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Cost of Capital for Water Infrastructure Company

Report for the Queensland Competition Authority

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1 Introduction

NERA Economic Consulting (NERA) has been asked by the Queensland Competition Authority (the Authority) to estimate the value of the company-specific parameters in the weighted average cost of capital to be applied to SunWater.

SunWater's existing irrigation price path commenced on 1 July 2006 and is due to expire on 30 September 2011. The Premier and the Treasurer (the Ministers) have directed the Authority to develop irrigation prices to apply to the following SunWater water supply schemes (WSS) from 1 October 2011 to 30 June 2016:[1]

Barker Barambah	Lower Fitzroy
Bowen Broken Rivers	Macintyre Brook
Boyne River and Tarong	Maranoa River
Bundaberg	Mareeba-Dimbulah
Burdekin-Haughton	Nogoa-Mackenzie
Callide Valley	Pioneer River
Chinchilla Weir	Proserpine River
Cunnamulla	St George
Dawson Valley	Three Moon Creek
Eton	Upper Burnett
Lower Mary	Upper Condamine

For all schemes, or segments of schemes, irrigation prices will include a commercial return of, and on, prudent capital expenditure for augmentation commissioned after 30 September 2011. We note that the capital cost of any dam safety upgrades will not be covered by irrigation prices.

[1] Queensland Government Gazette No. 117, 17 December 2010.

1.1 The *WACC* equation

The standard method for determining a commercial return is to calculate a weighted average cost of capital (*WACC*). The *WACC* formula applied by the Authority is a *nominal 'vanilla' post-tax WACC* as shown below:

$$WACC = r_e(1 - L) + r_d \times L$$

where

r_e is the nominal return on equity, determined by a domestic Sharpe-Lintner capital asset pricing model (CAPM), ie:

$$r_e = r_f + \beta_e \times (r_m - r_f)$$

where

r_f is the domestic risk-free rate;

β_e is the levered equity beta of the asset; and

$(r_m - r_f)$ is the forward looking domestic market risk premium;

r_d is the nominal cost of debt, that is, the expected return on domestic corporate debt,

$$r_d = r_f + DM$$

where

DM is the nominal debt margin, ie, the difference between the risk-free rate and the expected total cost of appropriately rated corporate debt; and

L is the assumed proportion of debt financing to debt plus equity financing (ie, value) of a benchmark efficient business.

The *WACC* formula can be specified on either a pre- or post-tax basis in either real or nominal terms, with the appropriate *WACC* formula depending on how the regulated cash flows are determined.

1.1.1 Market v specific parameters

The estimation of the required return on equity and debt contains both company-specific and market parameters. Market parameters are those elements of the *WACC* that would be the same for all companies. For example, estimates of the risk-free rate (r_f) and the market risk premium (*MRP*) would be the same for all companies. By contrast, company-specific parameters provide investors with compensation for the risks of investing in a particular company. The three company-specific parameters of the *WACC* formula are:

- the assumed proportion of debt financing in the capital structure (*L*);
- the debt margin (*DM*), which is the difference between the risk-free rate and the total cost of appropriately rated corporate debt; and

- the levered equity beta (β_e), which is a measure of the non-diversifiable asset and financial risk to an investor of holding the equity of a particular company within a diversified portfolio.

The remainder of this report is structured as follows:

- section 2 – provides some background to SunWater's regulated activities;
- section 3 – analyses the appropriate benchmark leverage for a water infrastructure business;
- section 4 – considers the available evidence on the total costs of debt and the debt margin;
- section 5 – estimates the levered equity beta of a water infrastructure business;
- section 6 – provides estimates of the market parameters of the *WACC*, ie:
  - the risk-free rate;
  - market risk premium;
  - forecast inflation; and
  - value of imputation credits; and
- section 7 – provides a short conclusion to our analysis.

Attached to this report are three appendices. Appendix A sets out the companies considered in our equity beta analysis. Appendix B sets out some alternative methods for estimating the equity beta that were investigated, but not used in our analysis. Appendix C provides some alternative estimates of the equity betas of portfolios of regulated utilities.

2 Background and Context

The price investigation currently underway for 2011-16 is the first review for which a *WACC* will be applied to new augmentation asset owned and operated by SunWater. Specifically, the Ministers' direction requires that irrigation prices include a commercial return on prudent capital expenditure for augmentation commissioned after 30 September 2011.

It is therefore important to examine the nature of SunWater's business and existing regulatory arrangements in order to identify the key issues for consideration in determining the commercial return required by SunWater.

2.1 Overview of SunWater

SunWater is a statutory Queensland Government Owned Corporation (GOC) established on 1 October 2000. It provides a number of services to irrigators including:

- *bulk water delivery* - the storage and delivery of water using dams and weirs to a customer in accordance with their entitlements;
- *channel/network services* - the diversion of water to a customer's offtake using pump stations and distribution works; and
- *drainage services* - the acceptance and disposal of water from land serviced by the channel network.

SunWater operates under a 'decentralised' water delivery regime, whereby SunWater owns and maintains the service infrastructure and provides a contracted service to its customers that own water access entitlements (WAEs). SunWater also holds WAEs to account for distribution losses, general allocations without a specific purpose and reserve allocations that are held for a specific customer or use.[2]

This decentralised regime means that water users undertake their own supply management decisions, which includes planning and procurement for any future demand changes.[3] Users can manage their water supply risks by holding surplus entitlements with SunWater, sourcing alternative supplies (eg, groundwater) or using temporary trade markets. Under the decentralised regime, when SunWater undertakes investments to generate additional water entitlements, existing users neither bear the costs of spare capacity nor the risks associated with whether or not that capacity is taken up. Rather, under the current arrangements, users who derive a benefit in the form of additional entitlements to water pay for the cost of providing that benefit. SunWater does not provide water treatment other than that required to comply with its environmental obligations.

SunWater primarily provides three types of services:

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2 SunWater, *Tier 1 Working Paper No. 11, Treatment of SunWater Allocations, Reserve Allocations and 'Free' Allocations*, 2 March 2006, pg1.

3 SunWater, *Background Paper QCA Review of Irrigation Prices: Service Framework*, May 2010.

- a bulk water service;
- a network service; and
- a drainage service.

The following sections briefly describe each of these services.

2.1.1 Bulk water service

SunWater's bulk water service involves storing and delivering raw water to customers in accordance with those customers' entitlement to take it (as prescribed by the customers' WAE). Customer entitlements have two features: the location for taking the water (usually defined by a section of river); and the priority of their water right or allocation (usually defined as high or medium). Water releases are scheduled by SunWater and constrained by storage outlet size and travel times to reach customers' premises.

The Resource Operating Plan (ROP) is the overarching regulatory framework for SunWater's bulk water service, which is approved by the Department of Environment and Resource Management (DERM). The ROP also specifies the scope of the assets that are used to carry out the service in each scheme. Key aspects set out in the associated ROP include:[4]

- operational conditions for storages, such as minimum storage levels, environmental release rules and constraints on changes in the rates of release;
- water sharing rules (such as announced allocation or continuous sharing rules);
- environmental monitoring and reporting requirements; and
- recording and reporting water use by entitlement holders.

SunWater is only able to provide bulk water services to holders of WAEs and so WAE holders must also hold a contract with SunWater, the asset owner. Since SunWater operates a decentralised system, it is not required to provide a defined level of service through supply planning and augmentations. During droughts or water shortages SunWater continues to be responsible to deliver water to entitlement holders, in accordance with the water sharing rules as well as Critical Water Sharing Arrangements, which are both approved by DERM.

Most schemes operate under an announced allocation regime whereby the water sharing rules specify the restrictions imposed on water users when there is not enough water to fully supply all users. The announced allocation can vary between 0% and 100% and describes the percentage of the WAE that is available to customers. These rules apply within one year.

2.1.2 Channel service

Channel or network services are a separate and additional contracted service from the bulk water delivery service. For this service, SunWater is obliged to divert the water available to

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[4] SunWater, *Background Paper QCA Review of Irrigation Prices: Service Framework*, May 2010, pg5.

the customer and deliver it to its offtake from SunWater's pump stations or river offtakes, which are sometimes also used to provide the bulk water service.

Water is supplied at different times of the year depending on availability, as opposed to a specified season, which applies in the case in New South Wales and Victoria. Water availability can also vary significantly between schemes and is any case determined after the announced allocation system has accounted for minimum operating levels, evaporation and transmission loss provision, high priority reserves for current and future years and any carryover provisions that may exist. Deliveries are subject to ordering times, which are constrained by the nature of the infrastructure. In some cases orders can be provided 'on demand' whereas others require advance notice. When demand exceeds supply or the capacity of the system, water is rationed in accordance with an established regime of flow rate limitations and/or a roster.[5]

2.1.3 Drainage service

The drainage service is the acceptance and disposal of water from land, which is usually also serviced by the channel network. Drainage infrastructure is designed to remove large rainfall events, although it can also accept excess water from irrigation. Since the drainage assets were developed with the channel network these services are provided in the same area.[6]

2.2 Current Forms of Price Control[7]

Over the 2006-11 period prices for SunWater services in each WSS were set for the five-year period based on demand forecasts, with annual adjustments for the change in the Consumer Price Index (CPI). Prices have two components, ie:

- a fixed charge (Part A) which applies to the whole WAE; and
- a water volume based variable charge (Part B).

Ideally, this two part pricing structure would allow SunWater to configure its tariffs to reflect the underlying costs of the businesses. In other words, the fixed charge would ideally recover costs associated with the cost of providing access to fixed infrastructure, since these costs do not vary with the amount of water delivered, while the variable charge would recover the incremental costs of providing water, such as the electricity used at pumping stations.

Over the 2006-11 period the ratio of charges between Part A and Part B was approximately 70:30. We understand that this tariff structure does not reflect SunWater's cost structure. During the process for establishing the 2006-11 price path, an independent consultant, Indec Consulting, was engaged to review SunWater's costs. According to this study SunWater's

5 SunWater, *Background Paper QCA Review of Irrigation Prices: Service Framework*, May 2010, pp6-7.

6 SunWater, *Background Paper QCA Review of Irrigation Prices: Service Framework*, May 2010, pg7.

7 SunWater, *Statewide Irrigation Pricing Working Group, Tier 1 Report*, April 2006; and SunWater, *SunWater Irrigation Price Paths 2006/07 – 2010/11: Final Report*, September 2006.

fixed costs average 93% of its historical total annual costs[8] whereas the fixed portion of prices averages 64% across schemes.[9]

An important consequence of a tariff structure that does not reflect the substantially fixed nature of costs is that variations between forecast and actual demand will result in SunWater over- or under-recovering the cost of providing its regulated service. Where actual demand is less than expected, those WSSs that opted for a revenue cap SunWater would over-recover their costs. On the other hand, in those WSSs subject to price cap regulation, SunWater will not recover all its expected costs if actual demand is less than expected. When demand is greater than expected, SunWater will over-recover its expected costs in those WSSs that opt for a price cap and under-recover in those WSSs that decide on a revenue cap.

However, if SunWater were to restructure its prices, it could remove this demand risk by adopting more cost reflective tariffs. With cost reflective prices, SunWater would levy capacity charges (ie, fixed prices) so that it would recover its expected fixed costs and adjust its variable prices so that it would recover its expected variable costs. A regulatory regime that set a cost reflective tariff structure would remove demand forecasting risks from SunWater.

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8 SunWater, *SunWater Irrigation Price Paths 2006/07 – 2010/11: Final Report*, September 2006, pg12.

9 Calculated using SunWater information contained in *SunWater Irrigation Price Paths 2006/07 – 2010/11: Final Report*, September 2006.

3 Leverage

Leverage is a measure of a firm's capital structure and refers to the proportion of debt to total capital (ie, debt plus equity) used to finance the regulated entity's asset base. The leverage of a benchmark efficient business is used to weight the cost of debt and equity in the *WACC* formula. Benchmark leverage is also:

- used to re-lever asset betas to produce the equity beta used in the CAPM to determine the cost of equity; and
- is a factor in determining the credit rating of the regulated entity.

Estimates of the credit rating and equity beta of a benchmark business are provided in sections 4 and 5 of this report.

3.1 Determining the benchmark leverage for SunWater

The optimal capital structure or leverage of a business is one that maximises the current value of the firm and depends on a variety of business-specific factors. In the absence of data limitations, benchmark leverage would be set by reference to a portfolio of comparable listed Australian water companies and would be measured as:

$$L = \frac{D}{D+E} \tag{1}$$

where

L is the benchmark leverage

D is the book value of the debt of a benchmark firm;[10] and

E the market value of the equity of a benchmark firm.

However, the absence of any listed Australian water businesses means that SunWater's benchmark leverage must be inferred from a variety of second best sources. For the purposes of this study we have considered the following sources:

- the leverage of domestic water businesses using the book values of both debt and equity;
- the market leverage of UK and US water businesses;
- the market leverage of Australian regulated energy businesses; and
- the leverage allowed by domestic and international regulators.

The following sections discuss each of these sources in detail.

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[10] Ideally the market value of debt would be used to measure leverage. However, corporate debt markets are generally illiquid, with few transactions, making any measures of the market value of debt unreliable.

3.2 Accounting values of Australian water companies

This section uses the accounting book values of debt and equity to estimate the leverage of water utilities in Australia. These utilities operate in the same industry as SunWater and so their accounting leverage does provide some indication of the optimal leverage for a benchmark water business. However, the use of these accounting data to estimate leverage should be treated with caution because:

- the capital structures of government-owned water businesses may not necessarily be optimal – government owners have a range of objectives and maximising the value of the business may not be a priority;
- accounting leverage may understate the market leverage of a firm where it is unable to earn an economic return on all its assets;[11] and
- accounting leverage may overstate the market leverage of the water firm where the regulatory asset base is indexed under the relevant regulatory regime.[12]

Table 3.1 sets out the accounting capital structures of Australian water businesses. It shows that the proportion of debt in the capital structures of most Australian water businesses ranges between 33 and 60 per cent.[13]

Table 3.1
2009/2010 Accounting Capital Structure of Water Businesses

Australian Water Businesses	Gearing = Total Liabilities / Total Assets (%)
SunWater	34
Brisbane City Council	8
South East Queensland Water Corporation	84
Gladstone Area Water Board	45
ACTEW	59
Melbourne Water Corporation	55
Hunter Water Corporation	42
SA Water Corporation	39
Sydney Water Corporation	60
Water Corporation	33

Sources: Publicly available annual reports.

11 Where firms are unable to earn an economic return on their assets the book value of their equity will exceed its market value. Consequently, the accounting leverage of a firm will understate its market leverage. For example, SunWater is unable to earn a commercial return on its existing assets and so its accounting leverage will tend to understate the true leverage of the firm.

12 An indexed regulatory asset base may have greater value than a firm's book asset value. Consequently, the accounting leverage of a firm will overstate its true leverage.

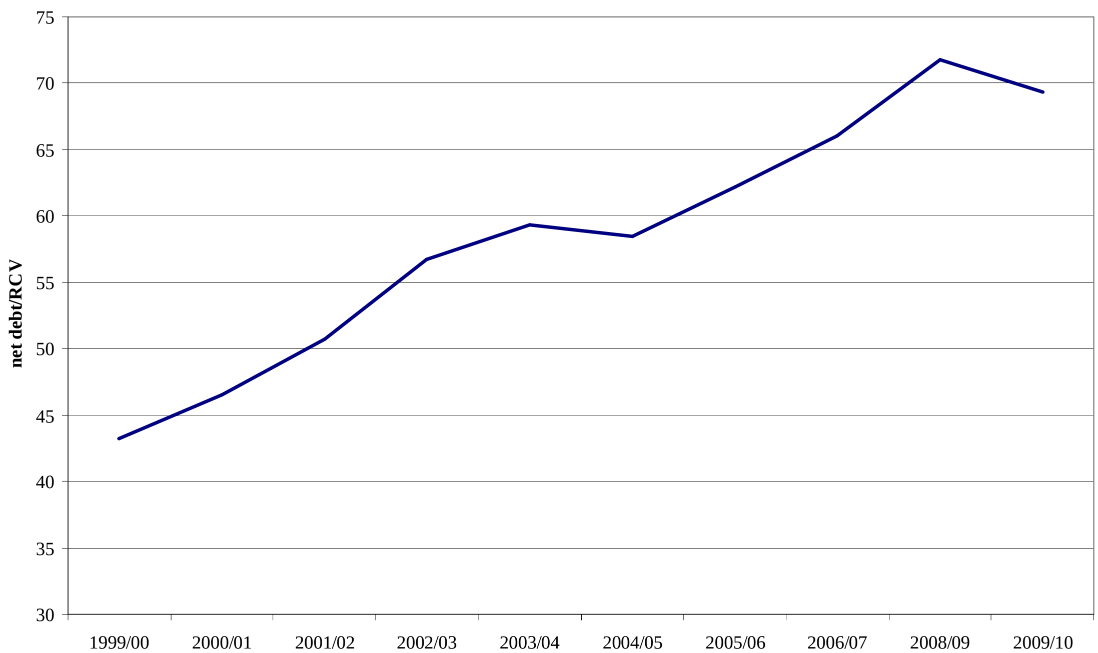
13 Brisbane City Council (8%) and South East Queensland Water Corporation (84%) are two outliers and have significantly less or more debt in their capital structure compared with most Australian water utilities.

3.3 Leverage of international water utilities

The leverage of international water utilities may also provide some insight into the optimal leverage for an Australian water company. In this section we consider the leverage of a range of firms in the UK and the US.

The UK Water Services Regulation Authority (Ofwat) estimates that the leverage (the ratio of net debt to regulatory capital value) of UK water companies at the end of the 2009/10 financial year was 69.3 per cent.[14] Figure 3.1 shows that the regulatory leverage of UK water companies has steadily risen over time from 43.2 per cent in 1999/00 to a peak of 71.8 per cent in 2008/09, followed by a slight decline in 2009/10.

Figure 3.1
UK Regulatory Leverage



Sources: Ofwat, Financial performance and expenditure of the water companies in England and Wales 2003/04 and 2009/10.

Table 3.2 shows the market leverage of 12 listed US water utilities as of 31 December 2010. The average leverage is 44.2 per cent. While there is considerable disparity in the leverage of US water utilities, most are leveraged somewhere in the range of 30 to 50 per cent.

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14 Ofwat, *Financial performance and expenditure of the water companies in England and Wales 2009-10*, p.10.

Table 3.2
Market Leverage of Listed US Water Utilities

Company	Net Debt*	Market Cap*	Total Value*	Leverage
American Water Works	5,447,568	4,438,281	9,885,849	55.1%
Aqua America	1,476,732	3,206,063	4,682,795	31.5%
California Water	429,171	780,303	1,209,474	35.5%
American States Water	349,782	645,940	995,722	35.1%
San Jose Water	297,151	478,354	775,505	38.3%
Middlesex Water	145,849	292,982	438,830	33.2%
Connecticut Water Service	137,825	229,321	367,146	37.5%
York Water	80,730	215,137	295,867	27.3%
Cadiz Inc	36,825	178,495	215,320	17.1%
Artesian Resources	133,087	145,253	278,340	47.8%
Pennichuck Corp	58,095	130,312	188,407	30.8%
Pure Cycle Corp	-5,114	82,708	77,594	-6.6%
Average	**8,587,801**	**10,823,148**	**19,410,849**	**44.2%**
Simple Average				**31.9%**

** In thousands of dollars*
Source: Bloomberg as of 31 December 2010.

3.4 Leverage of regulated Australian energy companies

The market leverage of regulated Australian energy companies represents another potential benchmark. The Australian Energy Regulator (AER) has recently undertaken a comprehensive study of the leverage of the six listed Australian energy businesses for which market data are available from Bloomberg: [15, 16]

- the APA Group;
- Diversified Utility and Energy Trust (DUET);
- Envestra;
- GasNet;
- SP AusNet; and
- Spark Infrastructure.

15 AER, *Electricity transmission and distribution network service providers - Review of the weighted average cost of capital (WACC) parameters Final decision*, May 2009, pp.111-127.

16 The AER also considered the book leverage of a larger sample of unlisted regulate energy companies using data supplied by Standard and Poor's.

The findings of the AER's investigation are reproduced in Table 3.3 below.

Table 3.3
AER's Investigation of the Leverage of Australian Energy Companies

Year	Bloomberg (market)	Bloomberg (ACG)
2002	66.3	67.4
2003	63.9	63.7
2004	62.2	58.2
2005	62.8	63.3
2006	60.3	62.1
2007	58.7	57.8
Average	**62.4**	**62.1**

Source: Table 5.3 of the AER's Electricity WACC parameter review: Final decision, May 2009.

Table 3.3 shows that the average market leverage of listed Australian energy companies, as estimated by Allen Consulting Group (ACG)[17] and Bloomberg, has remained relatively stable over time at around 60 per cent.

3.5 Regulatory precedent

This section reviews the capital structure benchmarks applied by Australian and international regulators. While consideration of regulatory precedent is not a substitute for an analysis of the leverage decisions made by private firms, such information does provide some guidance as to the optimal leverage of a regulated business.

Table 3.4 sets out the benchmark leverage used by jurisdictional regulators to determine the rates of return for Australian water businesses in Queensland, NSW, Victoria, Tasmania, South Australia and the ACT. It shows that regulators have set the *WACC* on the basis of a leverage of between 50 to 60 per cent, with most regulators choosing a benchmark leverage figure at the top of that range.

[17] ACG adjusted the Bloomberg data to remove the impact of stapled securities from the leverage estimate. Listed stapled securities generally combine a loan note with an equity share and so underestimates the leverage of a firm.

Table 3.4
Australian Regulatory Determinations
Water

Regulator	Year	Industry (Jurisdiction)	Leverage Debt/(Debt+Equity)
QCA[18]	2010	Water (Qld)	50
SA Treasury[19]	2010	South Australian Water (SA)	55
IPART[20]	2010	Country Energy Water (NSW)	60
ESC[21]	2009	Metropolitan Water (Vic)	60
IPART[22]	2009	Gosford & Wyong Councils (NSW)	60
IPART[23]	2008	Sydney Water Corporation (NSW)	60
ICRC[24]	2008	Water (ACT)	60
GPOC[25]	2007	Bulk Water (Tas)	50

The benchmark leverage set by regulators for water businesses is consistent with that set for other regulated industries. Table 3.5 shows that the benchmark leverage for regulated electricity, gas and port owners is generally set at 60 per cent. The leverage set for regulated rail businesses ranges from 50 to 60 per cent.

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18 QCA, *Gladstone Area Water Board: Investigation of Pricing Policies*, June 2010, p.125.

19 *Transparency Statement 2010-11 Potable Water and Sewerage prices in South Australia*, May 2010. p.98.

20 IPART, *Review of prices for Country Energy's water and sewerage services*, June 2010, p.93

21 ESC, *Metropolitan Melbourne Water Price Review: Final; Decision*, June 2009, p.67.

22 IPART, *Gosford City Council Wyong Shire Council: Prices for water, sewerage and storm water drainage services*, May 2009, p.67.

23 IPART, *Review of prices for Sydney Water Corporation's water sewerage, storm water and other services,* June 2008, p.174.

24 ICRC, *Water and Wastewater Price review: Final Report and Price Determination,* April 2008, p.106.

25 Government Prices Oversight Commission (GPOC), *Investigation into the Pricing Policies of Hobart Regional Water Authority, Esk Water Authority Cradle Coast Water: Final Report*, June 2007, p.18.

Table 3.5
Australian Regulatory Determinations
(Non Water)

Regulator	Year	Industry (Jurisdiction)	Leverage Debt/(debt+equity)
AER[26]	2010	Electricity distribution (Vic)	60
AER[27]	2009	Electricity transmission (NSW)	60
AER[28]	2010	Gas distribution (ACT, Queanbeyan and Palerang)	60
ACCC[29]	2008	Gas transmission (Vic)	60
QCA[30]	2010	Ports (QLD – DBCT)	60
QCA[31]	2010	Rail (QR Network)	55
IPART[32]	2009	Rail (Hunter valley network)	50-60
ACCC[33]	2008	Rail (Interstate network)	50

Table 3.6 shows that regulators in the UK have set the benchmark leverage for water utilities at between 54 and 57.5 per cent.

26 AER, *Victorian electricity distribution network service providers – Distribution determination 2011-2015: Final decision*, October 2010, p.519.

27 AER, *TransGrid transmission determination 2009-10 to 2013-14: Final decision*, 28 April 2009, p.65.

28 AER, *Access arrangement proposal ACT, Queanbeyan and Palerang gas distribution network 1 July 2010-31 June 2015: Final Decision Public*, March 2010, p.71.

29 ACCC, *Revised access arrangement by GasNet Australia for the Principal Transmission System*, 30 April 2008, p.72.

30 QCA, *Dalrymple Bay Coal Terminal 2010 Draft Access Undertaking: Final decision*, September 2010, p.8.

31 QCA, *QR Network's DAU – Tariffs and Schedule F, Draft decision*, June 2010, p.56.

32 IPART, *NSW Rail Access Undertaking – Review of the rate of return and remaining mine life from 1 July 200*9, August 2009, p.6.

33 ACCC, *Australian Rail Track Corporation- Access Undertaking - Interstate Rail Network: Final Decision*, July 2008, p.52.

Table 3.6
Determinations on Capital Structure of UK Water Utilities

Regulator	Year	Industry (Jurisdiction)	Gearing (%)
OFWAT[34]	2009	Water (UK)	57.5
OFWAT[35]	2004	Water (UK)	55
WICS[36]	2009	Water (Scotland)	54
NIAUR[37]	2010	Water (Northern Ireland)	55

3.6 Conclusion

The benchmark leverage is used to weight the amount of debt and equity finance used in the *WACC* formula. Ideally, benchmark leverage would be set by reference to a portfolio of publicly listed businesses with similar operations as the regulated firm, ie, Australian listed water infrastructure businesses with similar characteristics to SunWater. However, water infrastructure businesses in Australia are generally government owned and so are not listed. As a result, it is not possible to directly observe the capital structure of these businesses.

As second-best measures, we have considered a range of domestic and international benchmarks, including:

- the *book* leverage (debt to value) of Australian water infrastructure businesses – this generally falls within the range of 33 to 60 per cent;
- the market leverage of *UK and US water utilities* – the average market leverage of these businesses is 69.3 per cent and 44.2 per cent, respectively;
- the market leverage of *Australian regulated energy companies* – over the 2002 to 2007 period the average leverage of these companies was just above 60 per cent; and
- the *benchmark leverage* used by regulators of domestic and international infrastructure businesses – this generally falls within the range of 50 to 60 per cent.

None of the above benchmarks provide definitive evidence on the optimal capital structure of a regulated water infrastructure business. However, all of these sources support a capital structure of between 50 and 60 per cent debt to value. In our opinion, the capital structure adopted by publicly listed Australian regulated energy companies provides the most reliable guide as to what the leverage of a benchmark business should be. We therefore recommend that leverage of 60 per cent be adopted in the *WACC* formula for SunWater.

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34 Ofwat, *Future of water and sewerage charges 2010-15: Final determination,* July 2009, p.131.

35 Ofwat, *Future of water and sewerage charges 2005-10: Final determination,* October 2004, p.222.

36 WICS, *Financing Scottish Water: Staff Paper 3.*

37 NIAUR, *Water and Sewerage Service Price Control 2010-13: Final Determination Main Report,* February 2010 p.152.

4 Debt Margin

The cost of debt can be described as either the expected marginal cost to a firm of raising additional debt finance or, alternatively, the expected return that a firm's debt holders require on new borrowings. In the absence of transaction costs, the expected rate paid by a company for debt finance and that expected to be received by debt owners would be the same. However, as we discuss later in this section, the transaction costs associated with debt can be substantial. This raises the question of whether transaction costs should be included in the cost of debt or added to the operating expenditure component of the aggregate revenue requirement.

To date, the Authority's approach has been to include these costs in the cost of debt. In contrast the AER's approach has been to include these costs in the expected operating costs of a regulated firm.[38] The advantages of the QCA's approach are that:

- unlike other operating costs, debt transaction costs are estimated by reference to a benchmark and do not reflect the firm's expected costs – consequently if the firm outperforms (or underperforms) against this benchmark cost all the associated profits (or losses) are retained by the business, in contrast other operating costs are reset at the beginning of each regulatory period based on the regulated firms actual costs;
- it simplifies the calculation of taxable income in the post-tax revenue model since the full costs of issuing 10-year corporate debt should be deducted from the firm's gross income; and
- the discount rate (ie, the *WACC*) that is used to smooth SunWater's revenue over the regulatory period should be set by reference to the opportunity cost of capital for the firm, which should include the full cost to the firm of debt finance and so include debt transaction costs.

On the other hand, including debt transaction costs in the firm's operating costs increases transparency by specifying the dollar value of debt transaction costs.

Whether debt transaction costs are included in the *WACC* or in the cash flow calculations should not change the aggregate revenue requirement of the regulated firm. However, in our opinon, including debt transaction costs in the *WACC* is appropriate since the *WACC* is used as the discount rate to smooth regulated revenues and so should reflect the full opportunity of cost of capital to a firm.

It follows that the total debt margin is composed of the following four elements:

- the margin above the risk-free rate demanded by debt holders to provide new debt finance;
- an allowance for credit default swaps, to compensate businesses for the cost of converting the debt premium element of the cost of debt into 5-year debt;

[38] See AER, Electricity transmission network service providers – Post-tax revenue model handbook: Amendment, December 2010.

- an allowance for interest-rate swaps, to cover the costs of converting the risk-free rate element of the cost of debt into 5-year debt; and
- an allowance for annual debt refinancing costs.

Each of these elements is discussed in the remainder of this section. However, first I discuss whether the debt margin should be measured by reference to expected or promised yields.

4.1 Expected or promised yields

The *WACC* is a measure of the opportunity cost of capital and so only expected returns are relevant. It follows that the cost of debt should be defined as the expected yield on debt. However, regulators estimate the cost of debt by reference to the promised yields on corporate debt, rather than expected yields. The difference between promised yields and expected yields are the expected losses to bondholders of default. [39]

The distinction between promised and expected yields was considered by the Panel of Experts engaged by the New Zealand Commerce Commission.[40] In their report Professors Myers and Franks stated that:[41]

> 'strictly speaking, the cost of debt should be defined as the expected rather than promised yield on debt, but in practice the expected yield is not easy to estimate. So, in most situations (unless the debt premium is very high, due to a high risk of default), promised yields can be used as proxy for expected yields. '

One possible explanation of the observed increase in the promised yields on corporate debt following the Global Financial Crisis is that there has been an increase in the expected costs of default, for example, by an increase in the probability that bond holders will default. In this case, the promised yield may not be a good proxy for the expected yield. Trying to extract that part of the promised yield that is due to the probability of default, though, is not a straightforward task.

Using a pricing model like the CAPM to estimate the expected cost of debt is also fraught with difficulties because:

- corporate debt is infrequently traded; and

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39 Theses costs include the direct costs of bankruptcy and some of the indirect costs of bankruptcy. See, for example,

Fanks, J., Lally, M. and Myers, S., *Recommendation to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology*, 18 December 2008, page 31.

Ruback, R., *Estimation of Implicit Bankruptcy Costs: Discussion*, Journal of Finance, July 1984, pages 643-645.

40 Fanks, J., Lally, M. and Myers, S., *Recommendation to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology*, 18 December 2008.

41 Fanks, J., Lally, M. and Myers, S., *Recommendation to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology*, 18 December 2008, page 31.

- the expected cost of debt almost surely includes a liquidity premium and a model like the CAPM, which assumes that trading is costless, is not well suited to estimating the required return to an illiquid security.

So while the theoretically correct approach is for the *WACC* to reflect the expected cost of debt, it is our opinion that, given the difficulties to which we have alluded, the current regulatory approach of using promised yields on corporate debt is appropriate.

4.2 Debt margin

The margin above the risk-free rate required by debt holders critically depends on the benchmark credit rating. A benchmark credit rating provides a simple indication of the risks of default associated with a particular business. A credit rating is influenced by a range of industry, business and financial factors. Among other things, these factors include:

- business cash flows;
- the level of debt;
- the stability of revenue; and
- a range of non-quantitative factors such as regulatory stability, support from related companies and the management of the business.

Standard & Poor’s credit ratings are expressed as a relative ranking of creditworthiness. Issuers with a higher rating are judged by Standard & Poor’s to be more creditworthy than issuers with lower credit ratings. Standard and Poor’s long-term credit ratings range from AAA to D, with a D-rating signifying that a debt payment has not been made on the date due (ie, a default). In Australia, most regulated utilities are assigned an investment grade rating of between AA and BBB.[42]

Standard and Poor’s description of these ratings are:[43]

> AA: An obligation rated 'AA' differs from the highest-rated obligations only to a small degree. The obligor's capacity to meet its financial commitment on the obligation is very strong
>
> A: An obligor rated 'A' has strong capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.
>
> BBB: An obligor rated 'BBB' has adequate capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.

[42] AER, *Electricity transmission and distribution network service providers - Review of the weighted average cost of capital (WACC) parameters Final decision*, May 2009, p.376.

[43] Standard and Poor’s, *General Criteria: Understanding Standard & Poor's Rating Definitions*, 3 June 2009.

Ideally, the benchmark credit rating for an Australian water infrastructure business would be set by reference to the credit rating of a stand-alone Australian listed water business with a leverage of 60 per cent debt. However, since water infrastructure businesses in Australia are government owned, their credit ratings also reflect the potential financial support provided by government ownership. Consequently, in our assessment of the appropriate benchmark credit rating for SunWater we have considered:

- the credit ratings provided to other Australian regulated water, energy and infrastructure businesses; and
- SunWater's financial profile.

4.2.1 Regulatory precedent

The credit ratings assigned to Australian regulated businesses have ranged between BBB and BBB+. Table 4.1 shows the credit ratings and gearing assumptions chosen for regulated water businesses by jurisdictional regulators.

Table 4.1
Australian Regulatory Determinations on Credit Ratings and Leverage (Water)

Regulator	Year(s)	Industry (Jurisdiction)	Credit rating	Assumed leverage
QCA[44]	2010	GAWB (QLD)	BBB	50
IPART[45]	2010	Country Energy Water (NSW)	BBB+ to BBB	60
IPART[46]	2009	Gosford and Wyong councils (NSW)	BBB+ to BBB	60
IPART[47]	2008	Sydney Water Corporation (NSW)	BBB+ to BBB	60
ESC[48]	2009	Metropolitan Water (VIC)	TVC Estimate[49]	60
ICRC[50]	2008	Water (ACT)	BBB	60
GPOC[51]	2007	Water (Tas)	NA	50

The credit ratings for regulated water businesses are consistent with those applied to other Australian regulated businesses as shown in Table 4.2. It follows that there is a strong regulatory precedent for the debt margin for SunWater to be estimated on the basis of a BBB to BBB+ credit rating.

44 QCA, *Gladstone Area Water Board: Investigation of Pricing Policies*, June 2010, p.133.

45 IPART, *Review of prices for Country Energy's water and sewerage services*, June 2010, p.93.

46 IPART, *Gosford City Council Wyong Shire Council: Prices for water, sewerage and storm water drainage services*, May 2009, pp.189-191.

47 IPART, *Review of prices for Sydney Water Corporation's water sewerage, storm water and other services*, June 2008, p.166.

48 ESC, *Metropolitan Melbourne Water Price Review: Final; Decision*, June 2009, pp.64-65.

49 Estimated benchmark cost of debt provided by the Treasury Corporation of Victoria.

50 ICRC, *Water and Wastewater Price review: Final Report and Price Determination*, April 2008, p.103.

51 Government Prices Oversight Commission (GPOC), *Investigation into the Pricing Policies of Hobart Regional Water Authority, Esk Water Authority Cradle Coast Water: Final Report*, June 2007, p.18.

Table 4.2
Australian Regulatory Determinations on Credit Ratings and Leverage

Regulator	Year(s)	Industry (Jurisdiction)	Credit rating	Assumed leverage
AER[52]	2010	Electricity distribution (Vic)	BBB+	60
AE[53]R	2009	Electricity transmission (NSW - TransGrid)	BBB+	60
AER[54]	2009	Gas distribution (ACT, Queanbeyan and Palerang)	BBB+	60
ACCC	2008	Gas transmission (VIC – GasNet)	BBB+	60
QCA[55]	2010	Ports (QLD – DBCT)	BBB+	60
QCA[56]	2010	Rail (QR Network)	BBB	60
IPART[57]	2009	Rail (Hunter valley network)	BBB-BBB+	50-60
ACCC[58]	2008	Rail (Interstate network)	BBB	50

Further benchmarks for the credit ratings are provided by the ratings used by international regulators. Table 4.3 shows that the UK water regulator (Ofwat) has consistently determined a credit rating of between A and BBB.

52 AER, *Victorian electricity distribution network service providers – Distribution determination 2011-2015: Final decision*, October 2010, p. 473.

53 AER, *TransGrid transmission determination 2009-10 to 2013-14: Final decision*, 28 April 2009, p. 53.

54 AER, *Access arrangement proposal ACT, Queanbeyan and Palerang gas distribution network 1 July 2010-31 June 2015: Final Decision Public*, March 2010, p. 41.

55 The QCA accepted DBCT management's proposed approach to update the debt margin on the basis of observed BBB+ corporate bond yield. See QCA letter to Anthony Timbrell, entitled, *DBCT 2010 Access Undertaking – WACC update*, 29 October 2010.

56 QCA, *QR Network's DAU – Tariffs and Schedule F, Draft decision*, June 2010, p.

57 IPART, *NSW Rail Access Undertaking – Review of the rate of return and remaining mine life from 1 July 200*9, August 2009, p.6.

58 ACCC, *Australian Rail Track Corporation- Access Undertaking - Interstate Rail Network: Final Decision*, July 2008, p.52.

Table 4.3
International Regulatory Determinations on Credit Ratings and Leverage (Water)

Regulator	Year(s)	Industry (Jurisdiction)	Credit rating	Assumed leverage
OFWAT[59]	2004	Water (UK)	A-BBB	55
OFWAT[60]	2009	Water (UK)	A-BBB+	57.5

In summary, there is a strong Australian regulatory precedent for the debt margin for SunWater to be estimated on the basis of BBB to BBB+ credit rating. This is further supported by the credit ratings determined by the UK water regulator.

4.2.2 SunWater financial profile

In addition to our review of Australian regulatory precedent, we have also considered SunWater's actual financial profile as a check on the appropriateness of a BBB to BBB+ credit rating. It should be stressed that we have only used SunWater's actual financial profile as a check, since the purpose of the *WACC* is to determine a benchmark cost of capital. Importantly, the benchmark *WACC* is based on a leverage of 60 per cent which differs from SunWater's actual leverage.

A report by ACG on the cost of capital for the Gladstone Area Water Board (GAWB) contained a table of the financial ratios typically associated with a particular credit rating for international transmission utilities.[61] This has been reproduced in Table 4.4 below.

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59 Ofwat, *Future of water and sewerage charges 2005-10: Final determination,* July 2009, p.267.

60 Recommendation of Ofwat advisors, Europe Economics, *Cost of Capital and Financeability at PR09,* 21 July 2009, p.93.

61 ACG, *Gladstone Area Water Board - Assessment of the Cost of Capital: report for the Queensland Competition Authority*, November 2004, p 27.

Table 4.4
Ratio Ranges for International Transmission Utilities

Rating / Ratio	AA	A	BBB
Pretax interest coverage[62]	2.0 – 3.0	1.5 – 2.5	1.0 – 1.7
FFO interest coverage[63]	3.0 – 4.0	2.0 – 3.3	1.5 – 2.0
FFO to total debt[64]	12% – 17%	10% – 15%	5% – 10%
Total debt to total capital[65]	50% – 60%	55% – 70%	65% – 80%

Source: Standard and Poor's (2004) Project and Infrastructure Finance review, October, p.59

Assessing the creditworthiness of a company normally involves an assessment of its current and projected cash flows, as well as an assessment of previous performance. Table 4.5 sets out SunWater's financial ratios over the past five years.

Table 4.5
SunWater's Historical Financial Ratios

Year	Pretax cover	FFO Cover	FFO/debt	Book gearing
2006	3.80	4.42	8%	27%
2007	4.18	3.65	12%	44%
2008	1.43	2.22	9%	58%
2009	3.62	6.56	21%	62%
2010	4.36	4.02	10%	65%

Source: SunWater Annual Reports, NERA analysis

The ratios for 2006 and 2007 support a credit rating significantly higher than BBB, and are more consistent with a rating of at least AA. However, in our opinion the financial ratios in these two years should have little bearing on the benchmark credit rating because the book gearing ratio is significantly less than the assumed leverage of 60 per cent.

SunWater's financial ratios from 2008 onwards suggest that adopting the credit rating applied to Australian regulated businesses (ie, BBB to BBB+) is conservative.

62 Pretax interest coverage is calculated by dividing earnings before interest, tax depreciation and amortization (EBITDA) by the sum of interest payments and debt repayments.

63 Funds from operations (FFO) interest coverage is calculated by dividing earnings before interest depreciation and amortization by interest payments.

64 FFO to total debt is calculated by dividing earnings before interest depreciation and amortization by total debt.

65 Total debt to total capitalisation is calculated by dividing total debt by total book capitalisation.

4.2.3 Conclusion

Benchmarking the credit rating for SunWater by reference to observed credit ratings is complicated by:

- the absence of privately owned Australian water businesses, since the credit rating of state and local government businesses are influenced by their ownership structure; and
- the fact that the observed leverage of water businesses normally differs from that assumed in the *WACC*.

It follows that determining the credit rating of a hypothetical water infrastructure business involves a significant degree of subjectivity. Notwithstanding these limitations, there is considerable consistency in the decisions of Australian regulators which have calculated the debt margin by reference to a BBB or BBB+ credit rating.

Our analysis of SunWater's financial profile suggests that the benchmark credit rating should be at the top of this range. We therefore propose that the Authority adopt a BBB+ credit rating when determining the debt margin for SunWater.

Consistent with the Authority's previous decisions,[66] the indicative debt margin has been estimated to be 3.50 per cent using Bloomberg fair value yields for 5-year Australian corporate debt over the 20 days ending the 31 January 2011.

4.3 Credit default swap allowance

In section 4.2 we estimated the debt margin for 5-year BBB+ corporate debt. We matched the term of debt with the length of the regulatory period to minimise the potential difference between financing costs and capital revenues. However, firms that issue shorter term debt have greater refinancing risk. It follows that an efficient firm may seek to issue debt for a term greater than 5 years to minimise its refinancing risk.

The absence of privately owned water businesses prevents us from examining the extent to which Australian water companies issue longer term debt. However, in our opinion the behaviour of Australian electricity businesses is a reasonable guide as to the behaviour of water companies because:

- they invest in similar long-lived assets;
- are subject to the same regulatory framework with 5-year regulatory periods; and
- are subject to a similar level of refinancing risk.

In its 2009 review of the *WACC* parameters for electricity lines businesses, the AER found that the average term of debt at issuance for Australian energy businesses was approximately

[66] QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, p.133.

10 years.[67] In our opinion, it is reasonable to presume that a stand-alone water company would issue debt of a similar term.

Since water firms are likely to issue 10-year corporate debt, it is necessary to provide an allowance for the difference between its debt costs (ie, 10-year) and the debt margin allowance (ie, 5-year) calculated in section 4.2. A firm could effectively convert its 10-year debt to 5-year debt by purchasing an appropriately specified credit default swap.

In its previous decisions the Authority has estimated the cost of credit default swaps by reference to the difference between 10-year and 5-year debt margins for BBB rated bonds.[68] Further, the debt margin on 10-year BBB rated bonds was estimated by extrapolating the 7-year Bloomberg BBB yields by adding the term premium between 10-year and 7-year Bloomberg AAA fair value yields.

This approach is no longer possible since Bloomberg stopped producing 10-year AAA fair value yields on 2 June 2010. An alternative approach to estimating a 10-year debt margin would be to extrapolate the 5- and 7-year Bloomberg BBB fair value yields to 10-year yields and then deduct the 10-year risk-free rate. Table 4.6 applies this approach to estimate the 10-year debt margin over the 20 days ending the 31 January 2011.

Table 4.6
Bloomberg 10-year Debt Margin

	5-Year	7-Year	10-Year
Bloomberg BBB	8.55%	9.75%	
Estimated Bloomberg BBB[69]			11.10%
Risk-free rate	5.35%	5.35%	5.62%
Debt Margin	3.50%	4.40%	5.48%

All estimates are annualised values.

The debt margin estimated by extrapolating the available Bloomberg BBB fair value yields is 5.48 per cent. We note that this significantly higher than that estimated for GAWB (ie, 4.49%) where the extrapolation was done using Bloomberg AAA 7- and 10-year yields.

In assessing the reasonableness of this approach to estimating the BBB 10-year bond yield we have considered the estimated yield of a range of individual BBB and A rated bonds. Figure 4.1, shows the yields of a range of long-term BBB and A rated bonds listed on the Bloomberg data service.

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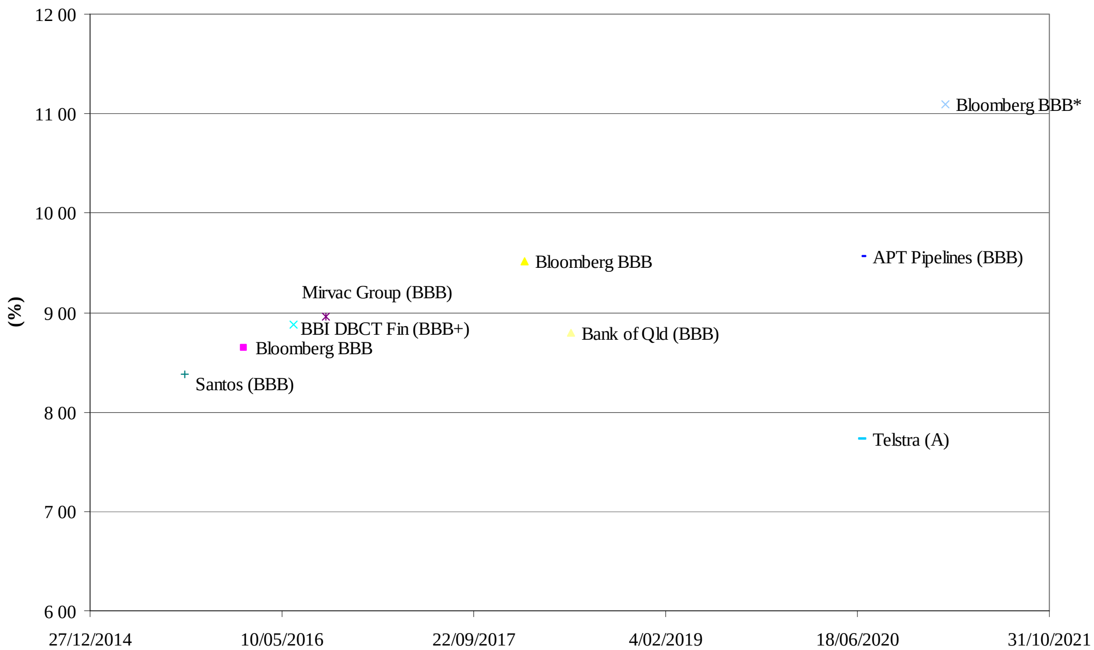
[67] AER, *Electricity transmission and distribution network service providers - Review of the weighted average cost of capital (WACC) parameters Final decision*, May 2009, pp. 158-165.

[68] QCA, *Gladstone Area Water Board: Investigation of Pricing Policies*, June 2010, pp.132-133.

[69] The 10-year Bloomberg fair value yield is estimated by a straight line extrapolation of the 5- and 7- year Bloomberg BBB fair value yields.

Figure 4.1
Australian Corporate Bond Yields
(20 days to 31 January 2011)



Source: Bloomberg data service, downloaded on 13 February 2011.

Figure 4.1 shows that there are very few observations on the Bloomberg data service on BBB debt margins with a term of greater than 8 years. In fact, the only BBB corporate yield over 8 years on Bloomberg is for the APT Pipelines bond. Figure 4.1 also shows that the estimated yield for 10-year Bloomberg BBB bonds is substantially greater than that of the APT bond which has a term of around 9.5 years.

The AER recently considered the issue of estimating the 10-year BBB debt margin when neither CBASpectrum nor Bloomberg estimates of the yield on long-term corporate bonds are available. The AER concluded that it was not reasonable to rely solely on an extrapolation of the Bloomberg series and recommended:[70]

> 'that an average of Bloomberg's 10 year, BBB fair estimate curve and the APA Group bond represents the best DRP estimate possible in the circumstances of Envestra. Specifically, in exercising its discretion, the AER has given equal weight to both Bloomberg's fair value yield estimates, and the APA Group bond.'

Further, to estimate the Bloomberg 10-year BBB fair value curve:[71]

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[70] AER. *Envestra Ltd - Access arrangement for Qld gas network: 1 July 2011 – 30 June 2016*, February 2011, p.257.

[71] AER. *Envestra Ltd - Access arrangement for Qld gas network: 1 July 2011 – 30 June 2016*, February 2011, p.256.

> 'the AER considers that the most reasonable extrapolation approach is to add the spread on Bloomberg's AAA rated estimates from 7 to 10 years – as averaged over the last 20 trading days when these estimates were available, ending 22 June 2010 – to the most recent estimates of Bloomberg's 7 year, BBB rated fair value curve.'

In the absence of better data, we recommend that the Authority adopt a similar approach to estimating the 10-year BBB debt margin. Table 4.7 estimates the 10-year debt margin using the approach proposed by the AER. Using the approach results in a debt margin of 4.45 per cent and so an estimated cost of a credit default swap of 0.95 per cent.

Table 4.7
10-year Debt Margin

	Rate
Bloomberg BBB	9.75%
Spread between 10 and 7 year AAA	0.60%
Estimated Bloomberg BBB	10.35%
APT Bond (BBB)	9.56%
BBB 10 year yield*	10.07%
Risk-free rate – 10 year	5.62%%
10 year debt margin	4.45%
5 year debt margin	3.50%
Credit default swap	0.95%

* *Debt margin based on an equal weight on the Bloomberg 10 year estimate and the APT bond yield.*

4.4 Interest rate swap cost allowance

The interest rate swap costs ensure that SunWater is compensated for the cost of converting the risk-free rate element of its 10-year corporate debt into 5-year debt. The current difference between the 5 and 10 year risk free rate is 27 basis points.

Consistent with its decision for GAWB, we recommend that the Authority provide an allowance of 27 basis points, for the cost of interest rate swaps.[72]

4.5 Annual debt issuance allowance

Issuing corporate debt is not free and these costs should be included in either the cash flows or the assumed cost of debt for the firm. In its most recent decision the Authority has provided an allowance of 12.5 basis points in the debt margin for these costs. In our opinion, this is a reasonable annual allowance for these costs.

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72 QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, p.132.

4.6 Debt margin conclusion

Including transaction costs in the debt margin is a simple and transparent approach to ensure that firms are fully compensated for the full costs associated with raising debt finance. It follows that the total debt margin should include:

- the five-year debt margin, estimated using Bloomberg data as 3.50 per cent for the 20 days ending 31 January 2011;
- an allowance for the cost of credit default swaps, which is estimated to be 0.95 per cent (using the difference between the 5 and 10-year BBB debt margins);
- an allowance of 27 basis points for an interest-rate swap; and
- an allowance of 12.5 basis points for annual debt issuance costs.

Under this formulation, as of the end of January 2011, the indicative total debt margin for SunWater is 4.85 per cent and the cost of debt is 10.20 per cent. We note that the estimated cost of debt is high by historical standards. Further, the estimated cost of equity (ie, 10.15 per cent) in section 7 of this report is slightly lower than the above estimated cost of debt (ie, 10.20 per cent). This is an unusual result since the risk of equity financing is greater than the risk of debt financing.

However, we note that 10.20 per cent is based on the promised yield on debt, not the expected yield. Following the global financial crisis of late 2008, promised debt yields have increased markedly. In part, this rise in promised yields may be explained by an increase in the likelihood of default. Therefore, the expected yield on debt may be below the promised debt yield and may be below the expected return on equity that we compute. Again, however, extracting the portion of the promised yield on debt that can be attributed to the risk of default is not a straightforward task.

5 Equity Beta

5.1 Summary

The Authority has decided that the return required on equity will be determined using a domestic version of the Sharpe-Linter Capital Asset Pricing Model (CAPM). The CAPM links the return the market requires on an asset to its risk, measured by beta. This section discusses how a value for the equity beta of a rural water business might be estimated to derive a return on equity that matches, as far as is possible, that which the market requires.

A major difficulty in estimating an equity beta for an Australian water business is that no Australian water business has equity that is publicly traded. It is therefore not possible to estimate the equity beta of an Australian water business directly, and so one must form an indirect estimate of the equity beta using available data.

In a report to the Authority, Officer (2005) argues that the return on equity for electricity and gas utilities can act as a proxy for the return on the equity of water companies whose major customers are commercial and industrial users of water.[73] Also, the AER (2008) has argued that foreign data can provide useful information about the risks of Australian equities.[74] Consistent with these sentiments, we have relied on the following data to estimate the equity beta of a benchmark:

- the market prices of regulated Australian energy utilities; and
- the market prices of regulated UK and US water and energy utilities.

Since a large number of regulatory decisions have been made about the equity betas of Australian and foreign utilities, we have also examined:

- recent Australian regulatory decisions about the equity betas of utilities; and
- recent UK regulatory decisions about the equity betas of utilities and US regulatory decisions about the cost of equity for utilities.

Theory suggests that the way in which the prices that a firm sets are regulated can affect the equity beta of the firm. So we also discuss what theory predicts should be the impact of regulation on the equity beta of a firm, whether the theoretical predictions we outline are borne out empirically and hence the extent to which the regulatory regime the Authority adopts should influence the equity beta of a benchmark.

5.1.1 Estimates

We have used market data to estimate the equity betas of portfolios of Australian, UK and US utilities and compared these estimates to the values set in recent regulatory decisions in those

[73] GAWB, *QCA Investigation of GAWB's Pricing Practices GAWB: Submission in response to the QCA's Draft Report*, 2005.

[74] AER, *Explanatory Statement, Electricity transmission and distribution network service providers: Review of the weighted average cost of capital (WACC) parameters*, 2008.

same jurisdictions. To do this we have re-levered the market estimates using an assumed leverage (ratio of debt to value) of 60 per cent. The market data suggests that:

- estimates of the equity beta of a regulated Australian energy utility are significantly below one and below the value that Australian regulators typically use of between 0.8 and one;
- whether or not the equity beta of a UK energy utility falls below one depends on the data used, while estimates of the equity beta of a UK water utility are significantly below one and are significantly below estimates of the equity beta of a UK energy utility; and
- estimates of the equity beta of a US water utility do not differ significantly from one, whereas those of a US energy utility are below one and below estimates of the equity beta of a US water utility.

Alternatives to using market data to estimate the equity beta of a water business are to use either accounting data alone or a combination of accounting and market data. However, there are problems with these alternatives, as we explain in Appendix B. In light of these problems, we have not attempted to use accounting data to generate an estimate of the equity beta of a benchmark water business.

5.1.2 Regulatory decisions

A review of recent Australian and UK regulatory decisions on the cost of equity for energy and water utilities shows that, after adjusting for any minor differences in financial leverage authorised, regulators set similar equity betas for energy and water utilities. US regulators typically do not set explicit values for the equity beta of a firm, although a review of US regulatory decisions shows that, after adjusting for differences in leverage, regulators set similar costs of equity for energy and water utilities.

5.1.3 Regulatory framework

Theory suggests that the regulatory framework that a firm faces can affect its equity beta. For example, a firm operating under rate-of-return regulation could be expected to have a lower equity beta than a firm operating under a fixed-term price cap. Empirically, there is some support for a link between the way in which a firm is regulated and its equity beta, although it is far from clear how strong that link is. For this reason, we suggest that, consistent with Australian regulatory precedent, relatively little weight be placed on the theoretical predictions as to the influence of the regulatory framework the Authority chooses on the equity beta of a benchmark.

5.1.4 Conclusions

In our opinion, the equity beta of an Australian water business should be set at a value that is no different from the equity beta of an Australian energy utility. This is because:

- there are no systematic differences between estimates of the equity betas of energy and water utilities; and

- regulators in Australia, the UK and the US set equity costs for energy and water utilities at similar levels, after adjusting for differences in financial leverage.

Recent Australian regulatory decisions set the equity beta of an energy utility that has an assumed financial leverage of 60 per cent to be around 0.8. We recommend that the equity beta for an Australian water business be set no lower than this value.

5.2 The Capital Asset Pricing Model and leverage

The Authority has decided that the return required on equity will be determined using a version of the CAPM of Sharpe (1964) and Lintner (1965).[75] In the CAPM, no individual invests solely in a single risky asset; rather, investors diversify. In particular, each investor combines risk-free borrowing or lending with a position in the market portfolio of risky assets. Thus, in the CAPM, the return that an investor requires on an individual asset is determined not by how risky the asset would be if held alone, but rather by how much the asset contributes to the risk of the market portfolio. This contribution is measured by the asset's beta. So, in the CAPM, the risk of an individual asset is measured not by the variability of its return, but by its beta.

The CAPM implies that:

$$\mathrm{E}(R_j) = R_f + \beta_j[\mathrm{E}(R_m) - R_f], \tag{2}$$

where

$E(R_j)$ = is the expected return on asset j;

R_f = is the risk-free rate;

β_j = asset j's beta; and

$E(R_m)$ = the expected return to the market portfolio of risky assets.

The CAPM states that the return that the market requires on an asset must be the sum of the risk-free rate and a risk premium. If an asset has a beta of zero, it must earn the risk-free rate but no more, even if the return to the asset is uncertain. The risk premium is the product of the asset's beta and the price of risk. The price of risk is the market risk premium, ie, the difference between the expected return to the market portfolio and the risk-free rate.

The CAPM is widely used by regulators in Australia and the UK. For simplicity, regulators in both countries assume that international equity markets are segmented – even though empirically this is untrue. In addition, Australian regulators assume that investors face the same tax rates on capital gains as on dividends – even though empirically this is also untrue – and that a representative investor values the imputation credits that companies distribute.

[75] Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk,* Journal of Finance 19, 1964, pages 425-442.

Lintner, John, *The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets,* Review of Economics and Statistics 47, 1965, pages 13-37.

Thus there are theoretical weaknesses with the version of the CAPM used by regulators. These are also weaknesses in the ability of the CAPM to successfully explain the cross-section of average returns to equities. Empirically, the CAPM tends to underestimate the returns to low-beta assets and overestimate the returns to high-beta assets. Since the equities of utilities often have low betas, this observation implies that the CAPM will tend to underestimate the cost of equity for utilities. This suggests that considerable caution should be exercised by regulators who rely only on the CAPM, before setting a lower than average equity beta for a regulated utility.

5.2.1 Leverage

We have used market data to estimate the equity betas of portfolios of Australian, UK and US utilities. The equity beta of a firm is positively related to its financial leverage. It is therefore helpful to make an adjustment for any difference between the financial leverage of these utilities and the leverage of an efficient benchmark Australian water business. Such an adjustment involves two steps. First, estimates of the equity betas of the utilities should be de-levered to produce estimates of their asset betas. Second, the resulting estimates should be re-levered to produce estimates of the equity betas the utilities would have under the same leverage as a benchmark Australian water business.

Precisely how the equity beta of a firm is related to the firm's financial leverage depends, among other things, on the assumptions one makes about whether the firm may default on the debt it has outstanding and the debt policy that the firm will follow. ACG (2008) and Henry (2008, 2009) use, and the AER (2008, 2009) accepts the use of, the following simple formula[76]

$$\beta_e = \beta_a\left(1+\frac{D}{E}\right) \tag{3}$$

where

β_e	=	the firm's equity beta;
β_a	=	the firm's asset beta;
D	=	the value of the firm's debt; and
E	=	the value of the firm's equity.

[76] AER, *Explanatory Statement: Electricity transmission and distribution network service provider, review of the weighted average cost of capital (WACC) parameters*, 2008.

AER, *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 2008.

Henry, Olan T., *Econometric advice and beta estimation*, Attachment C to the AER's *Explanatory Statement: Electricity transmission and distribution network service provider, review of the weighted average cost of capital (WACC) parameters*, 2008.

Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

This formula (the "AER formula") states that the equity beta of a firm will be higher, holding constant the beta of the firm's assets, the higher the firm's financial leverage. While it may appear that the formula assumes that there are no taxes, this is not the case. Taggart (1991) notes that the firm's equity beta and its asset beta will be related in this way if:[77]

- there are taxes at both the corporate and personal level; and
- a firm continuously issues and retires default-free debt so as to keep the leverage of the firm constant.

Since imputation credits provided to investors represent negative personal taxes on dividend income, the AER formula is also consistent with a world in which imputation credits are distributed.

In contrast, the leverage formula generally adopted by the Authority is:[78]

$$\beta_e = \beta_a\left(1+\frac{(1-T)D}{E}\right)-\beta_d\,\frac{(1-T)D}{E} \qquad (4)$$

where

T	=	the corporate tax rate; and
β_d	=	the beta of the firm's debt.

Conine (1980) shows that a firm's equity beta and asset beta will be related in this way if:[79]

- there are taxes at the corporate level;
- tax rates on personal income from debt and equity are identical; and
- the firm issues perpetual debt that promises the same fixed coupon payment at the end of the current period and every future period.

In using the Conine formula, the Authority adjusts the corporate tax rate for the provision of imputation credits.[80]

Comparing the two formulae:

- the Conine formula allows the debt a firm issues to be risky while the AER's formula requires the debt that the firm issues to be default-free;[81]

77 Taggart, Robert A., *Consistent valuation and cost of capital expressions with corporate and personal taxes*, Financial Management, 1991.

78 QCA, *Final Report: Gladstone Area Water Board: Investigation of Pricing Practices*, 2010.

79 Conine, Thomas, E., *Corporate debt and corporate taxes: An extension*, Journal of Finance, 1980.

80 Note that it is the debt beta and not the total risk of the debt that appears in the Conine formula and that inferring the debt beta from the difference between the promised yield on the debt that the firm issues and the risk-free rate will in general mislead. This is because the promised yield on the debt will reflect the probability of default and this will depend not only on the systematic risk of the debt but also on its total risk.

- the AER's formula allows the personal rates of tax on income from debt and equity to differ while the Conine formula requires that they be identical; and
- the Conine formula assumes that the amount of debt that a firm has outstanding (in dollar terms) is constant while the AER's formula assumes that a firm issues and retires debt so as to keep the leverage of the firm constant.

The proposition that companies maintain a constant leverage is broadly consistent with the behaviour of firms across time and consistent with the regulatory assumption that leverage is held at a constant percentage of regulatory assets. Also empirically:

- the beta of the debt of an Australian water business is not large; and
- the personal rates of tax on income from debt and equity differ.

For these reasons, in what follows we use the AER's leverage formula rather than the Conine formula to de-lever and re-lever equity betas. The AER (2009) and QCA (2010), however, acknowledge that, in general, it does not make a significant difference which de-levering and re-levering formula is used, so long as the same formula is used to de-lever and re-lever. Nevertheless, because the Authority has generally adopted the Conine formula, we also report, in Appendix C, equity beta estimates that have been de-levered and re-levered using this formula.

5.3 Equity beta estimates

Since no Australian water business has equity that is publicly traded, we estimate the equity beta using market data for Australian and foreign utilities that we deem to have characteristics that are similar to those of an Australian water business. In particular, we use data from Bloomberg information service to estimate the equity betas of:[82]

- the nine Australian energy utilities that Henry (2009) employs to estimate the equity beta of an electricity utility in his report for the AER;[83]
- the three UK energy utilities and five UK water utilities that PriceWaterhouseCoopers (2009) employs in its report on the cost of capital for the Office of Gas and Electricity Markets; [84] and

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81 One can relax the assumption that the AER formula makes that the debt that the firm has outstanding is default-free. Sick (1990) and Cooper and Nyborg (2008) show that a more general version of the AER formula will contain, besides the beta of the firm's debt, both the corporate and personal tax rates that investors face.

Sick, G.A., *Tax-adjusted discount rates*, Management Science, 1990, pages 1432-1450.

Cooper, I. A. And K. G. Nyborg, *Tax-adjusted discount rates with investor taxes and risky debt*, Financial Management, 2008, pages 365-379.

82 Tables A.1 through A.4 in Appendix A list the companies that we use.

83 Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

84 PriceWaterhouseCoopers, *Advice on the cost of capital analysis for DPCR5: Final Report*, 2009.

- the 21 US energy utilities that ACG (2008) identifies in its submission to the AER and nine of the 10 US water utilities that the California Public Utilities Commission (2009) employs in a recent rate-of-return decision.[85,86]

We compute re-levered betas for equally weighted and value-weighted portfolios of these companies relative to the MSCI Australia, UK and US Standard Core indices. Like Henry (2008, 2009), we use weekly as opposed to monthly data since this raises the precision of our estimates and all but eliminates any concerns over the effect of infrequent trading that might arise were one to use daily data.[87] To determine whether there have been recent changes in the equity betas of energy and water utilities we compute estimates over two different periods: the period from 2000 to 2011 and the more recent period of 2009 to 2011.[88]

5.3.1 Estimates

Table 5.1 shows the estimates that we derive using these data. Table 5.1 shows that:

- estimates of the equity beta of a regulated Australian energy utility are significantly below one. Moreover, most of the estimates are also significantly below the range that Australian regulators have set in recent decisions for energy utilities, ie, 0.8 to 1.0. The estimates, though, are well within the range of between 0.4 and 0.7 that Henry (2008, 2009) provides for the equity beta of an Australian energy utility;[89]
- whether one concludes that the equity beta of a UK energy utility differs significantly from one depends on the length of the time series considered. By contrast, estimates of the equity beta of a UK water utility are significantly below one and are sufficiently low that one can conclude that the equity beta of a UK water utility is significantly lower than the equity beta of a UK energy utility; and
- estimates of the equity beta of a US water utility do not differ significantly from one. One of the four estimates of the equity beta of a US energy utility, though, is significantly

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85 We drop Southwest Water Company because, as California Water Services (2008) argues, Southwest derives less than half of its revenue from regulated water operations.

Public Utilities Commission of the State of California, *Decision 09-05-019*, 7 May 2009.

California Water Services, *Opening brief of California Water Service Company*, 1 October 2008.

86 Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 2008.

87 Henry, Olan T., *Econometric advice and beta estimation*, Attachment C to the AER's *Explanatory Statement: Electricity transmission and distribution network service provider, review of the weighted average cost of capital (WACC) parameters*, 2008.

Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

88 We choose 2000 as our starting point because this is when the MSCI indices first appear on Bloomberg on a daily basis.

89 Henry, Olan T., *Econometric advice and beta estimation*, Attachment C to the AER's *Explanatory Statement: Electricity transmission and distribution network service provider, review of the weighted average cost of capital (WACC) parameters*, 2008.

Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

below one and significantly lower than the corresponding estimate of the equity beta of a US water utility.

However, we recognise that there are potential difficulties with using estimates of the equity betas of Australian energy utilities as guides to the equity beta of a benchmark for SunWater. There are also potential problems with using estimates of the equity betas of foreign energy and water utilities relative to foreign market indices as guides to choosing the equity beta of a benchmark. These challenges are that:

- energy and water companies operate different businesses and even within the energy or within the water industry different companies service different sets of customers;
- utilities face a variety of different regulatory frameworks and theory suggests that the regulatory framework that a firm faces can affect its equity beta;
- differences in the leverage of firms across markets can lead to differences between domestic and foreign re-levered equity betas; and
- differences in the significance of industries to the domestic and foreign economies can lead to differences between domestic and foreign equity betas.

In what follows we examine how important empirically these problems are.

Table 5.1
Equity Beta Estimates for Energy and Water Utilities

		Equity beta			
		2000 - 2011		**2009 - 2011**	
Country	**Industry**	**Estimate**	**Water less energy**	**Estimate**	**Water less energy**
		Panel A: Equally weighted portfolios			
Australia	Energy	**0.518**		**0.646**	
		(0.064)		(0.136)	
UK	Energy	1.090		**0.634**	
		(0.130)		(0.127)	
UK	Water	**0.543**	**-0.547**	**0.396**	**-0.239**
		(0.074)	(0.087)	(0.076)	(0.113)
US	Energy	0.880		0.962	
		(0.072)		(0.088)	
US	Water	1.019	0.139	1.091	0.129
		(0.088)	(0.075)	(0.109)	(0.108)

Panel A: Value-weighted portfolios

Australia	Energy	**0.449**		**0.458**	
		(0.060)		(0.093)	
UK	Energy	1.071		**0.648**	
		(0.124)		(0.126)	
UK	Water	**0.685**	**-0.386**	**0.492**	-0.156
		(0.095)	(0.077)	(0.086)	(0.112)
US	Energy	**0.787**		0.857	
		(0.071)		(0.077)	
US	Water	0.978	**0.192**	0.890	0.033
		(0.088)	(0.080)	(0.085)	(0.066)

Notes: The estimates are computed from weekly data taken from Bloomberg and MSCI and are re-levered using a benchmark leverage of 60 per cent. Standard errors are in parentheses. Beta estimates in bold differ significantly from one at the 5 per cent level while estimates of the difference between water and energy betas in bold differ significantly from zero at the 5 per cent level.

5.3.2 Firm characteristics

SunWater and some of the utilities whose returns we use to estimate equity betas have very different characteristics. For example, SunWater is a water business while many of the utilities are energy businesses. SunWater also has a different customer base from many of the utilities. SunWater has 5,000 customers across the resources, energy, urban and irrigation sectors. By contrast, Centrica, one of the utilities included in our analysis, is a UK provider of gas and electricity and has over 25 million residential customers.

The rationale for using the equity betas of energy businesses as proxies for the equity betas of water businesses is that:

- the income elasticities of energy and water are both low; and
- the fixed costs of distributing and transmitting energy and water are both high relative to the total costs of doing so – in other words, the operating leverages of energy and water businesses are high.

The income elasticity of demand for a product measures the extent to which its demand will change with a change in income. Goods that are necessities have a low income elasticity of demand because an increase or decline in income has little impact on demand for the goods. Goods that are luxuries have a high income elasticity of demand because an increase or decline in income has a substantial impact on demand. The low income elasticities of demand for energy and water mean that the equity betas of energy and water businesses will be lower than they would be if their income elasticities were high.

Companies with high fixed costs relative to total costs, ie, high operating leverage, can expand output without incurring the costs faced by otherwise identical companies that face high variable costs relative to total costs. Thus the high operating leverages of energy and water companies mean the equity betas of energy and water businesses will be higher than they would be if their operating leverages were low.

Whether the equity betas of energy and water companies differ substantially is an empirical question. Although there is no direct Australian evidence, estimates using UK and US data do not suggest that, after adjusting for differences in leverage, that there are systematic differences between the equity betas of energy and water businesses. Our estimates of the equity beta of a UK water utility are always below the corresponding estimates for a UK energy utility. On the other hand, our estimates of the equity beta of a US water utility are always above the corresponding estimates for a US energy utility.

While the income elasticity of water is low, the income elasticities of some water customers may be higher than the income elasticities of other customers. For example, it is likely that the income elasticities of commercial water customers exceed the income elasticities of residential customers. However, as both Frontier (2010) and ourselves have pointed out, measuring differences in income elasticities and the effect that these differences will have on the equity beta of a water business is difficult.[90] For this reason, both we and Frontier conclude that caution should be exercised before trying to take into account any impact. Frontier, for example, concludes that:

> ‘Energy businesses are much more likely to have a customer base that includes a material proportion of residential or domestic customers and so their equity beta may be lower than that of a rural water business.
> In determining if the equity beta needs to be amended to reference this additional risk, the ACCC will need to consider a number of issues, including ... the practical difficulties inherent in trying to quantify the extent of difference between equity betas for energy and rural water.’

5.3.3 Regulatory framework

The regulatory frameworks faced by the utilities that make up our empirical analysis may differ from the framework that SunWater will face going forward. In principle, the regulatory framework that a firm faces may affect its equity beta.

In what follows, it will be useful to note that the profits of a firm can be expressed as the difference between a firm’s revenues (ie, price multiplied by output) less its total variable costs (ie, variable cost per unit of output multiplied by output) less its fixed costs. This relation can be expressed by the following formula:

$$\pi = px(p,W) - v(x(p,W)) - f \tag{5}$$

where

[90] Frontier Economics, *The cross sectoral application of equity betas: energy to water, A report prepared for the Australian Competition and Consumer Commission*, April 2010.

NERA, *Single or multiple rates of return: SunWater, A report for the Queensland Competition Authority*, 30 August 2010.

π	=	the firm's profits;
p	=	the price per unit of output;
x	=	the firm's output;
W	=	aggregate wealth;
v	=	variable costs; and
f	=	fixed costs.

The terminology $x(p, W)$ means that output (x) depends on the price of outputs (p) and aggregate wealth (W). Similarly, the terminology $v(x(p, W)$ means that variable costs (v) depend on output (x) which in turn depends on price and aggregate wealth, ie, p and W. So equation (5) simply says that profits are revenue less the sum of fixed and variable costs, variable costs depend on output and output depends on the price per unit of output and aggregate wealth. The firm's output, x, will in general vary inversely with the price per unit of output (ie, as price falls demand increases), p, and positively with aggregate wealth, W (ie, demand increases as aggregate wealth increases).

Broadly speaking economic regulation can be characterised in one of three ways, ie:

- rate-of-return regulation;
- price-cap regulation; and
- revenue-cap regulation.

Abstracting from the many practical complexities that tend to blur these distinctions, as a matter of high level principle:

- rate-of-return regulation fixes profits, that is, π;
- price-cap regulation fixes the price per unit of output, that is, p; and
- revenue-cap regulation fixes revenue, that is, px.

Maintaining this same abstraction from practicality, it follows that as a matter of principle:

- rate-of-return regulation implies there is no relation between profits, π, and aggregate wealth, W;
- price-cap regulation implies there will typically be a positive relation between profits, π, and aggregate wealth, W; and
- revenue-cap regulation implies there will be a negative relation between profits, π, and aggregate wealth, W.

Thus, maintaining this abstraction from practical reality and setting aside considerations of the impact of risk between regulation and risk, these principles would imply that:[91]

- under rate-of-return regulation the equity beta of a regulated firm will be zero; and
- under price-cap regulation the equity beta of a regulated firm will be positive.

Inspection of (5) indicates that an increase in aggregate wealth, under revenue-cap regulation, will raise output and variable costs while the regulated firm will be forced to lower prices to keep revenue constant. Thus (5) suggests that:

- under revenue-cap regulation the equity beta of a regulated firm will be negative.

Regulation of whatever form typically allows or encourages utilities to set two part tariffs that fix both the price per unit of output, *p*, as well as a fixed charge, call it *c*. For example, the Authority has in the past used a framework of this kind to regulate Sunwater.[92] Under this framework, the profits of the firm will be given by:

$$\pi = (p - h(x(p,W)))\,x(p,W) - f + c\,, \tag{6}$$

where *h* is the variable cost per unit of output.

If *p* is set equal to *h* (prices are set to cover variable costs) and *c* is set an appropriate amount above *f* (the fixed charge more than covers fixed costs) then profits will be fixed and there will be no difference between this form of regulation and rate-of-return regulation.

If *p* is set above *h* (prices more than cover variable costs) and *c* is set to zero (there is no fixed charge), then profits will be a positive function of output and there will be no difference between this form of regulation and price-cap regulation.

If *p* is set to zero (there is no variable charge) and *c* is set to a positive number (there is only a fixed charge), then revenue will be fixed and there will be no difference between this form of regulation and revenue-cap regulation.

We pointed out in our previous report that, in the current framework that the Authority uses to regulate Sunwater, the fixed charge does not cover fixed costs but the variable charge more than covers variable costs. It follows that SunWater is effectively operating under a price-cap regime.

Alexander, Mayer and Weeds (1996) estimate the equity betas of regulated firms across a large number of countries that use a variety of different regulatory frameworks and provide

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[91] Alexander, Alexander, I., Mayer, C., Weeds, H., Regulatory structure and risk: An international comparison, World Bank Policy Research Working Paper No 1698, 1996.

Grout, Paul A. and Anna Zalewska, *The impact of regulation on market risk*, Journal of Financial Economics, 2006, pages 149-184.

[92] NERA, *Single or multiple rates of return: SunWater, A report for the Queensland Competition Authority*, 30 August 2010.

some support for a link between the regulatory framework that a firm faces and the equity beta of the firm. [93] For example, they argue that:

> '[price-cap] regimes involve high-powered incentives ... rate-of-return regulation is low-powered'

and state that they find that:

> 'high-powered incentives appear to be related to higher systematic risk, while low-powered incentives imply low market risk.'

The same results, though, also provide evidence against the link that theory says should exist between the regulatory framework and the equity beta of a regulated firm because Alexander, Mayer and Weeds also argue that:

> 'revenue-cap regimes involve high-powered incentives'

So they include in the set of firms that face high-powered incentives, firms that face a revenue cap. Alexander, Mayer and Weeds also find – as do we – that firms that face rate-of-return regulation have assets betas that are large enough to suggest that the equity betas of the firms are far from zero. We find that US firms that face rate-of-return regulation have equity betas that are not far from one.

More recent work is similarly inconclusive about the link between the regulatory framework and the equity beta of a regulated firm. Grout and Zalewska (2006) find that a proposal to introduce profit sharing in the UK led to a fall in the equity betas of regulated firms and so are able to provide some support for a link.[94] Gaggero (2010), on the other hand, finds that:[95]

> 'Using a worldwide panel of 170 regulated companies operating in electricity, gas, water, telecommunication and transportation sectors during the period 1995–2004, I find that different regulatory regimes do not result in different levels of risk to their regulated firms.'

Of course, the simple theoretical analysis we describe above abstracts from reality. For example, firms that face rate-of-return regulation face a regulatory lag that causes their profits to vary above or below the specified rate of return. Also, as Campbell and Mei (1993) show, in practice, one cannot infer what the equity beta of a firm must be from its cash-flow beta alone.[96] They show that the equity beta of a firm can be broken into three components: a cash-flow beta, an expected excess-return beta, and a real-interest rate beta. They find that while the cash-flow beta of a portfolio of US utilities is -0.125 – not significantly different from zero and consistent with our simple analysis above – the beta of the portfolio is 0.619 – far from zero.

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93 Alexander, Alexander, I., Mayer, C., Weeds, H., Regulatory structure and risk: An international comparison, World Bank Policy Research Working Paper No 1698, 1996.

94 Grout, Paul A. and Anna Zalewska, *The impact of regulation on market risk*, Journal of Financial Economics, 2006, pages 149-184.

95 Gaggero, Alberto A., *Regulation and risk: A cross-country survey of regulated companies*, Bulletin of Economic Research, 2010.

96 Campbell, J.Y. and J. Mei, *Where Do Betas Come From? Asset Price Dynamics and the Sources of Systematic Risk*, Review of Financial Studies, 1993, pages 567-592.

In light of the lack of strong evidence of a relation between the regulatory framework and the equity beta of a regulated firm, we suggest that relatively little weight be placed on the link that high level principle predicts should exist between the regulatory framework the Authority chooses and the equity beta of a benchmark.

Other Australian regulatory bodies have also considered whether the regulatory framework that a firm faces should be an important determinant of its equity beta. Transmission network service providers (NSPs) under the control of the AER face revenue caps while distribution NSPs typically face price caps. Theory suggests that, all else constant, the equity beta of a transmission NSP should be set below the equity beta of a distribution NSP. However, the lack of empirical support for a theoretical link between the regulatory framework that a firm faces and its equity beta led the AER (2009) to conclude in its recent *WACC* review that:[97]

> 'there were not compelling reasons or evidence to suggest a benchmark efficient NSP's exposure to systematic risk changes significantly under different control mechanisms, such that different equity betas would be appropriate.'

Thus our decision to place little weight on the link that theory predicts should exist between the regulatory framework the Authority chooses and the equity beta of a benchmark is consistent with regulatory precedent.

5.3.4 Financial leverage

Differences in the leverages of firms across markets can lead to differences between domestic and foreign re-levered equity betas. For example, ACG (2008) estimated the weighted leverage of the S&P 500 to be 40 per cent and the weighted leverage of the ASX 200 to be 34 per cent.[98] Under the assumption that the risks of the unlevered assets underlying the two indices are identical, a guide as to the equity beta of a corresponding Australian firm should be, re-levered estimates of the equity beta of a US firm to be increased by a factor of:

$$\frac{1-0.34}{1-0.40}=1.10$$

5.3.5 Industry weighting

Differences in the significance of industries to the domestic and foreign economies can lead to differences between domestic and foreign equity betas. Australia, for example, has a larger resources sector relative to the rest of the economy than either the UK or the US. It is therefore likely that, all else constant, the equity beta of an Australian resources firm relative to an Australian equity index will exceed the equity beta of a UK or US resources firm relative to a UK or US equity index. Similarly, it is likely that, all else constant, the equity beta of an Australian firm that is not in the resources sector relative to an Australian equity index will fall below the equity beta of an otherwise identical UK or US firm.

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97 AER, *Electricity transmission and distribution network service providers – review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009, pages 252.

98 Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 2008.

ACG (2008) reports that the higher weight of resources in the Australian index lowers the equity beta of a firm that is not in the resource sector relative to the Australian market portfolio. For this reason, ACG suggests that re-levered estimates of the equity beta of a US firm should be decreased by a factor of 0.81 to provide a guide as to what the equity beta of a corresponding Australian firm should be.[99] ACG consequently concludes that the effect of differences in leverage and industry weighting appear to largely offset each other – at least when it comes to differences between the Australian and US markets.[100]

Finally, ACG examines whether differences in the regulatory environments that firms face produce differences in their equity betas. They find little evidence to support that possibility.[101]

5.4 Regulatory decisions

Previous regulatory decisions provide some guidance as to how a value for the equity beta of an Australian water business might be determined on the basis of a domestic version of the CAPM. In this section we examine regulatory decisions made in Australia, the UK and the US in respect of energy and water businesses.

5.4.1 Australian regulatory decisions

Table 5.2 shows the results of some recent Australian regulatory decisions on the equity betas of energy and water utilities. The table also provides re-levered betas using the assumed leverage (ratio of debt to value) of a benchmark business of 60 per cent.

Table 5.2 indicates that Australian regulators have set the cost of equity in such a way as to come close to matching the re-levered equity betas of energy and water utilities, which suggests that they consider electric and gas utilities as good proxies for water businesses. For example, in 2010 the Authority set an equity beta of 0.65 and leverage of 0.5 for GAWB. This combination of equity beta and leverage produces a re-levered beta of 0.81 which is almost identical to the equity beta set by the AER for electricity and gas distribution in 2010.

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99 After they have been increased by a factor of 1.10 to take into account differences in financial leverage.

100 Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 17 September 2008, pp. 51-53.

101 Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 17 September 2008, p. 52.

Table 5.2
Recent Australian Regulatory Determinations on Equity Betas

Regulator	Year	Industry	State	Equity beta*	Leverage	Re-levered beta
AER	2010	Elec. Dist.	VIC	0.80	0.60	0.80
AER	2008	Elec. Trans.	NSW	1.00	0.60	1.00
AER	2010	Gas Dist.	ACT	0.80	0.60	0.80
ACCC	2008	Gas Trans.	VIC	1.00	0.60	1.00
GPOC	2007	Water	TAS	0.77	0.50	0.96
ICRC	2008	Water	ACT	0.90	0.60	0.90
ESC	2009	Water	VIC	0.65	0.60	0.65
IPART	2009	Water	NSW	0.90	0.60	0.90
QCA	2010	Water	QLD	0.65	0.50	0.81

** Midpoint where a range is specified.*
Sources: Publicly available regulatory decisions.

5.4.2 UK regulatory decisions

Table 5.3 shows the results of two recent UK regulatory decisions on the equity betas of energy and water utilities. As in Australia, this limited evidence suggests that regulators have set the cost of equity in such a way as to come close to matching the re-levered equity betas of energy and water utilities.

It is not possible to provide more information on recent UK regulatory decisions because the UK regulatory authorities are not always forthcoming on how they set the cost of equity for utilities. For example, the Office of the Gas and Electricity Markets (Ofgem) (2009), in a recent decision on the cost of equity for electricity distributors, stated that: [102]

> 'We have not disaggregated our cost of equity determination.'

While Ofgem does not reveal precisely how its arrives at the cost of equity, it does provide some hints. For example, it state that:

> 'a gearing level at the top of our range (and arguably above it) is required to obtain an equity beta approaching one. We think that a notional gearing of 65 per cent is appropriate.'

Since a gearing (leverage) of 65 per cent is at the top of its range, the statement suggests that Ofgem has applied an equity beta of around one for electricity distributors. An equity beta of one and a leverage of 65 per cent would produce a re-levered beta of 0.87, which matches the re-levered equity beta chosen by the Utility Regulator (UR) for Northern Irish electricity

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[102] Ofgem, *Electricity distribution price control review: Final proposals – allowed revenues and financial issues*, 2009.

distributors and is similar to the equity beta chosen by the UK water regulator (OFWAT) in 2009 for water businesses.

Table 5.3
Recent UK Regulatory Determinations on Equity Betas

Regulator	Year	Industry	Jurisdiction	Firm	Equity beta*	Leverage	Re-levered beta
UR	2011	Elec. Dist.	NI	SONI	0.77	0.55	0.87
OFWAT	2009	Water	UK	Various	0.90	0.57	0.96

Sources: Publicly available regulatory decisions.

5.4.3 US regulatory decisions

US regulators differ from those in Australia and the UK in that they typically do not rely on any single model to determine the equity beta. For example, the California Public Utilities Commission (2009) states that: [103]

> 'The Commission has never adopted a single preferred cost of capital model because no one model is perfect and the results produced by all models are highly susceptible to various input assumptions.'

Regulators generally use discounted cash flow analysis to generate the cost of equity for a utility and, in addition, may or may not use the CAPM. As a result, a regulator may not determine a value for the equity beta of a company that it regulates. However, a regulator will always set a cost of equity for the company. In Table 5.4 we show the cost of equity determined for a number of major water and energy utilities in recent US regulatory decisions.

Table 5.4 shows that there is little variation in the leverage of major water utilities. However, on average, the leverage of water companies is approximately 5 percentage points higher than that of electricity and gas companies. The table also shows that the authorised cost of equity for electricity companies is, on average, around 20 basis points higher than the authorised cost of equity for gas companies. The authorised cost of equity for gas companies is, on average, around 20 basis points higher than the authorised cost of equity for water companies. This data suggest that US regulators do not disagree with Officer's hypothesis that the risks of water and energy utilities are similar.

Since our focus is on a value for the equity beta of an Australian water business that, using a domestic version of the CAPM, will provide a return to equity that matches as far as is possible the return the market requires on equity, we examine a single US regulatory decision in more detail. We focus on a single decision because Table 5.4 indicates that there is relatively little variation in the leverage or cost of equity for a water utility set in recent major US regulatory decisions.

[103] California Public Utilities Commission, Decision 09-05-019 May 7, 2009.

In May 2009, the California Public Utilities Commission set the cost of capital for the three largest water utilities operating in California: the California Water Service Company, the California-American Water Company and the Golden State Water Company (a subsidiary of American States Water). [104] In setting these rates the Commission examined rates computed by the three companies and the Division of Ratepayer Advocates (DRA), a Californian state government body.

The DRA used a sample of 10 water companies as its proxy group. These companies were the nine water companies listed in Table 5.4, excluding Connecticut Water Service but including the Southwest Water Company and the York Water Company. For this group of companies the DRA estimated an equity beta of 0.89, which is not significantly different from the values we estimate in Table 2 for portfolios of US water utilities. Using the CAPM, a risk-free rate and market risk premium of 4.75 per cent and 4.60 per cent, the DRA consequently computed a cost of equity of 8.8 per cent for a water utility.

The DRA also computed a cost of equity for a water utility using discounted cash flow analysis which gives rise to a cost of equity of 9.6 per cent. Thus corresponds to an implied equity beta of 1.05.

[104] California Public Utilities Commission, Decision 09-05-019 May 7, 2009.

Table 5.4
Recent US Regulatory Determinations on the Cost Of Equity

Year	Firm	Exchange	Ticker	Industry	Leverage	Authorised cost of equity
2008	Various			Elec.	48.41	10.46
2009	Various			Elec.	48.61	10.48
2010	Various			Elec.	47.96	10.41
2008	Various			Gas	50.47	10.37
2009	Various			Gas	48.72	10.19
2010	Various			Gas	48.10	10.10
2009	American States Water	NYSE	AWR	Water	49.00	10.20
	American Water Works	NYSE	AWK	Water	57.60	9.63
	Aqua America	NYSE	WTR	Water	57.40	10.33
2009	Artesian Resources	NDQ	ARTNA	Water	58.60	10.00
2009	California Water Service	NYSE	CWT	Water	50.10	10.20
2007	Connecticut Water Service	NDQ	CTWS	Water	55.90	9.75
	Middlesex Water Company	NDQ	MSEX	Water	47.60	10.15
	Pennichuck Corporation	NDQ	PNNW	Water	51.50	9.75
2010	SJW Corporation	NYSE	SJW	Water	53.80	10.20

Notes: Leverage includes in the calculation of debt, preferred stock.
Sources: AUS Utility Reports and Research Regulatory Associates.

The three water companies also used discounted cash flow analysis and the CAPM to estimate the cost of equity. All of the companies produced higher cost of equity estimates than the DRA. The Commission chose a cost of equity of 10.2 per cent. This rate was higher than the rate that the DRA had recommended but less than the rates that the three companies had put forward. A cost of equity of 10.2 per cent, using the DRA's choices of a risk-free rate and market risk premium, corresponds to an implied equity beta of 1.18.

An equity beta of 1.18 is significantly higher than the estimates of the equity beta of a US water utility that we produce in Table 5.1. However, it is important to remember that an equity beta of 1.18 is based, in large part, on estimates of the cost of equity produced using discounted cash flow analysis. Discounted cash flow analysis, while it will not mislead in a world in which the CAPM is true, does not presume that the CAPM is true.

5.5 Conclusions

Our findings are that:

- there are no systematic differences across the UK and US in estimates of the equity betas of energy and water utilities; and

- regulators in Australia, the UK and the US set the costs of equity for energy and water utilities at similar levels, after adjusting for differences in financial leverage.

We therefore conclude that the equity beta of an Australian water business should be set at a value that is no different from the equity beta of an Australian energy utility. Recent Australian regulatory decisions set the equity beta of an energy utility that is authorised to have a leverage of 60 per cent to be 0.8. This value lies above the estimates that we produce of the equity beta of an Australian energy utility. However, there is a lot of evidence that the CAPM underestimates the returns the market requires on low-beta equities. In our opinion, therefore, if one is to use the CAPM, it is reasonable to set the equity beta of an energy utility – and so a water utility – to be above the empirical estimates one observes. We recommend that the equity beta of an Australian water business be set no lower than 0.8 and in light of recent UK and US regulatory decisions, no higher than 1.2.

6 Market *WACC* parameters

WACC parameters that would be the same for all companies are considered market parameters. The four cost of capital *WACC* parameters common to all companies are:

- the risk-free rate;
- expected inflation;
- the market risk premium (MRP); and
- the value of imputation credits.

The values of these parameters have been considered by the Authority in a number of previous decisions and so, to ensure consistency, we have been instructed to adopt these values and approaches.

6.1 Risk-free rate

The risk-free rate is the rate of return required by investors for holding an asset with guaranteed payments, ie, there is no risk of default and the timing of all capital payments is certain. As a consequence, the risk-free rate compensates investors for:

- the time value of money;
- the expected reduction in the purchasing power of money, ie, inflation; and
- liquidity and inflation risk.

The Authority in its recent decisions for the Gladstone Area Water Board[105] (2010) and QR Network[106] (2010) used the annualised 5-year yield on Commonwealth government bonds as the proxy for the risk-free rate. We note that the decision to use Commonwealth government bond yields as the proxy for the risk-free rate is not controversial. However, the Authority's decision to use a 5-year risk-free rate is at odds with other regulators, which generally use a 10-year risk-free rate. On the other hand, the Authority has included an explicit allowance in the debt margin for the additional cost that businesses would incur to borrow for a 10-year term.

An indicative estimate of the risk-free rate based on the annualised 5-year Commonwealth bond averaged over the 20 days ending on 31 January 2011 is 5.35 per cent.

6.2 Expected inflation

Expected inflation is normally considered a cost of capital parameter, even though it is not a component of the post tax nominal *WACC*. However, under a post-tax revenue approach the regulatory asset base is indexed to the Consumer Price Index.[107] Therefore, it is necessary to

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105 QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, p122..

106 QCA, *QR Network's 2010 DAU – Tariffs and Schedule F: Draft Decision*, June 2010, p.38.

107 Australian Bureau of Statistics, *Consumer Price Index, Australia (6401.0)*.

remove the expected appreciation in the regulatory asset base due to inflation from regulated revenues. This ensures that the firm is not compensated for the expected cost of inflation in both an appreciating asset value and in regulated revenues through the use of a nominal *WACC,* ie, the nominal risk-free rate includes compensation for expected inflation.[108]

The Authority's preferred approach is to set expected inflation equal to the midpoint of the Reserve Bank of Australia's inflation target, which is currently 2.5 per cent.[109]

6.3 Market risk premium

In the CAPM the market risk premium (MRP) is a positive premium over a risk-free rate that investors expect to earn on a portfolio of all assets. In practice, an Australian Stock Exchange (ASX) index is used as the proxy for the market portfolio.

The Authority's MRP value is based on the following considerations:[110]

- the long-term historical average premium of the ASX over the 10-year government bond yield is below 6 per cent;
- that the MRP should not be adjusted for short-term market fluctuations, which are subjective in both scale of required adjustment and period of application; and
- the use of a 5-year risk-free rate does not materially change the MRP estimate.

The value adopted by the Authority for the MRP in its recent decisions is 6 per cent.

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108 Removing the value of the expected inflationary increase in the regulatory asset base from regulated revenue means that a post-tax revenue approach effectively provides a real rate of return in revenues plus an inflation indexing asset base.

109 QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, p.136; and QCA, *QR Network's 2010 DAU – Tariffs and Schedule F: Draft Decision*, June 2010, p.83.

110 QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, pp.123-124; and QCA, *QR Network's 2010 DAU – Tariffs and Schedule F: Draft Decision*, June 2010, pp. 38-39.

6.4 Value of imputation credits (gamma)

Gamma is a parameter used to represent the value that equity investors receive from imputation credits created through the payment of company income tax. The imputation tax system was introduced in Australia on 1 July 1987 and allows resident investors to deduct from their taxable income any credits distributed to them by way of franked dividends. Since 1 July 2000 investors that have franking credits in excess of their tax liabilities have received a rebate from the Australia Tax Office (ATO). Australian utility regulators use gamma to determine the proportion of company income tax that does not need to be included in a regulated firm's annual revenue requirement, because of the benefit shareholders receive from the imputation tax system.

Australian regulators have generally adopted a gamma value of 0.5 in regulatory decisions. The exception is the AER which adopts a gamma value of 0.65.[111] We note that the AER's decision is currently being appealed by a number of regulated businesses.[112]

The Authority's preferred value for gamma is 0.5, which is consistent with the value adopted by most Australian regulators.[113]

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[111] AER, *Electricity transmission and distribution network service providers – review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009.

[112] ETSA Utilities, Ergon, Energex and Jemena have each lodged appeals on the value of gamma to the ACT.

[113] QCA, *Gladstone Area Water Board Investigation of Pricing Practices: Final Decision*, June 2010, p.135; and QCA, *QR Network's 2010 DAU – Tariffs and Schedule F: Draft Decision*, June 2010, p. 55.

7 Conclusion

Table 7.1, sets out the *WACC* parameters recommended to apply to SunWater and as well as an indicative estimate of the cost of capital.

Table 7.1
Recommended *WACC* Parameters

Parameter	Value
Credit Rating	BBB+
Risk-free rate[a]	5.35%
Market risk premium	6.0%
Asset beta[b]	0.32
Gearing (% debt)	60%
Equity beta[b]	0.80
Post-tax nominal return on equity	**10.15%**
Debt margin	3.50%
Credit default swap	0.95%
Interest rate swap allowance	0.27%
Annual debt refinancing allowance	0.125%
Debt margin (total)	4.85%
Pre-tax nominal return on debt	**10.20%**
Post-tax nominal vanilla *WACC*	**10.18%**
Officer pre-tax real *WACC*	**8.19%**

[a] *The average of 5-year nominal Commonwealth Government bond yields over the 20-days up to and including 31 January 2011.*

[b] *Calculated using the AER formula to leverage betas,* Table C.2 *sets out the betas consistent with the Conine formula.*

Appendix A. Companies Used in Empirical Work

This appendix lists the companies we used to estimate the equity betas for Australian energy businesses, and for UK and US energy and water businesses. We also report the debt-to-value ratios of each company computed using all available data from 29 December 2000 to 14 January 2011.[114]

The Australian energy utilities that we use, listed in Table A.1, are the nine utilities that Henry (2009) and the AER employ to estimate the equity beta of an electricity utility.[115]

Table A.1
Australian Energy Utilities

Company	Ticker	Debt-to-Value
Alinta Limited	AAN	0.336
The Australian Gas Light Company	AGL	0.305
APA Group	APA	0.556
Duet Group	DUE	0.760
Envestra Limited	ENV	0.735
GasNet	GAS	0.641
Hastings Diversified Utilities Fund	HDF	0.365
Spark Infrastructure Group	SKI	0.534
SP AusNet	SPN	0.612

There are relatively few listed UK energy and water utilities. We use the three energy utilities and five water utilities that PriceWaterhouseCoopers (2009) employs in its report on the cost of capital for the Office of Gas and Electricity Markets.[116] The energy utilities are listed in Table A.2 while the water utilities are listed in Table A.3. Table A.2 shows that UK energy utilities are less levered than their Australian counterparts.

[114] For each firm the ratio is the average of the debt-to-value ratios for the firm recorded at the end of June and December each year.

[115] Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

[116] PriceWaterhouseCoopers, *Advice on the cost of capital analysis for DPCR5: Final Report*, 2009.

Table A.2
UK Energy Utilities

Company	Ticker	Industry	Debt-to-Value
Centrica	CNA	Gas	0.091
National Grid	NG	Electricity & Gas	0.453
Scottish and Southern Energy	SSE	Electricity & Gas	0.202

Table A.3
UK Water Utilities

Company	Ticker	Industry	Debt-to-Value
Dee Valley Water	DVW	Water	0.472
Northumbrian Water	NWG	Water	0.621
Pennon	PNN	Water	0.343
Severn Trent Water	SVT	Water	0.552
United Utilities Group	UU	Water	0.472

By contrast to the UK, there is a large number of US energy and water utilities. The US energy utilities that we use are the 21 companies that ACG (2008) employs in its report to the AER.[117] These utilities are listed in Table A.4. The US water utilities that we use are the 10 water utilities that the California Public Utilities Commission (2009) employs less Southwest Water Company, because, as California Water Services (2008) argues, Southwest derives less than half of its revenue from regulated water operations.[118] These utilities are listed in Table A.5.

[117] Allen Consulting Group, *Beta for regulated electricity transmission and distribution: Report to Energy Networks Association*, Grid Australia and APIA, 2008.

[118] Public Utilities Commission of the State of California, *Decision 09-05-019*, 7 May 2009.

California Water Services, *Opening brief of California Water Service Company*, 1 October 2008.

Table A.4
US Energy Utilities

Company	Ticker	Industry	Debt-to-Value
AGL Resources Inc	AGL	Gas	0.437
Atmos Energy Corp	ATO	Gas	0.450
CH Energy Group Inc	CHG	Electricity & Gas	0.260
Centerpoint Energy Inc	CNP	Electricity & Gas	0.658
Energy East Corp	EAS	Electricity & Gas	0.514
Consolidated Edison Inc	ED	Electricity & Gas	0.427
Nicor Inc	GAS	Gas	0.264
ITC Holdings Corp	ITC	Electricity	0.447
The Laclede Group Inc	LG	Gas	0.419
NiSource Inc	NI	Electricity & Gas	0.572
New Jersey Resources Corp	NJR	Electricity & Gas	0.238
NSTAR	NST	Electricity & Gas	0.401
Northeast Utilities	NU	Electricity & Gas	0.567
NV Energy Inc	NVE	Electricity	0.682
Northwest Natural Gas Co	NWN	Gas	0.380
Piedmont Natural Gas Co Inc	PNY	Gas	0.267
Pepco Holdings Inc	POM	Electricity & Gas	0.582
South Jersey Industries Inc	SJI	Gas	0.296
Southwest Gas Corp	SWX	Gas	0.543
UIL Holdings Corp	UIL	Electricity	0.352
WGL Holdings Inc	WGL	Gas	0.333

Table A.5
US Water Utilities

Company	Ticker	Industry	Debt-to-Value
Artesian Resources	ARTNA	Water	0.390
American States Water	AWR	Water	0.353
Conn Water Services	CTWS	Water	0.290
California Water Services	CWT	Water	0.325
Middlesex Water	MSEX	Water	0.330
Pennichuk Corporation	PNNW	Water	0.299
SJW Corporation	SJW	Water	0.201
Aqua America Incorporated	WTR	Water	0.263
York Water Company	YORW	Water	0.235

Appendix B. Methods for Estimating Beta

B.1.1. Accounting data

Mandelker and Rhee (1984) show that, under the assumption that:

> the gross with-dividend return to the equity of a firm is equal to the ratio of earnings per share to the price of a share, that is, the reciprocal of the price-earnings ratio,

the equity beta of the firm will be related to its financial leverage and operating leverage in the following way: [119]

$$\beta_e = DFL \times DOL \times \beta_a^o \qquad (6)$$

where

DFL	=	the degree of financial leverage, defined to be the elasticity of net income with respect to earnings before interest and taxes;
DOL	=	the degree of operating leverage, defined to be the elasticity of earnings before interest and taxes with respect to sales volume;
β_a^o	=	the beta of an otherwise identical firm that is financially and operationally unlevered.

Mandelker and Rhee show that, in principle, one can estimate the beta of an otherwise identical firm that is financially and operationally unlevered by using accounting data for the firm in combination with a time series of returns to the market portfolio. It follows that, in principle, one can use the above formula to estimate the equity beta of an Australian water business without data on the returns to the equity of the business.

However, the Mandelker and Rhee formula is based on a restrictive assumption linking a firm's earnings per share to the return on its equity, ie, that the gross with-dividend return to equity is equal to the reciprocal of the price-earnings ratio. Empirically, a large fraction of the variation in equity returns can be attributed to information about future earnings and changes in the rate at which investors discount future earnings. So it is not surprising that, empirically, equity returns are far more volatile than earnings-price ratios. In other words, there is a lot of evidence against the assumption that Mandelker and Rhee make.

Thus estimates of beta computed using the Mandelker and Rhee formula or other similar formulae should be treated with caution since they are unlikely to be reliable. For this reason we do not use accounting data to estimate the equity beta of an Australian water business.

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[119] Mandelker, Gershon N. and S. Ghon Rhee, *The Impact of the Degrees of Operating and Financial Leverage on Systematic Risk of Common Stock*, Journal of Financial and Qunatitiative Analysis, 1984, pages 45-57.

We should note, however, that Mandelker and Rhee do not use their formula to estimate the equity beta of a firm. Instead they use the formula to test whether variation in financial leverage and operating leverage across firms can explain variation in the equity betas of firms. Consistent with their theory, they find that the equity beta of a firm is a positive function of its financial leverage and a positive function of its operating leverage.

B.1.2. Accounting and market data

The theory and empirical results of Mandelker and Rhee suggest that there is an alternative strategy for estimating the equity beta of a firm for which no market data are available. First, like Mandelker and Rhee, this involves estimating a relation between beta, financial leverage and operating leverage, ie, the parameters of the regression

$$\ln(\beta_e) = \gamma_0 + \gamma_0 \ln(DFL) + \gamma_0 \ln(DOL) + \varepsilon_e \tag{7}$$

using data for firms that have estimates of beta available. The next step involves estimating beta for a firm that has no market data available – whose shares, for example, are not traded – using the parameter estimates and the firm's financial leverage and operating leverage. An estimate of this kind is called a fundamental beta.

However, the results that Mandelker and Rhee produce suggest that financial leverage and operating leverage together never explain more than one half of the variation in equity betas across portfolios of firms formed on the basis of financial leverage or operating leverage. There is too much variation in equity betas across firms not explained by financial leverage and operating leverage to place much reliance on such a strategy.

Although we do not use this strategy for computing an estimate of the equity beta of an unlisted company the analysis of Mandelker and Rhee suggests that good proxies for an Australian water business should have financial leverage and operating leverage that do not differ markedly from those of a water business.

Appendix C. Re-levering using the Conine formula

In this appendix we report estimates of the equity betas of our portfolios of Australian, UK and US utilities that have been de-levered and re-levered using the Conine formula that the Authority has generally adopted.

In using this formula we have followed Lally (2011) and chosen the debt beta to be 0.11, the Australian imputation-adjusted tax rate to be $30 \times (1 - 0.5) = 15$ per cent and the UK and US tax rates to be 30 and 39 per cent.[120] As in the text we have assumed that the leverage (ratio of debt to value) of an efficiently geared benchmark business is 0.6.

The results in Table C.1 indicate, as in Table 5.1, that:

- estimates of the equity beta of a regulated Australian energy utility are significantly below one and below the value that Australian regulators typically use of between 0.8 and one;
- whether one concludes that the equity beta of a UK energy utility falls below one depends on the data one uses – estimates of the equity beta of a UK water utility are significantly below one and are significantly below estimates of the equity beta of a UK energy utility; and
- estimates of the equity beta of a US water utility do not typically differ significantly from one – estimates of the equity beta of a US energy utility are below one and below estimates of the equity beta of a US water utility.

[120] Lally, M., *The estimated WACC for the SEQ interim price monitoring*, 5 January 2011.

Table C.1
Equity Beta Estimates for Energy and Water Utilities

		Equity beta			
		2000 - 2011		2009 - 2011	
Country	**Industry**	**Estimate**	**Water less energy**	**Estimate**	**Water less energy**
		Panel A: Equally weighted portfolios			
Australia	Energy	**0.524**		**0.686**	
		(0.066)		(0.141)	
UK	Energy	0.877		**0.516**	
		(0.115)		(0.113)	
UK	Water	**0.487**	**-0.392**	**0.379**	-0.137
		(0.070)	(0.074)	(0.074)	(0.100)
US	Energy	**0.761**		**0.819**	
		(0.065)		(0.077)	
US	Water	**0.786**	0.025	0.872	0.054
		(0.075)	(0.071)	(0.084)	(0.077)
		Panel A: Value-weighted portfolios			
Australia	Energy	**0.435**		**0.504**	
		(0.064)		(0.102)	
UK	Energy	0.871		**0.534**	
		(0.109)		(0.113)	
UK	Water	**0.616**	**-0.254**	**0.477**	-0.057
		(0.088)	(0.066)	(0.084)	(0.100)
US	Energy	**0.696**		**0.746**	
		(0.065)		(0.067)	
US	Water	0.905	**0.209**	0.843	0.098
		(0.098)	(0.082)	(0.103)	(0.082)

Notes: The estimates are computed from weekly data taken from Bloomberg and MSCI and are re-levered using the Conine (1980) formula, a benchmark leverage of 60 per cent, a debt beta of 0.11, an Australian imputation-adjusted tax rate of 30 × (1–0.5) = 15 per cent and tax rates for the UK and US of 30 and 39 per cent. Standard errors are in parentheses. Beta estimates in bold differ significantly from one at the 5 per cent level while estimates of the difference between water and energy betas in bold differ significantly from zero at the 5 per cent level.

Table C.2, summarises the WACC parameters set out in section 7 that are consistent with the Conine formula.

Table C.2
Recommended *WACC* Parameters

Parameter	Value
Credit Rating	BBB+
Risk-free rate[a]	5.35%
Market risk premium	6.0%
Asset beta[b]	0.41
Debt beta	0.11
Gearing (% debt)	60%
Equity beta[b]	0.80
Post-tax nominal return on equity	**10.15%**
Debt margin	3.50%
Credit default swap	0.95%
Interest rate swap allowance	0.27%
Annual debt refinancing allowance	0.125%
Debt margin (total)	4.85%
Pre-tax nominal return on debt	**10.20%**
Post-tax nominal vanilla *WACC*	**10.18%**
Officer pre-tax real *WACC*	**8.19%**

[a] *The average of 5-year nominal Commonwealth Government bond yields over the 20-days up to and including 31 January 2011.*

[b] *Calculated using the Conine formula for leveraging betas.*