Appendix 2

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Review of GAWB Demand Forecasts

(Synergies Economic Consulting)

Review of GAWB Demand Forecasts

November 2009

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www.synergies.com.au

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In conducting the analysis in the report Synergies has used information available at the date of publication, noting that the intention of this work is to provide material relevant to the development of policy.

Mark Christensen is a Principal with Synergies and is also a member of the Queensland Competition Authority. Mark has had no involvement in the preparation of this report.

Contents

1 Introduction

Gladstone Area Water Board (GAWB) has requested Synergies Economic Consulting (Synergies) to undertake a review of its demand forecasts which cover the period 2011 to 2030. In particular, Synergies was requested to:

- comment on the appropriateness of GAWB's forecasts at an aggregate and individual customer level; and
- in a separate, confidential document, comment on the appropriateness of each individual customer forecast and recommend any changes, taking into account:
  - historic demand trends, including a comparison of actual demand against customer forecasts and previous Queensland Competition Authority (QCA) forecasts;
  - changes in relevant markets for industrial customers;
  - future outlook for industrial customers;
  - inclusion (or exclusion) of new or prospective customers; and
  - for municipal customers, consider also the forecast growth for the region and changes in domestic water usage habits.

In developing a methodology to forecast demand, GAWB faces two decisions:

- the choice of forecasting methodology or technique; and
- the choice of demand scenarios.

This report is in two parts. The body of the report includes a review of GAWB's methodology and its application by:

- comparing previous forecasts to actual demand (Section 2);
- reviewing GAWB's methodology for demand forecasting (Section 3);
- reviewing the demand scenarios chosen by GAWB (Section 4);
- examining water demand drivers by customer group (Section 5);
- assessing the applications of the methodology (Section 6); and
- providing concluding comments (Section 7).

The second part is an attachment, and is a confidential document which comments on the application of the forecasting methodology at an individual customer level.

In reviewing GAWB's forecast, Synergies has focussed on a test of 'reasonableness' taking into account the circumstances and information available to GAWB.

2 Recent forecasting performance

Formal demand forecasts were developed for GAWB's price review which commenced in 2005/06. Forecasts to date have been for a 20 year period, as the planning period recommended by the QCA for price setting.

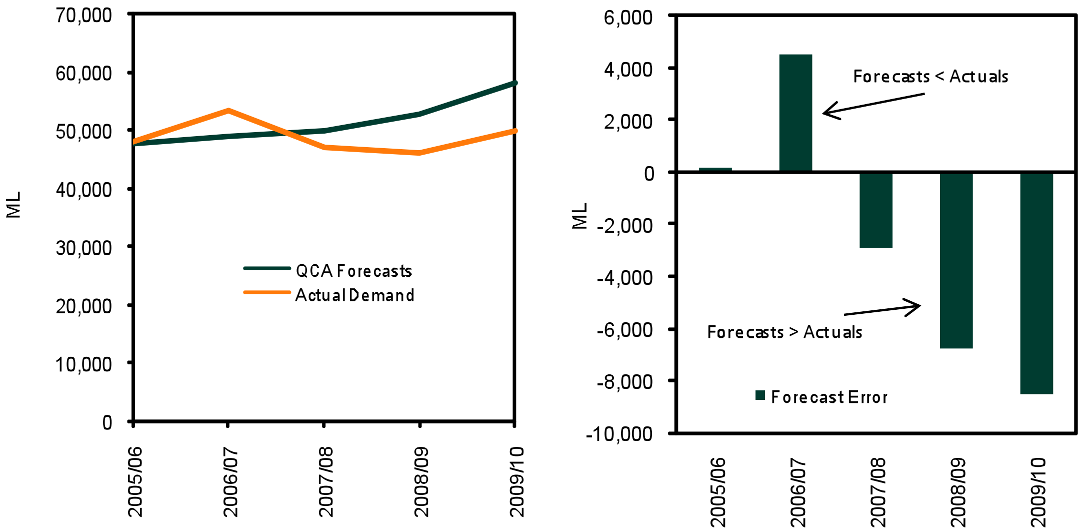
This section describes the current forecast and compares it to actual demand since 2005/06.

2.1 Aggregate demand forecasts versus actual

The demand forecasts adopted by the QCA for the 2005-06 price review predicted an increase in demand from 47,606 ML in 2005-06 to 58,177 ML in 2009-10. Actual demand was greater than forecast for 2006-07, but less than forecast for the remaining 4 years (Figure 1).

As a percentage of the forecast values, the forecast errors range from +9.3 per cent (2006-07) to -12.9 per cent (2008-09). Based on current forecast information provided by customers, the forecast errors may be larger for 2009-10 at -14.7 per cent.

Figure 1 Aggregate forecast error for all customer groups



Note: Forecast error is calculated as the forecast volumes used by the QCA at the time of the 2005-06 price review less subsequent and actual observed volumes. Actual' data for 2009-10 based on customer forecasts provided to GAWB for this review.
Data source: QCA, GAWB

It is likely that forecast error will increase as time increases. This appears to be the case even within the first five years of the 20-year forecast.

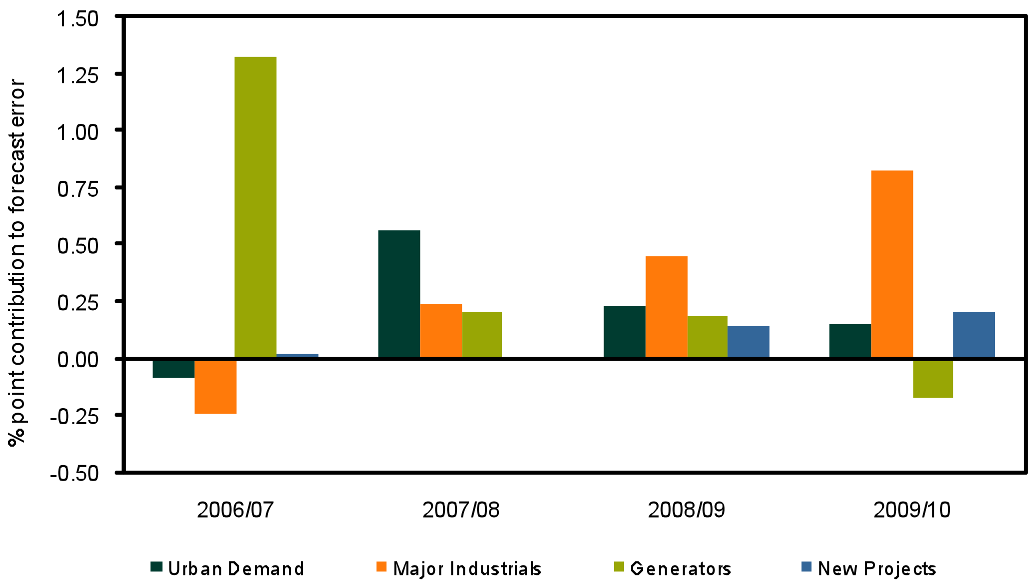
2.2 Contributions to the forecast error by sector

Over the period 2005-06 to 2009-10, councils accounted for 18 per cent of water demand on average, generators 45 per cent, and major industrials 37 per cent. The drivers for demand from each sector are considered in later sections, and these are consistent with the reasons behind the variation in demand experienced over this period.

The most significant contributor to the aggregate forecast error by customer group has varied by year (Figure 2). In 2005-06 (not shown; see notes to the figure) and 2006-07, the largest contributions came from the electricity generators.

In 2007-08, urban demand contributed the most to the aggregate forecast error. In 2008-09, the largest contributor was major industrial customers (especially if major projects are included). Major industrials also look likely to be the major contributor in 2009-10.

Figure 2 Customer group contributions to the aggregate forecast error



Note: The sum of the bars for each year equals 1.0 (representing 100 per cent of the error). In 2005-06, the forecast errors for the major customer groups were offsetting such that actual demand of 48,204ML was marginally higher than forecast demand at 47,606ML. Urban demand and major industrials forecast demand was greater than actual demand, while electricity generator actual demand was significantly above forecasts. This resulted in large percentage point contributions of -7.1, -8.0 and +15.8 to the small net forecast error of +0.31%. 2005-06 has been excluded from the chart as the inclusion of these contributions would significantly change the y-axis scaling and suppress the contributions for the other years.
Data source: GAWB and Synergies estimates

2.3 Implications

There is clearly substantial variation in demand by different sectors, at different times. The 2005 forecast has also proven to be overly optimistic as time goes on, with the gap between forecast and actual demand widening over recent years. The exception is in the first years of this period, where generation demand was far higher than forecast.

It is also notable that new industrial demand that was forecast but did not occur is increasingly the source of the discrepancy.

3 Forecasting methodology

This chapter outlines GAWB's forecasting methods and provides an assessment of whether its chosen method is appropriate in the current situation.

3.1 Methodologies

There are three main forecasting methods that can be used to estimate future water use: customer aggregation methods, causal forecasting using econometric models; and time series extrapolation methods using trend analysis.

3.1.1 Customer aggregation methods

This method involves collecting demand forecasts directly from customers to form an aggregate demand forecast. A sample of customers can be surveyed, or where numbers are sufficiently small, customers can be fully enumerated. The methods are usually suitable more for major industrial customer demand, given their smaller numbers.

The process of surveying individual industrial customers can provide information on:

- specific industry factors impacting on the water business' customers (and their water demands); and
- customers' views as to the significance and reliability of the impacts identified by customers.

Individual businesses are best placed to understand trends in their industries, potential industry growth rates, their production processes, and implications for future water demand.

3.1.2 Causal forecasting - econometric models

A further option is to model demand as a function of price and other economic and environmental factors. This approach is likely to be most useful where broad identifiable trends are major drivers of water use (for example, population, income, etc.) even if the precise magnitude of these drivers is not known. It is less useful when discreet events, such as a new industrial user, drive consumption. These econometric approaches can also be very useful for characterising the robustness and confidence intervals for demand forecasts. These econometric models can provide estimates of the direction of the relationship between two variables and an estimate of the magnitude or strength of the relationship.

Some of the conditions that will increase the likelihood that a structural econometric model will produce robust estimates of demand forecasts include:

- the model should be based on a solid theoretical foundation of the determinants of demand;
- a significant number of data observations are available (e.g. annual observations for urban demand, say, thirty years);
- reliable information is available on prices observed over time, to the extent that price elasticity of demand is viewed as an important component of demand;
- there is good variance in the data so that changes in one variable can be related to changes in a dependent variable;
- there is stability in relationships (although there are techniques for incorporating changes in, for example, slope parameters); and
- the final form of the model broadly accords with practical experience in the sector.

However, there are a number of difficulties associated with econometric forecasts including:

- data problems, particularly inconsistency of data collection over time and a lack of a sufficient time series;
- difficulty in representing some types of discreet events robustly in the models, for example public policy measures during periods of drought; and
- representing future outcomes that may represent combinations of external factors that are considerably outside the range represented in the econometric database.

3.1.3 Time series extrapolation methods

Time series extrapolation methods use the information within individual time series to predict future patterns. The methods usually do not seek to establish a relationship between demand and the determinants of demand.

The methods range from simple techniques (e.g. taking a ten year average of previous water demand and projecting the average rate forward) to fairly sophisticated statistical techniques. For the more complex techniques, a long time series of observations is required which is not always available.

3.2 Assessment

For GAWB, the customer aggregation method is a sensible approach to forecasting as:

- these demands are an objective measure of a customer's anticipated water needs, including for any expansion or growth, where these are included in the contracted volume;
- contracted demands are an expression of future supply commitments;
- it would be unusual for customers with long-term water needs to not hold a long-term contract, and we understand GAWB is taking steps to secure long-term contracts with all customers. Where supply is not underpinned by an appropriate contract, GAWB proposes to undertake a detailed analysis having reference to current customer demand, customer sourced forecasts, historical demand and external information. This is appropriate as:
  - customers are generally best placed to understand their respective growth opportunities, and derived water demands, although there are some important issues around the bias to overestimate future water requirements, hence justifying a broader assessment incorporating current and past use; and
  - it is practical, given most customers should hold contracts reflective of their long-term needs.
- it is possible to gather knowledge about planned and potential projects into the future, as these projects have long-lead times and typically need to inform GAWB of their water requirements, allowing project demands to be incorporated into forecasts well in advance. However, uncertainty remains about these projects in terms of their future demands, and if they proceed at all;
- this approach can incorporate behavioral responses, such as to price changes and the incentives to efficiently use water through GAWB's proposed augmentation process and demand management measures;[1]; and
- it builds on prior experience in enumerating customers to produce water demand forecasts.

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[1] Refer to GAWB's submission to the QCA, *Commercial Framework and Pricing Principles*. September 2009.

3.2.1 Reliability and customer incentives to provide accurate information

It is also more likely that firms will be optimistic than pessimistic when forecasting growth. For example, security of supply is an important issue for customers such that their forecasts may contain an upward bias to lock in contingency or cater for possible increases, particularly where it is costless to do so. That is, the risk for customers of forecast error is asymmetric as there there is no downside from submitting a higher forecast, compared to providing a forecast at the lower end of possibilities. This asymmetry does not occur where there are cost implications arising from the forecast, as would be the case under long-term contracts.

Furthermore, customers will have incentives to overstate demand where this has beneficial pricing impacts. This might occur, for example, under a price cap regime where there is spare capacity for the foreseeable future (ie augmentation would not be triggered or brought forward as a result).

3.2.2 Contribution from other forecasting techniques?

A hybrid approach would be to augment its customer aggregations with other forecasting techniques.

However, it is often difficult to know if statistical modelling will be successful prior to having undertaken development and testing. Some difficulties associated with the use of statistical modelling of demand are:

- establishing long and consistent price time series;
  - changes in pricing approaches over time (e.g. structure of tariffs (single, multi-part, increasing block tariffs), use of free allowances, etc) would need to be taken into account in establishing the price time series;
- volumetric charging;
- restrictions on water use and other demand-management measures that would need to be controlled for in seeking to statistically identify a relationship between changes in prices and changes in water demand volumes; and
- the proportion of aggregate water demand from consumers facing volumetric charges at the margin would have changed over time. This would impede identifying the relationship between price, demand and consumer's willingness to pay for water.

For major industrial customers, the role of contracting introduces additional problems to the use of statistical forecasting techniques. Historical data on the quantity of raw water demanded in a year and the price/s prevailing in that year only partly provides information on the relationship between the price of raw water and the quantity demanded at that price. A proportion of observed demand relates to prices established under pre-existing contracts. This introduces error into the statistical relationship between the year-on-year variation in prices and quantities.

GAWB has also indicated that the threat of water shortages in the early 2000s has had a major impact on industrial water use, with many customers implementing measures to reduce total water consumption. These were not price-induced responses.

In addition, one of the major sources of uncertainty for major industrial customer demand is the start-up of new businesses. Using statistical techniques to extract information from the historical relationships between existing major industrial customer demand and its drivers, will not address this source of uncertainty (i.e. the models will not provide predictions of new start-ups, only the strength of relationships between demand and its determinants). In terms of extrapolation techniques, GAWB does analyse trends in major industrial customer demand.

For electricity generators, rather than statistical models for the individual generators, the planning performed for the National Electricity Market can be referred to when considering the generator water demands. The processes provide output projections which can be used to consider the derived demand for water (discussed later).

3.2.3 Behavioural responses

When forecasting demand, consideration should be given to the scope for behavioural responses that will alter the demand for water, in particular:

- responses that improve the efficiency of water use; and
- substituting responses away from GAWB to alternative supply options.

Behavioural responses could also be driven by regulatory requirements, for example the Water Efficiency Management Plans (WEMPs) currently required in South East Queensland. Similarly, incentive or subsidy schemes, such as the Business Water Efficiency Program (BWEP), are also designed to change water use practices.

The enumeration and aggregation of forecasts is a procedure sometimes referred to as the "requirements approach" to forecasting. The approach is commonly criticised for producing upwardly biased estimates resulting from the downplaying of the role of price in determining demand (Box 1 below). However, estimating a robust structural model which endogenises price is a complicated exercise. Even if successful for urban water demand, it would be unlikely to be a useful approach for major industrial and generator demand.

Box 1 Centrality of price

Griffin has emphasised the importance of forecasting demand for water within a theoretically robust economic framework. He criticises the 'requirements' approach, which is based on aggregating independently made forecasts for each customer group, as historically failing to produce reliable forecasts. The problem is that the approach largely removes the central role of price in influencing demand.

If prices adjust to reflect scarcity/opportunity costs, then the demand of each customer group is linked through the price of water as each of their demands influence that price. The estimation of separate demand functions for each customer group assumes that each group can take the price of water as exogenously determined. However, their demands also influence price.

With econometric modelling, there are ways to specify, test and estimate models to overcome mis-specification due to endogeneity/simultaneity of price.

Data source: Griffin, R.C. 2006, Water Resource Economics: the analysis of scarcity, policies and projects, The MIT Press, Cambridge, Massachusetts

Behavioural responses to the risk of supply shortages are also potentially significant. A customer's demand may change depending on their outlook. If customers believe that supply from GAWB is not suitably reliable, they would be inclined to seek out other sources, or reduce their total demand by increasing on-site efficiency (eg increased recycling).[2] Behavioural responses in the urban sector can also be influenced from demand management campaigns from local government.

The various responses to price, drought or other matters are of course relevant to forecasting, although these can be expected to have been factored into the forecasts already provided by customers. However, in comparing customer forecasts to their historic use, some differences may be attributable to changes between past and future behaviour. For example, past consumption may have been influenced by drought or the threat of drought.

This should be considered when considering adjustments to customer forecasts, which are discussed in later sections.

[2] On the basis that a smaller demand is easier to replace, compared to a larger requirement, if a shortage arose.

4 Demand scenarios

Demand forecasting is conducted for many purposes – such as to inform budgeting, pricing and planning decisions. It is essential that the forecasts used suit each particular purpose, and take account of the uncertainties and risks of predicting future demand and the implications of error. This section examines the suitability or 'fitness of purpose' of GAWB's various demand scenarios.

4.1 GAWB's approach

The QCA has previously made a number of criticisms of GAWB's earlier demand forecasts. The main criticisms have been in relation to, in the Authority's view, the overstatement of future demand, demonstrating a potential bias to bring forward augmentation. The Authority has been particularly critical of subjective assessments of demand, preferring that forecasts are based on contracted demand.

For the regulatory period commencing July 2005, the QCA used anticipated customer contractual arrangements as opposed to subjective probability assessments of the likelihood of new projects or project expansions.

GAWB has constructed three different demand forecasts[3]

- *base case*: is a hybrid of the following:
  - contracted demand (using the aggregation approach). This adopts demand which is highly certain and is underpinned by customer contracts. In the unusual case that supply is not underpinned by an appropriate customer contract, GAWB will undertake a detailed analysis to incorporate any additional uncontracted demand. This analysis will have reference to current customer demand, customer sourced forecasts, historical demand, and external information;
  - a spare capacity take up allowance. This take up allowance is applied from year 6 to year 20 of the planning period, and is set to achieve a straight line increase in demand from the Year 6 contracted demand, to a nominated capacity (70,000ML). This is different to the demand forecasts below which deal with future growth from new users.

[3] Refer to GAWB's submission to the QCA: *Commercial Framework and Pricing Principles*. September 2009. p23.

- *upper bound*: includes both base case demand and demand that is not considered certain, but which is considered to be sufficiently credible to ensure that capacity exists to meet these additional demand requirements within a defined timeframe upon the demand becoming certain. GAWB's objective is for this demand to be secured by forward supply contracts under its forward supply policy, but currently includes demand for industrial projects that have been the subject of substantial pre-feasibility expenditure (in excess of $10 million), and are also well progressed towards receiving all necessary Government approvals; and
- *potential demand*: includes upper bound demand and demand for projects where the proponent has either made direct contact (or indirect contact via government) with GAWB, seeking an indication from GAWB that it could meet the proponent's water requirements.

GAWB applies these demand scenarios for the following purposes:

- base case forecasts: used to determine capital works expenditure (including source augmentation), revenue forecasts and price setting;
- upper bound forecasts: used to define the parameters of capacity that is capable of deployment with certainty within a defined timeframe (presently two years) in accordance with GAWB's Contingent Supply Strategy; and
- potential demand forecasts: used to monitor potential demand for the purpose of long-term planning.

4.2 Assessment

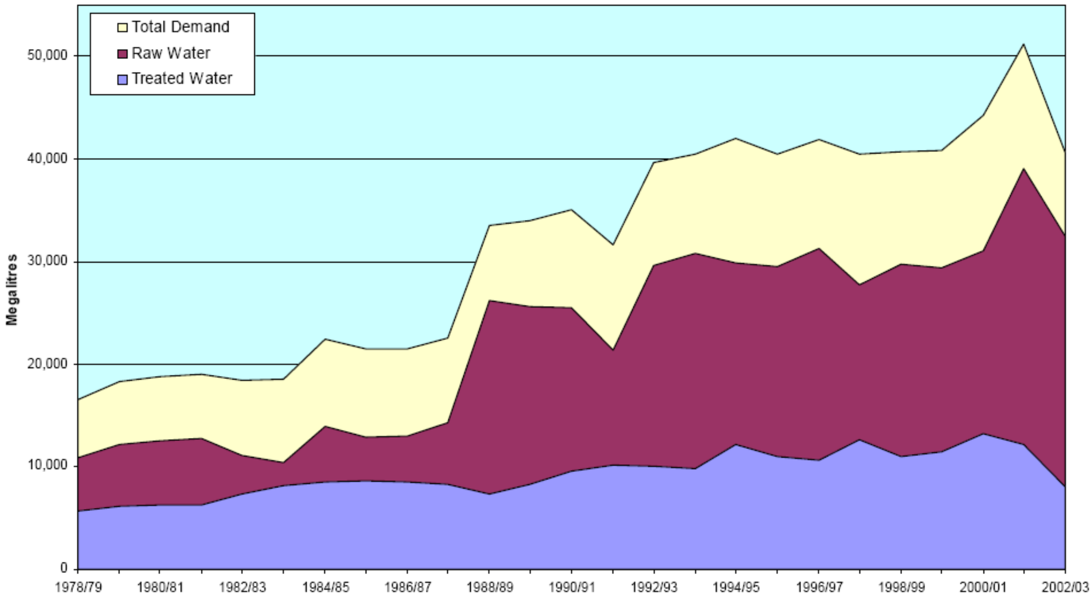
The suitability of each scenario is discussed below.

4.2.1 Base Case Demand

The QCA has previously noted water consumption in Gladstone had increased at an annual average growth rate of 4.8% between 1978 and 2003. [4] Figure 3 below illustrates this growth in demand over this time.

[4] Queensland Competition Authority. Gladstone Area Water Board: Investigation of Pricing Practices. March 2005. (p81).

Figure 3. Consumption of GAWB's water, 1978/79 to 2002/03.



Source: QCA (2005).

This growth was not organic, but driven by major project developments with large, lumpy increases in demand. For example, the development of the Callide B power station in 1988 appears to be a major source of growth, followed by other industrial developments (including further expansion at Callide by CPM in 2001).[5]

This highlights the challenge in developing an accurate demand forecast, as the likelihood, timing and ultimate water requirements for any future projects will remain speculative until such time as proponents have entered into binding contracts with GAWB. Furthermore the quantum of potential error is significant, as a new project demands can represent a significant increase.

The QCA has previously acknowledged this, and supported the need to use contracted volumes in demand forecasts:

> In recognition of the lumpiness of demand, uncertainty involved, and past propensity for overestimation, the Authority has noted the importance of contractual arrangements. Basing demand on estimates of likely demand independently of customers' proposed contractual amounts is not sound and errors could impose high costs on users and the community. [6]

5 The sudden decline in demand in 2002/03 is related to drought conditions at the time.

6 Ibid. (pp 83-84).

GAWB's approach to base case demand and its application to pricing is consistent with the QCA's views, in so far as it has used contracted demands as a platform for the base case scenario.

Contracted demand

GAWB's contracted demand forecast assumes that existing customers without long-term contracts will continue to require water over the initial 5-year period, and beyond to the end of the 20-year forecasting period. While we would expect that major industrial users would continue to require water over the next five years, this is not certain where those users do not hold contracts for this term.[7]

However, this is less relevant over the 20-year period, given the additional take up allowance which is added to contracted demand from year 6.

Take-up allowance

The take up allowance is based on an assumption that demand will reach 70,000ML in year 20 of the forecasting period (2030). This 70,000ML represents GAWB's current water allocation.[8] The annual allowance is set to reach this 70,000ML demand in equal annual increments from Year 6 to Year 20. This increment is 1084ML per annum.

This take up allowance is not a synthesis of available information or analysis about actual, future demands in the same was as the upper bound and potential demand scenarios. Rather, the take up allowance responds to two related issues:

- a forecasting issue given the length of the forecasting period; and
- pricing the spare capacity in Awoonga Dam and the delivery network.

It is worthy to note the QCA's consideration of these issues in its 2005 report:[9]

> The key objective which should guide the selection of the length of a planning period relates to the need for prices to provide appropriate signals for long term planning by customers. This is important to deal with any efficient excess capacity and provide consistent and stable pricing signals given the lumpiness of infrastructure investments. Under a shorter pricing period:

7 There may also be incentives for customers to avoid making long-term commitments where they themselves are uncertain about their long-term requirements, and where augmentation will occur to meet demand growth (ie water will not become scarce).

8 GAWB's water allocation increases to 78,000ML once Awoonga Dam reaches pre-defined levels.

9 Queensland Competition Authority. Gladstone Area Water Board: Investigation of Pricing Practices. March 2005 (p33).

· current customers would be forced to pay for excess capacity inherent in lumpy capacity expansion, albeit optimal to meet long term demand;

· significant price shocks may result if a price smoothing period is adopted which is shorter than that required to utilise the capacity of major infrastructure. For example, such an approach would potentially result in much higher prices in earlier regulatory periods, declining in subsequent periods until the next major augmentation; and

· future additional demand, once the asset is utilised, could be priced at a relatively lower amount due to the larger denominator used in pricing calculation at that time and would not signal the correct marginal cost to new consumers.

It is extremely difficult to forecast demands over a 20 year period, and more so for GAWB given the uncertainty and lumpiness of future demands. Indeed, it has proven difficult to forecast over a shorter, five-year period as experienced during the current regulatory period.

Very few regulatory decisions go beyond a 5-year timeframe. In the electricity sector (for planning purposes) a shorter time horizon is adopted for planning purposes. For example, the National Electricity Market (NEM) forecasts over a 10-year horizon, and even over this shorter horizon there is significant uncertainty about demand.

Box 2 NEM planning timeframes

Supply demand planning and transmission planning, is undertaken by the Australian Energy Market Operator (prior to the formation of AEMO this planning was undertaken by NEMMCO). The Statement of Opportunities is the primary source of long term identification of augmentation needs in the NEM, as it identifies for 10 years in advance the demand forecasts across all the NEM regions and identifies expected supply shortfalls. The SOO is intended to identify the need for:

- electricity supply capacity;
- demand-side participation (DSP); and
- transmission network augmentation in support of NEM operations.

Data source: NEMMCO, Statement of Opportunities 2008.

We believe that the 20-year period is problematic – demand simply cannot be predicted with any accuracy over this period, and hence introduces significant risk of error. Rather, a planning/pricing period aligned to each 5-year regulatory period, combined with a revenue cap, would be more appropriate.[10]

[10] This is discussed in more detail in previous advice to GAWB, but is not discussed further in this report given its focus is on the forecasts themselves.

In undertaking a 20-year forecast, the key consideration inevitably turns to the price outcomes of different demand profiles.

GAWB has already addressed the price implications arising from augmentations, by suggesting a regime that excludes augmentations from the forecast and as a result, user prices. Rather, prices are only adjusted following an augmentation trigger. Hence price increases from augmentation would not be a relevant consideration when setting assumptions about long-term demand.

The second and more relevant issue is spare capacity in Awoonga Dam. The take-up allowance is primarily a mechanism to assign the costs of spare capacity between existing and future users over the 20-year planning period, rather than an attempt to predict annual demand.

In closing, contracted demands over the first five years provide an objective basis for the forecast and remove the scope for bias from customers or GAWB to present higher or lower forecasts to achieve a certain price outcome.

The take up allowance is essentially a response to a pricing issue related to spare capacity and the uncertainty about demands over the planning period. It is difficult to comment upon the appropriateness of the take up allowance itself, given it is not a demand forecast but rather a mechanism to assign costs between current and future users amidst uncertainty.

4.2.2 Upper bound

The upper bound scenario is designed to inform decisions about spare capacity for future augmentations. As such, this scenario includes an allowance for future demand that is sufficiently credible to ensure that capacity exists when required.

In principle, the use of upper bound demands to inform augmentation decisions is reasonable for this purpose. This is particularly the case where these demands are contractual requirements upon GAWB, in which case the provision of spare capacity to meet these demands should be uncontroversial.

Decisions about the amount of spare capacity beyond a contractual requirement will ultimately depend upon the costs and benefits. For example, spare capacity is likely to be available in lumpy increments. There may be a relatively 'cheap' increment of spare capacity that is available from an augmentation which may be greater than the contracted requirement. In this case, there may be merit in building additional capacity beyond the forward sales contract volume. [11]

As such, the upper bound forecast is suitable as a reference point for decisions about spare capacity for an augmentation. Contractual requirements for additional water will dictate the minimum amount of capacity to be constructed. The efficient amount of spare capacity above this will be driven by supply-side factors and project-specific considerations and may involve trade-offs between the likelihood of this additional demand and the costs of providing additional capacity.

4.2.3 Potential demand

The potential demand scenario is a mechanism to identify "what is on the horizon" for the purpose of long term planning. Consultations with customers and tracking of contacts made by potential major industrial customers are sensible approaches to constructing the estimates.

The use of the potential demand scenario appears reasonable, particularly in light of the nature of the projects attracted to the Gladstone region, and consequently the need to ensure:

- GAWB's long-term planning enables it to be able to adapt to range of demand scenarios; and
- project proponents have confidence about the future availability of water and GAWB's capacity to respond.

[11] This would need to be informed by a cost benefit assessment.

5 Water demand drivers

GAWB supplies raw water and potable water to three customer groups:

- urban demand comprised of residential and commercial customers of the Gladstone Regional Council. This accounts for roughly 20 per cent of total water demand;
- two electricity generators in the Callide Valley which account for roughly 40 per cent of total water demand; and
- other major industrial customers, such as Rio Tinto Alumina, Gladstone Power Station, Orica, QAL and Boyne Smelter accounting for the remaining 40 per cent of demand.

Demand forecasts should recognise major groups of customers where the drivers of water demand differ. The material provided to us allowed identification of the demands for each of these customer groups under the base case, upper bound and potential demand scenarios.

In a purely technical sense, GAWB does not need to understand the drivers of water demand to construct demand estimates as it has chosen to base its forecasting methodology on enumerating client demands. If it had chosen an econometric/structural modeling approach, then an examination of determinants becomes an integral part of the process of actually arriving at forecast demands.

However, it is in GAWB’s interests to validate or check the reasonableness of customer forecasts, particularly where these are not subject to appropriate long-term contracts, and this does require an understanding of demand determinants and how drivers may change over the forecast period.

The purpose of this section is to examine the drivers relevant to each customer sector and the forecasts adopted by GAWB.

5.1 Urban demand

5.1.1 Demand determinants

The main parameters generally found to be significant in explaining urban water demand are the price of water, population, household composition and dwelling type, income levels (sometimes proxied by property values), climate variability and the extent and nature of external rationing and usage measures. Rainfall as a substitute to demand can also play a role in determining variation in demand between seasons and years, and between regions.

Demand management is also a significant factor. Most urban centres in Australia are adopting permanent water conservation measures to reduce household water demand. If these measures are adopted in Gladstone, they may have a significant impact over the long term.

Urban water demand is accepted as being price inelastic in the short run, but increasingly elastic as the time horizon is expanded allowing for greater substitution possibilities (e.g. planting of native gardens and installation of alternative supplies, such as rainwater tanks). Recent estimates of elasticities tend to be higher than earlier studies with some elasticities approaching a unitary elasticity (refer B ox 3)[12].

12 It should be noted that to say a response is "inelastic" is not to say that the response is economically insignificant. The terms "elastic" and "inelastic" simply refer to whether or not the percentage change in water demand is more or less than the percentage change in the price of water. An inelastic estimate of -0.3 can still have important consequences for urban water demand, and supply planning.

Box 3 Estimates of the price elasticity of urban water demand

Econometric studies have used a range of variables to explain observed variation in urban water demand over time and across households. Common explanatory variables include population, income levels, water use efficiency, housing characteristics, water prices and weather conditions such as temperature and evaporation (Dalhuisen et al. 2003[13]; Hoffman, Worthington and Higgs 2006[14]). The responsiveness of urban water demand to changes in price has been the focus of a substantive volume of economic literature.

The responsiveness of demand to changes in price can be measured in terms of price elasticity. The price elasticity of demand refers to the percentage change in the quantity demanded of a good in response to a given percentage change in price. Econometric techniques are commonly used to estimate price elasticities based on historical data on quantities and prices. A large number of econometric studies have attempted to estimate the price elasticity of urban water demand both in Australia and overseas. A wide range of elasticity values has been estimated, generally from 0 to –1, where an elasticity of –1 means that a 10 per cent increase in price results in a 10 per cent reduction in demand. As noted by the Productivity Commission 2008, a large amount of the variation among different studies can be explained by differences in study methodologies.

Dalhuisen et al. (2003) present a comprehensive meta-analysis of 64 US econometric studies, estimating a mean price elasticity of –0.41. A study by Graham and Scott 1997[15] estimated the price elasticity of residential water demand in the ACT region to be in the range of –0.15 to –0.39. Grafton and Kompas 2007[16] estimated the price elasticity for urban water in Sydney to be –0.35. Hoffman et Al. 2006 conducted a panel data study (data across multiple regions and over time) of urban water demand in Brisbane and estimated a contemporaneous price elasticity of between –0.67 and –0.55. Another panel data study, by Xayavong et al. 2008[17] for Perth, estimated an indoor elasticity of between –0.70 and –0.94, and an outdoor elasticity of between -1.30 and -1.45.

Source: Reproduced from Hughes et al 2008[18],

5.1.2 Commentary

The drivers for per capita consumption may change over time, for example due to household composition, planning laws requiring water sensitive design, changes to existing household water use practices and permanent conservation measures or other imposed restrictions.

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13 Dalhuisen, J, Florax R, de Groot H and Nijkamp, P 2003, ‘Price and income elasticities of residential water demand: a meta analysis’, Land Economics. vol. 79, no. 2, pp. 292–308.

14 Hoffman, M, Worthington, A and Higgs, H 2006, ‘Modelling residential water demand with fixed volumetric charging in a large urban municipality: The case of Brisbane, Australia’, Australian Journal of Agricultural and Resource Economics, vol. 50, no. 3, pp. 347–59.

15 Graham, D and Scott, S 1997, Price elasticity & sustainable water prices’, Annual conference of economists, Hobart, 29 September to 1 October.

16 Grafton, Q and Kompas, T 2007, ‘Pricing Sydney water’, Australian Journal of Agricultural and Resource Economics, vol. 51, pp. 227–41.

17 Xayavong, V, Burton, M and White, B 2008, Estimating Urban Residential Water-Demand With Increasing Block Prices: The Case of Perth Western Australia 52nd Annual conference of the Australian Agricultural and Resource Economics Society, Canberra, Australia, 6–8 February.

18 Hughes, N, Hafi , A, Goesch, T and Brownlowe, N 2008, Urban water management: optimal pricing and investment policy under climate variability, ABARE research report 08.7, Canberra, August.

5.2 Electricity generators

5.2.1 Demand determinants

There are a large number of factors to be taken into account when forecasting or projecting growth in demand for water from generators:

- existing generator demand: the demand for water is a derived demand with the demand for electricity influenced by:
  - population and economic growth;
  - household energy intensity (e.g. air conditioning);
  - fuel price and availability (e.g. coal);
  - policy induced changes related to climate change (eg carbon taxes and an emissions trading scheme) and impacts costs for coal-fired generation compared to other forms;
  - technological change and energy intensity of industrial activity;
  - Queensland and national power consumption given the NEM and inter-connection;
- demand for water is understood to be (in broad terms) proportional to output. This demand profile can be changed using new technology (eg conversion to dry cooling or alternative fuels) or increasing the 'cycling' of water within the power station. Any increases to cycling will be constrained by chemistry within the station, as well as the limits on concentrations of pollutants as power stations discharge wastewater to the environment;
- demand forecasts from generators can vary depending on electricity market conditions, scheduled plant shutdowns[19] and availability of substitute water. Significant year-on-year variation can occur due to changes in generator demand; and
- new power station demand might eventuate in the Callide Valley and surrounds. As well as the factors influencing demand for existing power stations, key considerations for new power stations relate to factors such as fuel availability, form of cooling used by generator, locational attractiveness having regard to factors such as transmission constraints and proximity to load growth.

[19] Electricity generators can also experienced unscheduled plant outages for a range of reasons, but unscheduled outages would not be expected to be reflected in water demand forecasts.

5.2.2 Energy market outlook

Long term forecasts of energy market demand and supply are available. The Statement of Opportunities (SOO) is the primary source of information, as it identifies for 10 years in advance the demand forecasts across the NEM and the expected supply shortfalls. The SOO is intended to identify the need for:

- electricity supply capacity;
- demand-side participation (DSP); and
- transmission network augmentation in support of NEM operations.

The 2008 SOO identified that demand across Queensland would continue to grow strongly in the future, and that additional capacity was expected to be required by 2013/14. Figure 4 below demonstrates the Queensland supply/demand balance to 2017/18.

Figure 4 QLD Regional Supply-Demand Outlook

The following factors impact the supply-demand outlook for Queensland:

- Braemar 2, Condamine, Darling Downs and Yarwun Power Stations and the expansion of the Mt Stuart Power Station progressively increase the region's available capacity prior to summer 2010/11.
- Swanbank B Power Station remains in operation for the outlook period (reported in the 2007 SOO as retiring from June 2011).
- The projected Queensland summer 10% POE scheduled MDs are lower than reported in the 2007 SOO.
- The region experiences reserve deficits from 2013/14.

Because the Queensland minimum reserve level is a local requirement, additional reserves must be sourced from within Queensland and not through interconnector transfers.

Data source: Statement of Opportunities – Executive Briefing, 2008.

Available modelling results suggest that electricity prices will increase in the future, in particular due to policies to reduce Australia's greenhouse gas emissions. For example, the Carbon Pollution Reduction Scheme (CPRS) White Paper has estimated that household electricity prices are expected to increase by 18% due to the implementation of the CPRS.[20] However, these increases are not expected to affect the broader supply demand balance for electricity, in which demand is expected to increase requiring new sources of supply and/or demand side measures.

[20] Australian Government, Carbon Pollution Reduction Scheme Australia's Low Pollution Future, p17-5.

5.2.3 Greenhouse Gas Emissions uncertainty

The two electricity generators supplied by GAWB are black coal generators. Black coal generators are likely to be impacted by the policy proposals, particularly the combination of the CPRS and Renewable Energy Target, but the effects on individual generators will vary. The most significant effects would be expected to impact the most emissions intensive electricity generators.

It is possible that the black coal generators that receive water supplied by GAWB will be adversely affected by greenhouse gas emissions policies. The impact of these policies remains uncertain, although they could include reduced generation by one or both of the generators, which would lead to a reduction in aggregate water demand.

5.2.4 Commentary

Demand from generators is uncertain, and is increasingly so over very long timeframes. Indeed, forecasts for the NEM only extend for 10 years.

Major influences on demand forecast accuracy include the following:

- possible new entry of generation to meet increased demand;
- possible new entry of generation displacing GAWB's customers in the dispatch merit order;[21]
- possible exit of large industrial electricity consumers impacting on electricity generation; and
- alternative sources of water supply for existing GAWB customers.

Furthermore, year-on-year demand can be expected to vary based on electricity market conditions at the time.

[21] During usual NEM operation, it can be expected that the dispatch of generating units will reflect the merit order of the generating units. That is, a unit with lower costs would be expected to be dispatched in preference to a unit with higher costs in order for the NEM to be operating effectively.

5.3 Major industrial demand

5.3.1 Demand determinants

Some characteristics of the demand for water by large industrial customers are:

- demand is relatively stable from year to year compared to urban and generation demand; and
- growth in demand is lumpy, rather than organic, and usually relates to expansion of existing operations or new industrial projects; and
- the investment decisions for industry are often subject to world commodity prices. Locational decisions are often made on a global scale.

Responsiveness to changes in price is believed to be inelastic due to[22]:

- water is a necessity for operations;
- the cost of water is believe to form a small proportion of total input costs for most major industrials;
- it takes time to substitute more water efficient production technologies and processes for existing capital and processes given the large scale and integrated nature of a firm's existing capital stock and processes; and
- there are few suitable substitutes for water used in most commercial and industrial processes.

5.3.2 Industry outlooks

Although movement to best practice and technological change impact on the efficiency with which water is used in production processes, an expanding industry is likely to demand more water and a declining industry less (to the extent that water use changes with output).

Industry outlooks for each of the major industrial customers (including those with demands under the upper bound and potential demand cases) are provided in Table 1

[22] QCA 2001, GAWB Projected Demand for Water 2000/01 to 2019/20, page 12.

below. Given recent global economic conditions, there is a high degree of uncertainty about the potential for industry expansion over the short to medium term.

5.3.3 Commentary

In general, it is unlikely that GAWB's major industrial customer demand will change materially in relation to their existing operations, and any change is likely to be driven by technology improvements that might reduce water requirements from GAWB through new or lower cost processes. The extent of demand (length and volume) of these customers will be subject to long-term economic conditions and demand for the materials produced. This is of course uncertain in the medium and long-term.

Table 1 Outlook for major industrials

Industry/Product	Demand Driver	Outlook
Aluminium	Motor Industry/Construction Industry Activity	Reduced demand for building materials and motor vehicle parts due to the global financial crisis is expected to lead to lower prices and increased stocks. However ABARE forecast Australian aluminium production and exports to remain relatively stable over the period from 2009-2014.[(a)]
Cement	Construction	The latest Australian Industry Group/Australian Constructors Association Construction Outlook survey suggests that after rising by 9.9% in 2008, the value of engineering and commercial construction work for 2009 is expected to drop to a growth rate of 2.3%. Thereafter, a fall of 2.4% is expected in 2010 driven by a reduction in heavy investment in the resources sector, declines in mining related infrastructure projects, and weaker private sector commercial building activity.[(b)]
Nickel and Cobalt Refining	Stainless Steel for the construction and motor Industries (Nickel), alloys for turbine, batteries (Cobalt)	According to ABARE in the wake of the financial crisis, 'The weakening economic growth prospects have also contributed to the sharp falls in commodity prices... with global demand for minerals and energy expected to remain weak throughout 2009.'[(b)] In relation to nickel specifically, consumption is forecast to grow moderately in the second half of 2009, in response to an assumed improvement in the economic outlook. However, the moderate increase is not expected to offset the significant fall in consumption in the first half of the year. For 2009 as a whole, world nickel consumption is forecast to decline by an estimated 8 per cent to 1.2 million tonnes.[(c)]
Liquefied Natural Gas	Industrial Activity/Domestic Consumption/Electricity Generation	Despite the impact of the global financial crisis on industrial activity and domestic gas consumption, the increasing popularity of natural gas is also influencing the outlook for the natural gas industry and ABARE forecast increased natural gas production in Australia over the next 5 years. [(d)]
Steel Making	Construction/ Industrial activity/International demand	Global production of steel is forecast by ABARE to decline by 11 per cent in 2009 to 1.2 billion tonnes, before increasing by 6 per cent to 1.3 billion tonnes in 2010. The forecast decline in production in 2009 is a result of sharply weakening demand for steel, associated with the global economic slowdown and the slowing of world industrial production growth. In 2010, the forecast resumption of steel production growth reflects growth in steel consumption in line with the assumed recovery in world economic growth.[(e)]

Sources:

(a) Rebecca McCallum, Aluminium Outlook to 2014, in Australian Commodities March Quarter Vol 16 No. 1 www.abare.gov.au. **(b)** Jane Mélanie, Trish Gleeson, Nikki Rogers and Clare Stark, ABARE Conference Paper 09.4: The Energetic North (2008) p9. Available at abare.gov.au **(c)** Rebecca McCallum, Nickel, in ABARE, Australian Commodities, Vol 16 no 2 p364 www.abare.gov.au **(d)** Suwin Sandu and Alan Copeland Natural Gas Outlook to 2013-2014, in Australian Commodities March Quarter Vol 16 No. 1 www.abare.gov.au. **(e)** Robert New, Steel and Steel Making Materials, in ABARE, Australian Commodities, Vol 16 no 2 p347 www.abare.gov.au

6 Application

This chapter provides an assessment of how GAWB has applied its forecasting methodology to develop each demand scenario.

6.1 General assessment

For customers without contracts, GAWB has sought forecasts and then analysed these forecasts and expressed them in terms of base case and upper bound demand scenarios. GAWB also compared forecasts to historic demand and other information and made some adjustments.

The following assessment applies across customer groups and demand scenarios.

6.1.1 Data quality

In terms of the quality of data used:

- datasets were transparent and well documented;
- customer forecasts were documented or discussed and verified with them; and
- customer forecasts have been viewed critically by GAWB in recognition of the inherent uncertainties in forecasting demand and the upward bias inherit in customer-provided forecasts.

6.1.2 Forecasting practice

The forecasting of future water demand and assembling of the three demand scenarios have been done competently. This assessment is based on the following:

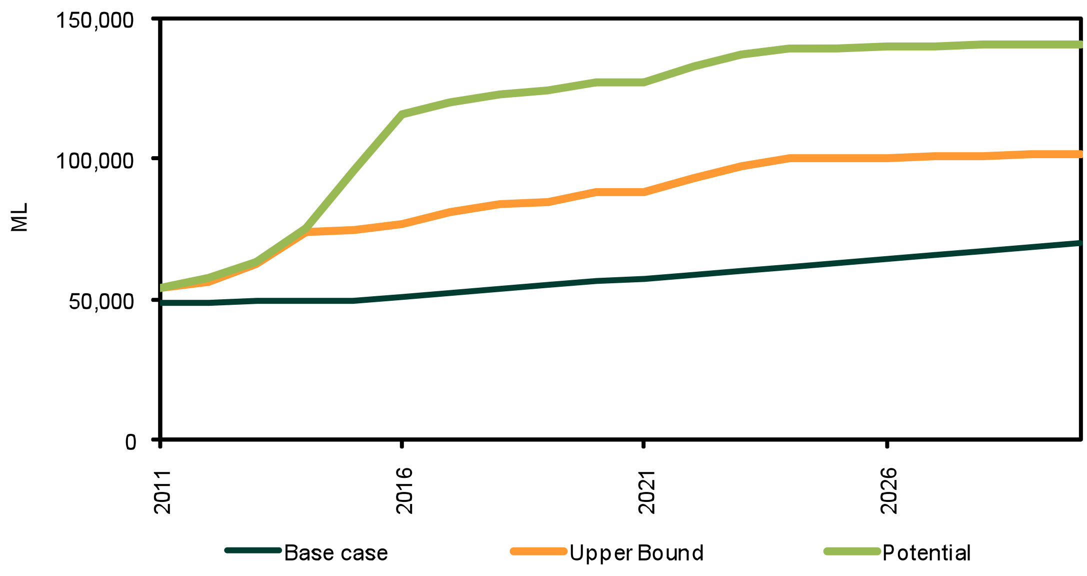
- all material adjustments made to customer demand forecasts are transparent;
- while not being party to discussions between GAWB and its customers, the adjustments are supported and documented; and
- the forecasts that have been produced by GAWB can be replicated. The spreadsheets provided are easy to follow and independent analysis of the forecasts can be undertaken.

Forecasting practice should apply a consistent approach. Consistency refers to the degree to which the forecast corresponds to the forecaster's best judgment about the situation, based upon their knowledge base.[23] This is obviously difficult to assess as it relates to GAWB's internal views about how well the forecasts align with what GAWB believes is most probable (in the context of the purpose of the different demand scenarios). However, most of GAWB's adjustments are based on their knowledge about project status (which is in the public realm or otherwise advised by customers), or historic demand which GAWB has information about.

6.2 Assessment of base case forecast

GAWB has submitted a base demand forecast where demand rises from 48,923ML in 2011 to 70,000 in 2030. Figure 5 provides a comparison to upper bound and potential demand scenarios.

Figure 5 Total demand under the three scenarios



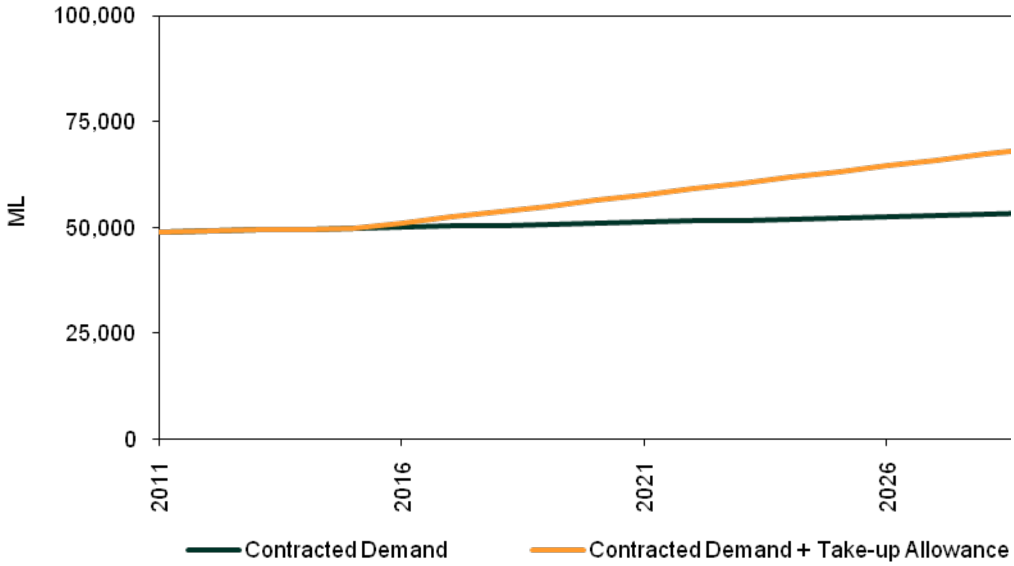
Note: Demand in the upper bound and potential demand scenarios is in addition to demand in the base case scenario. At 2011, demand in the upper bound and potential scenarios is zero, but demand accumulates rapidly

Data source: GAWB

The composition of base case demand between contracted demand and the take up allowance is set out below.

[23] See, Murphy, P (1993). "Desirable characteristics of forecast models". See also Hendry, D and Clements, M (2002) Economic Forecasting ; Some Lessons from Recent Research, Oxford Economic Papers 23 (3), pp. 23-34.

Figure 6. Composition of Base Case Demand



Source: GAWB

Contracted demand

GAWB's analysis of contracted demand considered whether demands were base case or upper bound/potential demand, and whether the customer projections could be supported by historic use, and if not, the basis for the variation.

For industrial customers without contracts, GAWB has generally adopted a forecast based on the average, historic use over recent years (typically 2 – 4 years), unless the customer has nominated a lesser amount, in which case, this was adopted. In other cases, GAWB has adopted the customer's 2009/10 forecast, which we understand is generally used as the reservation volume for pricing purposes.

A significant adjustment related to the shifting of demand from an existing customer from base case to upper bound demand Figure 7, lower right-side panel).

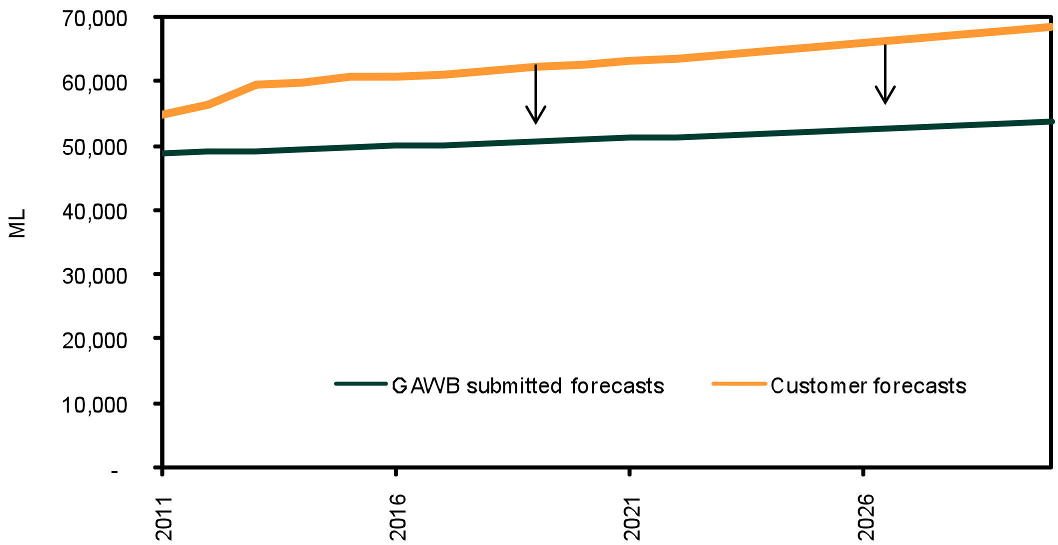
The net effect of all adjustments to contracted demand was a reduction in demand by about 10,782 ML per year from 2013 increasing to 14,644 ML by 2030. This comprised:

- 6,000 ML per annum related to shifting a single customer's demand from base case to upper bound demand;
- a reduction in council's potable water forecast demands of about 782 ML in 2013 increasing to 4,846 ML by 2030; and

- a reduction of industrial and generation demand by around 4,000ML to accord more closely with historic or current use.

The total contracted demand forecasts provided by customers and the forecasts being submitted by GAWB are shown below (Figure 7).

Figure 7 Total base case forecast water demand

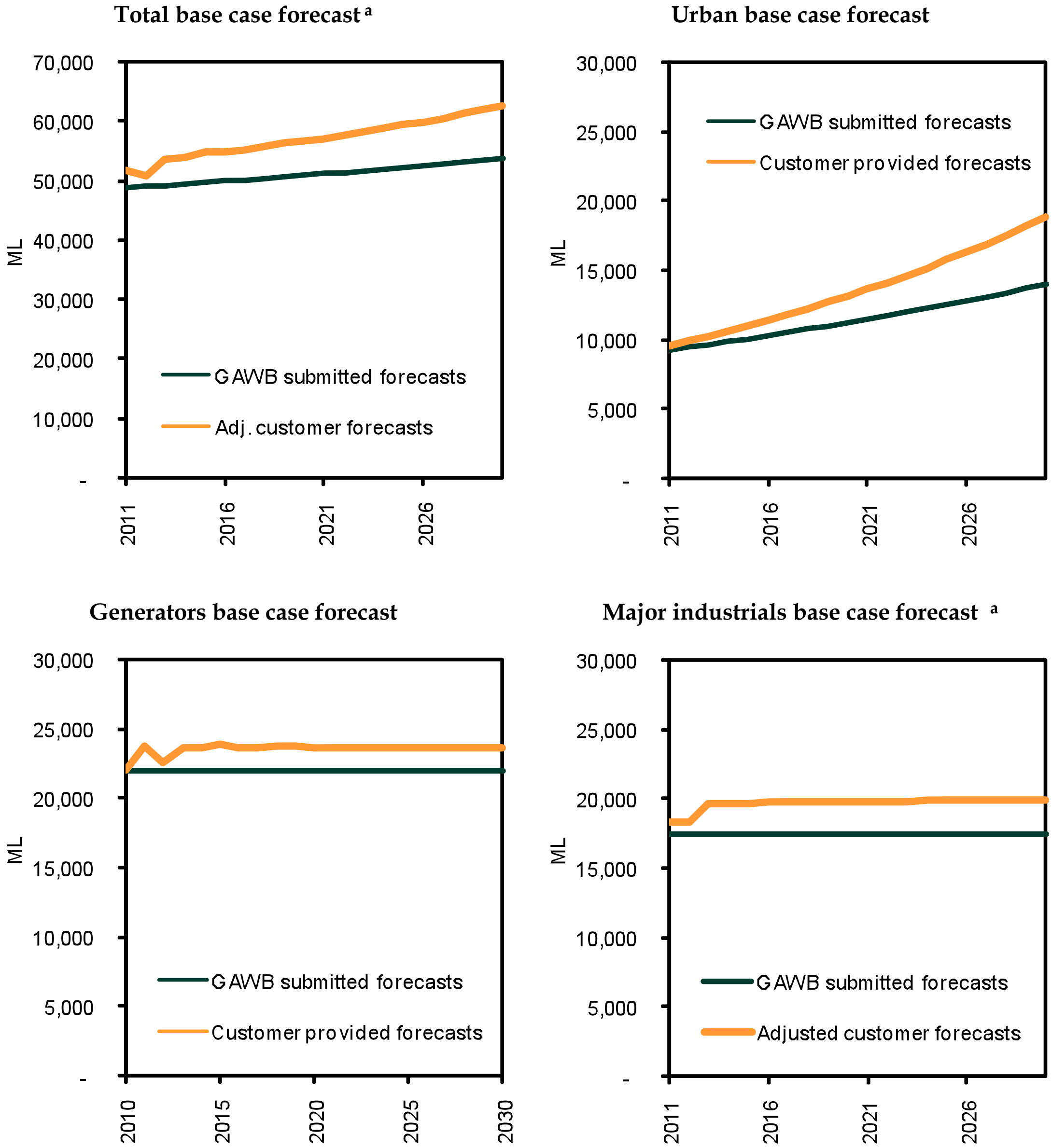


Data source: GAWB

GAWB's reclassification of one customer's demand from base case (as originally provided) to upper bound demand exaggerates the magnitude of the adjusted customer forecasts. Therefore, the starting point for the analysis below includes an adjustment for the reclassification.

The increase in total contracted demand is driven solely by urban demand (Figure 8), which GAWB has referenced to population growth forecasts. Urban demand grows at a rate of 2.1 per cent per annum. Industrial demand and generator demand do not increase over time in the base case.

Figure 8 Base case demand forecasts by customer group



a Customer provided forecasts adjusted to remove demand related to upper bound demand.

Note: Urban demand is for potable water. Generator demand is for raw water. Major industrial demand is both raw and potable water.

Data source: GAWB

Take up allowance

The take up allowance has not been based on a demand assessment, apart from a judgement that 70,000ML will be contracted in 2030.

6.2.1 Risk

The major sources of forecasting error can be expressed in terms of downside and upside risks to demand over the 20-year period:

- downside risks (demand lower than forecast) over the 20-year horizon:
  - increased availability of substitutes to water from GAWB, including rainfall and other sources and the emergence of new, lower cost technologies to reduce water demand;
  - reductions to the per capital water demand in urban centers (eg through water sensitive planning schemes, changes in household composition or dwelling type, demand management, permanent conservation measures etc), and/or slower population growth;
  - export driven industrial growth is lower than what is captured in the base case;
  - generator output is impacted significantly by a change in total electricity demand or the merit order of dispatch, for example by the introduction of climate change policies that suppress the demand for electricity or the introduction of lower cost generation; and
  - uncontracted customer demands do not span 20 years as forecast due to changes to commercial viability (eg change in demand or cost conditions), technology change or other factors.
- upside risk (demand higher than forecast) over the 20-year horizon:
  - a combination of domestic and export driven growth for major industrials results in demands greater than the levels as at 2009 for existing major industrials; and
  - new industrials projects that require water during the regulatory period (for example, any of the demands currently included in the upper bound estimates).

The consequences of demand variance from forecast will depend upon the assignment of volume risk in prices, the choice of revenue cap or price cap, and the treatment and impact of future augmentations as a result of meeting demand growth.

The variability of year-on-year demand is also important. The base case forecast describes a stable annual demand. In reality, there is likely to be significant variation between years, due to factors largely outside GAWB’s control. These factors are also difficult to predict. For example, high-rainfall years in Gladstone may reduce urban demand, or hotter summer months may increase demands from generators.

6.2.2 Commentary

Contracted demand

Ideally, contracted demands would be based upon long-term contracts as is GAWB's intention for the base case scenario.

Where long-term contracts are not in place, GAWB must undertake analysis to assess demand. In accordance with GAWB's stated approach, it has had obtained customer-sourced forecasts and given further consideration to current and historical demand, and other external information.

Adjusting customer forecasts introduces GAWB's judgment into the process[24], hence increasing subjectivity of the forecasts. However, some scrutiny of customer forecasts is required to adjust for any bias for customers to overestimate demand, as customers can be expected to be optimistic, rather than pessimistic, about their forecasts (refer section 3.2.1). Where the basis for the customer's forecast is not available to GAWB, current and historic use provides a reasonable and objective comparator for this task, in conjunction with direct customer discussion and feedback. It also removes scope for GAWB or the customer to bias the forecasts based on subjective assessments. Indeed, average historic use is a reasonable starting point for the base case forecast.

In comparing historic use, changes in behaviour between the past and future should be considered. For example, allowances might need to be made for customer responses to any threat of drought in recent years, although we understand that GAWB's window for assessing historic use did not extend back to the 2002-2003 drought.

The major adjustment made by GAWB related to the reclassification of demand from one customer from base case to upper bound. GAWB faces a difficult problem in dealing with this demand (which is discussed in more detail in the attachment) given the absence of a long-term contract and the status of the project in question. While there is an argument that this demand should be included in the base case, in doing so, GAWB would assume significant risk under a price cap regime.

Given the current circumstances, GAWB's approach is considered reasonable. However the treatment of this particular demand should be kept under review to account for any change of status of the project. Of course, should a long-term contract emerge for this demand, it would be incorporated into base case.

[24] It is acknowledged that GAWB's preferred approach is to avoid having to make such assessments by relying on contracted demand. This concern only arises where existing customers do not have long term contracts.

Urban demand forecasts should account for changes in dwelling type and consumption at a household level, and the separate contribution of demand from the commercial and residential sectors. Urban demand should also consider Council's policies about future demand management, including whether permanent conservation measures are to be introduced as has occurred in major metropolitan areas in Australia. GAWB does not have access to this information.

GAWB has also noted that Council's past forecasts have been well above their actual use, and Council's projected increases are well above the rate of population growth.

In light of these factors and the information available to GAWB, referencing demand growth to population growth is a reasonable approach.

There is also uncertainty about growth from new projects and the longevity of demand under short-term contracts. GAWB's approach assumes no increase in demand over the next five years from new projects, unless there is a contract in place. It should be acknowledged that under a price cap regime, there is considerable risk in doing so given the uncertainty involved in new or proposed projects.

There is also significant variability in demand between years, even after excluding the potential impact from major new industrial projects.

Finally, the contracted demand forecast will change as more existing customers enter into long-term contracts. The application of these base case forecasts (including for price setting) should allow for updates as new contracts are made. For the current price re-set, this might mean updating the forecast just prior to finalising the new prices.

Take up allowance

As discussed earlier, the take up allowance responds to a pricing issue and should not be evaluated in terms of a demand forecast.

The take up allowance has been calculated in accordance with GAWB's intended approach, to apply an increase in equal annual increments from Year 6 to Year 20 to achieve an ultimate demand of 70,000ML. This increment of 1085ML has been assigned between the North Industrial Raw water zone (1,022ML) and North Industrial Potable zone (63ML). This has been done using a 'future industrial customer' demand in its spreadsheet, in these zones.

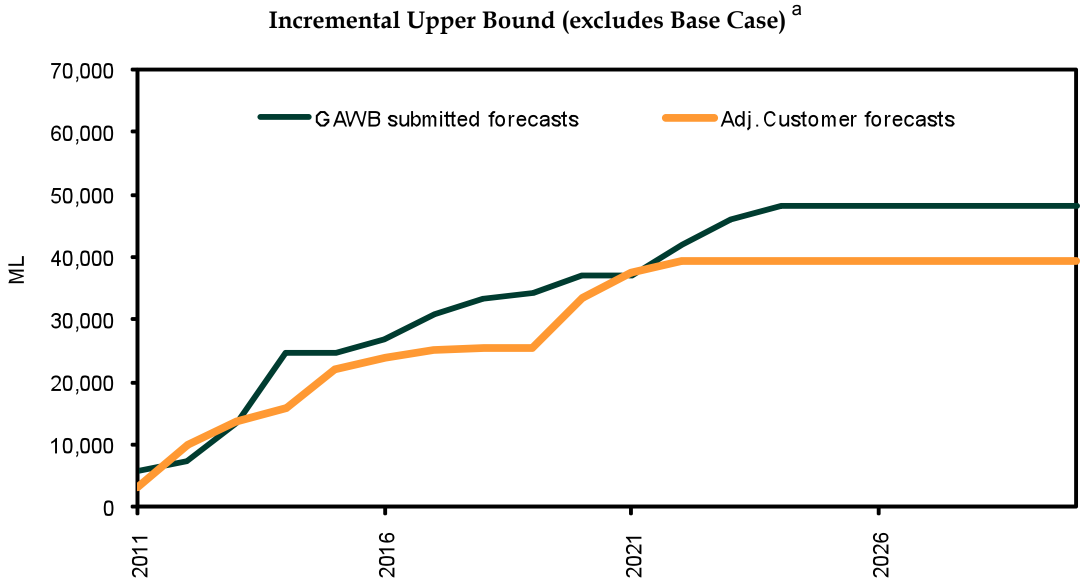
We understand that the 70,000ML ultimate demand in 2030 has been set based on GAWB's current water allocation. This demand is net of distribution losses. The quantity of these losses will ultimately be determined by the location and type of demands in the future. This may not be an issue if the 70,000ML is meant to be the limit of sales, rather than diversions. Furthermore, the take-up allowance is based on simplifying and arbitrary assumptions and is not a forecast, and hence allowances for distribution losses are less relevant in this context (also given GAWB's maximum, potential allocation is 78,000ML).

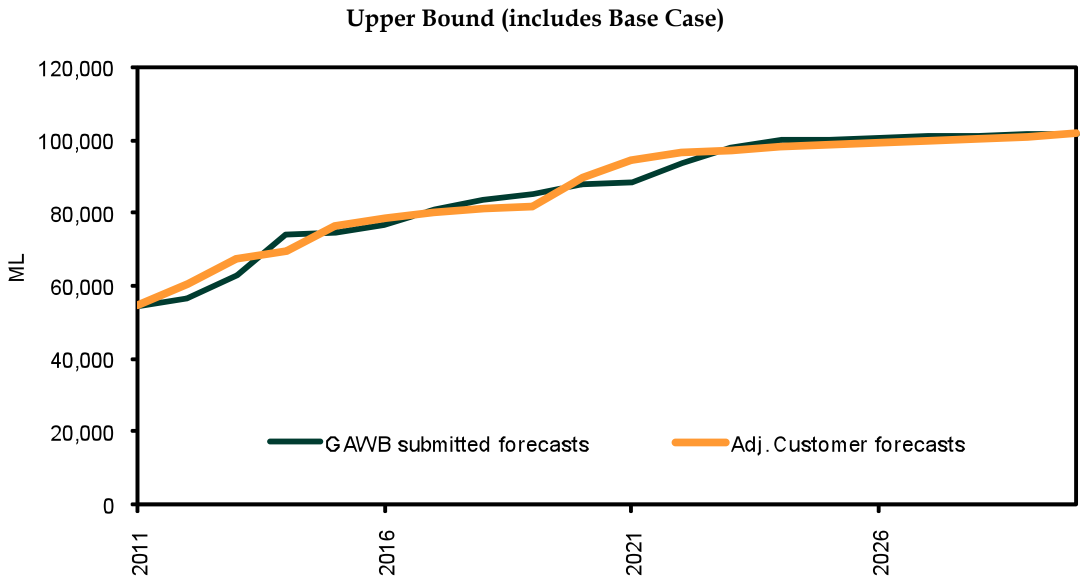
6.3 Assessment of upper bound forecasts

GAWB's upper bound forecast is set out in Figure 8 below. Upper bound demands (those demands that are in addition to Base Case demand) increase rapidly, although this is driven by large, lumpy increments in demand from new projects (upper panel).

Upper Bound demand (including Base Case demands) increase at an annual average growth rate of 3.3 per cent (lower panel).

Figure 8 Upper bound demand forecasts [a]





a Incremental Upper Bound refers to those volumes that are in addition to Base Case demands.
Data source: GAWB

GAWB's preference for determining upper bound demand is to adopt demands under forward supply contracts, but it currently includes demands for industrial projects that have been the subject of substantial pre-feasibility expenditure (in excess of $10M) and are also well progressed towards receiving all Government approvals.

There are six major expansions or new projects that are included in the upper bound demand, and a further six minor (less than 250ML per annum) projects or expansions. Our assessment has focused upon the six major projects. Of these:

- one project is under construction, although financial and commodity market conditions is understood to have caused delay;
- two projects have obtained environmental approvals;
- one project has released its environmental impact statement (EIS);
- the draft terms of reference for an EIS for a further project has been released, which has also received Major Project Status by the Coordinator-General; and
- one project involves changes internal to an existing plant that will result in increased water use.

The details about each project are discussed in the confidential attachment.

6.3.1 Risks

GAWB's test for the likelihood of a project proceeding and hence being included in upper bound demand provides a reasonable filter to reduce forecasting error.

The downside risk to demand is that these projects are delayed, do not obtain final development/environmental approvals (despite being well advanced in the approval process), or do not proceed on commercial grounds. There is also a downside risk that these projects, if they proceed, will require less water than currently indicated.

The upside risk to demand is that other projects emerge, including those accounted for in the potential demand scenario, or identified projects require more water than anticipated. The consequences of under-estimating demand for planning purposes and infrastructure capacity decisions are significant (Refer Box 4 below).

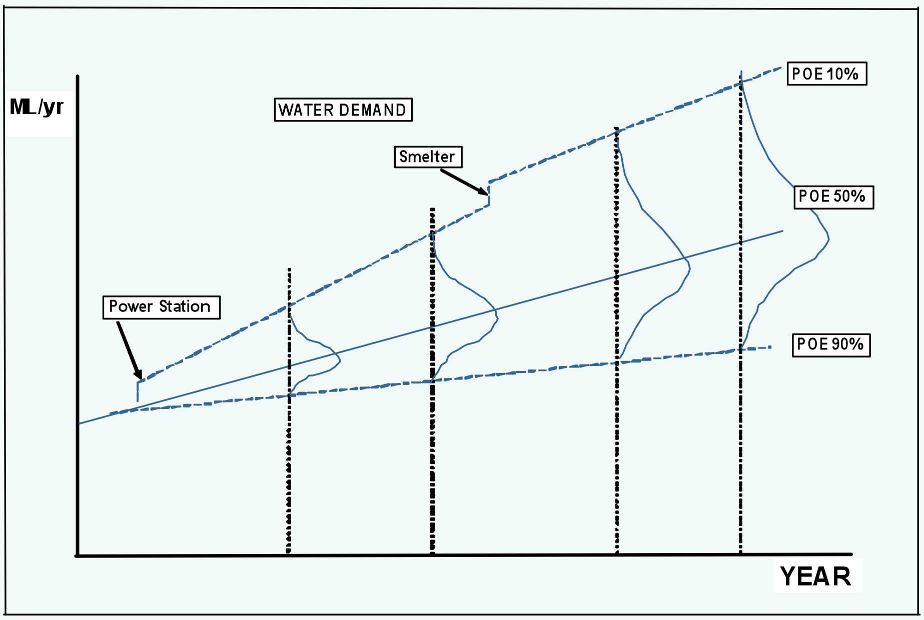
Box 4 Economic efficiency costs of over (under) estimation of demand for planning purposes

For planning, the consequences of forecast error relate to the existence of inefficient spare capacity or capacity being insufficient to meet demand, forcing severe supply restrictions to be imposed (imposing costs on GAWB's customers, including foregone output) or resulting in the Gladstone region being overlooked for future industrial development due to an inability to provide a suitably reliable water supply at the required time.

In other words, the economic costs of inefficiently delaying augmentation will generally outweigh the cost of augmenting too early (e.g. comparing new capacity provided two years early versus two years too late).

The approach that is normally adopted to address this uncertainty is for the forecasting approach to explicitly recognise that there is a distribution of forecast demand levels each with a certain probability of being below the actual level of demand. As the forecasting horizon increases, so too does the range of the distribution: it makes more likely that significant demand shocks will be observed.

A very conservative forecast of future demand growth is the lowest forecast – where the probability of exceeding the demand forecast is assessed at 90% (figure below). A "mean" demand forecast is shown by the probability of exceeding the forecast of 50% However, because of the asymmetric consequences of insufficient water availability, a much lower probability of exceedence is appropriate for planning purposes (bearing in mind a range of scenarios should be adopted for planning purposes).



6.3.2 Commentary

GAWB has set reasonably stringent criteria for upper bound demand. However it is often difficult to obtain information about the expenditure on feasibility for various projects. GAWB has been able to reference the status of the various projects, particularly in relation to environmental and planning approvals.

We would expect that the project proponents are more likely to provide forecasts at the upper end of their potential needs, particularly where there are no costs to them for doing so, in order to secure water for their project. Similarly, we would expect that the timing of demand from proponents would be the earliest likely date for project requirements.

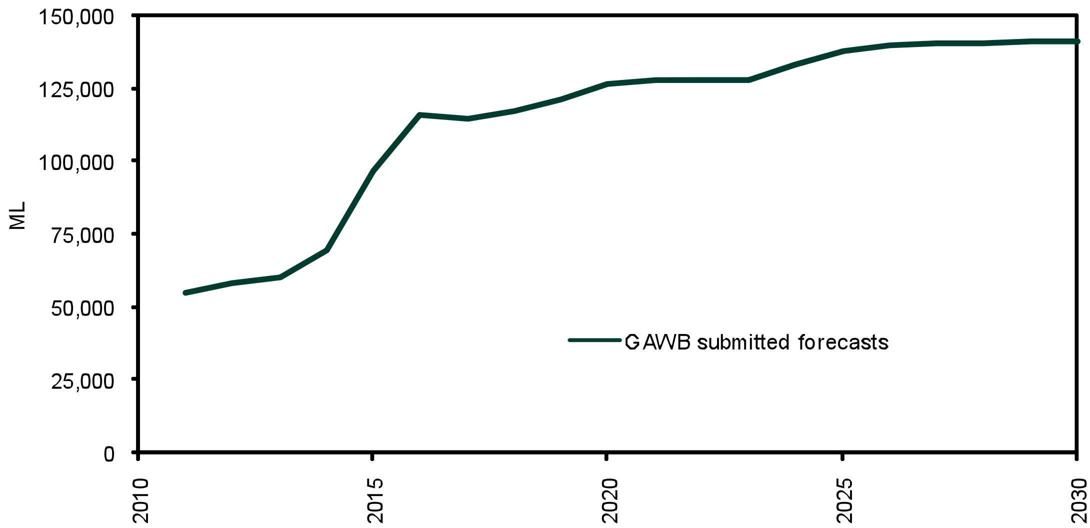
While there is no evidence to suggest that GAWB has adjusted customer forecasts to account for this, it is difficult to expect GAWB to objectively do so, as it has no historic information or other data upon which to make an informed review. Indeed, GAWB faces the possibility that these demands do in fact eventuate and it is not able to respond. On balance we believe that consulting with customers about their forecasts and reaching a consensus position with customers is a reasonable approach.

There are some specific issues in applying GAWB's assessment to some of these projects given individual circumstances, which are discussed in the confidential attachment.

6.4 Assessment of potential demand forecasts

Potential demand increases from 54,575ML in 2011 to 141,109ML by 2030 (Figure 9). Demand increases at an annual average growth rate of 5.0 per cent.

Figure 9 Potential demand case



Note: There is no urban or generator demand in the potential demand case.
Data source: GAWB

This scenario is simply a listing of all known possible demands that might eventuate, for long-term planning purposes. One matter is whether GAWB has captured all potential demands. We have not reviewed GAWB's processes for doing so, but understand this includes formal and informal contact with regional development agencies and the Department of Infrastructure and Planning, as well as a formal register of interest from project proponents.

Given the uncertain nature of these projects and their early phase of development, the timing and volume of demand is likely to be unreliable. However, we do not believe it is necessary for GAWB to actively adjust the demands provided to it given its purpose, and the need to ensure GAWB can respond to a range of scenarios in order to meet the region's demand-supply balance. Furthermore, we note that GAWB does not propose for this forecast to have any consequence in terms of customer prices, as prices would not be adjusted until following the augmentation occurred.

Finally, GAWB's planning processes might be enhanced by considering a number of 'sub-scenarios' based on different combinations of projects proceeding, and then assessing the different supply-side responses or combinations or sequencing of augmentation that might best respond to these scenarios.

7 Conclusion

GAWB forecasting task is difficult given uncertainty over future customer mix and demand, lumpy demand growth and the 20-year planning horizon. This is evidenced by the variation over a relatively short period since the previous (2005) forecasts.

The approach of using contracted demand for the first five years of the base case forecast provides an objective measure and should reflect a customer's realistic expectations.

For customers without appropriate, long-term contracts, GAWB has sought forecasts and then sorted demands into the three scenarios. GAWB has consulted with customers in undertaking this process, and has also reviewed the forecasts themselves and, in some cases, made adjustments.

While these adjustments introduce GAWB's judgment into the process, we believe that customers have a natural upward bias in presenting information which needs to be considered for the base case. Average historic water use provides a reference point for customers to explain future variations in demand. In most cases, adopting average historic use as the basis of the forecast is reasonable given the lack of information to support any variation. Average historic use is also an objective measure that removes scope for bias by either customers or GAWB.

Adjustments were made by GAWB to Gladstone Regional Council provided forecasts to align water use with long term population growth. This is lower than Council's forecast and the adjustment appears reasonable in the circumstances.

The take up allowance is not a forecast of actual, year-on-year demand, but rather responds to a pricing issue in relation to spare capacity and the length of the pricing period.

The contracted demand, and in turn aggregate base case demand, may change as more existing customers enter into long-term contracts. The use of these base case forecasts should respond to these changes as they occur. This may mean that the base case forecast is updated just prior to finalising the parameters used for price setting or any future augmentation.[25]

The upper bound and potential demand scenarios appear reasonable in terms of the purpose and application.

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25 Given this is the purpose of the base case demand forecast.