Review of South Gippsland Water demand forecasts

Independent review of demand forecasts, undertaken for Essential Services Commission, Water Price Review 2018

February 2018

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Advisory

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Executive Summary

To support the Essential Services Commission (the Commission) and Water Price Review 2018, KPMG was engaged to review South Gippsland Water's (SGW) demand forecast and provide advice on whether the water businesses' proposed demand forecasts are appropriate and have been developed on a reasonable basis. In order to provide this advice KPMG has sought to answer the following four questions:

- Are SGW's forecast based on appropriate forecasting methods?
- Are SGW's forecasts arithmetically accurate and an appropriate reflection of the forecasting method?
- Are SGW's forecasts consistent with historical trends?
- Do SGW's forecasts reflect reasonable assumptions about the key drivers of demand (including price elasticities)?

The following is a brief synopsis of KPMG's analysis and findings in relation to each of the above questions.

Are SGW's forecasts based on appropriate forecasting methodologies?

This stage of KPMG's analysis focuses on the underlying method adopted for forecasting. KPMG notes that acceptance of the method does not amount to acceptance of the forecasts themselves as they will reflect SGW's application of the forecasting method.

In order to address this question KPMG has considered a forecasting method to be appropriate where:

- The method is suitable given historical consumption and connection growth
- The method exhibits logical validity and is internally consistent
- The method is broadly accepted as an industry standard
- The method is supported by regulatory precedent

Table 1: Are SGW's forecasts based on appropriate forecasting methods?

Forecast	Suitability	Logically valid	Industry acceptance	Regulatory precedent
Residential Water Connections	Yes	Yes	Yes	Yes
Residential Water Volumes	Yes	Yes	Yes	Yes
Residential Wastewater Connections	Yes	Yes	Yes	Yes
Wastewater volume	Yes	Yes	Yes	Yes
Non-residential Water Connections	Yes	Yes	Yes	Yes
Non-residential Water Volumes	Yes	Yes	Yes	Yes
Non-residential Wastewater Connections	Yes	Yes	Yes	Yes
Trade west connections	No	Yes	Yes	Yes

SGW has adopted relatively simple approaches to demand forecasting. For connections they have used extrapolations of historical growth rates. The historical averages for both residential and non-residential customers are based on a ten year period. SGW has chosen to use historical data rather than Victoria in Future (ViF) forecasts for connections. While the Commission does recommend the use of ViF data, it has also accepted forecasts in previous price reviews that were demonstrated to be consistent with historical trends. KPMG has accepted this approach on the basis that it is logically valid (given the absence of any major demographic shifts in SGW population) and has previously been accepted by the Commission in similar circumstances.

In relation to all volume forecasts, SGW has extrapolated consumption over the regulatory period by applying historical connections growth to the average consumption per connection (10 year historical period for residential and 5 year historical period for non-residential). This simple approach to forecasting has been used extensively throughout the regional water sector. This approach and variances of this approach (such as extrapolations based on litres per person per day) have been accepted by the Commission and other regulators as appropriate. KPMG has accepted this approach as reasonable.

An exception is trade waste connections. SGW's forecast is based on extrapolation of the last year of actual data and this approach does not reflect recent historical trends. KPMG has recommends that the approach to forecasting trade waste connections be amended to reflect recent growth.

Are the calculations contained within the forecasting model arithmetically accurate and do they appropriately reflect the forecasting method?

In order to address this question KPMG have sought to replicate SGW's forecasts based on the methods outlined in the price submission and historical data provided by SGW in response to a request for further information. The SGW forecasts were considered to be mathematically accurate and reflective of the forecasting method where KPMG was successful in replicating them.

Table 2: Are the calculations contained within the forecasting model arithmetically accurate and do they appropriately reflect the forecasting method?

Forecast	Successfully replicated
Residential Water Connections	Yes
Residential Water Volumes	Yes
Residential Wastewater Connections	Yes
Wastewater volume	No
Non-residential Water Connections	No
Non-residential Water Volumes	No
Non-residential Wastewater Connections	No
Trade west connections	No

Based on the historical data initially provided by SGW to KPMG, KPMG was unable to replicate any of the average growth rates for connections or the averages for per connection consumption. The immediate conclusion drawn from this inability to reproduce SGW's forecasts, as outlined in its pricing proposal using the methods outlined in that proposal, is that the forecasting models used by SGW were not arithmetically accurate and could be subject to systemic error or alternatively that SGW has utilised multiple and different sets of data.

KPMG sought clarification from SGW, who indicated that the issue was primarily due to conflicting sets of data. SGW provided a definitive data set on 16 February. On the basis of this data set KPMG was able to successfully replicate SGW's projected growth rate for residential connection and residential per connection usage.

For those forecasts we were unable to replicate, KPMG has amended the forecasts to reflect the average growth rates and per connection consumption derived from the definitive data set provided by SGW. We have recommended that these amended forecasts be used.

Are SGW's forecasts consistent with historical trends?

In order to address this question KPMG has compared the forecasts to historical data based on the following criteria:

- Forecasts exhibit growth rates comparable to those evident in historical data?
- Do the forecasts exhibit any step changes in demand relative to historical trends?
- Are the forecasts appropriately aligned to either long run trends in demand (in this case 10 year trends) or short run trends in demand (in this case over the immediate five year period)?

Table 3: Are SGW's forecasts consistent with historical trends?

Forecast	Comparable growth rates	Step changes	Alignment
Residential Water Connections	Yes	Yes	Yes
Residential Water Volumes	No	Yes	Yes
Residential Wastewater Connections	No	Yes	Yes
Wastewater volume	No	Yes	No
Non-residential Water Connections	Yes	Yes	Yes
Non-residential Water Volumes	No	Yes	Yes
Non-residential Wastewater Connections	Yes	Yes	Yes
Trade west connections	No	Yes	No

We note that SGW's forecast growth in volumes is lower than long term trends in water (based on 10 years data). This is consistent with our expectations and reflects potential differences in the historical data and the impact of price elasticity of demand on consumer behaviour. These aspects of the forecasts are covered in sections 2 and 4 of this report respectively.

We note that forecast wastewater volumes are higher than would be expected based on historical trends. We also note that SGW has made an explicit decision to forecast above historical trends on the basis that it is assuming demand side risk on behalf of its customer base. Under the new PREMO framework businesses are actively encouraged by the Commission to assume risk. Consequently, we have not recommended amending SGW's waste wastewater volume forecast to reflect the lower historical rates of growth.

Forecasted growth rates for connections for residential wastewater are lower than both the long term and short term averages. KPMG have recommended that forecasts of residential wastewater connections be amended to reflect the long term average per annum growth rate.

We note that SGW is forecasting growth rates for non-residential volumes higher than those observed either in the long run historical data or the short run historical data. This would imply that SGW is assuming a degree of risk in relation to its non-residential forecasts that is consistent with the new PREMO framework being implemented by the Commission.

Forecast trade waste connections are also not consistent with historical cost over the prior 5 year period. KPMG has recommended that a positive growth rate be applied to trade waste connections consistent with historical trends.

Are the key assumptions and forecasting methods reasonably based and justified?

Reasonable assumption are those that appear rational and logical and are based on evidence and are correctly reflected in forecasts.

Table 4: Are the key assumptions and forecasting methods reasonably based and justified?

Forecast	Rational	Evidenced	Correctly applied
Population/household growth	Yes	Yes	Yes
Weather	Yes	No	Yes
Consumer behaviour	Yes	Yes	No

There are three main underlying assumptions that have been assessed by KPMG:

- ***Population/household growth:*** Assumptions around population and household growth have a direct bearing on both connections and, due to the forecasting approach adopted by SGW, volumes forecasts. The Commission recommends the use of ViF and has previously allowed businesses to use historical growth rates. SGW has adopted connections forecasts based on historical growth. KPMG believes this is a valid approach and one which, when executed correctly, can avoid potential errors associated with reconciling connections forecasts to population or household data.
- ***Weather:*** SGW has assumed normal weather patterns over the course of the regulatory period and has not assumed any periods of drought or flood events. SGW has not provided any supporting evidence for this assumption. Given the inherent difficulties associated with forecasting weather over a five year period (noting that the BoM forecasts only extend to 3 months), KPMG considers SGW's weather assumption to be reasonable.
- ***Consumer behaviour***: The primary issue associated with consumer behaviour is price elasticity of demand. SGW has proposed significant price rises over the course of the regulatory period and has rightly sought to reflect price elasticity of demand in its demand forecasts. Rather than calculate its own elasticities SGW has adopted those from a 2011 study undertaken by Sydney Water and Sarafidis. The Sarafidis paper is widely considered to be the preeminent water elasticity study undertaken in Australia. While SGW has chosen a respected study to use as a proxy for their own elasticity, they have made a number of errors in its application. Accordingly, KPMG have recommended a number of amendments be made to the manner in which elasticity is applied to residential volume forecasts.

1. Summary of findings

1.1 Recommended amendments

The following list outlines all of KPMG's recommended amendments to SGW's proposed demand forecasts.

- The resetting of all connection and volume forecasts to properly reflect SGW's stated methods and the historical data provided to KPMG. Amendments include adopting the following parameters;
    - 10 year average residential water connections 1.63%
    - 10 year average non-residential water connections 0.75%
    - 10 year average residential water use per connection 121 kL per connection
    - 5 year average non-residential water use per connection 311 kL per connection
- Resetting of residential water volume forecasts to properly reflect the application of the Salafidis elasticity estimates, as follows;
    - Apply elasticity to the appropriate time period.
    - Adopt initial price rise of 18.77%.
    - Adopt appropriate short run elasticity estimates.
    - Ensure the rolling nature of elasticities is incorporated correctly.
    - Apply year on year estimates of elasticity.
- The resetting of forecasts for residential wastewater connections and volumes consistent with the long-term average growth rates for residential wastewater observable in the historical data.

The resetting of trade waste forecasts such that connections and volumes for TW minor cat 1 are consistent with the positive growth observable in the short run historical data. KPMG has utilised non-residential wastewater growth over the preceding five year period (0.47%) as a proxy as it is concerned that the magnitude of growth exhibited in the historical trade waste data would be inappropriate without further understanding the drivers for the recent growth.

1.2 Amended demand 2018-19 to 2022-23

District	Tariff Description	Type	Unit	2018-19	2019-20	2020-21	2021-22	2022-23
SGW Proposed demand								
Volume	Customers excl Majors	Water	kL	3,275,000	3,312,635	3,350,837	3,389,615	3,428,980
Access Fee	East / West (Dev / Un)	Water	cust	20,391	20,679	20,973	21,271	21,573
Access Fee	All Regions (Developed)	Wastewater	cust	17,327	17,580	17,837	18,098	18,364
Access Fee	Minor TW Cat 1	Trade waste	cust	264	264	264	264	264
KPMG amended demand								
Volume	Customers excl Majors	Water	kL	3,320,405	3,362,485	3,405,124	3,448,329	3,492,109
Access Fee	East / West (Dev / Un)	Water	cust	20,445	20,760	21,081	21,407	21,738
Access Fee	All Regions (Developed)	Wastewater	cust	17,362	17,632	17,908	18,187	18,471
Access Fee	Minor TW Cat 1	Trade waste	cust	277	278	279	280	282
Difference								
Volume	Customers excl Majors	Water	kL	1.4%	1.5%	1.6%	1.7%	1.8%
Access Fee	East / West (Dev / Un)	Water	cust	0.3%	0.4%	0.5%	0.6%	0.8%
Access Fee	All Regions (Developed)	Wastewater	cust	0.2%	0.3%	0.4%	0.5%	0.6%
Access Fee	Minor TW Cat 1	Trade waste	cust	4.8%	5.3%	5.8%	6.2%	6.7%

2. Introduction

SGW's demand forecasts form a critical component of its 2018 price submission. They are a crucial requirement for the calculation of prices for the next five year regulatory period, being 1 July 2018 to 30 June 2023.

Demand forecasts are a central component of economic regulation. Ensuring that the forecasts are as accurate as possible is a primary mechanism for reducing regulatory risk and promoting regulatory outcomes that maximise technical, allocative and dynamic efficiency.

The quality of demand forecasts has a direct impact on:

- Revenue and prices — for both fixed and volumetric charges;
- Capital expenditure — particularly where growth is a major driver of system augmentations;
- Operating and maintenance expenditure — particularly expenditure that is volume-related; and
- Service standards — ensuring that supply-demand balance is achieved and supply continuity is provided.

The ultimate objective of demand forecasting is to generate the most reliable estimates of customer growth and service delivery over the forthcoming regulatory period or planning period. The more reliable the demand estimates, the more informed will be the choices that water businesses and the regulator can make.

2.1 Scope and Purpose

In order to provide this advice KPMG has sought to answer the following four questions:

- Are SGW's forecast based on appropriate forecasting methods?
- Are SGW's forecasts arithmetically accurate and an appropriate reflection of the forecasting method?
- Are SGW's forecasts consistent with historical trends?
- Do SGW's forecasts reflect reasonable assumptions about the key drivers of demand (including price elasticities)?

2.2 Our approach

Each of the above questions is discussed below.

Are SGW's forecasts based on appropriate forecasting methodologies?

Best practice demand forecasting calls for the adoption of robust and proven methods. Rather than dictate to businesses the specific forecasting approach that they should adopt, the Commission has a long standing position that businesses are best placed to develop and maintain their own forecasting capacity and approach given that they collect the necessary data and are best placed to understand the characteristics of their own customer groups. Accordingly the Commission's assessment of the methods utilised by businesses has been conducted at a fairly high level and does not include detailed reviews of comparable statistical models.

Consistent with the ESC's approach, KPMG has considered a method for forecasting to be appropriate where:

- The method is suitable given historical consumption and connection growth
- The method exhibits logical validity and is internally consistent
- The method is broadly accepted as an industry standard
- The method is supported by regulatory precedent

Are the calculations contained within the forecasting model arithmetically accurate and do they appropriately reflect the forecasting method?

KPMG has not undertaken any detailed auditing or reviewing of SGW's models for forecasting demand.

Rather, in order to address this question, KPMG has sought to replicate SGW's forecasts based on the methods outlined in the price submission and historical data provided by SGW in response to a request from KPMG for further information. The SGW forecasts were considered to be mathematically accurate and reflective of the forecasting method where KPMG was successful in replicating them.

Are SGW's forecasts consistent with historical trends?

It is not a necessary requirement of accurate forecasts to be 100% consistent with historical trends. There are many reasons that forecasts differ from history. These reasons should reflect SGW's expectations regarding changes in their operating environment in the future. Such changes should form the assumptions underlying the forecasts. However it is reasonable to expect in the absence of any unanticipated change that forecasts are consistent with historical trends.

Where forecasts deviate from trends KPMG has sought to identify and assess the underlying assumption driving the change in demand. In order to address this question KPMG has compared the forecasts to historical data based on the following criteria:

- Forecasts exhibit growth rates comparable to those evident in historical data?
- Forecasts do not exhibit any step changes in demand relative to historical trends?
- Are the forecasts appropriately aligned to either long run trends in demand (in this case 10 year trends) or short run trends in demand (in this case over the immediate five year period)?

Are the key assumptions and forecasting methods reasonably based and justified?

Forecasts over the regulatory period may be influenced by assumptions that represent SGW's changing expectations of its operating environment and the behaviour of its customers. Such assumptions should be clearly outlined by SGW in its pricing proposal.

In order to ensure that the forecasts are robust these assumptions should be;

- Logical
- Evidenced based (with a preference for evidenced sourced from an independent third party)
- Properly applied to the forecasts

Where KPMG has identified issues associated with any of the above questions, including incomplete or inappropriate forecasts, it has sought to recommend amendments to the Commission. To the degree possible, KPMG in making an amendment has sought to be consistent with the broader forecasting approach adopted by SGW.

KPMG takes the approach that any amendments recommended to forecasts should be robust and defendable and based on observable evidence.

2.3 Supporting information

On the basis of the information templates and the information requests, KPMG has reviewed SGW's proposed forecasts against the above criteria. In providing this advice KPMG has had regard to:

- the *2018 Water Price Review Guidance Paper*[1] - this contains the Commission's requirements for developing a capex forecast (refer to section 3.8, in particular 3.8.1 and 3.8.2). Attachment 5 contains the PREMO Assessment Tool, which is the framework the Commission will use to assess SEW's submission and the forecasts contained within;
- the *Water Pricing Framework and Approach Paper*[2] - this details the PREMO framework and discusses the Commission's expectations regarding (amongst other things) how the forecasts should reflect the PREMO framework;
- the information set out in SGW's price submission (and accompanying information template) and the explanations that SGW has provided with respect to the basis used to derive the forecasts and the assumptions used;
- comparisons amongst the businesses of their forecasting methodologies and assumptions, and resulting forecasts;
- Victoria in Future 2017 population forecasts; and
- KPMG's experience in preparing and assessing the veracity of forecasts of demand for urban water services in Victoria and other Australian states.

2.4 Consultations

To inform KPMG's assessment, KPMG issued a further information request on 16 January 2018. SGW responded on 22 January, 23 January and 2 February 2018. KPMG also met with Philippe du Plessis on Monday 22 January via phone conference to discuss both SGW's proposed demand and KPMG's further information request.

On 9 February KPMG provided SGW with a draft copy of this report and sought feedback from SGW in terms of any errors of fact and any potential misinterpretations that may have been made regarding SGW's proposed forecasts. SGW were also given the opportunity to provide any further information that it believes would assist KPMG in its assessment of the proposed forecasts.

SGW provided a response to the draft on 15 February. SGW response has been considered by KPMG in its findings.

2.5 Structure of KPMG's report

The remainder of this report is structured to reflect KPMG's review, being:

- Section 2 —introduction.
- Section 3 —outlines KPMG's analytical approach to reviewing SGW's proposed demand forecasts.
- Section 4 —sets out KPMG's assessment of the methods adopted by SGW to forecst demand over the regulatory period.

[1] Essential Services Commission, *2018 Water Price Review Guidance Paper*, November 2016.
[2] Essential Services Commission, *Water Pricing Framework and Approach – Implementing PREMO from 2018*, October 2016.

- Section 5 —sets out KPMG's comaprative analysis of SGW's forward foecasts against the trends that are observable in historical use data.
- Section 6 —sets out KPMG's assessment of the underlying assumptions driving SGW's proposed forecasts.

3. Are SGW's forecasts based on appropriate forecasting methodologies?

Under KPMG's analytical approach, the first stage of KPMG's analysis involves a critical review of the method adopted by SGW to forecast demand over the regulatory period.

There are three primary ways of forecasting demand that are common across water businesses. Each method has its own advantages and disadvantages. In a regulatory context, each method may require slightly different information to be presented. The three methods are:

1. **Simple trend extrapolations.** This is the simplest approach and involves identifying trends observable in historic usage data and extrapolating these forward over the regulatory period based on some unit of measurement. For example, the simple litres per capita per day (LCD) method of analysing historical bulk (aggregated) water demand to determine an overall LCD figure which is then multiplied by the projected population.
2. **Sector based trend extrapolations**. A sector based approach typically considers residential demand (single and multi-residential properties), non-residential demand (commercial, industrial and institutional and sub-sectors within these) and non-revenue water (real and apparent losses). An understanding of how water is used is generated for each sector which is then projected forward according to growth in sector-specific base units (e.g. number of residential connections, number and class of non-residential users) as deemed appropriate.
3. **An end-use analysis method**. This method uses a 'bottom-up' approach to explain historical usage (predominantly in the residential sector) associated with typical end uses such as toilets, bathrooms, washing machines and evaporative air conditioners. The demand for that end use is translated into aggregate demand by multiplying an individual end-use demand by frequency of usage, projected demographic growth (population, single and multi-residential dwelling numbers, occupancy as appropriate), and functions that reflect changes in the efficiency of the technology and mix of stock over time.

Each of these approaches are amenable for review under an economic regulatory framework as they allow for the generation of estimates for each price being proposed and, as such, allow the regulator to assess the business's proposed revenue stream.

3.1 SGW's forecasting methods

The following methods are employed by SGW to forecast demand.

Table 5: SGW's methods for forecasting demand

Forecast	Method
Residential water volumes	Simple trend extrapolation based on ten year average for volume per connection extrapolated over the regulatory period based on ten year average growth in connections.
Residential water connections	Simple trend extrapolation based on ten year average of historical connection growth.
Wastewater volumes	Assumed zero growth over the course of the regulatory period.

Forecast	Method
Residential wastewater connections	Adopted residential water connections growth.
Non-residential water volumes	Simple trend extrapolation based on five year average for volume per connection extrapolated over the regulatory based on connections.
Non-residential water connections	Simple trend extrapolation based on ten year average of historical connection growth.
Non-residential wastewater volumes	Simple trend extrapolation based on five year average for volume per connection extrapolated over the regulatory period based on connections.
Non-residential wastewater connections	Simple trend extrapolation based on ten year average of historical connection growth.
Non-residential trade waste connections	Unspecified minor customers. Historical trend extrapolation major customers.
Non-residential trade waste loads	Unspecified minor customers. Historical trend extrapolation major customers.

3.2 The logical validity of the forecasting method

3.2.1 Residential and non-residential water and wastewater volumes

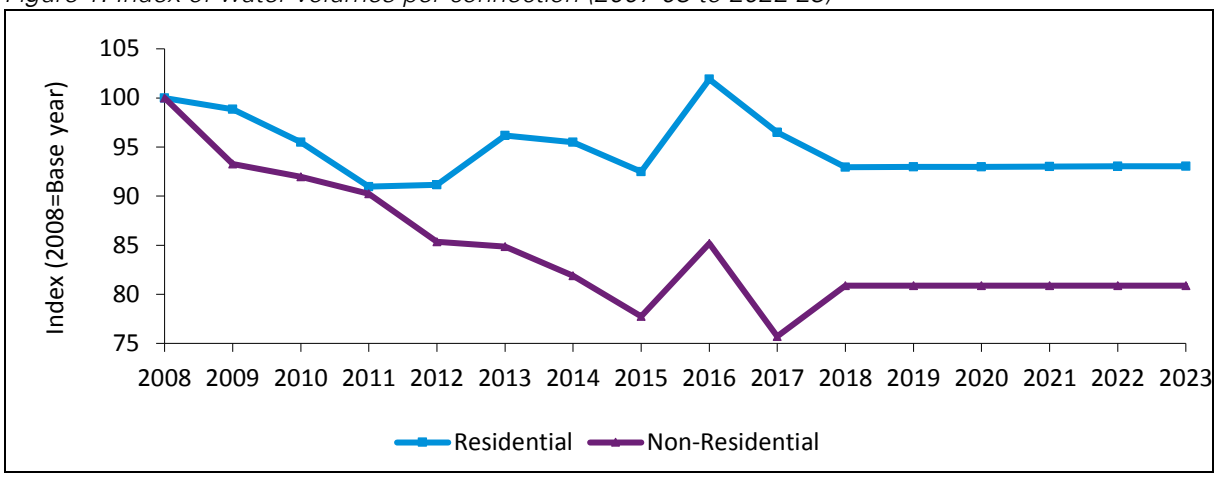
SGW's forecast residential and non-residential water and wastewater volume forecasts are based on average annual metered water sales as the starting point for its forecasts. It has on average provided some 4.6GL/yr. of potable water, of which 43% is used to supply residential and 53% is used to supply business customers.

SGW has adopted simple trend extrapolation based on ten year average for volume per connection extrapolated over the regulatory period based on ten year average growth in connections. Simple trend extrapolations are the most basic approach adopted in Victoria to the forecasting of water and sewerage volumes. This approach is widely adopted across regional water businesses and is accepted as a valid approach by industry standard. The approach involves identifying trends observable in historic usage data, and extrapolating these forward over the regulatory period based on growth in projected connections. This approach is considered to be logically valid.

While the approach is logically valid, the degree to which its application results in satisfactory outcomes will depend on the assumptions adopted by SGW. These assumptions are assessed in section 6 which compares historical trends with forecasts and section 6 which considers underlying assumptions, including per connection consumption. One particular assumption is that the long term historical average (10 year) per connection consumption is more appropriate than the short term average (5 year).

The following graph outlines the growth rates in SGW's per connection consumption over ten years of historical data using indexes with 2007-08 as the base year (=100). The graph clearly shows that 2015-16 is an outlier. It follows that adoption of short term averages may lead to relatively distorted outcomes. Under these circumstances long term averages would be more consistent with what would be considered to be a normative outcome.

Figure 1: Index of water volumes per connection (2007-08 to 2022-23)



We note that there is a PREMO requirement to consult with large customers. SGW has indicated that large customer growth is considered on a case by case basis. Major customer water consumption is forecast to increase by approximately 0.5% p.a. over the fourth regulatory period. It appears that feedback from consultation indicated that future demand will be reflective of historical demand.

SGW noted difficulty in forecasting for large customers:

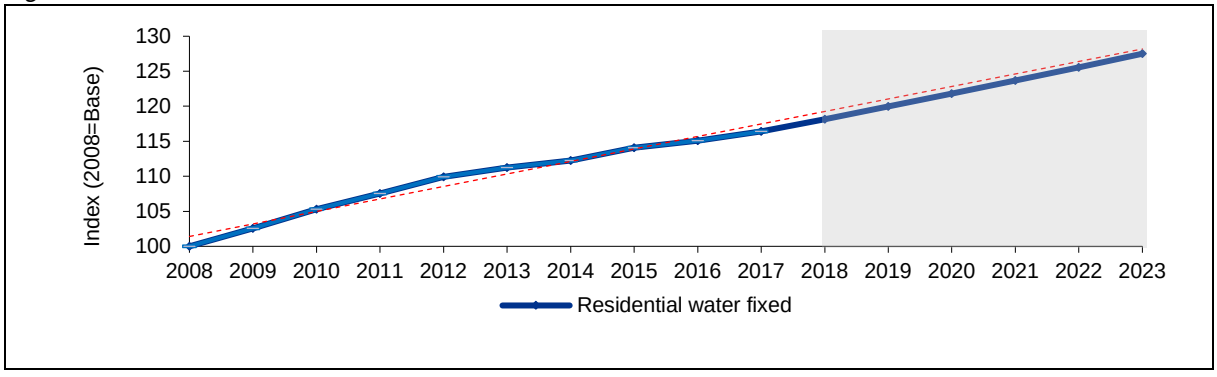
> *There are several major industrial demands in the South Gippsland Water supply area. Long term growth in major industrial demand is difficult to predict due to their short planning horizons, technological developments, commodity market fluctuations and their reluctance to be forthcoming due to commercial confidentiality. Recent announcements on structural change by Murray Goulburn poses further uncertainty regarding their future water consumption.* [3]

3.2.2 Residential connections

The Commission recommends the adoption of Victoria in Future (ViF) population and dwelling forecast as the basis for forecasts of residential connections. However, the Commission has also historically accepted alternative forecasts where the proposal could evidence a strong correlation with historical growth rates.

SGW has adopted a connection growth rate based on the ten year average annual growth rate for historical data, 1.52%. SGW did consider ViF but found its forecasts to be unrepresentative of historical rates.

Figure 2: Index of residential water connections (2007-08 to 2022-23)



3 SGW (2017) 2018/19 2022/23 Pricing submission p.19

The above figure shows that residential connections have experienced steady growth over the last ten years. A linear trend line with a high fit to the data (see R^2 value) is consistent with the ten year average being an appropriate basis for forecasting.

SGW considered the disaggregated Victoria in Future Small Areas (ViFSA) statistical data. The relevant VIFSAs are:

- Wonthaggi District,
- Korumburra District,
- Leongatha District,
- Promontory District, and
- Yarram District.

SGW noted that actual historical growth varies significantly from year to year having been well above long term averages in the second regulatory period and well under in the third. The proposed growth rate has been higher than the VIFSA rate in the period 2012 to 2016, but is lower than the VIFSA rate from 2017 to 2022.

In terms of wastewater SGW has proposed to utilise the same growth rates as those for water being the 10 year average growth rate of 1.52% p.a. KPMG notes that it is common in regional water businesses to assume that the connections rate the same or similar. The appropriateness of this assumptions depends on the observable degree of historical correlation between the two data series. In the case of SGW, section 3.2.1 clearly shows that residential wastewater connections have historically experienced growth in excess of water connections. For this reason KPMG recommends that SGW's approach for residential wastewater connections be amended such that annual growth reflects that observable over the ten year historical period for wastewater.

3.2.3 Non-residential connections

SGW has forecast 0.5% for non-residential water and 0.51% per annum growth rates for non-residential wastewater connections. SGW has utilised the historical ten year average growth rate (0.50% p.a.) for its Pricing Submission forecasts for non-residential connection growth. This rate has been used across the non-residential categories of Agreement, Concessional and all other Non-residential connections.

Simple trend extrapolations based on historical averages are an accepted approach to developing demand forecasts. The degree to which its application results in satisfactory outcomes will depend on the assumptions adopted by SGW. These assumptions are assessed in section 6 which compares historical trends with forecasts and section 6 which considers underlying assumptions.

3.2.4 Trade waste

SGW has forecasted trade waste numbers based on 2016-17 historical data extrapolated with no growth.

There is disparity between the numbers reported in the pricing submission and those submitted in the financial template. Under normal regulatory practice the numbers submitted in the financial template take precedent over any numbers reported in the pricing submission word document. The information template numbers exhibit a small incremental decrease in both connections and volume from 2016-17 to 2017-18 followed by forecasts of constant connections and volume with zero growth.

Based on these numbers, it appears SGW has taken the last year of actual data (2017-18) and assumed zero growth over the course of the regulatory period. This approach is often adopted by businesses

that experience stochastic demand. KPMG will assess the forecasts themselves against historical trends (see section 5) and any relevant underlying assumptions (see section 6).

The validity of this approach will largely depend on the how it relates to trends observable in the historical data. For example, if a growth trend is readily observable in historical data then the assumption of constant demand over the regulatory period is not appropriate. Section 3.15 makes this comparison and finds that in the short term there is a clearly identifiable growth trend in trade waste connections. On the basis of this finding KPMG are recommending that the forecast method be amended to reflect positive growth in the regulatory period. More detail is provided in Section 3.15. Major customers for trade waste are forecast based on historical data trends which is a valid approach.

3.2.5 Summary of findings

Table 6: Are SGW's forecasts based on appropriate forecasting methods?

Forecast	Suitability	Logically valid	Industry acceptance	Regulatory precedent
Residential Water Connections	Yes	Yes	Yes	Yes
Residential Water Volumes	Yes	Yes	Yes	Yes
Residential Wastewater Connections	No	Yes	Yes	Yes
Wastewater volume	Yes	Yes	Yes	Yes
Non-residential Water Connections	Yes	Yes	Yes	Yes
Non-residential Water Volumes	Yes	Yes	Yes	Yes
Non-residential Wastewater Connections	Yes	Yes	Yes	Yes
Trade west connections	No	Yes	Yes	Yes

Findings

Connections: Connections for all services (exception of trade waste) are based on historical ten year average growth rates extrapolated over the regulatory period. This simple approach is widely adopted in the Victorian regional water sector and has widespread acceptance by the industry. The approach, while relatively simple is logically valid and has been accepted before by the Commission in previous price reviews.

Volumes: A similar approach to connections has also been adopted for volume forecasts with residential volumes being forecast based on ten year historical averages and non-residential volumes being forecast based on five year historical averages. The approach, while relatively simple is logically valid and has been accepted before by the Commission in previous price reviews.

Trade waste: KPMG notes inconsistencies between the trade waste forecasts reported in the pricing submission and those populating the financial template. As per standard regulatory treatment KPMG has given primacy to the numbers contained in SGW template. Based on these numbers it appears SGW has taken the last year of actual data and assumed zero growth over the course of the regulatory period.

4. Are the calculations contained within the forecasting model arithmetically accurate and do they appropriately reflect the forecasting method?

In order to ascertain the mathematical integrity of the forecasts proposed by SGW, KPMG has sought to duplicate the forecast growth rates based on ten years of historical data provided by SGW. Where the averages were able to be duplicated by KPMG, and the forward forecasts were consistent with KPMG's calculations KPMG considered SGW's approach to be mathematically sound. The results of KPMG's analysis are listed in the following table.

Table 7: SGW's methods for forecasting demand

Forecast	Comments	Duplicated
Residential water volumes	KPMG was not able to replicate the forecasts based on the ten year average per connection consumption and the ten year average growth rate for connections.	No
Residential water connections	KPMG was not able to replicate the forecasts based on the ten year average growth rate for connections.	No
Residential wastewater volumes	KPMG was not able to replicate the forecasts based on the ten year average per connection consumption and the ten year average growth rate for connections.	No
Residential wastewater connections	KPMG was not able to replicate the forecasts based on the ten year average growth rate for connections.	No
Non-residential water volumes	KPMG was not able to replicate the forecasts based on the five year average per connection consumption and the ten year average growth rate for connections.	No
Non-residential water connections	KPMG was not able to replicate the forecasts based on the ten year average growth rate for connections.	No
Non-residential wastewater volumes	KPMG was not able to replicate the forecasts based on the five year average per connection consumption and the ten year average growth rate for connections.	No
Non-residential wastewater connections	KPMG was not able to replicate the forecasts based on the ten year average growth rate for connections.	No

Based on the historical data provided by SGW, KPMG was unable to replicate any of the average growth rates for connections or the averages for per connection consumption. The immediate conclusion drawn from this inability to reproduce SGW's forecasts, as outlined in its pricing proposal using the methods outlined in its pricing proposal, was that the forecasting models used by SGW were not arithmetically accurate and may be subject to systemic error.

Given KPMG's inability to replicate the forecasts, KPMG further investigated this issue with SGW. With the help of SGW, KPMG was able to identify discrepancies in the data provided and that used in the pricing submission. KPMG provided SGW with another opportunity to resubmit supporting data when it sought comment from SGW on a draft version of this report.

In response to our draft report SGW stated that it challenged the data set used by KPMG, although acknowledging that the data was provided by SGW. SGW believe the data may exclude vacant land connections.

SGW have challenged the data used for Residential and Non-residential connections growth and for Non-residential waste water connections. SGW took the opportunity to provide a definitive data set on 16 February. This data set allowed KPMG to successfully replicate SGW's projected growth rate for residential customers and average per connection consumption for residential customers.

However, we note that the SGW approach has utilised two separate sources of data — annual data collected in April for connections and annual data collected in June. We note that there are material differences between the two sets of data. The June to June data is that which SGW reports to the ESC.

KPMG believe that best practice would suggest that where possible the data should be internally consistent and generated by a common source. Given that the June to June data is that reported to the ESC and that KPMG does not have volume data collected on an April to April basis we recommend that the forecasts be amended to reflect the June to June data as provided by SGW. While KPMG notes that the differences may be contained to less than a percentage point, these amendments will effect most of SGW's forecasts.

Recalculation of SGW's forecast parameters based on KPMG's data set are out lined below:

- 10 year average residential water connections 1.63%
- 10 year average non-residential water connections 0.75%
- 10 year average residential water use per connection 121 kL per connection
- 5 year average non-residential water use per connection 311 kL per connection
- 10 year average residential wastewater connections 2.19%
- 10 year average non-residential water connections -0.30%.

4.1.1 Summary of findings

Findings

Based on the 10 years of historical data provided by SGW, KPMG was not able to duplicate the proposed forecast using the methods outlined by SGW in its pricing submission. On this basis KPMG believes that potentially there are either systemic mathematical issues imbedded in SGW's proposal that need to be addressed or alternatively that there are multiple and varying sets of data being utilised to generate forecasts.

In response to our draft findings SGW resubmitted a definitive data set which enabled KPMG to reproduce SGW's projected growth rate for residential water connections and per connection consumption. However we noted that SGW was utilising data different sets of data that were inconsistent.

KPMG recommends that the forecasts be reset consistent with the method outlined in the pricing submission and utilising the June to June corrective data provided by SGW.

5. Are SGW's forecasts consistent with historical trends?

5.1 Historical trends and forecasts

In this section, KPMG assesses the scale and causes of any variances between the proposed forecasts and trends based on historical data. The analysis involves identifying trends in consumption based on historical data. Forecasts are then compared to historical trends to enable the identification of instances where SGW is forecasting step changes in consumption or material deviations from historical trends.

KPMG has used simple indexes to undertake historical comparisons, these indexes use either 2007-08 or 2008-09 as the base year (=100). Indexes are often used in assessing forecasts as they allow us to directly observe growth rates over the period and identify changes in the drivers of demand that should be accompanied by or explained by the assumptions underlying the forecasts. In each graph the regulatory period is shaded grey.

In a number of the graphs KPMG has included linear trend lines based on the historical data. These trend lines are indicative only and must be treated with caution as their associated R^2 values are typically less than 0.85. This indicates that the trend line has a relatively weak fit to the historical data. The trend lines are red dashed lines.

In addition to comparisons based on indexed growth KPMG also compares the annual compounding growth rate over the regulatory period with both the short run (5 year) and long run (10 year) historical rates.

5.1.1 Residential water and wastewater volumes

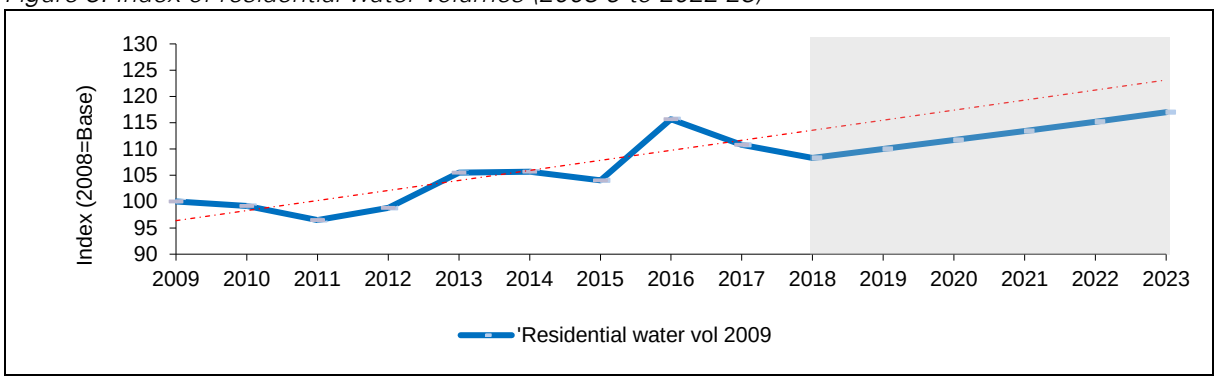
SGW's forecasts and historical data are used to generate an index series for each of the residential volumetric forecasts for water and wastewater. The indexes were constructed with 2008-09 as the base year, and each subsequent year illustrates the level of growth compared to 2008-09. The index does not extend back to 2007-08, as with other services, on the basis that the wastewater volume series begins in 2008-09.

The index evidences a fairly linear growth pattern for SGW's aggregate residential volumes with the exception of 2012-13 and 2015-16 which appears to be a year of higher than average growth. This observable pattern is consistent with the contention that 2015-16 was an exceptionally hot year that generated exceptionally high levels of demand.

Figure 1 also includes a linear trend line (red dashed line). Based on this trend line the forecasts over the regulatory period appear to be on the low side. These results must be treated with a degree of caution as the R^2 value associated with the trend line is low. This result is consistent with KPMG's findings from the review of the mathematical integrity of SGW's modelling. Based on KPMG's historical data KPMG would expect to see the regulator period forecasts as being lower than historical trend. KPMG expects that this will be corrected with the resetting of the forecasts to reflect the historical data that is outlined in section 2.

The low forward projections also reflect the application of price elasticity of demand which is discussed in section 6.2.

Figure 3: Index of residential water volumes (2008-9 to 2022-23)



Comparisons of the average annual growth rates for the long term historical period from 2008-09 to 2015-16 to five years of actual data preceding the regulatory forecasts (2011-12 to 2015-16) to the forecasts over the regulatory period (2018-19 to 2022-23) are set out in the table below. These growth rates illustrate the sensitivity of the projected growth rates to changes in timeframe. The differences between the series is primarily driven by the relative impact of the above average growth experienced in 2015-16 on the short term historic growth rate. As KPMG would expect given the method adopted for forecasting the forecast growth rate is more consistent with the long term historical rate.

While demand has moved year on year in the historical data, figure one does indicate that the period from 2008-09 to 2014-15 was relatively steady compared to 2014-15 to 2016-17. This would indicate that the adoption of long term averages is preferable to the adoption of a short term average approach for water, given that the short term is relatively volatile and includes a spike in demand in 2015-16. The long term average under these circumstances is more consistent with an assumption of normal weather patterns and steady population growth.

Table 8: Residential water historic growth

Forecast	Annual average change % ACTUAL (2008-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Residential water volumes	1.29%	2.32%	1.55%

A common expectation is that residential water and residential wastewater volumes are correlated. While SGW's wastewater volumes are not directly comparable to residential water volumes, as they also include non-residential wastewater volumes, KPMG would expect to see a higher level of correlation between the two series than is evident in the following graph. The historical data clearly shows the two series are un-correlated.

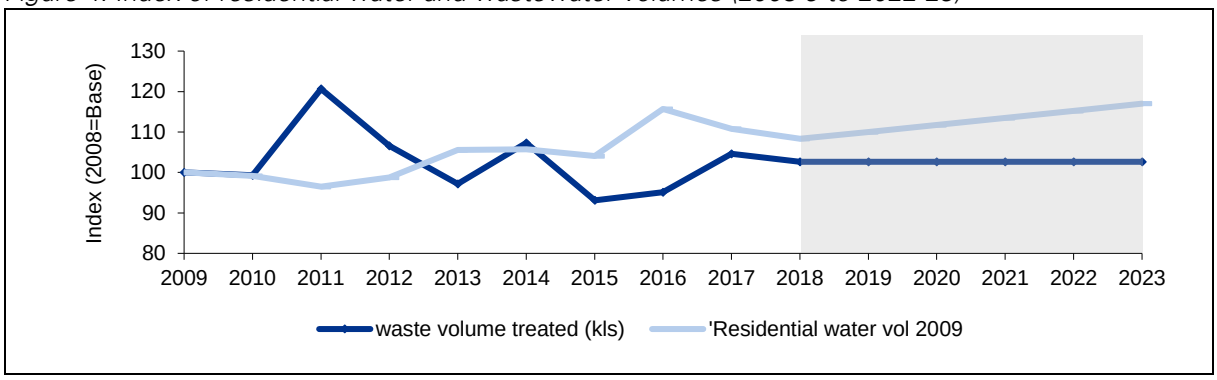
Comparisons between non-residential water volumes and wastewater are undertaken in section 5.13.

SGW was queried on this apparent lack of correlation and responded:

> *Many of SGW's towns are serviced with both water and wastewater and theoretically a new connection will require both services. However, there are a number of smaller areas that are provided only water or only wastewater, for example Dumbalk only has water, while Waratah Bay only has wastewater.*

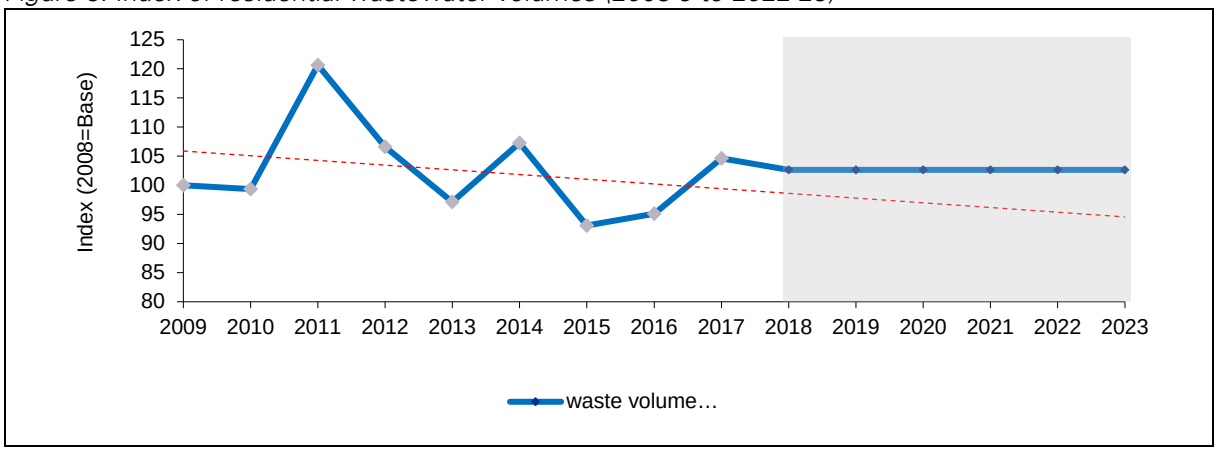
Therefore, there can be a lack of symmetry between water and wastewater connections. This is exacerbated when new sewer systems are implemented, which has happened in the last ten years in Poowong, Loch, Nyora and Meeniyan.

Figure 4: Index of residential water and wastewater volumes (2008-9 to 2022-23)



Growth in wastewater volumes are outlined in the following figure. The figure also includes a linear trend line. As with water this line must be treated with caution given the associated R^2 values. Based on the graph it appears that SGW are forecasting greater wastewater volumes than would be implied by historical trends.

Figure 5: Index of residential wastewater volumes (2008-9 to 2022-23)



We note that forecast growth for wastewater is lower than that of water. This is consistent with a forecast relative decline in non-residential wastewater growth rates. KPMG also notes that SGW is forecasting no growth in wastewater which represents a positive change from the short term observable growth rate which is negative. This would indicate that SGW is assuming a degree of risk going forward with wastewater volumes.

Table 9: Wastewater historic growth

Forecast	Annual average change % ACTUAL (2008-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Wastewater volumes		-0.37%	0%

Findings

We note that forecast growth in water volumes is lower than long term trends. This is consistent with KPMG's expectations and reflects potential differences in the historical data and the impact of price elasticity of demand on consumer behaviour. These aspects of the forecasts are covered in sections 3 and 4 respectively.

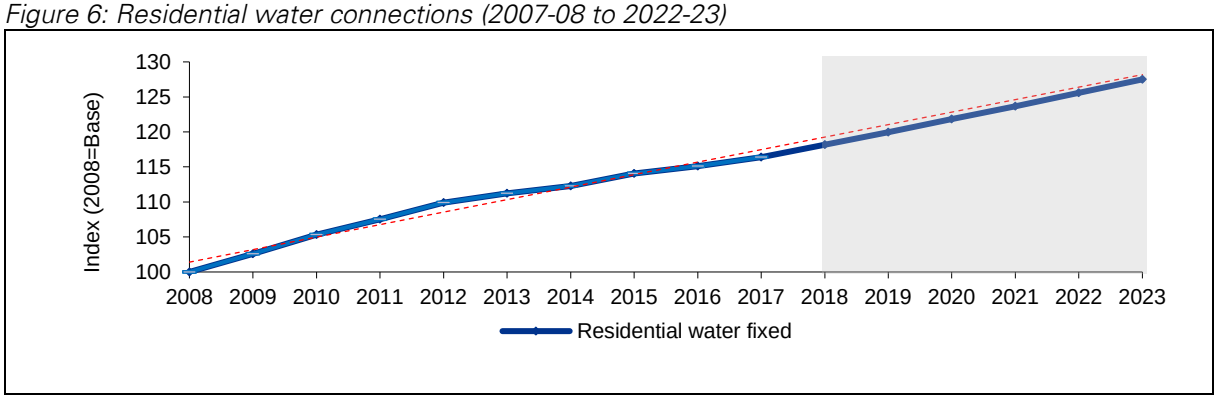
We note that wastewater volumes are higher than would be expected based on historical trend. KPMG also notes that SGW has made an explicit decision to forecast above historical trend on the basis that it is assuming demand side risk on behalf of its customer base. Under the new PREMO framework businesses are actively encouraged by the Commission to assume risk, consequently KPMG has not recommended amending SGW's wastewater volume forecast.

5.1.2 Residential connections

Indexes were constructed with 2007-08 as the base year, and each subsequent year illustrates the level of growth compared to 2007-08. The index evidences a fairly linear growth pattern for SGW's residential connections with the exception of 2011-12 with a slight growth and 2015-16 which appears to be slightly lower than average growth.

In this instance the trend line has a strong R^2 value of 0.97. The trend line indicates that the forecast connections are slightly lower than historical numbers would suggest. This is consistent with KPMG's expectations given the data issues outlined in section 3 KPMG would expect this small under-forecast to be corrected once the forecasts are reset to reflect the historical averages.

Figure 6: Residential water connections (2007-08 to 2022-23)



Comparisons of the average annual growth rates for the long term historical period from 2007-08 to 2015-16 to five years of actual data preceding the regulatory forecasts (2011-12 to 2015-16) to the forecasts over the regulatory period (2018-19 to 2022-23) are set out in the table below. These growth rates illustrate the sensitivity of the projected growth rates to changes in timeframe. For water connections the forecast growth rate is lower than the long run historical but higher than the short run historical growth rates.

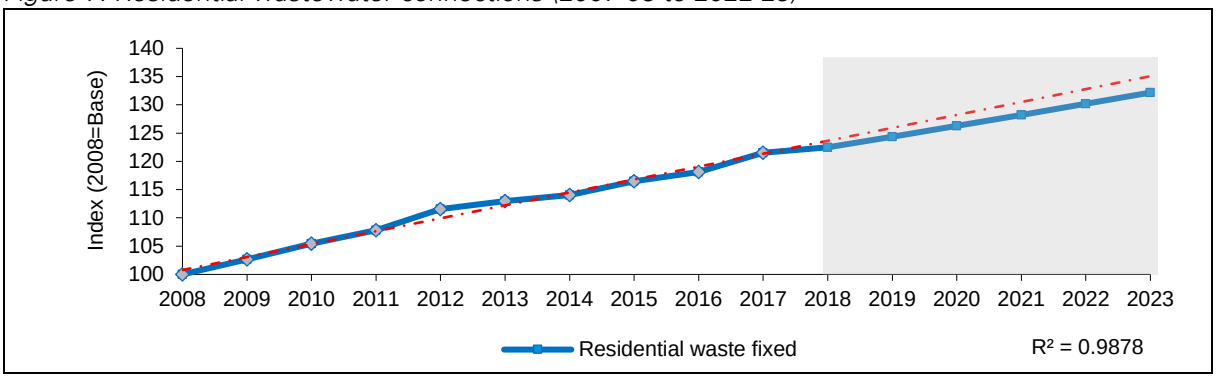
Table 10: Residential water connections - historic growth and forecast growth

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Residential water connections	1.70%	1.15%	1.53%

The residential wastewater connections index is very similar to that of water and evidences a fairly linear growth pattern for SGW's residential connections with the exception of 2011-12 with a slight growth and 2015-16 which appears to be slightly lower than average growth.

In this instance the trend line has a strong R^2 value of 0.99. As with water the trend line indicates that the forecast connections are slightly lower than historical numbers would suggest. This is consistent with KPMG's expectations given the data issues outlined in section 3. KPMG would expect this small under-forecast to be corrected once the forecasts are reset to reflect the historical averages.

Figure 7: Residential wastewater connections (2007-08 to 2022-23)



For wastewater the forecast growth rate is lower than both the long run historical and short run historical growth rates. SGW has not provided a justification for a decline in the growth rate for residential wastewater connections over the forecast period.

Table 11: Residential wastewater connections - historic growth and forecast growth

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Residential wastewater connections	2.19%	1.72%	1.53%

In our draft report we initially found that the approach to forecasting adopted by SGW is an almost exclusive reliance on the adoption of historical trend extrapolation, it would be more internally consistent to align the residential wastewater connections forecasts with observable historical trend. Subsequently KPMG recommended that projected growth rates for connections for residential wastewater be amended to reflect the long term average per annum growth rate.

In response to our draft report SGW indicated that it would be inappropriate to utilise historical growth rates for residential wastewater connections as they would reflect the recently completed small town sewer schemes for Meeniyan, Alberton, Poowong, Loch and Nyora. While, SGW did not provide any quantification of the impact of small town schemes on historical growth rates, KPMG accepts that it is logical that they would have some positive impact.

In light of SGW's response KPMG recommends that the forecasts be amended to reflect forecasted growth rates for residential water connections (consistent with the approach adopted by SGW in its proposal).

Findings

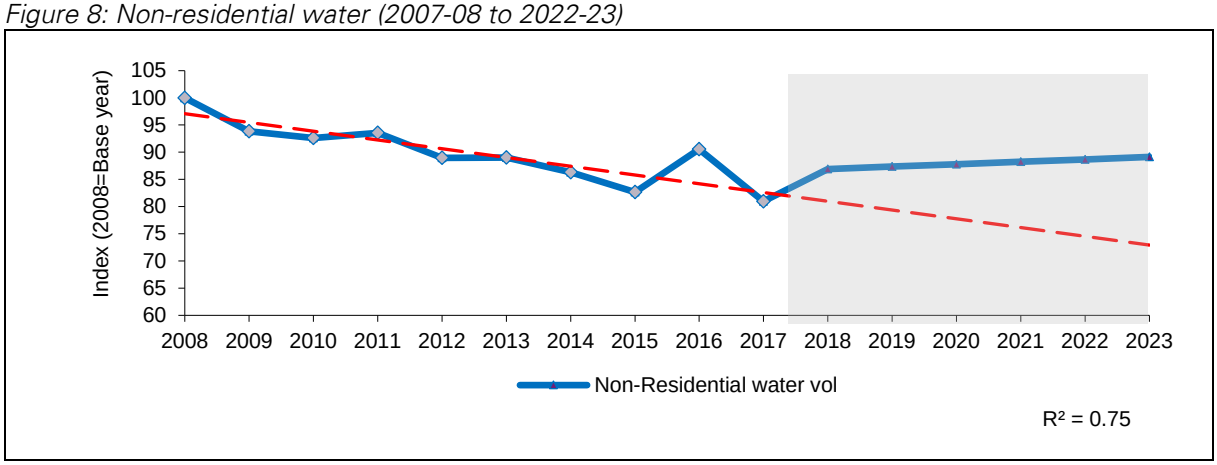
KPMG recommends that residential wastewater forecasts be amended to reflect forecasted growth rates for residential water connections (consistent with the approach adopted by SGW in its proposal).

5.1.3 Non-residential water and wastewater volumes

As with residential water and wastewater, SGW's forecasts and historical data are used to generate an index series for each of the non-residential volumetric forecasts for water and wastewater. The indexes were constructed with 2007-08 as the base year, and each subsequent year illustrates the level of growth compared to 2007-08.

The historical data charted in the following figure exhibits a strong decline in volume between 2007-08 and 2016-17, with a spike increase in 2015-16. Forecasts from 20017-18 onwards exhibit a slight increase overtime. Forecasts relative to the historic trend line show that SGW is forecasting significantly above trend. Although this observation must be treated with caution as the R^2 value indicates the trend line has a weak fit to the historical data.

Figure 8: Non-residential water (2007-08 to 2022-23)



Comparisons of compounding annual growth rates in the following table show SGW forecasting at annual growth rates, that while small, are in excess of those observed in either the long run historical data or the short run historical data. While this approach may not be consistent with the extrapolation of historical trends over the regulatory period, it is consistent with the requirement under the PREMO framework for businesses to assume risk (where appropriate) to benefit customers.

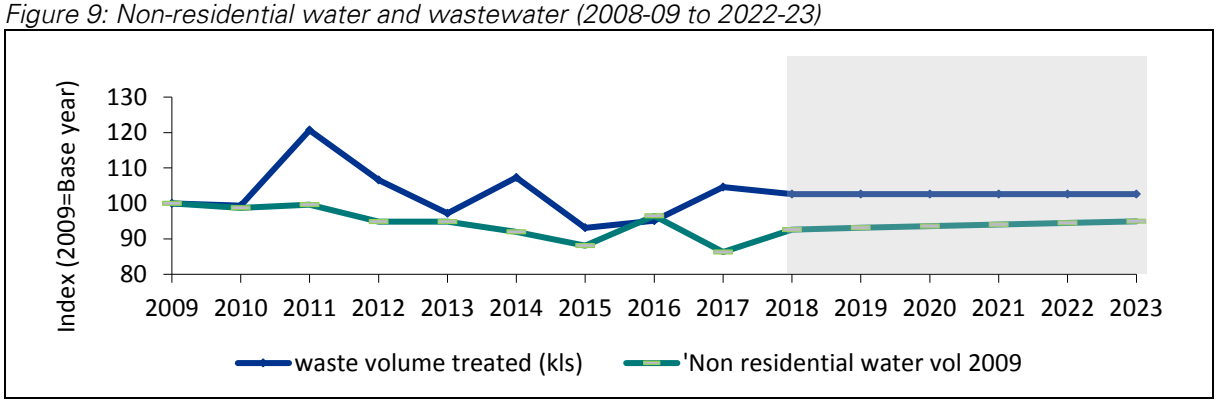
We note that water volumes are lower than would be expected based on historical trend. KPMG also notes that SGW has made an explicit decision to forecast above historical trend on the basis that it is assuming demand side risk on behalf of its customer base. Under the new PREMO framework businesses are actively encouraged by the Commission to assume risk, consequently KPMG has not recommended amending SGW's non-residential water volume forecast.

Table 12: Non-residential water historic growth and forecast growth

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Non-residential water volumes	-2.32%	-1.87%	0.5%

As with residential volumes, comparisons between wastewater and water need to be qualified by acknowledging the inclusion of residential waste in the wastewater data series. It is worth noting that neither residential nor non-residential water use appears to be the driver behind the large increases in historical wastewater. SGW has indicated that these increase are due to rain water incursion events and the role out or not of sewerage services to small communities. It is worth noting that there appears to be little to no correlation between non-residential water and wastewater volume evident in the graph for the historical data.

Figure 9: Non-residential water and wastewater (2008-09 to 2022-23)



Findings

We note that SGW is forecasting growth rates for non-residential volumes higher than those observed either in the long run historical data or the short run historical data. This would imply the SGW is assuming a degree of risk in relation to its non-residential forecasts that is consistent with the new PREMO framework being implemented by the Commission.

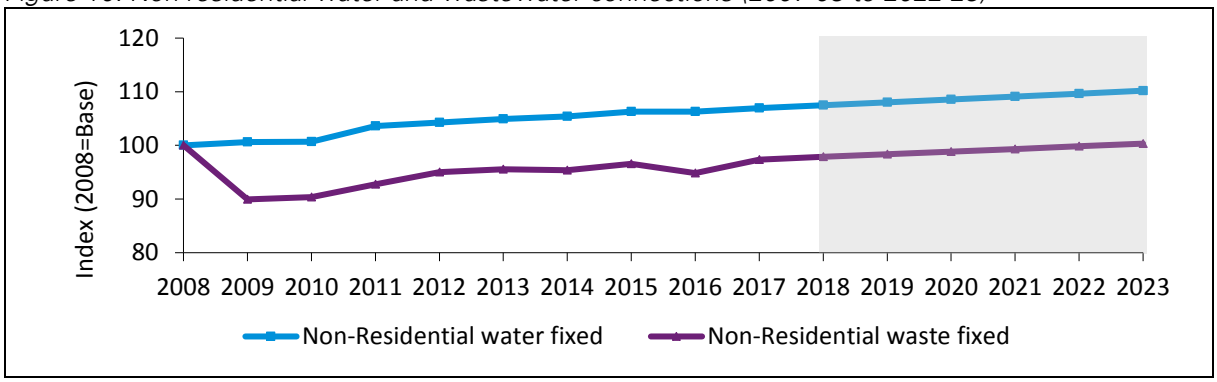
5.1.4 Non-residential connections

Indexes were constructed with 2007-08 as the base year, and each subsequent year illustrates the level of growth compared to 2007-08. Non-residential water connections appear to be growing at a fairly constant rate over time and over the forecasts. Non-residential connections for wastewater also exhibit fairly consistent growth with the exception of 2009-10 which show a sharp decline in the historic growth

of wastewater connections. While unexplained by SGW's pricing proposal, KPMG does not believe this decline in actual connections growth is of material concern for the forecasts as the subsequent growth in actual historic data is fairly consistent over time.

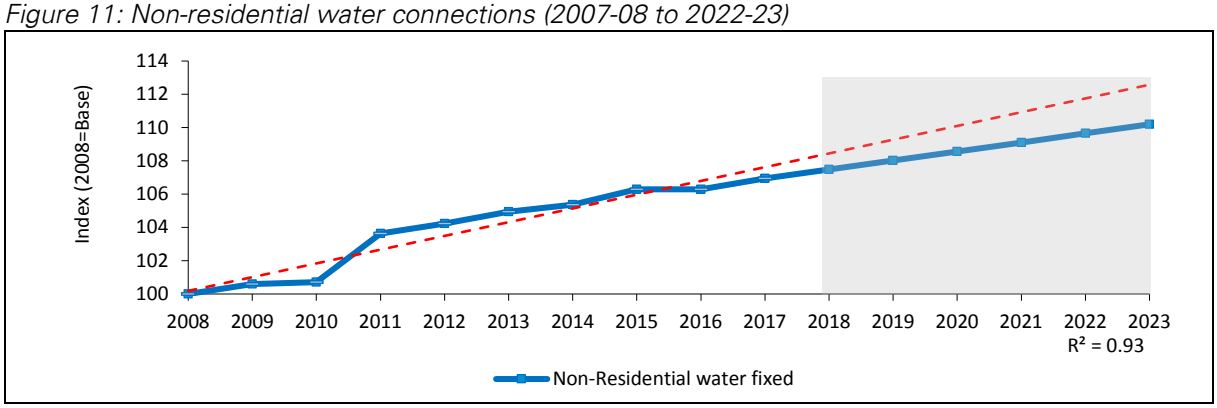
Our expectation is that both series should be correlated, and this is evident in the graph from 2008-09 onwards.

Figure 10: Non-residential water and wastewater connections (2007-08 to 2022-23)



The following figure outlines growth in non-residential water connections. The trend line exhibits a good fit with the historical data. The graph shows SGW is forecasting growth rates lower than those evident in the historical data. This is consistent with KPMG's expectations and will be addressed through the resetting forecasts as recommended in section 2.

Figure 11: Non-residential water connections (2007-08 to 2022-23)

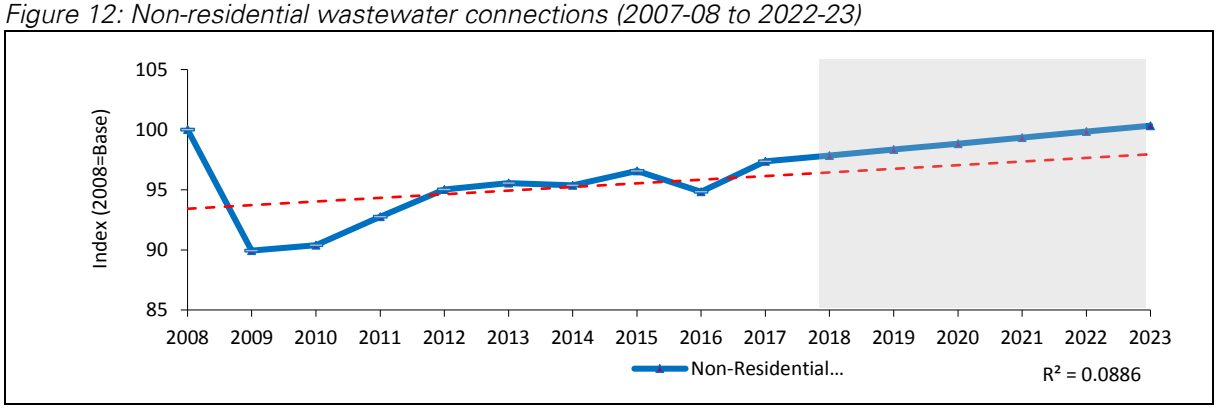


Historical growth rates for non-residential customers for both water are broadly consistent with those forecast for the regulatory period. The differences between the growth rates are not material enough to raise concerns for the price review.

Table 13: Nonresidential water connections historic growth and forecast growth

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Non- residential water connections	0.75%	0.52%	0.50%

Figure 12: Non-residential wastewater connections (2007-08 to 2022-23)



Short run historical growth rates for non-residential customers for wastewater are broadly consistent with those forecast for the regulatory period. Long run growth rates are lower than those forecast. Given the PREMO framework incentivises businesses to assume greater amounts of risk on behalf of their customers, KPMG is not recommending forecasts be amended downwards towards historical trends.

Table 14: Nonresidential wastewater connections historic growth and forecast growth

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Non-residential wastewater connections	-0.30%	0.47%	0.50%

Findings

Growth rates in non-residential connections for both water and wastewater are broadly consistent with those observable both over the long term historical period and over the short term historical period.

5.1.5 Trade waste

Trade waste volumes and loads are often viewed as one of the most difficult or problematic areas for forecasting. Water businesses adopt a number of methods to forecast trade waste ranging from flat line extrapolations using the latest year of available data for actual volumes and loads through to more sophisticated approaches that seek to derive volumes and loads based on correlations between trade waste and water consumption. SGW has adopted a flat line extrapolation based on 2017-18.

Table 15: Trade waste forecasts

Tariff	2016-17	2017-18	Annual average change % FORECAST 2018-23
Access Fee			
Minor TW Cat 1	274.0	264.0	0.0% (flat)
Minor TW Cat 2	16.0	16.0	0.0% (flat)
Minor TW Cat 3	28.0	28.0	0.0% (flat)
Major Customer			
Burra Foods TW	1.0	1.0	0.0% (flat)
Murray Goulburn TW	1.0	1.0	0.0% (flat)
Other Majors TW	1.0	1.0	0.0% (flat)
Volume Usage Fee (excl Majors)	65,000.0	64,231.5	0.0% (flat)

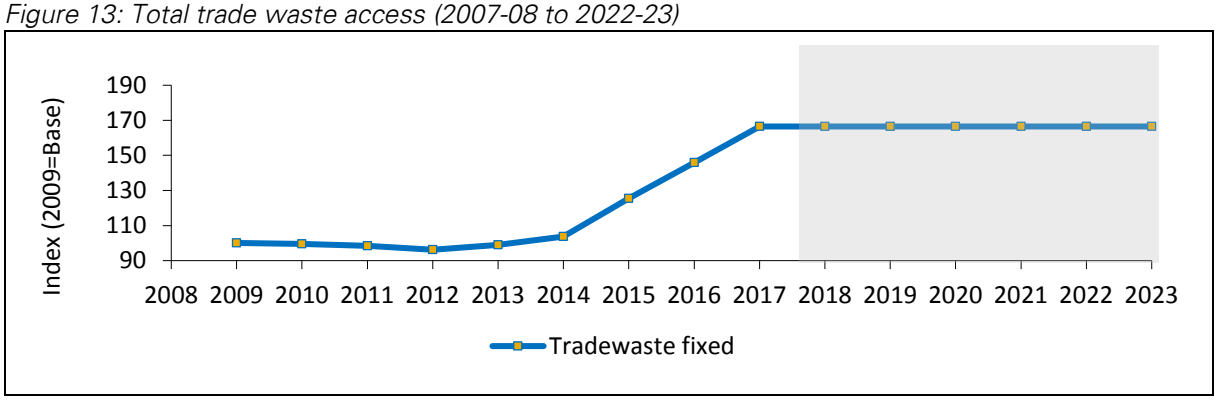
The forecasting approach while simplistic is one that has been accepted by industry standard and is common in regional water businesses and has been accepted by the Commission in previous price reviews. However, its appropriateness does depend on how the non-growth assumption compares with historical data.

SGW provided historical data for connections (see graph below). This data evidences fairy strong growth from 2014-15 to 2016-17. Given the strength of this growth it would be more appropriate for SGW to assume a positive level of growth over the course of the regulatory period. This growth occurs exclusively in Minor TW Cat 1. Based on recent growth KPMG believes it would be appropriate to apply a growth rate to Minor TW Cat 1 over the course of the regulatory period. The long run historical average is 6.58% per annum. Given that trade waste growth appears to be concentrated over the course of the last three years KPMG is hesitant of imposing a growth rate of such magnitude. The sudden increase in trade waste has not been explained by SGW in its pricing proposal or in any of KPMG's correspondence or in response to the draft version of this report.

In response to KPMG's draft report SGW noted that it is proposing to apply a revenue cap form of price control to trade waste services over the course of the regulatory period. KPMG notes that in the event that a revenue cap is applied to trade waste services, SGW will be capable of adjusting forecasts and their associated prices during the course of the regulatory period and that this ability will not be impacted on by our recommendation. Given that KPMG will not know or have any indication of the Commission's regulatory decision in regard to the price control mechanism till its draft decision, KPMG has erred on the side of caution and recommends that the growth rate for non-residential customers over the preceding five years (0.47%) be adopted as proxy for trade waste customers.

KPMG also notes that SGW do not believe that the proxy KPMG has adopted is appropriate, as it includes recent completions of small town sewer schemes. However, KPMG's concerns regarding the use of relatively high short term historical growth rates remains and while residential growth rates may not be a perfect proxy KPMG believes that in the absence of SGW providing an alternative, it is a more prudent approach.

Figure 13: Total trade waste access (2007-08 to 2022-23)



Findings

Based on the trade waste data provided in the financial template, most charging parameters appear to be in a steady state with the exception of minor trade waste category 1. For this category historic volumes exhibit strong growth over the short term.

In order to be consistent with recent trends KPMG recommends that TW Minor Cat 1 customers be forecast using the non-residential waste connections growth rate as a proxy.

5.2 Summary of findings

Table 16: Are SGW's forecasts consistent with historical trends?

Forecast	Comparable growth rates	Step changes	Alignment
Residential Water Connections	Yes	Yes	Yes
Residential Water Volumes	No	Yes	Yes
Residential Wastewater Connections	No	Yes	Yes
Wastewater volume	No	Yes	No
Non-residential Water Connections	Yes	Yes	Yes
Non-residential Water Volumes	No	Yes	Yes
Non-residential Wastewater Connections	Yes	Yes	Yes
Trade west connections	No	Yes	No

6. Are the key assumptions and forecasting methods reasonably based and justified?

There are a number of key drivers of demand that SGW will have had to have made assumptions about that will materially influence its forecast. These assumptions need to be logically valid and ideally defendable based on third party evidence. In undertaking KPMG's review of SGW's forecasts, KPMG has identified and considered each of the main assumptions driving its forecasts.

6.1 Population growth

Assumptions regarding population growth are pertinent to the forecasting of connections. Rather than base its forecasts on population or household projects from a third part such as the ABS or ViF, SGW has based its connections forecasts on historical connections data. The use of historical data is accepted by the Commission as a valid approach, and it should be noted that such an approach avoids any error that may be associated in deriving connections from population or housing forecasts that may arise due to demographics (for example, using population growth requires assumptions to be made about residents per connection) or simple billing practices (for example, household statistics may vary from connections based on differences in the definition of what constitutes a household compared to what the water business considers to be a separate connection for the purposes of billing).

KPMG believes this is a valid approach and one which when executed correctly can avoid potential errors associated with reconciling connections forecasts to population or household data.

The assumptions regarding connections growth have been discussed in section 4 for each of the forecasts. KPMG has in general found the forecasts to be consistent with historical trends.

6.2 Price elasticity and tariff structures

SGW has applied price elasticity to its residential volumetric forecasts.

> *Due to the significant real price increases proposed by South Gippsland Water, these have been adjusted for price elasticity. Non-residential average consumption patterns of the last five (rather than ten) years are forecast to continue. This is due to a declining trend apparent over the 10 year period. These have not been adjusted for price elasticity. The Corporation* [SGW] *has decided to take on the risk that average demand from non-residential customers will decline due to price increases.*

SGW forecast residential water consumption is estimated using the ten year average (calculated by SGW as 121 kL) adjusted downward to 117 kLs, due to the impact of price elasticity. The residential price per kL of water is proposed to increase in accordance with all tariffs (by 8% in year one of the regulatory period. This increase is compounded by a further increase of 7.5% aimed at increasing the volumetric component of their bill. In total the volumetric residential water tariff is proposed to increase by 15.5% in year one of the regulatory period.

The following table (provided by SGW) shows the percentage reduction to demand that has been applied by SGW based on a Sydney Water study undertaken by Sarafidis (2011). SGW interpreted Sydney Water's study as finding that the long term price elasticity impacts ranged from -0.06 to -0.18. SGW applied the report as follows: at a price of $2.00 per kl, that is, a 10% increase in price could

reduce demand by around 1.8% in the long term (two years), immediate impact would be a reduction of 0.3%.

Table 17: SGW's propose elasticity

	Year 1	Year 2	Year 3	Year 4	Year 5
10-year average Residential consumption (per connection)	121.3	121.0	121.0	121.0	121.0
Volumetric price increase	7.5%	0%	0%	0%	0%
Real price increase	8.0%	3.5%	3.5%	3.5%	3.5%
% reduction to demand	0.47%	1.98%	1.98%	1.98%	1.98%
Revised average	120.76	120.20	117.82	115.49	113.20
5 year average	117.50				

Source: SGW information responses

Note: The calculation of the second revised average is not consistent with the method outlined. By KPMG's calculations the revised average for the second year should be 118.37.

0.47% reduction to demand in Year 1 is calculated as follows:

*((7.5%+8%)/10%)*0.3%*

1.98% reduction to demand in Years 2-5 is calculated as follows:

*((7.5%+3.5%)/10%)*1.8%*

The 5-year average of 117.5 kLs has been derived by adjusting each year's average consumption by the % reduction to demand calculation above.

There are a number of discrepancies between the data provided to the Commission in the financial template and the numbers quoted by SGW in both its pricing proposal and in responses to KPMG's own requests for additional information. KPMG notes that based on the prices outlined in the template the proposed increases are as outlined in the following table. The initial increase is 18.77% not 15.5%.

Table 18: SGW's propose price increase, annual increases %

	Year 1	Year 2	Year 3	Year 4	Year 5
Water volume tariff	18.77%	3.5%	3.5%	3.5%	3.5%

Source: ESC price review template

The following table outlines the elasticity findings contained within the Sarafidis study. Given the initial price is $1.79 SGW has correctly assumed that the appropriate elasticity measures are those associated Sydney Water's long run marginal cost. However, KPMG notes that SGW has underestimated the immediate elasticity impact as -0.03 rather than the -0.09 stated in the paper.

Table 19: Weighted average real price elasticities, all residential households, ($2009-10)

	Short run marginal cost	Pre October 2005	Long run marginal cost
Prices	**$0.70 per kL**	**$1.20 per kL**	**$2.00 per kL**
Immediate impact	-0.03	-0.05	-0.09
Long term impact	-0.06	-0.11	-0.18

Source: Sarafidis (2011) The residential price elasticity of demand p41

SGW has proposed significant price rises over the course of the regulatory period and has rightly sought to reflect price elasticity of demand in its demand forecasts. Rather than calculate their own elasticities they have adopted those from a 2011 study undertaken by Sydney Water and Sarafidis. The Sarafidis paper is widely considered to be the preeminent water elasticity study undertaken in Australia. While SGW has chosen a well-respected study to use as a proxy for their own elasticity, it has made a number of errors in its application.

- The elasticity appears to have been applied in 2017-18 one year prior to the associated price rise. The initial price rise is 18.77% not the 15.5% stated in the pricing proposal. Price rises subsequent to the initial rise are consistent with the proposal.
- SGW has applied a long run elasticity estimate to the first year of the regulatory period, where a short run estimate would be more appropriate.
- SGW has adopted an inappropriate short run elasticity estimate that is associated with a much lower price. The most appropriate Sarafidis estimate would have been that associated with Sydney Water's long run marginal cost of $2.00.
- There appears to have been some issues associated with the calculation of demand decreases given the compounding nature of the price rises.
- Rather than adopt per connection consumption numbers that reflect the timing of the price increases, SGW took an average over the five years. Taking an average will distort the associated revenue number as the extrapolation for volumes forecast is based on positive growth in connections. It would be more appropriate to reflect the year on year impact of elasticity in the forecasts.

Once these issues have been addressed the resulting per connection consumption statistics will be consistent with those outlined in the following table.

Table 20: SGW's impact of amended elasticity

	Year 1	Year 2	Year 3	Year 4	Year 5
Proposed price increse	18.77%	3.5%	3.5%	3.5%	3.5%
Total price elastcity impact	-1.65%	-0.31%	-0.31%	-0.31%	-0.31%
Residential water user per connection	119.3	118.9	118.5	118.1	117.8

KPMG has recommended that SGW's application of price elasticity of demand be amended to reflect a correct application of the Sarafidis elasticity estimates and all of the above dot points.

Finding

We recommend that elasticity be recalculated to reference the correct elasticity rates and to be applied in an appropriate manner.

6.3 Average consumption

SGW has stated that it has invested in demand management over the last 15 years that have resulted in a notable decline in per connection usage levels.

> *South Gippsland Water, like the wider Victorian water industry, undertook measures in order to reduce per capita demand over time. This has included targeting all major aspects of water use with an emphasis on education and behavioural change. Customer rebate schemes for water conservation products have operated widely and with good impact. Outdoor water use has been targeted through the introduction of permanent water saving measures. As a result, average water consumption patterns have steadily declined over the last 15 years. Since 2002/03 average residential and non-residential water consumption has reduced by around 30%. The residential average consumption patterns of the last 10 years are forecast to continue.*

Average residential consumption per connection and average non-residential consumption per connection are forecast to decrease significantly at the beginning of the regulatory period and then remain constant over the course of the regulatory period. The long-term trends are reported in the table and graph below. Average non-residential consumption is forecast to increase in the first year of the regulatory period and then remains constant over the remainder of the regulatory period.

Table 21: SGW's average consumption

	Historical data						Forecasts				
Customer type	**2012-13**	**13-14**	**14-15**	**15-16**	**16-17**	**17-18**	**18-19**	**19-20**	**20-21**	**21-22**	**22-23**
Residential	122	121	117	129	122	118	118	118	118	118	118
Non-residential	325	314	298	327	290	310	310	310	310	310	310

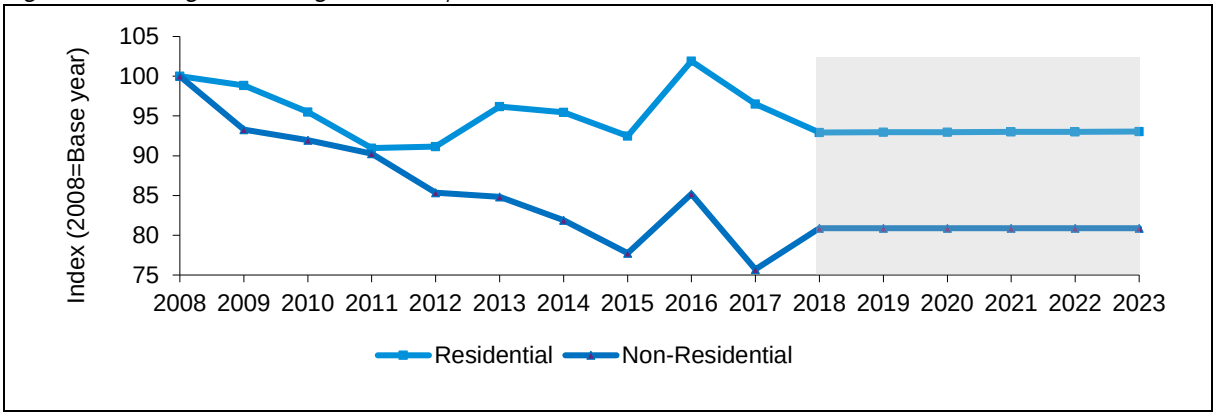
Average annual growth rates for residential water based on the ten year historical data set provided by SGW are consistent with the contention that there has been decline in per connection consumption over the long term. However, the short term average exhibits a positive growth trend. This positive trend appears to be driven largely by a large spike in consumption levels in 2015-16. KPMG recognise the appropriateness of long term average as the basis for forecasting as it will provide forecasts that are closer to what would be considered normative years.

We note that SGW appears to assuming the risk associated with further declines in non-residential water consumption over the course of the regulatory period by proposing flat consumption levels.

Table 22: Per connection consumption growth rates

Forecast	Annual average change % ACTUAL (2007-2017)	Annual average change % ACTUAL (2012-17)	Annual average change % FORECAST (2012-17)
Residential water connections	-0.39%	0.09%	0 %
Non-residential water connections	-3.04%	-2.81%	0 %

Figure 14: change in average consumption over time (2007-08 to 2022-23)



The changes in per connection residential consumption evidenced by the historical data provided by SGW are not consistent with contention that SGW has experienced material declines in consumption over time. KPMG has also compared SGW's proposal against over comparable water businesses operating in the immediate surrounding area. Figure 14 provides direct comparisons with Gippsland Water (CGW). As is evidenced in the table the two water businesses report broadly similar per connection consumption for non-residential customers, however very different levels of consumption for residential customers.

We note that the differences between SGW and CGW residential customers are apparent in the historical data and that the differences in the forecasts are therefore consistent with historical trends relating to actual consumption per connection.

We note that residential consumption over the course of the regulatory period will also be impacted by the price elasticity of demand assumptions adopted by SGW (see section 6.2). In the absence of elasticity the per connection consumption levels would be set at 121kL. Notwithstanding price elasticity of demand, there does not appear to be any broad issues associated with the per-connection consumption levels being proposed by SGW. They are broadly consistent with historical trends.

Table 23: SGW, CGW comparisons

	Historical data					Forecasts					
Customer type	**12-13**	**13-14**	**14-15**	**15-16**	**16-17**	**17-18**	**18-19**	**19-20**	**20-21**	**21-22**	**22-23**
SGW											
Residential	122	121	117	129	122	118	118	118	118	118	118
Non-residential	325	314	298	327	290	310	310	310	310	310	310
CGW											
Residential	169	164	158	164	160	166	164	163	161	160	159
Non-residential	331	319	317	327	339	327	327	327	327	327	328

6.4 Weather correction

SGW does not appear to have factored into its forecasts any assumptions regarding long-term weather change or weather correction. KPMG also notes that SGW is not proposing any weather related use restrictions over the course of the regulatory period.

Given the inherent difficulties associated with forecasting weather over a five year period (noting that the BoM forecasts only extend to 3 months), KPMG considers SGW's weather assumption is reasonable.

KPMG accepts this assumption as and note that it implies no necessary amendments be made to the trend extrapolations and has therefore been applied correctly

6.5 Summary of findings

Table 24: Are the key assumptions and forecasting methods reasonably based and justified?

Forecast	Rational	Evidenced	Correctly applied
Population/household growth	Yes	Yes	Yes
Weather	Yes	No	Yes
Consumer behaviour	Yes	Yes	No

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