Appendixes

To

Otway Water Book 51

APPENDICES.

APPENDIX 1

Barwon Water

Minutes

Barwon Downs Groundwater Community Reference Group

Date:	Tuesday 17 February 2015
Time:	4.00 pm – 6.30 pm
Location:	COPACC
Present:	Community: Jan Greig (Chair), Doug Chant, Gavin Brien, Hans Fankhanel, Malcolm Gardiner, Robert Maxwell, Robin Povey. Additional guest: Nellie Shalley. Jacobs SKM: Dr Andrew Sharpe, Stephen Parsons, Dr Joshua Hale. Barwon Water: Carl Bicknell, Justin Franklin, Jo Lee, Casey Tomkins.
Apologies:	Henry Bongers.

1.0 Welcome

- Apologies: Henry Bongers

C 1

Jan advised that she would like to invite Nellie Shalley to join the CRG as a permanent observer with full speaking rights.

Nellie queried why her initial application to sit on the CRG had been declined.

Carl advised Barwon Water did not think it was appropriate for anyone pursuing legal action against the organisation to be on the reference group, however time has moved on and with the matter not being pursued, it can now be considered as 'in the past'.

- Confirmation of minutes

C 2

Malcolm requested his statements be added to the November 2014 meeting minutes:

- His query of local landholders' invitations to the meeting. He advised that three of the Shalleys, Potter, Stewart and Alford landowners were not included in the invitation.
- His disappointment that Daryl Sell did not turn up, as he could confirm what summer flows along Boundary Creek were like pre-supplementary flows. Anecdotal evidence suggests that pools in the area were spring fed.
- Regarding historical knowledge, he mentioned the Rural Water Commission carried out extensive surveys in 1990s before supplementary flows were released.
- If Barwon Water provided him historical data and reports to look at, that he would fill in gaps with material he has. Additionally, that he would not do much until Barwon Water cooperates with his requests.
- Stewart Anderson investigated and found it would be too costly to investigate the cause of Big Swamp turning into an ASS swamp.
- That a climate change report which was to be included at the next meeting was not included.

Jan advised that the minute taking process is not intended to be a verbatim report of meeting.

C 3

Carl suggested in future, any amendments to minutes of a previous meeting be added as

additional notes in the minutes of the current meeting.

ACTION: Going forward, amendments to minutes to be added as additional notes

C 4

Robert asked for his comments on past cattle deaths in Boundary Creek be added to minutes.

- Confirmation of agenda: confirmed.
- Additional items: no additional items.

2.0 Presentation of stream flow objectives

C 5

Refer to presentation by Dr Joshua Hale (Jacobs SKM).

Introduction/background

Jan asked for a clear definition of a FLOWS study.

Josh advised it involved looking at what the creek previously supported, what it currently supports and what it might support in the future. Andrew added the study determines what flow is required in a river system to support particular values (i.e. fish, water quality, and certain types of vegetation).

C 6

Malcolm questioned if there was a change in the study from investigating two reaches to three reaches. Josh advised that it was Jacobs' assessment that there has not been a change in habitat since Lloyd's (2005) work on reach three, therefore no direct assessment for reach three is required.

Jacobs will review available literature to describe current environmental values associated with Reach three and to document known changes in environmental values. Jacobs will also comment on the extent to which the current flow recommendations for reach three are likely to support the values that would have likely been present before the Barwon Downs borefield began operating. The review will also consider the extent to which other catchment impacts such as land clearing and stock access, may affect the identified environmental values.

ACTION: Jacobs to review available literature for changes to environmental values in reach three

Reach 1

C 7

Reach one has potential to be habitat to 12 different fish species. Of the 12 species, the study found that if the right environment was provided to four of those species, they would likely act as an umbrella species to provide the right habitat and flow conditions for the remaining species.

The objective of this reach is to identify a flow regime that would support the ecological values that were historically associated with the reach. The current flow regime (taking account of existing flow releases) will be compared against the recommended flow regime to determine the extent to which groundwater harvesting for the Barwon Downs scheme has likely affected those environmental values.

The study has made preliminary recommendations that to maintain refuge pools, 50cm of water depth to certain water quality standards is likely to be sufficient to support the fish life. Work is underway to determine critical flows that can support these refuge pools during summer.

Reach 2

This reach is broader and damper than reach one, and has a much less defined channel. The vegetation in this reach is very diverse with no evidence of significant die back and doesn't appear to have changed much since European settlement.

The objective for reach two is to maintain important habitat (i.e. keeping broad areas moist and maintaining flow paths) which would allow fauna to respond. As an example, Andrew explained

the rotting wood from trees in reach two created food for macro-invertebrates.

C 8

Jan asked if a drop in groundwater levels could be substituted by a rise in surface water levels. Andrew advised that if the groundwater levels dropped but enough water was being delivered upstream, the habitat would not care about water type.

Malcolm observed that supplementary flows kept that area pretty well during drought. Flows went halfway through Big Swamp and disappeared, however after the drought broke, the area 800 m from McDonalds dam dried out. He went upstream to the crossing with a resident (Victoria); the pair walked a kilometre upstream and still found the creek dry.

Andrew asked how long the area was dry for and Malcolm replied he did not check it after that visit. He did ask Southern Rural Water for an explanation and they said it was related to a lack of rainfall, however the period in question was after the drought.

Steve said a nearby bore, plus anecdotal evidence, suggests the water table in the area would be very shallow. Jan wondered whether the supplementary flows were going straight to the aquifer.

Doug commented there were once floods down Boundary Creek which would have flushed out issues in reach two. Andrew advised that a flood wouldn't flush a lot out; rather it would fill the wide area of the valley to a shallow depth. Any debris, such as logs, that was dislodged would be reasonably slow moving.

Jan asked Nellie what happened in the top reaches during the 1996 flood. Nellie recalled the area was underwater and they could only get to the bottom of their hill.

Andrew advised that flood events were important for allowing fish and platypus to move into new areas. They would otherwise struggle to move between the reaches in usual times.

Reach 3

Aerial photos of the reach indicate it is a fairly straight section that does not appear to be like a natural creek. Nellie advised it had never been channelised in her time (60 years), and that her family has been there since 1912 and had never channelised the creek in their time.

Andrew suggested channelisation may have occurred before the Shalleys occupied the land. Jan said other areas near her property had been channelised (particularly Gannons), and that many of them are over 150 years old.

Josh said the habitat of the area is relatively simple. While putting flows down the reach would provide a habitat for fish, it did not provide much habitat diversity (which fauna like).

C 9

Malcolm said the Tunbridge (1986) study indicated the reach was very healthy and supported black fish (territorial fish that require permanent flowing water). Malcolm believes that this contradicts what Lloyd found in 2006. It was the only tributary of the Barwon in 1986, Tunbridge recorded black fish.

Andrew believed other issues, such as land clearing and stock access (as seen in this area of the Barwon) was having just as much an impact on the area.

Malcolm asked Nellie if their farming practices had changed. She advised the section of creek along their property is fenced off and they have plantations along it.

Malcolm said Lloyd's study gave the wrong impression of what Boundary Creek was like pre-pumping.

Andrew said it looked like a lot of other parts of the West Barwon River – they are not affected by groundwater pumping but look the same. He said the creek did not get markedly better until looking at reaches one and two.

Gavin said there was no ecological value in the West Barwon River as it had been straightened.

C 10

Malcolm said Lloyd's study (which recommends two fortnightly periods of no flow for those reaches of the river) could not be used, as historically it was not typical of what the creek looks like. Andrew countered this by stating that the two fortnightly periods of no flow would be enough flow to maintain refuge pools if reach three had any ecological value worth preserving. It should be noted that Malcolm disagreed with this. Andrew further added that it is likely that these pools no longer exist due to channelisation effects (e.g. eroded banks). Malcolm requested that this discussion be noted in the minutes.

Jan said looking at it, there was no doubt the creek had been channelised (similar to Matthews and Gosling Creek), however when it happened was another matter. She believes it places a greater need to look at the period between 1986 and 2005 to see if any work had been done that could provide answers.

ACTION: Jacobs to review literature between 1986 and 2005 for previous reports on channelisation

Gavin said there were a lot of other creeks in other parts that had been started from a plough line that were now 20 feet deep.

Jan said the situation was the reality of the location. She believed it was important to look at what happens with pumping, recognising that pumping is always coincident with drought.

Doug suggested the plough line was put through the swamp areas to use the land for agriculture, hence changing the environment. He pointed out water was being put in artificially to maintain an environment.

Robin highlighted that the situation raises an interesting point about how far back you look and how many parameters you examine to determine impacts based on rainfall, groundwater and channelisation. He said the group needed to draw a line as a baseline from this point and move forward.

C 11

Malcolm said Tunbridge (1986) was still alive and could set the record straight on what the area was like at that time. As the FLOWS method talks about looking at history, it needed to be considered.

ACTION: Barwon Water to consider contacting Tunbridge to discuss his study

In concluding, Josh observed the values for reach one didn't spark a lot of discussion, that reach two was quite different to reach one and had some different processes that needed to be considered. Finally, more thinking is required for reach three, which would be considered.

C 12

Malcolm asked if a project advisory group being set up. Josh advised the CRG is the advisory group, having had the objectives of each reach presented to them.

3.0 Presentation of western flank review

Refer to presentation by Steve Parsons (Jacobs SKM).

Malcolm asked why there was a gap in the data (the grey area in the middle of the Graben) divide (on the 2014 water levels slide).

Steve advised the bore had interpreted the bedrock as being high, but believes it's a geological misinterpretation.

Doug noted the changes over the years 2014 – 2010. Steve said 2010 was the borefield's peak use, and now being in recovery mode the divide is shifting towards where it was in 1987.

Gavin asked if this would allow for predictions on how quickly the divide could move back to where it had been. Steve said they could make rough predictions. The divide may move back,

but this does not necessarily mean that the levels will return to the same elevation as 1987. Whether the divide has moved isn't the full story, focus also needs to be around drawdown.

Malcolm asked why there was not much detail around 10 Mile Creek.

Steve advised the study looked at the area generally (i.e. the groundwater level mapping included 10 Mile Creek), and that in addition to a bore being put in, it was one of the vegetation sites being investigated.

Malcolm believed the area is important to look at, as the conceptual model would suggest that impacts are more likely to occur in this area rather than around the Gellibrand/ Porcupine area.

Robert commented Porcupine Creek dries up every year. Steve advised Porcupine gets some flow from the aquitard, however 10 Mile Creek is fed by the aquifer. He advised the cone of influence plotted on drawdown mapping for 2012 did not get to 10 Mile Creek.

Robert believed the area was fed from the recharge area, which Steve confirmed. He believed the impact on 10 Mile Creek had been negligible and asked if a nearby gauge was still being monitored. Malcolm advised it was decommissioned in 2009.

Steve said the site was part of the vegetation study and the newly installed bore would look at changes in groundwater levels. There are two deep bores down the road but the shallow one installed will complement those.

Jan asked the slides be distributed for a Q&A session at a later date. She asked the group to put any questions on the record and for Barwon Water to come back with answers. Jan observed that, based on the slides, there did not appear to be any influence on the western flank, but asked the group to come up with questions and be comfortable with the outcome.

ACTION: Barwon Water to distribute slides from western flank review presentation

ACTION: CRG members to review slides and forward any questions to Barwon Water

Steve advised the study was never meant to be definitive, but instead look at whether more bores/gauges are needed to address concerns about the area.

Carl asked if the answer to the question was no. Steve advised that was their recommendation (not to put in any additional bores/gauges). Carl said he would be bothered if detailed further investigations were conducted for very little result.

Jan said any further investigations would need a good reason to be justified, but she believed an explanation was all that was required.

Robin commented it would be interesting to get Jacobs SKM's interpretations and conclusions rather than a summary of what was presented.

Steve said there were other aspects that needed to be integrated, which was still a while off. The group has heard segments of the overall study which needs to be pulled in.

Justin asked if there were any high-level conclusions yet. Steve advised a key conclusion was the existence of a hydraulic barrier that meant there was minimal impact in the Gellibrand area. The other major conclusion was that the numerical model needs updating.

Robin believed the group was at a crucial point where it could tick off any impacts to Gellibrand and swing its focus to 10 Mile Creek.

Robert believed there should be some focus on recharging the area to protect summer flows.

Malcolm requested a copy of the draft report. Jan suggested offering Barwon Water the opportunity to read the report, but advised the group would like to know once the report is finalised – at which stage it would be appropriate to allow the group access to the report.

Doug suggested that once satisfied with the draft report, Barwon Water could perhaps release it

to a few CRG members for comment. This would mean any issues would already be addressed before finalising the report.

Jan said while she did not like draft reports being circulated generally, any draft reports issued would need an 'in confidence' sticker applied to protect people.

Justin advised Barwon Water's efforts had been on getting presentations ready for the meeting. He advised it would be ready by the May meeting, but if it was ready prior that it could be viewed. Carl advised it was for the purposes of providing feedback, not to grab paragraphs and publish.

Hans said he would like to view the draft report and comment on it in addition to the meeting's presentations.

Carl suggested people put forward any questions from the meeting's presentations, and that some questions may be answered due to the more detailed nature of the draft report.

ACTION: Barwon Water to distribute the draft report in confidence when available

ACTION: CRG members to feed any questions/comments on the documents back to Barwon Water

4.0 Communications update

- Action plan

A communications action plan for the first six months of 2015 was distributed to the committee. Casey advised the period would be relatively quiet for communications. One of the main items to be communicated was the completion of works to install new monitoring equipment in June.

C 13

- Boundary Creek – opportunity for community input

Casey advised two advertisements had been placed in the Colac Herald (Friday 30 January and Friday 13 February) calling for information on Boundary Creek. A number of community members had delivered information to Barwon Water's Colac office. This information will be passed on to Jacobs SKM to inform the FLOWS study.

5.0 General

- Monitoring program update: this agenda item was skipped due to time constraints.

C 14

Malcolm requested that Neil Stewart be provided copies of meeting minutes. He advised Neil has had no contact whatsoever. Jan questioned whether meeting minutes should be going outside of the committee, and instead suggested he be kept in the loop on information.

ACTION: Barwon Water to contact Neil Stewart regarding the monitoring program

Malcolm asked that Justin update the group on his meeting with Professor Bush on Big Swamp.

ACTION: Justin to update group on meeting with Professor Bush

Doug requested committee members be given a folder to keep his their agendas/minutes in

ACTION: Barwon Water to provide folders for each committee member

- Agenda and date of next meeting: Tuesday 19 May 2015, 4.00 pm – 6.30 pm.

6.0 Close

-----Original Message-----
From: Malcolm Gardiner [redacted]
Sent: Wednesday, 20 May 2015 9:34 AM
To: Justin Franklin
Subject: Last night's meeting.

Hello Justin,
This email is a follow up to some of the things discussed last night to clarify what was being asked for and in some cases the answer given.

Extract taken from this email sent to Justin Franklin of Barwon Water.

I know that things got a bit heated and out of hand last night regarding Nellie Shalley being asked to cease being a member of the Group but I would like to make it clear that at this stage there is no legal action taking place between the group of people wanting to discuss their stock and domestic water supply along Boundary Creek with Barwon Water. This process of trying to discuss the matter with BW has been going on for nearly two years. Now that a meeting has been set up for Friday I am sure that meaningful and fruitful discussion will take place. Consequently I think it should be considered that Nellie be asked if she would be willing to come back onto the Group. See what you think.

Regards,
Malcolm.

No such invitation was given to Nellie.

APPENDIX 2

From: Jo Lee <Joanna.Lee@barwonwater.vic.gov.au>
To: 'John Day' <johnday8@bigpond.com.au>
Subject: Invitation to FLOWS worksop - 17 FEB 2015
Date: 6 February 2015 4:19:42 pm AEDT

Afternoon John,

Barwon Water would like to invite you to a follow up workshop for the Boundary Creek FLOWS study. The workshop's goal is to reach consensus on the ecological objectives for the catchment. This will ensure all stakeholders, including the community, have a clear understanding of what the objectives are trying to achieve (i.e. maintain, improve or rehabilitate certain values).

The workshop will include discussion on:

- How the computer model for Boundary Creek was developed and what early results are indicating,
- The draft issues paper describing the historical and current distribution and condition of environmental values in Boundary Creek, and
- The flow objectives for each of the reaches and what flow is needed to meet those objectives.

The workshop will be held at COPACC on Tuesday 17 February at 4.00pm. For catering purposes, please advise if you can attend by Friday 13 February.

If you have any questions, please give me a call.
Jo
Joanna Lee
Senior Engineer, Water Resources Planning I Barwon Water
61-67 Ryrie Street (PO Box 659) Geelong VIC 3220

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From: John Day [mailto:johnday8@bigpond.com.au]
Sent: Friday, 2 January 2015 10:29 AM
To: Jo Lee
Subject: boundry creek

Dear Joanna, you called me on Christmas eve looking for photos of boundry creek and I told you that it was running ever so slightly. Well, that must have surprised you to as that evening it stopped altogether and has since all dried up. On previous flow events I have noticed the coincide with meetings about Boundry Creek. Probably makes you feel good. I also spoke to a neighbour, Alan & Heather Shally, whom have property on boundry creek and haven't been informed or included. They have been here for their whole life, (70 years or there about), and would be a wealth of knowledge. Although I see this whole exercise as a paper only one, so you look like your interested considering the environmental flows your talking about will only occur around meeting schedules. john day

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From: Justin Franklin <Justin.Franklin@barwonwater.vic.gov.au>
To: "'johnday8@bigpond.com.au'" <johnday8@bigpond.com.au>
Cc: Jo Lee <Joanna.Lee@barwonwater.vic.gov.au>
Subject: FW: Response to John Day - draft for review
Date: 6 January 2015 3:35:22 pm AEDT

Dear John,

Thank you for contacting Joanna Lee here at Barwon Water regarding the Boundary Creek FLOWS assessment study. Your feedback is appreciated.

As you correctly pointed out, flow in Boundary Creek at Colac-Forest Road ceased at the end of December. Barwon Water has been releasing two megalitres per day into the creek at Bushby's Lane, as required by its borefield licence, since September last year. Despite this additional water, after peaking at five megalitres per day on October 9 flows at the Colac-Forest Rd gauge have been declining and finally stopped completely on December 31. As you may have noticed, rainfall in the Boundary Creek catchment has been well below average between October and December 2014, with December being particularly dry. This low rainfall would have had a significant impact on water levels in Boundary Creek.

The Barwon Downs Groundwater Community Reference Group was established in 2013 to provide feedback on the revised groundwater monitoring program prior to licence renewal in 2019. As you are aware, the group's last meeting on November 17 included a workshop on stream flow and aquatic ecology in Boundary Creek. The purpose of undertaking an environmental flows study is to determine the flow regime and volume of water needed to maintain aquatic values in Boundary Creek within parts of the creek that have remaining ecological value (i.e. not overwhelmed by land clearing, channel straightening, unrestricted stock access or willow and blackberry infestation). An invitation was extended to landowners, including yourself, along parts of Boundary Creek where ecological value was identified in previous field inspections conducted by specialists. Your neighbours Alan and Heather Shalley were not contacted as their property does not intersect with these sections of the creek that have ecological value.

In response to your suggestion to cast the net wider in the search for relevant information on Boundary Creek, Barwon Water will be seeking information by advertising in the Colac Herald and also through direct contact with all landholders along the creek, including your neighbours.

Thanks again for your feedback, if you have any further queries please don't hesitate to contact Jo Lee or myself.

Kind regards,

Justin Franklin
Acting Manager, Asset Planning | Barwon Water
61-67 Ryrie Street (PO Box 659) Geelong VIC 3220

APPENDIX 3

An important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to identify the aquatic values of the Boundary Creek and to determine the flow requirements of these values, in accordance with the scope of services set out in the contract between Jacobs and Barwon Water. That scope of services, as described in this report, was developed with Barwon Water.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Barwon Water and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

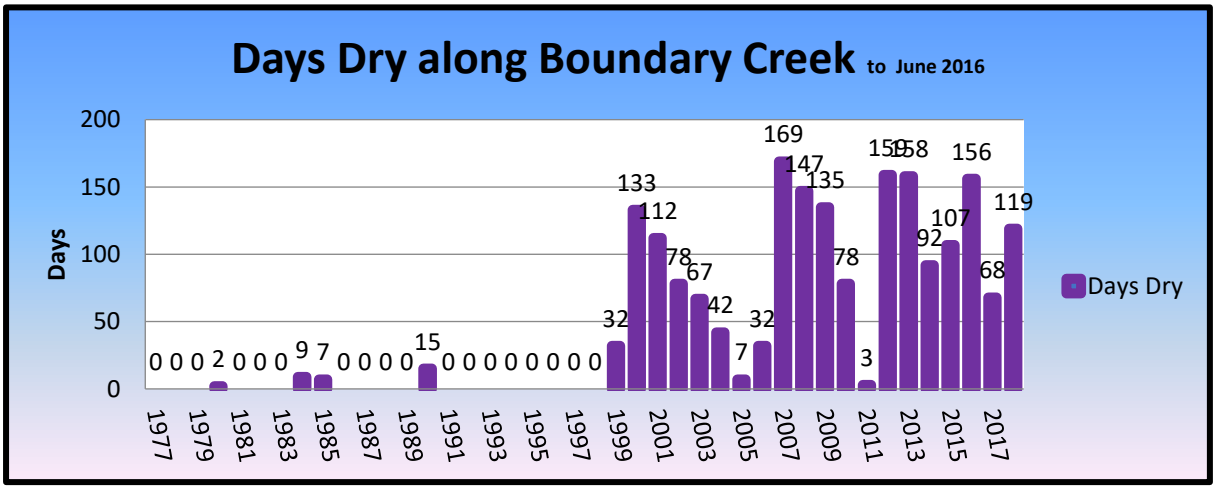
Jacobs derived the data in this report from information sourced from the Barwon Water, members of the public and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

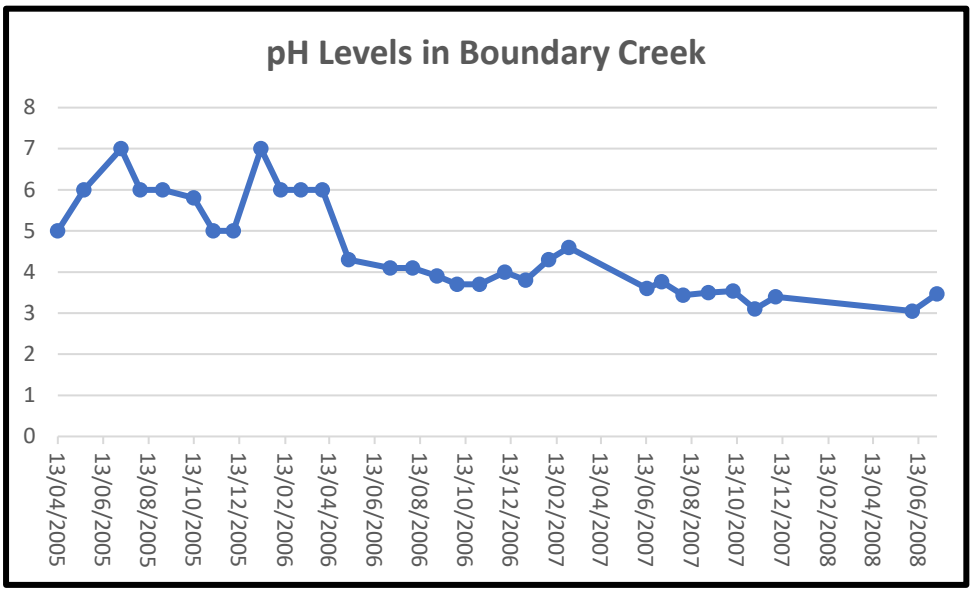
This report has been prepared on behalf of, and for the exclusive use of, Barwon Water, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Barwon Water. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

APPENDIX 4

The data presented here has been taken from Barwon Water financial year reports to Southern Rural Water as condition of the 2004 licence, and from www.data.water.vic.gov.au for the Stream Flow Gauging Station Number 233228.



APPENDIX 5



Data taken from www.data.water.vic.gov.au for the Stream Flow Gauging Station Number 233228.

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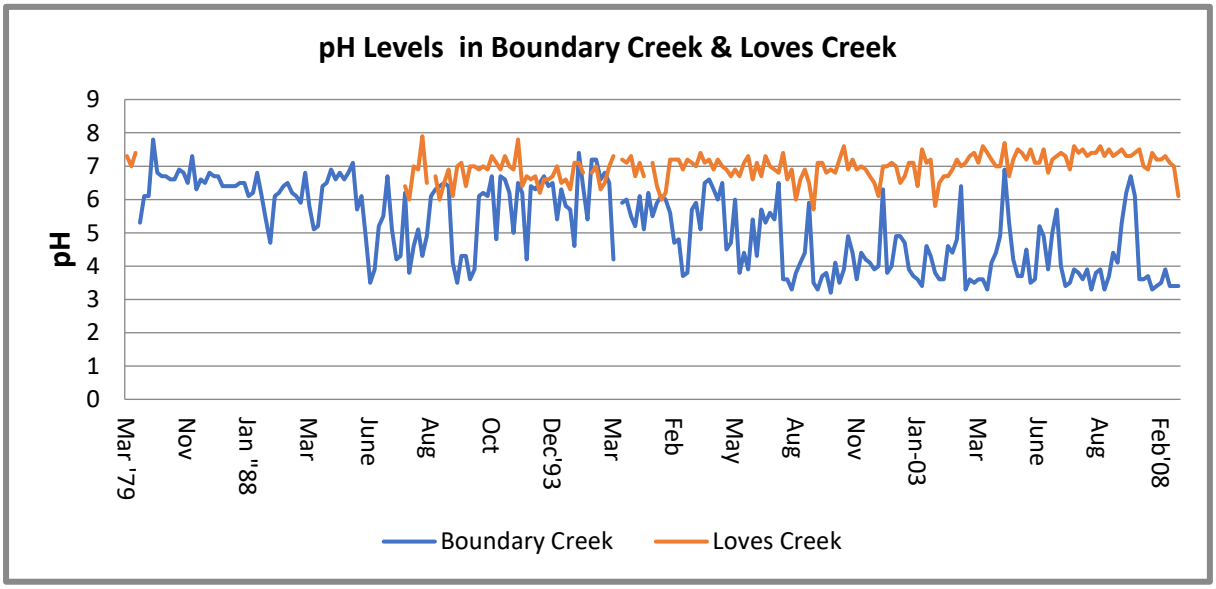

Data taken from www.data.water.vic.gov.au for the Stream Flow Gauging Station Number 233228 on Boundary Creek and 235234 Station on Loves Creek.

APPENDIX 6

Groundwater Licence No. 893889
Barwon Region Water Authority

8. PROTECTION OF DOMESTIC AND STOCK USE

Barwon Water must comply with the guidelines contained in the Fifth Schedule to ensure access is maintained for Domestic & Stock use in the area of outcrop of the aquifer from which groundwater is extracted under this Licence.

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FIFTH SCHEDULE

The owner of a domestic and stock bore within the recharge or outcrop areas of the groundwater aquifer from which groundwater is extracted under licence by Barwon Water, may request that the Authority determine whether the extraction by Barwon Water is adversely affecting the performance of that bore.

If the Authority forms a reasonable opinion that Barwon Water's licensed operations are the most likely cause of significant problems in respect to access to water from a well constructed and well maintained domestic and stock bore, then Barwon Water must:

- restore the access to normal water availability by undertaking to deepen or replace the bore, or
- provide alternative arrangements to restore access to water for stock and domestic use.

In forming a reasonable opinion, the Authority may (where it can be established) have regard to:

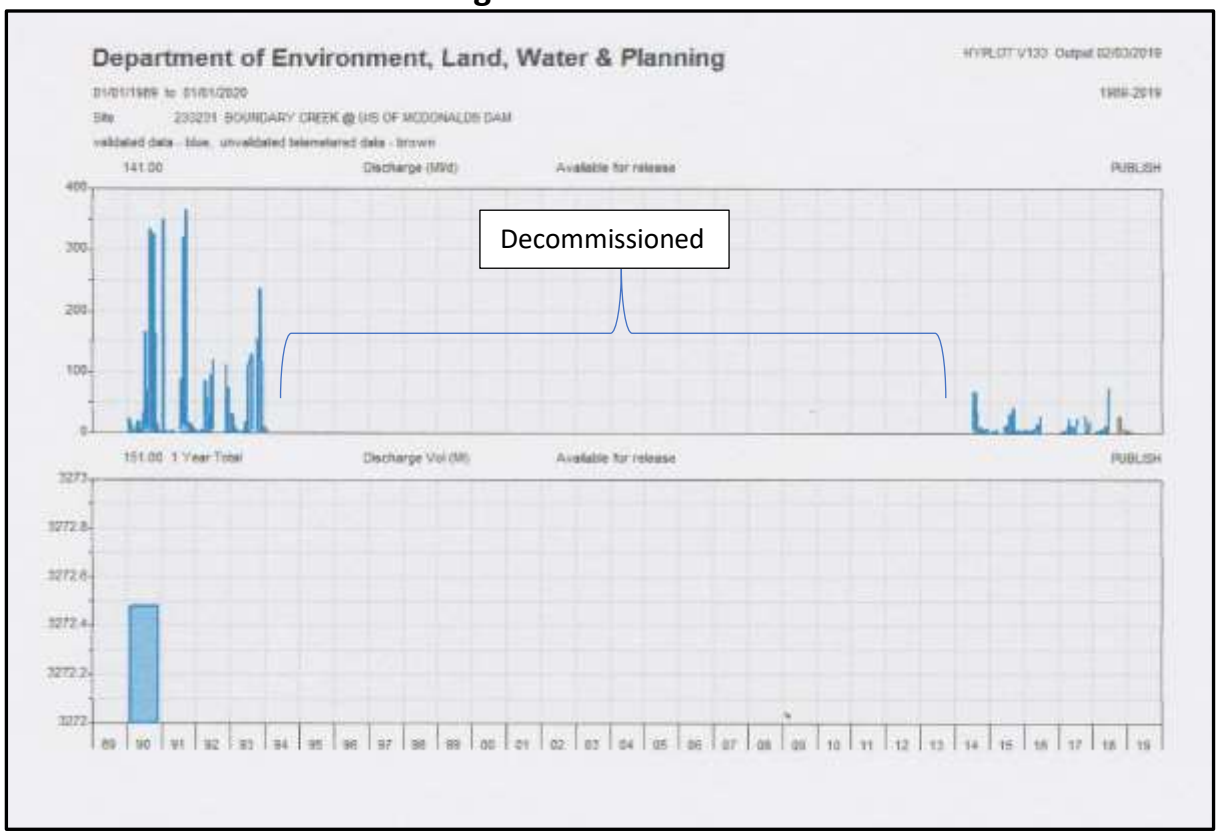
- the current condition of the bore (visual inspection);
- the historical maintenance of the bore (interview with current landowner);
- historical water levels within the bore;
- the location of the bore with respect to Barwon Water operations;
- the age of the bore (from Groundwater Management System or Bore Construction Licence records);
- the depth of bore (from Groundwater Management System or Bore Construction Licence records and visual inspection);
- the geological formation that the bore intercepts and the hydrogeological connection with the geological formation targeted by Barwon Water (from Bore Construction Licence records);
- climatic conditions;
- the decline in the regional water table.

Having reached its determination, the Authority shall document the reasons and basis of determination and supply its findings to the bore owner and Barwon Water.

Either party may appeal the Authority's determination and lodge a request for appeal with the Authority within 21 days of receipt of determination, whereby the Authority's determination and supporting documents are referred to the arbitrator for review and final determination within a further 60 days.

The appointment of an arbitrator will be made by the Authority having regard to appropriate expertise and independence to all parties. The cost of the arbitrator and associated process will be borne by the appellant.

APPENDIX 7. Stream Flow Gauges above and below McDonalds Dam.



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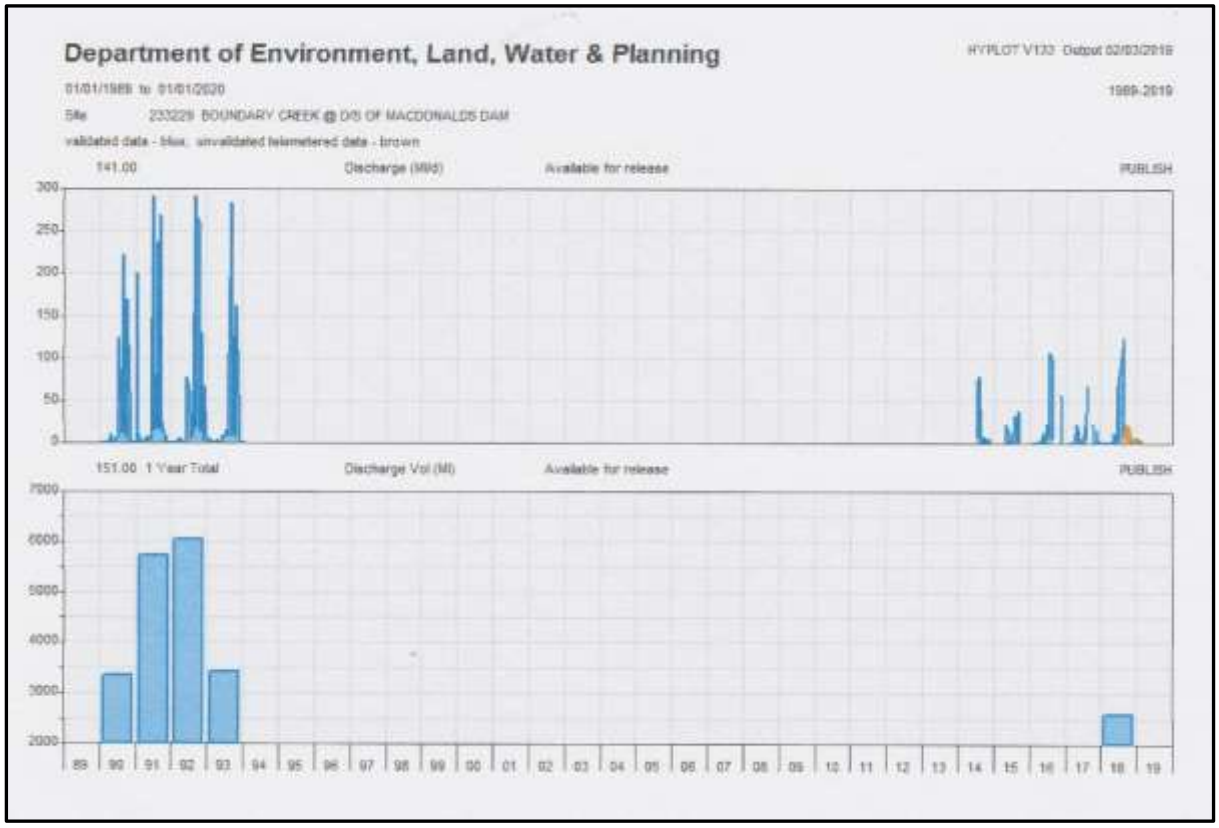
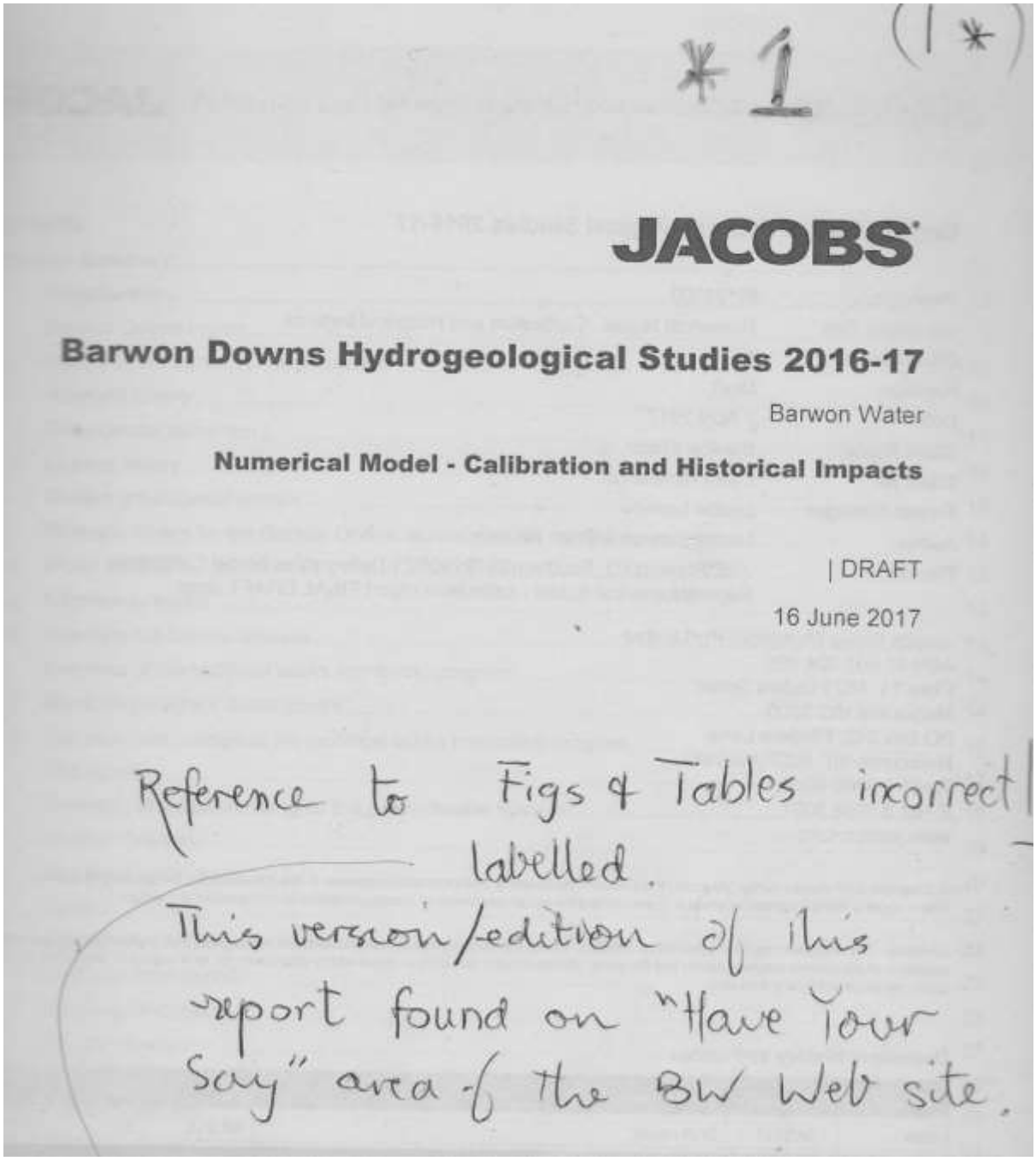


Data sheets in Appendix 7 downloaded from www.data.water.vic.gov.au.

APPENDIX 8. Morphing.

Four versions of the "***Barwon Downs Hydrogeological Studies 2016-2017, Barwon Water, Numerical Model – Calibration and Historical Impacts***," are shown on the next 8 pages.

The first two pages were taken from the original copy placed on the Barwon water website "Have Your Say."



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JACOBS

Barwon Downs Hydrogeological Studies 2016-17

Barwon Water

Numerical Model - Calibration and Historical Impacts

| DRAFT

16 June 2017

Reference to Figs & Tables incorrect | labelled.

This version/edition of this report found on "Have Your Say" area of the BW Web site.

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Executive Summary

KEY FINDINGS

- The groundwater model has attained the highest ranking in confidence level classification in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). It is considered to be fit-for-purpose to assess future groundwater behaviour and impacts that may occur from groundwater extraction at a regional scale.
- The revised groundwater model is well calibrated at both a regional scale and local scale, and is now a more reliable representation of the hydrogeological setting and the rivers and creeks that interact with groundwater.
- The model was used to simulate historical impacts by separating groundwater extraction from natural climate fluctuations.
- The model indicates that operation of the borefield over the past 30 years is most likely responsible for two thirds of the reduction of base flow into Boundary Creek. The dry climate experienced during the same period accounts for the remaining third.
- This suggests that the lower sections of Boundary Creek would likely have no flow periods during summer regardless of groundwater pumping; however pumping has increased the frequency and duration of no flow periods in lower reaches of Boundary Creek.
- No other rivers or creeks have been impacted as significantly as Boundary Creek by the operation of the bore field. Operation of the borefield has likely resulted in a minor reduction in base flow in a small section of the Gellibrand River. Dry climate conditions have caused a greater reduction in base flow than the historical borefield operation.
- Shallow aquifers across most of the study area have not been significantly influenced by operation of the bore field which suggests that there is very little impact to vegetation outside the Boundary Creek catchment.
- Further technical studies are in progress to assess the future impact of a range of alternative borefield operating regimes on flows in Boundary Creek to maintain current ecological values in the lower part of the catchment, and measures to address the issue of acid water release from Yeodene Swamp into Boundary Creek. The outcomes of these studies will support Barwon Water's licence application.

BACKGROUND

The Barwon Downs borefield is operated under licence from Southern Rural Water and provides a drought resilient water source for greater Geelong. At the height of the worst drought on record (2006-10), the borefield provided up to 70 per cent of Geelong's drinking water. This licence is due for renewal in mid-2019.

Using groundwater has, in the past, generated community concern about impact to the local environment. To address these concerns, Barwon Water has carried out a program of technical studies and increased monitoring activities.

The outcomes of this program have been used to update the groundwater model. This has improved the model's ability to accurately predict impacts of pumping, allowing Barwon Water to better address community concerns.

This report presents the findings of the program to develop and calibrate a numerical groundwater model that can be used as a key tool in assessing possible effects of borefield operation.

The next two pages have been taken from an edition supplied on 31 July 2017.

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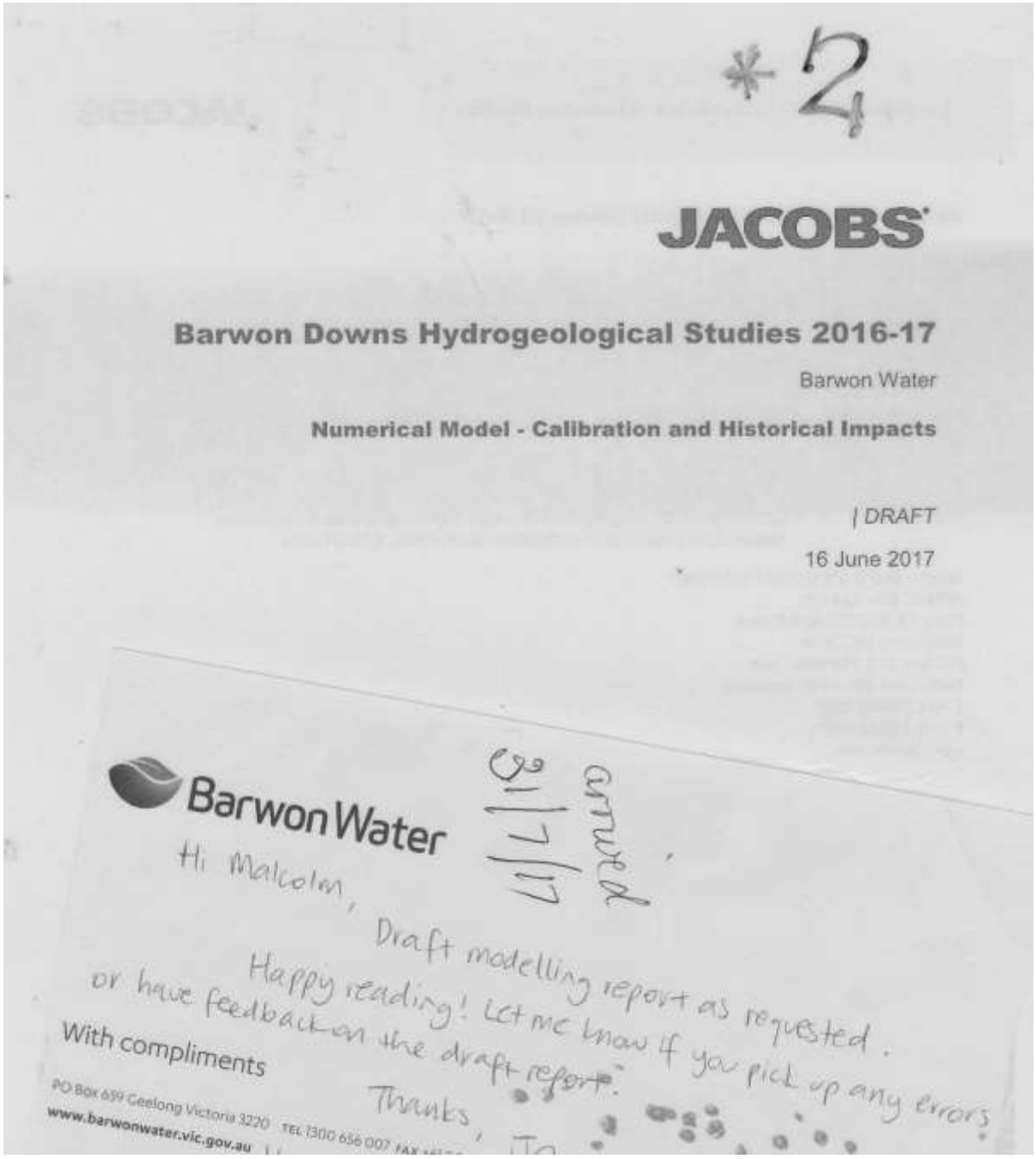


* 2

JACOBS

Barwon Downs Hydrogeological Studies 2016-17

Barwon Water

Numerical Model - Calibration and Historical Impacts

I DRAFT

16 June 2017

Barwon Water

31/7/17 arrived

Hi Malcolm,

Draft modelling report as requested.

Happy reading! Let me know if you pick up any errors or have feedback on the draft report.

With compliments

Thanks,

PO Box 659 Geelong Victoria 3220 TEL 1300 656 007 FAX

www.barwonwater.vic.gov.au

Executive Summary

KEY FINDINGS

- The groundwater model has attained the highest ranking in confidence level classification in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). It is considered to be fit-for-purpose to assess future groundwater behaviour and impacts that may occur from groundwater extraction at a regional scale.
- The revised groundwater model is well calibrated at both a regional scale and local scale, and is now a more reliable representation of the hydrogeological setting and the rivers and creeks that interact with groundwater.
- The model was used to simulate historical impacts by separating groundwater extraction from natural climate fluctuations.
- The model indicates that operation of the borefield over the past 30 years is most likely responsible for two thirds of the reduction of base flow into Boundary Creek. The dry climate experienced during the same period accounts for the remaining third.
- This suggests that the lower sections of Boundary Creek would likely have no flow periods during summer regardless of groundwater pumping; however pumping has increased the frequency and duration of no flow periods in lower reaches of Boundary Creek.
- No other rivers or creeks have been impacted as significantly as Boundary Creek by the operation of the bore field. Operation of the borefield has likely resulted in a minor reduction in base flow in a small section of the Gellibrand River. Dry climate conditions have caused a greater reduction in base flow than the historical borefield operation.
- Shallow aquifers across most of the study area have not been significantly influenced by operation of the bore field which suggests that there is very little impact to vegetation outside the Boundary Creek catchment.
- Further technical studies are in progress to assess the future impact of a range of alternative borefield operating regimes on flows in Boundary Creek to maintain current ecological values in the lower part of the catchment, and measures to address the issue of acid water release from Yeodene Swamp into Boundary Creek. The outcomes of these studies will support Barwon Water's licence application.

BACKGROUND

The Barwon Downs borefield is operated under licence from Southern Rural Water and provides a drought resilient water source for greater Geelong. At the height of the worst drought on record (2006-10), the borefield provided up to 70 per cent of Geelong's drinking water. This licence is due for renewal in mid-2019.

Using groundwater has, in the past, generated community concern about impact to the local environment. To address these concerns, Barwon Water has carried out a program of technical studies and increased monitoring activities.

The outcomes of this program have been used to update the groundwater model. This has improved the model's ability to accurately predict impacts of pumping, allowing Barwon Water to better address community concerns.

This report presents the findings of the program to develop and calibrate a numerical groundwater model that can be used as a key tool in assessing possible effects of borefield operation.

The next two pages have been taken from a copy obtained on 15 October 2017.

*3 Supplied to me @ 15th Oct 2017 "Planting Festival" Charleys Crk revegetatn.

JACOBS

(supplied by Jo Lee)

Barwon Downs Hydrogeological Studies 2016-17

Barwon Water

Numerical Model - Calibration and Historical Impacts

| Draft

16 June 2017

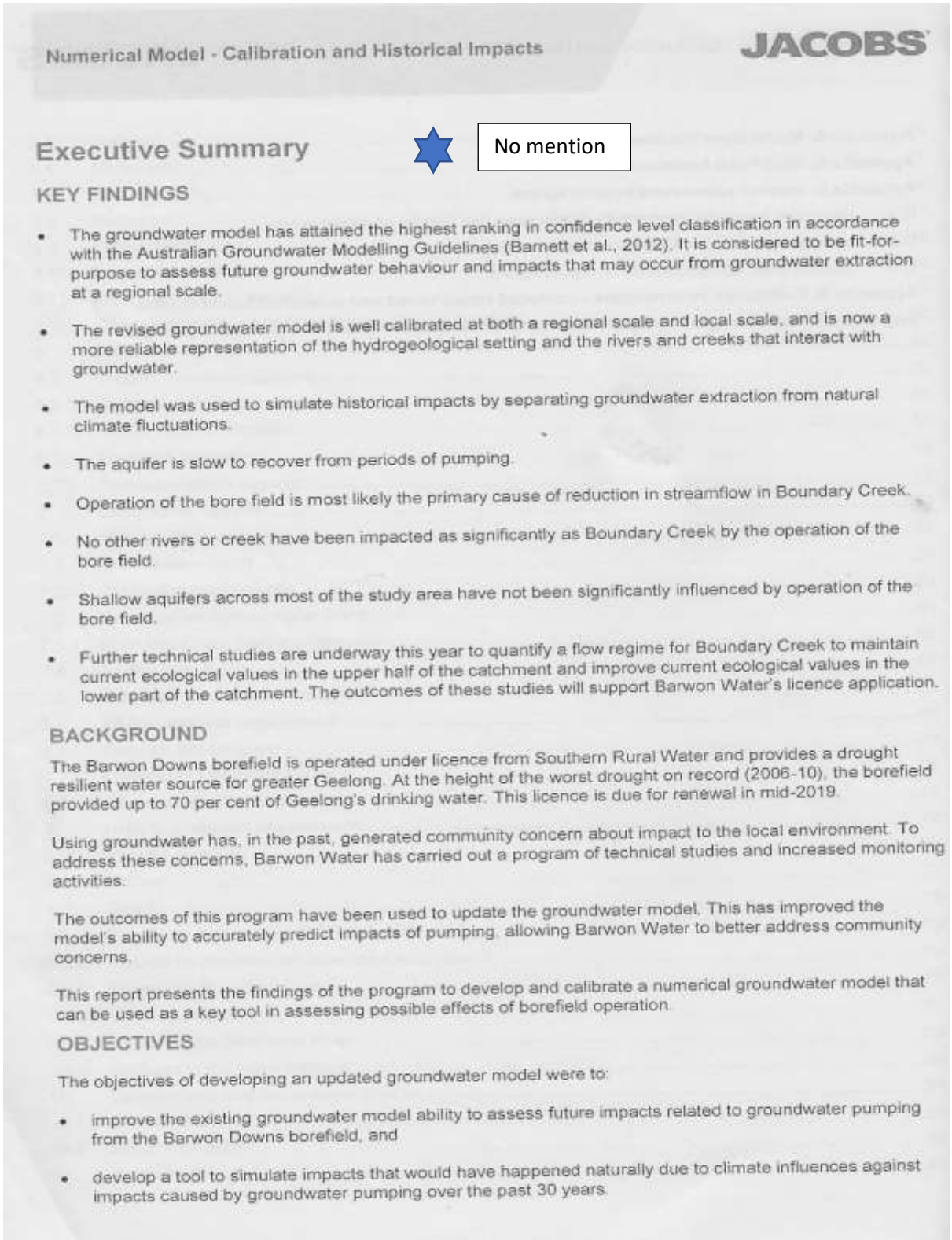
Asked for this because earlier version (1*) did not have the Appendixes included.

AND Figs & Table References wrong in most cases. (Rhys did the corrections)

The Fig 1-4 on P. 16 has not been corrected - Public Consultatn - as promised it would be & promised since ____

That it had been corrected.

(Good at talking the talk BUT dismal at walking the walk)



Numerical Model - Calibration and Historical Impacts

JACOBS

Executive Summary

No mention

KEY FINDINGS

- The groundwater model has attained the highest ranking in confidence level classification in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). It is considered to be fit-for-purpose to assess future groundwater behaviour and impacts that may occur from groundwater extraction at a regional scale.
- The revised groundwater model is well calibrated at both a regional scale and local scale, and is now a more reliable representation of the hydrogeological setting and the rivers and creeks that interact with groundwater.
- The model was used to simulate historical impacts by separating groundwater extraction from natural climate fluctuations.
- The aquifer is slow to recover from periods of pumping.
- Operation of the bore field is most likely the primary cause of reduction in streamflow in Boundary Creek.
- No other rivers or creek have been impacted as significantly as Boundary Creek by the operation of the bore field.
- Shallow aquifers across most of the study area have not been significantly influenced by operation of the bore field.
- Further technical studies are underway this year to quantify a flow regime for Boundary Creek to maintain current ecological values in the upper half of the catchment and improve current ecological values in the lower part of the catchment. The outcomes of these studies will support Barwon Water's licence application.

BACKGROUND

The Barwon Downs borefield is operated under licence from Southern Rural Water and provides a drought resilient water source for greater Geelong. At the height of the worst drought on record (2006-10), the borefield provided up to 70 per cent of Geelong's drinking water. This licence is due for renewal in mid-2019.

Using groundwater has, in the past, generated community concern about impact to the local environment. To address these concerns, Barwon Water has carried out a program of technical studies and increased monitoring activities.

The outcomes of this program have been used to update the groundwater model. This has improved the model's ability to accurately predict impacts of pumping, allowing Barwon Water to better address community concerns.

This report presents the findings of the program to develop and calibrate a numerical groundwater model that can be used as a key tool in assessing possible effects of borefield operation.

OBJECTIVES

The objectives of developing an updated groundwater model were to:

- improve the existing groundwater model ability to assess future impacts related to groundwater pumping from the Barwon Downs borefield, and
- develop a tool to simulate impacts that would have happened naturally due to climate influences against impacts caused by groundwater pumping over the past 30 years.

This edition had no mention of the model results of the impact from the borefield operation over the last 30 years.

The following two pages have been taken from the copy sent to Southern rural Water as part of Barwon Water's renewal of the 2004 groundwater extraction licence.

Received 23/01/2019

Part of the 2019 Licence Renewal Applicatn.

JACOBS

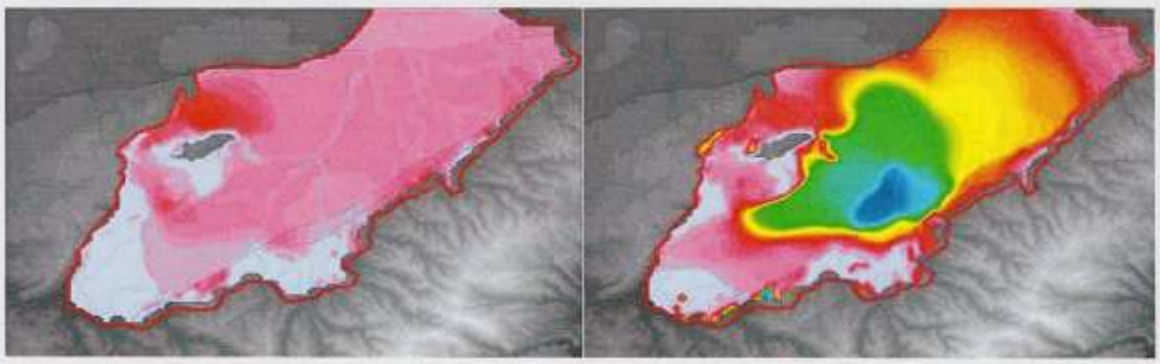
Barwon Downs Hydrogeological Studies 2016-17

Barwon Water

Numerical model calibration and historical impacts

| Final

22 August 2018



Executive Summary

KEY FINDINGS

- The groundwater model has attained the highest ranking in confidence level classification in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). It is considered to be fit-for-purpose to assess future groundwater behaviour and impacts that may occur from groundwater extraction at a regional scale.
- The revised groundwater model is well calibrated at both a regional scale and local scale, and is now a more reliable representation of the hydrogeological setting and the rivers and creeks that interact with groundwater.
- The model was used to simulate historical impacts by separating groundwater extraction from natural climate fluctuations.
- Operation of the bore field is the main cause of reduction in streamflow in Boundary Creek. The model indicates that operation of the borefield over the past 30 years is responsible for two thirds of the reduction of base flow into Boundary Creek. The dry climate experienced during the same period accounts for the remaining third.

  This suggests that the lower sections of Boundary Creek would likely have no flow periods during summer regardless of groundwater pumping, however pumping has increased the frequency and duration of no flow periods in lower reaches of Boundary Creek.
- No other rivers or creeks have been impacted as significantly as Boundary Creek by the operation of the bore field.
- Operation of the borefield has resulted in a minor reduction in base flow in a small section of the Gellibrand River. Dry climate conditions have caused a greater reduction in base flow than the historical borefield.
- Shallow aquifers across most of the study area have not been significantly influenced by operation of the bore field. The model did not indicate historic impact to vegetation outside the Boundary Creek catchment.
- Further technical studies are underway to quantify a flow regime for Boundary Creek to maintain current ecological values in the upper half of the catchment and improve current ecological values in the lower part of the catchment. The outcomes of these studies will support Barwon Water's licence application.

BACKGROUND

The Barwon Downs borefield is operated under licence from Southern Rural Water and provides a drought resilient water source for greater Geelong. At the height of the worst drought on record (2006-10), the borefield provided up to 70 per cent of Geelong's daily drinking water. This licence is due for renewal in mid-2019.

Using groundwater has, in the past, generated community concern about impacts to the local environment, particularly in the Boundary Creek catchment. To address these concerns, Barwon Water has carried out a program of technical studies and increased monitoring activities.

The outcomes of this program have been used to update the groundwater model. This has improved the model's ability to accurately predict impacts of pumping, allowing Barwon Water to better address community concerns.

This report presents the findings of the program to develop and calibrate a numerical groundwater model that can be used as a key tool in assessing possible effects of borefield operation.

Each reference of the model results indicated by the ✡ states the finding "***indicates***" and is "***most likely***." It must also be kept in mind that this finding is a modelled result.

In an email from Managing Director of Barwon Water this page was included.

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Dear Malcolm,

Email Reply 21/02/2018

Thank you for your email dated 11 February.

As you correctly point out Barwon Water has developed a proposed management plan based on outcomes the community identified as important for the next licencing period.

This plan aims for us to work with our community and stakeholders over the next 15 year journey and will include the three phases of remediation, adaptive yield assessment and long term sustainable operation.

Barwon Water is committed to remediation efforts in the Boundary Creek catchment regardless of the outcome of the licence application.

We have also committed to not using the borefield again, other than if necessary for operational maintenance purposes, until the current licence application is resolved.

Further to this, as part of the licence application we will propose to reduce the reliance on the borefield during the first two phases of remediation and adaptive yield assessment. This will be assisted by shifting the borefield's use from the first to the last alternate source ie after the Anglesea borefield and the Melbourne Geelong Pipeline.

In response to your information requests:

1. Do you have a list of the impacts caused by extraction at the Barwon Downs Borefield?

In 2016, a major update of the Barwon Downs groundwater model was complete. The updated model can separate groundwater extraction and natural climate fluctuations to simulate historical impact. The technical reports (which can be found on the Have Your Say website) concluded:

- Barwon Water's pumping from the Barwon Downs borefield over the past 30 years is the main cause of a reduction in baseflow (groundwater contribution to streamflow) in the lower reach of Boundary Creek increasing the frequency and duration of no flow periods.
- No other rivers or creeks have been impacted as significantly as Boundary Creek by the operation of the bore field.
- Operation of the borefield has likely resulted in a minor reduction in base flow in a small section of the Gellibrand River (in the order of 0.3ML/day or 0.8% of low flows). Dry climate conditions have caused a greater reduction in base flow (in the order of 0.6ML/day or 1.6% of low flows) according to the groundwater model.

This statement is only a slight deviation from the original statement.

However, the next step in the morphing process is significant.

Southern Rural Water
Managing Water, Serving Communities

MINISTERIAL NOTICE

Issued pursuant to Section 78 of the Water Act 1989

Issued to:	Barwon Region Water Corporation (Barwon Water)
Property Address (the Property):	

BW asset name	Bore ID	Address
GW4	64248	Dewing Bridge Road, Gerangamete VIC 3243
GW2a	64246	Dewing Bridge Road, Gerangamete VIC 3243
GW6	S56301/01	Dewing Bridge Road, Gerangamete VIC 3243
GW5	64245	Dewing Bridge Road, Gerangamete VIC 3243
GW8	S56301/02	Dewing Bridge Road, Gerangamete VIC 3243
GW3	64247	Dewing Bridge Road, Gerangamete VIC 3243

Property Description:	Gerangamete Groundwater Field
Licence Number:	BEE032496
Legal Reference:	*Water Act 1989* (Vic) s.78

Trevor McDevitt (Delegate)
Manager Applications
Groundwater & Rivers

11 / 9 / 2018

Date Notice Issued

Email from J Lee 25/10/2018 otwaywater

.

Southern Rural Water
Managing Water. Serving Communities.

1. Background and reasoning

1.1 The Minister for Water, the Hon Lisa Neville wrote to SRW on 7 August 2018 requiring SRW, as a delegate, issue a notice (under Section 78 of the *Water Act 1989* (Vic)) requiring Barwon Water to:

a) continue no extraction, other than for maintenance and emergency response, and
b) prepare a plan for the remediation of Boundary Creek, Big Swamp and the surrounding environment impacted by groundwater pumping at Barwon Downs, and
c) describe the environmental outcomes for the waterways to be achieved by the remediation plan.

1.2 It is acknowledged that:

a) Barwon Water has operated the Barwon Downs Borefield under groundwater extraction licence BEE032496. Barwon Water has undertaken a monitoring and assessment program over the past six years, with input from a Community Reference Group, to improve the understanding of the impacts of operation of the borefield.
b) Barwon Water has been working to address confirmed impacts and has commenced the development of a remediation plan for Boundary Creek and Big Swamp with input from community, stakeholders and independent technical experts nominated by the community and stakeholders.

1.3 A report commissioned by Barwon Water titled "*Barwon Downs Hydrogeological Studies 2016-17: Numerical model calibration and historical impacts*" (Jacobs June, 2017) found that: operation of the borefield over the past 30 years is responsible for two thirds of the reduction of groundwater base flow into Boundary Creek; the dry climate experienced during the same period accounts for the remaining one third, and operation of the borefield has increased the frequency and duration of no flow periods in lower reaches of Boundary Creek."

1.4 A further report commissioned by Barwon Water titled "*2016-2017 Technical Works Program Yeodene Swamp Study*" (Jacobs, November 2017) found that the current groundwater licence condition requiring the release of the 2 ML/d of supplementary flow into Boundary Creek has not been effective at offsetting the impacts of operation of the borefield on groundwater base flows in Boundary Creek.

1.5 This led to the swamp drying, acid sulphate soils being generated and the release of acid water downstream of the swamp and impacting the downstream environment.

1.6 On this basis, and considering the observations previously stated, I have formed a view and I am satisfied that a process or activity which is being/or has been carried out at the

A modelled result that originally stated a finding "***indicates***" and is "***most likely***" responsible for an action has morphed into a definitive statement, "***is respomsible***.".

APPENDIX 9

f(267)

SOUTHERN RURAL WATER
WATER ACT 1989
Section 51 and 67

GROUNDWATER LICENCE No. 893889
(Licence to take and use groundwater from a bore and to operate works)

Gippsland and Southern Rural Water (the Authority) authorises:

Barwon Region Water Authority
PO Box 659
GEELONG VIC 3220

to take and use water from the bore or bores specified in the First Schedule and to operate works for that purpose and subject to the conditions in the Second Schedule.

The licence is valid until 30 June 2019.

Trevor McDevitt
Authorising Officer
Date: 7/11/2006

---oooOOOooo---

PREAMBLE

Barwon Water's Greater Geelong water supply system conjunctively uses surface water from the Barwon and Moorabool catchments together with groundwater from the Gerangamete Groundwater Management Area. The most efficient use of the resources dictates that Barwon Water only extracts groundwater during dry periods when surfacewater supplies are falling. This principle has been incorporated into Barwon Water's REALM model to determine the periods when the Barwon Downs wellfield should be operated.

1/14

Groundwater Licence No. 893889
Barwon Region Water Authority

FIRST SCHEDULE

1.	Type of use for which water is to be taken	**Urban Supply**
2.	Groundwater Management Area from which water is to be taken	**Gerangamete**
3.	Maximum daily rate at which water may be taken	**72 ML/day**
4.	Maximum volume of water that may be taken in any year (ending 30 June)	**20,000 ML**
5.	Maximum volume of water that may be taken in any period of 10 years (ending 30 June)	**80,000 ML**
6.	Maximum volume of water that may be taken in any period of 100 years (ending 30 June)	**400,000 ML**
7.	The taking of water is to be in accordance with the assumptions of the REALM modeling of Barwon Water's supply system undertaken for the renewal of this Licence. When Barwon Water applies for renewal of this licence, it must submit a report demonstrating how the Barwon Downs wellfield has been operated in accordance with the intent of the REALM model.	**4,000 ML/year**

8. Quantities of water that may be taken from each bore:

Bore Number	Maximum daily rate at which water may be taken	Maximum volume of water that may be taken each day
64245	**12.0 ML/day**	**12.0 ML**
64246	**12.0 ML/day**	**12.0 ML**
64247	**12.0 ML/day**	**12.0 ML**
64248	**12.0 ML/day**	**12.0 ML**
S56301/01	**12.0 ML/day**	**12.0 ML**
S56301/02	**12.0 ML/day**	**12.0 ML**

Additional bores may be added during the period of this licence, subject to normal bore construction licensing requirements

2

SECOND SCHEDULE

1. REGIONAL WATER LEVEL MONITORING

1.1 Water Level Monitoring

Barwon Water must for each bore listed in the Third Schedule:

a. read the potentiometric level quarterly, provided the bore is in working order; and
b. record the potentiometric level on a database within 30 days of measurement.

1.2 Maintenance

Barwon Water must for each bore listed in the Third Schedule:

a. inspect the headworks at least once each year for signs of bore failure;
b. examine the water levels recorded under sub-clause 1.1(a) to determine whether abnormal readings indicate bore failure; and
c. keep a database of all inspections and examinations under sub-clauses 1.1(a) and 1.1(b).

1.3 Reporting

Barwon Water must provide to the Authority within 60 days of the end of each year a report containing:

a. all water levels recorded under sub-clause 1.1(a) for the year;
b. a plot of bore hydrographs containing all recorded water levels for each bore listed in the Third Schedule;
c. a map of residual drawdown for the year;
d. details of any bore failure determined from the inspection of headwork condition under sub-clause 1.2(a) or assessment of abnormal water level readings under sub-clause 1.2(b) during the year; and
e. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any.

1.4 Monitoring Network

Barwon Water:

a. may provide to the Authority a proposal, formulated after consultation with the Department of Sustainability and Environment and the Authority, to modify the list of bores in the Third Schedule in order to maintain the effectiveness and efficiency of regional water level monitoring; and
b. must provide to the Authority a proposal, formulated after consultation with the Department of Sustainability and Environment and the Authority, to modify the list of bores in the Third Schedule in order to maintain the effectiveness and efficiency of regional water level monitoring within 90 days of:
    i. Barwon Water concluding that there are significant gaps in the regional water level monitoring; or
    ii. a material number of the bores listed in the Third Schedule are failing to provide valid data; or
    iii. the Authority requesting a proposal following its receipt of a report under clause 1.3.

2. GROUNDWATER SALINITY

2.1 Salinity Monitoring

Barwon Water must by 31 December 2004, and then at the end of each year for the next 5 years, and then at the end of every fifth year:

a. obtain a water sample from Bore YEO 23 (Bore ID 109114), Bore W7 (Bore ID 107720), and Bore YYG221 (Bore ID 102868);
b. determine the salinity of the sample; and
c. record the result of the salinity determination on a database within 30 days of undertaking the determination.

3

2.2 Reporting

Barwon Water must provide to the Authority within 90 days of undertaking the sampling under sub-clause 2.1(a) a report containing:

a. the salinity for each bore;
b. a comparison of the salinity under sub-clause 2.1(a), with any previous salinity data from the same bore;
c. an assessment of the risk of groundwater salinity increase due to pumping under this Licence, based on the information obtained in sub-clause 2.2(b);
d. an assessment of the suitability of each bore specified in sub-clause 2.1(a) above for the purpose of ongoing salinity monitoring; and
e. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any.

3. WATER LEVEL DECLINE

3.1 General

A. Barwon Water must by 31 December 2004 install a new monitoring bore at a site in the vicinity of bore YEO 40 (Bore ID 109131). This new bore is to be used for any purposes ascribed in this Licence to bore YEO 40 (Bore ID 109131)

B. Barwon Water must not cause groundwater levels in the bores listed below to decline below the respective levels listed, as expressed in metres relative to the Australian Height Datum (AHD):

a. G 13 (Bore ID 64229) - 85.2m AHD;
b. G 20 (Bore ID 64236) - 98.7m AHD;
c. M 28 (Bore ID 83844) - 124.1m AHD; and
d. YEO 40 (Bore ID 109131) - 142.6m AHD.

3.2 Monitoring

Barwon Water must:

a. determine the potentiometric level from the bores listed in sub-clause 3.1:
   i. monthly from the commencement of pumping until 18 months after the conclusion of pumping; and
   ii. thereafter quarterly; and
b. record the potentiometric levels obtained under sub-clause 3.2(a) on a database within 30 days of measurement.

3.3 Notification

If the potentiometric level of any bore in sub-clause 3.1 declines below the respective level specified in sub-clause 3.1, Barwon Water must:

a. notify the Authority within 7 days of taking the measurement;
b. limit total groundwater extraction to a daily rate of up to 34.4 ML/d, determined by Barwon Water after considering the state of Geelong's water supply and water restrictions
c. initiate the following monitoring program:
   i. immediately undertake subsidence level measurements as specified under sub-clause 5.2, and thereafter at 6 monthly intervals from the time of notification in sub-clause 3.3(a);
   ii. increase the frequency of the monitoring as specified under sub-clause 1.1 to monthly; and
   iii. within a period of 30 days of commencing the monitoring specified in sub-clause 3.3(c)(ii) and thereafter at monthly intervals provide to the Authority a report mapping depth to potentiometric surface and potentiometric surface relative to AHD;

4

d. provide to the Authority within 90 days of any notification provided in sub-clause 3.3(a) a report that includes:
   i. a review of predicted groundwater level decline and recovery;
   ii. an assessment of the water supply situation for Geelong; and
   iii. a plan, formulated after consultation with the Department of Sustainability & Environment, to manage further pumping under this Licence and water supply to Geelong whilst the potentiometric level remains below the respective level specified in sub-clause 3.1; and
e. except as provided for in sub-clause 3.3(f), only vary the actions required under sub-clauses 3.3(b) and 3.3(c) to the extent necessary to implement the plan specified in sub-clause 3.3(d)(iii); and
f. only cease the actions required under sub-clauses 3.3(b) and 3.3(c) when the potentiometric level of all bores in sub-clause 3.1 are above the respective level specified in sub-clause 3.1.

3.4 Maintenance
Barwon Water must:
a. maintain the bores referred to in sub-clause 3.1 in working order and replace or refurbish any bore as necessary;
b. undertake an assessment of the remaining bore life of the bores referred to in sub-clause 3.1, at intervals not exceeding five years; and
c. keep a database of all maintenance undertaken.

3.5 Reporting
Barwon Water must provide to the Authority:
a. within 60 days of the end of each year a report containing:
   i. the potentiometric levels determined under sub-clause 3.2(a) for the year;
   ii. a summary of all work done under sub-clause 3.4(a);
   iii. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any;
b. within 90 days of undertaking each assessment under sub-clause 3.4(b) a report of the assessment including a bore maintenance and replacement plan.

4. METERING

4.1 General
Barwon Water must meter the extraction of groundwater from all bores listed in the First Schedule.

4.2 Metering
Barwon Water must:
a. read the meters referred to in sub-clause 4.1 each week; and
b. record the meter readings and the weekly metered extraction on a data base within 7 days of measurement.

4.3 Notification
Barwon Water must:
a. notify the Authority within 7 days if any metered extraction has exceeded the extraction rates and volumes specified in the First Schedule; and
b. immediately reduce extraction to within the extraction rates and volumes specified in the First Schedule.

5

4.4 Maintenance

Barwon Water must, with respect to the meters referred to in sub-clause 4.1:

a. inspect their condition whenever they are read;
b. maintain them in good condition;
c. recalibrate them periodically and whenever there is reason to believe that a reading may be inaccurate;
d. replace them if damaged; and
e. keep a database of all work done under sub-clauses 4.4(b), 4.4(c) and 4.4(d).

4.5 Reporting

Barwon Water must provide to the Authority within 60 days of the end of each year a report containing:

a. weekly groundwater extractions for the year pursuant to sub-clause 4.2, in both graphical and tabular formats;
b. a summary of all work done under sub-clauses 4.4(b), 4.4(c) and 4.4(d); and
c. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any.

5. SUBSIDENCE

5.1 General

Barwon Water must not extract groundwater to the extent that it causes subsidence to exceed 200mm, as measured at any measuring station in the subsidence monitoring network specified in the Fourth Schedule.

5.2 Monitoring

Barwon Water must:

a. undertake annual subsidence level measurements in a manner consistent with its current methodology, unless more frequent levelling is required under 3.3(c)(i); and
b. record the subsidence level measurements on a database within 30 days of measurement.

5.3 Notification

If the subsidence limit in sub-clause 5.1 is exceeded, Barwon Water must:

a. notify the Authority within 7 days of taking the measurement;
b. limit total groundwater extraction to a daily rate of up to 34.4 ML/d, determined by Barwon Water after considering the state of Geelong's water supply and water restrictions;
c. initiate the following monitoring program:
    i. immediately undertake subsidence level measurements as specified under sub-clause 5.2, and thereafter at 6 monthly intervals from the time of notification in sub-clause 5.3(a); and
    ii. undertake within 30 days from the time of notification in sub-clause 5.3(a) a field assessment of potential impacts of subsidence, that will include but not be limited to the effects of subsidence on drainage, buildings, and infrastructure (roads, bridges, pipelines, dams);
d. provide to the Authority within 90 days of any notification provided in sub-clause 5.3(a) a report that includes:
    i. a report of the assessment undertaken under sub-clause 5.3(c)(ii);
    ii. an assessment of the water supply situation for Geelong; and
    iii. a plan, formulated after consultation with the Department of Sustainability & Environment, to manage further pumping under this Licence and water supply to Geelong; and

e. except as provided for in sub-clause 5.3(f), only vary the actions required under sub-clauses 5.3(b) and 5.3(c) to the extent necessary to implement the plan specified in sub-clause 5.3(d)(iii); and
f. only cease the actions required under sub-clauses 5.3(b) and 5.3(c) when the subsidence limit in sub-clause 5.1 is no longer exceeded.

5.4 Maintenance

Barwon Water must:

a. maintain the subsidence monitoring network specified in the Fourth Schedule in working order;
b. keep a database of all maintenance undertaken on the subsidence network; and
c. notify the Authority within 7 days if the subsidence monitoring network is found to be defective.

5.5 Reporting

Barwon Water must provide to the Authority:

a. within 60 days of the end of each year a report containing:
   i. the measured subsidence under sub-clause 5.2 for the year;
   ii. details of maintenance undertaken under sub-clause 5.5 during the year; and
   iii. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any; and
b. when it applies for the renewal of this Licence, a report by an appropriately-qualified geotechnical consultant that reviews the subsidence monitoring program and includes:
   i. a comparison of actual and predicted subsidence;
   ii. an assessment of the accuracy and reliability of the subsidence measurements undertaken; and
   iii. recommendations regarding amendments to the program to improve the adequacy, reliability or accuracy of monitoring.

6. FLOW IN BOUNDARY CREEK

6.1 General

A. Barwon Water must by 31 December 2004 install a new monitoring bore at a site in the vicinity of bore YEO (Bore ID 109131). This new bore is to be used for any purposes ascribed in this licence to bore YEO 40 (Bore ID 109131).

B. Barwon Water must provide a flow of 2 ML/d to the headwaters of Boundary Creek from any time that groundwater extraction commences under this Licence until:

a. the groundwater level in bore YEO 40 (Bore ID 109131) recovers above a level of 158.5m AHD following the cessation of pumping; or
b. at any time between 1 June and 30 November the natural flow at the Yeodene stream gauge exceeds 1 ML/d.

B. Prior to extraction of groundwater under this Licence, Barwon Water must obtain relevant approvals regarding the discharge of water to Boundary Creek from the Environment Protection Authority.

6.2 Monitoring

Barwon Water must:

a. install a meter at the point of discharge to Boundary Creek referred to in sub-clause 6.1;
b. read the meter each week; and
c. record the weekly flow on a database within 7 days of measurement.

6.3 Maintenance

Barwon Water must, with respect to the meter referred to in sub-clause 6.2:

a. inspect its condition whenever it is read;
b. maintain it in good condition;
c. recalibrate it whenever there is reason to believe that a reading may be inaccurate;
d. replace it if damaged; and
e. keep a database of all work done under sub-clauses 6.3(b), 6.3(c) and 6.3(d).

6.4 Reporting

Barwon Water must provide to the Authority within 60 days of the end of each year a report containing:

a. weekly meter readings pursuant to sub-clause 6.2 (b), in both graphical and tabular formats;
b. daily stream gauging data from the Yeodene gauge (233228), also graphed at weekly intervals;
c. a summary of water discharged to Boundary Creek under sub-clause 6.1;
d. a summary of all work done under sub-clauses 6.3(b), 6.3(c) and 6.3(d); and
e. details of any issues arising from the monitoring results, including significant variations to predicted trends, and associated recommendations, if any.

7. PROTECTION OF RIPARIAN VEGETATION

7.1 General

A. Barwon Water must undertake a floral survey at the following sites within 5 years of the commencement of this Licence and thereafter at five-yearly intervals:

a. Flora Site 25 on Boundary Creek (Grid Ref 341441, Mapsheet Gerangamete 7621-3-2);
b. Site upstream of Site 25 (Grid Ref 330456, Mapsheet Gerangamete 7621-3-2);
c. Control sites away from Boundary Creek:
    c.1 (Grid Ref 267421, Mapsheet Barongarook 7621-3-3);
    c.2 (Grid Ref 304377, Mapsheet Gerangemete 7621-3-2);
    c.3 (Grid Ref 299360, Mapsheet Gerangemete 7621-3-2);
    c.4 Survey Site No.22 ,(Grid Ref 303409, Mapsheet Gerangemete 7621-3-2); and
d. Flood plain East Barwon River, EVC - Riparian Swamp Woodland:
    d.1(Grid Ref 392367, Mapsheet Gerangemete 7621-3-2);
    d.2 (Grid Ref 390381, Mapsheet Gerangemete 7621-3-2).

B. Prior to engaging a consultant to undertake a floral survey, Barwon Water must:

a. consult with the Department of Sustainability & Environment regarding suitable consultants; and
b. then obtain the approval of the Authority for the consultant it proposes to use.

7.2 Reporting

Barwon Water must provide to the Authority:

a. within 180 days of completing a floral survey under sub-clause 7.1, a report containing:
    i. the results of the floral surveys; and
    ii. a review of groundwater levels as determined from the bores listed in the Third Schedule that are adjacent to the flora sites; and
b. when it applies for the renewal of this Licence, a report assessing the degree of dependence of riparian vegetation at the sites specified in sub-clause 7.1 on the regional groundwater system, and that includes recommendations for any further work necessary to ensure their protection.

8. PROTECTION OF DOMESTIC AND STOCK USE

Barwon Water must comply with the guidelines contained in the Fifth Schedule to ensure access is maintained for Domestic & Stock use in the area of outcrop of the aquifer from which groundwater is extracted under this Licence.

9. PROTECTION OF FLOW IN BARWON RIVER AND TRIBUTARIES

9.1 General

Barwon Water must:

a. by 31 December 2004, install a monitoring bore at a site in the vicinity of Boundary Road, Gerangamete, to the east of the West Barwon River;
b. by 31 December 2004 propose to the Authority an in-situ gauging program at the following sites: at the existing monitoring station (233253), at approximately 1 km downstream from the existing station, and at a site immediately upstream of the King Creek junction.
c. prior to installing the monitoring required under sub-clauses 9.1(a) and 9.1(b), seek the Authority's approval of the proposed locations.

9.2 Monitoring Bore

Barwon Water must undertake water level monitoring, maintenance, and reporting for the bore referred to in sub-clause 9.1(a), in accordance with the requirements of clause 1.

9.3 Stream Flow Monitoring

Prior to undertaking the in-situ gauging program referred to in sub-clause 9.1(b) Barwon Water must propose to, and gain approval of the Authority, arrangement s for the program, including frequency and location of stream flow measurement, and reporting.

9.4 Assessment

Barwon Water must provide to the Authority:

a. by 30 June 2006, a report containing an assessment of the potential for groundwater to discharge to the West Barwon River based on the relative levels of river water and groundwater; and
b. when it applies for the renewal of this Licence, a report containing an assessment of the loss of flow in the East Barwon River between the stream gauge referred to in sub-clause 9.1 and the aqueduct crossing on the East Barwon River east of Yaugher due to pumping under this Licence.

10. COMMUNITY ENGAGEMENT

10.1 Information

Barwon Water must:

a. within 7 days of submitting to the Authority a report required under sub-clauses 1.3, 3.5(a), 4.5, 5.5(a) or 6.4 make it available to the public;
b. make available to members of the public on request any information held in a database referred to in this Licence; and
c. provide to the Authority, within 14 days of the Authority's request, any information held in a database referred to in this Licence.

10.2 Engagement

Barwon Water will continue to engage with the local community and stakeholders regarding their operation of the Licence.

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11. OTHER

11.1 Definitions
In this Licence:
"Authority" means the Gippsland & Southern Rural Water Authority
"Barwon Water" means the Barwon Regional Water Authority
"domestic and stock use" has the same meaning as in Section 3 of the Water Act 1989
"year" means the 12 months next following 1 July.

11.2 Good Practice
A. Barwon Water must implement the requirements of this Licence in accordance with contemporary industry standards, protocols and regulatory requirements.

B. Where this Licence requires Barwon Water to undertake an action on an annual, quarterly, weekly or other periodic basis, it must program and undertake the action so that as far as reasonably possible a regular and evenly-spaced pattern is achieved.

11.3 Pollution
Barwon Water must not pollute any groundwater through the spillage of fuel or lubricant or any other matter used in connection with works and appliances.

11.4 Charges
Barwon Water must pay the following charges under this Licence when requested by the Authority:
a. the standard fee, if any, set by the Authority for a licence under S.51 of the Water Act to take and use groundwater;
b. the standard fee, if any, set by the Authority for a licence under S.67 of the Water Act to operate works to take and use groundwater; and
c. the reasonable costs incurred by the Authority in reviewing, assessing and responding to reports prepared and data provided by Barwon Water under this Licence.

11.5 Notice of Pumping
If required by the Authority, Barwon Water must give three days notice of its intention to take groundwater under this Licence.

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Groundwater Licence No. 893889
Barwon Region Water Authority

THIRD SCHEDULE

BoreID	RunID	Zone AMG	Easting	Northing	Parish	Locality	Road Name	Nearest Cross Road	VicRoads Ref	BoreType
47771	BD3M	54	750880	5744900	BAMBRA	DEANS MARSH	Pennyroyal Valley Rd	Winchelsea-Deans Marsh Rd	92F8	non artesian
47773	BD3M	54	752700	5747000	BAMBRA	DEANS MARSH	Smiths Lane	Bambra Cemetery Rd	92G8	non artesian
47774	BD3M	54	753850	5749150	BAMBRA	BAMBRA	Winchelsea-Deans Marsh Rd	Fultons Lane	92G7	non artesian
47775	BD3M	54	750000	5749000	BAMBRA	DEANS MARSH	Salt Creek Lane	Rifle Butts Rd	92F7	non artesian
48001	BD3M	54	729350	5741750	BARONGAROOK	BARONGAROOK	Barongarook-Gerangamete Rd	Westwards Track	92C9	non artesian
48249	BD3M	54	740280	5737655	BARWON DOWNS	BARWON DOWNS	Woodlands Rd	Mahers Rd	92E9	non artesian
62578	BD3M	54	730605	5747505	ELLIMINYT	YEO	Yeo-Yeodene Rd	Old Yeo Rd	92C8	non artesian
64227	BD3M	54	731088	5737164	GERANGAMETE	GERANGAMETE	Pipeline Rd	Boundary Rd	92C9	non artesian
64228	BD3M	54	731155	5736982	GERANGAMETE	GERANGAMETE	Pipeline Rd	Boundary Rd	92C9	non artesian
64229	BD3M	54	737615	5740832	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Seven Bridges Rd	92D9	artesian
64230	BD3M	54	738700	5741367	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Dewings Rd	92D9	artesian
64233	BD3M	54	734250	5741550	GERANGAMETE	GERANGAMETE	Westwood Rd	Westwood Track	92C9	non artesian
64234	BD3M	54	738750	5741450	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Dewings Rd	92D9	artesian
64235	BD3M	54	732400	5739150	GERANGAMETE	GERANGAMETE	Meadowell Rd	Gold Hole Rd	92C9	non artesian
64236	BD3M	54	738300	5737800	GERANGAMETE	GERANGAMETE	Seven Bridges Rd	Dewings Bridge Rd	92D9	non artesian
64237	BD3M	54	733800	5738100	GERANGAMETE	GERANGAMETE	Seven Bridges Rd	Colac-Forrest Rd	92C9	artesian
64238	BD3M	54	733600	5742900	GERANGAMETE	GERANGAMETE	Westwood Rd	Thru Track	92C8	non artesian
64239	BD3M	54	732150	5742000	GERANGAMETE	GERANGAMETE	Thru Track	Westwoods Rd	92C9	non artesian
64240	BD3M	54	734200	5741500	GERANGAMETE	GERANGAMETE	Westwoods Rd	Westwoods Track	92C9	non artesian
64241	BD3M	54	736900	5738550	GERANGAMETE	FORREST	Track off Seven Bridges Rd (thru State Forest)	Seven Bridges Rd	92D9	non artesian
64242	BD3M	54	738850	5741375	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Dewings Rd	92D9	non artesian
64244	BD3M	54	731725	5739500	GERANGAMETE	GERANGAMETE	Link Rd	Gold Hole Rd	92C9	non artesian
64245	BD3M	54	738288	5737858	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Dewings Rd	92D9	artesian
64246	BD3M	54	738870	5741370	GERANGAMETE	GERANGAMETE	Dewings Rd	Dewing Bridge Rd	92D9	artesian
64247	BD3M	54	737557	5740323	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Seven Bridges Rd	92D9	non artesian
64248	BD3M	54	738779	5742075	GERANGAMETE	GERANGAMETE	track off Dewings Bridge Rd	Dewings Rd	92D9	artesian
82838	BD3M	54	742052	5743756	MURROON	MURROON	Wire Lane	Colac-Forrest Rd	92E8	non artesian
82840	BD3M	54	742052	5743756	MURROON	MURROON	Wire Lane	Colac-Forrest Rd	92E8	non artesian

THIRD SCHEDULE

BoreID	RunID	Zone AMG	Easting	Northing	Parish	Locality	Road Name	Nearest Cross Road	VicRoads Ref	BoreType
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47774	BD3M	54	753850	5749150	BAMBRA	BAMBRA	Winchelsea-Deans Marsh Rd	Fultons Lane	92G7	non artesian
47775	BD3M	54	750000	5749000	BAMBRA	DEANS MARSH	Salt Creek Lane	Rifle Butts Rd	92F7	non artesian
48001	BD3M	54	729350	5741750	BARONGAROOK	BARONGAROOK	Barongarook-Gerangamete Rd	Westwards Track	92C9	non artesian
48249	BD3M	54	740280	5737655	BARWON DOWNS	BARWON DOWNS	Woodlands Rd	Mahers Rd	92E9	non artesian
62578	BD3M	54	730605	5747505	ELLIMINYT	YEO	Yeo-Yeodene Rd	Old Yeo Rd	92C8	non artesian
64227	BD3M	54	731089	5737164	GERANGAMETE	GERANGAMETE	Pipeline Rd	Boundary Rd	92C9	non artesian
64228	BD3M	54	731155	5736982	GERANGAMETE	GERANGAMETE	Pipeline Rd	Boundary Rd	92C9	non artesian
64229	BD3M	54	737615	5740832	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Seven Bridges Rd	92D9	artesian
64230	BD3M	54	738700	5741367	GERANGAMETE	GERANGAMETE	Dewings Bridge Rd	Dewings Rd	92D9	artesian
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64239	BD3M	54	732150	5742000	GERANGAMETE	GERANGAMETE	Thru Track	Westwoods Rd	92C9	non artesian
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64241	BD3M	54	736900	5736550	GERANGAMETE	FORREST	Track off Seven Bridges Rd (thru State Forest)	Seven Bridges Rd	92D9	non artesian
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64248	BD3M	54	738779	5742075	GERANGAMETE	GERANGAMETE	track off Dewings Bridge Rd	Dewings Rd	92D9	artesian
82838	BD3M	54	742052	5743756	MURROON	MURROON	Wire Lane	Colal-Forrest Rd	92E8	non artesian
82840	BD3M	54	742052	5743756	MURROON	MURROON	Wire Lane	Colac-Forrest Rd	92E8	non artesian

Groundwater Licence No. 893889
Barwon Region Water Authority

BoreID	RunID	Zone AMG	Easting	Northing	Parish	Locality	Road Name	Nearest Cross Road	VicRoads Ref	BoreType
82841	BD3M	54	742052	5743756	MURROON	MURROON	Wire Lane	Colac-Forrest Rd	92E8	non artesian
82842	BD3M	54	746450	5743200	MURROON	MURROON	Gannons Rd	Murroon Rd	92F8	non artesian
82843	BD3M	54	743660	5741770	MURROON	BARWON DOWNS	James Rd	Division Rd	92E9	artesian
82844	BD3M	54	742250	5747100	MURROON	MURROON	Colac-Murroon Rd	Birregurra-Forrest Rd	92E8	artesian
82845	BD3M	54	746060	5741270	MURROON	MURROON	Wickhams Rd	Division Rd	92F9	non artesian
82846	BD3M	54	748700	5743050	MURROON	PENNYROYAL	Pennyroyal-Wymbootiel Rd	Pennyroyal Station Rd	92F8	non artesian
82847	BD3M	54	743750	5739600	MURROON	BARWON DOWNS	Creamery Rd	McPaddens Rd	92E9	non artesian
102865	BD3M	54	746662	5749707	WHOOREL	WHOOREL	Whoorel Station Rd	Rifle Butts Rd	92F7	non artesian
102867	BD3M	54	749134	5748032	WHOOREL	WHOOREL	Birregurra-Deans Marsh Rd	Bushs Lane	92F8	artesian
102868	BD3M	54	745650	5751950	WHOOREL	BIRREGURRA	Birregurra-Deans Marsh Rd	Cape Otway Rd	92E7	artesian
102869	BD3M	54	746140	5748540	WHOOREL	BIRREGURRA	Deepdene Rd	Birregurra-Deans Marsh Rd	92F8	artesian
107716	BD3M	54	756450	5749850	YAN YAN GURT	BAMBRA	Brickmakers Rd	Bambra School Rd	92G7	non artesian
107717	BD3M	54	756450	5749850	YAN YAN GURT	BAMBRA	Brickmakers Rd	Bambra School Rd	92G7	non artesian
107720	BD3M	54	753950	5752000	YAN YAN GURT	BIRREGURRA	Fultons Lane	Winchelsea-Deans Marsh Rd	92G7	artesian
108915	BD3M	54	733810	5736050	YAUGHER	GERANGAMETE	Boundary Rd	Colac-Forrest Rd	92C9	non artesian
109106	BD3M	54	734326	5744493	YEO	YEODENE	track off McCalls Rd	McCalls Rd	92C8	non artesian
109110	BD3M	54	734460	5745190	YEO	YEODENE	McCalls Rd	Bingami Rd	92C8	non artesian
109111	BD3M	54	734460	5745190	YEO	YEODENE	McCalls Rd	Bingami Rd	92C8	non artesian
109112	BD3M	54	736500	5743950	YEO	YEODENE	Colac-Forrest Rd	Boundary Hill Rd	92D8	artesian
109113	BD3M	54	736950	5744350	YEO	YEODENE	Possum Ridge Rd	Colac-Forrest Rd	92D8	non artesian
109114	BD3M	54	737100	5751000	YEO	WARNCOORT	Warncoort Cemetery Rd	Collyers Rd	92D7	non artesian
109128	BD3M	54	734240	5744300	YEO	YEODENE	Track on private property off McCalls Rd	Bingami Rd	92C8	non artesian
109129	BD3M	54	734310	5744310	YEO	YEODENE	Track on private property off McCalls Rd	Bingami Rd	92C8	non artesian
109130	BD3M	54	734090	5745190	YEO	YEODENE	McCalls Rd	Bingami Rd	92C8	non artesian
109131	BD3M	54	734370	5744490	YEO	YEODENE	Track on private property off McCalls Rd	Bingami Rd	92C8	non artesian
109133	BD3M	54	734650	5746950	YEO	YEODENE	Yeo-Yeodene Rd	McCalls Rd	92C8	non artesian
109134	BD3M	54	735650	5748600	YEO	YEODENE	Arundells Rd	Colac-Forrest Rd	92D8	non artesian
109135	BD3M	54	740300	5750900	YEO	BIRREGURRA	Dunlops Rd	Birregurra-Yeodene Rd	92E7	non artesian

Groundwater Licence No. 893889
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109110	BD3M	54	734460	5745190	YEO	YEODENE	McCalls Rd	Bingarni Rd	92C8	non artesian
109111	BD3M	54	734460	5745190	YEO	YEODENE	McCalls Rd	Bingarni Rd	92C8	non artesian
109112	BD3M	54	736500	5743950	YEO	YEODENE	Colac-Forrest Rd	Boundary Hill Rd	92D8	artesian
109113	BD3M	54	735950	5744350	YEO	YEODENE	Possum Ridge Rd	Colac-Forrest Rd	92D8	non artesian
109114	BD3M	54	737100	5751000	YEO	WARNCOORT	Warncoort Cemetary Rd	Collyers Rd	92D7	non artesian
109128	BD3M	54	734240	5744300	YEO	YEODENE	Track on private property off McCalls Rd	Bingarni Rd	92C8	non artesian
109129	BD3M	54	734310	5744310	YEO	YEODENE	Track on private property off McCalls Rd	Bingarni Rd	92C8	non artesian
109130	BD3M	54	734090	5745190	YEO	YEODENE	McCalls Rd	Bingarni Rd	92C8	non artesian
109131	BD3M	54	734370	5744490	YEO	YEODENE	Track on private property off McCalls Rd	Bingarni Rd	92C8	non artesian
109133	BD3M	54	734650	5746950	YEO	YEODENE	Yeo-Yeodene Rd	McCalls Rd	92C8	non artesian
109134	BD3M	54	735650	5748600	YEO	YEODENE	Arundells Rd	Colac-Forrest Rd	92D8	non artesian
109135	BD3M	54	740300	5750900	YEO	BIRREGURRA	Dunlops Rd	Birregurra-Yeodene Rd	92E7	non artesian

FOURTH SCHEDULE

The subsidence monitoring network shall consist of four deep seated bench marks control clusters (high stability marks), and eleven monitoring stations given in Table 1. It shall be levelled using GPS (accuracy of approximately 10 mm).

Table 1

	Station ID	Easting	Northing
Control Clusters			
Yoo	20790040	730262	5745488
Forrest	39780106	734047	5731948
Dewings	20880024	742309	5736919
Bambra	20590052	752872	5741632
Monitoring Stations			
	32390045	740327	5738869
	32390046	742196	5743862
	26470027	734015	5737951
	26470032	737430	5741001
	26470033	738685	5740722
	36470036	735959	5743011
	39870025	745547	5751969
	39870026	733833	5745378
	38090024	749124	5753920
	38090025	745547	5751969
	38090026	746148	5746544

13

FIFTH SCHEDULE

The owner of a domestic and stock bore within the recharge or outcrop areas of the groundwater aquifer from which groundwater is extracted under licence by Barwon Water, may request that the Authority determine whether the extraction by Barwon Water is adversely affecting the performance of that bore.

If the Authority forms a reasonable opinion that Barwon Water's licensed operations are the most likely cause of significant problems in respect to access to water from a well constructed and well maintained domestic and stock bore, then Barwon Water must:

- restore the access to normal water availability by undertaking to deepen or replace the bore, or
- provide alternative arrangements to restore access to water for stock and domestic use.

In forming a reasonable opinion, the Authority may (where it can be established) have regard to:

- the current condition of the bore (visual inspection);
- the historical maintenance of the bore (interview with current landowner);
- historical water levels within the bore;
- the location of the bore with respect to Barwon Water operations;
- the age of the bore (from Groundwater Management System or Bore Construction Licence records);
- the depth of bore (from Groundwater Management System or Bore Construction Licence records and visual inspection);
- the geological formation that the bore intercepts and the hydrogeological connection with the geological formation targeted by Barwon Water (from Bore Construction Licence records);
- climatic conditions;
- the decline in the regional water table.

Having reached its determination, the Authority shall document the reasons and basis of determination and supply its findings to the bore owner and Barwon Water.

Either party may appeal the Authority's determination and lodge a request for appeal with the Authority within 21 days of receipt of determination, whereby the Authority's determination and supporting documents are referred to the arbitrator for review and final determination within a further 60 days.

The appointment of an arbitrator will be made by the Authority having regard to appropriate expertise and independence to all parties. The cost of the arbitrator and associated process will be borne by the appellant.

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APPENDIX 10. Early 2012 Local Community Participation & requests for FLOWS METHOD Manual.

From: otwaywater@yahoo.com.au
Subject: Happy new year and...
Date: 3 January 2014 23:54
To: justin.franklin@barwonwater.vic.gov.au

Hi Justin,
Hope your new year has started well.
I have a query for you that I would like you to respond to.
At one of the early meetings of the Groundwater Reference Group I was critical that the 2012 SKM, Ecology Australia and La Trobe University appeared to lack any local representation, contribution or involvement, as I thought there was a great deal that locals could have provided making the suggested new monitoring programme so much better. You stated that there had been local community participation. My query is could you provide me with the names of the local community people that were involved in this process.
I notice that the 2013 SKM report also states that there had been local community involvement at this very initial stage. It would be appreciated if you would provide details on what and who this involved.
Regards,
Malcolm.

Malcolm Gardiner
Email otwaywater@yahoo.com.au
www.otwaywater.com.au
Phone +61 3 52358325

Similar requests were often made at the CRG meetings.

Some of the Issues and Action List items.

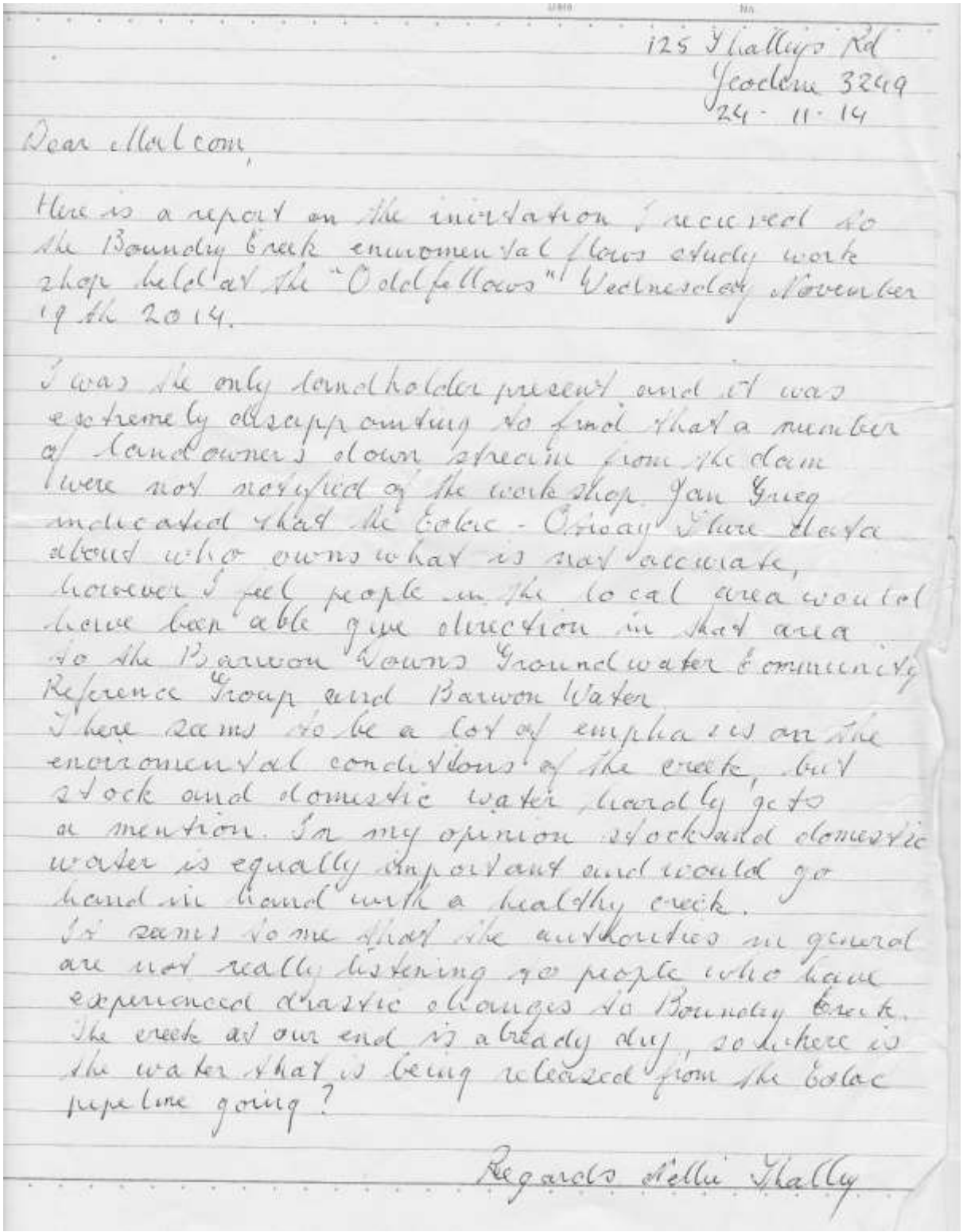
BDGCRG Issues and Actions list

Version / Last Updated 8/04/2014

Medium	Meeting 6 (20 February 2014)		Investigate if extra shallow bores are needed in addition to the current scope. This is related to the request on nested bores and the possibility of leakage between aquifers.			
Medium	Meeting 6 (20 February 2014)		Re-send summary document on nested bores.			
High	Meeting 6 (20 February 2014)		Members to consider and provide feedback on the location sites of the nested bores as outlined in the scope of works for the groundwater monitoring component.			
Medium	Meeting 6 (20 February 2014)		Confirm a representative from SKM to discuss supplementary environmental flows. Key questions include the potential to stop flows to allow area to revert to a natural state, whether environmental flows are indirectly recharging the aquifer and what environmental reason there was to continue with an environmental			
High	Meeting 6 (20 February 2014)		CRG members to review the PASS component of the SKM report for discussion at the next meeting (March 2014).			
High	Meeting 6 (20 February 2014)		Conceptualisation of the western flank to be presented to committee members once work is completed. This will influence whether there is a need to install additional stream gauge monitoring sites at 10 Mile and Porcupine Creek.			
Low	Meeting 6 (20 February 2014)		Confirm how far west pre-construction letters went (and check whether Gavin was included on mailing list).			
High	Meeting 6 (20 February 2014)		Investigate a suitable alternative meeting day to increase			
Medium	Meeting 6 (20 February 2014)		SRW availability for presenting to the group on the licence renewal process.			
Medium	Meeting 6 (20 February 2014)		MG to provide the CRG with a written list documenting his concerns on the recommended monitoring program scope.			
Low	Meeting 6 (20 February 2014)		Request for explanation on why the supplementary flows been switched on recently when there has been extensive rain and flows at the Colac/Forrest Road Bridge? Under the licence conditions this is not required.			
High	Meeting 6 (20 February 2014)		Request for how many nested bores does Barwon Water deal with in data collection for the Gerangamete Borefield?			
High	Meeting 6 (20 February 2014)		Request for how many nested bore sites are recommended in the new monitoring program as outlined by Steve Parsons the other night			
High	Meeting 6 (20 February 2014)		conceptualisation of Barongarook High to be added to the issues list and that Barwon Water will look at updating the "conceptual model" of this area.			
Medium	Meeting 6 (20 February 2014)		Request for data on shallow bores related to SKM, 2013 monitoring program scope - on page 33 of Steve Parson's handout under TB2 it says, "Former shallow bores in this area could not be located during the field inspection (assumed lost/ destroyed)." "Could you provide me with the data you have on these shallow bores?" E.g. Location, depth, dates that they operated, data that has been collected & by whom, reasons for drilling them - any other data that			
Medium	Meeting 6 (20 February 2014)		Request for provision of the names of the local community people that were involved in this process (SKM, 2012). "I notice that the 2013 SKM report also states that there had been local community involvement at this very initial stage. It would be appreciated if you would provide details on what and who this involved."			
Low	Meeting 6 (20 February 2014)		Request for copy of SKM's modelling scenarios for extractions that resulted from SKM's July 2030 recommendations in the "Barwon Downs Groundwater Modelling Scope Study," by Hoxley			
Medium	Meeting 6 (20 February 2014)		Request for copies of the modified versions of the minutes for meetings 3 & 4			
Low	Meeting 6 (20 February 2014)		Request for information if Barwon Water obliged to take water from the desalination plant when it comes on line			
Medium	Meeting 6 (20 February 2014)		Request for a copy of the 2005 FLOWS report as mentioned on page 98 of the SKM 2013 report			

Malcolm's request for list of names of local people involved in the preparation of the 201213 Monitoring Program given medium priority.

FLOWS Method request rated as Medium priority.



125 Hallys Rd
Yeodene 3249
24 - 11 - 14

Dear Malcom,

Here is a report on the invitation I received to the Boundry Creek environmental flows study work shop held at the "Oddfellows" Wednesday November 19th 2014.

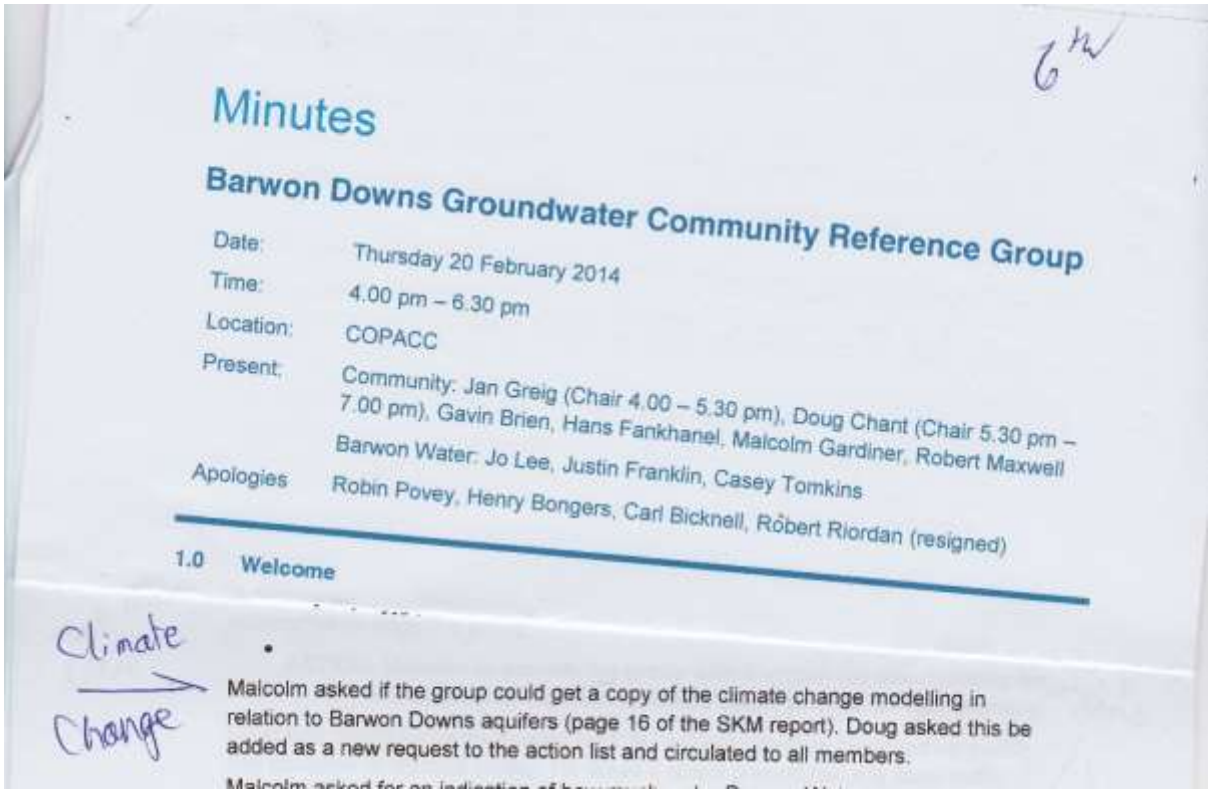
I was the only landholder present and it was extremely disappointing to find that a number of landowners down stream from the dam were not notified of the work shop. Jan Grieg indicated that Mr Eglac - Otway Shire Manager about who owns what is not accurate, however I feel people in the local area would have been able give direction in that area to the Barwon Downs Groundwater Community Reference Group and Barwon Water
There seems to be a lot of emphasis on the environmental conditions of the creek, but stock and domestic water barely gets a mention. In my opinion stock and domestic water is equally important and would go hand in hand with a healthy creek.
It seems to me that the authorities in general are not really listening to people who have experienced drastic changes to Boundry Creek. The creek at our end is already dry, so where is the water that is being released from the Eglac pipeline going?

Regards Kelli Hally

Attempts to involve local community participation seemed to be a low priority. Going through the motions appears to be the order of the day.

APPENDIX 11

An effort to gain a copy of the Climate Change document and shallow bores referred to in the 2013 New Monitoring Program.[1]



6w

Minutes

Barwon Downs Groundwater Community Reference Group

Date:	Thursday 20 February 2014
Time:	4.00 pm – 6.30 pm
Location:	COPACC
Present:	Community: Jan Greig (Chair 4.00 – 5.30 pm), Doug Chant (Chair 5.30 pm – 7.00 pm), Gavin Brien, Hans Fankhanel, Malcolm Gardiner, Robert Maxwell
	Barwon Water: Jo Lee, Justin Franklin, Casey Tomkins
Apologies	Robin Povey, Henry Bongers, Carl Bicknell, Robert Riordan (resigned)

1.0 Welcome

Climate Change

- Malcolm asked if the group could get a copy of the climate change modelling in relation to Barwon Downs aquifers (page 16 of the SKM report). Doug asked this be added as a new request to the action list and circulated to all members.

Malcolm asked for an indication of how much

This request was not followed up.

From: **Malcolm Gardiner** otwaywater@yahoo.com.au
Subject: Re: Some areas of concern
Date: 4 April 2014 8:58
To: jangreig@iprimus.com.au

Dear Jan,

I have some concerns with changes made to the minutes of meeting 2 tabled 14 November 2013 and the minutes tabled 27 November 2013.

IN the first instance, I put forward changes at the 3rd meeting that were accepted by the Group as an accurate account of what was said at the second meeting. The minutes tabled at the next meeting did not reflect these changes. As a consequence I typed out the changes and submitted them. In the revised/amended minutes handed out on the 25 March 2014 the changes were still not made.

The typed changes were...

" PAGE 1, second paragraph, Re: confirmation of previous meeting minutes. To read...shallow bores on Gavin's property have been performing well since sunk and Rick's confirmation that vertical leakage impacts on Gavin's shallow bores may takes years to eventuate."

The second instance of change proposed and accepted by the Group as an accurate account that was not amended, is found in the minutes of the 3rd meeting. The typed change handed in was...

"Bottom on Page 5.

Malcolm asked if more work would be done around the 10 Mile Creek area regarding the aquifer divide that separates the recharge flows from the Barongarook High to the South East (Barwon Downs) and South West (Gellibrand) flows. Steve replied that there were enough monitoring bores in the area to determine whether the aquifer divide has shifted. There is sufficient data available to determine this."

Also Jan, as I said after the last meeting, althogh more costly, it would be quicker to gain requested information via the FOI proces than through the Reference Group. Things requested going back monthhs include...

- the Climate change report mentioned on page 16 of the 2013 SKM Report.
- the SKM scenarios on different pumping regimes including the effects on the aquifer

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GHB done in the early 2000s.

- the list of local community residents consulted regarding the new monitoring program.
- which layers form the upper, middle and lower EVF
- the supposed location and data on the shallow bores located in the TB2 area.

If you could look into these matters as Chair of the group I would appreciate it.

Kind regards,
Malcolm.

Malcolm Gardiner
1805 Colac Lavers Hill Road
Kawarren
Vic 3249
ph (03) 52 358 325
www.otwaywater.com.au

Gaining no response to this email either by written reply or at the NEXT CRG meeting, an FOI was sent off requesting several things including the Climate Change report and information on the shallow bores mentioned on page 33. The FOI was extremely specific citing the 2013 New Monitoring Program report[(1)]and the pages where the 2103 referred to these things.

Barwon Water

Freedom of Information

BARWON REGION WATER CORPORATION
61-67 Ryrie Street
PO Box 659
GEELONG VIC 3220
www.barwonwater.vic.gov.au
ABN 86 348 316 514

Telephone Local (03)5226 2543
Telephone Overseas +61 3 5226-2543
Fax No. Local (03) 5222 6983

Freedom of Information Act 1982

Access request form

NAME: Malcolm Gardiner

POSTAL ADDRESS: 1805 COLAC LAVERS HILL ROAD KAWARREN VIC 3249

TELEPHONE CONTACT: BH _____ AH 03 52 358 325

DETAILS OF DOCUMENTS REQUESTED:

1. The names of the aquifers located in the upper Eastern Formation; the lower Eastern View Formation and the aquifers in the middle Eastern View Formation.
2. On Page 33 of Barwon Waters "Barwon Downs Monitoring Program" STAGE1 Field Investigations + Monitoring Program Scope, it mentions former shallows bores in the area of site TB2 Big Swamp upstream of burnt peat. Could I have the location, depth, dates operated and any data that has been collected, why collected the data and why the bores were constructed?
3. A copy of SKM's modelling scenarios for extractions that is from SKM's July 2000 recommendations in the "Barwon Downs Groundwater Modelling Scope Study" by Hoxley.
4. On Page 16 of the same Report as mentioned in point 2 above, a 2011 SKM Climate Change Modelling report is mentioned. Could I have a copy of

FORM OF ACCESS REQUIRED: (Tick one)

(i)	A copy of the document(s)	☑
(ii)	Inspection of the document(s)	☐
(iii)	Access in another form (specify)	☐

I understand that an application fee of ~~$22.70~~ $30.00 must accompany this request and that further reasonable charges for photocopying and other processing costs may be applicable. FOI fees and charges are not subject to GST.

Signature _____ Date 16/4/2014

Send request and cheque/money order (payable to Barwon Water) for $22.70 to:
FREEDOM OF INFORMATION MANAGER
BARWON WATER
PO BOX 659
GEELONG VIC 3220

Barwon Water replied stating that there was insufficient information to be able to locate/find the documentation requested.

Barwon Water

Our Ref: F079152
Your Ref:
Enquiries To: Paul Rawson

20 May 2014

Mr Malcolm Gardiner
1805 Colac Lavers Hill Road
KAWARREN VIC 3249

Dear Mr Gardiner

Freedom of information request

I refer to my letter to you of 2 May 2014.

In the letter I invited you to consult with Barwon Water in relation to your FOI request of 22 April 2014. This was with a view to amending or clarifying your request to provide such information as was reasonably necessary for us to be able to identify the documents you seek. Without that information no valid request existed under the Act.

It has been more than 18 days since I sent my letter to you and no response has been received to consult or to amend your FOI request.

As you have been provided with a reasonable opportunity to respond, and there has been no change to your request, I am unable to process your request on the basis that it does not comply with s 17(2) of the Act – you have not provided such information about the documents you seek as is reasonably necessary to identify them.

Accordingly, please find enclosed a cheque for the amount of $30.00 in refund of the application fee you sent to us with your Freedom of Information request.

Yours sincerely

Paul Rawson
Manager Corporate Support Services
Barwon Water

Cc Justin Franklin

Encl.

Barwon Region Water Corporation
ABN 86 348 316 514

61-67 Ryrie Street, Geelong Victoria 3220
PO Box 659 Geelong Victoria 3220 TEL 1300 656 007 FAX +61 3 5221 8236
DX22061 (Geelong)

www.barwonwater.vic.gov.au

Lawyer Neil Longmore, sent of another FOI requesting the documents asked for with a little more specific information.

Barwon Water

Our Ref: **F079152**
Your Ref:
Enquiries To: **Paul Rawson**

31 July 2014

Mr Neil Longmore
25 Raffetys Road
GELLIBRAND RIVER VIC 3239

Dear Mr Longmore

Re: Freedom of Information Request - Mr Malcolm Gardiner

I refer to your letter dated 2 July 2014 in which you clarified your client, Mr Malcolm Gardiner, sought access under the *Freedom of Information Act 1982* ("**Act**") to:

1. *The location, depth, dates operated and data collected from shallow bores operated in the area of Site TB2 upstream of the burnt peat area on Boundary Creek, Yeodene. Reference is made to the above information at page 33 of the document* ***Barwon Downs Monitoring Program Stage 1 Field Investigations & Monitoring Program Scope,*** *referred to in more detail in item 3 below. Our client is not aware of the name of the document containing this information, but he requests that a copy of the document containing this information be provided to us.*

2. *The modelling that deals with the interaction with the adjacent Kawarren/Gellibrand aquifer on the western boundary of the Barwon Downs drawdown influence in the vicinity of the aquifer divide that is referred to in the following Barwon Water report.*

   26 July 2000 Barwon Downs Groundwater Scoping Study. Specification of Groundwater and Subsidence Modelling. FINAL 2 Sinclair Knight Mertz WCO1341:RO4 MODELSPEC (FINAL).DOC

3. *The report "****Climate Change Modelling for the Barwon Downs Aquifers July 2011 SKM****" This report is referred to in the Barwon Water publication,* ***Barwon Downs Monitoring Program Stage 1 Field Investigation & Monitoring Program Scope.1\VWESP\Projects\VW07070\Deliverables\Reports\Barwon Downs Work Package 1 Task C&D Final Report_26_11_13.docx***

Barwon Region Water Corporation
ABN 86 348 316 514

61-67 Ryrie Street, Geelong Victoria 3220
PO Box 659 Geelong Victoria 3220 TEL 1300 656 007 FAX +61 3 5221 8236
DX22061 (Geelong)

www.barwonwater.vic.gov.au

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Preliminary

In making the decision set out below, I have had regard to:

- The documents sought and
- Discussions with officers of Barwon Region Water Corporation ("**Barwon Water**".

Decision and reasons for decision

I have determined to refuse to grant access to the documents your client seeks in relation to part 1 of your client's request and to grant you access to those documents comprising part 2 and 3 of your client's request.

Part 1 of your client's request

In relation to part 1 of the request, I have determined that Barwon Water does not hold a document that addresses every aspect of your client's request for "*location, depth, dates operated and data collected from shallow bores operated in the area of Site TB2 upstream of the burnt peat area on Boundary Creek, Yeodene*". In any event, your client has sought access to information, rather than access to documents. However, each of these points of information is collected by the Department of Environment and Primary Industries and freely available on its website at: http://www.vvg.org.au/cb_pages/wmis.php.

Part 2 of your client's request

In relation to part 2 of the request, I have determined to provide you with access to a draft report entitled "Barwon Downs Groundwater flow and subsidence Modelling Project, May 2001".

This document is a draft report; the groundwater model has been further refined and improved since the draft report was prepared 14 years ago. Care should be taken in the use and reliance on information contained in the report as a consequence of its draft nature. Your client should also consider the report as containing non-current information.

Barwon Water has recently initiated work that aims to provide more comprehensive understanding of the interaction with the adjacent Karwarren/Gellibrand aquifer. The current work specifically addresses part 2 of your client's request. When the new report is completed, I propose that Barwon Water will provide your client with a copy of the report on the outcomes of this current work, outside of the Act.

It was most unsettling that the bore information requested in part 1 could not be located, especially when these bores were mentioned in the 2013 New Monitoring Program[(1)] and were often referred to by SKM staff at CRG meetings.

The part 2 reply reads well, seems reasonable but the document requested was not a draft document. FINAL is stated twice in the title of the request.

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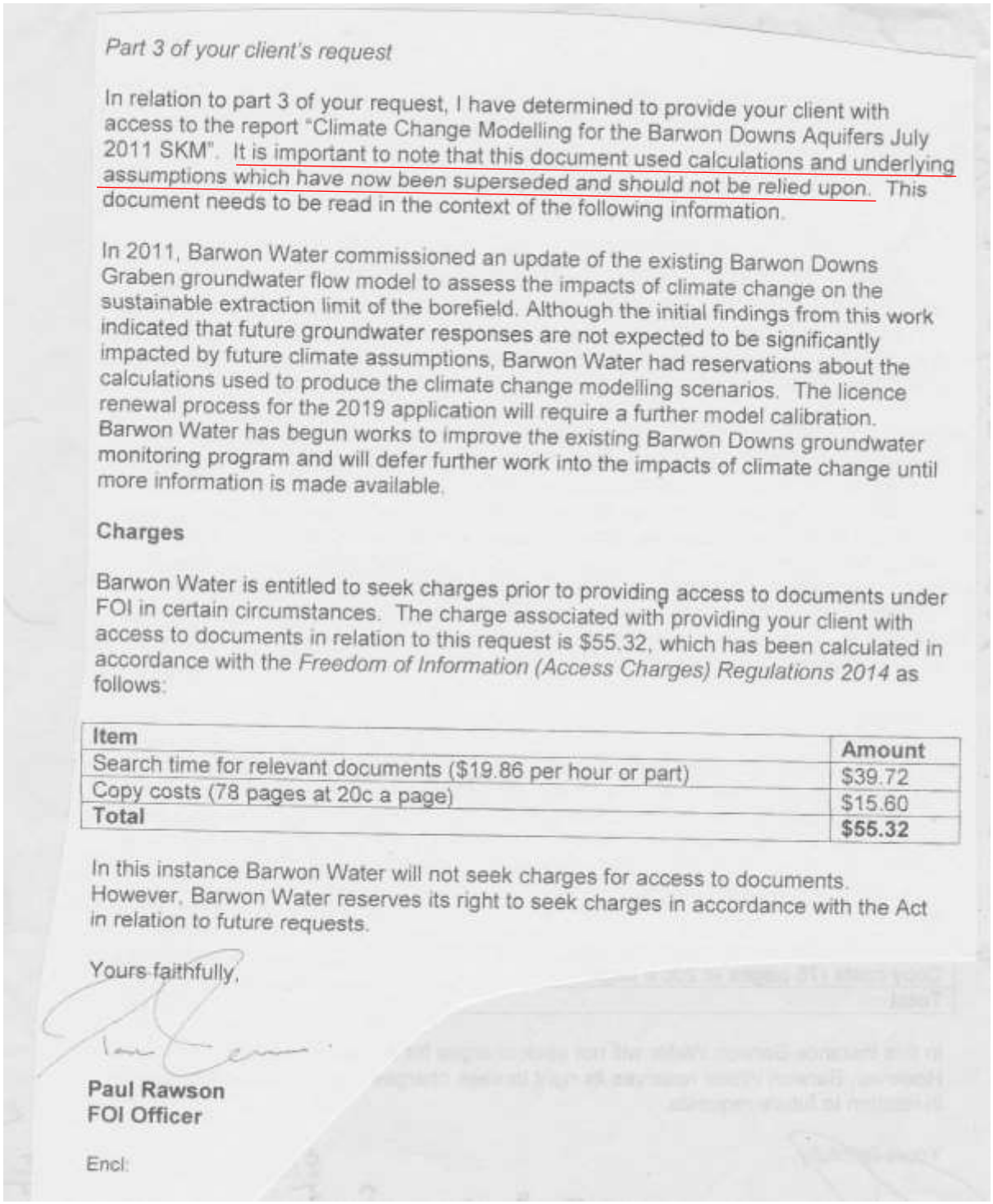


Part 3 of your client's request

In relation to part 3 of your request, I have determined to provide your client with access to the report "Climate Change Modelling for the Barwon Downs Aquifers July 2011 SKM". It is important to note that this document used calculations and underlying assumptions which have now been superseded and should not be relied upon. This document needs to be read in the context of the following information.

In 2011, Barwon Water commissioned an update of the existing Barwon Downs Graben groundwater flow model to assess the impacts of climate change on the sustainable extraction limit of the borefield. Although the initial findings from this work indicated that future groundwater responses are not expected to be significantly impacted by future climate assumptions, Barwon Water had reservations about the calculations used to produce the climate change modelling scenarios. The licence renewal process for the 2019 application will require a further model calibration. Barwon Water has begun works to improve the existing Barwon Downs groundwater monitoring program and will defer further work into the impacts of climate change until more information is made available.

Charges

Barwon Water is entitled to seek charges prior to providing access to documents under FOI in certain circumstances. The charge associated with providing your client with access to documents in relation to this request is $55.32, which has been calculated in accordance with the *Freedom of Information (Access Charges) Regulations 2014* as follows:

Item	Amount
Search time for relevant documents ($19.86 per hour or part)	$39.72
Copy costs (78 pages at 20c a page)	$15.60
Total	**$55.32**

In this instance Barwon Water will not seek charges for access to documents. However, Barwon Water reserves its right to seek charges in accordance with the Act in relation to future requests.

Yours faithfully,

Paul Rawson
FOI Officer

Encl:

The Climate Change report was good enough to portray a notion in the 2013 New Monitoring Program but not, as stated above, not good enough for Barwon Water in regard to other aspects of the report.

Little wonder access to the 2011 Climate Change report was first refused at the February 2015 CRG meeting, stating it was in draft format, and then every attempt made to deny access through the FOI process.

APPENDIX 12

In 2012 BWater had SKM, Ecology Australia & Latrobe Uni complete a report titled "Barwon Downs Monitoring Program" "... highlighting gaps in the existing program that may hinder successful licence renewal."

22 January 2013 BWater put out a tender Contract N°000534 containing tasks to complete A-F

01 May 2013 Draft report + recommendations to be finished by 01/05/2013

17 May 2013 Finial report to be finalised no later than 17/05/2013

March 2013 Some residents were sent a letter saying "up to 5 field workers are expected to be in the area from April 2, 2013 for about 3 wks." Title Re: 3/Downs borefield monitor review.

29/05/2013 As normal requests denied. an FOI was sent asking for the brief outlining the work being done by these 5 workers.

04/06/2013 BW received FOI.

16/07/2013 BW sends Contract N° 000534 in reply to FOI BW FOI Ref: FO76088

22/07/2013 A 2012 SKM, Ecology Aust + Latrobe Uni report mentioned in Contract N° 000534 was requested + denied. Another FOI sent off requesting the 2012 report. In the same FOI request asked for the report that should have been finished by 17 May 2013 as per Contract N° 000534.

10/09/2013 The SKM 2012 report arrives, dated 28 August 2013. The 17 May 2013 report denied as it is still in draft form. (even tho' the report had to be finished after draft form 1 may by 17 May 2013). The reply said I would be contacted after 1st November 2013 to advise when this doc. is finalized and a copy will be forwarded to me.

BW Ref: FO79852

17/12/2013 Still no 17 May report - BUT promised it would be given out @ the BD Borefield Renewal Community Meeting tonight. (Provided) This was the last meeting for the year - good Christmas break reading ≈ 350 pages.

Barwon Water

25 March 2013

W F LATTA
18 School Rd
KAWARREN VIC 3249

034
6000306

Dear Resident,

Barwon Downs borefield monitoring review

Barwon Water is currently reviewing its monitoring program for the Barwon Downs borefield. This program consists of a series of monitoring bores and observation points that enable measurement of changes to the environment as a result of groundwater extraction.

The Barwon Downs borefield has been switched off since 2010 and the existing monitoring network is showing that underground water levels have been recovering at a steady rate since then. The current monitoring network is extensive, but could potentially be enhanced by installing additional monitoring facilities that would provide more comprehensive information on groundwater behaviour.

The first stage of providing better monitoring facilities involves some site inspections, which will be carried out by consultants SKM and Ecology Australia in April, 2013. This will include inspecting bore sites and taking measurements at observation bores. Up to five field workers are expected to be in the area from April 2, 2013 for about three weeks.

The monitoring program review will include investigations into water quality, stream flows, eco-systems near the borefield and groundwater recharge rates. The scope of these investigations has not yet been finalised.

The first stage of the review will help determine whether the existing monitoring is adequate or whether additional monitoring equipment is required to better understand groundwater processes.

The Barwon Downs community will be consulted and kept informed throughout the review. For more information regarding the monitoring program review or the field investigations, please contact Barwon Water on 1300 656 007 or email info@barwonwater.vic.gov.au

Yours sincerely,

Carl Bicknell
General Manager Strategy and Planning

Barwon Region Water Corporation
ABN 86 343 318 514

61-67 Ryrie Street, Geelong Victoria 3220
PO Box 659 Geelong Victoria 3220 TEL 1300 656 007 FAX +61 3 5221 8236
DX 22061 (Geelong)

www.barwonwater.vic.gov.au

-----Original Message-----
From: Malcolm Gardiner [mailto:otwaywater@yahoo.com.au]
Sent: Monday, 13 May 2013 8:57 PM
To: Justin Franklin
Subject: Fwd: Service contract, Barwon Downs study

> Hi Justin,
> Would it be possible to gain a copy of the brief, I guess it is a Service Contract, given to SKM to conduct the work as outlined in the letter dated 25 March 2013 from Carl Bicknell that was sent to landholders in the Barwon Downs Region regarding Barwon Water's monitoring for the Barwon Downs

Information regarding the monitoring program review and the field investigations would be appreciated.

From: **justin.franklin@barwonwater.vic.gov.au**
Subject: RE: Service contract, Barwon Downs study
Date: 24 May 2013 15:57
To: **Malcolm Gardiner**

Hi Malcolm,

Given that information issued to our panel contractors is not normally published, it would be best to submit an FOI request for this type of information.

You can get a form and submission details via the following link:

http://www.barwonwater.vic.gov.au/contact/foi

If you have any further questions in the meantime, feel free to email me.

Regards,

Justin Franklin
Water Resource Planning Coordinator | Barwon Water
61-67 Ryrie Street (PO Box 659) Geelong VIC 3220

Arrived 10 Sep 2013

Barwon Water

Our Ref: F079152
Your Ref:
Enquiries To: Paul Rawson

9 September 2013

Malcolm Gardiner
1805 Colac Lavers Hill Road
Kawarren VIC 3249

Dear Mr Gardiner

Re: Freedom of information request

I refer to your request received at Barwon Region Water Corporation on 26/07/2013 in which you sought access to various documents under the Freedom of Information Act 1983 **("Act").**

Please find enclosed the following documentation as requested:

- Barwon Downs Monitoring Program Final 1 Report
- Colac Water Supply Upgrade Preferred Option Survey Results

The third report requested in your application and emanating from Contract No. 000534 is currently in draft status and being finalised. Under the FOI legislation, documents in draft form on the date an FOI application is received are exempt under the Act.

I have reviewed the draft document and once it is finalised it would no longer be exempt under the FOI legislation. Based on this review, Barwon Water is happy to provide you access to the document once it has been finalised without requirement for an additional FOI application.

A Barwon Water employee will be in contact with you after the 1 November 2013 to advise when this document will be finalised and a copy forwarded to you.

If you have any further queries, please contact me at Barwon Water on ph: 1300 656 007 or email paul.rawson@barwonwater.vic.gov.au.

Yours faithfully,

per MRW.

Paul Rawson
FOI Officer
Manager Corporate Support Services

Barwon Region Water Corporation
ABN 86 348 316 514

61-67 Ryrie Street, Geelong Victoria 3220
PO Box 659 Geelong Victoria 3220 TEL 1300 656 007 FAX +61 3 5221 8236
DX22061 (Geelong)

www.barwonwater.vic.gov.au

APPENDIX 13

State of Victoria – Evidence Act 1958

[JP-Dec.LI-2009]

STATUTORY DECLARATION

I, Petronella Cornelia Shalley
[full name]

of "Sunny Side" Yeodene Lot 45 Parish of Yeo. 125 Shalleys Road, Yeodene, Victoria 3249
[address]

Farmer
[occupation], do solemnly and sincerely declare that:-

I have lived at the above address for 44 years. This property abounds both sides of Boundary Creek and on the north west boundary of the West Branch of the Barwon River. My late husband's family have owned this property since 1912. Frank, my husband, and I wrote to Mr. Whiteside of the Geelong Water Trust on the 29th of January 1990 and informed him that Boundary Creek continued to flow through the 1914 drought and the 1967-1968 drought even when the West Barwon River became dry and dusty. The West Barwon forms our south eastern boundary. Boundary Creek was the salvation of our property through these droughts. Our family has relied on this permanent water for three generations.

We had relied on the continuos flow in Boundary Creek all the time that I have been on this property up until the year after Barwon Water pumped water from the ground at Gerangamete during the 1982-1983 drought. On the 19th of February 1991 we wrote to Mr K Maxwell of the Rural Water Commission in Camperdown because we were gaining no satisfaction from the Geelong and District Water Board. We stated that since water was being pumped from the Gerangamete wells in 1988 Boundary Creek ceased to flow in the summer of 1989-1990 and was bone dry by the 10th of January 1990.

This has happened numerous times since. After many discussions and hours spent Barwon Water agreed to release supplementary water using discharge from the Colac pipeline. A trial was conducted in 1999 but repairs had to be done to the Colac pipeline late in 1999. A meeting with Barwon Water and Sinclair Knight Merz with results that showed groundwater pumping affects Boundary Creek. Water was again released from the Colac pipeline in May 2002 but was very slow to reach our home farm.

In February 2003 water was trucked in because Barwon Water could not release the water from the Colac pipeline because I was told it was affecting the Colac supply. This scenario of trucking water in went on until 2006. Barwon Water has been now releasing 2 ML a day as per the requirement of their Licence Number 893889. However, the water doesn't reach the lower parts of Boundary Creek until it rains so the released water is of no value to our farm, to the creek and its environment, nor can we rely on Boundary Creek as a water supply.

Before Boundary Creek ran dry during 1984 there were colonies of platypus along our stretch of the creek. There were many blackfish, trout, red fin and brown trout. None of these animals have been able to live in a dry creek bed and disappeared soon after Boundary Creek dried up.

After rains and when the creek begins to flow again I am unable to use the water for stock from the creek until 4-5 inches of rain has flushed away the unpalatable water.

I acknowledge that this declaration is true and correct, and I make it with the understanding and belief that a person who makes a false declaration is liable to the penalties of perjury.

Declared at Forrest

in the State of Victoria, this 19TH day of

September 2009

P C Shalley
Signature of person making this declaration
[to be signed in front of an authorised witness]

Before me,

Signature of authorised witness

DR. R. SARKIS
Grant & Henry Street,
Forrest Vic. 3236
Ph. 052-366 355
Prov. No. 0108014 H

.

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2009]

STATUTORY DECLARATION

I, John Graeme Day
[full name],

of 1645 Colac Forrest Rd Yeodene
[address],

Dairy Farmer.
[occupation], do solemnly and sincerely declare that:-

Re: Boundary Creek, Yeodene, Victoria, post code 3249, Australia.

In 1979 my parents and I purchased the property on Boundary Creek, Yeodene. We came from a high rainfall area and looked for a new home with permanent water. The biggest asset to us with this farm was the permanent water flowing down Boundary Creek. The property came with good fishing (blackfish, eels and fresh water crayfish). On many nights, cars would park on the side of the road to fish these waters just as our family did. We made use of the swimming holes to cool off in the heat of the day during summer. With irrigation equipment we were able to irrigate from the creek in mid summer.

In the years 1982-1983 it was very dry and our investment in a permanent water supply became apparent. The Boundary Creek flow was still very strong whilst the area was in the grips of drought. Late in summer it still had sufficient flow to irrigate. However, we did not take advantage of this.

It was soon after the 1982-83 drought however that for some reason Boundary Creek rapidly died. I witnessed the death of many eels in small muddied pools at this time. Boundary Creek has gone as a permanent creek, it now exists as a lifeless open stormwater drain. Boundary Creek is now often dry for months at a time during periods of no rain.

I acknowledge that this declaration is true and correct, and I make it with the understanding and belief that a person who makes a false declaration is liable to the penalties of perjury.

Declared at Colac

in the State of Victoria, this 16th day of November 20 11

Signature of person making this declaration
[to be signed in front of an authorised witness]

Before me,

Signature of authorised witness

TRACEY WILLIAMS
PHARMACIST

The authorised witness must print or stamp his or her name, address and title under section 107A of the Evidence Act 1958 (Vic)
(eg. Justice of the Peace, Pharmacist, Police Officer, Court Registrar, Bank Manager, Medical Practitioner, Dentist)

Colac Healthwise Pharmacy
Charlie Tomeo, B.Pharm.
ABN 62 551 908 022 Approval Number 23419N

State of Victoria – Evidence Act 1958

[JP/DOJ 1/2006]

STATUTORY DECLARATION

I, Donald Francis Whitehead.
[full name]

of 9 McAdam Cresent COLAC Victoria 3250
[address]

Retired Dairy Farmer.
[occupation], do solemnly and sincerely declare that:-

Between 1965 and 1979 I owned and lived on the property now owned by the Day family. This property is on the east side of the Colac to Forrest Road, Yeodene. The property has Boundary Creek running through it from the west to the east boundaries.

At no stage during the period I owned this land did Boundary Creek stop flowing. It was a permanent flowing stream that could be relied upon for a constant supply of water for stock. In this regard Boundary Creek made the property drought proof.

I acknowledge that this declaration is true and correct, and I make it with the understanding and belief that a person who makes a false declaration is liable to the penalties of perjury.

Declared at COLAC
in the State of Victoria, this 2ND day of
MAY 2011

D W Whitehead
Signature of person making this declaration
[to be signed in front of an authorised witness]

Before me,
Signature of authorised witness
FCPA.

The authorised witness must print or stamp his or her name, address, and title under section 107A of the Evidence Act 1958 [Vic.]
(eg. Justice of the Peace, Pharmacist, Police Officer, Court Registrar, Bank Manager, Medical Practitioner, Dentist)

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, FREDERICK JAMES SWAN
[full name],

of 51 CHURCH ST. COLAC VIC. 3250
[address],

FARMER/BUS DRIVER.
[occupation], do solemnly and sincerely declare that:-

My family has owned the farming land to the south, which directly abuts the area known as the Big Swamp, since 1935. I was born in 1943, attended the Gerangamete School, just down the road, and have recollections of the Big Swamp from around the age of four i.e. 63 years of memories. My father would take me, while fencing our property, into this area and show me various things he had discovered there, such as possum nests and other things. I can recall him telling me that the Big Swamp did not even catch fire when the 1939 fires completely surrounded it.

Until the fires in the 1990's you could not see into or over this swamp area because of its denseness. The ti-tree scrub and paper barks were so tall, close together and thick that it was almost impossible to penetrate them, and, because it was such a wet area, you weren't inclined to go too far into the swamp. Even in the bad drought of 1982/83 this whole area was still covered in water and didn't appear to be any drier because of the drought.

In 1987, I took the quick-fill pump from the local fire brigade down to Boundary Creek to get necessary water to fight a fire in the nearby bush and I was astounded to see the creek was so low, with virtually no flow at all. I quickly had to source an alternative water source. After the first of the 1990's fires in the Big Swamp I was fortunate enough to get a helicopter flight over the swamp. From the air it was amazing to see how much of a jungle and wilderness the swamp was and it was obvious that many areas had dried out. When fighting fires in the Big Swamp area we nicknamed it "Jurassic Park". Excavators and bulldozers were almost useless in trying to get to the seat of the hot spots because whilst the dried out peat on top looked firm the wet peat further down was really treacherous. Considering the wet winters we had had over this time I was amazed that the Big Swamp had dried out so much, and the flows in Boundary Creek were so low.

I still work our family farm and since the fires of 1998 we have been able to look right across the Big Swamp. The fires this year have wiped the area virtually clean of standing vegetation and the area bears no resemblance to the healthy swamp I once knew.

I acknowledge that this declaration is true and correct, and I make it with the understanding and belief that a person who makes a false declaration is liable to the penalties of perjury.

Declared at COLAC

in the State of Victoria, this 5TH day of

OCTOBER 2010

F J Swan
Signature of person making this declaration
[to be signed in front of an authorised witness]

Before me,

Signature of authorised witness

(GRAHAM HONEY
S/C OF POLICE 25054)

Colac Police Station
Queen Street
COLAC 3250

The authorised witness must print or stamp his or her name, address, and title under section 107A of the Evidence Act 1958 [Vic.]
(eg. Justice of the Peace, Pharmacist, Police Officer, Court Registrar, Bank Manager, Medical Practitioner, Dentist)

To
Malcolm Gardner.

From
Jim Speirs.
Forrest 3236.
23-6-2010

Dear Malcolm.

In response to your inquiry regarding the area at Boundary Creek, Barongarook, in particular the area known locally as the Big Swamp the following information may be of some interest to you.

I was involved in that area as I was employed by the former Forests Commission from 1952 until my retirement in 1991, firstly building and maintaining the roads and tracks as well as managing the forest produce and the control of fire and hazard reduction burning.

The entire area of the Barongarook forest was hazard reduced with fire from time as required to limit the danger from wildfire.

Hazard reduction burns were carried out either in Spring or Autumn in order protect the soil and over story vegetation from excessive heat damage.

The swampy areas were mostly very wet during these burns, however very good results were obtained as the swamp grass would burn very well after just a few dry days.

A burn during the early 1970,s in particular, in the Big Swamp was carried out by the crew wearing rubber boots as the water was quite deep, rather than just wet at ground level, which was the case mostly during burns.

Newer crew members were surprised to see the swamp grass burn very well down to the water, and complained about being bitten by the large stripped {Tiger} Leaches always present in the swampy areas at Barongarook.

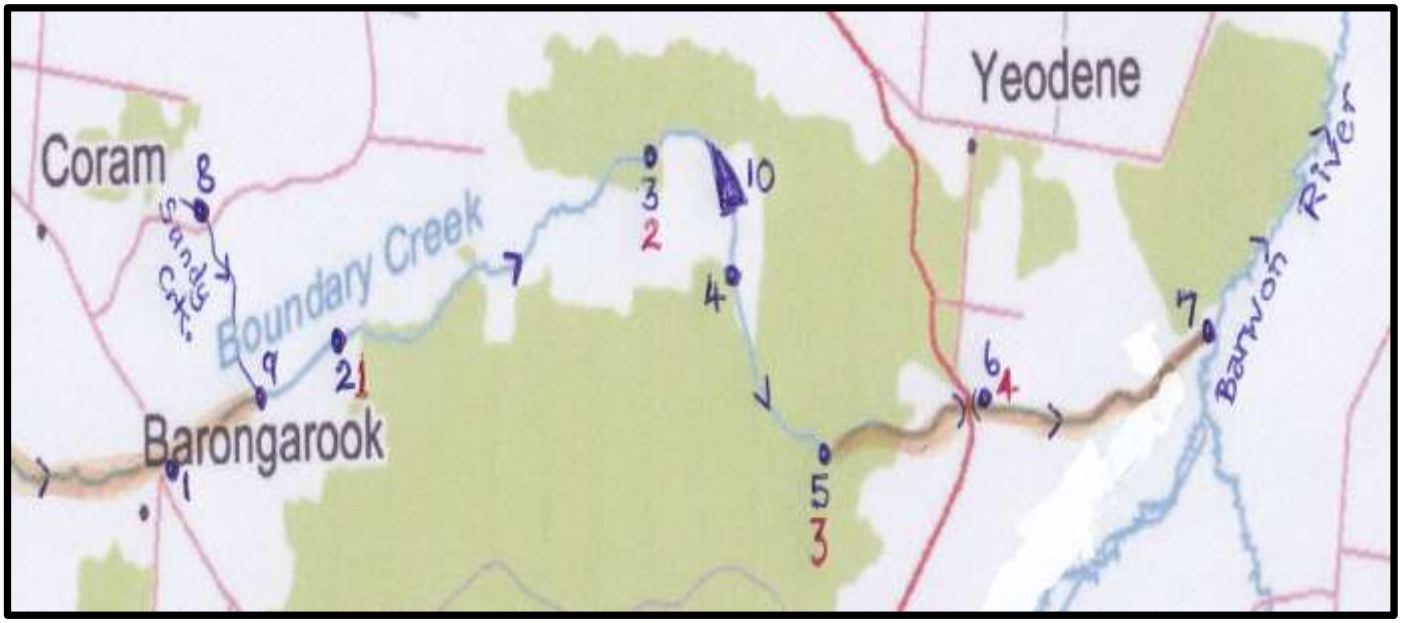
The Big Swamp must have dried out completely in recent years as I understand it is now burning through the peat and into the coal bellow, and for some years the local farmers have been complaining that no water is in the creek at the Boundary Creek Bridge on Colac Rd.

Although I am no expert it seems that for some reason the water table most have dropped away considerably for this to be happening.

Regards Jim Speirs.
Retired Forest Officer,

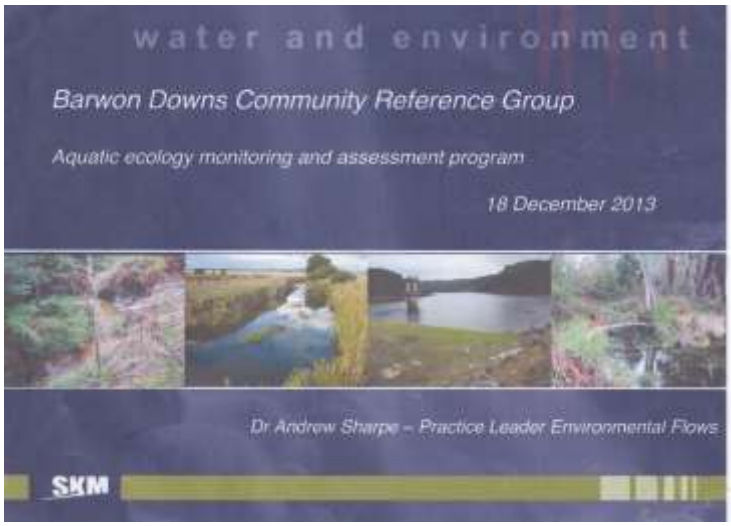
APPENDIX 14

This Appendix has been taken from Otway Water Book 27[32] written in March 2015. The adapted extract shows that at least five fish studies have been carried out along Boundary Creek, not just one as stated in SKM/Jacobs' reports up to 2017. It took Otway Water Book 39[31] (November 2017) and discussion at CRG meetings to convince SKM/Jacobs that more than one study had been done and that Barwon Water had funded some of these as earlier licence application work.

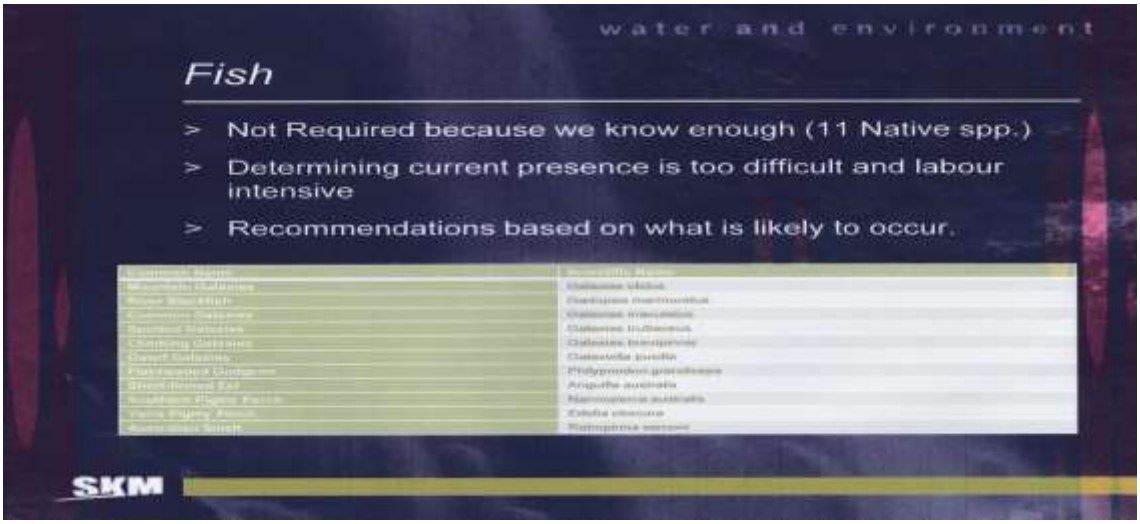


A. Numbered sites **1, 2, 3, 4, 5 & 6** (marked in Blue) are the sites surveyed for fish in 1992, 1993 and 2001.
B. Sites **1, 2, 3 & 4** (marked in red) are the 2015 macro-invertebrate sites for Barwon Water's 2013 Barwon Downs Monitoring Program.
C. Sites **2 & 3** (marked in red) are the sites for the new Barwon Water environmental flow investigations.
D. Site **6/4** is the Stream Flow Gauaging Station Number 233228.
E. From site **7 to 6** is the reach that Llyod investigated in 2006 to determine environmental flows for Boundary Creek.
F. Site **8** is the release point of the artificial supplementary flows out of the Otway to Colac Pipeline into Sandy Creek.
G. Site **9** is the confluence of Sandy Creek and Boundary creek.
H. Site **10** is McDonald's Dam. Since a change of ownership this dam is sometimes now called Buttigieg's Dam.

Part of the new monitoring program.



The "Fish" statement below,[32] is most baffling when considering one and a half million dollars is being spent on the new monitoring program for the Barwon Downs Borefield, and a fish study is not being included. Not carrying out a fish survey because it "...***is too difficult and labour intensive***" is quite



strange as the sites being investigated are easily accessible, with only a maximum flow of 2 ML/day released during the dry summer months. The cost would be minimal and take no longer than a day for each sampling effort. Because the creek reaches upstream and downstream of the artificial flows are dry in the summer months, little would be achieved "fishing" these reaches.

Also, to state that a fish study is not required because enough is known of 11 native species is a totally misleading statement. This statement gives the impression that there are 11 native species known to exist in the Boundary Creek Catchment. This is most definitely not the case.

FISH SPECIES FOUND ALONG BOUNDARY CREEK.

Tarmo Raadik of the Arthur Rylah Institue provided a list of fish species found along Boundary Creek. This list was current as February 2015. Only four native freshwater fish species have ever been recorded in Boundary Creek.

1. **River Blackfish** (Gadopsis marmoratus). Recorded by Tunbridge in 1986.[7] None have been recorded since 1986.
2. **Mountain Galaxias** (Galaxias olidus). Recorded by Sadlier on three occasions between May 1992 and June 1993,[24][25][36] AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.[27]
3. **Southern Pigmy Perch** (Nannoperca australis). Recorded by Sadlier on three occasions between May 1992 and June 1993,[35][26] AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.[37]
4. **Short Finned Eel** (Anguilla australis). Recorded by Sadlier on three occasions between May 1992 and June 1993,[35][36] AND by the Freshwater Ecology Section of the Arthur Rylah Institute in December 2001.[37]

In a 2014 research document[38] Tarmo Raadik determined that the fish species described as Galaxias olidus recorded in the Barwon River Catchment system, is in fact Galaxias ornatus. Future reference to any Galaxias found in the Barwon River Catchment needs to keep this piece of research in mind.

LAWROC Landcare Group has been given a quote for electrofishing at a daily rate of $3000. The 2001 fish study conducted by Arthur Rylah Institute was a one off effort and on that basis a follow up study should not be too costly, difficult or labour intensive to conduct. However, Barwon Water has made the decision not to conduct a fish survey.

1992-2001 Fish Studies.

The following pages of this Appendix have been taken from the Freshwater Ecology Section of the Arthur Rylah Institute's report prepared for Barwon Water in 2001.[37] Up until February 2015 Barwon Water acknowledged only 3 native fish species to habitat Boundary Creek. Barry Tunbridge's finding regarding Blackfish discovered in Boundary Creek in 1986 has never been included in any of Barwon Water fish studies, studies that have been presented as supporting argument for licence renewal applications.

Study sites

All sites were located on Boundary Creek, a small tributary of the Barwon River, situated approximately 10 km south east of Colac in southern Victoria. Sites extended from Barongarook (approximately 5 km from the origin of Boundary Creek), downstream to Yeodene, covering a distance of around 11 river km. Location details of all sites, including grid reference and altitude is presented in table 1. Location of all sites is also presented in map form in Map 1.

Table 1. Location and altitude information of each site surveyed on Boundary Creek during May 1992, October 1992, June 1993 and October-December 2001.

Site number	Map no.	Grid reference	Altitude (m)
1	7621	277/440	220
2	7621	295/447	197
3	7621	333/457	165
4	7621	341/451	159
5	7621	345/438	154
6	7621	365/437	138

Results

A total of four fish species were captured from the six sites surveyed. These included three indigenous species, the most common of which was the Mountain galaxias *Galaxias olidus* (captured from five of the six sites surveyed), Short-finned eel *Anguilla australis* and Southern pigmy perch *Nannoperca australis* (both of which were captured from two sites). The introduced Redfin (English perch) *Perca fluviatilis* was also captured from two sites. At each site, decapod crustacea were also recorded.
A complete species list is presented in table 2.

Table 2. List of species (including common and scientific names of fish and decapod crustacea) captured from Boundary Creek during October-December 2001.

Scientific name	Common name
INDIGENOUS FISH SPECIES	
Anguilla australis	**Short-finned eel**
Galaxias olidus	**Mountain galaxias**
Nannoperca australis	**Southern pigmy perch**
INDIGENOUS CRUSTACEA	
Engaeus sp.	**Land yabbie**
Paratya australiensis	**Freshwater shrimp**
INTRODUCED FISH SPECIES	
Perca fluviatilis	**Redfin**

Table 3. Summary of fish species captured from sites 1-6 in Boundary Creek on four sampling occasions from May 1992 to December 2001.

Site	Species captured	Sampling date			
		May 1992	Oct 1992	June 1993	Oct /Dec 2001
1	Anguilla australis		2		1
	Galaxias olidus	14	19	51	2
	Nannoperca australis	6	1	46	16
	Engaeus sp.	6	~70	5	30
2	Galaxias olidus	49	21	98	12
	Nannoperca australis	10			
	Engaeus sp.	4	~35	9	25
3	Galaxias olidus	48	10	90	36
	Nannoperca australis				20
	Engaeus sp.	1			8
	Paratya australiensis	~50			
4	Anguilla australis	1	5	1	8
	Galaxias olidus	1		91	12
	Perca fluviatilis	1	9	4	49
	Paratya australiensis	~50			
5	Anguilla australis	1	1		
	Galaxias olidus	3	1	42	1
	Perca fluviatilis				1
	Engaeus sp.		17		29
6	Anguilla australis	1	2		
	Galaxias olidus		1	58	
	Engaeus sp.	3	14		1

By 1992 Blackfish had disappeared from Boundary Creek. Of note is the fact that Barwon Water part funded the Tunbridge study that found Blackfish in the lower reaches of Boundary Creek in 1986.

End adapted extract from Otway Water Book 27.

APPENDIX 15

Email from J. Lee 14/06/2018

Hi Malcolm,

Josh Hale from Jacobs is finalising the low flow report for Boundary Creek and was wondering whether you could assist with the following:

- Can we please have your permission to reference the Otway Water Book 39 – there were some observations in there relevant to the low flows report about fish that would be good to capture.
- The Otway Water Book 39 also references two fish surveys that were conducted in the 1990s that I can't find a copy of – if you have copies of these surveys can you please send them through?

5. Saddlier S.R. 1992a: Survey of Fish, Crustacea and Habitat of the Colac Region. A consultants report, prepared for the Geelong and District Water Board. October 1992.
6. Saddlier S.R. : Survey of Fish, Crustacea and Habitat of the Colac Region. A consultants report, prepared for the Geelong and District Water Board. June 1993.

We are still working towards completing this report by 30 June – will send you a copy as soon as it's available.

Thanks for your help on this one,

Jo

Joanna Lee
Senior Engineer, Water Resources Planning | Barwon Water

APPENDIX 16

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Hi Malcolm, Email 15/03/2017 (2)

I hope you found the presentation at the last CRG meeting on the Urban Water Strategy useful in providing some broader context for how Barwon Downs and the Melbourne Geelong Pipeline fit into Barwon Water's long term planning for supply and demand.

In response to your email queries, please find the following information:

1. Could you tell me what the water entitlement Barwon Water has regarding water from the Melbourne system down the Melbourne to Geelong pipeline?

Under the *Bulk Entitlement (Greater Yarra System – Thomson River Pool – Barwon Water) Order 2014*, Barwon Water has a nominal 16 gigalitre (GL) per year entitlement volume which equates to a 2.56% of the greater Yarra / Thomson total pool of 624.3 GL/year. This annual total pool volume of 624.3 GL is set based on historical average net storage inflow data from 1913-2005.

Although Barwon Water holds a nominal entitlement of 16 GL/year out of the total of 624.3 GL/year in the Greater Yarra / Thomson pool, the allocation of water to Barwon Water under the entitlement depends on actual inflows and losses each year. If net inflows are less than the long term historical average of 624.3 GL, then Barwon Water will receive proportionally less than the 16 GL. For example, in 2015/16, net inflows were 258.4 GL which is 41.4% of the 624.3 GL long term historical average inflows. Therefore in 2015/16 Barwon Water was allocated 41.4% of its 16 GL entitlement which equates to 6.6 GL.

Under the Bulk Entitlement, Barwon Water has the ability to carryover unused allocations from one financial year to the next. If spills occur from storages in the Greater Yarra Thomson system, a portion of the total spill volume is subtracted from Barwon Water's carryover volume.

2. Also, could I have the dates and volumes of entitlement already taken up?

Since the construction and commissioning of the Melbourne to Geelong Pipeline in 2013, Barwon Water has transferred water from Melbourne to Geelong on one occasion. From March to September in 2016, Barwon Water transferred 1.341 GL to Geelong.

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As part of Barwon Water's management of its carryover water, and to assist Western Water, Barwon Water traded 5.0 GL of its carryover water to Western Water in 2016. As of 1 March 2017, Barwon Water holds a balance of 30.7 GL of water in the Greater Yarra/Thomson system.

Thanks,

Jo

Joanna Lee
Senior Engineer, Water Resources Planning I Barwon Water
49-51 Malop Street I P.O. Box 659, Geelong, Victoria 3220
T [redacted] I [redacted] I W www.barwonwater.vic.gov.au

From: Mal Gardiner [mailto:otwaywater@yahoo.com.au]
Sent: Wednesday, 1 March 2017 10:06 PM
To: Jo Lee <Joanna.Lee@barwonwater.vic.gov.au>
Subject: Geelong/Melbourne water entitlement

Hello Jo,

Another request. Could you tell me what the water entitlement Barwon Water has regarding water from the Melbourne system down the Melbourne to Geelong pipeline? Also, could I have the dates and volumes of entitlement already taken up?

Kind regards,

Malcolm

Sent from Yahoo Mail for iPad

Morning Malcolm, Email 11/10/2017 (4)

Here is the rest of the information you were after for the Melbourne Geelong pipeline.

If you have any questions, please let me know.

Yearly information	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
The cost of the variable tariff ($ per ML)[1]	$1,132	$1,947	$1,899	$1,964	$229	$237
The annual fixed service fee ($ per annum)[1]					$5.3M	$5.6M
How much water was pumped to Geelong	30 ML[2]	0	0	271	1,055	0
The cost of pumping this water per ML				$112	$112	-
The start-up and shut down costs				$66K[3]	$25K[4]	-
The amount of water reserved in the pool for Geelong, ML[5,6]	-	-	12,878	21,484	27,702	32,021
The amount of water taken out of reserve for other purposes, ML	0	0	0	0	5,000[7]	0
Who this water was traded with	-	-	-	-	Western Water	-

1. Greater Yarra System – Thomson River Headworks charge. The bulk entitlement costs were separated into a fixed and variable component in 2016/17 resulting in a lower variable component in 2016/17. The $ figures are in nominal

terms as per annual pricing advice from Melbourne Water
2. For commissioning only; not used for supply to Geelong
3. Start-up cost only in 15/16 FY as pumping started in that year but finished in 16/17 FY
4. Shut down cost only in 16/17 FY
5. The volume of available water in Barwon Water's account as of 1 July each financial year
6. From 1 July 2014, Melbourne's joint bulk entitlements were disaggregated. The new Bulk Entitlement allowed Barwon Water to carryover unused water allocation from one water season to the following water season(s) for use. Prior to 1 July 2014, there was no carryover.
7. 5,000ML traded to Western Water in late 2016

Finally, in regards to the question "How much water was forfeited from the pool due to evaporation/leakages etc." as per the Bulk Entitlement, the allocation determined by Melbourne Water are based on the monthly change in total system storage, so any losses due to evaporation and leakage are accounted for. The Bulk Entitlement does allow for any evaporation and seepage losses agreed between the Primary Entitlement Holders, the Storage Manager and Resource Manager to be deducted from the volume. However, when the seasonal determination methodology was initially developed by Melbourne Water in 2014, it was found that, on average, the annual rainfall on the surface of Melbourne's reservoirs exceeded the estimated evaporation.

Thanks,

Jo

Joanna Lee
Senior Engineer, Water Resources Planning I Barwon Water
55 – 67 Ryrie Street I P.O. Box 659, Geelong, Victoria 3220
T [redacted] I M [redacted] I W www.barwonwater.vic.gov.au

I respectfully acknowledge the traditional custodians of the land where I work, and the Elders past, present and future.

(3)

From: Mal Gardiner [mailto:otwaywater@yahoo.com.au]
Sent: Friday, 8 September 2017 11:14 AM
To: Jo Lee <Joanna.Lee@barwonwater.vic.gov.au>
Subject: Bulk entitlement Greater Yarra Thomson River Pool

Hello Jo,

How are you? The weather has been great with all this rain but we do need a break.

I have a few more requests if you could follow them up for me, please.

Regarding the Melbourne to Geelong water connection and the Bulk Entitlement.

1. Can you tell me the length of the Melbourne Geelong connection?
2. What diameter is the pipe?
3. The cost to put the pipe in?

And for each of the financialyears since the pipe was connected could I have the yearly information including the following.

A. The cost of the variable tariff per ML.

B. The annual fixed service fee.

C. The amount of water reserved in the pool for Geelong.

D. How much water was pumped to Geelong.

E. The cost of pumping this water per ML.

F. The start up and shut down costs.

G. The amount of water taken out of reserve for other purposes.

H. Who this water was traded with.

I. How much water was forfeited from the pool due to evaporation/leakages etc.

I know this is a lot but I would assume it is on file already. However, Jo see how you go. I would suspect that there would be some cost chasing this information down. Maybe even an FOI may be needed.

Kind regards,

Malcolm.

Email 06/03/2019

(6)

Hi Malcolm,

No nuisance at all.

Current volume of water held in storage in the Yarra-Thomson by Barwon Water: 46,449 ML (as of 1 February 2019).

1,326ML was pumped to Geelong in 2016.

5,000ML was traded to another water corporation in 2016/17.

Hope this helps.

Jo

Joanna Lee

Coordinator Water Resource Planning

Barwon Water
T: [redacted] | M: [redacted]
55-67 Ryrie Street, Geelong, VIC 3220
www.barwonwater.vic.gov.au

Enabling regional prosperity through high quality, affordable and secure water services.

(5)

From: Mal Gardiner <otwaywater@yahoo.com.au>
Sent: Monday, 4 March 2019 3:28 PM
To: Jo Lee <Joanna.Lee@barwonwater.vic.gov.au>
Subject: Water held in storage

Hello Jo,

Nuisance again here again.

Could you tell me how much water is currently kept in reserve by BW in the Yara Thompson system; how much has been pumped to Geelong in the past and how much has been sold to other parties?

If you can put your hands on this that would be greatLy appreciated.

Cheers,

Malcolm.

Sent from Yahoo Mail for iPad

APPENDIX 17

This Appendix is an extract from Otway Water Book 42 C.[38] Similar replies were given by Southern Rural water and the Minister for Water, Lisa Neville's office.

Request for List of Remediations sent to Tracey Slatter.

Hello Tracey,

The Barwon Downs Borefield has been in operation for over three decades now and I believe Barwon Water plans little to no extraction during a remediation period in phase one of the new licence.
At this stage and even after numerous requests during the public consultative process a list of what has to be remediated has not been given.

Considering there have been so many extensive studies conducted over the years starting way back in the 1980s,

"...monitoring impact and changes with regular reports and upgrades." (Barwon Water to NREC, August 1988) and

"as indicated previously in evidence to the committee, the Board wishes to ensure that environmental needs are adequately recognised and safeguarded in any water resource development that it may seek to undertake." (BarwonWater to NREC hearing,1989),

this remediation list should be easily compiled, if not already in existence.

My requests are:
1. Do you have a list of the impacts caused by extraction at the Barwon Downs Borefield?
2. Is there a list of which things are to be remediated, and
3. If you do have these two lists could you send me copies, please?

Kind regards,
Malcolm.

Sent from Yahoo Mail for iPad Emailed 11/02/2018

Reply from Tracey.

Dear Malcolm,

Email Reply 21/02/2018

Thank you for your email dated 11 February.

As you correctly point out Barwon Water has developed a proposed management plan based on outcomes the community identified as important for the next licencing period.

This plan aims for us to work with our community and stakeholders over the next 15 year journey and will include the three phases of remediation, adaptive yield assessment and long term sustainable operation.

Barwon Water is committed to remediation efforts in the Boundary Creek catchment regardless of the outcome of the licence application.

We have also committed to not using the borefield again, other than if necessary for operational maintenance purposes, until the current licence application is resolved.

Further to this, as part of the licence application we will propose to reduce the reliance on the borefield during the first two phases of remediation and adaptive yield assessment. This will be assisted by shifting the borefield's use from the first to the last alternate source ie after the Anglesea borefield and the Melbourne Geelong Pipeline.

In response to your information requests:

1. Do you have a list of the impacts caused by extraction at the Barwon Downs Borefield?

In 2016, a major update of the Barwon Downs groundwater model was complete. The updated model can separate groundwater extraction and natural climate fluctuations to simulate historical impact. The technical reports (which can be found on the Have Your Say website) concluded:

- Barwon Water's pumping from the Barwon Downs borefield over the past 30 years is the main cause of a reduction in baseflow (groundwater contribution to streamflow) in the lower reach of Boundary Creek increasing the frequency and duration of no flow periods.
- No other rivers or creeks have been impacted as significantly as Boundary Creek by the operation of the bore field.
- Operation of the borefield has likely resulted in a minor reduction in base flow in a small section of the Gellibrand River (in the order of 0.3ML/day or 0.8% of low flows). Dry climate conditions have caused a greater reduction in base flow (in the order of 0.6ML/day or 1.6% of low flows) according to the groundwater model.

- Shallow aquifers across most of the study area have not been significantly influenced by operation of the bore field suggesting that there is very little impact to vegetation outside the Boundary Creek catchment.

2. Is there a list of which things are to be remediated

As outlined at the workshops sessions Barwon Water is keen to develop the remediation approach with members of the catchment community. While there is a report that outlines a proposed approach to remediation, Barwon Water would like to test this approach further. To this end a Boundary Creek remediation working group will be established. The purpose of this working group is to actively engage with Barwon Water to jointly design a remediation plan for Boundary Creek and Big Swamp via a series of workshop sessions. An Expression of Interest will be advertised soon for interested community members to participate in this process. We envisage this process running from March to September, 2018.

The remediation approach under review includes the information presented to the Community Reference Group in October 2017.

Ongoing monitoring will continue with emphasis placed on sites that the groundwater model has identified at risk of impact from future pumping. These include:

- Gellibrand River - recommend site specific study is undertaken south of Kawarren to confirm the effectiveness of the alluvial aquifer in maintain base flow to the rivers and presence of high value GDEs. Additional groundwater or streamflow monitoring and vegetation mapping is likely to be required as part of this study.
- Barwon River East and West Branch south east of the Bambra Fault – recommend site specific study to confirm the effectiveness of the alluvial aquifer in maintaining base flow to the rivers and presence of high value GDEs. Additional groundwater or streamflow monitoring and vegetation mapping may be required as part of this study.
- Ten Mile Creek – Reinstate stream flow gauge
- Yahoo Creek – Reinstate stream flow gauge
- Barongarook Creek – recommend site specific study to confirm presence of high value GDEs. As part of this study additional groundwater monitoring and stream flow monitoring may be recommended.
- Porcupine Creek – review the need for an additional PASS site for ongoing monitoring.

3. If you do have these two lists could you send me copies, please?

All reports have been circulated to all Community Reference Group members and are available on the Have You

Say webpage – if you require a hard copy of any reports please let me know and I will organise to post it out.

Regards

Tracey Slatter
Managing Director I Barwon Water
55-67 Ryrie Street (PO Box 659) Geelong VIC 3220
T (03) 5226 2544 I W www.barwonwater.vic.gov.au

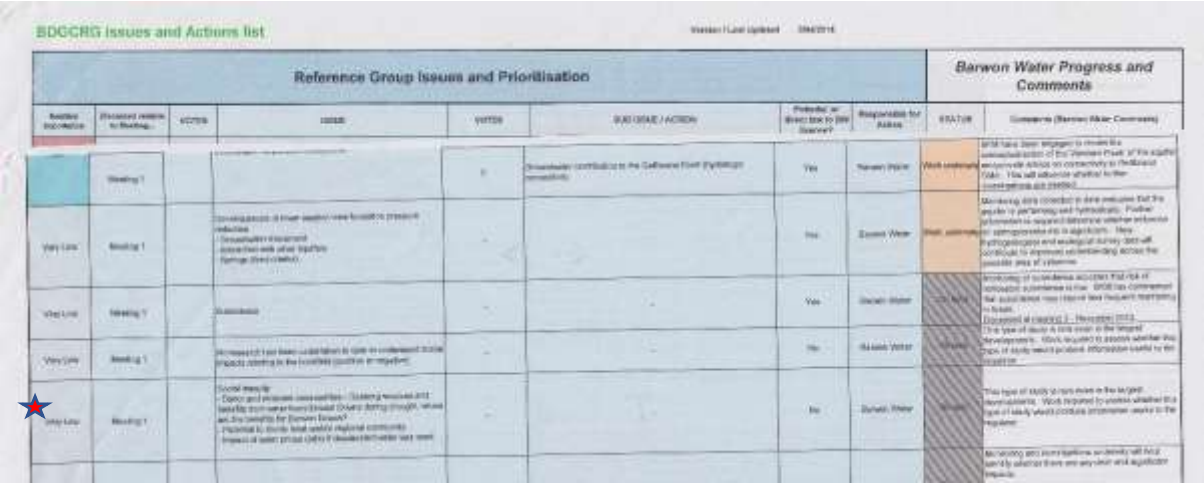
It would appear there is no list of impacts or a list of things for remediation other than the Big Swamp Wetlands and Boundary Creek. Even the impact within the wetlands and the Boundary Creek Catchment still have not been listed.
Tracey Slatter states there is a small impact on the Gellibrand River but…
no impact anywhere else.

The rest of the letter explains that a working group would be set up to oversee the remediation of the Big Swamp Wetlands and Boundary Creek. Further monitoring would be conducted at some other locations while others may be or are likely to be monitored and studied.

One of the problems the remediation working group has found with the remediation plan was a failure to have gathered sufficient data on the Big Swamp Wetlands to make any informed decisions. This was confirmed by the three experts called in to assist. Facilitation of successful remediation could not be based upon serious data gaps missing in relation to the Big Swamp Wetlands.

End extract.

APPENDIX 18


BDDCRG Issues and Actions list

Reference Group Issues and Prioritisation

Barwon Water Progress and Comments

APPENDIX 19

The pages in Appendix 19 is an exact extract from Otway Water Book 42 F.

Impacts from the Barwon Downs Borefield Extractions.

Known Impacts from Groundwater Mining.

1. Big Swamp devastation.
    1.1.1. Perennial wetlands dried out.
    1.1.2. Previous fire proof area turned into a permanent fire hazard.
    1.1.3. Release of carbon and other gases to the atmosphere.
    1.1.4. Creation of one of the highest Inland Freshwater Actual Acid Sulfate Soil sites in Australia.
    1.1.5. Pollution and contamination of aquifers.
    1.1.6. Vegetation shift to species tolerant to much drier conditions.
    1.1.7. Acid water and heavy metal releases into the Barwon River Catchment.
    1.1.8. 30 KM fish kill down the Barwon River.

1.1.9. Stygofauna compromised.
1.1.10. Soil composition drastically changed.

2. Soaks, springs and creek drying up.
3. Farmland viability threatened.
   3.1.1 Actual Acid Sulfate Soils resulting in unproductive soils.
   3.1.2 Stock and Domestic water rights lost through water contamination and cessation of creek flows.
   3.1.3 Infrastructure degraded.
   3.1.4 Spring fed dams compromised.
   3.1.5 Summer grassland pick on river flats decreased.
   3.1.6 Fire retardation ability of these same flats lessened.
4. Boundary Creek Catchment.
   4.1.1 Constant flow from Artificial Supplementary Flows in the upper reaches of Boundary Creek have created a different creek and riparian vegetation ecosystem.
   4.1.2 The lower reach of Boundary Creek has large periods of no flow.
   4.1.3 Loss of platypus, fish, yabbies and other freshwater species.
   4.1.4 Riparian and Groundwater Dependent Ecosystems within the Boundary Catchment have been dried out, devastated or compromised.
5. Dubious reports have been produced that are being used as reference and or basis for present and future water resource management decisions.
6. The Lower Tertiary Aquifers are being mined.
7. The extremities and area of impact are continuing to expand.
8. A cone of depression has been created under Kawarren.
9. Groundwater flow paths have been seriously altered.
10. Baseflows in waterways of the upper Gellibrand River Catchment have lessened.
11. Deterioration of trust and faith by local communities in Barwon Water's motives, actions and ability to environmentally and agriculturally manage water resources in the area.

(See Book 42C, page18-20)

Impact on the Kawarren Area.
Jacobs 22 March 2017 Integration Report, page 71.
"***An investigation by Jacobs (2016f) confirmed that drawdown extends to Kawarren area.***"

Impact on the Gellibrand River.
SKM/Jacobs (18 December 2017) maintain that there is limited impact on the Gellibrand River.

Impact on the Campbell's property at Yan Yan Gurt.
SKM/Jacobs State the "***This assessment makes the assumption that current conditions at the investigated sites are not materially affected by pumping from the borefield.***" (14-09-2015)
It is also stated in this report that the drawdown under the Campbell's site is 2-5 metres – inside the area of drawdown influence.

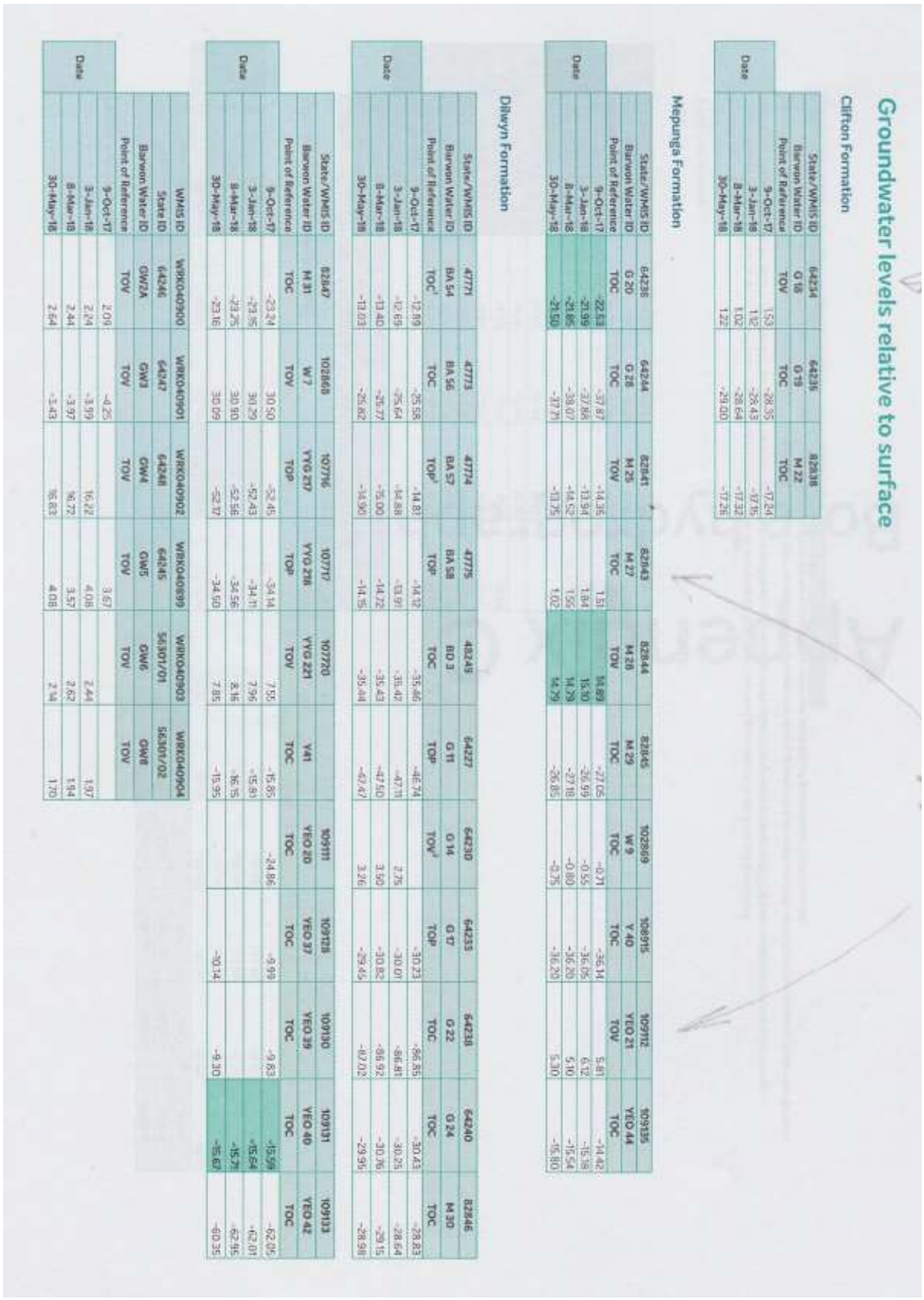
Unkowns that could be impacting the region.

1. Salinity movement within the earth structures under changing hydrogeological conditions.
2. Downward vertical leakage and movement of groundwater.
3. Source of the recharge waters achieving an 80% recovery near the borefield as described by Jacobs.
4. The time needed for aquifer recovery.
5. The impacts that will continue to manifest during any recovery period.
6. The cost of remediation, recovery and or future groundwater extraction.
7. Reduction in surface and aquifer inflows/outflows to and from Lake Colac.

(See Otway Water Book 42C for discussion impacts/trust etc.)

End Extract.

APPENDIX 20 Observation Bores Monitoring the Aquitard.



Groundwater levels relative to surface

Clifton Formation

Date	State/WMIS ID	64234	64235	82838
	Barwon Water ID	G 18	G 19	M 22
	Point of Reference	TOV	TOC	TOC
9-Oct-17		1.53	-28.35	-17.24
3-Jan-18		1.12	-28.43	-17.15
8-Mar-18		1.02	-28.64	-17.32
30-May-18		1.22	-29.00	-17.26

Mepunga Formation

Date	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 26	M 29	W 9	Y 40	YEO 21	YEO 44
	Point of Reference	TOC	TOC	TOV	TOC	TOV	TOC	TOC	TOC	TOV	TOC
9-Oct-17		-22.53	-37.87	-14.35	1.51	14.89	-27.05	-0.71	-36.14	5.81	-14.42
3-Jan-18		-21.99	-37.86	-13.94	1.84	15.50	-26.99	-0.55	-36.05	6.12	-15.38
8-Mar-18		-21.86	-38.07	-14.52	1.56	14.79	-27.18	-0.80	-36.20	5.10	-15.54
30-May-18		-21.50	-37.71	-13.75	1.02	14.79	-26.85	-0.75	-36.20	5.30	-15.80

Dilwyn Formation

Date	State/WMIS ID	47771	47773	47774	47775	48243	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[1]	TOC	TOP[1]	TOP	TOC	TOP	TOV[1]	TOP	TOC	TOC	TOC
9-Oct-17		-12.89	-25.58	-14.81	-14.12	-35.46	-46.74		-30.23	-86.85	-30.43	-28.83
3-Jan-18		-12.65	-25.64	-14.88	-13.91	-35.42	-47.11	2.75	-30.01	-86.81	-30.25	-28.64
8-Mar-18		-13.40	-25.77	-15.00	-14.22	-35.43	-47.50	3.50	-30.82	-86.92	-30.76	-29.15
30-May-18		-13.03	-25.82	-14.90	-14.15	-35.44	-47.47	3.26	-29.45	-87.02	-29.95	-28.98

Date	State/WMIS ID	82847	102868	107716	107717	107720		109111	109128	109130	109131	109133
	Barwon Water ID	M 31	W 7	YYG 217	YYG 216	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
9-Oct-17		-23.24	30.50	-52.45	-34.14	7.55	-15.85	-24.86	-9.99	-9.83	-15.59	-62.05
3-Jan-18		-23.35	30.29	-52.43	-34.11	7.96	-15.81				-15.64	-62.01
8-Mar-18		-23.25	30.90	-52.56	-34.56	8.16	-16.15				-15.71	-62.95
30-May-18		-23.16	30.09	-52.37	-34.60	7.85	-15.95		-10.14	-9.30	-15.67	-60.35

Date	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
9-Oct-17		2.09	-4.25		3.67		
3-Jan-18		2.24	-3.99	16.22	4.08	2.44	1.97
8-Mar-18		2.44	-3.97	16.72	3.57	2.62	1.94
30-May-18		2.64	-3.43	16.83	4.08	2.94	1.70

These two pages of tables taken Barwon water 2017-18 report to Southern Rural Water.

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
9-Oct-17		-25.60	-25.40	-5.02	-3.17	-71.25	-11.73	-30.60	-35.26	-16.03	-63.03
3-Jan-18		-25.67	-25.28	-4.56	-2.96	-71.35	-11.31	-30.19	-34.92	-15.63	-62.70
8-Mar-18		-25.86	-25.55	-5.05	-2.83	-71.72	-11.88	-30.06	-34.86	-15.96	-63.15
30-May-18		-25.79	-25.45	-4.32	-0.54	-71.77	-10.80	-29.55	-34.80	-15.83	-62.47

Critical Monitoring Bore Readings

Date	State/WMIS ID	64229	64236	82844	109131
	Barwon Water ID	G 13	G 20	M 23	YEO 40
	Point of Reference	TOV	TOC	TOV	TOC
20-Jul-17		-5.33	-23.50	12.64	-15.65
6-Aug-17		-5.46	-24.16	13.36	-15.70
15-Aug-17		-5.30	-23.15	13.64	-15.63
14-Sep-17		-5.30	-22.77	13.85	-15.58
10-Oct-17		-5.02	-22.53	14.89	-15.59
5-Dec-17		-4.84	-22.11	14.42	-15.63
3-Jan-18		-4.80	-21.99	15.30	-15.64
2-Feb-18		-4.56	-21.64	13.66	
26-Feb-18		-4.58	-21.69	14.28	
9-Mar-18		-5.05	-21.85	14.79	-15.71
23-Mar-18		-4.36	-21.51	14.89	-15.62
23-Apr-18		-4.26	-21.36	14.99	-15.58
21-May-18		-4.32	-21.50	14.79	-15.67
31-May-18		-4.30	-21.31	13.87	-15.63
19-Jun-18					

Notes:

1: TOC - Top of casing

2: TOP - Top of Pipe

3: TOV - Top of Valve

YEO20, YEO37, YEO39 & YEO40: Operations staff were unable to access these bores at times during 2017/18. This prevented groundwater levels from being recorded.

GW4 & GW4: These bores were artesian in October 2017 and did not have the right fittings to enable artesian readings to be taken. Fittings were installed in 2017/18 and now artesian pressure can be read.

GW6 & GW8: These production bores had bore pumps installed from April 2016 – October 2017 for extraction of groundwater during an extended dry period in 2016. While extraction ceased in December 2016 the pumps were not removed until October 2017 when pump maintenance was completed. After the bore pumps were removed, recording of groundwater levels resumed.

Indicates a critical monitoring bore as listed in the Licence

The aquitard does not have to be monitored as part of the licence, and there were zero observation bores in the aquitard when the 2004 licence was issued.

	Bores in Gerangamete GMA	Bores in Gellibrand GMA
Narrawarturk Marl	0	0
Clifton Formation	3	0

Taken from Otway Water Book 30, page 12.

7 Jan. 2016 at 13:44 to otwaywater@yahoo.com.au (17)

Malcolm

Please find attached a map of the groundwater monitoring network (SOBN) within the Gellibrand and Gerangamete GMAs.

The Clifton formation (unit 109) is shown in figure 4-8, and the Narrawaturk marl (unit 100) is shown in figure 4-9.

The formation extent is shown by the dotted area, while the GMA boundaries are shown with dashed lines.

The Clifton formation (Figure 4.8), is shown by the blue dots and the Gellibrand GMA by the dashed black line, and the Gerangamire GMA by the light blue dashed line.

In the Clifton formation, there are 3 SOBN bores within the Gerangamete GMA, and no SOBN bores within Gellibrand (there is only a small aquifer extent in this GMA). The coloured dots show the location of the SOBN bores.

The Narrawaturk marl (figure 4.9) is shown by the blue dots and the Gellibrand GMA by the dashed black line, and the Gerangamire GMA by the light blue dashed line.

In the Narrawaturk Marl there are no SOBN bores within either GMA. This is because there is very little available water in the Narrawaturk marl.

Hopefully this map will help with your query.

cheers

Paul

Paul Wilson | Acting Manager, Water Resource Monitoring
Water and Catchments | Department of Environment, Land, Water & Planning
Level 10, 8 Nicholson St, East Melbourne, Victoria 3002
T: 03 9637 9483 | E: paul.wilson@delwp.vic.gov.au
www.delwp.vic.gov.au

(18)

Hi Mick,

Can you please help Paul out with the request below from Malcolm Gardiner?

Thanks,
Emma

Emma Davidson | Water Information Management
Water and Catchments Group | Department of Environment, Land, Water & Planning
Level 10, 8 Nicholson St, East Melbourne, Victoria 3002
T: 03 9637 9276 | F: 03 9637 8119 | **E:** emma.davidson@delwp.vic.gov.au

---- Forwarded by Emma Davidson/DSE/VICGOV1 on 30/11/2015 08:45 AM -----
---- Forwarded by Paul Wilson/DSE/VICGOV1 on 30/11/2015 08:09 AM -----

From: Malcolm Gardiner <otwaywater@yahoo.com.au>
To: Paul.Wilson@delwp.vic.gov.au,
Date: 29/11/2015 12:08 PM
Subject: Observation bores

Hello Paul,
Would it be possible to also ask people in your department to provide a map of the Gellibrand Groundwater Management Area and the Gerangamete Groundwater Management Area showing the locations of observation bores that are monitoring the Clifton Formation and The Narrawaturk Marl. It would be helpful if the Clifton and Narrawaturk bores are marked differently.

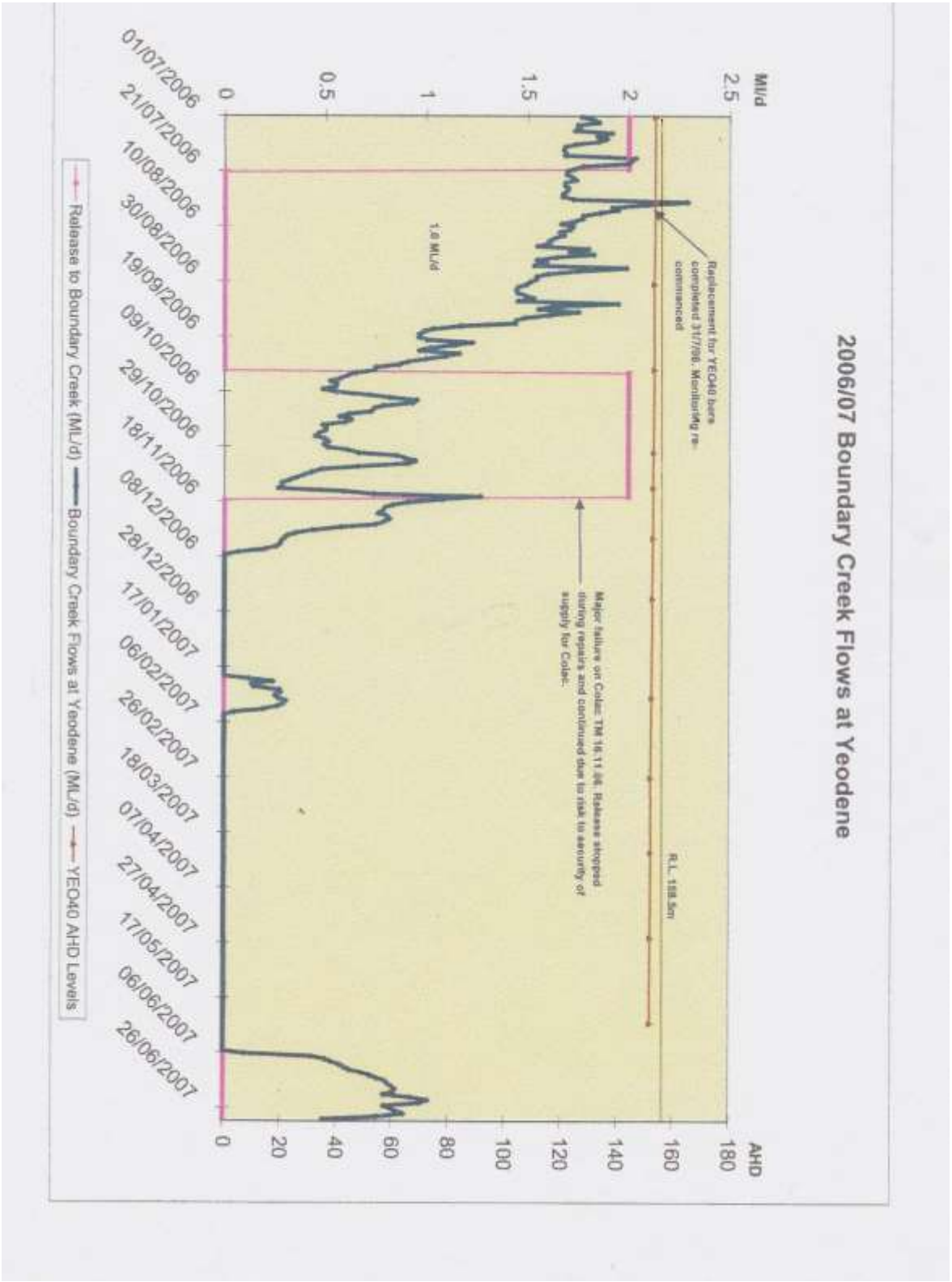
Kind regards,
Malcolm.

Malcolm Gardiner
Email otwaywater@yahoo.com.au
www.otwaywater.com.au
Phone +61 3 52358325

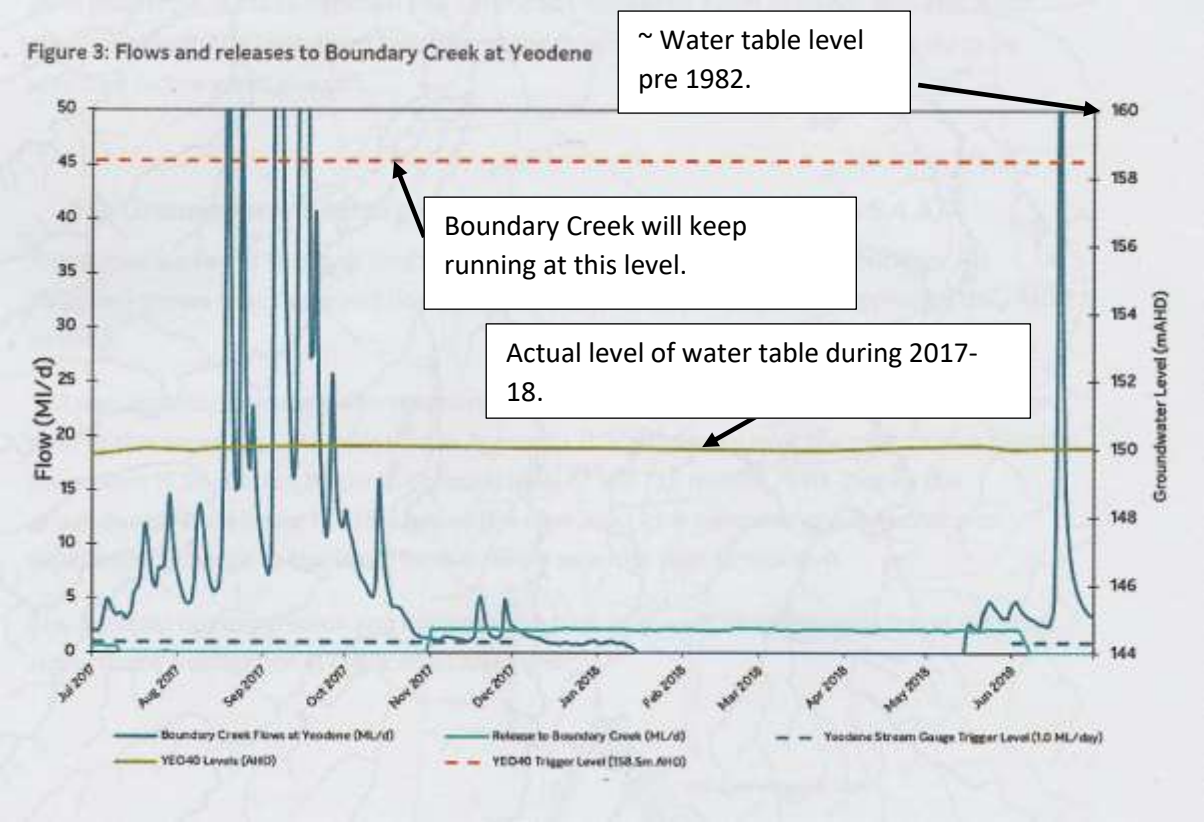
Hopkins - Corangamite_V2[1]...

Barwon Water has put in aquitard observation bores since 2014 but they only monitor very restricted areas and levels of the Aquitard. The area of impact from groundwater extraction drawdown is in the order of 500 km^2 and these bores provide very limited data.

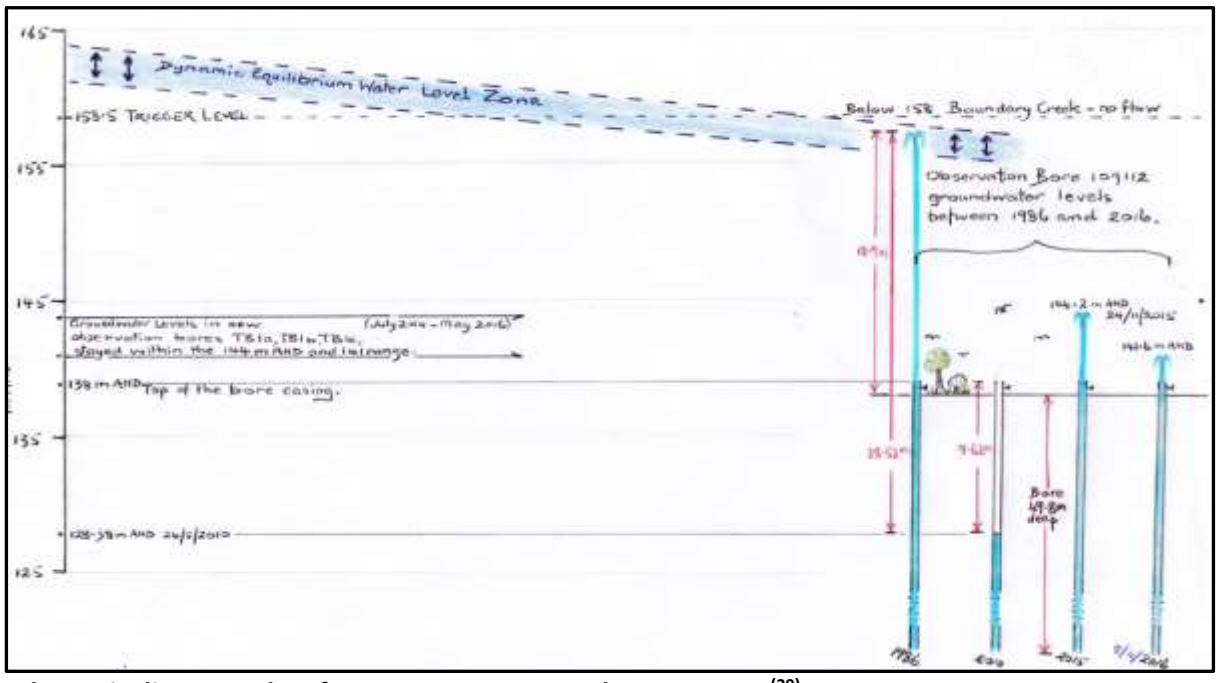
APPENDIX 21. Buffering Capacity of the LTA.



Taken from the 2006-2007 Barwon Water Gerangamete Borefield report to Southern Rural Water.



Taken from 2017-2018 Barwon Water Gerangamete Borefield report to Southern Rural Water.



Schematic diagram taken from Otway Water Book 35, page 41.[39]

APPENDIX 22

Boundary Creek, Big Swamp and Surrounding Environment – Remediation and Environmental Protection Plan
Scope of Works
Received 23/01/2019
Barwon Water

This page is taken from Appendix C of the above Scope of Works submitted 20 December 2018.

between September 2014 and September 2018 suggests that this whole section of Boundary Creek is net losing (at a rate of about 1.6 ML/day). If most of the loss is in Reach 2 then this needs to be factored into the design of environmental flows for Big Swamp. Furthermore, an understanding of the hydrology and hydrogeology of Reach 2, is necessary to understand water dynamics in Big Swamp

Previous studies: Jacobs has undertaken both modelling (Jacobs, 2017c) and field work (Jacobs, 2017a) to examine the hydrology and hydrogeology in this reach. Based on the most recent fieldwork Jacobs (2017a) suggests that the western section is net gaining (from local inflows from the immediate catchment) while the eastern section is net losing. These conclusions are based on a limited set of observations.

Potential Activities: Undertake a more detailed (and on-going) assessment of water dynamics in Reach2. This would include the installation of a v-notch weir on Boundary Creek immediately upstream of Big Swamp as well as a series of piezometers in the damplands to measure water depth and hydraulic pressure.

Feasibility: Identifying a suitable site for the installation of the v-notch weir may be difficult. Site access for machinery for the installation of the weir and piezometers may prove to be problematical.

Cost: $$$$? for installation; $ for on-going monitoring

Current Ecological Condition

Question 3: Can surface water alone sustain the ecological condition of the damplands?

Context: It is probable that the ecological condition of the damplands has be sustained by groundwater inflows from the lower tertiary aquifer (e.g. See Jacobs 2017b). Loss of these inflows may impact on the ecological condition of the damplands.

Previous studies: This area was included in the survey by Carr and Muir (1994) and was recently surveyed by Jacobs in 2014, (Jacobs 2015) and 2016 (Jacobs 2017d).

Potential Action - on-going condition assessment through the establishment of photo points supplemented by periodic (5 year?) ground assessments. Results interpreted based on hydrology and hydrology identified at Question 2.

Feasibility: Feasible

Cost: Photo points - $; Ground Survey - $

2.2.3 Big Swamp

Big Swamp is a highly modified peat bog on Boundary Creek. In the past the swamp was drained for agricultural purposes. More recently water inflows into the swamp have been altered through a combination of groundwater extraction, surface water harvesting and climate change. Drying has exposed acid sulfate soils in the soil profile causing episodic acid events downstream. As a consequence of drying there have also been a series of peat fires in the swamp. To contain the fires a trench has been dug through the swamp, further altering the hydrodynamics within the swamp. There is strong community support to restore the ecological condition of the swamp.

Water balance and flow paths

Question 4: Is there a hydraulic connection between Big Swamp and the Lower Tertiary Aquifer (LTA)?

6

This page is taken from Appendix C of the Scope of Works.

should be EVERYBODIES concern. NRM manage especially ✓

13 ✗ *Context:* There is community concern that Big Swamp is directly connected to the LTA and poor water quality originating from the swamp (metals, metalloids and acidity) is impacting on water quality in the aquifer. Understanding where the LTA intersects Boundary Creek is critical in understanding the hydrology and hydrogeology of the region, which in turn is critical in assessing potential management interventions.

Guesswork + bores NOT in the Swamp

14 ✗ *Previous Studies:* Based on modelling and earlier bore logs Jacobs (2017a and 2017c) have suggested that Big Swamp lies over an aquitard and the outcropping of the LTA is in Reach 2. No detailed drilling has been undertaken within the swamp to determine the substrate under Big Swamp.

Potential Activity 1: Undertake a drilling program to determine the extent of the aquitard under Big Swamp.

Feasibility: The problem with this proposed activity is physically getting a drilling rig capable of drilling through to the aquitard onto the swamp. Even if the remaining peat could support the weight of a drilling rig, there would be substantial damage to the swamp through clearing of access tracts.

15 ✗ Cost: $$$$ - $$$$$?

↑ Couldn't do much more damage than has been done. AND veg there now is opportunistic

Potential Activity 2: Undertake surface water mass balance accounting using the three extant gauging stations on Boundary Creek plus the additional gauge immediately upstream of Big Swamp proposed to address Question 2.[7]

Feasibility: Identifying a suitable site for the installation of the v-notch weir may be difficult. Site access for machinery for the installation of the weir may prove to be problematical.

Cost: $ (excluding construction of the v-notch weir).

Potential Activity 3: Use remote sensing, specifically ground penetrating radar and or electromagnetic (EM) surveys to determine location of the aquitard and LTA.

Feasibility: Deploying ground penetrating radar in Big Swamp may be difficult given the terrain. Aerial EM surveys may have already been flown over the region

Cost: $$ - $$$$?

Question 5: Are there preferential surface or subsurface flow paths in Big Swamp?

Context: Jacobs (2017a) preferred mitigation approach was to construct a barrier across the swamp to permanently wet the swamp. The design of the barrier (including depth) needs to be based on a detailed understanding of the alter flow paths in the swamp.

Previous Studies: As a part of its recent investigation into Big Swamp, Jacobs installed 5 piezometers in the swamp - each to a maximum depth of about 3 metres.

16 ✗ *Proposed Activity:* It is proposed that up to an additional 18 piezometers are installed to determine groundwater dynamics. The piezometers would be evenly distributed across the

Not sure where these are IN the swamp

[7] During the review process of the original Discussion paper it was suggested to include a second v-notch weir at the eastern end of Big Swamp.

7

APPENDIX 23

57

Your ref:
Our ref:
Ext. no: 003980
Contact: 651 3940
R Bugeja

Department of Water Resources Victoria
2nd Floor,
35 Spring Street
Melbourne, 3000
Telephone: (03) 651 2977
Facsimile: (03) 651 2989

8 February 1989

Mr Malcolm Gardiner
RMB 5180
KAWARREN 3249

Water Victoria

Dear Mr Gardiner,

DRAFT WATER MANAGEMENT STRATEGY - SOUTH-WESTERN REGION

Thank you for your letter of 31 January 1989 in which you ask a series of questions about recommendations made in 1986 for environmentally oriented studies to form part of the monitoring program to accompany groundwater pumping at Barwon Downs. You also sent me a copy of your notes, apparently prepared at about the same time, in which you identify what you thought were discrepancies between recorded and forecast water consumption figures in the Geelong water supply system.

I understand that you have also sent these latter notes to the Geelong and District Water Board and that a meeting has been arranged with the Board for this week at which the basis of the water demand forecasts will be discussed. Under the circumstances I think I should leave it to the Board's officers to answer the points raised in your notes. However I would still be prepared to talk to you if you wish, after your meeting with the Board.

In relation to the studies recommended by Quentin Farmar-Bowers in his October 1986 report, I can provide you with the following information:

1. Vegetation studies

(a) Pasture
DARA Geelong have examined the intermediate elevation recharge areas and have indicated that any effects of reduced groundwater levels on agricultural species would not be significant. This is because of the

Warren's ?? comments..

14/2/89 Warren asked Frank Barkla of DARA Geelong. Reply "I have no idea where the statement in 1(a) came from."

marginal agricultural nature of the area and the substantial absence of improved pasture species.

(b) Native Vegetation

Not done

Involves detailed mapping of existing vegetation, identifying areas subject to possible changes due to changed groundwater levels, establishing monitoring plots, doing base-line monitoring followed by progressive monitoring.

2. Fauna

(a) Fish

DCFL (B Tunbridge) included Boundary Creek in the environmental flow and fish study of the Barwon catchment. This study was funded jointly by state government agencies and local water authorities, including the Geelong and District Water Board.

(b) Mammals, Reptiles and Frogs

Not done

Involves documentation of the abundance and species composition. Work to be co-ordinated with the vegetation work.

→ No mention of birds

3. Water Quality Studies.

RWC simulation studies of the Barwon River system included an assessment of reduced flow in Boundary Creek. Direct monitoring of Boundary Creek forms part of the artificial recharge study.

4. Landscape Assessment

Not Done

A visual management assessment by DCFL appears to be the appropriate approach.

5. Archaeology

NOT DONE

Involves work by the Victorian Archaeology Survey.

During 1987 I wrote to DCFL, Colac in relation to items 1(b), 2(b) and 4 asking for advice on the priority which should be placed on the recommended work. I was concerned to know whether the work should be commenced immediately at that stage of the groundwater testing or if it could reasonably be deferred until after a review of the testing indicated whether or not there was some prospect that the Barwon Downs wellfield could be developed to the next stage. I also wanted to know whether DCFL thought that the work would contribute to its Regional priorities and whether it would be prepared to undertake the work.

CRITICAL →

Although item 5 did not fall within the area of DCFL responsibility, the same reasoning applied in relation to the

NOT DONE.

timing of the work.

At the time, other priorities and commitments relating to the NREC hearings resulted in the advice from DCFL being deferred. However with the strong strategic direction in favour of intensified groundwater investigations emerging in the Regional Strategy, I have recently asked DCFL to re-examine the matter. Their advice will enable the South-Western Region Task Force Working Group on groundwater to take the appropriate further action on these outstanding recommendations by Quentin Farmar-Bowers.

What about K+Catli → as specifically asked for??

In answer to your postscript, survey bench marks have been established and are being monitored to detect any regional subsidence which may be attributed to the groundwater extractions. However based on theoretical assessments made by Dr Evans of the Rural Water Commission, no significant subsidence is anticipated.

As discussed with you by telephone, I would welcome the opportunity to discuss these matters with you in person or to talk to a meeting of your Committee.

Yours sincerely

RM Bugeja

RM BUGEJA
Planning and Environment Branch

APPENDIX 24.

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1/8

Comment on:

Boundary Creek, Big Swamp and Surrounding Environment – Remediation and Environmental Protection Plan. Scope of Works. Barwon Water, 20th December 2018.

by the Southern Rural Water Independent Technical Review Panel, January 24th 2019.

Summary

Barwon Water has prepared and submitted a Scope of Works to Southern Rural Water on December 20th, 2018 in response to the Ministerial Notice served to the corporation under Section 78 of the *Water Act 1989*. The Scope of Works documents the extents of the investigations required to prepare a Plan for the remediation of Boundary Creek, Big Swamp and the surrounding environment impacted by groundwater pumping at Barwon Downs. The document has been provided to the Independent Technical Review Panel (ITRP) appointed by SRW to provide their comments.

Overall the Scope of Works document addresses the Section 78 Notice requirements and is clearly presented. However, the ITRP consider that the focus of the Scope of Works is too narrow, being centred on managing the impacts of acid sulfate soils, rather than managing any broader effects of groundwater drawdown. The geographical extents of the environment impacted by groundwater pumping at Barwon Downs, and the breadth of environmental issues, are both considered too limited.

This technical review of the Scope of Works includes commentary on the limitations identified by the ITRP and suggestions on where more clarity or additional information is required to assess the scientific logic or provide justification for the proposed investigative works.

Introduction

This document reviews the Scope of Works submitted to Southern Rural Water (SRW) on December 20th, 2018 in response to the Ministerial Notice served to Barwon Water under Section 78 of the *Water Act 1989*. The Section 78 notice directed the corporation to:

a) continue no extraction, other than for maintenance and emergency response, and

b) prepare a Plan for the remediation of Boundary Creek, Big Swamp and the surrounding environment impacted by groundwater pumping at Barwon Downs, and

c) describe the environmental outcomes for the waterways to be achieved by the remediation Plan.

The notice required Barwon Water to submit a Scope of Works that should include:

- the identification of the area covered by the Plan, the environmental values to be included, and the necessary environmental assessments and the methodology for how it proposes to develop the Plan.

The Scope of Works has been provided to the Independent Technical Review Panel (ITRP) appointed by SRW to provide their comments on the document.

For example, the above figure also identifies areas on the southern side of the Barwon Downs Graben, where the Lower Tertiary Aquifer (LTA) outcrops near the Barwon River East and West branches, that are affected by groundwater level drawdown to a similar degree as near the Boundary Creek and Big Swamp. Furthermore, and contrary to statements in the Scope of Works (section 5.1), the groundwater model does not over-predict drawdown in the Barwon River area (e.g. the first figure in Appendix D of the cited technical report by Jacobs (2017) shows sound model predictions at monitoring bores 64241, 48249 and 82845).

The Scope of Works document cites Jacobs (2017) as concluding that the "main driver of reduced baseflow in Boundary Creek was related to the lowering of groundwater levels in the Lower Tertiary Aquifer (LTA) which outcrops along much of Boundary Creek" (which lies at the northern margin of the Barwon River basin). By extension, the drawdown in the southern LTA outcrop area of the basin is also likely to be reducing stream flows in the Barwon River branches that cross it. While there are no stream gauging stations in this area that could provide data to confirm whether or not this is occurring, the groundwater model could and should be used to quantify the effect.

Indeed, the Groundwater Assessment Report (Jacobs, 2018) uses the groundwater model results to identify these river reaches as highly connected to groundwater (Figure 7-1), significantly affected by drawdown (Figure 7-2) and at high (unmitigated) risk (Figure 8-3). While it is suggested that there are factors that "mitigate" the impact risks because they "are not represented well in the model", these factors are not adequately justified; for example:

- the regional aquitard is indeed represented quite well in the groundwater model, so the predicted drawdown is actually a "mitigated" drawdown;
- minor alluvial aquifers are indeed not represented in the groundwater model, but they should be, to justify the claims of a Class 3 model confidence level, and thus it has not yet been established to what degree the alluvium may mitigate drawdown effects.

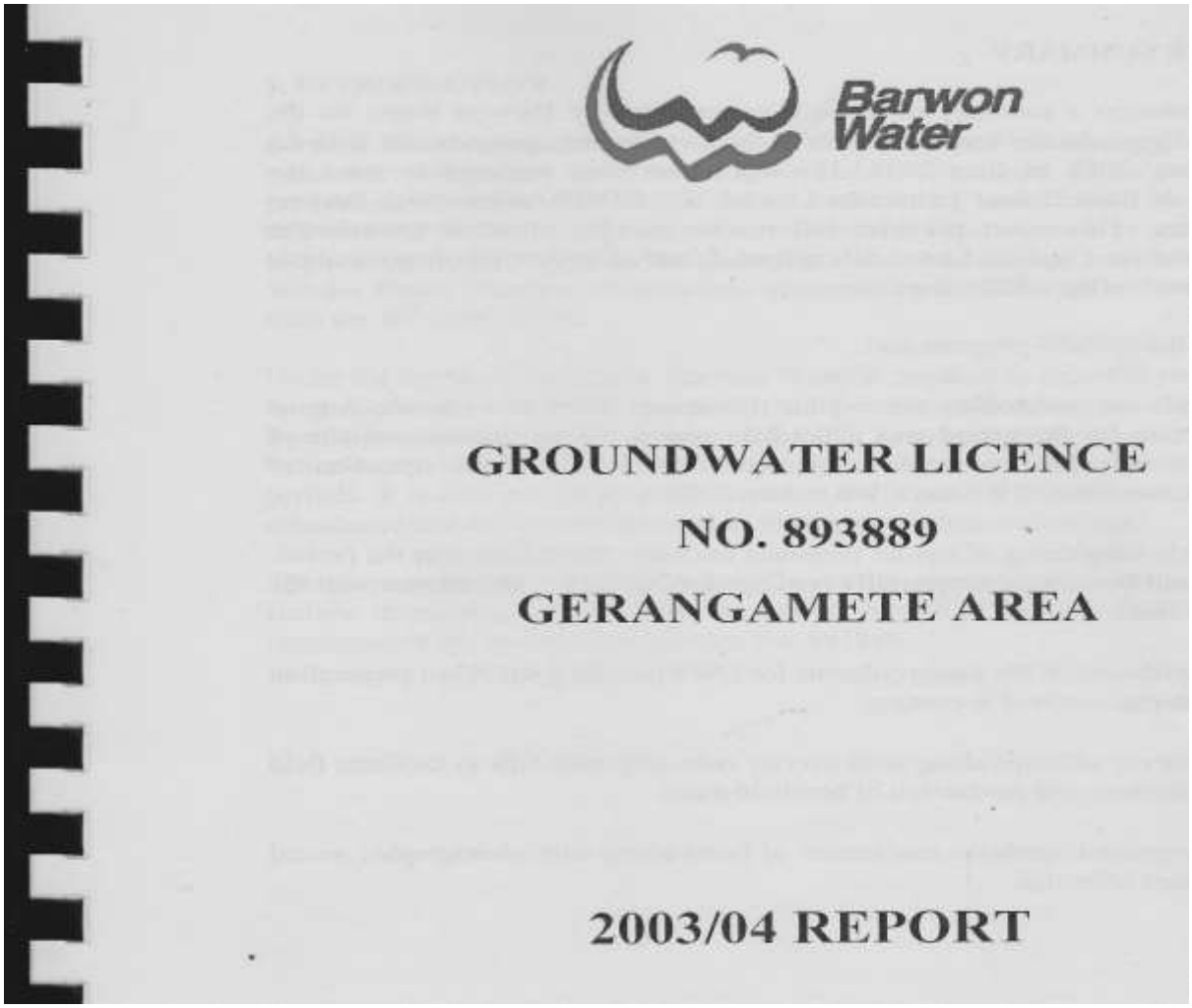
When reviewing the area covered by the Plan (tabulated in Table 1 of the Scope of Works, page 27), Reaches 2c and 3 are well-justified for inclusion, but the rationale for not including Reach 2a and Reach 2b of Boundary Creek is questioned, and the upstream extent of Reach 2a (or downstream extent of Reach 1) is not adequately justified.

Reaches 2a and 2b are excluded on the basis that surface flow offsets can manage the impacts, but that only allows for management of the in-stream effects. It does not adequately consider the effects on the surrounding vegetation (not simply the riparian margins) and on stream-aquifer interactions and the hyporheic zone due to these reaches changing from previously gaining streams supported by high groundwater levels to now losing streams and a deep watertable.

There is no rationale provided for the extension of Reach 1 to the downstream side of McDonald's Dam, given that Reach 1 is described as where Boundary Creek flows over outcropping bedrock. Reach 1 should end at the downstream end of that bedrock, where the LTA outcrops. The stream-aquifer interactions change at that point, due to drawdown in the LTA but steady levels in the basement outcrop area (i.e. the basement reach remains a gaining stream, but the LTA reach has changed from a groundwater-dependent gaining stream to now losing). Reach 2a should be extended upstream across where the LTA outcrops, as the hydrological conditions are wholly consistent with the current Reach 2a in terms of groundwater levels and stream-aquifer interactions.

The Scope of Works focuses on water quality impacts associated with ASS within the Yeodene Swamp, and this appears to be the key rationale for limiting the focus of investigative works to Reach 2c and Reach 3, which are either within or downstream of the swamp. However, limited water quality data from Jacobs (2017) suggests that pH is dropping and EC, soluble Al, Fe, Ca, Mg and importantly sulfate are rising in Boundary Creek from the Damplands to a location upstream of the Yeodene Swamp (i.e. across

APPENDIX 25.



1. INTRODUCTION

Barwon Water operates the Gerangamete Groundwater Field to supplement surface water harvesting from the Barwon River and its tributaries. There are currently 6 production bores each licenced to deliver between 9.5 and 11.0 ML/day. The bores deliver water to the Gerangamete Water Treatment Plant where it is pre-treated prior to pumping to the main transfer channel and eventual storage and full treatment at Wurdee Boluc. The licence came into operation on the 29th April, 2004 and is valid until the 30th June, 2019.

Under the terms of the licence, Barwon Water is required to report at yearly intervals on groundwater extraction operations and provide information on the impacts on aquifer pressures. These are monitored through a network of observation bores which indicate groundwater levels and rate of change of levels during pumping and recharge periods. It is also a requirement to monitor and report on groundwater salinity, land subsidence and environmental impacts from groundwater extractions.

The purpose of this report is to provide details of regional groundwater and land surface monitoring activities for the period July 2003 to June 2004 to meet the requirements of Groundwater Licence No. 893889.

Water levels did not decline below the critical levels stipulated in Clause 3.1 of the licence. Note that YEO40 is reported as dry and currently not read. Preparations are underway to log each of the above bores and replace YEO40 with a new bore before December 31, 2004. Final recommendations and actions from the bore logging will be included in the 2004/05 annual report.

6. METERING (Clause 4)

Groundwater extractions were recorded in July 2003 for the new bores GW6 and GW8. The extractions were minor and part of the commissioning process for these bores. Daily extractions are recorded on the attached Appendix G.

7. SUBSIDENCE (Clause 5)

7.1 Land Subsidence Measurement (Cl. 5.5a)

Measurements were carried out and compared to 2002/03 readings for the subsidence monitoring network specified in the Fourth Schedule. Readings were conducted by the Spatial Information Services section of Barwon Water and presented as a report within Appendix H. The report includes a brief item on maintenance inspections for the monitoring marks.

There were no issues arising from the measurements with all variations in level less than 10mm.

8. FLOW IN BOUNDARY CREEK (Clause 6)

8.1 Discharge to Boundary Creek

A total of 70ML was discharged into Boundary Creek between November and March during 2003/04.

At present the flows are measured by noting the drop in flow to Colac Basin No.4 as the scour is opened. It is planned to install a new scour and flowmeter during the next stage of the Colac Pipeline replacement in the 2005/06 financial year.

Planning is underway to install a new bore in Boundary Road to replace YEO 40. Works will be completed by early January, 2005.

9. PROTECTION OF RIPARIAN VEGETATION (Clause 7)

Floral surveys are required at several sites within the first five years of the licence (by July 2009). No surveys have been carried out to date.

APPENDIX 26. When Licence 893889, 2004-05/2005-06 Reports were sent to SRW.

Southern Rural Water
Managing Water. Serving Communities.

FREEDOM OF INFORMATION

Request for Access to Documents

Applicant Details

Surname:	GARDINER	First Name:	MALCOLM
Postal Address:	1505 COLAC LAVERS HILL ROAD	KAWARREN	
	VIC	Postcode:	3249
Telephone (H):	03 52 355 325	Telephone (B):	
Telephone (M):		Email:	stongwater@yahoo.com.au

Forms of Access

Please (tick) ✓ where appropriate

- ☑ I request copies of the document(s) to be forwarded by mail.
- ☐ I request an inspection of the original document.
- ☐ I am prepared to inspect copies of the document(s) where the provision of originals would interfere unreasonably with the operations of Southern Rural Water.
- ☐ Other (Please Specify)

Details of Request

Under the Freedom of Information Act 1982, I wish to gain access to the following documents:

The records showing the dates when the final copies of the 2004-05 and the 2005-06 Reports of the "GERANGAMETE GROUNDWATER MANAGEMENT AREA, GROUNDWATER LICENCE Number 893889," from BARWON WATER reached or was lodged with Southern Rural Water.

Note: If there is insufficient room in the space provided, please attach details.

I enclose an application fee of $24.40 which is payable for this application and I understand that I will be supplied with a statement of further charges if appropriate.

I understand that a charge may be made for the reasonable costs incurred in searching for the records and supplying a copy of the information or for making arrangements to view a record or for supervising inspection of any material.

Applicants Signature: _____ Date: 29/06/2012

Where to send this form:

Mailed to:

Freedom of Information Officer
Southern Rural Water
PO Box 153
MAFFRA VIC 3860

.

Southern Rural Water
Managing Water. Serving Communities.

Our Reference: 1048526

30 July 2012

Malcolm Gardiner
1805 Colac Lavers Hill Road
KAWARREN VIC 3249

Dear Mr Gardiner

FREEDOM OF INFORMATION REQUEST

I refer to your Freedom of Information Request received at our office on 5 July 2012.

Your request included the following item;

1. *"The records showing the dates when the final copies of the 2004-05 and the 2005-06 report of the Gerangamete Groundwater Management Area, Groundwater Licence Number 893889, from Barwon Water reached or was lodged with Southern Rural Water."*

Please find enclosed a copy of the documents as requested. A cover letter from Barwon Water dated 5 April 2006 for the 2004-05 report was received at our Maffra office on 18 April 2006. The 2005-06 report was lodged electronically, following a thorough search of our system we could not locate the covering email but a zip file that is used to bind all the Annual Report documents together was located which indicates the documents were submitted around 11 January 2007.

As part of the FOI process I am also required to draw your attention to Section 51 (1) of the Act, which gives you the right to have the decision reviewed. If you wish to do so, it will be necessary for you to write to the Chief Executive at this address asking for an internal review of my decision. You have 28 days from the date of this letter in which to ask for a review.

Yours sincerely

HAYLEY JOHNSON
FOI Officer

88 Johnson Street, Maffra Victoria, 3860 | Post Office Box 153, Maffra Victoria, 3860 | Phone 1300 139 510, Fax (03) 5139 3150 | srw@srw.com.au, www.srw.com.au | DX 217245 | ABN 70 801 473 421

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Our Ref: 15/160/00232
Your Ref: 00893889
Enquiries To: Justin Franklin

Barwon Water

BARWON REGION WATER AUTHORITY
61-67 Ryrie Street,
Geelong, Victoria.
P.O. Box 659,
Geelong, Victoria, 3220.
D X 22061 (Geelong)
Phone: 1300 656 007
Fax: (03) 5221 8236
ABN 86 348 316 514
www.barwonwater.vic.gov.au

April 5, 2006

Trevor McDevitt
Manager Licensing Administration
Sourthern Rural Water
PO Box 153
MAFFRA VIC 3860

Dear Trevor,

Re: GROUNDWATER LICENCE 893889 - 2004/05 REPORT

Please find enclosed the Groundwater Licence Report for 2004/05. The report has been prepared in accordance with the requirements of the licence including groundwater level monitoring results and a description of works carried out during the year.

Barwon Water's storage levels did not reach the critical point in 2004/05 that triggers pumping in the Gerangamete bore field. However significant maintenance work was completed on the monitoring network and production bores.

If you have any queries relating to the 2004/05 Groundwater Licence Report, please contact Justin Franklin on 5226 9129.

Yours sincerely,

Ian Davis
Manger
Water Supply

Encl: Barwon Water Groundwater Licence Report 2004/05

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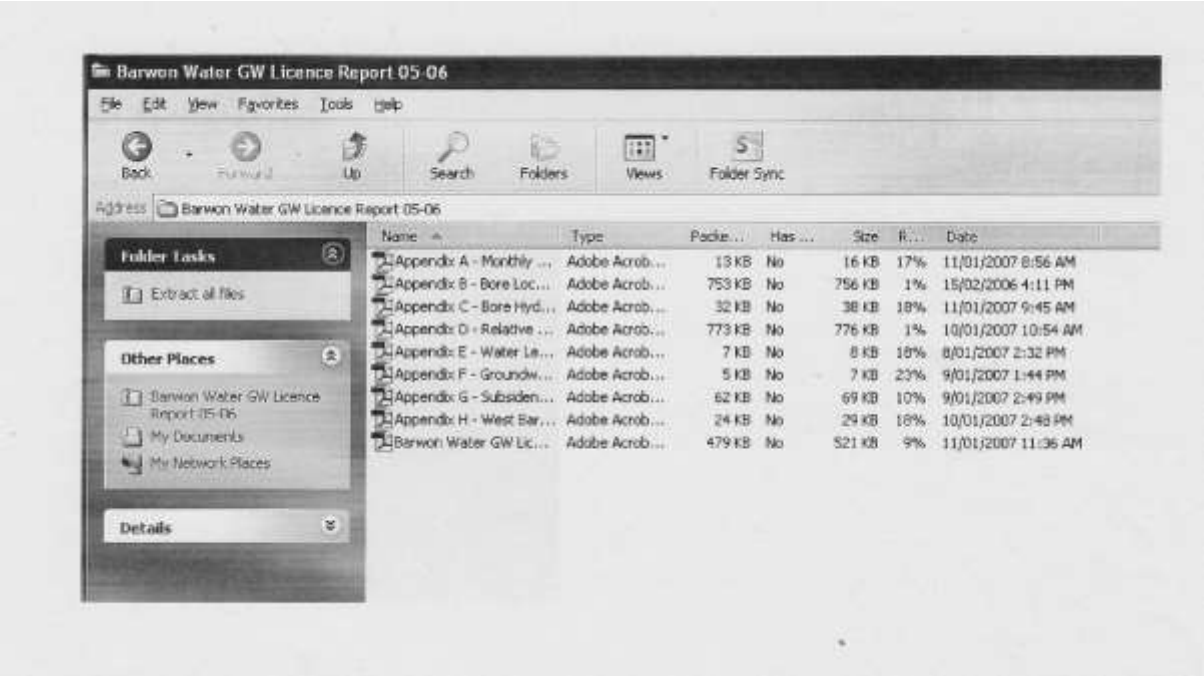

Barwon Water GW Licence Report 05-06
File Edit View Favorites Tools Help
Back Up Search Folders Views Folder Sync
Address Barwon Water GW Licence Report 05-06
Folder Tasks
Extract all files
Other Places
Barwon Water GW Licence Report 05-06
My Documents
My Network Places
Details
Name Type Packe... Has ... Size R... Date
Appendix A - Monthly ... Adobe Acrob... 13 KB No 16 KB 17% 11/01/2007 8:56 AM
Appendix B - Bore Loc... Adobe Acrob... 753 KB No 756 KB 1% 15/02/2006 4:11 PM
Appendix C - Bore Hyd... Adobe Acrob... 32 KB No 38 KB 18% 11/01/2007 9:45 AM
Appendix D - Relative ... Adobe Acrob... 773 KB No 776 KB 1% 10/01/2007 10:54 AM
Appendix E - Water Le... Adobe Acrob... 7 KB No 8 KB 18% 8/01/2007 2:32 PM
Appendix F - Groundw... Adobe Acrob... 5 KB No 7 KB 23% 9/01/2007 1:44 PM
Appendix G - Subsiden... Adobe Acrob... 62 KB No 69 KB 10% 9/01/2007 2:49 PM
Appendix H - West Bar... Adobe Acrob... 24 KB No 29 KB 18% 10/01/2007 2:48 PM
Barwon Water GW Lic... Adobe Acrob... 479 KB No 521 KB 9% 11/01/2007 11:36 AM

APPENDIX 27.

GROUNDWATER LICENCE

NO. 893889

GERANGAMETE AREA

2003/04 REPORT

2.2 Groundwater Modelling

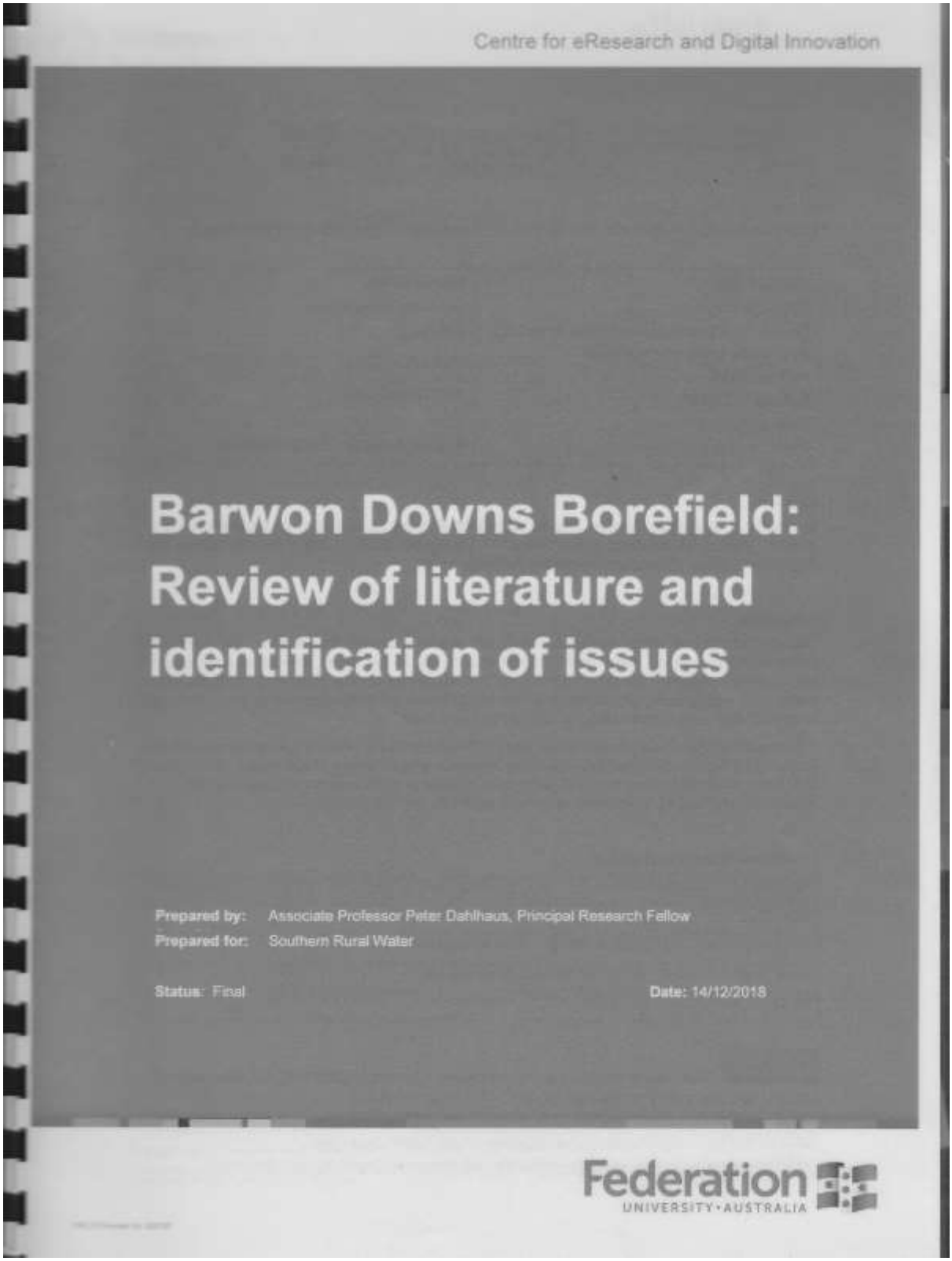
The groundwater model has been developed using the internationally recognized modular, finite difference, three dimensional model: USGS MODFLOW. Visual Modflow pre and post processing interface was used to construct the model and execute processes.

The objectives of the model are to determine the long term sustainability yield of the aquifer and to determine the impact of pumping from the wellfield. The model also provides potential behaviour of the aquifer system in response to pumping.

The hydrostratigraphy of the Barwon Downs graben has been simplified into a five-layer system for the numerical model as summarized below.

Model Layer	Model layer name	Hydrostratigraphic units included
Layer 1	Gellibrand Marl	Gellibrand Marl, Newer Volcanic Viaduct Moorabool, Quaternary
Layer 2	Clifton Formation	Clifton Formation
Layer 3	Narrawatuk Marl	Narrawatuk Marl
Layer 4	Dilwyn Formation	Menpunga, Dilwyn Formation, Pember Mudstone
Layer 5	Pebble Point Formation	Pebble Point Formation

The model shows that the proposed licensed extraction can be supported by the aquifer.


Centre for eResearch and Digital Innovation
Barwon Downs Borefield: Review of literature and identification of issues
Prepared by: Associate Professor Peter Dahlhaus, Principal Research Fellow
Prepared for: Southern Rural Water
Status: Final
Date: 14/12/2018
Federation
UNIVERSITY·AUSTRALIA

1. Conceptual model of the Barwon Downs Graben

It is clear from the literature that a considerable effort has been put into understanding the conceptual model of the groundwater storage and movement in the Barwon Downs Graben, and its relationship to the rest of the Otway Basin hydrogeology. This included drilling and constructing investigation, observation and monitoring bores; undertaking aquifer tests to measure parameters; measuring and monitoring groundwater heads; measuring and monitoring water chemistry and isotopes; and constructing and calibrating numerical models to run pumping scenarios. The result is that much is known about the physics and chemistry of the groundwater system.

A gap in the current conceptual model of the groundwater system of the Barwon Downs Graben is that it does not yet include the broader environmental and social components, such as groundwater dependent rivers, wetlands, ecologies, aesthetics, amenity, and cultural values. As a result, the conceptual model does not yet credibly explain the potential links of cause and effect in all the monitoring trends (climate, groundwater, surface water, hydrochemistry, flora, fauna, subsidence, and water use/demand) considering the time and place of the observations in broader Barwon Downs landscape.

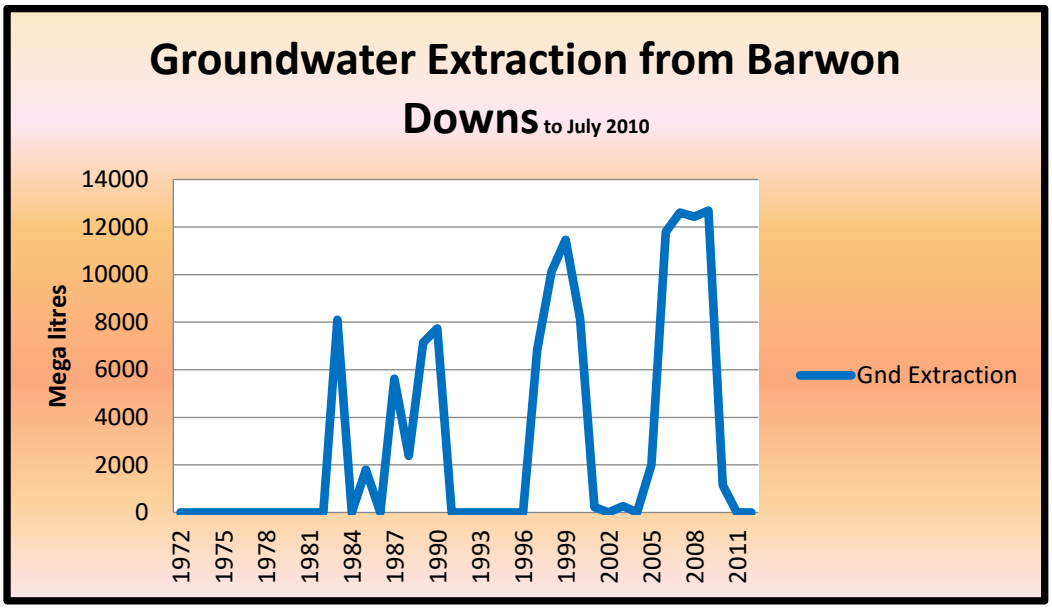
2. Numerical model of the Barwon Downs borefield

From the literature it appears that there have been at least six numerical models developed over the past thirty years, and the latest model reportedly meets the highest Confidence Level Classification (Class 3) in the Australian Groundwater Modelling Guidelines. The main purpose of the new numerical model is to predict future impacts for various borefield management scenarios.

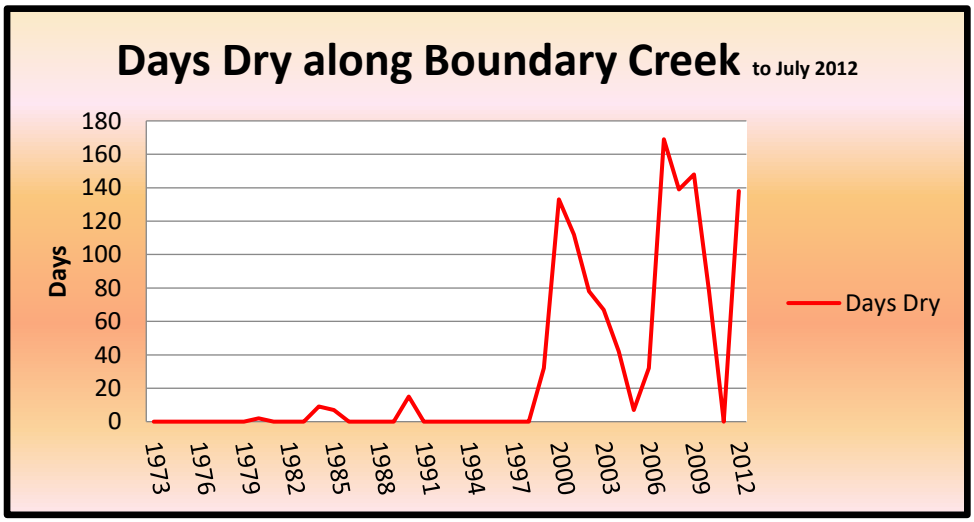
The identified gaps in the numerical model relate to the accuracy with which it can estimate the impact on groundwater dependent environmental values under different scenarios, time periods and at different locations. This is partly due to the incomplete conceptual model on which it is based. In addition, the ability to link the numerical groundwater model to the latest numerical climate change models is unclear.

3. Environment protection

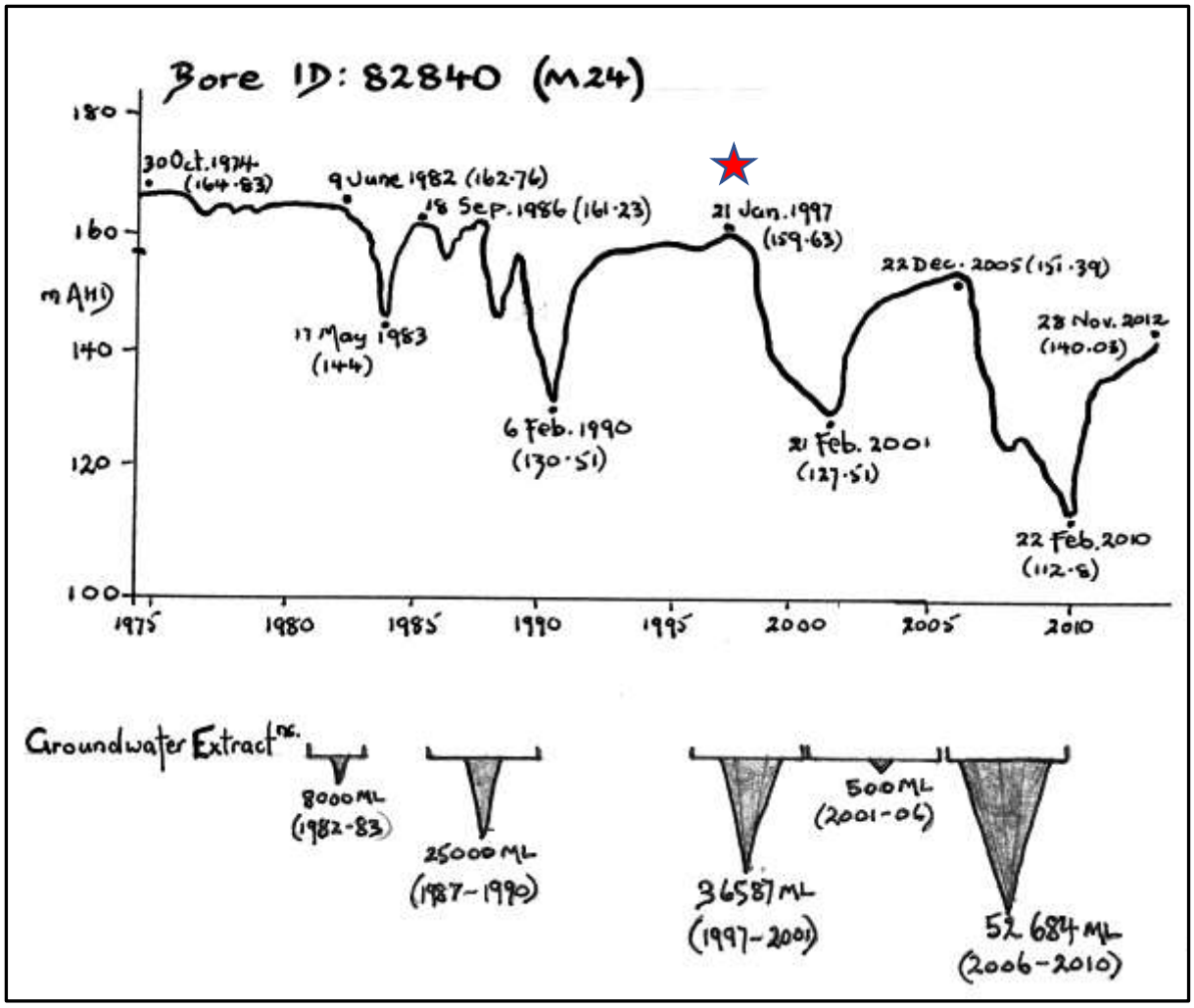
APPENDIX 28.



SOURCES: Barwon Water, Southern rural Water,



SOURCE: Vic Water Data Warehouse website.


Bore ID: 82840 (M24)
180
160
140
120
100
mAHD
30 Oct. 1974 (164·83)
9 June 1982 (162·76)
18 Sep. 1986 (161·23)
21 Jan. 1997 (159·63)
22 Dec. 2005 (151·39)
28 Nov. 2012 (140.03)
17 May 1983 (144)
6 Feb. 1990 (130·51)
21 Feb. 2001 (127·51)
22 Feb. 2010 (112·6)
1975
1980
1985
1990
1995
2000
2005
2010
Groundwater Extraction
8000 ML (1982-83)
25000 ML (1987-1990)
500 ML (2001-06)
36587 ML (1997-2001)
52 684 ML (2006-2010)

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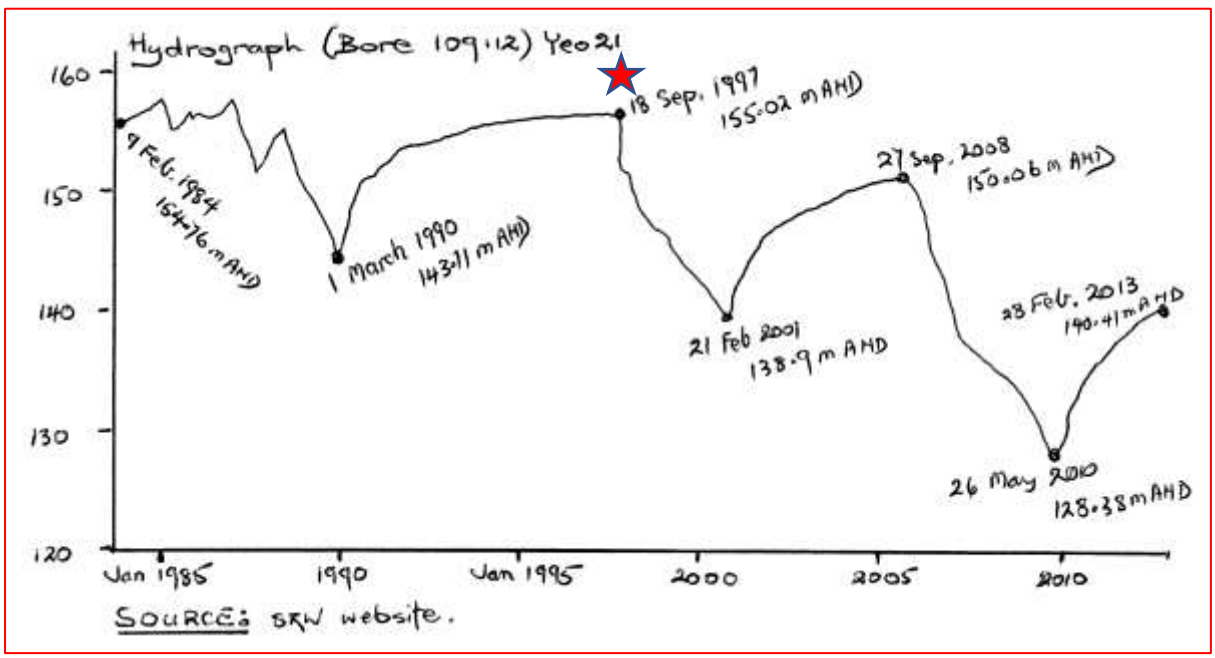
Hydrograph (Bore 109:12) Yeo 21
160
150
140
130
120
9 Feb. 1984 164·76 m AHD
1 March 1990 143·11 m AHD
18 Sep. 1997 155·02 m AHD
21 Feb 2001 138·9 m AHD
27 Sep. 2008 150·06 m AHD
26 May 2010 128·38 m AHD
28 Feb. 2013 140·41 m AHD
Jan 1985
1990
Jan 1995
2000
2005
2010
SOURCE: SRW website.

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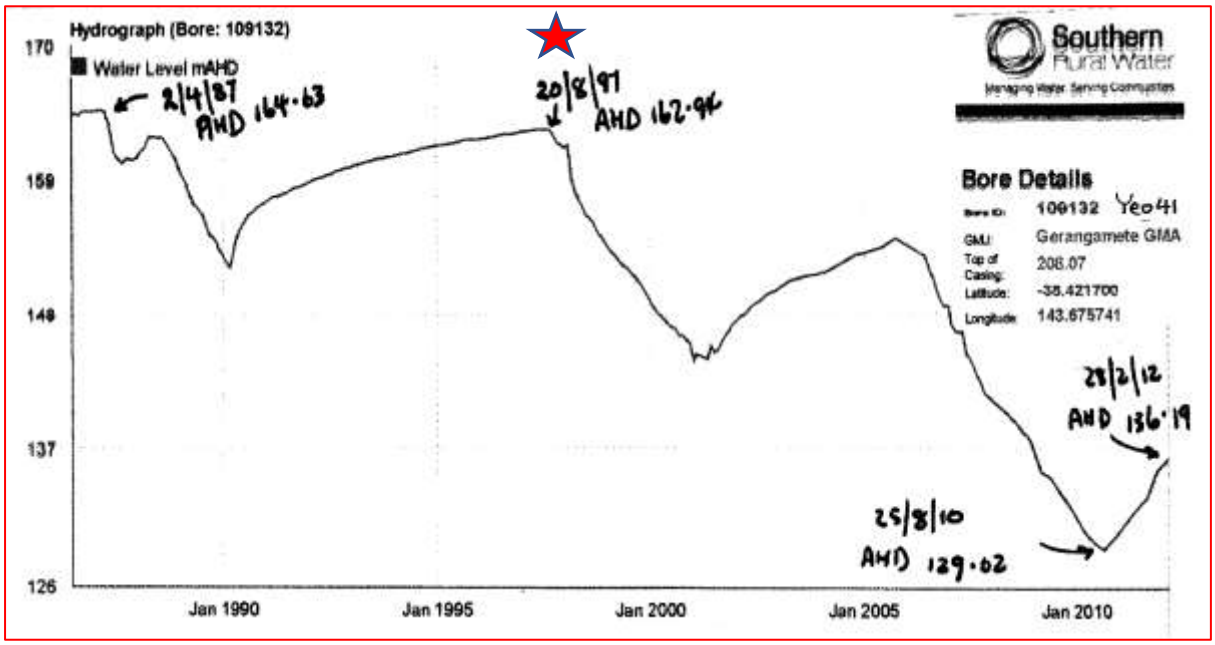
Hydrograph (Bore: 109132)
Water Level mAHD
2/4/87
AHD 164·63
20/8/97
AHD 162·96
25/8/10
AHD 129·02
28/2/12
AHD 136·19
170
159
148
137
126
Jan 1990
Jan 1995
Jan 2000
Jan 2005
Jan 2010
Southern
Rural Water
Bore Details
109132 Yeo41
GMU: Gerangamete GMA
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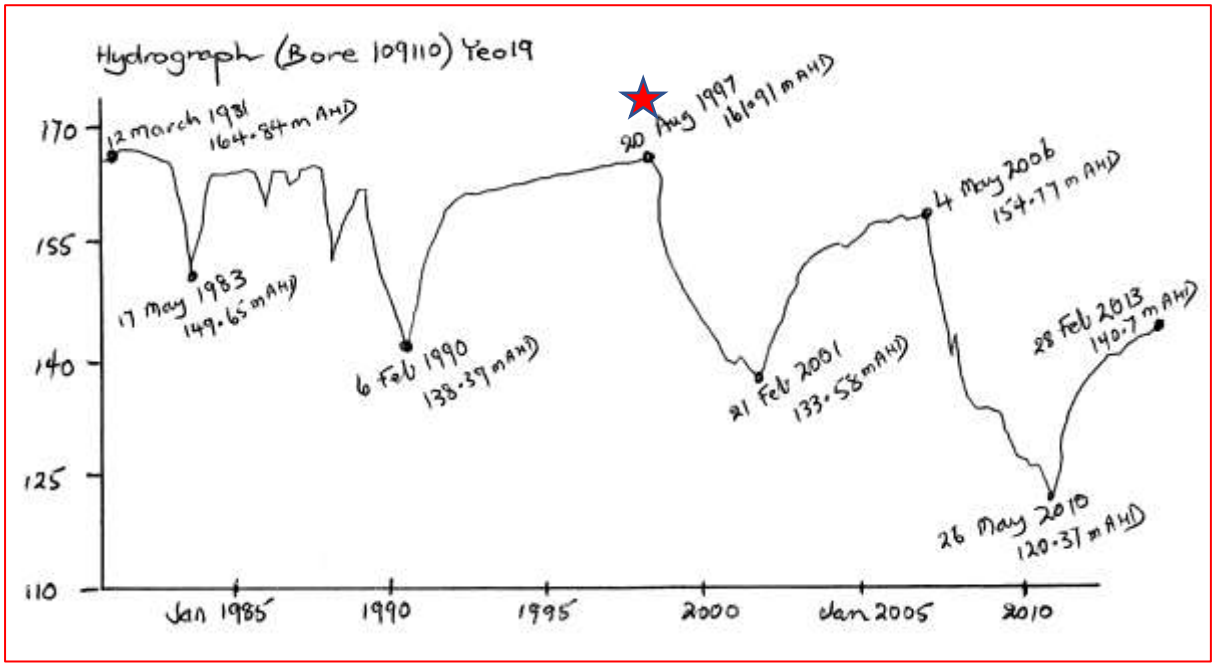
Latitude: -38.421700
Longitude: 143.675741


Hydrograph (Bore 109110) Yeo19
12 March 1981
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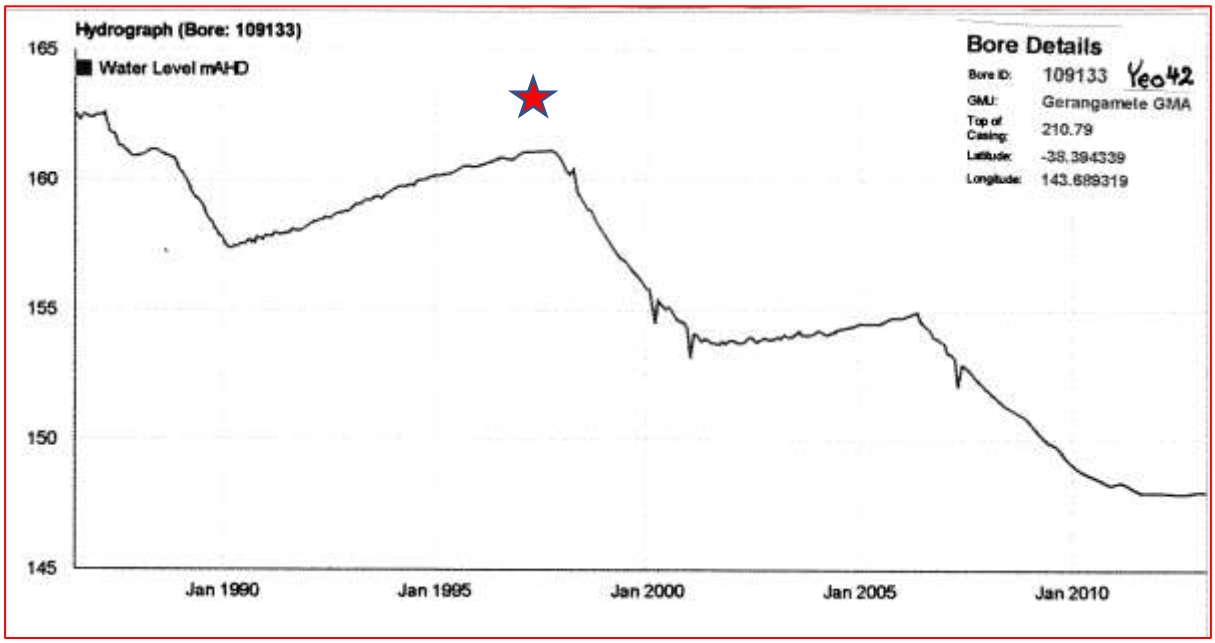
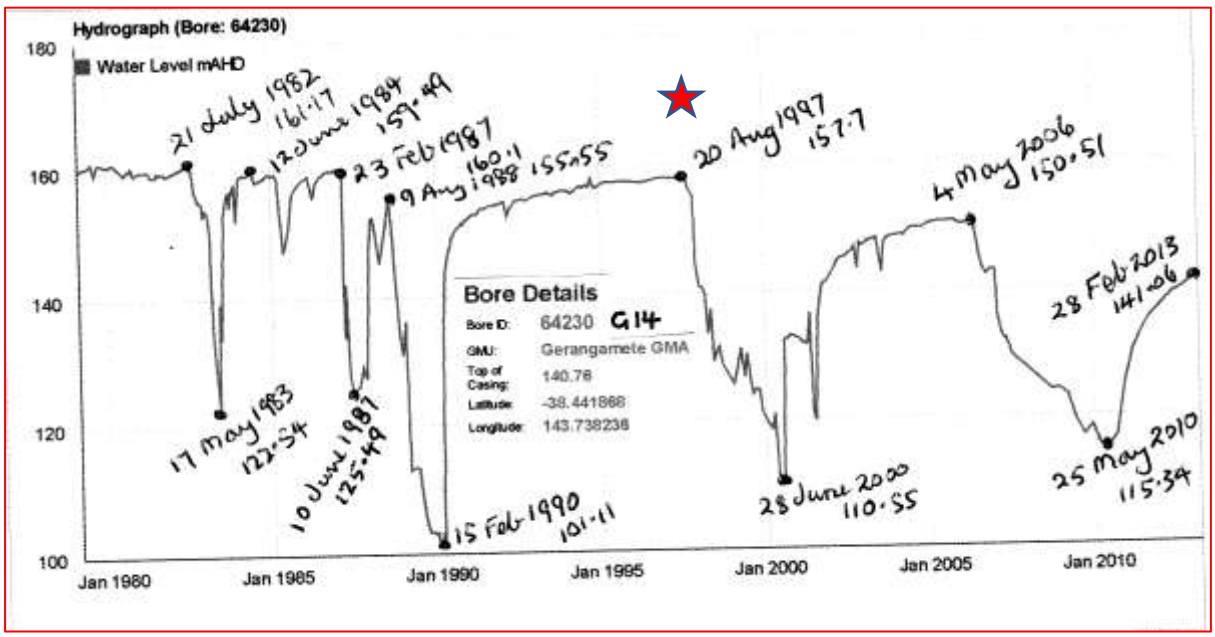
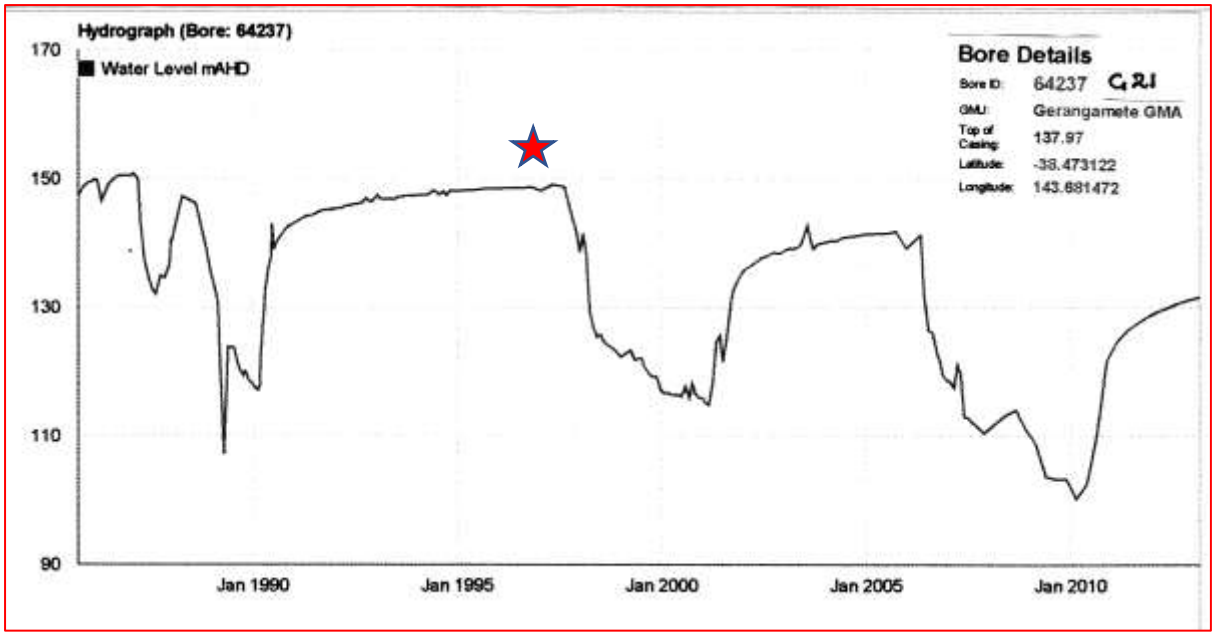
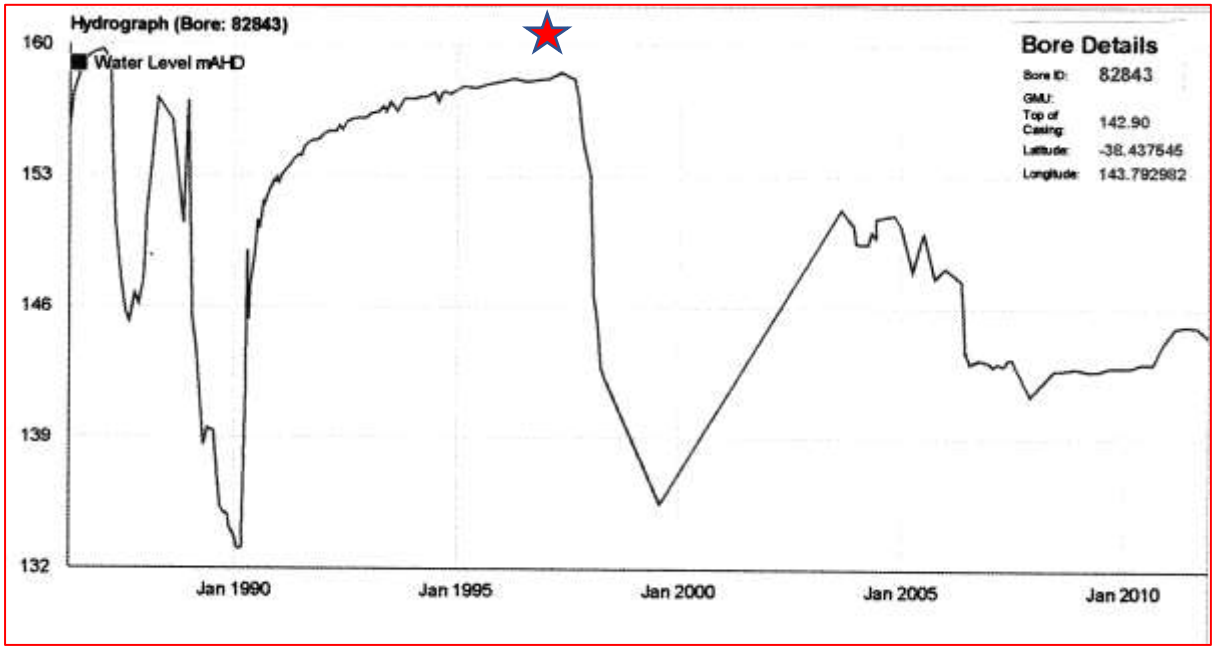
17 May 1983
149·65mAHD
6 Feb 1990
138·39mAHD
20 Aug 1997
161·91m AHD
21 Feb 2001
133·58mAHD
4 May 2006
154·77m AHD
28 Feb 2013
140·7m AHD
26 May 2010
120·37m AHD
170
155
140
125
110
Jan 1985
1990
1995
2000
Jan 2005
2010


Hydrograph (Bore: 109133)
Water Level mAHD
165
160
155
150
145
Jan 1990
Jan 1995
Jan 2000
Jan 2005
Jan 2010
Bore Details
Bore ID: 109133 Yeo42
GMU: Gerangamete GMA
Top of Casing: 210.79
Latitude: -38.394339
Longitude: 143.689319


Hydrograph (Bore: 64230)
Water Level mAHD
180
160
140
120
100
Jan 1980
Jan 1985
Jan 1990
Jan 1995
Jan 2000
Jan 2005
Jan 2010
21 July 1982 161.17
12 June 1984 159.49
23 Feb 1987
9 Aug 1988 155.55
20 Aug 1997 157.7
4 May 2006 150.51
28 Feb 2013 141.06
17 May 1983 122.34
10 June 1987 125.49
15 Feb 1990 101.11
28 June 2020 110.55
25 May 2010 115.34
Bore Details
Bore ID: 64230 G14
GMU: Gerangamete GMA
Top of Casing: 140.76
Latitude: -38.441868
Longitude: 143.738238


Hydrograph (Bore: 64237)
Water Level mAHD
170
150
130
110
90
Jan 1990
Jan 1995
Jan 2000
Jan 2005
Jan 2010
Bore Details
Bore ID: 64237 G.2.1
GMU: Gerangamete GMA
Top of Casing: 137.97
Latitude: -38.473122
Longitude: 143.681472


Hydrograph (Bore: 82843)
Water Level mAHD
160
153
146
139
132
Jan 1990
Jan 1995
Jan 2000
Jan 2005
Jan 2010
Bore Details
Bore ID: 82843
GMU:
Top of Casing: 142.90
Latitude: -38.437545
Longitude: 143.792982

Very Low	Meeting 1		Social inequity - Donor and recipient communities - Geelong receives and benefits from water from Barwon Downs during drought, where are the benefits for Barwon Downs? - Potential to divide local and/or regional community - Impact of water prices (bills) if desalinated water was used	

APPENDIX 29. Extract from Dahlhaus – see Appendix 27.

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3 Identification of issues

Because it is a hidden resource, groundwater is notoriously difficult to conceptualise and model, with even the most experienced hydrogeologists acknowledging that models only approximate reality (Voss, 2011a, 2011b). Groundwater movement is through complex pathways within the voids in the geological materials of an aquifer, and the flux continuously responds to external forces, both natural and man-made. Understanding these transient fluxes in groundwater systems requires information about aquifer hydraulics, hydrological drivers, and time scale of management. It is widely recognized that aquifers respond on different timescales to hydrological change and that hydrological drivers themselves, such as climate, are not stationary in time (Currell et al., 2016).

In response to this reality, the hydrogeological understanding and management of the Barwon Downs borefield is continuously evolving. These challenges have been acknowledged to some extent in the recent consultant reports by Jacobs (2017b) that have extended the list of potential impacts to the broader region (e.g. Jacobs, 2017b, Figure 1.5, p.17).

A groundwater system should be conceptualised and modelled based on all the available data: climatic, topographic, geological, geophysical, boreholes, aquifer tests (i.e. pumping tests), chemical and isotopic analyses, geomorphological features (e.g. soil profiles, rivers, springs, soaks, etc.), the regional ecologies (i.e. the groundwater dependency of the flora and fauna) and the man-made changes (i.e. pumping, irrigation, diversions, contamination, excavations, etc.)[1]. Therefore, in conceptualising groundwater systems there are inevitable uncertainties, as it is impossible to fully envisage, with certainty, the three-dimensional geometry of aquifers and confining beds, groundwater movement and storage, and the groundwater interactions with the surface and where and when they occur.

When considering the uncertainties, a distinction is made between statistical variability (known as aleatory uncertainty) and lack of information (known as epistemic uncertainty). In reviewing the 166 items for this study, it is apparent that there are potential gaps in the completeness of the information (that is, the epistemic uncertainty) that is considered by the author as necessary to assess the impacts of operating the Barwon Downs borefield. These have been grouped into five broad areas discussed in the following sections.

3.1 Conceptual model

From the reviewed literature, it is apparent (Figure 2.3) that most of the past effort has gone into understanding the conceptual model of the groundwater storage and movement in the Barwon Downs Graben, and its relationship to the rest of the Otway Basin hydrogeology. All this past work is based on the standard scientific method of observation and gathering empirical and measurable evidence to hypothesise groundwater behaviour, with a focus on groundwater exploitation. In other words, much of the effort to date has been put into drilling and constructing investigation, observation and monitoring bores, undertaking aquifer tests to measure parameters, measuring and monitoring groundwater heads, measuring and monitoring water chemistry and isotopes, and constructing and calibrating numerical models to run pumping scenarios. Over time, the reduction in statistical variability has greatly improved the accuracy of the models to predict drawdowns and in some more recent studies, the impacts on baseflows to some waterways such as Boundary Creek and the Barwon River.

However, the impacts on the broader environment, detailed later in Section 3.3, were not predicted by the models. This raises the question of whether the current conceptual model is adequate to fully explain the links between the groundwater extraction and environmental impacts within the broader biophysical landscape. The answer is not easily gleaned from the

[1] Recent examples in the global literature include conceptual models that include economic, environmental, social and cultural values (or 'services') provided by the groundwater system.

literature, because of the piecemeal studies (both geographic and quality). While academic research has added a massive understanding of some issues (e.g. Atkinson et al., 2014; Atkinson et al., 2015; Cartwright et al., 2013; Howcroft, 2018; Petrides & Cartwright, 2006), the entire conceptual model remains obscure.

The last well-documented conceptual model is that of Witebsky et al. (1996), also partly published by Shugg and Jayatilaka (1998). This model includes the geological (Figure 2.5) and hydrogeological components and their geometry, groundwater flow, movement and quality, but is limited in its environmental components to streamflow, springs, and surface subsidence. The report on the latest numerical model partly explains the conceptual model of groundwater-surface water interaction, and the model area has been extended (Jacobs, 2017b). However, a full conceptual model of the Barwon Downs groundwater system that includes groundwater dependent rivers, wetlands, ecologies, aesthetics, amenity, cultural values, etc. has not been found in this extensive review of the literature.

Hence key questions remain in the following areas:

- What is the current conceptual model? Is it extended from the previous models?
- How complete is the current conceptual model? Where are the gaps and what components or processes are they specifically related to?
- What are the boundaries for the conceptual model and what is the logic for choosing those boundaries? Are the model boundaries adequate to account for all potential issues?
- Does the conceptual model logically and convincingly describe the groundwater-surface water interactions and requirements for the waterways, wetlands, springs, flora, fauna, diverters/irrigators, recreational uses and cultural uses?
- Does the conceptual model credibly explain the potential links of cause and effect in all the monitoring trends (climate, groundwater, surface water, hydrochemistry, flora, fauna, subsidence, and water use/demand) considering the time and place of the observations in broader Barwon Downs landscape?
- Does the conceptual model logically and convincingly explain the hydrogeological processes implicated in the generation of acid sulphate soils, ground subsidence, soil salinity and changes to water quality?

3.2 Numerical Model

The construction of numerical models, or mathematical models, is based on the conceptual models. Therefore, the numerical models keep evolving as new investigations, bores and tests are used to refine the conceptual models. From the literature it appears that there have been at least six numerical models developed over the past thirty years. An original model by Geelong and District Water Board, referred to in Teng (1996); the model described by Witebsky et al. (1996); the model by Teng (1996); the models by SKM (2001, 2007) and the model by Jacobs (2017b; shown in Figure 3.1). More may have been developed but missed in this review of the literature, e.g. Jacobs (2017b) refers to a model by SKM in 2011. The main purpose of the models was to predict the permissible volumes (Table 2.1).

The latest model is a Modflow Unstructured Grids (USG) model (using Groundwater Vistas V6) that meets (self-assessed) the highest Confidence Level Classification (Class 3) in the Australian Groundwater Modelling Guidelines (Jacobs, 2017b).

The main purpose of the new numerical model is to predict future impacts for various borefield management scenarios. The intention is that the model closely approximates hydrogeological reality, the model parameters are derived from experiments and the algorithms that are used in the model encapsulate the laws of groundwater hydraulics.

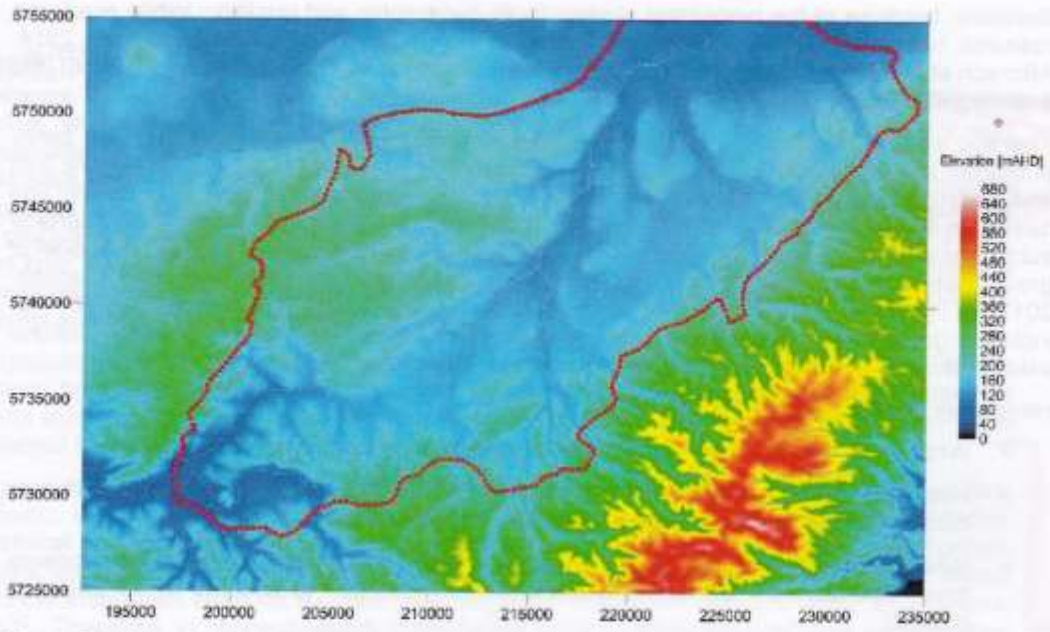

Figure 3.1 Current model domain (dotted line) sourced from Jacobs (2017b, Figure 5.2, p.45)

But the model is subject to both statistical uncertainty and incomplete information and the challenge is in understanding the limitations of these uncertainties when using it to predict impacts within the entire Barwon Downs landscape. For example, hindcast[2] scenarios have been run using historical climate and groundwater pumping data in the current numerical model to compare with the past observed impacts on Boundary Creek and the Gellibrand River. However, the accuracy of the hindcast is unstated, and the observed effects on springs, flora, fauna, subsidence, stock and domestic bores, diverters/irrigators, recreational uses and cultural uses are omitted.

Key questions that arise in the numerical model are:

- Given the uncertainties in the conceptual model, how confidently can the numerical model represent the potential impacts on the biophysical landscapes of the Barwon Downs region? In particular, how accurately can it estimate the impact on groundwater dependent environmental values under different scenarios, time periods and at different locations?
- What is the statistical accuracy with which the numerical model can hindcast the observed impacts on the environment, and groundwater use by others, at various times and places in the Barwon Downs region?
- How well integrated is the current numerical model with other numerical models available for climate, environmental flows and species distributions[3]?

[2] Hindcasting is the opposite of forecasting, that is, using the model to calculate what has already happened, and compare it to the historical data as a check of the model accuracy and usefulness.
[3] For example, the CSIRO Conformal Cubic Atmospheric Model (CCAM) developed for regional climate change research and CSIRO CLIMEX AdaptNRM module for species distribution under climate change.