frontier economics

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REVIEW OF WATERNSW AND ESSENTIAL ENERGY'S WATER FORECASTS

DEMAND FORECASTS AND CUSTOMER CONNECTIONS FORECASTS

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1 INTRODUCTION

Frontier Economics has been engaged to assist IPART with their ongoing review of water pricing for the Murray River to Broken Hill Pipeline. Our engagement involves providing water demand forecasts and customer connection forecasts to IPART, and reviewing the forecasts provided to the pricing review by WaterNSW and Essential Energy. The forecasting covers a five year period beginning 1 July 2019.

1.1 Our scope

The scope of our work is to deliver:

- An appropriate approach that forecasts water demand and customer connections in the context of potentially non-representative historical data. Historical consumption might not be a good indicator of future water consumption because:
  - consumption in recent years has been impacted by water restrictions
  - the population and number of households in Broken Hill has been falling
  - the completion of the new Broken Hill to Murray River Pipeline is designed to deliver a more secure source of water to customers in Broken Hill.
- Advice on the appropriate elasticity of demand to apply if water usage prices increase or decrease.
- A set of baseline forecasts that hold usage prices constant, and a spreadsheet IPART can use to estimate forecast demand if usage prices change.
- A review and assessment of the reasonableness of the utilities' demand forecasts, including inputs and models used to generate these forecasts. Our understanding is that WaterNSW and Essential Energy's forecasts have both been prepared using the historical consumption of Essential Energy's customers as a basis.

Our scope is to consider water consumption and connections. This does not include sewerage services.

1.2 Background

1.2.1 IPART's role

IPART has commenced reviews of the maximum prices to apply for:

- Essential Energy's water and sewerage services supplied to customers in Broken Hill and surrounding areas (Menindee, Sunset Strip and Silverton).
- The prices that WaterNSW can charge to its customers for the bulk water transportation service delivered through the Murray River to Broken Hill Pipeline (the Pipeline).

The Murray River to Broken Hill Pipeline will provide a long-term secure water supply to Broken Hill and supply some additional offtakes.

1.2.2 Broken Hill water supply network

There are many elements to the Broken Hill water supply network including:

- **Menindee Lakes.** The Darling River off-take at the Menindee Lakes Scheme has to date been the main source of water for Essential Water. Once the pipeline from the Murray is operational, Broken Hill's water supply will be decoupled from the Menindee Lakes system (see section 1.2.3 below).
- **Stephens Creek Reservoir**, a 19,000 ML reservoir with a large surface area and a shallow depth, resulting in historically high evaporative losses and low reservoir efficiency. The reservoir receives water from its own catchment as well as water pumped from the Darling River.
- **Umberumberka,** a 7,800 ML reservoir located 28 kilometres northwest of Broken Hill on Umberumberka Creek. Water is pumped to Blue Anchor tank using diesel pumps, and then gravity fed to Broken Hill, supplying Silverton as it passes by.
- **Imperial Lake**, a small, 670 ML reservoir that collects water from its own small catchment, which includes part of the Broken Hill urban area. Water can be transferred to Imperial Lake from Stephens Creek and Umberumberka via the Mica Street water treatment plant. The lake is used as emergency storage only.

1.2.3 Impact of pipeline

Once, fully operational, The Murray River to Broken Hill Pipeline will have a capacity of 37.4ML/day, and Broken Hill's water supply will be decoupled from the Menindee Lakes system.

However, Menindee Lakes will remain the primary source of supply for the Menindee township and the Sunset Strip. Both locations will also retain use of the Menindee common bore field as a supplementary source. There is the option to supply Menindee and Sunset Strip by gravity fed raw water from Stephens Creek via existing pipeline if required.

Stephens Creek Reservoir will be used as a raw water balancing storage.

1.3 Structure of this report

The remainder of this report is structures as follows:

- Section 2 provides a summary of the forecasts by Frontier Economics and Essential Water.
- Section 3 reviews the Essential Water and WaterNSW (via GHD Advisory) water demand forecasts.
- Section 4 presents the methodology and analysis underpinning Frontier Economics' water demand forecasts.

2 FORECAST SUMMARY

Our forecasts for customer connections and water usage are presented in **Table 1** and **Table 2** respectively.

Table 1: Frontier Economics connection forecasts

TYPE OF CONNECTION	2020	2021	2022	2023	2024
Number of residential treated water and/or chlorinated water connections	9,509	9,474	9,426	9,378	9,330
Number of non-residential treated water and/or chlorinated water connections	588	588	588	588	588
Pipeline connections (excluding exempt properties and mines)	46	46	46	46	46
Mine connections (treated water and chlorinated water)					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Mine connections (untreated water)					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Exempt properties					
Total residential meters	-	-	-	-	-
Total non-residential meters	215	215	215	215	215
Total untreated water customers	-	-	-	-	-
Total meters (excluding vacant land)	***10,312***	***10,277***	***10,229***	***10,181***	***10,133***

Source: Frontier Economics analysis

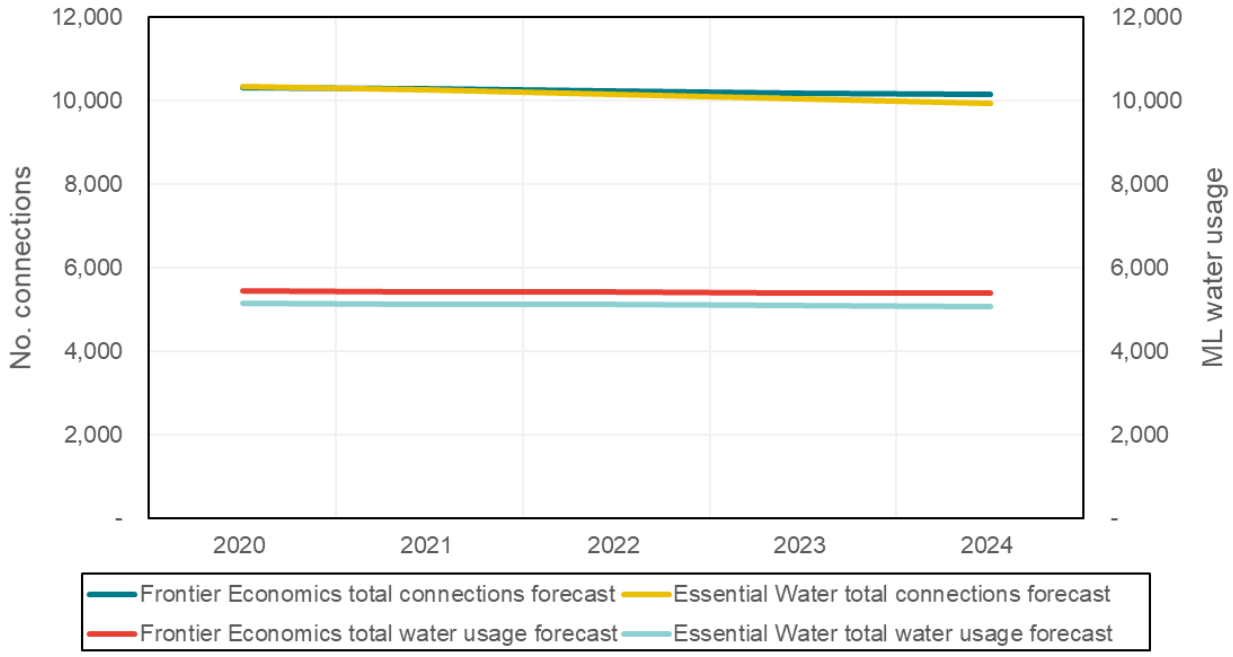
Table 2: Frontier Economics usage forecasts

TYPE OF WATER	TYPE OF CUSTOMER	2020	2021	2022	2023	2024
Treated						
	Residential	2,681	2,669	2,654	2,639	2,624
	Business	300	300	300	300	300
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Exempt properties	347	347	347	347	347
Total metered treated water consumption (includes exempt property consumption)		**4,477**	**4,466**	**4,451**	**4,436**	**4,421**
Chlorinated						
	Total metered residential chlorinated water consumption	49	48	48	48	48
	Exempt properties	-	-	-	-	-
Total metered chlorinated water consumption		49	48	48	48	48
Untreated						
Total metered untreated water consumption		**909**	**909**	**909**	**909**	**909**
Total water demand		***5,435***	***5,423***	***5,408***	***5,393***	***5,378***

Source: Frontier Economics analysis

These differ somewhat from the forecasts submitted by Essential Water. The forecasts are compared in **Figure 1** below and discussed through this report.

Figure 1: Comparison of Frontier Economics and Essential Water forecasts



Source: Frontier Economics analysis

3 DOCUMENT REVIEW

3.1 Essential Water's forecasts

Chapter 5 of Essential Water's submission to IPART's pricing review focusses on forecast water sales (**Table 3**) and customer numbers (**Table 4**).

Table 3: Essential Water's forecast water sales volumes

VOLUME (ML)	2018-19	2019-20	2020-21	2021-22	2022-23
Total treated water	4,149	4,129	4,111	4,093	4,075
Total chlorinated water	42	42	42	42	41
Total untreated water	976	976	976	976	976
Total water sales	5,167	5,147	5,129	5,111	5,092

Source: Essential Water 2019-23 Water and Sewerage Pricing Submission, Table 5-1.

Table 4: Essential Water's forecast water customer numbers

CUSTOMERS	2018-19	2019-20	2020-21	2021-22	2022-23
Residential	9,605	9,505	9,405	9,305	9,205
Non-residential	880	880	880	880	880
Total water customers	10,485	10,385	10,285	10,185	10,085

Note: The customer numbers are the number of unique customers, irrespective of the number of water services they receive from Essential Water.
Source: Essential Water 2019-23 Water and Sewerage Pricing Submission, Table 5-2.

Essential Water noted that the major driver of the forecast is decreasing population, offset slightly by higher residences with fewer occupants and lower average use.[1]

The approach used to generate these forecasts includes "historical trends and analysis", in addition to "socio-demographic and climate information published by government agencies such as the Australian Bureau of Statistics (ABS) and the Australian Bureau of Meteorology"[2].

The only detail provided on the methodology for forecasting water consumption comprised the following steps:

- The starting point is Essential's last available actual data for consumption and customer numbers (i.e. 2016-17),

[1] Essential Water submission to IPART pricing review, p. 103.

[2] Ibid.

- customer numbers are forecast for 2017-18 and 2018-19 (the last two years of the current regulatory period) and cross-checked with other relevant data, such as ABS data for population trends and assessments of new housing starts,
- customer numbers are then forecast for 2019-23 (the four years of the upcoming determination period) and cross-checked with other relevant information, including ABS data (as per Step 2 above),
- rainfall and temperatures are forecast based on climatic data from the Australian Bureau of Meteorology; forecasts are based on average conditions,
- a ratio of water usage per customer is calculated according to major customer categories and applied to Essential's forecast customer numbers,
- potential impacts of price elasticity are identified
- forecasts are cross-checked for reasonableness against recent trends.

Essential Water later notes that they have not included the potential effects of price elasticity in their forecasts.[3]

Based on the declining population in Broken Hill, customer numbers are forecast to decline by approximately 1.0 per cent per annum. Residential customer numbers are forecast to decline by 1.1 per cent annum, with other customer segments remaining flat.[4]

We could not see a declining trend in the historical residential connections data. Rather, there is a break in the data given changes to connection classifications. Further, Essential Water has noted that there is an increasing number of residences with fewer occupants — meaning that population decline does not necessarily correspond to a decline in the number of connections.

Essential Water forecast average water consumption per residential customer to remain relatively constant over 2019-23, averaging 260 kL per year per residential customer.

We could not determine how this level was estimated, given that there are a number of historical observations that would have been influenced by periods of low demand, i.e. wet years, and years when water restrictions were in place.

3.2 WaterNSW's forecasts

WaterNSW engaged GHD Advisory to prepare their forecast report. However, we found the reported figures in the GHD report (**Table 6**and **Table 7**) to be different those in the WaterNSW submission (**Table 5**).

[3] Essential Water submission to IPART pricing review, p. 104

[4] Essential Water submission to IPART pricing review, p. 109

Table 5: WaterNSW Forecast Consumption (ML per calendar year)

	2019	2020	2021	2022	2023	2024	2025	2026	2027
Broken Hill	5,650	5,700	5,750	5,800	5,850	5,899	5,949	5,999	6,049
Offtakes	30	30	30	30	30	30	30	30	30
Total	5,680	5,730	5,780	5,830	5,880	5,929	6,079	6,029	6,079

Source: WaterNSW, Table 26.

Table 6: Projected annual consumption met by the Broken Hill Pipeline – projected from 20-yr history

	2019	2020	2021	2022	2023	2024	2025	2026	2027
Broken Hill	4,762	4,635	4,509	4,383	4,257	4,131	4,005	3,878	3,752
Farm offtake	400	400	400	400	400	400	400	400	400
Total	5,162	5,035	4,909	4,783	4,657	4,531	4,405	4,278	4,152

Source: GHD Advisory, 2018. (April 5 Update). Table 4, p. 14

Table 7: Projected annual consumption met by the Broken Hill Pipeline – projected from 10-yr history

	2019	2020	2021	2022	2023	2024	2025	2026	2027
Broken Hill	5,884	5,939	5,994	6,049	6,104	6,158	6,213	6,268	6,323
Farm offtake	400	400	400	400	400	400	400	400	400
Total	6,284	6,339	6,394	6,449	6,504	6,558	6,613	6,668	6,723

Source: GHD Advisory, 2018. (April 5 Update). Table 5, p. 15

GHD used a linear regression model based on 20 years of historical data and have made two projections of the annual water demand for Broken Hill Pipeline for the two regulatory periods 2019 to 2027. The first projection is based on 20-year history of data and results in a steady decline in demand, from a total of 5,162 ML in 2019 to a total of 4,152 ML in 2027. The second projection is based on 10-year history of data and results in a moderate increase in demand, from a total of 6,284 ML in 2019 to a total of 6,723 ML in 2027. Both of these projections include an assumed 400ML per annum for farm offtake consumption.

GHD considered that the second projection better reflects the likely trends in the underlying factors, specifically the lifting of a downward price effect on demand, and a return to more typical annual rainfall conditions (from the high rainfall periods of 2010-2011 to lower rainfall). Both of these factors result in an increase in demand per domestic dwelling which offsets the general decline in population growth.

We consider there are three main issues with this approach, specifically:

- The analysis conflates change in connections/customers and change in per connection/customer demand. For example, GHD states "we consider that any projection based on this historical data will have captured inherently the future population decline expected by Essential Water"[5].
- The analysis only considers trends in overall consumption — this does not take into account potential differences in the component elements of demand, i.e. Residential, Business and Mining.
- The analysis includes data from years which may be considered unrepresentative — GHD base the forecast on OLS of all data points in the respective time period. However, they note that "Essential Water has provided some commentary on factors influencing demand in recent years. For example, years 2007 and 2010-2012 had abundant rainfall or were un-seasonally wet, so consumption was low. And in 2015 and 2016, there were severe water restrictions in place which have suppressed demand (assuming the restrictions were adhered to)"[6].

[5] GHD Advisory, 2018. Projection of water demand for the Broken Hill Pipeline (April 5 Update), p. 8.

[6] GHD Advisory, 2018. Projection of water demand for the Broken Hill Pipeline (April 5 Update), p. 6.

4 OUR FORECASTS

We have been asked to provide our own forecast of water usage and connection numbers.

This section sets out:

- Our approach
- Our data concerns
- Our forecasts
- Seasonality
- Elasticity

4.1 Approach

The approach we have taken is to:

- examine data and produce forecasts for connection numbers
- examine data and produce forecasts for 'per connection usage'
- combine the above to forecast water usage
- examine monthly trends in water use
- consider the elasticity of water demand.

This approach has been applied using disaggregated data for residential and non-residential connections.

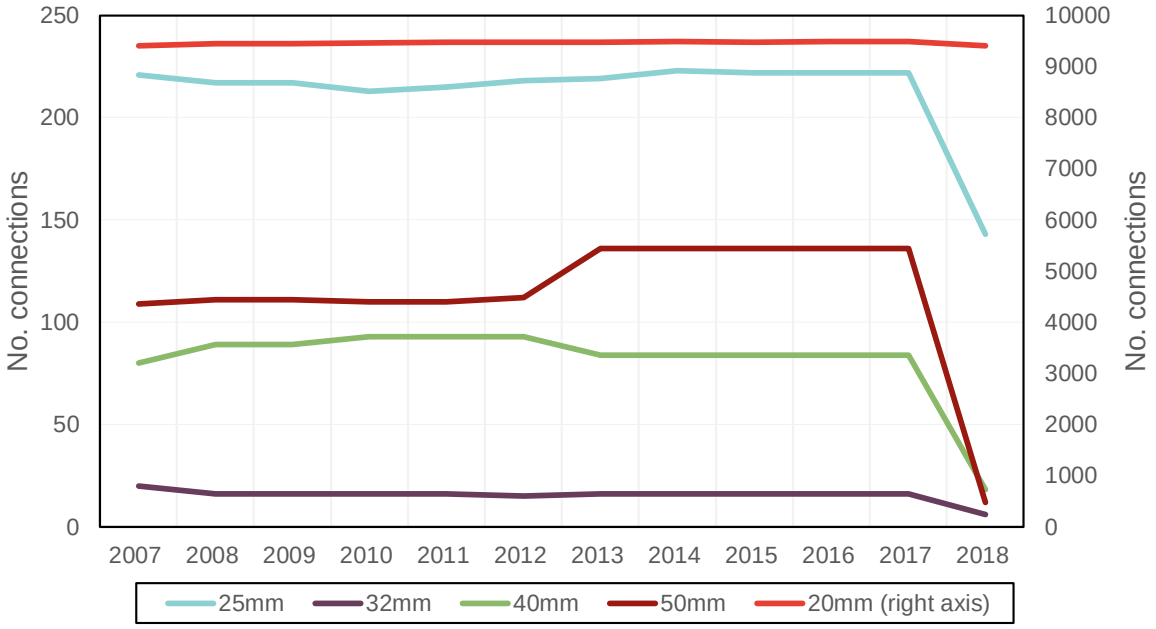
4.2 Data concerns

4.2.1 Residential data

Connection numbers

We raised concerns with Essential Water regarding some aspects of their connections data — in particular, the 2018 values for components of residential connections (**Figure 2**). We were concerned that there may be a break in the data from 2017 to 2018, possibly due to a change to the way data was collected/recorded. **Figure 2** illustrates the sharp, uncharacteristic drop-off in 2018 values following relatively stable trends since 2007 which may reflect a change in data collection method.

Figure 2: Components of residential connections



Source: Frontier Economics analysis

Essential Water's response noted that they "included all flats/units historically, but IPART advised only connection points not dwelling numbers be included. This is reflected in 2017/18 and forecast."[7]

This response suggests that the historical data, rather than the 2018 values, is indicative of the longer-term trend. Despite this, the 2018 values represent the best available estimate of customer connections under the new data reporting approach, and we have therefore generated our forecasts of customer connections from the basis of the 2018 values.

Water usage

For 'per connection usage': the greatest data concern was the treatment of low water demand years. These occur due to either:

- Years with high rainfall — such that outdoor residential water use to supplement rainfall and water gardens is lower.
- Years when urban water restrictions are in place — such that restrictions prevent/reduce outdoor water use.

A simple and defensible approach is to identify and exclude those observations which are known to be low demand and hence not representative observations.

For example, GHD noted that Essential Water has provided some commentary on factors influencing demand in recent years:

[7] Essential Water, 2019. Email communication dated 03/12/2019

For example, years 2007 and 2010-2012 had abundant rainfall or were un-seasonally wet, so consumption was low. And in 2015 and 2016, there were severe water restrictions in place which have suppressed demand (assuming the restrictions were adhered to)[8].

Essential Water has provided the dates and levels of the permanent urban restrictions that were in place in Broken Hill and surrounding areas, shown in **Table 8**.

Table 8: Urban water restriction dates

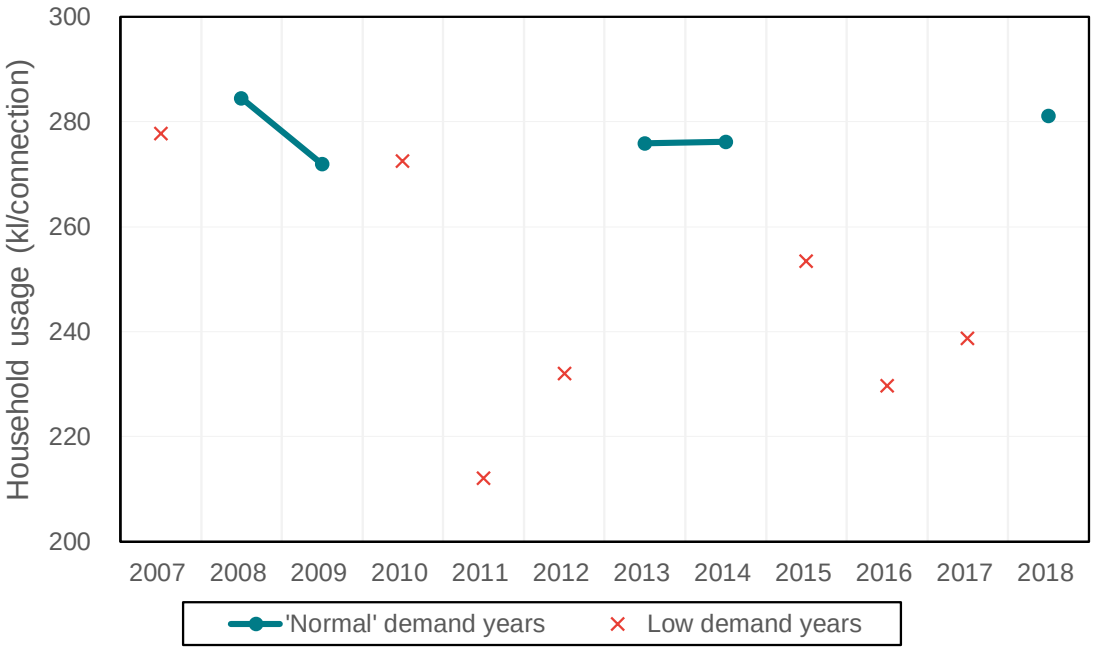
RESTRICTION	START DATE	END DATE	FINANCIAL YEAR OF DATA AFFECTED
Level 1	29 August 2016	8 December 2016	2016-2017
Level 3	4 January 2016	28 August 2016	2015-16 and 2016-2017
Level 2	1 September 2015	3 January 2016	2015-16
Level 1	8 December 2014	31 August 2015	2014-15 and 2015-16

Source: Frontier Economics analysis

This segregation of per connection residential water usage data based on the Essential Water characterisation is presented in **Figure 3** below.

[8] GHD Advisory, 2018. *Projection of water demand for the Broken Hill Pipeline* (April 5 Update), p. 6

Figure 3: Per connection usage in 'normal' and low demand years



Source: Frontier Economics analysis

It was outside the agreed scope of this project to undertake more detailed regression analysis, which may have been able to link observed water demand to observed rainfall data and information regarding restrictions in order to better understand low demand years.

4.2.2 Non-residential data

Connection data is effectively constant over time for treated and untreated connections, until a drop-off in 2018 values. This has been treated similarly to the residential connection data above, i.e. we have extrapolated the trend from the 2018 values because these are the best available estimate of customer connections going forward even though the historical data better captures the longer-term trend.

We have not raised any other concerns regarding non-residential data.

4.3 Forecasts

Our forecasts are reported in Section 2. This section steps through the analysis undertaken to prepare these forecasts.

4.3.1 Residential

Connection numbers

As discussed in Section 4.2.1, Essential Water confirmed that an observed drop-off in residential connection numbers was the result of a break in the data collection where the definition of 'connections' changed from dwellings to metered connections.

To address this, we adjusted the historical data in the following way:

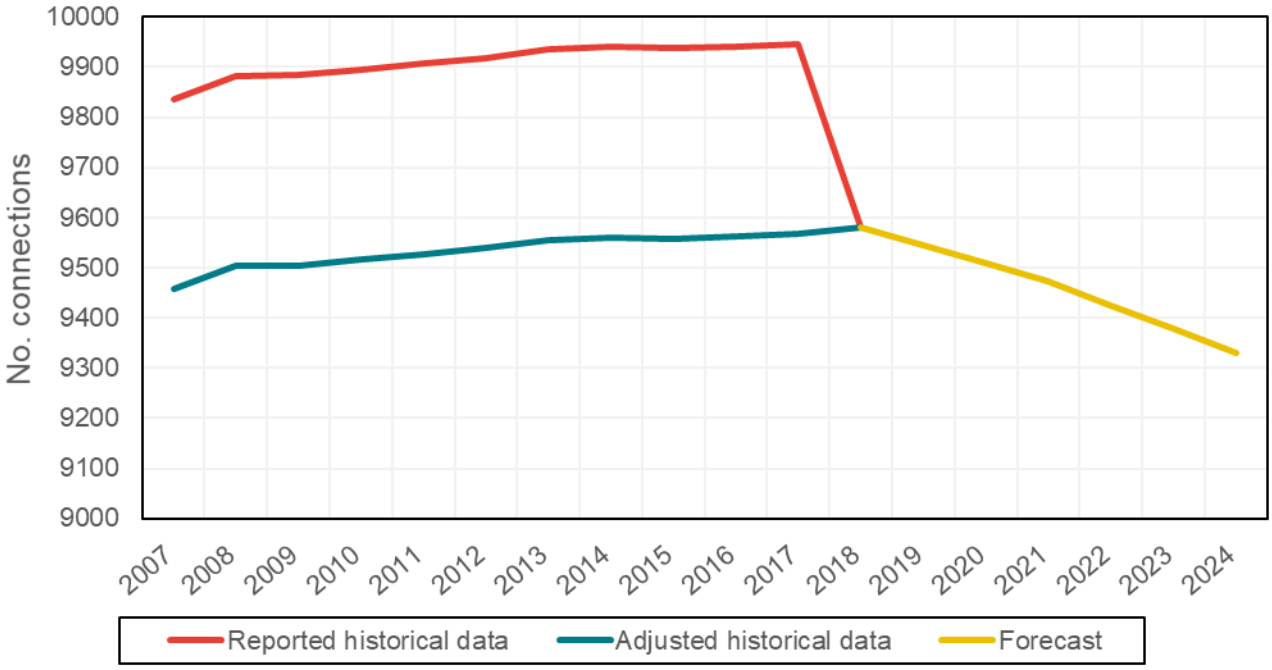
- We calculated the forecast value for 2018 using OLS on 2007–2017 data.

- We calculated the difference between this estimate of 2018, and the observed 2018 data point.
- Using this difference, the historical (dwelling) connection data was adjusted

In order to forecast for the required periods, we relied on NSW population and household projections prepared by the NSW Department of Planning and Environment. These projections estimated that the number of households in Broken Hill would change by -0.37% annually over the period 2016-21, and by -0.51% annually over the period 2021-26.[9]

Our forecast is based on the published projection of the change in the number of households, from the starting point of the observed 2018 data point (**Figure 4**).

Figure 4: Residential connections



Source: Frontier Economics analysis

Per connection usage

The per connection usage calculation is based on observed residential water usage and a consistent estimate of connection numbers. This means that it is based on adjusted historical connection data described above.

Our forecasts of per connection treated water usage (**Figure 5**) were based on the following steps:

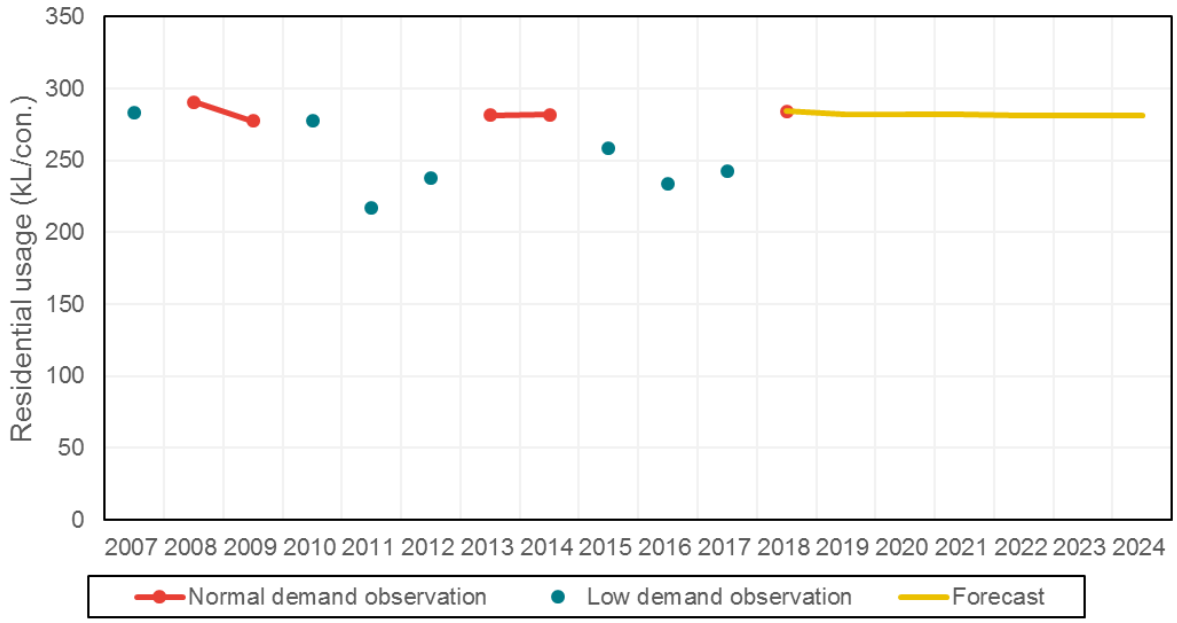
- Calculation of per connection usage for 2007–2018, based on observed usage and adjusted historical connection data.
- Classification of observations from 2007 and 2010–2012 as 'low demand' observations, based on the high rainfall context of these observations (see section 4.2.1).
- Classification of observations from 2015–2017 as 'low demand' observations because urban water restrictions were in place during these years (see section 4.2.1).

[9] https://www.planning.nsw.gov.au/Research-and-Demography/Demography/Population-projections

- Classification of remaining observations (non-'low demand' years) as 'normal demand' observations.
- Assuming that these normal demand observations are indicative of future demand under average seasonal conditions, our forecast is based on OLS trend extrapolation of these normal demand observations.

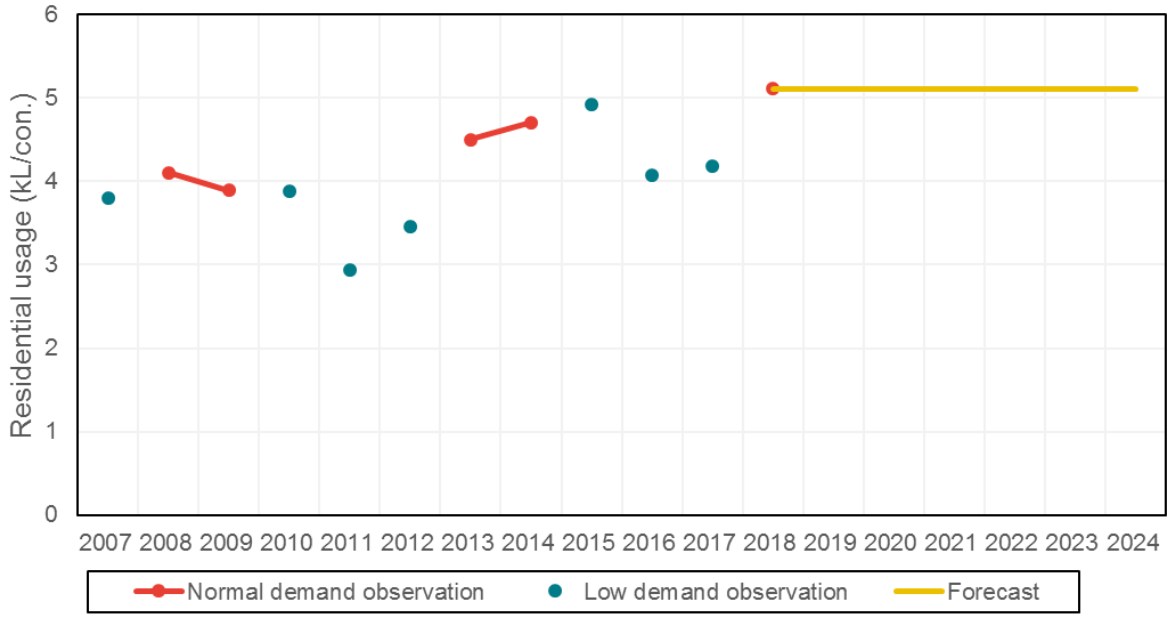
Given the relatively flat per connection usage forecast for treated water, and the fact that chlorinated water is only delivered to Silverton customers, we propose a flat forward forecast for chlorinated water usage (**Figure 6**).

Figure 5: Treated water — residential usage per connection



Source: Frontier Economics analysis

Figure 6: Chlorinated water — residential usage per connection



Source: Frontier Economics analysis

We note that the inclusion of the 2018 observation is important to this forecast of residential demand for treated water. Essential Water noted that "Demand in 2017/18 was higher than average due to higher seasonal temperatures and minimal rainfall. This was also the first year not impacted by water restrictions for the previous 2 years."[10] There are two factors that influence demand in such circumstances:

- higher seasonal temperatures and minimal rainfall would be expected to elevate residential outdoor water use.
- following a period of urban water restrictions, there may be behavioural change in residential water uses. Customers may be choosing to use less water outdoors, or may have made water-efficient investments during the period of restrictions. This type of behavioural change would be expected to suppress water demand.

Further, we re-estimated the forecast with the 2018 data excluded and found that this changed the estimated per connection demand to 278kL/connection in 2019, falling to 275kL/connection over the forecast period, instead of 282kL/connection falling to 281kL/connection over the forecast period.

On balance, we suggest that the 2018 observation be included.

The sharp reversion of per connection usage in 2018 to levels significantly above those observed in 2015-16 and 2016-17 is consistent with observations of 'bounceback'. Bounceback is commonly defined as the degree to which consumption returns to pre-restriction levels once restrictions have been lifted and corresponding water use behaviour changes.[11] In the Victorian water business context we have previously found that it is reasonable to assume that consumption on a per-user or per-connection basis will remain lower than pre-restriction levels due to permanent behaviour change and the uptake of water efficient appliances. However, in the context of Broken Hill water customers, the temporary water

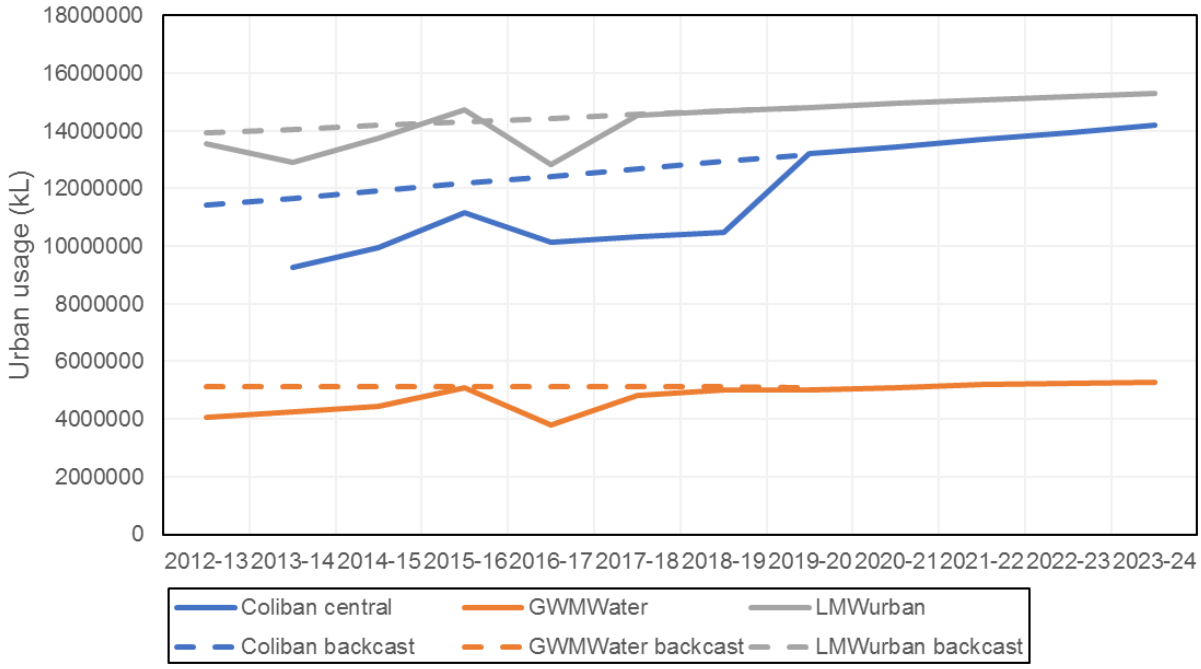
[10] Email dated 3 December 2018.

[11] Frontier Economics 2013, www.esc.vic.gov.au/sites/default/files/documents/7b008e2c-109f-4400-b150-3e6c38848e3f.pdf

restrictions on outdoor water use may not have led to investment in water efficient appliances if restrictions were not accompanied by other demand management programs, and there is there is no expected customer growth (which should also be expected to be associated with new housing stock with newer and more water efficient appliances). Overall, this suggests that Broken Hill consumption may not remain lower than pre-restriction levels.

The magnitude of the difference between our forecast levels of per connection water usage and observations in 'low demand' conditions (of +9%, +21% and +16% for 2014-15, 2015-16 and 2016-17 respectively) is not out of step with the expectations of other rural/regional water businesses. For example, Wannon Water[12] discusses a modest bounce back from 134kL to 148kL (+10%), and Coliban Water, GWMWater and Lower Murray Water (urban) have variations of -3% to 25% implied in their current price determinations (**Figure 7**, **Table 9**). This provides further confidence around the robustness of the forecast of 282kL/connection falling to 281kL/connection over the forecast period.

Figure 7: Observed bounceback assumptions in 2018 Price Review documents



Source: Frontier Economics analysis of Coliban Water, GWMWater and Lower Murray Water price submission financial models

[12] www.wannonwater.com.au/media/855/water-plan-3-2013-2018.pdf

Table 9: Difference between backcast levels of per connection water usage and observations in 'low demand' conditions

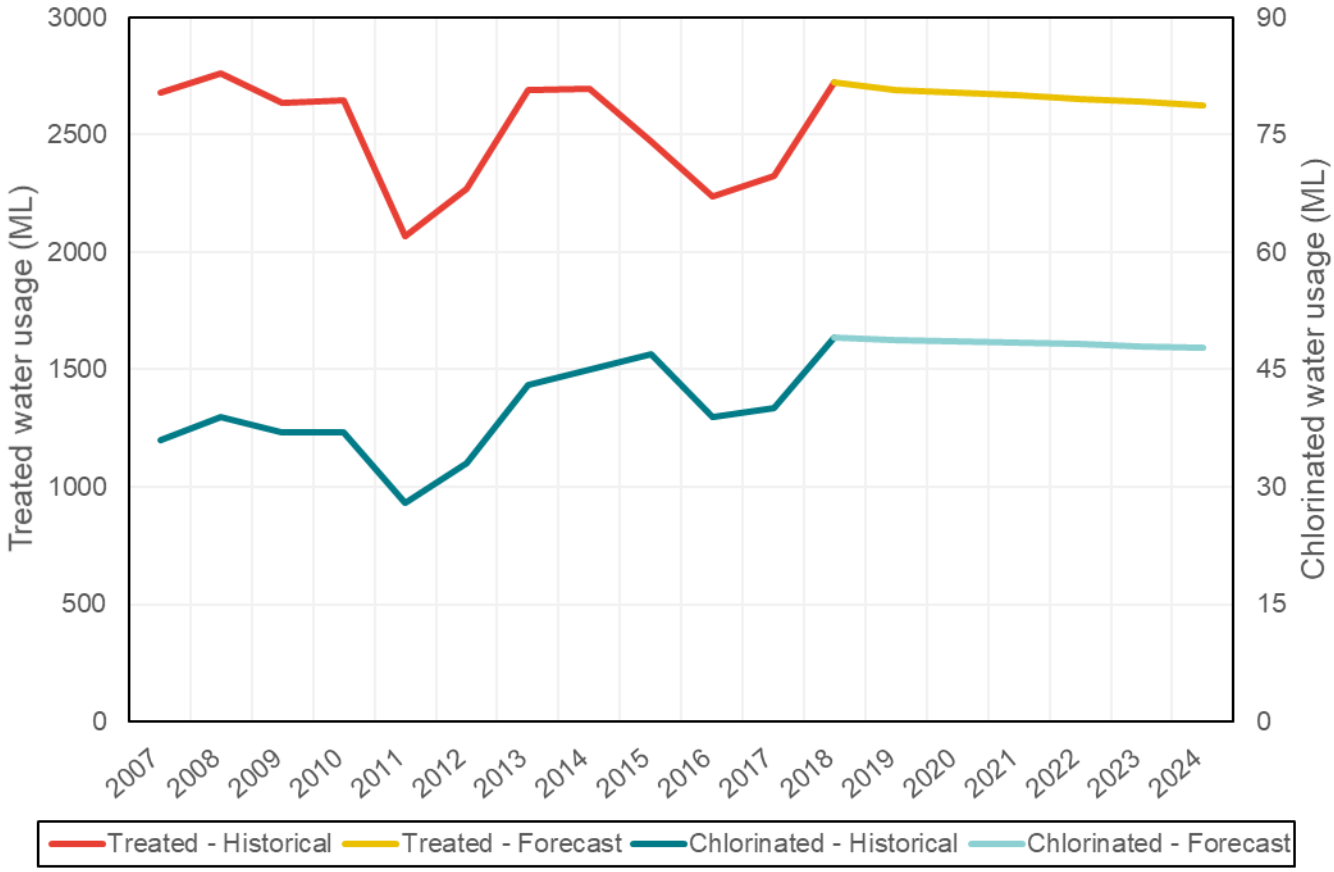
	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Coliban Water	-21%	-16%	-8%	-18%	-19%	-19%
GWMWater	-17%	-13%	-1%	-25%	-6%	-2%
LWM urban	-8%	-3%	3%	-11%	0%	0%

Source: Frontier Economics analysis of Coliban Water, GWMWater and Lower Murray Water price submission financial models

Water usage

In line with our approach, our forecast of connections and per connection usage are then combined to provide a forecast of residential water usage. These are presented in **Figure 8**. The low water demand observations, especially 2011–2012 and 2016–2017, are also apparent in this chart.

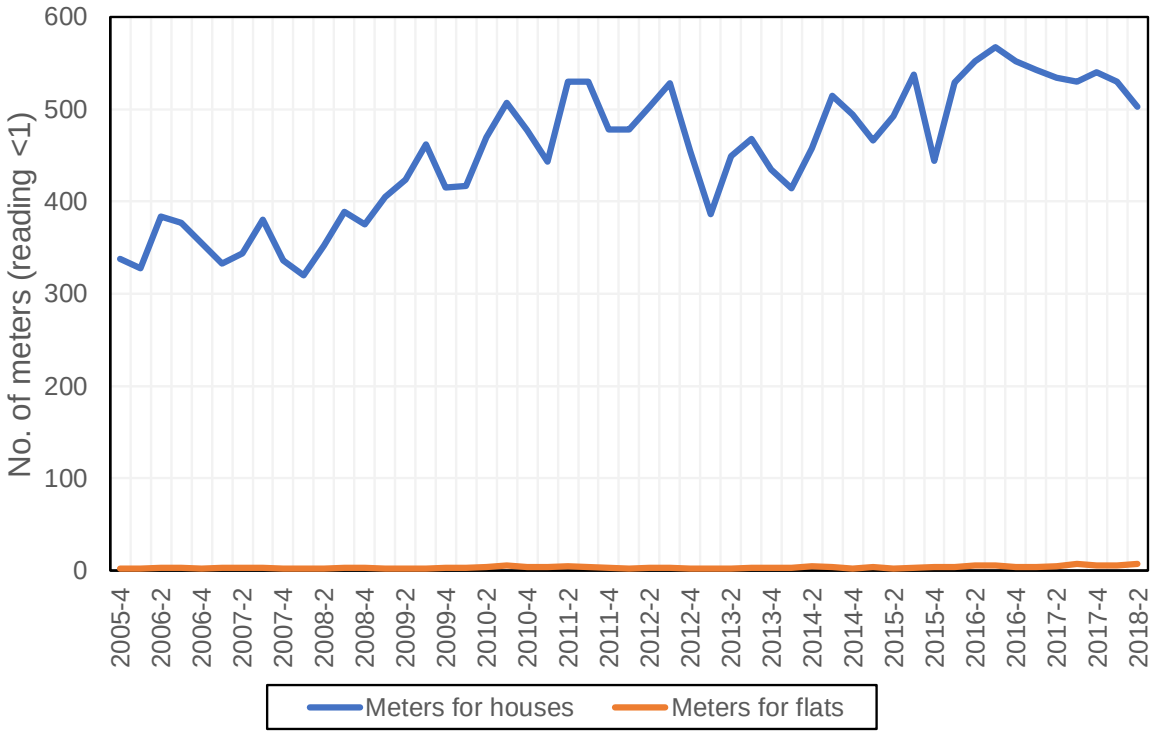
Figure 8: Residential water usage — treated and chlorinated



Source: Frontier Economics analysis

We note that our approach to combine connection forecasts and per connection usage forecasts could be affected by changes in the number of connections that have zero/minimal usage[13]. To explore the materiality of this issue, we have examined quarterly individual meter data for the period from the fourth quarter of 2005 to the end of the second quarter 2018. **Figure 9** shows that there was an increase in the number of household meters with zero/minimal usage between 2005 to 2011, and that the current (2018) level is similar to the 2011 level. Overall, the insights provided by the data were not sufficient for us to recommend a change in approach.

Figure 9: Number of meters with zero/minimal usage



Source: Frontier Economics

4.3.2 Non-residential

WaterNSW consults with the industrial and mining sector of Broken Hill as part of their pricing submission process. Their consultation involves the following non-residential customers:

- Cristal Mining Australia Ltd
- Perilya Ltd
- Mawsons Concrete & Quarries
- CBH Resources Ltd

As a result of this consultation process, the GHD water forecasts predict "no material change in the water consumption for the industrial and mining sector over the next two regulatory periods"[14]. Demand is assumed constant.

[13] In this context, "minimal" is defined as any meter reading less than 1kL of volume.

[14] GHD Advisory, 2018. *Projection of water demand for the Broken Hill Pipeline (April 5 Update),* p. 4

Some non-residential customer responses were separately determined by GHD to represent average conditions. Specifically:

- Mawson Concrete & Quarries suggested demand will vary with sales. GHD considers their statements on par with average conditions.
- CBH Resources Ltd. is currently actively engaged in mining exploration around the area, though with no firm expectation for further mine development.

The Essential Water submission assumes flat non-residential demand for its forecasts, the exact methodology for which is contained within in an in-house model. The submission implies a consultation process with non-residential customers, but details of such a process are not provided. They note that though one of the two local mines, Broken Hill Operations, began to "ramp up" operations in 2012, "Our forecast assumes that the mines will remain at current levels of consumption and that no new mines will commence operations during the regulatory period."[15]

Overall and given the consultation that WaterNSW and Essential Water have presented, there is no evidence base available to support a deviation in our modelling from the assumption of constant industrial and mining demand.

The effect of this (as set out below) is that forecasts of connection numbers are equal to 2018 observations, and the per connection usage is assumed to remain constant (at a level informed by historical data).

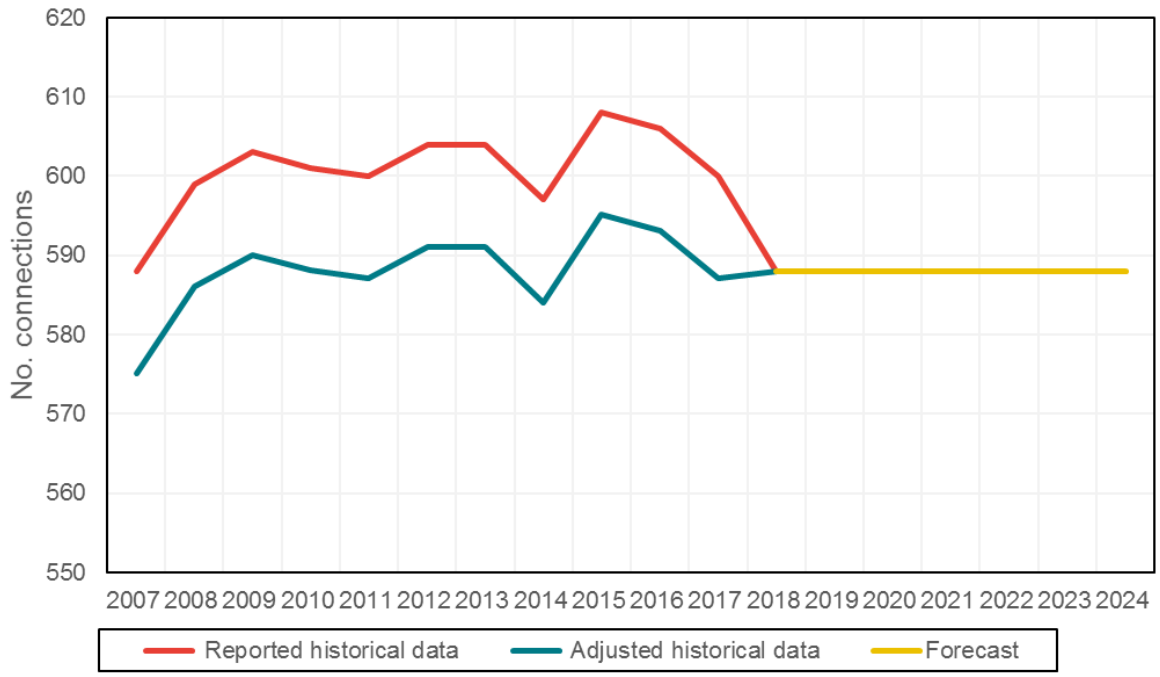
Connection numbers

Based on the reported consultation by the water businesses, forecasts of connection numbers are equal to 2018 observations.

As discussed above, Essential Water confirmed that connection numbers had a potential break in the data collection due to changed data definitions. In order to forecast usage per connection, an adjusted historical series is required (as undertaken for residential connections). These are set out in **Figure 10** to **Figure 12.**

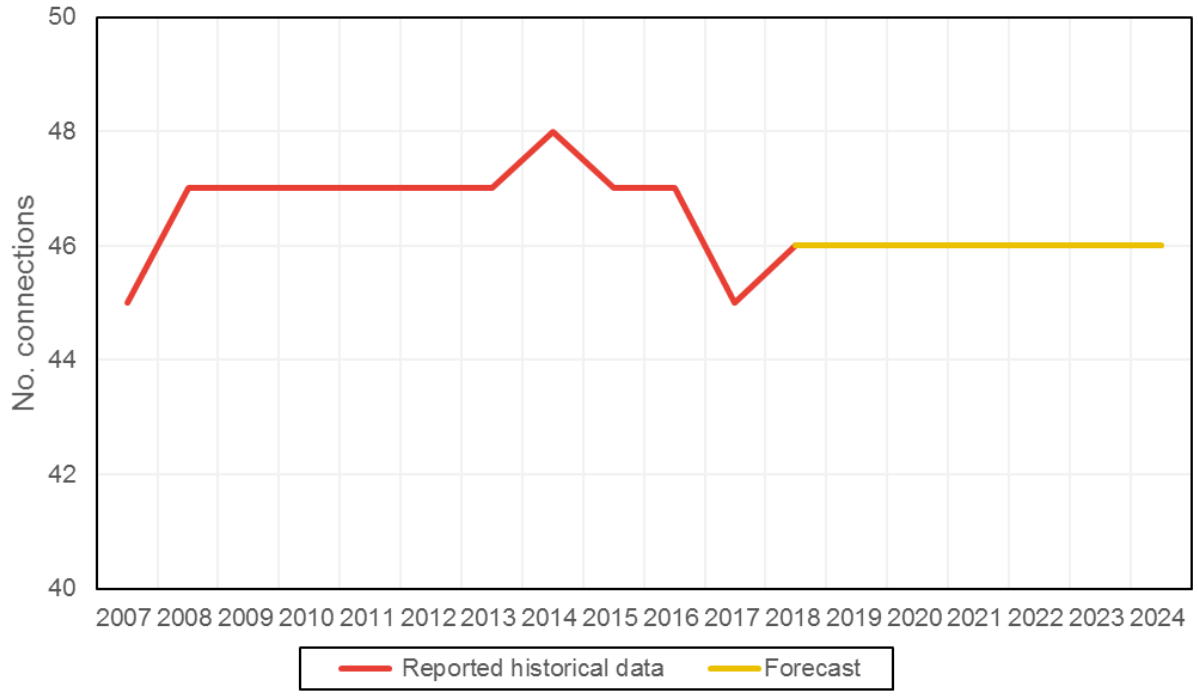
[15] Essential Water, 2018. *2019-23 Water and Sewerage Pricing Submission*, p. 109

Figure 10: Non-residential connections — business (treated/chlorinated)



Source: Frontier Economics analysis

Figure 11: Non-residential connections — pipeline (untreated)



Source: Frontier Economics analysis

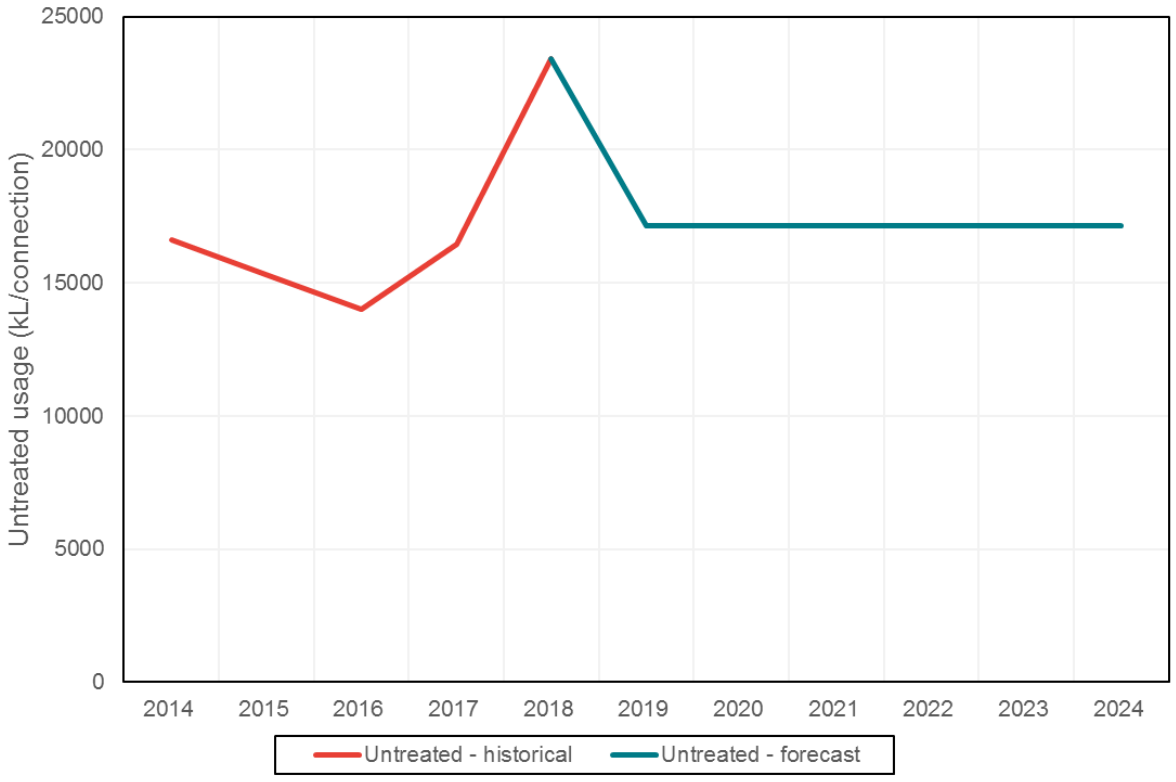
The reported data for exempt properties was a zero value in all years for residential, non-residential and untreated. The only exception to this was 215 reported connections for non-residential in 2018. Based on this, our forecast was for 2018 values to persist in the future — i.e. zero in every year for residential and untreated, and 215 connections in every year for non-residential.

Per connection usage

Per connection usage was based on average per connection usage over the past 5 years (or less in order to avoid zero volume observations).

[redacted]

Figure 14: Untreated water — non-residential usage per connection



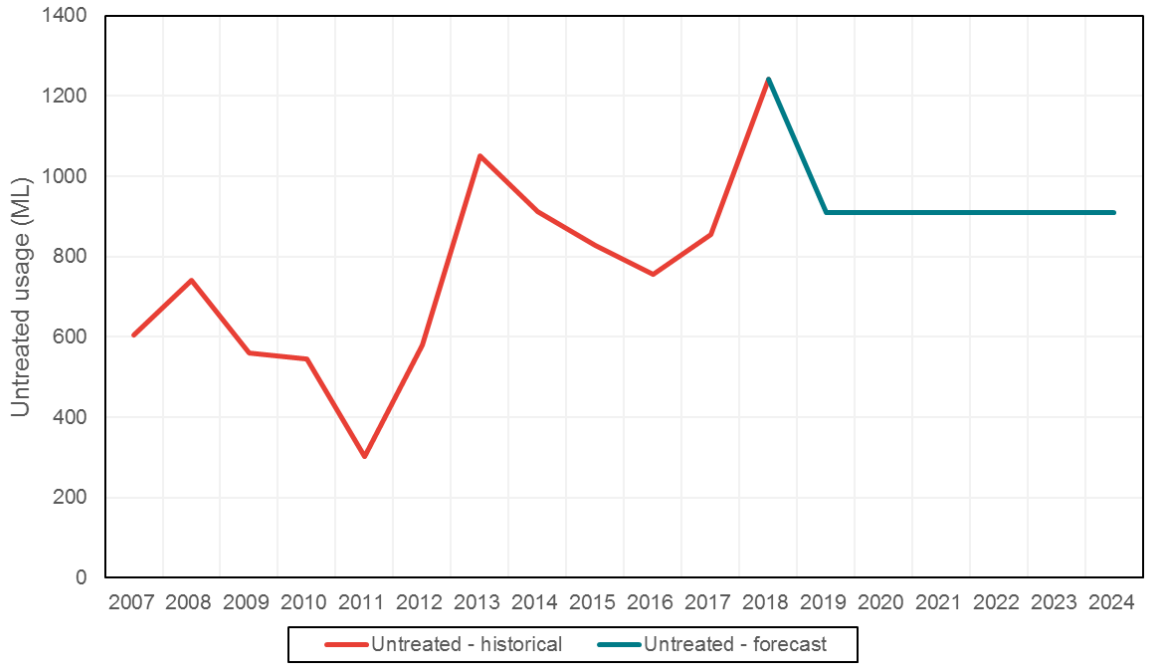
Source: Frontier Economics analysis

Water usage

In line with our approach, our forecast of connections and per connection usage are then combined to provide a forecast of water usage.

[redacted]

Figure 16: Non-residential water usage — untreated



Source: Frontier Economics analysis

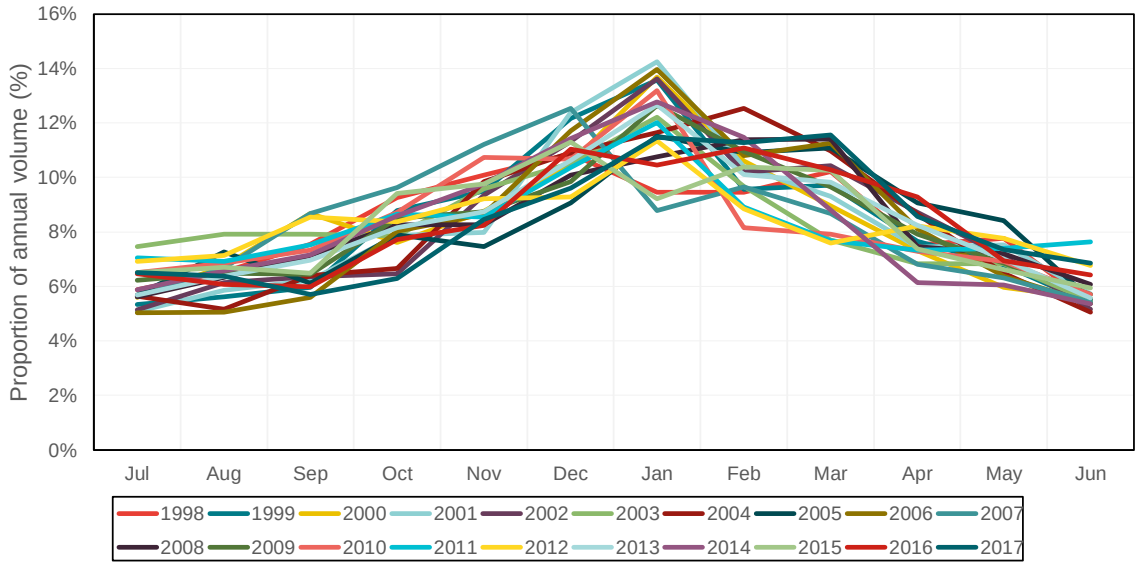
4.4 Seasonality

In addition to the above forecasts, we have considered the seasonality of demand by analysing monthly demands (relative to annual totals) from 20 years of daily raw water volume data. The data used had been adjusted — daily volumes that were less than 9ML were replaced with the volume of 9ML, consistent with Essential Water's judgement.

There is a consistent pattern of water use, with smaller volumes in winter months, and demand increasing to peak in summer (**Figure 17**).

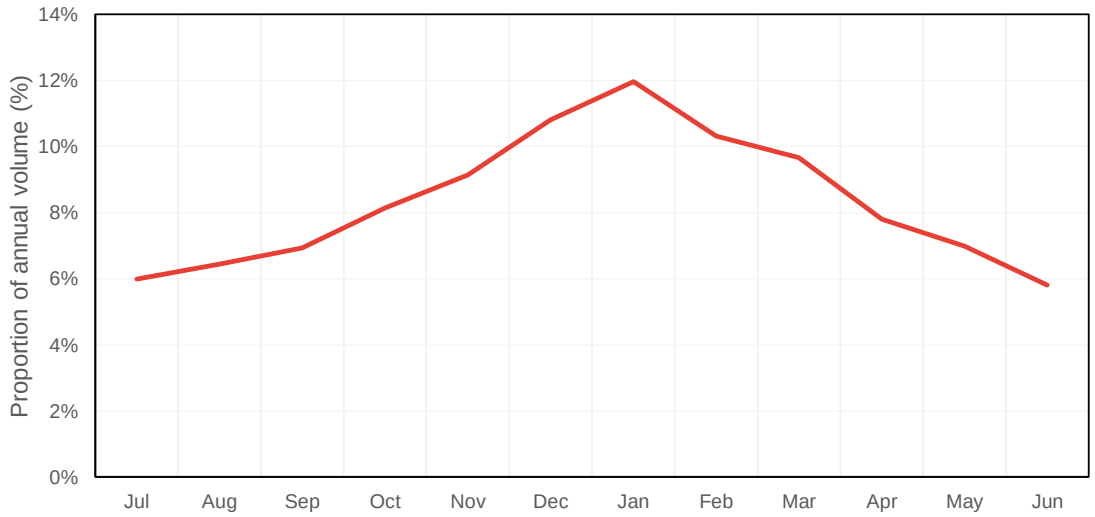
From this 20 year series, the average monthly proportion was calculated (**Figure 18**).

Figure 17: Monthly proportion of annual adjusted raw water volume



Source: Frontier Economics analysis

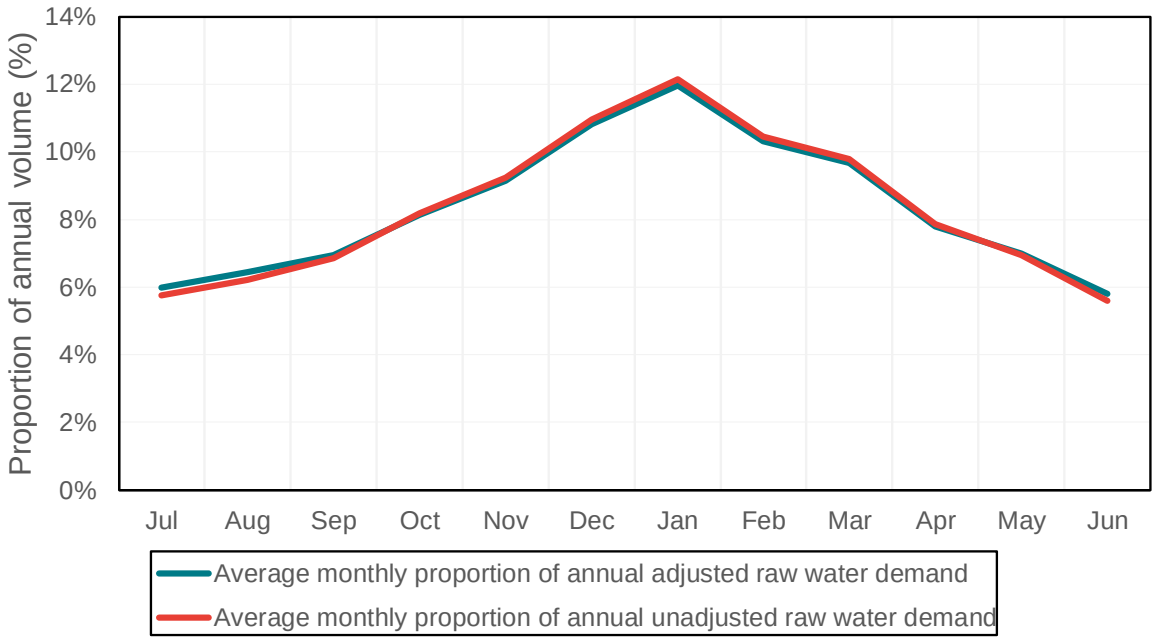
Figure 18: Average monthly proportion of annual adjusted raw water volume



Source: Frontier Economics analysis

This same seasonality analysis was undertaken using the unadjusted series and it was found that there was no substantial difference in results (**Figure 19**).

Figure 19: Comparing results for adjusted and unadjusted raw water data



Source: Frontier Economics analysis

The pattern of seasonality has been overlayed on the forecast of total water demand to provide a forecast of seasonal water demand (**Table 10**).

Table 10: Monthly forecast of water demand (ML)

FINANCIAL YEAR ENDING 30 JUNE	2020	2021	2022	2023	2024
Total water demand	**5435**	**5423**	**5408**	**5393**	**5378**
July	326	325	324	323	322
August	350	349	348	347	346
September	377	376	375	374	373
October	442	441	440	439	438
November	497	496	495	493	492
December	588	586	585	583	581
January	650	649	647	645	643
February	561	560	558	556	555
March	525	524	523	521	520
April	424	423	422	421	419
May	380	379	378	377	376
June	316	315	314	313	312

Source: Frontier Economics analysis

4.5 Elasticity

In order to consider the own-price elasticity of water demand, we have drawn on the 2018 Essential Services Commission water price review information for regional and rural urban water businesses from Victoria with potentially similar customers. These include Lower Murray Water (urban), Coliban Water and GWMWater.

4.5.1 Lower Murray Water

Lower Murray Water (LMW) is the urban water supplier to Mildura, Robinvale, Kerang, Irymple, Merbein, Red Cliffs, Lake Boga, Nyah, Nyah West, Swan Hill, Koondrook, Murrabit, Piangil and Woorinen South.

LMW's approach is to generate a price elasticity from the results of other published empirical studies of demand for residential-use water. This approach assumes that the forecast consumption derived from the regression analysis provides an estimate of 'base demand' prior to taking account of any price changes.

Taking into account LMW's tiered volumetric charges, extent of outdoor use, lack of volumetric charges for sewerage and lower price elasticities for households which have implemented water savings measures, they used the range of price elasticity assumptions set out in **Table 11**.

Table 11: Lower Murray Water's price elasticity assumptions

VOLUMETRIC TIER	ASSUMED PRICE ELASTICITY
1st Price Tier	-0.05
2nd Price Tier	-0.10
3rd Price Tier	-0.15

Source: Lower Murray Water Price Submission 2018-23 Urban, p. 35.

LMW has assumed no impact on non-residential demand due to price elasticity — i.e. the assumed price elasticity is zero.

4.5.2 Coliban Water

Coliban Water is the urban water supplier to Bendigo and surrounds.

For the 2018 price review, Coliban Water assumed that demand elasticity is immaterial given the small changes to real prices being proposed.

Coliban Water provided the example of one area that had seen significant price changes over the past few years. Variable water prices in the supply zone have risen by around 10.5% each year, translating to around a 4.7% increase in average bills. Despite this, water demand in Murray townships has not shown appreciable price sensitivity, and any impact of price rises has been swamped by natural variation in demand due to temperature or rainfall.

In the 2013 price review, Coliban Water assumed a value of -0.10 as the price elasticity for residential water demand.[16]

4.5.3 GWMWater

GWMWater is the urban water supplier to towns in the Grampian-Wimmera area — such as Horsham Stawell and Ararat.

In the 2018 price review, GWMWater found that in the absence of any significant increase in water price across the period, consumption is not expected to change significantly unless influenced by any decline in overall household disposable income.

Water price increases were expected to be observed in towns that receive a water supply upgrade — to transition the town to the potable water tariff. GWMWater reviewed average residential customer demands in towns recently converted to a drinking water supply and referenced a study by Sydney Water on the price elasticity of water demand (**Table 12**). GWMWater noted that, although they had observed correlation between price and demand where there is a greater price uplift, a complicating factor was that varying seasonal conditions and water quality tend to have a greater impact on consumption.[17]

[16] Frontier Economics 2013, www.esc.vic.gov.au/sites/default/files/documents/7b008e2c-109f-4400-b150-3e6c38848e3f.pdf

[17] Specifically, where these towns have been receiving a water supply with elevated salinity, GWMWater expected to observe a reduction in average consumption because water with lower saline levels is more effective in irrigation activities.

Table 12: Price elasticity of water demand

HOUSEHOLD TYPE	IMMEDIATE	LONG-TERM
Owner occupied houses	-0.08	-0.14
Tenanted houses	-0.02	-0.10
Housing units	-0.01	-0.03
Weighted average	**-0.05**	**-0.11**

Source: Abrams, B., Kumaradevan, S., Sarafidis, V. and Spaninks, F. (2011) The Residential Price Elasticity of Demand for Water, Joint Research Study, Sydney, February.

4.5.4 Implications for Broken Hill

Based on the above, we propose the mid-point level of -0.10 as the price elasticity for residential water demand and 0 as the price elasticity for non-residential water demand. This is based on the LMW assumptions above, and the fact that Essential Water data shows that all residential water is charged at the single variable tariff (i.e. there is no separation into tier 1, 2 and 3 prices). Further, the income characteristics of Broken Hill and LWM customers are broadly similar (**Table 13**).

Table 13: Comparing incomes of Broken Hill and LWM customers

REGION	MEDIAN TOTAL PERSONAL INCOME ($/WEEKLY)
Broken Hill (SA2)	527
Mildura (SA3)	555

Source: Australian Bureau of Statistics 2016 Census Community Profiles

Using a price elasticity of -0.10 is also consistent with the value previously used by Coliban Water and the long-term weighted average value identified by Sydney Water and referenced by GWMWater.[18]

[18] Abrams, B., Kumaradevan, S., Sarafidis, V. and Spaninks, F. (2011) The Residential Price Elasticity of Demand for Water, Joint Research Study, Sydney, February.

5 BROKEN HILL DEMAND VS PIPELINE DEMAND

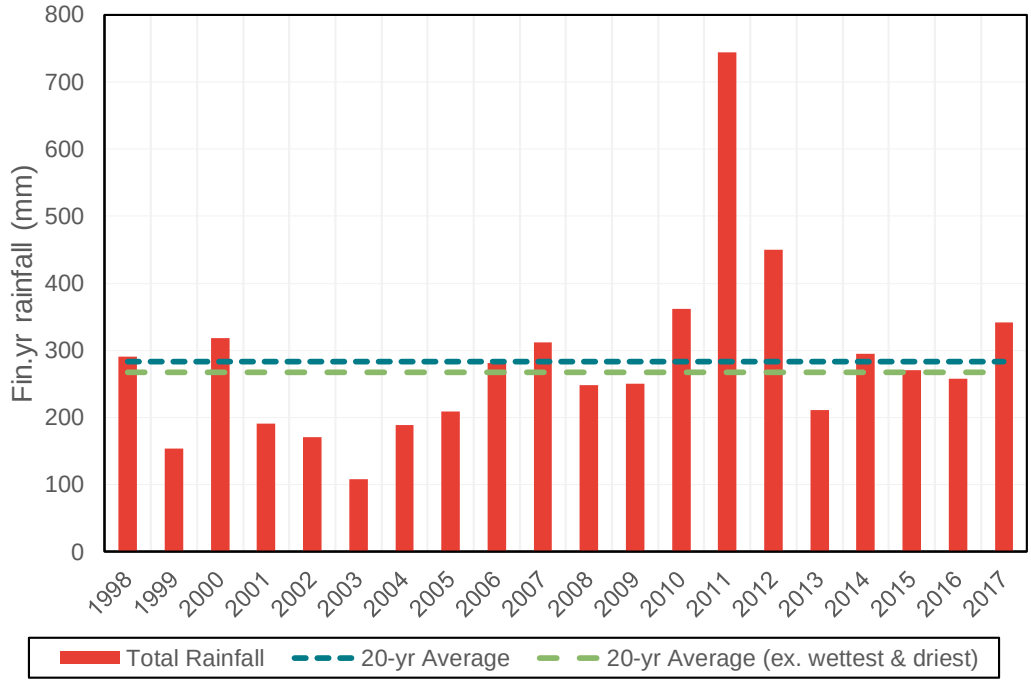
This project has thus far focused on analysing future water usage and connections in Broken Hill in order to inform regulatory decision-making around the Murray to Broken Hill Pipeline. It is therefore important to also consider the distinction and relationship between *pipeline* water demand and overall Broken Hill water demand.

If the pipeline were to be the sole source of water for Broken Hill, then the pipeline demand would be directly linked to Broken Hill demand (with allowances for losses in bulk water transfer/storage). However, if the pipeline serves to significantly increase the security of the Broken Hill water supply and is used in combination with other supply sources, then pipeline demand may be lower and more variable than if it were the sole source of water. This is because if the traditional water supply from local storages can provide water, then these traditional water sources may be used preferentially to pipeline supply. This means that, in combination with an understanding of overall Broken Hill water demand, an understanding of the potential performance of Broken Hill's traditional local water supplies is necessary to forecast pipeline demand.

Local water storage performance around Broken Hill is broadly determined by rainfall patterns and volumes. Rainfall in Broken Hill is highly variable, with a long-term annual average of 259.7mm.[19] Based on the 20-year daily data from Essential Water, the long-term financial year average is 283mm (if all financial years are included), and is 267mm if the wettest and driest years are excluded (see **Figure 20**).

[19] http://www.weatherzone.com.au/climate/station.jsp?lt=site&lc=47048

Figure 20: Broken Hill rainfall (mm)



Source: Essential Water 20-year daily data series.

The Essential Water data on rainfall is also linked to prevailing storage heights in Stephens Creek Reservoir. However, the data was not sufficient to establish an estimate of the storage inflow associated with rainfall observations (a more complete hydrological model would be necessary to capture inflow, loss and use relationships).

Other information was identified to establish the magnitude of local catchment water supplies that are available to supply Broken Hill under alternative seasonal conditions. Essential Water's submission to the 2012 *Inquiry into Adequacy of Water Storage in NSW* stated:[20]

> *Essential Water owns and operates:*
> *• Stephens Creek Reservoir (capacity 18,800 megalitres (ML);*
> *• Umberumberka Reservoir (capacity 7,800 ML) and;*
> *• Imperial Lake Reservoir, an emergency water supply (capacity 670ML).*
> *These water sources all receive and store rainfall from the local catchment area, and supply between 30 per cent and 90 per cent of local annual water needs, depending on rainfall.*

[20] Essential Water 2012, Submission to *Inquiry into Adequacy of Water Storage in NSW, Submission No. 51, www.parliament.nsw.gov.au/lcdocs/submissions/41996/0051%20Essential%20Water.pdf*

> *Essential Water is also licensed to extract 9.975 gigalitres (GL) of water per year from the Darling River. (Essential Water 2012, p.1–2)*

This suggested that, in the years prior to 2012, the local catchment water supplies provided between 30–90% of Broken Hill water demands. Given that the total water demand forecasts are of a similar magnitude to these prior demands, the 30–90% may be applicable to the forecasts with the balance being sourced from the Murray pipeline.

Adelaide provides a similar example of these dynamics (at least before the commissioning of the Adelaide Desalination Plant at Lonsdale). Traditionally, Adelaide sourced 50% of its water from the Murray and 55% from local storages (Adelaide Hills) in an average year, while reliance on the Murray would increase to 90% in a drought year (when Adelaide Hills storages performed poorly).[21]

However, there may be other factors that lead to the available local catchment water supplies supplying less than the 30–90% observed historically, for example:

- **Climate change that reduces storage inflows in the local catchment.**
  - For example, The NSW Government has identified that areas near Broken Hill have projected climate change impacts of increasing temperatures and decreasing rainfall in spring.[22] Both of these changes could be expected to reduce storage inflows in the local catchment.
- **Degradation of existing water storages and catchment.**
  - Essential Water noted that "Approximately 25 per cent of the reservoir capacity at Stephens Creek has been lost to sedimentation over the past century. Relative to many water resource catchments in other arid zones, the rate of erosion and siltation in the Stephens Creek catchment is not excessive. Order of magnitude estimates indicate that sediment is continuing to move slowly towards the reservoir."[23]. This suggests a gradual decline in storage capability of the traditional supply sources.

In order to inform a forecast of pipeline demand, further consultation with Essential Water may be required to provide additional information about the potential performance of Broken Hill's local water supplies.

[21] www.murrayriver.com.au/about-the-murray/water-use-and-consumption/

[22] www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Climate-change/climate-change-fact-sheet-160595.pdf

[23] Essential Water 2012, Submission to *Inquiry into Adequacy of Water Storage in NSW, Submission No. 51, www.parliament.nsw.gov.au/lcdocs/submissions/41996/0051%20Essential%20Water.pdf*

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