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20 November 2002

Mr John Hall
Chief Executive
Queensland Competition Authority
GPO Box 2257
**BRISBANE QLD 4001**

Dear Mr Hall

**SUBMISSION ON DRAFT REPORT ON BURDEKIN HAUGHTON WATER SUPPLY SCHEME: ASSESSMENT OF CERTAIN PRICING MATTERS RELATING TO THE BURDEKIN RIVER IRRIGATION AREA**

Please find below SunWater's submission on the Authority's draft report for the Burdekin Haughton Water Supply Scheme.

**Expectations regarding capital expenditure and contributions**

The draft report states the principles for defining capital contribution as:

> "*capital payments made towards the capital cost of an asset by a third party with the intention of reducing the capital outlay by the owner of the asset and with the expectation that the payment will be recognised for pricing purposes". (p15)*

The Authority's *Statement of Regulatory Pricing Principles for the Water Sector* states that:

> *"Recognition of prior capital contributions in the setting of prices depends on the particular circumstances surrounding the capital contribution, particularly the expectations of the parties at the time the capital contributions were made." (p38)*

The draft report refers to documentation describing the different forms of payment to arrive at the conclusion that such payments were capital contributions and it is appropriate to recognise these for future price benefits. While this documentation provides insight into the way in which Government considered funding for the scheme, none of the documents quoted by the Authority provide any definitive statements in relation to future pricing. In fact, the vast majority of documents quoted by the Authority are silent on future pricing.

Therefore, SunWater does not believe the Authority has clearly established that there would have had reasonable expectations in relation to future prices and urges the Authority to more closely examine this issue and provide greater evidence to support this conclusion.

Furthermore, there are internal inconsistencies in the report in respect of the Authority's view of expectations. SunWater made a submission in relation to the provision of above ground channels, stating that these were provided in part of the scheme following consultation with the Farm Inspection Committee that advised on farm layout. This Committee was strongly of the view that above ground channels and the provision of command was essential for the efficient operation of the farms and their attractiveness to the market. The draft report states that:

> *"With respect to the arguments raised by SunWater pertaining to the representation of irrigators on the Farm Inspection Committee, the Authority understands that the potential cost implications for water pricing were not considered as part of the decision making process. That is, irrigators assumed that any costs would not affect their price for water." (p50)*

If the Authority is to adopt the view that certain payments were made by irrigators with the reasonable expectation that they would be treated as capital contributions, then it follows the capital cost of the scheme would have been relevant to irrigators.

That is, any expectations that payments would form capital contributions attracting future pricing effects could only arise if irrigators expected that the capital cost of the scheme was of relevance in regards to ongoing pricing.

To conclude that "irrigators assumed that any (capital) costs would not affect their price for water (p50)" is clearly inconsistent with the statement that "irrigators had a reasonable expectation to believe, that the headworks contributions were to be regarded as a capital contribution" (p21).

As noted in the draft report and in SunWater's submission, there was consideration provided for the above payments in the form of land or water entitlements. As such, those who made these payments have received the benefits already.

The draft report refers to this issue in part on page 21, stating that sale of capital assets can occur to finance developments, and that entitlement holders should enjoy the benefits or losses of their asset. SunWater does not disagree with these statements, and in fact strongly supports the latter statement.

However, these are not the pertinent points in relation to this issue. The key issues that SunWater believes need to be addressed are:

- Whether such payments can in themselves be characterised as capital contributions when they involved their own form of consideration (asset purchase) and are vastly different in nature to those payments recognised as contributions by other regulators[1]; and
- Whether equity grounds apply when there has clearly been other consideration for such payments apart from future prices[2]; and
- Whether economic efficiency grounds apply given users have already received a benefit at least proportionate to their payments.[3]

SunWater urges the Authority to reconsider its conclusions in light of its test for capital contributions. Furthermore, SunWater encourages the Authority to examine the payments on equity and economic efficiency grounds given that benefits have already been received in the form of land or water entitlements.

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[1] For example, donated assets or payments for assets gifted to the service provider with no consideration other than ongoing service arrangements or reduced prices.

[2] Refer to the draft report, page 16, that sets out the grounds for recognising contributions.

[3] As above.

**Consumption of Capital Contributions**

Despite the above points, should the Authority maintain its position that the payments represented capital contributions warranting some future price adjustment, SunWater notes that the Authority acknowledged that recognition of past capital contributions would not be appropriate if:

- Past price reductions have fully compensated the contributor for the contribution; or
- The asset towards which the contribution was made has been consumed.

Page 31 of the Report at "3.10 Additional Issues Regarding Capital Contributions", it is further highlighted that:

> *"if it could be established that prices for 2000-01 within the price path (for which the Authority has calculated the efficient capital base) lay below the efficient cost-based price, then irrigators may have been compensated to some extent through lower than efficient historical prices." (p31 )*

This issue was not taken any further in the Report due to the view being held by the QCA that any offsetting price benefits was difficult to establish as:

- "The historical accounting data on Scheme revenues and costs is not available for BRIA specifically, or is not sufficiently detailed, to accurately determine the magnitude of any operating profits or losses. Reliance on historical accounting data is further complicated by the inconsistencies in data reporting standards since the Scheme's development; and
- Even if it were found that such a benefit was received by irrigators, it is not clear that the Burdekin Scheme was optimally staged in respect of construction, pace and location of channel and land development, or whether an optimal development of the scheme could have resulted in different net operating profits or losses." Page 32.

SunWater agrees with the QCA that it would be inappropriate to recognise past capital contributions in future prices to the extent that they have been recognised in past price reductions. Further, SunWater holds the view that based on published data it can be shown that the capital contribution of $49.7M as at 2000 had been fully consumed through prior year pricing at less than MAR. The process for doing this is as set out:

1. The QCA already has the data on the Project land being served by the new scheme for each year back to 1989. If we assume that the year 2000/01 is the base year and at that time the scheme was serving 100% of the Burdekin project land then we can apportion the year 2000/01 MAR proportionately by the project land being served in each prior year. This approach can be used as a very conservative estimate of the optimal staging of the assets being used in the scheme and as a result can also be used to conservatively estimate MAR for each of the years back to 1989 using the QCA data published for the year 2000/01.

   As an example in the year 1993 there was 23,241 Ha of land being served by the new scheme compared to a total now of 38,468. This gives a proportionate figure of MAR as $12,048,853 (23,241/38,468 x 19,943,000).

   This can be calculated for each year to give an optimised proportional MAR for each year from 2000/01 back to 1989.

2. In the same manner we have also determined the actual revenue by conservatively estimating the land being served and multiplying by 8ML/Ha to give a total amount of ML for each year. This figure has then been multiplied by the $40/ML taking into account an average 86% of allocation be used annually as adopted by the Water Reform Unit. This $40/ML approximates the real channel prices for the scheme as per QCA draft report (p14 Figure 2.2) and assumes all sales at this rate. This approach will overstate revenues as it assumes sales to river and groundwater customers at the higher channel rate.

3. The difference between the figures calculated as above for each year is then a conservative estimate of the shortfall observed in pricing offered to the BRIA since 1989.

SunWater holds the view that the above analysis is very conservative especially in determining previous year MAR because:

- Staging assumption is very optimistic and no scheme could have been staged to directly meet the demand in proportion to the land in the scheme.
- WACC would have been much higher due to higher interest rates in the 1990's.

In addition the actual revenue figures are overstated as they assume river or groundwater sales at the higher channel rate.

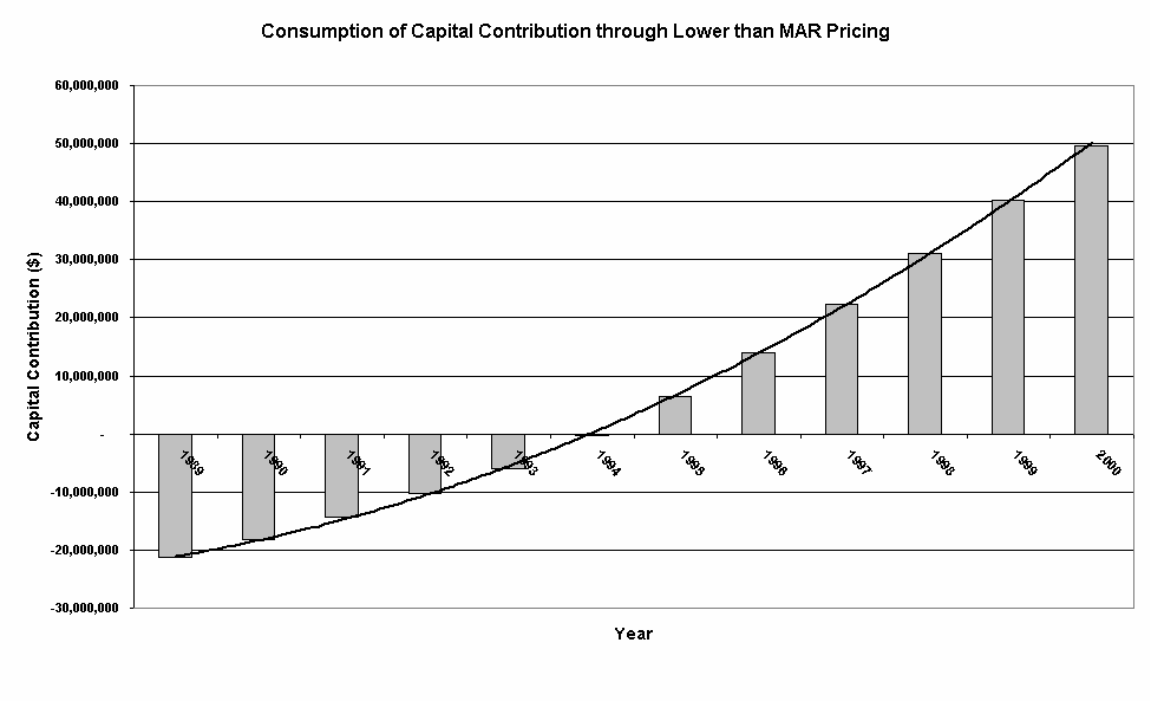
The results of the above analysis is set out in Table One and graphed in Chart One.

## Table One

**Analysis of Consumption of Capital Contribution through Lower than MAR Pricing**

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outstanding Capital Balance ($) | - 21,260,427 | - 18,263,093 | - 14,328,346 | - 10,216,285 | - 6,012,525 | - 359,596 | 6,391,765 | 14,076,888 | 22,274,986 | 30,986,787 | 40,343,394 | 49,700,000 |
| | | | | | | | | | | | | |
| MAR | 6,388,624 | 8,386,657 | 8,764,593 | 8,960,041 | 12,048,853 | 14,390,087 | 16,380,343 | 17,473,714 | 18,568,640 | 19,943,000 | 19,943,000 | 19,943,000 |
| Actual Revenue | 3,391,290 | 4,451,910 | 4,652,531 | 4,756,282 | 6,395,923 | 7,638,726 | 8,695,219 | 9,275,616 | 9,856,838 | 10,586,394 | 10,586,394 | 10,679,000 |
| Shortfall | - 2,997,334 | - 3,934,746 | - 4,112,062 | - 4,203,760 | - 5,652,929 | - 6,751,360 | - 7,685,124 | - 8,198,098 | - 8,711,801 | - 9,356,606 | - 9,356,606 | - 9,264,000 |
| | | | | | | | | | | | | |
| | - 18,263,093 | - 14,328,346 | - 10,216,285 | - 6,012,525 | - 359,596 | 6,391,765 | 14,076,888 | 22,274,986 | 30,986,787 | 40,343,394 | 49,700,000 | |
| | | | | | | | | | | | | |
| Land Served (H | 12,323 | 16,177 | 16,906 | 17,283 | 23,241 | 27,757 | 31,596 | 33,705 | 35,817 | 38,468 | 38,468 | 38,468 |
| ML/Ha | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | |
| Total ML | 98,584 | 129,416 | 135,248 | 138,264 | 185,928 | 222,056 | 252,768 | 269,640 | 286,536 | 307,744 | 307,744 | |
| Proportion of Total ML in Year to 2000 Yr | 32% | 42% | 44% | 45% | 60% | 72% | 82% | 88% | 93% | 100% | 100% | |

**Chart One**




The results effectively show that if we start with the QCA calculated capital contribution of $49.7M for the BRIA we can see that this amount has been fully consumed through the pricing shortfalls in previous years. More specifically the analysis shows that pricing shortfalls back to 1993 have fully consumed the $49.7M. As a result, in accordance with the QCA approach to dealing with capital contributions, BRIA has been fully compensated through past price reductions. SunWater now submits that the capital contribution be added back to the asset base for future price path calculations.

**Optimisation of the Haughton Pump Station**

The Authority adopted SKM's recommendation that submersible concrete volute pumps were the appropriate technology to adopt, along with a cheaper contemporary alternative to the dry well pump station (p50).

SunWater believes that SKM have ignored the historical development of the pump station and have in fact punished SunWater for adopting innovative and world-first technologies.

The first Haughton Pump Station was constructed in accordance with standard engineering practice at the time. Dry well pump stations were the normal solution to this situation and provided highly reliable service to customers. As part of an ongoing assessment of alternatives to minimise capital costs while maintaining service levels, the submersible concrete volute pump option was later examined.

The adoption of concrete volute pumps in flowing rivers was, to SunWater's knowledge, a world first innovation. This innovation provided a substantial cost saving in the development of the scheme. Furthermore, the adoption of such technology for the remainder of the pump station (and achievement of cost savings) was only possible given the presence of the existing dry-well pump station that could reliably pump when the submersible pumps could not be used during certain flood events.

If SunWater were to have continued with the original design, and construct dry-well stations for the remainder of the pump station, then the optimised asset value would be substantially higher.

Submersible concrete volute pumps would not have been considered in the optimisation process as modern day technology had SunWater not adopted them.

SunWater is most concerned as to the signal that the draft report sends to asset developers contemplating breakthrough technologies as it introduces significant regulatory risk to such decisions.

SunWater believes that in fact the Authority should reward such innovation in order to send appropriate signals to the market, rather than remove all the benefits of such innovation or penalise the asset owner as has occurred through the SKM optimisation.

Furthermore, SunWater does not believe the optimised solution suggested by SKM would in fact be cheaper than the existing arrangement. We understand that SKM suggested replacing the dry well pump station (which has two 3.5 cumec pumps) with 7 cumecs of axial flow pumps on the bank of the river for high level flood pumping and six 1.5 cumec submersibles in the bed of the river to maintain the full pumping capacity presently installed.

The capital cost of this was estimated by SKM at $2.37M, saving $4.8M.

SunWater does not believe that this solution would either be practical or could be achieved for the stated cost. The cost of the submersible component alone would be in excess of the stated $2.37M, based on a comparison with similar pumps (five 1.5 cumec units) that SunWater has recently installed elsewhere. This is before the additional cost of the duplicated pumping capacity located higher on the river bank to take water during flood events.

Furthermore, the suggested optimised solution would incur higher operating and maintenance costs, and is exposed to far greater risks of damage (eg from Flood). These additional ongoing costs have not been factored into the optimised solution.

Finally, SunWater does not believe the proposed optimised solution of duplicating low level duty pumps with high level standbys to be practical, and is unaware of any application of such an arrangement elsewhere in Australia. The reason such an arrangement is not practical is that the axial flow pumps have to be high up the bank to be clear of flow induced sediments for large floods, and would not be operable for a significant portion of the river stage between where the low level pumps cease to be able to operate (>6,000 cumecs) and the high level pumps. Hence, there would be significant periods where no pumping would be able to occur when river levels were between the two levels of these pumps.

On a more general note, SunWater believes the approach taken to optimisation by SKM introduces significant regulatory risk to other asset developers. Many of the items optimised by SKM were done so with perfect hindsight without due regard to the reasonableness of the decision at the time. Applying such a harsh approach to optimisation sends a signal to the market that regulators will not optimise with regard to the circumstances of the time but will optimise by applying perfect hindsight. Hence, there are significant risks to developers in terms of financial capital maintenance as it is inevitable that asset values will be overly-optimised using such an approach into the future.

SunWater believes that the optimisation decision should be based on the circumstances at the time, and that asset owners should not be punished for making decisions regarding capacity and design at the time of construction. To do otherwise will introduce significant regulatory risk for those considering providing new assets that would be to the detriment of the economy as a whole.

There are a number of other optimisation issues relating to the assumptions used by SKM to arrive at a DORC valuation that SunWater believes are inappropriate. While many of these are significant, they are not necessarily material in the context of this draft report given the Authority's conclusions.

**Asset Valuation Methodologies**

SunWater notes that the Authority used the capacity of sugar cane growers to pay to determine economic value for the scheme. As noted by the Authority, an accurate assessment of economic value is difficult for a range of reasons spelt out in the draft report.

SunWater submits that the assumptions and methodologies adopted by the Authority should not be interpreted as definitive for determining economic value or any future pricing recommendations outside the context of this particular report.

The Authority's approach essentially makes the scheme value (and potentially the water price) the residual amount after all other input costs for customers are taken into account. This may not be appropriate for all circumstances.

The approach also adopts the predominant use of water to be the basis for the capacity to pay valuation, as opposed to the highest and best use of the water. Adopting the current use may be appropriate in the context of this particular report, but would not necessarily achieve the objectives of any other pricing investigations or recommendations outside this context. For example, setting price signals to encourage the highest value use (given agronomic and other production factors) may be more appropriate in the context of pricing recommendations or other activities undertaken by the Authority.

**Weighted Average Cost of Capital (WACC)**

SunWater has engaged the Network Economics Consulting Group (NECG) to review the QCA's analysis of the WACC for the scheme (attached). The WACC for the scheme has been set at an unprecedented low level compared to other regulatory decisions. SunWater does not believe that this is appropriate given the weight of evidence presented to the contrary to the Authority in its first submission and the analysis of the Authority's draft report in this subsequent submission.

SunWater is also concerned about the signal that such an unreasonably low WACC will send to water developers, particularly given the range of water infrastructure projects currently being considered in Queensland at the current time.

Thank you for the opportunity to provide comments on this draft report.

Yours sincerely

Peter Noonan
**CHIEF EXECUTIVE**

Att: NECG Report

# SunWater

## Response to QCA Draft Report on the Burdekin Haughton Water supply Scheme

**November 2002**

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# Contents

# 1 Introduction

The QCA recently published its draft report for consultation entitled *Burdekin Haughton Water Supply: Assessment of Certain Pricing Matters relating to the Burdekin River Irrigation Area* (the draft report).

This report focuses on the QCA's assessment of the beta for SunWater and its evaluation of the market risk premium. The report is set out as follows:

- section 2 considers the market risk premium and the reasons provided by the QCA not to change from a value of 6% for this parameter;
- section 3 addresses the QCA's assessed asset beta for SunWater's activities in the BRIA; and
- section 4 concludes the paper.

# 2 Market risk premium

The essence of the QCA's approach to the issue of the market risk premium was that there was no statistical basis for it to move away from the 6% it has adopted in a series of regulatory determinations. The QCA also cited correspondence from Professor Bob Officer that the market risk premium fell within a range of between 5% and 7%.

It is accepted that the value of 6% falls within a range of possible values for the market risk premium. This is self-evident given the consensus that the market risk premium has varied between 6% and 8% over the last century. However, the fact that the value falls within a range of possible values does not mean that it represents the value that ought to be adopted for policy reasons.

Recently, Dimson, Marsh and Staunton[1] undertook a comprehensive study of financial market performance for sixteen countries from the end of the nineteenth century to the beginning of the twenty-first, finding that the MRP for the Australian economy was 7.9% over this period with a standard deviation of 1.9%. This means that a 95% confidence interval of the market risk premium would range between 4.1% and 11.7%. Whilst clearly the figure of 6% falls within this range, it does not mean that 6% represents the most appropriate value for regulatory purposes.

The statement that there is no statistical basis to move away from 6% is merely confirmed by the assumptions that underlie it. It says nothing about what the market risk premium should be. The real issue is the most appropriate value for the market risk premium in the first place.

As was indicated in the draft report, there is considerable empirical evidence that the market risk premium varies over time. In its earlier submission, SunWater quoted the relevant comments of the Productivity Commission relating to the estimation of values for regulatory purposes – a point that bears reiteration in the context of the current issue:

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1 Dimson E, Marsh P, Staunton M, "Global Investment Returns Yearbook: 2002", London Business School, Table 5, p35.

> The possible disincentives for investment in essential infrastructure services are the main concern. In essence, third party access over the longer term is only possible if there is investment to make these services available on a continuing basis. Such investment may be threatened if inappropriate provision of access, or regulated terms and conditions of access, lead to insufficient returns for facility owners.
>
> While the denial or monopoly pricing of access also impose costs on the community (see above), they do not threaten the continued availability of the essential services concerned. Thus, over the longer term, the costs of inappropriate intervention in this area are likely to be greater than the costs of not intervening when action is warranted. The substantial information and other difficulties that confront regulators in establishing access terms and conditions, make this asymmetry in the benefits and costs of access regulation even more important in a policy context.[2]

This suggests that there is a strong public interest argument in favour of a higher MRP than has been customary in Australian regulatory decision making in recent years.

In assessing historical evidence, the generally accepted range among corporate finance professionals in Australia has been 6% to 8%.[3] Given this range, it is submitted it makes little sense to estimate a parameter at the low end of this range given the asymmetric consequences of regulation. This is the real issue – rather than whether it is possible to prove a claim or otherwise or whether it is appropriate to move away from a particular position.

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2 Productivity Commisssion, "Review of the National Access Regime. Position Paper", March 2001, pp xviii-xix.

3 For example, see R. Officer, "Rates of Return to Shares, Bond Yields and Inflation Rates: An Historical Perspective," in *Share Markets and Portfolio Theory*, 2nd ed, 1989 University of Queensland Press, St Lucia, 1989, pp. 207-11.

# 3 Assessment of beta

The QCA assessed the asset beta in respect of the Burdekin Haughton Water Supply Scheme at 0.35, generating an equity premium of 2.1%. We are not aware of a lower asset beta or equity premium being explicitly recorded by a regulatory body in Australia.[4]

This section examines the QCA's assessment of the asset beta and the equity premium above the risk free rate as follows:

- section 3.1 provides an overview of the QCA's reasoning in arriving at its beta estimate;
- section 3.2 addresses the QCA's comments regarding adjustments for international beta comparisons;
- section 3.3 analyses the factors affecting the asset beta of the Burdekin Haughton Water Supply Scheme in light of the QCA's analysis;
- section 3.4 considers issues relevant to the benchmarking of other regulatory decisions.

## 3.1 Overview of the QCA's reasoning

The QCA's analysis of SunWater's undiversifiable risk in respect of the BRIA was as follows:

- concerns were expressed with the lack of adjustment undertaken for international comparators;
- the international survey of water companies included developing countries – if these countries and certain others nations are excluded, the average beta of the sample is lower than that submitted by SunWater;

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[4] Indeed, as we demonstrate below, the QCA's approach to re-levering asset betas, which is unique amongst Australian regulators, actually *increases the gap* between the risk premium assessed by the QCA relative to other regulators.

- there are United Kingdom water companies with very low betas;
- returns to the rural sector are more likely to be determined by factors unrelated to the general performance of the economy;
- it is reasonable to expect stable cash flows given the low variation in water required to irrigate sugar;
- the asset beta for SunWater's activities in the BRIA should therefore be consistent with the lower end of the range generally suggested for the urban sector.

## 3.2 Adjustments for international beta comparisons

The QCA criticised the lack of international adjustments made to the beta estimation put forward in SunWater's original submission. There is no generally accepted approach to the adjustment of such betas although one approach that has been suggested is as follows:

$$\beta_{i,OZ} = \beta_{US,OZ} * \beta_{i,US} + cov(R_i, e_{OZ,US}) / var(R_{OZ})$$

where

$\beta_{i,OZ}$ = the domestic beta of an Australian company;

$\beta_{US,OZ}$ = the beta of the US index regressed against an Australian index;

$\beta_{i,US}$ = the domestic beta of a US company; and

$cov(R_i, e_{OZ,US}) / var(R_{OZ})$ = the relationship between the return of company i and the return on the Australian market that is uncorrelated with the return on the US market.

If we assume that the last term in the equation above equals zero (so that the component of the return on the Australian market that is uncorrelated with the return on the US market is also uncorrelated with the return on stock i), the equation then reduces to:

$$\beta_{i,OZ} = \beta_{US,OZ} * \beta_{i,US}$$

The essence of the adjustment is to regress the foreign company onto the Australian market. In other words, this transformation estimates the foreign country beta (say, US company) as

if it were listed in another country (say, Australia) whilst continuing to operate in its home country (the US).

The relevance of this transformation is questioned – what we are really trying to ascertain amongst a number of countries is the covariance between the water business and the economy in which it operates – as opposed to the covariance between the water business and a foreign country (in this case Australia).

In practice therefore, it is submitted that these adjustments lose sight of the essential fact that a beta estimates a level of volatility relative to the market with which the covariance is assessed.

Accordingly, much can be learned from applying a beta estimate in the way that was undertaken – it showed that in many economies water businesses exhibit a relatively high correlation with the local economy. The essential point is that beta is a *relative* measure of covariance. That relativity is important irrespective of the volatility of one market or another.

In other words, one cannot criticise the irrelevance of a "high" beta measure in a highly volatile exchange on the basis that it will be too high for Australia since the measure simply records the covariance between the stock and that (highly volatile) market – generally speaking, the beta would be even higher were the market to exhibit lower volatility.

Indeed, despite the QCA's comments on the lack of an international adjustment, it appears that the QCA was content not to make such adjustments in conducting its analysis of the beta for the BRIA. Moreover, the absence of adjustments of the type suggested would appear to accord with the QCA's previous practice.[5] It is therefore submitted that the unadjusted approach is appropriate for current purposes.

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[5] It would appear that there were no adjustments adopted in the QCA's decision on the Gladstone Area Water Board.

## 3.3 Factors affecting SunWater's asset beta

The uncertainty created by the absence of domestic or even close international comparators makes the assessment of beta very problematic. However, it is noted that the asset beta of CSR, a major refiner of sugar which operates in the Burdekin is 0.75 (unadjusted) or 0.76 adjusted provides some guidance to the assessment of the appropriate beta for SunWater's operations in the BRIA.[6]

Moreover, there are some critical observations that can be made:

- on the cost side, SunWater's sensitivity to the general economy is likely to be significant and at least equal to the other comparators used in the QCA's analysis; and
- on the revenue side, SunWater's volatility is likely to be at least as high as other water businesses considered in Australian regulatory decisions to date.

It is submitted that the appropriate basis for the assessment of SunWater's beta in its BRIA operations is in the context of it adopting a market based pricing approach as described in the draft report so long as it does not involve the extraction of monopoly profit over time (after taking into account assessed contributed assets etc).

In this regard, the draft report is noted in respect of its position that:[7]

> As the current price paths do not provide a mechanism by which SunWater can capitalise on past capacities to pay, it would be inappropriate to reduce the level of return when the expected capacity to pay is low. The situation would be different if SunWater had a more market based pricing policy which sought to share in

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6 Based on an equity beta of 0.95, debt to value ratio of 0.27 (sourced from Bloomberg) and an "A" credit rating. It is noted that CSR has a presence in several markets – although its sugar refining business represents a not insignificant component of its operations.

7 Page 103

industry highs and lows with other participants in the industry. This is of course an option for future price paths.

It is submitted that the primary concern for the assessment of asset beta should be the signal provided to new investment by the way in which past investment is remunerated. Accordingly, whilst low infrastructure prices might be associated with low volatility, this volatility is a function of a regulatory environment. Regulators could reduce betas for all regulated industries merely by insisting that they set prices at short run marginal cost. However, clearly assessing the volatility of the cash flows (and in turn covariance) on this basis would be fundamentally incompatible with attracting new investment to water infrastructure, or, for that matter, any other infrastructure.

In other words, whilst the setting of a price path at a level that is materially below a commercial return can remove much of the volatility from an entity's cash flows, it also results in the regulatory intervention distorting the assessment of beta. Notice that this is a different situation to that normally found in regulatory settings, where the regulator sets the price (or the maximum allowed revenue) at a level which is deemed to approximate the outcome of a competitive market.

Accordingly, the following analysis proceeds on the basis that the beta for SunWater's activities in the BRIA should be assessed on the basis of the QCA's suggestion of possible pricing arrangements (as described above).

### 3.3.1 Cost related exposures to the economy

The correlation between SunWater's costs and the economy as a whole should be very similar to the other water companies that have been considered in regulatory decisions. Accordingly, there is no basis for suggesting a relatively low beta value for SunWater's activities in the BRIA on account of cost related concerns.

### 3.3.2 Revenue exposures to the economy

It is also contended that it would be a mistake to simply assume that a low beta is appropriate for SunWater merely because of its exposure to international sugar market. This is based on the following observations:

- it is reasonable to expect that SunWater's capacity to earn revenue from its operations will be significantly affected by domestic macroeconomic factors;

- the export orientation of SunWater's customers business does not necessarily justify a low asset beta; and
- SunWater is exposed to material volume risk (including current excess capacity).

It is submitted that for the purposes of assessing SunWater's rate of return, it should be assumed that SunWater faces a pricing environment that best reflects its capacity to earn a commercial rate of return on its investment. However, an inevitable corollary of this approach for SunWater's operations in the BRIA is that it creates pricing volatility which should be considered in the context of beta.

The QCA's previous investigations have highlighted the impact of pricing risk on equity and asset betas. For example, table 15.8 of the QCA's *Final Decision on the Proposed Access Arrangements for Gas Distribution Networks: Allgas Energy Limited and Envestra Limited*:

**Table 15.8: Summary of domestic comparable asset betas**

| Industry | Asset beta range (based on adjusted equity betas) |
|---|---|
| Gas distribution (listed companies) | 0.46 – 0.47 [1] |
| Electricity generation (listed companies) | 0.88 – 1.22 |
| Electricity distribution (listed companies) | 0.46 |
| Gas distribution (regulatory decisions) | 0.40 – 0.60 |
| Electricity distribution (regulatory decisions) | 0.35 – 0.50 |

[1] The actual range for Australian gas distributors is 0.09 to 0.47. However, for Envestra (asset beta of 0.09) the equity beta was estimated using only 46 observations, and the company had a leverage ratio of 0.8328. This makes Envestra's leverage ratio and therefore its asset beta an outlier relative to other distributors, which have a leverage ratio in the range of 0.1736 to 0.2988. It was therefore excluded.

Notice in this table the fact that the asset betas for the electricity generators materially exceed those of distributors – the key difference being the extent to which generators operate in a competitive market and consequentially face price volatility.

In this regard, the following observation from the draft report is instructive:

> However, the Authority notes that the estimated capacity of sugarcane producers to pay has shown considerable volatility in the past and may do so in the future. The Authority also notes that, given that volatility, point in time estimates of expected capacity to pay based on future prices are necessarily quite problematic and caution needs to be exercised when using them for pricing purposes.

The key point here is that in assessing SunWater's asset beta in respect of its activities in the BRIA it is important that it be considered in the context of the environment – most notably one in which the inherent volatility in the returns is considered in the absence of a constraint that requires prices be maintained for a period well below upper bound (the normal starting point for pricing and regulatory investigations).

Therefore, the fact that SunWater faces price volatility if it is to earn a commercial return must affect the assessment of beta. We are not aware of an instance in Australian regulatory history where a service provider is exposed to such a high level of volatility in earnings if it is to earn a commercial return on its investment.

Furthermore, SunWater's capacity to earn such a return can be expected to be materially affected by domestic factors, most particularly, interest rates and exchange rates because of the impact of these parameters on its customers. The exposure to interest rates was highlighted in the draft report and confirmed by the Queensland Rural Debt Survey undertaken by the Queensland Rural Adjustment Authority which is illustrated below (the peak in the figure corresponds to the region comprising the Burdekin).[8]

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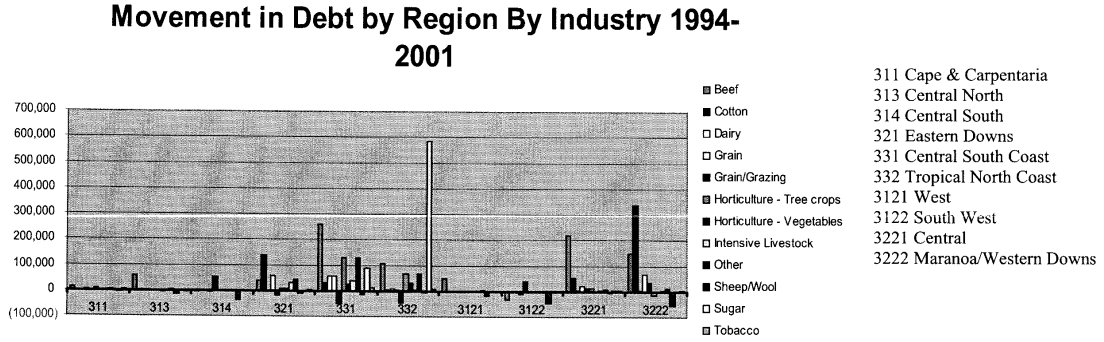
8 Queensland Rural Adjustment Authority (2002) Rural Debt in Queensland Survey, p24.




Source: Queensland Rural Debt Survey, January 2002

The extent of debt is likely to materially affect the exposure to interest rates and with it SunWater's exposure to interest rates through the exposure of its customers. This means that the covariance of SunWater's returns with the Australian market can be expected to be higher than that normally experienced by urban water suppliers.

In addition, SunWater's capacity to earn a commercial return will also be affected by another macroeconomic variable, namely exchange rates. This is because the sugar that is produced in the BRIA region is exported – hence the capacity to pay for water infrastructure related services will be materially affected by interest rates. Again, we are not aware of a similar situation arising in Australian regulatory history.

Moreover, it is submitted it is wrong to suggest an export orientation necessarily results in a low beta because of a low correlation between sugar prices and domestic equity markets.[9] Australia is a small open economy – nearly ¼ of Australian GDP is made up of exports.[10] However, export orientation is not necessarily conducive to a low beta – for example, Figure 2 below illustrates that the industry average beta for diversified resources is well above 1 whilst the industry average equity beta for energy which is about 0.8.

9 Page 80.

10 ABS Series 5204 for 2000/01 financial year gives the ratio of exports to GDP of 22.9%.

Table 1 lists several Australian companies who earn a substantial proportion of their income from foreign sources and highlights that these companies have relatively high betas.

**Table1 – Betas for export orientated Australian companies**

| COMPANY | % | Equity beta | Raw asset beta | Adjusted asset beta |
|---|---|---|---|---|
| News Corporation | 94% | 2.05 | 1.61 | 1.34 |
| CSR | 55% | 0.95 | 0.75 | 0.76 |
| Westfield | 75% | 0.64 | 0.60 | 0.71 |
| James Hardie Industries | 80% | 0.68 | 0.63 | 0.72 |

Source: JB Were Research and Bloomberg

Finally, the foregoing discussion has focused on pricing related risks. However, it is noted that SunWater's predominant customer in the region is currently under extreme stress. Accordingly, beyond the price related risks outlined above, there must also be material volume related risk – if the sugar industry is to substantially scale back its activities it must materially affect SunWater's capacity to earn revenue for an extended period of time. This risk only serves to highlight the case for a relatively high asset beta to be assigned for SunWater's operations in the BRIA. Furthermore, SunWater's operations in the BRIA are currently the subject of excess capacity, a factor the QCA thought of particular relevance in the assessment of the rate of return for GAWB.[11]

### 3.3.3 Validity of international comparisons

It is noted that the QCA referred to the declining betas of British water companies. However, based upon Bloomberg data (November 2002) the standard error of the beta

[11] This is discussed further in section 3.4.1 below.

estimates of each of the water companies was sufficiently high that, from a statistical perspective, the betas contain relatively little information from which any inferences of fact can be drawn. Statistically, it is likely the measured decline is not nearly statistically significant. Therefore, no implications about a trend can be made from the data.

## 3.4 Comparison with other regulatory decisions

There are three issues that emerge from the QCA's consideration of other regulatory decisions:

- the consistency with other regulatory decisions of the QCA;
- the relevance of the range that has been adopted by other regulators; and
- the beta adjustment process adopted by the QCA which results in lower risk premia relative to the other regulators against which the QCA has benchmarked the asset beta.

### 3.4.1 Comparison with other QCA decisions

In the QCA's *Final Report Gladstone Area Water Board: Investigation of Pricing Practices*, concluded that GAWB's asset beta was 0.45 on account of:

> The main factor which supports a beta towards the upper bound of the range is uncertainty associated with future sales and thus future revenue stability. Firm commitments have been established for only 20 per cent of the 40,000 megalitre current capacity augmentation.

Notice however, that SunWater also is exposed to volatility in returns arising from the current excess storage capacity in the Burdekin Falls Dam. Moreover, for the reasons described above, it is submitted SunWater is exposed to material volume risk.

Interestingly, GAWB's existing demand was largely driven by industrial demand which in turn was backed by take or pay contracts. The customer whose demand is likely to be most highly correlated with the economy was that of a base load generator operating at the lower end of the generation cost curve (suggesting relatively low volume risk and no price link). Any risk from industrial demand is also moderated by take or pay arrangements and the fact that water constitutes a relatively minor cost for the relevant production processes.

This situation can be contrasted with the environment it is suggested should underpin the assessment of the beta for SunWater's BRIA operations, namely where there is a degree of volatility in future pricing levels due principally to movements in international sugar prices, domestic interest rates and exchange rates. Whilst these factors would no doubt be relevant to GAWB in some way, particularly in relation to new sales, it is clear that the directness of the impact is more dramatic in the case of SunWater's BRIA operations as it affects virtually the totality of its potential revenue from the region. Accordingly, it is submitted that SunWater's asset beta should lie above that assigned to GAWB.

The QCA assigned an asset beta of 0.45 for both QR and the electricity distributors. Whilst exposure to the economy on the cost side is similar for SunWater's BRIA operations, the fact that regulatory arrangements for both QR and the electricity distributors involved revenue caps (in the case of QR, this being provided as an option) means that there is little exposure to the domestic economy for the regulated cash flows of these entities – in marked contrast to SunWater.

Finally, the QCA assessed the asset beta for gas distributors at 0.55 partly as a consequence of size and also the higher risk associated with a price cap as opposed to a revenue cap (principally manifesting itself in intra-regulatory period volume risk). However, it is likely that the volatility of the cash flow from SunWater's operations in the BRIA (on the basis of the stated assumptions) would be higher again than the gas distributors on account of the range of possible pricing outcomes and the fact that it too is subject to material volume risk.

### 3.4.2 Range adopted by other regulators

The QCA summarised regulators' decisions on water asset betas as follows:

> Based on all the above, it has been concluded that asset betas for the water industry typically fall within a range from 0.3 to 0.45, with most falling around 0.3 to 0.4, although GPOC considers they may range up to 0.55 in Tasmania given that State's smaller water businesses and the tendency for these to have less diversified customer bases.

It is submitted however that whilst this accurately depicts regulatory decisions on the asset beta, those decisions do not represent the totality of the available data on the issue. This is highlighted by the international sample of statistically significant betas provided to the QCA as part of SunWater's initial submission.

For example, even applying the sub-sample suggested by the QCA (being the US, the UK, France, Spain, Italy provides a range of between 0.29-0.77 (unadjusted) and 0.38-0.85 (adjusted).[12] It is noted that even this list omits OECD countries such as Greece whose inclusion increases the upper end of the range to 0.88 (unadjusted) and .91 (adjusted).[13]

Moreover, it is submitted that the selective interpretation of a world-wide sample is not justified for the reasons outlined above – what is being measured is relative risk in the context of an economy. Moreover, it is noted that once regard is had to the dispersion around beta estimates, there is little difference between the asset beta range of OECD and non-OECD countries – which is not surprising given that beta measures risk relative to an economy.

Our survey of regulatory decisions suggests that this issue may not have been the subject of a thorough international benchmarking exercise in previous investigations (which generally have been limited to the UK, the US, New Zealand and in some cases France). Indeed, if it were, it is suggested that a wider range of asset beta estimates would have been considered.

### 3.4.3 Approach to debt beta in regulatory decision making

Regulatory bodies have adopted different practices to the quantification of debt betas which means that comparing asset betas in isolation does not portray an accurate reflection of allowed risk margins. In regulatory decisions in Australia, two main approaches have been taken on the debt beta:

- estimating the debt beta using the debt risk premium (DRP) and the CAPM structure, or

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12 This assumes a debt beta of .144.

13 It is thought inappropriate to limit an international survey in this way – for example, limiting the assessment to OECD countries would exclude Brazil – yet Cia Saneamento Basico De SP services the San Paulo district which produces approximately one half of Brazil's sugar.

- assuming the debt beta is zero or a number materially lower than the DRP would imply.

The first view (and that adopted by the QCA) begins with the argument that debt is risky. This is evidenced and measured by the DRP. The debt beta is estimated in the context of the CAPM structure using the estimates of DRP and market risk premium (MRP). To illustrate, assume the DRP = 1.5% and MRP = 6%. Then the CAPM structure in excess returns form is used as follows:

$DRP = ß_d * MRP$

$ß_d = DRP \div MRP$

$ß_d = 1.5\% \div 6\% = 0.25$

The second view (and that adopted by many other regulators in Australia) is argued from two different perspectives. Regulators have sometimes argued that they will assume the debt beta is zero for simplicity. Others argue that the systematic risk of debt is low and in particular, much lower than assumed by the first approach set out above. This is because the volatility of returns to debt is not highly correlated with volatility in the market. Therefore, the debt beta is lower than that implied by the DRP (and in some cases approximately zero) and the return to debt can be represented as:

$R_d = R_f$ + R(systematic risk) + R(default risk) + transactions costs

This approach highlights that the DRP is a reward for systematic risk, default risk and recovery of transactions costs. However, with the assumptions of the CAPM there is no reward for default risk (independent of systematic risk) and there are no transactions costs. Therefore, on this view, the debt beta should be based only on the extent of which the returns to debt vary systematically with the market. Because of the difficulty of measuring returns to debt, there is a dearth of empirical literature that provides measurements of this systematic risk. However, consideration of the behaviour of debt yields and other insights

into the issue support an estimate that the systematic risk of debt is below that implied by the DRP alone (and sometimes it has been assumed to be near zero).[14]

In summary, the approaches adopted by the regulators include:

- the QCA determines the debt beta based on the first approach – namely the debt premium divided by the market risk premium;
- the ACCC has traditionally adopted a value of zero in its electricity decisions and a value between 0.06 and 0.15 in its gas decisions;
- the ESC has adopted a pragmatic approach, and in its most recent decisions has adopted a value of between 0 and 0.12; and
- IPART has assumed a debt beta of 0.06 in its decisions to date.

The implication of the QCA approach is that the nominal vanilla WACC can be estimated solely from the CAPM using the asset beta. For other regulators, the DRP has an additional significance as it represents an additional return above that implied by the asset beta in isolation (in contrast to the QCA approach).

The effect of this different approach is seen in figure 1 below, which sets out, for all QCA decisions and the most recent decisions of other regulators, the asset beta multiplied by the

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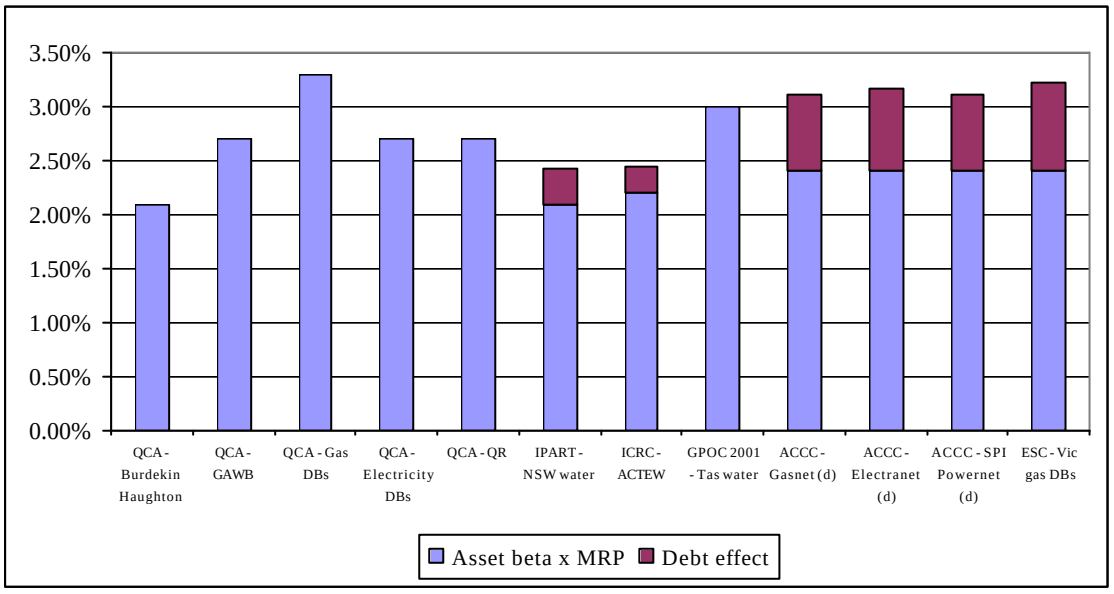
14 The rationale for a low debt beta is further clarified when we consider why we generate a debt beta in the first place. Its only use in estimating a WACC is in the de-levering and re-levering of equity betas. It is fundamental to note that all of the conversion formulas that use debt beta are in a CAPM framework, including the CAPM assumptions. What is important as we convert between asset betas and equity betas is systematic risk. The role of the debt beta is to show how there is a sharing of a firm's systematic risk between the systematic risk of equity and the systematic risk of debt. This justifies measuring the debt beta only in terms of its systematic risk. If debt has risks that are rewarded in the market, but are assumed away in the CAPM world, then they would not be relevant to the de-levering and re-levering process.

market risk premium plus any increment allowed in the WACC to reflect the effect of the debt beta being set below the debt margin divided by the market risk premium.

The key point is that the QCA should make a corresponding adjustment to take account of the debt beta when benchmarking off other Australian jurisdictions. Alternatively, debt betas should be estimated to incorporate only systematic risk which in turn suggests that debt betas in general should be much lower than applied in the QCA's regulatory processes to date.

**Figure 1: Composition of premium of vanilla WACC over the risk free rate: QCA and other recent decisions**




The implication of the differing approaches, as illustrated in figure 1 is that comparing the asset betas allowed by regulators is misleading unless the approach to the debt beta is considered.

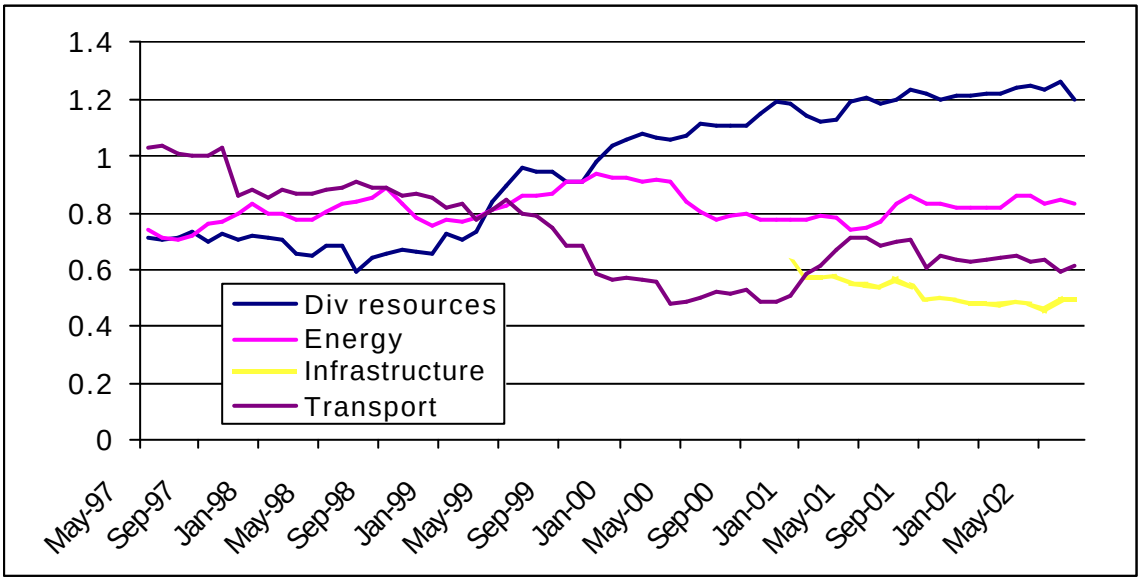
## 3.5 The case for beta adjustments

The QCA indicated that it considers both adjusted and unadjusted beta estimates in its analysis, although it appears that in the current case it relied exclusively on unadjusted beta estimates (the sample included no raw asset betas in the vicinity of that ultimately applied by the QCA).

In assessing betas, the following comments are offered:

- beta measures are subject to high levels of dispersion – the average dispersion is over 0.30;
- beta measures are volatile – figure 2 illustrates this volatility by comparing industry average betas over time. Note that individual company betas can be expected to exhibit greater volatility than industry averages.

**Figure 2 Volatility in industry average betas over time**




The Attachment to this submission sets out the basis for adjustments to beta from a technical perspective.

In such an environment, there is substantial cause to be concerned about the level of precision inherent in the measurement of beta, particularly where it is used to set maximum prices. The importance of the issue is only magnified when it is noted that it is not possible for regulated businesses to hedge against this volatility or the regulatory risk involved in beta estimation. This is in contrast, to say, uncertainty in the 10 year bond rate, where regulated businesses have an opportunity to hedge their exposure to movements in that parameter.

Several beta providers have responded to this uncertainty by applying adjustment factors. It is submitted that more explicit reference to the treatment of adjusted asset betas ought to be applied by the QCA.

# 4 Recommendation

It is recognised that difficult judgements form an inherent and unavoidable component of regulatory decision making and that indeed, the there are even more difficulties in assessing an appropriate asset beta in respect of the BRIA than normally arises in regulatory investigations. Nevertheless, in spite of these difficulties, the QCA decided to adopt an asset beta which is extremely low when compared to other regulatory decisions in Australian history.

SunWater submits therefore that considerably greater caution is appropriate in assessing the equity premium for SunWater's operations in the BRIA. In particular, the reality of substantial uncertainty highlights the importance of not adopting too low a rate of return in the current circumstances – especially the importance of moving away from a finding that we believe represents the lowest risk margin in Australian regulatory history. In this regard, SunWater notes the recent finding of the Productivity Commission:

> "These considerations suggest that regulators should not be too ambitious in their approach, and that governments should not place too great a level of expectations upon them. A sensible goal is to improve on unregulated outcomes, but recognise that precision is not possible with the information and instruments available." [15]

SunWater therefore contends that an asset beta of 0.60 is appropriate for the BRIA on the basis that:

- it is consistent with international evidence of the riskiness of water businesses generally;
- SunWater does not have the market power that is enjoyed by most regulated businesses – in particular, any return on its asset base in any regulatory environment that affords it the opportunity to earn a commercial return (the appropriate basis to consider opportunity cost concepts such as the cost of capital)

15 Productivity Commission (2001), Review of National Access Regime, Position paper, Canberra, March, page 207.

will only ever be the subject of substantial price volatility which is unprecedented in Australian regulatory experience to date;

- there is good reason to believe that SunWater's pricing flexibility would be materially affected by domestic economic conditions, and in particular, more so than urban water businesses; and
- there is also good reason to believe that SunWater is exposed to material volume risk for the foreseeable future.

# Attachment - Tendency for Regression to the Mean of Estimated Betas

It is a well-documented empirical result that estimates of beta for securities have a strong tendency to regress toward the mean of all betas of one. The seminal research in this area is attributed to Marshall Blume (1971, 1975). Betas that are estimated to be greater (less) than one in a period, tend to be lower (higher) in the subsequent period.

An empirical estimate of beta will be made with error.

$$\hat{\beta}_{it} = \beta_{it} + \varepsilon_{it}$$

where

$\hat{\beta}_{it}$ = estimated beta of security i in time t,

$\beta_{it}$ = true beta of security i in time t, and

$\varepsilon_{it}$ = measurement error term of security i in time t.

To illustrate the effect of measurement error through time, it is conventional to assume that $\varepsilon_{it}$ is independent, homoskedastic normal distributed with mean-zero.[16] Also, the true beta is allowed to be non-stationary,[17] and the estimated and true betas are assumed to be distributed bivariate normal.

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16 That is the error process is stationary white noise. Analytically, $E(\varepsilon_{it}, \varepsilon_{it-j})$, $j \neq 0$, $E\left(\varepsilon_{it}^2\right) = (\sigma_i^2)$ $\forall t$, $\varepsilon_{it} \sim N(0, \sigma_i^2)$. Intuitively, this assumption means that the measurement error does not display memory.

17 The assumption that is generally made in this literature is that true beta is non-stationary. We use that assumption. However, a better assumption is that true beta is time varying. So, $\beta_{it} = \overline{\beta_i} + \varphi_i$, where $\varphi_i$ is white noise. For purposes of this discussion, the distinction is not critical.

With these assumptions, there are two reasons why, in general, $\hat{\beta}_{it} \neq \hat{\beta}_{it+1}$. First, the measurement error in the estimated beta in one period will tend to revert to its expectation of zero in the subsequent period. Secondly, the true beta may change such that $\beta_{it} \neq \beta_{it+1}$.

## Measurement error

To illustrate the first case where measurement causes reversion to the mean, an example adapted from Blume (1975) will be used. Because the expected value of $\varepsilon_{it}$ is zero in all periods, the expectation of $\hat{\beta}_{it}$, conditional on $\beta_i$, is $\beta_i$ for all periods.[18] That is, $E(\hat{\beta}_{it} | \beta_i) = \beta_i$. However, when beta is estimated, $\varepsilon_{it}$ may not equal zero. Therefore, $\hat{\beta}_{it}$ may not equal $\beta_i$.

Assume that $\beta_i$ = 1.0 and that $\varepsilon_{it}$ equals zero with probability 0.4, equals -0.2 with probability 0.3 and equals +0.2 with probability 0.3. Then, the outcome table for $\hat{\beta}_{it}$ is:[19]

$\hat{\beta}_{it}$ = 0.8 with probability 0.3

$\hat{\beta}_{it}$ = 1.0 with probability 0.4

$\hat{\beta}_{it}$ = 1.2 with probability 0.3

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18 To indicate that the true beta is assumed stationary in this example, the time period subscript is dropped.

19 This example is simplified to a discrete distribution for expository simplicity.

Because of the probability distribution assumed for the measurement error, the expectation of $\hat{\beta}_{it+1}$, conditional on $\beta_i$, is again $\beta_i$. Therefore, $E(\hat{\beta}_{it} - \hat{\beta}_{it+1}) \approx E(\varepsilon_{it})$, and the estimated beta in period t+1 will tend to revert to the true beta (which is assumed to be stationary). Across all securities the mean of all true betas is one by construction, so a general description of the process is that it tends to revert to the mean of one.

It is clear from the discussion above that conventional assumptions on the behaviour of the factors (the betas and measurement error) leads to observed mean reversion in the estimated betas.

## Non-stationarity of the true beta

A second source of difference between $\hat{\beta}_{it}$ and $\hat{\beta}_{it+1}$ can be from non-stationarity in the true beta. From the assumption that measurement error is distributed independent normal with mean-zero, $E(\hat{\beta}_{it}|\beta_{it}) = \beta_{it}$ and $E(\hat{\beta}_{it+1}|\beta_{it+1}) = \beta_{it+1}$.[20] Then when non-stationarity of the true beta results in $\beta_{it} \neq \beta_{it+1}$ it follows that $E(\hat{\beta}_{it} \neq \hat{\beta}_{it+1})$.

From this analysis of non-stationarity in the true beta, it is shown that the estimated beta may shift between periods. However, the analysis does not establish the direction of the shift. So the analysis does not necessarily support the observed mean reversion.

Although the analytical analysis does not indicate a direction of shifts in estimated beta, empirical research by Blume (1975, 1979), Elgers et al (1979) and others does indicate that non-stationarity displays mean reversion properties. Blume (1975, p786) says, "that for some unstated economic or behavioral reasons, the underlying betas do tend to regress towards the mean over time."

Changes in the business or financial risk of the company will change the true beta of the company. Two factors that would likely be important would be changes in the investments or the capital structure of the company. If there is an optimal capital structure for a

20 To allow for non-stationarity in the true betas, the subscript for time is reintroduced.

company[21] and changes in capital structure move the company toward its optimal level, then mean reversion will tend to result. If a company's leverage is below (above) its optimal level, its beta will tend to be below (above) its mean. A change in leverage toward the optimum will then increase (decrease) its beta toward the mean.

The impact of changes in investments of a company upon the true beta is not so clear. It could be argued that low beta companies may seek higher risk investments, while companies that have high betas will tend to seek lower risk investments. However, this is only conjecture and empirical support for such behaviour is sparse.

In conclusion, the observed mean reversion in betas is consistent with the expected impact of measurement error in the estimation of betas. Non-stationarity in true betas will tend to cause shifts in estimated betas, but a case that this will tend to induce mean reversion is problematic.

## Adjustments for mean reversion

Vasicek (1973) has proposed a Bayesian adjustment procedure to correct for the measurement error in estimated betas. This approach has had some application in empirical research, but it seems to have had little if any application in practice.

A standard approach has developed to correct for measurement error in estimated betas. This approach makes use of a weighted average of the estimated beta and the assumed mean beta.[22] Analytically this is:

$$ß_{adj} = ? * ß_{raw} + (1-?) * ß_{mean}$$

[21] This is a contentious issue and many experts do not accept that there is an optimal capital structure. The discussion in this section depends upon the existence of an optimal level, and that managements changes in leverage will be in the direction of the optimal level.

[22] The assumed mean beta in this approach is comparable to the prior on the true beta in the Bayesian approach of Vasicek (1973). The Bayesian approach also makes use of variances of the prior and estimated beta distributions.

where ? is the weight given to the estimated beta ($\beta^{raw}$). It is standard practice to assume that $\beta^{mean} = 1$.

This approach has significant support in practice. Three of the world's most prominent and reputable purveyors of beta estimates use this approach. The companies and their weighting factors are:

| | |
|---|---|
| Bloomberg | ? = 0.67 |
| Merrill Lynch | ? = 0.65 |
| Value Line | ? = 0.67 |

The effect of the adjustment is to adjust the raw beta so that the adjusted beta is closer to the market-wide mean of one. The following table shows the result of using this approach with a weighting factor of 0.67 and a mean beta of one.

| $\beta^{raw}$ | ? | $\beta^{adj}$ |
|---|---|---|
| 0.7 | 0.67 | 0.80 |
| 1.0 | 0.67 | 1.00 |
| 1.6 | 0.67 | 1.40 |

## Conclusion

There is substantial empirical evidence that conventional ordinary least squares estimates of beta demonstrate mean reversion properties.[23] There are at least two explanations of why this is observed: measurement error and non-stationarity of the true betas. The tendency for measurement errors to contribute to mean reversion is clear and a standard result in

[23] Research by Chen and Sauer (1997) also shows mean reversion tendencies in returns of corporate bonds and preferred stock.

statistics. A case can be made to support non-stationarity contributing to mean reversion, but it is more problematic.

There is substantial support in practice for adjusting estimated betas toward a mean of one. The best-known approach is based upon a weighted average of the estimated beta and the expected mean beta. This approach has long-standing use in practice as well as empirical support. To the extent that providers of beta estimates make their estimation procedures known, there is broad agreement that the weighting factor (i.e., ?) should be approximately 0.67.

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