Lorne's water supply.
Briefing paper for the Friends of Lorne.

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February 2022

Background

At the end of 2021, Barwon Water, the water supply authority for Lorne, called for comment on a draft of its plans for the future [1] and Friends of Lorne developed a response. Overall, we found the draft very informative, particularly in explaining Barwon Water's approach to handling uncertainty in supply and demand. We were left, however, with the feeling that environmental aspects of water supply in Lorne had slipped under the radar.

Lorne's water comes from the Allen Reservoir[a] on the St George River, just upstream of the Phantom Falls. Having a standalone reservoir of water with its own catchment makes the water supply less variable than that of Kennett River, for example, where each household gets their water from a personal tank filled by rain falling on a single roof. Lorne's supply is, however, probably more variable than that of the Surf Coast north of Lorne because, since 2019, this area has been connected to a wide geographic area extending to the other side of Melbourne [2].

Lorne uses about 340 million litres (ML) each year, which is more than the 215 ML capacity of the Allen Reservoir. Lorne therefore relies not just on rain falling in its catchment, but also on it falling often enough each year to top up the Reservoir before it runs dry.

Planning for water supply in Lorne is critical. Worst case predictions of climate models suggest a 40% decrease in rainfall in our region. As data we refer to later in this paper indicates, 2027 is Barwon Water's worst-case estimate of when water supply will fall below agreed service levels. Exacerbating the problem of reduced supply is a predicted increase in demand. Government departments and private enterprise promote growth in tourism, and sections of the Lorne community are lobbying for subsidised growth in the permanent population [3]. Only Barwon Water contemplates the possibility that the supply of water may not meet the increased demand. Strategies to address supply and demand issues must be developed and developed in ways which cause least damage to the environment.

How well does our system work for humans?

Lorne cruised through the millennium drought (~1996-2010) because there was enough rain in the catchment to keep the Reservoir above the level that triggers restrictions. Much of the rest of the region was, however, under Stage 4 restrictions by 2009. Because the Reservoir is not connected to anywhere else, water was not shared with needy places.

The other side of the supply coin was revealed in late 2015 and early 2016. From Bureau of Meteorology data, we can calculate that rainfall in the St George River catchment, as measured at Mt Cowley and Benwerrin, was between 54 and 64% of the long-term averages. The dry weather, exacerbated by higher-than-average temperatures, resulted in Lorne using about 8% more water than in the previous year [4]. With a high demand for water and not much inflow, water level in the Allen Reservoir fell to a record low of 24% of capacity (Figure 1). Level 2 restrictions were introduced in March followed by Stage 3 in May 2016. Water was trucked in to reinforce supply [4].

[a] The Allen Reservoir is also known as the Lorne Dam or the Allen Dam. Technically speaking, the word 'dam' is not a synonym for reservoir; instead it refers to the barrier that holds back the water. The authors will refer to the 'Reservoir' in this paper as we are discussing water levels and 'barrier' when we are referring to the dam.

Apollo Bay and Colac also had restrictions in 2015/2016, but other towns in the region had by now been connected to a water network which enabled them to call on a wider range of sources.

Figure 1. Water levels at the barrier of the Allen Reservoir in 2016.

Left: 30 March, about a month before the minimum water level was reached.
Right: 29 May, following rain. The structure on the barrier was presumably a temporary measure to increase capacity.
(Images courtesy of Barwon Water)

Other circumstances in which Lorne's reliance on a single source could be to its disadvantage by comparison with networked systems, and even rainwater tanks, include extensive fires in the catchment. Fires could greatly reduce the availability of safe drinking water in both the short and long term [5].

How well does our system serve environmental objectives?

The volume of water reaching the estuary of the St George River in summer is probably about half that received when the river was wild. Flow even ceases in some summers. In 2015/2016 the estuary closed in early 2016 (Figure 2). Water remained near and upstream of the bridge on the Great Ocean Road, but by April it was bluish instead of brown, smelled of sulphur, and dissolved oxygen was 3.0% of saturation level. At its edges, the water was iridescent [6]. These conditions can be lethal to fish and other aquatic life.

Figure 2. St George River estuary.

Left. The entrance to the St George estuary closed in January 2016.
Right. Blue-grey water near the bridge.
Images courtesy of Jenny Cerins and CCMA

Water reaching the estuary comes from two main tributaries - the St George River itself and the Cora Lynn Creek which joins the St George River just below the Allen Reservoir (near the Phantom Falls). When the Reservoir drops below full, water stops spilling over into the St George River. The length of this no-spill period varies from zero months of the year (2021) to eight months (2015) [7]. The raising of the barrier, completed in 2018 [1], means that we should anticipate longer no-spill times in the future irrespective of whether predicted reductions in rainfall come about. At no-spill times, flow downstream of the Reservoir is dependent on flow in the Cora Lynn because Barwon Water does not release water from the Reservoir for environmental purposes [8].

We know about the condition of the estuary in early 2016 from the work by the citizen science program 'EstuaryWatch' run by the Corangamite Catchment Management Authority (CCMA) [9]. Despite calling these events 'unusual/extraordinary occurrence[s]' [6], we have not found any follow-up work on the causes (acid sulfate soils are a possibility [10]) or consequences. Indeed, Barwon Water, when contacted in early 2021 by Friends of Lorne, was not aware of the events, perhaps because the lower reaches of the St George River are not part of the proclaimed area under the direct control of Barwon Water [11]. Barwon Water does, however, have an obligation under its water entitlement to manage the environmental effects of its operations, including water quality in the St George River [8], a responsibility which surely extends to the lower reaches.

There are other puzzling aspects of the CCMA's and Barwon Water's approach to the St George River. A CCMA web page quotes a description of the St George River as 'near-pristine', a strange term to apply to a dammed river [12]. Environmental concerns are taken into account by Barwon Water and other agencies in management of the Anglesea River and bore field, to environmental flows in the Barwon and Moorabool Rivers, and there are summer limits on withdrawing water from the Barham River at Apollo Bay [1]. Furthermore, when Lorne drew on the Erskine River for its water supply, that river was protected by a prohibition on harvesting water when flows were low [8].

The St George River has scenic and environmental value. Viewed from Teddy's Lookout (Figure 2), its estuary is one of the most photographed sites on the Great Ocean Road. The paddock just upstream of the bridge on the Great Ocean Road is popular among tourists for kangaroo viewing. Walks along it are among the most traversed in the Lorne region. Its valley is broader and less gorge-like than the valleys of its immediate neighbours, the Cumberland and Erskine Rivers, with more extensive lengths of relatively slow flowing water between muddy banks. The platypus, a threatened species in Victoria, is monitored at one site [13], and is known to be present at others, including the Allen Reservoir.

Has the St George River flowed under the environmental radar?

What does the future hold?

The most pessimistic climate change models foresee rainfall in our catchment declining by more than 40% over the next 50 years [1]. The summer of 2015/16 could be a portent of things to come.

Increasing water supply

Barwon Water generates a range of future scenarios in various documents. Its worst-case scenario depicts supply falling by 35% and demand increasing by 60 % over the 50 years from 2020 to 2070, in which case supply is likely to fall short of the 'agreed service level' from 2027 onwards. The agreed service level means being able to '*meet unrestricted demand at least 95% of the time'* [1].

With more modest growth in demand and less dramatic effects of climate change on rainfall, the current system is sufficient until about 2050.

Some options for increasing water supply, drawn from two Barwon Water documents are in Table 1 below. Costs date from 2017, and water sources and volumes from 2017 and 2021.

Table 1. Options for Increasing Lorne's Water Supply [1][14]

Option	Source of Water	Average Annual Yield (ML)	Total Capital Cost ($M)	Annual Operating Expense ($M/year)	Levelised Cost ($/ML)
1. Connect to water grid	New pipeline from Aireys Inlet to Lorne	139	47.0	0.789	25,300
2. Increase storage	Raise Allen dam	63	9.0	0.135	10,100
3. Desalination	Localised desalination plant	240	20.0	0.494	11,500
4. Recover more from existing storage	Efficiency of water treatment	16	1.3	0.033	6,600
5. Other	More use of recycled water	3	1.2	0.020	28,500
	Rainwater tanks on new houses	9	0.8	0.014	6,600
	Rainwater tanks retrofitted	Not available			Not available
	Diversions from other rivers	240			Not available

Notes on the Table:

1. As a point of reference, Barwon Water supplied a total of 33,533 ML of water to its customers in 2020/2021 when its total expenditure was $225 M, so averaged over its whole supply system, (Lorne is about 2% of the system), the total cost of collecting and delivering water in 2020/2021 was around $6,700/ML [15].
2. Raising the Allen Reservoir would be detrimental to the health of the St George River. It would prolong periods in which there is no spill-over of water into the River.
3. Increasing the efficiency of treatment would also be detrimental if it means that water level in the Reservoir can be drawn down to lower levels.
4. Potable (drinkable) recycled water is used in much of the world but not in Australia. At present most of Lorne's recycled water (not of potable grade) is discharged into the sea.
5. Rainwater tanks (at least 2,500 L) are mandated for new houses and substantial renovations in Lorne [16].
6. Barwon Water indicates that diversions from other rivers would be environmentally damaging but does not elaborate on the form this damage would take. Furthermore, Barwon Water suggests there is little to be gained from this option because when flows in the St George River are low they are likely to also be low in nearby rivers. Nonetheless, Barwon Water does have the right to withdraw up to 1.4 ML/day from the Erskine River, subject to environmental constraints when the River is low [8]. The reason for this right is historical - Lorne used to be supplied from the Rough and Tumble storage which was filled from the Cherry Tree Creek and by a pipe from a weir on the Erskine River (Figure 3).

Figure 3. Remnants of past water supply system based on the Erskine River

Former water intake showing iron water pipe leaving the weir (left), water offtake system (looking like a letterbox, left of centre) and water flowing over the concrete weir (centre right). Image: Mary Lush

Desalination, probably involving a local plant, is likely to be part of the future. We have not yet investigated this option.

Given that there is always an environmental cost of harvesting water, and that the natural environment is invariably the thing visitors to the Victorian coast say they value most, none of the options are easy ones and some are likely to cause further damage to the St George River. Making more use of recycled water is environmentally attractive but the most expensive option. Rainwater tanks may warrant more consideration. In Kennett River, Wye River and Separation Creek, dependence on tanks for supply is regarded as being part of the neighbourhood character [17].

Containing demand

Barwon Water's draft document [1] deals with demand under the heading 'smarter water use'. Apart from things like leaks in the pipe network, Barwon Water does not control demand. It tries to influence consumer behaviour through education about ways of saving water, from replacing tap washers and fixtures, through running community programs to identify water saving opportunities, to trying to get us to think differently about what will increasingly be a scarce resource. It sometimes hands out grants and at other times imposes water restrictions. In theory, Barwon Water could influence demand through the price of water, but the politics of water pricing make increases difficult to achieve. In Lorne, the current (December 2021) cost of water to residential consumers is $2.09 per 1,000 L.

Procedures and rules in place to limit demand for domestic water in Victoria start with the 'permanent water saving rules'. These rules, which apply even when supply is 'unrestricted', include the requirement that hand-held hoses have a trigger nozzle, watering systems should only operate between 6 p.m. and 10 a.m. and a general prohibition on using water to clean hard surfaces. When the water level in storages fall below predetermined levels, restrictions on the use of water, escalating from Stage 1 to Stage 4, come into play [18].

To better understand demand for water in Lorne we looked at data presented in Barwon Water Annual Reports. These suggest that people in Lorne are profligate users of water. In 2020/2021, for example, Barwon Water calculate usage in Lorne as being 410 L/person/day [15]. In the same

period, users in Geelong consumed 194 L/person/day. In 2018/2019, before COVID-19, Lorne used 371 L/person/day compared to Geelong's 213 L/person/day [19].

There are, however, deficiencies in these statistics. In them, Barwon Water attributes all of the water usage in Lorne to the permanent residents and none of it to part-time residents or tourists[b]. Personal water use in Aireys Inlet/Fairhaven is also high and they too are tourist destinations. On this basis we might conclude the high use can be attributed to failure to adjust for water use by non-permanent residents and dismiss the idea that Lorne users are more extravagant than need be, but for the fact that water use in Apollo Bay/Skenes Creek, also tourist destinations, is much lower at 260 and 295 L/person/day in 2020/2021 and 2018/2019 respectively.

Tourism is, on an international scale, a heavy user of water. Estimates of the water use of the accommodation component of tourism alone are up to 2,000 L/tourist/day [21]. But before we blame it all on tourists, we need a careful accounting of water use in Lorne in order to target areas in which savings can be made. Friends of Lorne has raised the data interpretation issues noted above with Barwon Water which is investigating further[cd].

From the perspective of Barwon Water, rainwater tanks (also called static water supplies) are a means of increasing the volume of water available to consumers and hence of increasing supply. We deal with it in this section on demand because, from the householder's perspective, water from tanks reduces their demand for reticulated water. Because Lorne has a bushfire management overlay, rainwater tanks are mandated for all new, or substantially renovated, houses. Depending upon lot size and proximity to a hydrant [22], the minimum volume of tanks varies from 2,500-10,000 L. Although the primary reason for mandating tanks is to provide water for firefighting, use for domestic purposes (e.g. garden watering, washing, cisterns) is allowed. In a dry period, domestic use may run tanks dry making them useless for firefighting, so the logic for allowing domestic use is not clear to us.

How useful are water tanks in reducing demand for reticulated water? Consider toilet flushing. A startling amount of water, up to 55 L/person/day, disappears down toilets with old single flush cisterns. A very efficient, dual-flush cistern can reduce flush volumes to less than 18 L/person/day[e]. With an efficient cistern, a full 2,500 L tank used solely for flushing should last a two-person household for about 71 days without rain[f]. Neglecting complications related to the pattern and timing of rain, we estimate that at least 25 mm of rain is needed to completely recharge the tank, assuming it collects from a roof area of 10 metres by 10 metres. These data suggest tanks could be a practical way of reducing demand for reticulated water, especially in intermittently occupied houses. Their overall environmental benefit is, however, offset to some extent by increased greenhouse gas emissions if a pump is needed to deliver water. With a bit of forethought, gravity feed should suffice for many domestic purposes.

A second option is to make better use of waste water (which includes water from washing and other uses, not just toilets) by treating it to the standard needed for reuse. Unofficial recycling is par for the course wherever water supply is withdrawn from rivers downstream of habitations. An Australian example is the discharge of Canberra's effluent into the Murray-Darling system via the

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[b] Personal communication (email) from Barwon Water 19/1/2022

[c] Personal communication (email) from Barwon Water 21/1/2022

[d] *Addendum*: In its 23/2/2022 response to our questions, Barwon Water asserted that 'the only way to get really accurate data is through digital water meters…' These are being tested in Birregurra as part of a Sustainable Communities project. It also supplied the following information:
Water consumption [in Lorne] is highest in Quarter 3 (January to March)… 43% of the total annual use occurs during this quarter. 23% of the total annual use occurs during spring, 20% during autumn and 14% during winter. Residential use accounts for 80% of all water consumption, with almost half of all water use consumed in single dwellings, many of which are used as holiday houses. 32% of water is used in multi-dwelling properties including units, flats, townhouses and retirement villages, with 10% of use occurring within designated tourism facilities such as hotels, motels, guesthouses and caravan parks.

[e] Assumptions are as follows. A person flushes on average 5 times a day [23]. With a very efficient cistern [24] the average volume per flush is 3.5 L or 17.5 L per person per day.

[f] Dual flush systems connected to a tank are designed to convert to mains water if the tank runs out.

Murrumbidgee River. This river system supplies water to many towns including Adelaide [25]. Australians, however, have been unenthusiastic about using recycled water except for purposes like irrigation. Distribution of non-potable (not to drinking standard) water requires purpose-built reticulation systems – unlikely to happen at a household level. If retreatment is to potable water standard, the retreated water can be distributed along the existing networks.

One community-wide way of reducing demand would be for Lorne to agree to a lower service level. We might, for example, accept that in order to keep the St George River flowing we have to factor environmental demand into our equations and put up with restrictions occurring more frequently.

Conclusion

Taking into account forecasts of a significant decline in rainfall and an increase in Lorne's demand for water, Barwon Water models indicate that from as soon as 2027 it may not be able to supply Lorne in the manner to which it is accustomed. Strategies for managing water supply to residents and visitors to Lorne are critical. Ways of limiting human consumption of water, and developing additional sources of water supply such as rainwater tanks and recycled water must be investigated and evaluated. Central to all strategies is management of the Allen Reservoir and the St George River downstream of it. Careful consideration must be given to the environmental impacts of each strategy. Residents and visitors cite natural environment as a key feature that draws them to Lorne. The natural environment of both land and sea are critical to mankind and must be protected when developing ways of ensuring adequate water supply in the years to come.

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Acknowledgements:

Both Barwon Water and the Surf Coast Shire Council have helped us by responding to requests for information and through the extensive information they make available online to the public.