OTWAY WATER BOOK 11

BOUNDARY CREEK

And

The Big Swamp.

Evans[19] states that, "***The time lag between the starting pumping groundwater and the resulting effects on a stream can vary from only hours to many centuries.***"

Hydrophobic soils in the Big Swamp 13 years after the 1996 fire.

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Introduction

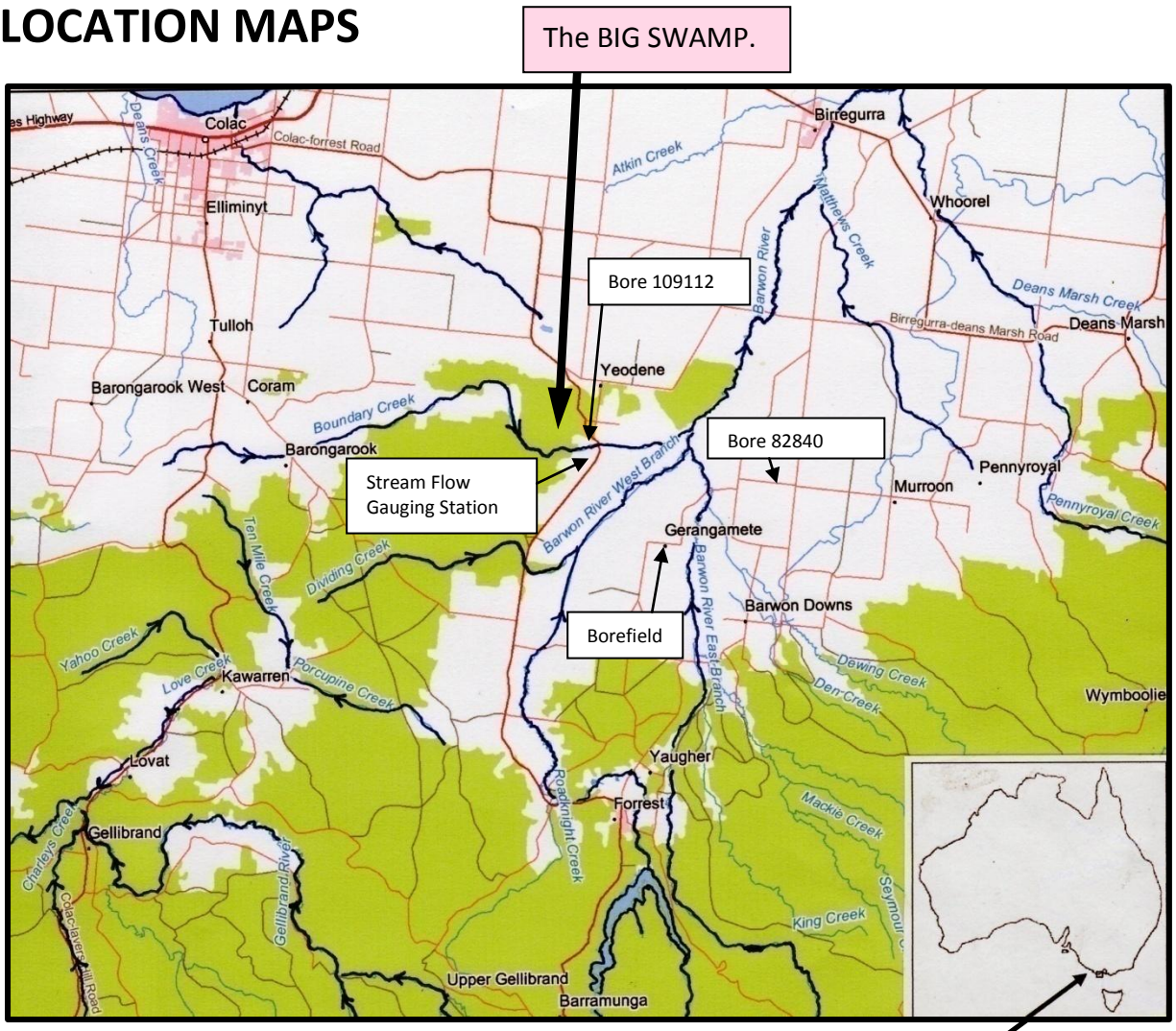
This book examines and discusses the available data on the connectedness between the surface and groundwater flows of Boundary Creek and the Big Swamp. The Otway Water books preceding this one have dealt with...

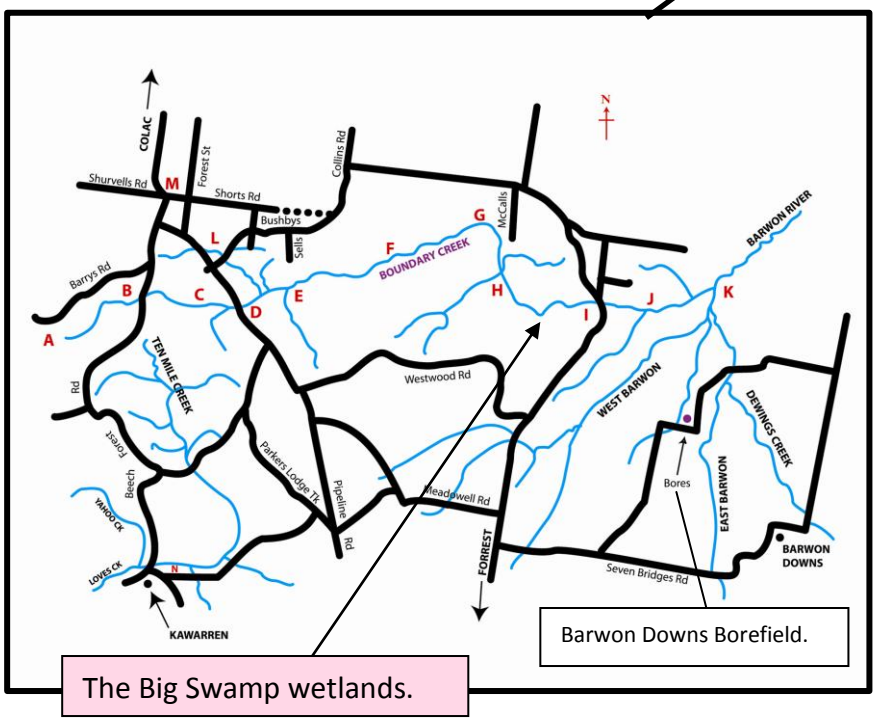
Extensive groundwater extraction – followed by Boundary Creek drying for the first time on record.
Pre-pumping environmental studies not done.
Studies post pumping inadequate, inaccurate and based on dubious information.
Decades of flora recommendations largely ignored.
Permissible Annual Volume recommendation for groundwater extraction being exceeded by a factor of 5.
Southern Rural Water granting a 15 year groundwater extraction licence.
Licence conditions being broken.
Licence not scrutinised, reviewed or adequately policed by Southern Rural Water.
Local knowledge largely being ignored.
Platypus colonies being wiped out.
Blackfish and other instream life forms decimated by acidic waters and no flows.
Springs and wetlands drying out.
Intensity and incident of fire dramatically increasing.
Environmental flows not being allocated.
Supplementary flows released into Boundary Creek and then disappearing into the depleted aquifer.
No consideration being given to stygofauna (groundwater life forms), and the evidence pointing to a serious Actual Inland Acid Sulfate Soil problem.

If planned studies determine conclusively that there are Actual Inland Acid Sulfate Soils (AIASS) present in the Big Swamp the next step will be ascertaining the cause. Considering the extended drawn out periods taken by statutory Government authorities to commence and conduct such investigations this could take a considerable amount of time. Even with extensive circumstantial evidence that there is an Actual Inland Acid Sulfate Soil (AIASS) problem in the Big Swamp area the site has only been visited by representatives of the Colac Otway Shire (as at February 2010). Over 12 months earlier the first written formal complaint was sent to the Environment Protection Authority (Geelong). Formal complaints were also sent to the Department of Sustainability and Environment, Barwon Water, the Colac Otway Shire and Southern Rural Water. The Corangamite Catchment Management Authority was also consulted. The only authority to be proactive has been the Colac Otway Shire. Other authorities didn't bother to reply; said there wasn't an identified problem; stated it was someone else's responsibility or indicated investigations will be carried out in the future.

If authorities are so tardy investigating formal complaints of toxic acidified, heavy metal laden waters along Boundary Creek, it is anticipated that investigating the cause would take considerably longer. Pre-empting that Actual Inland Acid Sulfate Soils will be proven to exist along Boundary Creek this Book looks at the historical data available in an effort to determine the reasons for the creation of these soils. Also some of the commonly accepted ideas put forward by these very same statutory authorities will be challenged.

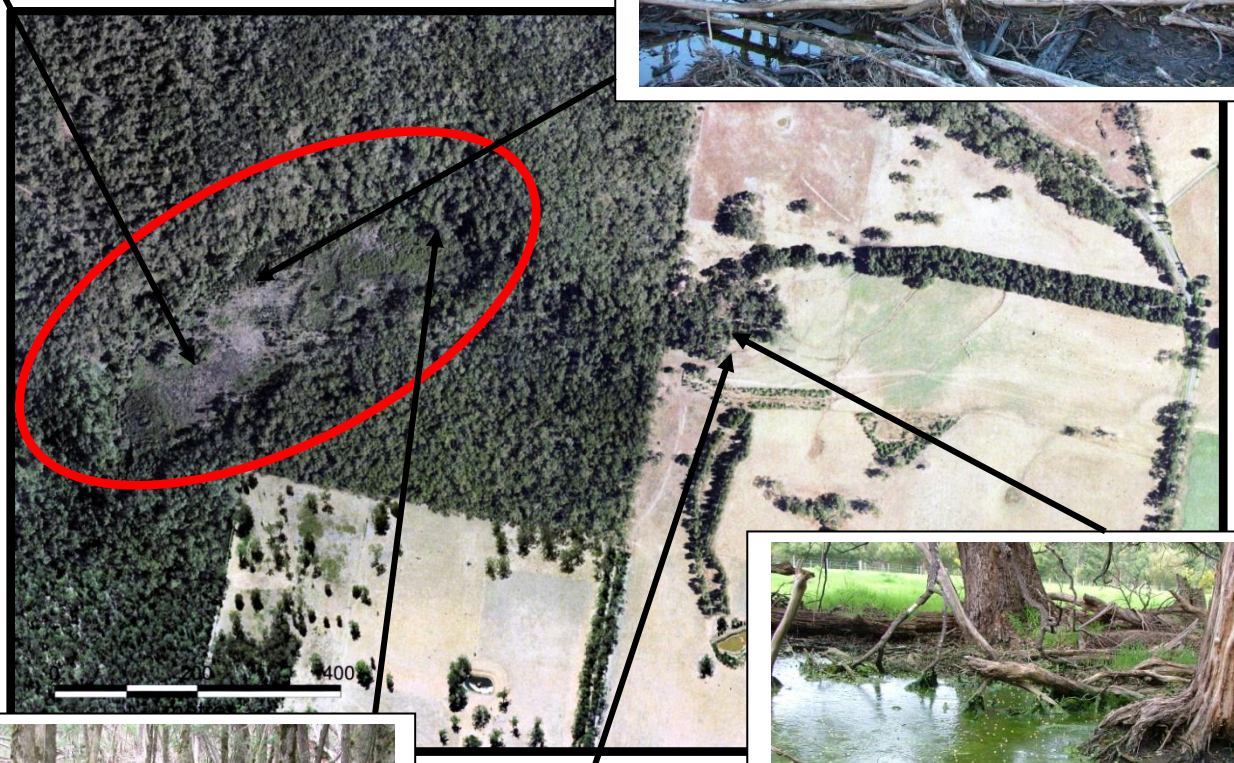
LOCATION MAPS

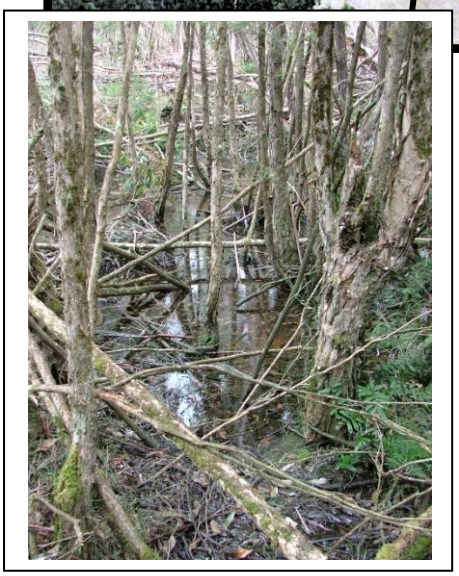




Boundary Creek is a tributary of the Barwon River (Victoria, Australia) and is approximately 19 kilometres long. The headwaters start in the Barongarook High area(see page 7). The average daily flow down Boundary Creek before pumping was 3.2 megalitres (ML).

The Big Swamp





1912 to present day.

The Shalley family has owned land bounding the lower reaches of Boundary Creek at the confluence with the Barwon River since 1912 (see page 4, points J to K).

1975, 1977 and 1978.

Witebsky et al.[49] when compiling the results of the 1986-91 test pump, mentions that there were periods of pumping from the deep water aquifer in the Barwon Downs region in 1975 (6 months), 1977 (3 months) and again in 1978 (1 month). No record of the volumes pumped can be found.

Under a Freedom Of Information (FOI) request in 2006 Barwon Water was unable to provide extraction figures pre 1988. This is quite astounding because the findings of the test pump formed the basis for the granting of the Stage One groundwater extraction licence issued by Southern Rural Water in 1995. It is quite amazing that critical data could not be found and that other data could be so inaccurate.

The reply to the FOI included, **"*Please note there are no records prior to 1988.*"**[24]

Luckily *"Barwon Downs Groundwater Test Pump Program Progress Reports Numbers 7 an 8"* were obtained and filed by M. Gardiner under FOI back in the early 1990s. Report Number 8, 1989 indicated that there would have been many more reports before the conclusion of the 1987-91 test pump. None of these reports could be found by Barwon Water.[24]

Under the 2006 FOI request Barwon Water stated that 5565 ML were extracted in 1988. However, Groundwater Test Pumping Progress Report Number 8 states that 6148 ML were in fact extracted that year. There are other instances of discrepancies for amounts of groundwater extracted. For example Barwon Water's August 2006 Annual Update states that the Barwon Downs Borefield had not been used between July 2001 and April 2006. Over 2 000 ML had been extracted in this period (see graph page 37).

1979. Land Purchased Because of Reliable Water Supply

Graeme and Leila Day purchased their Boundary Creek property because of its permanent running water supply. A bonus was the abundant water life – platypus, blackfish, trout and fresh-water-cray. Graeme states that back in the 1980s in warm weather he would often observe many crayfish floating on top of the water. However today he has no such pleasure when he reminisces over the creek he now calls "Dead Creek."

The Drought of 1982-1983.

The drought of 1967-68 prompted serious groundwater extraction investigations at Gerangamete as a possible source of water for urban use. Up until 1982 very little groundwater extraction had been undertaken in the Gerangamete Groundwater Management Area. The first significant extraction was prompted by the drought of 1982-83 when Barwon Water extracted approximately 8 000 ML of groundwater. This borefield at Gerangamete is locally called the Barwon Downs Borefield. Witebsky et al.[49] reported that this 82-83 extraction provided half of Geelong's domestic supply and was a "life-saving" event.

Little thought was given to any other consideration than providing potable water for Geelong users.

1984. Boundary Creek Dries Up.

For the first time in the Shalley family's history (see page 42, Nellie's statutory declaration) Boundary Creek was dry for 4 days.

Evans[19] referred to Boundary Creek drying up as an example of a creek being impacted one year following groundwater extraction.

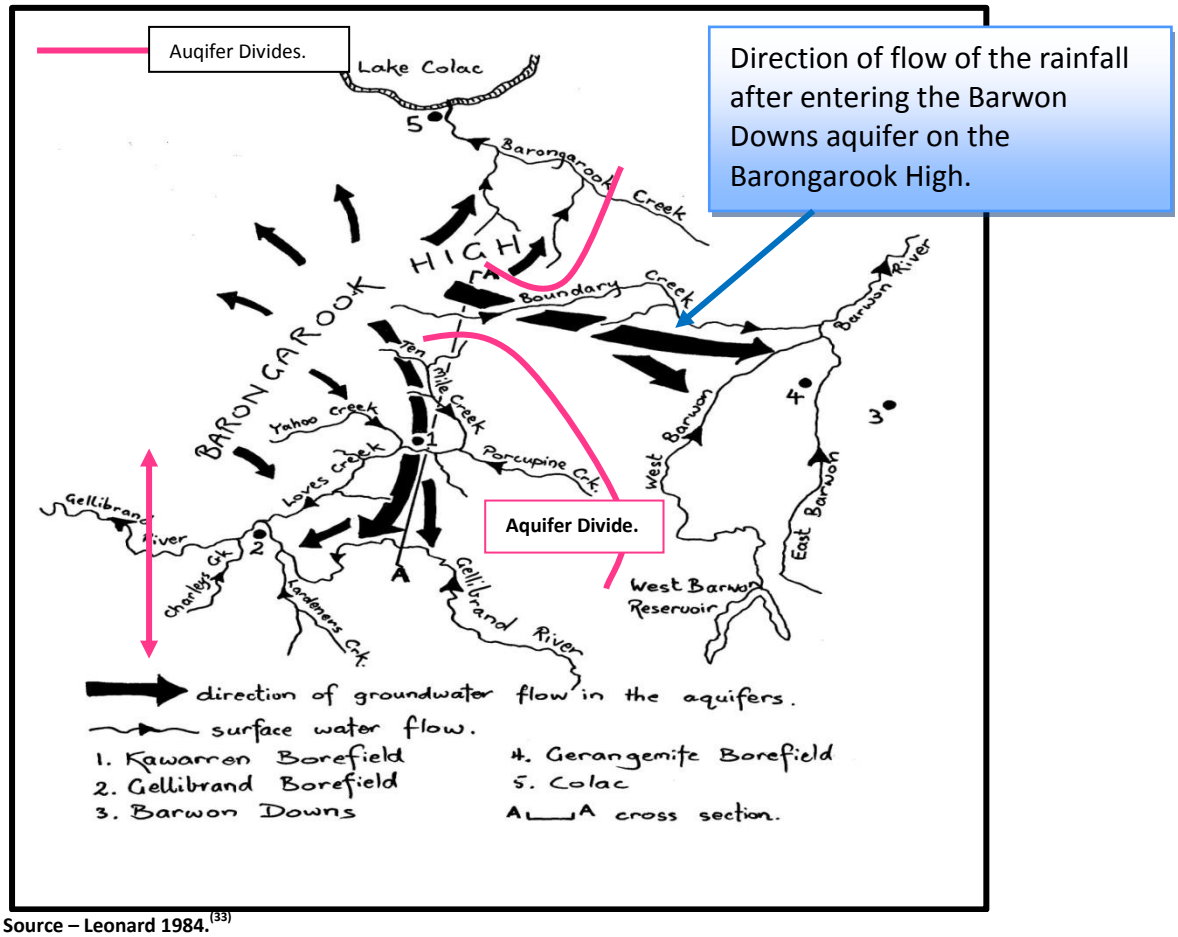
The potentiometric water level of the deep water aquifer throughout the Barwon Downs valley was in the order of 160 metres AHD. Water from any bore drilled into this aquifer with a surface level lower than 160 AHD would be artesian. For example bore number 82840 that is lower than 160AHD, squirted water 8.7 metres into the air and observation bore 109112 squirted water over 18 metres above the ground (see page 70).

Originally the upper reaches of Boundary Creek were swamplands. The actual formation of a creek bed was formed by early settlers in attempts to drain the swamp waters away. In the upper reaches this was largely successful, however, the Big Swamp had resisted all attempts to drain it.

The pH levels in Boundary Creek were similar to other creeks in the area – neutral to slightly acidic.

1984. Leonard.

In 1984 John Leonard[33] indicated that the deep water aquifer under the Barwon Downs Borefield gained the majority of its recharge waters from rain falling onto the exposed aquifer in the Barongarook High region. Leonard's work has been substantiated numerous times since.[12][31][40]



Source – Leonard 1984.[33]

1985. Next Significant Groundwater Extraction.

The next significant groundwater extraction took place in 1985 and Boundary Creek was dry on seven occasions (see graph page 69).

1986. Studies Recommended Before Any Further Groundwater Extraction.

The Department of Minerals and Energy recognised the fact that sustained pumping from the borefield at Barwon Downs could have noticeable impact on the environment within the Boundary Creek catchment. Quentin Farmar-Bowers was commissioned to look at environmental issues that could arise as a result of any pumping.

The **OBJECTIVE** of his work was to...

> "***Develop a program to clarify the environmental issues relevant to the groundwater investigations in the Barwon Downs area and assist in the directing the establishment of the appropriate monitoring program***."

From these findings it was anticipated that various scenarios regarding the sustainability of the aquifer could be drawn.

Farmar-Bowers[21] completed a comprehensive report recommending studies to be completed before any further groundwater extraction was to take place. The results of these studies would provide the necessary pre-pumping comparative data. He found that from the limited data available Boundary Creek had sufficient environmental value to warrant concern.

Farmar-Bowers was explicit when stating that environmental flows for Boundary Creek should be established pre-pumping. Environmental flows have never been allocated.

None of Farmar-Bower's recommendations were conducted before the test pump of 1987 commenced.

From his investigations and figures available to him, Farmar-Bowers stated that the sustainable extraction that the aquifer was capable of producing was 1600 ML/year. When Barwon Water extracted 8 000 ML from this aquifer during the 1982-83 drought Boundary Creek was dry for 4 days during the next summer.

Farmar Bowers also made these important comments in his report:

- The pumping of the Barwon Downs wellfield is likely to create changes in groundwater levels of the order of 25 to 50 metres at the site.
- Aquifer pumping during droughts, as is proposed, would tend to exacerbate the effect of natural variation by extending the effects of drought.
- If there is a deficit of natural flow into wetlands over an extended period some of the environmental changes will have become entrenched and will not be easily reversed.
- Changes may occur quite rapidly within a few years.
- Some of the Boundary Creek riparian area is swamp with fine mud, rich in organic matter several metres deep.
- The dense swamp vegetation prevents floods occurring.
- The saturated zone may shrink in size.
- Aquatic vegetation at spring and swampy areas may be affected as these areas dry out.

- In most of the areas, the change may be gradual, one habitat being replaced by another, however in the wetter areas, (riparian zones adjacent to springs and wet areas), the change may be quite rapid.
- The area has a low agricultural and timber production value as soil fertility is low and some low lying areas are often waterlogged.
- From an agricultural aspect the lowering of the water table in the water logged areas may allow this land to be utilised for agricultural production.

From these comments and observations made by Farmar-Bowers it can be safely said that there were areas that never dried out and the vegetation in the swamps and wetlands was dense, vigorous and healthy. This area was unsuitable for agriculture because of the water logging.

The importance of this report is the descriptive nature of the wetlands abounding Boundary Creek pre the 25 000 mega litres extracted in the test pump period (1987-1990). One of the most significant statements made in the whole of Farmar-Bowers report would have to be this one...

> "***Currently water tables appear to be quite stable and there is little movement between seasons or years***."

This very same observation had been made by farmers as far back as 1912 and this fact is extremely important to bear in mind as the story of detrimental impacts along Boundary Creek and the Big Swamp unfold.

1986-87. Tunbridge Fish Study.[45]

Farmar-Bower states that when preparing his 1986 report he had made personal contact with Tunbridge and was told that in the winter of 1986 Tunbridge had recorded freshwater crayfish, brown trout, short finned eel, mountain galaxias, southern pigmy perch and blackfish in Boundary Creek.

In the summer of 1986-1987 Barry Tunbridge conducted fish studies in the Barwon River catchment. He states in this report[45] that Boundary Creek was the only tributary of the Barwon River that he had studied that contained blackfish.

Paradoxically Barwon Water part funded this study[24] in conjunction with the Arthur Rylah Institute, an authority of the State Government of Victoria. When the Arthur Rylah Institute was commissioned by Barwon Water to conduct the 1990s studies Tunbridge's earlier studies were not recognised.

1986/87. Artificial Recharge into the Deep Water Aquifer.

Because Boundary Creek runs across the deep water aquifer where it outcrops on the surface (see pages 72, 73, 74) it was thought that the simple construction of pits to increase the portion of creek water which naturally infiltrates down into the aquifer would be possible.[39] However, because the water table levels were higher than Boundary Creek, meaning that the aquifer was overflowing into Boundary Creek and was fully recharged at that point, artificial recharge under these conditions would be pointless[39] (see page 16 for the next attempt at artificial recharge).

1987- 1991. Groundwater Extraction Test Pump.

The pressing argument to augment Geelong's existing water supply and especially so during drought, prompted the implementation of an investigative test pump. On March the 10th pumping commenced at the Barwon Downs borefield extracting 25 000 ML of groundwater.

In the 1995[49] report evaluating this test pump it was stated...

"***The overall objective of the groundwater study was to quantitatively assess the groundwater resource potential of the Barwon Downs Graben***."

SUBSIDIARY OBJECTIVES[49] were...

1. To determine the extent of the aquifers in the Graben and the quantity and quality of the groundwater.
2. To identify the flow patterns within the Graben.
3. To quantify the recharge to the Lower Tertiary aquifer from direct precipitation and influent surface streams. (Influent – gaining of water to the aquifer).
4. To examine groundwater movement between the Lower tertiary aquifer and the confining formations. (This is called vertical leakage).
5. To examine the interaction between groundwater and surface water systems.
6. To develop a reliable numerical model with which to assess the response of the Lower tertiary aquifer to different pumping regimes.

By conducting this test pump it was hoped that it would be established that the aquifer could sustain considerable groundwater extraction, enough to satisfy Geelong's requirements for many years. Any groundwater extraction rates were to be designed so the scenario as depicted in this book would not take place – decimation of creeks and wetlands.

Sometime Between 1987 and 1991.

From the very beginning of the test pump it became apparent that the environment was to be given little consideration. The water being extracted from the Barwon Downs Borefield was being sent along the Wurdee Boluc Inlet Channel on its way to Geelong. However, because of repairs on the channel and the fact that the authorities wished the pump to continue the water had to be discharged into tributaries and the East Branch of the Barwon River. This water was many degrees hotter than the ambient temperature of the receiving waters. Dewings Creek, one of the Barwon River tributaries, suffered irreparable damage from huge volumes of this heated groundwater being discharged into it from the test pump. A full account of this fiasco can be found in "Otway Water the Summaries Part 4, Book 6."[23] The following statutory declaration is indicative of this account.

State of Victoria – Evidence Act 1958
[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, John Thomas Callahan ,

of 105 Callahans Road Barwon Downs,

FARMER,

do solemnly and sincerely declare that:-

My family has owned this property I live on since 1850. I am now 67 years old and except for a period when I went away to secondary school I have lived on this Dewings Creek property for my whole life.

I have an extremely thorough knowledge of the environmental background and history of this area. I have watched my father and uncles "tickle" trout in Dewings Creek, fished the blackfish and collected the abundant mussels. The vegetation along the creek was once lush and thriving.

One of the delights was being able to observe 2 colonies of platypus. Dewings Creek has been a vital asset to our farm and having crossed it twice a day during my school days, farmed beside it and utilized its resources, I have developed a comprehensive knowledge of its biodiversity through close observation since the 1940s.

For a period during the 1987 to 1990 groundwater extraction test pumping at Gerangamete, the Geelong and District Water Board began letting large volumes of this groundwater into Dewings Creek. My attention was drawn to this by the huge amounts of steam coming off the water. On closer inspection, I could see that the water had turned an opaque, rusty, dirty brown colour and the smell coming from it was foul and offensive to the senses. I could no longer see the bottom of the stream through this obnoxious water.

I was able to determine that the water was being let out of the Wurdee Bolouc Inlet Channel and I then traced the source back to the groundwater bores. I could then understand why there was steam coming off the water. Our son had his feet burnt from heated water while constructing one of those bores.

I was appalled that this water could be allowed to flow into a stream that contained so much life, life that I had been consistently observing in the creek since I was a young boy. When I saw the water authority letting that hot water into Dewings Creek I was concerned but I did not then know just what a devastating effect it would eventually have on the life in the creek.

Immediately after this event, all vegetation soon died except for willows. The bulrushes, white tussocks and other vegetation disappeared. Because of the lack

of vegetation and until it returned, the creek was eroded and I estimate it dropped by one metre. It took some time to stabilize this erosion.

The two colonies of platypus disappeared and have not been seen since.

Formerly abundant blackfish, trout and eels also disappeared and, if any have come back, there numbers must be very low because I have not seen any. The once abundant bi-valve mussels have all but disappeared.

The heated and noxious groundwater discharge into Dewings Creek was a sudden event but the creek has never returned to the healthy state that existed before the water authority discharged groundwater into the creek.

Also, when I was 9 or 10 years old, I used to go out fishing with Len and Dave Harris in their barracouta fishing boat from Lorne.

Offshore from Anglesea and all but out of sight of land, Dave would stop and throw a bucket overboard into the sea then pull the bucket back in and it was fresh drinkable water. Ducks could be seen swimming in the area as well.

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

Declared at BARWON DOWNS

in the State of Victoria, this 14 day of

MARCH 2008.

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

Before me,

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

Neil Leonard Longmore
50 Fairy Street, Warrnambool, Victoria 3280
an Australian Legal Practitioner (within the meaning of the *Legal Profession Act* 2004)

The Environment Protection Authority (EPA), Geelong Branch, became involved. This authority directed that a better, safer and environmentally sensitive method of discharging this toxic heated water be found. Discharging smaller amounts into a multitude of stream in

the area was the solution. However, the extent of the environmental impacts will never be determined.

Dewings Creek running through Callahan's property at the spot where John used to cross the creek on his way to school.

Platypus colonies, blackfish, trout and macro-invertebrates used to live in this creek before huge amounts of toxic groundwater was dumped into it.

This photograph was taken in 2008. Its dry state is attributed to years of groundwater extraction.

1988. Submission to the South Western Regional Water Enquiry.

In August, a year after the test pump commenced, the Geelong and District Water Board, now Barwon Water, stated that the environment in the Boundary Creek area was being studied, "***... monitoring impact and changes with regular reports and upgrades.***" When Barwon Water was asked for copies of the environmental studies, observations and recordings, none could be produced. Barwon Water stated that the Rural Water Commission, now Southern Rural Water was doing them. Southern Rural Water said the Department of Agriculture and Rural Affairs (DARA) was doing them. Both the Colac and Geelong branches of DARA had no idea about these studies. Nothing had been done.[24] The recommendations made by Farmar-Bowers[21] had never been commenced. Vital pre testing pumping data had not been collected.

1988. A Fatal Mistake.

The following quote was to be repeated over and over again in Victorian Government documents[17] and became a commonly held belief being accepted as true and accurate.

> ***"Because the use of groundwater usually has few adverse environmental effects, it is often favoured over surface sources which can have marked effects."***

However well intentioned, this is not true nor is it accurate. The urban policy makers of the time took this as a green light to exploit groundwater resources while paying little or no attention to the springs, wetlands, creeks and associated ecosystems that relied on groundwater discharge. Having a plentiful supply of reticulated water on tap in the cities and towns fostered a very limited understanding of the importance placed on these sources of groundwater discharge by rural folk and the environment.

Unfortunately it has only been in the last few years some recognition of groundwater and surface water connectedness has been accepted. Hopefully 2010 will see this recognition reflected in dramatic changes being made to ground and surface water management practices.

1989. Bi-partisan Government Committee.

Barwon Water officers reported to the Natural Resources and Environment Committee (NREC), a Victorian bi-partisan Government committee investigating the water resources of the South Western Region of Victoria, that the studies recommended by Farmar-Bowers had been conducted. After being "shunted" from one Government body to another in an attempt to gain a copy of the results of the Farmar- Bowers studies it was found that NONE had been commenced let alone completed.

At this same hearing in March Barwon Water officers stated, "***As indicated previously in evidence to the Committee, the Board wishes to ensure that environmental needs are adequately recognised and safeguarded in any water resource development that it may seek to undertake***."[26]

These words need to be kept in mind as the impacts caused by the water resource development of the Barwon Downs Borefield unfold.

Days of No Flow Along Boundary Creek Skyrocket.

As the groundwater extraction period increased the number of days that Boundary Creek did not flow also increased. 17 more dry days in 1990 (see pages 37, 69). Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continued to flow.

1990. Drawdown as at 15 February.

When the Department of Natural resources and Environment commissioned Witebsky et al.[49] to analyse the results of the test pump at Barwon Downs (1987-1990) the following drawdown map comprised part of the report.

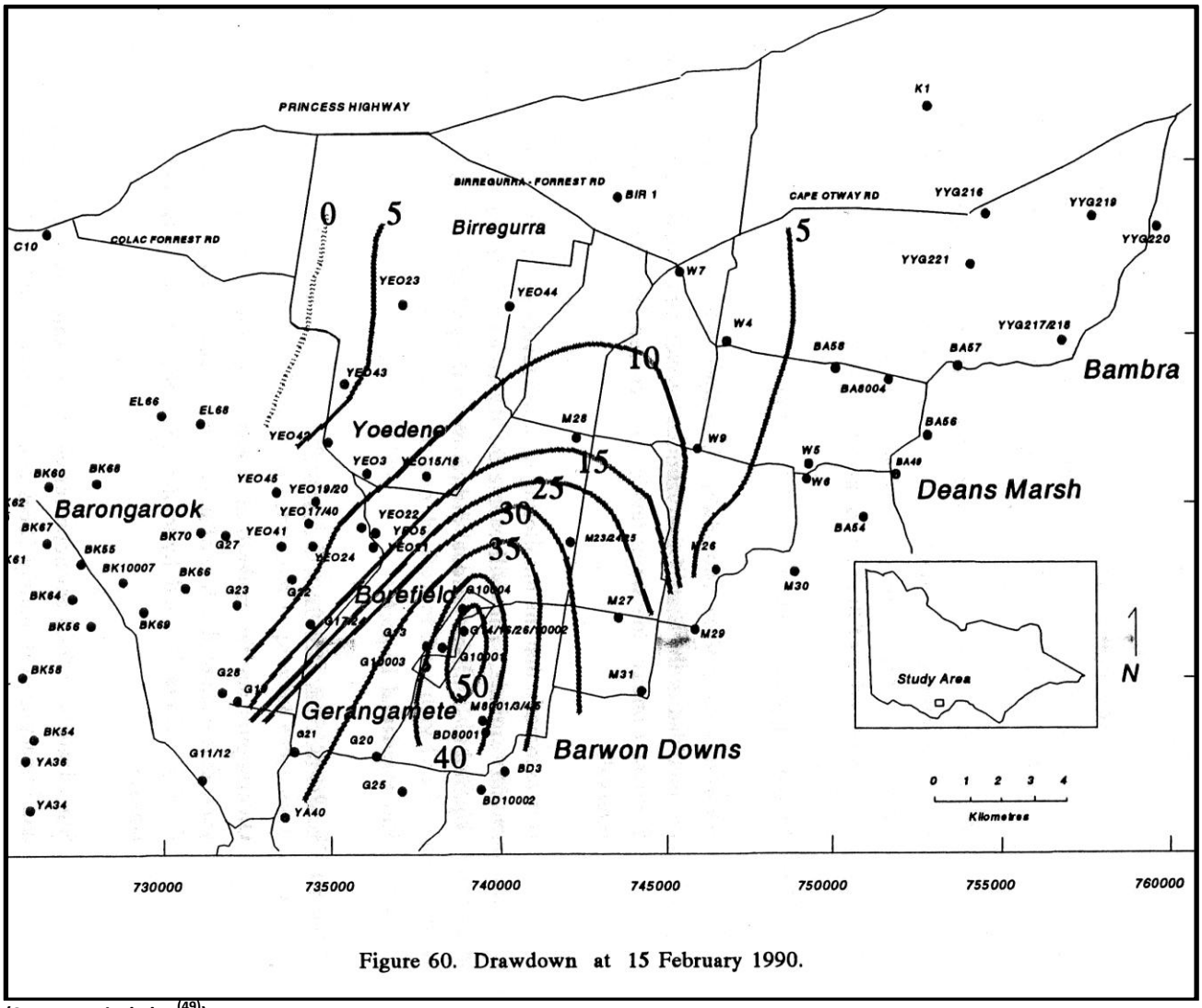
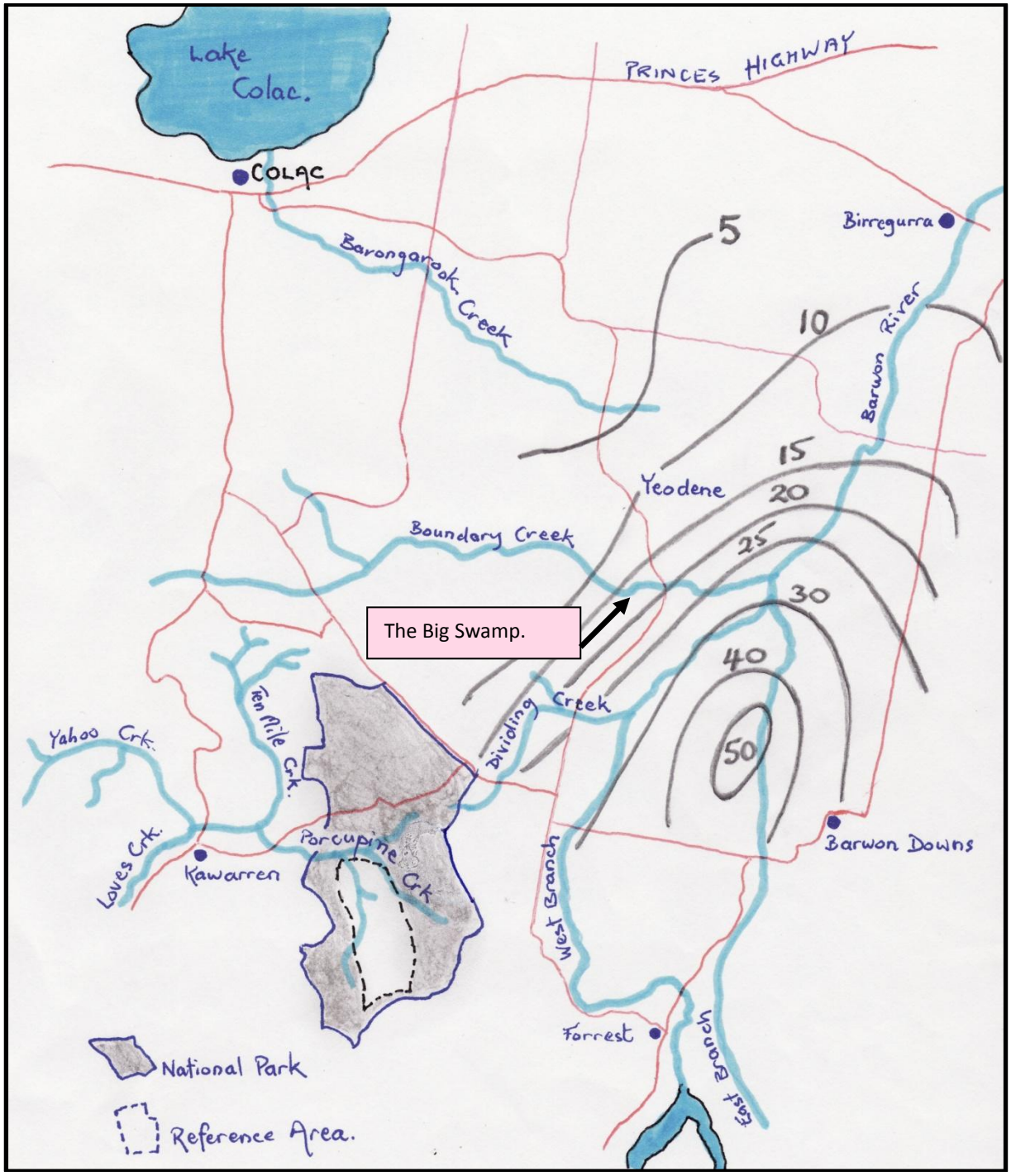


Figure 60. Drawdown at 15 February 1990.

(Source: Witebsky.[49])

These drawdown levels were calculated after the extraction of approximately 25 000 ML of groundwater between 1987-1990. In the vicinity of the Barwon downs Borefield the water tabled had been lowered at least 50 metres in the deep water aquifer.

The map below has these Witebsky drawdown figures superimposed upon it.



Other drawdown maps can be found on pages 29, 49, 50, 68, 72, 73.

1990. Artificial Recharge Useless.

After lowering the water table during the 1987-90 test pump at Barwon Downs, recharge trials were conducted. Recharge pits were dug into the outcropping aquifer in the Barongarook High area. However, the site chosen indicated that artificial infiltration of 1000 ML/year would require several kilometres of pits (see map page 35). The notion was abandoned.[49]

1991. Board Accepts Blame.

In the Colac Herald 18 January on page 3 the headline ran with "**Board Accepts Blame For Dry Creek**." The creek being Boundary Creek.

1992-1994 Studies.

Fish Studies conducted by Arthur Rylah Institute.

Fish studies were conducted in May 1992, October 1992, and June 1993. There was no mention of Barry Tunbridge's 1986-87 findings.[45] If any reference had been made to the Tunbridge report it was ignored(see page 9). This was a significant omission.

Aquatic Invertebrate Studies.

The Department of Conservation and Environment, now called the Department of Sustainability and Environment, were going to conduct these studies but never got around to them.

Flora Studies (Carr and Muir[8]).

Flora studies were conducted in June 1994. Recommendations were made but none have been followed up. Otway Water Book 9[53] is entirely dedicated to the flora studies of 1986, 1994, 2002 and 2009. The inadequacies of these studies is summarised on pages 30-32.

Fauna Studies.

Amphibians, reptiles, birds and mammals were studied in 1993. In the follow up study in 2001 it was stated that this 1993 survey was conducted prior to groundwater extraction. The groundwater extraction graphs on pages 37, 39 show this to be nonsense. Extensive groundwater pumping had been done.

Before any of these studies had been conducted the flows in Boundary Creek and its adjoining wetlands had already been seriously compromised by extended periods of no flow due to groundwater pumping..

1993. Acid Levels in Boundary Creek Begin to Rise.**(see graph page 63).**

In 1993 the acid levels in the water of Boundary Creek started to drop below the 4 pH critical level for instream biota survival. The cause of these dropping pH levels should have been investigation. The longer this situation continued to show up on the regular monitoring at the stream flow gauging station on Boundary Creek, the more obvious it should have been that there was something seriously wrong upstream.

A test strip indicating a pH between 3 and 4 that would have been similar to that experienced along Boundary Creek in 1993.

1994. Recognised that Creeks Will Dry Up.

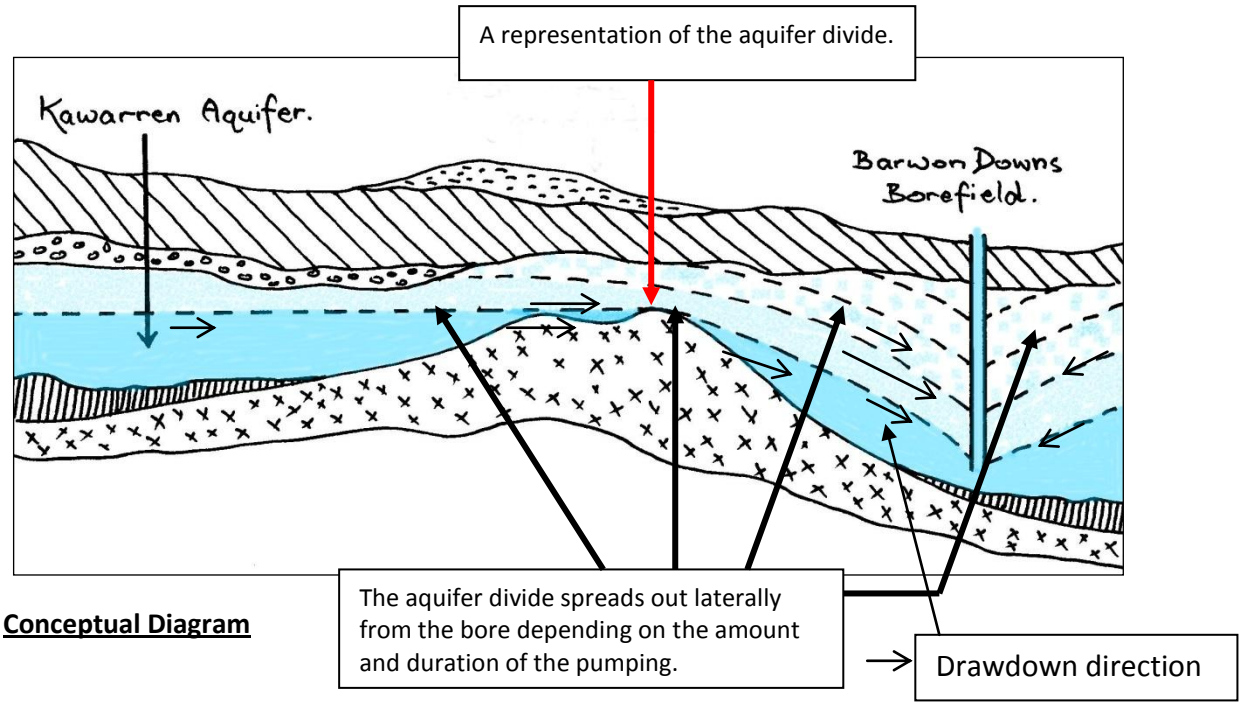
When reporting on a proposal to conduct a test pump at Kawarren, Hydro Technology[32] was concerned that sustained pumping at the Kawarren and or Gellibrand Borefields would have serious impacts drying up creeks such as the Yahoo, Ten Mile and Loves. Also flows in the Gellibrand River were anticipated to be significantly reduced. The most disturbing quote found in the 1994 Hydro Technology report is, "***It is anticipated that large scale extraction in the Gellibrand-Kawarren region will have an influence on flow, in particular Yahoo and Ten Mile Creeks, similar to the effects noted at Boundary Creek due to pumping at the Barwon Downs wellfield.***"

There seems little doubt that the impacts along Boundary Creek were recognised in the early 1990s. However, it is doubtful that the extent of the impact to follow was ever anticipated.

1994. Aquifer Divide will shift.

It is anticipated that the aquifer divide between the Ten Mile and Boundary Creeks would shift towards the Ten Mile Creek Catchment as pumping from the Barwon Downs Borefield progressed.[31] Page 7 indicates the approximate area of this aquifer divide.

The diagram below is a diagrammatical representation of the concepts involving the aquifer divide between the Kawarren and Barwon Downs branches of the aquifer. The aquifer divide will shift towards the Kawarren area in relation to the amount and duration of groundwater extracted. The fact that a divide does exist is certain but why and how it actually functions is still under investigation.



Conceptual Diagram

June 1994. Carr and Muir Report for Barwon water.

Carr & Muir[8] included the following statement when reporting on a flora and fauna survey they conducted for Barwon Water.

"***Another highly significant modification to the physical environment is predictable if watertables are lowered in swampy locations, especially those supporting Scented Paperbark – Woolly Tea-Tree and other wetland vegetation communities. This is the accelerated oxidation of the organic sediments, i.e. peats of several types – see Gibbons and Rowan (1993). When drained, peats become oxidised, lose the greater part of their bulk resulting in slumping of the landscape, and are much more prone to burning – peat fires (Gibbons and Rowan 1993). The particular physico-chemical conditions prevailing in peaty substrates (e.g. pH, aeration, water and nutrient availability) determine the highly distinctive vegetation of these environments.***"

This statement is particularly relevant to the peat fires of 1996, 1997 and 1998 (see page 23).

Scented Paperbark and Wolly Tea-tree in the Big Swamp area.

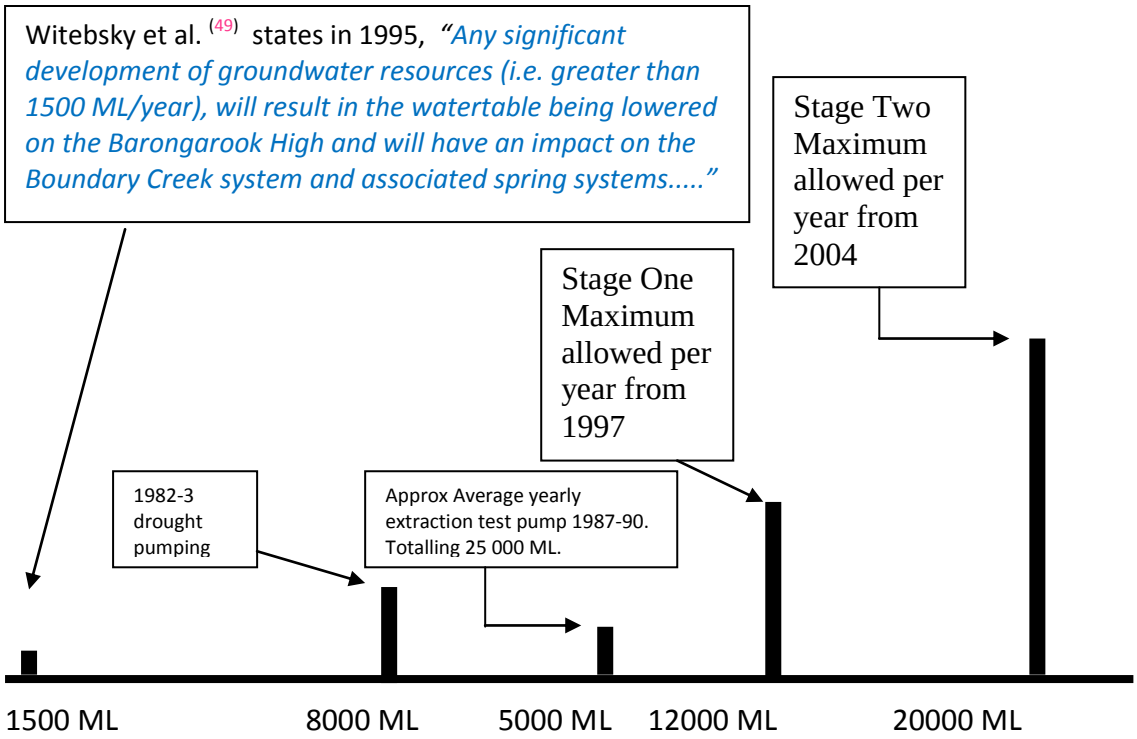
Inland Acid soils have a devastating effect on most vegetation.

1995. The Department of Natural Resources and Environment (DNRE) Test Pump results.

The DNRE now known as the Department of Sustainability and Environment, tabled an extensive report prepared by Witebsky et al.[49] on the 1987-91 groundwater extraction test pump conducted at the Barwon Downs Borefield.
The Preface of this report had this to say,

> *"**The information presented here represents a significant contribution to our understanding of the groundwater systems of the region. It provides a sound technical basis for the establishment of a bulk groundwater entitlement for the groundwater resources within the graben and adjoining areas, under the Water Act 1989**."*

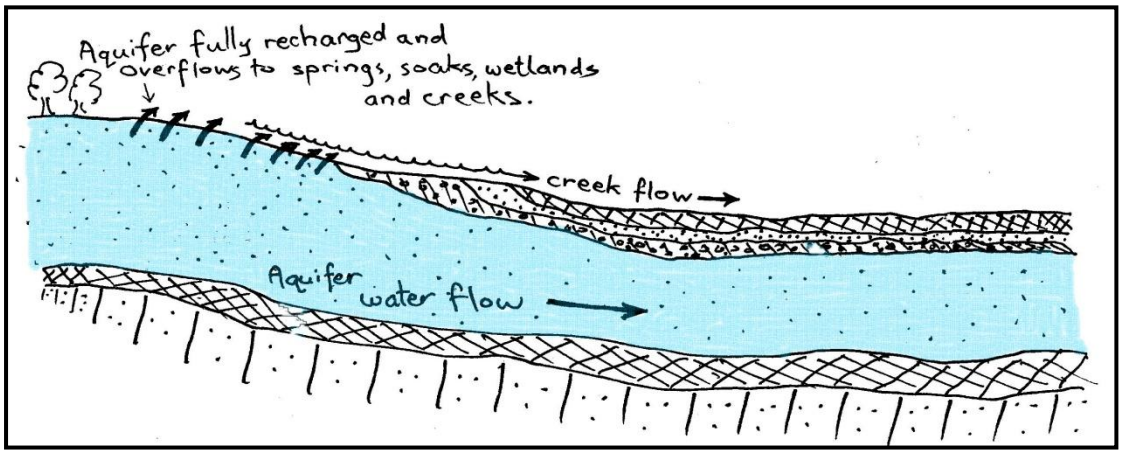
This 300 page report established that Boundary Creek had an average summer flow of 3.2 ML/day and that there were extensive swampy marsh areas adjacent to Boundary Creek. Any significant development of groundwater extraction greater than 1500 Ml/year would result in the watertable being lowered on the Barongarook High and would have an impact on Boundary Creek and associated spring systems. 4 000 ML/year extraction would see a noticeable impact on the flows in Boundary Creek (see graph on page 37). In 1986 Farmar-Bowers calculated the sustainable yield to be around 1500 ML/year.



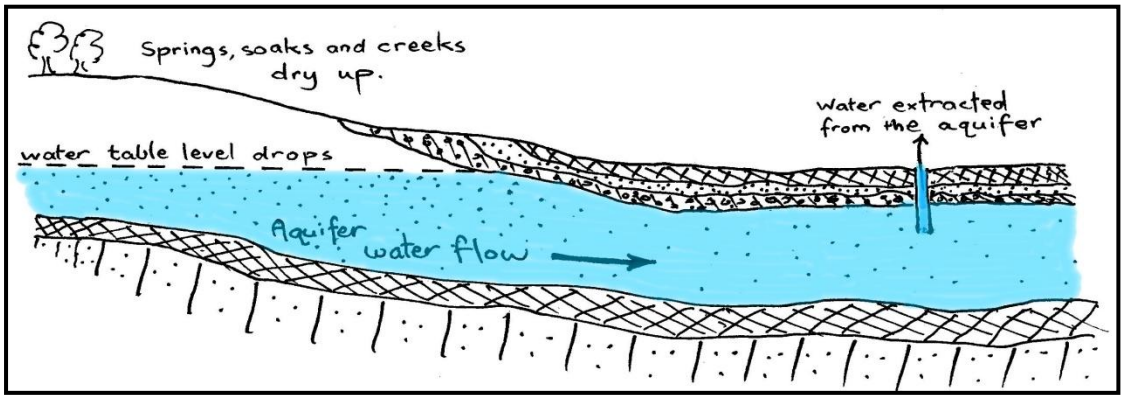
This graph clearly shows that from an environmental point of view the Witebsky et al. recommendations and findings have been completely ignored.

Witebsky et al.[49] found that diminished flows in Boundary Creek were directly attributed to the pumping of groundwater at Barwon Downs and that adverse impacts could take years to reverse.
If the water table is lowered enough Boundary Creek ceases to flow and the adjacent wetlands begin to dry out. This area would no longer discharge water from the aquifer but

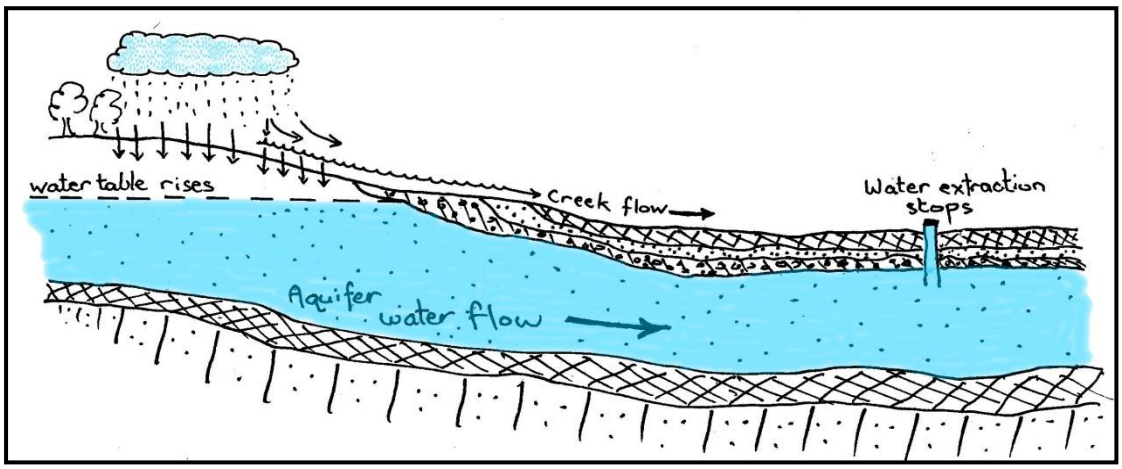
become an important source of groundwater recharge where any surface water would seep downwards replenishing the depleted aquifer below. This concept is diagrammatically presented below.



If the aquifer is full during summer it naturally overflows into springs, soaks, swamps, wetlands and creeks.



Any time water is pumped from an aquifer at a faster rate than it is recharged from rain falling onto the unconfined aquifer the water table level in the aquifer drops. If it drops below the surface it will no longer discharge or overflow into the springs, soaks, swamps, wetlands and creeks - they will dry up.
Normally, at Barongarook High, approximately 16 % of rainfall soaks into the ground to recharge the aquifer. 84% becomes run off as surface water.



Once the water table has fallen below the stream bed of the creek and the creek flows as a result of rainfall a percentage of the creek water can infiltrate down into the unconfined aquifer and speed up the aquifer's recharge.

Figures 1 to 3 look at the above process from a different perspective.

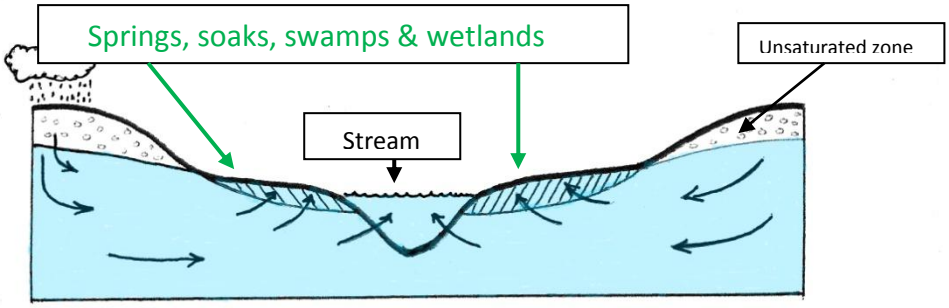


Figure 1. Wetlands and stream interaction with groundwater. In this situation they are regarded as gaining or influent – aquifer overflows.

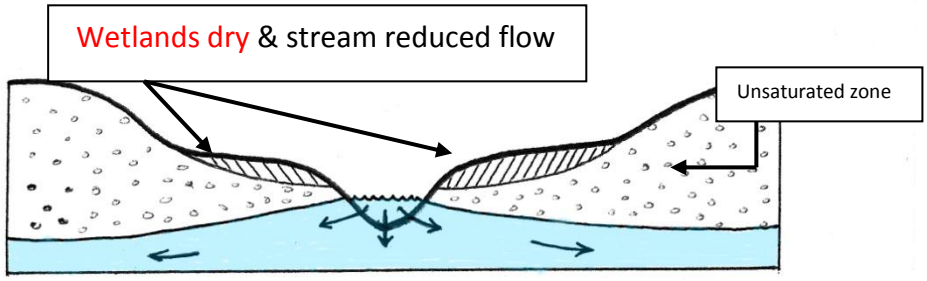


Figure 2. Lower the water table by extracting groundwater and the wetlands and stream are affected when enough water is pumped from the aquifer. The stream is now a losing or effluent stream and is recharging the aquifer.

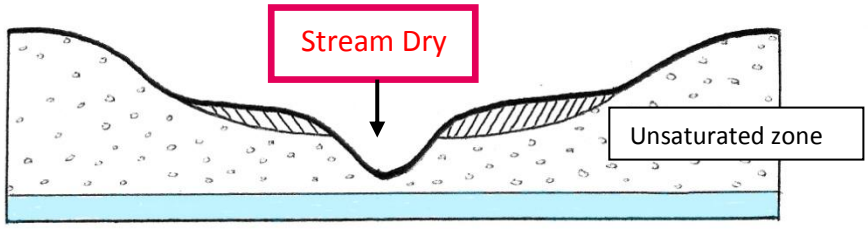


Figure 3. Lower the water table to this degree and the stream will cease to flow in periods of no rain – the baseflow from the aquifer is totally eliminated.

1

Witebsky et al.[49] said that depending on a reliable rainfall and the amount of water extraction at Barwon Downs, watertable recovery in the Boundary Creek area may take several years to recover after the cessation of pumping.

Spring Monitoring.

In regard to spring monitoring Witebsky et al. found that on the basis of limited data available, borefield pumping did not appear to have had a significant impact on springs in

the Boundary Creek spring monitoring area. However, it was stated that insufficient monitoring of spring systems had occurred to enable the impact of pumping on spring flow to be accurately determined. The spring monitoring mentioned by Witebsky et al. as insufficient, was suspended in 1994.

Comparative Study – Groundwater/Surface Water.

Witebsky et al.[49] decided that if significant groundwater extraction development occurred, it would be appropriate to compare environmental impacts with a surface water development. In fact the report concludes that the environmental impacts of groundwater development in the Barwon Downs borefield must be weighed against impacts of comparable surface water developments. This report states it is unfortunate that the scope of the report did not permit such a comparative study.

As it turned out and after this 1995 report was tabled, significant groundwater extraction development did occur at the Barwon Downs borefield between 1997 and 2004. This Stage One development was largely based on the Witebsky report. The decision, made without heeding the advice contained in the report, and thus without a comparative study being made, was therefore not based on sound environmental grounds. To proceed with the extraction of groundwater in the face of this advice would seem to have been a political decision.

1995. Groundwater Extraction Licence Issued - 12 000 ML/year.

Southern Rural Water issued Barwon Water with a licence to extract 12 000 ML/year from the Barwon Downs Borefield.

1996, 1997, 1998 & 2006. Fires Along Boundary Creek.

In 1986 Farmar-Bowers[21] wrote that if Boundary Creek were to become dry environmental changes could become entrenched and not easily reversed. He also indicated that under these circumstances increased fire intensity and occurrences could become a problem.

In the Boundary Creek wetlands he found swamps rich and dense in organic matter several metres deep. In this area water was released from the aquifer forming springs and waterlogged areas. These areas were supporting types of vegetation that coped with periodically or constantly wet conditions and that these areas would be affected by a fall in groundwater level. Farmar-Bowers stated that these saturated zones were likely to dry out or at least shrink in size with groundwater pumping. In the wetter areas the change could be expected to be rapid but whatever the speed of change the wetter dependent vegetation types would be replaced by vegetation of a drier habitat. He also stated that 2 000 ML extraction per year would alter the flow regime of Boundary Creek substantially. Farmar-Bowers calculated the summer base flow from the groundwater source into Boundary Creek to be approximately one megalitre a day.

From an agricultural point of view Farmar-Bowers noted that waterlogging was a major problem along the flats adjacent to Boundary Creek. He believed that lowering the watertable would have improved the land for agricultural production.

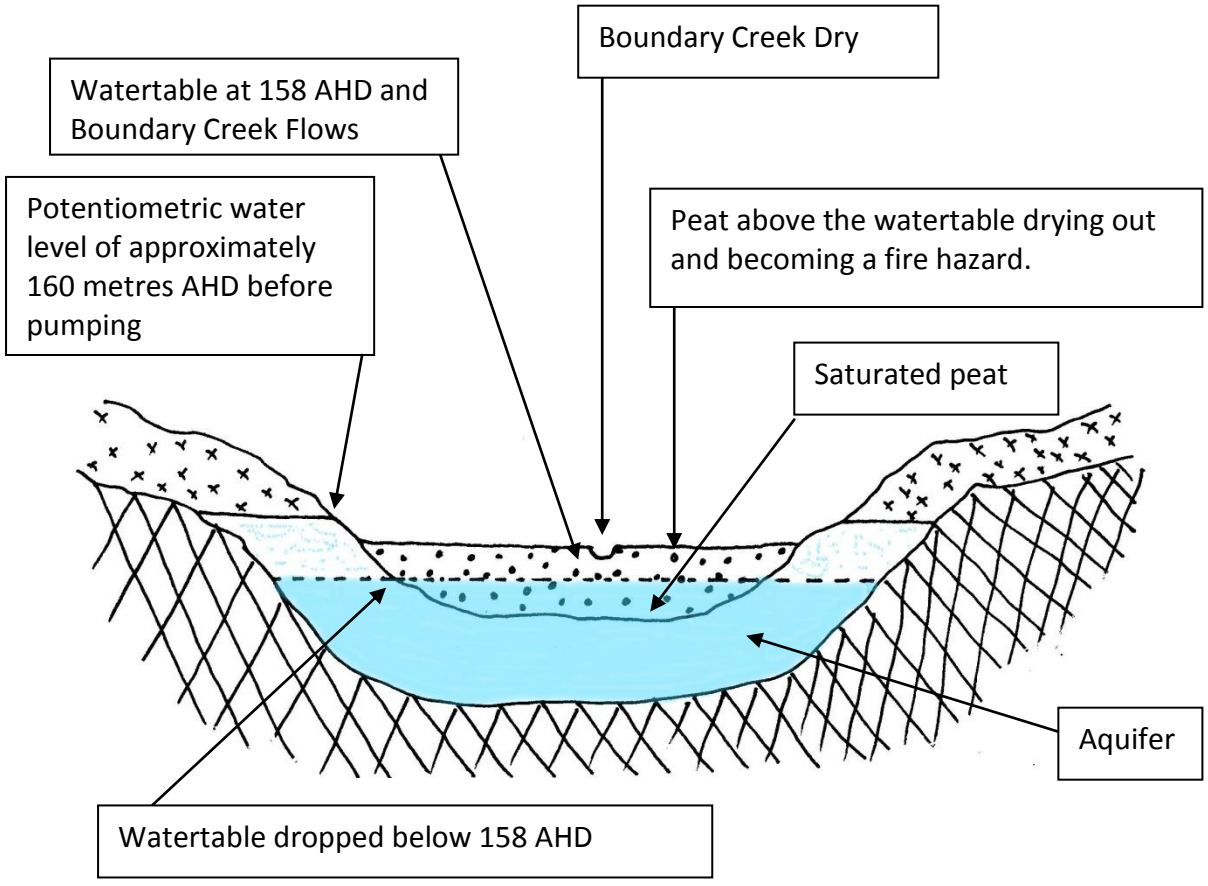
Noting the work of Quentin Farmer-Bowers[21] and from years of local resident observation, it is blatantly obvious that the integrity of the wetlands has not been maintained; waterlogging is no longer a major problem and the swamps rich and dense in organic matter, commonly called peat, have become a major fire risk.

Gibbons et al.[27] writes about drained peat oxidising that results in the lowering of the landscape and the increased risk of burning.

In **1996** a nearby fire spotted into the area known as The Big Swamp igniting the peat (see map page 4, half way between points H & L). From local knowledge The Big Swamp had always been waterlogged and for it to catch alight was unheard of, it was totally unexpected. It took many days and huge volumes of water to put the peat out. The creek bed of Boundary Creek ran through the peat fire location. Huge volumes of water had to be found to put this fire out.

But, on October 10 **1997** the peat, that must have been smouldering, reignited. The difficulty with peat fires is being able to accurately determine when they are completely extinguished. Peat fires could smoulder for years. In a Colac Herald report[9] on a peat fire at Stonyford (Victoria), a Country Fire Authority deputy group leader stated that peat could smoulder for at least ten years, if left unchecked.

As in 1996 huge volumes of water were used to bring the 1997 peat fire under control. However on 12 March 1998 the smouldering peat, along Boundary Creek, once again ignited and caused extensive wildfire in the area. An early wind change prevented mass evacuation (pers com. John Modra who was present at the Country Fire Authority headquarters).



Representation of the concepts being involved – drop the watertable below 158 AHD and Boundary Creek and the adjoining wetlands begin to dry out.

In an attempt to blade off the dry peat to get at the fire sources a bulldozer became hopelessly bogged once it broke into the saturated peat below. In this situation a bulldozer was found to be useless. An excavator had to be used to cross the peat to get at the fire points by laying a timber corduroy road on the peat. Without this the excavator would also have become hopelessly bogged.

Jim Speirs an Otway forester who started with the Forest Commission of Victoria in 1954, was involved in fire hazard reduction burns in the Boundary Creek Big Swamp area. Jim retells that throughout the period up to 1991, when he retired, the foresters would do fuel reduction burns in the Big Swamp area in rubber boots. The foresters would be working in water. Leaves, grass and other matter would burn off down to the water level (J. Speirs. Pers. Com. October 2008).

On 19 September **2006** and within 800 metres of the original fires in the Big Swamp, the peat was once again ablaze. The Colac Herald in an article on the 20 November 2006, stated it took 22 days to extinguish. Once the fire was under control thermal imaging couldn't detect any smouldering activity but no guarantee could be given that the fire in the peat was finally out. To reduce the likelihood of reoccurrence the Country Fire Authority successfully argued that a mineral earth policy be adopted. This involved extensive clearing and removal of vegetation in the 2006 peat fire area.
Local farmer, Michael McDonald, owner of the land where the 2006 peat fire took place, was completely taken by surprise that this area could burn. He had unsuccessfully attempted to drain this area pre the test pump groundwater extraction period. Attempts were made several times including during the 1967 drought. His equipment was unable to do the drainage work because of continually becoming bogged. Eventually taking heed of family history and through his own experiences, Michael had come to accept the fact that this area of his farm could never be farmed, or so he thought.
When the 2002 Flora study[7] was conducted a survey site (Number 25) located in this vicinity was noted as having significant reduction in waterlogged area.
On 8 November 2002 Ian Smith of the Department of Natural Resources and Environment, Colac, stated in a report to the Barwon Downs Licence Renewal Panel that a consultant expressed on going concern over three swamp areas and a gully near site 25.

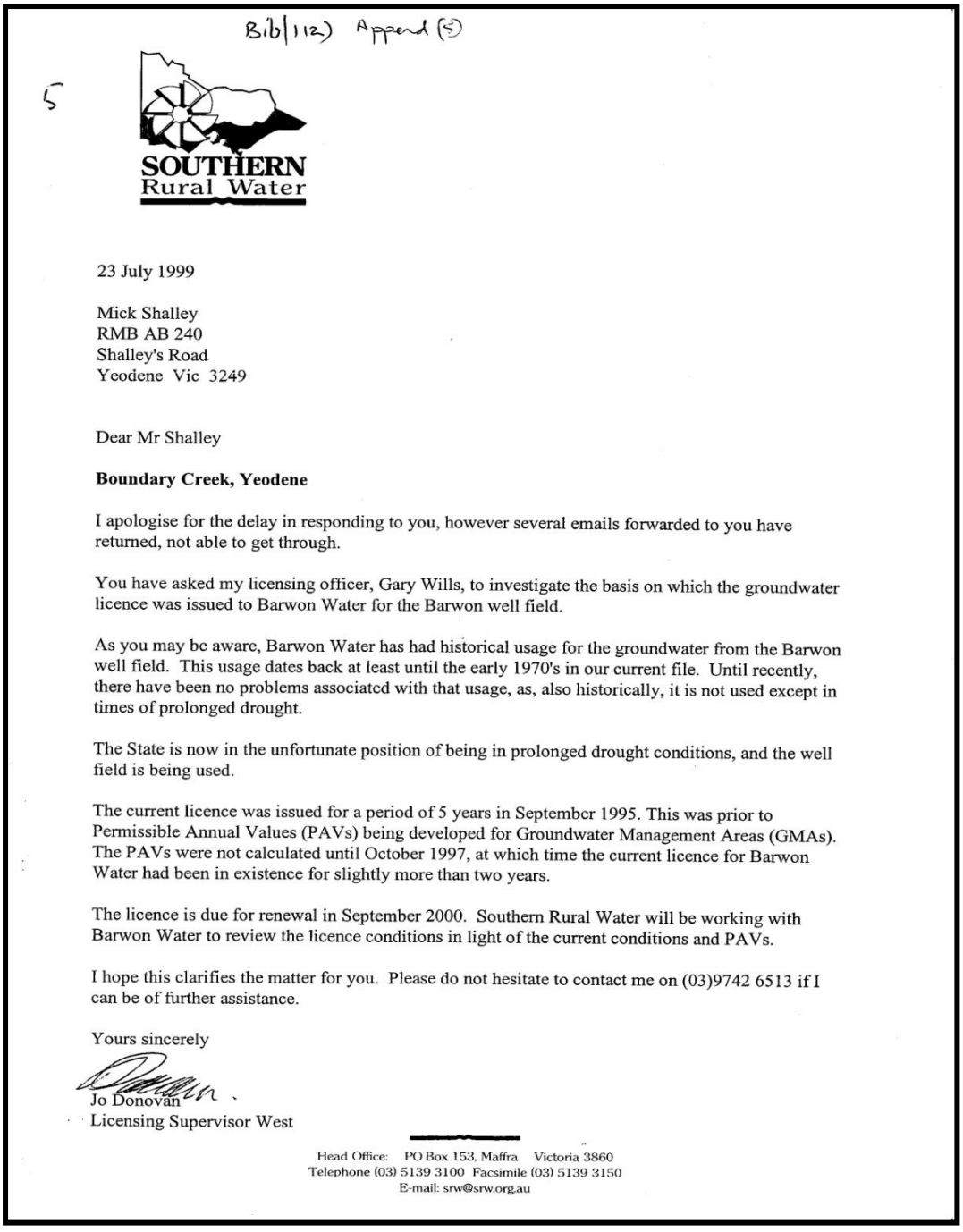
There can be no doubt that the lowering of the water table due to groundwater extraction was the main reason for the wetlands drying out and as a consequence being susceptible to fire. When Farmar-Bowers made his prediction back in 1986 he was not aware how intense the fires and situation would be.

September 1997 Barwon Water Begins Pumping Again – Stage One.

One month before the Permissible Annual Volume was set at 4 000 ML/year for groundwater extraction at the Barwon Downs Borefield, Barwon Water began to pump from the borefield exercising for the first time a licence granted 2 years previous.

October 1997 Permissible Annual Volume (PAV) Established.

The PAV was set at 4 000 ML/year.[24] However, because Barwon Water was exercising the licence given in 1995, the imposing of the 4 000 ML/year PAV would not be applicable until this licence ran out in 2002 (see letter page 26).



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

The Department of Natural Resources and the Environment (DNRE), Victoria, commissioned Sinclair Knight Merz to calculate a PAV for the Gerangamete Groundwater Management Area.[13] This area includes the township of Barwon Downs and covers the Boundary Creek catchment and the Gerangamete borefield, which is more commonly known as the Barwon Downs Borefield. This particular document was dated January 1998. However, the PAV was calculated and stated as policy in October 1997 (see letter above).

In the DNRE document it states, ***"The purpose of the PAV is to provide the rural water authority with a limit to which groundwater licences may be issued within the GMA, based on the long term sustainable yield of the aquifer system."*** (GMA - Groundwater Management Area).

The Gerangamete GMA Permissible Annual Volume was calculated primarily as a result of Barwon Water needing groundwater from Barwon Downs as a water supply for Geelong. As part of its Gerangamete GMA Permissible Annual Volume determination Sinclair Knight Merz[13] referred to a Department of Natural Resources and Environment (DNRE) document [14] and quoted this, ***"The report concluded 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."***

There was no mention that huge amounts could be extracted in any one year, for example 12 000 ML/year. In 2004 the licence was set at 20 000 ML/year with no more than 80 000 ML in a ten year period and no more than 400 000 ML over one hundred years. Huge extractions like this were totally in conflict with the notion of a Permissible Annual Volume. Annual - being defined as 4 000 ML a year; 4 000 ML a year and no more. Anything over this limit would be in direct conflict with the spirit of the PAV.

December 1997. Special Gazette Number S 160.

The Victorian Government published a Special Gazette, Number S 160,[48] specifying certain management principles to be applied to groundwaters of Victoria.

- The protection of existing and potential beneficial uses, including:
  - Ecosystems,
  - Stock and domestic water,
  - Agriculture, and
  - Primary contact recreation.
- The intergenerational equity and precautionary principle.
  - An interpretative definition of the precautionary principle is, "There is a problem until it is proven otherwise, NOT that there is **no** problem until one is created."
- Protection agencies (e.g. Southern Rural Water, the Environment and Protection Authority, the Department of Sustainability and Environment, the Corangamite Catchment Management Authority and the Colac Otway Shire) must implement the policy.

The implementing of these and other specifications to the management of groundwaters were based on sound management practice of the time and should have been strictly adhered to with any new groundwater project. When renewing the groundwater extraction licence in 2004 it would appear that the intent of this Special Gazette was ignored.

1998. Long Term Impacts Significant.

Hatton (CSIRO) and Evans[29] (Sinclair Knight Merz) wrote in 1998, "***It is clear that long term and permanent use at the Barwon Downs borefield would have a significant impact on ecosystems in Boundary Creek and adjacent vegetation.***"

1998. Permissible Annual Volume Project.

The Permissible Annual Volume[13] report was distributed January 1998. Three quotes from this report are worthy of particular note.

1. Page 7. "***A comprehensive review of the hydrological 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 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 sustainable use of the resource, than can be undertaken by the PAV project."

2. Page 9. "***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***."
3. Page 10. "***The volume (4 000 ML/year) has been adopted from the results of a comprehensive study of the groundwater resources, which included groundwater modelling in the Barwon Downs Graben undertaken by DNRE (1995)***."
   (DNRE – Department of Natural Resources – now called the Department of Sustainability and Environment.)

1999. Supplementary Flow Trials.[24]

Because Boundary Creek was regularly drying up and farmers' stock and domestic supplies were being seriously impacted Barwon Water began supplementing flows in Boundary Creek by releasing water from the Colac Otway pipeline (see page 4, point L).

2000. Barwon Water Seeks Change to Planning Scheme.

The Gerangamete Flats Landcare Group presented a submission to the Colac Otway Shire when Barwon Water was seeking a change to the Planning Scheme C5. The Landcare Group was concerned with loss of aquatic life, loss of riparian habitat, creek-bank subsidence and farm water shortages. The submission made a point of lack of public consultation, little concern for the environment or the local and regional landholders.

Creek Bank Subsidence.

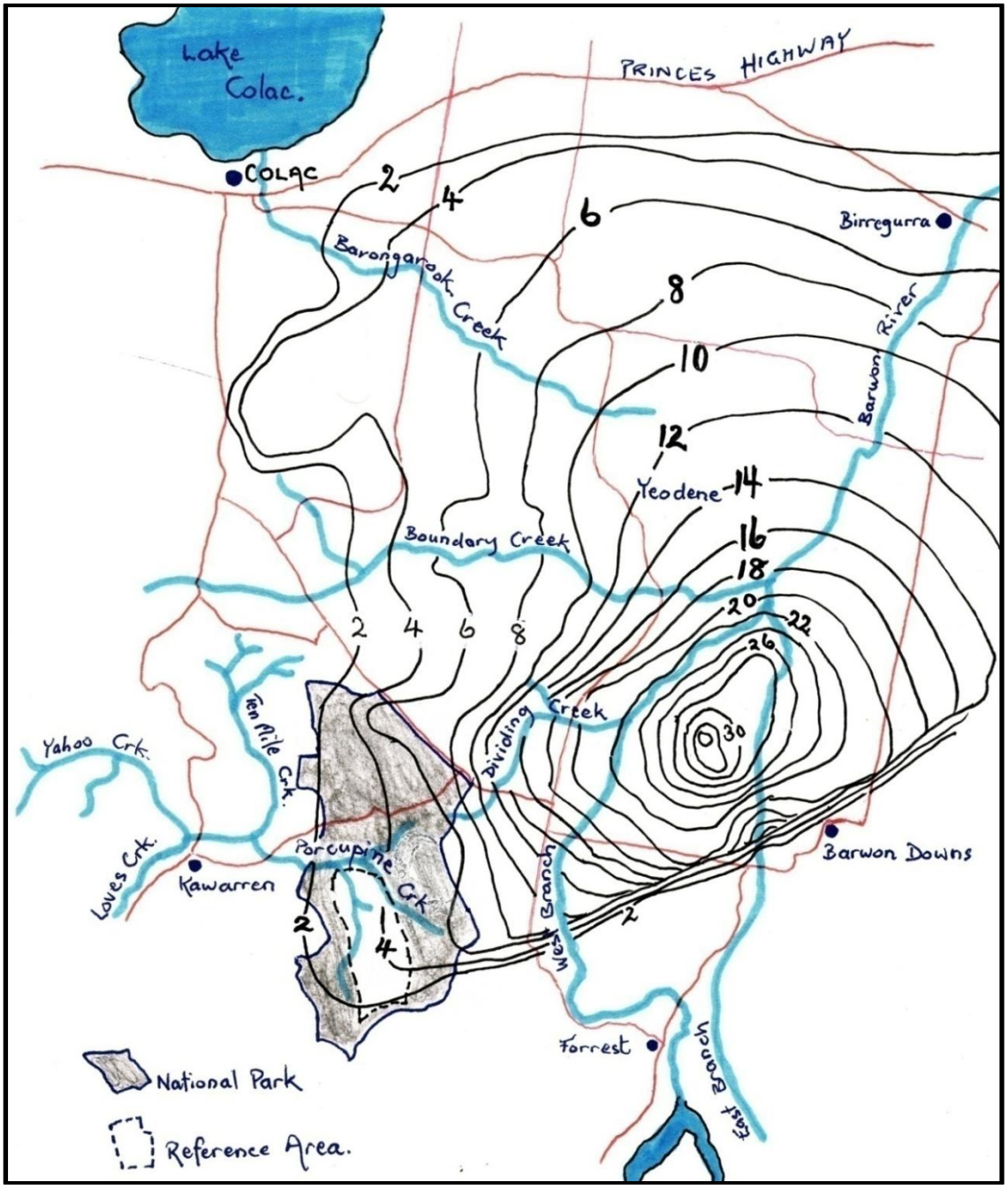
Boulton et al.[6] refers to river bank storage of water and where a river summer base flow is uncoupled from the river there is quite often physical changes in the stream bed and banks. In all probability the wetted banks of Boundary Creek maintained their integrity through capillary action. Once the creek dried out the witnessing of the crumbling banks became quite obvious to farmers with years of local knowledge.

2002. Stage One Licence Due for Review.

The extraction licence at Barwon Downs was due for review in September 2000 but for some reason the process did not appear to start until 2002. One reason could have been that the fish, flora and fauna studies referred to on page 30 needed to be completed.

In the mean time the licence extraction rate for Stage One was increased from 12 000 to 12600 ML/year. The process that brought this increase about has never been explained. It is quite strange because Barwon Water was not utilising its full 12 000 ML/year rights anyway. This is a mystery yet to be solved.

2000. Drawdown Figures.



(Source: Barwon Water handout 2000 superimposed over local map.)

Groundwater extraction between 1998 and 2000 was approximately 28 000 ML. The drawdown figures in this map indicate a lowering of the deepwater aquifer to be in the order of 34 metres in the vincinity of the Barwon Downs Borefield.

2001. Boundary Creek Dry 280 days.

Since the summer of 1984 Boundary Creek had been dry on 280 days (see page 69). Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continue to flow.

2001 -2002. Gerangamete Flats Landcare Group.

The Colac Herald ran with two reports, 20 July 2001 and 15 May 2002 where the Gerangamete Flats Landcare Group was claiming that groundwater extraction was affecting riparian vegetation along Boundary Creek and had killed aquatic life including platypus and fish species.

2001-2002. Studies Completed.

There was no doubt that there were extensive reserves of groundwater that could be extracted from the Barwon Downs Borefield. However, before a new licence was to be issued for Stage Two, attempts were made to determine the sustainability of the aquifer. As part of this renewal process Barwon Water needed supporting evidence to justify an increase in the amount of water that could be pumped from the aquifer at the Barwon Downs borefield. Many studies and reports were prepared and scrutinised in this process.

During this period the use of the word sustainable came in vogue. Unfortunately the term sustainability is often defined depending on the result required. From a hydrological sense the water reserves in the aquifer were sustainable for many, many years. Under this definition any extra water sucked down from surface flow or vertical downwards leakage from higher aquifer formations, was regarded as part of the sustainability process. If sustained pumping from a deep water aquifer caused springs, streams and wetlands to dry up and become recharging sources for the same aquifer, this is seen by some as adding to the sustainability of the resource. However, environmental and social values would not be sustained under this regime.

In other words the groundwater could be pumped from the deep water aquifer for an indefinite period. However, when reviewing the extraction licence for the Barwon Downs Borefield the environmental and social impact should have been considered as well. An Evans report[19] states that the nationally agreed definition of sustainable yield for groundwater systems is as follows, ***"The groundwater extraction regime, measured over a specified planning timeframe that allows acceptable levels of stress and protects dependent economic, social and environmental values."*** To increase an aquifer's "sustainability" by drying up streams, springs and wetlands could not be regarded as protecting environmental or social values. Neither should causing higher aquifers to vertically leak down into the lower deep water aquifer be regarded as increasing the aquifer's sustainability.

When the renewal of the Barwon Downs Borefield extraction licence was being considered the social impacts appeared to be covered by the representation of local landholders on the steering committee. Earlier Otway Water books[23][24][25][52] illustrate that consideration of social impact was purely a token effort. Local contribution and knowledge was basically ignored.

The environment was reportedly being catered for through fish, flora and fauna studies and by representation from the various environmental Government authorities.

However, from a social and environmental viewpoint this whole process was farcical.

2001 Fish Studies.

This study summarised the 1992-93 and 2001 findings and stated that a total of four fish species were captured.

Three indigenous species – Mountain galaxias (Galaxias olidus), Short-finned eel (Anguilla australis) and Southern pigmy perch (Nannoperca australis). An introduced species being Redfin (Perca fluviatilis).
Indigenous crustacean species Land yabby (Engaeus sp.) and Freshwater shrimp (Paratya australiensis) were also captured.
The 2001 report concluded that in general, there was at that stage not enough data to suggest that the population structure of density of aquatic fauna had altered significantly within Boundary Creek since the surveys were initiated in May 1992.
The report went on to say there were some anomalies and suggested that follow up studies be carried out.
None of the recommendations in this report were ever implemented; Barry Tunbridge's report was still overlooked and local landholder's (Nellie Shalley) assertion that there used to be abundant blackfish pre pumping was ignored (see page 42).

Flora Studies.

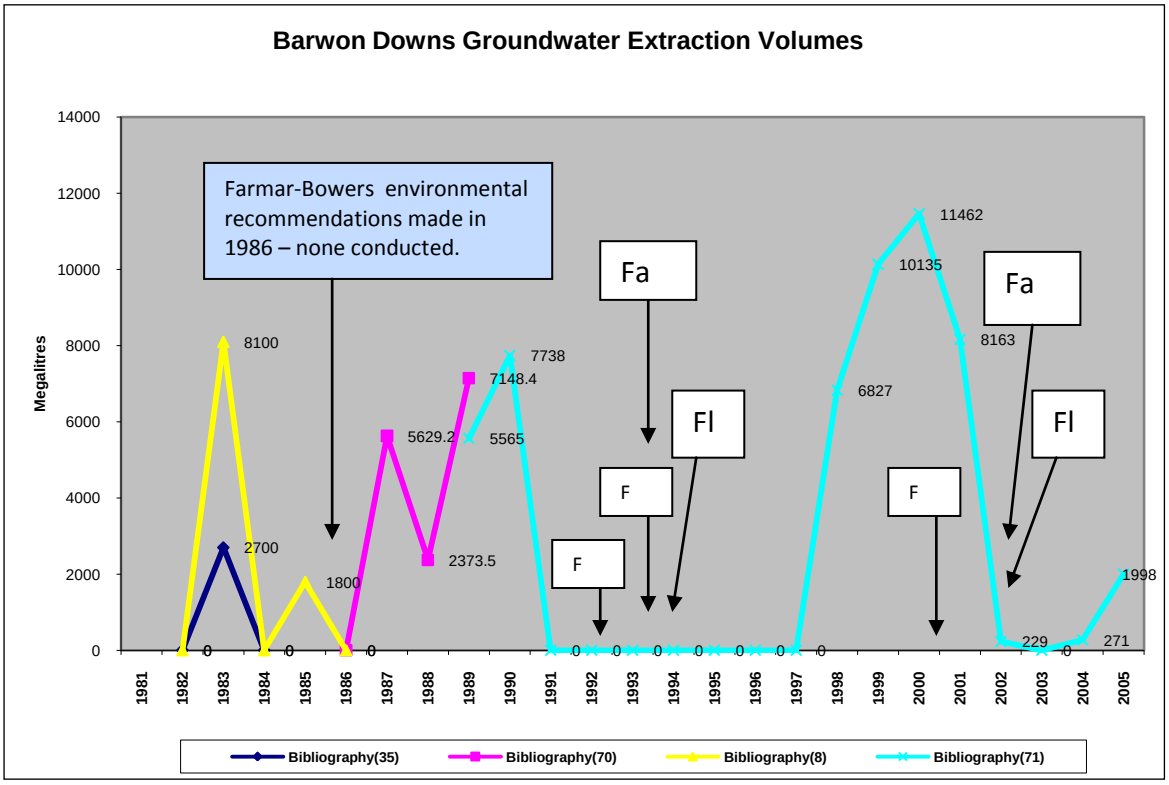
The 2002 report was aimed at concentrating on hydrological sensitive vegetation sites in the Boundary Creek area. 32 of the 1994 study sites were chosen to be resurveyed. Recommendations made in 1994 were mirrored in the recommendations made in this report. The 1994 recommendations had not been implemented.
It is most intriguing that the 2002 flora survey found Scented Paperbark species being affected by increased insect and pathogen attack. These symptoms were predicted by Farmar-Bowers back in 1986 as signs of a lowered water table due to groundwater extraction.

Fauna Studies.

The 2002 report stated that compared to the initial survey of 1993 it suggested that the extraction of groundwater had not had a long term impact on the fauna dependent aquatic and riparian habitats. It was also stated that the 1993 survey was carried out before any groundwater extraction had been undertaken.
The report concluded that because of a lack of control sites it was difficult to draw any definite conclusions on the impact of pumping groundwater. Difficulties encountered was to become an often used statement justifying inconclusive results.

To provide an accurate pre pumping data base these studies should have been done prior to the 8 000 ML extracted in the drought of 1982-83. It is also nonsense when this 2002 report states that the fauna surveys were commenced prior to groundwater extraction (see graph page 37 "Barwon Downs Groundwater Extraction Volumes").
Appropriate control sites have never been established nor have there been any follow up fauna studies.

The graph below clearly shows that the various environmental studies conducted by Barwon Water took place long after extensive groundwater extractions had taken place. It is most apparent that if the people conducting these studies had been made aware of earlier facts, studies and local knowledge they would have reached markedly different conclusions. Fortunately for Barwon Water the results of these studies did not indicate the devastation that was taking place along Boundary Creek and in the adjoining wetlands. Perhaps the study briefs were too limiting. However, Barwon Water was able to claim little environmental impact. A greatly increased extraction licence was to be issued as a result.



(F *indicates when the fish studies were done;* Fa *the Fauna studies and* Fl *the flora studies.)*

Bibliography (35) - figures from the June 2002 Northey briefing on the Barwon Water Licence Renewal Project. **Bibliography (70) -** figures from the June 1989 Barwon Downs Groundwater Test Pumping Progress Report No. 8. **Bibliography (8)** - 1995 figures calculated from a Department of Natural Resources and Environment Report (Witebsky et al.) **Bibliography (71)** – figures from a Freedom of Information reply from Barwon Water November 2006 (Barwon Water Reference 15/260/0003X(3)).

The bibliography references in the above graph refer to bibliographies found in "Otway Water Book 1."[24]

February 2002. Impacts on Boundary Creek Barely Discernable Over 100 Years.

In February 2002 Sinclair Knight Merz[42] table a report concluding that for all of the pumping scenarios investigated impacts, from a hydrological point of view, would be barely discernable along Boundary Creek when taken over a 100 year period. However, from an environmental point of view detrimental impacts have been enormous.

June 2002. Northey Presentation at 1st Meeting, Stage One Licence Review.

On 17 June 2002 Paul Northey of Barwon Water, delivered a Powerpoint presentation titled, "Barwon Downs Aquifer-Historical, Existing and Future Development," as a briefing at the Barwon Downs Licence Renewal Project-1st meeting. Slide 13 of this presentation stated that studies conducted by Barwon Water concluded that drawdown ***does*** occur in the recharge areas and Boundary Creek ***is*** affected by pumping at the Barwon Downs borefield.

2002. Concerns of the Upper Barwon Landcare Network.

In 2002, Peter Greig President of the Upper Barwon Landcare Network, in a submission[28] to Barwon Regional Water Authority's Licence Renewal Panel, reported that groundwater extraction effects similar to those being experienced along Boundary Creek were apparent along many creeks including Barongarook Creek. Looking at the map on page 29 would indicate that there is also considerable influence in the National Park vicinity. If this is the case it would appear that the Gellibrand Groundwater Managment Area is being impacted upon from groundwater extraction at Barwon Downs.

Spread of the Impact.

It is feasible to suggest that there is a drawdown affect well outside the expected area of impact. Thompson[44] in 1971 calculated that 3000 acre feet of groundwater was flowing into Lake Colac. He also stated that the seepage losses of lakes in the area to groundwater could range between 12 and 20 % in drier periods. Blake[5] as late as November 1995 made a recommendation that groundwater discharging into Lake Colac should be quatified. He also makes mention that the drying out of wetlands and the lowering of lake levels in the area are the main risk if there is an over exploitation of the groundwater.

By 2002 Licence Increased.

By the time the Barwon Downs Borefield licence was due for review the licence had been increased to 12 600 ML/year.

The lengthy process of reviewing the groundwater extraction licence took another two years to complete.

2003. Barwon Water Resource Development Plan.[4]

Between 1982 and when this Plan was written Boundary Creek had been dry on 407 days and 64 900 000 000 litres of groundwater had been pumped out of the aquifer at Barwon Downs. Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continued to flow.

Barwon Water's 2003 Water Resources Development Plan states that the Barwon Downs Borefield is sustainable, "***Extensive studies indicate the proposal is sustainable,***" (Page iv of the Plan) and that Barwon Water "***... perform***(s) ***its functions in an environmental way***." (Page 3 of the Plan)

The Plan states that groundwater extraction from the Barwon Downs Borefield reduces the baseflows in Boundary Creek by about one megalitre a day. No mention is made that Boundary Creek has been drying up.

This Plan also has this to say, "***No long-term flora and fauna impacts have been detected in the Boundary Creek area resulting from the operation of the Barwon Downs wellfield.***"

This is not surprising considering recommendations made in 1986 and the early 1990s to conduct studies that would provide adequate longitudinal comparative data were never implemented.[53]

Barwon Water's 2003 Plan[4] states that. "***Additional flora and fauna surveys could be carried out, although by supplementing flows in Boundary Creek impacts on flora and fauna should be eliminated.***" A statement such as this is based on wishful thinking.

Unfortunately the studies and research required to reach such a conclusion that the supplementary flows eliminate the impacts on flora and fauna have never been done. Although no photographs have been found showing the state of Boundary Creek when it was dry in 2003, it can be assumed that it would be very little different to the pictures taken in 2007 below.

Photo *taken at Boundary Creek on the 15 May 2007 at the stream flow gauging station Number 233228 immediately below the bridge on the Colac to Forrest Road* *(see page 4 point I).*

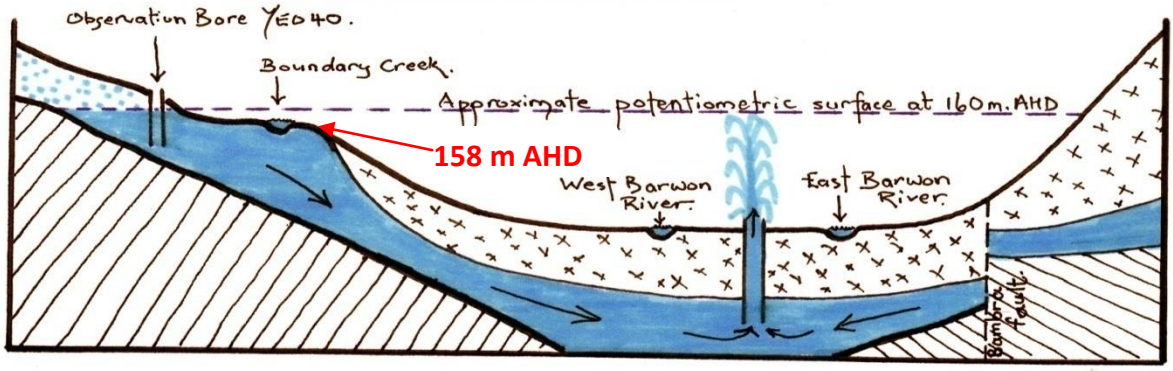
Photo *taken looking east just below the photograph above.This shot was also taken on 15 May 2007*

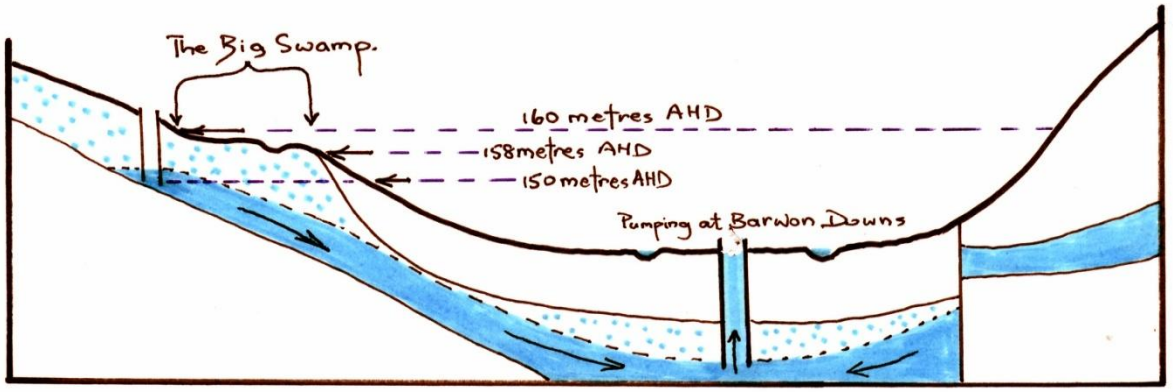
2003. Maintenance of Stream Flow Trigger Level Recommendation.

Sinclair Knight Merz[50] recommended that observation bore Yeo 40 have a maintenance of stream flow trigger level for Boundary Creek set at 158.5 metres Australian Height Datum (AHD).

Sinclair Knight Merz (SKM) calculated that if the potentiometric level of the water held in the deep water aquifer dropped below 158 m AHD then Boundary Creek would most likely cease to flow. A half metre tolerance was allowed making the critical trigger level 158.5 m AHD.

The SKM[50] report stated that, "***Pumping from the Barwon Downs borefield reduces groundwater discharge to Boundary Creek. Barwon Water will be required to supply water to the creek at times when groundwater pumping is causing unacceptable impacts on the stream.***"



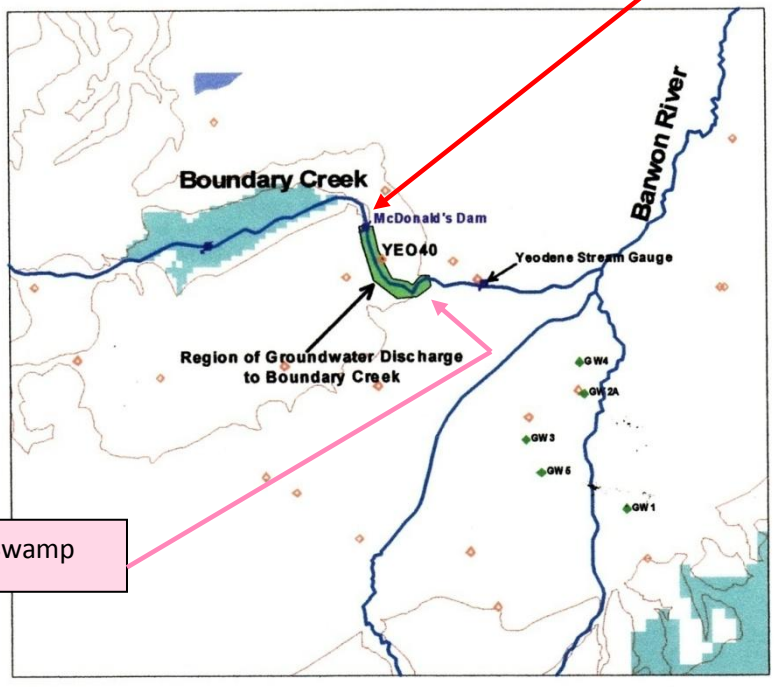


These two diagrams above are representative of the concepts involve. If pumping at the Barwon Downs Borefield lowers the potentiometric level below 158 m then Boundary Creek dries up.

SKM

Barwon Water
Recommendations for Groundwater Licence Conditions
14 May, 2003

■ **Figure 3-1 Region of groundwater discharge to Boundary Creek**



Area of Artificial Recharge Trials 1990

The Big Swamp

The green section on this map clearly shows the area where the deep water aquifer discharges into Boundary Creek. This area covers the Big Swamp wetlands.

2003. Victorian Government Special Gazette Number S 107.

The year before Southern Rural Water granted the 2004 Stage Two licence to extract 20 000 ML/year from the Barwon Downs borefield, the Victorian Government published the Victorian Government Gazette Number S 107[46] and included these items to be addressed when dealing with waters of Victoria:

- ***The principle of integration of economic, social and environmental considerations.***
  - *Sound environmental practices and procedures should be adopted*
  - *Effective integration of economic, social and environmental considerations in decision-making processes with the need to improve community well-being and the benefit of future generations.*
- ***The precautionary principle.***
  - *If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*
  - *Decision making should be guided by a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable.*
- ***The principle of intergenerational equity.***
  - *The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*
- ***The principle of conservation of biological diversity and ecological integrity.***
  - *The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making.*
- ***The principle of shared responsibility.***
  - *Protection of the environment is a responsibility shared by all levels of government and industry, business, communities and the people of Victoria.*
- ***The principle of enforcement.***
  - *Environmental requirements should be enforced.*
- ***Principle of accountability.***
  - *Access to reliable and relevant information in appropriate forms to facilitate a good understanding of environmental issues.*
  - *The opportunities to participate in policy and program development.*
- ***There should be no increased water allocation approved unless it is subject to a process which is designed to provide environmental flows.***
- *Groundwater managers need to ensure that their activities do not pose an environmental risk to surface water beneficial uses, particularly through the excessive extraction of water and the subsequent prevention of surface water environmental flows, and through reducing the quality of adjoining surface waters.*
- *Water managers must ensure that groundwater quality does not impact on the beneficial uses of surface waters and vice versa.*
- *Persons who generate pollution and waste should bear the cost of containment, avoidance and abatement.*

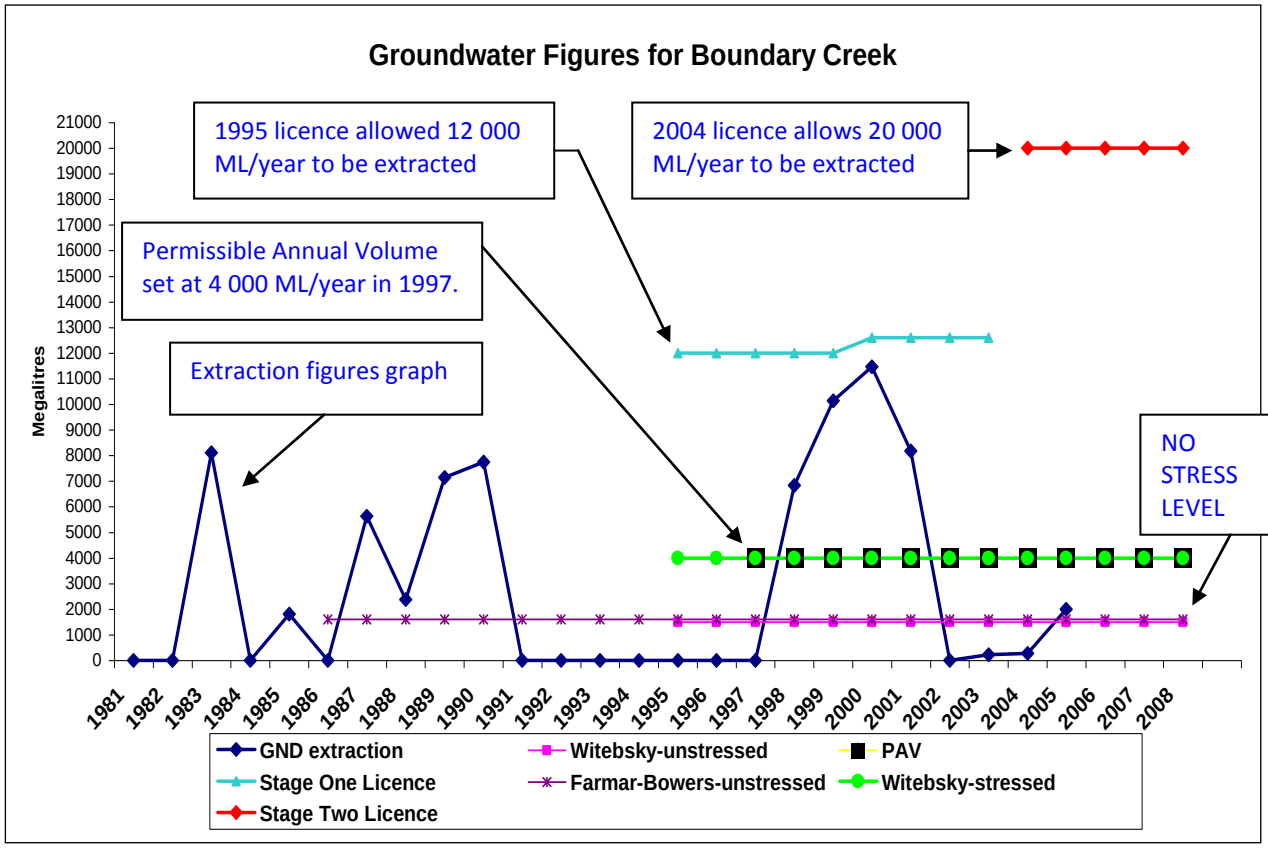
Implementing these principles and intentions outlined in Government Gazette S 107, would have ensured sustainable groundwater extraction management practices in the true sense of sustainability. Unfortunately, it would appear that the decisions makers granting the Stage Two licence were ignorant of this Gazette and its rulings. Determining and allocating

environmental flows to streams should have been done as a matter of course even if there was not a Government ruling saying this should be done.

2004. A 20 000 ML/year Licence Issued – Stage Two.

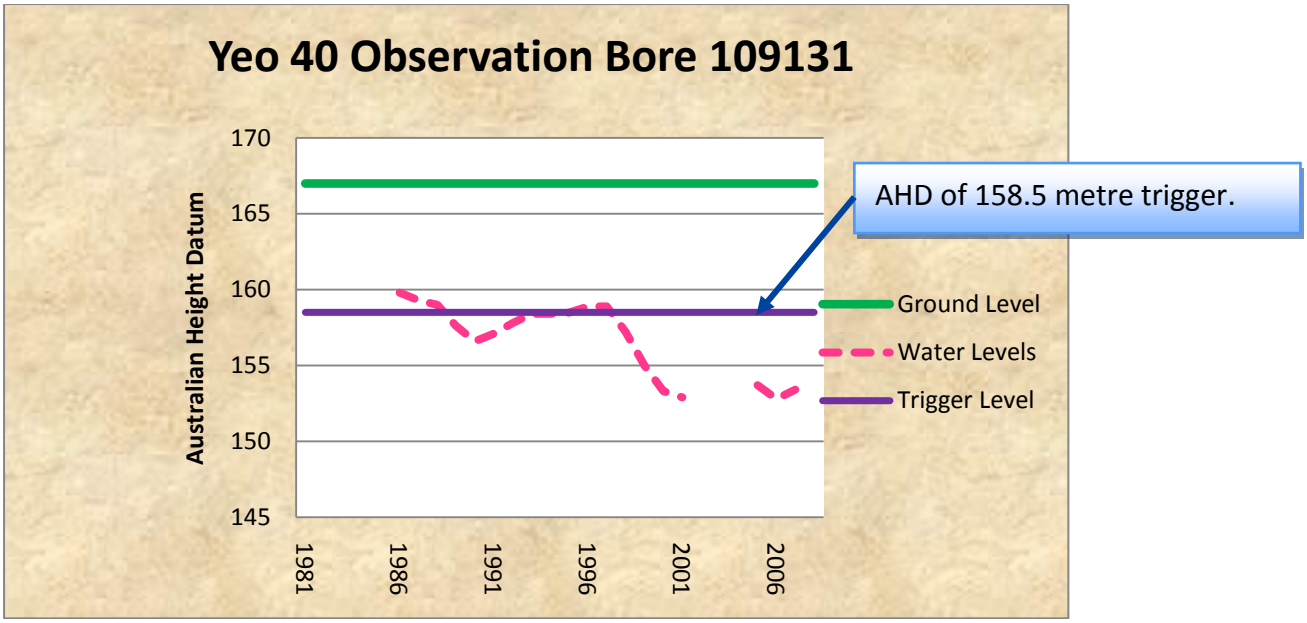
Barwon Water is issued with a licence for 15 years allowing 50 ML/day to be pumped; with a maximum of 20 000 ML/year; a maximum of 80 000 ML in any ten year period and no more than 400 000 ML over 100 years.

The red line on this graph shows the 2004 allowable extraction rate; the green line the Permissible Annual Volume set in 1997 and the no stress pink line of 1500 ML/year. The dark blue line indicates the extraction amounts. Considering the impacts experienced from these amounts it is frightening to contemplate the impacts if the full 20 000 ML/year were extracted.



2004. Yeo 40 Designated as A Trigger Bore for Maintenance of Flows in Boundary Creek.

Yeo 40, Observation Bore 109131 (see point H page 4) was chosen as the trigger level bore for the maintenance of flows in Boundary Creek. Bore 109112 could just as easily been chosen as the maintenance of stream flow trigger for flows in Boundary Creek (see graph page 70).



Yeo 40

Back in 1986 Farmar-Bowers[21] indicated that Yeo 40, high on a hill above Boundary Creek, had never been an artesian bore. Its natural ground surface level was at approximately 167.34 metres above sea level. Because the water table level was at approximately 160 metres the water in Yeo 40 was initially around 7.34 metres below ground level.

Farmar-Bowers also had these things to say in his report...

- *"Currently water tables appear to be quite stable and there is little movement between seasons or years. (J. Leonard Pers. Com.)."*
  The graph above clearly indicates that this is no longer the case.
- *"Map 2*(this map is one referred to in the Farmar-Bowers report) *gives information on groundwater levels in the area adjacent to the middle reaches of Boundary Creek. The levels are taken from current (1986) readings of D.I.T.R. bores. They indicate that groundwater adjacent to the creek is artesian*."

Comparing the work of Farmar-Bowers with the water table graph of Yeo 40 it should have been most obvious to the decision makers looking at the Stage Two licence that the 158.5 metres trigger level was regularly being breeched and that Boundary Creek and its adjoining wetlands were in desperate trouble.

2005. Groundwater Almost Fully Allocated.

In Our Water Our Future[47] it states that groundwater in Victoria is almost fully allocated and that groundwater is an important water resource for agricultural and rural stock and domestic supplies. This document also states that, "***In addition groundwater provides an excellent drought reserve (for example in Geelong) where use above the average sustainable volumes can be allowed provided there is no significant environmental impacts and the resource is allowed to recover in subsequent years.***"
When this document was tabled in April 2006 Boundary Creek had been dry on 530 days, the acidic waters created in the Big Swamp continued to leach out heavy metals from the soil and the oxidising peat was releasing previously locked up carbon, into the atmosphere. These were easily recognisable "*environmental impacts*."

2006. Groundwater Extraction re-commenced.

Petrides et al.[38] wrote that the age of the water, more than 20 000 years old, being pumped from the Barwon Downs Borefield indicates that the recharge rates may be low and that the resource could easily be over-exploited.

In August of this year Barwon Water's Annual Update states that pumping had recommenced in April because reservoir levels had recovered. As the West Barwon Reservoir had not recovered it was assumed that this reference was in regard to the aquifer levels. However, if the flows in Boundary Creek were used as a reference point indicating recovery then the Charts on pages 69, 70 tends to contradict this notion. Boundary Creek was still experiencing many days of no flow. If aquifer reservoir levels had recovered then Boundary Creek should have been experiencing an average daily groundwater flow of 3.2 ML.

Extracted groundwater being delivered to the holding ponds at the Barwon Downs Borefield.

2006. Environmental Flows recommended for Boundary Creek.

The Corangamite Catchment Management Authority (CCMA) commissioned Lloyd Environmental, Fluvial Systems and Ecologiclal Associates to prepare the following report, February 2006.[10]

"**Environmental Flow Recommendations for the Barwon River: Final Report – Flow Recommendations**."

The section dealing with Boundary Creek is most disturbing and the following discussion concentrates on the Boundary Creek research section of this document.

An objective of the CCMA report includes the development of Environmental Flow Objectives. These objectives were reported to have taken into account current social, econmic and environmental values of the river. It was designed to cover the research and classification of flows, to predict the frequency, duration and seasonality of each flow band required to sustain the ecosystems along the various streams dealt with.

The report compiled by the ***Environmental Flows Technical Panel***, involved literature review, field assessments, consultations with agencies and community members, topographic surveys of each site, hydraulic modelling and a scientific panel workshop to make environmental flow recommendations. Having read these ascertions the reader would have every confidence that a thorough study had been undertaken. However, on closer examination this is not the case.

1. On page 22 the report mentions that the cessation of flows in Boundary Creek during summer and autumn are "***natural characteristics***." It goes on to state that ***if*** the reach studied along Boundary Creek flowed ***all year*** and ***did not stop*** flowing it would cause changes in vegetation assemblages and may degrade habitiat for platypus, larger fish species, such as Blackfish, and macroinvertebrates.
   Comment: *Considering that all balckfish, larger fish species and platypus had already been decimated these assertions are pure nonsense*.
2. Table 18 states that Boundary Creek has a summer flow of 1 ML/day or more, 40% of the time, which is stated as about natural frequency. Page 64 states that the recommendations provided in this CCMA report are based on long-term statistics.
   Comment: *Unfortunately it would appear that long-tern statistics only go back as far as 1984.*
3. The conclusions section states that the flow recommendations for the tributaries of the Barwon River are largely met by the current flow.
   Comment: *For Boundary Creek this cannot be substantiated.*
4. It also states that recommendations are based on the long-term statistics that are described as an "*average year*."
   Comment: *How an "average year" is determined has not been stated and considering the material presented in this book, it appears that serious miscalculations have been made.*
5. The report states that Boundary Creek has a summer flow of more than 1 ML/day 40% of the time.
   Comment: *This may have been the case since serious groundwater extraction has taken place but it is most definitely not true for the decades pre-pumping. The low flow periods occurr at or following groundwater extraction times and it is beyond any doubt that the 40% is not based on "**long-term statistics**." The average daily summer flow used to be 3.2 ML.*
6. The natural characteristics for Boundary Creek is that it stops flowing at regular periods during the summer.
   Comment: *The finding that it is a natural characteristic for Boundary Creek to cease flowing is most definitely not correct. To recommend periods of **NO FLOW** to potect vegetaion and life forms in the creek is nonsense and beyond belief.*

How the CCMA literature review, the consultants, the historical statistic analysis and the ***Enviornmental Flows Technical Pane***l missed the following historical data is puzzling to say the least.

1. An 2002 SKM[43] report dealing with impacts on Boundary Creek had these things to say:
    a. ... there is a direct hydraulic connection between the aquifer and Boundary Creek.
    b. ... generally the baseflow from the aquifer represents a relativley **stable** and **constant** streamflow component.
    c. "***It has been noted that during periods of significant pumping from the aquifer, the flow in Boundary Creek is reduced and in some instances it has ceased flowing altogether***."
2. Witebsky et al.[49] reported in 1995 that the average daily summer flow pre-pumping was 3.2 ML.
3. In 2002 SKM[41] calculated the baseflow from the aquifer into Boundary Creek to be approximately 2 ML/day.
4. Acid levels increasing since the mid 1990s making it difficult for anything to survive in Boundary Creek (see page 63).
5. Local knowledge ignored.
   If local knolwdge had actually been asked for, collected and recorded as the introduction to this study lead the reader to believe, many of the mistakes made recommending environmental flows for Boundary Creek could have been avoided. To make the recommendation for an environmental flow for Boundary Creek to include **two fortnightly periods of NO FLOW** is astoudning to say the least.
6. Landholder, Nellie Shalley, with the longest history and who is most affected by cessation of flows in Boundary Creek is the person who gave permission to enter her property to study the reach of Boundary Creek (pers. com). There is no evidence that points to Nellie having been interviewed with the specific task of gaining an insight into her long standing knowledge of the area. Naming Nellie as a member of a Community Advisory Committee gives the impression that Nellie was part of a thorough data collecting process. This was not the case.

By ingoring historical facts, failing to do a thorough literature review and not adequately involving the community, a skewed and incorrect benchmark has been calculated for numerous aspects of Boundary Creek. Rigorous scientific disciplines appear to have been ignored. This report is laugable and is most definitely not a credible piece of research.

It is surprising that the Corangamite Catchment Management Authority appears to have accepted the *modus operandus* of the researchers and has paid good money for such a poorly constructed piece of research.

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, Petronella Cornelia Shalley
[full name]

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

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

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

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

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

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

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

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

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

Declared at Forrest

in the State of Victoria, this 19TH day of September 2009

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

Before me,

Signature of authorised witness

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

2007. Evans's Response Ratio.

In 2007 Evans[18] reported in his Land & Water Senior Research Fellowship Report that one way to understand the relationship between groundwater and surface water is to calculate

the response ratio. Evans worked this out to be a factor of 0.3. If Witebsky's unstressed 1500 ML/year extraction was pumped from the ground each year for ten years the following response would take place.

1500 ML divided by 365 days and multiplied by 0.3 would see after ten years, a daily decrease in stream flow from groundwater extraction by 1.2 ML. Boundary Creek had an annual summer flow pre-pumping of 3.2 ML/day. At an extraction rate of 1500 ML/year Boundary Creek would have been unstressed just as Witebsky determined.

However, using the 4000 ML/year extraction rate, divided by 365 and multiplied by 0.3 would see a reduction in the daily stream flow by 3.28 ML/day after ten years.

Comparing the findings of Evans with Witebsky's recommendations (see pages 20-22, 37) it would appear to indicate that a 12000 ML/year licence to extract groundwater at Barwon Downs, issued in 1995, was to shift from extraction and sustainability to exploitation with the expectations of impending disaster. With all the indicators pointing to the fact that disasters had taken place, renewing the licence in 2004 allowing 20 000 ML/year to be extracted was madness.

2006. Regional Groundwater Decline.

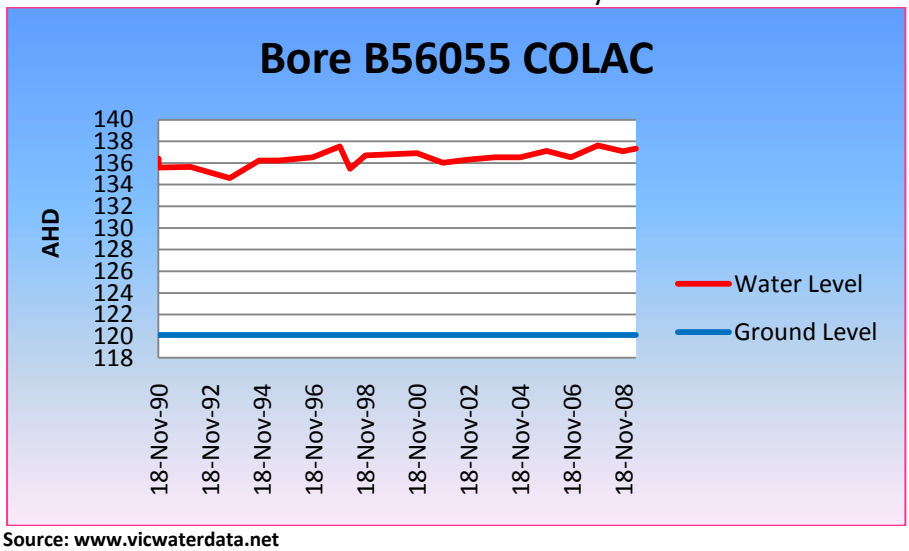
In December 2006 the Department of Sustainability & Environment (DSE) tabled a report "Regional Groundwater Monitoring Network Review for the Deep Water Aquifer System in South West Victoria."[15] This report states that the groundwater is declining generally at rates less than 10 centimetres a year. This report goes on to say that at the current rate of decline watertables will drop in the order of one metre in ten years. This was taking into account climate change and present groundwater extraction in the South West. However, this study did not included the Barwon Downs borefield area of influence.

Kawarren Borefield Area (No groundwater extraction).

The Birnam Station and Kawarren observation bores on the Ten Mile Creek and Loves Creek verges have basically remained the at the same level(see page 53).

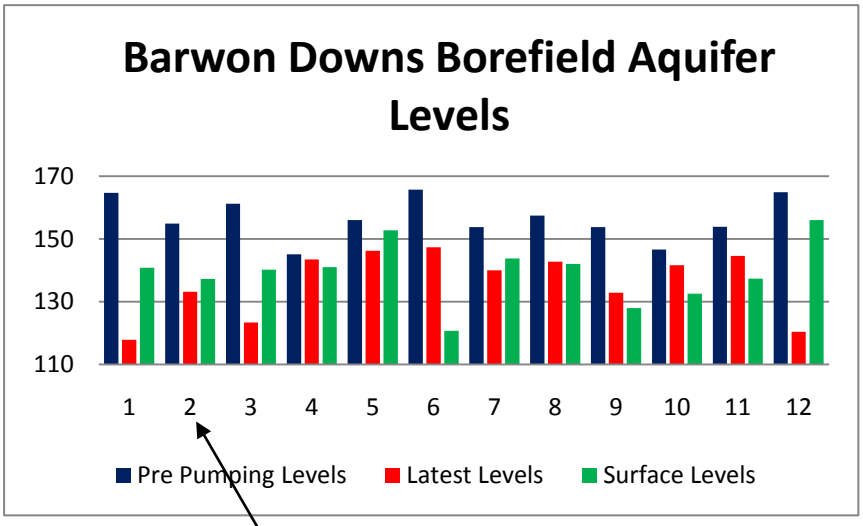
An Obeservation Bore in Colac.

The water level in this bore has in fact risen by 2 metres.



Source: www.vicwaterdata.net

Barwon Downs Borefield Observation Bores (Extensive Groundwater Extraction).
In contrast the bores in the Barwon Downs borefield area of influence show a significantly marked watertable drop. In some observation bores the drop has been over 40 metres.
As part of the 2004 licence granted to Barwon Water for the extraction of groundwater from the Barwon Downs borefield, Barwon Water had to monitor many observation and extraction bores. In May/June 2008 (sender receipts CV9201839 & CV9120201), Barwon Water was asked to provide the drawdown data on those observation artesian bores that were no longer artesian.



Bores 1, 3, 11 and 12 were drilled in 1973, 1979, 1974 and 1974 respectively.

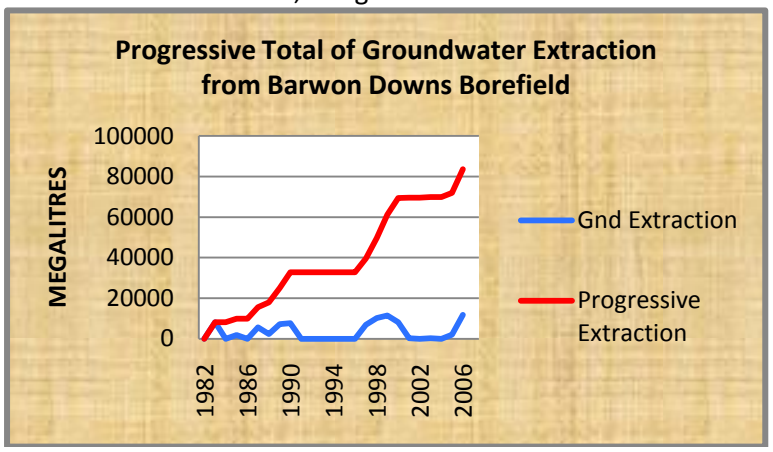
All the other bores were drilled after the 1982-83 drought extraction of 8000 ML.

Data Source: Barwon Water.

A detailed graph of Bore 2 (Bore 109112) can be see on page 70. Even if the 2006 DSE report[15] is wrong by a factor of 10, the Barwon Downs Borefield Aquifer Levels graph indicates that groundwater extraction in the Barwon Downs area significantly differs to the trend in the South West of Victoria.

2007. By June Boundary Creek Dry 714 Days.

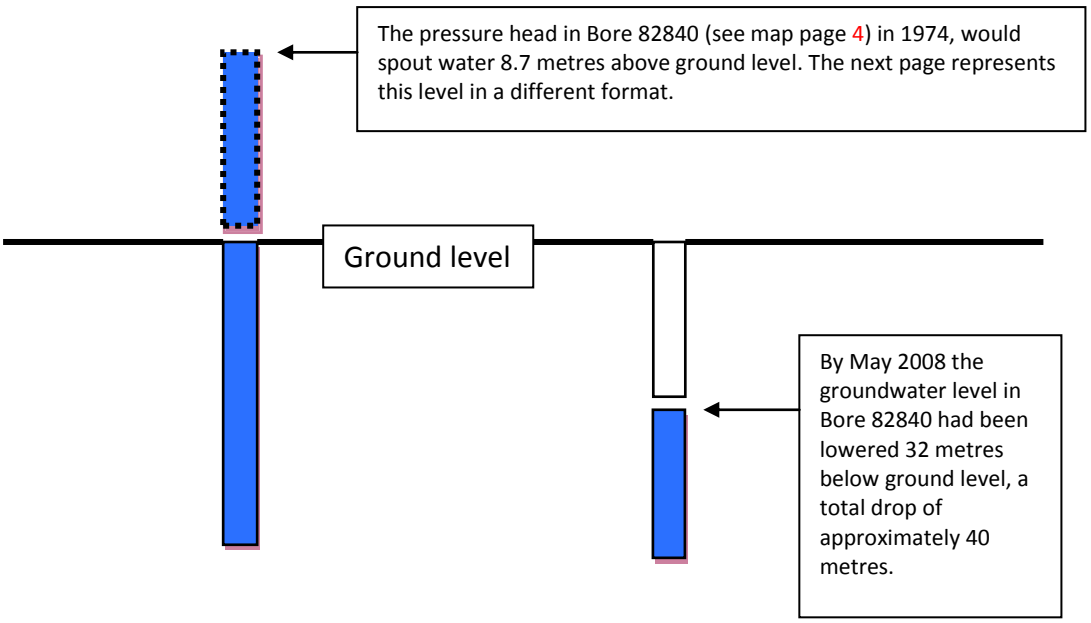
As the groundwater pumping progressed so do the days of no flow in Boundary Creek increase (see page 69). Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continued to flow.
Until the drought of 1982-83 when Barwon Water extracted huge amounts of groundwater from the Barwon Downs borefield, the groundwater resources from this aquifer were relatively untouched.



Sources [23][24][25]

By the end of the 2006-07 reporting period approximately 83 000 ML had been extracted. Drawdown influence was being experienced throughout the Barwon Downs district.

In simplistic terms the following sketch gives some indication of the extent that this extraction has had on the drawdown of the water table in the deep water aquifer.



In the same way the drawdown graphs for Yeo 40 (see page 38) and Bore 109112 (see page 70) clearly show the same influence.

Impacts from this drawdown observed at the Colac Forrest Road stream flow gauging station.

When Bore 82840 was first drilled into the aquifer this was the height of the water spurting out of the ground, 8.7 metres above ground level. This is the same aquifer that Barwon Water extracts groundwater from. As at November 2007 this extraction had lowered the water table point at least 40 metres lower.

Bore Number 82840 along Wire Lane (see map page 4).

A similar drawdown in the water table is apparent throughout the area as a result of groundwater extraction at Barwon Downs. At the point of extraction the drawdown has been in the order of 50 metres.

Before groundwater extraction at Barwon Downs, the deepwater aquifer in this area would spurt from artesian bores high into the air.

Declaration Re: Artesian Bores along Wire Lane

M J Freshwater
519 St Michael St
Deniliquin NSW 2710

June 11, 2008

To whom it may concern:

From the early 1970s until 1988 our family owned and operated a property on the corner of Wire Lane and Barwon Downs Road at Murroon, Victoria. Observation bores were drilled in the early 1970s on Wire Lane, adjacent to that property.

When bore 82839 and bore 82840 were drilled they were observed by me to be artesian with streams of free flowing water. These bores were capped and fitted with gate valves. For many years (until the gate valves were locked in the mid 1980s) opening the gate valves resulted in water escaping under considerable pressure, with no obvious loss of pressure over time.

It is still my belief that these bores remained artesian in nature at least until I left the district in 1989.

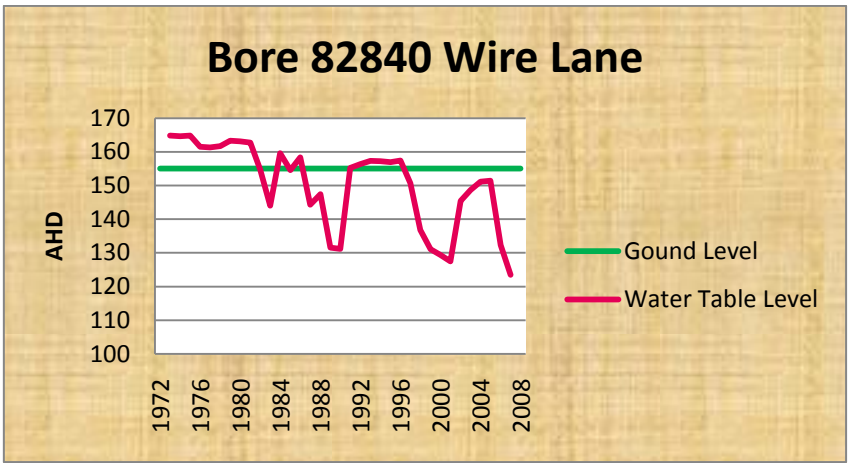
Yours sincerely,

M.J. Freshwater.

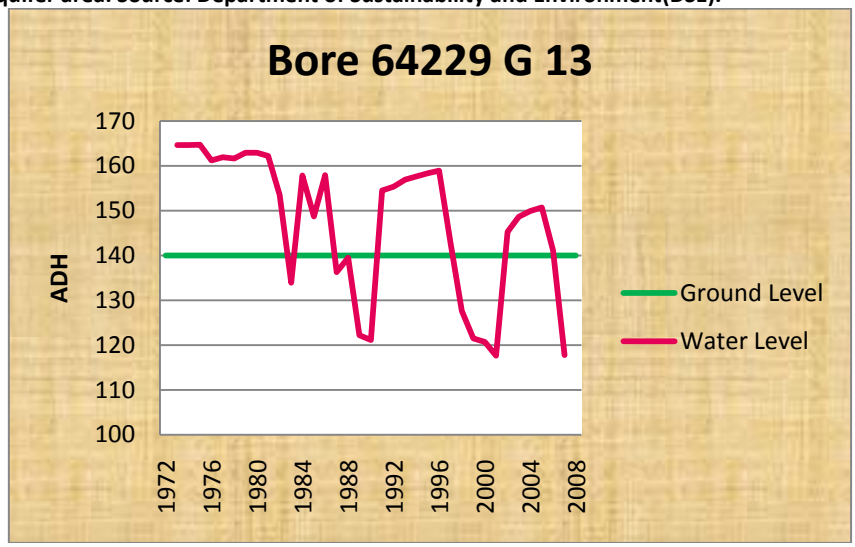
Murray James Freshwater

Witnessed by: K. Henderson J.P. 12/6/08

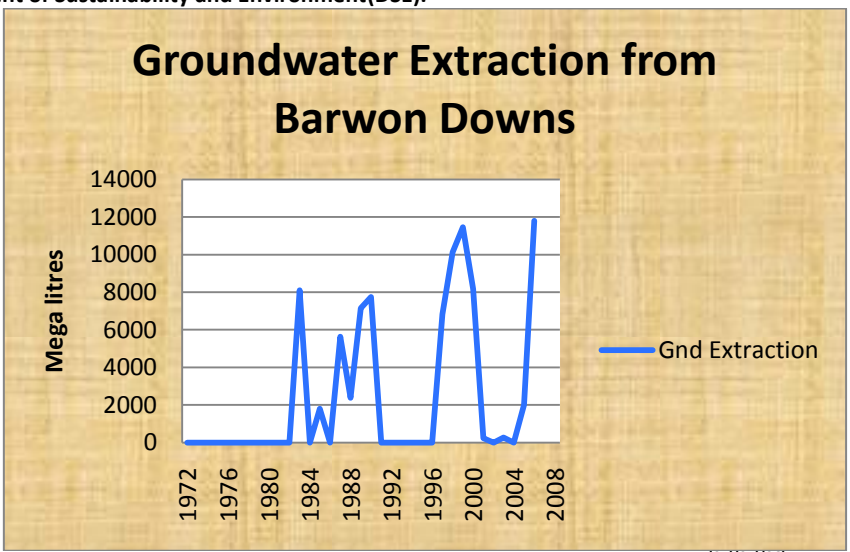
Kathy M Henderson JP 137876



This Wire Lane bore is approximately 4 km from the extraction bores at the Barwon Downs borefield. This bore is in the Barwon Downs aquifer area. Source: Department of Sustainability and Environment(DSE). [16]



G 13 is at the extraction point at the Barwon Downs Borefield.. This bore is also in the Barwon Downs aquifer area. Source: Department of Sustainability and Environment(DSE). [16]

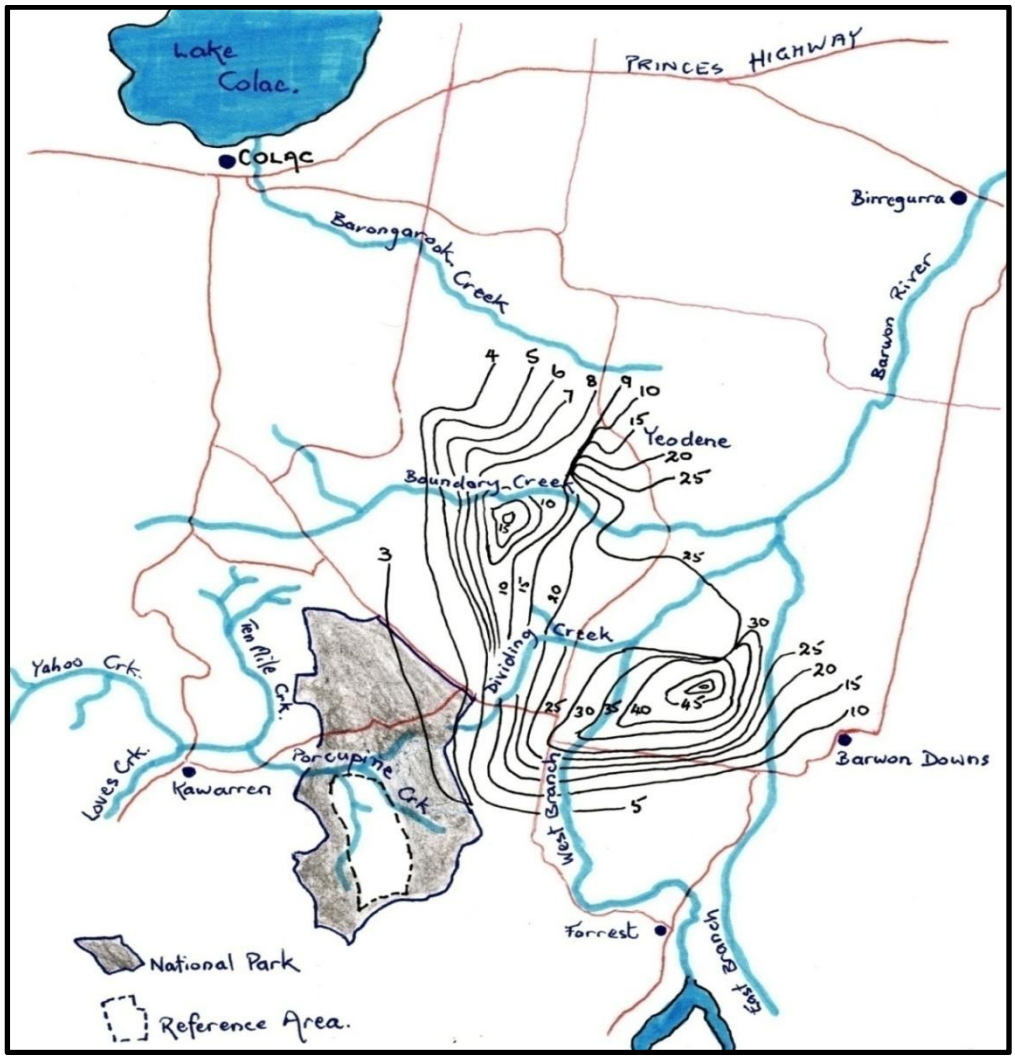


This graph depicts the yearly extraction rates from the Barwon Downs borefield. Source: [24][25][26].

The drawdown graphs in pink, closely follow the inverse to the extraction rates from the Barwon Downs borefield as seen in blue. As the extraction of groundwater increases the lower the water table drops.

When groundwater is extracted from the deep water aquifer the pressure head is lowered and the dynamics of the earth's crust of sedimentary layers and crystalline rock that floats on the Moho begin to undergo subtle changes. The greater the amount of deep aquifer water that is extracted the more the dynamics in the crust are altered. Taking out sizeable amounts of groundwater makes the symptoms of these changes blatantly apparent. They are no longer subtle. The crust above the depleted aquifer begins to dry as the water from the saturated sediments begin to leak downwards. As these sediments dry out they begin to shrink and crack. Impacts such as creeks, wetlands and springs drying up; increased peat wild fire; fire intensity; vegetation changes and creek bank subsidence start to become apparent.
In times of drought this situation is further compounded with the lack of rain water percolating down from precipitation.

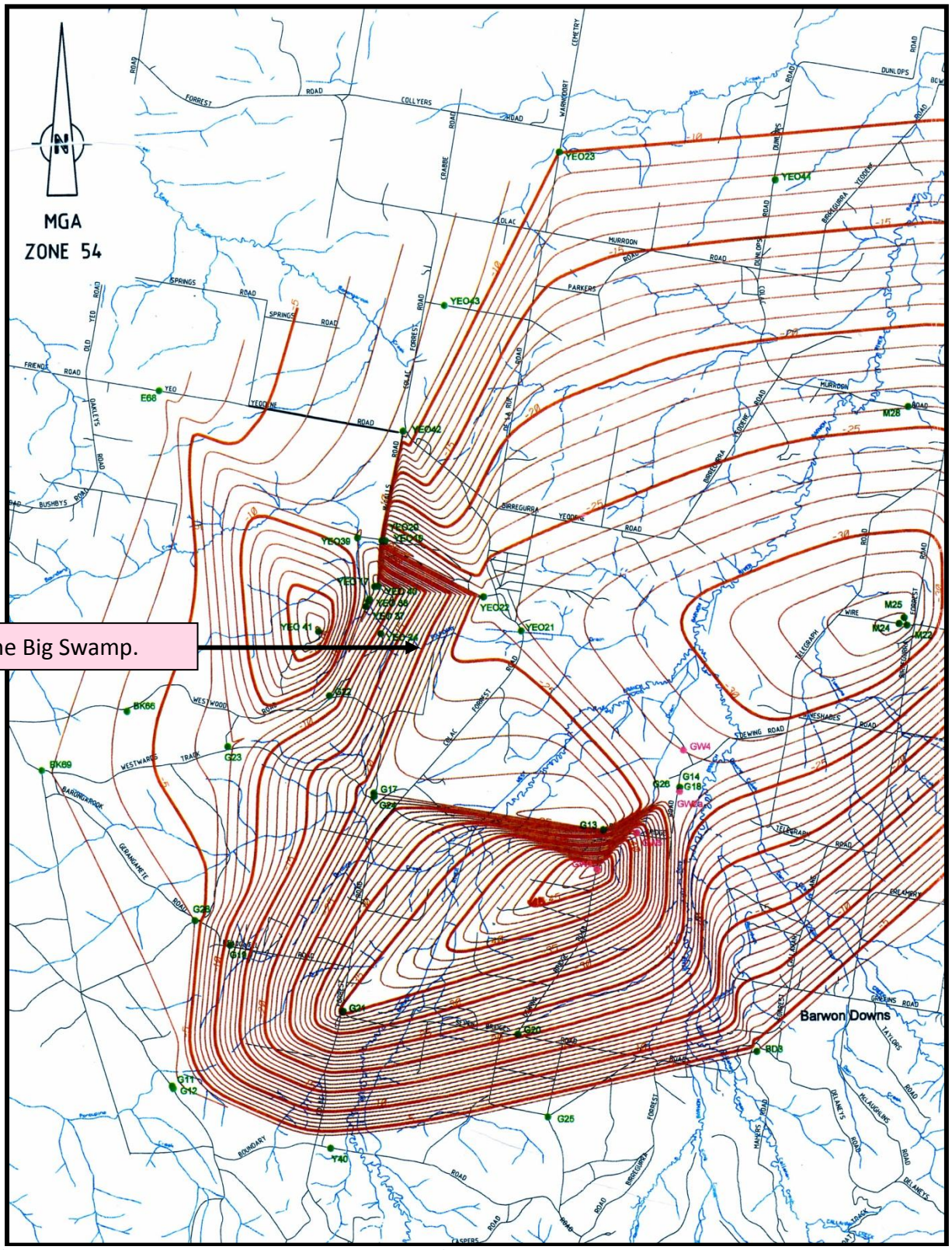
June 2007. Groundwater Drawdown.



(The drawdown contours on this map have been superimposed from the contours from the map found on page 50.)

Between 2005 and June 2007 groundwater extraction has been approximately 14 000ML.

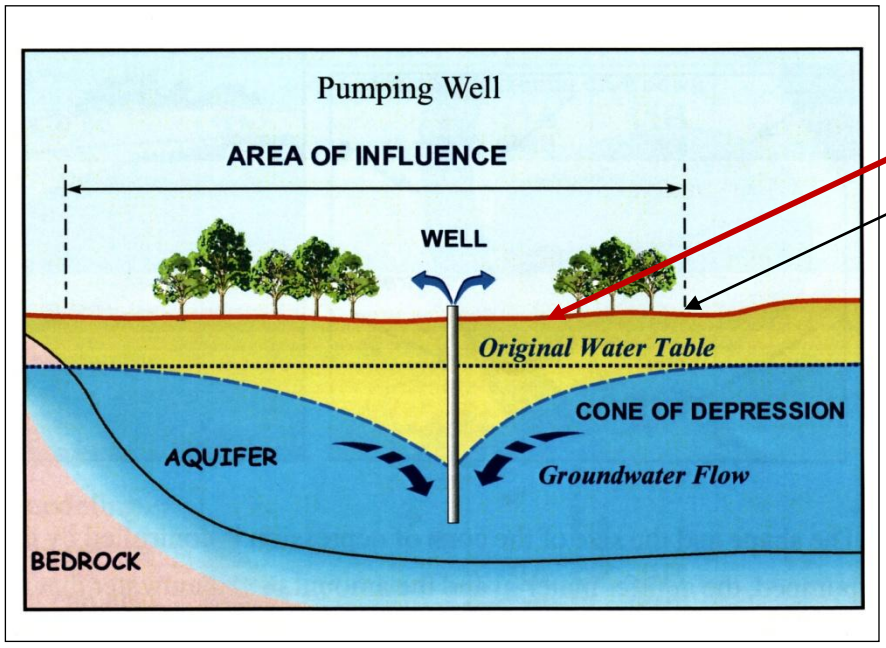
These groundwater drawdown figures are the only ones Barwon Water will release as the officers of Barwon Water relate they are the only ones that have to be supplied under the 2004 “licence requirements.”



(Source: Barwon Water 2006-07 Report to Southern rural water.)

The Point Of Zero Drawdown & Vertical Leakage.

The two maps above show the drawdown impact out to the 3 metre mark to the west. It is significant that Barwon Water will not provide the drawdown figures out to the zero mark especially when considering the diagrams below. The area of the Big Swamp is being influenced in two ways. The bulk of this book deals with the first, and that is the lowering of the deep water aquifer where it outcrops at the surface. The data available documents the impacts of this and these impacts are readily observable. However, there is another and much more subtle influence of drying out that takes place as aquifers are drawn down.



Big Swamp

Any site located on the outer perimeter of the drawdown effect will suffer from drying out as the water in the upper layers leaks down to replenish the depleted aquifer below. Any drying out as a consequence of vertical leakage may take some time to eventuate.

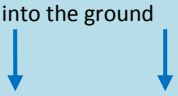
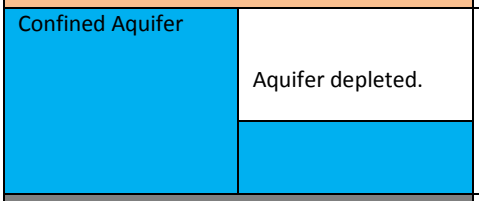
Diagram Source –Centre for Groundwater Studies, Blackwood South Australia.

The area of drawdown influence goes right out to the point of zero drawdown effect. The diagram above, from the Australian Centre for Groundwater Studies highlights this fact. If the Big Swamp was to be marked in on the diagram above it would be well inside the cone of depression, a considerable distance from the zero area of influence.

When a confined aquifer is full it forces water up into the layers above and over time reaches a state of relative equilibrium. The unsaturated zone at the surface oscillates between being relatively dry during summer and relatively saturated during winter. However, this equilibrium can be upset with regular and sustained amounts of groundwater extraction from the deep water aquifer below. As the aquifer is depleted the phenomenon of vertical leakage downwards takes place. Over an extended period the aquitard above the confined aquifer begins to dry out and causes a similar downwards leakage effect to take place all the way from the surface. Considering the amount of water extracted from the Barwon Downs borefield and the extended period of 24 hours a day, 365 days a year pumping for some years, the probability of vertical leakage is extremely high.

During rainfall events even when the sediments are seriously drying out below, the surface layer supporting lush pastures and maintenance of vegetation, can give the false impression that things are returning to “normal.” However, a slow and insidious drying out of deeper layers may take years to impact and become apparent at the surface.

Vertical Leakage from One Layer to Another.

Sky – rainfall soaks into the ground 	A certain amount of rain falling soaks into the ground.
Unsaturated zone 	In the gaps between particles of soil this zone contains both air and water.
Aquiclude/Aquitard 	An aquitard is a confining bed but can be saturated and can allow water to move slowly vertically through it An aquiclude is a confining bed that can be saturated allowing little water to pass through it at a greatly reduced speed.
Confined Aquifer 	Confined aquifers are usually full of water. These aquifers are recharged where they are exposed at the surface and from leaky confining beds or aquitards above.
Aquifuge 	An aquifuge is a layer containing minute amounts of water and doesn't allow water to pass through easily e.g. solid granite.

The blue and black arrows indicate movement of water in an unexploited aquifer. The Blue and red arrows indicate the movement of water when the deep water aquifer is unnaturally being depleted.

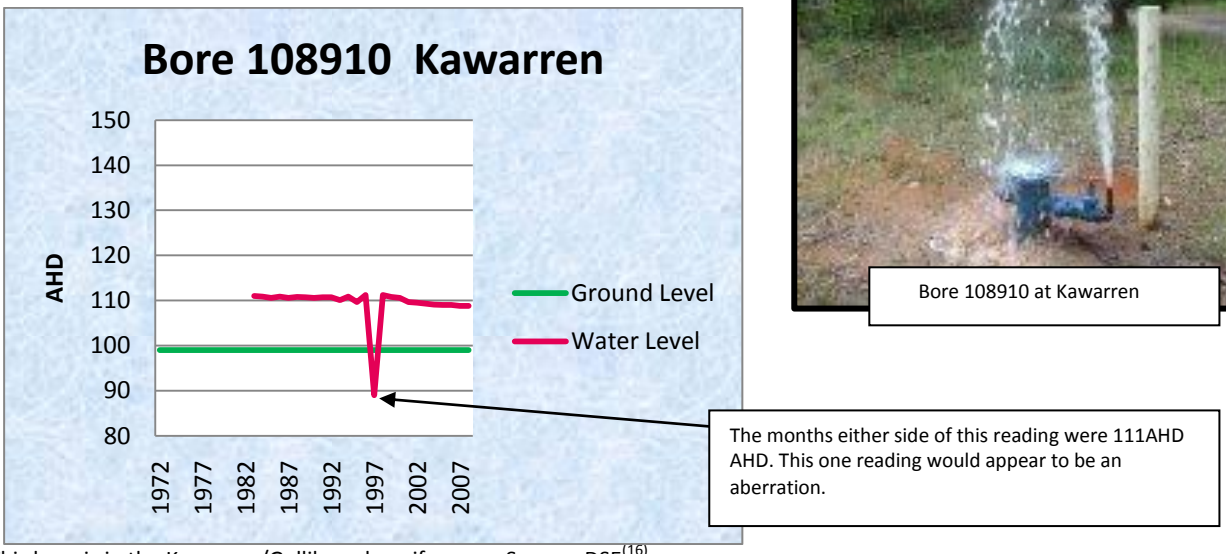
Leonard[33] discussed the distinct possibilities of vertical leakage in the district in 1984. A subsidiary objective of the 1987-91 test pump conducted at the Barwon Downs borefield was to examine groundwater movement between the deep water aquifer and the confining formations above. When Witebsky et al.[49] summarised and made recommendations for Stage One groundwater extraction, it was found that the there was insufficient monitoring done during the test pump to gain a clear understanding of the amount and influence of vertical leakage down into the deep water aquifer. Consequently the recommendation was made that in the advent of any revision of Barwon Water's licence, it should include a requirement to provide and monitor bore(s) constructed into the overlaying clays to determine the amount of vertical leakage. To date there is no indication that this has ever been done, 23 years after it was first recommended.

Barwon Water was asked in February 2010, "*Is it also possible to have a copy of any work done or commissioned by Barwon Water, on vertical leakage between aquifers in the Barwon Downs borefield investigations?*"
Dated 16 February 2010, Barwon Water Ref: 55/100/0001C, the reply was, "*In relation to your request regarding any investigations Barwon Water has conducted with respect to vertical leakage between aquifers in the Barwon Downs borefield, there have been no such studies since the pre-licence renewal investigations in 2002-03.*"

2007. Artesian Bores at Kawarren Negligible Impact.

Bore 109810 and Bore 114168 in the Kawarren/Gellibrand area, are artesian. There is a distinct difference between the water table graphs of these bores, where there has been negligible groundwater extraction, to the ones in the Barwon Downs area where there has been significant groundwater extraction. From this limited data it would appear most obvious that groundwater extraction in the Barwon Downs area is having a significant impact. At the very least this comparison requires further investigation. It must also be noted that these two Kawarren bores have shown little effect from the worst drought on record.

Bore 108910 at Kawarren



This bore is in the Kawarren/Gellibrand aquifer area. Source: DSE[16]

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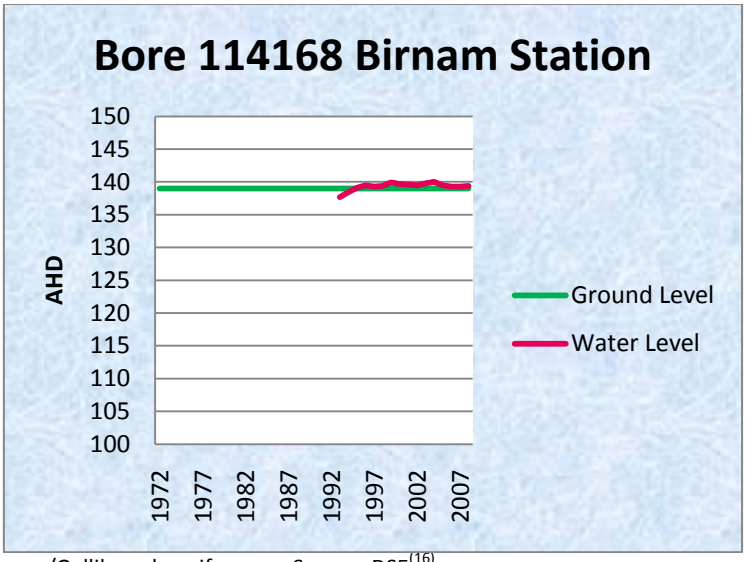


This bore is in the Kawarren/Gellibrand aquifer area. Source: DSE[16].

The locations of these two bores are marked on the map on page 76.

July 2007. Statement of Obligations.

On 1 July 2007 the Victorian State Government Gazetted the latest Statement Of Obligations – Barwon Region Water Authority. It is an interesting 13 page document. Some extracts from it are relevant to this issue.

Page 8 Point 24 Sustainable Management.

24.1 The Authority must:

(a) in performing its functions, exercising its powers and carrying out its duties, apply the Sustainable Management Principles: and

(b) demonstrate in its Water Plan how the Authority proposes to apply these principles.

24.2 In applying the Sustainable Management Principles the Authority must develop and implement programs for assessing, monitoring and continuously improving the Authority's sustainability performance, including:

(a) responding to climate change;

(b) maintaining and restoring natural assets;

(c) using resources more efficiently; and

(d) managing everyday environmental impacts, and

Must include those programs in its Water Plan.

Page 9, Part 6 – Environmental Management.

28 River and Aquifer Health.

28.1 The Authority must manage the impact of its activities on any waterway, aquifer or wetland to minimise environmental impacts on and risks to the aquatic ecosystem.

SCHEDULE A. Page 12-13 Definitions.

"Sustainable Management Principles" are:

- the need to ensure that water resources are conserved and properly managed for sustainable use and for the benefit of present and future generations, and
- the need to encourage and facilitate community involvement in the making and implementation of the arrangements relating to the use, conservation and management of water resources; and
- the need to integrate both long-term and short-term economic, environmental, social and equitable considerations; and
- the need for the conservation of biological diversity and ecological integrity to be a fundamental consideration; and
- if there are threats of serious or irreversible environmental damage, lack of full scientific certainty as to measures to address the threat should not be used as a reason for postponing such measures.

John McDonald Has His Say.

The Geelong Advertiser 7 December 2007 in the Perspective section reported that, "***Critics of tapping the Barwon Downs borefield, Geelong's saviour during the drought, have it wrong, says John McDonald.***"

"***Barwon Water has compiled extensive data and knowledge on the Barwon Downs aquifer over more than three decades. This information has been crucial in determining how and when to operate the wellfield under licence.***"

In the same article it states, "***Research gleaned from numerous studies and constant monitoring has concluded the current yield is sustainable.***"
There is that loosely used word "sustainable" again. Unfortunately in this situation when not defined, the word sustainable gives the impression that the activity being conducted can be continued indefinitely with little impact on the resource being exploited. In many cases the use of the word conjures up the mental picture that there will be no impact or such a small one that it really doesn't matter.
To have ready access through an open and transparent process to the extensive data that Barwon Water has compiled over the decades can best be described as a fanciful dream. Such access has never been given.
The Geelong Advertiser article also states, "***It is not, as some would have readers believe, a "water grab" by Geelong to the detriment of the environment, or farmers, or some other party.***"

- ***"John McDonald is deputy chair of Barwon Water."***

2007. Anglesea Community Bulletin – Anglesea Borefield.

The Barwon Water's April 2007 Community Info Bulletin on the Anglesea Borefield Project states, "***To make sure groundwater is extracted sustainably, recharge rates are measured (the rate at which the aquifer replenishes itself). This is used to calculate the Permissible Annual Volume (PAV), the amount of water that can be extracted annually from the aquifer.***"
Back in 1997 the Permissible Annual Volume for the Barwon Downs aquifer was set at 4 000 ML/year. The present licence that runs until 2019 allows 20 000 ML/year. The current average extraction for the last few years is well over the 10 000 ML/year mark (see pages 69 & 71).
There is considerable doubt that the PAV was seriously taken any notice of in the Boundary Creek scenario for long-term summer extractions. 20 000 ML/year is far in excess of the PAV. It has been successfully argued by Barwon Water that if an extraction rate of 400 000 ML is spread over 100 years then periodic large summer volumes shouldn't create serious impacts. From a hydrological sense the aquifer would appear to be sustainable using this regime. However, it is doubtful that anyone arguing the case for instream biota, flora and ecosystems would agree (see photographs on pages 1, 2, 5, 13, 34, 45, 59, 66,, 77, 80). Groundwater and surface water dependent ecosystems disappear completely when their habitat is dried out and decimated.

2008. By April Boundary Creek Dry 900 Days.

The no flow days in Boundary Creek increase (see page 69) to 900. Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continued to flow.

2008. Potential Inland Acid Sulphate Soils Discovered in the Big Swamp.

In 2008 Boundary Creek had stopped flowing for many months (see graph page 69) despite Barwon Water releasing 2 ML/day of water from the Otway to Colac pipeline (see the map on page 66 point L for the release site). It rained at the end of May, early June 2008 and Boundary Creek began to flow. The water was deceptively crystal clean looking but on examination proved to be extremely acidic and containing elevated levels of heavy metals.

Simply put, when dried out and then rewetted some water saturated soils become acidic. The acid then has the tendency to release heavy metals previously locked up in the soil. Boundary Creek and the Big Swamp are two possible sites of Potential Inland Acid Sulfate Soils (PIASS). As a result of groundwater extraction causing this permanent stream and wetland to dry out, particularly over the summer period, these PIASS can become Actual Inland Acid Sulphate Soils. Once disturbed PIASS are very environmentally unfriendly.[30]

In an anaerobic condition (see diagrams page 22) certain bacteria in organically rich water saturated soils convert sulfate and iron from the sediments into iron sulphide. In the saturated state the acid sulfate soils are relatively harmless. However, as the Potential IASS are exposed to air due to drainage, groundwater extraction, drought or disturbance, the exposed iron sulphides oxidise and produce sulfuric acid. As the sulfuric acid moves through the soil it liberates iron, aluminium and sometimes manganese from the soil. It can also dissolve other heavy metals including lead and arsenic. Many chemical reactions can take place and products such as Jarosite can be produce. Jarosite is a yellow coloured bi-product of the oxidation process. Once this process takes place the soils are called Actual Inland Acid Sulfate Soils (AIASS).

This oxidation process can continue for many years. In some areas of Australia[36] Inland Acid Sulfate Soils drained a hundred years ago are still releasing acid.

Pyrite[37] is formed when there is:

- rotting organic matter which acts as an energy source for bacteria
- a source of iron
- temperature greater than 10^0C
- a relatively oxygen depleted condition, and
- a supply of sulphur.

Boundary Creek has soils in conditions that match these indicators.
Saline Groundwater containing sulfates can also be a contributing factor. Considering the salinity problems now being encountered in the immediate area there is every possibility that saline groundwater is a source of sulfates.

Leonard[33] on page 54 of his report states that "***This suggests that the iron is derived from oxidation of pyrite which is relatively abundant in the stratigraphic sequence particularly in the (upper) Dilwyn formation.***" The Dilwyn Formation is the deep water aquifer at the Barwon Downs Borefield and also is the outcropping aquifer in much of the Barongarook High region including Boundary Creek and the Big Swamp (see maps pages 72-74).

After the author experienced and observed what appeared to be the effects of acidification, water samples were sent to Deakin University Warrnambool campus, for testing. The following statutory declaration best relates this experience.

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, MALCOLM JOHN GARDINER
[full name]

of 1805 COLAC BEECH FOREST RD. KAWARREN VICTORIA 3249.
[address]

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

After Boundary Creek at Yeodene began to flow for the first time after being dry for many months at the Stream Flow Gauging Station Number 233228 in late May 2008, I did a taste and sip test of the clear water flowing over the notch weir. I had asked Nellie Shalley to inform me when the creek began to flow.
The water was foul tasting causing me to spit as much as it out of my mouth as I could. Because it was so clear and healthy looking I had swallowed some before reacting to the taste. The next day I had a small case of diarrhoea and the skin on the hand I had cupped the water out with developed that skin catching on garments symptom that one gets after concreting without gloves. My other hand had not been subjected to this water and did not suffer the same symptoms.

I rang Nellie to alert her and warned her not to use the water. She said she never did in the last few years until four to five inches of rain had fallen to flush the creek out.

This started me thinking about causes of this degradation. I had read a little on Acid Sulfate Soils(ASS) and began to research it. Returning to the Station Number 233228 on occasions I noticed the crystal clear surface water with pockets of greeny/bluey/yellow opaque water hugging the stream bottom in depressions. In August 2008 my enquiries and readings of ASS indicated that this may be caused by high levels of aluminium. I captured a bottle of this deep water and had it tested for aluminium. I knew the pH was extremely low from tests done by the Upper Barwon Landcare Group and Thiess. I had the pH tested anyway and the iron was also tested. The following sheet marked MGardiner No. 3249 is the result of this testing.

On the 12 September 2008 the opaque "slug" had cleared from under the bridge at the Steam Flow Gauging Station Number 233228 but was still present in a deep hole four metres to the west of the bridge. The water was crystal clear right to the bottom of the creek under the bridge.

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

Declared at COLAC

in the State of Victoria, this 18th day of

September 2008

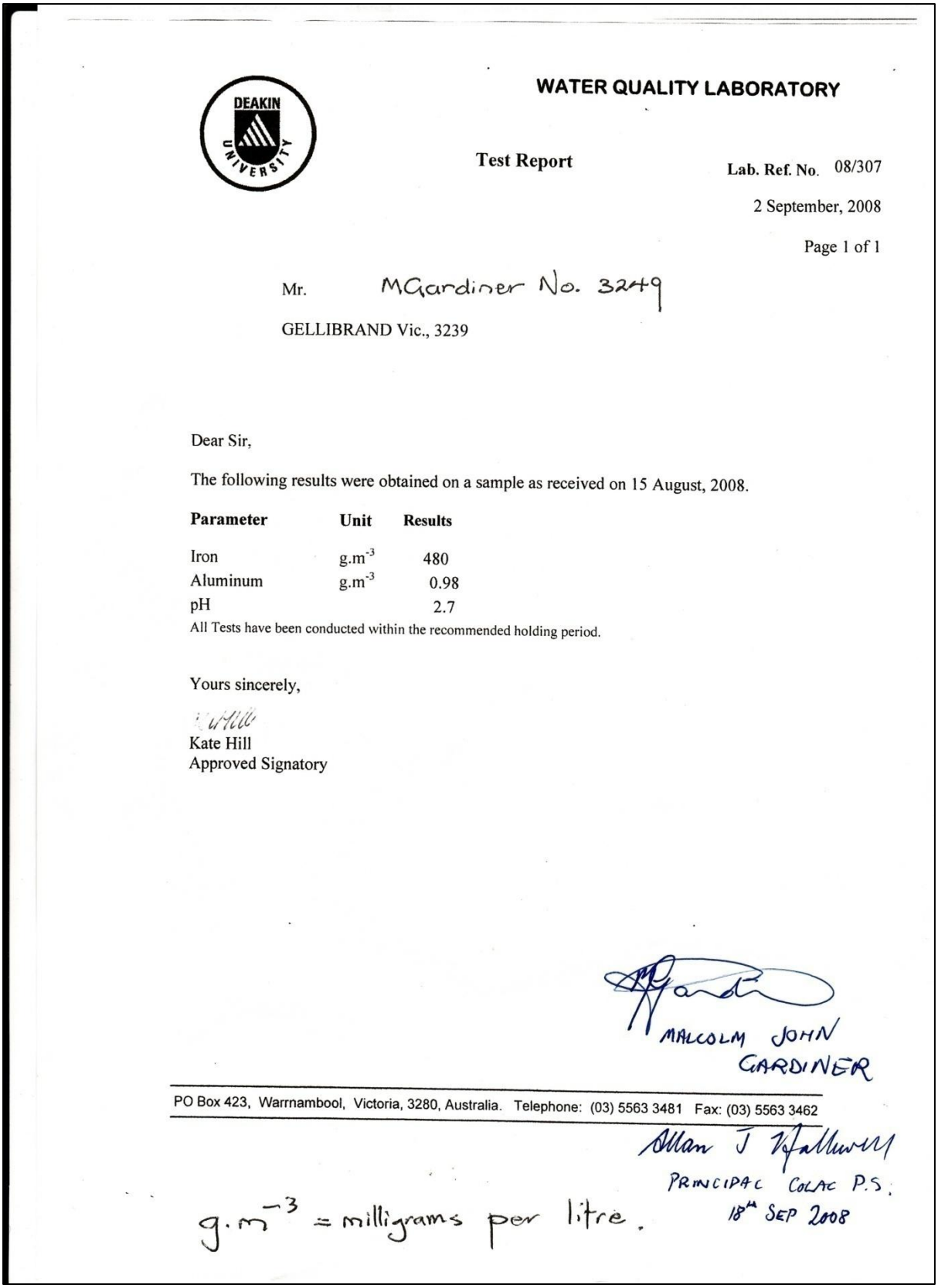
.....
Signature of person making this declaration
[to be signed in front of an authorised witness]

Before me,

.....
Signature of authorised witness

PRINCIPAL COLAC P.S.

One can only imagine what the pH level would have been if it had been tested in late May/early June. After a considerable flushing from rain in August it was 2.7 (see page 58).



WATER QUALITY LABORATORY

Test Report

Lab. Ref. No. 08/307

2 September, 2008

Page 1 of 1

Mr. MGardiner No. 3249

GELLIBRAND Vic., 3239

Dear Sir,

The following results were obtained on a sample as received on 15 August, 2008.

Parameter	Unit	Results
Iron	$g.m^{-3}$	480
Aluminum	$g.m^{-3}$	0.98
pH		2.7

All Tests have been conducted within the recommended holding period.

Yours sincerely,

Kate Hill
Approved Signatory

MALCOLM JOHN GARDINER

PO Box 423, Warrnambool, Victoria, 3280, Australia. Telephone: (03) 5563 3481 Fax: (03) 5563 3462

Allan J Wallwork
PRINCIPAL COLAC P.S.
18TH SEP 2008

$g.m^{-3}$ = milligrams per litre.

Because of this very high acid reading it was decided to make an attempt to ascertain the source of this acid. After speaking to fire fighters who fought the Big Swamp peat fires in the late 1990s the prospect of going into this area was daunting. The fire fighters found the Big Swamp to be like a jungle and nick named it Jurassic Park.

With this impression of a vibrant, dense and healthy wetland ecosystem in mind an "expedition" was planned for exploration along Boundary Creek west of the Colac to Forest Road. It was anticipated that this would not be an easy task to carry out. The flora survey done back in 2002[7] spoke of "***impenetrable vegetation***" in this area. As it turned out the opposite was the case.
A four wheel drive vehicle had to be used traversing overgrown fire tracks. Access to the Big Swamp was difficult. However once into the Big Swamp area the scenery changed dramatically.

From several visits to the site, digging into the dry peat for some depth and waiting for the holes to partially fill, water samples were taken. The test results can be seen on pages 60-62.

These test results appeared to indicate that there was an extremely convincing argument for further investigation of the wetlands along Boundary Creek.

WATER QUALITY LABORATORY

Test Report **Lab. Ref. No.** 08/347

1 October, 2008

Mr. Malcom Gardiner,
18/05 Colac-Lavers Hills Rd,
KAWARREN Vic., 3249

Dear Sir,

The following results were obtained on samples as received on 15 September, 2008.

Method	Parameter	Unit	Sample 1-A 14/9	Sample 1-B 14/9	Sample 1-C 14/9
4500-H^+ B	pH		3.3	4.2	3.3
2510 B	Elec. Conductivity	$\mu S.cm^{-1}$	1,900	2,060	1,960
3500-Na B	Sodium	mg/L	170	170	160
3500-K B	Potassium	mg/L	3.7	3.8	3.6
4500-$SO_4^{=}$ E	Sulfate	mg/L	270	470	440
EG005T #	Iron	mg/L	104	40.5	28.2
EG020T #	Aluminum	mg/L	29.0	14.8	15.3
EG020T #	Arsenic	mg/L	0.018	0.002	0.003
EG020T #	Cadmium	mg/L	0.0006	0.0005	0.0006
EG020T #	Chromium	mg/L	0.012	<0.001	<0.001
EG020T #	Copper	mg/L	0.154	0.463	0.165
EG020T #	Lead	mg/L	0.022	0.024	0.016
EG020T #	Manganese	mg/L	0.565	0.526	0.508
EG020T #	Nickel	mg/L	0.182	0.171	0.159
EG020T #	Zinc	mg/L	0.782	0.586	0.520
EG020T #	Boron	mg/L	<0.05	<0.05	<0.05

Analysis performed by Accredited Laboratory NO. 825 and shown on report No. EM0807013.
All Tests have been conducted within the recommended holding period.

Yours sincerely,

Kate Hill
Approved Signatory

PO Box 423, Warrnambool, Victoria, 3280, Australia Telephone: (03) 5563 3481 Fax: (03) 5563 3462

WATER QUALITY LABORATORY

Test Report Lab. Ref. No. 08/347b

22 October, 2008

Mr. Malcom Gardiner,
1805 Colac-Lavers Hills Rd,
KAWARREN Vic., 3249

Dear Sir,

The following results were obtained on samples as received on 15 September, 2008.

Method	Parameter	Sample 2-A 13/9	Sample 2-B 13/9	Sample 3 13/9
4500-H^+ B	pH	2.7	2.5	2.6

All Tests have been conducted within the recommended holding period.

Yours sincerely,

Kate Hill
Approved Signatory

PO Box 423, Warrnambool, Victoria, 3280, Australia Telephone: (03) 5563 3481 Fax: (03) 5563 3462

WATER QUALITY LABORATORY

Test Report Lab. Ref. No. 08/388

31 October, 2008

Mr. Malcom Gardiner,
1805 Colac-Lavers Hills Rd,
KAWARREN Vic., 3249

Page 1 of 1

Dear Sir,

The following results were obtained on samples as received on 9 October, 2008.

Method	Parameter	Unit	Sample 1.	Sample 2.
4500-H^+ B	pH		2.6	2.6
2510 B	Elec. Conductivity	µS.cm^{-1}	2,160	2,140
3500-Na B	Sodium	mg/L	90	90
3500-K B	Potassium	mg/L	4.8	12
4500-$SO_4^=$ E	Sulfate	mg/L	390	325
EG005T #	Iron	mg/L	372	354
EG020T #	Aluminum	mg/L	6.93	12.6
EG020T #	Arsenic	mg/L	0.193	0.222
EG020T #	Cadmium	mg/L	0.0020	0.0026
EG020T #	Chromium	mg/L	0.010	0.012
EG020T #	Lead	mg/L	0.017	0.016
EG020T #	Manganese	mg/L	0.339	0.384
EG020T #	Nickel	mg/L	0.091	0.140
EG020T #	Zinc	mg/L	0.854	1.08
EG020T #	Boron	mg/L	<0.05	<0.05

Analysis performed by Accredited Laboratory NO. 825 and shown on report No. EM0808632
All Tests have been conducted within the recommended holding period.

Yours sincerely,

Kate Hill
Approved Signatory

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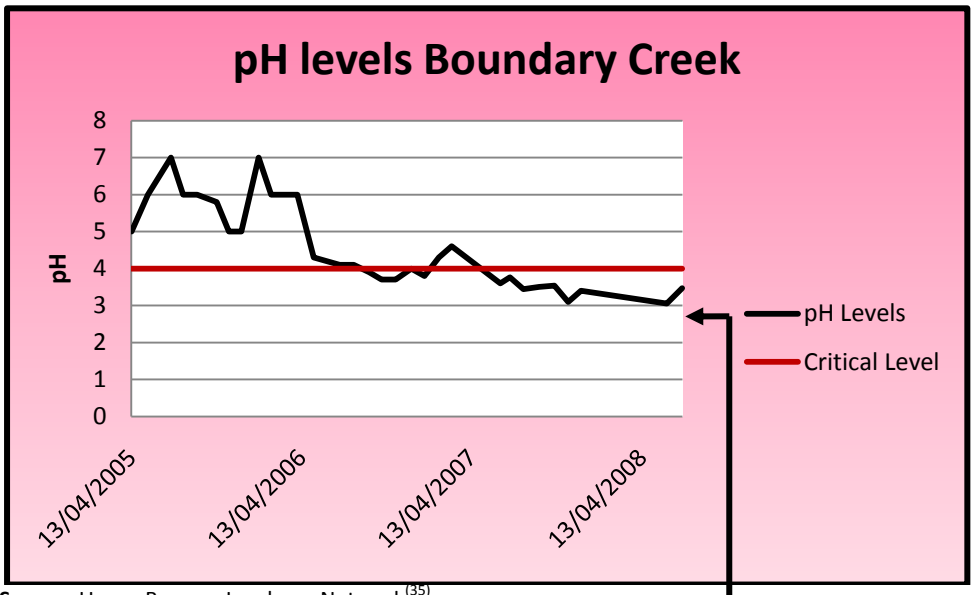
Accredited Laboratory No. 2457

PO Box 423, Warrnambool, Victoria, 3280, Australia Telephone: (03) 5563 3481 Fax: (03) 5563 3462

Acidity

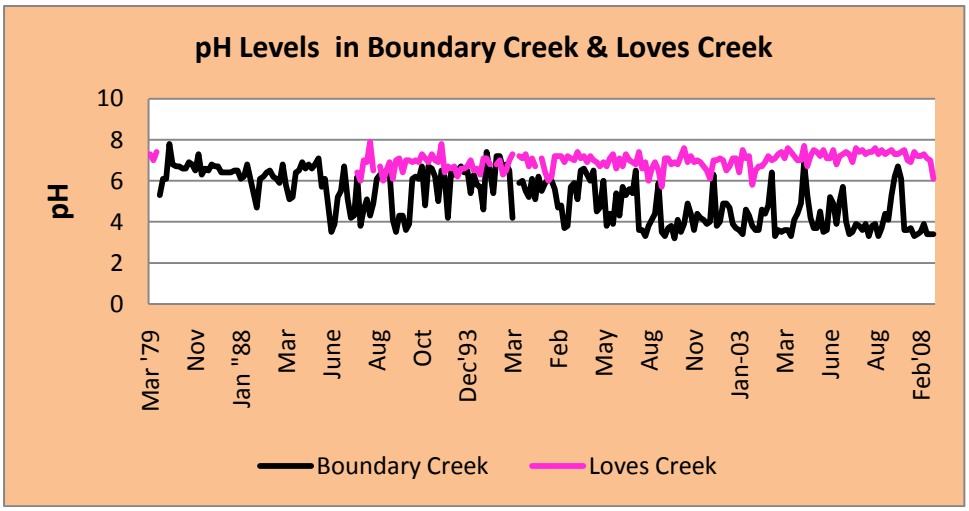
Most aquatic life needs a minimum pH of 6 to survive. Anything below a pH of 4 and a stream would in effect be devoid of all normal stream life.

The graph below shows Boundary Creek has been under a pH reading of 4 on numerous occasions since September 2006.



Source: Upper Barwon Landcare Network[35].

September 2008 a test done on an opaque "slug" was 2.7 (see page 58).



Source: www.vicwaterdata.net Boundary Creek@Yeodene Site Code 233228. Loves Creek@ Kawarren Site Code 235234.

This graph depicts acid problems since the late 1980s. The latest water tests suggest the pH has not stopped falling. Loves Creek the other side of the aquifer divide (see page 7) has remained relatively stable and healthy throughout the same period.

Indicators of Actual Inland Acid Sulfate Soils[11] that are present along Boundary Creek and in the Big Swamp:

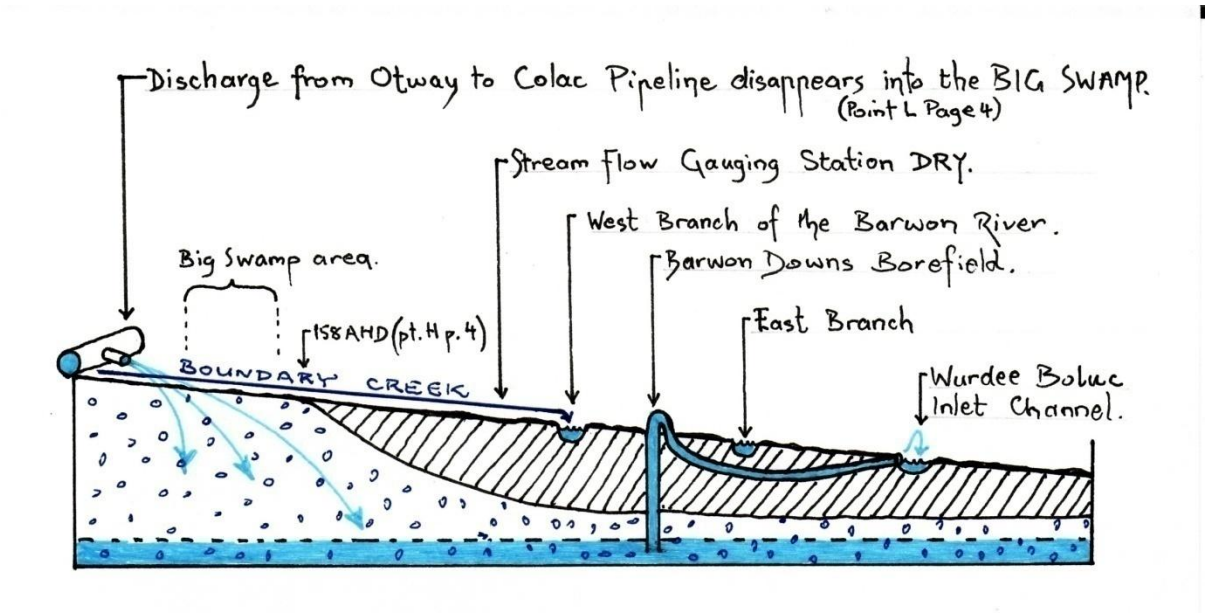
- Water of pH less than 5.5
- Unusually clear or milky blue-green water
- Extensive iron stains and ochre deposits

- Corrosion of concrete and steel
- Sulphurous smell.
- Oily bacterial scum.

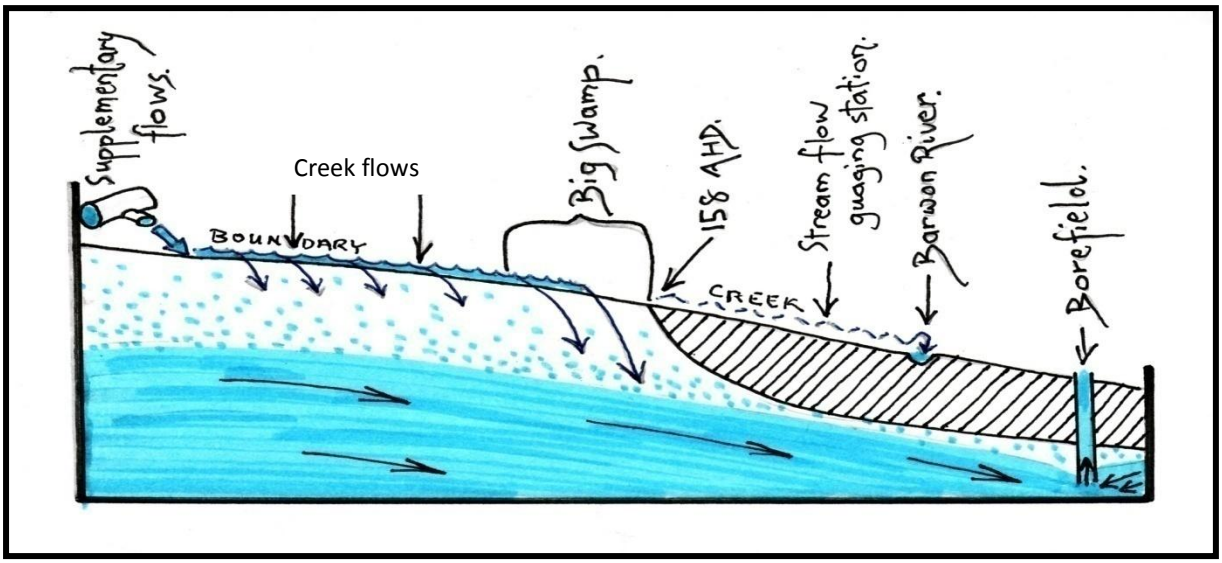
A full account of the possible Inland Acid Sulfate Soil problem can be found in "Otway Water – One Giant environmental Footprint – Book 8."[52]

2008. Supplementary Flows into Boundary Creek.

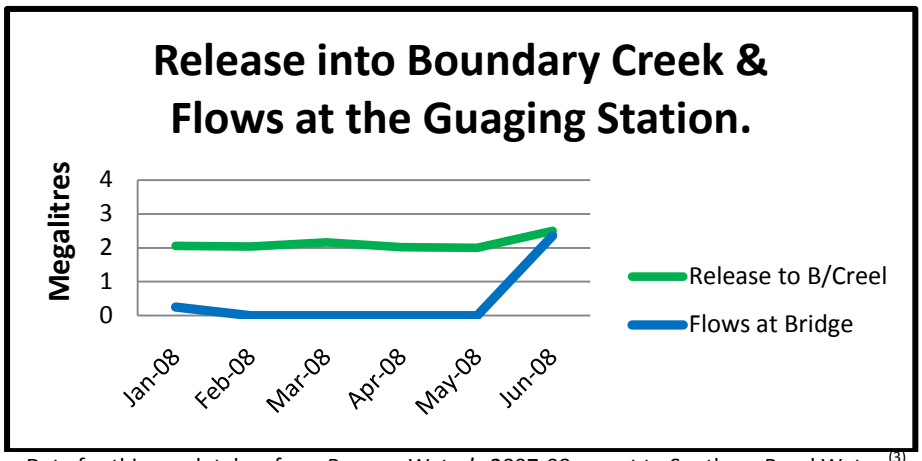
Whenever the Maintenance of the Stream Flow Trigger Point in the Yeo 40 observation bore dropped below the 158.5 metre mark supplementary flows had to be released into Boundary Creek until there was a flow of at least one ML/day at the Yeodene stream flow gauging station on the Colac Forrest Road (see map page 4 point I).
The following graph and diagrams will highlight the futility of this venture.



Diagrams representative of the process. (Not to scale)



The diagrams above are representative of the flow paths of the supplementary water releases from the Colac Otway pipeline. As the released water flows down Boundary Creek, wherever the creek bed is in direct connection with the depleted aquifer, the water seeps into the ground. In the Big Swamp area the water table has been lowered to such a degree this area has dried out. As a consequence the peat in the Big Swamp acts like a giant sponge. In periods of low rainfall the supplementary water completely disappears into this area never reaching the stream flow gauging station at the Colac Forrest Road bridge.
The green line on the next graph displays the megalitres of water released each day. The blue line clearly indicates that this supplementary water disappeared before reaching the stream flow gauging station.



Data for this graph taken from Barwon Water's 2007-08 report to Southern Rural Water.[3]

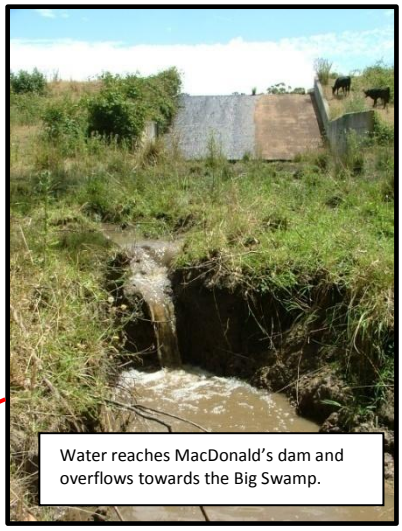
Between February and the end of May 2008 there was negligible rain. During this same 3 month period zero flows (blue) were recorded at the Colac Forrest Road bridge stream flow gauging station. The supplementary flows disappeared into the depleted aquifer at the Big Swamp. This has been a regular occurrence during low rainfall episodes.

To illustrate the disappearance of the supplementary flows a series of pictures were taken on 21 January 2010 (see page 66). These photographs show;

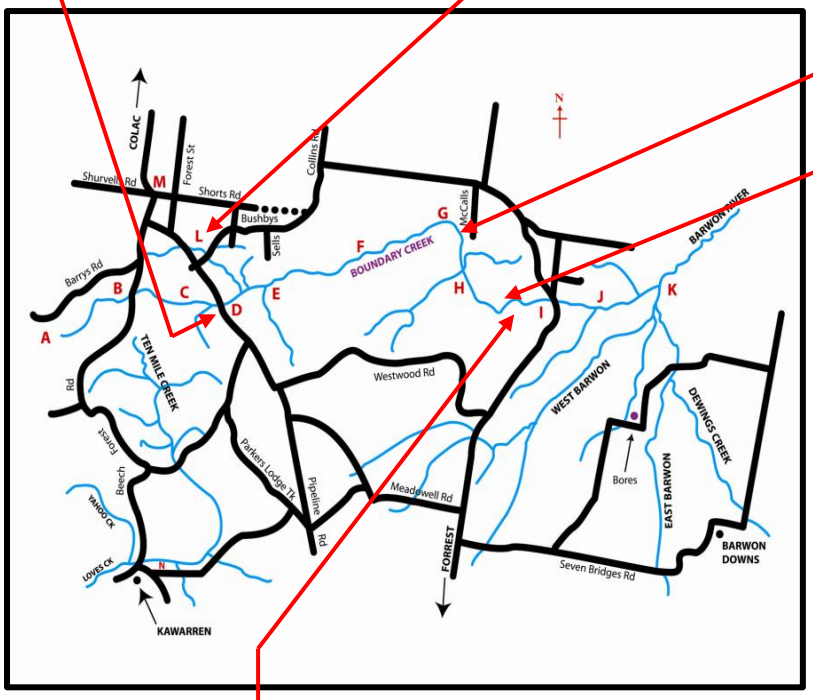
- Boundary Creek **dry** in the Barongarook High area at the bridge on the Colac to Barongarook Road.
- 2 ML/day supplementary releases from the Colac Otway Pipeline into Sandy Creek, a tributary of Boundary Creek. The licence conditions intention is that one megalitre of this water reaches the Colac Forrest Road gauging station.
- Overflowing water from the dam built across Boundary Creek. The water from the supplementary flows released at Sandy Creek makes it this far.
- A **dry** Boundary Creek as it passes through the Big Swamp. The water has disappeared.
- A galvanised steel dropper plunged deep into the peat of the swamp showing dampness at its lower end but definitely not into water. Ground level way below the 158.5 metres AHD trigger level at this point.
- Boundary Creek dry from the Big Swamp wetlands all the way to the Barwon River.

Boundary Creek dry at Barongarook Bridge.

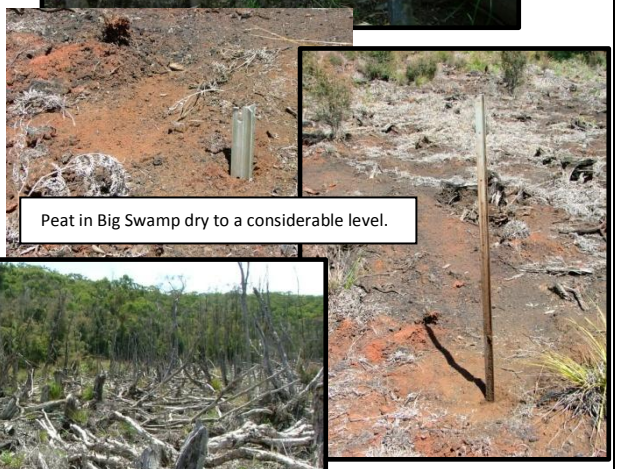
Supplementary releases of water.



Water reaches MacDonald's dam and overflows towards the Big Swamp.

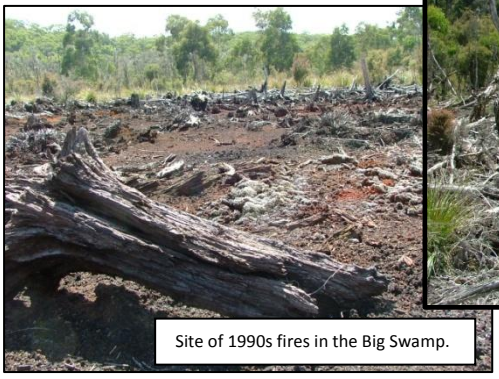


Boundary Creek dry passing through the Big Swamp.



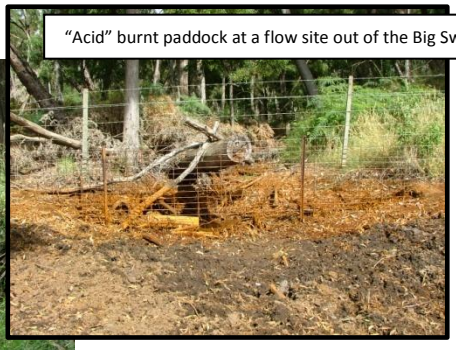
Peat in Big Swamp dry to a considerable level.

All of these photographs were taken on 21 January 2010.



Site of 1990s fires in the Big Swamp.

Something is slowly killing all vegetation downstream of the fire site. This "creeping" condition is moving downstream and is over the majority of the Big Swamp wetlands.

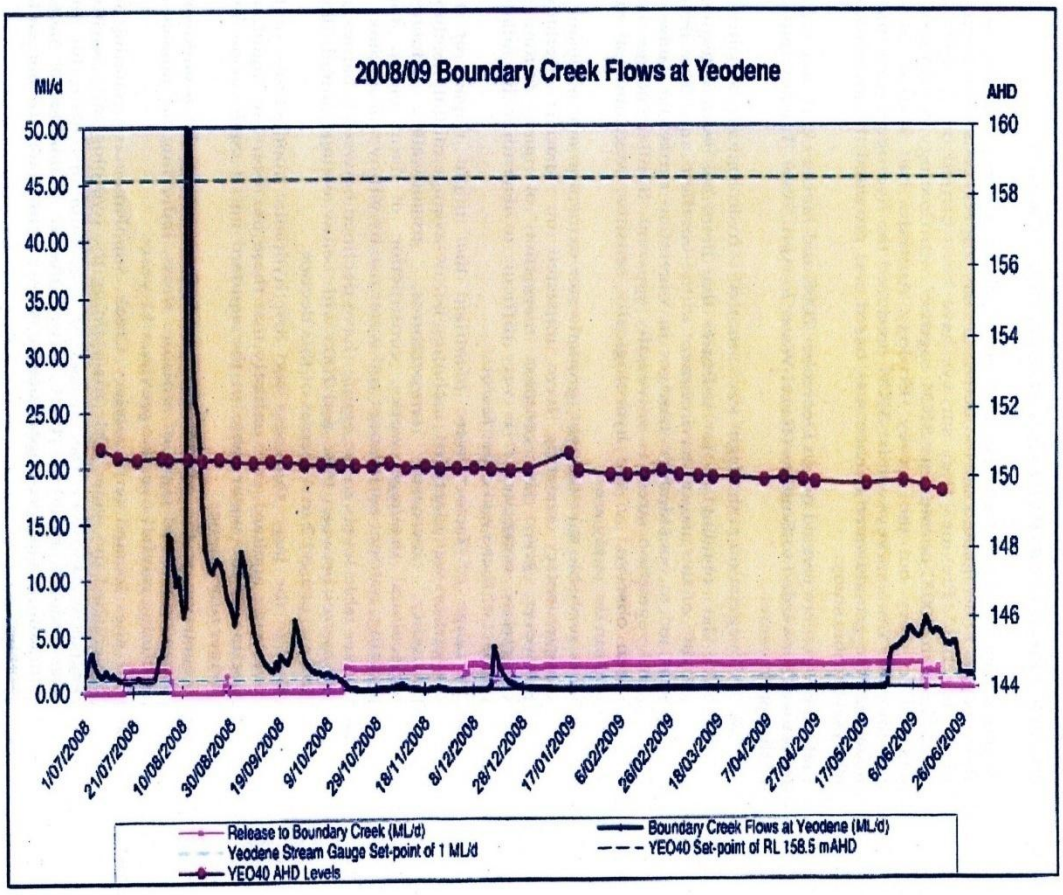


"Acid" burnt paddock at a flow site out of the Big Swamp into pasture land.

The main branch of Boundary Creek exiting the Big Swamp area.

Stream Flow Gauging Station weir "dry as a bone." The supplementary water doesn't reach this point. It all disappears into the Big Swamp.

Figure 3. Flows in and Releases to Boundary Creek at Yeodene



This graph is taken from Barwon Water's 2008-09 report to Southern Rural Water.[51]

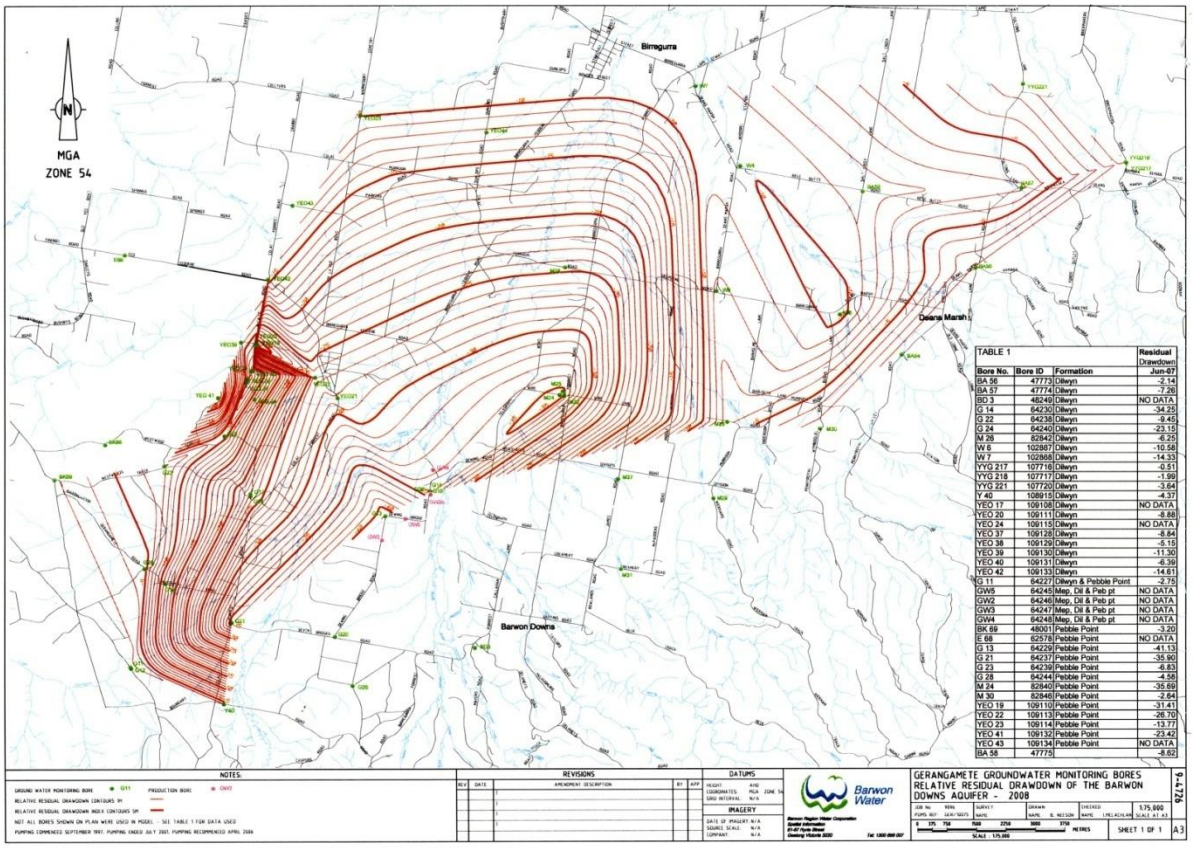
This page taken from the 2008-09 Barwon Water report to Southern Rural Water shows a very similar scenario to the one that happened between February 2008 and June 2008. The pink line indicates supplementary flows, around the 2 ML/day rate, and the Boundary Creek flow at the stream flow gauging station as zero.

Ecological Flows.

A Barwon Water report completed in 2009[40] states that the reasons for the supplementary flows were to maintain ecological conditions. If this is the case it was not spelt out in the 2004 Licence Number 893889. It is more likely that the supplementary flows were to protect domestic and stock use as described under Section 8 of the licence. In this section it clearly states that Barwon Water must ensure access is maintained for Domestic & Stock use along Boundary Creek. When water fails to reach point "J" (see map, page 66) Barwon Water has been obliged to cart truck loads of water at huge cost, into at least one farmer on Boundary Creek located below the Big Swamp. There can be no doubt that groundwater extraction at Barwon Downs has had dramatic impact on this area as a result of significantly drawing down the water table in the deep water aquifer.

On page 22 of this same report[40] it has this to say, "***This reversal of groundwater flow has caused this reach of Boundary Creek to change from a gaining stream to a losing stream***."

2008. Drawdown Figures.



This map was taken from the Barwon Downs annual report to Southern Rural Water.[3] There was no explanation why the drawdown contours had been dramatically reduced on this map. The drawdown contours do not even cover the deepest drawdown "hole" under the actually borefield pumps when compared with the maps on pages 50 and 72.

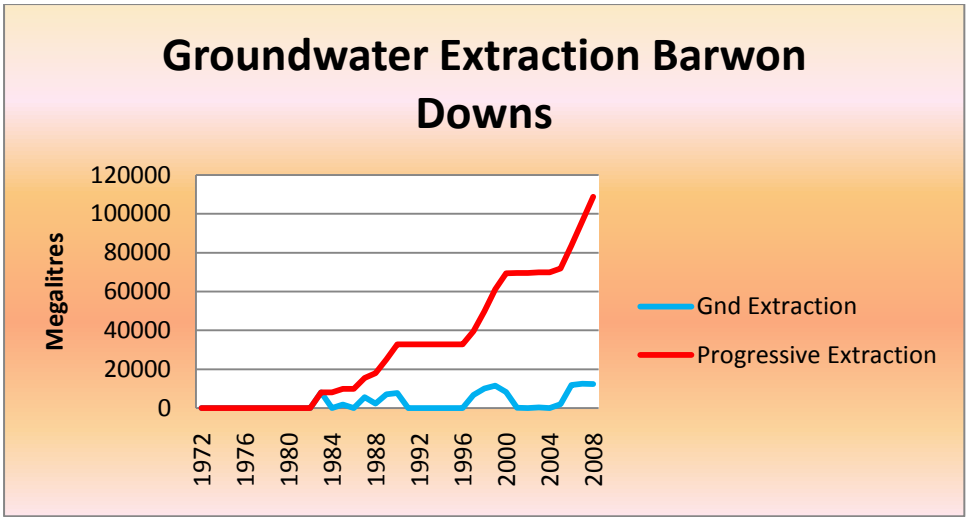
2008-2009. Formal Complaints of Possible Actual Inland Acid Sulfate Soils.

After consultation with various statutory government bodies asking for the Big Swamp area to at least be visited and at best tested for Actual Inland Acid Sulfate Soils and having no success, formal complaints were sent to the Environment Protection Authority (EPA), Barwon Water, the Department of Sustainability, Southern Rural Water and the Colac Otway Shire. The Colac Otway Shire is attempting to co-ordinate these statutory authorities into some action. The first formal complaint was delivered to the EPA over 15 months ago and still the site has not been visited by the EPA.

A full account of this tardiness can be found in "Otway Water – One Giant environmental Footprint – Book 8" and "Otway Water – Waves of Obfuscation – Book 10."

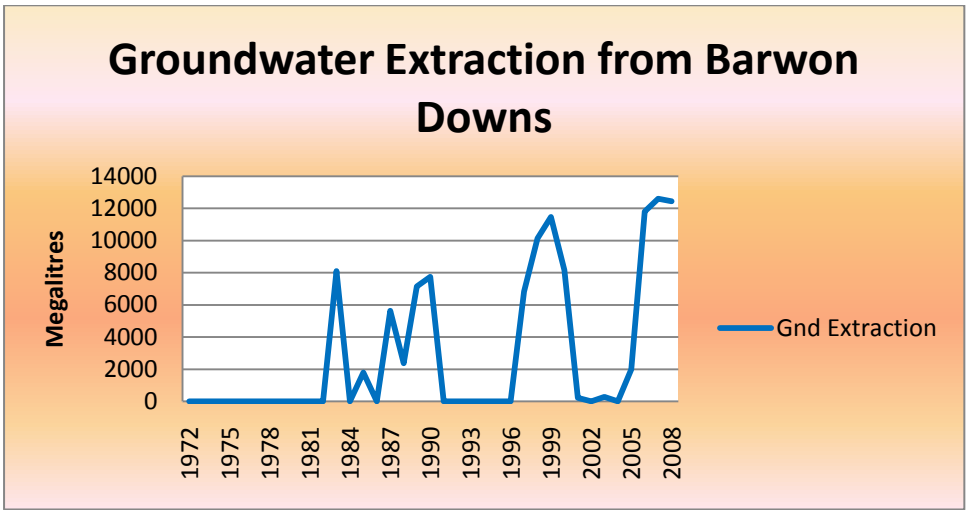
June 2009 Groundwater Water Extraction from the Borefield.

The following graphs include the latest data provided in the 2008/2009 Barwon Downs Gerangamete Groundwater Management Area Groundwater Licence No. 893889 report[50] to Southern Rural Water. Gaps in data have been taken from the Victorian water data computer bank website.[16]



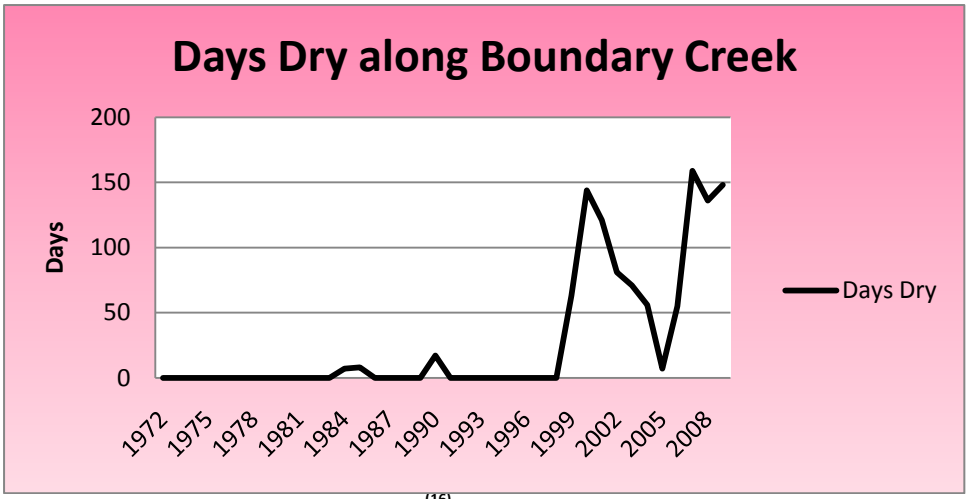
Yearly Groundwater Extractions & the Progressive Total.

The progressive total of groundwater extracted up to June 2009 was 108 722 million litres.



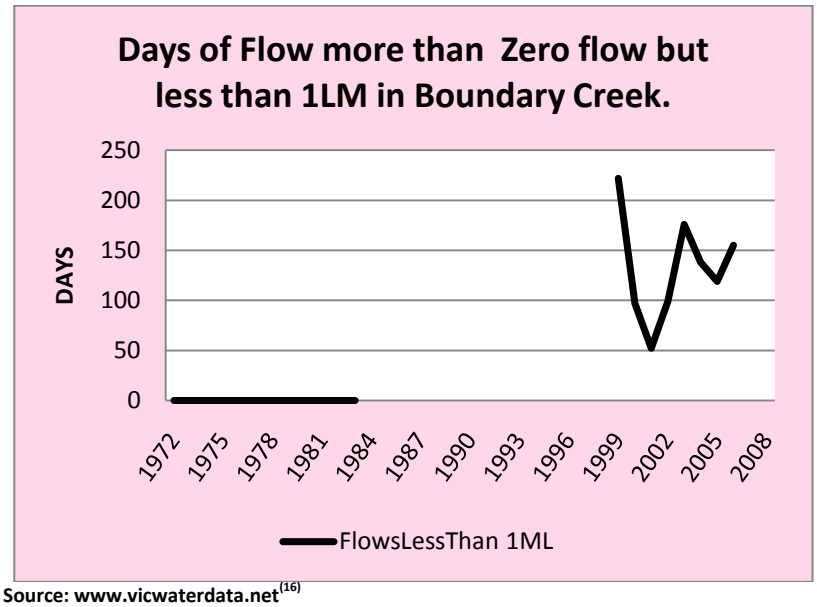
Yearly groundwater Extractions form the Barwon Downs Borefield.

The days Boundary Creek are dry closely mirrors the yearly extractions graph above.



Yearly Days Boundary Creek Has Been Dry.[16]

The Barwon Water reports to Southern Rural Water from 2004 to 2006 should have included data on the flows in Boundary Creek but failed to do so. When compiling this missing and other data from Government records, the days of flows less than one megalitre but more than a zero flow were also recorded. The days of no flow are not included in this graph. If combined the two sets of data would paint an extraordinary dismal picture of flows in Boundary Creek.

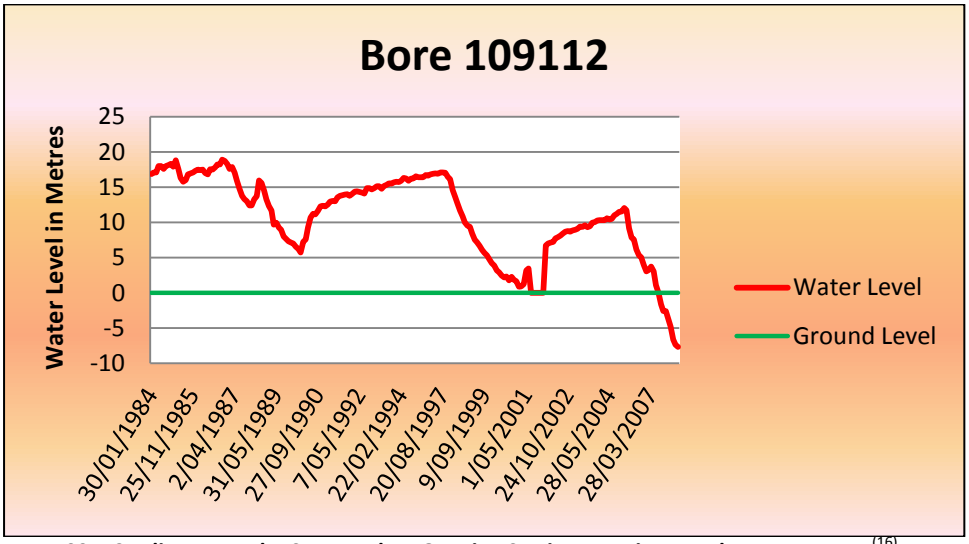


Source: www.vicwaterdata.net[16]

The period 1972 to 1984 has been shown as days of no flows less than 1 ML based on local knowledge and the Witebsky et al.[49] report. Witebsky stated that the daily average summer flow was in the order of 3.2 ML. Farmar-Bowers[21] also confirms a vibrant healthy Boundary Creek pre 1986.

November 2009. Bore 109112.

Bore 109112 is in very close proximity to Boundary Creek on the Colac to Forrest Road just upstream of the Yeodene stream flow gauging station on Boundary Creek (see page 4 point I). The decline in water table level is dramatic.



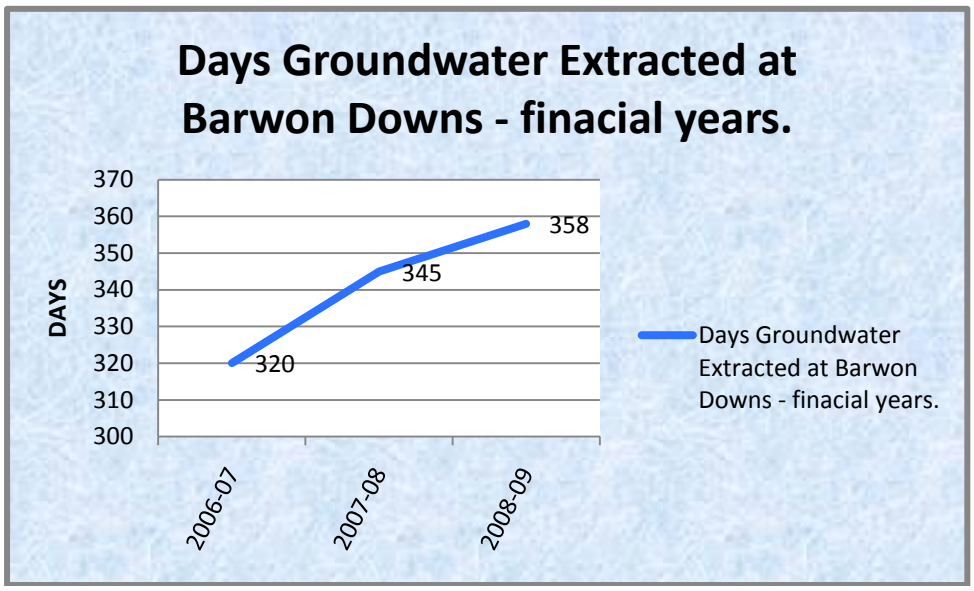
Bore 109112 Adjacent to the Stream Flow Gauging Station at Point I on the map Page 4.[16]

This Bore 109112, pre-pumping was squirting water into the air to a height of nearly 20 metres. The water level as at November 2009 was down to 7.69 metres below ground level.

Bore 109112 is approximately 2 kilometres downstream of the Big Swamp. The water level is so far below ground level at this point that the only time Boundary Creek flows is during rain episodes.

From August 2006 - 2009 Continuos Groundwater Extraction.

From August 2006 groundwater from the Barwon Downs Borefield has been extracted virtually no stop. Not only is the pumping continuous except for a few days each year, it would appear from observation of the

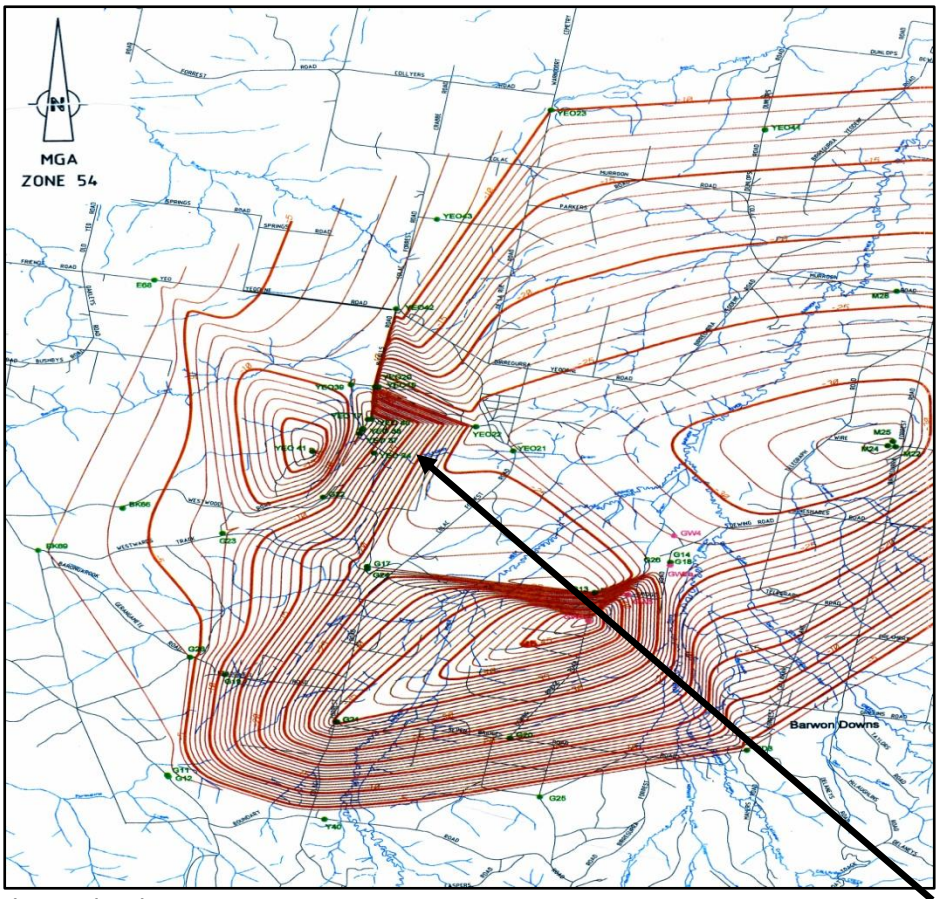


outflow pipes that the rate of extraction has also increased (see pictures page 39) since early January 2009. In the financial years 2006/07, 11 807 ML were extracted; 2007/08, 12 604 ML and last financial year 12 438 ML were extracted.
Barwon Water has licence rights to extract 20 000 ML/year. To step the extraction up to 20 000 ML/year would almost double the amount being sent to Geelong. The impact on Boundary Creek at 11 000 ML/year is horrific enough but extraction at 20 000 ML/year can only be imagined.

2009 Drawdown Figures.

On page 73, the two maps on page 72 have been combined. The 2009 drawdown map[51] has been superimposed over the SKM 2003 map.[50]

Two sections of the red drawdown contours that depict drawdown holes in the Yeodene area are almost directly under the Big Swamp wetlands. This fact alone clearly demonstrates how the drawdown from the Barwon Downs Borefield is having a direct and detrimental impact on the Big Swamp wetlands. There is little doubt that the deep water aquifer outcrops in the Big Swamp and that there has been significant drawdown in this very same area.



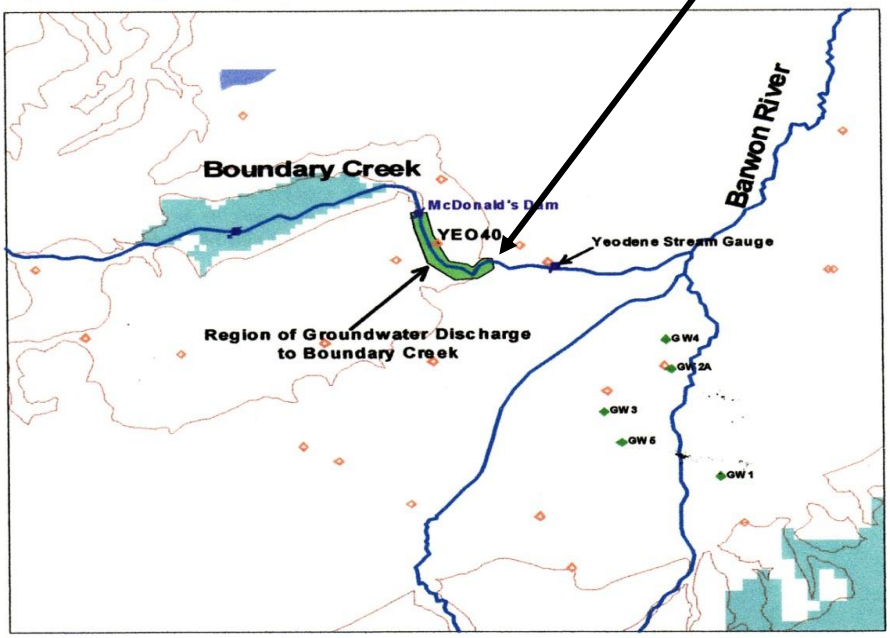
The 2007 drawdown map.

The Big Swamp.

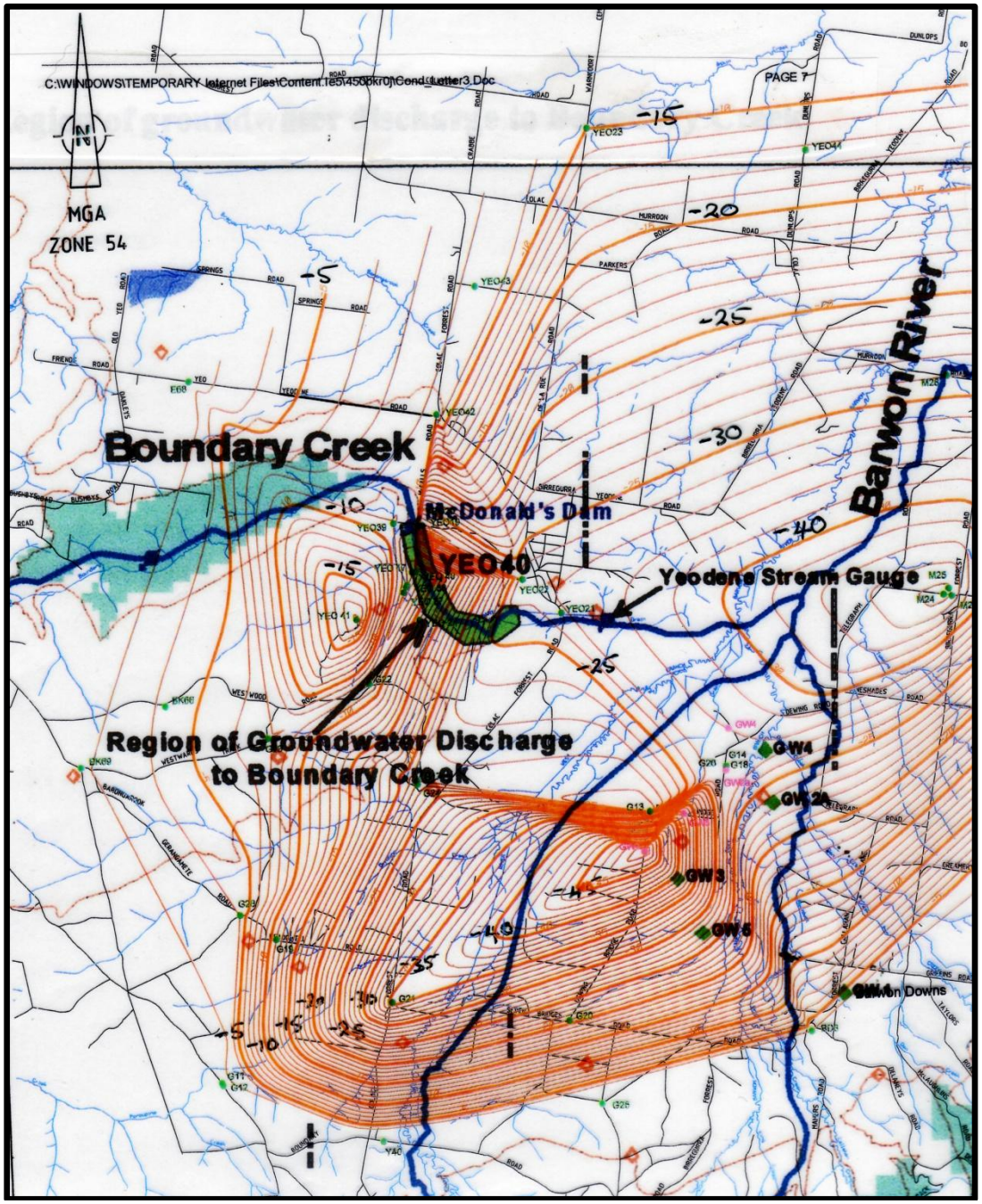
SKM

Barwon Water
Recommendations for Groundwater Licence Conditions
14 May, 2003

■ **Figure 3-1 Region of groundwater discharge to Boundary Creek**

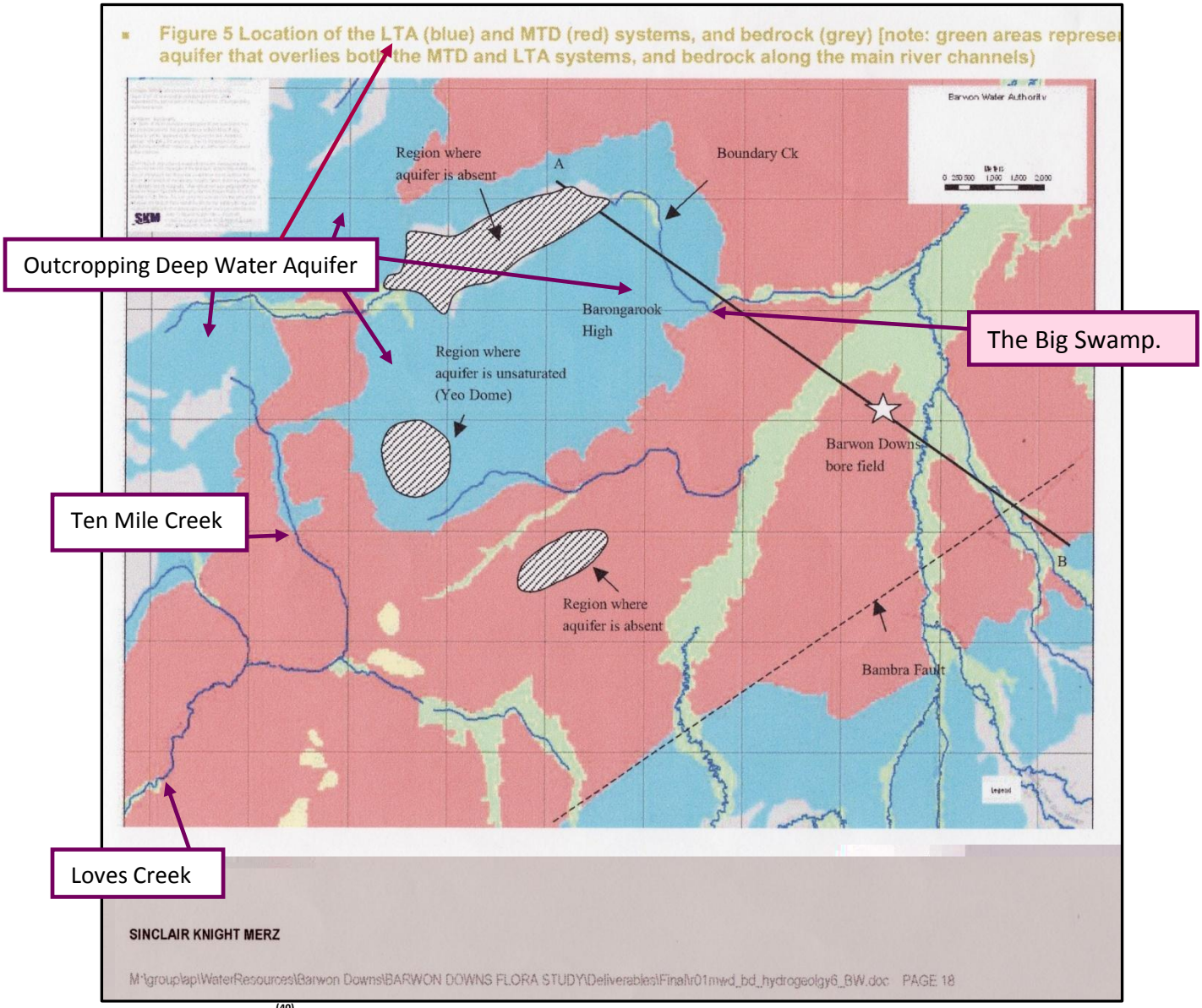


There can be little doubt that the outcropping deep water aquifer has been lowered many metres below where the groundwater discharges into Boundary Creek. Much of the water entering this green area on the map will soak down into the depleted aquifer. The only time Boundary Creek will flow will be during high rainfall events. In the first rainfall flushes there will be elevated acid levels and significant loads of heavy metals flowing down the creek and into the Barwon River. Boundary Creek is a "Dead Creek."



Superimposed maps found on page 4.

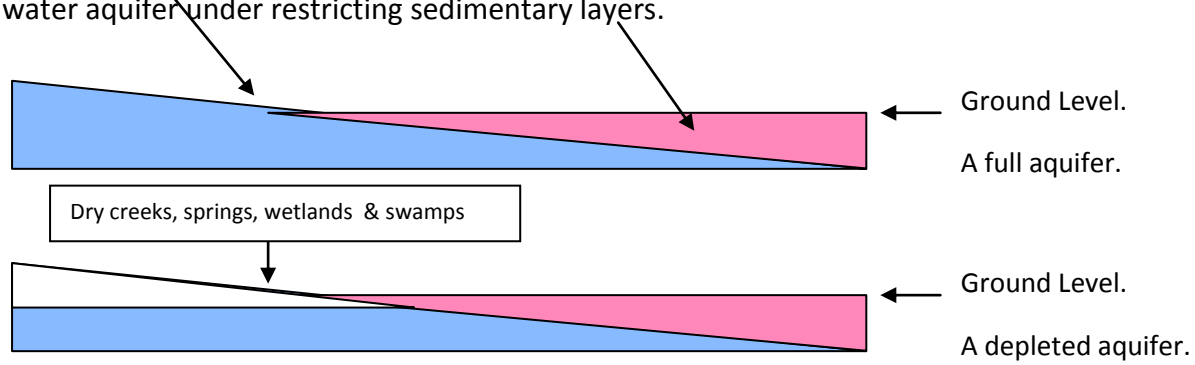
As with much of the data obtained from Barwon Water detail is quite often difficult to read. Some of the red drawdown contours have been marked in in black (e.g. -25) to assist with the understanding of the "holes" created by the groundwater extraction.



Source: 2009 SKM Map[40]

The blue shaded area indicates where the deep water aquifer outcrops at the surface. The pink shaded areas are overlaying the blue aquifer.

The Big Swamp would be in the region between the outcropping and confining of the deep water aquifer under restricting sedimentary layers.



The diagrams on pages 21, 22 also depict this phenomena.

2009. Flora Study Completed.[40]

"Otway Water – Barwon Water Flora Studies 1986-2009 , Book 9"[53] presents an entirely different result to the published results of a study[40] conducted by Sinclair Knight Merz (SKM) on behalf of Barwon Water. The SKM study centred on the Boundary Creek Catchment.

When the Sinclair Knight Merz report[40] was tabled Barwon Water released a media statement (April 23, 2009. REF: 063/09). The release contained half truths, misleading information and incorrect statements that masks some incredibly poor research. The media release was headed "**Flora study inconclusive**."

Otway Water Book 9[53] demonstrates that conducted differently, this flora study would have had another and more plausible result. If the "***conducted field surveys, reviewed groundwater levels and assessed new and previous data***,"[40] had been completed as suggested it was, the results would have shown Boundary Creek and the Big Swamp to be seriously degraded from groundwater extraction at the Barwon Downs Borefield. However, an inconclusive finding is to Barwon Water's favour as it does not reflect badly on the management and operation of the borefield. Such a finding is not unexpected.

Suffice is to say, however, conclusive results would have been reached if the will to do so was present. Narrow study briefs and lack of effort to implement recommendations made over the last 2 decades reflects badly on the groundwater extraction management at Barwon Downs.

2009 recommendations for future studies that will enable a conclusive result to be arrived at, are mirror images of those recommendations that were made in 1986, 1991 and 2002, recommendations that have never been implemented. Little has changed.

The tardy pursuit of truth, honesty and integrity in regard to the deplorable environmental degradation happening along Boundary Creek and in the Big Swamp wetlands appears to be an ingrained problem.

Ground Water and Surface Water Catchments Protected?

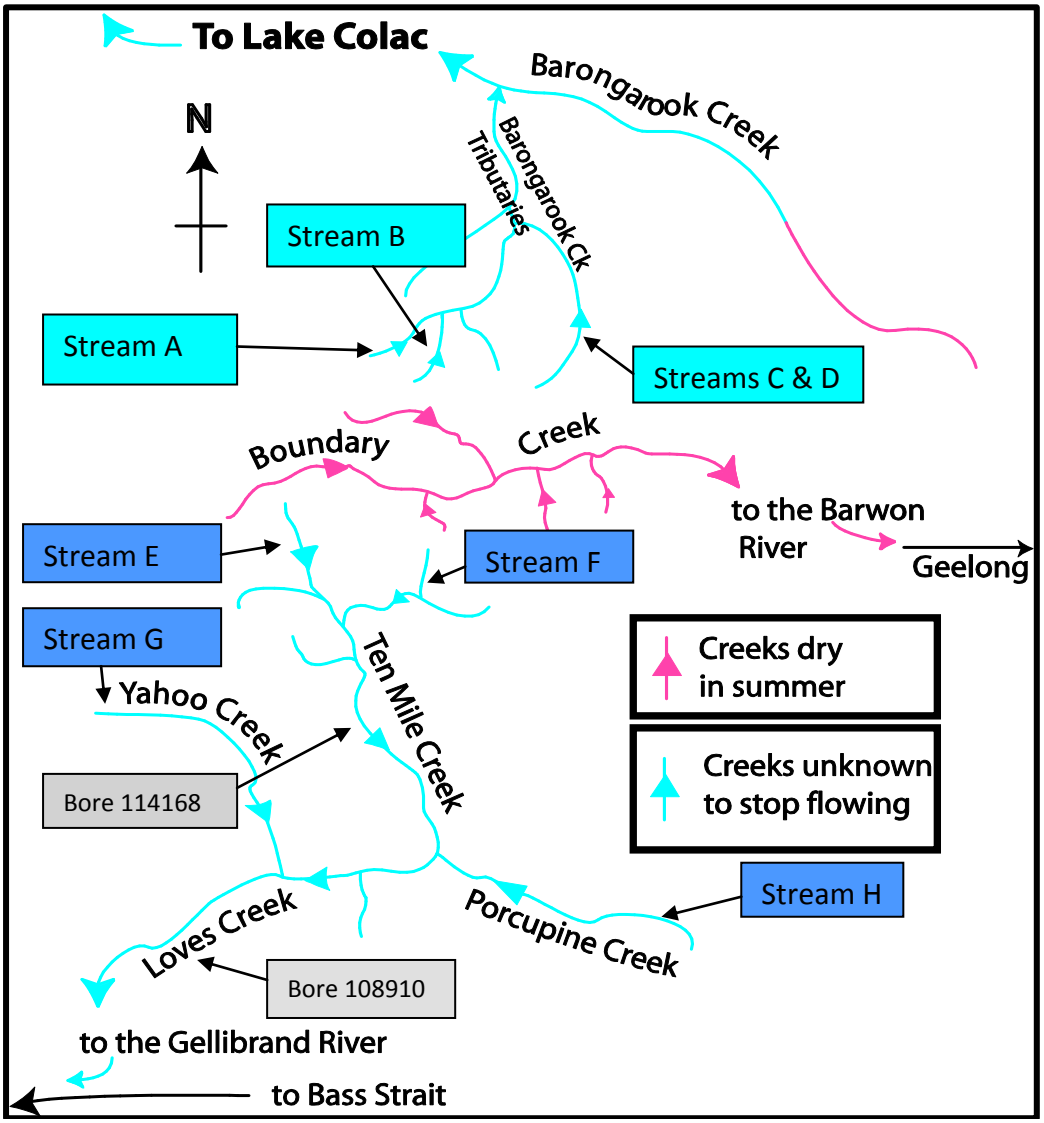
The quality and quantity of water harvested from a water resource is strongly influenced by the management of the catchment from which it is taken. In an effort to protect the resource and have extraction conducted in a sustainable and appropriate fashion regulatory measures are applied. In simplistic terms whenever an activity is contemplated there is a process of regulation that must be followed. In many cases being aware of the regulations and implementing them would suffice. However, there are always the situations where a statutory authority must be involved. In the Boundary Creek area this authority would most likely be the Colac Otway Shire. If the need arose the Shire would refer this onto other and appropriate authorities for their input. For a local resident any breeching of this regulatory system would bring down the full force of the law. The point to be made here is this same system appears to lack a process whereby the same consequences apply to the regulators. In regard to the protection of Boundary Creek and the Big Swamp it would appear that regulations can be ignored by the regulators. If a local resident was to cause such degradation the penalties against the resident would be substantial.

2010. Creeks in the Loves Creek Catchment and tributaries of the Barongarook Creek continue to flow.

Since groundwater extraction started from the borefield at Barwon Downs, Boundary Creek has been dry on at least 1000 days. However, the streams to the north and south of the Boundary Creek Catchment have continued to flow through this worst drought on record.

The map on page 7 indicates that there is an aquifer divide between the tributaries of Barongarook Creek to the north of the Boundary Creek Catchment and an aquifer divide between the tributaries of Loves Creek and the Boundary Creek Catchment to the south. In essence an aquifer divide splits the aquifer into parts. This can be the result of faults, volcanic action, uplifts and other movements that have occurred in the earth's crust. Often the divides are poorly understood and as often are loosely defined.

The streams to the north of the Boundary Creek Catchment are marked on the map as Streams A, B, C and D. The streams to the south are marked as Streams E, F, G and H.



The headwaters of Streams A-G start in the Barongarook High area. It is a puzzle how these streams can still flow during the worst drought on record as Barongarook High is the highest point in this section of the foothills of the Otway Ranges. Why has Boundary Creek dried up?

BOUNDARY CREEK.

Boundary Creek as it begins to dry after a rainfall episode. The toxic looking " sludge" evident in this picture, comes from upstream out of the Big Swamp.

Boundary Creek no longer flowing over the spillway at the Yeodene stream flow gauging station at the Colac to Forrest Road bridge. This has been a regular occurrence since groundwater extraction at the Barwon Downs Borefield.

THE BIG SWAMP – seriously impacted by acid water and acid creep.

Tributaries of Barongarook Creek to the north of the Boundary Creek Catchment.

STREAM A.

This stream has never been known to dry up. It has continued to flow through this latest drought as the following statutory declarations indicate. The photographs show vibrant healthy wetlands from where this stream originates and flows through.

I, MICHAEL RICHARD KENNETH POTTER.

of TINTERN LOOP. HILLSIDE in the State of Victoria do solemnly and

sincerely declare

THAT I previously owned a property on the corner of Forest Street South and Shorts Road Ellimeyet. I purchased this property in 1997 and sold it in August 2007. A significant part of the land was covered in bush surrounding an old quarry site that has long ago become overgrown with many species of native vegetation. There was always numerous wildlife in this bushland and was a major attraction of the property. Springs originated from this area and a creek flows into it from the south and out of it to the east into the neighbouring property as indicated on the accompanying map marked MAP ONE. Throughout the period of my ownership this creek never stopped flowing to the best of my knowledge. I did not check it everyday, but everytime I checked it, it was flowing. Even in summer from December to February and March, when rainfall was at its lowest.

AND I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of an Act of the Parliament of Victoria rendering persons making a false declaration punishable for wilful and corrupt perjury.

DECLARED at KEILOR DOWNS in the State of Victoria this FOURTEENTH day of JANUARY in the year of 2010

Before me

Michael R.K. Potter

A JUSTICE OF THE PEACE FOR VICTORIA
Reg No 11755
Donald Richard Lorter
221/111-139 Coburns Rd,
Brookfield 3338

JUSTICE OF THE PEACE J.P. FOR VICTORIA

These two photographs were taken from Shorts Road. They show a lush, vibrant and healthy wetland compared to the Boundary Creek wetlands in the Big Swamp.

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, Jan elaree Scobie
[full name]

of 305 Forest Street, Ellimiyt
[address]

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

I have been the owner of the above mentioned property since October 2007 & from that time until now the water supply running through my property has been continual. The creek runs constantly & always has fresh running water.

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

Declared at Colac

in the State of Victoria, this 11th day of

February 2010

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

Before me, (CPA)
.....
Signature of authorised witness

CHRISTOPHER ALAN KEMP
175 BROMFIELD STREET, COLAC VIC 3250

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

Jan Scoble purchased Michael Potter's property.

STREAM B.

This stream passes under Shorts Road a little further to the east and has also never been known to dry up.

At the culverts on Shorts road. The wetlands to the south of Shorts Road are very similar to the ones on the Potter/Scoble property, Stream A.

State of Victoria – Evidence Act 1958

STATUTORY DECLARATION

I, John E. Duggan. [full name],

of 185 Shorts Road Barongarook. Victoria 3249 [address],

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

We have lived at the above address since we purchased this property from Mr Ron Phillips in 2001, who told us this creek has never run dry. Since our tenure this creek has never run dry, and has been a source of water for our horses and cattle. It has also attracted the wild-life of the area as well as seasonal ducks.

We hope this healthy state of the creek will continue for ourselves and for many others who share the asset with us.

We are. Yours faithfully.

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

Declared at Colac.

in the State of Victoria, this 25 day of January 2010

J Duggan

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

Before me,

Signature of authorised witness

R.P. Hynes HealthWise Pharmacy
Alex Pappas, B Pharm., M.P.S.
56 Corangamite Street
Colac 3250
Telephone: 5231 2041

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

STREAM C & D.

Olive Parker's property has two tributaries flowing through it. The stream to the west that Olive writes about is marked **D** on the map and the stream to the east is marked **C**.

The middle of summer with springs running out of the bank.

These photographs are all at site C.

Looking down over the wetlands to the south of the Bridge.

State of Victoria – Evidence Act 1958

BP DOLL 26

STATUTORY DECLARATION

I, Olive Stella Parker.
[full name]

of 115 Old Friends Rd Yeo
[address]

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

I have lived at the above address for 59 years. When my husband and I purchased this property we were told that the creek to the west of the house was known to have never run dry as far back as 1903. Since arriving at this property in 1950 the creek has never stopped flowing and has been an invaluable water supply for our stock. During the recent dry years our dams haven't filled. Due to this the creek has been very important to us.

In 1968 we purchased the O'Reillys property to the east of our property. This land also has a permanat creek on it. This creek has a large wetland area which is home to numerous birds. This water supply is also valuable to us.

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

Declared at Colac

in the State of Victoria, this 16 day of September 2009

O. S. Parker
Signature of person making this declaration
(to be signed in front of an authorised witness)

Before me,

Signature of authorised witness

Joseph Sahhar

Colac HealthWise Pharmacy
Alex Pappas, B.Pharm., M.P.S.
S 3-7 Safeway Complex 52 Bromfield St. Colac Tel: 5231 4022
21586D

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

Commonwealth of Australia

STATUTORY DECLARATION

Statutory Declarations Act 1959

1 *Insert the name, address and occupation of person making the declaration*

I,[1] Jennifer Rosemary Broome
110 Oakleys Rd
Yeo Farmer

make the following declaration under the *Statutory Declarations Act 1959:*

2 *Set out matter declared to in numbered paragraphs*

[2] During the period from 1938 until the date below, the creek that runs under the bridge on Old Friends Road at Barongarook, at S38 38748 E 143 62891 (Garmin etrex 12 GPS used) has never run dry.

I understand that a person who intentionally makes a false statement in a statutory declaration is guilty of an offence under section 11 of the *Statutory Declarations Act 1959*, and I believe that the statements in this declaration are true in every particular.

3 *Signature of person making the declaration*

[3] JBroome

4 *Place*
5 *Day*
6 *Month and year*

Declared at [4] Colac on [5] 14TH of [6] JUNE 2007.

Before me,

7 *Signature of person before whom the declaration is made (see over)*

[7]

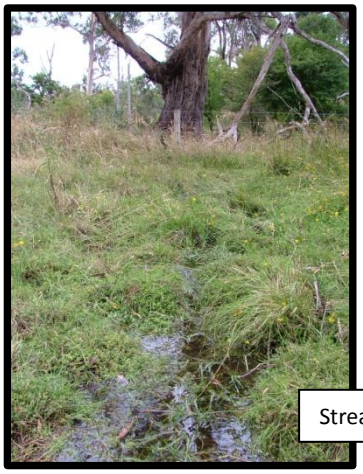
8 *Full name, qualification and address of person before whom the declaration is made (in printed letters)*

[8] ADAM JOHNSTON
SENIOR CONSTABLE 33642

POLICE STATION
Queen St. Colac Vic 3250
Date: 14/6/07

Note 1 A person who intentionally makes a false statement in a statutory declaration is guilty of an offence, the punishment for which is imprisonment for a term of 4 years — see section 11 of the *Statutory Declarations Act 1959*.

Note 2 Chapter 2 of the *Criminal Code* applies to all offences against the *Statutory Declarations Act 1959* — see section 5A of the *Statutory Declarations Act 1959*.



Stream D.

The site Jennifer is referring to is Stream C.

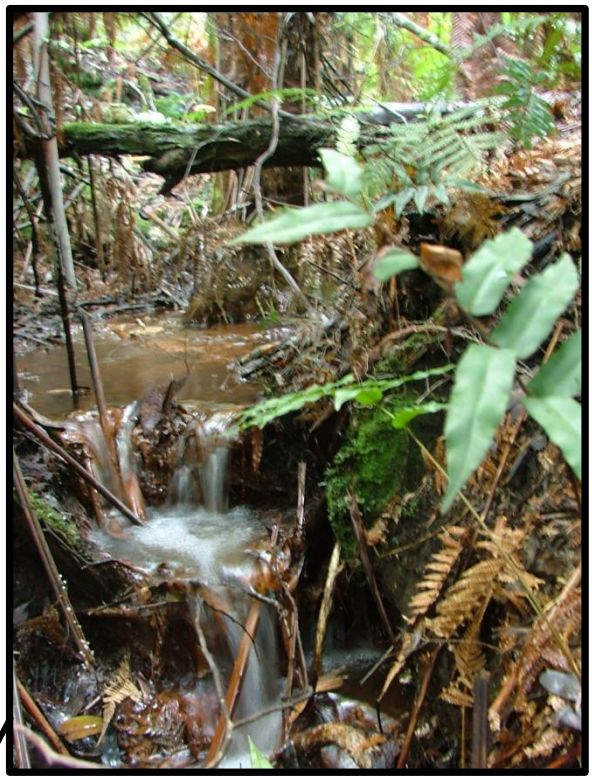
The stream marked D has anecdotal history of being known to have run continuously since around 1903. The story goes that goats, horses, cattle, sheep and even camels were brought to this site to survive a severe drought sometime in the early 1900s.

Unfortunately any written record of this happening has not as yet been found.

Tributaries of Loves Creek to the south of the Boundary Creek Catchment.

STREAM E.

Maggios Wetland and peat swamp.



Photos taken December 2009.

Maggios Wetland in the headwaters of Ten Mile Creek and at the top of the Barongarook High, has maintained its integrity throughout the worst drought on record. This wetland of peaty swamp has had the added pressure of being surrounded by intense agroforestry. Late in 2009 bluegum forest to the north and west were harvested. The pine tree plantation to the east is still standing. These plantations require considerable amounts of soil moisture to survive. Even with these plantations taking their share of water the wetland continues to thrive. The dense wetland vegetation in this swamp is comparable to what the Big Swamp used to be like pre groundwater extraction at the Barwon Downs Borefield. Because of the saturated peats this wetland has defied all efforts to clear it.

STREAM F.

State of Victoria – Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, RAY MOORFOOT
[full name]

of 250 ROBINSON RD BARONGAROOK
[address]

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

I HAVE LIVED AT THE ABOVE ADDRESS FOR 20 YEARS. WHEN I FIRST ARRIVED THE WEATHER AND RAINFALL WAS GOOD AND WATER SUPPLY TO DAMS WAS GOOD AND ALL DAMS ALWAYS HAD WATER. DURING SUMMER MONTHS THERE WAS NEVER A PROBLEM WITH WATER AS THE LARGE DAM IN THE GULLY WAS SPRING FED. UNFORTUNATELY THE DAM WASHED AWAY DURING A VERY HEAVY STORM. BUT NOT TO WORRY BECAUSE THE GULLY ALWAYS HAD WATER FLOWING ALL YEAR ROUND; LESS IN SUMMER, BUT ALWAYS SMALL AMOUNT OF WATER FLOWING. DURING THE DROUGHT I HAVE HAD ONE SMALL STOCK DAM DRY UP. LARGE DAM IN PADDOCK VERY LOW; BUT THE GULLY, EVEN THOUGH SMALL, WATER STILL FLOWED. IN ALL THE TIME I HAVE LIVED HERE THE SPRINGS HAVE ALWAYS HAD WATER - AT VARIOUS FLOWS - BUT ALWAYS FLOWED

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

Declared at COLAC

in the State of Victoria, this 21st day of JAN 20 10

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

Before me, P. [illegible]
Signature of authorised witness

P. CRAIG
45 C 2830

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

STREAM G.

The Yahoo Creek also sources it water from the Barongarook High and supports colonies of platypus and other significant stream biota. This creek although a small flowing stream has never run dry at any stage during this last drought.

State of Victoria – Evidence Act 1958

STATUTORY DECLARATION

I, Alan Alexander Porteous,
[full name]

of 1430 Colac–Lavers Hill Rd Kawarren Vic 3249,
[address]

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

In 2006 I started looking for a small Lifestyle property to retire on that had some permanent water on it. During the drought I kept my eye on this property which has the Yahoo Creek running through it (I had been told that the Yahoo creek had never dried up). At the northern end of my neighbours ~~my properties~~ there is about 4 Ha of wet land + from the wetland the creek starts flowing about 1.5 km down to Lower creek.
After seeing for myself that the creek +wetland didn't dry up in droughts I bought the place.

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

Declared at Colac,
in the State of Victoria, this 2 day of February 2010

Before me,
Signature of authorised witness

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

R.P. Hynes HealthWise Pharmacy
Alex Pappas, B.Pharm., M.P.S.
56 Corangamite Street
Colac 3250
Telephone: 5231 2041

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

STREAM H.

The Porcupine Creek flows out of a National Park and a declared Reference Area. Although there is an extremely convincing case that drawdown over an aquifer divide from the Barwon Downs Borefield is having a detrimental impact on the Porcupine Creek Catchment, the creek has continued to flow.

The daily summer flow in the Porcupine is quite low and runs at approximately 300000 litres but has never stopped flowing.

These pictures were taken at the stream flow gauging station just upstream of the confluence with the Ten Mile Creek.

State of Victoria — Evidence Act 1958

[JP/DOJ.1/2000]

STATUTORY DECLARATION

I, PETER GORDON MACDONALD,
[full name]

of 130 MACDONALD'S ROAD KAWARREN VIC 3249,
[address]

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

Our family first moved to Kawarren in February 1945. Grandad, Sydney MacDonald and Dad, Gordon MacDonald dairy farmed together at 195 MacDonald's road.
In 1971 due to ill health, Granddad Sydney MacDonald had to leave the farm. Then I Peter MacDonald joined the dairy farming partnership with Gordon MacDonald until 1979 when I purchased 190 MacDonald's road.
Since 1945 the pools in Porcupine creek have never been dry at the bridge on MacDonald's road.
Since the gauging station on Porcupine creek was installed beside the bridge, the only time the flow has stopped at the gauging station was when I have been pumping (diverting) water to the dairy tank.

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

Declared at Kawarren

in the State of Victoria, this 14th day of January 2009

Before me, ...
Signature of authorised witness

L/S/C 31609
Colac Police

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

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

Barongarook High Intake Area.

Southern Rural Water and Barwon Water maintain that the major influence causing the detrimental impacts apparent along Boundary Creek is the extended drought. Up to 2010 both these authorities have had difficulty separating the drought and groundwater drawdown influences. However, if a thorough investigation is never conducted then it is impossible to reach a conclusive result. For this very reason decades of Boundary Creek studies have been inconclusive and in this particular case it would seem that inconclusive results favour the exploiter of the groundwater resource. Having ignored identical recommendations made in several studies going back to 1986 that would have provided the necessary data, it is doubtful that adequate studies will ever be done.[53]

Perhaps the most convincing argument that groundwater extraction is the major cause of detrimental impacts is that the creeks to the north and south of Boundary Creek have continued to flow non-stop. These creeks and their wetlands elevated high in the Barongarook High area, should have been affected in a similar fashion to Boundary Creek if the major influence was the extended drought. This has not been the case.

i) The major recharge area to the aquifers for the westerly tributaries of the Barongarook Creek, the Barwon Downs Borefield and the Loves Creek Catchment streams are the sands of the Barongarook High.
ii) All of these streams have been under the same drought influences.
iii) The only difference is that the Boundary Creek Catchment has experienced extreme drawdown from groundwater extraction at the Barwon Downs Borefield.
iv) The integrity of the wetlands high in the headwaters of these streams to the north and south of the Boundary Creek Catchment have been maintained.
v) The Boundary Creek wetlands of the Big Swamp have been decimated.

SUMMARY.

Pre-pumping

1. The Shalley family relied on the fact that Boundary Creek was a permanent flowing stream since 1912.
2. Pre-pumping recommendations for studies and the collection of data were ignored and never implemented.
3. The recommendations to establish environmental flows were also ignored.
4. Numerous observation bores that were drilled in the area of the Barwon Downs Borefield were artesian, some squirting 10s of metres into the air.
5. The water tables in the district were stable with little variation between seasons and years.
6. All of the hydrological investigative studies indicated there would be serious impacts if more than 4000 ML/year were extracted from the borefield.
7. Local knowledge, concerns and recommendations largely ignored.

After Pumping commenced.

8. Artificial recharge attempts along Boundary Creek in 1987, found that this was a waste of time. The reason being the Big Swamp was always saturated, overflowing and no more water could be forced into it. A full aquifer overflowing into Boundary Creek was the reason for an average daily summer flow of 3.2 ML.

9. The word “annual” in the Permissible Annual Volume (PAV) was omitted and replaced to read Permissible Consumptive Volume (PCV). In effect this gave justification to the authorities to “fiddle the books” as far as Boundary Creek flows were concerned. The PAV was 4000 ML/year and this was calculated to have “mild” effects on Boundary Creek. Anything over this 4000 a year and the creek was expected to encounter serious environmental problems. Changing the PAV to a PCV would allow the 4000 ML/year extraction to be averaged out over a set period. Consequently a 20 000 ML/year licence could be justified with no more than 80 000 ML over a ten year period and 400 000 ML over 100 years. To make things worse the ten year period worked in such a way that in the 11th year the 1st year of extraction could be left out of the calculations. In the 12th the 2nd year of extraction figures were no longer used.
10. Drawdown “holes” began to appear in the deep water aquifer in various locations.
11. Artesian bores stopped flowing.
12. Boundary Creek was dry for the first time in the Shalley family’s history.
13. Platypus, blackfish, trout and other water dependent species died out.
14. The Big Swamp began to dry out with dramatic vegetation changes.
15. Fires caused serious problems in the previously saturated peats.
16. Maintenance of Stream Flow Trigger Levels were regularly breached.
17. Government regulations, policy and law largely ignored.
    e.g. The Statement of Obligations set down by the Victorian State Government that Barwon Water must follow includes, “... ***if there are threats of serious or irreversible environmental damage, lack of full scientific certainty as to measures to address the threat should not be used as a reason for postponing such measures.***”
18. Supplementary flows into Boundary Creek from the Otway to Colac Pipeline disappear into the Big Swamp.
19. Over the years Barwon Water has had to cart numerous truck loads of fresh water into the Shalley farm to maintain it as a viable enterprise.
20. A 2006 study recommending environmental flow allocations for Boundary Creek was farcical.
21. The Rick Evans Response Ratio verifies that Boundary Creek has run dry as a result of groundwater extraction.
22. The licence regulatory body Southern Rural Water, is inept at “policing” the management of the licence for the extraction of groundwater at the Barwon Downs Borefield.
23. **The Big Swamp and Boundary Creek are DEAD.**
24. Creeks to the north and south of the Boundary Creek Catchment continue to maintain their integrity, flowing freely and supporting healthy wetlands.

CONCLUSION.

There can be no doubt that the Boundary Creek Catchment in the vicinity of the Big Swamp was a thriving and healthy wetland before groundwater extraction took place at the Barwon Downs Borefield. From the Big Swamp to the confluence with the Barwon River, Boundary Creek supported a diverse collection of water dependent flora and fauna. Platypus and blackfish were abundant, animals high in the food chain. The Big Swamp wetlands were "jungle" like supporting many water dependent species. Farmers downstream had a secure and reliable source of fresh water. The flood plains maintained a green summer pick for stock and the stream banks maintained their stability. The boggy dense wetlands did not have to be fenced out as domestic stock would not enter the treacherous peats. Numerous attempts to drain these peaty Big Swamp wetlands had failed. These things were known to have remained relatively stable since 1912. The waters of Boundary Creek had been the salvation to farmers through many serious droughts. Farmers with stock water bores found them to be as reliable as the creeks in the area.

Up to 1986 groundwater levels had varied very little. From this time on the Barwon Downs area has seen a dramatic decrease in water tables. Comparative deep water artesian bores in the Loves Creek Catchment, just south of the Boundary Creek Catchment, have maintained relatively stable water tables to the present day, February 2010.

During the 1982-83 drought Geelong was in desperate need of an additional water source. Groundwater from the Barwon Downs borefield was Geelong's salvation but started a series of events that has left Boundary Creek and the Big Swamp in a shockingly degraded state. Firstly the flows in Boundary Creek began to decrease and then dry up for short periods. The more water that was extracted from the borefield the longer the period of dry days for the creek. The water table was dropped to such a degree that the Big Swamp then started to dry out. The peat caught on fire, was hard to extinguish and was to become an ongoing area of concern. Vegetation in the big swamp began to die and this effect started to spread downstream killing the vegetation as it went. The acid levels in Boundary Creek sky rocketed to killer levels for instream animal life. River flats began to dry out and a summer pick for stock disappeared. Creek banks began to crumble and at least one farmer's stock water bore became unreliable.

A stream flow maintenance trigger level was being breeched on numerous occasions. Supplementary flows released from the Otway to Colac pipeline were seen as the solution to the huge drawdown of the water table under Boundary Creek and the Big Swamp. However, as quick as the water was being released from the Otway to Colac pipeline it would disappear into the depleted peats of the Big Swamp. Boundary Creek would remain dry until excess runoff was experienced during rainfall events.

Throughout this period of changing circumstances the long standing local landholders appeared to be largely ignored, treated with contempt or given token involvement by the regulatory authorities, Barwon Water being the driving force behind most developments. It was also apparent that even though there were regulations, laws and policy that were designed to protect the beneficial uses of the groundwater resource, these things were only applicable to the landholders. The statutory authorities appeared to be able to ignore such things. The water board gave the impression that the extraction of potable drinking water

for the City of Greater Geelong was all that was being considered, no matter the consequence to the environment or country folks' wellbeing.

Over the decades social and environmental studies and recommendations that would have easily identify the impacts of groundwater extraction were never implemented. Throughout this period poorly designed environmental study briefs supported by half hearted political will ensured that inconclusive results were always obtained. Each environmental report making similar recommendations to the ones made earlier. At best the authorities were able to state that the studies were being conducted even if in large part they were useless.

However, no claim one way or the other could be made regarding social impact studies. The reason for this is that not one social impact study has ever been commissioned. It is as though the country people living in the area of influence from the Barwon Downs Borefield do not exist. Throughout the life of the Barwon Downs Borefield Barwon Water has maintained the argument that the impacts as outlined in the Otway Water books cannot be the result of groundwater extraction. Barwon Water has adopted the stance that the extended drought has been the major influence causing Boundary Creek and the Big Swamp devastation. Using the drought as a "scapegoat" has successfully diverted attention from the major influence, massive groundwater extraction.

Streams and wetlands in catchments to the north and south of the Boundary Creek Catchment have maintained a basic integrity despite the extended drought. All reports state that the streams in these three catchments gain their summer flows from excess overflow from the deepwater aquifer. The source of water for the various branches of this aquifer being rain falling onto the exposed aquifer sands of the Barongarook High. If drought was the major factor causing such impact in the Boundary Creek Catchment it is more than reasonable to expect the same degree of impact in the adjoining catchments to the north and south. This is not the case. 50, 40 and 30 metre drops of the water table in observations bores in the Barwon Downs borefield area are not happening in the adjoining catchments.

Numerous hydrological reports, including Barwon Water's own consultant Sinclair Knight Merz, predicted the devastation that could be caused from pumping more than the Permissible Annual Volume. Both Barwon Water and Southern Rural Water chose to ignore this fact and preceded with licence extraction rates 5 times this Permissible Annual Volume safe limit.

Even before the Stage One licence was issued the danger signs from an environmental and social perspective, were already becoming apparent and it should have been obvious that things were going terribly wrong. Acid levels were rising, the creek was drying up, vegetation was dying, farmers were running out of otherwise reliable water, summer feed on the flats was diminishing, creek banks were crumbling and platypus had disappeared from the creeks.

Efforts to gain access to reports, studies and open discussion have been met with "waves" of obfuscation. Doubts and questions of suspicion arise when confronted with secrecy and a lack of willingness to be open and transparent. An understandable conclusion to be drawn from this chain of events is that the environmental and social management of the

groundwater extraction at Barwon Downs encompasses rhetoric and spin with little substance. However, piecing together a multitude of data from a wide variety of sources clearly demonstrates that the severe and detrimental impacts experienced along Boundary Creek and in the Big Swamp can squarely, convincingly and directly be related to the groundwater extraction from the borefield at Barwon Downs.

A Significant Omission.

The following letter from Chris Hughes of Southern Rural Water has not been included in earlier Otway Water Books. Most of its content is a repetition of earlier correspondence. However, on reflection, it should have been included as there is an important paragraph dealing with the Acid Sulfate Soils issue.

SOUTHERN
Rural Water

17 December 2008

Mr Malcolm Gardiner
1805 Colac Beach Road
KAWARREN VIC 3249

Dear Mr Gardiner

COMPLAINT - BARWON WATER GROUNDWATER LICENCE NO 893889

Thank you for your letter of 23 October 2008 outlining your concerns with Barwon Region Water Corporation's (Barwon Water) operation of the Groundwater Licence No. 893889 (the licence) and compliance with the specific conditions.

As you are aware, Barwon Water is required to provide Southern Rural Water (SRW) with annual reports detailing the operations of the bore field and addressing the specific reporting requirements detailed in the licence. The annual reports are reviewed by SRW hydrogeologists to monitor the annual groundwater extraction and groundwater levels, particularly in the four key monitoring bores. The annual reports are also reviewed by field operations to monitor compliance directly related to licence conditions.

SRW takes compliance of all licence holders seriously. Our response to non-compliance is informed by the impact the non-compliance caused to the resource, how blatant the action was and whether it has been rectified, among many other things. In the case of Barwon Water, there have been instances of non-compliance in relation to some reporting requirements in the licence. These instances of non-compliance are administrative oversights and are not critical to the overall sustainability of the borefield, or the impacts on the nearby area, to be of such a serious nature to warrant legal action. We have formed the view that this is the correct approach and is the same approach that would be given to any licence holder, notwithstanding that this licence is not like most licenses.

In light of the above, SRW has taken a pragmatic approach, which means working with the licence holder to resolve the matter. SRW is continually working with Barwon Water to improve reporting under the licence, and appreciates the feedback provided in your correspondence. The licence conditions are unique to this situation and it has taken some time to fully implement the various reporting needs within the licence. SRW will meet at least annually with Barwon Water to discuss their groundwater extraction, the licence and review a draft of the annual report prior to the completion of the final report. This will be in addition to the usual communications and will ensure that the concerns highlighted in your correspondence are given appropriate consideration.

The matters that you have raised in your correspondence are of a specific and detailed nature, with many relating to administrative oversights from the annual reports. SRW doesn't consider it practical or relevant to respond in significant detail to the concerns relating to administrative oversights, as these are matters of the past and cannot be changed. I would say however that Barwon Water Corporation has been co-operative in recognising areas of reporting that need improvement and have responded positively to our requests. Whilst reporting is vital, our main focus is ensuring that Barwon Water comply with the conditions relating to how much water they can take and groundwater level triggers.

PO Box 153 MAFFRA VIC 3860
Telephone: (03) 5139 3100
Facsimile: (03) 5139 3150

ABN: 70 801 473 421
Email: srw@srw.com.au
Website: http://www.srw.com.au

With the above in mind, I have endeavoured to respond in appropriate detail to the concerns that you have outlined which related broadly to sustainable water management. The matters of particular concern appear to relate to the monitoring bore YEO 40, the metering of Boundary Creek discharge point, Acid Sulphate Soils and groundwater levels. Several of the matters that you have raised may be better addressed through a face-to-face discussion rather than in writing.

YEO 40

YEO 40 is one of the four critical monitoring bores specified in the licence that has been assigned a trigger level used to protect the groundwater resource. Barwon Water must act in a specified manner set out in the licence when groundwater levels in the bores decline below the respective levels listed in the licence.

It was a condition of the licence that YEO 40 be replaced with a new monitoring bore by 31 December 2004 in the vicinity of the original bore. The replacement of YEO 40 was finalised in May 2005. The replacement occurred 6-months after the date required under licence conditions, however the process required the input of expert consulting hydrogeologists and the availability of a suitably qualified drilling contractor.

The replacement bore for the designated monitoring bore "YEO 40" has been operational since the date of construction. It is located within approximately 300 metres of the original bore at a location off McCall's Road Yeodene near Boundary Creek. The confusion surrounding the location of YEO 40 may have arisen as a result of an incorrect reference in the 2004/05 Annual Report, which stated the location as being "in Boundary Road". This relates to the designated bore Y-40 and the drilling of YEO-40's replacement is clearly shown in a photo in the 04/05 report.

Boundary Creek

Barwon Water is required to provide a flow of 2ML/d to the headwaters of Boundary Creek from anytime that groundwater extraction commences under the licence until:

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

A meter has been installed at the point of discharge into Boundary Creek, however prior to the installation of a meter alternate means of monitoring the stream flows were agreed between SRW and Barwon Water in order to comply with conditions detailed in section 6 of the licence. The alternate means included monitoring of the Forest Road gauging station and measuring the reduction in flow between the supply reservoir and Colac Basin No. 4. SRW is satisfied that these actions were a sufficient interim action to achieve the outcomes intended by the licence conditions.

Barwon Water complies with the discharge conditions the majority of time; however they occasionally experience operational difficulties due to variations in stream flow after rain events and external influences beyond their control. These instances are short lived and rectified as soon as practicable.

Water Usage & Groundwater Levels

Barwon Water's licence was developed with input from technical experts, community representatives and government departments to ensure the best management of the resources were appropriately considered balanced against the needs of an urban water supply. The stakeholders identified the following issues that would assist in the evaluation of the sustainability of the borefield, all of which were incorporated into conditions of the licence:

- Limits on daily, annual, 10-year and 100-year maximum volumes.
- Groundwater levels.
- Groundwater Salinity.
- Subsidence.

- Flow in Boundary Creek.
- Protection of riparian vegetation.
- Protection of stock and domestic use.
- Protection of flow in Barwon River and tributaries.

After reviewing the annual reports it is apparent that Barwon Water has operated within the annual use limits of the licence, with the maximum annual extraction being 12,604ML in 2007/08. The annual reports also show that groundwater levels in the four critical monitoring bores have remained above the trigger levels listed in the licence.

Acid Sulphate Soils

In accordance with condition 7 of the licence, SRW has required Barwon Water to undertake a detailed Flora Survey. Barwon Water has sought tenders from suitably qualified expert consultants and the successful tender has not yet been appointed. Barwon Water must consult with the Department of Sustainability and Environment regarding suitable consultants. The investigation into Acid Sulphate soils will be incorporated into the consultant's analysis and the completed report is expected by mid-2009.

In closing, I can confirm that SRW is committed to working closely with all stakeholders to continually improve the management of the resource, which will also include improved annual reporting. It is worth noting that SRW has reviewed the 2007/08 annual report in detail and as a result sought clarification on some areas of the report. Barwon Water subsequently made the necessary adjustments and re-submitted the annual report to the satisfaction of SRW.

As with all licences, Barwon Water's licence will be reviewed on expiry as part of the renewal process, which requires SRW to again consider matters outlined in S.53 &.40 of the Water Act 1989. Barwon Water does not self regulate their water extraction in relation to their groundwater licence. SRW is the delegated authority with the responsibility of regulating the take and use of groundwater in Southern Victoria in accordance with the Water Act 1989 and licence conditions.

Your correspondence is of significant detail and content; therefore in order to clarify all your points, I would be pleased to have a face-to-face discussion. If you have any questions or would like to schedule a meeting, please contact me on 0418582763.

If you are not satisfied with SRW's level of service, the Energy & Water Ombudsman (Victoria) can be contacted on 1800 500 509.

Yours sincerely

CHRIS HUGHES
MANAGER FIELD OPERATIONS & COMPLIANCE

Otway Water Books 8, 9 and 10 amply demonstrate the rhetoric, nonsense and spin contained in the bulk of this letter. However, the section referring to the Acid Sulfate Soils is extremely notable and is the reason for its inclusion.

Chris clearly states in this letter that the ASS **would be** incorporated in the 2009 Flora Study being conducted by Barwon Water. He made it clear that there was ample time to arrange for this to happen. Despite this written assurance, the Acid Sulfate Soil site at the Big Swamp **WAS NOT** included. An explanation for this has never been forthcoming from Southern Rural Water.

In another letter dated four months later, 20 April 2009,[54,Page35] Chris Hughes stated that the extraction of groundwater at Barwon Downs was going as planned and "*Barwon Water's licence will be reviewed on expiry as a part of the renewal process*."
It is shameful that this review does not take place until 2019, in 9 years time.
"...*Southern Rural Water believes that the current licence conditions are adequate for the responsible management of the resources and there isn't a need to review the licence and licence conditions at this point in time.*"
It is incomprehensible that an immediately review is not initiated on the evidence currently available. Considering that the majority of this evidence has been gleaned from government sources makes the inaction more deplorable.
"*The concerns that you have highlighted with Acid Sulphate Soils in your correspondence and a further formal complaint (4 March 2009) will be addressed separately in the near future.*"
Nearly a year has elapsed and there have been no further developments or correspondence indicating when the "near future" is close to eventuating.

Four months later, 16 July 2009, the Secretary of the Department of Sustainability and Environment penned a letter[53,Page 86] stating that Southern Rural Water is the licensing authority and is satisfied with the management of the Barwon Downs Borefield. Regarding the Acid Sulfate Soils concern, Peter indicated that it is unclear whether the dry conditions or the pumping of groundwater was at fault. Regardless of this, Peter stated that Acid Sulfate Soil assessment and impacts was the responsibility of the Department of Primary Industry (DPI). The DPI would be looking at state-wide occurrences of Acid Sulfate Soils and the results of this would be available soon. Peter also noted that the Barwon Water 2009 Flora Report had been presented to Southern Rural Water and the Corangamite Catchment Management Authority. This Flora Report stated there was only circumstantial evidence of ASS but none was found.

Eight days later, 24 July 2009, Water Minister Tim Holding states in a letter[53,Page 91] that Southern Rural Water "... *is satisfied that BW* (Barwon Water) *is adhering to its licence conditions.*"
Tim goes on to say, "*BW recently completed a flora study as part of the monitoring requirements of the groundwater extraction licence it has for Barwon Downs. Whilst acid sulphate soil (ASS) monitoring was outside the scope of the study, no evidence of acidification was found. Nevertheless, BW is now proposing to work with agencies to specifically investigate ASS impacts at local and regional scales.*"
Pages 57 -64 of this Otway Water book dramatically illustrate that there was indeed positive evidence of acidification as far back as September 2008. The pH levels (see page 63) taken from government sources indicated an acidification problem in Boundary Creek going back even further to the late 1980s.

By February 2010 state government agencies have failed to perform the most basic statutory responsibilities they are required to perform; Barwon Water has not initiated any investigations and Southern Rural Water maintains that the licence conditions are being adhered to and that the water resources management by Barwon Water and Southern Rural Water is satisfactory.

Finally, Einstein's idea that ...

"***The significant problems we face today, cannot be solved at the same level of thinking that created the problems***,"

... is worth considering. Perhaps it could be said that the significant problems we face today along Boundary Creek and the Big Swamp cannot be solved by the same managers that created the problems.

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