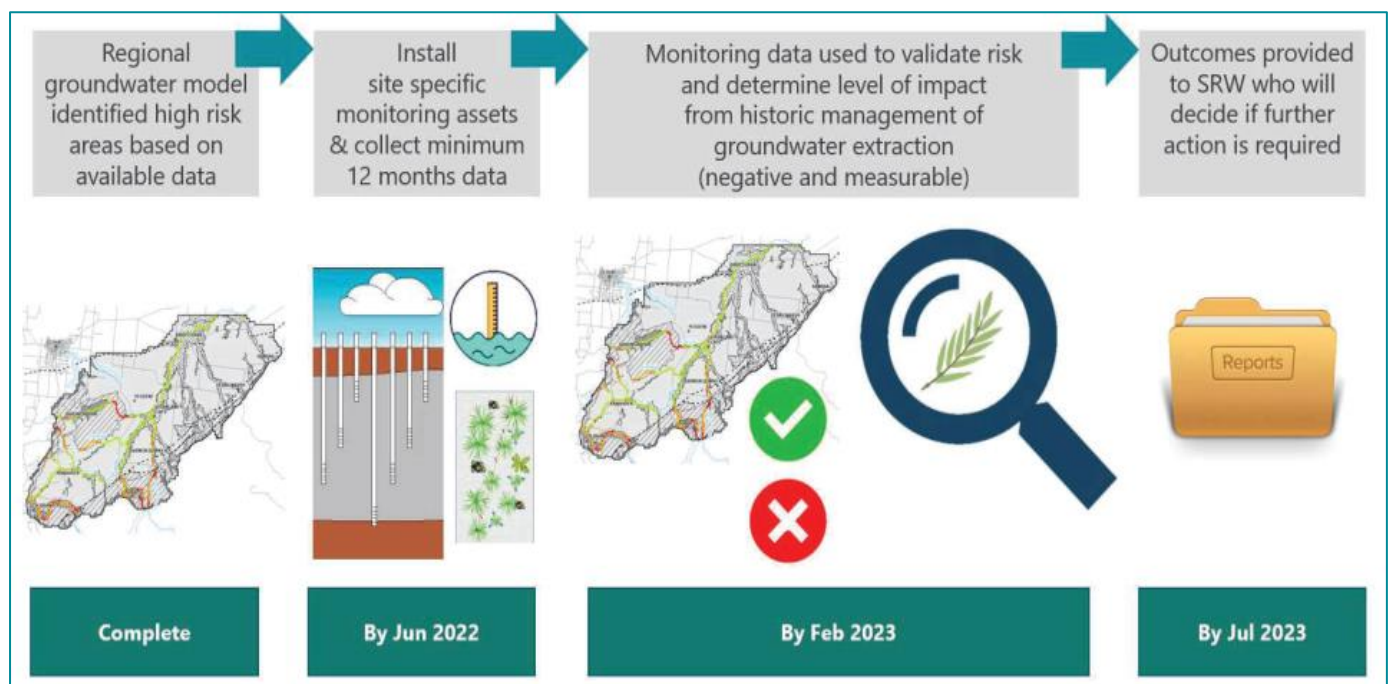


Figure 2: Process overview for the Surrounding Environment Investigation

## 2.2.1 Implementation actions completed during 2019-2020 for the Surrounding Environment Investigation

Table 4: Completed actions for Surrounding Environment Investigation during 2019/20

Completed actions - Surrounding Environment Investigation	Comment / Link
<b>Q1 2019/20 (1 July – 30 September 2019)</b>	
N/A	
<b>Q2 2019/20 (1 October – 31 December 2019)</b>	
N/A	
<b>Q3 2019/20 (1 January – 31 March 2020)</b>	
REPP accepted by SRW, 27 <sup>th</sup> February 2020*	<a href="https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/137031">https://www.yoursay.barwonwater.vic.gov.au/36559/widgets/204123/documents/137031</a>
Continued collection of streamflow data for Ten Mile Creek and Yahoo Creek (a tributary of Loves Creek)	Surface water flow data can be found on the Victorian Water Measurement Information System: <a href="https://data.water.vic.gov.au/">https://data.water.vic.gov.au/</a>
<b>Q4 2019/20 (1 April – 30 June 2020)</b>	
Continued collection of streamflow data for Ten Mile Creek and Yahoo Creek (a tributary of Loves Creek)	Surface water flow data can be found on the Victorian Water Measurement Information System: <a href="https://data.water.vic.gov.au/">https://data.water.vic.gov.au/</a>
Final register of REPP feedback provided by Southern Rural Water confirmed, 30 April 2020.*	
Appointment of a dedicated Project Manager*	
Commenced design and planning for installation of new stream gauges on: East Barwon River West Barwon River Barwon River downstream confluence with Boundaary Creek Gellibrand River Barongarook Creek	
Stream gauge site inspection undertaken with the CCMA and Arthur Rylah Institute to assess requirements for maintaining fish passage whilst meeting the objective of ensuring critical low flow data can be captured. This includes: Not creating a physical barrier to fish movement Not installing infrastructure that changes fish behaviour Not creating shading/darkness that would impact fish movement Maintaining/re-creating natural streambed profiles	

Not installing infrastructure that changes flow profiles and increases stream velocities	
Engaged Streamology to assess stream gauge locations and gauge designs from a geomorphology perspective to determine ability to achieve objectives for collection of accurate low flow data whilst meeting fish passage requirements identified during the initial site inspections	
Commenced planning for installation of additional observation bores to accompany new stream gauges and vegetation monitoring sites	
Commenced development of the work plan detailing how Barwon Water will respond to the register of feedback, including prioritisation of actions, the timeframe for responding to each item and the process for reporting and closing out each item (due 31 July 2020)*	
Commenced development of a communication and engagement plan (due 31 July 2020)*	
Commenced development of the governance framework (due 31 July 2020)*	
Two email updates provided to the Remediation Working Group in lieu of a face to face meeting and feedback sought on future community engagement*	

\* Denotes actions also captured in Table 1: Completed actions for Implementation of the Boundary Creek and Big Swamp Remediation Plan during 2019/20

## 2.2.2 Quarterly update for the period 1 July to 30 September 2020 for the Surrounding Environment Investigation

Table 5: Quarterly Update - Q1 2020/21 (July – September 2020) – Surrounding Environment Investigation

Q1 2020/21 Update (July – September 2020)	Comment / Link
Progressed design and planning for installation of additional stream gauges and observation bores in Summer 2020/21	
Governance framework submitted to and accepted by Southern Rural Water, 31 July 2020*	
Submission of the REPP feedback work plan to SRW which was accepted by SRW on 31 July 2020, detailing how Barwon Water will respond to the register of feedback including prioritisation of actions, the timeframe for responding to each item and the process for reporting and closing out each item*	
Overview of Communication and Engagement Plan submitted to Southern Rural Water, 31 July 2020*	
Submission of proposed REPP amendments addressing agreed actions in the REPP feedback work plan for SRW consideration*	

\* Denotes actions also captured in Table 2: Quarterly update - Q1 2020/21 (1 July – 30 September 2020) – Boundary Creek and Big Swamp Remediation Plan

## 2.2.3 Upcoming implementation actions & milestones for the period 1 October 2020 to 30 September 2021 for the Surrounding Environment Investigation (Annual Work Plan)

Table 6: Upcoming actions for the Surrounding Environment Investigation for the period 1 October 2020 to 30 September 2021

Upcoming tasks – Remediation of Boundary Creek and Big Swamp	Due (if applicable)
<b>Q2 2020/21 (1 October – 31 December 2020)</b>	
Establish vegetation baseline monitoring for Surrounding Area Investigations	31/12/2020
Installation of 2 of 5 stream gauges	1/12/2020
Update groundwater-surface water model and geochemical model* SRW and ITRP feedback to be sought	31/12/2020
Q2 Remediation Reference Group Meeting (first meeting)* Draft agenda: terms of reference, annual report, REPP updates to address SRW REPP feedback.	TBA
Submit quarterly update to SRW for the period 1 October to 31 December 2020 and publish to website*	31/12/2020
<b>Q3 2020/21 (1 January – 31 March 2021)</b>	
Installation of remaining 3 stream gauges	31/03/2021
Q3 Remediation Reference Group Meeting* Draft agenda: Updated GW-SW model, bore and stream gauge installations	TBA
Submit quarterly update to SRW for the period 1 January to 31 March 2021 and publish to website*	31/03/2021
<b>Q4 2020/21 (1 April – 30 June 2021)</b>	
Complete installation of additional monitoring assets identified as 'high risk' in the Surrounding Environment Investigation	31/05/2021
Q4 Remediation Reference Group Meeting* Draft agenda: Progress with Detailed design, monitoring site installations	TBA
Submit quarterly update to SRW for the period 1 April to 30 June 2021 and publish to website*	30/06/2021
<b>Q1 2021/22 Q2 (1 July – 30 September 2021)</b>	
Continue collection of data from new monitoring assets for the surrounding environment investigation	
Q1 Remediation Reference Group Meeting* Draft agenda: in-stream contingencies & detailed design	TBA
Submit 2020-2021 Annual report to SRW and publish to website Annual report to incorporate the quarterly update to SRW for the period 1 July to 30 September 2021	30/09/2021

\* Denotes actions also captured in Table 2: Quarterly update - Q1 2020/21 (1 July – 30 September 2020) – Boundary Creek and Big Swamp Remediation Plan

## 3.0 Issues register

Table 7 below outlines any issues that have been identified during implementation of the REPP that may impact future implementation activities.

Table 7: Issues register

Issue	Likelihood	Consequence	Comments
Coronavirus (COVID-19) pandemic limits/delays engagement with stakeholders and the community	Medium	Medium	Coronavirus (COVID-19) impacted face to face stakeholder and community engagement with a Remediation Working Group meeting proposed for March 2020, it was postponed due to restrictions. Email updates were provided in lieu of a face-to-facemeeting. The likelihood and consequence have been scored medium as the new quarterly Remediation Reference Group meetings are anticipated to commence early December 2020. These are planned to be delivered online or face to face depending on restrictions and group member needs.
Coronavirus (COVID-19) pandemic impacts availability of appropriate consultants or contractors to undertake required work for implementation of the REPP	Low	Low	To date Barwon Water has experienced little to no impact on availability of consultants and contractors to complete work during the coronavirus (COVID-19) pandemic.

## 4.0 Community engagement

Barwon Water is committed to continuing an open and transparent relationship with the community and key stakeholders during the implementation of the Boundary Creek, Big Swamp and Environmental Protection Plan.

The coronavirus (COVID-19) pandemic has presented challenges in meeting community groups in traditional settings. Barwon Water reviewed the way we work with the community to ensure engagement meets the requirements of the Victorian Government's changing coronavirus (COVID-19) guidelines.

Due to the coronavirus (COVID-19) restrictions Barwon Water was unable to proceed with a scheduled meeting with the Remediation Working Group (RWG) in March 2020. To ensure ongoing communication with the RWG, two email updates were issued on 30 March and 20 May 2020 along with another email to share the Quarterly update, which was issued on 30 June 2020 to keep the group informed of progress with implementation of the REPP. This annual report and incorporated quarterly update will also form the basis of a fourth working group update on progress.

The development of a communication and engagement strategy considered the ability to use technology to host online meetings with the RWG and supporting members to participate. This approach may mean for some members that the meetings are more accessible because travel times are reduced.

As part of the remediation working group email updates, Barwon Water also sought feedback from the group on preferred methods for engaging with and keeping the community informed of progress going forward.

We are continuing to share updates with the broader community via our dedicated Boundary Creek web page and local newspapers.



## 5.0 Success targets

Table 8 below summarises the interim success targets outlined in the REPP and performance to date. Further detail is provided for each success target in the sections below the table. In order for successful remediation to be demonstrated, all success targets need to be achieved concurrently, while some targets such as flows in Boundary Creek need to also be achieved for a minimum period of two consecutive years to confirm sustainability. Therefore, while some interim target values may have been observed, they have not been observed for sufficient time and as such the target status remains listed as in progress.

It is also important to note that, as outlined in the REPP, some of these success targets may need to be further refined as more data is collected, and once the detailed design has been completed, to ensure appropriate environmental outcomes are achieved through remediation.

Success targets for the Surrounding Environment will also be developed if adverse impacts resulting from historical groundwater extraction at Barwon Downs are confirmed and remediation determined to be required in accordance with the Section 78 Notice and the REPP.

Table 8: Remediation Success Targets as provided in the REPP

Success Target	Measurement	Timeframe	Status
Recovery trend for groundwater levels in the LTA  (subject to median climate and no additional groundwater extraction above the current PCV limit)	Monitoring of groundwater levels in observation bores 64229, 64236, 82844 and 109131 to develop hydrographs to confirm a recovery trend line in LTA groundwater levels	The term of the s78 notice	In Progress
No further encroachment of terrestrial woodland into the swamp plain	Independent monitoring of established transects to map changes in distribution and area, with current vegetation mapping to form the baseline for assessment of change along with condition scores.	Within 10 years of implementation of hydraulic barriers	In Progress
No encroachment of Lowland Forest dominant species into areas of Damp Forest	Independent monitoring of established transects to map changes in distribution and area, with current vegetation mapping to form the baseline for assessment of change along with condition scores.		In Progress
No loss of structural or floristic diversity along the main channel and western end of the swamp.	Independent regular monitoring of quadrats to assess changes in species diversity over time, with a baseline assessment undertaken to form the basis for measuring changes in structural or floristic diversity along with condition scores.		In Progress
Increase diversity of understorey species within the swamp plain, with a focus on ferns and sedges	Independent monitoring of established transects to map changes in distribution and area, with current vegetation mapping to		In Progress



Success Target	Measurement	Timeframe	Status
	form the baseline for assessment of change along with condition scores.		
Big Swamp BH01 water table level less than 1.0 m below ground level* maintained for a period of 2 years	Water table levels	Within 10 years of implementation of hydraulic barriers	In Progress
Big Swamp BH06 water table level less than 1.5 m below ground level* maintained for a period of 2 years	Water table levels	Within 10 years of implementation of hydraulic barriers	In Progress
Big Swamp BH09 water table level less than 1.8 m below ground level* maintained for a period of 2 years	Water table levels	Within 10 years of implementation of hydraulic barriers	In Progress
Big Swamp BH12 water table level less than 1.9 m below ground level* maintained for a period of 2 years	Water table levels	Within 10 years of implementation of hydraulic barriers	In Progress
Big Swamp BH15 water table level less than 1.0 m below ground level* maintained for a period of 2 years	Water table levels	Within 10 years of implementation of hydraulic barriers	In Progress
At least 0.5 ML/day flow maintained at site 233228 Boundary Creek @ Yeodene stream gauge maintained for a period of 2 years (Subject to passing flow conditions being enforced at 'McDonald's Dam' in accordance with its licence conditions - dam licence no. WLE043336)	Flow ML/day	Within 10 years of implementation of hydraulic barriers	In Progress
Annual median pH equal to or greater than 6.5* at site 233228 Boundary Creek @ Yeodene stream gauge maintained for a period of 2 years  To be refined pending completion of geochemical modelling (Dec 2020).	pH equal to or greater than 6.5* (annual median)	Within 10 years of implementation of hydraulic barriers	In Progress

\*Additional data is required to be collected to enable the modelling of the hydrological and geochemical processes through the swamp and for this to be used to refine the forecast of the achievable target for this measure. The interim target of median pH of 6.5 has been selected based on the SEPP Guidelines. The interim target for water table levels for each bore have been set based on a very short period of data and depending on the final locations of the hydraulic barriers, the location of the water table level targets may be revised to ensure protection of key areas and vegetation.

## 5.1 Recovery trend for LTA groundwater levels

Groundwater levels in the observation bores nominated in the REPP for the interim success targets has continued to show a recovery trend since groundwater extraction ceased from the Barwon Downs Borefield. In line with the REPP feedback received from SRW, it is proposed that this interim success target will be reviewed and refined as part of the further technical work required to inform the detailed design for remediation.

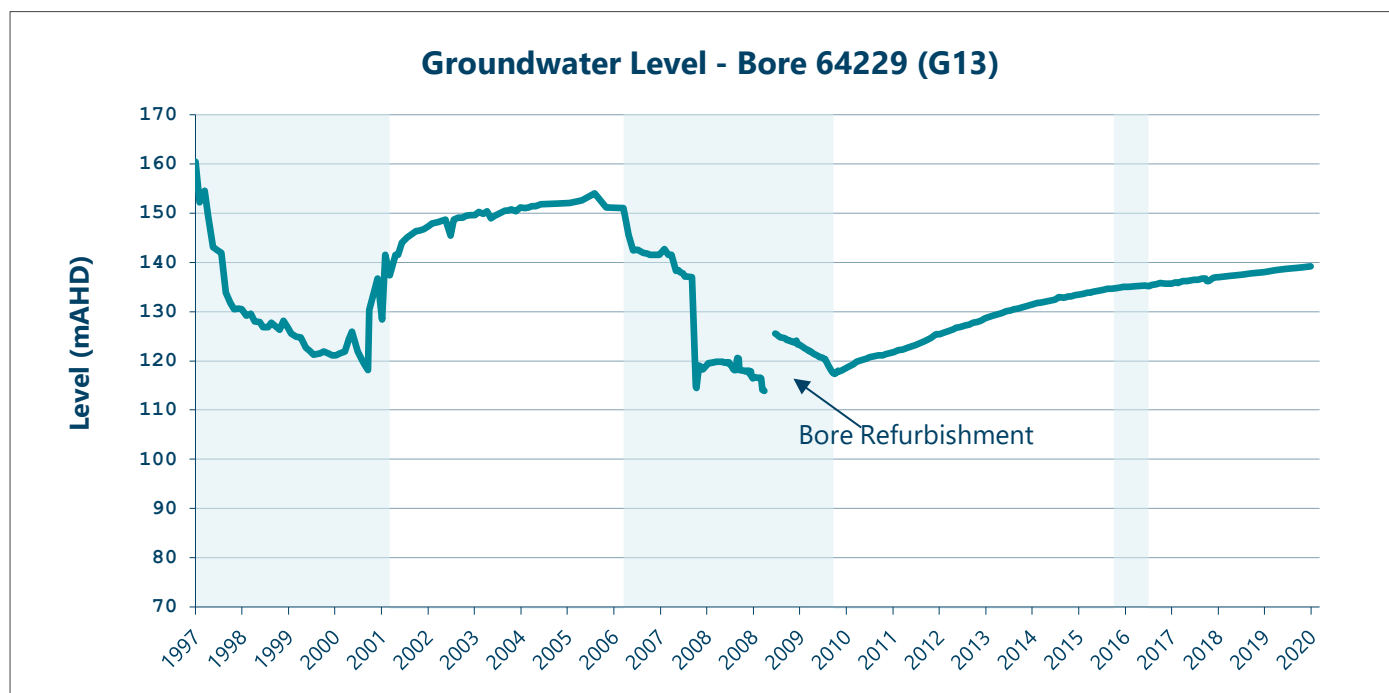


Figure 3: Groundwater Level – Bore 64229 (G13)

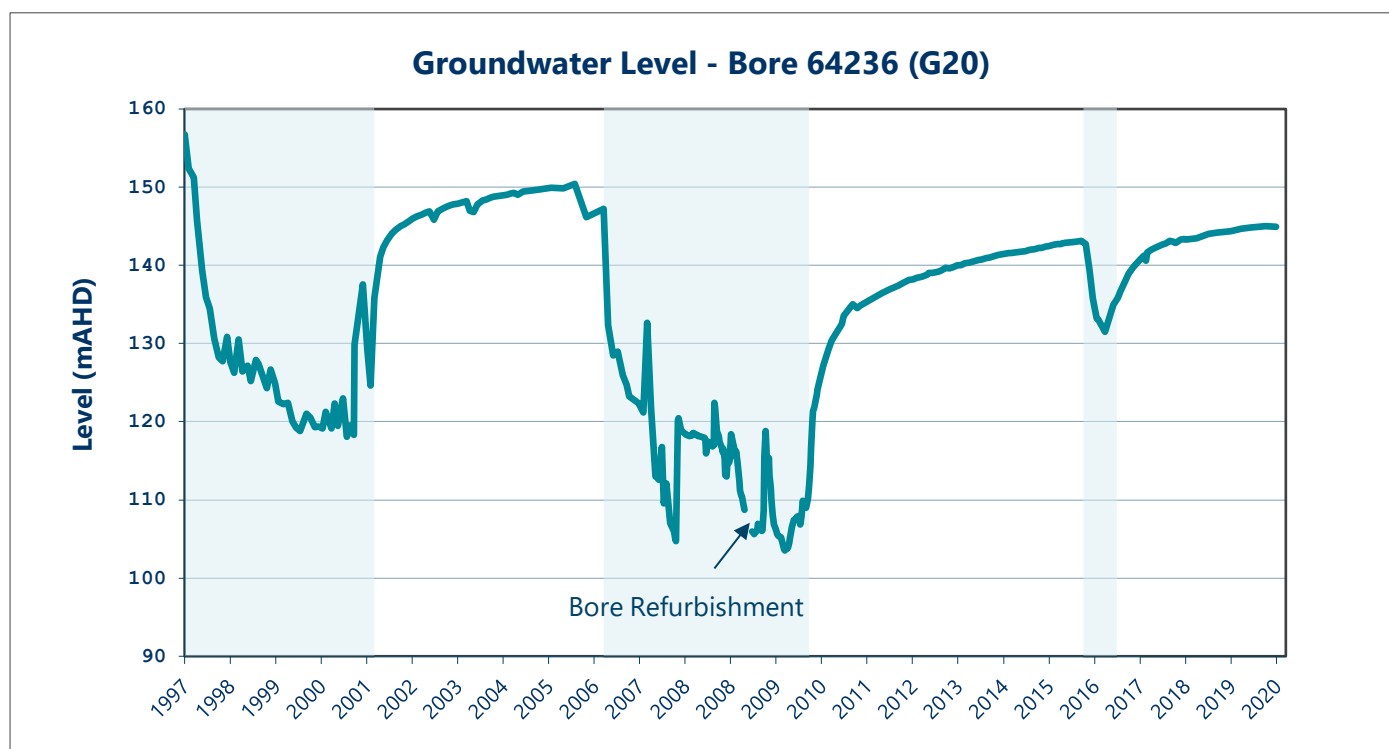


Figure 4: Groundwater Level – Bore 64236 (G20)

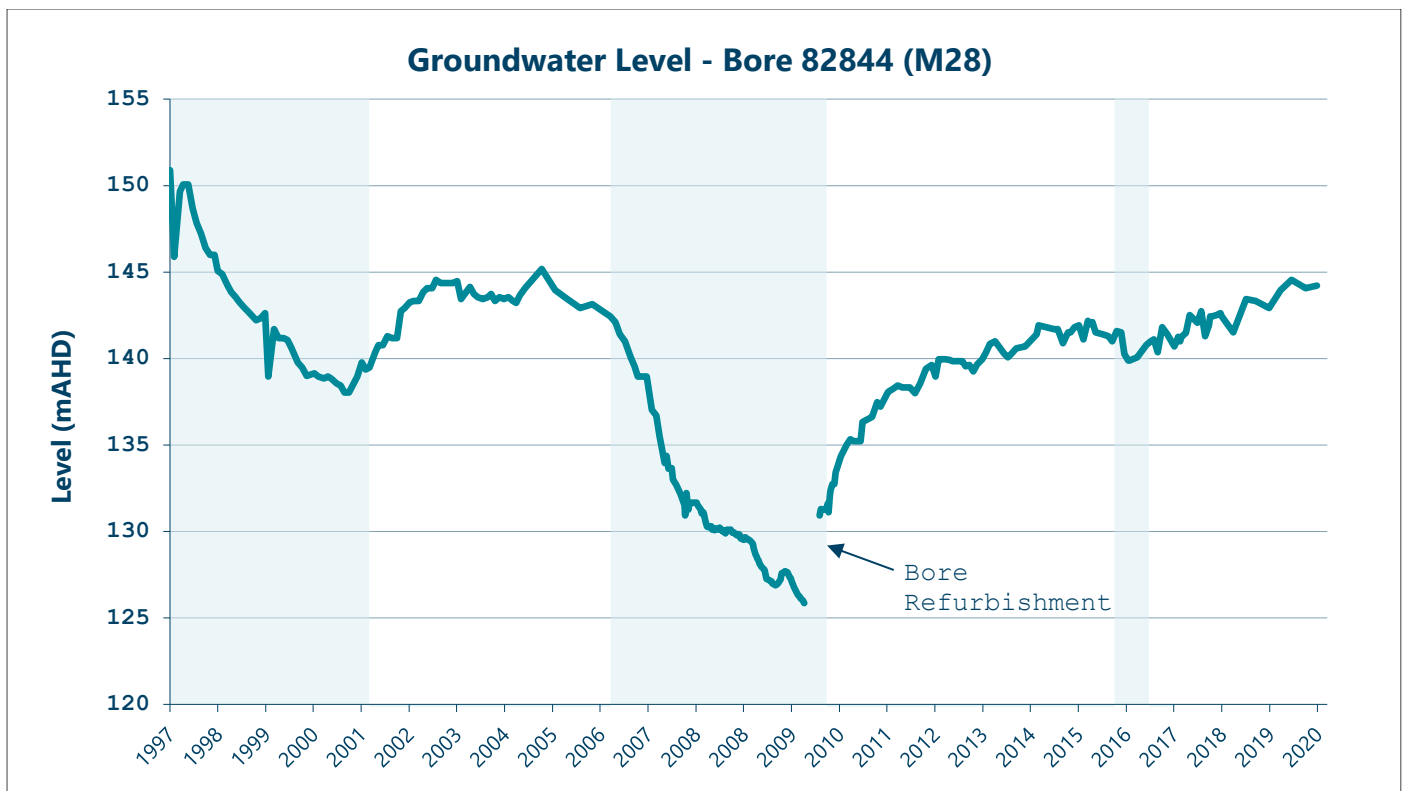


Figure 5: Groundwater Level – Bore 82844 (M28)

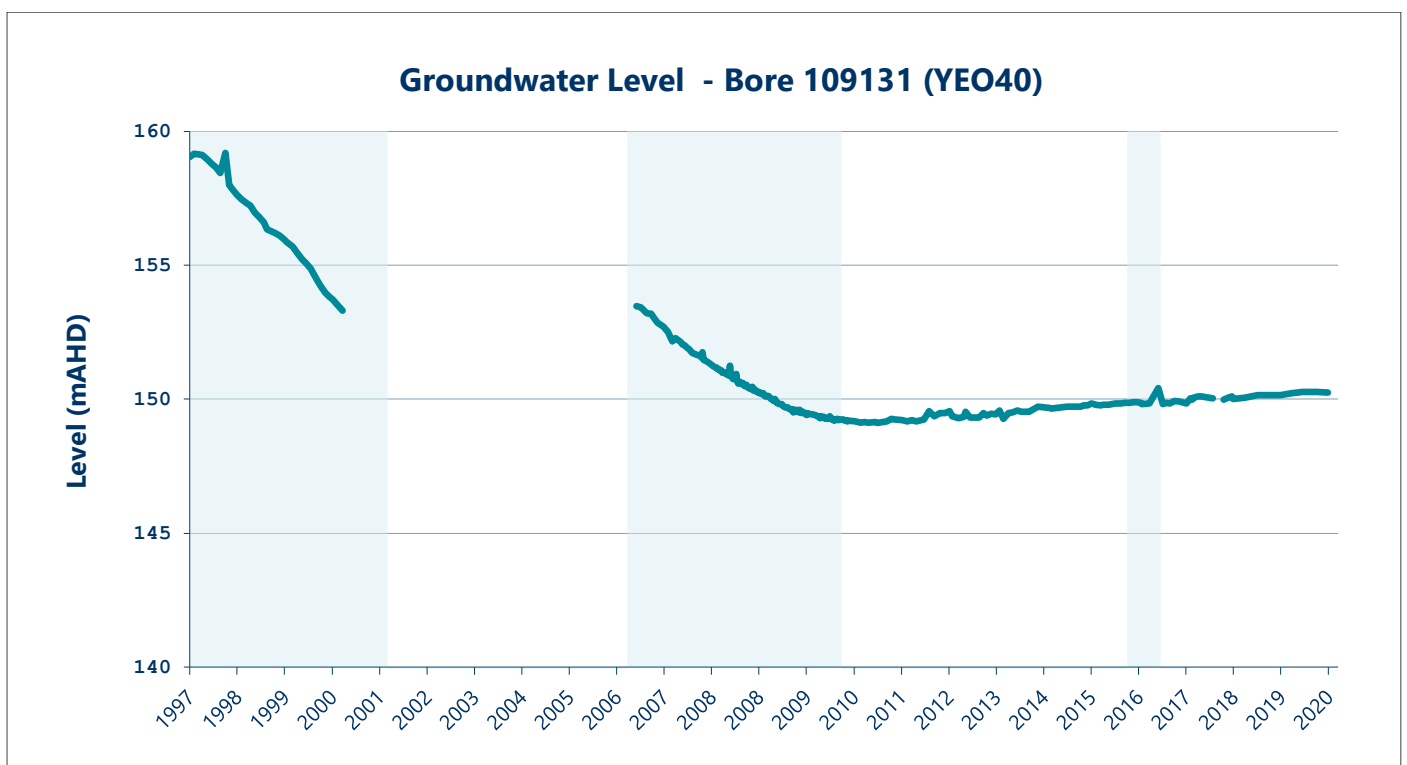


Figure 6: Groundwater Level – Bore 109131 (YEO40)

## 5.2 Big Swamp Vegetation

Ongoing vegetation monitoring is yet to be established as part of implementation of the REPP. This work is scheduled to take place in the September-December quarter. The monitoring program that is established will allow progress to be tracked against the following success targets as outlined in the REPP:

- No encroachment of terrestrial woodland into the swamp plain
- No encroachment of Lowland Forest dominant species into areas of Damp Forest.
- No loss of structural or floristic diversity along the main channel and western end of the swamp.
- Increased diversity of understorey species within swamp plain, with a focus on ferns and sedges.

Monitoring of vegetation for Big Swamp and Boundary Creek will also be designed to identify any unintended changes in vegetation and inform consideration of possible contingencies required to address these changes.

Vegetation monitoring proposed for the Surrounding Environment Investigation will also be established at the same time as the vegetation monitoring for Big Swamp.

## 5.3 Big Swamp groundwater levels targets

All hydrographs for the monitoring bores in Big Swamp have been provided in Appendix A – Big Swamp Groundwater Hydrographs. The hydrographs in Figure 7 to Figure 11 below represent those from BH01, BH06, BH09, BH12 and BH15 and are those for which interim Big Swamp groundwater level targets have been set, as shown in Table 9.

Table 9: Groundwater level targets (water level meters below ground level)

Bore	Target WL (m bgl)
BH01	1.00
BH06	1.50
BH09	1.80
BH12	1.20
BH15 <sup>1</sup>	1.00

<sup>1</sup>Target water level based on sulfide horizon > 10 %S

It is noted that while interim targets were set within the REPP, these were based on limited groundwater level monitoring data from within the swamp and were therefore set to limit the exacerbation of acidification within the swamp via sulfide oxidation. Further, these targets will be revised as part of the further groundwater-surface water modelling which will aim to confirm whether mitigation of sulfide oxidation via surface water flow augmentation is achievable, or if other contingency measures are necessary. Additional bores may also be required to determine whether diversion of surface water flows through the swamp are reaching the required areas. As such, success targets may also be required for these additional monitoring bores to ensure success targets are aligned to achieving the intended environmental outcomes.

Based on the monitoring data obtained to date, the groundwater level targets in Big Swamp were maintained at BH01 BH06 and BH09 over the summer period. Groundwater levels briefly fell below the target at BH15 for a cumulative total of 26 days spread over three periods between November 2019 and January 2020 and is considered to present moderate risk of further acid generation. The groundwater level target at BH12 was not maintained for a period of five months from December 2019 to May 2020 and represents an increased risk of ongoing acid generation via sulfide oxidation if groundwater levels cannot be maintained as part of the remediation strategy. This will need to be a focus for groundwater level maintenance during remediation and any further modelling.

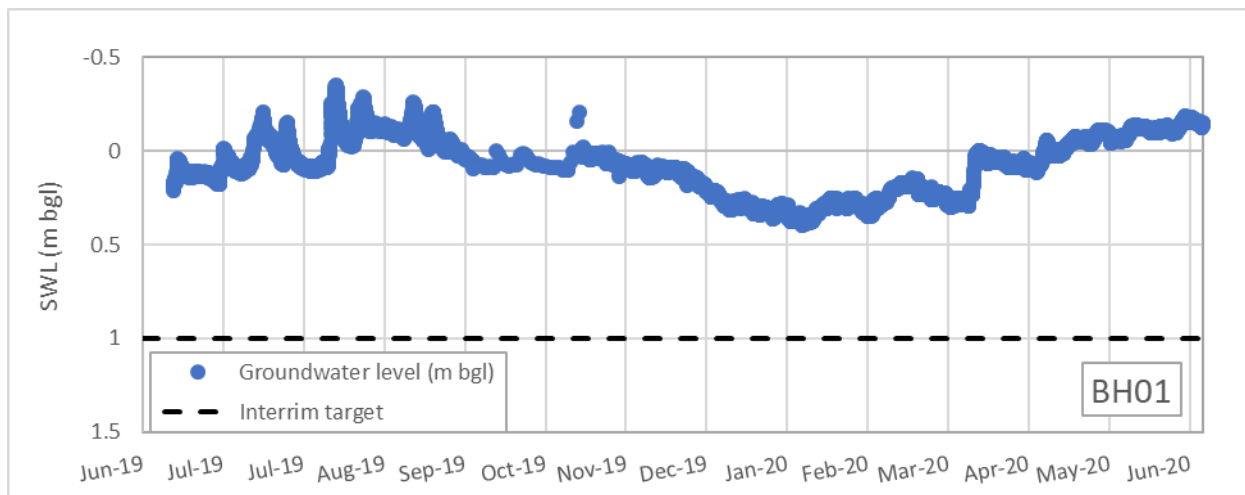


Figure 7: Groundwater hydrograph and interim target at BH01

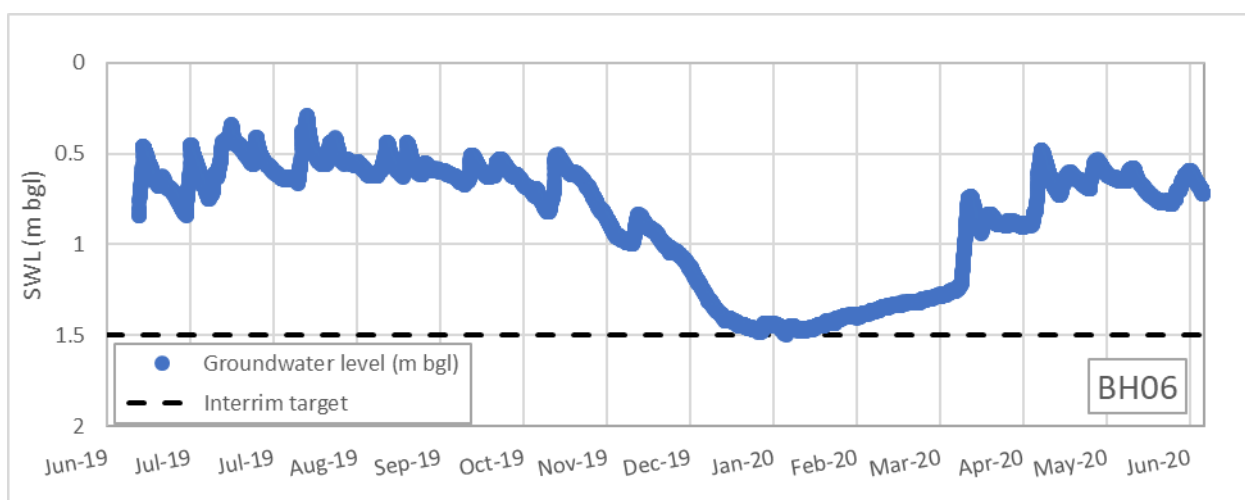


Figure 8: Groundwater hydrograph and interim target at BH06

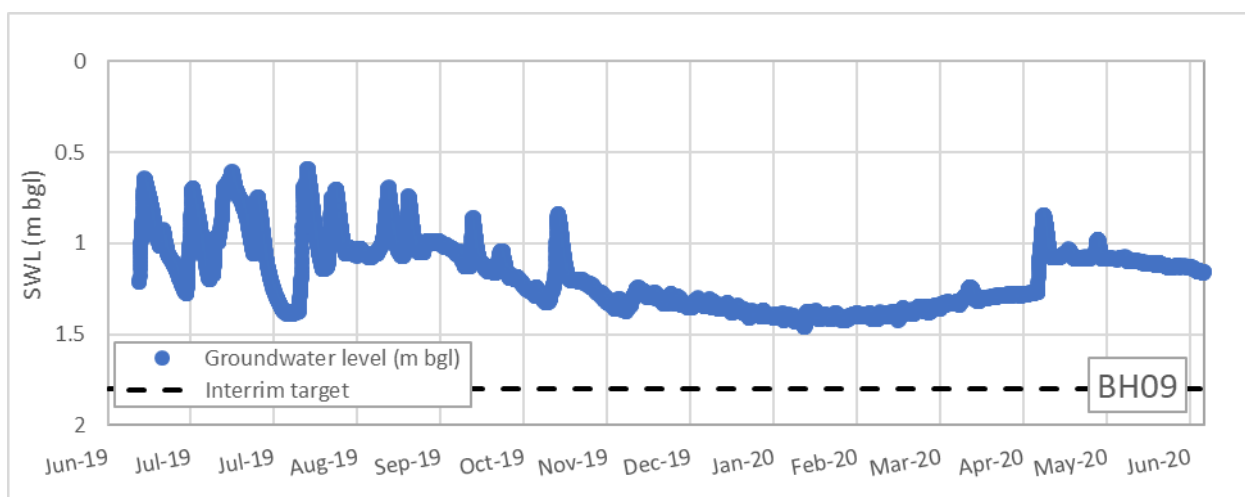


Figure 9: Groundwater hydrograph and interim target at BH09

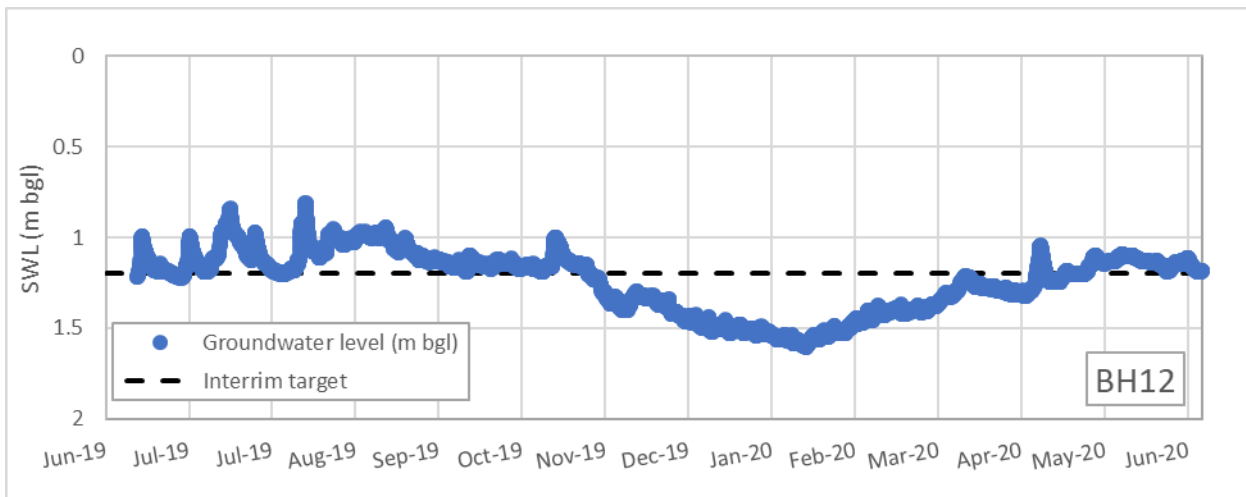


Figure 10: Groundwater hydrograph and interim target at BH12

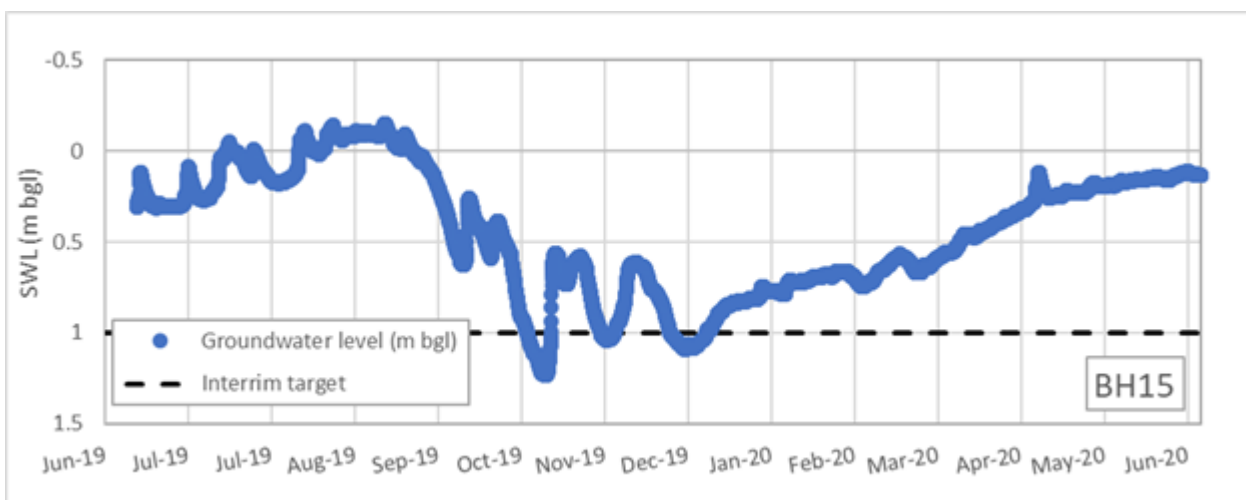


Figure 11: Groundwater hydrograph and interim target at BH15

## 5.4 Surface water flow in Boundary Creek

Approximately 460 ML of water was released into Boundary Creek as a supplementary flow during the 2019-2020 year to try to maintain flow in Boundary Creek, test assumptions around losses through the different reaches of Boundary Creek, and confirm outputs from modelling undertaken during the development of the REPP. The charts in Figure 12 to Figure 16 show the supplementary flows released to Boundary Creek in 2019-20 and the flows recorded at each of the stream gauges located along Boundary Creek from upstream of McDonald's Dam down to the Yeodene gauge. The raw flow data for the Boundary Creek at Yeodene gauge and supplementary flow release data is included in Appendix B – Surface Water flow in Boundary Creek.

The flow data presented indicates that the supplementary flow release predominantly occurred during periods when flows were less than 1 ML/day at the Yeodene gauge and were typically passed in full at McDonalds Dam during the period, excluding a 23-day period between December 20 and January 10, and two 3- to 4-day periods in March. Barwon Water will continue to work with SRW to ensure any supplementary flows released to Boundary Creek pass through McDonald's Dam.

The data also confirms that, as expected and as predicted by the surface water model, the majority of losses in Boundary Creek occur between the stream gauge downstream of McDonald's Dam and the stream gauge Upstream of Big Swamp.

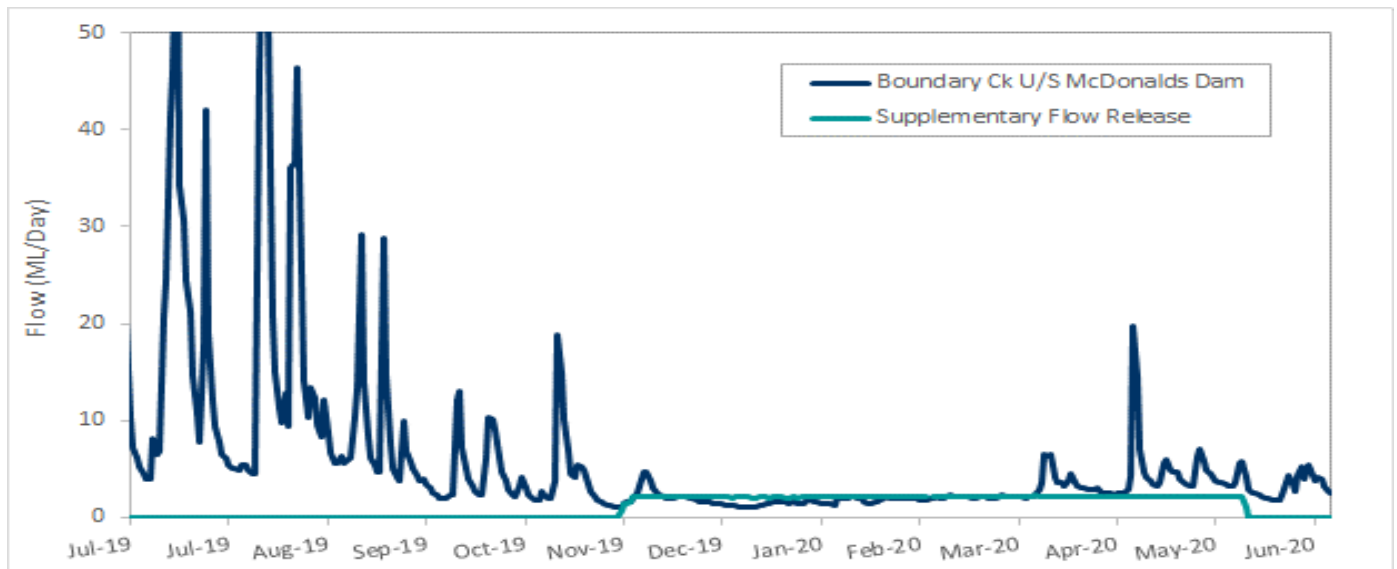


Figure 12: Flows for Boundary Creek upstream of McDonalds Dam and supplementary flow releases for 2019/20

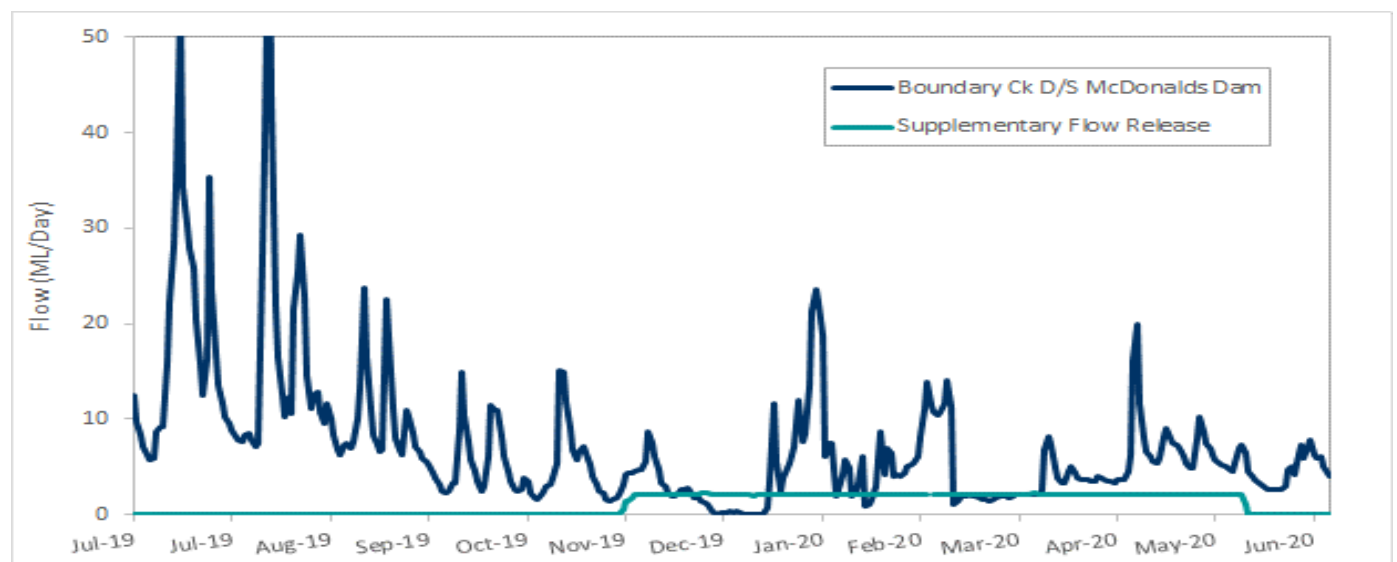


Figure 13: Flows for Boundary Creek downstream of McDonalds Dam and supplementary flow releases for 2019/20

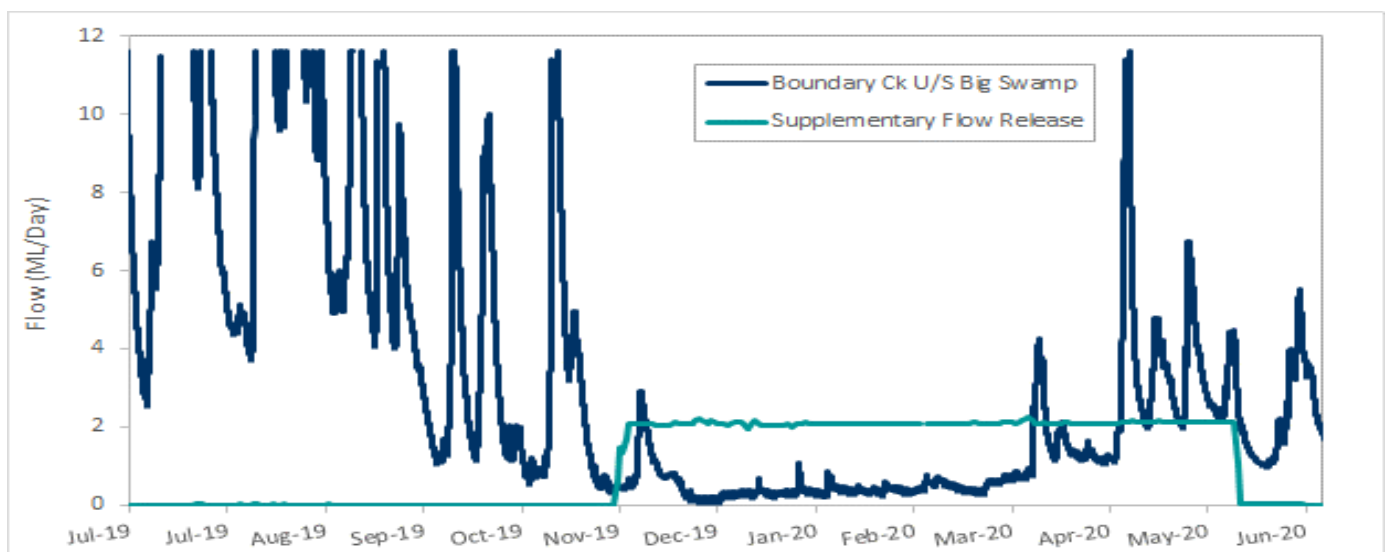


Figure 14: Flows for Boundary Creek upstream of Big Swamp and supplementary flow releases for 2019/20

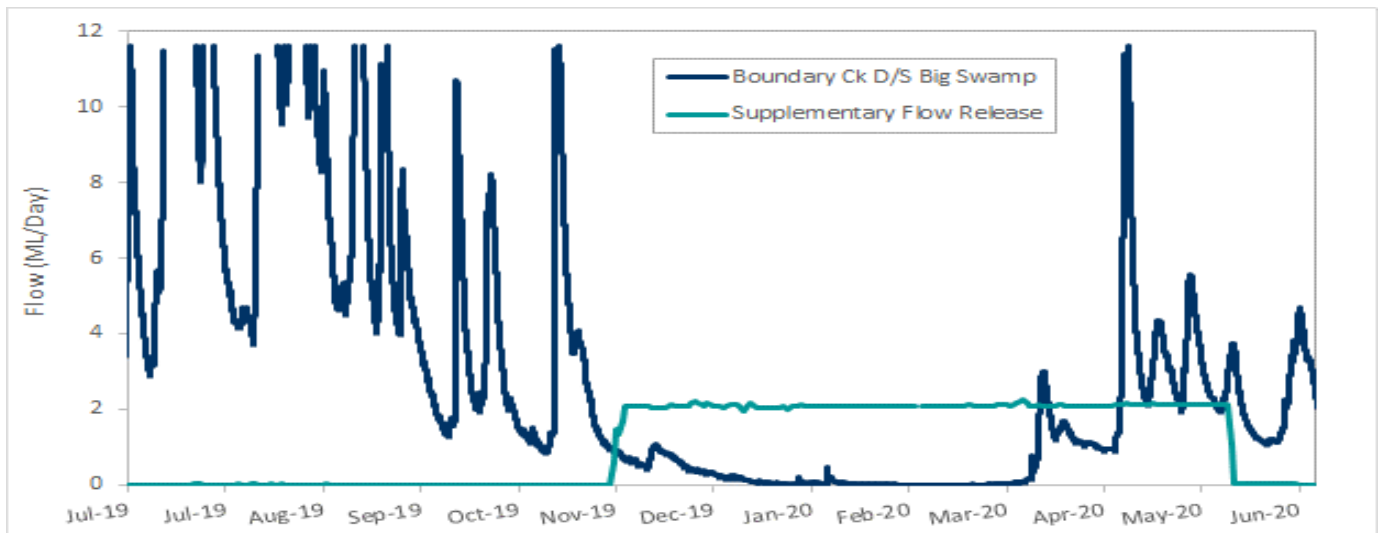


Figure 15: Flows for Boundary Creek downstream of Big Swamp and supplementary flow releases for 2019/20

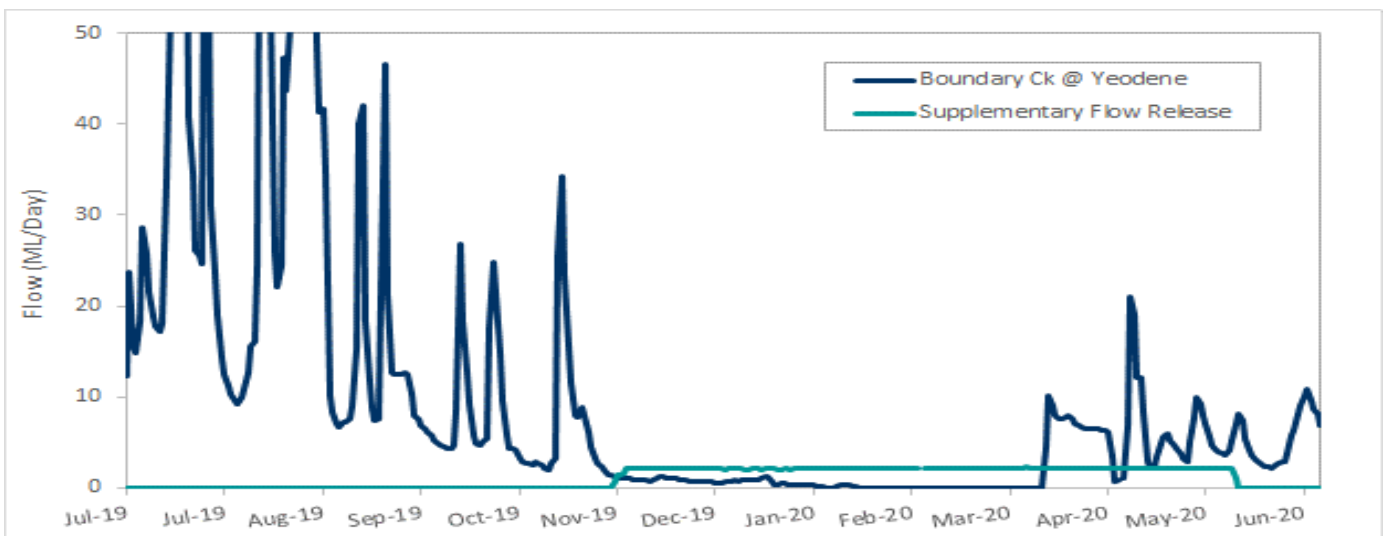


Figure 16: Flows for Boundary Creek at Yeodene and supplementary flow releases for 2019/20

Overall, flows in Boundary Creek were lowest between December 2019 and March 2020. Between December 2019 and March 2020, average flows upstream of the swamp were 0.37 ML/day. Over the same period, flows downstream of the swamp were 0.08 ML/day, indicating an average loss of ~0.3 ML/day over this period. Given the area of surface water inundation and driving head over this time is lower than at other times, it is likely that these losses are related to higher rates of evapotranspiration during the warmer summer months rather than seepage loss to groundwater. This is also evidenced by groundwater levels in the swamp continuing to decline over this period (see section 5.3 Big Swamp groundwater levels).

Inflows upstream of Big Swamp did not cease over the monitoring period, with a minimum flow of 0.08 ML/day recorded even during summer low flow conditions. The lowest flows into the swamp occurred in late December before increasing slightly to approximately 0.2 ML/day in early January. Outflows downstream of the swamp diminished to less than 0.5 ML/day in January and effectively stopped between the 9th of February and the 1st of April. Over this period, flows did not exceed 0.1 ML/day, and only exceeded 0.05 ML/day on a combined total of 9 days over the 52 day period. Flows less than 0.05 ML/Day are probably within the error of accuracy at the flow gauge and could effectively be considered as cease flow.



Flows in Boundary Creek at the Yeodene gauge were maintained during the 2019-2020 year excluding the period between February 11 and April 7. Given flows were absent at the Yeodene Gauge during March, and that the average passing flows at McDonalds Dam were 3.7 ML/day, with an average release volume of 2.1 ML/day over the same period, this indicates that under such conditions greater supplementary flow release would be necessary to maintain flows at Yeodene. This confirms, as outlined in the REPP, that supplementary flow releases will need to be adapted throughout the year according to the climatic conditions and magnitude of losses through the system in order to maintain flow in Boundary Creek at the Yeodene gauge.

## 5.5 Boundary Creek pH

The pH of water collected from Boundary Creek between October 2019 and August 2020 is illustrated in Figure 17 below. Water pH upstream of the swamp generally ranged from 6 to 8 over the monitoring period, while pH downstream was less than 4. Water pH at Yeodene was similar to that downstream of the swamp, ranging from 3.3 to 4.6. However, an increase in pH occurred between the swamp and Yeodene in June-August, most likely as a result of increased surface water inflows to the reach during these periods.

The concentrations of acidity in Boundary Creek downstream of Big Swamp is illustrated in Figure 18 below. The concentration of acidity downstream of the swamp increased from 100 to 300 mg/L CaCO<sub>3</sub> equivalent and increased with flow reduction over summer, before falling in May when higher flows returned. The load of acidity under low flow conditions ranged between 14 and 110 kg CaCO<sub>3</sub>/day and increased to 480 kg/day in May. While the concentration of acidity peaked in April, the total load of acidity discharging from the swamp peaked in May. This is consistent with the flushing of acidity accumulated during the summer drying period and based on the monitoring data available, represents the period of greatest risk to the lower reaches of Boundary Creek and the Barwon River. This data will be critical for informing the further geochemical analysis and detailed design work to be undertaken for remediation.

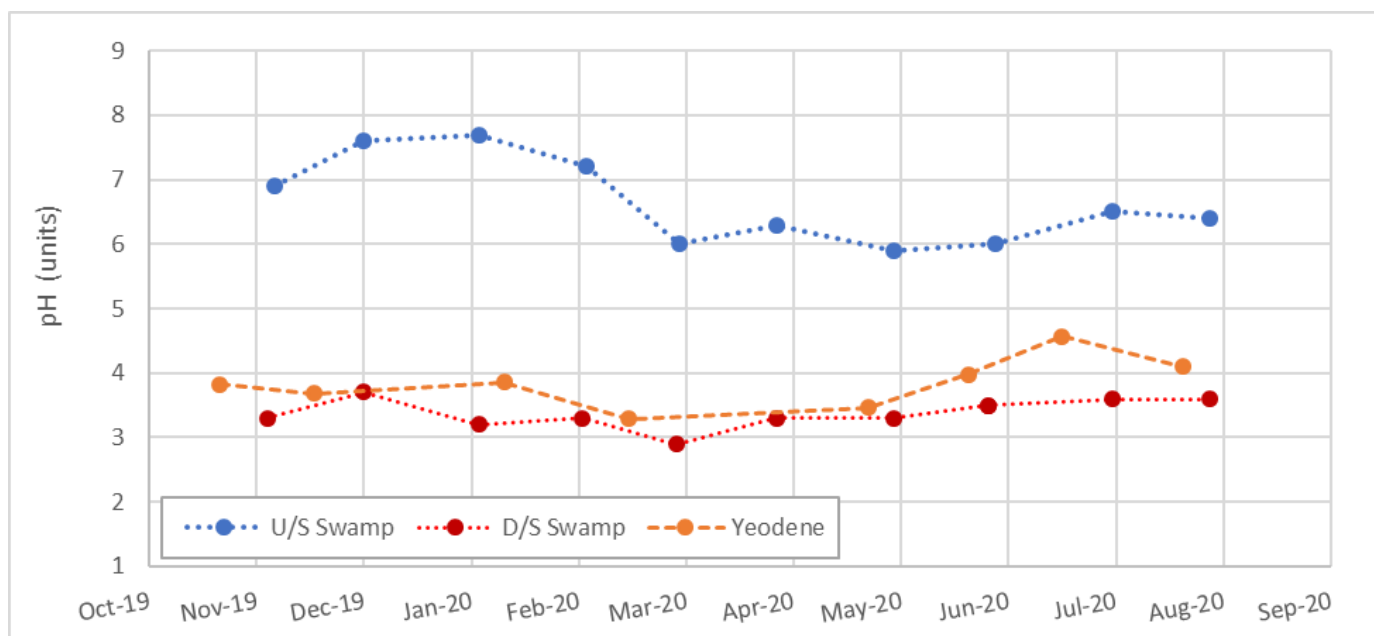


Figure 17: Monthly spot surface water pH in Boundary Creek upstream of Big Swamp, Downstream of Big Swamp and at Yeodene

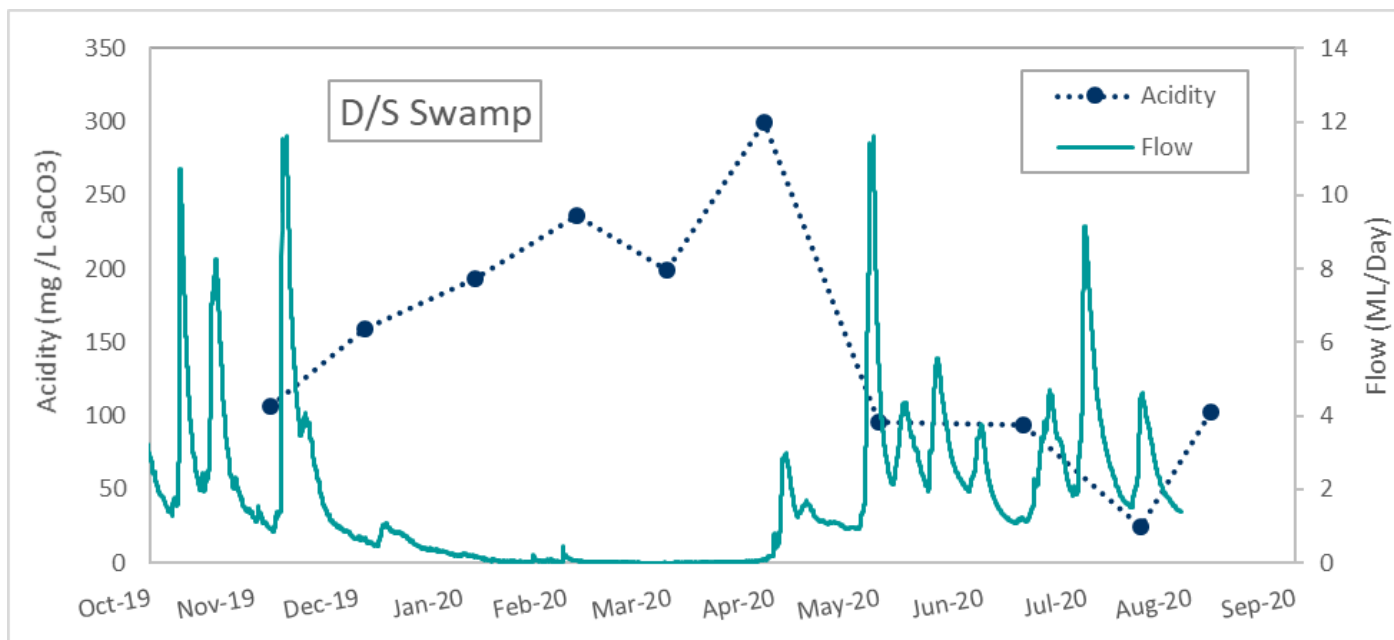


Figure 18: Acidity concentrations and flow downstream of Big Swamp

## 6.0 Further Monitoring and Assessment

The following sections present summaries of the data collected and preliminary analysis undertaken in addition to the information presented above in relation the REPP success targets. It also includes a summary of the technical assessments that have been undertaken, as well as some of the regional groundwater information previously reported in the Gernagamete Groundwater Licence Annual Report.

### 6.1 Big Swamp groundwater levels

Groundwater level data for the monitoring bores in Big Swamp that were identified in the REPP for remediation success targets have been presented and discussed in section 5.3 Big Swamp groundwater levels targets.

Hydrographs for all of the Big Swamp monitoring bores have been provided in Appendix A – Big Swamp Groundwater Hydrographs. Generally, it was noted that groundwater levels at BH04, BH08 and BH14 exhibited lesser groundwater level response to surface water flows, indicating limited connection between groundwater and surface water at these sites. This is consistent with surface water flow modelling which indicates these bores are further from surface water flow paths than other bores. This information will help inform the detailed design for remediation and location of hydraulic barriers.

### 6.2 Water quality

While an ongoing groundwater quality monitoring program is in progress, a comprehensive review of the monitoring data within the context of groundwater-surface water modelling has yet to be undertaken. As such, this section evaluates key parameters and trends in order to provide a high-level assessment of the processes that may be occurring within the swamp. It is envisaged that this, in conjunction with groundwater-surface water modelling and either a comprehensive review of the monitoring data and/or geochemical modelling will be used to better define which analytes, monitoring locations and targets should be set for ongoing reporting.

As presented in Figure 19, there is some correlation between groundwater acidity and the soil sampling results collected during installation of the swamp monitoring bores, with some bores having higher concentrations of groundwater acidity where higher concentrations of existing soil acidity had been previously identified. Groundwater acidity also generally appears to be lower in those bores which exhibited greater groundwater-surface water exchange. This suggests that acidity in the soil may be flushed from the swamp via surface water exchange.

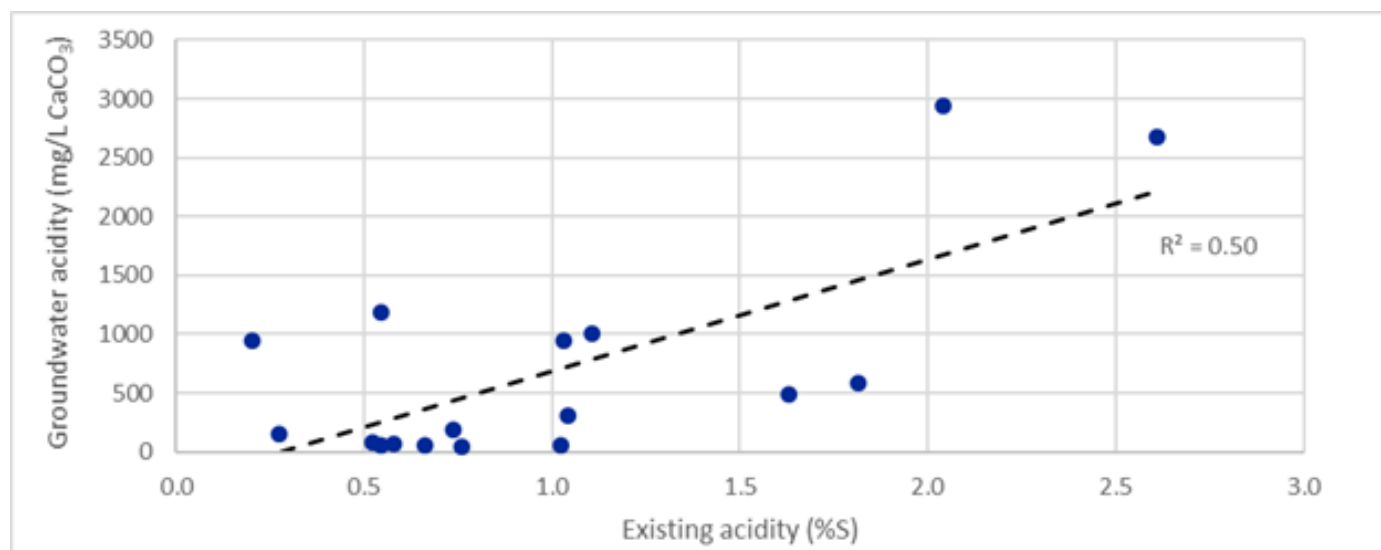


Figure 19: Correlation between existing soil acidity and groundwater acidity at each location. Existing acidity has been taken as the average of the results from the upper 1.5 m at each bore location; while groundwater acidity has been plotted as the average measured between November 2019 and August 2020

Further to this, the dynamic nature of groundwater-surface water exchange appears to affect the redox chemistry of groundwater. For example, for BH01, Bh02 and BH03, the concentration of  $\text{Fe}^{2+}$  declines between March and May when groundwater levels rise in response to recharge via surface water flows (Figure 20). However, it is noted that trends in groundwater acidity do not exhibit a strong correlation with  $\text{Fe}^{2+}$  as indicated in Figure 21. This is consistent with the results of the soil incubation study, which indicated that reduction of iron to  $\text{Fe}^{2+}$  provided only a transient source of alkalinity which is subsequently released upon oxidation (in this case, the time between collection of the sample in the field and subsequent titration in lab). This data suggests that trends in  $\text{Fe}^{2+}$  may be useful in identifying groundwater-surface water interaction, but not necessarily acid generation.

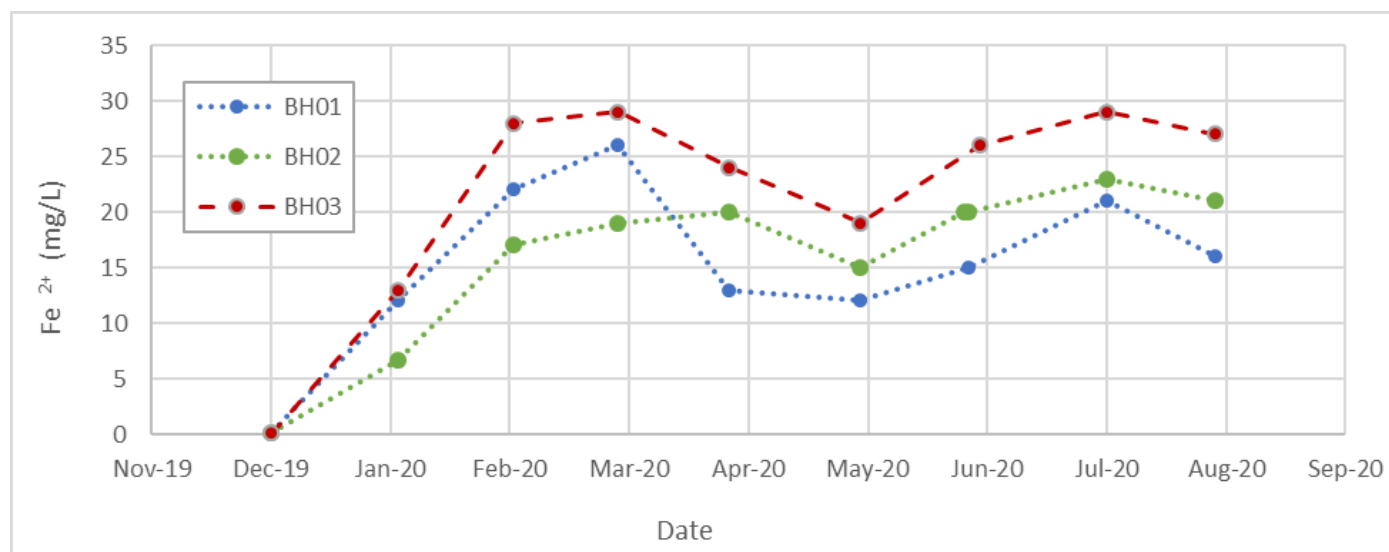


Figure 20: Concentration of  $\text{Fe}^{2+}$  in groundwater from BH01, BH02 and BH03

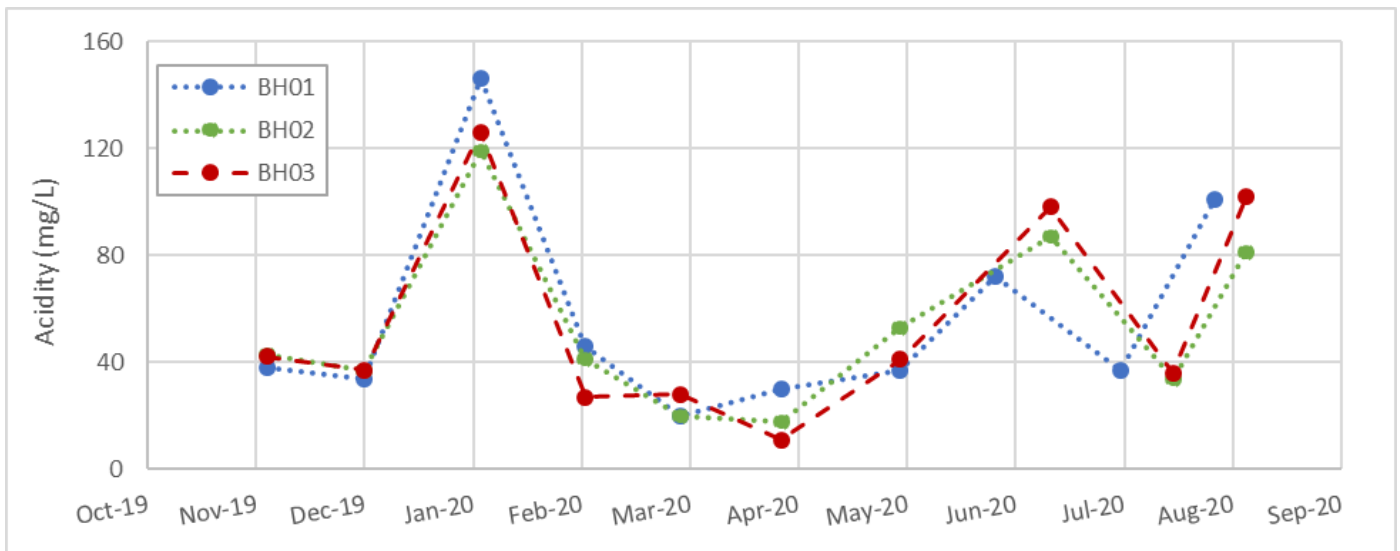


Figure 21: Concentration of acidity in groundwater from BH01, BH02 and BH03

### 6.3 Soil incubation study

The soil incubation study undertaken by Monash University was initiated under the scope of works that was implemented to inform development of the REPP. The timeframes required for completion of the soil incubation tests meant that the final incubation period and reporting on outcomes could not be finalised until after development and submission of the REPP in accordance with the timeframes stipulated under the Section 78 Notice. However, interim results and progress reports provided by Monash University were used to help inform development of the REPP and in particular, understanding of the geochemical processes within the swamp and implications for remediation options. The key objectives of the soil incubation study were therefore to:

- 1) Determine the extent and nature of acid generating material within the swamp; and
- 2) Determine to what extent acid neutralising reactions including iron and sulfate reduction are likely to occur upon re-inundation of the swamp.

The final results and conclusions presented by Monash University are consistent with the preliminary findings that helped inform development of the REPP and confirmed the requirement for inundation of Big Swamp as per the preferred remediation option and further consideration of contingency measures to manage existing acidity entering Boundary Creek from Big Swamp.

The study found that the swamp contains large amounts of potential acidity deposited throughout the swamp, but to date, only a small proportion of this material has been oxidised releasing 'actual acidity' in the top two metres of sediment. If the swamp undergoes further drying, there will be large and further long-term (many decades) release of additional acidity periodically through wetting and drying cycles.

It was found that the surface soils which have already experienced oxidation and the generation of actual acidity had the potential to undertake iron reduction under anoxic conditions at rates sufficient to neutralise the local actual acidity in 1-2 years. This reaction, however, still produces mobile potential acidity in the form of dissolved iron (II), and any release of this from groundwater would regenerate acidity upon contact with oxygen. The timescale over which this occurs depends on the release rate of groundwater. Longer term immobilisation of acidity also requires sulfate reduction to take place and, based on the results of the incubation tests, this process may not occur for several years and even then, there is unlikely to be enough sulfate present in the soil to lead to the complete immobilisation of dissolved iron.

Based on these findings, Monash University has recommended that the swamp be maintained in a saturated state, and that the groundwater contained within the swamp that has both high actual and potential acidity due to the dissolved iron should be prevented from leaving the swamp or treated upon discharge to Boundary Creek.

These final results will now be used to inform further geochemical analysis and Groundwater-Surface Water modelling required for completion of the detailed design for re-wetting of Big Swamp and development of any required contingency measures.

## 6.4 Barwon River macroinvertebrate survey

Austral Research and Consulting were engaged by Barwon Water to investigate the extent of impacts from Big Swamp on surface water, sediments and the macroinvertebrate community structure in Boundary Creek and the upper Barwon River in Spring 2019 and Autumn 2020. Water samples were collected for analysis with a specific focus on metals and the impacts of pH on these analytes from the East and West Barwon Rivers, Boundary Creek downstream of Big Swamp, and the Barwon River down to Winchelsea. Sampling locations are shown on the map provided in Figure 22 below.



Figure 22: Boundary Creek and Barwon River water quality and macroinvertebrate sampling locations

Surface water and sediment results from the Spring sampling suggested that the drying and wetting of Big Swamp has mobilised Aluminium, Cadmium, Iron, Lead and Zinc in the Barwon River, but this impact is not recorded downstream of Birregurra. Autumn and the Spring/Autumn analysis suggests reduced flows over Summer decreased the concentration of most metals in water in Boundary Creek and the continuing poor macroinvertebrate diversity in Boundary Creek is most likely affected by low pH.

Metal concentrations in the surface water were observed to have generally decreased between Spring and Autumn, most likely due to reductions in flow over Summer which would reduce the opportunity for the resuspension of metals from the sediments. Iron is the exception to this, with concentrations in Boundary Creek more than three times higher in Autumn than in Spring. Austral also reports that while iron levels were also elevated at the site immediately below



the Boundary Creek/Barwon River confluence, this does not appear to extend to the Colac-Lorne Road sample site, nor does it appear to have impacted the macroinvertebrate community composition in the Barwon River downstream of the confluence with Boundary Creek.

An observed increase in Zinc levels at Site 12, immediately downstream of Winchelsea was identified by Austral as likely a result of stormwater runoff from the township. Austral also noted that while the observed concentration of 0.015mg/L is above ANZECC water quality guidelines (0.08mg/L), it is well below the reported acute toxicity levels (0.14 mg/L) for macroinvertebrates in Australian freshwater systems.

Austral believes it is evident from the sampling undertaken that Big Swamp continues to impact the macroinvertebrate community composition in Boundary Creek as measured at Site 5 on Colac-Forrest Road. Austral also concluded that while the high iron concentrations recorded in the water at this site in Autumn (17mg/L) may be affecting macroinvertebrates with acute toxicity reported at iron concentrations ranging from 0.32 to 16 mg/L, they believe it is more likely that the continuing low pH is having more of a long-term effect on macroinvertebrate populations.

Austral also concluded that the biological scores reported for sites along the Barwon River above and below the confluence with Boundary Creek suggest that severe impacts are limited to Boundary Creek at this time. The absence of taxa such as snails from Site 6 directly downstream of the confluence in Spring was not evident in Autumn and this site recorded more taxa than what was expected by the AusRivAS model. Sites 8 (Colac-Lorne Road), 9 (Biregurra), and 12 (Winchelsea) all have reference condition macroinvertebrate assemblages and Site 6 (immediately downstream of Boundary Ck confluence) has more macroinvertebrate families than expected.

Whilst Boundary Creek remains impacted by Big Swamp, Austral believes that the overall waterway health indices suggest that the Barwon River downstream of Boundary Creek is healthy with an average Aquatic Life index of 8 out of 10. Austral has also recommended that water quality and macroinvertebrate monitoring of Boundary Creek and the upper Barwon River is continued during the remediation process to provide feedback as to the success of remediation works, which aligns with the further monitoring proposed in the REPP monitoring program

## 6.5 Flow in East Barwon River

Flows in the East Barwon River have been manually measured at six-monthly intervals in three locations (refer Figure 23) since 2005. The three locations are:

1. East Barwon gauge (Monitoring site 233253A)
2. Approximately 1km downstream of the East Barwon gauge
3. Approximately 250m upstream of the Kings Creek junction.

The data collected and presented in Table 10 below indicates that for the times when measurements have been taken during 2019/20, flows in the East Barwon have been relatively stable or increase downstream with increased surface water runoff. As part of the surrounding environment investigation, a new stream gauge will be installed at location 3 and will replace these manual measurements going forward.

Table 10: East Barwon flow measurements 2019-2020

Date	Flow at site (ML/d)		
	Site 1	Site 2	Site 3
26/07/2019	1.63	2.33	2.35
31/10/2019	2.25	1.81	1.21
29/01/2020	5.49	4.13	2.98
28/04/2020	5.57	3.26	3.12

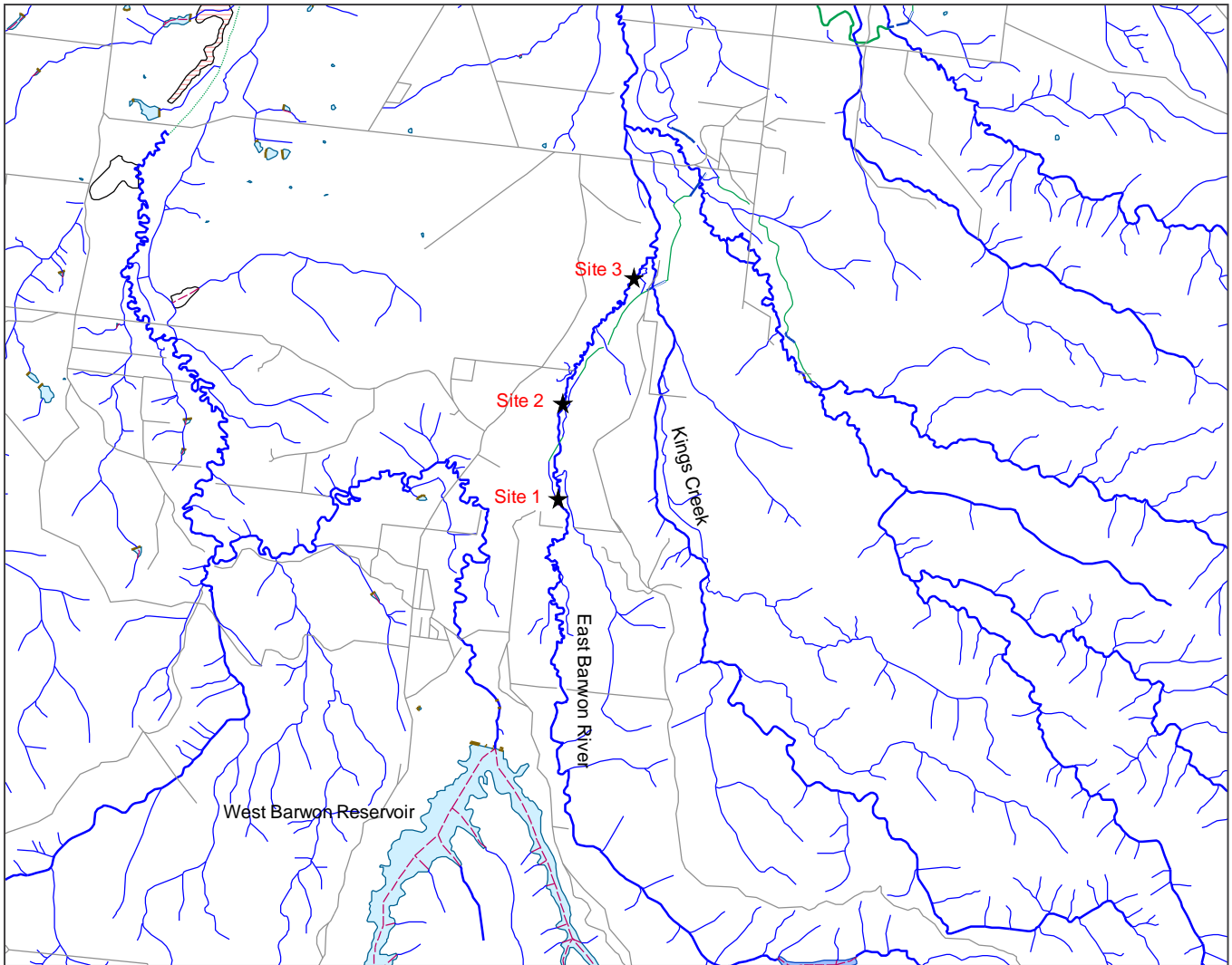


Figure 23: Stream flow spot measurement locations on the East Barwon River

## 6.6 Regional groundwater monitoring

This sections covers some of the groundwater monitoring that was previously provided in the Gernagamete groundwater annual report.

### 6.6.1 Metering

No groundwater was extracted from the Barwon Downs borefield in 2019-2020. Barwon Water's groundwater licence expired 30 June 2019 and the bore pumps were removed in 2017-18.

### 6.6.2 Monitored area

The monitoring network for the Gerangamete groundwater management area takes in the areas of Barongarook, Yeodene, Birregurra, Gerangamete, Barwon Downs, Deans Marsh and Bamba.

Table 11 below indicates the bores that are monitored for each aquifer formation across the management area.

Table 11: Observation Bore number and aquifer monitored

Model layer	Aquifer/Aquitard	Active Monitoring Bores	Inactive Monitoring Bores
Layer 1	Gellibrand Marl		
Layer 2	Clifton Formation	G18, G19, M22	
Layer 3	Narrawatuk Marl		
Layer 4	Mepunga/Dilwyn Formation	BA54, BA56, BA57, BA58, BD3, G11, G14, G17, G20, G22, G24, G28, M25, M27, M28, M29, M30, M31, W7, W9, YYG217, YYG218, YYG221, Y40, Y41, YEO20, YEO21, YEO37, YEO39, YEO40, YEO42, YEO44	G12, G25, W4, YEO38
Layer 5	Pember Mudstone		
Layer 6	Pebble Point Formation	BK69, E68, G11, G13, G14, G21, G23, M24, YEO19, YEO22, YEO23, YEO41	
Layer 7	Basement		

### 6.6.3 Regional groundwater levels & hydrographs

Monitoring of the regional observation bore network continued during 2019-20. The locations of the observation bores have been included in the map in Appendix C – Regional groundwater bore locations. Groundwater levels have been recorded at each of the observation bores quarterly and provided in the table in Appendix D – Regional groundwater bore levels.

The hydrographs for the observation bores in close proximity to the Barwon Downs Borefield indicate that groundwater levels in this area have demonstrated a quick but expected drawdown and recovery in response to historical groundwater pumping. Observation bores that are further from the borefield show a slower drawdown in response to groundwater extraction and then take longer to recover. Hydrographs have been prepared for each bore and are presented in Appendix E – Regional groundwater hydrographs. Comments have been provided for observation bores where recorded levels weren't consistent with the expected levels.

Overall, regional groundwater levels in the LTA continue to display a recovering trend in the majority of observation bores.

### 6.6.4 Residual drawdown

Figure 24 below shows that overall, groundwater levels are continuing to recover post groundwater extraction at Barwon Downs Borefield in 2016/17. Of the 51 observation bores monitored, the 2019-20 year showed recovery with only eight bores not recording positive groundwater level change from the previous year. Only one of the eight bores has a negative groundwater change greater than 0.2m. In comparison, in 2016-17 only 17 bores were indicating a positive change in groundwater level.

Readings were taken in April 2020 and are compared to the May 2019 levels.



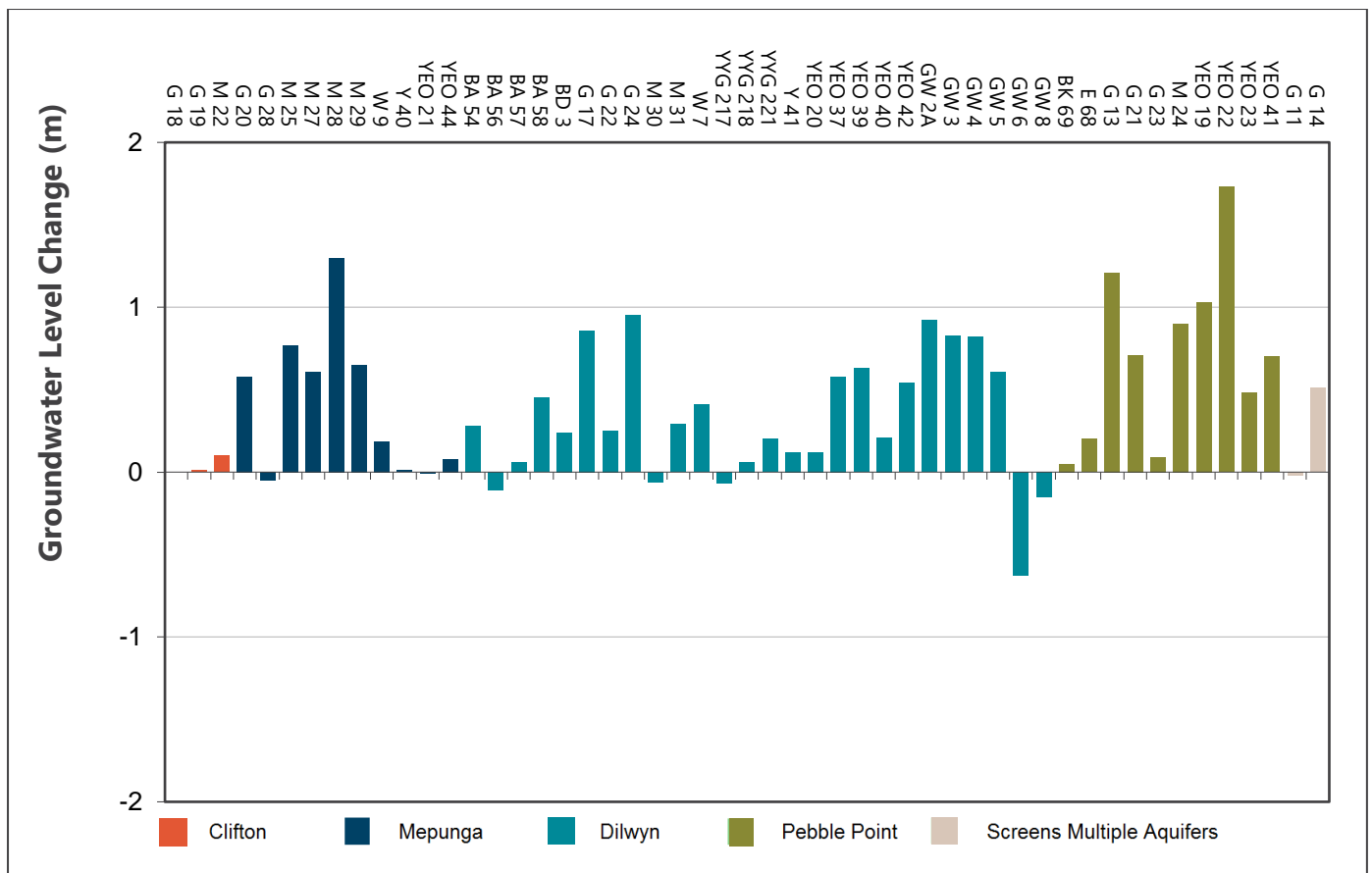


Figure 24: Change in groundwater levels between May 2019 and May 2020

Note: W9 did not have a reading for April 2020, the next closest reading, from late January 2020, was used.

The contour maps provided in Appendix F – Contour Maps illustrate the residual drawdown in groundwater levels since June, 1997. The contours are based on the difference in the groundwater levels measured in May 2020 compared to those levels recorded in 1997.

The baseline used for determining residual drawdown was June 1997 because it represents the end of an extended period of no groundwater extraction and because it is prior to extended periods of groundwater extraction during September 1997 - July 2001, and May 2006 - August 2010. Prior to September 1997, groundwater extraction had occurred intermittently from 1982 – 1990 with a total extraction volume during that time of 25,858 ML. The majority of groundwater extraction during that period was undertaken March 1987 – February 1990, with a total of 20,559 ML.

For this 2019-20 report, the residual drawdown contours have been plotted for each groundwater formation separately. Each aquifer has been observed to have varying rates of recovery and different cones of depression, and so plotting the contours for each aquifer individually is considered the most accurate method of representing the drawdown within each formation. However, the ability to accurately represent drawdown contours within each formation is highly dependent on the number and distribution of the observation bores within each formation. Evenly distributed observation bores across the whole formation would provide greater confidence in the drawdown contour map.

As per previous years, bore Y41 has been excluded from the residual drawdown map for the Dilwyn formation as it was only constructed in 2006 and provides no comparative data back to 1997.

## 6.6.5 Land subsidence

Measurements were carried out and compared to 2003 readings for the subsidence-monitoring network previously monitored in accordance with the now expired Gerangamete groundwater licence. Surveying was conducted by Barwon Water's spatial services team and the results are presented below. Positive values indicate an increase in ground levels compared to the readings taken in 2003, while a negative value indicates subsidence. The results indicate a slight subsidence in ground levels up until May, 2010. After 2010, the ground levels at most observation points have shown a small recovery, while some levels have been observed to stabilise.

Table 12: Land Subsidence Monitoring – Variation from 2003 Readings

Ellipsoid Height Differences as compared to 2003 data (mm)																		
Primary Control Station ID	June 2004	May 2005	May 2006	June 2007	Dec 2007	June 2008	July 2009	May 2010	July 2011	June 2012	June 2013	June 2014	June 2015	June 2016	June 2017	June 2018	July 2019	July 2020
20790040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20880024	-8	-2	-8	-18	-16	-8	-21	-25	-25	-12	-23	-20	-21	-11	-19	-19	-19	-15
20590052	-6	0	6	-3	-12	7	8	8	15	8	14	1	3	13	27	11	-1	-26
39780106	-1	0	3	-27	-9	-15	-16	-30	-14	-16	-30	-24	-25	-11	-19	-15	-17	-20
Monitoring Station ID																		
32390045	-6	1	-11	-42	-42	-36	-66	-75	-47	-42	-54	-42	-42	-47	-35	-39	-30	-15
32390046	3	1	-8	-20	-19	-20	-47	-50	-32	-25	-46	-32	-28	-37	-25	-27	-10	-3
26470027	-6	2	-2	6	-11	-22	-37	-45	-36	-39	-43	-42	-35	-32	-37	-36	-21	-23
26470032	-5	5	-1	-43	-30	-36	-63	-63	-35	-40	-45	-42	-37	-42	-39	-40	-15	-17
26470033	-8	3	-13	-40	-35	-36	-65	-76	-38	-39	-44	-38	-35	-46	-39	-36	-21	-22
26470036	5	10	1	-32	-23	-30	-48	-63	-42	-38	-39	-33	-23	-33	-33	-24	-12	-11
39870025	-1	-4	-5	-15	-11	-17	-23	-34	-37	-31	-25	-29	-33	-27	-27	-21	-17	-27
39870026	-3	0	2	-9	-6	-15	-22	-38	-37	-33	-31	-31	-35	-21	-28	-23	-10	-5
38090024	-4	-3	12	8	NA	0	-26	-25	-18	-30	-15	-36	-36	-81	-74	-89	-65	-85
38090025	-5	-5	9	-12	NA	-5	-30	-33	-28	-48	-23	-33	-35	-27	-27	-34	-18	-31
38090026	-5	0	6	-15	NA	-6	-33	-31	-30	-41	-30	-33	-28	-31	-31	-33	-19	-31

## 7.0 Contingency measures

Table 13 outlines any contingency measures confirmed to be required during the detailed design or implementation of the REPP.

Table 13: Contingency measures to be implemented

Contingency measure	Status
Nil	

## 8.0 REPP amendments

Table 14 outlines any REPP amendments current as of the time of this report.

Table 14: Amendments to the REPP

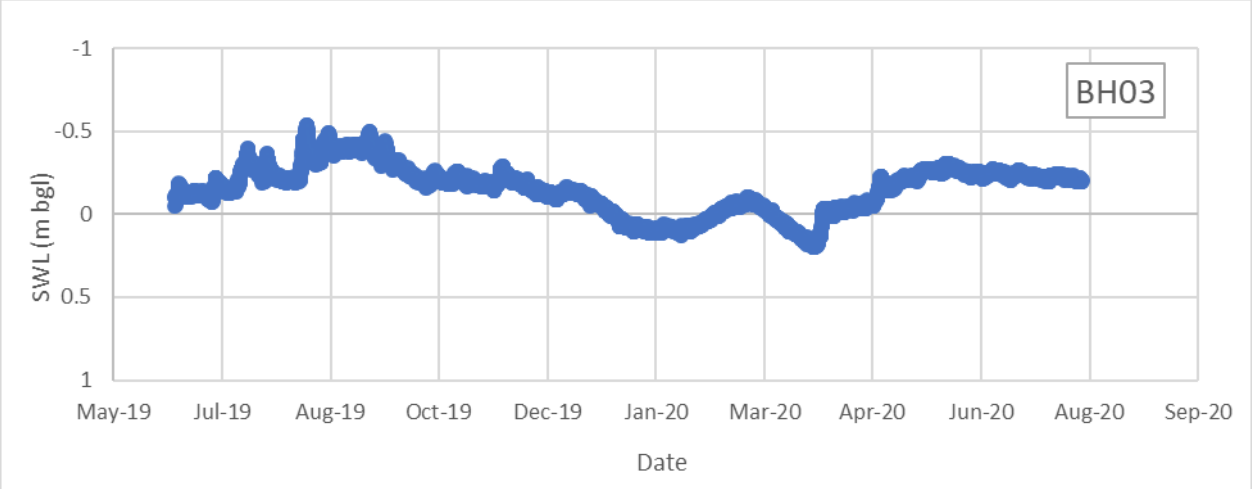
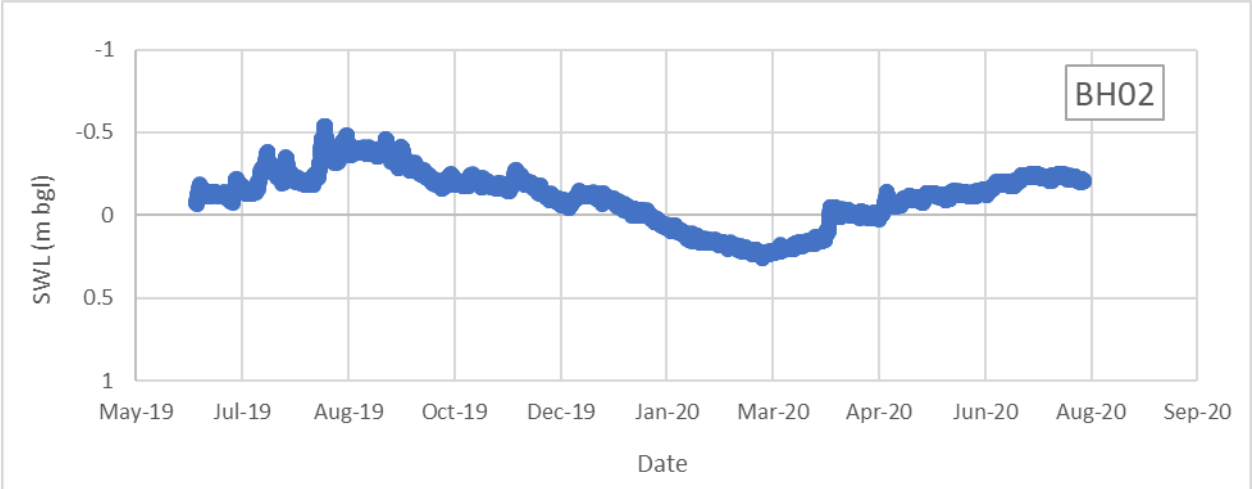
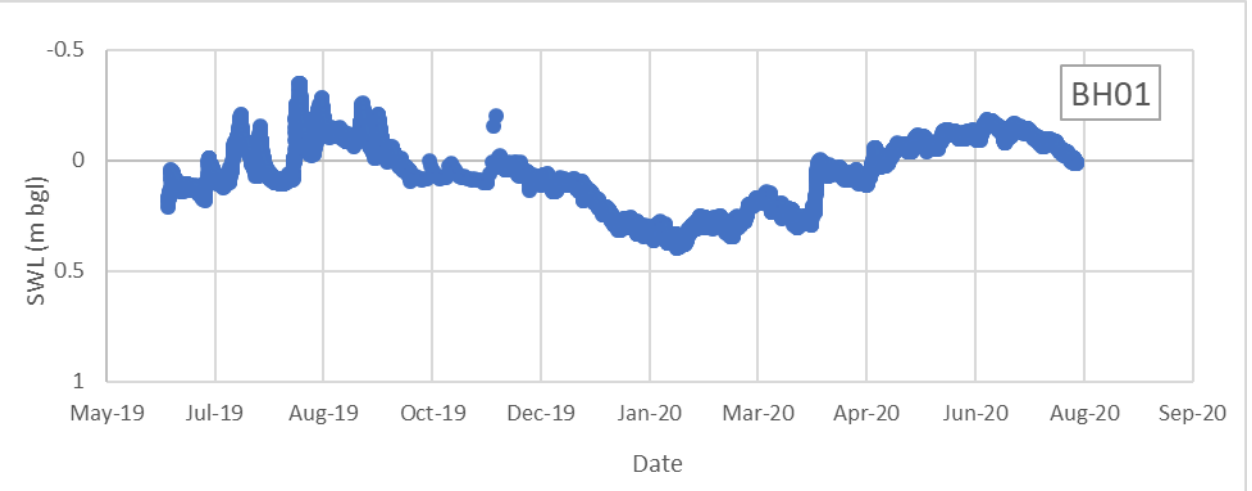
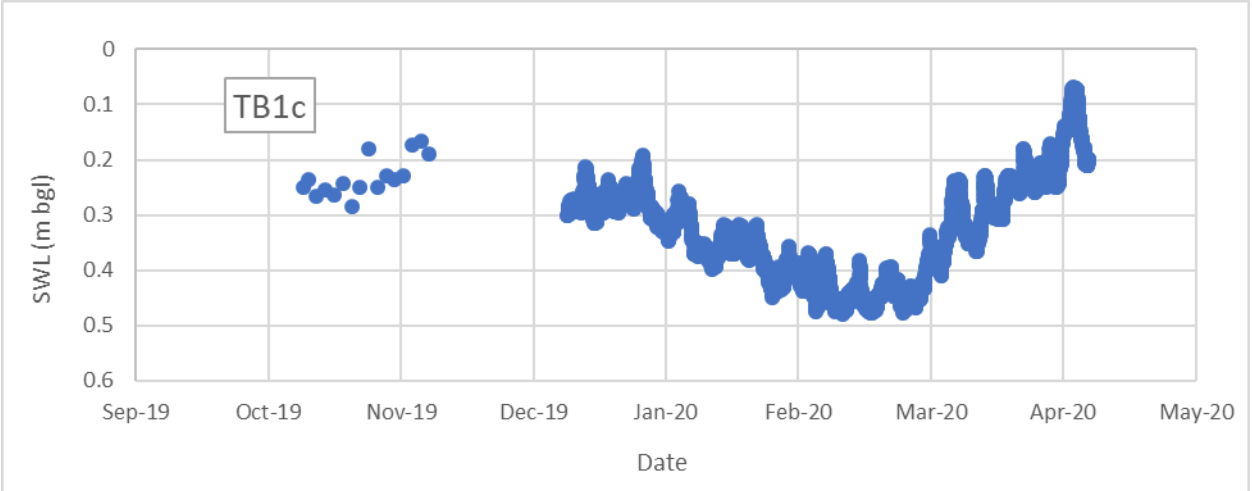
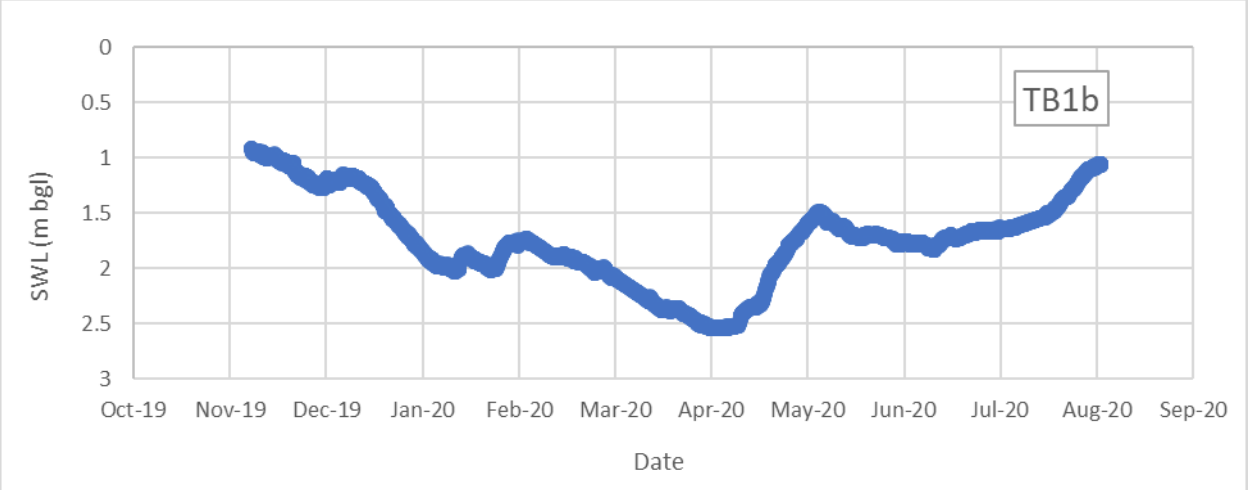
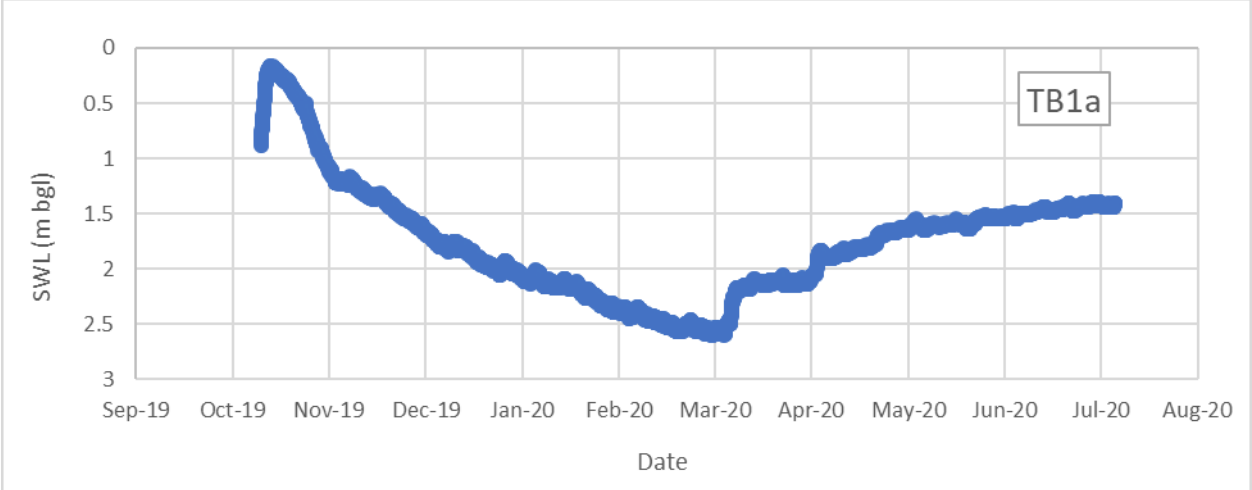
No.	REPP amendments	Status
1	REPP updated 27 <sup>th</sup> February 2020 to include new section capturing SRW feedback on the REPP	Complete

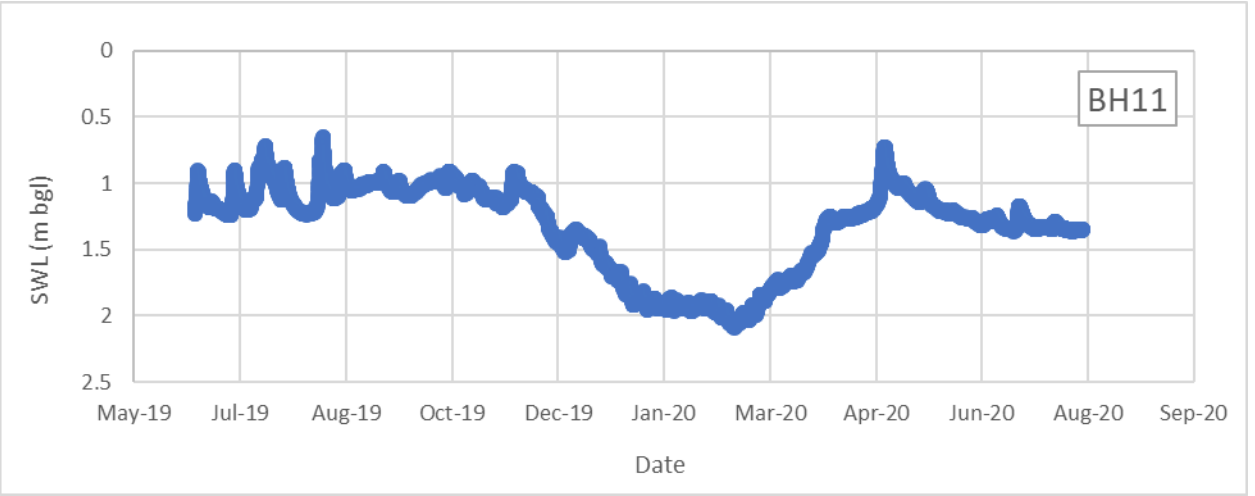
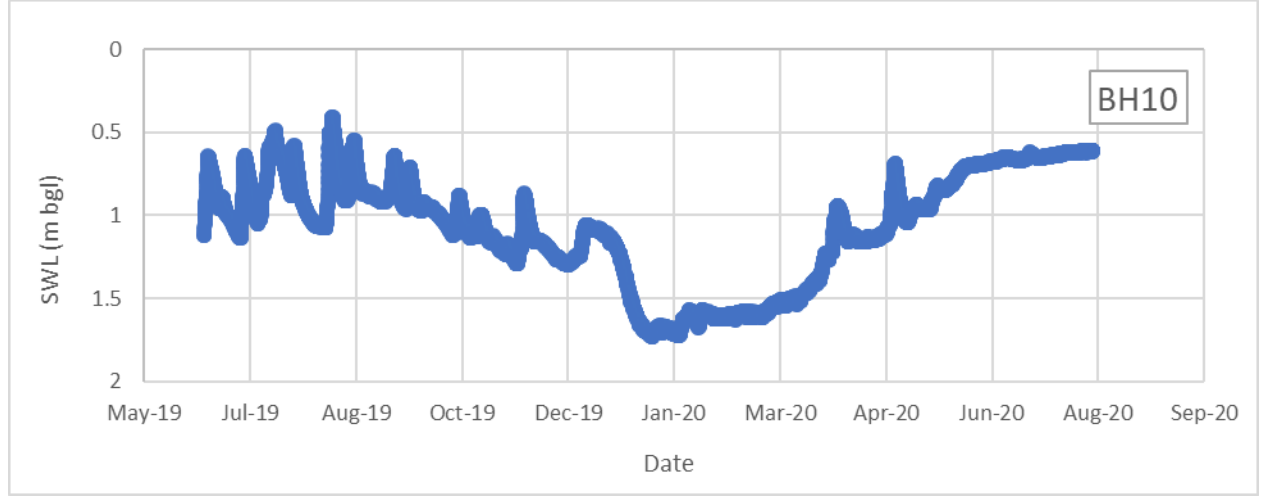
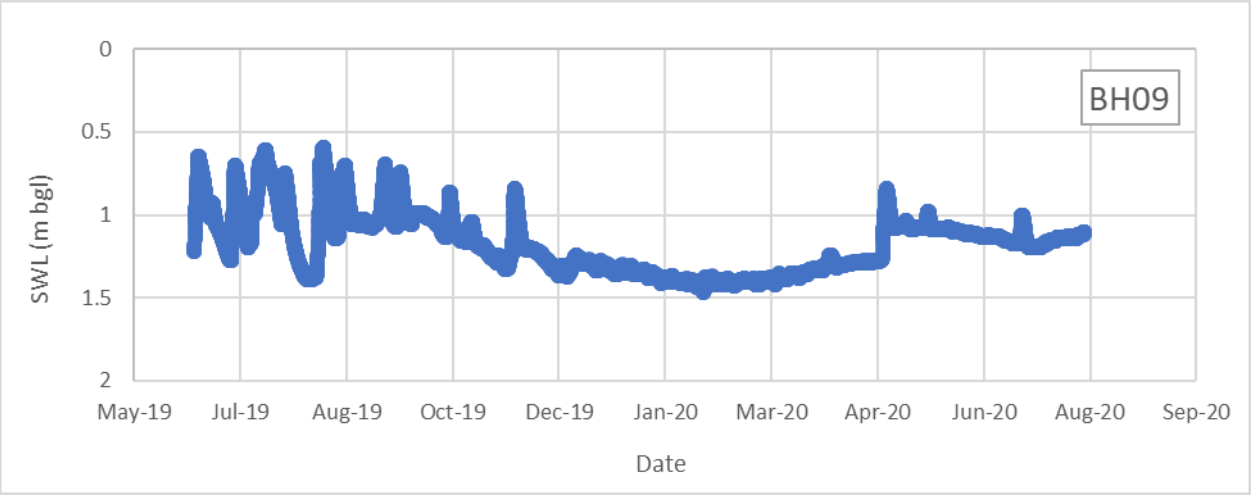
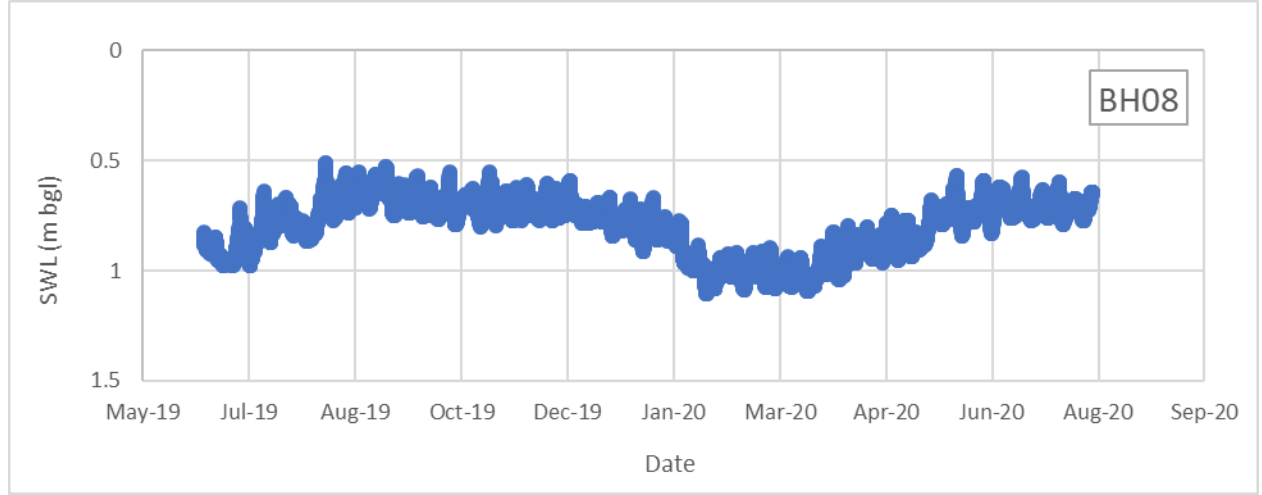
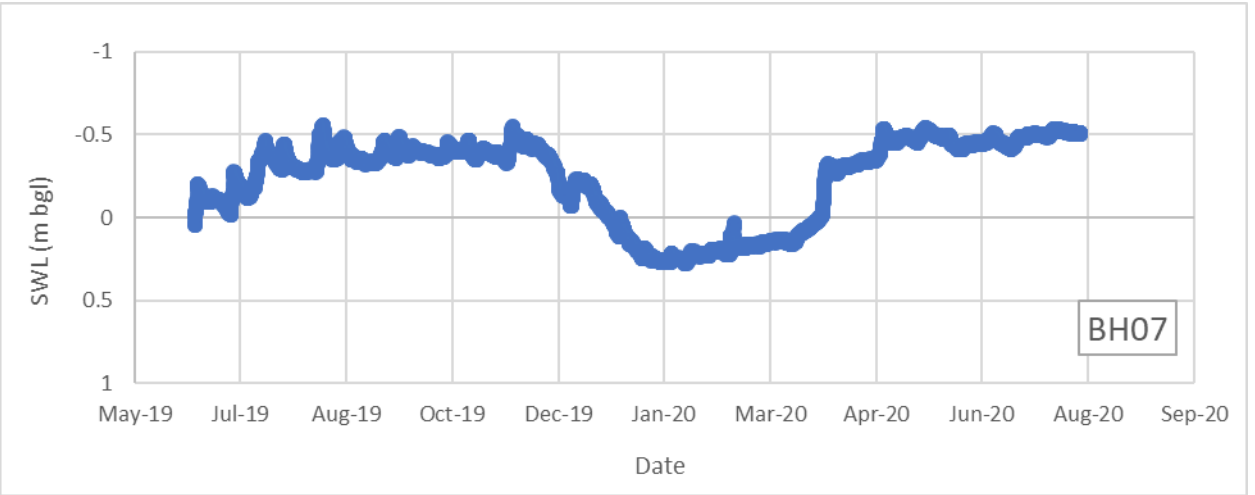
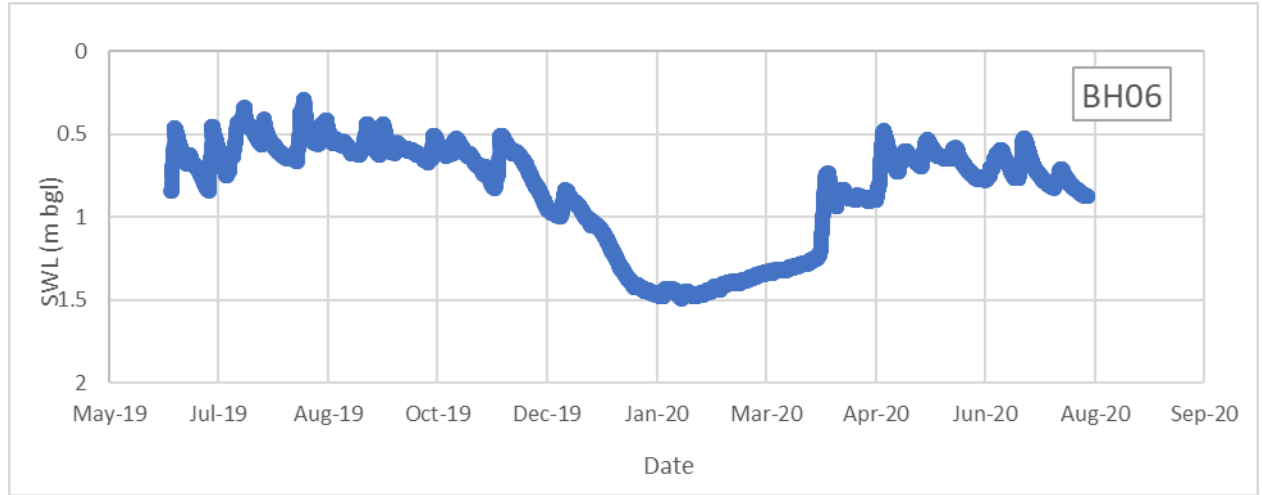
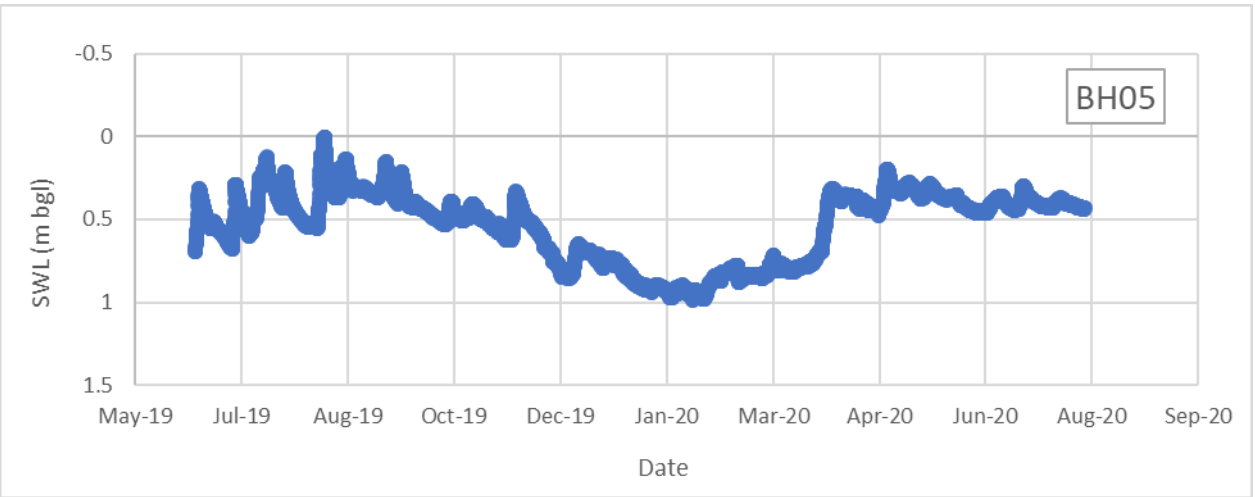
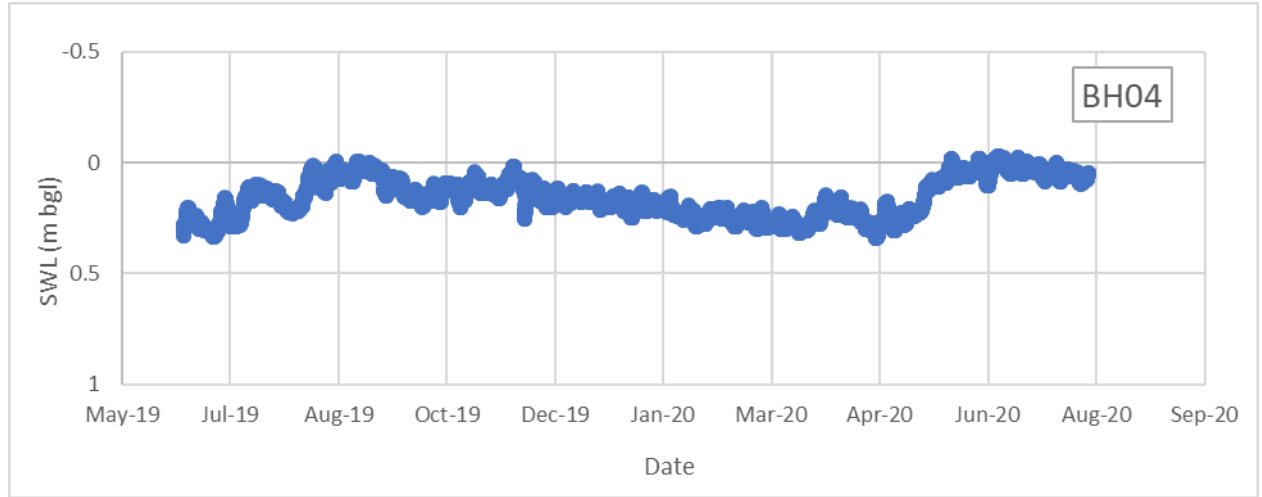
## 9.0 Progress report

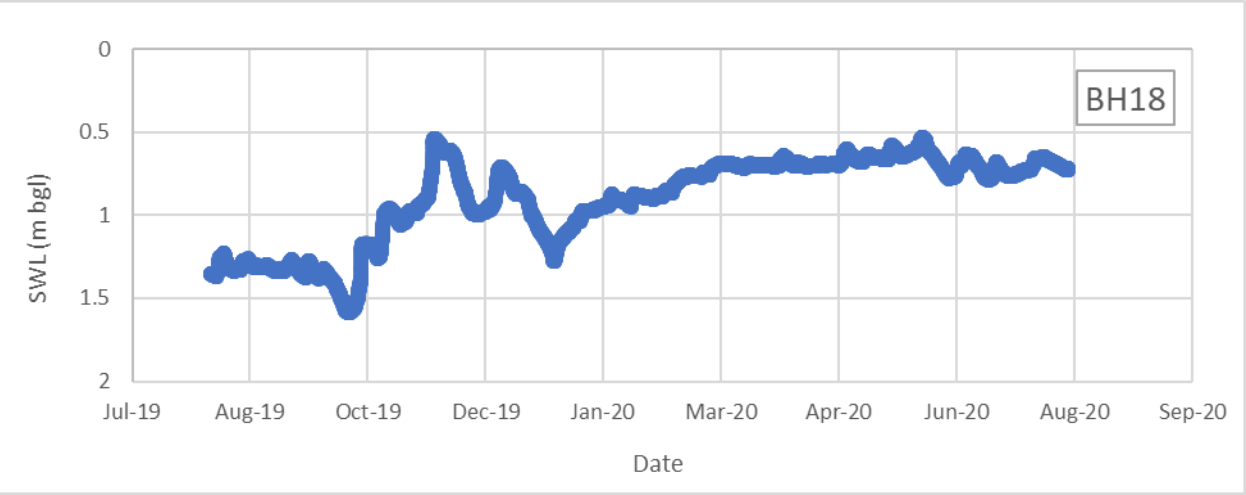
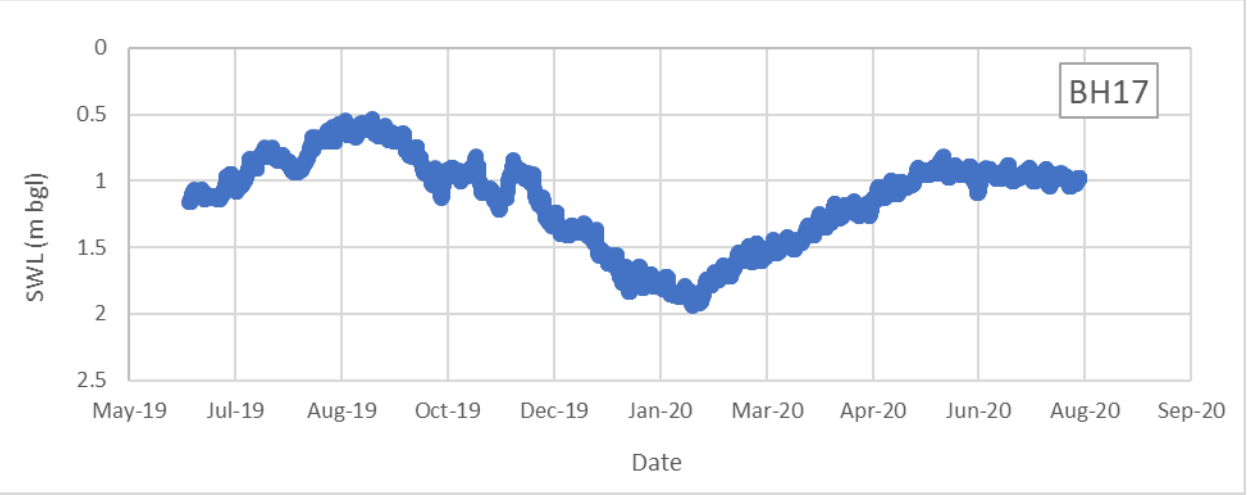
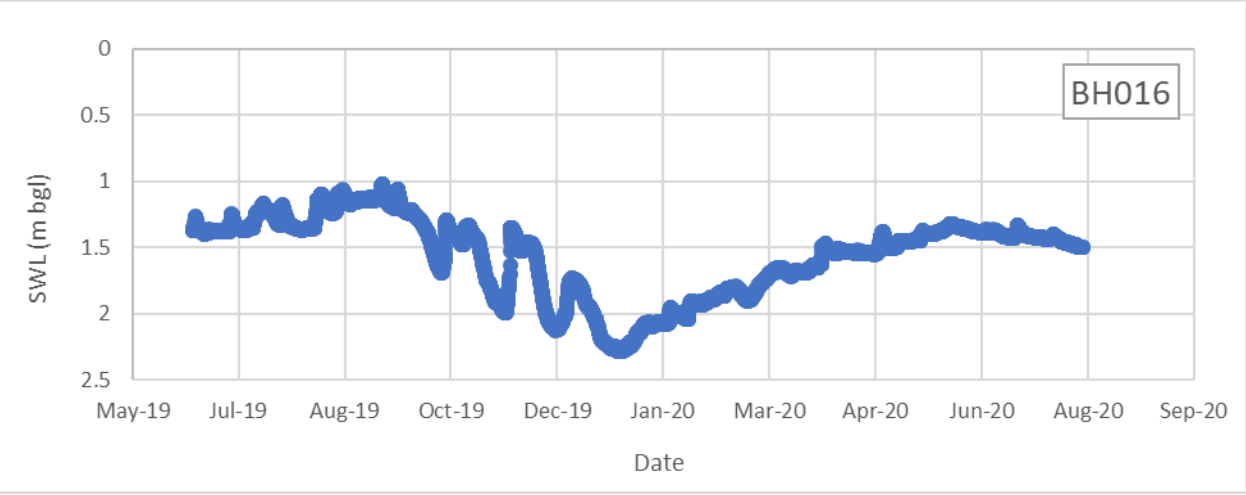
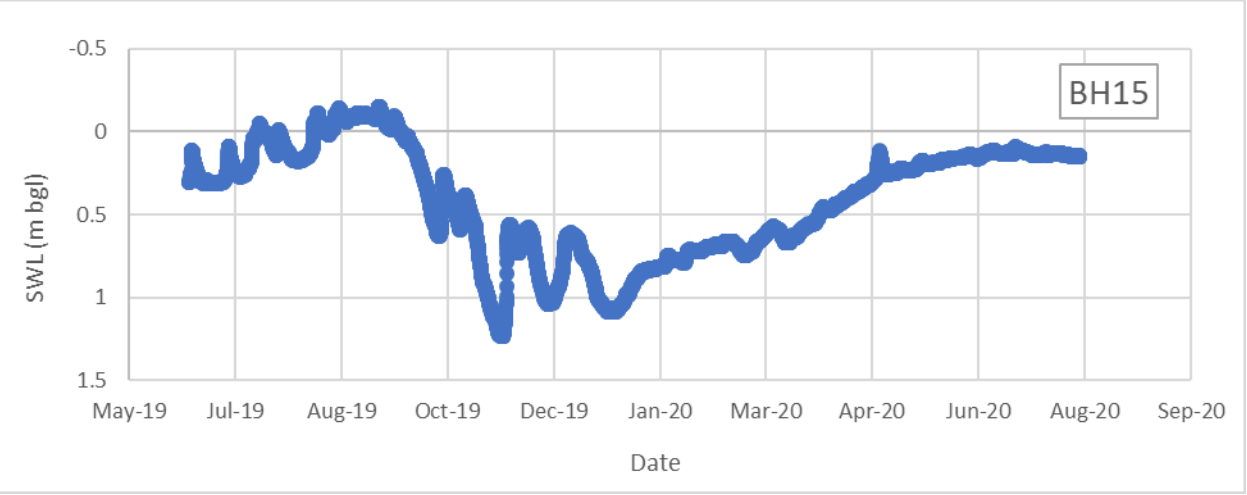
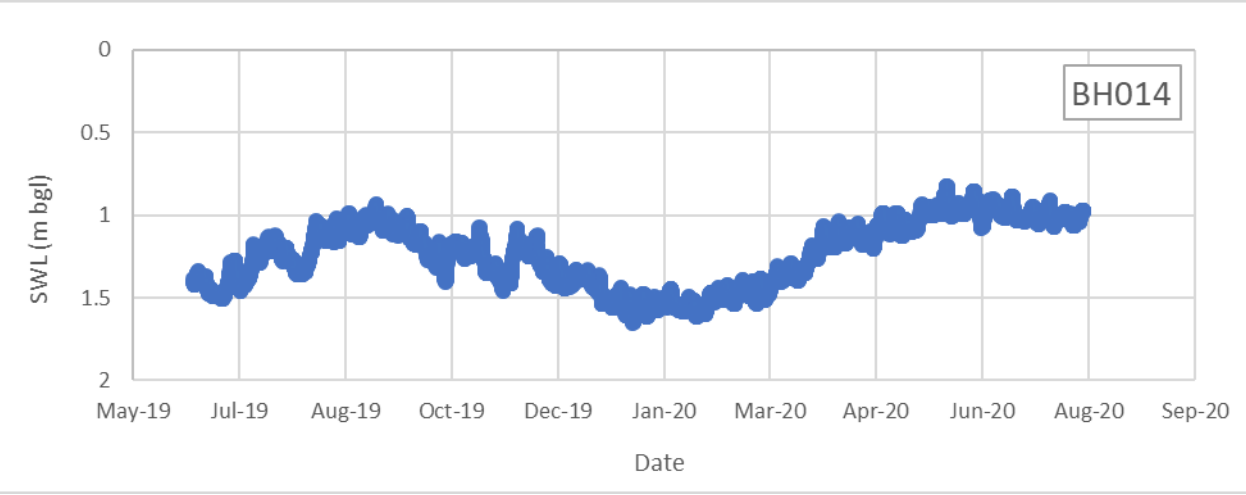
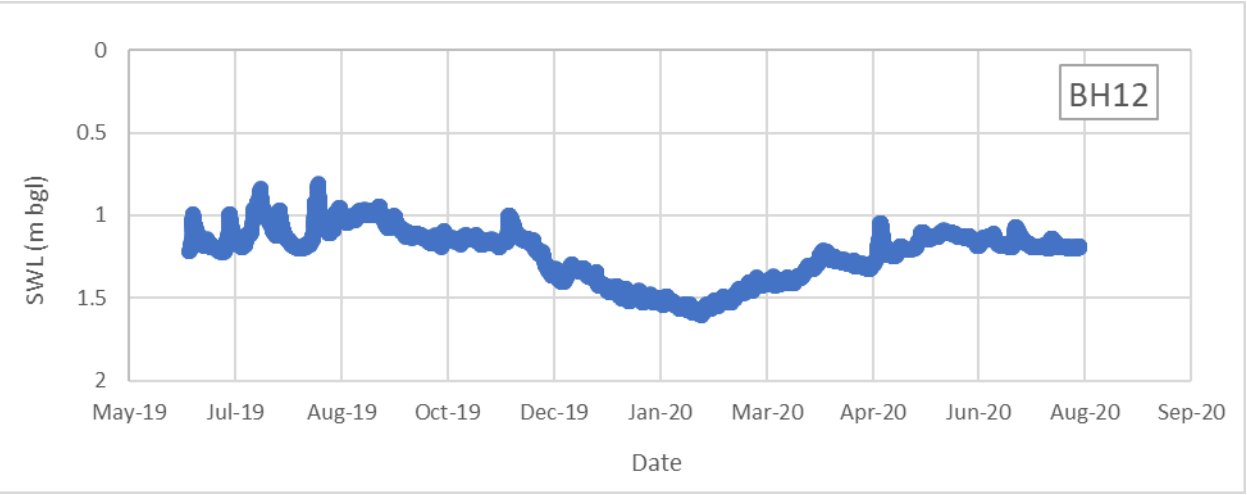
Appendix G – Progress Report presents actions that have been completed, are currently in progress, or are yet to commence as part of implementation of the REPP. It is important to note that additional tasks may be added or updated as they are identified during implementation of the REPP.

# 10.0 Appendices

## Appendix A – Big Swamp Groundwater Hydrographs







## Appendix B – Surface Water flow in Boundary Creek

### Flows in Boundary Creek at Yeodene Stream Gauge 233228 (ML/day)

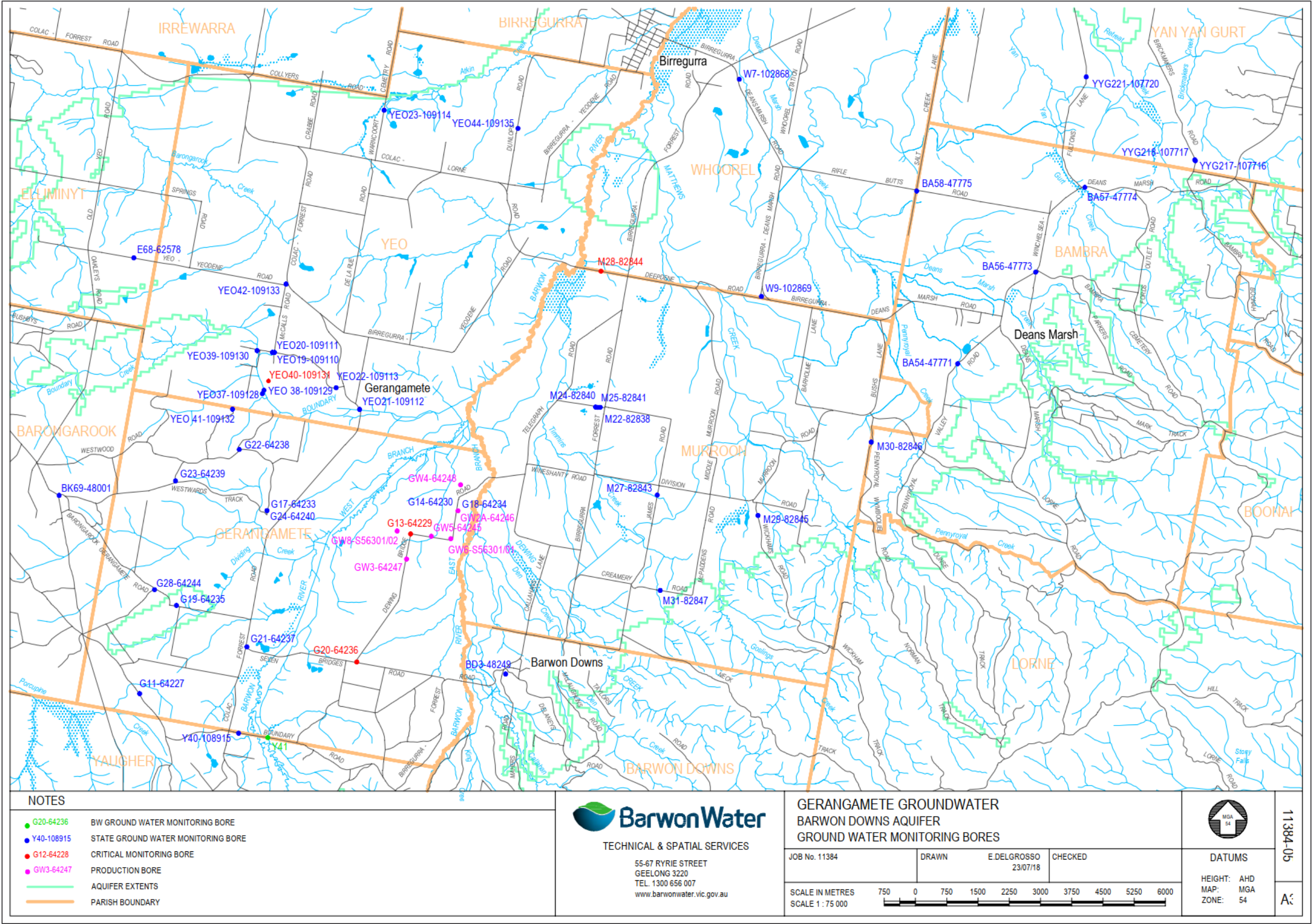
Date	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020
1	12.37	11.27	10.14	6.16	2.64	1.01	0.74	0.00	0.00	0.00	1.13	3.54
2	23.65	10.32	8.32	5.74	2.48	0.98	0.77	0.01	0.00	0.00	6.90	4.22
3	15.54	9.55	7.12	5.30	2.87	0.96	0.90	0.06	0.00	0.00	21.01	5.15
4	14.89	9.31	6.70	4.90	2.70	0.93	0.70	0.25	0.00	0.00	19.01	7.06
5	18.34	9.95	7.30	4.76	2.44	0.92	0.83	0.36	0.00	0.00	12.18	8.13
6	28.57	10.87	7.30	4.55	2.09	0.87	0.87	0.36	0.00	0.00	12.14	7.33
7	25.72	12.68	7.58	4.27	1.96	0.79	0.85	0.30	0.00	0.00	8.28	5.36
8	21.61	15.48	9.00	4.26	2.63	0.76	0.87	0.16	0.00	4.50	2.83	4.14
9	18.78	16.04	15.36	4.76	3.28	0.81	0.84	0.07	0.00	10.14	2.26	3.54
10	17.73	24.24	40.08	8.53	25.61	1.01	0.90	0.02	0.00	8.95	2.24	3.01
11	17.25	100.96	42.05	26.75	34.19	1.26	0.99	0.00	0.00	7.95	3.34	2.79
12	18.13	120.85	18.28	18.20	23.37	1.20	1.24	0.00	0.00	7.51	4.78	2.54
13	33.94	116.87	11.59	12.70	15.49	1.10	1.28	0.00	0.00	7.56	5.68	2.36
14	44.15	53.93	8.64	9.17	11.49	1.08	0.76	0.00	0.00	7.85	5.92	2.25
15	64.79	25.92	7.49	5.77	7.99	1.07	0.38	0.00	0.00	7.87	5.14	2.21
16	83.92	22.18	7.52	4.82	7.76	1.03	0.40	0.00	0.00	7.52	4.73	2.47
17	85.17	24.46	21.15	4.70	8.88	0.93	0.45	0.00	0.00	7.10	4.34	2.78
18	84.86	47.23	46.56	4.98	7.87	0.84	0.47	0.00	0.00	6.81	3.71	2.81
19	67.83	43.74	21.10	5.33	6.21	0.79	0.42	0.00	0.00	6.74	3.16	2.91
20	40.78	51.03	12.67	17.59	4.56	0.72	0.41	0.00	0.00	6.55	2.86	3.73
21	34.40	133.77	12.45	24.85	3.32	0.68	0.39	0.00	0.00	6.48	5.07	5.71
22	26.06	161.16	12.45	21.34	2.60	0.70	0.32	0.00	0.00	6.54	7.68	6.31
23	25.52	160.21	12.45	14.67	2.34	0.70	0.25	0.00	0.00	6.58	10.02	8.10
24	24.59	178.38	12.67	9.50	1.88	0.66	0.37	0.00	0.00	6.54	9.24	9.11
25	61.60	174.61	12.45	5.82	1.49	0.64	0.28	0.00	0.00	6.39	7.87	10.15
26	56.97	101.03	10.22	4.40	1.34	0.62	0.25	0.00	0.00	6.28	6.96	10.82
27	30.98	69.20	7.88	4.34	1.20	0.61	0.25	0.00	0.00	6.22	5.61	9.67
28	23.46	48.97	7.50	4.06	1.09	0.59	0.21	0.00	0.00	3.47	4.61	8.63
29	18.97	41.34	6.95	3.32	1.06	0.59	0.13		0.00	0.78	4.11	8.19
30	14.26	41.68	6.48	2.85	1.07	0.60	0.06		0.00	0.84	3.99	6.84
31	12.47	34.63		2.73		0.71	0.01		0.00		3.73	
<b>Total</b>	<b>1067.30</b>	<b>1881.86</b>	<b>417.45</b>	<b>261.08</b>	<b>193.91</b>	<b>26.16</b>	<b>17.58</b>	<b>1.57</b>	<b>0.00</b>	<b>147.16</b>	<b>200.47</b>	<b>161.87</b>

## Release to Boundary Creek (ML/day)

Date	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020
1	0.01	0.01	0.00	0.00	0.00	2.08	2.08	2.08	2.09	2.25	2.13	2.12
2	0.01	0.01	0.00	0.00	0.00	2.10	2.13	2.07	2.09	2.17	2.14	2.12
3	0.01	0.01	0.00	0.00	0.00	2.10	2.12	2.08	2.10	2.09	2.16	2.11
4	0.01	0.02	0.00	0.00	0.00	2.09	2.13	2.09	2.10	2.08	2.14	1.03
5	0.01	0.00	0.00	0.00	0.00	2.09	2.10	2.09	2.09	2.10	2.14	0.02
6	0.01	0.01	0.00	0.00	0.00	2.09	1.97	2.09	2.09	2.11	2.13	0.03
7	0.01	0.01	0.00	0.00	0.00	2.08	2.02	2.09	2.10	2.10	2.13	0.03
8	0.01	0.02	0.00	0.00	0.00	2.07	2.15	2.09	2.10	2.10	2.12	0.02
9	0.01	0.02	0.00	0.00	0.00	2.06	2.13	2.08	2.10	2.09	2.13	0.03
10	0.01	0.01	0.00	0.00	0.00	2.06	2.06	2.08	2.10	2.09	2.14	0.03
11	0.01	0.01	0.00	0.00	0.00	2.06	2.05	2.08	2.10	2.09	2.15	0.02
12	0.01	0.01	0.00	0.00	0.00	2.06	2.06	2.08	2.09	2.11	2.14	0.02
13	0.01	0.01	0.00	0.00	0.00	2.06	2.06	2.08	2.08	2.11	2.14	0.02
14	0.01	0.02	0.00	0.00	0.00	2.10	2.06	2.08	2.08	2.10	2.14	0.02
15	0.01	0.01	0.00	0.00	0.00	2.11	2.06	2.08	2.11	2.09	2.14	0.02
16	0.01	0.01	0.00	0.00	0.00	2.10	2.05	2.09	2.11	2.08	2.13	0.03
17	0.00	0.02	0.00	0.00	0.00	2.09	2.02	2.09	2.10	2.09	2.13	0.02
18	0.01	0.01	0.00	0.00	0.00	2.08	2.07	2.09	2.09	2.10	2.14	0.03
19	0.01	0.01	0.00	0.00	0.00	2.08	2.06	2.09	2.08	2.10	2.13	0.03
20	0.01	0.01	0.00	0.00	0.00	2.09	2.01	2.09	2.08	2.10	2.12	0.03
21	0.02	0.01	0.00	0.00	0.00	2.19	2.07	2.10	2.10	2.09	2.12	0.03
22	0.02	0.01	0.00	0.00	0.00	2.20	2.10	2.09	2.10	2.10	2.13	0.03
23	0.02	0.00	0.00	0.00	0.00	2.19	2.10	2.10	2.10	2.09	2.11	0.03
24	0.01	0.01	0.00	0.00	0.00	2.13	2.11	2.10	2.11	2.09	2.12	0.03
25	0.01	0.01	0.00	0.00	0.00	2.09	2.10	2.09	2.11	2.09	2.12	0.01
26	0.01	0.01	0.00	0.00	0.00	2.15	2.09	2.08	2.12	2.09	2.13	0.01
27	0.01	0.01	0.00	0.00	0.62	2.14	2.09	2.09	2.11	2.09	2.12	0.01
28	0.01	0.01	0.00	0.00	1.46	2.10	2.10	2.10	2.10	2.10	2.12	0.01
29	0.01	0.01	0.00	0.00	1.34	2.08	2.09		2.14	2.11	2.12	0.00
30	0.01	0.01	0.00	0.00	1.69	2.07	2.09		2.16	2.13	2.12	0.00
31	0.01	0.02		0.00		2.04	2.09		2.21		2.11	
<b>Total</b>	<b>0.33</b>	<b>0.33</b>	<b>0.00</b>	<b>0.00</b>	<b>5.11</b>	<b>65.01</b>	<b>64.42</b>	<b>58.44</b>	<b>65.23</b>	<b>63.10</b>	<b>66.04</b>	<b>7.95</b>



Appendix C – Regional groundwater bore locations



Appendix D – Regional groundwater bore levels

Clifton Formation

	State/WMIS ID	64234	64235	82838
	Barwon Water ID	G 18	G 19	M 22
	Point of Reference	TOV	TOC	TOC
	29-Jul-19	1.48		-17.11
	15-Oct-19			-17.05
Date	28-Jan-20	1.73		-17.03
	17-Apr-20	1.63	-28.42	-17.05

Mepunga Formation

	State/WMIS ID	64236	64244	82841	82843	82844	82845	102869	108915	109112	109135
	Barwon Water ID	G 20	G 28	M 25	M 27	M 28	M 29	W 9	Y 40	YEO 21	YEO 44
	Point of Reference	TOC	TOC	TOV	TOC	TOV	TOC	TOC	TOC	TOV	TOC
	29-Jul-19	-20.06	-37.76	-12.46	4.59	16.32	-26.17	-0.01	-35.87	6.80	-30.24
	15-Oct-19	-19.95	-37.83	-12.11		16.93	-25.97	-0.60	-35.88	5.80	-27.76
Date	28-Jan-20	-19.77	-37.83	-12.11	5.41	16.42	-25.82	-0.05	-35.93	5.93	-31.3
	17-Apr-20	-19.82	-37.83	-12.03	5.20	16.60	-25.56		-35.95	6.19	-31.18

Dilwyn Formation

	State/WMIS ID	47771	47773	47774	47775	48249	64227	64230	64233	64238	64240	82846
	Barwon Water ID	BA 54	BA 56	BA 57	BA 58	BD 3	G 11	G 14	G 17	G 22	G 24	M 30
	Point of Reference	TOC <sup>1</sup>	TOC	TOP <sup>2</sup>	TOP	TOC	TOP	TOV <sup>3</sup>	TOP	TOC	TOC	TOC
	29-Jul-19	-12.20	-24.73	-14.62	-13.05	-34.95	-46.93	4.59	-28.24	-86.77	-28.38	-28.65
	15-Oct-19	-12.02	-24.45	-14.65	-12.86	-34.96	-47.03		-28.04	-86.66	-28.12	-28.42
Date	28-Jan-20	-12.12	-25.55	-14.63	-12.78	-34.90	-47.05	4.69	-27.83	-86.60	-27.89	-28.41
	17-Apr-20	-12.00	-25.28	-14.60	-12.85	-34.84	-47.07	4.59	-27.68	-86.55	-27.65	-28.60

	State/WMIS ID	82847	102868	107716	107717	107720		109111	109128	109130	109131	109133
	Barwon Water ID	M 31	W 7	YYG 217	YYG 218	YYG 221	Y41	YEO 20	YEO 37	YEO 39	YEO 40	YEO 42
	Point of Reference	TOC	TOV	TOP	TOP	TOV	TOC	TOC	TOC	TOC	TOC	TOC
	29-Jul-19	-22.76	32.13	-52.50	-34.05	8.06	-15.54	-24.28	-10.28	-8.32	-15.46	-61.33
	15-Oct-19	-22.66		-52.43	-34.11	7.96	-15.53	-24.08	-8.92	-7.91	-15.40	-61.15
Date	28-Jan-20	-22.58	32.13	-52.56	-34.56	8.16	-15.52	-23.87	-8.92	-7.78	-15.40	-61.07
	17-Apr-20	-22.51	32.13	-52.17	-34.50	7.85	-15.50	-23.76	-8.77	-7.75	-15.44	-60.96

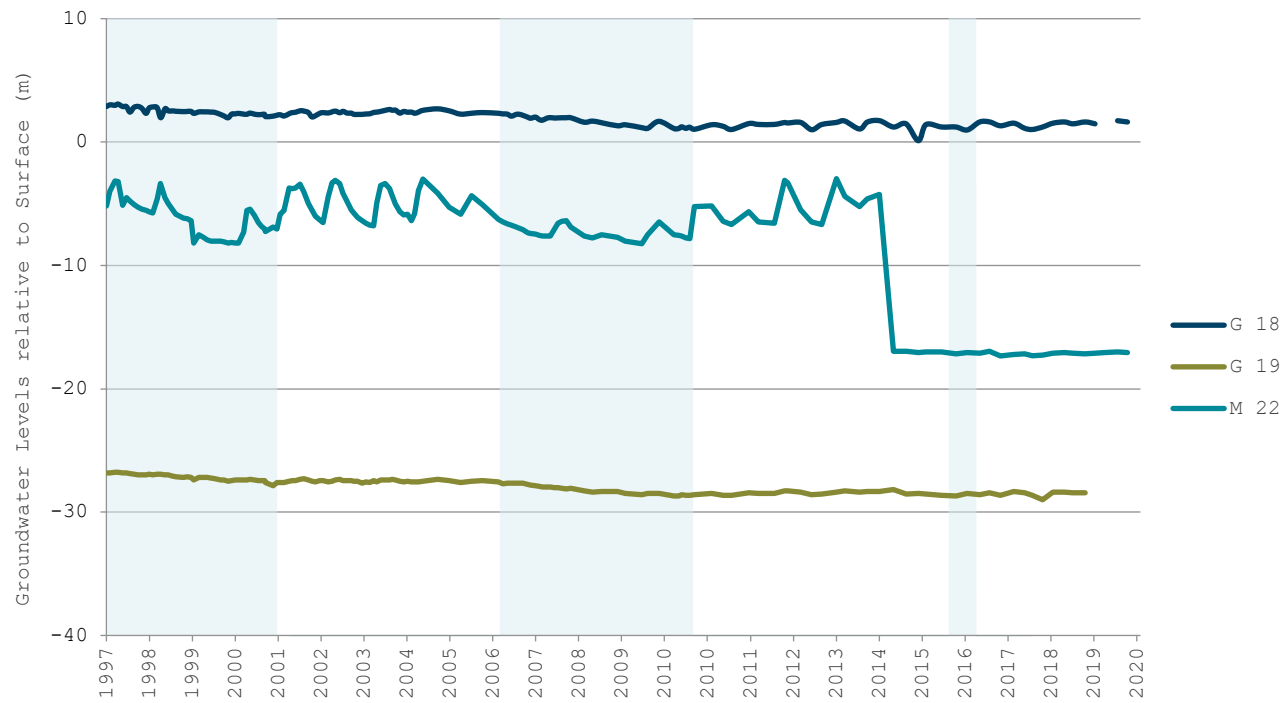
	WMIS ID	WRK040900	WRK040901	WRK040902	WRK040899	WRK040903	WRK040904
	State ID	64246	64247	64248	64245	56301/01	56301/02
	Barwon Water ID	GW2A	GW3	GW4	GW5	GW6	GW8
	Point of Reference	TOV	TOV	TOV	TOV	TOV	TOV
	29-Jul-19	3.67	-2.07	18.15	5.50	0.70	0.32
Date	15-Oct-19		-1.87			0.62	0.03
	28-Jan-20	4.39	-1.69	18.36	6.12	0.38	0.20
	17-Apr-20	4.59	-1.52	18.56	6.22	0.42	0.30

**Pebble Point Formation**

Date	State/WMIS ID	48001	62578	64229	64237	64239	82840	109110	109113	109114	109132
	Barwon Water ID	BK 69	E 68	G 13	G 21	G 23	M 24	YEO 19	YEO 22	YEO 23	YEO 41
	Point of Reference	TOC	TOC	TOV	TOV	TOC	TOV	TOC	TOC	TOC	TOC
	29-Jul-19	-25.65	-24.99	-2.89	-1.43	-71.27	-9.27	-27.82	-33.69	-14.55	-60.41
	15-Oct-19	-25.60	-24.84	-2.61	-1.23	-71.23	-9.16	-27.70	-33.51	-14.23	-60.10
Date	28-Jan-20	-25.64	-24.77	-2.39	-1.09	-71.24	-8.96	-27.46	-33.32	0.00	-59.68
	17-Apr-20	-25.55	-24.82	-2.04	-0.96	-71.21	-8.80	-27.27	-32.32	-14.30	-60.00

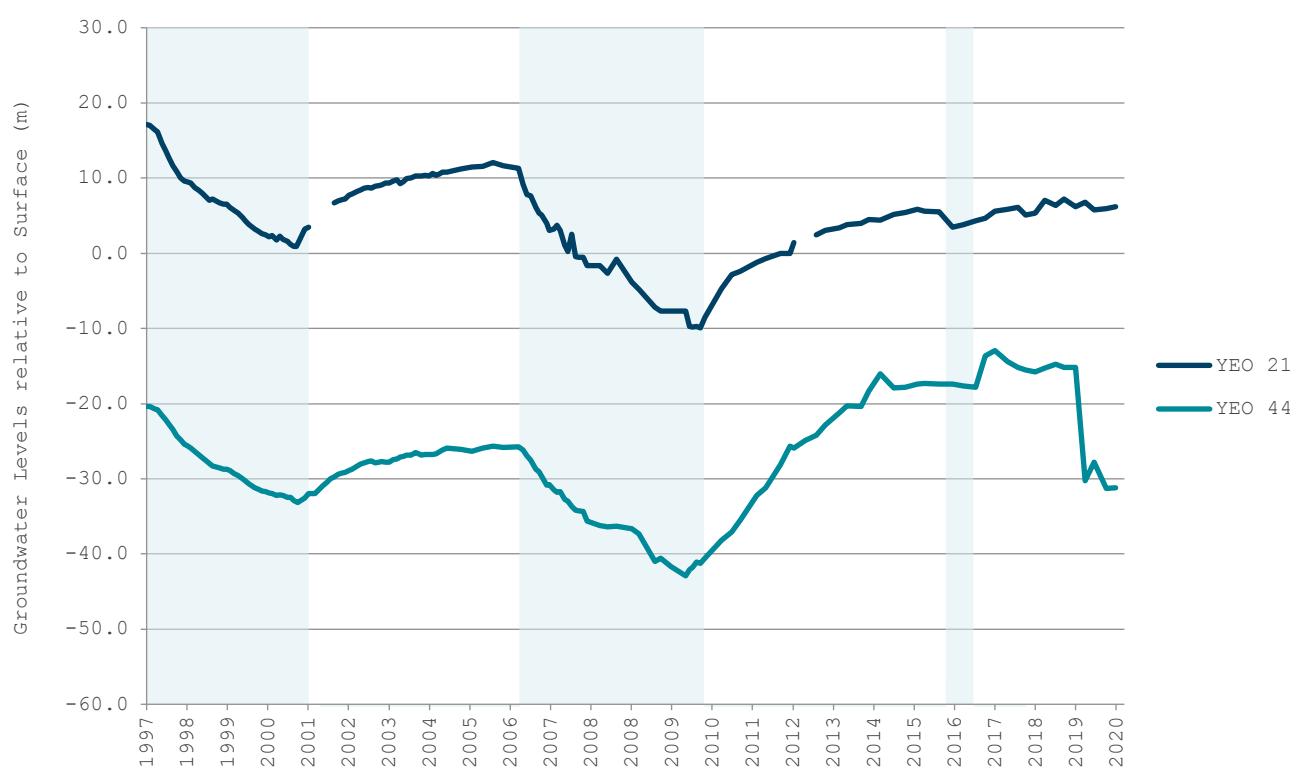
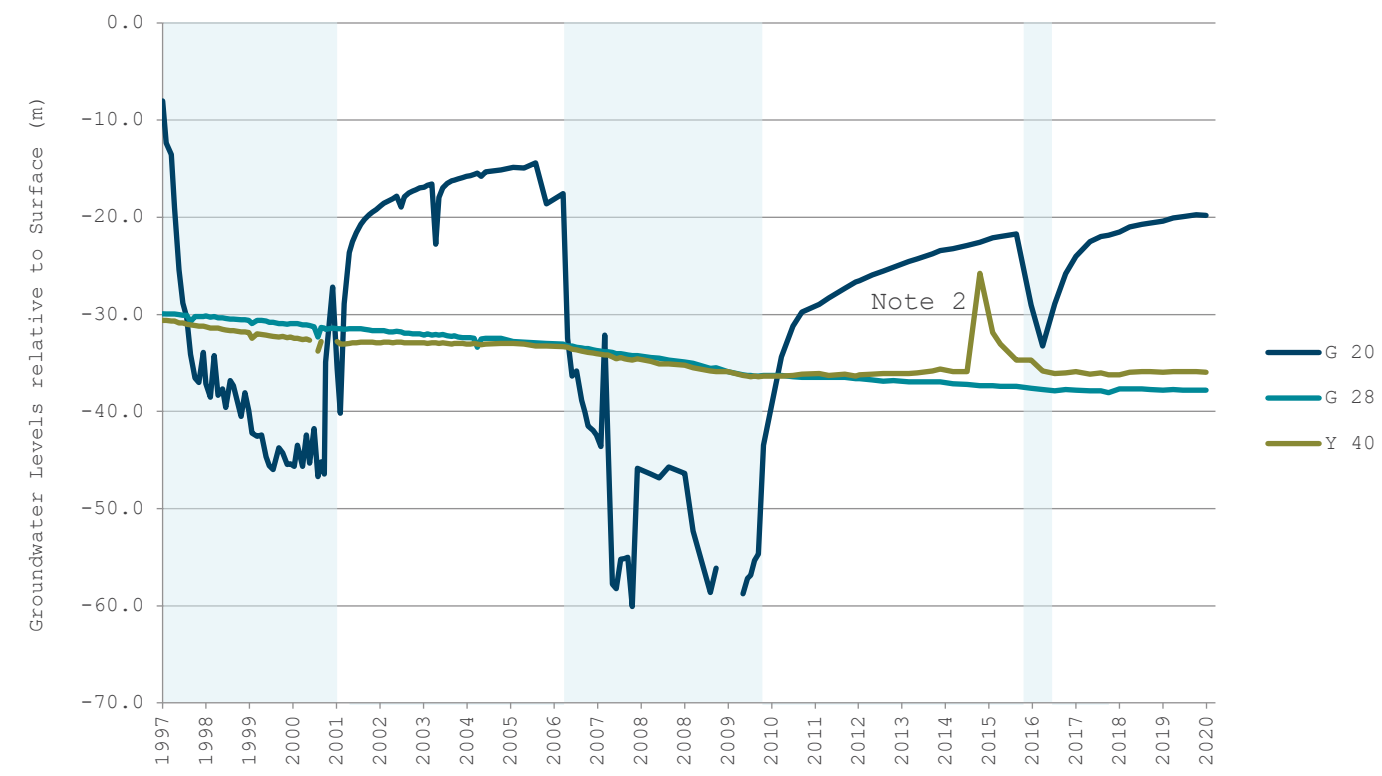
Appendix E – Regional groundwater hydrographs

Clifton

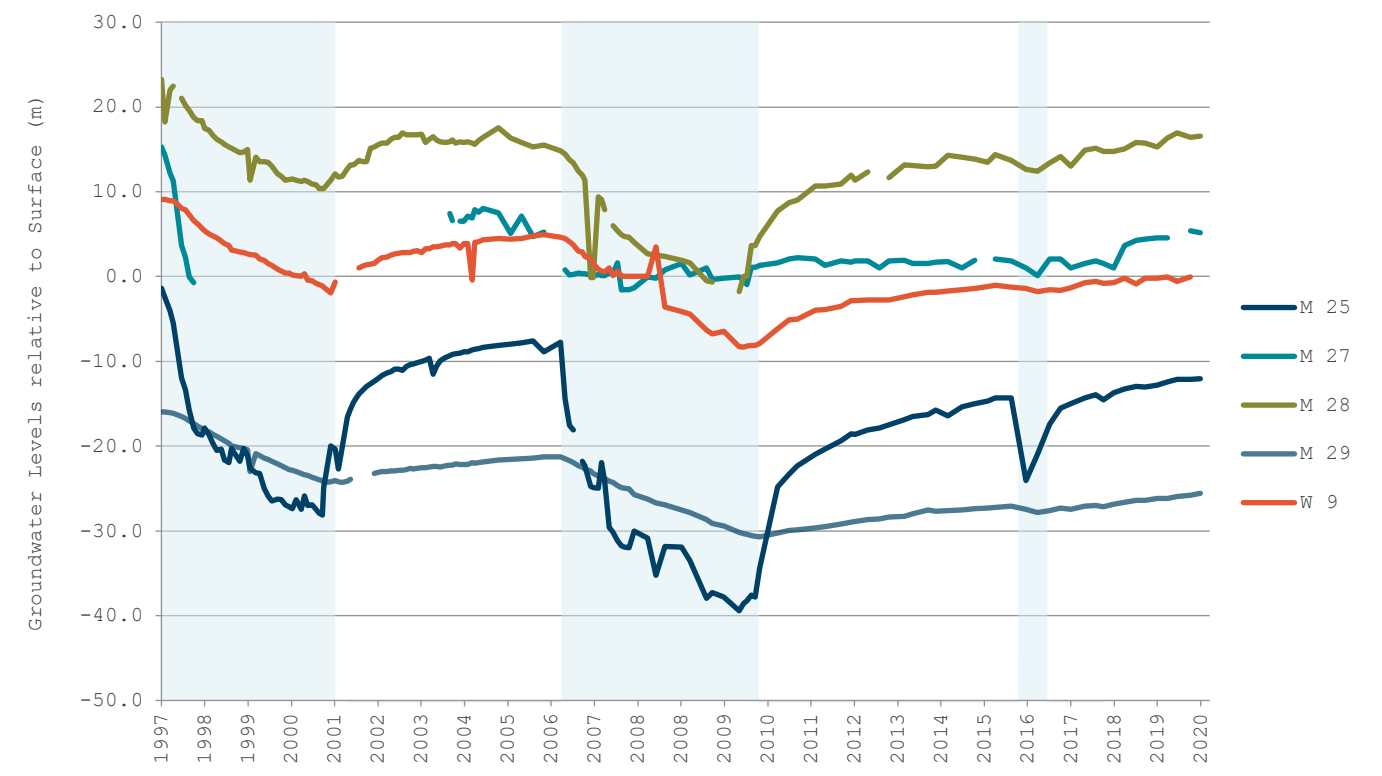


- Notes:
- 1. Light blue shading denotes periods of groundwater extraction
  - 2. M22 was refurbished by DELWP in 2014-2015. The drop in groundwater levels observed in 2014-2015 are due to the refurbishment and this bore is now recording accurate levels.

Mepunga

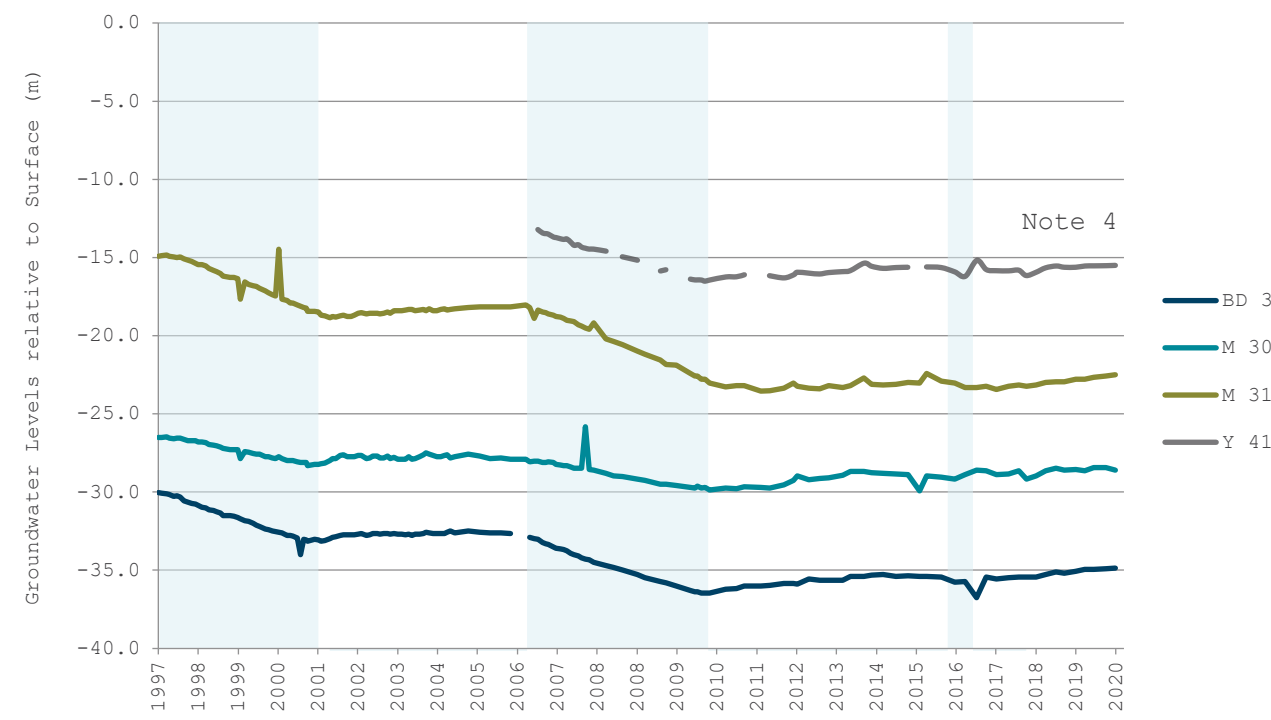
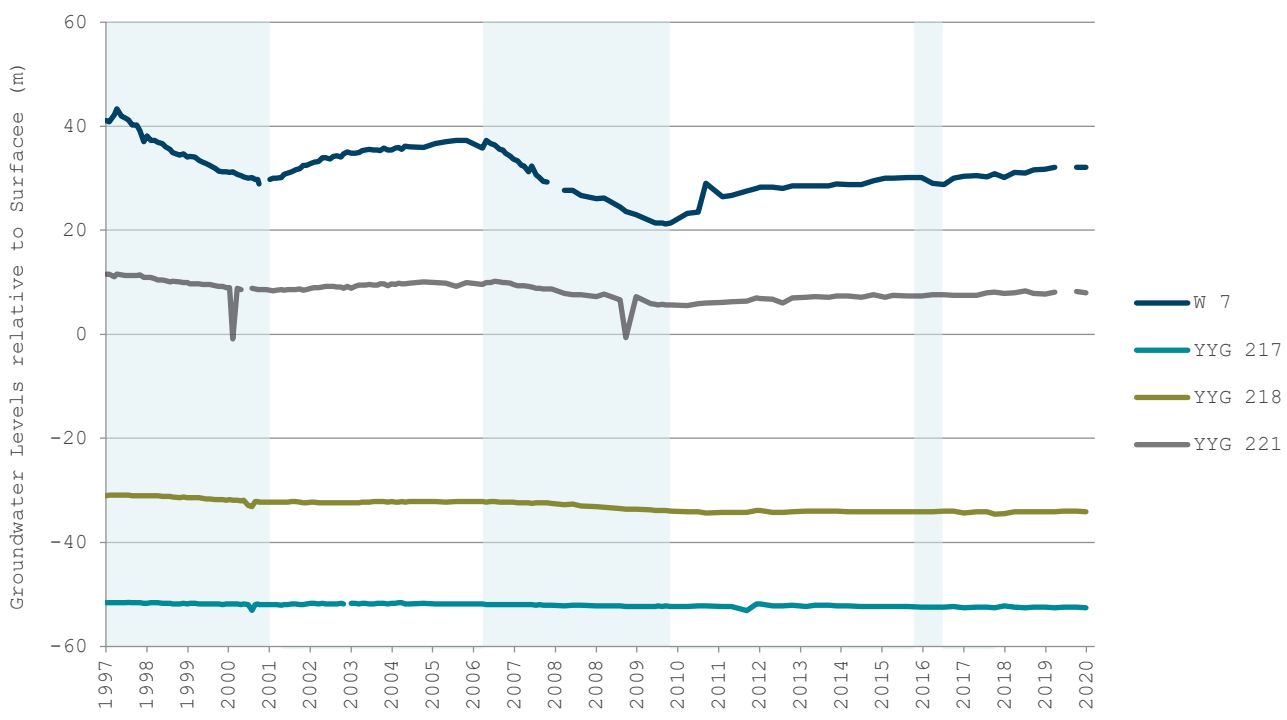
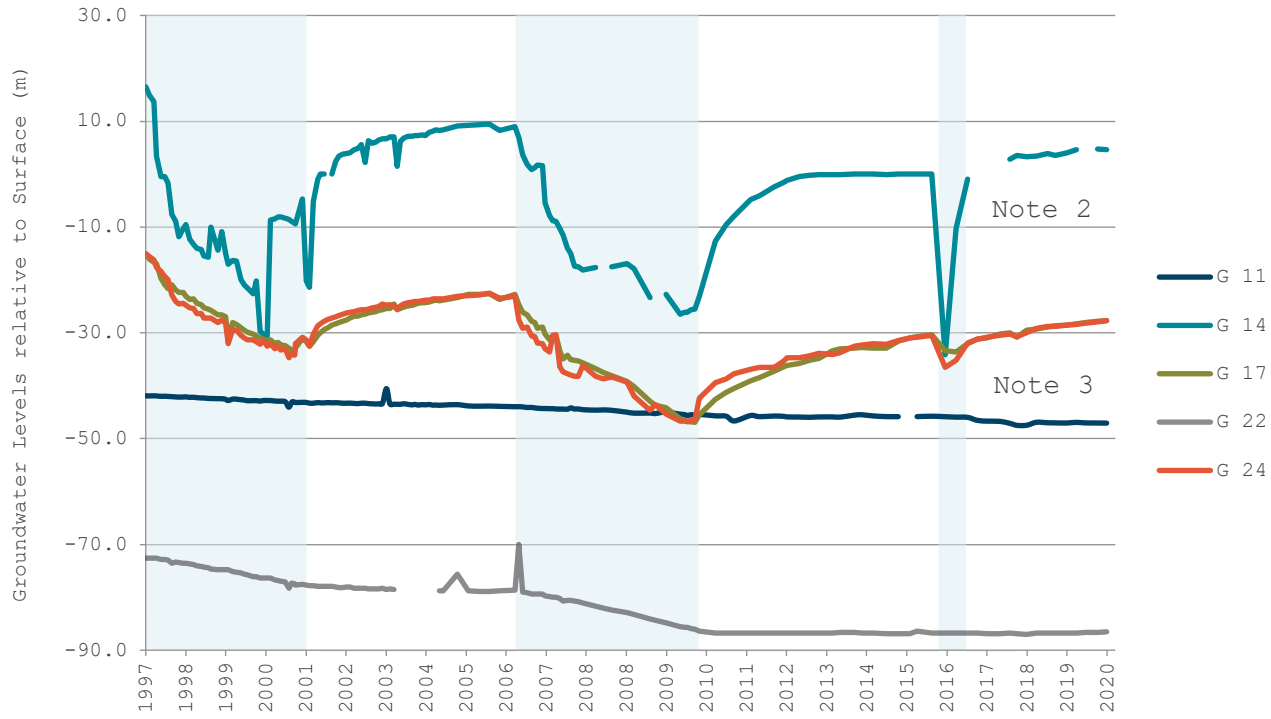
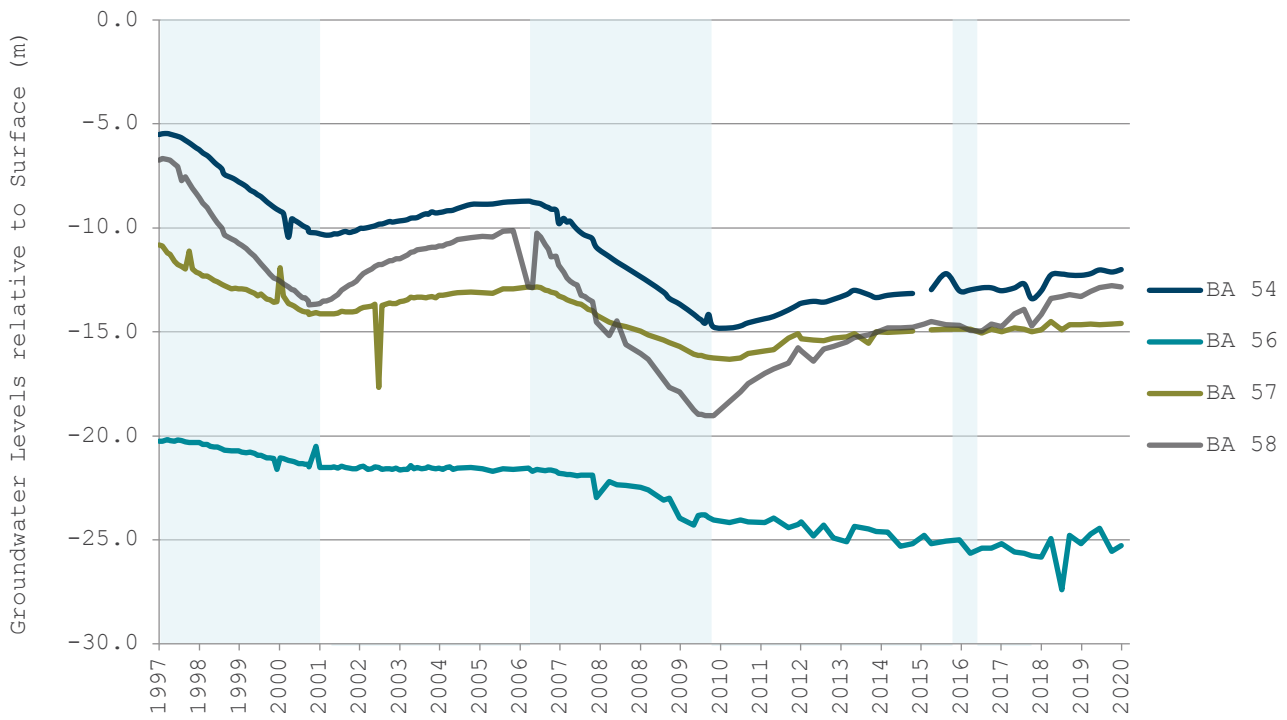


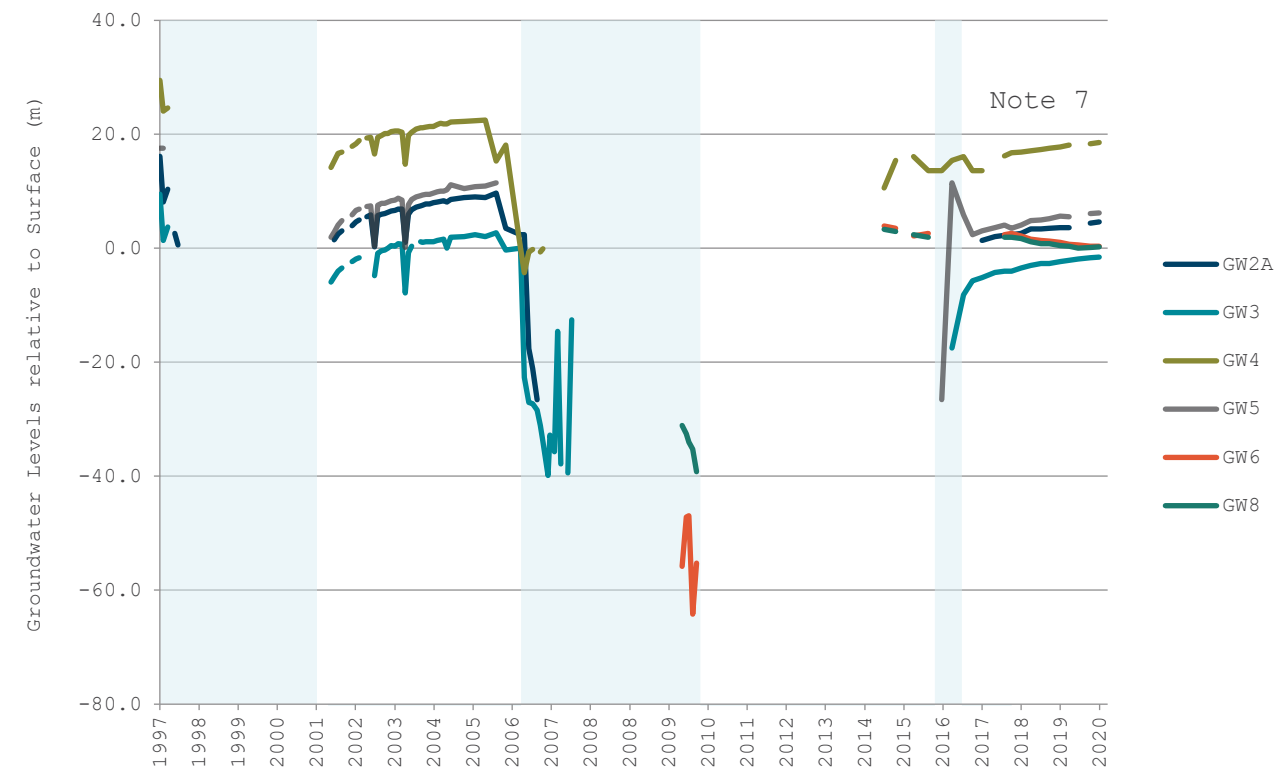
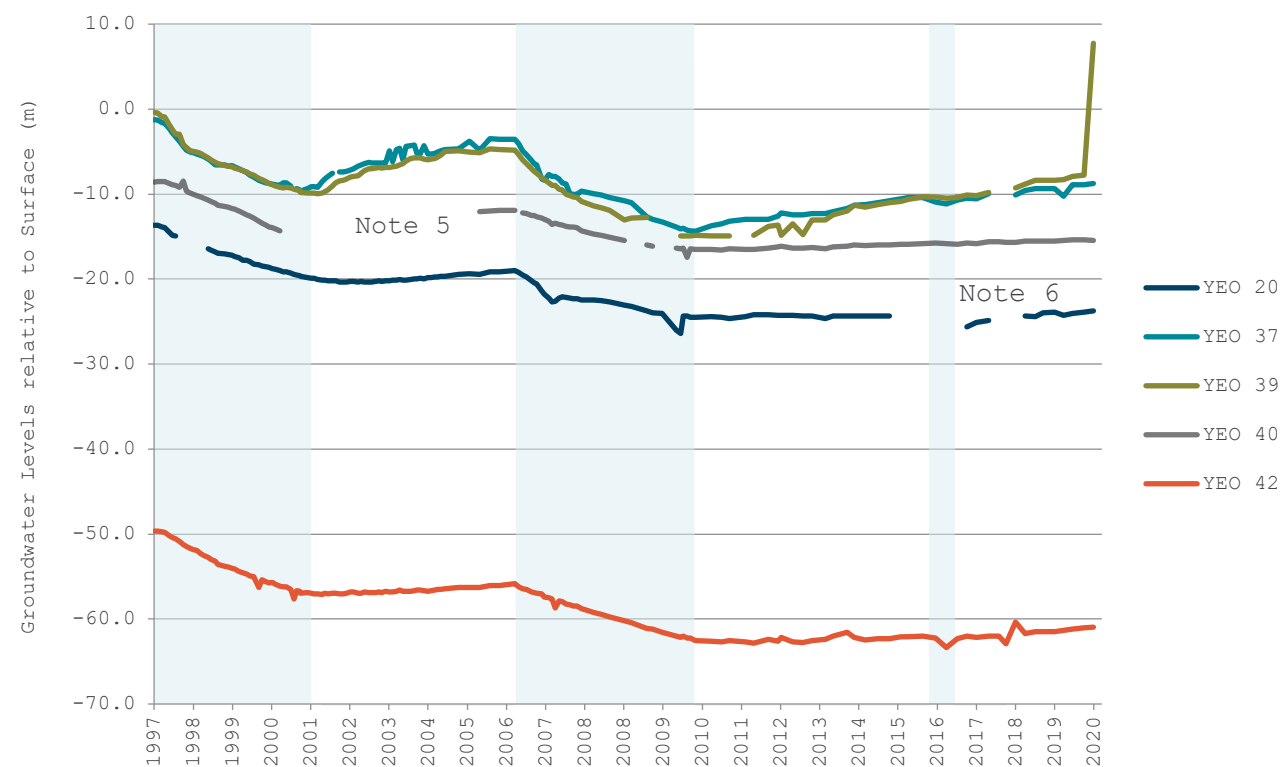
- Notes:
- 1. Light blue shading denotes periods of groundwater extraction
  - 2. A condition assessment was conducted on Y40 in 2015/16. This indicated that the screens were blocked causing erroneous readings. Y40 was refurbished in 2016/17 and is now providing representative results.
  - 3. Yeo44 (SOBN 109135) was refurbished post May 2019





Dilwyn



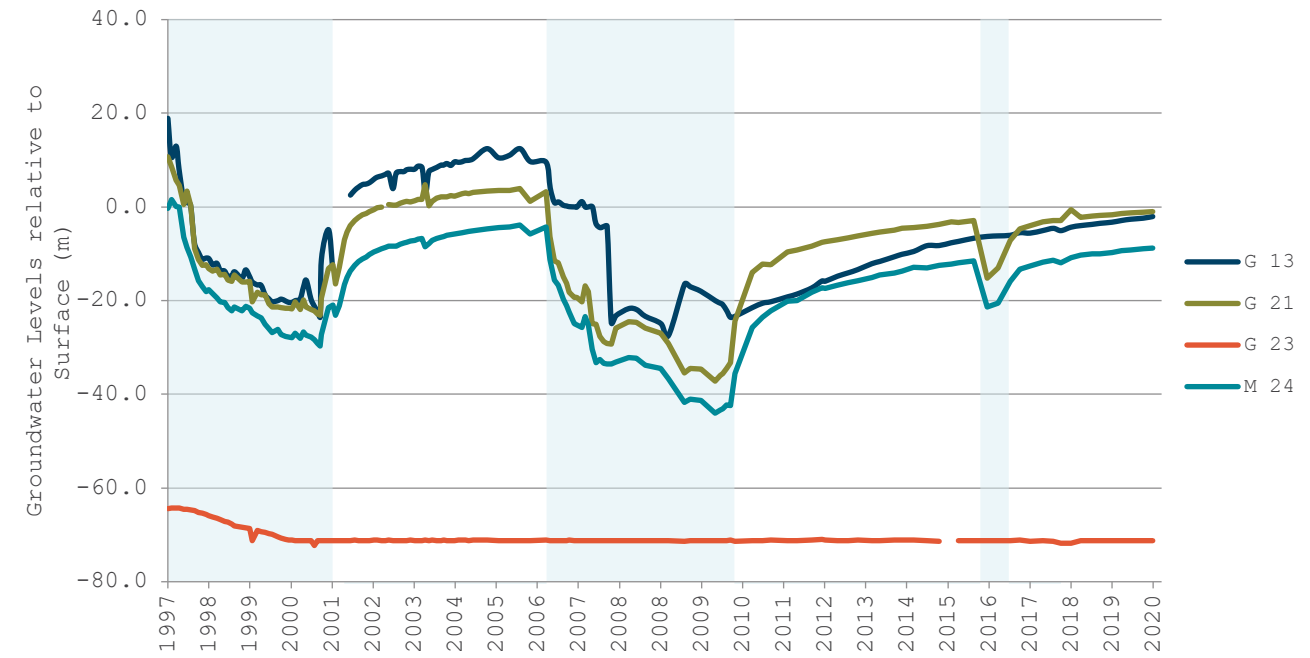
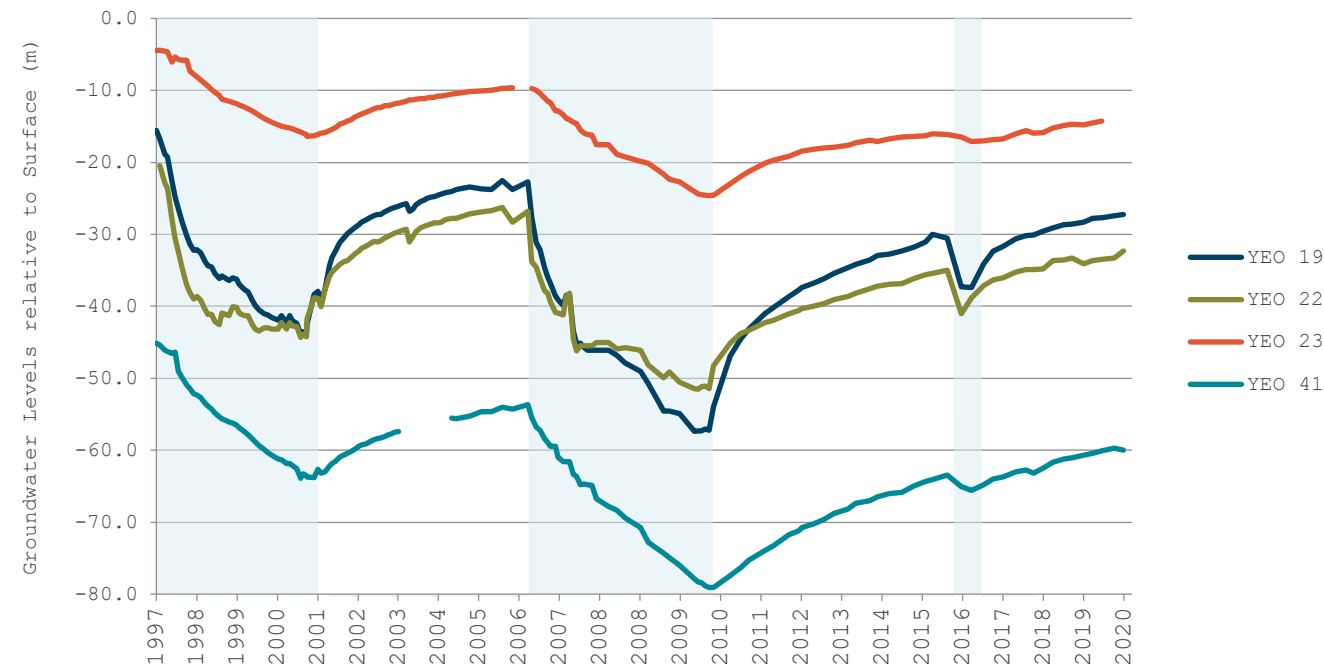
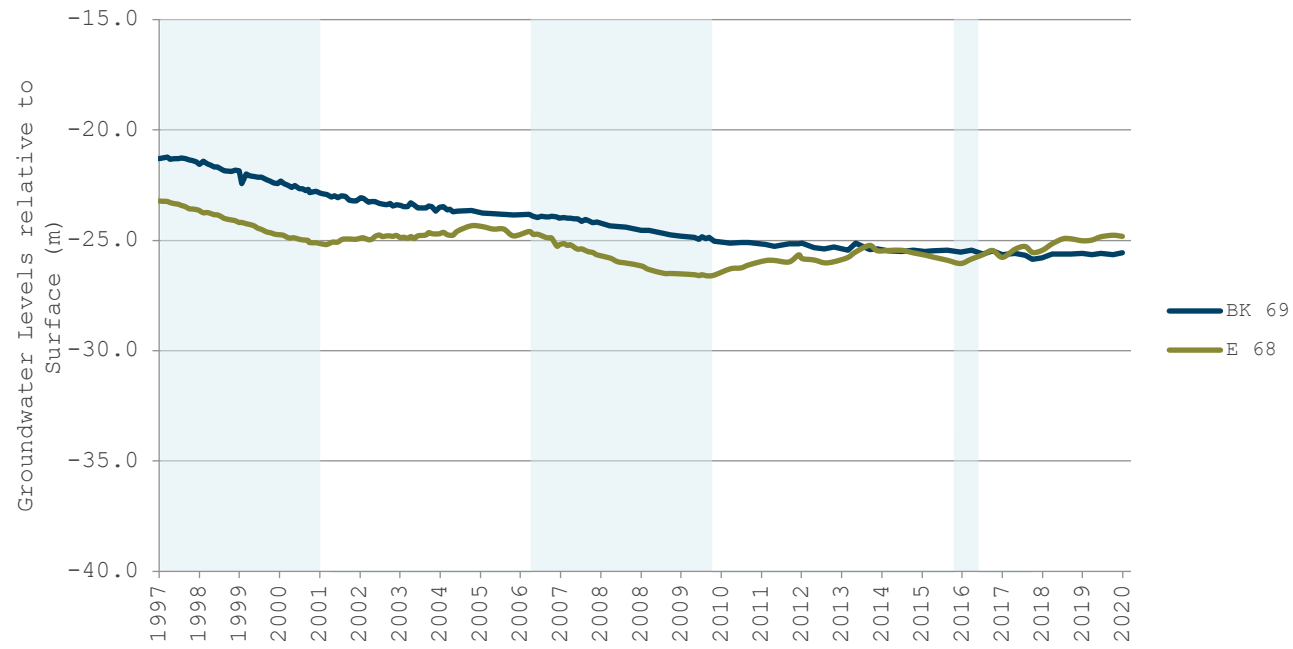


#### Notes:

1. Light blue shading denotes periods of groundwater extraction
2. G14 was artesian for a period of time in 2017 and did not have the correct fittings to enable pressure readings to be taken. Fittings have now been installed to enable pressure readings to be taken.
3. G11 has recorded a consistent decline in the groundwater levels over the whole reporting period. A condition assessment was conducted on this bore in 2015-2016 which indicated that it needed refurbishment. The refurbishment on G11 was completed in 2016-2017 and it is now providing reliable data.
4. Y41 was constructed in 2006 and therefore no data exists for this bore prior to then.
5. YEO40 has an extended period of missing data from October 2000 – June 2006. YEO40 was part of the DELWP State Observation Bore Network and was decommissioned in October 2000. A new observation bore was constructed by Barwon Water in June 2006 to replace YEO40.
6. YEO20 had a condition assessment conducted in 2015-2016 that showed it was completely blocked by tree roots. This bore has been decommissioned and a new bore has been redrilled in the same location. Readings on the new YEO20 bore commenced in June 2017. Site access prohibited some readings from being taken during 2017-2018 as operations staff were denied access to the landowner's property.
7. Data collected for the groundwater production bores varies with well head access, infrastructure arrangements and extraction. Groundwater levels are now being recorded at all production bores.



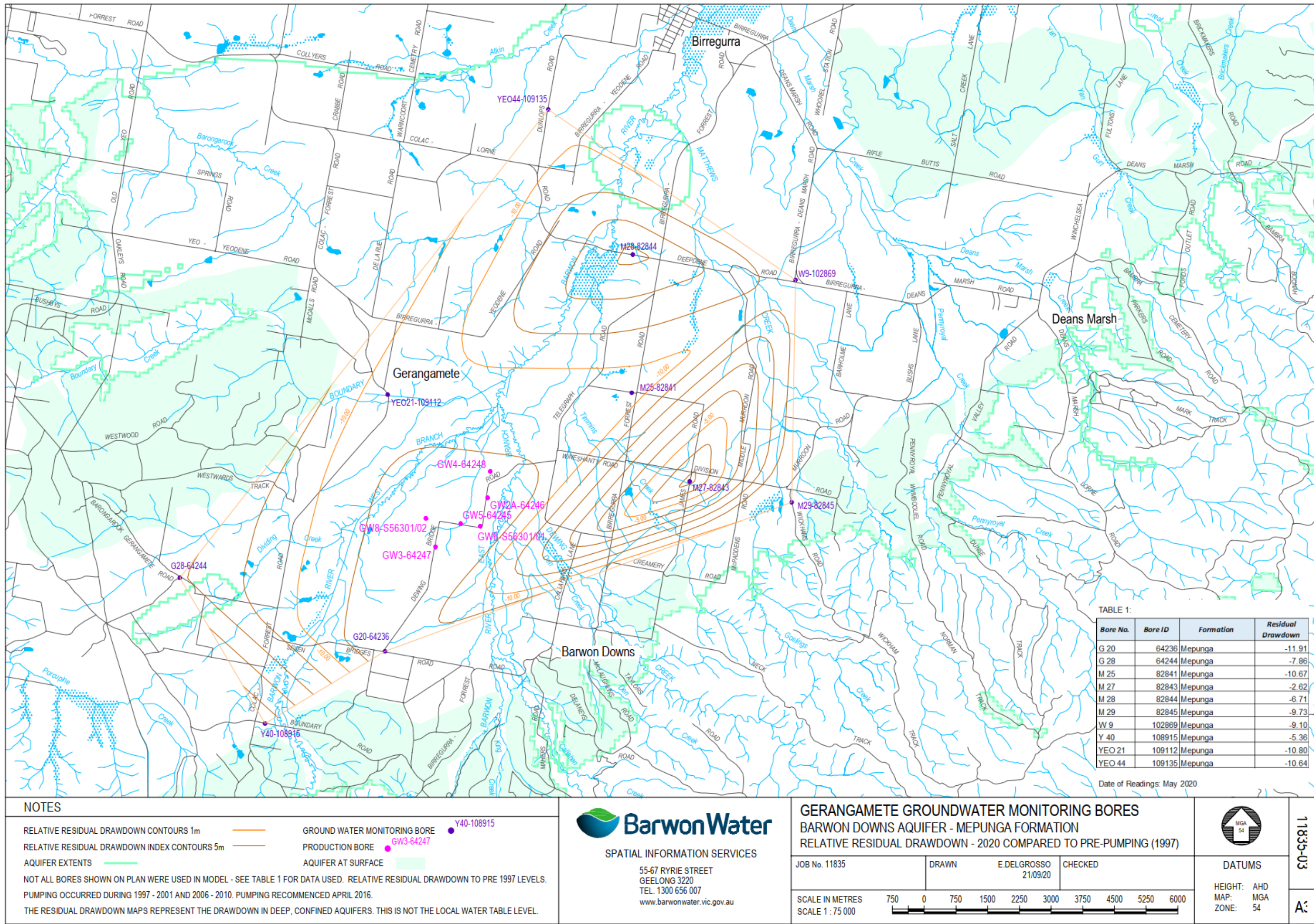
Pebble Point



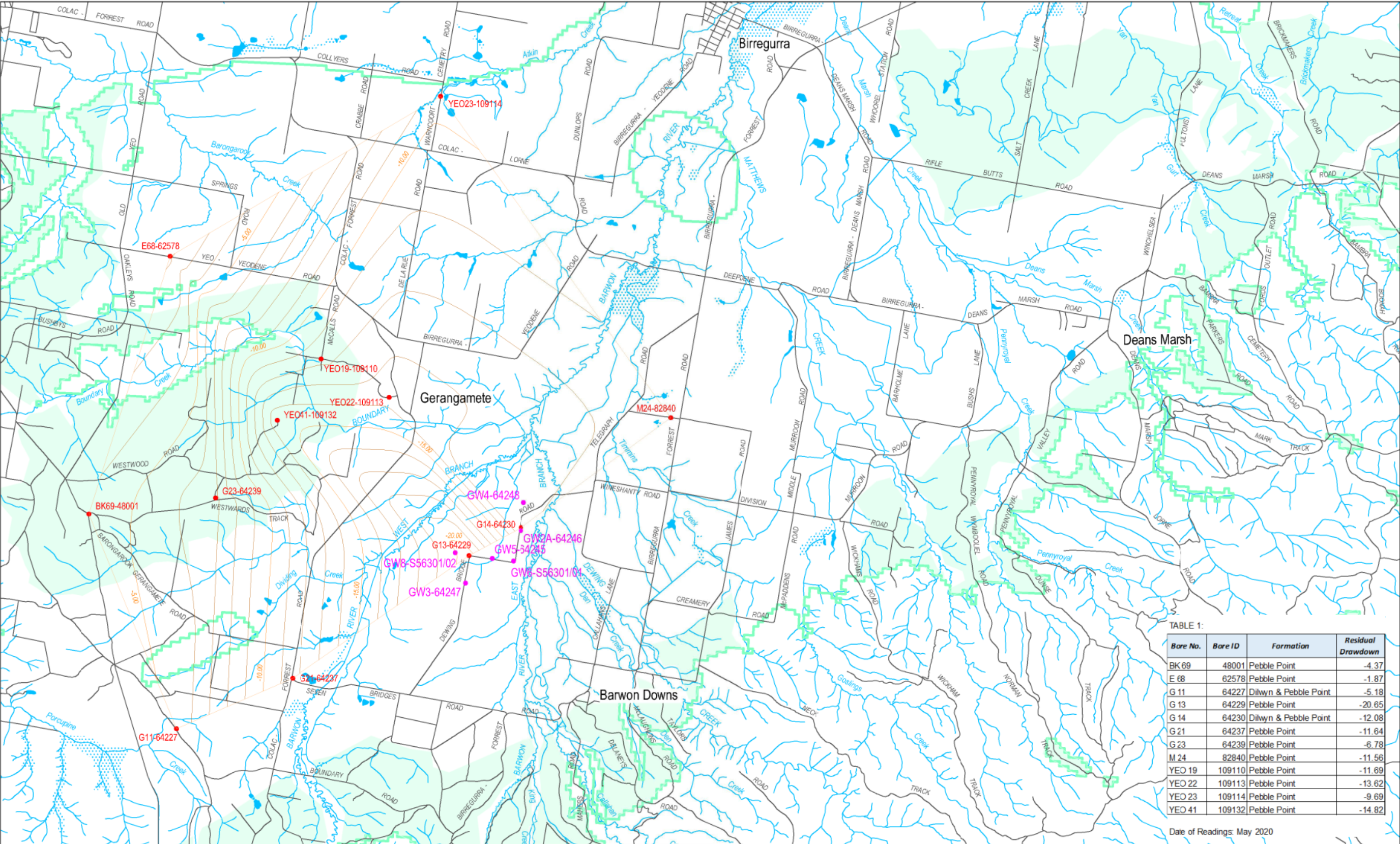
Notes:

1. Light blue shading denotes periods of groundwater extraction
2. BK69 has demonstrated a declining trend in groundwater levels. A condition assessment was conducted on this bore in 2015-2016 that confirmed that these readings were representative of the actual groundwater levels.

Appendix F – Contour Maps







**NOTES**

RELATIVE RESIDUAL DRAWDOWN CONTOURS 1m  
RELATIVE RESIDUAL DRAWDOWN INDEX CONTOURS 5m  
AQUIFER EXTENTS  
NOT ALL BORES SHOWN ON PLAN WERE USED IN MODEL - SEE TABLE 1 FOR DATA USED. RELATIVE RESIDUAL DRAWDOWN TO PRE 1997 LEVELS.  
PUMPING OCCURRED DURING 1997 - 2001 AND 2006 - 2010. PUMPING RECOMMENCED APRIL 2016.  
THE RESIDUAL DRAWDOWN MAPS REPRESENT THE DRAWDOWN IN DEEP, CONFINED AQUIFERS. THIS IS NOT THE LOCAL WATER TABLE LEVEL.

**BarwonWater**  
SPATIAL INFORMATION SERVICES  
55-67 RYRIE STREET  
GEELONG 3220  
TEL. 1300 656 007  
www.barwonwater.vic.gov.au

**GERANGAMETE GROUNDWATER MONITORING BORES**  
BARWON DOWNS AQUIFER - PEBBLE POINT FORMATION  
RELATIVE RESIDUAL DRAWDOWN - 2020 COMPARED TO PRE-PUMPING (1997)

JOB No. 11835  
DRAWN E.DELGROSSO 21/09/20  
CHECKED

SCALE IN METRES  
SCALE 1 : 75 000

**DATUMS**  
HEIGHT: AHD  
MAP: MGA  
ZONE: 54

**11835-02**  
**A3**



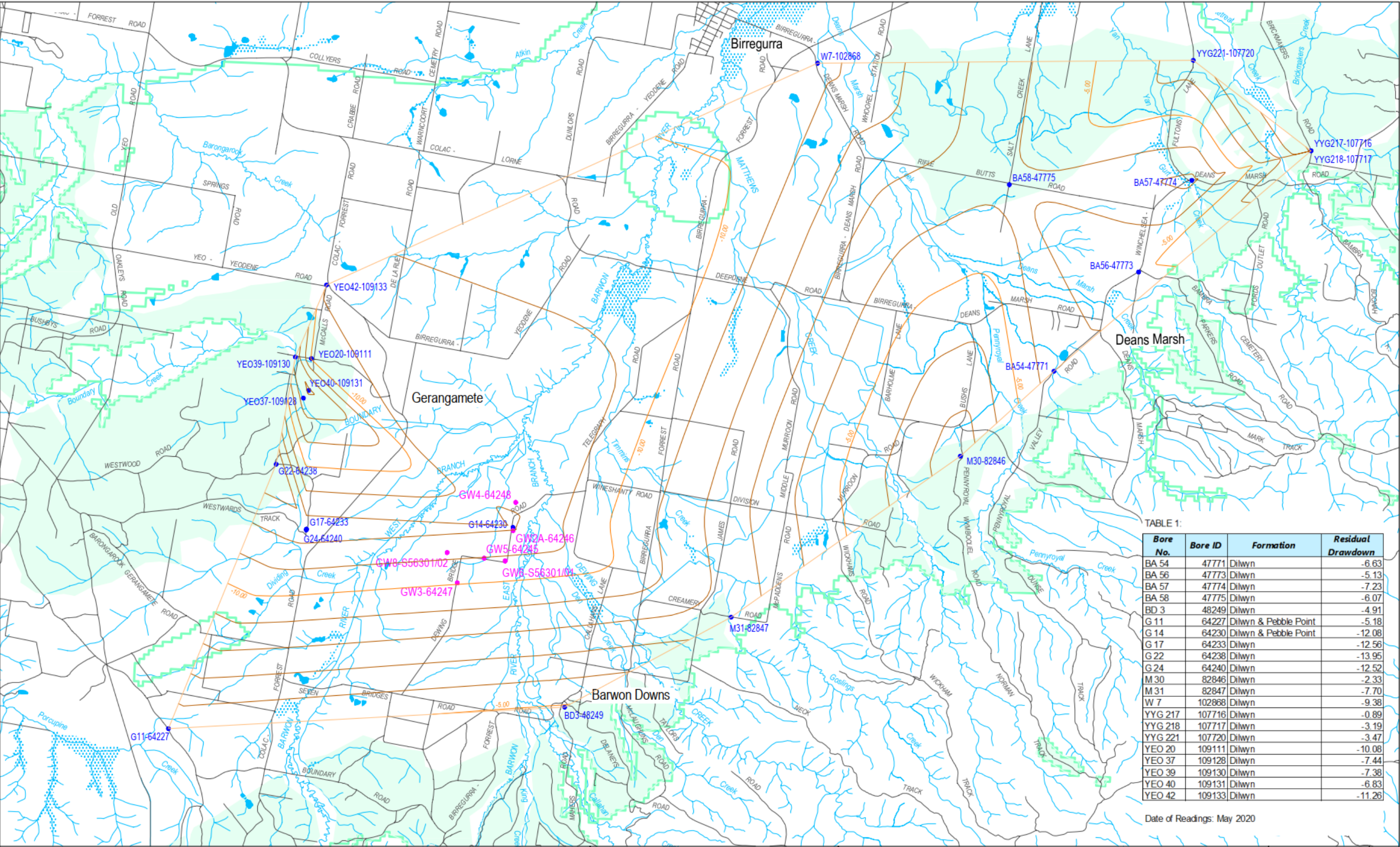


TABLE 1:

Bore No.	Bore ID	Formation	Residual Drawdown
BA 54	47771	Dilwyn	-6.63
BA 56	47773	Dilwyn	-5.13
BA 57	47774	Dilwyn	-7.23
BA 58	47775	Dilwyn	-6.07
BD 3	48249	Dilwyn	-4.91
G 11	64227	Dilwyn & Pebble Point	-5.18
G 14	64230	Dilwyn & Pebble Point	-12.08
G 17	64233	Dilwyn	-12.56
G 22	64238	Dilwyn	-13.95
G 24	64240	Dilwyn	-12.52
M 30	82846	Dilwyn	-2.33
M 31	82847	Dilwyn	-7.70
W 7	102868	Dilwyn	-9.38
YYG 217	107716	Dilwyn	-0.89
YYG 218	107717	Dilwyn	-3.19
YYG 221	107720	Dilwyn	-3.47
YEO 20	109111	Dilwyn	-10.08
YEO 37	109128	Dilwyn	-7.44
YEO 39	109130	Dilwyn	-7.38
YEO 40	109131	Dilwyn	-6.83
YEO 42	109133	Dilwyn	-11.26

Date of Readings: May 2020

NOTES

RELATIVE RESIDUAL DRAWDOWN CONTOURS 1m

RELATIVE RESIDUAL DRAWDOWN INDEX CONTOURS 5m

AQUIFER EXTENTS

NOT ALL BORES SHOWN ON PLAN WERE USED IN MODEL - SEE TABLE 1 FOR DATA USED. RELATIVE RESIDUAL DRAWDOWN TO PRE 1997 LEVELS. PUMPING OCCURRED DURING 1997 - 2001 AND 2006 - 2010. PUMPING RECOMMENCED APRIL 2016.

THE RESIDUAL DRAWDOWN MAPS REPRESENT THE DRAWDOWN IN DEEP, CONFINED AQUIFERS. THIS IS NOT THE LOCAL WATER TABLE LEVEL.

GROUND WATER MONITORING BORE

PRODUCTION BORE

AQUIFER AT SURFACE

BarwonWater

SPATIAL INFORMATION SERVICES

55-67 RYRIE STREET  
GEELONG 3220  
TEL. 1300 656 007  
www.barwonwater.vic.gov.au

GERANGAMETE GROUNDWATER MONITORING BORES

BARWON DOWNS AQUIFER - DILWYN FORMATION

RELATIVE RESIDUAL DRAWDOWN - 2020 COMPARED TO PRE-PUMPING (1997)

JOB No. 11835

DRAWN E.DELGROSSO 21/09/20

CHECKED

SCALE IN METRES

SCALE 1 : 75 000

750 0 750 1500 2250 3000 3750 4500 5250 6000

DATUMS

HEIGHT: AHD

MAP: MGA

ZONE: 54

11835-01

A



## Appendix G – Progress Report

#	Activity	Due Date	Status	Health Indicator	Comments/Risks
1.0	Meeting with SRW to be held at the Barwon Water office to develop work plan towards confirming priority actions relating to feedback provided.	30-Apr-20	Complete	Complete	Complete – Note due to COVID restrictions the meeting was held online
2.0	Complete autumn macro-invertebrates survey for Boundary Creek and the Barwon River	30-Jun-20	Complete	Complete	Report now complete and is now uploaded on website
	2.1 Consultant to undertake survey	1-Jun-20	Complete	Complete	Survey undertaken in April
	2.2 Draft report reviewed	19-Jun-20	Complete	Complete	Draft report reviewed and feedback provided
	2.3 Report finalised and published to website	29-Jun-20	Complete	Complete	
3.0	Complete soil incubation testing	31-May-20	Complete	Complete	Report has been finalised and is now uploaded on website
	3.1 Final report from Monash reviewed	20-May-20	Complete	Complete	
	3.2 Report finalised by Monash	31-May-20	Complete	Complete	
	3.3 Report published on website	29-Jun-20	Complete	Complete	
4.0	Submit Quarterly Update to SRW and publish to website	30-Jun-20	Complete	Complete	Quarterly Update uploaded to website on 30th June.
	4.1 Draft quarterly update complete - internal reviews	19-Jun-20	Complete	Complete	
	4.2 Meet with SRW and check in on format of report and review draft content	22-Jun-20	Complete	Complete	
	4.3 Finalise quarterly update and submit to SRW	30-Jun-20	Complete	Complete	
	4.4 Publish quarterly report to website	30-Jun-20	Complete	Complete	
5.0	Scoping of technical work packages required to inform detailed design and address feedback register	31-Dec-20	In progress	On track	Scoping of technical work requirements has commenced
	5.1 Identify information gaps to be filled	20-May-20	Complete	Complete	
	5.2 Identify technical work required to address feedback	1-Jun-20	Complete	Complete	
	5.3 Map out sequence of technical work to be undertaken to align with delivery of detailed design by 31 July 2021	16-Oct-20	In progress	On track	
	5.4 Confirm technical work packages required to inform detailed design	31-Dec-20	In progress	On track	
6.0	Complete installation of additional monitoring assets for the following sites identified as 'high risk' in the Surrounding Environment Investigation	31-May-21	In progress	On track	Design of stream gauges underway for installation next summer along with associated observation bores. Design of gauges needs to consider both data accuracy and fish passage objectives
	6.1 Confirm feasibility for installation of an additional bore in Big Swamp for determining interaction between LTA and Swamp (west end). If feasible include in scope for installation of monitoring bores for the surrounding environment investigation	31-Dec-20	In progress	On track	Jacobs completing the RFQ for these bore installation.
	6.2 Preliminary Environmental Assessments on all new monitoring site locations	31-Oct-20	In progress	On track	Environmental Team is currently completing these
	6.3 Installation of stream gauge and monitoring bores Barwon River (East branch)	31-May-21	In progress	On track	
	6.4 Installation of stream gauge and monitoring bores Barwon River (downstream of the confluence)	31-May-21	In progress	On track	
	6.5 Installation of stream gauge and monitoring bores Gellibrand River	31-May-21	In progress	On track	
	Installation of monitoring bores to support stream gauge monitoring already installed at Ten Mile Creek	31-May-21	In progress	On track	
	Installation of monitoring bores to support stream gauge monitoring already installed at Yahoo Creek	31-May-21	In progress	On track	
	6.8 Installation of stream gauge (Barongarook Creek), monitoring bores and establish vegetation monitoring for Groundwater dependent ecosystems west of the graben (near Yeodene)	31-May-21	In progress	On track	
	6.9 Installation of monitoring bores and establish vegetation monitoring for Groundwater dependent ecosystems east of the graben (Barwon Downs-Dean Marsh)	31-May-21	In progress	On track	
	6.10 Installation of monitoring bores and establish vegetation monitoring for Groundwater dependent ecosystems south of the graben (along the Gellibrand River)	31-May-21	In progress	On track	
7.0	Conclusion of minimum monitoring period enabling the capture of a full seasonal cycle of data to inform updates to the groundwater-surface water model and geochemical model.	31-Jul-20	Complete	Complete	1 year of monitoring completed. Monitoring of GW levels, stream flows and water quality continues in Big Swamp and Boundary Creek.
8.0	REPP Feedback Work plan - Submission and Acceptance	31-Jul-20	Complete	Complete	Complete
	8.1 BW review internally and breakdown feedback into categories of responses	19-Jun-20	Complete	Complete	
	8.2 Draft responses, meet and discuss with SRW	2-Jul-20	Complete	Complete	
	8.3 Final work plan submitted and accepted by SRW	31-Jul-20	Complete	Complete	
	8.4 Update simple REPP feedback items prior to 30/09/2020 - follow Governance Framework for REPP updates proposals	30-Sep-20	Complete	Complete	Submitted 30th of September
9.0	Governance Framework - Submission and Acceptance	31-Jul-20	Complete	Complete	Complete
	9.1 BW review internally	19-Jun-20	Complete	Complete	
	9.2 Draft Governance Framework complete, meet and discuss with SRW	3-Jul-19	Complete	Complete	
	9.3 Finalise Draft Governance Framework and submit to SRW	17-Jul-20	Complete	Complete	
	9.4 SRW accept Governance Framework	31-Jul-20	Complete	Complete	
10.0	Barwon Water Comms and Engagement Plan	30-Sep-20	Complete	Complete	
10.1	10.1 Comms and Engagement Plan Overview submitted to SRW	31-Jul-20	Complete	Complete	

#	Activity	Due Date	Status	Health Indicator	Comments/Risks
10.2	10.2 Remediation Working Group Terms of Reference completed and released	25-Sep-20	In progress	On track	
11.0	Submit proposed REPP changes to SRW to address feedback items in accordance with the accepted REPP feedback work plan	30-Sep-20	Complete	Complete	Barwon Water drafting changes to the REPP for 30th September deadline. Submission to SRW for review on the 14/09/20
12.0	Submit 2019-2020 annual report (including quarterly update for Q1 2020-21) to SRW and publish to website	30-Sep-20	Complete	Complete	Data presentation - review Barwon Downs Annual report
13.0	Establish vegetation baseline monitoring for Boundary Creek and Big Swamp Remediation Plan:	31-Dec-20	Not started		Need to start this soon post annual report
	13.1 Engage consultant	TBD	Not started		
	13.2 Undertake vegetation baseline survey building of survey work done to inform development of the REPP	TBD	Not started		
	13.3 Technical review of findings	TBD	Not started		
13.4	13.4 Finalise report and publish report to website	TBD	Not started		
14.0	Update groundwater-surface water model and geochemical model	31-Dec-20	In progress	At Risk	Timeframes are tight - Focus for October
	14.1 Engage consultants	10-Jul-20	Complete	Complete	Complete
	14.2 Conceptualisation and Model Design	2-Oct-20	In progress	On track	Data transferred to GHD. Conceptualisation begun
	14.3 Calibration and Sensitivity Analysis	26-Oct-20	Not started		
	14.4 Predictive Modelling	30-Nov-20	Not started		
	14.5 Uncertainty Analysis	14-Dec-20	Not started		
	14.6 Review draft report	20-Dec-20			
	14.7 Finalise report	31-Dec-20			
	14.8 Publish report to website	31-Dec-20	Not started		
15.0	Complete stage 1 detailed design for Boundary Creek and Big Swamp Remediation Plan: - obtain / progress permits	TBD	Not started		
16.0	Submit quarterly update to SRW and publish to website	31-Dec-20	Not started		
17.0	Submit quarterly update to SRW and publish to website	31-Mar-21	Not started		
18.0	Infill the existing fire trenches and the agricultural drain at the eastern end of the swamp to allow the swamp to retain more water over the winter months: - obtain necessary permits and approvals - engage contractor - undertake works	TBD	Not started		
19.0	Submit quarterly report to SRW and publish to website	30-Jun-21	Not started		
20.0	Complete feasibility assessment for in-stream contingency measures	31-May-21	Not started		
21.0	Complete stage 2 detailed design: - specification to confirm size, location and construction requirements for hydraulic barriers	31-May-21	Not started		
22.0	Submission of detailed design of the hydraulic barriers outlining proposed controls or actions and any revisions to success measures/targets.  SRW to accept the detailed design, including proposed actions, controls, and success measures/targets.	31-Jul-21	Not started		
23.0	Submit annual report (incorporating quarterly update) to SRW and publish to website	30-Sep-21	Not started		
24.0	Submit quarterly report to SRW and publish to website	31-Dec-21	Not started		
25.0	Construction of hydraulic barriers: - engage consultants and contractors - undertake construction	31-Mar-22	Not started		
26.0	Submit quarterly report to SRW and publish to website	31-Mar-22	Not started		
27.0	Submit quarterly report to SRW and publish to website	30-Jun-22	Not started		
28.0	Conclusion of monitoring period for Surrounding Area Investigation enabling the capture of a full seasonal cycle of data (12 month minimum) to inform updates to the groundwater-surface water model and geochemical model.	31-Jul-22	Not started		
29.0	Submit quarterly report to SRW and publish to website	30-Sep-22	Not started		
30.0	Update regional groundwater model or build new local scale groundwater models for the Surrounding Investigation Area 'high' risk sites to assess magnitude of impact as a result of historic groundwater management.	31-Oct-22	Not started		
31.0	Submit quarterly report to SRW and publish to website	31-Dec-22	Not started		
32.0	Review risk assessment for 'high' risk areas for the Surrounding Area Investigation to confirm risk rankings based on updated groundwater model/s		Not started		
33.0	Submit quarterly report to SRW and publish to website	31-Mar-23	Not started		
34.0	Submit quarterly report to SRW and publish to website	30-Jun-23	Not started		
35.0	Outcomes of the Surrounding Area Investigation to be provided to Southern Rural Water to determine if further remedial works is required.  SRW to decide if further action is required.	31-Jul-23	Not started		
36.0	Submit annual report to SRW and publish to website	30-Sep-23	Not started		
37.0	Submit quarterly report to SRW and publish to website	31-Dec-23	Not started		