OTWAY WATER

BOOK 55

APPENDIXES

APPENDIX Contents…

APPENDIX ONE. Stock and Domestic Water Rights.

Under present legislation a landholder is permitted to apply for a groundwater extraction bore licence that allows a free from any cost, an annual extraction of 2 ML free, as long as it is used solely for stock water and or domestic purposes.

APPENDIX TWO. Permissible Consumptive Volumes Legislated Media Releases.

Media Release

The Hon Lisa Neville MP
Minister for Water
Minister for Police and Emergency Services

Tuesday, 2 July 2019

ENFORCING SUSTAINABLE WATER EXTRACTION IN THE OTWAYS

The Andrews Labor Government is securing water supply for Geelong communities and protecting the environment by limiting groundwater extraction in the Otways to a bare minimum.

Minister for Water Lisa Neville today reduced the limit on how much water can be taken from the Gerangamete Groundwater Management Area (GMA) from 20,000 megalitres per year to just 239 megalitres per year.

The limit on taking water from the neighbouring Gellibrand GMA, that shares a common recharge area with Gerangamete GMA, has been set at zero.

This decision cuts the Permissible Consumptive Volumes (PCV) – the amount of groundwater that can be extracted – to allow for the much-needed recovery of the Gerangamete groundwater resource and its surrounding environment and ecosystems.

This amendment will support Barwon Water's critical remediation works to improve and protect the health of Boundary Creek, Big Swamp and the surrounding environments.

Importantly, three local farmers who have access to the groundwater will not be impacted by the reduction, with the limit for the Gerangamete GMA set to cover the total volume of these existing licenses.

The PCV also includes provision for a small quantity of water per year to be used for pump testing and maintenance – and access for emergencies can also be facilitated.

Setting the limit at just two per cent of what was originally permitted to be taken from the area ensures the environment is being protected and the groundwater can recover.

The Labor Government has listened to feedback from the local community, addressing their concerns that the current extraction level was compromising the health of waterways and ecosystems in the area.

This is the outcome of a 2018 review ordered by Minister Neville to assess the Gerangamete PVC, delivering a sensible and sustainable new limit that supports the community, local businesses and the environment.

The Labor Government has invested in the Melbourne-Geelong pipeline, which along with other Barwon Water initiatives will ensure water security for the region.

Quotes attributable to Minister for Water Lisa Neville

"Healthy waterways mean healthy communities, and we're keeping the water flowing to greater Geelong in a sustainable way that ensures the natural environment is protected."

"Reducing the extraction limit at Gerangamete is a common sense move that will allow the groundwater resource and its surrounding areas to recover from the impacts of past extraction."

"This builds on critical remediation works we've required Barwon Water to carry out to improve the health of these catchments and their ecosystems."

Media contact: Nikki Mott 0416 311 214 | elwpmedia@minstaff.vic.gov.au

Media release

Barwon Water

2 July 2019
REF: 045/19

Barwon Water welcomes new limits on Gerangamete groundwater

Barwon Water welcomes the Minister's decision to reduce the permissible consumptive volume for the Gerangamete groundwater management area, which is consistent with the organisation's commitment to not operate the Barwon Downs borefield while it focuses on remediating Boundary Creek and Big Swamp.
The Minister for Water The Hon. Lisa Neville announced that the permissible consumptive volume (PCV) for Gerangamete groundwater management area (GMA) was amended to 239 megalitres a year.

The PCV is the maximum amount of water that can be allocated to licence holders over a specific period of time.

Barwon Water managing director Tracey Slatter said the new PCV protects the aquifer from usage while remediation is being completed.

"In March this year, Barwon Water withdrew its licence application for the Barwon Downs borefield to focus wholly on the remediation of the past impacts of water pumping," Ms Slatter said.

"The PCV level set means no other party will apply to use the resource. This provides excellent protection while we focus on remediation," she said.

"The process for developing and implementing a remediation plan has been progressing well as we continue to partner with independent technical experts and the remediation working group made up of community members and representatives from local agencies and environmental groups.

-continues-

"In April this year, Barwon Water undertook an extensive field program, which involved taking soil samples from the site to assist in selecting the best method for remediation.

"Those samples are currently being tested by bio-geochemical experts at Monash University, with the results expected to be known in September 2019."

The remediation plan will be submitted to Southern Rural Water and its independent technical review panel by 20 December 2019.

A review of the PCV is expected to occur when remediation is complete.

-ends-
For further Information, please contact:
Bernadette Collins, Media and Communications Advisor

Water Act 1989

PERMISSIBLE CONSUMPTIVE VOLUME GROUNDWATER (GELLIBRAND AND GERANGAMETE GROUNDWATER MANAGEMENT AREAS) AMENDMENT ORDER 2019

I, Lisa Neville MP, Minister for Water, as Minister administering the **Water Act 1989**, make the following Order:

1. Citation

This Order is called the Permissible Consumptive Volume Groundwater (Gellibrand and Gerangamete Groundwater Management Areas) Amendment Order 2019 (this Order).

2. Authorising provision

This Order is made under section 22A of the **Water Act 1989** and section 27 of the **Interpretation of Legislation Act 1984**.

3. Commencement

This Order comes into operation on the date it is published in the Victoria Government Gazette.

4. Purpose

The purpose of this Order is to amend the Permissible Consumptive Volume Groundwater Order 2011 published in the Victoria Government Gazette G28 on 14 July 2011 to declare new permissible consumptive volumes for the Gellibrand Groundwater Management Area and the Gerangamete Groundwater Management Area and to make provision for test pumping to be carried out in the Gerangamete Groundwater Management Area.

5. Declaration of permissible consumptive volumes and amendment of the Permissible Consumptive Volume Groundwater Order 2011

(a) I declare that the total volume of groundwater that may be taken in a water season in the Gerangamete Groundwater Management Area is 239 megalitres plus a volume of no more than 30 megalitres in any water season that may be taken in that area under any licence issued or amended or to be issued or amended under section 51 of the Act for the purpose of pumping tests.

(b) The Table to the Permissible Consumptive Volume Groundwater Order 2011 is amended as follows:

(i) after clause 9(b)(iii) **insert**:

'(c) the volume listed in Column D for the Gerangamete Groundwater Management Area plus a volume of no more than 30 megalitres in any water season that may be taken in that area under any licence issued or amended or to be issued or amended under section 51 of the Act for the purpose of pumping tests.';

(ii) **after**:

'Frankston Groundwater Management Area	LEGL./04-133	All formations below the surface	3,200

insert:

'Gellibrand Groundwater Management Area	LEGL./04-134	All formations below the surface	0

'; and

(iii) **for**:

'Gerangamete Groundwater Management Area	LEGL./04-135	All formations below 60 metres	In any one year 20,000 In any consecutive period of ten years 80,000

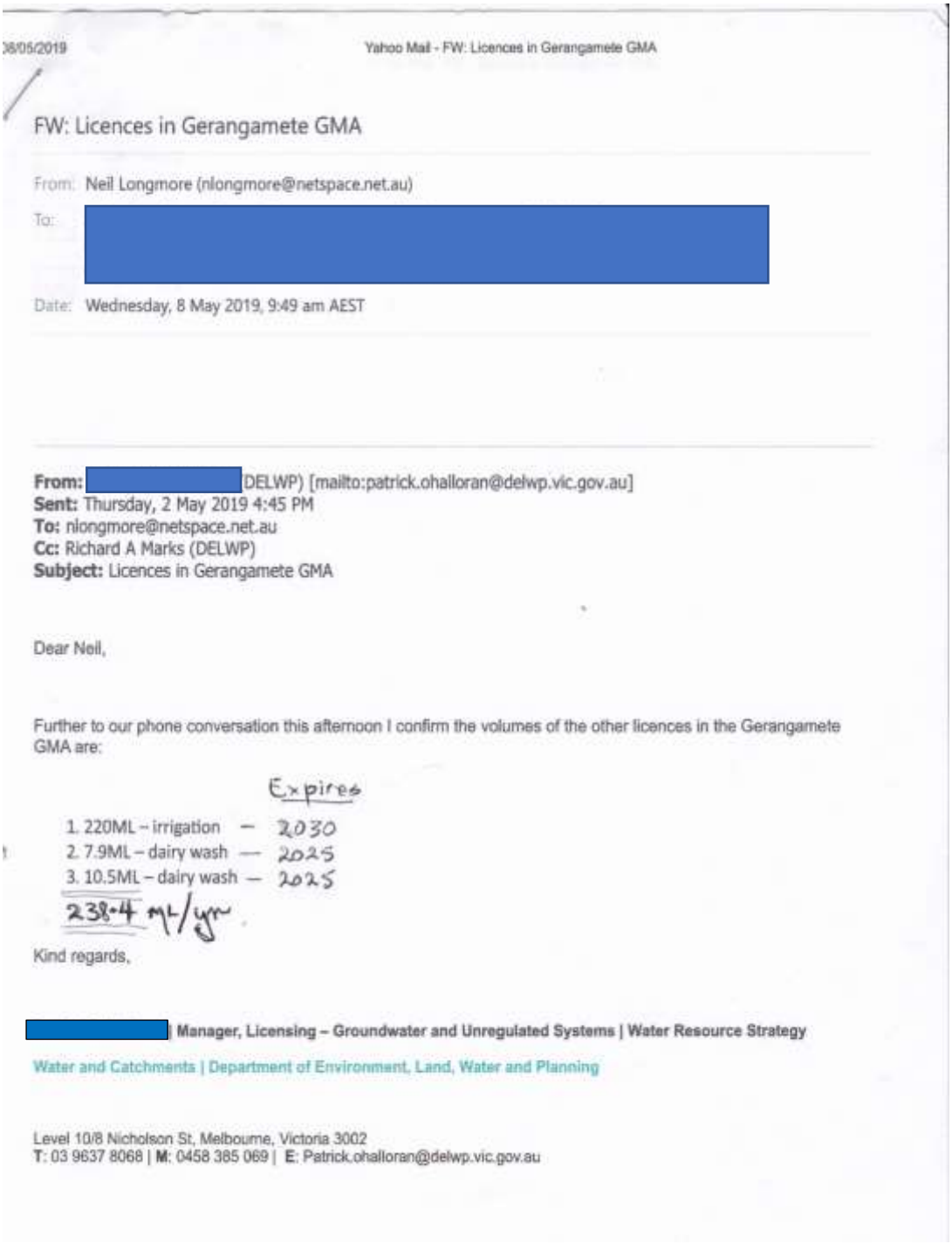
substitute:

'Gerangamete Groundwater Management Area	LEGL./04-135	All formations below the surface	239

Dated 26 June 2019

HON. LISA NEVILLE MP
Minister for Water

APPENDIX THREE



8/05/2019 Yahoo Mail - FW: Licences in Gerangamete GMA

FW: Licences in Gerangamete GMA

From: Neil Longmore (nlongmore@netspace.net.au)

To: [redacted]

Date: Wednesday, 8 May 2019, 9:49 am AEST

From: [redacted] DELWP) [mailto:patrick.ohalloran@delwp.vic.gov.au]
Sent: Thursday, 2 May 2019 4:45 PM
To: nlongmore@netspace.net.au
Cc: Richard A Marks (DELWP)
Subject: Licences in Gerangamete GMA

Dear Neil,

Further to our phone conversation this afternoon I confirm the volumes of the other licences in the Gerangamete GMA are:

Expires

1. 220ML – irrigation – 2030
2. 7.9ML – dairy wash — 2025
3. 10.5ML – dairy wash – 2025

238·4 ML/yr

Kind regards,

[redacted] | Manager, Licensing – Groundwater and Unregulated Systems | Water Resource Strategy

Water and Catchments | Department of Environment, Land, Water and Planning

Level 10/8 Nicholson St, Melbourne, Victoria 3002
T: 03 9637 8068 | M: 0458 385 069 | E: Patrick.ohalloran@delwp.vic.gov.au

APPENDIX FOUR

Colac Herald 23/7/2019 P2

Government cuts groundwater allocation

The State Government has slashed groundwater allocations by 98 per cent in the Gerangamete groundwater management area in an effort to protect the Otways environment.

Water Minister Lisa Neville announced yesterday that the permissible consumptive volume for Gerangamete GMA would go from 20,000 megalitres per year to 239 megalitres per year.

The change will stop Barwon Water from drawing on the area's aquifer for drinking supplies.

The new PCV limit will maintain water entitlements for three farmers in the area who have existing licenses, as well as water provision for pump testing and maintenance.

The change aims to allow for the recovery of the Gerangamete groundwater resource and the surrounding environment and ecosystems.

Land and Water Resources Otway Catchment's Malcolm Gardiner has welcomed the reduction but said the recovery would take longer than expected.

"Even if there's no more pumping there can still be problems that manifest themselves in the coming years because the drawn-out impact is going to go on for ages, it's not a matter of stop and everything recovers from there," Mr Gardiner said.

"The major reason why a sensible result has come about is the enormous amount of public pressure that was put on the whole process and it's my belief that if there weren't a lot of people that contributed to this particular process then Barwon Water would have been given permission to continue pumping," he said.

Barwon Water managing director Tracey Slatter said the new PCV would protect the aquifer from use while Barwon Water completed its critical remediation works.

"In March this year, Barwon Water withdrew its licence application for the Barwon Downs borefield to focus wholly on the remediation of the past impacts of water pumping," Ms Slatter said.

"The PCV level set means no other party will apply to use the resource. This provides excellent protection while we focus on remediation," she said.

"The process for developing and implementing a remediation plan has been progressing well as we continue to partner with independent technical experts and the remediation working group made up of community members and representatives from local agencies and environmental groups."

APPENDIX FIVE.

Richard, my request is for a copy of the documentation sent to the Minister supporting and justifying your recommendations that lead to the Minister's final decision. If these documents could be provided this would be most appreciated.

Kind regards,
Malcolm.

Sent from Yahoo Mail for iPad

From: [redacted]
Subject:
Date: Today at 9:30 AM
To: Mal Gardiner otwaywater@yahoo.com.au

Hi Malcolm

[redacted]

We are not in the practice of providing people outside the Department with copies of briefings to a Minister. However, we are very happy to meet with you and explain the rationale behind the advice provided to the Minister.

[redacted]

Kind regards,

[redacted] | Director Water Resource Operations Policy | Water Resources Strategy Division
Water and Catchments | Department of Environment, Land, Water and Planning
10/8 Nicholson Street, East Melbourne, Victoria 3002
T: 0396378995| M: 0409455519| E: richard.marks@delwp.vic.gov.au

APPENDIX SIX. Freedom of Information Request.

From: Mal Gardiner <otwaywater@yahoo.com.au>
Sent: Monday, 1 July 2019 2:27 PM
To: [redacted] (DELWP) [redacted]
Subject: Groundwater Management Areas

Hello Richard,
The Minister's GMA legislation for the Gellibrand and Gerangamete Groundwater Magement Areas is most welcome and a very good result for what has transpired. Well done all.

From: [redacted]@delwp.vic.gov.au
Subject: RE: Groundwater Management Areas
Date: Today at 9:50 AM
To: Mal Gardiner otwaywater@yahoo.com.au

Hi Malcolm

Thank you for your email regarding the Minister's decision to set the Gellibrand and Gerangamete PCVs at 0ML/yr and 239 ML/yr. Sorry for the delay in getting back to you. I think you've since spoken to Grace about this.

We are not in the practice of providing people outside the Department with copies of briefings to a Minister. However, we are very happy to meet with you and explain the rationale behind the advice provided to the Minister.

I am aware you were also interested in how Barwon Water could be granted pumping rights from the Gerangamete GMA if they do not have any rights under the PCV. The PCV Order includes provision for a volume of no more than 30 megalitres in any water season (i.e. per annum) to be taken under a s51 licence for the purpose of pumping tests. Barwon Water would have to apply to Southern Rural Water for a licence and this would be assessed in accordance with the requirements of the Act.

Please let me know if you would like to make arrangements for me to meet with you.

Kind regards,

[redacted] | Director Water Resource Operations Policy | Water Resources Strategy Division
Water and Catchments | Department of Environment, Land, Water and Planning
10/8 Nicholson Street, East Melbourne, Victoria 3002
T: 0396378995|M: 0409455519| E: richard.marks@delwp.vic.gov.au

Department of Environment, Land, Water & Planning

Freedom of Information Request

Send to: FOI & Privacy Unit
Department of Environment, Land, Water and Planning
PO Box 500
East Melbourne Vic 8002

Email: foi.unit@delwp.vic.gov.au

Name: MALCOLM JOHN GARDINER
Address: 1805 COLAC LAVERS HILL ROAD KANARREN VIC 3249
Phone: 0475 358 747
Email: otwaywater@yahoo.com.au

Description of documents sought:

On Friday the 26th June 2019, Minister for Water, Hon Lisa Neville signed off on a zero Permissible Consumptive Volume (pcv) for the Gellibrand Groundwater Management Area (Victorian Government Gazette S265, June 2019, PAGE 17, LEGL./04-134). And, a 239 ML PCV for the Gerangamete Groundwater Management Area on the same day (Victorian Government Gazette S265, June 2019, PAGE 18, LEGL./04-135). The two PCVs were determined on advice from [redacted] s' DELWP team of administrators or advisors at 8 Nicholson St. Melbourne.

The request under this FOI is for copies of this advice from these administrators to the Minister, justifying the determination of these two Permissible Consumptive Volume allocations.

I understand that further reasonable charges for photocopying and other processing costs may be applicable.

Signature: [signature] Date: 07/07/2019

Send the application form with a cheque/money order (payable to DELWP) for $29.60.

If you wish to lodge your request online and pay by credit card you may do so via www.foi.vic.gov.au

If you wish to pay by BPay or at an Australia Post office, please contact us for a payment form.

FOI fees and charges are not subject to GST.

Privacy Statement

Any personal information about you or a third party in your correspondence will be protected under the provisions of the *Privacy and Data Protection Act 2014*. All personal information provided by you will only be used for the purpose of managing your Freedom of Information request and will only be disclosed to relevant department and ministerial staff. We will not use your personal information for any other purpose, and will not disclose it without your consent except as required by law. Where information is required for statistical reporting purposes, all identifying details will be removed. Enquiries about access to information about you held by the department should be directed to the Manager FOI & Privacy, Department Environment, Land, Water and Planning – PO BOX 500, East Melbourne, Victoria 8002.

From: **Mal Gardiner** otwaywater@yahoo.com.au
Subject: Re: 4816 - Email to M Gardiner dated 26072019
Date: 26 July 2019 at 5:27 PM
To: [redacted]@delwp.vic.gov.au

Hello Terry,
I do not want third party personal information. What I am requesting is the advice given to the Minister that she used to assist with her decision. Third persons were named so that it would be quite clear where the documents originated.
Kind regards,
Malcolm..

Malcolm Gardiner
Email otwaywater@yahoo.com.au
www.otwaywater.com.au
Phone +61 0475358747

On 26 Jul 2019, at 4:13 PM, [redacted] (DELWP)
[redacted]@delwp.vic.gov.au> wrote:

Dear Mr Gardiner,

I am the officer responsible for your recent Freedom of Information request (**FI/03/4816**) made to the Department of Environment, Land, Water and Planning (**DELWP**).

Third party personal information
In the course of processing your request, it has become apparent that third party personal information is likely to be included in the documents you seek. This third party personal information and does not include the names of the relevant minister(s) or executive level officers or DELWP.

Could you please **advise** whether you require third party personal information as part of your request?

If you have any questions, please do not hesitate to respond **via return email** or contact me on the phone number **below**.

Kind regards,

[redacted] **FOI Officer | Legal & Governance**
Corporate Services | Department of Environment, Land, Water and Planning

Level 15, 8 Nicholson Street, East Melbourne
PO Box 500, East Melbourne VIC 3002
T: 03 9637 8019 | **E**: [redacted]@delwp.vic.gov.au

<image016.jpg>

APPENDIX SEVEN. Summary of Objections to Licence Application.

Barwon Downs Licence Renewal Application: Summary of public submissions

Background

On 10 December 2018 Barwon Water submitted an application to Southern Rural Water (SRW) to renew their groundwater licence for the Barwon Downs borefield.

As part of the renewal assessment SRW advertised the receipt of the application and called for public submissions from Monday 10 December 2018 until Friday 1 March 2019. This period was extended until Tuesday 12 March 2019 after to a minor, temporary technical issue that affected the SRW website during the original submission period.

SRW also hosted a community drop-in information session for interested people on Monday 18 February 2019 at the Barwon Downs Public Hall. This session was attended by about 40 people, most of whom had concerns about the renewal of the groundwater licence.

Barwon Water have since withdrawn their application to renew this groundwater licence, and it has now expired. Given SRW were unable to proceed with through the application assessment process, the community group working with SRW felt it would be valuable to prepare a summary submissions received and provides this to Barwon Water. Barwon Water separately approached SRW and requested that this information would be beneficial.

This document provides an overview of the submissions received with regard to the groundwater licence renewal application. The original submissions have been recorded and held in SRWs document management system. This document has been reviewed by the community group working with SRW.

Basic stats and facts

- SRW received 1044 written submissions on this matter and all but two opposed the application.
- Nearly 80% of the submissions used a standard "proforma" circulated by local advocacy group/s.
- Where address information was provided, about 98% of submissions were from local individuals or business, however a small percentage (~1-2%) were from Melbourne, interstate or overseas.
- One submission made reference to a Change.org petition which recorded 1736 signatures as at 2 March 2019. There is no way to ascertain what percentage of these signatories also provided a formal, written submission.

What we heard

The number of submissions received easily exceeded submissions made to SRW on any other licence application or renewal, indicating a high level of interest from the community.

The high percentage of "proforma" submissions provided a high level of consistency to the feedback received.

The individualised submissions demonstrated a high level of personal investment, and in some cases incorporated information and evidence indicating a deep, historic understanding of the issues associated with the groundwater licence.

The clear message from the submissions is that there was strong objection to the renewal of the groundwater licence and a common belief that the system would take at least 50 years to recover.

Many submissions made reference to the s78 notice currently imposed on Barwon Water by SRW and the importance of allowing the positive impacts of any remediation works to be realised before a renewal could be considered.

Two key themes were consistent across nearly all submissions:

- The need to act to protect the environmental values of the region
- The belief that Barwon Water have sufficient alternative water supply solutions to service Geelong

More specifically, the most common views expressed through the submissions suggested that the past water extraction had caused, and would likely continue to cause:

- Reduced river and creek flows, particularly in summer
- The drying of springs and wetlands, particularly Big Swamp
- Acidification of soils and acid flow events
- Fish kills
- Reduced fish and platypus populations
- Reduced access to groundwater in D&S bores
- Negative impacts on local farming communities
- Impacts on recreational fishing
- Regional drawdown of aquifers
- Continued and reoccurring peat fires

All individual submissions have been recorded in SRWs data management system and can be retrieved and provided upon direct request.

Southern Rural Water
Managing Water, Serving Communities

Attachment 1: Copy of the standard proforma submission letter

/2019

To:
Barwon Downs Licence Submission
Southern Rural Water
P.O. Box 729
Warrnambool 3280

www.stopgroundwatermining.com.au

Southern Rural Water,

Re: Groundwater Extraction Licence renewal for the Barwon Downs Borefield.

The Barwon River, Groundwater Dependent Ecosystems, the Gellibrand River and agricultural land are in crisis. The Barwon River at Winchelsea stops flowing; wetlands continue to suffer & farmland is ruined from the creation of acute acid sulfate soil contamination. The area of impact has now expanded into the Kawarren and Gellibrand region and the question is how far will it extend before it stops. What other damage will be done even if no more extraction is carried out. Do not grant this licence renewal to take place.

The deplorable and harmful effects on just ***one*** of our iconic native species, the ***Platypus***, must not be allowed to continue. You have it in your power to stop this continuing.

The Melbourne – Geelong interconnecting pipeline and water kept in storage is sufficient to meet Geelong's future requirements for decades.

I submit that Southern Rural Water refuse the licence renewal and that there be no further extraction applications considered until the Lower Tertiary Aquifers return to normal.

REDACTED

SAVE PLATYPUS JO

--- stopgroundwatermining ----

APPENDIX EIGHT. FOI Reply nearly there.

From: **Terry Hammoud** terry.hammoud@delwp.vic.gov.au
Subject: 4816 - Email to M Gardiner - decision dated 12082019
Date: Yesterday at 3:50 PM
To: otwaywater@yahoo.com.au

Dear Mr Gardiner,

Please find **attached** a decision letter and payment form for your recent Freedom of Information request (**FI/03/4816**) made to my department.

Contact details have been provided should you have any further queries.

Kind regards,

Terry Hammoud | FOI Officer | Legal & Governance
Corporate Services | Department of Environment, Land, Water and Planning

Level 15, 8 Nicholson Street, East Melbourne
PO Box 500, East Melbourne VIC 3002
T: 03 9637 8019 | **E**: terry.hammoud@delwp.vic.gov.au

Munganin Gadhaba 'Achieve Together'

Aboriginal Inclusion Plan 2016–2020

We acknowledge Victorian Traditional Owners and their Elders past and present as the original custodians of Victoria's land and waters and commit to genuinely partnering with them and Victoria's Aboriginal community to progress their aspirations.

Department of Environment
Land, Water and Planning

PO Box 500
East Melbourne, Victoria 8002
www.delwp.vic.gov.au

Ref: FI/03/4816

Mr Malcolm Gardiner
By email only: otwaywater@yahoo.com.au

Dear Mr Gardiner

***Freedom of Information Act 1982* – Notice of Decision**

I refer to your request under the *Freedom of Information Act 1982* (FOI Act), dated 7 July 2019, and received on 11 July 2019, seeking access to:

> *'On Friday the 26th June 2019, Minister for Water, Hon Lisa Neville signed off on a zero Permissible Consumptive Volume (PCV) for the Gellibrand Groundwater Management Area (Victorian Government Gazette S265, June 2019, Page 17, LEGL./04-134). And, a 239 MLPCV for the Gerangamete Groundwater Management Area on the same day (Victorian Government Gazette S265, June 19, Page 18, LEGL./04-135). The two PCVs were determined on advice from Richard Marks & Patrick O'Hallorans' DELWP team of administrators and advisors at 8 Nicholson Street Melbourne.*
>
> *The request under this FOI is for copies of this advice from these administrators to the Minister, justifying the determination of these two Permissible Consumptive Volume allocations'.*

Document Searches

After a thorough, diligent and complete search by the department's Water Resources Strategy division, two documents were located.

Decision

I am an officer authorised under section 26 of the FOI Act to make decisions in relation to FOI requests.

I have assessed the relevant documents and determined that one document can be released to you in full, and the other document released to you in part in accordance with section 30 of the FOI Act.

Section 25 - Irrelevant material

A decision has been made not to grant access to certain information on the ground that it would disclose information that would reasonably be regarded as irrelevant to the request. For example, the direct contact details of staff members, and one instance of a staff member's name have been removed as irrelevant. You confirmed in your email to me on 26 July 2019 that you did not require this information as part of your request.

Section 30(1) - Internal working documents

A document is an exempt document if it is a document the disclosure of which under the FOI Act-

(a) would disclose matter in the nature of opinion, advice or recommendation prepared by an officer or Minister, or consultation or deliberation that has taken place between officers, Ministers, or an officer and a Minister, in the course of, or for the purpose of, the deliberative processes involved in the functions of an agency or Minister or of the Government; and

(b) would be contrary to the public interest.

The relevant brief which is part of this response to your request, *MBR039221- Gerangamete and Gellibrand Groundwater Management Areas Permissible Consumptive Volumes*, and its attachment being a draft Order (**Attachment 1**), contain information which has been exempted under this section.

The body of the brief and the Order contains opinion and advice from departmental staff to the Minister. The views expressed by the author are either the author's opinion or preliminary in nature and do not reflect the views of the department. As such, disclosure would be contrary to the public interest as the document would misrepresent the department's final position on the matters being discussed, namely, the relevant Permissible Consumptive Volumes for the particular sites named in your description.

Review rights

If you are not satisfied with my decision you have the right to request a review from the Information Commissioner by writing to:

Office of the Victorian Information Commissioner
PO Box 24274
MELBOURNE VIC 3001

Email: enquiries@foicommissioner.vic.gov.au

You have **28 days** from the date you receive this letter to submit your request for review.

Access charges

Your request has accrued access charges of:

Type of charge	Rate	Quantity	Amount
Search time	$22.20 per hour	2	44.40
Photocopying charges	20c per b&w A4 page	46	9.20
Subtotal			53.60
Amount due			**$53.60**

VICTORIA

When your payment of **$53.60** is received, the documents will be released to you. A payment form is enclosed. Please either complete the form and return it to the department or forward the receipt number to me at the address above or email to foi.unit@delwp.vic.gov.au.

If you wish to discuss this matter further, please contact me on **(03) 9637 8019.**

Yours sincerely

T Hammoud

Terry Hammoud
FOI Officer

12 / 08 / 2019

Department of Environment, Land, Water & Planning

Freedom of Information

Payment form

Name: Malcolm Gardiner

Reference number: F1/03/4816

Payment type:

- ☐ Application fee: $
- ☐ Deposit : $
- ☐ Access charges: $

Total Amount: $ 53.60 (FOI fe

You must pay the total amount as above using payment optior

You must note receipt number on the form and return it to th

Please contact the FOI team on (03) 9637 8331 for if you hav

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EFTPOS	53.60

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Strictly No Refunds or Reversals

The FOI Unit will not process this form until payment has been confirmed. Once payment has been made, **please record your Receipt No. and** Receipt date and the amount here:	**Return this form to:**
03/47309 **Receipt No.** 15/08/19 **Receipt Date**	Freedom of Information Unit
$_____ **Amount paid**	Department of Environment, Land, Water and Planning
	PO Box 500
	EAST MELBOURNE VIC 3002
	OR
	Email: foi.unit@delwp.vic.gov.au

Payment Options (Please keep your Receipt No. for future reference)

BPAY

BPAY Biller Code: 72637
Customer Ref: 520123456789

Telephone & Internet banking BPay. Contact your bank or financial institution to make this payment from your **cheque, savings, debit, credit card or transaction account**. More info: www.bpay.com.au.

POST billpay

Pay by **cheque, cash or debit card** at any local Post office

*844 0834 0000052012345678 70
(Credit card payment not accepted for this payment option)

Privacy Statement

Any personal information about you or a third party in your correspondence will be protected under the provisions of the Privacy and Data Protection Act 2014. It will only be used or disclosed to appropriate Ministerial, Statutory Authority, or departmental staff in regard to the purpose for which it was provided, unless required or authorised by law. For the purposes of this Freedom of Information request, your application form may be distributed to various areas of the department to enable searches for relevant documents. Enquiries about access to information about you held by the Department should be directed to the Privacy Coordinator, Department of Environment, Land, Water and Planning, PO Box 500, East Melbourne Victoria 8002.

VICTORIA State Government

APPENDIX NINE. The FOI Reply.

To: Minister for Water

VICTORIA Environment, Land, Water and Planning

GERANGAMETE AND GELLIBRAND GROUNDWATER MANAGEMENT AREAS PERMISSIBLE CONSUMPTIVE VOLUMES

Core message **Dept Initiated - Minister**

Your endorsement is sought to revise the Gerangamete Groundwater Management Area (GMA) Permissible Consumptive Volume (PCV) from '20 000 megalitres in any one year / 80 000 megalitres in any consecutive period of ten years' to 239 megalitres per year; and to declare the Gellibrand PCV at zero megalitres per year. A letter has been prepared for your signature to the Minister for Energy, Environment and Climate Change (MfEECC), Hon. Lily D'Ambrosio, as Minister administering Part 4 of the *Catchment and Land Protection Act 1994* (the CaLP Act) seeking comment on the proposal, as required under section 22A(3A) of the *Water Act 1989* (the Act).

Timing 21 May 2019 to allow time for consultation with the Minister for Environment, Energy and Climate Change and final declaration of Permissible Consumptive Volumes no later than 30 June 2019.

Recommendations

1. Consider and endorse the proposals to:
   a) Amend the PCV for Gerangamete GMA from '20 000 megalitres per year / 80 000 megalitres in any consecutive period of ten years' to 239 megalitres per year;
   b) Amend the PCV for Gerangamete GMA to apply to "all formations below the surface" rather than "all formations below 60 metres", and
   c) Declare a PCV of zero megalitres per year for Gellibrand GMA.

   ☑ Approved ☐ Not approved ☐ Noted ☐ Returned for review

2. Consider and endorse the proposals as Minister administering Part 4 of the CaLP Act.

   ☑ Approved ☐ Not approved ☐ Noted ☐ Returned for review

3. Sign the attached letter to the MfEECC as Minister administering Part 4 of the CaLP Act on the proposals.

   ☑ Approved ☐ Not approved ☐ Noted ☐ Returned for review

Comments

Signed Hon Lisa Neville MP, Minister for Water **Date** 10/6/19

Approved by Irrelevant **Date** 13/5/19

Grace Mitchell, Executive Director Water Resource Strategy ☎ Irrelevant

Irrelevant Irrelevant Irrelevant Irrelevant Irrelevant 13/5/19

MBR039221

To: Minister for Water

From	WATER RESOURCE STRATEGY	**Ref**	MBR039221
Title	GERANGAMETE AND GELLIBRAND GROUNDWATER MANAGEMENT AREAS PERMISSIBLE CONSUMPTIVE VOLUMES	**File**	CS/03/0165 CS/03/0283

Key Information

1. Your endorsement is sought to revise the Gerangamete GMA PCV and declare a PCV for the Gellibrand GMA (**Attachment 1**).
2. The current PCV for the Gerangamete GMA (**Attachment 2**) reflects Barwon Water's (BW) licence entitlement which is '20 000 megalitres in any one year / 80 000 megalitres in any consecutive period of ten years'. The PCV was based on BW's requirement for supplementary urban water supply for the greater Geelong area. However, groundwater extraction at an average annual rate of 3400 megalitres per year has taken more water out of storage than has been recharged, detrimentally impacting groundwater dependent ecosystems. Groundwater levels are expected to decline further if extraction continues at this rate.
3. BW has been licensed to extract groundwater, via the Barwon Downs borefield, for over 30 years. BW has been the biggest user of groundwater in the area for supplementary urban supply to the greater Geelong area. BW's current licence expires on 30 June 2019. This licence is for 20 000 megalitres in any one year / 80 000 megalitres in any consecutive period of ten years.
4. In addition to BW, three other parties hold licences in the Gerangamete GMA. Two of these are bores used for dairy washdown (<10 megalitres per year) issued under the Dairy Shed Water Licence Transition Program in 2010. The third, for 220 megalitres per year, is used for irrigation. These three licences are due for renewal between 2025 and 2030.
5. The Gellibrand GMA abuts the Gerangamete GMA. Both GMAs are in the Otways and recharge from the same area, known as the Barongarook High, as detailed in the PCV review (**Attachment 3**). Historically, the PCV for Gellibrand GMA was set at zero megalitres per year. This was revoked to allow BW to conduct a pumping test. BW have not utilised the resource and no longer require access to it. There are no other users in the Gellibrand GMA.
6. The review of the PCV for the Gerangamete GMA was initiated by you and has been undertaken by the Department of Environment, Land, Water and Planning (DELWP) in consultation with Southern Rural Water (SRW). The review considered the need to manage the Gerangamete GMA as a renewable resource and in accordance with the objectives of the Act. The review included consideration of the Gellibrand GMA PCV because groundwater drawdowns from Barwon Downs borefield also extend into the Gellibrand GMA.
7. Under section 22A(3A) of the Act, prior to declaring a PCV, you are required to consult with the Minister for Energy, Environment and Climate Change, the Hon Lily D'Ambrosio MP, as Minister administering Part 4 of the CaLP Act. A letter has been prepared for your signature (**Attachment 4**).

s30(1)

Gerangamete GMA PCV

s30(1)

Prepared by: Irrelevant Senior Policy Officer Irrelevant

MBR039221

To: Minister for Water

12. A PCV of 239 megalitres per year is equivalent to the rounded-up volume of the remaining three existing licences in the area. This option will allow the aquifer to recover over time and is within the range of 200-400 megalitres per year the review considers could be extracted from the area without causing adverse impacts to the waterways, once groundwater levels recover to the elevations that occurred before groundwater extraction took place. This is the recommended option.

13. The review also recommends that the PCV apply to all formations below the surface rather than all formations below 60 metres. This then ensures coverage for the areas of the Lower Tertiary Aquifer (LTA) that are above 60 metres. The PCV also makes provision for periodic maintenance of the Barwon Downs Borefield and allows for its review when BW's remediation plan is finalised.

Gellibrand GMA PCV

14. Zero megalitres per year is recommended for the Gellibrand GMA because there are potential risks of drawdowns from groundwater use in Gellibrand GMA impacting on local waterways, and risks from extraction in the Gerangamete GMA impacting on those waterways because of the joint recharge area.

s30(1)

s30(1)

Stakeholder views

s30(1)

18. Land and Water Resources Otway Catchment (LAWROC) Landcare Group is a community group that has previously written to you. They hold serious concerns about the detrimental impact groundwater extraction has had on the environment. DELWP visited the area and met with LAWROC members and other community members on 4 April 2019. LAWROC and the community were united in their view the PCV should be set to zero. They believed this was non-negotiable for remediation and to prevent the further drying out of the catchment exposing more acid sulphate soils, increasing risk of dangerous peat fires and causing the collapse of ecosystems.

19. It has since been clarified with the group that while they were aware of the other licences, they saw the PCV as primarily being about BW's licensed use, which is the largest in the area. The other licences are located on the margins of the GMA and are not near the areas impacted by groundwater extraction. When the presence of the other three licences was raised with a member representative of LAWROC, he agreed that it would be unreasonable to set the PCV to zero which would cast doubt over the future of licences held by these small groundwater users.

20. Subsequently, LAWROC has met to discuss the issue and conveyed their position to DELWP. They consider the PCV must be set to zero until the water levels have recovered in the entire drawdown area.

s30(1) However, given that there are three other licence holders in the area that will have ongoing access, s30(1)

s30(1)

22. SRW agreed with the findings of DELWP's PCV review when provided with a high-level update. SRW noted that under BW's licence there are passing flow requirements for Boundary Creek. Maintaining these flows may form part of BW's remediation plan. In the meantime, BW has committed to voluntarily maintain these flows. SRW will continue to meet with customers and key stakeholders throughout the process of assessing BW's remediation plan and its implementation.

s30(1)

Prepared by Irrelevant Senior Policy Officer Irrelevant

MDR/5922

To: Minister for Water

s30(1)

s30(1)

s30(1)

Context

26. The Gerangamete GMA refers to the groundwater resources of the LTA in the Barwon Downs Graben. The LTA is confined across much of the Graben by a regional aquitard, except in the northwest, where the LTA outcrops around the Barongarook High. Rainfall recharge to both the Gerangamete GMA and the Gellibrand GMA occur from the Barongarook High, flowing south east to the Barwon Downs Graben or south west to the Gellibrand Graben.

27. Discharge from the aquifer to the south east supports Boundary Creek and Yeodene Swamp environments, and other groundwater dependent ecosystems. Prior to development of the borefield and groundwater extraction by BW, the groundwater levels were elevated in the Barongarook High and groundwater discharged to Boundary Creek which flows into Yeodene (Big) Swamp. Declines in groundwater levels affect the ability to maintain and protect these systems.

28. Other waterways in the Gerangamete GMA that are highly connected to groundwater include: Ten Mile, Yahoo, Love Creek and Barwon East Branch.

29. To the south west, the Gellibrand River is highly connected to the Barongarook High recharge area with some 60 per cent of recharge from the Barongarook High estimated to flow towards the Gellibrand River catchment. This area forms part of the Gellibrand GMA.

30. The riverine environments support significant ecological values including the endangered Growling Grass Frog, Platypus, freshwater and migratory fish including various Galaxiids, Yarra and Southern Pygmy Perch, Tupong, Short-finned eel, Australian Smelt and Common Jollytail. The Barwon River has also been listed as an important river for Australian Grayling in the National Recovery Plan. Many of these species are protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) and the *Flora and Fauna Guarantee Act 1988* (Vic).

31. Groundwater extraction from the Gerangamete GMA, of which 98 per cent has been by BW, has caused groundwater levels to decline, creating a regional cone of depression of groundwater near the borefield, and regional lowering of watertables at Barongarook High. The groundwater is no longer connected to Boundary Creek and it no longer discharges to Yeodene Swamp. Groundwater levels are expected to take 15-30 years to recover.

32. Lack of flow, especially during summer months has caused Yeodene Swamp to dry out, the activation of naturally occurring acid sulphate soils in the swamp resulting in changes in vegetation and the release of acidic water and heavy metals downstream of the swamp.

33. Access to groundwater from the Gerangamete GMA has provided an important water supply during drought, at a time when no other water source was available. The potential for adverse impacts was anticipated and planned for, but the compensatory surface water flows to Boundary Creek that BW was required to provide have not been able to maintain the environmental water reserve needed for maintenance of the ecosystem given climate change and experience from actual drawdowns.

34. SRW issued a notice to BW under section 78 of the Act on 11 September 2018 that requires it to develop, submit and implement a plan for the remediation of Yeodene Swamp, Boundary Creek and the surrounding environment. The notice includes a restriction on BW from any groundwater extraction, except for maintenance and emergency purposes, while the notice is in place.

s30(1)

To: Minister for Water

36. BW applied to renew its groundwater licence in accordance with section 58 of the Act ahead of its expiry. SRW received the application in December 2018. BW subsequently withdrew their licence application on 14 March 2019.

37. A PCV operates to cap the total volume of groundwater that may be allocated as entitlements (licences, shares or bulk entitlements) in a defined area or water system. A PCV may be declared or amended by you under section 22A of the Act. Declaration of a PCV supports the sustainability of the resource by preventing new entitlements being issued once the PCV has been reached.

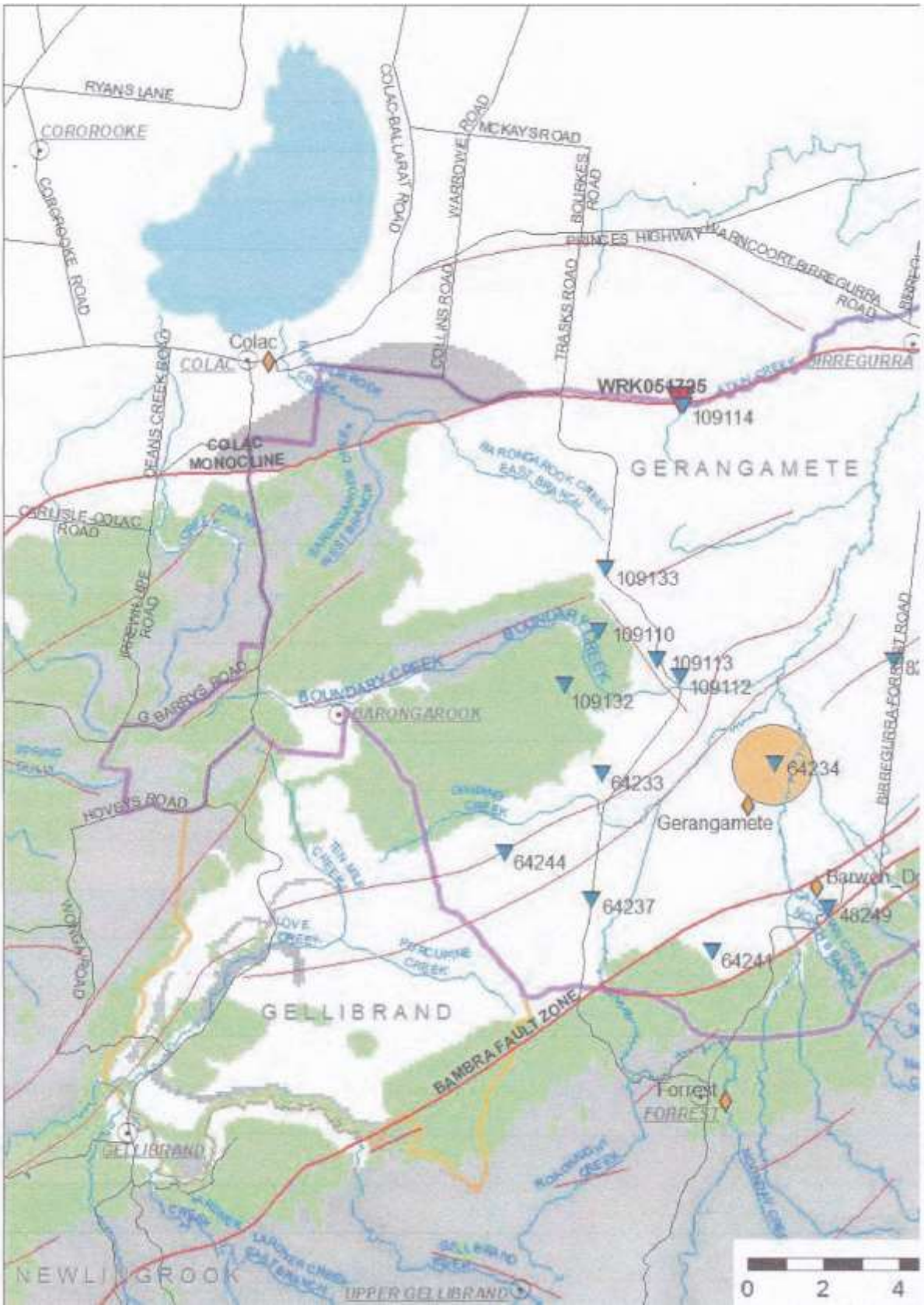
Consultation

Irrelevant, Manager Infrastructure Coordination, DELWP
Victorian Farmers Federation
Land and Water Resources Otway Catchment Group
Barwon Downs Licence Community Reference Group
Southern Rural Water
Barwon Water

Attachments

No.	Attachment name
1	Draft PCV Amendment Order - Gerangamete and Gellibrand Groundwater Management Areas
2	Map of the Gerangamete GMA
3	Report: Review of the PCV for the Gerangamete GMA (Department of Environment, Land, Water and Planning, 2019)
4	Letter to Minister for Energy, Environment and Climate Change

Prepared by: Irrelevant Senior Policy Officer Irrelevant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COLLINS ROAD
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DEANS CREEK ROAD
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COLAC MONOCLINE
GERANGAMETE
CARLISLE-COLAC ROAD
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BOUNDARY CREEK
BARONGAROOK
G BARRY'S ROAD
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Gerangamete
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Hon Lisa Neville MP

Minister for Police and Emergency Services
Minister for Water

8 Nicholson Street
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The Hon Lily D'Ambrosio MP
Minister for Environment, Energy and Climate Change
Level 16, 8 Nicholson Street
EAST MELBOURNE VIC 3002

Ref: MBR039221

Dear Minister Lily

GERANGAMETE AND GELLIBRAND GROUNDWATER MANAGEMENT AREAS PERMISSIBLE CONSUMPTIVE VOLUMES

In my capacity as Minister for Water, I am considering a proposal to amend the Permissible Consumptive Volume (PCV) Groundwater Order 2006 to revise the PCV for the Gerangamete Groundwater Management Area (GMA) to 239 megalitres per year. I am also considering a proposal to declare a zero megalitre per year PCV for the Gellibrand GMA. A PCV operates to cap the total volume of groundwater that may be licensed in a defined water system.

The Gerangamete and Gellibrand GMAs are part of the Lower Tertiary Aquifer which supports sensitive groundwater dependent ecosystems. Drawdown in the aquifer affects the ability to maintain and protect these systems. The new PCVs aim to support remediation of historical damage to the area and ensure the sustainable use of the groundwater resources.

While Barwon Water has been the principal user of groundwater from the Gerangamete GMA, they recently withdrew their application to renew their licence which expires on 30 June 2019. There are three other licence holders in the area with licences extending past 1 July 2019 that require the 239 megalitres per year of groundwater. The new PCV also provides for licences to be issued for pumping tests to allow Barwon Water to maintain its borefield. I anticipate declaring these PCVs to take effect from 1 July 2019.

Section 22A(3A) of the *Water Act 1989* requires that I consult you, as one of the Ministers administering Part 4 of the *Catchment and Land Protection Act 1994* (the CaLP Act), before declaring a PCV. Therefore, I am writing to you in your capacity as joint administrator of the CaLP Act to seek your comment on the proposal.

A copy of the draft orders for the Gerangamete Groundwater Management Area Permissible Consumptive Volume and Gellibrand Groundwater Management Area Permissible Consumptive Volume are enclosed. I would appreciate any comments you may have on this proposal within 21 days of the date of this letter.

Should you or your officers have any queries, please contact Irrelevant Licensing – Groundwater and Unregulated Systems, Department of Environment, Land, Water and Planning on Irrelevant or via email Irrelevant @delwp.vic.gov.au.

Yours sincerely

Hon Lisa Neville MP
Minister for Water

10 / 6 / 19

Encl.

VICTORIA

Water Act 1989

PERMISSIBLE CONSUMPTIVE VOLUME GROUNDWATER (GELLIBRAND AND GERANGAMETE GROUNDWATER MANAGEMENT AREAS) AMENDMENT ORDER 2019

I, **Lisa Neville MP**, Minister for Water, as Minister administering the **Water Act 1989**, make the following Order:

1. Citation

This Order is called the Permissible Consumptive Volume Groundwater (Gellibrand and Gerangamete Groundwater Management Areas) Amendment Order 2019 (this Order).

2. Authorising provision

This Order is made under section 22A of the **Water Act 1989** and section 27 of the **Interpretation of Legislation Act 1984**.

3. Commencement

This Order comes into operation on the date it is published in the Victoria Government Gazette.

4. Purpose

The purpose of this Order is to amend the Permissible Consumptive Volume Groundwater Order 2011 published in the Victoria Government Gazette G28 on 14 July 2011 to declare new permissible consumptive volumes for the Gellibrand Groundwater Management Area and the Gerangamete Groundwater Management Area and to make provision for test pumping to be carried out in the Gerangamete Groundwater Management Area.

5. Declaration of permissible consumptive volumes and amendment of the Permissible Consumptive Volume Groundwater Order 2011

(a) I declare that the total volume of groundwater that may be taken in a water season in the Gellibrand Groundwater Management Area is 239 megalitres plus a volume of no more than 30 megalitres in any water season that may be taken in that area under any licence issued or amended or to be issued or amended under section 51 of the Act for the purpose of pumping tests.

(b) The Table to the Permissible Consumptive Volume Groundwater Order 2011 is amended as follows:

(i) after clause 9(b)(iii) **insert:**

"(c) the volume listed in Column D for the Gerangamete Groundwater Management Area plus a volume of no more than 30 meglitres in any water

season that may be taken in that area under any licence issued or amended or to be issued or amended under section 51 of the Act for the purpose of pumping tests.";

(ii) **after:**

"Frankston Groundwater Management Area	LEGL./04-133	All formations below the surface	3,200

"

insert:

"Gellibrand Groundwater Management Area	LEGL./04-134	All formations below the surface	0

"; and

(iii) **for:**

"Gerangamete Groundwater Management Area	LEGL./04-135	All formations below 60 metres	In any one year 20,000 In any consecutive period of ten years 80,000

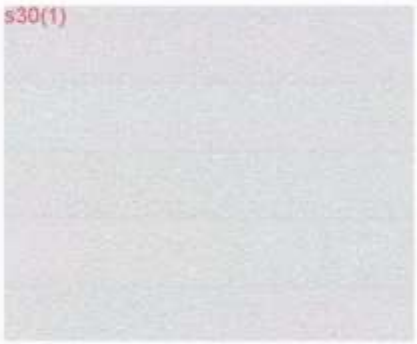
"

substitute:

"Gerangamete Groundwater Management Area	LEGL./04-135	All formations below the surface	239

".

s30(1)



REVIEW OF THE PERMISSIBLE CONSUMPTIVE VOLUME FOR THE GERANGAMETE GROUNDWATER MANAGEMENT AREA

PURPOSE

1. To review the permissible consumptive volume (PCV) for the Gerangamete Groundwater Management Area (GMA).

CONTEXT/BACKGROUND

2. Operation of the Barwon Downs borefield by Barwon Water has significantly impacted Boundary Creek and Yeodene Swamp (aka Big Swamp) in the Gerangamete Groundwater Management Area.
3. Barwon Water have committed to cease extracting from the borefield whilst a remediation plan is developed and implemented, which is in accordance with a Section 78 notice from Southern Rural Water to Barwon Water.
4. The Minister has requested a review of the Gerangamete Permissible Consumptive Volume (PCV) in response to the issuing of the S78 notice.
5. Barwon Water made an application to Southern Rural Water in December 2018 to renew its groundwater licence for the Barwon Downs borefield. The groundwater licence authorises the taking and using of groundwater from the Gerangamete Groundwater Management Area. An application to renew the licence was initially submitted by Barwon Water to SRW and was withdrawn in March 2019.
6. Southern Rural Water, as the Minister's delegate, may renew a groundwater licence in accordance with the provisions of Divisions 1 and 3 of the *Water Act 1989* (the Act). This includes consideration of the PCV, if any, for the area.
7. The PCV is the total volume of water that may be taken during a specified time. PCVs are made by the Minister under section 22A of the Act.
8. The PCV for Gerangamete Groundwater Management Area was first set 2 November 2006 (Ref 1) and restated 14 July 2011 (Ref 2).
9. The Gerangamete PCV volume (2011) was set to equal the volume specified in the Groundwater Licence No 893889 issued to Barwon Water for the extraction of groundwater to meet urban water supply needs for Greater Geelong.
10. There are three other groundwater licenses that have been issued in the Gerangamete GMA for dairy wash and irrigation purposes totalling 238.4 ML per annum. These licenses were not included in the PCV assessment in 2006 or in 2011.
11. Section 22A (3) of the Act states that the Minister may declare a PCV on the Ministers' initiative or at request of an Authority.
12. The Minister is required to consult with the Minister administering Part 4 of the Catchment and Land Protection Act 1994 prior to declaring a PCV.
13. This review of the Gerangamete Groundwater Management Area is initiated by the Minister, and is undertaken by DELWP.
14. The Gerangamete Groundwater Management Area includes the resources in the Pebble Point Formation, Dilwyn Formation and Mepunga Formations, collectively known as the Eastern View Formation or the Lower Tertiary Aquifer. The Gerangamete Groundwater Management Area is

defined by the spatial boundary shown in LEGL.04/135 (shown in Figure A1). The existing PCV is set for all aquifers below 60m depth.

15. The Gerangamete Groundwater Management Area borders the Gellibrand Groundwater Management Area on the south-western boundary (approximated by the catchment boundaries of the Barwon River and Gellibrand River).

MATTERS TAKEN INTO ACCOUNT IN THE REVIEW

16. For the purposes of this review the objectives for setting the PCV aligns with the following purposes of the Act:
    - Section 1(c) 'To promote the orderly, equitable and efficient use of water resources'
    - Section 1(d) 'To make sure that water resources are conserved and properly managed for sustainable use for the benefit of present and future Victorians'.
17. For the purposes of this review the following matters are relevant (from section 40 of the Act) in consideration of setting the volume for PCV and achieving the objectives as follows:
    - The existing and projected availability of water and water quality in the area
    - Any adverse effect that the allocation or use of water is likely to have on
        - existing authorised users of water; or
        - a waterway or aquifer; or
        - the drainage regime; or
        - the maintenance of the environmental water reserve
    - The need to protect the environment, including the riverine and riparian environment
    - If appropriate, the proper management of the waterway and its surrounds or of the aquifer
    - Conservation policy of government
    - Government policies concerning the preferred allocation or use of water resources
    - Whether the source of water is within a heritage river area or the natural catchment area within the meaning of the Heritage Rivers Act 1992 and whether there is any restriction on the use of the area under that Act
    - The purposes for which the water is to be used
    - So far as available to the Minister
        - any relevant report or statement prepared under any Act;
        - the findings of, or any evidence given or submission made to, any relevant investigation or inquiry held under any Act or held by any Committee of the Cabinet, government department or public statutory body whether or not under the Act;
        - to give effect to an approved management plan for any relevant water supply protection area under the Act
    - Any other matters that the Minister thinks fit to have regard to.

REVIEW

18. The matters considered in the review are described below and informed by the technical review detailed in Appendix A (*Assessment of groundwater resources of the Gerangamete GMA, 6 May 2019*):

The existing and projected availability of water in the area

This review concerns the availability of groundwater in the Gerangamete Groundwater Management Area which encompasses the Barwon Downs Graben, located on the north western flanks of the Otway Ranges. The stratigraphic sequence in the Barwon Downs Graben is transitional between the Otway Basin and the Torquay Basin. The main aquifers are Pebble Point, Dilwyn and Mepunga formations referred to as Eastern View Formation or Lower Tertiary Aquifer system. The aquifer system which is up to 250 m thick is confined to semi confined by up to 500 m of marl, silt and clay.

- In regard to the existing availability of water, it is estimated that there is in excess of 3,500,000 megalitres of water stored in the aquifer. However, the volume that is available for allocation is defined by the need to conserve the resource and to limit any adverse impacts from its use. Towards this, the volume of recharge and discharge and its interaction with the environment are important considerations.
- The annual rate of recharge to the Gerangamete GMA from the Barongarook High where the aquifer outcrops is estimated to be between 1,100 and 1,200 megalitres per year.
- The aquifer discharges to Boundary Creek downstream of McDonalds Dam near Yeodene Swamp. Discharge estimates from the aquifer system to Boundary Creek range from 500 ML to 1,260 ML/yr prior to development of the aquifer.
- Prior to development of the borefield and groundwater extraction by Barwon Water the groundwater levels were elevated in the Barongarook High and groundwater discharged to Boundary Creek. The discharge volume was equal to the recharge volume prior to development.
- Groundwater extraction (totalling 115,206 ML in the period 1983 to 2016, equivalent to approximately 3,400 ML/yr) has resulted in groundwater level decline. A regional cone of depression of up to 59m occurred near the borefield along with regional lowering of the watertable at Barongarook High. The groundwater levels which were once above are now beneath the elevation of Boundary Creek and groundwater no longer discharges to the creek or Yeodene Swamp.
- Since 1983 groundwater levels have not recovered to the elevations prior to groundwater extraction and are not expected to recover for another 30-50 years with no further substantive groundwater extraction near Boundary Creek and the Barongarook High. Historic groundwater extraction at an average annual rate of 3,400 ML/yr has taken more water out of storage than has been recharged, essentially mining the resource. Groundwater levels are expected to continue to decline if extraction continued at this rate. Recovery of levels is dependent on location and whether its in the confined or unconfined part of the aquifer and could take up to 100 years or more in some parts of the aquifer.

With respect to this criteria, it is estimated that 1,100 ML to 1,200 ML could be taken each year without causing further decline in levels. This rate of extraction is expected to stabilise groundwater levels in the aquifer but will not allow for recovery of groundwater levels. Groundwater would remain disconnected from Boundary Creek with groundwater levels below the elevation of the creek bed.

Appendix D

The existing and projected quality of water in the area

- Historic groundwater extraction and subsequent lowering of the watertable, has resulted in reduced flows in Boundary Creek and Yeodene Swamp. This has led to activation of acid sulphate soils, which when coupled with high rainfall events has caused acid flows events into Boundary Creek and the Barwon River. Low pH water has occurred most notably in the period 2017 to 2018.
- Until groundwater levels recover or remediation arrangements are in place for Boundary Creek and surrounding environment the acid events may continue.
- Stock watering from Boundary Creek near Yeodene Swamp has ceased due to the poor quality of the creek in recent years (low pH). Alternate water supplies have had to be found to water stock.
- In respect to groundwater quality, a review of groundwater quality monitoring shows no perceptible changes from groundwater extraction and none are expected in the future.

Any adverse effect that the allocation or use of water under the permissible consumptive volume is likely to have on

- *existing authorised users of water;*
  - Barwon Water was the principal authorised user of water from the Gerangamete Groundwater Management Area, taking 115,206 ML between 1983 and 2019.
  - There are three additional groundwater licences within the Gerangamete GMA. Two of these are dairy bores given entitlements (<10 ML/yr) under the Dairy Wash conversion program in 2010, with bore depths of 44m and 210m and screened in the aquifer. The third groundwater licence 220 ML/year for irrigation purposes is located near Atkins Creek in the northern part of the Area and is 245m deep. These licenses are due for renewal between 2025 and 2030. Total extraction from these three bores is approximately 1,300 ML between 2009 and 2019, equivalent to 130 ML/yr.
  - There are farm dams and divertors in the area that take water from local waterways. Some of these have been impacted by reduced flows and changes in water quality that are partially caused by the borefield.
  - There are 6 stock and domestic bores in the Gerangamete GMA. There are also approximately 50 registered stock and domestic bores in the shallow aquifer (<30m depth) in the area. These bores target the watertable and not the deeper Lower Tertiary Aquifer. It is not known how many of these deep or shallow stock and domestic bores are operational.
- *a waterway or aquifer;*
  - Until groundwater levels are recovered or remediation arrangements are in place for Boundary Creek, Yeodene Swamp and the surrounding environment the acid events in the waterways may continue.
  - If groundwater levels recover to the elevations prior to groundwater extraction and assist the remediation of Yeodene Swamp and surrounding area then it is estimated that groundwater extraction in the range of that 200 to 400/ML yr could be taken without adverse impacts on the waterways.
  - Other waterways in the area (eg Barwon River East) have negligible or no monitored impact from historic groundwater extraction.

- *the drainage regime;*
  - Historic groundwater extraction (an equivalent of 3,400 ML/yr) has had no adverse impact on the drainage regime (eg land subsidence altering the drainage regime) with less than 200mm subsidence recorded. Extraction at a lesser volume is expected to have less impact.

- *the maintenance of the environmental water reserve*
  - Environmental water reserves are not set for groundwater and none has been set for the Gerangamete GMA.
  - The environmental water reserve comprises a volume of surface water that is set aside for the environment. In the Upper Barwon catchment this includes environmental entitlements, above cap water and passing flows.
  - There is an environmental entitlement held by the Victorian Environmental Water Holder (VEWH) for the Upper Barwon River catchment of 1GB/year for the West Barwon River, East Barwon river and tributaries. This water is sourced from the West Barwon Reservoir.
  - There are passing flow requirements for Boundary Creek that must be provided by Barwon Water as a condition of their groundwater licence. These are currently set at 2 ML/day under specified conditions. These flows have not been able to maintain the environmental water reserve required for maintenance of the ecosystem (Ref 3).
  - Impacts on Boundary Creek are localised impacts which do not impact on the regional environmental water reserve for the Barwon River.

The need to protect the environment, including the riverine and riparian environment

- Discharge from the aquifer supports Boundary Creek and Yeodene Swamp environments, and other groundwater dependent vegetation. Declines in groundwater levels affect the ability to maintain and protect these systems.
- There are a number of waterways in the study area. Those that are highly connected to groundwater are Ten Mile, Yahoo, Love Creeks (Gellibrand) and Boundary Creek (Reach 2) and Barwon East Branch (Jacobs 2018b). Baseflow to Boundary Creek supports inflow to Yeodene peat swamp.
- The riverine environment supports significant ecological values including the endangered Growling Grass Frog, Platypus, freshwater and migratory fish including various Galaxiids, Yarra and Southern Pygmy Perch, Tupong, Short-finned eel, Australian Smelt and Common Jollytail. The Barwon River has also been listed as an important river for Australian Grayling in the National Recovery Plan. Many of these species are protected under the Environmental Protection and Biodiversity Conservation Act (EPBC Act) and the Flora and Fauna Guarantee Act 1988 (FFG Act), (Ref 4).

If appropriate, the proper management of the waterway and its surrounds or of the aquifer

- On 11 September 2018, Southern Rural Water, as the Minister for Water's delegate, issued Barwon Water a direction notice under Section 78 of the Water Act 1989 to submit and implement a legally enforceable remediation plan for the Boundary Creek, Big Swamp and the surrounding environment. Barwon Water must discontinue any extraction activities, other than for maintenance and emergency response purposes, while the assessment is being

completed and until all remediation work specified under the remediation plan has been completed.

- The need for the s78 notice arose from studies that determined that the operation of the borefield over the past 30 years has 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 (Ref 8).
- The process around Barwon Water's response to the s78 notice is independent of the s58 licence renewal application and this review of the PCV of groundwater for the Gerangamete GMA.

The conservation policy of the Government

- The Government's conservation policies that are considered to be relevant are Victoria's River Health Strategy, the Barwon River Health Strategy and Victoria's Biodiversity Strategy. A considerable range of works have been undertaken in consultation with relevant statutory bodies to improve the environmental condition of the Barwon catchment.

Government policies concerning the preferred allocation or use of water resources

- The Central Region Sustainable Water Strategy (CRSWS) was released in October 2006 (Ref 4) and foreshadowed augmentation requirements of an additional 29,000 ML per year for water supply for the Greater Geelong Area. These have been achieved (Appendix 2). The Melbourne to Geelong Pipeline was successfully constructed reducing the need to identify new water sources (Ref 7).
- There is no policy under the CRSWS concerning the preferred use of water resources for the greater Geelong Area. However, under the previous groundwater licence Barwon Water may only extract groundwater during dry periods when surface water supplies are falling. This principle has been incorporated into Barwon Water's REALM model to determine the periods when the Barwon Downs borefield should be operated (Ref 3).
- The review of the CRSWS is underway and was completed in 2018.
- Gerangamete GMA groundwater resources are considered to be a renewable resource. In respect to renewable and non-renewable resources the Western Sustainable Water Strategy (policy 10.1) states "government will allow access to non-renewable groundwater resources where agreed management plans are in place that balance the short and long term water requirements of the community and consider the needs of the environment." If it's deemed that this resource should be managed as a non-renewable resource a statutory groundwater management plan would be required.
- The Western Sustainable Water Strategy also provides the following advice on Groundwater dependent ecosystems: those with high environmental values and high risk of being affected by changes in groundwater levels, will be given the highest level of protection (Ref 9). Boundary Creek, Yeodene Swamp and associated ecosystems have high environmental values as documented in the recent FLOWS study on the Upper Barwon, Leigh and Yarrawee Rivers (Ref 4).

Whether the proposed source of water is within a heritage river area or the natural catchment area within the meaning of the Heritage Rivers Act 1992 and whether there is any restriction on the use of the area under that Act

- Not applicable – the aquifer is not within a heritage area or natural catchment area under the Schedule 1 and Schedule 2 of *Heritage Rivers Act 1992*.

The purposes for which the water is to be used

- Barwon Water was issued a license to extract groundwater to augment Barwon Water's water supply for Greater Geelong, primarily in periods of water shortage. The licence was originally issued in 1975 but did not come into effect until 1982. The bores were brought into operation during the 1982/83 drought.
- Three other private license holders use groundwater for dairy and irrigation purposes.
- Access by other potential users for other purposes is regulated through the declaration of a PCV for groundwater use in the Gerangamete Groundwater Management Area.

The needs of other potential applicants

- Not applicable

So far as available to the Minister or Governor in Council

(i) any relevant report or statement prepared under any Act;

- *Nil*

(ii) the findings of, or any evidence given or submission made to, any relevant investigation or inquiry held under any Act or held by any Committee of the Cabinet, government department or public statutory body whether or not under the Act;

- Not applicable – no investigation or inquiry has been held.

In considering the application under section 36(1), the Minister must give effect to an approved management plan for any relevant water supply protection area (section 40(2))

- Not applicable – No part of the Gerangamete Groundwater Management Area is declared a water supply protection area.

Any other matters that the Minister thinks fit to have regard to

- The community has made its view strongly that in the interests of protecting the waterways and surrounding environment that the PCV should be set at zero.
- The boundaries of the area have been reviewed are considered appropriate.
- The Gellibrand GMA abuts the Gerangamete GMA. Groundwater drawdowns from Barwon Downs borefield extend into the Gellibrand GMA however the full impacts of these drawdowns and potential increased use in the area have not been assessed. The Gellibrand River is dependent on groundwater with up to 60% of flow sourced from groundwater. Currently no PCV has been set for the Gellibrand GMA.
- Barwon Water has advised DELWP that a small amount of groundwater pumping is necessary for periodic maintenance of the Barwon Borefield equipment.

CONCLUSION/SUMMARY

19. The groundwater dependent ecosystems in the Gerangamete GMA have high environmental values that need to be protected.
20. These high environmental value ecosystems have been impacted from historic groundwater extractions and there is a remediation notice in place that must be met.
21. 1,100 ML/yr could be extracted from the area without causing further declines in levels. This rate of extraction is expected to stabilise groundwater levels in the aquifer but will not allow for recovery of groundwater levels. Groundwater would remain disconnected from Boundary Creek

with groundwater levels below the elevation of the creek bed. Adverse impacts on the waterways and surrounding environment are likely to continue to occur unless remediation has occurred.

22. Approximately 200-400 ML/yr could be extracted from the area without causing adverse impacts to the waterways, once groundwater levels recover to the elevations that occurred before groundwater extraction occurred.

RECOMMENDATIONS

23. On the basis that:

- groundwater in the Gerangamete GMA is a renewable resource and water is not taken out of storage;
- the groundwater dependent ecosystems are high environmental values and need to be protected;
- that these high environmental value ecosystems have already been impacted from groundwater extractions and there is a remediation notice in place that must be met;
- the remediation plan has yet to be implemented and proven;
- the groundwater resource is degraded and recovery of groundwater of groundwater levels may assist in the remediation in the long term;
- and any substantive groundwater extraction in the immediate term is mutually exclusive to the recovery of groundwater levels;

To achieve these outcomes it is recommended that:

- the PCV for the Gerangamete PCV be set to 239 ML/year to allow groundwater extraction under the 3 existing licenses;
- the PCV declaration provide for the taking and using of minor quantities of groundwater for periodic maintenance of the Barwon Downs Bore Field by Barwon Water;
- the PCV is reviewed once the remediation plan is finalised and implementation of the plan has begun.

24. The depth boundary of the GMA be amended from "all formations below 60 metres" to "all formations" to ensure that all parts of the Lower Tertiary Aquifer are included in the PCV.

25. On the basis that there are potential risks of drawdowns from groundwater use in Gellibrand GMA on local waterways, and risks from extraction in the Gerangamete GMA impacting on those waterways it is recommended that:

- the PCV for the Gellibrand GMA be set at zero;
- the PCV is reviewed once the remediation plan is finalised and implementation of the plan has begun.

REFERENCES

Ref 1 *Water Act 1989, Permissible Consumptive Volume Order 2006*, Victorian Government Gazette G44 2 November 2006 (pg 2396 – 2399)

Ref 2 *Water Act 1989, Permissible Consumptive Volume Order 2011*, Victorian Government Gazette G28 2 November 2006 (pg 1639 – 1641)

Ref 3 *Jacobs 2017*, 2016-17 Technical Works Program. Yeodene Swamp Study. Report for Barwon Water. Final Draft report 9 November 2017.

Ref 4 *Alluvium et al., 2018*. Upper Barwon, Leigh and Yarrawee FLOWS study update. Draft in confidence. November 2018.

Ref 5 *Groundwater licence 893889 issued to Barwon Water*', Southern Rural Water, July 2004

Ref 6 *Our Water Our Future – Sustainable Water Strategy Central Region, Action to 2055*.Victorian Government, Department of Sustainability and Environment, Melbourne; October 2006

Ref 7 *Central Region Sustainable Water Strategy Review*. The State of Victoria Department of Environment, Land, Water and Planning, 2018

Ref 8 *Ministerial Notice, Section 78 of the Water Act 1989 issued to Barwon Water Corporation 11 September 2018*. Southern Rural Water

Ref 9 *Western Sustainable Water Strategy*. The State of Victoria Department of Sustainability and Environment, 2011.

APPENDIX A - ASSESSMENT OF GROUNDWATER RESOURCES FOR THE GERANGAMETE GROUNDWATER MANAGEMENT AREA

1. Purpose

This assessment of groundwater resources of the Gerangamete Groundwater Management Area (GMA) and surrounding areas to inform a review of Permissible Consumptive Volumes.

2. Scope

The groundwater resources in the Gerangamete GMA have been intensively studied since the 1960's. The studies include resource investigations, numerical modelling, aquifer testing and monitoring. DELWP have independently reviewed the available information including recent studies undertaken by consultant firm Jacobs to support the Barwon Water groundwater licence application (Dec 2018); monitoring data (metered use and groundwater levels) and other studies which have been used and referenced throughout.

The key reports that this review has relied on are:

1. Jacobs, 2016 - 2018. Barwon Downs Technical Works Program, Numerous reports prepared for Barwon Water – see References (p20) for full list.
2. Leonard, J., Lakey, R. and Blake, R. (1983) Hydrogeological Investigation and Assessment Barwon Down Graben, Otway Basin, Victoria. Victorian Department of Minerals and Energy
3. Leonard, J. (1988) Groundwater recharge estimates, basal tertiary aquifer system, Barwon Downs graben. Geological Survey Victoria Unpublished Report 1988/7
4. Witebsky, S., Jayatilaka, C. and Shugg, A. (1995) Groundwater development options and environmental impacts Barwon Downs graben, south western Victoria

3. Context

The Gerangamete GMA includes the resources in the Pebble Point Formation, Dilwyn Formation and Mepunga Formations, collectively known as the Eastern View Formation or the Lower Tertiary Aquifer (LTA). The Gerangamete GMA includes the area known as the Barwon Downs Graben (Annex A1). The groundwater resources were investigated in the late 1960s with construction of a test bore and a subsequent pumping test of the LTA. The first licence was issued in 1975 and groundwater was first extracted in 1982 to supply water to Geelong during drought. To date, Barwon Water has extracted approximately 115,000 ML from the aquifer (Table 1).

Table 1- History of groundwater extraction from the Barwon Downs borefield

Period	Volume (ML)
1983	3,652
1987 – 1990	19,074*
1997 – 2001	36,817
2006 – 2010	52,684
2016	3,449
Total	**115,206**

*Witebsky (1995) quoted 21,250 ML take for this period (Mar 1987-February 1990).

There are three other groundwater licenses in the Gerangamete GMA with a total entitlement of 239 ML/yr. From 2009 to 2019 extraction from these licences was 1300 ML. This is less than 2% of Barwon Water's take from the LTA. This extraction volume is not deemed substantive in comparison to Barwon Water's and is discounted due to its non-material impact on the groundwater resource. Water levels in the LTA near these bores were reviewed and they reflect the regional response of the aquifer to the pumping at the Barwon Downs borefield.

Significant drawdowns of groundwater levels have occurred in the LTA around the area of pumping by Barwon Water, with up to 60 m near the Barwon Downs borefield (Bore 64234, Figure 3) and 35m near the Barongarook High (Bore 64233, Figure 1) with partial recovery during periods of no pumping. The drawdowns have been linked to environmental impacts in the catchment such as:

- Two thirds of reduction in groundwater flow to Boundary Creek (Jacobs, 2017a);
- Increased acid sulphate soils in the Yeodene peat swamp and associated ecological impacts downstream of the swamp from decreased pH due to reduced flow in Boundary Creek resulting in drying of the swamp (Jacobs , 2017c).

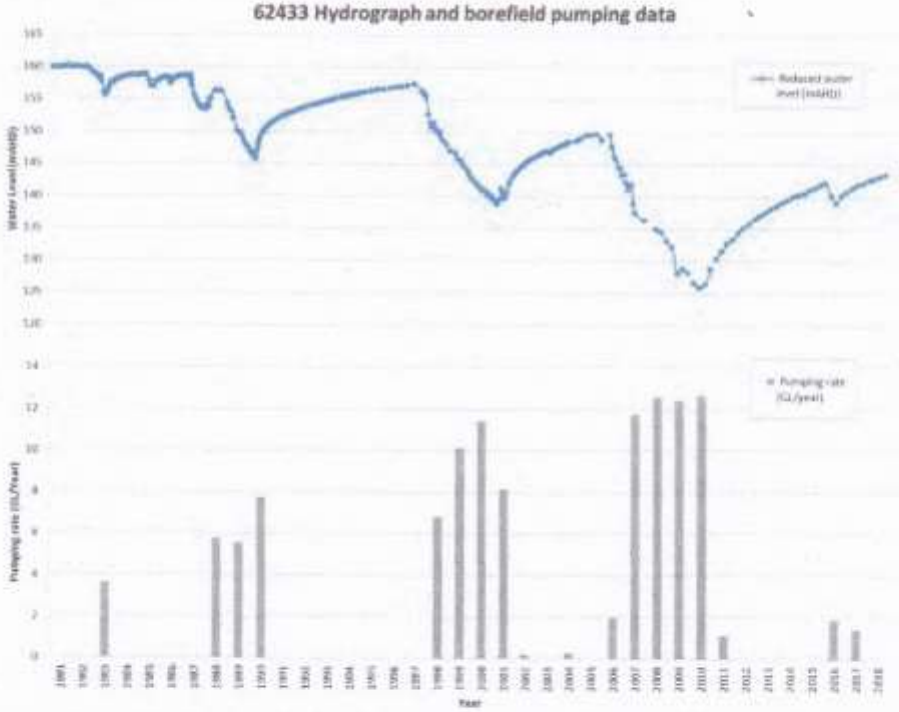


Figure 1 – Groundwater levels (Lower Tertiary Aquifer - confined part) and borefield pumping rate

4. Stratigraphy and groundwater occurrence

The Gerangamete GMA covers a thick sequence of tertiary sedimentary units which overlie a depression in the bedrock known as the Barwon Downs Graben. The tertiary sediments are bordered to the south by the Bambra fault and to the north by the Colac and Birregurra faults which are barriers to flow. Overlying the bedrock is the Lower Tertiary Aquifer (LTA), a high yielding aquifer which consists of the Mepunga, Dilwyn and Pebble Point formations. The LTA is confined across much of the graben by a regional aquitard (Narrawaturk and Gellibrand Marls), except in the north-west where the LTA outcrops around the "Barongarook High".

A groundwater flow divide separates the Barwon and Gellibrand River groundwater catchments, starting in the north-west on the Barongarook High and continues easterly to south-easterly across to the Bambra Fault. The flow boundary on the Barongarook High is far enough away from the borefield not to be affected by the drawdown in the aquifer. To the south of the borefield, however, the flow boundary moves in accord with the cone of depression in the LTA and has moved several kilometres west during periods of extended pumping.

5. Groundwater in storage

The Barwon Downs graben covers a geographical region of approximately 250 km^2. The LTA has a maximum thickness of up to 300 m in the central part of the graben, ranging from 150m to 250 for most of the graben.

The volume of groundwater in storage is estimated between 3,500 GL (Witebsky (1995)) and 5,935 GL (Leonard et al (1983)), based on a specific yield of 0.20 for the unconfined part of the aquifer and 15 GL in elastic storage.

6. Rainfall

Annual rainfall across the GMA varies from 1042mm in the south and 728mm to the north. Both rainfall stations in the area show similar trends (Barwon Downs (090004) and Gerangamete (090189)). The Barwon Downs station has the longest period of record of monitoring, since 1889 and is still in operation. The most recent rainfall data is presented in Figure 2. The baseline period for the assessment is 1975 to current includes the Millenium Drought and is represents current climate conditions. It also follows the advice provided in the "Guidelines for Assessing the Impact of climate Change on Water Supplies in Victoria", (DELWP, 2016). The historical average annual rainfall of 650 mm/yr for the Barwon River catchment based on the period of 1975 to 2014. Rainfall statistics for the catchment are tabulated in Table B1.

The climate scenarios for the groundwater modelling have been determined based on the "Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria (DELWP, 2016). The groundwater model used a range of annual rainfall from 800 to 1200 mm/yr and applies the change in rainfall to these figures to determine the rainfall and resultant recharge for the groundwater model scenarios. The resultant average annual rainfall for these climate change scenarios ranges from 655 mm/yr to 935 mm/yr (Jacobs, 2018c) using unsaturated zone modelling.

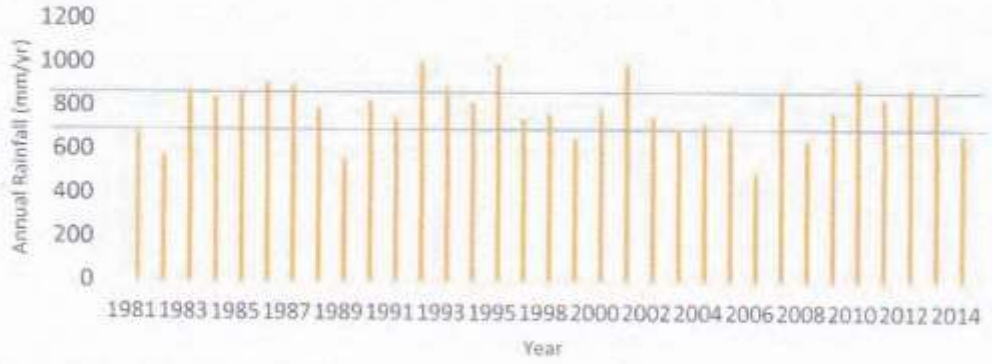


Figure 2 – Annual rainfall since 1981 at Barwon Downs, rainfall station 90004 (BoM website, data missing for years 2015-2018)

7. Recharge

Rainfall recharge to the LTA occurs where the aquifer outcrops around Barongarook High. Recharge from the Barongarook High flows both to the Gellibrand river catchment (south west flows (40 km^2)) and to the Barwon Downs Graben (south-east flows (28 km^2)). Due to the hydraulic disconnect of the outcropping area (3km^2) east of the Bambra Fault it has been assumed that this area does not contribute recharge to the Barwon Downs Graben (Leonard (1988), Dudding (2016)).

DELWP has determined recharge for the historical period of extraction during operation of the borefield (Table 2) at 1,050 ML/yr (5% recharge) to 2,270 ML/yr (9% recharge). The rates of 5% and 9% are taken from previous studies of recharge in the Barwon Downs Graben consistently identify natural rates of recharge equal to 5% to 9% of annual rainfall, with some upper estimates of around 11% (based on annual rainfall of 750 mm/yr, (Jacobs, 2016a)). Jacobs (2016a) undertook additional studies to quantify recharge to the Barwon Downs borefield using isotope and groundwater quality data. This work also concluded that natural recharge is between 5% and 9% (the upper estimates of 11-14% included results that were deemed to represent a maximum potential recharge rate, Jacobs (2016a).

The outcropping area in the Gerangamete GMA is estimated as 28 km^2 (Leonard 1988, and estimated from Victorian Aquifer Framework (VAF) (DELWP, 2019) outcropping area). Applying these percentages to the outcrop area of the LTA in the Barongarook High and only to the area that flows into the Barwon River catchment results in the following recharge volumes (Table 2). (nb Jacobs 2016b groundwater model has 38 km^2 for recharge from Barongarook High. The basis for this is not known. The consequence of the larger area is a higher estimate of recharge).

Table 2 – Estimated recharge to Gerangamete GMA

	Recharge (ML/yr)		Annual rainfall percentiles using 1981-2018 record from Barwon Downs 90004
Climate scenario	5% rainfall	9% rainfall	
Dry 750 mm/yr	1050	1890	25th percentile = 751 mm/yr
Medium 835 mm/yr[1]	1170	2100	Median = 808 mm/yr 50th percentile (average) = 820 mm/yr
Wet 900 mm/yr	1260	2270	75th percentile = 897 mm/yr

1. The medium scenario has used average rainfall from the period of operation of the Barwon Downs Borefield, which is from 1989 to 2010, which is slightly higher than the historic period of record.

The volume of recharge has been estimated in the Jacobs technical work and models, and also in previous literature. There is significant variance in the literature on recharge volumes quoted for different climate scenarios and based on varying assumptions (outcrop area, annual rainfall) (Annex B).

It is important to note that the groundwater modelling work by Jacobs provides much higher estimates of recharge which includes induced recharge as well as recharge direct from rainfall. Jacobs adjust the recharge to achieve the observed groundwater levels, making the recharge a calibration parameter and variable of the modelling. As such these results provide good predications of drawdown in the LTA but they are less reliable for determining aquifer recharge.

The model (Jacobs (2018b)) estimates the volume of recharge ranges from 6,336ML/yr in a wet climate (rainfall varying from 837-675mm) to 4,410ML/yr in a dry climate (rainfall 725-535mm). Notably, the method assumes there is no recharge when rainfall falls below 650 mm/yr, and that recharge is approximately 15% of annual rainfall on the Barongarook High. These are all significantly higher than other literature and the field estimates of recharge rates as a percentage of annual rainfall.

8. Groundwater flow and discharge

From the recharge area in the Barongarook High groundwater flows either south east to the Barwon Downs Graben or south west to the Gellibrand Graben (Lakey et al, 1983) and (pre-development (pumping) of the aquifer) discharges to waterways. Where the regional aquitard overlies the LTA, there is no connection between the confined aquifer and surface water and the potential for inter-aquifer flow is very low. The tertiary sediments are bordered to the south by the Bambra fault and to the north by the Colac and Birregurra faults which are barriers to flow.

The south-west groundwater flow system discharges to the Gellibrand river and throughflow (to the Gellibrand GMA and then the Newlingrook GMA). Approximately 60%,of recharge from the Barongarook High is estimated to flow towards the Gellibrand river catchment (Leonard 1988).

In respect to the south-east groundwater flow system a significant difference exists between pre and post groundwater development as follows:

- Pre-development (pumping); the groundwater levels at the Barongarook High were elevated and groundwater discharged into Boundary Creek.
- Post development; groundwater levels have declined below the base of Boundary Creek and therefore are no longer connected to Boundary Creek. Boundary Creek is now a source of recharge to the LTA.

The Barwon River East branch transects an area of outcropping LTA. This occurs south of the Bambra Fault where the aquifer is disconnected from the Barwon Downs borefield. There is no monitoring of groundwater levels in the alluvial aquifer near the East Barwon River or streamflow gauges to assess impacts on this tributary due to historical pumping. All impacts assessed are based on the groundwater modelling and risk and impact assessment undertaken for the licence application (Jacobs, 2016-2018).

Jacobs (2018a) report a 2012 study by SKM which confirmed that there are several springs along Ten Mile Creek, Yahoo Creek, Love Creek and farm dams. These springs flow from the regional aquitard, which is supported by an upward gradient from the underlying LTA. Discharge to these springs is not quantified, and is considered to be a minor volume but possibly locally important.

Jacobs (2018c) does not provide a water balance of throughflow and discharge. The model applied in the Jacobs assessment provides data on change in water budget but does not provide pre and post development. This assessment has reviewed previous studies and has summarised the available information on discharge and throughflow volumes (Table 3).

The annual volume of discharge to waterways under natural conditions (pre-development) in the Gerangamete GMA is estimated by previous studies to be approximately 1,130 ML to 1,260 ML (Table 3).

Table 3 - Discharge rates quantified by various studies

	Discharge (ML/yr)			
Discharge point	**Jacobs, 2017b[2]**	**Witebsky, 1995**	**Leonard, 1988**	**Leonard et al, 1983**
South East – Barwon Downs Graben				
Boundary creek	500 (16 L/s)	1,260[1]	-	-
Barwon River East Branch	630 (20 L/s)	-	-	-
East Throughflow	NA	-	1,300[5]	3,200
South West - Gellibrand				
Ten Mile/Love Creek	250 (8 L/s)	-	-	-
Gellibrand throughflow	2,000 (65 L/s)[3]	-	3,500[6]	11,600[4]

1. Witebsky reports discharge to Boundary Creek under predevelopment conditions as 3.5 ML/day.
2. Pre-development discharge are taken from Jacobs (2017b) (see Figures 7-6 and 7-7 of Jacobs report).
3. Jacobs (2017b) reports discharge to Gellibrand River as 65 L/s. Throughflow is not quantified in the report.
4. Leonard et al. (1983) calculated throughflow to Gellibrand based on a recharge of 14,800 ML/year from the Barongarook High, apportioned to Gellibrand and Barwon Downs. This was based on 900 mm/yr rainfall and 30% recharge from rainfall.
5. Leonard (1988) revised throughflow to Gellibrand using total recharge of 4,800 ML/year from the Barongarook High.
6. Leonard (1988) estimated throughflow to Gellibrand from recharge in Kawarren (3000 ML) and Yeodene (500).

9. Aquifer response to groundwater pumping

Barwon Water has extracted approximately 115,000 ML from the LTA for the period 1983 to 2016. This equates to an annual extraction rate of 3,400 ML/yr over the period of pumping or 3,200 ML/yr since pumping began (1983 to 2018).

Three other licensed bores have taken 1300 ML from the aquifer between 2009 and 2019, which equates to approximately 2% of the groundwater extractions. The aquifer response to date includes the extractions from these bores, and so recovery estimates include the current level of pumping at approximately 130ML/yr from these bores in these calculations. Additionally there are six stock and domestic bores in the Gerangamete GMA. It is not known if these bores are operational. The estimated extraction volume from these bores is 132 ML between 2009 and 2019 assuming they are taking 2 ML/yr per bore and represents 0.1%.

Groundwater levels have drawn down creating a cone of depression centred around the borefield, reaching a maximum depth of 59 m drawdown (Bore 64230) in 1990.

Full recovery at the borefield (Bore 64230) occurred within 2 years of the 1983 pumping (3.6GL of pumping) after the first pumping event (Figure 3). This implies that groundwater levels may be relatively stable pumping at a rate of 1.8 GL/yr, noting that the groundwater system had not been stressed at this time, and rainfall was above average.

Groundwater levels in the LTA have not stabilised to pre-development levels since 1987. The recovered groundwater levels recovering rate is slower after each pumping event and the recovered levels are lower that the preceding recovered levels. This suggests that under the current pumping regime the groundwater levels are not reaching equilibrium and are drawing water from storage. In other words the groundwater is being mined. That is the rate of extraction exceeds the rate of replenishment by recharge.

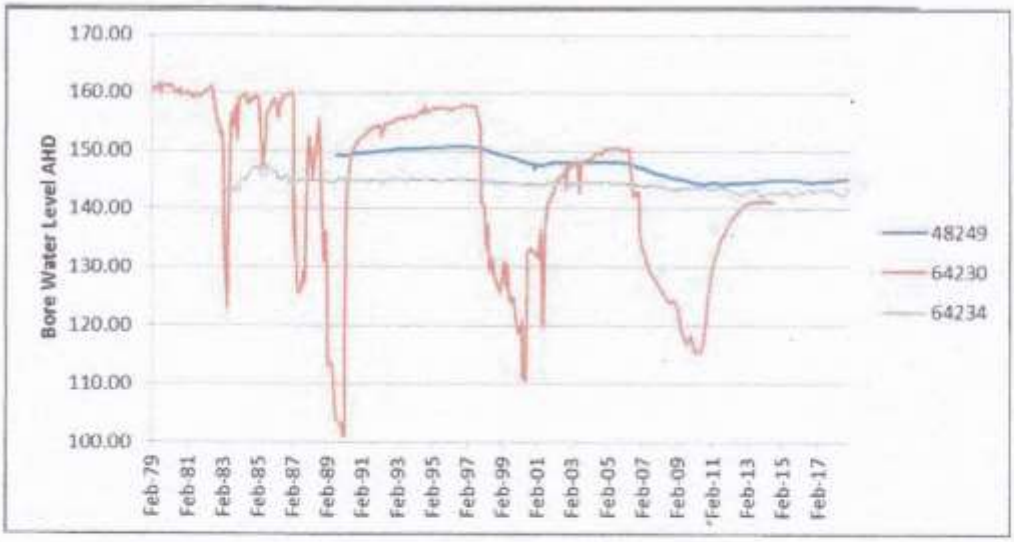


Figure 3 – Groundwater levels near Barwon Downs borefield

This assessment estimates (based on groundwater level trends) that without further pumping from the Barwon Downs borefield including the 3 other licenses, recovery at the borefield will require 30 to 50 years. The rate of recovery of groundwater levels if extractions from the Barwon Downs borefield cease and the three other licenses continue to extract is difficult to determine. The aquifer response to pumping from the Barwon Downs borefield and the three licensed bores is not able to be separated in the analysis of the drawdown curves. Assuming that the annual take from the three licensed bores is approximately 25% of the estimated annual recharge then the recovery could be 25% longer. However, due to the location of the bores and the way confined aquifers respond in a non-linear way this may an upper estimate.

Recovery of levels is dependent on location and whether its in the confined or unconfined part of the aquifer and could take up to 100 years or more in some parts of the aquifer. Recovery curves at various locations are shown in Annex C.

Since 2000 groundwater levels have been drawdown below the base of the Boundary Creek and creek has been a losing stream (Jacobs 2016b).

Groundwater levels in the shallow alluvial groundwater systems show stable trends and do no exhibit the regional drawdowns and recovery of the LTA (Jacobs, 2018a).

Groundwater levels south of the Bambra fault are not showing the same response to pumping as those near the borefield. The response is dampened by the disconnect between the LTA either side of the fault which impedes the flow in the LTA across the Bambra fault. The nearest bore (Figure 3, Bore 48249) in the LTA which is located south of the Bambra Fault shows some fluctuation from extraction but not to the same extent as the other two bores 64230 (LTA) and 64234 (Clifton Fm). The Bambra Fault has been conceptualised as a no-flow boundary along south-west portion of the fault, with a dampened response due to partial barrier to flow along the north-east section (Dudding, (2016)).

Jacobs (2017a) record land subsidence of up to 76mm in 2010 which has recovered to 42mm in June 2015. Several sites have recorded land subsidence which has either partially recovered and stabilised or is still recovering (Barwon Water, 2018). The risk of land subsidence has been assessed as low in

the borefield (Jacobs, 2017a), and the recorded land subsidence to date is within the licensing conditions which specify a maximum of 200mm subsidence. Subsidence occurs due to reduced pressures in the aquifer from groundwater extractions.

Analysis of pumping events at bores near Boundary Creek indicates that between 1,300 to 1,400 ML +/-100 ML p.a may be sustainably extracted based on the residual drawdown and annualised pumping volumes from the bores near Boundary Creek (Annex E).

10. Waterways and Groundwater Dependent Ecosystems

There are a number of waterways in the study area. Those that are highly connected to groundwater are Ten Mile, Yahoo, Love Creeks (Gellibrand) and Boundary Creek (Reach 2) and Barwon East Branch (Jacobs 2018b). Baseflow to Boundary Creek supports inflow to Yeodene peat swamp as well as numerous high value environmental assets (fish, platypus, etc) instream (Alluvium et al, 2018).

The impacts of reduction in groundwater levels from groundwater pumping has been assessed and is summarised in Annex D (Jacobs, 2018). The major potential impacts to streams from changes to groundwater levels are;

- waterways that shift from being gaining stream to losing streams; and
- shallow water tables beneath potential acid sulphate soils.

Pumping from the LTA has lowered the watertable in the unconfined parts of the aquifer. Jacobs (2017b) found that the operation of the Barwon Downs borefield over the past 30 years is most likely responsible for two thirds of the reduction of baseflow into Boundary Creek. The creek (reach 2) has changed from gaining to losing system. While the system is losing further groundwater extraction will not increase the impacts on the stream as the rate of loss will remain the same. However, the same may not be said for acid sulphate soils which have the potential to generate acid flows with new rainfall events whilst they are unsaturated and disconnected from the watertable (Jacobs, 2018b).

Water quality monitoring of waterways in the catchment has been undertaken since the borefield began operation. In more recent years this monitoring program has increased its range of parameters to assess the risk for acid flows and any alteration of condition of the waterways. Low flow periods in many of the streams have shown higher acidity with lower pH levels recorded in 2018. The lowest recorded pH was in Boundary Creek at Colac-Forrest Road of 3.4 between June and September 2018. Acidity of the waters has returned to neutral state in the Barwon River and so WaterWatch monitoring of this has ceased in September 2018 (Annex F). The Corangamite CMA was managing this monitoring program during the acid flows event. Stock watering from Boundary Creek near Yeodene Swamp has ceased due to the poor quality of the creek in recent years (low pH). Alternate water supplies have had to be found to water stock.

Other creeks that groundwater discharges to in the Gerangamete GMA include Barwon River East Branch and Loves Creek. Neither of these have shown any change in flow due to pumping at Barwon Downs borefield (Jacobs, 2018a – Section 8.3). Loves Creek is outside the cone of depression and Barwon River East Branch is on the south side of the Bambra Fault where groundwater is partially disconnected (95% transmissivity loss across the fault, Dudding (2016)) from the borefield.

Groundwater dependent vegetation near streams and waterways has been assessed as low risk from regional lowering of groundwater levels. This is because the ecosystems are dependent on perched and alluvial aquifer systems not the regional LTA (Jacobs 2018).

Groundwater also contributes to other creeks outside of the Barwon River catchment, including Gellibrand River and tributaries. The risk assessment (Jacob, 2018a) indicates low risk of impact to these streams. DELWP also consider the risk to these waterways to be low based on the available information. The modelled decline in watertable due to pumping in these areas is not significant and hence are assessed as low risk. Some of the creeks are connected to the LTA whilst others are also connected to shallow alluvial systems which provide inflows to the creeks.

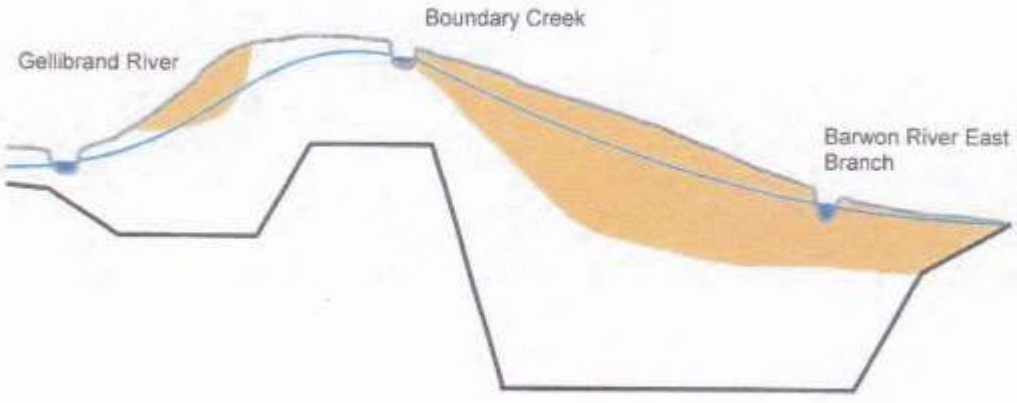
The Corangamite CMA recently completed a review of the FLOWS for the Upper Barwon River catchment (Alluvium et al, 2018). This review has highlighted the dependency of high value environmental features on the maintenance of low flows in Boundary Creek.

11. Water Balance

Jacobs (2016b, 2017b, 2018c) do not provide a water balance that clearly defines or states the net contribution from each component of the groundwater system. No other literature provides a complete water balance either. Comments have been made by various authors that prior to development of the borefield the groundwater system was in equilibrium with discharge to waterways equal to recharge into the system ((Leonard, 1988), (Jacobs, 2018c)).

Based on the information described in this report, a conceptualisation of the groundwater system is illustrated in Figure 4 and 5, representing the pre-development and post development aquifer conditions. The assumptions about the water budget for these scenarios is provided with each figure.

Figure 4 – Barwon Downs graben water budget, pre-development (Conceptual diagram)



Note:

- Blue line = watertable or potentiometric surface
- Brown shading = overlying confining layers and aquifers above LTA.

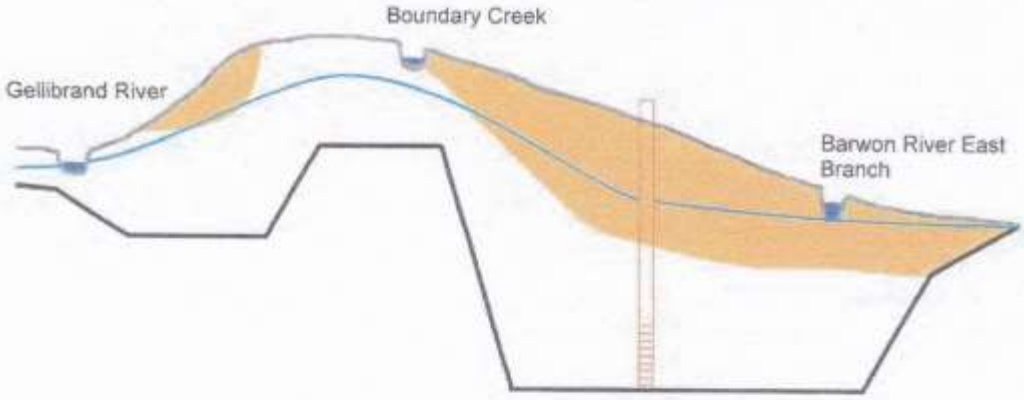
- The Barongarook High is shown in the centre of the illustration with the Gellibrand River catchment left of Boundary Creek (and the Barongarook High), and the Barwon River catchment on the right side of Boundary Creek.

Assumptions –

- The Barwon Downs Graben basin is a closed system, there is negligible leakage or flow between aquifers or across faults.
- Recharge has been partitioned to reflect contribution to Barwon Downs Graben. Flows to Gellibrand catchment are excluded. Flows to Barwon East Branch River are excluded.
- Discharges to springs are minor and not quantified.
- The system is in equilibrium, discharge equals recharge and groundwater levels were stable.

In a pre-development (and unimpacted) scenario the estimated volume of groundwater that can be extracted on an annual basis is between 200 ML/yr and 400 ML/yr. This is based on 20% of the recharge (SKM, 2011). This assumes full recovery of groundwater levels and allows for connection to Boundary Creek to be maintained as a gaining stream. This estimate is based on the assumptions listed above.

Figure 5 – Barwon Downs graben water budget, post-development (Conceptual diagram)



Note:

- Blue line = watertable or potentiometric surface
- Brown shading = overlying confining layers and aquifers above LTA.
- The Barongarook High is shown in the centre of the illustration with the Gellibrand River catchment left of Boundary Creek (and the Barongarook High), and the Barwon River catchment on the right side of Boundary Creek.

Assumptions –

- As above, except Boundary Creek is not connected, so no discharge to waterways.
- The small movement of the flow divide to the west during pumping has negligible consequences for the water balance of the basin

Under developed conditions the estimated annual extraction is between 1,100 ML/yr to 2,200 ML/yr. This maintains storage in the aquifer (i.e. extraction is equal to recharge to the system). A more conservative estimate based on drawdown response during pumping of the aquifer is 1,200 to 1,500

ML/yr (Annex E). This does not allow for baseflow to Boundary Creek from the LTA, as regional groundwater levels would be lower than the creek bed elevation.

12. Groundwater quality

Groundwaters in the alluvial aquifers are low in salinity due to high recharge rates and connections to waterways. Salinity in the LTA is consistent across the aquifer with only one or two results outside the potable water segment A1&A2: 0-1500 mg/L (SEPP Waters, 2018).

There are no perceptible changes in groundwater quality since groundwater extraction began in the 1983 and none are expected in the future. Theoretically pumping could induce leakage from the aquitard above the LTA which has higher salinities of 2,500 mg/L, however, there is no evidence of this occurring to date.

Groundwater quality is monitored by Barwon Water at the borefield and at other monitoring sites. A summary of this monitoring and additional monitoring undertaken during the technical works program is summarised in Annex F.

13. Summary of technical assessment

This assessment of groundwater resources is to inform a review of the PCV for the Gerangamete GMA. The information reviewed provides the following basis for the PCV review:

- The Barwon Downs Graben forms a closed system.
- Under predevelopment:
  - All recharge to the system discharges to waterways under natural conditions.
  - Groundwater discharges to several waterways and streams, with Boundary Creek and East Barwon River most at risk from changes in groundwater levels
- Since development:
  - Boundary Creek has ceased to flow in some reaches due to operation of the Barwon Downs borefield.
  - Groundwater flows through the Yeodene Swamp have reduced causing actualisation of the acid sulphate soils and production of acid flows to Boundary Creek and the Barwon River.
- Recharge volumes are estimated at between 1,100 (dry) and 2,200 (wet) ML /yr for various climate scenarios.
- The three private license holders have extracted approximately 1,300 ML between 2009 and 2019, compared to over 115,000 extracted by Barwon Water at the Barwon Downs borefield between 1983 and 2019.
- The Barwon Downs borefield has pumped an average of 3,400 ML /yr over the period of operation (1983 to 2016).
- Significant drawdown (up to 58m) of the aquifer has occurred near the borefield, with levels still recovering, and projected to continue recovering till at least 2066 (50 – 100 year recovery period).
- Groundwater levels near Boundary Creek remain 10m below pre-development levels and are recovering very slowly with a 30 to 50 year period anticipated before full recovery may occur.
- Assessment of individual pumping events have indicated that between 1,300 to 1,400 ML +/- 100 ML p.a may be extracted based on the residual drawdown and annualised pumping volumes from the bores near Boundary Creek (Annex E).
- It is estimated that 1,100 to 1,200 ML /yr could be taken each year without causing long term decline in levels. This rate of extraction is expected to stabilise groundwater levels in the aquifer but will not allow for recovery of groundwater levels. Groundwater would remain

disconnected from Boundary Creek with groundwater levels below the elevation of the creek bed.

- It is estimated that an annual extraction of 200 ML /yr to 400 ML /yr could be taken whilst maintaining connection to Boundary Creek, assuming that groundwater levels recover and connect with Boundary Creek as an outcome of the implementation of the remediation plan.

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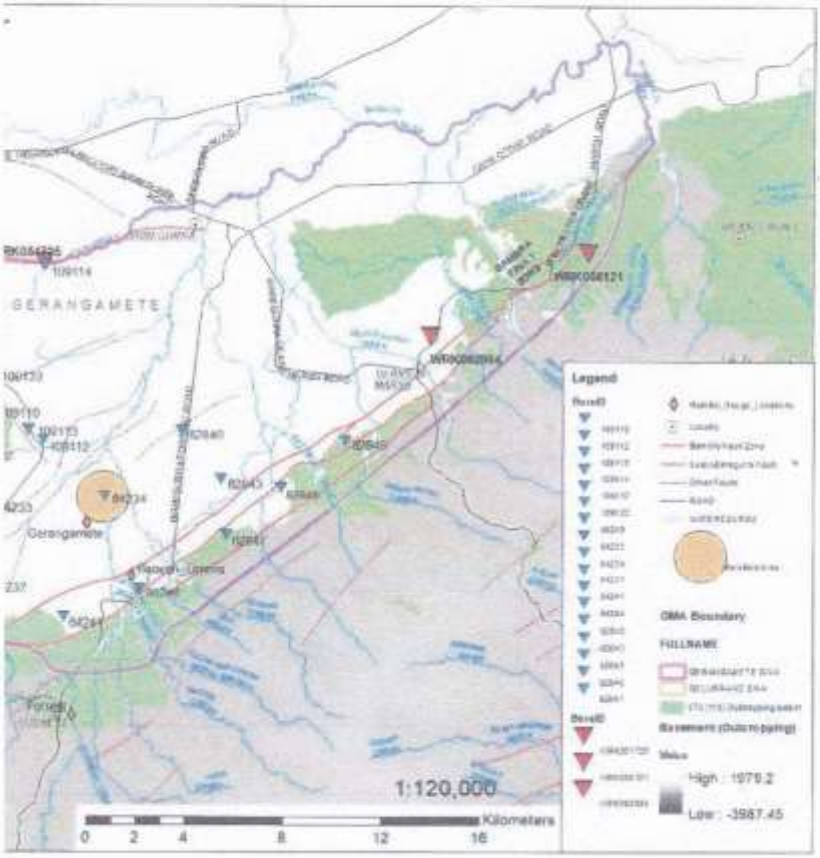
GERANGAMETE
Gerangamete
Legend
OMA Boundary
FULLNAME
High : 1979.2
Low : -3987.45
1:120,000
0 2 4 8 12 16
Kilometers

Annex B – Recharge Rate values and calculations from previous studies

Table B1 – Rainfall statistics for the period 1975 to 2014

Rainfall Station no.	Location	Average annual rainfall (mm/yr)	25th percentile	75th percentile
090004	Gerangamete	795	725	880
090040	Barwon Downs	805	744	878
090147	Colac	728	630	819

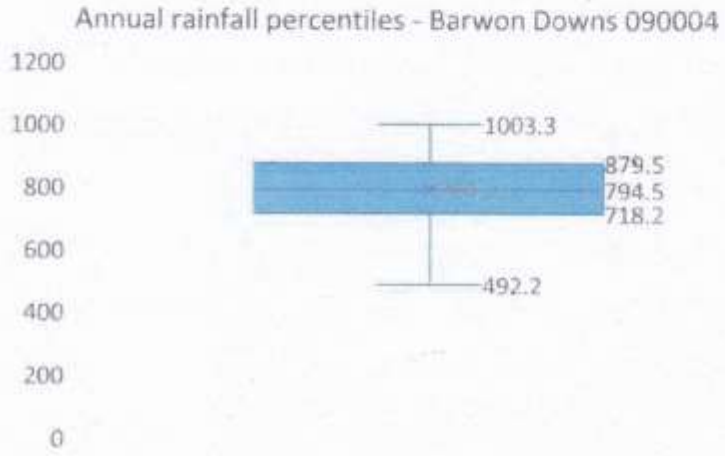

Figure B1 – rainfall percentiles for Barwon Downs 090004 (1975 – 2014)

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literature (from most recent to oldest)

(mm/year) rainfall	Method	Comments
	Calibrated model	Average recharge in the calibration model (30 years) (5% of rainfall, 38 km²)
	Calibrated model	Wet climate – Rainfall 837-675mm (10 percentile scenario, GCM)
	Calibrated model	Median climate – Rainfall 796-632mm (50 percentile scenario, GCM)
	Calibrated model	Dry climate - Rainfall 725-535mm (90 percentile scenario, GCM)
	Calibrated model	Rainfall 780-633mm – Step repeat of the climate sequence July 1997 to 2016.
	Calibrated model	Climate period not stated, but given as January 1980 to May 2016 in Jacobs (2018b) Average recharge in the calibrated model =5% of rainfall where the LTA outcrops and 1% of rainfall where the MTA outcrops (Table 7-1). Section 6.2.2 transient recharge listed as 4% in outcrop and 0.6% aquitard. (multiplier of 0.25 of unsaturated zone modelled estimates).
	Calibrated model	Climate over last 30 years – Page 22 (steady state recharge prior to final calibration run)
20³/8.1%	Independent	Table 3.2 – conclusion reports 8.9% (67mm) but uses data deemed not suitable in this same report
24³ / 11%	interface	Represents more recent recharge
5.5%	Chloride mass	Effectively prior to land use change in the area – represents historical recharge
33³ / 14%	Differential	Considered an "upper bound" of potential recharge
n average / LTA)		Recharge to LTA – Table 2-4 Steady state to 1982, transient 1982 to 2016. Recharge using 1971-2014 rainfall (MIKE-SHE unsaturated zone modelling)
	Numerical model	9,000 ML estimated from no pumping scenario from the model water balance 14,000ML includes induced leakage with pumping.

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	Numerical model	Recharge along Bambra Fault from groundwater model (Part D), initial estimate of 9%. Recharge to Barongarook High estimated at 12% initially.
	Numerical model	
	Flow net and baseflow	17% of 1000mm rainfall over 28km2 (p14) Gellibrand throughflow = 3,000 from Kawarren "avenue" + 500ML diverted from Barwon graben 1,300 ML to Barwon Downs Graben.
	Flow net and baseflow	30% rainfall (900mm rainfall * 54km2 outcrop) Gellibrand throughflow = 8,500 from Kawarren "avenue" + 3,100ML diverted from Barwon graben
		Direct infiltration estimated for Gellibrand River catchment from Barongarook High.
		5% rainfall (890 mm rainfall * 120 km2 outcrop)

ngarook High in table 3.2 - results is 61 +-20mm/yr. The summary table then lists this as 67 +-20 mm/yr. This is equivalent to 8.1% of mass balance is given as 41 mm/yr or 5.4% of rainfall (1476 ML/yr) The age dating method are higher as it assumes recharge pulse has hit n't so the method is less reliable. Historical recharge rates over the last 100 to 1000s of years may be considerably lower, representing rainfall

o 31st December 2014 with an additional 7 years of "average" conditions to make 50 years from 2016.

consider recent modelling indicate recharge is much lower, as reflected in Leonard (1988).

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ısed on Jacobs (2016) recharge rate report.

oted rate of recharge (mm/yr)	Estimated Recharge (ML/year)[1]
± 20 [1] / 8.1%	1,708 +/- 560
± 24 [1] / 11%	2,352 +/-784
[1] / 5.5%	1,148
± 33 [1] / 14%	2,912 +/-924

a of 28km2 (Leonard 1988) and quoted rate of recharge.

Annex C – Recovery levels in groundwater monitoring bores and estimated recovery times

Using the groundwater levels from the last pumping period, an estimate of the time to recovery (to pre-development levels) is provided in the table below. This is based on a log-linear relationship. Based on visual inspection of the recovery curve for Bore 64230 it appears that the curve has plateaued and will not recover to pre-development levels, even with cessation of pumping.

Table C1 – Estimated recovery time from pumping events

Bore	Pre-pumping level (mAHD)	Lowest level (mAHD)	Recovery time from 2010 (years)	
			100%	90%
109110	165	120	93	49
64230	160	115	24	15*
64233	160	126	309	154

*Groundwater levels were not available for the full record for bore 64230.

Figure C1 shows the full period of record of the monitoring with the blue box highlighting the last pumping period, which is shown in Figure C2. The predicted recovery curves are not shown on these figures.

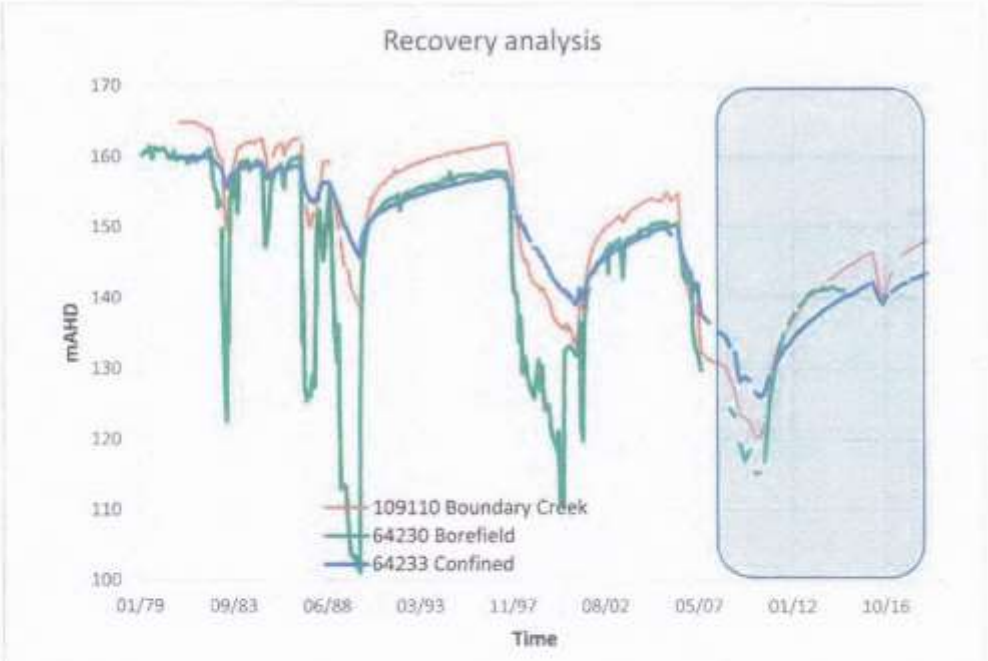

Figure C1 – groundwater levels near the borefield for the entire period of pumping at Barwon Downs

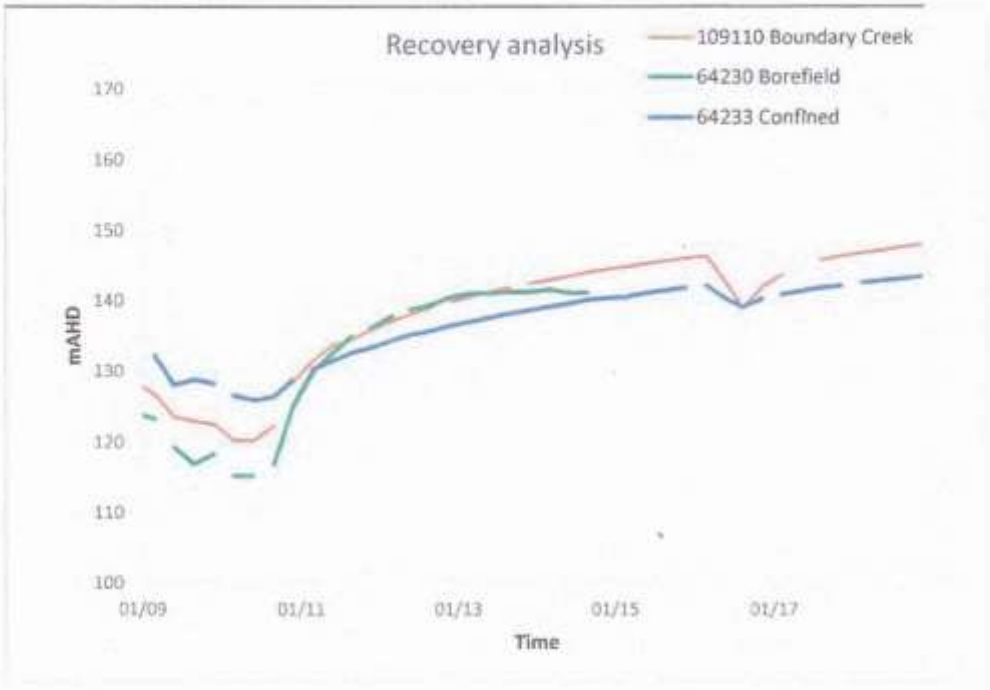

Figure C2 – groundwater levels near borefield showing the last significant pumping event and recovery from 2010 to 2018.

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s from pumping (Jacobs 2018a)

s from pumping on environmental receptors

	Risks assessment	Risk Rating
	Not connected to LTA	Low
	Connected to LTA (section between Yeodene Swamp (Big Swamp) and McDonalds Dam). Predicted reduction in groundwater contributions of 2ML/day.	High
	Not directly connected to LTA.	Medium
	Gaining in some sections south east of borefield. Risk of impacts during low flow periods.	Medium
	Connected to alluvial aquifers and the LTA.	Low
	Connected to alluvial aquifers and the LTA.	Low
	Losing creek disconnected from the LTA. Up to 2m of drawdown predicted in this area.	Medium
	Some areas directly connected to LTA. Key discharge feature for the LTA and from alluvial aquifer.	Medium
	Flows into Loves Creek, and over the aquitard (MTD) and then into the Gellibrand River. Also connected to alluvial aquifers.	Low
	Tributary of Loves Creek, gaining in sections from the LTA but also connected to alluvial aquifers.	Medium
	Flows over the aquitard and predicted drawdown is less than 0.1m.	Low
	Flows north west to Lake Colac, and flows over the aquitard.	Medium to Low.

-	Vegetation monitoring has not observed significant impacts at most sites. Modelling indicates 98% of the study area is protected by the presence of the aquitard and alluvial aquifers. The remaining 2 % high risk area lies on the Barongarook High along reach 2 of Boundary Creek and small areas along Gellibrand River. (Figures 9-1 to 9-4 and Table 9-1, Jacobs 2018a)	Low (98% of area) High (2% of area – Reach 2 Boundary Creek and Gellibrand River)
	Modelling predicts drawdowns similar to that experienced during the Millenium drought. As such it is not expected that PASS areas will increase. Known areas of Actual Acid Sulphate Soils (AASS) are not expected to increase in area and are to be assessed under the S78 remediation plan.	Low to High depending on drawdown.

the modelled drawdown in the Barwon Downs groundwater model (Jacobs 2018b). If any of the drawdowns are under-
ily, if over-estimated the risk could decrease. The risk is based on a combination of likelihood of impact (based on depth to
pendency on groundwater levels).

Annex E – Residual drawdown and groundwater pumping event relationship near Boundary Creek

The aquifer response to pumping has been used to empirically determine a possible range of extraction volumes based on a review of the individual pumping events from the two bores closest to Boundary Creek. The selection of these sites is based on the need to manage drawdown near Boundary Creek. The two bores are both screened in the Pebble Point Formation of the LTA.

The bore levels have been used to determine residual drawdowns from recovery curves from each pumping event. This has been plotted against the annualised pumped volume for each of those pumping events. This is an empirical relationship and there is no literature or description of this method in literature. The concept is based on the fact that the residual drawdown from a closed system at any point in that system will represent the net aquifer response to that event.

The intercept from the linear trend line gives an estimate of an annual pumped volume that would result in a 0m residual drawdown. By inference this would imply that this volume would also be a sustainable volume of extraction from the borefield that would result in full recovery of groundwater levels after each pumping event at that location.

The residual drawdown assumes full recovery takes place in the period of no pumping. This does not occur for the events after 1987. If allowance was made for full recovery by drawing the recovery curve in and dividing this period by the pumped volume a range of values can be determined for each bore. Estimates are provided in the tables below for both bores.

Bore 109110 (Pebble Point Formation)
Estimated annual pumping volume of 1,400 ML/yr based on relationship of residual drawdown and pumped volume for each pumping event (Table E1). This could range from 1,100 to 1,500 ML/yr based on full recovery estimates.

Table E1 – Bore 109110 residual drawdown and pumping data

Year	Event recovery level	Drawdown (m)	Recovery (m)	Residual event drawdown	Pumping event total (ML)	Pumping event (ML/yr)	Pumped volume if full recovery occurs
1/01/1987	163	15.6	13.6	-2	3,652	1,826	n.a
1/01/1997	162	25	24	-1	19,074	1,907	1,192 (16 yrs)
1/01/2005	155	28.5	21.5	-7	37,087	4,636	1,472 (25 years)
1/01/2015	146.5	35	26.5	-8.5	52,684	5,268	1,315 (40 yrs)
1/01/2018	148	7.5	9	1.5	3,360	1,120	n.a

Bore 109113 (Pebble Point Formation)

Estimated annual pumping volume of 1,300 ML/yr based on relationship of residual drawdown and pumped volume for each pumping event (Table E2). This could range from 900 to 1,300 ML/yr based on full recovery estimates.

Table E2 – Bore 109113 residual drawdown and pumping data

Year	Event recovery level	Drawdown	Recovery (m)	Residual event drawdown	Pumping event total	Pumping event (ML/yr)	Pumped volume if full recovery occurs
1/01/1987	162	0	0	0	3,652	1,826	n.a
1/01/1997	161	29	28	-1	19,074	1,907	953 (20 years)
1/01/2005	153	26	18	-8	37,087	4,636	1,227 (30 years)
1/01/2015	145	25	17	-8	52,684	5,268	1,053 (50 years)
1/01/2018	148	6	7	1	3,360	1,120	

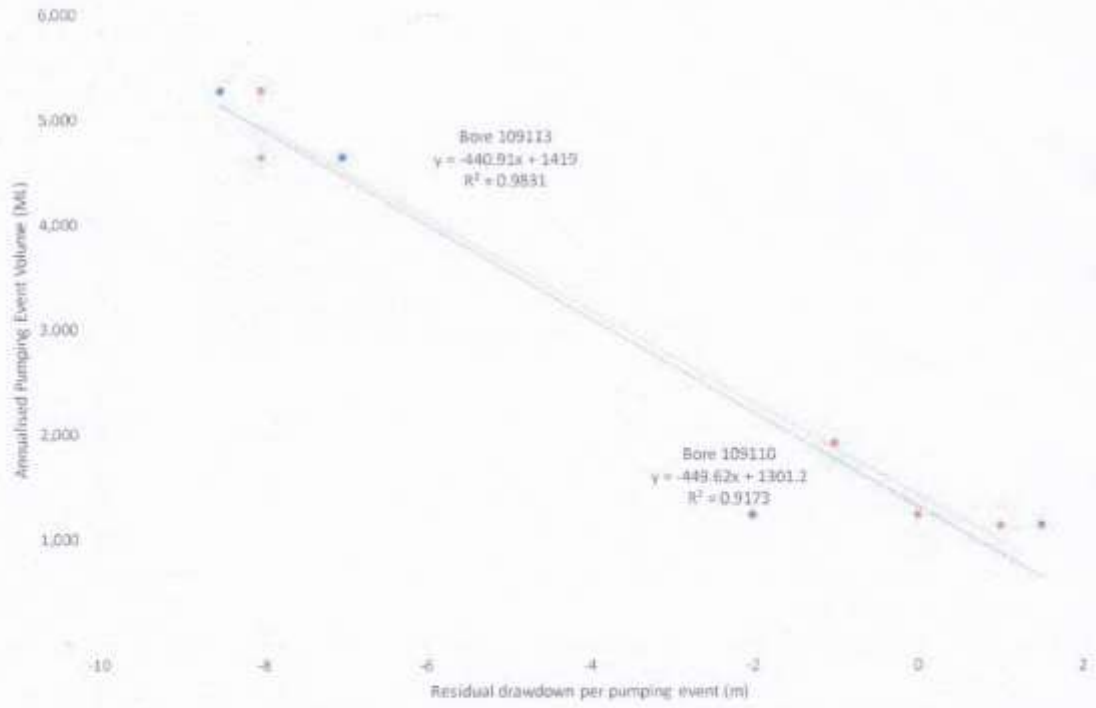


Figure E1 – Relationship between residual drawdown and pumping volumes at Boundary Creek

Annex F – Groundwater quality data

The annual report on the Gerangamete GMA provides a snapshot each year of groundwater salinity readings. Salinity from the selected monitored bores ranged from 335 uS/cm to 1100 uS/cm for 2017/18. The long term 10 year average for the 3 bores shown ranges from 660 uS/cm to 760 uS/cm.

Salinity monitoring undertaken by Jacobs as part of the field investigation program summarised regional groundwater salinity for each of the main aquifers, with the following salinity ranges (Jacobs, 2016c):

- Quaternary aquifer (QA) ranges in salinity (EC) from 200 to 460 uS/cm, with one outlier near 1000 uS/cm.
- Mid-Tertiary Aquitard (MTD) ranges in salinity (EC) from 1,070 to 3,890 uS/cm
- Lower Tertiary Aquitard (LTD) ranges in salinity (EC) from 170 to 8,230 uS/cm, noting that only two samples were recorded above 1500 uS/cm out of the 8.
- Basement ranges in salinity (EC) from 890 to 5,440 uS/cm
- Lower Mid-Tertiary Aquifer (LMTA) recorded one salinity measurement of 708 uS/cm.

Groundwater quality has also been assessed as part of Jacobs technical works program (2016b), mostly in relation to the groundwater recharge assessment study. Data was collected for isotope and chloride mass balance assessments with the following results:

- Groundwater pH was neutral to slightly acidic ranging from 5.24 to 6.74
- EC ranged from 232 to 1,320 uS/cm
- Temperature ranged from 8 to 11.3 degrees Celsius.
- Dissolved Oxygen in groundwater ranged from 0.2 to 6.4 mg/L
- Oxidation reduction potential (ORP) ranged from -114 to 83.0 mV.

Waterwatch have also undertaken monitoring of waterways during recent acid flow events in Boundary Creek and Barwon River and tributaries. The data collected is summarized in Table F1.

Table F1 – Waterwatch Water Quality Data 2018

	26/06/2018	29/06/2018	2/07/2018	4/07/2018	9/07/2018	12/07/2018	16/07/2018	19/07/2018	23/07/2018	26/07/2018	30/07/2018	2/08/2018	9/08/2018	14/08/2018	23/08/2018	30/08/2018
Barwon River @ Forrest	6.7	6.8	6.8	6.9	6.7	6.7	6.8	6.8	6.7	6.7	6.6	6.6	6.6	6.4	6.6	6.6
Boundary Creek @ Colac-Forrest Road	3.4	3.4	3.4	3.4	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.5	3.7	4	4	3.7
Barwon River @ Birregurra Colac-Lorne Road Bridge	4.5	4.6	4.6	4.8	4.7	4.7	4.9	5.4	5.7	5.3	5.4	6.3	6.5	6.5	6.6	6.6
Barwon River @ Birregurra - Birregurra Deans Marsh Rd bridge in town	4.8	4.8	5.5	5.6	4.8	5.5	5.7	6.4	6.3	6.3	6.8	6.7	6.7	6.7	6.8	6.9
Barwon River @ Conns Lane	5	5.2	6	6.3	5.1	5.7	6.2	6.6	6.6	6.8	6.9	6.8	6.9	6.8	6.9	7.1
Barwon River @ Winchelsea	6.5	6.5	6.6	6.6	6.5	6	6.6	6.7	6.9	6.9	7	7	7	7.1	7.1	7.3
Barwon River @ Winchelsea-Inverleigh Road (Inverleigh (Bells Bridge)	N/A	6.9	7.1	7.1	7.1	6.6	6.9	7	7.1	7	7.2	7.1	7.1	7.2	7.1	7.4

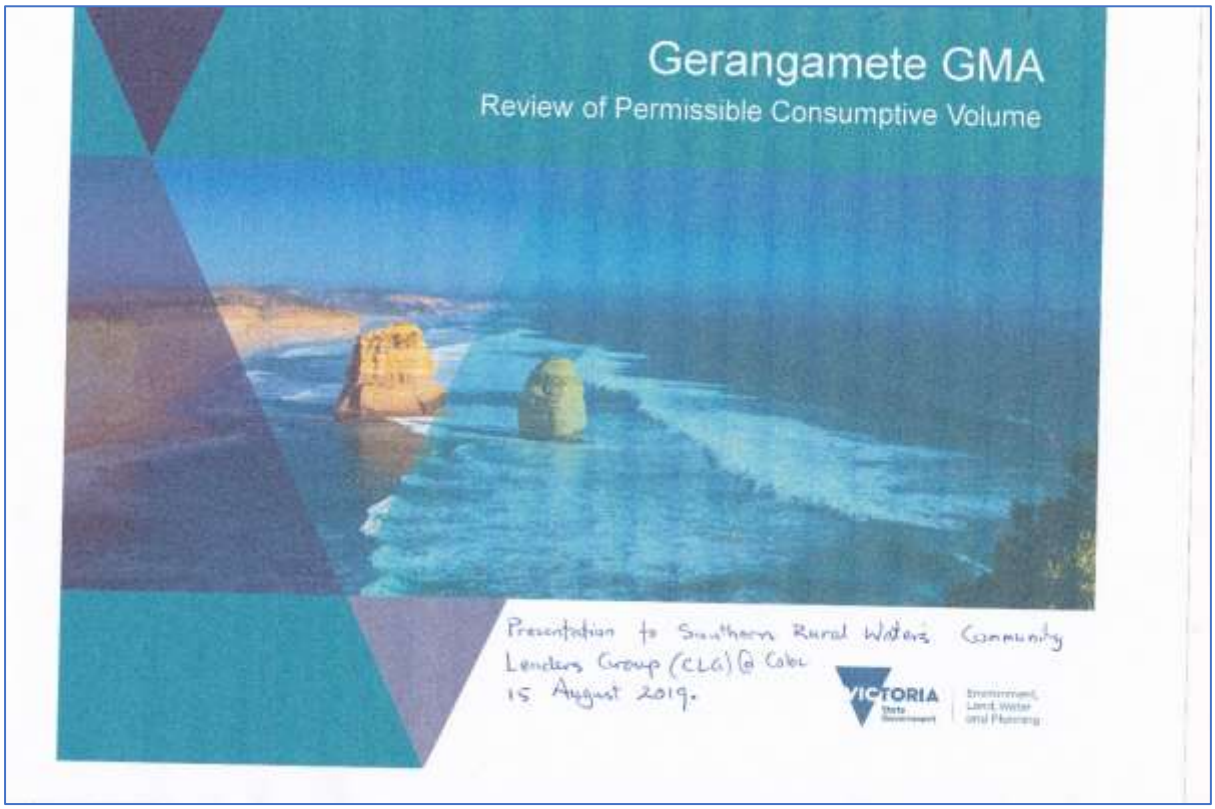
APPENDIX B

CENTRAL REGION SUSTAINABLE WATER STRATEGY, GREATER GEELONG ACTION STATUS AND DELIVERY PERIOD (Ref 5)

#	Action	Status	Delivery Period	Comments	Volume of water to be provided by 2015 (ML/yr) (Ref 4)
4.9	Reduce total per capita water consumption by 25% by 2015 and 30% by 2020	Achieved	March 2012	The action contributed to more-efficient water use in Greater Geelong. Per capita water use in Geelong fell in the mid-2000s from a 40-year average of about 470 L a person a day to about 270 L, a 42% reduction.	7,000
4.10	Implement a range of conservation and efficiency measures	Achieved	Ongoing	The action contributed to more-efficient water use in Greater Geelong. The Barwon Water Supply Demand Strategy 2012 to 2062 outlines previous, current and future demand reduction strategies.	7,000
4.11	Line the Wurdee Boluc Inlet Channel and Ballan Channel	Achieved	2016	The action contributed to reduce system losses and improved water quality. Reconstruction of sections of the two channels was completed in 2016.	100
4.12	Substitute river water with recycled water for on-site use at the Shell Refinery	Achieved	April 2013	The action helped to better manage water security for the Geelong Region. The Northern Water Plant, built adjacent to the Shell Refinery, provides the refinery with up to 2 GL of recycled water a year, reducing Geelong's demand for drinking water and reducing the volume of water discharged to the ocean.	2,000
4.13	Conduct an initial trial of aquifer storage and recovery	Achieved	March 2012	Barwon Water completed its Aquifer Storage and Recovery research program to investigate to investigate options for storage and recovery. The volumes in the CRSWS of 2,700 ML/y by 2030 and 12,500 ML/y in 2055 will need to be reviewed and not automatically	-

				carried forward to the next SWS.	
4.14	Feasibility study of groundwater resource at Newlingrook aquifer and possible Melbourne–Geelong connection	Achieved	December 2012	The Newlingrook groundwater feasibility study concluded the option was costly and lacked community support. The Melbourne to Geelong Pipeline was successfully constructed as an Our Water Our Future initiative in 2007, reducing the need to identify new water sources.	5,000
4.15	Entitlement for the use of the Jan Juc deep aquifer	Achieved	June 2009	The action ensured a reliable and safe water supply to increase water supply options for Greater Geelong. Barwon Water was granted an entitlement to access Anglesea groundwater in 2009.	7,000
4.16	Reinstate the Dewing Creek diversion into the Wurdee Boluc Inlet Channel	Achieved	No date available	The Dewing Creek diversion weir was reinstated.	700
				TOTAL	**28,800**

APPENDIX TEN Presentation of PCV Deliberations given to SRW.



Context

- Groundwater licences may be renewed, provided the cumulated licenced amount does not exceed the PCV
- The PCV is the total volume of water that may be taken during a specified time
- PCVs are set by the Minister
- Gerangamete GMA PCV was first set in 2 Nov 2006, the volume was the same as the groundwater licence issued to Barwon Water
- This review of the PCV is initiated by the Minister, and is undertaken by DELWP in consultation with Southern Rural Water

2

Matters taken into account

The objectives for setting PCVs (*Water Act*, 1989):

- 'To promote the orderly, equitable and efficient use of water resources'
- 'To make sure that water resources are conserved and properly managed for sustainable use for the benefit of present and future Victorians'.

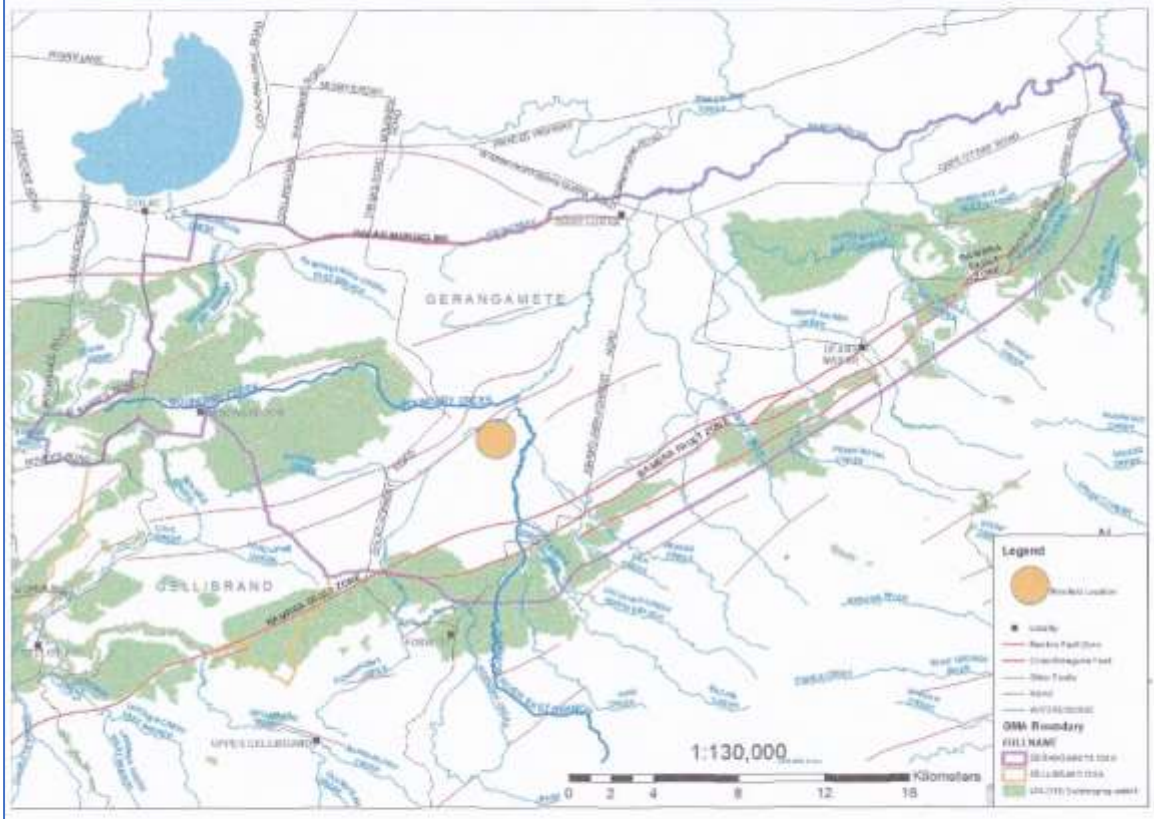
3

Matters taken into account

Matters relevant to achieving the objectives:

- The existing and projected availability of water
  - any adverse effect from use
  - the need to protect the environment
  - the proper management of the waterway and its surrounds or of the aquifer
- Government policies
  - preferred allocation or use of water resources
  - the purposes for which the water is to be used
  - the needs of potential applicants
  - conservation policies
  - any relevant report or statement prepared under any Act
  - any other matter that the Minister thinks fit to have regard to

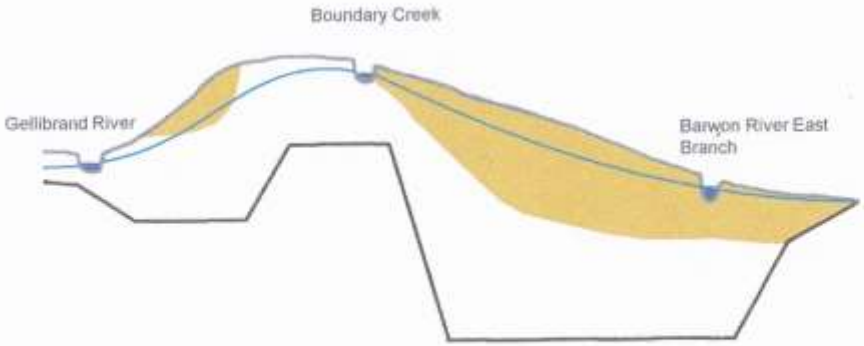
Gerangamete GMA



5

The existing and projected availability of water in the area – pre development conditions

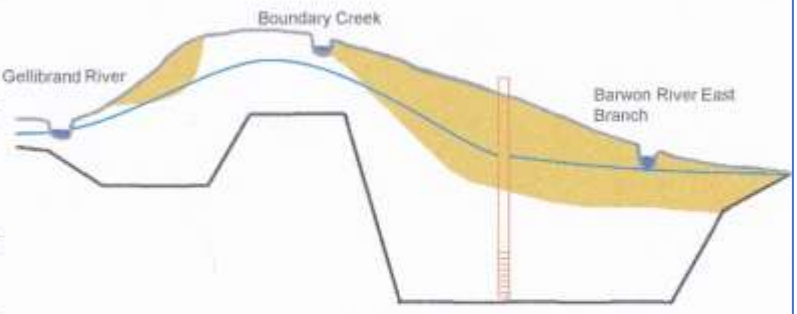
- Annual recharge 1,100 ML to 1,200 ML to Barwon Downs Graben
- Prior to development most recharge discharged to waterway
- Estimated volume with no adverse impacts ~200 ML/yr (20% of recharge, SKM (2011))



6

The existing and projected availability of water in the area – post development of the borefield

- 115,000 ML extracted by Barwon Water
- Equivalent to 3,400 ML/yr
- Additional 239 ML/yr entitlements from 3 bores
- Levels have not stabilised
- 15 to 30 years for water levels to recover
- Water levels drawdown and adverse impacts on the waterways
- Water from storage
- Groundwater levels may stabilise at extraction rates less than 1,200 ML/yr
- No change in water quality or impacts on the aquifers - land subsidence <200mm.



PCV Recommendation

On the basis that:

- groundwater in the Gerangamete GMA is a renewable resource;
- the groundwater dependent ecosystems are high environmental values and need to be protected;
- that these high environmental value ecosystems have already been impacted from groundwater extractions and there is a remediation notice in place that must be met;
- the remediation plan has yet to be implemented and proven;
- the groundwater resource is degraded and recovery of groundwater levels may assist in the remediation in the long term;
- and any substantive groundwater extraction is mutually exclusive to the recovery of groundwater levels;

RECOMMENDATION: that the PCV for the Gerangamete PCV be set at 239 ML/y based on the 3 private licences held and a low level of extraction.
Noting that the PCV make provision for periodic maintenance of the Barwon Bore Field.

8

Future reviews of PCVs, future water availability

Future reviews of the PCV:

- May occur if the Minister requests it;
- May occur if the DELWP consider it necessary to review the Gerangamete GMA.

When:

- Review of the current PCV will occur when the remediation plan is in place, and has been implemented.

What will be included in the review:

- All available information (at that time) will be included in the review.
- Statewide policy on allocation of unallocated resources will apply (when and if further water is made available under an increased PCV).

9

APPENDIX ELEVEN. Permissible Annual Volume Ignored October 1997.

Bib|112) Append (5)

5

SOUTHERN
Rural Water

23 July 1999

Mick Shalley
RMB AB 240
Shalley's Road
Yeodene Vic 3249

Dear Mr Shalley

Boundary Creek, Yeodene

I apologise for the delay in responding to you, however several emails forwarded to you have returned, not able to get through.

You have asked my licensing officer, Gary Wills, to investigate the basis on which the groundwater licence was issued to Barwon Water for the Barwon well field.

As you may be aware, Barwon Water has had historical usage for the groundwater from the Barwon well field. This usage dates back at least until the early 1970's in our current file. Until recently, there have been no problems associated with that usage, as, also historically, it is not used except in times of prolonged drought.

The State is now in the unfortunate position of being in prolonged drought conditions, and the well field is being used.

The current licence was issued for a period of 5 years in September 1995. This was prior to Permissible Annual Values (PAVs) being developed for Groundwater Management Areas (GMAs). The PAVs were not calculated until October 1997, at which time the current licence for Barwon Water had been in existence for slightly more than two years.

The licence is due for renewal in September 2000. Southern Rural Water will be working with Barwon Water to review the licence conditions in light of the current conditions and PAVs.

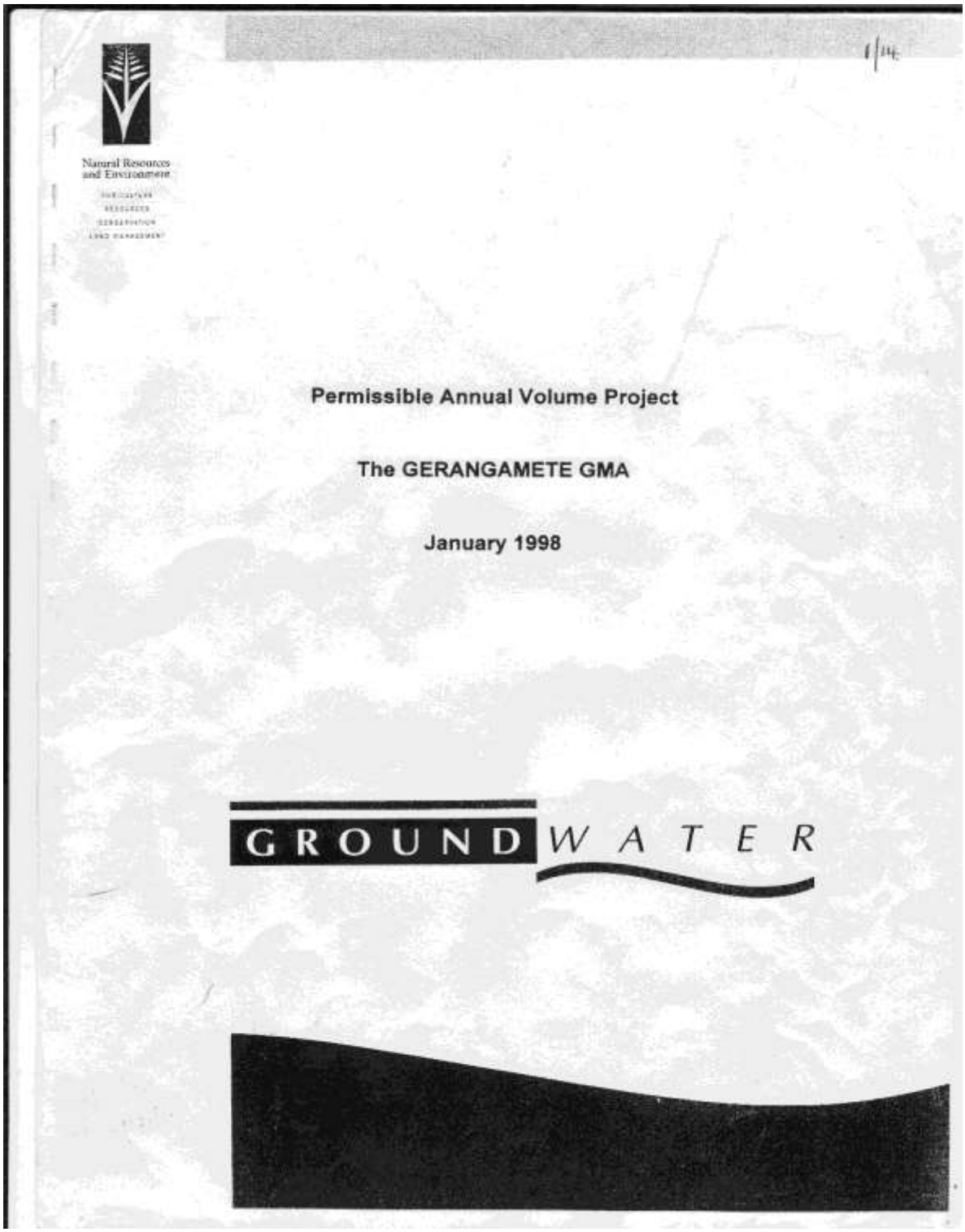
I hope this clarifies the matter for you. Please do not hesitate to contact me on (03)9742 6513 if I can be of further assistance.

Yours sincerely

Jo Donovan
Licensing Supervisor West

Head Office: PO Box 153, Maffra Victoria 3860
Telephone (03) 5139 3100 Facsimile (03) 5139 3150
E-mail: srw@srw.org.au

APPENDIX TWELVE. Permissible Annual Volume Ignored October 1997.



DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT

VICTORIA

Permissible Annual Volume Project

The GERANGAMETE GMA

January 1998

Monograph Series
ISSN 1328-4495
Groundwater Report No

SINCLAIR KNIGHT MERZ

Contents

Document History and Status

Issue	Rev.	Issued To	Qty	Date	Reviewed	Approved

Last Printed:	1 February 1998 11:25 AM
Last Saved:	4 February 1998 1:33 PM
File Name:	I:\WCMS\WC00146\REP97_06.05\R11LKSGG.DOC
Project Manager:	
Name of Document:	Gerangamete
Name of Organisation:	DNRE
Document Version:	Final
Job Number:	WC00146

1. Introduction

The Permissible Annual Volume Project was commissioned by the Department of Natural Resources and Environment to determine the Permissible Annual Volume (PAV) for Groundwater Management Areas (GMA's) identified by DNRE within Victoria.

GMA's have been selected because of a high level of groundwater development, or potential for development. GMA's cover both a surface area and an aquifer system. The aquifer system below ground is defined by a depth interval.

In most GMA's the PAV has been determined from an elementary assessment of the sustainable yield of the groundwater resource, using existing knowledge and a standard methodology as described in SKM(1998). In a small number of cases the PAV has been based on more detailed existing assessments which have utilised groundwater modelling. The purpose of the PAV is to provide the rural water authority with a limit to which groundwater licenses may be issued within the GMA, based on the long term sustainable yield of the aquifer system.

This report provides background information for the Gerangamete GMA, including the determination of the PAV. The Gerangamete PAV area consists of a large part of the Barwon Downs Graben located in the South Western part of Victoria, about 75km south-west of Geelong. The graben is bounded by structural highs, the Barongarook High in the west and the Otway Ranges in the south. The Barongarook High forms the major recharge area for the basin.

The major aquifers are the Dilwyn and Pebble Point Formations of the Wangerrip Group. The water movement in these Lower Tertiary aquifers is restricted primarily by structures in the area.

The GMA covers an area of approximately 380 km^2 as indicated on a map in Appendix A. A more detailed plan showing the GMA boundary has been lodged with the State Government Central Plan Office, Plan no. LGL./97-232.

Within the Gerangamete GMA vertical limits have been placed on the aquifer system corresponding with depths, greater than 60m in order to allow essentially for stock and domestic use of the shallow unconfined aquifers.

2. Geology and Hydrogeology

The Gerangamete GMA occurs in the Barwon Down Graben which consists of mainly middle and lower Tertiary sediments. The western and eastern branches of the Barwon River runs through the basin.

The geology of the basin is composed of the Gellibrand Marl and Clifton Formation of the Heytesbury Group, which is underlain by the Nirranda Group consisting of the Narrawaturk marl, Yaugher Volcanics and the Mepunga Formation. These units in turn are underlain by the Wangerrip Group consisting of the Dilwyn Formation and the Pebble Point Formation. The Otway Group of lower Cretaceous forms the bedrock in the area. The Eumerella Formation of the Otway Group borders the basin and is composed of sandstone and mudstone, interbedded with shale, of fluvial or lacustrine origin.

The Tertiary units within the Gerangamete GMA have been deposited under continental and marine environments. The Dilwyn and Pebble Point Formations of Lower Tertiary age form the basal Tertiary unit and contain quartz sands with mudstone, ligneous clays and brown coals. Marginal marine intercalations occur in the Dilwyn Formation.

The Narrawaturk marl, which is late Eocene to Oligocene in age, consists of carbonaceous, fossiliferous, dark grey to brown silty marl with thin sand beds which are thick bedded at the centre of the basin, and thin out on either side. The Yaugher Volcanics occur within the Narrawaturk marls within a limited part of the GMA.

The Clifton Formation consists of yellowish white limestone and quartz sand deposited in a littoral to marine environment. The Gellibrand Marl consists of fossiliferous marl and calcareous siltstone occurring to a maximum thickness of 300m, and overlies the Clifton Formation.

The Barwon Downs Graben which forms the groundwater basin is bounded by the Otway Ranges and the Barongarook High. The Barongarook High forms the major recharge area to the basin. The Bambra Fault forms the southern margin of the groundwater basin, where it abuts the Otway Ranges.,

The Dilwyn and Pebble Point Formations are the main aquifers in the basin with the overlying marls generally acting as aquitards. The Mepunga Formation has a maximum thickness of 30m is a minor aquifer. The Dilwyn, Pebble Point and Mepunga Formation aquifers are treated as a single aquifer system due to the hydraulic continuity between them (Lakey and Leonard, 1984).

The Otway group basement is not permeable enough to form a good aquifer.

The aquifer system has a thickness of 200-300m in the basin. The average hydraulic conductivity and storage coefficients for the aquifer system are estimated to be 6m/day and $2.4x10^{-4}$ respectively. A value of 4m/day has been considered as an effective K value by Lakey and Leonard (1964). A storage volume of 3,500,000ML of water has been estimated by earlier workers, for the lower Tertiary aquifer. Salinity does not exceed 750-800mg/l. Flow of groundwater is from the Barongarook High towards the basin.

A comprehensive review of the hydrogeology and sustainable yield of the Barwon Downs Graben, which included groundwater modelling was undertaken by DNRE (1995). The review examined the recharge to the basin and constraints to development of groundwater, such as the potential for subsidence and the reduction in surface water flows. Due to the nature of this work which conforms with the general thrust of the PAV project, it is proposed to adopt the conclusions from this report as it represents a far more sophisticated examination of the sustainable use of the resource, than can be undertaken by the PAV project.

3. GMA Boundary

The Gerangamete GMA covers the Barwon Downs Graben which contains a high value groundwater resource, in a deep confined aquifer system, which will be utilised mainly for urban supply for Geelong.

The southern boundary for the GMA is formed by the Bambra Fault. This also forms the northern boundary of the Otway ranges.

The northern boundary coincides approximately with the Colac monocline. It runs along the Barwon River in the north east of the area. It then turns along Atkins creek. In the north west, the boundary of the GMA runs along Collyers Road, and then Colac-Forrest Road. It joins the Colac-Lavers Road at Elliminyt, and runs southward along the western side of the GMA.

The boundary follows the Barongarook- Gerangamete Road for about 7-8 Km, joins the Pipe Line Road and further on Boundary Road along the south.

The south eastern boundary is marked by the foothills of the Otway Ranges.

4. PAV Determination

The PAV estimated here is primarily for the groundwater resource contained in Lower Tertiary aquifers of the basin.

The major potential user of the resource, is Barwon Water, who have a bore field installed in the aquifer system, which to date has been used as a back up supply for Geelong.

The work conducted by DNRE (1995), suggested that recharge to the lower Tertiary aquifers during periods when there is no pumping, may be as little as 1500 ML/year, as the aquifer system is essentially full under these conditions.
During periods of pumping however it is estimated that an increase of natural recharge would be induced into the aquifers up to a level of 4,000 ML/year.

It was concluded in the study that flow in Boundary Creek (located on the Barongarook High) would be affected by extraction at a rate of 4,000 ML/year, and that springs in the area and domestic and stock users extracting from shallow bores may be affected.

It was also concluded that drawdown in water levels in the Lower Tertiary aquifer system should be limited to prevent significant subsidence.

The report considered that the long term sustainable yield under conditions of natural recharge, with acceptable environmental impact should be 4,000 ML/year for the aquifer system. The use of artificial recharge could increase this yield.

Based on the DNRE report the PAV for Gerangamete is set at 4,000 ML/year.

5. Conclusion

The PAV determined for the Gerangamete zone has been estimated at 4,000 ML/year. This volume has been adopted from the results of a comprehensive study of the groundwater resource, which included groundwater modelling in the Barwon Downs Graben undertaken by DNRE (1995).

- It is understood that the groundwater licence held by Barwon Water is in excess of the PAV.

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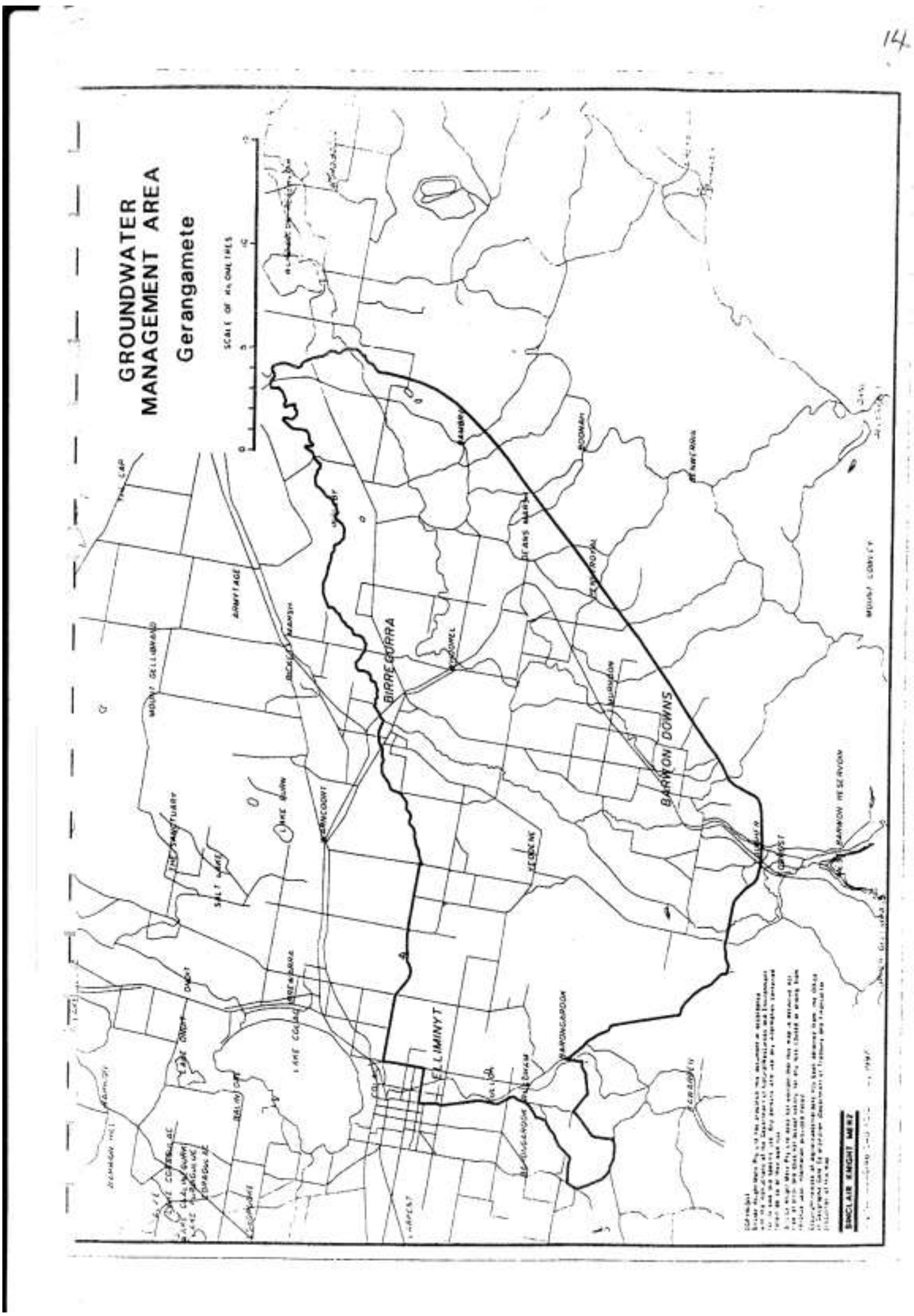
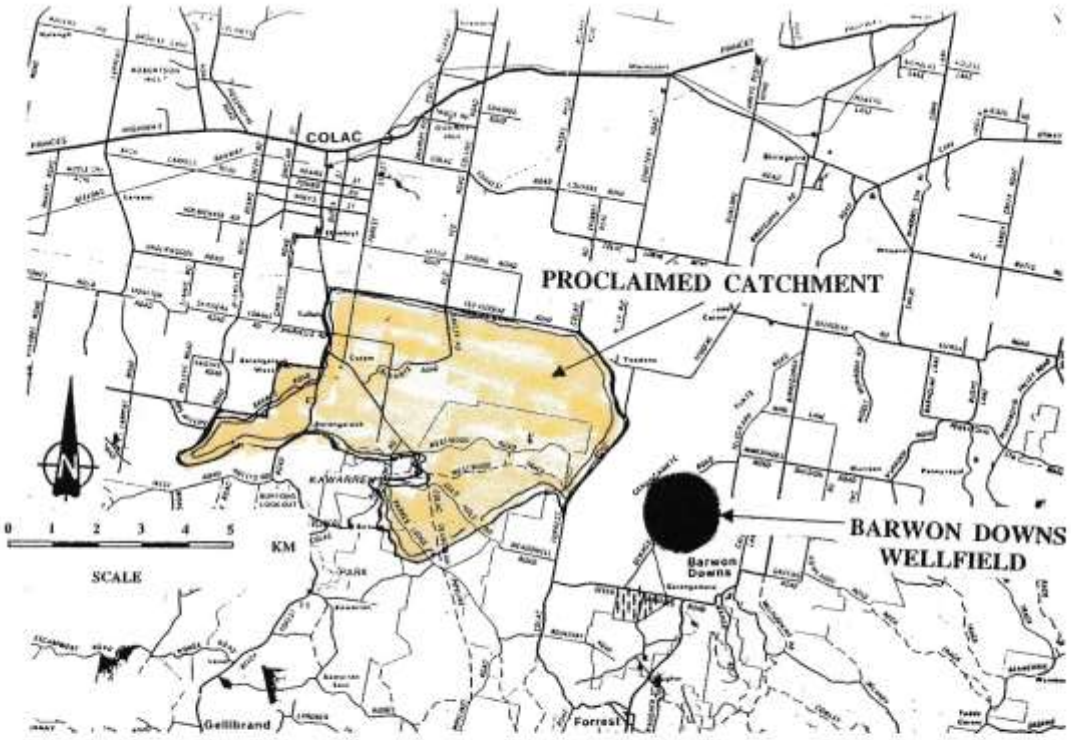
Appendix A - Location Map Gerangamete GMA

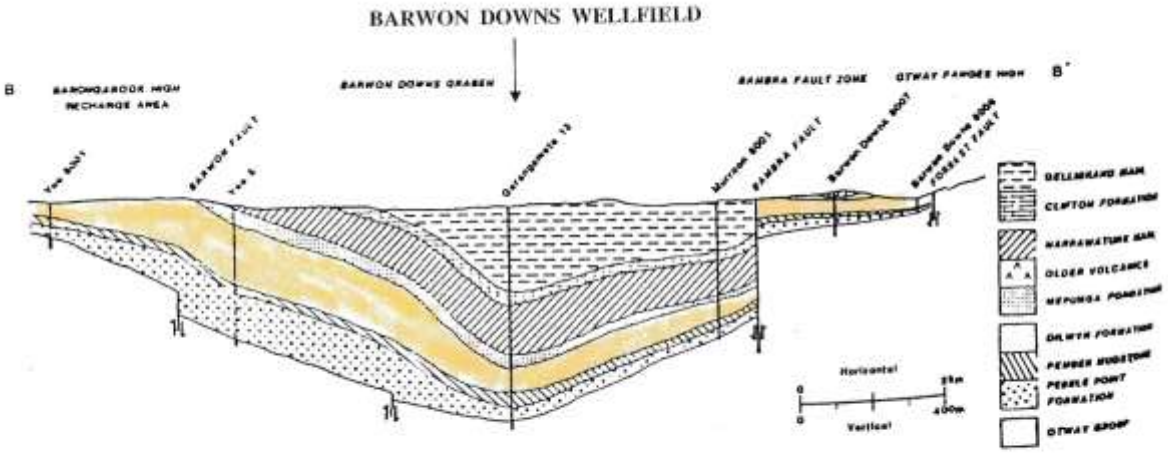

14
GROUNDWATER
MANAGEMENT AREA
Gerangamete
SCALE OF KILOMETRES
BIRREGURRA
BARWON DOWNS
ELLIMINYT
SINCLAIR KNIGHT MERZ



BARWON DOWNS WELLFIELD INTAKE AREA (GEELONG)

SPECIAL WATER SUPPLY CATCHMENT AREA

PROCLAIMED 15/3/89



Geological Cross-Section