Final Report
Inquiry on Harvey Water Bulk Water Pricing

12 April 2007

Economic Regulation Authority

WESTERN AUSTRALIA

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Executive Summary

The Economic Regulation Authority (the **Authority**) has undertaken an inquiry into the most appropriate level and structure of water storage charges to the South West Irrigation Cooperative (**Harvey Water**), at the request of the Treasurer, in accordance with section 32(1) of the Economic Regulation Authority Act 2003.

The water storage charges to Harvey Water are currently set as part of the Bulk Water Supply Agreement (**BWSA**) between the Water Corporation (**Corporation**) and Harvey Water. The BWSA expired on 30 June 2006 but has been extended in the same form by mutual agreement of the parties. A new agreement will be completed following this inquiry.

The recommendations in this report have been informed by a consultation process that included two opportunities for interested parties to provide written submissions.

The Authority has reviewed the Corporation's operating and capital expenditure proposals for the next ten years. High level benchmarking suggests that the order of magnitude of the Corporation's direct costs (excluding overheads) is similar to or less than the bulk water supply costs for similarly sized eastern State's water businesses. The Authority has accepted the Corporation's operating expenditure proposal on the basis that the overhead rate that is applied to the South West dams is the same as is applied to the Corporation's major consumers.

The Corporation's proposed capital expenditure programme for its South West dams is almost entirely to improve dam safety. The Authority has concluded that most of the proposed expenditure is justified under the Australian National Committee on Large Dams (**ANCOLD**) Guidelines, subject to some technical reassessments confirming this prior to the resigning of the BWSA. The exceptions are the proposed expenditure on Logue Brook Dam and Stage Two of the (already completed) works on Waroona Dam, which the Authority considers is (or was) not justified under the ANCOLD Guidelines.

The Authority has presented two options for charging Harvey Water. The first is to apply the ANCOLD framework and pass through to customers the costs of complying with ANCOLD. Under this option, charges to Harvey Water would increase from an average of $5.40 per Megalitre (**ML**) to $30.23 per ML (in real dollar values of 30 June 2006). The total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $73.82 per ML (in real dollar values of 30 June 2006).

Given that the costs attributed to Harvey Water are significantly higher than the current charges to Harvey Water, the Authority considers that it would be appropriate to phase-in the charges over a reasonable period, such as ten years. The phase-in would be funded by a Community Service Obligation (**CSO**) payment to the Corporation.

A second option is possible when the wider portfolio of risks facing the Western Australian community is taken into account. Subject to the Government moving to manage the wider portfolio of risks facing the Western Australian community on a whole-of-government basis, only the dam safety costs associated with Wellington Dam would be expected to proceed in the short-term and be recovered from customers. The dam safety costs associated with Stirling, Drakes Brook and Samson Brook dams would be expected to be deferred in favour of more effective options for reducing risk of life. Stage One of the remedial works on Waroona Dam would be recovered from customers.

Under this second option, charges to Harvey Water would increase from $5.40 per ML to $14.86 per ML (in real dollar values of 30 June 2006). The total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $58.45 per ML (in real dollar values of 30 June 2006). The Authority considers that it would also be appropriate to phase-in the charges under Option 2 over a reasonable period, such as ten years.

Both options 1 and 2 assume that the total costs associated with providing a storage service from Logue Brook, Waroona, Wellington and Drakes Brook dams are reduced by 20 per cent, which is an estimate of the recreational benefits associated with these dams. The value of 20 per cent is based on an analysis of the recreational benefits at Logue Brook dam (the dam with the most robust information available on recreational benefits). The estimate is higher than the 15 per cent value that was applied in the original BWSA (although the 15 per cent was applied to all dams, whereas the 20 per cent figure is only applied to four dams). The value assigned to recreational benefits is funded by a CSO payment to the Corporation.

Under Option 1, the annual CSO would be $7.0 million in 2007/08, reducing to $4.5 million in 2016/17 and remains at $4.5 million thereafter (the CSO reduces as the higher charges are phased-in). Under Option 2, the annual CSO would be $8.8 million in 2007/08, reducing to $7.9 million in 2016/17 and remains at $7.9 million thereafter. In comparison, the current annual CSO payment to the Corporation for the purpose of providing a dam storage service to Harvey Water is approximately $3.2 million.

The Terms of Reference requires the Authority to consider the merits of alternatives to the ANCOLD Dam Safety Guidelines. In conducting this analysis, the Authority has noted that, while other jurisdictions have introduced State-based regulatory arrangements, such arrangements interpret and clarify the application of the ANCOLD framework; they do not reject or dismiss the ANCOLD Guidelines. Based on the experience in other jurisdictions and international guidelines, the Authority considers that there are several potential clarifications that could be made in respect of the ANCOLD Guidelines for application in Western Australia. Within the context of the ANCOLD Guidelines, the Government could:

- introduce complementary legislation to limit the liability of dam owners;
- clarify the role of risk assessment in justifying expenditure on dam safety. Queensland, Victoria and New South Wales have government policies on the application of risk assessment to dam safety reviews. In the absence of such guidance, the Corporation has applied a standards-based approach;
- introduce a quality assurance process for dam safety expenditure. For example, New South Wales and Tasmania have independent committees that assess dam safety expenditure proposals. A quality assurance process for dam safety expenditure in Western Australia could be achieved by establishing the necessary review and approval functions within either the Department of Water or a separately constructed independent dam safety regulator; or by relying on periodic assessment and recommendations from the Authority under its reference function, based on advice from international dam safety experts, as has occurred in this inquiry; and
- set a threshold level of expenditure per statistical life saved, which would replace the current tentative guidance on threshold levels provided in the ANCOLD Risk Guideline.

In addition, the Government could introduce a mechanism that more transparently prioritises expenditure on dam safety against expenditure on safety elsewhere across Government services. If an alternative regime for prioritising expenditure on safety were

developed, with a threshold for the cost of saving a statistical life (**CSSL**) of say, $30 million (which is ten times the value often used to guide decisions on public health and safety expenditure in Australia), around $200 million of the Corporation's total proposed expenditure of $335 million for upgrades across the State-wide portfolio of dams, could be either deferred or removed.

The Government could also establish the institutional capability to coordinate and prioritise safety expenditures within Government and for the community as a whole. This capability might be located in a central agency such as the Department of Treasury and Finance or a new body such as an Office of Public Safety.

Recommendations and Findings

1) It would be appropriate to apply the NWI upper bound pricing principle for the purpose of determining the costs of operating and maintaining the irrigation dams.
2) The appropriate initial asset value as at 30 June 1995 is zero for the purpose of calculating the dam storage charges for Harvey Water's irrigation water and the written down replacement value for the purpose of calculating the dam storage charges for Harvey Water's non-irrigation water.
3) The appropriate asset value as at 30 June 2007 is consistent with the initial asset value as at 30 June 1995, rolled forward by adding appropriate dam safety and other capital expenditure, subtracting depreciation and adjusting for inflation.
4) In accordance with the views expressed by the parties in submissions, the Authority has assumed that the new agreement will be based on a smoothed revenue requirement approach.
5) The Authority considers that the new BWSA should be for a period of five years, at which time the future capital expenditure profile would be reconsidered and, if appropriate, revised.
6) Prior to renegotiating the BWSA, the Corporation should:
    a) review its estimates of Population at Risk at Stirling, Drakes Brook, Samson Brook and Logue Brook dams; and
    b) reconfirm the risks (failure probabilities, severity of flood and probable loss of life) associated with Wellington dam.
7) Subject to the recommended reassessments not changing either the justification or prioritisation of the Corporation's dam safety programme, there are two options for charging Harvey Water:
    a) Option 1: the proposed dam safety costs associated with Stirling, Drakes Brook, Samson Brook and Wellington dams should be recovered from customers;
    b) Option 2: subject to the Government moving to manage the wider portfolio of risks facing the Western Australian community on a whole-of-government basis, the dam safety costs associated with Wellington Dam should be recovered from customers (the dam safety costs associated with Stirling, Drakes Brook and Samson Brook dams are expected to be deferred in favour of more effective options for reducing risk of loss of life).
8) Under either option, the costs of $11.5 million for Stage One of Waroona Dam should be recovered from customers.
9) The Government should establish a legislative framework for regulating dam safety to:
    a) clarify the role of risk assessment in justifying expenditure on dam safety by providing a dam safety regulatory framework for Western Australia;
    b) introduce a quality assurance process for dam safety expenditure by establishing either an independent regulator or independent committee;
    c) set a threshold level of expenditure per statistical life saved, which would replace the current threshold levels set in the ANCOLD Risk Guidelines for applying the ALARP principle;

d) protect dam owners by limiting tort liability; and

e) introduce a mechanism that transparently prioritises expenditure on dam safety against expenditure on reducing other risks facing Government and the community. Such a mechanism would require all safety-related expenditures to be justified using common yardsticks (such as cost per statistical life saved and benefit cost ratios).

10) The Government should establish the institutional capability to coordinate and prioritise safety expenditures within Government and for the community as a whole. This capability might be located in a central agency such as the Department of Treasury and Finance or a new body such as an Office of Public Safety.

11) Dam safety expenditure should not be reduced by a legacy component because the decision to use the water from the irrigation dams (whether by Harvey Water or the Corporation) needs to be based on the costs of accessing that water, which appropriately includes the efficient costs of dam safety.

12) The total costs associated with providing a storage service from Logue Brook, Waroona, Wellington and Drakes Brook dams should be reduced by 20 per cent, which is based on an estimate of the recreational benefits associated with Logue Brook dam (the dam with the most robust information available on recreational benefits).

13) Harvey Water should be allocated its share of the costs of Logue Brook, after a deduction for recreational benefits has been made, even though recreational benefits would be extinguished by the trade between the Corporation and Harvey Water. The reason or this is that the Corporation should bear the costs of removing recreational benefits, not Harvey Water, given that the Corporation could develop alternative sources.

14) As there are both positive and negative aspects to the aesthetic benefits of dams and natural flood mitigation, no allocation of costs in respect of these should be attributed to the Government.

15) The allocation of costs of Waroona, Logue Brook, Drakes Brook, Wellington, Samson Brook and Samson Brook Pipehead dams should be on the basis of water allocations from each dam and take into account the trades between the Corporation and Harvey Water.

16) As per agreements between the parties, the costs of Harvey Dam and Wokalup Pipehead Dam should be met by the Corporation.

17) The allocations of the costs of Stirling Dam were the subject of an agreement between the Corporation and Harvey Water; however, the parties disagree on the terms of that agreement. While the Authority is reluctant to arbitrate the terms and conditions of a commercial trade, it has been assumed that the costs of Stirling Dam are allocated on the basis of the share of entitlements to the water in the entire Harvey, Stirling and Wokalup system.

18) The new BWSA should be based on:

a) an overhead rate for operating expenditure that is the same as is applied for the Corporation's major consumers (53 per cent);

b) a productivity rate of 1.88 per cent, which is consistent with the rate that has been applied to the Corporation generally;

c) asset lives for new capital expenditure of 80 years for the purpose of determining

depreciation allowances; and

d) a rate of return of 5.6 per cent (pre-tax real).

19) The storage charges to Harvey Water should be phased-in over a period of ten years.

20) Given that the mix of fixed and variable charges is primarily a commercial issue to do with managing the volume risk of uncertain annual streamflows, it is probably unnecessary for the Government to prescribe the structure of charges that the Corporation applies to Harvey Water.

21) Under Option 1:

a) average irrigation costs for dairy farms in the Harvey region increase to around $29,000 per farm (from around $18,000 presently, in real dollar values of 30 June 2006);

b) the total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $73.82 per ML (in real dollar values of 30 June 2006).

22) Under Option 2:

a) average irrigation costs for dairy farms in the Harvey region increase to around $23,000 per farm (from around $18,000 presently, in real dollar values of 30 June 2006;

b) the total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $58.45 per ML (in real dollar values of 30 June 2006).

23) Under Option 1, annual CSO payments to the Corporation for providing a dam storage service would reduce from $7.0 million in 2007/08 to $4.5 million in 2016/17 and remain at $4.5 million thereafter.

24) Under Option 2, annual CSO payments to the Corporation for providing a dam storage service would reduce from $8.8 million in 2007/08 to $7.9 million in 2016/17 and remain at $7.9 million thereafter.

1 Introduction

On 5 October 2006, the Treasurer of Western Australia gave written notice to the Authority to undertake an inquiry into the most appropriate level and structure of water storage charges to Harvey Water.

1.1 Terms of Reference

This inquiry has been referred to the Authority under Section 32 of the *Economic Regulation Act 2003* (**Act**), which provides for the Treasurer to refer to the Authority inquiries on matters related to regulated industries (i.e. water, gas, electricity and rail).[1]

The Terms of Reference are provided in Appendix 1.

In accordance with the Terms of Reference, the Authority will make recommendations on the level and structure of water storage charges to Harvey Water, which will require consideration of:

- the cost of operating and maintaining the irrigation dams;
- the additional costs associated with maintaining and improving dam safety of the Water Corporation's South West irrigation dams;
- the beneficiaries of the South West irrigation dams;
- the ability of South West irrigation farmers and Harvey Water to meet their share of the costs of dam safety improvements and the impact on farmers of the rate of change of an increase in prices (if any); and
- the impact on State Government's net financial position associated with the recommended price level and structure.

In examining the water storage charges to Harvey Water, the Authority is required by the Terms of Reference to have regard to:

- the Government's social, economic and environmental policy objectives.

In undertaking the inquiry, the Authority recognises section 26 of the Act, which requires the Authority to have regard to:

- the need to promote regulatory outcomes that are in the public interest;
- the long-term interests of consumers in relation to the price, quality and reliability of goods and services provided in relevant markets;
- the legitimate business interests of investors and service providers in relevant markets;
- the need to promote competitive and fair market conduct;
- the need to prevent abuse of monopoly or market power; and
- the need to promote transparent decision making processes that involve public consultation.

[1] Section 38 of the Act also provides for the Treasurer to refer to the Authority inquiries on matters related to other industries (i.e. not only the regulated industries of water, gas, electricity and rail).

1.2 Background to the Inquiry

In October 1996, the Corporation transferred its South West irrigation distribution business to the South West Irrigation Management Co-operative (now trading as Harvey Water) and entered into a ten-year water storage agreement with the irrigation water supplier.[2]

The Corporation owns and operates the eight dams in the South West that are used to provide water to three groups of customers: farmers, via the distribution network owned and operated by Harvey Water; private industry, which is supplied via Harvey Water (although the Corporation recoups some of the revenue); and customers in Perth and elsewhere within the Integrated Water Supply System (**IWSS**). In addition, most of the dams (all except Stirling and Samson Brook dams) are used for a variety of recreational purposes.

While the Corporation owns and operates the dams, it does not have the rights to all of the water in the dams. Harvey Water was granted water access entitlements under the *Rights in Water and Irrigation Act 1914* to the majority of the water in the dams (the entitlements, which were for a period of five years, have recently expired and Harvey Water has applied to have the entitlements reissued). The Corporation does not charge for the water itself but only the costs associated with storing the water (where the charges are based on the future costs of providing the storage service).

1.2.1 Description of System

Harvey Water owns and manages three separate irrigation systems (Waroona, Harvey and Collie), supplied by water from eight dams:

- Waroona Irrigation Scheme is supplied from Waroona Dam (which feeds into Drakes Brook Dam) and Samson Brook Dam;
- Harvey Irrigation Scheme is supplied from Harvey Dam, which is downstream of the Stirling Dam, and from Wokalup Dam and Logue Brook Dam; and
- Collie Irrigation Scheme is supplied from Wellington Dam (via Burekup Weir).

In 2005/06, Harvey Water had a total allocation of 152 Gigalitres (**GL**), most of which is supplied from Wellington Dam (68 GL) and Harvey Dam (40 GL). Water trading between Harvey Water and the Corporation will reduce the allocation to Harvey Water to 136 GL by 2009/10.[3]

The Waroona and Harvey Irrigation Schemes are connected to the IWSS via the Stirling Trunk Main.

[2] In fact, the assets were transferred to the South West Irrigation Asset Co-operative which was established as a separate entity to the South West Irrigation Management Co-operative, and which owns the assets.

[3] Harvey Water will have a reduced allocation from both Samson Dam, Stirling Dam and Logue Brook Dam. A potential future trade could reduce it by at least a further 22 GL.

1.2.2 Bulk Water Supply Agreement

The BWSA specifies the terms and conditions under which the Corporation provides the water storage service for Harvey Water.[4] The BWSA also provides for Harvey Water to meet a share of the costs of safety improvements on the South West irrigation dams.

Water storage charges to Harvey Water were set on the basis that 85 per cent of the future operating and renewal costs for dam headworks would be recovered from Harvey Water and other direct users with the remaining 15 per cent of costs, which are attributed to other beneficiaries such as recreational users, paid for by Government.

Water storage charges amounted to around $0.8 million in 2004/05, of which $0.39 million was for dam safety, $0.25 million was for storing water for Harvey Water and $0.16 million was for storing water for non-irrigation users. Water storage charges to non-irrigation users, which represents less than one per cent of the total volume of all dams, attracts a higher per unit charge than the charge to Harvey Water.

The Government makes a CSO payment ($3.3 million in 2004/05) to the Corporation to cover the difference between its water storage costs and revenue raised from the storage charges. The CSO provides the Corporation with a return on the dam assets that were in place at the time of the transfer and pays for the estimated benefits to the public, such as to recreational users.

The BWSA expired on 30 June 2006 but has been extended in the same form by mutual agreement of the parties. A new agreement will be completed following this inquiry. The new agreement will be framed within a context that is different now to 1996 when the BWSA was initially endorsed. At the time of the original agreement, a long-term reduction in rainfall compared to the historical average was not contemplated and neither was the prospect of trading water with the Corporation.

In addition, the original agreement did not contemplate the significantly higher expenditure on dam safety that would be required to meet the ANCOLD guidelines.[5] The costs of improvements to the dams were estimated at around $16 to $18 million at the time of the transfer, but have since increased to around $151 million.[6] A review by Marsden Jacob Associates (**MJA**) in 2003 concluded that the Corporation compared favourably with current Australian best practice in dam safety management, but suggested several areas where the process could be improved.[7] The review concluded that the allocation of dam safety costs to Harvey Water would be unaffordable, and recommended that Harvey Water pay 25 to 35 per cent of the dam safety costs for Waroona Dam and 40 to 50 per cent of the remainder of the dam safety program.

Following the MJA review, the State Government set up a working group chaired by the Department of Environment, with representatives from the Department of Treasury and Finance, the Water Corporation and Harvey Water, to investigate the merits of developing State-based dam safety regulations. The working group commissioned a report by the

[4] While the agreement is called the “Bulk Water Supply” Agreement it actually refers to the terms and conditions associated with the Corporation storing water that Harvey Water has a licence to take (i.e. the Corporation does not “sell” water to Harvey Water).

[5] The ANCOLD Guidelines can be ordered at the ANCOLD website, www.ancold.org.au.

[6] Source: Water Corporation.

[7] Marsden Jacob Associates (August 2003), *Review of Dam Safety Program Relating to South West Irrigation Dams: Final Report*, a report for Harvey Water and the Water Corporation. Suggested improvements in the Corporation’s process included more stakeholder involvement, greater use of expert reviews, greater use of detailed risk assessment; and achieving ANCOLD targets over a longer timeframe.

Snowy Mountains Engineering Corporation (**SMEC**) to evaluate alternative risk management strategies.[8]

The Terms of Reference for this inquiry require that the Authority, in its consideration on expenditure on dam safety on the South West irrigation dams, take into account the findings of the reports by MJA (2003) and SMEC (2006).

1.3 Review Process

The recommendations of this inquiry have been informed by the following public consultation process:

- The Authority published an issues paper on 13 October 2006 and invited comments. Six submissions were received in response to the issues paper. The issues paper and submissions are published on the Authority's web site (www.era.wa.gov.au).
- The Authority published a draft report on 14 December 2006 and invited comments. Five submissions were received in response to the draft report. The draft report and submissions are published on the Authority's web site.
- The Authority's Consumer Consultative Committee was consulted on the findings just prior to the release of the Draft Report on 13 December 2006.
- The final report for this inquiry was delivered to the Treasurer on 12 April 2007. Under the legislation, the Treasurer has 28 days following receipt of the report to table the report in Parliament.

In accordance with section 45 of the Act, the Authority acted through the Chairman in conducting this inquiry.

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[8] Snowy Mountains Engineering Corporation (June 2006), "Evaluation of Alternative Risk Management Strategies: Draft Report", report prepared for the WA Department of Environment. The draft report recommended further development of methods to compare risks and expenditure on life safety improvement across government agencies.

2 Method for Cost Recovery

2.1 Terms of Reference

The Authority is expected to consider and develop findings on:

> The cost of operating and maintaining the irrigation dams, based on:
>
> a. a "renewal costing" methodology which carries forward the model used for the 1996 Bulk Water Agreement;
>
> b. a "full costing" methodology, consistent with National Water Initiative pricing principles, including efficient operating costs and capital expenditure requirements and a suitable rate of return on past and future investment in storage and distribution assets owned by the Water Corporation.

2.2 Background

2.2.1 The BWSA

The BWSA was based on an assessment of the costs associated with providing a water storage service to Harvey Water. The following costs underpinned the contract price:

- the expected amount that needed to be put aside so that the assets that were in place at the time of the handover could eventually be replaced;
- the expected new capital expenditure (excluding dam safety expenditure); and
- the expected operating and maintenance expenditure.

After determining the expected costs for a period of 100 years, the Corporation calculated the annual amount of revenue that would cover those costs.[9] 85 per cent of this annual amount was charged to Harvey Water because it was assumed that 15 per cent of the benefits of the expenditure would accrue to third parties such as recreational users of the dams. The third party benefits were to be funded by CSOs from the State Government.

Dam safety expenditure was treated separately (that is, it was not used to determine the base contract prices). The agreement included a provision for Harvey Water to contribute to the costs of dam safety, and a payment was subsequently made by Harvey Water in 2004/05. Dam safety expenditure is discussed in Chapter 3.

2.2.2 Obligations Under the National Water Initiative

The National Water Initiative (**NWI**) Agreement requires the State Government to ensure that Harvey Water pays the Corporation an amount that makes the storage service a viable operation, which means that the Corporation would receive just enough revenue from Harvey Water to cover its share of any cash outlays that the Corporation either incurs or expects to incur. This is referred to as lower bound pricing, which has the following definition:

[9] Harvey Water has indicated that the agreement was to exclude the new Harvey Dam from these contributions because the effect of building that dam was to free up higher quality water from Stirling Dam for potable purposes.

> To be viable, a water business should recover, at least, the operational, maintenance and administrative costs, externalities, taxes or [tax equivalent rates] (not including income tax), the interest cost on debt, dividends (if any) and make provision for future asset refurbishment/replacement... Dividends should be set at a level that reflects commercial realities and stimulates a competitive market outcome.[10]

The BWSA meets the requirement of lower bound pricing.[11]

The NWI Agreement also specifies a form of pricing that seek to ensure that water businesses do not earn monopoly rents. This is referred to as upper bound pricing, which has the following definition:

> To avoid monopoly rents, a water business should not recover more than the operational, maintenance and administrative costs, externalities, taxes or [tax equivalent rates] (tax equivalent regime), provision for the cost of asset consumption and cost of capital, the latter being calculated using a WACC (weighted average cost of capital)…. The deprival value methodology should be used for asset valuation unless a specific circumstance justifies another method.[12]

This method of cost calculation results in a greater amount of revenue being generated than under lower bound pricing. The reason for the difference is that upper bound pricing assigns a value to the assets and ensures a rate of return is applied, whereas lower bound pricing does not strictly require this, although it does require that interest and dividend payments (if any) are provided for. Assets are valued using the deprival value method. Under this method, the value of an asset may be estimated by assigning a value to the asset consistent with the present value of the expected future net income stream that is generated using that asset.

The BWSA would only be consistent with upper bound pricing if the assets had a zero value at the time the BWSA was struck (this issue is discussed further on page 14 below). The issue of asset valuation is important because the NWI Agreement requires continued movement towards upper bound pricing and the payment of CSOs where this is not achieved:

> Full cost recovery for all rural surface and groundwater based systems, recognising that there will be some small community services that will never be economically viable but need to be maintained to meet social and public health obligations:
>
> 1) achievement of lower bound pricing for all rural systems in line with existing NCP commitments;
>
> 2) continued movement towards upper bound pricing for all rural systems, where practicable; and
>
> 3) where full cost recovery is unlikely to be achieved in the long term and a Community Service Obligation (CSO) is deemed necessary, the size of the subsidy is to be reported publicly and, where practicable, jurisdictions to consider alternative management arrangements aimed at removing the need for an ongoing CSO.

[10] Schedule B(i), Intergovernmental Agreement on a National Water Initiative.

[11] Indeed, it is likely that the BWSA exceeds the lower bound requirement because it assumes that a rate of return is applied to capital costs, which is not strictly necessary with lower bound pricing (as defined above) unless the assets are debt funded or dividend payments are made.

[12] Schedule B(i), Intergovernmental Agreement on a National Water Initiative.

Further information on the alternative approaches to pricing are provided in the advice the Authority has received from ACIL Tasman.[13]

2.3 Analysis

In establishing an appropriate method for cost recovery, the Authority recognises that the entitlements to the water in the dams are held by the Corporation and Harvey Water. The Corporation provides the storage service with the customers of the storage service including the Corporation, Harvey Water and non-irrigators (via Harvey Water).

Given the current institutional arrangements, it would be inappropriate to assign a scarcity value to the water and charge this value to the customers of the storage service because the customers already own this water and are free to trade this water should they wish to do so.

The Authority's view is that it would be inappropriate to apply lower bound pricing to the new BWSA. That is, lower bound pricing could (hypothetically) be applied by setting tariffs in the new BWSA to cover future costs only, and ignore the return on the assets that have been constructed over the period of the first BWSA. It would be inconsistent with the original BWSA to ignore the return on this capital expenditure.

Another approach considered by the Authority is to base prices on a Depreciated Optimised Replacement Cost (**DORC**) valuation of the dam assets. This approach involves estimating the cost of replacing the dams, optimised for the latest engineering standards and depreciated to be consistent with the current service level. The Department of Treasury and Finance stated a preference for the application of a DORC methodology to determine the cost of the asset base for the South West dams:

> [T]he DORC asset valuation method (with straight line depreciation) has become a conventional approach of valuing existing infrastructure assets and it is utilised by most Australian and overseas regulators in industries such as gas, electricity, telecommunications and rail and water. For long-lived assets such as the Harvey Dam scheme, DORC is especially appropriate. (Department of Treasury and Finance submission on Issues Paper, p3)

However, the Authority does not consider that the BWSA should be based on an estimate of the optimised replacement cost of the assets. The estimation of a DORC asset value for the South West dams would be a complex and expensive exercise (that may need to be repeated at the outset of each new BWSA). DORC valuations involve a substantial amount of judgement with regard to the costing and optimisation process. The estimation would need to take into account the costs a new party would incur in providing the equivalent level of dam services. It is likely that a new party would incur less expenditure to meet the dam safety guidelines than the Corporation would spend in retrofitting the dams. However, how much less a new party would spend would be a matter of contention (this matter is discussed further in the next chapter).

The Authority is of the view that the deprival value method offers advantages over the DORC method or written down replacement cost approach. The deprival value method is consistent with the pricing principles of the NWI; it is consistent with the method of charging irrigators in the original BWSA; it avoids the cost and complexity of a DORC valuation; and it offers flexibility in dealing with the allocation of dam safety costs (rather

[13] For a full discussion of the cost recovery methods discussed in this chapter, see ACIL Tasman (November 2006), *Harvey Water Supply System: Notes on Pricing Frameworks*, Paper 3 of 4 for the Authority, published on the Authority web site.

than incorporating the amount a new party would spend on dam safety into the DORC asset value, the dam safety costs can be allocated to users or the Government in a more flexible way (as is discussed in Chapter 4 below)).

In the Draft Report, the Authority indicated that it was inclined to recommend upper bound pricing using an initial asset value of zero at 30 June 1995. The Authority considered that zero may be an appropriate estimate of the initial asset value under the deprival value method given the possibility at the time that future expenditure could offset future revenue, particularly given the uncertain magnitude of dam safety expenditure.

Under this approach, the 30 June 2007 asset value can be calculated by starting with a zero initial asset value at the commencement of the BWSA on 30 June 1995, adding the capital expenditure that has been incurred by the Corporation over the period of the agreement, subtracting depreciation and adjusting for inflation. The value obtained from this approach is the value for the portfolio of South West dams.

This 30 June 2007 calculation is influenced by the assumption regarding the amount of dam safety capital expenditure already incurred being added to the regulatory asset base. The advantage of the approach suggested by the Authority is that it makes the assumption about dam safety expenditure explicit and transparent. As indicated above, this issue is discussed further in Chapter 3 below.

Harvey Water and the Corporation endorse this approach for irrigation pricing purposes:

> The ERA has taken the appropriate, and consistent, approach to the valuation of the asset base. Harvey Water agrees with the proposition that the value of the assets as they stood at the commencement of the BWSA, should stay at zero, and then add into the asset base the value of capital works undertaken since then, with appropriate depreciation…The ERA has made the appropriate decision in stating a preference for the deprival methodology over DORC. (Harvey Water submission on Draft Report, p2)

> The Water Corporation is generally supportive of the approach proposed for developing the prices for irrigators… (Corporation submission on Draft Report, p3)

However, the Corporation does not support the approach for non-irrigation pricing purposes (under the BWSA, the Corporation recoups a higher charge from Harvey Water for its non-irrigation water sales):

> The issue here is what cost should be attributed to non-irrigation customers.
>
> One view is that they should pay the full cost based on the written down replacement cost. Under this method the customers would obtain the benefit of the relatively cheap existing water sources.
>
> Another view is that they should pay the opportunity cost of the water as it relates to the long-run marginal cost of source development in the integrated scheme and would be consistent with the pricing approach taken by the ERA to urban water pricing. This is essentially the approach taken in the original BWSA … for non-irrigation water use. This charge was based on a calculation of the long-term opportunity cost of water for use in the Integrated Water Supply Scheme (IWSS). The opportunity cost calculation was done 12 years ago and does not factor in recent climate change. A similar calculation today would result in a much higher charge.
>
> The original higher charge for non-irrigation water also reflects a State government decision to maintain consistency with the Water Corporation's other major consumers. (Corporation submission on Draft Report, p15)

A related concern raised by the Corporation is of the Authority's description in the Draft Report of the charges that result from the Authority's proposed method as 'upper bound prices':

> The ERA appears to be seeking to continue the existing renewal approach but to relabel it an upper bound price. The Water Corporation supports this calculation but not its description as an upper bound price. This point is important as irrigators are not the only customers of the storage service, and describing this price as an upper bound price may place an artificial limit on other prices, which would ultimately be at the expense of Western Australian taxpayers through higher CSOs. (Corporation submission on Draft Report, p7)

The Corporation appears to be concerned that by not setting a higher storage charge to Harvey Water for the water that Harvey Water on-sells to non-irrigators, CSOs would be higher. The Corporation calculates CSOs as the difference between the revenue it receives for providing the dam storage service and its costs, which are based on the written down replacement value of the South West dams. Were the Corporation to receive less revenue from Harvey Water for its non-irrigation sales, it would require higher CSOs to make up the difference.[14]

However, in this instance the CSOs do not represent compensation for an economic subsidy. An economic subsidy occurs when a customer does not pay at least the incremental costs associated with providing the service; no economic subsidy was intended under the original BWSA, and no economic subsidy would result for either irrigators or non-irrigators if the Authority were to assume a zero asset value at 30 June 1995.

The submission from the Corporation indicates that the Corporation expects non-irrigators to at least make an ongoing contribution to the recovery of the expenditure on the dams prior to 30 June 1995, including a return on that expenditure, and further that they could be charged the opportunity cost of the water.

As noted above, it would not be appropriate for the Corporation to recoup a charge from non-irrigators that included the opportunity cost of water; the Authority's proposed method of cost recovery includes only the costs of the storage service and does not attempt to influence potential trades.

However, it is possible that the Corporation could have struck a different BWSA with Harvey Water if it had not been able to recoup a higher dam storage charge from non-irrigators. On the basis that the new BWSA should broadly reflect the terms and conditions of the original BWSA, the Authority has amended the cost recovery method it proposed in the Draft Report in the following way:

- a zero asset value as at 30 June 1995 has been applied for the purpose of calculating the dam storage charges for Harvey Water's irrigation water; and
- the written down replacement value as at 30 June 1995 has been applied for the purpose of calculating the dam storage charges for Harvey Water's non-irrigation water (using the estimates of non-irrigation volumes at 30 June 2007[15]).

[14] The higher CSO would be largely passed back to the Government in the form of dividends and tax equivalent payments.

[15] The allocation is fixed at 30 June 2007 because it would not be appropriate to have the Corporation benefit financially from any future growth in water sales to non-irrigation customers. The date 30 June 2007 was chosen rather than 30 June 1995 because the BWSA allowed the Corporation to benefit from growth in water sales to non-irrigation customers for the duration of the BWSA.

On the issue of whether the Authority's proposed method should be called upper bound pricing, the Authority considers that its proposed method is consistent with the definition of upper bound pricing (provided on page 12 above) using the deprival value method. Effectively, the revision to the cost recovery method explained above modifies the deprival value by taking into account the potential revenue from non-irrigation customers.

The Corporation also raises the concern that non-irrigators could be charged an amount that is inconsistent with charges to the Corporation's major consumers. The Authority considers that the charge that Harvey Water applies to non-irrigators is a matter for Harvey Water as the water currently going to non-irrigators is from Harvey Water's entitlement.

An issue raised by Harvey Water in its submission is that it considers that dam safety payments should be a separate charge.

> Harvey Water considers that dam safety costs should be kept separate from other costs and separately accounted for in water storage charges. This makes for greater transparency for all parties. (Harvey Water submission on Draft Report, p5)

The Authority considers that dam safety costs are a necessary cost of providing a dam storage service and has therefore calculated water storage charges inclusive of dam safety costs. However, for transparency purposes, the Authority has reported the dam safety component separately.

A related issue is that Harvey Water, in its submission on the Issues Paper, considers the dam safety contribution that it made in 2004/05 to be a capital contribution. The Authority sought comment from interested parties on this matter, and the Corporation's response was as follows:

> Dam safety payments should be treated as cash flows in the costing model, making it irrelevant whether it is treated as a capital contribution.
>
> It should be noted that the dam safety payment for the Waroona Dam upgrade represented 30% of the annualised cost of the upgrade. It was 30% of a renewals annuity that recovered the cost of the works over the life of the asset at a 6% real rate of return. As such it would not build up any "pre-paid" capital entitlement in the dam. (Corporation submission on Draft Report, p7)

The Authority concurs with the Corporation's view and has treated the dam safety payments as cash flows rather than capital contributions.

Recommendations

1) It would be appropriate to apply the NWI upper bound pricing principle for the purpose of determining the costs of operating and maintaining the irrigation dams.

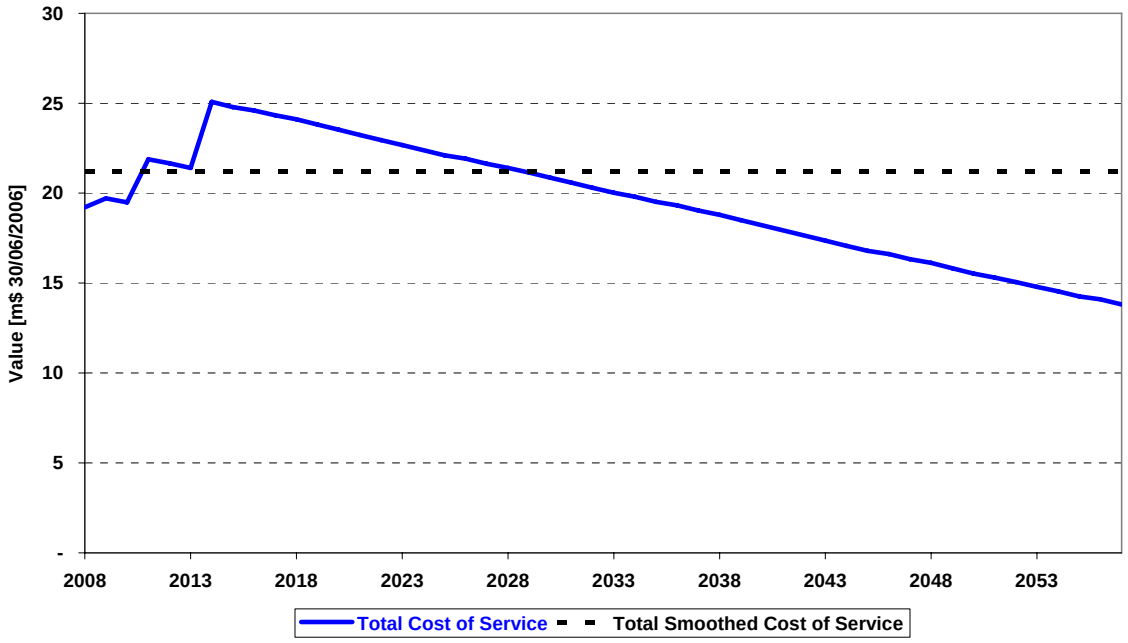
2) The appropriate initial asset value as at 30 June 1995 is zero for the purpose of calculating the dam storage charges for Harvey Water's irrigation water and the written down replacement value for the purpose of calculating the dam storage charges for Harvey Water's non-irrigation water.

3) The appropriate asset value as at 30 June 2007 is consistent with the initial asset value as at 30 June 1995, rolled forward by adding appropriate dam safety and other capital expenditure, subtracting depreciation and adjusting for inflation.

2.3.1 Approaches to Determining the Annual Revenue Requirement

A related issue is whether the payment schedule should be smoothed or not (i.e. whether the revenue requirement should be constant from year to year or vary). Figure 2.1 illustrates the implications of smoothing the Corporation's annual revenue requirements over the next 50 years (assuming the Authority's recommendations).[16] Both the smoothed and unsmoothed approaches have the same net present value.

Figure 2.1 Approaches to Determining the Annual Total Revenue Requirement



Source: Economic Regulation Authority

In situations where significant capital expenditure is expected at some relatively distant time, smoothing of this future outlay provides security that there will be sufficient revenues to fund the capital expenditure and to ensure the financial viability of the company. However, as can be seen in Figure 2.1 above, smoothing does not confer this advantage when the capital expenditure (i.e. the dam safety program) is impending. Instead, smoothing allows customers to defer their payments.

There are drawbacks associated with the smoothing approach, including that it does not encourage efficiency. Annuities based on long-range forecasts of future expenditure may be highly uncertain, which can lead companies to conservatively over-estimate expenditure requirements. It is difficult for regulators, who are at an informational disadvantage, to determine the efficiency of long-range capital expenditure programs, or to regulate against imprudent over-spending or under-spending on a year-to-year basis.

A further problem with the smoothing approach is that it can commit a company to a particular capital works program (since this is what customers have paid for) even if the economic case for a portion of this program weakens. Also, customers may prefer to spend their income today in other ways than in funding future investments.

[16] The figure is based on the scenario discussed in Appendix 2.

The alternative unsmoothed approach places greater discipline on companies to achieve efficient expenditure. The merits of each investment are evaluated before that investment is made, and the investment costs are included in prices only after the costs have been incurred.

Irrigation cooperatives have considered this issue, with varying outcomes as follows:

- Colleambally Irrigation Co-operative in NSW charges an annual asset renewals levy to its members to provide funding to maintain its infrastructure. Consultants are engaged every five years to assess the 50-year asset replacement profile and to determine a suitable renewals annuity.
- SunWater in Queensland also uses a smoothing approach, based on a 30-year rolling period.
- In Victoria, the Water Industry Regulatory Order requires that water businesses apply the unsmoothed approach to their urban activities, but that they may adopt either approach in respect of their rural activities. Of the five rural water businesses:
  - two businesses have moved to an unsmoothed approach (Goulburn-Murray Water and GWM Water). An independent consultant's review in 2005 of Goulburn-Murray Water's policies recommended a move to an unsmoothed approach, primarily on the grounds of improved incentives for efficiency in capital expenditure;[17] and
  - three businesses have elected to retain a smoothing approach for their rural activities (First Mildura Irrigation Trust, Lower Murray Water and Southern Rural Water). However, Lower Murray Water uses a pay-as-you-go approach for its urban activities.

Given the size of the dam safety capital expenditure program, the Authority is of the view that the decision whether to smooth the revenue requirement or not is best left to the Corporation and Harvey Water to agree.

The Corporation has responded by supporting the smoothed approach:

> The current BWSA is based on the renewals costing model smoothed over 100 years. The dam safety payments are similarly calculated. The Water Corporation expects that this arrangement would be carried forward into the new agreement as this arrangement helps create cash flow certainty for Harvey Water. (Corporation submission on Draft Report, p8)

Harvey Water has proposed a modification to the smoothed approach:

> Harvey Water considers that an "adjustable smoothed" approach is desirable. A smoothed approach is attractive because it provides for predictability. However, the disadvantage of a smoothed approach is that it potentially introduces inefficiencies because of the risks involved for both the service provider and the customer. The service provider will tend to set a higher charge to cover the risk of some unforeseen cost. At the same time, the customer will not receive the benefit of efficiency savings that were not anticipated at the time the price path was set.
>
> The Harvey Water preference is for a smoothed price that can be re-negotiated periodically in the light of new cost information. (Harvey Water submission on Draft Report, p17)

[17] Frontier Economics (March 2005), *Review of Pricing Policies*, a report prepared for Goulburn-Murray Water.

Harvey Water's request for periodical renegotiation in the light of new cost information is appropriate. The Authority considers that the new BWSA should be for a period of five years, at which time the future capital expenditure profile would be reconsidered and, if appropriate, revisions would be made to the BWSA. The periodic review reflects the uncertainty associated with the necessity for the Corporation's proposed dam safety expenditure.

In accordance with the views expressed by the parties in submissions, and subject to periodic review, the Authority has adopted the smoothed approach for the purpose of calculating Harvey Water's payment schedule.

Recommendation

4) In accordance with the views expressed by the parties in submissions, the Authority has assumed that the new agreement will be based on a smoothed revenue requirement approach.

5) The Authority considers that the new BWSA should be for a period of five years, at which time the future capital expenditure profile would be reconsidered and, if appropriate, revised.

3 Dam Safety Expenditure

3.1 Terms of Reference

The Authority is expected to consider and develop findings on:

> The additional costs associated with maintaining and improving dam safety for the Water Corporation's South West Irrigation Dams. This should include consideration of:
>
> a. the requirements of the current Australian National Committee on Large Dams (**ANCOLD**) dam safety guidelines and the requirement for the Water Corporation to manage their dams to these guidelines; and
>
> b. the overall merits, for all parties, of alternatives to the ANCOLD dam safety guidelines.
>
> These considerations should utilise existing studies, including:
>
> a. Marsden Jacob Associates August 2003 *"Review of Dam Safety Program Relating to South West Irrigation Dams";*[18] and
>
> b. Snowy Mountains Engineering Corporation July 2006 "*Evaluation of Alternative Risk Management Strategies*".[19]

The purpose of this chapter is to identify the appropriate amount of dam safety expenditure to be included in the Corporation's revenue requirement for the duration of the new BWSA. Consideration is given to the merits of ANCOLD versus alternative arrangements.

3.2 Background

3.2.1 Previous Work

Prior to 1995, the (then) Water Authority was aware of the issues regarding the safety of the South West dams, but no detailed review of the scope and costs of upgrading the dams had been carried out.[20] Following the establishment of the Corporation in 1995, the Corporation reviewed its dam safety requirements. In the absence of State-based regulations on dam safety, the Corporation adopted the framework of guidelines and risk standards set by ANCOLD.

The BWSA, signed in October 1996, required safety upgrades in accordance with the ANCOLD *Guidelines on Dam Safety Management 1994*. In the process of negotiating the BWSA, an estimated cost of $17 million for dam safety upgrades had been mentioned, although it was acknowledged that this estimate was highly uncertain, pending a thorough review of the dams.

The Corporation commenced a dam safety review in 1997 with a portfolio risk assessment to identify dams with the highest safety risk. Six South West dams were included in the high priority list for design reviews. These reviews were carried out in 1997-98, followed by concept designs, detailed designs and customer consultation (although not with Harvey

[18] This document is available on the Authority web site at www.era.wa.gov.au.

[19] This document will be available on the Authority's web site when the final report is completed (it is currently only a draft report).

[20] Water Corporation, personal communication, 25 August 2006.

Water), with detailed business cases by 2001. In 2002, dam safety upgrade costs for the South West irrigation dams were estimated at $101 million.

In 2002, the Corporation and Harvey Water jointly commissioned MJA to conduct a review of the expenditure on dam safety for the South West irrigation dams.[21] The MJA review examined best practice dam safety management in Australia and concluded that:

> Water Corporation currently utilises a process that compares favourably with current Australian best practice in dam safety management. They have adopted risk-based decision-making and a stated objective of eventually reaching compliance with modern ANCOLD dam engineering standards. (MJA, 2003, p122).

However, MJA identified scope for improvement in the Corporation's process including greater stakeholder involvement in the development of the dam safety program; greater use of expert reviews; greater use of detailed risk assessment techniques; and consideration of interim risk reduction works (i.e. achieving ANCOLD targets over a longer period).

MJA also drew attention to the fact that dam safety was simply one of many risks in the wider portfolio of risks facing the WA community and Government; and that the current partitioned approach to safety was unlikely to be efficient in terms of reducing risks to the WA community. MJA suggested that a broader, whole-of-government approach to risk management and reduction was warranted.

In May 2004, the Western Australian Government appointed a working group on dam safety, chaired by the Water Services Planning Branch of the Department of Environment, to examine the merits of developing State-based regulations on dam safety. The working group included representatives from the Department of Treasury and Finance, the Corporation and Harvey Water. The working group published a draft report in 2006 on the evaluation of alternative risk management strategies for dam safety.[22]

The draft report by the working group recommended that there be a greater acceptance of interim measures (upgrading over time) and risk mitigation measures such as monitoring, early warning systems and evacuation procedures.[23] It also recommended that the State Government develop methods to assess and compare risks so that the principles applying to expenditure on safety are consistently applied across government agencies.

Western Australia is not alone in its increased focus on dam safety. Dam safety management in the United States became more formal and pro-active following legislation and guidelines enacted in the decades following the failure of the Teton Dam in 1976. Since the corporatisation of State and Territory government organisations in Australia in the 1990s, the boards of dam-owning corporations have moved to assess the risks of dams and implement remedial works in accordance with the relevant standards (either ANCOLD or State-based standards, where they exist).[24]

3.2.2 ANCOLD

ANCOLD was established in 1937, as the national branch of the International Commission on Large Dams. ANCOLD produces guidelines, for example, on:

[21] Marsden Jacob Associates (August 2003), op.cit.

[22] Snowy Mountains Engineering Corporation (June 2006), *Evaluation of Alternative Risk Management Strategies Draft Report*, prepared for the Department of Environment.

[23] Snowy Mountains Engineering Corporation (June 2006), ibid.

[24] Ibid, p8.

- environmental management of dams;
- the selection of acceptable flood capacity for dams;
- assessment of the consequences of dam failure;
- dam design;
- dam safety management; and
- management of risk for dams.

ANCOLD Guidelines are not compulsory standards but include a range of measures for consideration when undertaking dam safety works. These measures include complementary means such as risk management as well as engineering solutions.

The ANCOLD Guidelines have been developed in the light of international dam safety standards and wider risk-based approaches such as that of the Health and Safety Executive in the UK.[25] Underpinning the ANCOLD Guidelines on risk are defined limits of tolerability of the risks of dam failure. The Guidelines require that all risks above the limits of tolerability be reduced to the limits of tolerability, except in exceptional circumstances. Below the limits of tolerability, risks could be tolerable, provided they are reduced to "As Low As Reasonably Practicable" (the **ALARP** principle).

The framework of the ANCOLD Guidelines addresses three key objectives in relation to public policy on safety:

- ***equity*** – the principle that all members of a society face equal levels of risk and they are entitled to a high level of safety. This principle is encapsulated in the limits of tolerability of risk, which are set without reference to the costs or benefits of investment in safety;
- ***efficiency*** – ensuring that investments in improving safety are cost effective, in that they achieve the greatest reduction in risk per unit of expenditure. Efficiency considerations can have a bearing on the timing and sequencing of investments. The ANCOLD Guidelines support the use of portfolio risk assessment, in which risks are assessed and addressed across a portfolio of assets (e.g. dams) to prioritise expenditure so that each step achieves the greatest possible reduction in risk; and
- ***protecting dam owners against liability*** – dam owners may be protected from liability by the ANCOLD requirement that risks be further reduced below the tolerability limits provided that the costs are not grossly disproportionate to the benefits of risk reduction.

The key features of the limits of tolerability are:

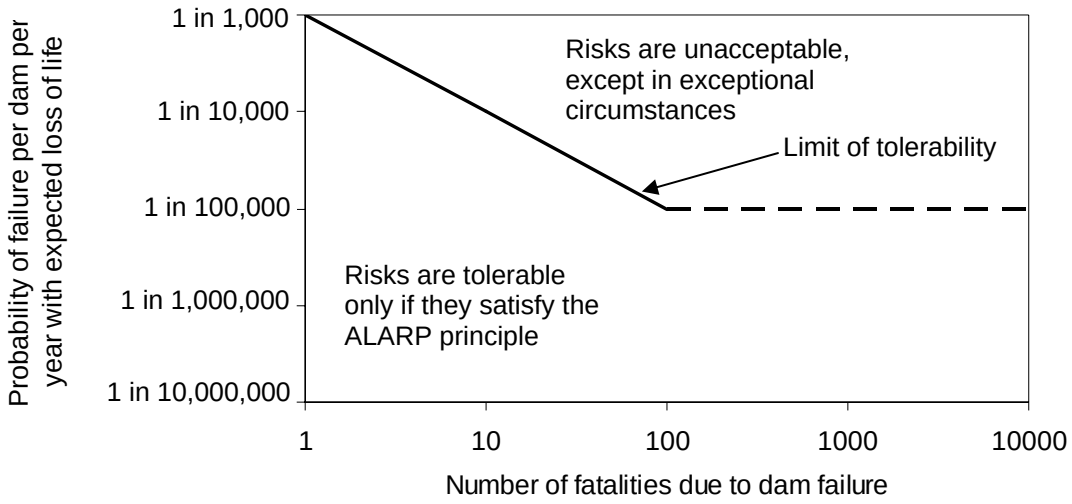
- no single individual should face a risk greater than 1:10,000 of death from dam failure in any one year (called the *individual risk* criterion);
- the expected (risk weighted) number of fatalities in any one year must not exceed 1:1,000 for an established dam (called the *societal risk* criterion); and

[25] For example, ICOLD (International Committee on Large Dams) standards; Health and Safety Executive (2001), *Reducing Risk, Protecting People: HSE's Decision-Making Process.*

- the limit of tolerability for multiple fatalities is capped for any number of deaths above 100 (1:100,000 for existing dams).[26]

Figure 3.1 shows the ANCOLD limits of tolerability for risks of dam failure for existing dams.

Figure 3.1 ANCOLD Societal Risk Reference Guidelines – Existing Dams



Source: ANCOLD Guidelines on Risk Assessment (2003), p47.

The limits of tolerability are more stringent for new dams and major augmentations than for existing dams, ranging from a risk of 1 in 10,000 for loss of one life to a cap of 1 in 1,000,000 for 100 lives or more. The less stringent tolerability limits for existing dams recognises that the marginal costs of providing extra safety on old dams is much higher than that for new dam investments.

The limits of tolerability of risk in the ANCOLD Guidelines are absolute and make no reference to the costs or benefits of investment in safety. However, the application of tolerability limits is moderated in a few ways, as follows:

- the less stringent tolerability limits for existing dams as opposed to new dams and augmentations;

[26] This truncation is an ANCOLD variation on international standards. The ANCOLD truncation is the product of two intersecting lines:

- first, the tentative limit of tolerability for any level of fatality. Whether one fatality, 100 or 1,000, the limit of tolerability indicates the locus of points where the probability of one life being lost is consistently one in 1,000. For large scale life loss, say, 10,000 lives, this implies that the probability of fatalities should not be greater than one in 10,000,000. The resulting tentative limit of tolerability is based on no aversion to multiple fatalities; and
- second, the recognition that once risks have been reduced to a low level (one in 100,000) the ability to assess further reductions in risk is diminished and may not be meaningful. For existing dams, the ANCOLD Risk Guidelines imply a level of meaningful probabilities as down to, but not beyond, 1.E 10^{-5}, i.e., one in 100,000 level. The ANCOLD Risk Guidelines state that the horizontal truncation line *"…defines ANCOLD's view of the lowest risks that can reasonably be assured, or demonstrated, over all dams, given the technology that was used for construction (for existing dams) or would be available (for proposed dams), the diversity of site geotechnical conditions and the available techniques for estimating risks."*
  The result of these two intersecting curves is a single limit of tolerability which is hinged at a risk level of 1.E 10^{-5}, i.e., one in one hundred thousand.

- the truncation of the tolerability limits for levels of risk lower than one in 100,000. For lower levels of risk, this truncation places a limit on the amount of expenditure required to meet tolerability limits;
- the Guidelines contain an "exceptional circumstances" clause, which allows for the exercise of discretion by a government or by a dam safety regulator acting on behalf of government (but not the dam owner) in cases where tolerating high risks is in the wider interests of society; and
- the Guidelines provide the dam owner with flexibility to adopt a portfolio approach across all its dams, or even across all types of infrastructure or sources of risk managed by the Corporation, to optimise the sequencing of expenditure to achieve the most efficient reduction in risk.

Despite these moderations, the requirement for dam owners to meet ANCOLD limits of tolerability with regard to dam safety, in the absence of a Government decision to exercise the exceptional circumstance provisions, is absolute and does not have regard to costs.

Once risks have been reduced to, or below, the limit of tolerability, the ANCOLD Guidelines further require dam owners to reduce risk to the point where the risks are ALARP, i.e. where costs are grossly disproportionate to benefits. The definition of ALARP in terms of factor of disproportionality between the benefits gained and the costs (sacrifice) involved is a cornerstone of the risk based approach adopted by the UK Health and Safety Executive (**HSE**).

MJA cite documentation relevant to the application of the HSE approach and the particular factors of disproportionately applied by HSE when assessing whether risks are ALARP. These vary between ten times for risks at or just below the limit of tolerability down to three times for risks well below the limit of tolerability.

In many cases, the prime benefit in safety expenditures is frequently the value of saving a life (**VOSL**). In these cases, the ALARP principle means that in reducing risks (further) below tolerable limits, costs of up to 10 times the VOSL (estimated to be around £1 million in the U.K. and around $2.7 million in Australia) would be considered justified. Except in unusual circumstances, costs above this multiple would be considered to be poorly justified under the approach adopted by the HSE. Thus, under this approach, costs of saving a statistical life (**CSSL**) in excess of £10 million in the U.K. and or – in round terms – $30 million in Australia would be considered to be poorly justified.[27]

U.S. approaches to safety have not in the past been based on an explicit limit of tolerability nor the ALARP principle. However, safety regulators have been observed to show distinct resistance to safety expenditures involving CSSLs greater than around USD 140 million.[28]

The ANCOLD Risk Guidelines are based on an interpolation between the implicit UK and US thresholds to derive a $A100 million upper limit to the CSSL beyond which further expenditure would not be warranted under the ALARP principle because of poor cost-effectiveness.

[27] The CSSL is also sometimes described as the Cost Per Statistical Life Saved (CPSLS). The concept is identical. The more prevalent term, CSSL, is used by ANCOLD and in this report.

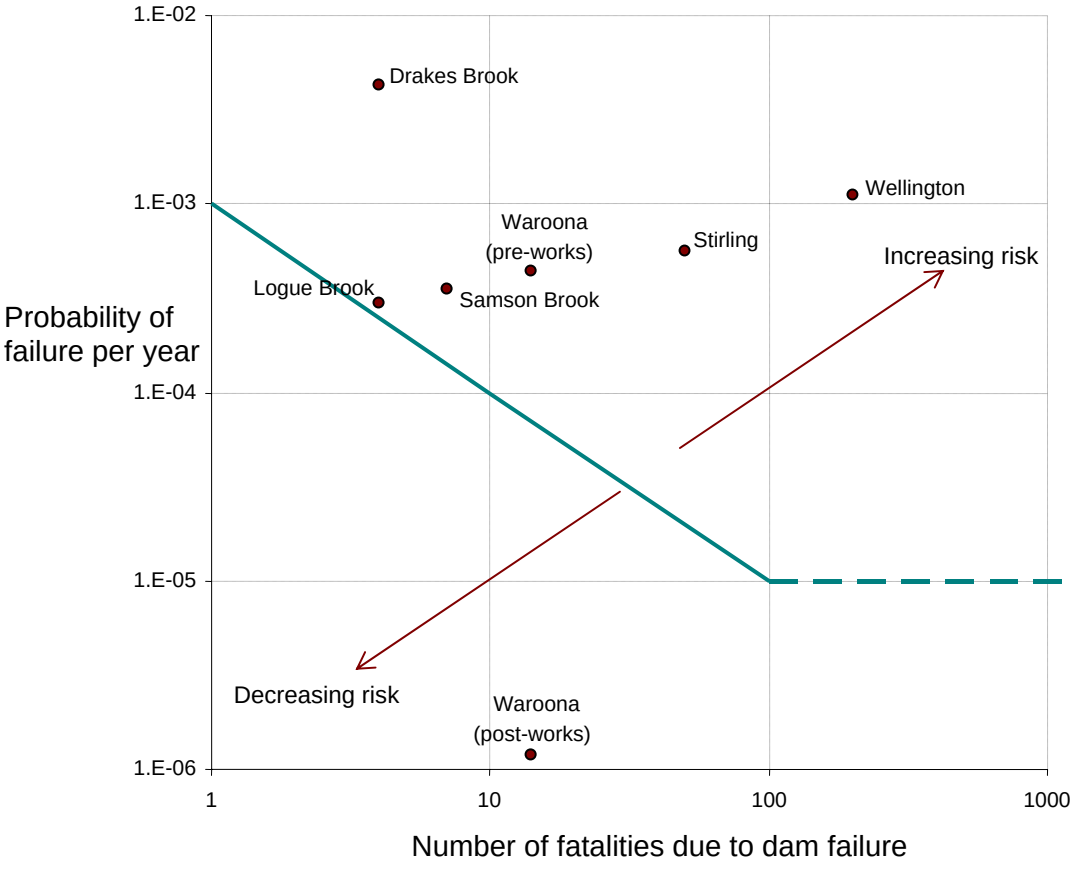
[28] See Bowles, D. S., and Anderson L. R., *Risk Informed Dam Safety Decision Making,* ANCOLD Bulletin No. 123, 2003.

3.3 The Corporation's Dam Safety Program

Since 1995, Corporation risk assessments have been based largely upon dam safety or design reviews conducted by engineering consultants. Figure 3.2 below describes the framework under which these reviews are conducted. Probabilities are attached to various failure scenarios for each dam and compared to a probable loss of life should that failure occur. The scenarios are aggregated into a plot of cumulative probability (the probability that loss of life would be equal to or greater than a particular value). The departure of that plot from the limit of tolerability line is a measure of the seriousness of the dam risks.

Figure 3.2 shows, for each dam, the greatest departure of the cumulative probability plot from the limit of tolerability. All points along the sloping section of the limit of tolerability line are considered of equal risk. Therefore, the further the greatest departure point for a particular dam above and to the right of this line, the higher priority and urgency ANCOLD attaches to the associated dam safety work. Similarly, the further the nearest point of the cumulative plot below and to the left of this line, the lower the urgency that is given. Below the limit of tolerability, further improvements are justified and prioritised according to the ALARP principle, i.e., involving consideration of the CSSL, the economic losses avoided, recognised good practice and societal concerns.

Figure 3.2 Highest Cumulative Probability of Loss of Life Scenario by South West Irrigation Dam Based on Dam Safety Reviews and ANCOLD Guidelines



Source: Water Corporation, Board Submission February 2007

The Corporation's current assessment is that Wellington, Stirling and Drakes Brook dams pose higher risks than the risks that Waroona dam faced prior to the commencement of work on that dam. According to the Corporation, the reason for undertaking Waroona first was that, prior to 1995, less robust assessments of dam safety had been conducted. At that time, Waroona was considered the highest risk dam in the portfolio and so it was the first dam to undergo the more robust method of a dam safety review. When this was completed in 1997, however, no other dam safety reviews had been conducted in the portfolio to enable comparison and prioritisation along ANCOLD guidelines. Therefore work began on Waroona dam prior to the establishment that three of the other dams were actually at higher risk.

The following table summarises, in the Corporation's order of priority, the potential consequences of a dam failure (in terms of loss of human life), as estimated by the Corporation, for those South West Irrigation dams that remain in the Corporation's safety program (Waroona dam is shown for comparison).[29] The population at risk estimates the number of people that would be directly affected by floodwater in the event of dam failure, and the probable loss of life is the Corporation's estimate of how many lives would be lost in such an event.[30]

[29] Waroona Dam has been included for reference even though its work program is now complete.

[30] The probable loss of life is considered highly uncertain. Pers. com. Michael Somerford, Water Corporation, December 5, 2006.

Table 3.1 Estimated Characteristics of Each Dam in the Corporation's South West Dam Safety Program – Latest Estimates

Dam	Population at Risk	Probable Loss of Life[31]		
		Under Flood Loading	*Under Normal Loading*	*Under Earthquake Loading*
Wellington Dam	30,000	400	-	500
Stirling Dam	3,200	50	50	-
Drakes Brook Dam	335	4	4	4
Logue Brook Dam-Main	242	3-5	8-15	5-9
Logue Brook Dam - Saddle	137	0-1	5-13	2-7
Samson Brook Dam	380	7	10	2
Waroona Dam	*580*	*7*	*14*	-

Source estimates: Water Corporation[32]

Wellington Dam	*Wellington Dam Remedial Works. Engineering Design Report, Section 11. January 2007.*
Stirling Dam	*Stirling Dam Upgrade Project Stage 2. Engineering Design Report, Appendix G. May 2006. Stirling and Harvey Dams. Dambreak Flood Inundation Study and Hazard Assessment Study, Section 5. February 2001.*
Drakes Brook Dam	*Drakes Brook Dam Remedial Works. Risk Assessment Report, Section 3. February 2007.*
Logue Brook Dam	*Logue Brook Dam Remedial works. Preliminary Design Report, Section 3. April 2005.*
Samson Brook Dam	*Samson Brook Dam Remedial Works. Preliminary Design Report, Section 3.8, September 2004.*
Waroona Dam	*Waroona Dam Remedial Works. Design Report, Section 2.8. May 2003. Note that the earlier estimates of PLL provided in the Definition Report, Section 3.2, September 2000 were higher at 14 persons for flood loading and 27 persons for normal loading.*

All of the dams, apart from Wellington Dam, are earthwork dams and are therefore subject to piping risk.

[31] The Corporation has provided the following advice in relation to the assumptions underlying the figures in Table 3.1 using Wellington Dam as an example: "The Probable Loss of Life (PLL) estimate for Wellington Dam was determined through the application of the method outlined in "A Procedure for Estimating Loss of Life Caused by Dam Failure" by Wayne Graham, (USBR 1999). A spreadsheet model was developed to apply the "Graham method" consistently across the portfolio. The model applied different warning times assigned to each of four time categories corresponding to likely emergency preparedness at different times of the day and weekday/weekend. The assumptions made with relation to the warning time have a significant influence on the PLL figures. The assumed warning time for flood failure was between 0.5hr and 2hr before the failure of the dam depending upon the time of day and week. The assumed warning time for earthquake failure was between 0.25hr and 2hr (depending upon the time of the day and week) after the flood wave has reached the South West Hwy. The PLL figures were weighted according to the time of day and weekday/weekend to give an estimated total PLL of 400 for the flood failure scenario and 500 for the earthquake failure scenario."

[32] Wellington Dam - Wellington Dam Remedial Works. Engineering Design Report, Section 11. January 2007; Stirling Dam – Stirling Dam Upgrade Project Stage 2. Engineering Design Report, Appendix G. May 2006. Stirling and Harvey Dams. Dambreak Flood Inundation Study and Hazard Assessment Study, Section 5. February 2001; Drakes Brook Dam – Drakes Brook Dam Remedial Works. Risk Assessment Report, Section 3. February 2007; Logue Brook Dam - Logue Brook Dam Remedial works. Preliminary Design Report, Section 3. April 2005; Samson Brook Dam – Samson Brook Dam Remedial Works. Preliminary Design Report, Section 3.8, September 2004; Waroona Dam 1 – Waroona Dam Remedial Works. Design Report, Section 2.8. May 2003; Waroona Dam 2 - Remedial Works Project. Definition Report, Section 3.2. September 2000.

The planned remedial works for the dams include:[33]

- for Wellington Dam, the installation of post tensioned anchors through the dam along with other minor works on instrumentation and decommissioning of the high level outlet;
- for Stirling Dam, the construction of a spillway crest to increase the dam's flood capacity, the placement of downstream filters, raising of the embankment and the upgrading of instrumentation;
- for Drakes Brook Dam, the excavation and rebuilding of the top three metres of the dam, raising the dam by one metre, the construction of a new main spillway and upgrade of instrumentation. There is also the possibility of work to be conducted on the outlet pipe;
- for Samson Brook Dam, the construction of a new spillway, the decommissioning of the glory hole spillway, the excavation of downstream rock fill, upgrade of the access track and upgrade of dam instrumentation;[34] and
- for Logue Brook Dam the construction of a new spillway, the extension of a chimney filter, work on the outlet conduit, the replacement of the intake tower with a submerged valve, an upgrade of dam instrumentation, the installation of guardrails and the construction of a chimney filter and downstream berm on the saddle dam.[35]

The Corporation's proposed expenditure on safety improvements for the South West dams, as shown in the capital budget, is approximately $151 million. Figure 3.3 shows that the Corporation is proposing to complete its dam safety program largely within the next six years. Waroona Dam remedial works have been completed.[36] The Corporation intends to complete the upgrade to Drakes Brook Dam by 2007/08, Wellington Dam by 2009/10, Samson Brook Dam by 2012/13 and Stirling Dam by 2012/13. The first stage of remedial works on Logue Brook Dam would be completed by 2011/12 and the second stage by 2015/16.

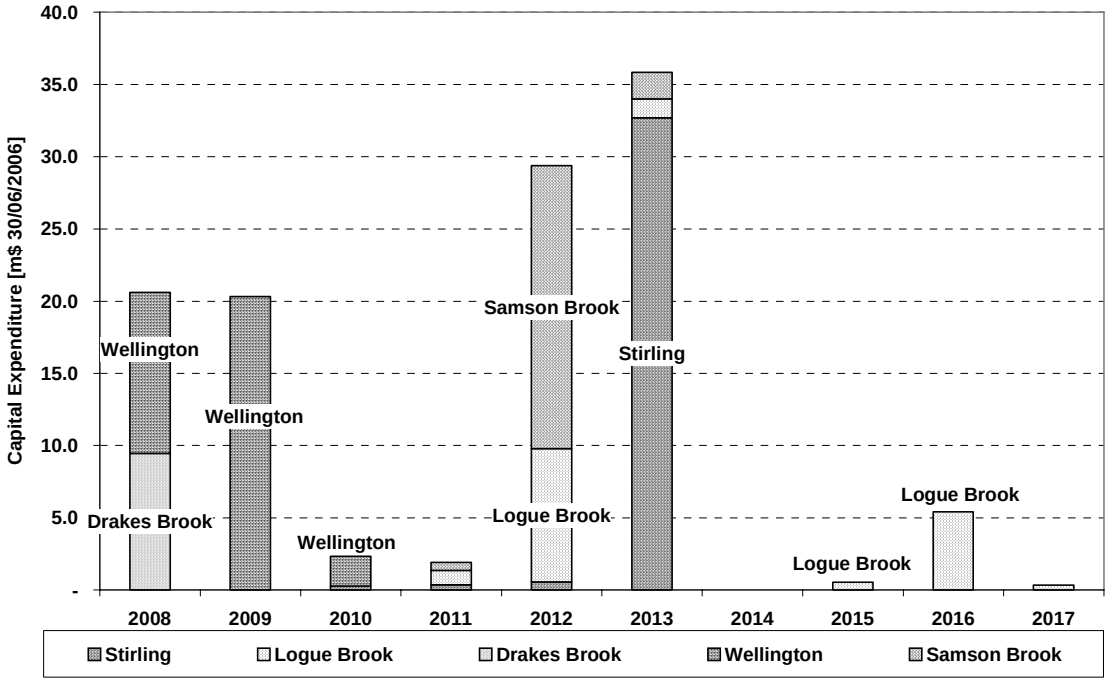
[33] For a detailed description of proposed works see Water Corporation (2006), *Dam Safety Remedial Works Program*.

[34] A glory hole spillway is a vertical flared funnel.

[35] A berm is a low earthen wall adjacent to a ditch or a "step" with a horizontal surface in the sloping face of a dam. A saddle dam is an auxiliary dam that confines the primary reservoir.

[36] Prior to the most recent dam safety reviews conducted on behalf of the Corporation, Waroona Dam was considered the highest priority dam in the Corporation's portfolio.

Figure 3.3 Corporation's Proposed Dam Safety Capital Expenditure



Source: Water Corporation, March 27 2007

The Corporation has advised that its proposed dam safety programme would take four of the five dams to the engineering design standards specified in the ANCOLD Guidelines, and notes in its submission:

> The Water Corporation has a duty of care to maintain dams to current community standards. Community standards in this case have been based on guidelines produced by [ANCOLD]. (Corporation submission on Issues paper, p4)

The Corporation indicated that, except for Logue Brook, the costs of moving to beneath the Limit of Tolerability are similar for the remaining dams to the costs of meeting engineering standards. For this reason, it would not be cost effective for the four other remaining South West dams to upgrade safety in a staged manner (by moving first to beneath the Limit of Tolerability and then to standards (or ALARP)).[37]

The Authority has also discussed with the Corporation the method it uses to prioritise its dam safety programme within its wider portfolio of capital projects, which has led to a continual reassessment of the timing of the dam safety programme. The Corporation has stated:

> The dam safety program is subject to a portfolio risk assessment against all the other projects in the Corporation's capital program, not simply against the ANCOLD criteria.
>
> The dam safety program is indirectly assessed against other Government expenditure as funding of the Corporation's budget is assessed in the overall State Budget formulation.
>
> Our capital program has been subject to significant reprioritisation since 1999. For example, the expenditure required to increase source capacity as part of the drought response has been funded through a combination of increases in the size of the capital

[37] For further discussion on this issue see (2007b) Marsden Jacob Associates "*Dam safety: some economic regulatory questions and answers"* paper on the Authority's web site.

> budget and reductions in expenditure in other parts of the program. (Letter from the Corporation, 23 March 2007)

As an indication of the impact of the prioritisation that occurs within the Corporation's capital budgeting process, the Corporation has indicated that some projects have more recently been deferred, and the programme (shown in Figure 3.3) now differs to that reported in the Authority's Draft Report:

> the projected timing of Stirling project has been delayed from 2008/09 to 2012/13, Logue Brook (Stage 1) from 2009/10 to 2012/13 and Samson from 2009/10 to 2011/12. (Letter from the Corporation, 23 March 2007)

3.4 Analysis

The Authority has undertaken an assessment of the proposed dam safety expenditure. The discussion below considers the Corporation's dam safety programme and its implications for the BWSA.

3.4.1 Assessment of the Corporation's Dam Safety Programme

The Authority employed MJA to review the Corporation's dam safety programme. A copy of their advice is available on the Authority's web site. The main findings, as summarised by MJA, are:

- The Corporation's identification of dam safety risks and engineering options is of a highly professional order;
- The Corporation's decisions are consistent with its policy of compliance with ANCOLD Guidelines;
- To justify the level of safety upgrades, the ANCOLD Risk Guidelines permit the use of both traditional engineering standards approaches and risk based assessments. In contrast to the policies of Queensland, Victoria, New South Wales and Tasmania (which either mandate risk-based justification or allow both approaches), the Corporation's policy is to rely on a traditional engineering standards based approach for justification;
- Consistent with the ANCOLD risk guidelines and the practice mandated by Governments in other States, the Corporation uses risk analysis to prioritise the sequencing of dams and potential upgrades;
- Detailed inspection of the design review and investigation reports provided by the Corporation confirms that the quality of the risk analysis and assessments undertaken for or by the Corporation has increased substantially since 2003 when the ANCOLD Risk Guidelines were issued. The quality of the Corporation's risk analysis is now of a high order. However, the quality of the earlier risk analysis for Waroona Dam and Wellington Dam is less robust;
- There is a common concern for five of the six dams that estimates of the Population at Risk (**PAR**) may not be robust and may have been overestimated.[38] The detail of the available documentation on the PAR estimates for four of the remaining dams is not sufficient to suggest that the issues noted for Waroona do not apply across the board. *Prima facie,* the issues raised by Harvey Water over the PAR estimates for Waroona Dam (where there are two widely divergent

[38] The same concern does not apply to the PAR estimate for Wellington where the Corporation has re-estimated the PAR.

counts) appear to apply to all dams other than Wellington. Any changes to the PAR estimates would affect the estimated Probable Loss of Life (**PLL**) for each dam and therefore the priority of the upgrades and possibly the justification of the upgrades;

- In the case of the sixth dam, Wellington Dam, the new PAR estimate has been undertaken differently and appears to be reliable.[39] In response to queries on the probabilities of failure and the dam break analysis, these and the severity of the flood that would result from a dam break have been explored with the Corporation by the Authority's consultants.[40] The Corporation will further explore locational and timing variations in the severity of the flood and its impact on PLL and the potential for Monte Carlo analysis to better inform the probability analysis. These refinements may affect the priority which ought to be accorded safety improvements for Wellington Dam, but are not expected to affect the need to reduce the risk of failure to below the limit of tolerability;
- Subject only to the concerns over the PARs, the risk assessments for Samson, Drakes Brook and Stirling dams are of a generally high order;
- In the case of Logue Brook dam, the pre-improvement failure probabilities and PLL place the risks just above the limit of tolerability. With the interim improvement achieved by lowering the Mean Operating Level (**MOL**) to 1.5m below the existing spillway crest, the risk is now assessed by the Corporation to be below the limit of tolerability. Neither the proposed Stage One improvements nor the Stage Two improvements can be justified by the ALARP principle on the cost-effectiveness thresholds recommended in the ANCOLD Risk Guidelines. The CSSL estimated for stages one and two are, respectively, around $1 billion and greater than $50 billion. Unless other ALARP considerations intervene very heavily, neither Stage One nor Stage Two can be justified in terms of the CSSL; and
- In the case of Waroona Dam, the initial risk assessments were undertaken prior to 2000. Although the ANCOLD 2003 Risk Guidelines had not been published at the time of the decision in December 2001 to proceed with the upgrade to standards, the development of the Risk Guidelines reflects the experience of insights from those dam owners undertaking best practice risk assessments prior to that date.

  Information available to the Authority's consultants on the Corporation's assessment of the risks indicates that the Stage One improvements would have alone shifted the risks associated with Waroona Dam – as assessed at that time – to below the limit of tolerability.[41]

  The estimated CSSL for Stage One and Stage Two combined is around $170 million per life. By inference, the CSSL for Stage Two would be higher, likely materially so on cost-effectiveness considerations, Stage Two would either not have been justified, or would certainly have been deferred. Stage Two would have been justified under the ANCOLD's engineering standards approach but could certainly have been deferred. Once the ANCOLD Risk Guidelines were formally published, Stage Two could not be justified unless other (and unknown) ALARP

[39] The PAR estimate for Wellington is accepted but may change as a result of any changes to flood severity.

[40] The Graham Method of estimating probable loss of life (PLL) uses different life loss percentages according to the severity classification of the assumed flood. The severity classifications are broad with sharply different life loss percentages. For instance, in the situation where there is warning the estimated PLL falls (by two orders of magnitude) from 3 percent to 0.03 percent of a PAR if the flood severity classification is reduced from moderate to low. Since the flood severity classification is based on estimates of inundation extent, depths and velocity, any revision of the dam break and flood severity analyses may have material impact on the estimated PLL.

[41] Water Corporation, Waroona Dam Remedial Works, Project Definition Report GEP 38/99, Figure 3.5 September, 2000.

considerations intervene heavily. The conclusion that Stage Two is either not justified or should have been substantially deferred also follows quite separately from the application of the convention "as if they [Harvey Water] owned the dams" were applied.[42]

Finally, these conclusions are further reinforced by the probable over-estimation of the PLL. The PAR estimates for Waroona have been reviewed and challenged by Harvey Water with credible alternative estimates based on an enumerated doorknock of the resident population. This much lower PAR estimate and several reasons why the severity of the flood resulting from a dam break would be lower, points to a significantly lower PLL.

The decision not to stage the Waroona improvements was based on several factors including the economies from undertaking the two stages together. A second important factor was the combination of the assumption that the gap between Stage One and Stage Two would be a short period only and the presumption that the objective is to minimise the present value of expenditures rather than to maximise the progressive improvement in life safety and in reduction of economic loss.

3.4.2 Implications for the BWSA

In considering the amount of dam safety expenditure that should be recovered from customers, the Authority has applied the following principles:

- ANCOLD guidelines are the appropriate default framework in Western Australia, in the absence of an alternative, for considering whether expenditure on dam safety is appropriate;
- Expenditure to reduce risks from above the Limit of Tolerability to the Limit is appropriate, assuming the risks are robustly identified; and
- Expenditure to reduce risks below the Limit of Tolerability is appropriate where the costs of doing so are not grossly disproportionate to the benefits. The ANCOLD Guidelines indicate that expenditure that results in a CSSL of more than $100 million has poor justification.[43]

[42] In interpreting and understanding the Bulk Water Service Agreement, it is useful to understand the context and the interpretations provided by other closely related documents. The 1996 Cabinet submission is particularly relevant. This states: *"The proposed bulk water price … is based on irrigation farmers paying on the same basis that they would pay if they owned the assets.*

This statement in the Cabinet submission clearly envisages that the bulk water price to irrigators would be established as if the irrigation farmers owned the dams rather than the Corporation.

Harvey Water as a dam owner would likely behave with a very acute awareness of its capital constraints and the opportunity cost of its available capital. This situation is not unique. It is clearly seen in the revealed behaviour of Goulburn-Murray Water, Melbourne Water and others and confirmed by MJA's discussions with senior officers of the respective organisations.

For a fuller discussion see MJA 2003 "Review of Dam Safety Program Relating to South West Irrigation Dams", chapter 6, a review jointly commissioned by the Water Corporation and Harvey Water.

[43] The Authority notes that where other ALARP considerations intervene, a greater divergence between the costs and benefits of the safety upgrade may be warranted.

Based on these principles, and the MJA assessment, the Authority has concluded with respect to the South West irrigation dams:

- The PAR estimates should be reviewed for Stirling, Drakes Brook, Samson Brook and Logue Brook;[44]
- Subject to confirmation based on the revised PAR estimates, the costs of Stirling, Drakes Brook and Samson Brook dams are costs that are necessary to reduce risks to below the Limit of Tolerability and should be recovered from customers. Further, there appears to be no merit in staging these projects as the costs of staging are greater than the costs of moving in one step to the relevant standards that take the dams below the Limit of Tolerability;
- For the Logue Brook Dam, the lowering of the Mean Operating Level has reduced the risks to below the Limit of Tolerability and the costs of the proposed safety upgrades are excessive when viewed against the tentative ALARP thresholds suggested in the ANCOLD Risk Guidelines. On the basis of the assessment provided by MJA, the proposed expenditure on Logue Brook dam is not justified and should not be passed on to customers;
- The status of the risks associated with Wellington Dam should be confirmed before proceeding with the proposed safety improvements; and
- For Waroona, since the Stage One improvement would have lowered the level of risks to the Limit of Tolerability, Stage Two would not be justified on cost-effectiveness grounds under the ANCOLD Risk Guidelines. While these were only first published in October 2003, approximately two years after the decision to proceed with both stages, the Authority notes that other dam owners in the same period were making decisions to defer safety improvements where cost effectiveness was low in terms of lives saved. Any deferral beyond October 2003 would then have provided the opportunity to reassess the justification for the Stage Two upgrades which would not be justified even in terms of the generous ALARP thresholds suggested by the ANCOLD Risk Guidelines. Since the publication of the Risk Guidelines, the Corporation's capital budgeting process has also led to deferral of dam safety upgrades. On that basis, the Stage Two costs would not be justified even in the longer term. The indexed costs incurred for Stage One ($11.5 million) should be included as a cost in the BWSA.

Overall, the Authority considers that if the recommended reassessments do not change either the justification or prioritisation of the Corporation's dam safety programme, all of the Corporation's dam safety expenditure on the South West irrigation dams, with the exception of the expenditure on Logue Brook Dam and Stage Two of Waroona Dam, should be recovered from customers.

This conclusion is consistent with Western Australia adopting a regulatory framework for dam safety (consistent with the ANCOLD Risk Guidelines), thus ending the current self-regulatory approach by the local water service provider, the Corporation.

Alternative Option

An alternative option becomes relevant when the wider portfolio of risks facing the Western Australian community is responded to by the Government. This would require moving formally to manage these risks on a whole-of-government basis, for instance, through an Office of Public Safety (as discussed further in Section 3.5).

[44] The PAR estimate for Wellington is accepted but may change as a result of any changes to assessed flood severity.

The practical impact of this alternative option would be that only the costs associated with Wellington Dam and Stage 1 of the Waroona Dam works would be passed through to customers in the near term (as the expenditure on Wellington Dam and Stage 1 of the Waroona Dam works each have a cost per statistical life saved of around $10 million). The upgrades for all other dams have a cost per statistical life saved an order of magnitude higher and would likely be deferred because of more cost effective opportunities to reduce risks elsewhere in the wider portfolio.

Under this option, dam safety upgrades would compete for priority against other opportunities to save lives and to reduce economic losses. Such other opportunities appear to lie, for instance, in the areas of road safety, hospital and medical procedures and equipment, other utility services and emergency services (as discussed in Section 3.5).

The multiple opportunities for more effective expenditure safety improvements and reductions in probable life loss (often in higher risk situations than contemplated for dams) means that the need to prioritise would be widespread. Moreover, the need to prioritise across different risk reduction options is necessary for risks both above and below the limit of tolerability (the effect of the limit of tolerability is to partition the two sets of risk so that there are two prioritisations rather than one global prioritisation).

Under this scenario of wider reform on safety management in the State, safety upgrades that have poor cost effectiveness would be deferred while expenditure is directed to reducing risk of life and economic loss in areas that have high cost effectiveness.

As a result of implementing a whole-of-government approach, the cost of the safety upgrades for the remaining South West dams, other than Wellington Dam, would be substantially deferred and become negligible in present value terms.

If the Corporation wished to make a special case for proceeding with dam safety upgrades with poor cost effectiveness compared with more cost effective investment opportunities, then this expenditure would require funding via CSO payments rather than be funded by customers.

This option is consistent with ANCOLD but places dam safety risks within the wider portfolio of risks facing the Western Australian community under a formal legislated whole-of-government approach. Conceptually, the (or perhaps a) limit of tolerability would apply to all risks in the total portfolio.

3.4.3 Implications for Dam Safety Expenditure Elsewhere in the State

The Authority notes that the application of the proposed principles and disciplines could have significant impacts on the magnitude and timing of dam safety expenditure for the State-wide portfolio of Corporation dams.

Based on the Corporation's November 2006 analysis, CSSLs were estimated by MJA for each upgrade module.[45] In terms of the ALARP justification thresholds suggested by ANCOLD, the distribution of the Corporation's full State-wide dam safety programme is:

- 5 per cent of expenditure is rated "very strong";
- 35 per cent of expenditure is rated "strong";

45 MJA analysed the Corporation's November 2006 PRA spreadsheet.

- 25 per cent of expenditure is rated “moderate”; and
- 36 per cent of expenditure is rated “poor”.[46]

The application of the maximum threshold suggested by ANCOLD of $100 million for the CSSL would remove, or defer, more than $120 million from the total proposed cost of $335 million for upgrades across the State-wide portfolio of dams. All of this $120 million of dam safety upgrades is assessed as poorly justified in terms of the ALARP thresholds suggested by ANCOLD.

The application of a lower maximum threshold of $30 million for the CSSL would remove or defer around $200 million worth of expenditure. All of this amount would be considered to be poorly justified against a threshold of $30 million which is directly calculated from first principles.[47]

[46] The percentages do not sum to 100 per cent due to rounding.

[47] The logic for a $30 million threshold follows from the Australian estimates of the value of saving a life (VOSL) and the usual upper level ALARP disproportionality factor recommended by the HSE (see “Australian evidence on the value of a human life” in Appendix 2.). These are respectively, $2.7 million in 2006 dollars and a factor of 10.

Recommendations

6) Prior to renegotiating the BWSA, the Corporation should:

   a) review its estimates of Population at Risk at Stirling, Drakes Brook, Samson Brook and Logue Brook dams; and

   b) reconfirm the risks (failure probabilities, severity of flood and probable loss of life) associated with Wellington dam.

7) Subject to the recommended reassessments not changing either the justification or prioritisation of the Corporation's dam safety programme, there are two options for charging Harvey Water:

   a) Option 1: the proposed dam safety costs associated with Stirling, Drakes Brook, Samson Brook and Wellington dams should be recovered from customers;

   b) Option 2: subject to the Government moving to manage the wider portfolio of risks facing the Western Australian community on a whole-of-government basis, the dam safety costs associated with Wellington Dam should be recovered from customers (the dam safety costs associated with Stirling, Drakes Brook and Samson Brook dams are expected to be deferred in favour of more effective options for reducing risk of loss of life).

8) Under either option, the costs of $11.5 million for Stage One of Waroona Dam should be recovered from customers.

3.5 Improving the Dam Safety Regulatory Framework in Western Australia

The Terms of Reference require the Authority to consider the merits of alternatives to the ANCOLD Dam Safety Guidelines. In conducting this analysis, the Authority has noted that, while other jurisdictions have introduced alternative regulatory arrangements, such arrangements interpret and clarify the application of the ANCOLD framework. They do not reject or dismiss the ANCOLD framework. Based on the experience in other jurisdictions and international guidelines summarised in MJA (2007b), the Authority considers that there are several potential improvements in dam safety outcomes in Western Australia. In particular the Government could:

- clarify the role of risk assessment in justifying expenditure on dam safety. Queensland, Victoria and New South Wales have Government policies on the application of risk assessment to dam safety reviews. In the absence of such guidance, the Corporation has applied a standards-based approach;
- introduce a quality assurance process for dam safety expenditure. For example, New South Wales and Tasmania have independent committees that assess dam safety expenditure proposals;
- set a threshold level of expenditure per statistical life saved, which would replace the current threshold levels set in the ANCOLD Risk Guidelines for applying the

ALARP principle. As indicated in Section 3.4, instead of the $100 million threshold per statistical life saved, the level could be $30 million. The Authority notes that if an alternative regime for protecting dam owners from tort liability were provided through a Western Australian Government regulatory framework for dam safety, then a lower, or no, factor of disproportionality could apply, potentially setting the threshold at simply the level of the VOSL[48]; or

- introduce a mechanism that more transparently prioritises expenditure on dam safety against expenditure on safety elsewhere across Government services.

This section discusses each of these options in turn. A full discussion of the issues is provided by MJA (2007b), which is available on the Authority's web site.

3.5.1 Clarifying the Role of Risk Assessment

The ANCOLD Risk Guidelines are not prescriptive and allow for both a standards based approach and a risk assessment approach to be used. There is therefore a range of interpretations which are consistent with the ANCOLD Guidelines, as is demonstrated by the different roles which risk assessment plays in determining dam safety expenditure in different States. However, there is a trend towards mandating risk assessment in other States using mechanisms that narrow and guide the interpretation of the ANCOLD Guidelines.

The risk assessment approach has the advantage over the standards-based approach of linking the expenditure on dam safety to the reduction in risk. The cost effectiveness aspect of the ALARP principle guards against incurring expenditure to meet a standard that is not justified from a risk reduction perspective.

The Queensland Government published new guidelines in February 2007.[49] These guidelines resulted from a review of spillway design standards prompted by an $880 million estimate of bringing spillways of major dams in Queensland to ANCOLD design standards. The new guidelines endorse the use of a risk based approach to justify dam safety upgrades to achieve acceptable flood capacity. Portfolio risk assessment is also used to prioritise dam upgrade works. The Queensland guidelines state that:

> The risk assessment procedure is based on the ANCOLD risk assessment process and is consistent with the framework of the national standard AS/NZS 4360:2004 Risk Management. It is a comprehensive tool intended to enable the dam owner to evaluate the deficiencies and available risk reduction options. This type of assessment should be adopted for major dams.
>
> …..
>
> The risk assessment procedure provides the owner with a review of the adequacy of the dam under all load conditions and failure scenarios, not just flood loadings. It also has the capability to more realistically assess the Acceptable Flood Capacity of gated spillway operations and the likelihood of premature failure due to causes such as spillway erosion.

The NSW Dam Safety Committee recently reviewed the regulatory policy framework for dam safety in NSW (the new framework was endorsed by Government in August 2006). The framework revised some standards-based approaches and recommended the progressive introduction of risk assessment practices that are broadly consistent across government agencies.

[48] This is the case, for instance in Queensland.

[49] Queensland Government (February 2007), *Guidelines on Acceptable Flood Capacity for Dams*.

In Victoria, a portfolio risk-based approach (**PFRA**) has been adopted in relation to dam safety expenditure, with the use of PFRA mandated by the Victorian Government to assess the business risks of dams in that State.[50] However, there appears to be some ambiguity in Victoria about the ability to also use a standards-based approach.[51]

In Tasmania, the Minister for Primary Industries and Water produces regulations on dam safety, which are largely based on ANCOLD Guidelines, but allow for variation away from the ANCOLD Guidelines.[52]

Mandating a risk-based approach to dam safety in Western Australia would require either:

- that the Government instruct the Corporation and other owners of major dams via its general powers for setting licence conditions on the harvesting or taking of water[53]; or
- that the Government provide a specific heads of power for dam safety through either a specific part of the general water legislation (as per Queensland) or a specific Act on dam safety (as per New South Wales); or
- that the Government establish a whole-of-government risk safety regulator and framework.

The Authority notes that the current overhaul of the State's water legislation provides a partial opportunity to review how the first two broad options above might be implemented.

The Authority notes that the current review of Western Australia's water legislation provides an immediate opportunity to consider and determine the choice between different options for mandating a risk-based approach. However, consideration of legislative reform to establish a State-wide whole-of-government Office of Public Safety or equivalent would require a broader forum.

3.5.2 A Quality Assurance Process for Dam Safety Expenditure

Some other jurisdictions have set up bodies to review dam safety expenditure proposals.

- In NSW, dam safety is governed by the Dam Safety Committee (**DSC**), established under the *Dam Safety Act 1978*.
- In Queensland, assessments are undertaken by the Regulator of Dam Safety, established under the Water Act 2000, who is located within the Department of Natural Resources and Water.
- In Tasmania, the *Water Management Act 1999* establishes the Assessment Committee for Dam Construction, operating under the Minister for Primary Industries and Water, as a decision making body on the appropriateness of expenditure.

[50] Dams Safety Committee (June 2006), *Review of Regulatory Policy Framework For Dam Safety*.

[51] See Marsden Jacob Associates (2007b) for a discussion of the interpretation of the Victorian approach to justification of dam safety upgrades.

[52] For example, the Tasmanian dam safety regulations require that the operation and maintenance manual "comply substantially with section 4.3 of the *Guidelines in Dam Safety Management* published in 2003 by ANCOLD, as amended from time to time" (Water Management (Safety of Dams) Regulations 2003, Part 3, section 12).

[53] General powers under the Water Services Licensing Act (Section 18) or the Rights in Water and Irrigation Act (Section 27.B or Schedule 1, Division 2, Clause 7)

These regulatory processes with independent committees or State agencies have the advantage of providing a transparent framework to support, and on occasion, discipline the dam owners by providing a method of ensuring a consistent approach to the interpretation of ANCOLD and/or State-based guidelines.

A quality assurance process for dam safety expenditure in Western Australia could be achieved by:

- establishing the necessary review and approval functions within either the Department of Water or a separately constructed independent dam safety regulator; or
- relying on periodic assessment and recommendations from the Authority under its reference function, based on advice from international dam safety experts, as has occurred in this inquiry. As in other States, such a quality assurance process would not be intended to remove legal liability from dam owners.

The Authority recommends that a quality assurance process for dam safety expenditure in Western Australia also be considered within the current review of Western Australia's water legislation.

3.5.3 Setting a Threshold Level of Expenditure per Statistical Life Saved

In other areas of public expenditure, such as public health, aviation, roads and rail, the assessment of the costs and benefits of health and safety programs aimed at reducing fatalities often requires a value to be assigned to the saving of a life. This "value of life" is the value that society places on the saving of an unknown life (or statistical life) in a given population.[54] To calculate the CSSL of an expenditure on safety improvement, the net expenditure is divided by the number of statistical lives it is expected to save.[55] These costs and impacts are spread over time, so discounting is applied to determine a present value estimate. Comparison of CSSL can then be made across different areas of public safety expenditure to assess cost effectiveness.

Although there is no generally agreed value of life in Australia, there are numerous examples of the use of different value of life estimates to guide decisions on public health and safety expenditure in Australia. These examples surveyed in Table A2.1 show that the value of life estimates used in Australia range between $1 million and $2.7 million (2006 dollars).

In comparison, the ANCOLD Risk Guidelines indicate that $100 million is the upper limit to the CSSL beyond which expenditure could be better spent elsewhere. It is therefore apparent that the application of the ANCOLD Guidelines can, in many cases, lead to a substantially greater amount spent on dam safety than on other areas of safety improvement.[56]

The legal precedent for the principle that an infrastructure owner needs to demonstrate disproportionate sacrifice (in terms of the costs incurred relative to the benefit) in order to

[54] Depending on the study, the value of life may be termed the Value of a Statistical Life (VOSL) or the Value of Preventing a Fatality (VPF).

[55] The term "statistical life" is used to denote the averaging of risk statistics across a population – the risk of fatality due to a particular cause will vary from person to person.

[56] However, this does not necessary follow. For a full discussion of the concept of disproportionality in safety expenditure, see the advice in MJA (2007a), which is available on the Authority's web site.

avoid tort liability follows from British case law, specifically *Edwards v National Coal Board*, and is recognised widely in Australia including in the area of occupation and health safety. The use of the ALARP test, including the emphasis on comparative levels of CSSL, places all risks on a common basis of assessment. However, the view that some risks justify a higher level of public expenditure than others has support in submissions:

> The Issues Paper suggests a possible approach involving the establishment of a benchmark for the level of expenditure that is required to prevent a fatality. This approach appears to be very narrow and ignores a number of fundamental issues associated with contemporary societal risk….(S. Fox, submission on Issues paper, p1)

One such factor is a possible aversion to multiple fatality risk. On this, the same submission suggested that:

> In general society has a bias against rare events with high consequences compared to more common events with lesser consequences. To illustrate compare the attention given to improving and maintaining an impeccable aircraft safety record in Australia to the tolerance of our current road safety record… (S. Fox, submission on Issues paper, p1)

However, the Authority notes the review of societal risks commissioned by the HSE from Ball and Floyd, who concluded that:

> Though the documented evidence is sparse, nowhere have we found any compelling support or arguments for an ex-ante stance other than risk neutrality in societal decision making.[57]

A second factor suggested as justifying a higher level of public expenditure on some risks is that:

> Australians appear to have a higher tolerance for risk that is self imposed compared to a risk that is imposed upon them by others. For example people often choose to engage in high risk activity (such as smoking cigarettes) knowing that they have a statistically greater risk of reduced lifespan, but would react strongly against the construction of a hazardous waste incinerator adjacent to their homes if an absolute guarantee of zero health impacts cannot be given. (S. Fox, submission on Issues paper, p2)

The Corporation makes a similar point:

> Communities do not generally take a simple equivalent cost of life approach to safety expenditures. Consideration is given to factors such as the choice the individual has in exposing themselves to the risk and the size of the potential loss of life. (Corporation submission on Issues paper, p8).

The Authority notes that within the portfolio of risks for which the Government has direct responsibility, there is a wide range of risks which (like dam safety risks) are involuntary.

As an example, potential deaths from accidents involving high voltage cables in the middle of a freeway pose involuntary safety risks in the same manner as does the failure of a dam. Thus, the compelling logic for prioritising safety expenditures across the portfolio of risks controlled by Government remains even if quality of risk arguments were to be accepted. Moreover, the Authority notes that neither the UK Treasury nor the authoritative review commissioned by HSE from Ball and Floyd found support or operational logic for this often asserted proposition that involuntary risks justify higher levels of expenditure by the community.

[57] Ball, D.J and Floyd, P.J (1998), "Societal Risks", Final Report, Report Commissioned by the Health and Safety Executive, United Kingdom.

To the Authority's knowledge, there has been only one major empirical study into community perceptions of dam safety in Australia.[58] The respondents of this survey indicated that, when compared to 19 other risks such as traffic accidents, medical error and bushfires, dam failure was the lowest of concern in both the short and the long term. Similarly, respondents indicated that dam safety was the lowest priority area for government spending. These (1992) results were particularly strong for Western Australia, where the level of expenditure was described by respondents as approaching "too much".[59, 60]

The Authority also notes the situation in Queensland, where the Guidelines effectively apply a factor of disproportionality of no more than two and, therefore, a much lower ALARP threshold than suggested by the ANCOLD Risk Guidelines.

Overall, the Authority's view is that rather than setting a fixed limit or threshold beyond which dam safety expenditures would not be approved, the preferable approach is to use the CSSL threshold as a trigger for a challenge and review process. Under such an approach, dam safety improvements with CSSL greater than, say, $30 million would require explicit and additional justification, including consideration of whether the amounts proposed could not better aid safety improvements across the Western Australian community if spent on lowering other risks. [61]

3.5.4 Prioritising Expenditure on Safety across Government Services

There was significant support in submissions to improve the allocation of safety expenditure across government services.

> The priorities and timetables for dam safety could be set within a whole of government risk assessment and management framework. The framework could prioritise all the Government's risk reduction expenditures to get the 'biggest bang for its buck' i.e. spending each dollar where it is most effective in reducing loss of life throughout the community, across a whole range of hazards. Also, there should be consistency in the valuation of loss of life in case of public safety. There is no reason why there should be much more money spent on dam safety than road safety in order to save a life. (Department of Treasury and Finance submission on Issues paper, p4)
>
> If legislation could limit the Corporation's liability, the priority assigned to dam safety would fall, freeing up funds for other capital works with higher priority, potentially including those

[58] Syme, G.J. and Bishop, B.J. (1992), "Community Perceptions of Dam Safety Issues: A Preliminary Study. CSIRO Division of Water Resources Consultancy Report 92/32 to the NSW Dams Safety Committee.

[59] Ibid p. 19

[60] The study concluded that *"…dam safety is not a highly salient issue in the community, even where upgrades have been discussed"* this being despite the fact that respondents saw dams as presenting an involuntary risk affecting a large number of people. The results of the Australian study mirror international studies on community perceptions, which show that the risk of dam failure is ranked significantly lower than events such as train or power station accidents, forest fires or earthquakes.((Syme, G.J. and Bishop, B.J., (1992b) pp. 25 and 71,
See for example, Kreft-Burman K. (2000), *Public Response to Dam Safety Issues* - Kyrkösjärvi Dam Pilot Project, Finnish Environment Institute; A.B. Almeida, C.M. Ramos, M.A. Santos and T. Viseu (2003), *Dam Break Flood Risk Management in Portugal*, Laboratório Nacional de Engenharia Civil Lisbon, Portugal,

[61] As noted above, the logic for a $30 million threshold follows from Australian estimates of the value of saving a life (VOSL) and the upper level ALARP disproportionality factor by the HSE. These are respectively, $2.7 million in 2006 and a factor of 10. Note that the VOSL is independent of whether the life lost is the result of a voluntarily incurred or an involuntary risk. However, the factors of disportionality recommended by HSE appear to relate to risks in Occupational Health and Safety which are generally regarded as involuntary risks. If a distinction were to be drawn between voluntary and involuntary risks, then the corresponding threshold for voluntary risks would be lower than $30 million CSSL.

> outside the Water Corporation. Whether Western Australia would benefit from such a reprioritisation is dependent on assessments being made that the current level of expenditure is too high. (Corporation submission on Issues Paper, p8-9)
>
> The reality is that dam safety standards (ANCOLD Guidelines are defacto standards) are far in excess of community safety standards elsewhere. (Harvey Water submission on Draft Report, p3)

As noted above, the current process does to some extent prioritise expenditure on dam safety within the Corporation's portfolio and also within the wider Government Budget. However, it is not clear that the current process provides an adequate basis for prioritising safety expenditures across the wide portfolio of risks facing Government and/or the Western Australian community.

One of the first developments of a generic risk management framework across statutory bodies was by the HSE in the United Kingdom. The framework originated after the 1987 inquiry into the safety of the Sizewell B nuclear power plant, and was developed over 13 years through extensive public comment and debate. It has since been extended to all other areas of health and safety within the HSE jurisdiction. The current framework sets out the HSE's decision process for risk management, including a generic framework for the tolerability of risks to society and individuals.[62]

The Department of Treasury and Finance supported the approach adopted by the HSE:

> A similar approach could be adopted in Western Australia to that of the whole of government approach to risk assessment and management as currently taken in the United Kingdom (UK), where every major government department has a risk management policy that is consistent with a common framework. Co-ordination of approaches to risk management is undertaken through a strategy unit in the Cabinet Office. (Department of Treasury and Finance submission on Issues paper, p4)

In view of the advantages of a whole-of-government approach to the assessment of risk there may also be a case for extending the scope of an independent review body (as discussed in Section 3.5.2) to oversee all public safety risks, including dam safety (e.g. an Office of Public Safety). The body could provide independent assessment of expenditure across all areas of public safety to determine where it can most effectively be spent. Such an approach is supported by Harvey Water:

> Harvey Water supports the concept of a wider Office of Safety or Risk Management to provide information and back-up to any risk management regulation, rather than one just devoted to dam safety. (Harvey Water submission on Draft Report, p19)

To achieve the portfolio-wide approach necessary to improve safety reduction across the Western Australian community would require:

1) the ability to assess all proposals for safety improvements in terms of common yardsticks. The Cost Per Statistical Life Saved and benefit cost ratios are examples of important such measures and should be calculated for all budget funding requests to Government above a specified threshold regardless of the sector; and

2) a body to prioritise safety expenditures within Government and for the Western Australian community as a whole. This capability would need to be located in either a central agency such as the Western Australian Department of Treasury and Finance or a new body such as an Office of Public Safety.

[62] Health and Safety Executive (2001), *Reducing Risk, Protecting People: HSE's Decision-Making Process.*

Recommendations

9) The Government should establish a legislative framework for regulating dam safety to:

   a) clarify the role of risk assessment in justifying expenditure on dam safety by providing a dam safety regulatory framework for Western Australia;

   b) introduce a quality assurance process for dam safety expenditure by establishing either an independent regulator or independent committee;

   c) set a threshold level of expenditure per statistical life saved, which would replace the current threshold levels set in the ANCOLD Risk Guidelines for applying the ALARP principle;

   d) protect dam owners by limiting tort liability; and

   e) introduce a mechanism that transparently prioritises expenditure on dam safety against expenditure on reducing other risks facing Government and the community. Such a mechanism would require all safety-related expenditures to be justified using common yardsticks (such as cost per statistical life saved and benefit cost ratios).

10) The Government should establish the institutional capability to coordinate and prioritise safety expenditures within Government and for the community as a whole. This capability might be located in a central agency such as the Department of Treasury and Finance or a new body such as an Office of Public Safety.

4 Cost Allocation

4.1 Terms of Reference

The Authority is expected to consider and develop findings on:

> The cost sharing arrangements between beneficiaries of the South West irrigation dams, including:
>
> a. customers that benefit from the water stored in the dams and how this may change over time with water trading;
>
> b. the recreational and other social benefits to the community of the dams; and
>
> c. the beneficiaries of dam safety expenditure, including an assessment of those who benefit from the use of the dams and those that benefit from a reduced risk of flooding.

4.2 Cost Allocation Issues

This chapter considers how the total costs of operating and maintaining the dams (including dam safety expenditure) should be recovered from Harvey Water and other beneficiaries.

In considering the allocation of costs to Harvey Water, the Authority has given consideration to the following issues:

- the efficient amount of revenue required by the Corporation to operate and maintain the dams;
- legacy costs;
- the classes of beneficiaries;
- the value that recreational users receive from using the dam surroundings;
- any net value that the community receives from the aesthetic and natural flood mitigation benefits associated with having the dams compared to the increased flood risk of dam failure; and
- the method for allocating costs that are attributable to the identifiable private beneficiaries.

Each of these issues is discussed below.

4.3 Efficient Revenue

The efficient revenue requirement required by the Corporation to provide the storage service for all customers (the Corporation included) is to be discussed more fully in Chapter 5 below. However, by way of introduction, the revenue requirement includes the return on the regulatory asset value, depreciation and operating costs. The efficient level of dam safety costs and other capital costs are added to the asset value, which is the basis for the return on assets and depreciation.

4.4 Legacy Costs

Legacy costs are costs that resulted from the activities of past users and could be considered unfair if they are charged to current and future users.[63] For a full discussion of the issues surrounding legacy costs, see ACIL Tasman's Paper 2.[64]

Harvey Water maintains that the costs of restoring the dams to ANCOLD standards, which prevailed at the time of the signing of the BWSA in 1995, should be viewed as legacy costs.

> [A]dopting a legacy cost approach implies that not all of the costs associated with the South West dams are "avoidable costs". The legacy approach recognises that some of these costs arise from any number of past factors, including for example poor policy decisions of government or poor commercial decisions of its agencies, past standards or community values, and past inactions to known problems – such as environmental or health consequences that could be foreseen but were not attended to.
>
> As such, governments accept responsibility for these past actions and, appropriately, bear their cost.
>
> …
>
> [L]egacy costs are the costs of restoring the dams to the community standards (the ANCOLD standards) as they were known in 1995. That the cost of this was estimated by the Water Corporation at $17 million and that cost has subsequently blown out to much more is not relevant to the issue of legacy costs. The principle of legacy costs says that the dam safety standards of the time should be re-established, and the full cost borne by the government.
>
> Harvey Water firmly believes that the Bulk Water Supply Agreement cannot be interpreted to expunge the generic principle of legacy costs. The BWSA was entered into in good faith by the irrigators at the time, in recognition that the Water Corporation was to restore the working condition of the irrigation assets, and the safety upgrades was a mechanism whereby the irrigators could make a contribution to the total work needed – but that was affordable to them. (Harvey Water submission, p21-22)

The latest ANCOLD Guidelines provide greater flexibility than the guidelines in place at the time of the BWSA.[65] The increase in expenditure is not therefore a result of increased standards, as this has had little significant impact.

The Corporation re-iterated in its submission that the BWSA assumed no legacy costs in relation to the dams.

> The renewals price in the original 1996 BWSA assumed there were no legacy costs associated with the dams, including dam safety expenditure. The current institutional arrangements provide the Water Corporation with an obligation to meet the ANCOLD guidelines and as such cannot be avoided by the Corporation. The extent that Harvey

[63] The legacy cost approach was originally developed to apply to asset valuation issues rather than pricing issues. The legacy approach was required where assets were valued using a line in the sand approach, which is where an asset value is determined as the value that delivers a revenue profile that matches expected costs. In the situation where future costs are the result of activities in the past (such as non-compliance with environmental standards), these costs can be treated separately, and possibly paid for by the Government, rather than be treated as a cost that will influence the asset value calculation.

[64] ACIL Tasman (November 2006), *Harvey Water Supply System: Cost Sharing Issues*, Paper 2 of 4 prepared for the Authority, published on the Authority web site, section 2.5.

[65] For example, in the case of small dams where few lives are at risk, the new ANCOLD Guidelines include a greater allowance for the limit of tolerability on the risk to a single life, dropping as low as 1:1,000 per annum, compared to the earlier 1:1,000,000. Also, the limits of tolerability in the current guidelines are capped at a probability of 1:100,000 for 100 or more fatalities due to dam failure, while the cap in 1998 guidelines was at 1:1,000,000 for 1,000 or more fatalities.

> Water's does not pay for its share of the dam safety costs means the cost burden is funded by a CSO payment. (Corporation submission Draft Paper, p13)

Harvey Water disagrees:

> Harvey Water firmly believes that the Bulk Water Supply Agreement cannot be interpreted to expunge the generic principle of legacy costs. The BWSA was entered into in good faith by the irrigators at the time, in recognition that the Water Corporation was to restore the working condition of the irrigation assets, and the safety upgrades was a mechanism whereby the irrigators could make a contribution to the total work needed – but that was affordable to them. (Harvey Water submission Issues Paper, p21-22)

There is a possible view that the agreement in the original BWSA would override any legacy cost argument, but this may not be valid given the likely information asymmetry and the possibility that contingent liabilities may not have been subject to good due diligence.

While the BWSA did not specifically recognise legacy costs, the agreement allowed for the Minister of Water Resources to decide on the amount that Harvey Water would pay for dam safety upgrades.

In the Draft Report, the Authority indicated that the dam safety expenditure that is appropriate could possibly be regarded as legacy costs. However, the Authority indicated that the decision to use the water from the irrigation dams (whether by Harvey Water or the Corporation) needs to be based on the costs of accessing that water, which appropriately includes the efficient costs of dam safety. Given that the application of the legacy argument could result in inefficient outcomes, the Authority's view was that charges should not be reduced by a legacy component.

Harvey Water responded to the Draft Report by arguing that the dam safety expenditure to date should be considered a legacy cost.

> Total expenditure under the dam safety program to date is $25.4 million (Water Corporation submission, page 4). Consistent with what ACIL Tasman appears to be saying in its advice paper, there is a strong case for most or all of this expenditure to be treated as legacy costs. (Harvey Water submission on Draft Report, p11)

The Authority considers that the appropriate reference point for considering whether the dam safety costs should be treated as legacy costs was the date when the original BWSA was signed. Since that date, the Corporation and Harvey Water have entered into water trades which would have been influenced by the need to incur dam safety expenditure. It would therefore not be appropriate to retrospectively interpret the historical dam safety expenditure as a legacy cost.

However, if the Government were to adopt the alternative option referred to in Chapter 3, that would limit the threshold per statistical life saved to say $30 million, the legacy cost issue raised by Harvey Water would no longer be relevant. Under the alternative scenario, the only dam safety costs that would be recovered from customers would be the future dam safety costs for Wellington Dam. The dam safety costs of Waroona Dam and the other dams would be recovered from the Government as CSO payments.

Recommendation

11) Dam safety expenditure should not be reduced by a legacy component because the decision to use the water from the irrigation dams (whether by Harvey Water or the Corporation) needs to be based on the costs of accessing that water, which appropriately includes the efficient costs of dam safety.

4.5 Classes of Beneficiaries

The Terms of Reference requires the Authority to consider the beneficiaries of maintaining and operating the dam infrastructure as well as how costs should be apportioned among these beneficiaries.

There are three classes of beneficiaries of dams:

1) *Identifiable private beneficiaries*. These beneficiaries are the customers who make a payment to the Corporation for their private use of water.[66] They are called private beneficiaries because property rights over who owns the resource are clear and because one person's use prevents another person's use. Markets can work well to allocate the private benefits provided the price is allowed to adjust freely to supply and demand. In the case of South West irrigation dams, the identifiable private beneficiaries include:

   a) farmers using irrigated water (64.7 per cent of the volume in 2005/06);[67]

   b) Corporation customers in the IWSS (34.0 per cent of the volume);

   c) Corporation customers in the region (0.6 per cent of the volume); and

   d) other purchasers of water (0.7 per cent of the volume).

2) *Identifiable public beneficiaries*. These beneficiaries typically include the recreational users of the dams such as water skiers, bush walkers and picnic goers. The public benefits generated have the main characteristic that their enjoyment does not fully diminish the value that accrues to others using the dam (e.g. the recreational use of the dam by one person can also be enjoyed by another). Public goods are typically underprovided by markets. Nevertheless, when public beneficiaries are identifiable they could, potentially, be excluded from using the dams (i.e. fences can be erected to keep people out that are unwilling to pay for amenity) and so could, in principle, be charged for the benefits they receive. In practice, however, the recreational users of South West irrigation dams have not been charged for their public usage – i.e. they have either been allowed

[66] Note that some of the rights to the water in the dams are owned by Harvey Water, and some by the Corporation. See Figure 4.2 in the next chapter for the allocation of rights to the water in the dams.

[67] The data in this dot-point has been sourced from the Corporation.

access to recreational areas without charge, or have been fully excluded from areas for purposes of water quality.[68]

3) *Non-identifiable public beneficiaries*. These beneficiaries are those who gain from the existence of the dam in such an indirect communal sense that they cannot be charged by the owner of the dam. This relates to the strongest type of public consumption: people cannot be excluded from their enjoyment of the good and the value that one person receives does not diminish the value that others receive. It is a lack of property rights, combined with communal usage that prevents a private company from capturing a financial reward through the provision of these non-excludable public goods. Therefore, without government provision, these goods will be undersupplied by markets. In the case of the South West dams, the non-identifiable public beneficiaries include:

   a) local residents who benefit from the presence of the dam because of the reduced risk of natural flooding;

   b) those who enjoy the aesthetic attributes of the local countryside that result from the dams (although there will be others who prefer the aesthetic attributes of non-irrigated land where rivers are not dammed);

   c) those local communities, tourists or passers-by who value the protection that accrues from maintaining the structural integrity of the dams; and

   d) in the case where land is set aside to protect dam water quality; those people who see value in a healthy environment (i.e. the preservation of natural vegetation, habitat and biodiversity).

It is worth noting that the economic value of agricultural production made possible by the dams is represented in the value of the water sold. Therefore, the local employment generated via increased agricultural productivity is accounted for in the value of economic benefits produced by the dams.

4.6 Recreational Benefits

The South West dams and surrounding reservoir areas provide recreational benefits to a significant number of visitors. With the exception of Stirling and Samson Brook dams, which supply water to the IWSS, the dams in the South West are open to recreational use (Table 4.1). The two most popular dams for recreational use are Waroona and Logue Brook, which offer a wide range of activities including cycling, bushwalking, sightseeing, horse riding, picnics, camping, water skiing, canoeing, windsurfing, swimming and fishing.

[68] It should also be noted that recreational use is not a pure public good in that: (a) restrictions on access are possible; (b) congestion can diminish the value of use to other public beneficiaries; and (c) in the case of potable water, contamination can reduce the value of the resource to private beneficiaries.

Table 4.1 Activities Permitted on the South West Irrigation Dams

	Activities Permitted			Recreational Activities Permitted*						
Dam	Irrigation	Recreation	Drinking Water	Swimming	Waterskiing	Camping	Fishing	Marroning	Walking trails	Canoeing
Waroona	✓	✓		✓	✓	✓	✓	✓	✓	✓
Logue Brook	✓	✓		✓	✓	✓	✓	✓	✓	✓
Wellington	✓	✓		✓		p	✓	✓	✓	✓
Drakes Brook	✓	✓		✓	p	p	✓	✓	✓	✓
Harvey	✓	✓				p	✓	✓	✓	✓
Samson Brook	✓		✓							
Stirling	✓		✓							

* Key:

✓ Permitted activities currently

p Possible medium term potential with capital investment

Source data: Water Corporation, Department of Environment and Conservation

It should be noted that only Queensland and Western Australia permit extensive recreational access to major dams.[69] Surveys of recreational use at water resources (including dams) indicate a relatively low percentage (less than 15%) of 'active' recreational use such as fishing or canoeing.[70] Visitor surveys indicate that around 50 to 60 percent of visitors to the Wellington Dam area are Perth residents (typically either on a tour of the South West or who have made a specific trip to the dam to undertake activities such as canoeing or rafting), while the majority of the balance were local residents. Of these visitors, the most popular activities were bushwalking (undertaken by 60 percent of visitors) and swimming (undertaken by 40 percent).[71]

Australian studies have estimated values (including recreational values) for rivers and wetlands, the value of regulating water storage and flows (including the impact on irrigators) and the impact of recreational activities on water quality. Although accurately measuring recreational benefits from the South West dams is difficult, the Authority has reviewed a number of these Australian studies (see details below) to assist in its assessment of the recreational benefits and costs associated with the South West irrigation dams. (see http://www.nqwater.com.au/facts.htm).

[69] See http://www.nqwater.com.au/facts.htm

[70] See for example, Hinze Dam Alliance (2006), Hinze Dam Recreation Issues Paper; also Harman J. and G. Hertzler (1998), *Economic Evaluation of the Swan-Canning*, Report to the WA Estuarine Research Foundation, University of Western Australia (pub.).

[71] Smith, A. (2003), "Campsite impact monitoring in the temperate eucalypt forest of Western Australia: An integrated approach", Ph.D. Thesis Murdoch University, Western Australia.

Two general findings from these studies are:

- water quality costs resulting from recreational activity at major irrigation dams are typically lower than the recreational benefits.[72] However, if irrigation dams are converted to drinking water supplies, recreational activities would typically cease and water quality costs can exceed recreational benefits;
- there are differences between values for passive and active recreational use;
  - Studies of recreational use in other States indicate that passive use may be valued at less than $10 per visit[73], visits to National Parks may attract a mid-range value of $25 a visit[74] while more active activities such as fishing and hunting may attract values at or above $50 per visit[75] (all in 2006 dollars).[76]
  - In Western Australia a valuation study was undertaken for the urbanised portions of the Swan-Canning Catchment in Perth which found that the per visit amount would be less than $5 per person (in 2006 dollars).[77]

Regarding valuation of recreational use of South West dams, the most relevant study for the purpose of this inquiry is the Lucas study in 1991 which estimated the recreational value of Logue Brook. This is the only valuation survey that has been undertaken of recreational benefits associated with the South West dams.

The Lucas study estimated that visitors incurred costs in the range of $13 to $30 per visit, depending on the assumption about the opportunity cost of their travel time (the costs have been adjusted to 2006 dollars).[78]

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[72] Monitoring for hydrocarbons, pathogens and turbidity is typically the major cost. Note also that cost estimates from the 15 major urban and rural water suppliers in Victoria showed total water monitoring costs to be around $1.5 million per annum (State Government of Victoria (July 2004), Drinking Water Quality Regulatory Framework For Victoria - Industry Draft Of The Safe Drinking Water Regulations: Consultation History, Analysis Of Submissions And New Cost Estimates). Department of Conservation and Land Management (1990), "Logue Brook Reservoir and Catchment Area: Management Plan 1990-2000"; also Department of Conservation and Land Management (1990), "Waroona Reservoir and Catchment Area: Management Plan 1990-2000. Also in Queensland, monitoring of water quality in dams has found no measurable adverse effects from water skiing and other recreational activities. (see http://www.nqwater.com.au/facts.htm)

[73] See for example, Lockwood M. and K. Lindberg (1996), Nonmarket Economic Value of Recreation in Eurobodalla National per, Johnstone Centre of Parks, Recreation and Heritage, report No. 67.; also Sappideen, B. (1992), 'Valuing the Recreation Benefits of Sale Wetlands using Contingent Valuation', in Lockwood, M. & DeLacy, T. (eds), Valuing Natural Areas: Applications And Problems Of The Contingent Valuation Method. Johnstone Centre of Parks, Recreation and Heritage, Charles Sturt University.

[74] See for example, Read Sturgess and Associates (1999), *Economic Assessment of Recreational Values of Victorian Parks*. Report for the Department of Natural Resources and Environment, Victoria.

[75] See for example, Rolfe, J., Prayaga, P., Long, P., and R. Cheetham (2004), "Estimating the value of freshwater recreational fishing in three Queensland dams", Report for the Queensland Department of Primary Industries; also Whitten, SM and Bennett, JW 2001,'A travel cost study of duck hunting in the Upper South East of South Australia', *Australian Geographer, Vol. 33, No. 2, pp. 207–221, 2002*

[76] Assigning a value to recreational benefits is difficult because the valuation methods often involve surveys using hypothetical scenarios for goods and services that have a market value. A common problem is that respondents may misstate their 'true' willingness to pay, given the nature of the hypothetical scenario (that is, answers often reflect the respondents' intentions rather than their actual behaviour).

[77] Harman J. et al (1998), op. cit. - found that respondents were willing to pay around $15 (in 2006 dollars) per person per annum to protect existing non-use and use values (use values are the value derived from actual use of the good or service (e.g. recreation) while non-use values include indirect values such as conservation values). Given that recreational use typically involved 3-4 visits per year, the per visit amount would be less than $5 per person.

[78] Using the travel cost method, a proportion of post-tax hourly wage is taken to represent the opportunity cost of travel time. In the Lucas study, the base case assumed a proportion of 0.3 (resulted in a value of $13 per visit) while the upper range assumed a proportion of 1.0 (resulted in a value of $30 per visit).

In June 2006, ACIL Tasman was employed by the Department of Water to conduct a reassessment of the recreational benefits specific to Logue Brooke dam, but did not conduct primary research, instead basing its analysis on the original (Lucas, 1991) study.[79] ACIL Tasman expressed "reservations" about Lucas' (1991) findings but stated that in "the absence of any other studies, the Lucas standard estimate…is the best available estimate of the recreational value of Logue Brook Dam".[80]

Given that the Lucas result of $13 to $30 per visit is between estimates of the value of passive and active recreational use in other studies, the Lucas range appears reasonable.

The Authority engaged ACIL Tasman to provide further advice on this matter, and they concluded that a ratio of recreational value to water value could be established from the Lucas study and from the value of temporary water trades as an indicator of the (net) market value of the water services supported by the dams.[81] ACIL Tasman suggested that the recreational value is in the order of $10 per ML and the value of temporary trades is in the order of $13 per ML. This suggests a ratio of recreational value to water services value of 10:13 (which is equivalent to 43:57 as reported by ACIL Tasman).

The Corporation has raised concerns with the approach recommended by ACIL Tasman:

> The 43:57 ratio calculated for the recreational benefits of Logue Brook dam has not been carried out on a consistent basis. The valuation of recreational benefits based on the Lucas study of 1c/kilolitre represents the full consumer surplus from the recreational benefits. The 1.3c/kL represents the marginal value of the water for a temporary trade between irrigators. This does not represent the producer surplus from using the water. The calculation is therefore inconsistent and not valid. The use of the value of temporary trades within the Harvey Water cooperative offers little guide to the full value of the water. Farmers are restricted from trading to outside customers and, therefore, this market only reflects marginal local and seasonal values. For example, the value to a horticultural operation is likely to be much higher. An assessment of producer surplus is required. If the average producer surplus is 10c/kilolitre the ratio becomes 9:91, 15c/kilolitre – 6:94 and 20c/kilolitre - 5:95. (Corporation submission on Draft Report, p13)

The Corporation is also concerned that the use of per ML values has limited application because of the varying yields of the dams.

> The value per kilolitre of the benefits is very specific to Logue Brook and depends on the yield of the dam. If, for example climate change halved the yield, the value per kilolitre of recreational benefits would double, while the absolute dollar value remained unchanged. There is a similar problem translating a benefit per kilolitre to other dams. (Corporation submission on Draft Report, p14)

The Authority accepts that the analysis presented in the Draft Report needs to be revised, and proposes the following method, using Logue Brook as the representative example:

- The per ML value of water in Logue Brook has been estimated by valuing the water at its opportunity cost. The water in Logue Brook could be valued at the long run marginal cost of water for Perth less transport and treatment costs, which

[79] ACIL Tasman then went on to convert this estimate into 2005 dollars for the purposes of their conclusion; ACIL Tasman (June 2006), "The value of recreation at Logue Brook Dam", prepared for the Department of Water,.

[80] Ibid, p.16

[81] ACIL Tasman (December 2006), *Harvey Water Bulk Water Pricing: Recreational value of the dams*, Paper 4 of 4 prepared for the Authority, published on the Authority web site.

could place the value at around $380 per ML ($820 per ML less $440 per ML transportation and treatment costs[82]).

- The total value of the water in Logue Brook can be estimated by multiplying the per ML value ($380 per ML) by the water available (11,000 ML), which gives a total value of $4.2 million in 2007/08, or $69.8 million in present value terms over a period of 50 years.
- The total value of recreational benefits in Logue can be estimated by multiplying the value per visit by the estimated number of visitors.
  - Recreational use of the area surrounding Logue Brook Reservoir (including the dam) is currently estimated to be in the range of 40,000 to 60,000 visits per annum,[83] with around 27,000 visitors to the Logue Brook Dam.[84] Harvey Water indicated in its submission that:

    > It should also be noted in this context that recent public discussions on Logue Brook dam accepted a figure supported by CALM of 65,000 visits per year to that dam. This is well above any other previous estimates and indicates the high level of recreational value which can be applied to other similar dams. (Harvey Water submission Draft Report, p12)

  - Noting that the only data (traffic count) collected for Logue Brook shows around 27,000 visitors per annum to the dam itself, and given the Department of Conservation and Land Management published information on estimated visitor numbers to the area surrounding Logue Brook reservoir, the Authority has taken 50,000 (the mid-point of the estimated range) to be a reasonable estimate of visitors to Logue Brook. It has been assumed that the number of visitors will increase by 0.4 per cent per year, based on Tourism Australia forecasts for Western Australia[85].
  - ACIL Tasman has also noted that the number of recreation substitutes, particularly for water skiing, may have become more limited since the 1991 study. It may therefore be appropriate to use a per visit value higher than the Lucas base case. A constant annual value of $20 per visit has been assumed.
  - Assuming 50,000 visits per annum to the dam and a value per visit of $20, the total recreational benefits could therefore be in the order of $1 million in 2007/08 or $17.7 million in present value terms over a period of 50 years.
- Based on these assumptions, the ratio of recreational benefits to water services benefits at Logue Brook is 17.7 : 69.8, or 20 per cent.

It should be noted that the Authority has assumed that the proposed trades between the Corporation and Harvey Water will take place and that there are no ongoing recreational benefits associated with Logue Brook from 2007/08.[86] However, the share of costs that would otherwise be attributed to recreational benefits (and paid for as a CSO) has been

[82] The Corporation has indicated to the Authority that $440 per ML is the average transportation and treatment cost associated with the Harvey Water trade.

[83] Department of Environment and Conservation (2006), "Logue Brook Dam Position Statement", South West Water Catchment Management Dialogue Forum July 2006, Information Package Dept Water

[84] The traffic count on the Dam road for 2004/05 was 27,376 (Tourism WA (July 2006), "Australia's South West Tourism Perspective 2005").

[85] Over the past five years, Tourism Australia figures show a relatively flat trend in overnight visits to the South West, which is similar to the trend for all of the State.

[86] Further information on the recreational future of Logue Brook is available on the Department of Water's web site at the following location: http://portal.water.wa.gov.au/portal/page/portal/dow/drinking_water/Projects/Logue_Brook.

attributed to the Corporation. The reason for this is that the loss of the CSO for recreational benefits is an avoidable cost (via investment in water treatment or by accessing other water sources), and it is appropriate that this cost be attributed to the Corporation as a cost associated with the trade. If this adjustment were not applied, Harvey Water would be charged, unfairly, a greater proportion of the costs of Logue Brook.

Waroona, Drakes Brook and Wellington dams also have extensive recreational activities[87] and a significant number of visitors.[88] However, the Authority considers that there is insufficient information to undertake a robust analysis of the recreational value of each of these dams. For the purpose of the BWSA, the Authority has assumed that 20 percent may represent a reasonable estimate of the proportion of benefits attributable to recreational usage at these dams.

The Authority has assumed that Stirling Dam has no recreational value given that recreational use is not permitted. The value of recreation for Harvey Dam has not been assessed for the reason that there is an agreement between Harvey Water and the Corporation to not pass the costs of Harvey Dam through to Harvey Water.

Recommendation

12) The total costs associated with providing a storage service from Logue Brook, Waroona, Wellington and Drakes Brook dams should be reduced by 20 per cent, which is based on an estimate of the recreational benefits associated with Logue Brook dam (the dam with the most robust information available on recreational benefits).

13) Harvey Water should be allocated its share of the costs of Logue Brook, after a deduction for recreational benefits has been made, even though recreational benefits would be extinguished by the trade between the Corporation and Harvey Water. The reason for this is that the Corporation should bear the costs of removing recreational benefits, not Harvey Water, given that the Corporation could develop alternative sources.

4.7 Other Community Benefits

The aesthetic costs and benefits attributable to dams are largely a matter of individual tastes and preferences. There will be those who enjoy the aesthetic attributes of the green pastures that result from the dams' presence, and there will be those who prefer a more natural environment. Special techniques (e.g. contingent valuation or travel costs methods) could be employed to estimate the relative strengths of each set of preferences; however, these methods are not robust and can be expensive to undertake. Moreover, preferences can change over time, so a correct estimation in the current period may not hold for future periods. In any case, the Authority's view is that, once aggregated, the opposing sets of aesthetic preferences could more or less cancel out. Therefore, the Authority proposes not to attribute any net aesthetic benefits to dams.

[87] For example, the Wellington Dam area has camping, swimming, canoeing and white water rafting. Water skiing occurs at Stockton Lake, 20km east of Wellington Reservoir.

[88] For example, the traffic count on Wellington Weir Road for 2004/05 was 79,391 (Tourism WA (July 2006), "Australia's South West Tourism Perspective 2005").

Another benefit associated with dams is that of flood mitigation. Harvey Water submitted that:

> Dams protect roads, railways and other public infrastructure from flood damage. (Harvey Water submission Issues Paper, p14)

and that:

> …there are net benefits from flood mitigation as local councils and governments seek to take advantage from the desirable locations adjacent to dams and approve closer development. This trend is likely to increase with increasing population flows to local towns. Harvey Water also points out that councils and government should also expect to take responsibility for the costs and management of risks associated with these developments. (Harvey Water submission Draft Report, p20)

The Authority has taken a similar view on the community costs and benefits of flood mitigation and risk to its view on aesthetic costs and benefits. This is because damaging floods can occur with or without the presence of dams. Dams provide some protection from *natural* flood events and in this sense provide a benefit to the community.[89] At the same time, the large stock of water behind a dam represents an *unnatural* flood risk. In general, these two values act in opposite directions to each other and may cancel out. Analysis in this area would also be highly prone to error due to the uncertainties involved. There is, for example, a requirement to multiply the uncertainty associated with climate change against the estimated probabilities associated with each type of flood risk. On balance, climate modelling points towards an increased likelihood of extreme natural events. At the same time, climate change has resulted in an overall decrease in average rainfall and thus a lower risk from unnatural flood events due to the resulting lowering of water levels in dams – although this might be offset by an increase in the propensity for more extreme floods. ACIL Tasman notes:

> The data, science and engineering on which the risk assessments are being based may have come a long way – but a very large uncertainty remains. Estimating the nature of extreme events with the limited available data, and the ranges that still apply to the climate change modelling, is subject to very large uncertainty. Given the evidence….of rapidly diminishing returns to investment in dam safety, this strongly suggests that the efficient costs, and the other components of incremental cost, are likely to be highly susceptible to deeper probing and the progressive accumulation of better data – especially if active investment is made in these processes.[90]

Moreover, the further away these changes in risk occur in time, the less impact they will have on the Authority's present value calculations. In all, these considerations have led the Authority to the view that the best position to take on natural flood mitigation benefits is a neutral one.

Recommendation

14) As there are both positive and negative aspects to the aesthetic benefits of dams and natural flood mitigation, no allocation of costs in respect of these should be attributed to the Government.

[89] Note that dams in WA have largely been built for water supply not flood mitigation.

[90] ACIL Tasman (November 2006), *Harvey Water Supply System: Cost Sharing Issues*, Paper 2 of 4 prepared for the Authority, published on the Authority web site, p10.

4.8 Customer Costs

Once the matters of legacy costs, recreational benefits and other community benefits have been resolved, the issue becomes how to allocate the remaining revenue requirement between the customers of dam services.

The first matter considered by the Authority was whether cost allocation should be on the basis of annual water entitlements or actual annual volumes used. The Corporation and Harvey Water support the entitlement approach:

> The Water Corporation supports an allocation process where an assessment is made of the value of the dams to non-consumptive beneficiaries, with the remainder of the costs being split on the basis of water allocations. (Corporation submission on Draft Report, p10)
>
> Harvey Water agrees that the allocation of costs can most appropriately be made on the basis of the relative shares of entitlement held by those accessing the water in each dam. (Harvey Water submission on Draft Report, p9)

Given that both parties support the use of annual water entitlements for cost allocation purposes, this is the method that has been applied by the Authority.

The allocation method used by the Authority takes into account the trades between the Corporation and Harvey Water as part of the project to convert open irrigation channels to pipes in the Harvey irrigation area. The water trades commenced in 2006 with a reduction in Harvey Water's allocation from Samson Brook dam and will continue until 2009/10 with further reductions from Samson Brook and reductions from Stirling and Logue Brook.

An issue between the parties has been the method for allocating costs following the construction of Harvey Dam and Wokalup Pipehead Dam. The history of this issue is understood to be as follows:

- The Corporation and Harvey Water agreed in the 1996 BWSA that the charge to Harvey Water would not be impacted by the capital or operating costs associated with Harvey Dam;
- Prior to 2001, Harvey Water accessed all of the water from Stirling Dam and Harvey Weir;
- The Corporation constructed Harvey Dam in 2001 for the purpose of gaining access to the higher quality water in Stirling Dam with irrigation water supply to Harvey Water then coming mainly from the new, larger Harvey Dam;
- The Corporation constructed Wokalup Pipehead Dam in 2003 for the purpose of accessing high quality water in Stirling Dam. Poorer quality Wokalup water is passed into Harvey Dam and a direct volumetric exchange is then made from Stirling Dam; and
- The Corporation and Harvey Water agreed in 2003 that the costs of constructing or operating Wokalup Pipehead Dam would not be passed on to Harvey Water.

In their submission on the draft report, the Corporation indicated that Harvey Water should continue to pay the notional operating and replacement costs of Harvey Weir (even though Harvey Weir was replaced by Harvey Dam).[91] However, Harvey Water has disputed this cost and claims that no agreement had been reached with the Corporation on this matter.

[91] The table on page 12 of the Corporation's submission on Draft Report shows that Harvey Water is allocated 27 per cent of the volume of water from Harvey Dam.

A related matter of disagreement between the parties is over the allocation of the costs of Stirling Dam:

- The Corporation's view is that the costs of Stirling Dam, including any future dam safety costs, should be allocated on the basis of the share of entitlements to the water in the entire Harvey, Stirling and Wokalup system (which would give an allocation to Harvey Water of approximately 56 per cent of costs reducing to 53 per cent with further water trading); and
- Harvey Water's view is that the costs of Stirling Dam should be allocated on the basis of the share of entitlements in Stirling Dam only (which would give an allocation to Harvey Water of approximately 9 per cent reducing to 4 per cent with further water trading).

The parties have not been able to cite any historical documentation to support their respective positions.

Harvey Water has commented to the Authority that their two water exchanges with the Corporation (the Harvey/Stirling swap and the Wokalup/Stirling swap) resulted in the exchange of good quality water for poor quality water.[92] In particular, Harvey Water has indicated to the Authority that the Wokalup swap was from a "public spirited perspective", which did not benefit Harvey Water.[93]

The Corporation has commented to the Authority:

> If [Harvey Water] are not going to meet the costs of [Harvey Water's] entitlement in its new location (Harvey Dam), they need to pay for it in its previous location. Without evidence to the contrary, it would be unreasonable to assume that the Corporation would have agreed to pay for the cost of this allocation in both locations.[94]

The Authority is reluctant to arbitrate the terms and conditions of a commercial trade. However, the Authority is not able to address the Terms of Reference without making assumptions about the allocation of costs and recognises that the Minister may be called on to arbitrate on this matter.

In the case of Harvey Weir, the Authority's view is that the absence of any evidence that such an agreement was made leads the Authority to consider that Harvey Water should not be charged the notional operating and replacement costs of Harvey Weir.

However, in the case of Stirling Dam, the Authority concurs with the Corporation's view as it seems unlikely that the Corporation would have entered into a deal with Harvey Water whereby it agreed to meet the costs of Harvey Dam and also nearly all of the costs associated with Stirling Dam. The Authority has allocated the costs of Stirling Dam on the basis of the share of entitlements to the water in the entire Harvey, Stirling and Wokalup system.

Non-irrigation customers

Harvey Water's operating and surface water licences allow it to sell water to non-irrigation customers. In addition, the BWSA incorporates a provision for Harvey Water to pay a higher charge to the Corporation for water sold to non-irrigation customers.

[92] Email communication with Geoff Calder, 30 March 2007.

[93] Ibid.

[94] Email communication with Lloyd Werner, 30 March 2007.

For the purposes of allocating the costs of providing dam services, the Authority considers that non-irrigation customers should be treated as if they are purchasing water directly from the dams. Once the costs have been appropriately allocated to non-irrigation customers, this amount would be charged to Harvey Water. Harvey Water would then pass on this cost, along with the costs of distributing the water, to the non-irrigation customers.

Recommendation

15) The allocation of costs of Waroona, Logue Brook, Drakes Brook, Wellington, Samson Brook and Samson Brook Pipehead dams should be on the basis of water allocations from each dam and take into account the trades between the Corporation and Harvey Water.

16) As per agreements between the parties, the costs of Harvey Dam and Wokalup Pipehead Dam should be met by the Corporation.

17) The allocations of the costs of Stirling Dam were the subject of an agreement between the Corporation and Harvey Water; however, the parties disagree on the terms of that agreement. While the Authority is reluctant to arbitrate the terms and conditions of a commercial trade, it has been assumed that the costs of Stirling Dam are allocated on the basis of the share of entitlements to the water in the entire Harvey, Stirling and Wokalup system.

5 Level of Water Storage Charges to Harvey Water

5.1 Terms of Reference

The Authority is to consider and develop findings on:

> the most appropriate level and structure of water storage charges to the South West Irrigation Cooperative (Harvey Water).

5.2 Analysis

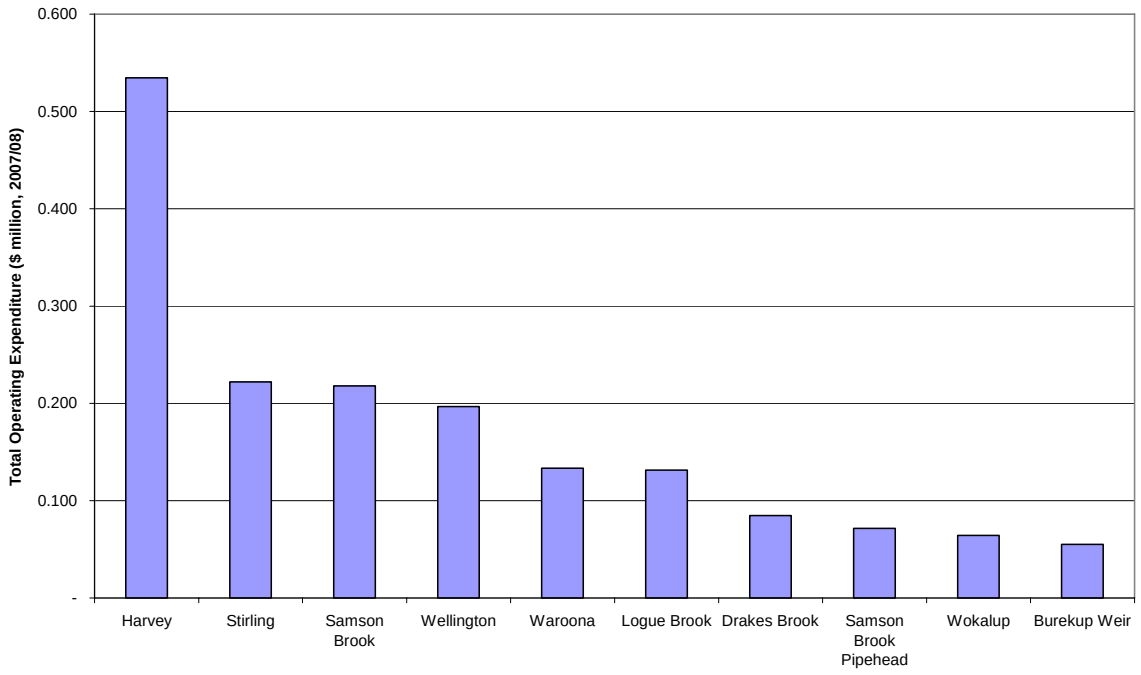
The purpose of this chapter is to provide an indication of the implications of the preceding discussion on the charges that could apply to Harvey Water. This chapter first considers other factors that influence the charges to Harvey Water, such as operating costs, asset lives and the rate of return.

5.2.1 Non-Dam Safety Expenditure

Operating Expenditure

Total operating expenditure is expected to amount to $1.712 million in 2007/08 and is attributed to each dam as indicated in Figure 5.1.

Figure 5.1 Operating Expenditure by Dam (2007/08, $million, Real Dollar Values of 2005/06)



Source: Water Corporation

MJA was employed to examine the appropriateness of the operating expenditure directly incurred and allocated to the South West dams (MJA's advice is available on the Authority's web site). MJA concluded that:

- high level benchmarking suggests that the order of magnitude of the Corporation's direct costs (excluding overheads) is similar to or less than the bulk water supply costs for similarly sized eastern State's water businesses (see Table 5.1);
- the overhead rate applied to the South West dams should be the same as is applied to the Corporation's major consumers (53 per cent of direct costs); and
- the same productivity rate that has been applied to the Corporation generally should also be applied to the South West dam operations (a real annual reduction of 1.88 per cent).

Table 5.1 Benchmark Against Regional Irrigation Providers 2005/06

	Annual Yield 2005 (GL/a)	Capacity (GL)	Number of Large Dams[95]	Total Operating Cost (Excl Overheads) ($ million)	Cost per ML Yield ($/ML)	Cost/ML Capacity ($/ML)
Regional Water Authority One	30	75	8	$0.4	13	5.2
Regional Water Authority Two	Approx. 120	766	9	$1.1	9	1.4
Southern Rural Water	300	499	9	$7.3[96]	24	15
Goulburn-Murray Water[97]	2,424	4,818	15	$17.1	7	3.5
Water Corporation (excl overheads)	232	684	9	$1.1	5	1.6

Source: MJA (March 2007), Harvey Irrigation Bulkwater Operating Cost Review, report for the Economic Regulation Authority.

The Corporation had proposed that the overhead rate should be based on their standard overhead recovery rate of 105 per cent. MJA's concern was that this overhead represents a retail overhead allocation rate, which includes expense items such as retail call centres, residential billing and land development services. MJA's review of the overhead rates of other water authorities indicated a range of 19 to 62 per cent. The Corporation's overhead rate for major consumers of 53 per cent, which excludes retail overheads, falls within the range used by other water authorities.

The Authority has accepted MJA's recommendations in relation to the appropriate amount of operating expenditure to recover from customers.

[95] From ANCOLD Large Dams Register.

[96] Whilst direct costs appear high, administrative costs appear very low (at only 13%), and it is possible that direct costs include some indirect costs (from 2006 Annual Report)

[97] Yield based on adding back 662.8 GL of "lost" supply to 1,762 GL of disclosed irrigation supply to give 2,424 total yield (from 2006 Annual Report). Yield also assumes that nothing comes from the Murray River at minimal or zero cost; however, even if a portion does, it would have the effect of *increasing* the cost per yield, not decreasing it, so the assumption does not adversely affect the relationships amongst the figures with the Water Corporation.

Non-Dam Safety Capital Expenditure

The Corporation has advised that the only significant capital expenditure that is not related to dam safety is an amount of $32 million in 2011 for outlet works on Stirling Dam. As this cost is for the purpose of servicing the IWSS, it has been allocated entirely to the Corporation.

Asset Lives

The Corporation has assumed that the remedial works for dam safety will last for 80 years. This is likely to be an appropriate assumption for the purposes of determining depreciation allowances in the Corporation's revenue requirement.

Rate of Return

The Authority has assumed the same real pre-tax rate of return that has been applied by the Government to the Corporation's urban and country water prices is also applied to the new BWSA. The rate of return is 5.6 per cent (pre-tax real) calculated as of 30 October 2006.

Recommendations

18) The new BWSA should be based on:

a) an overhead rate for operating expenditure that is the same as is applied for the Corporation's major consumers (53 per cent);

b) a productivity rate of 1.88 per cent, which is consistent with the rate that has been applied to the Corporation generally;

c) asset lives for new capital expenditure of 80 years for the purpose of determining depreciation allowances; and

d) a rate of return of 5.6 per cent (pre-tax real).

5.2.2 Price Path Options

Method

The Authority has developed a financial model for the purpose of calculating the charges to Harvey Water. The model estimates the total costs associated with providing a dam storage service from each of the eight dams and then attributes these costs across all of the customers of the dams, including recreational users, Corporation customers and Harvey Water (both irrigation and non-irrigation users). The model works as follows:

- The model keeps a running total of the regulatory asset value of each dam, starting in 1996, by adding capital expenditure for each year and deducting depreciation;

- The annual cost of providing the storage service from each dam is calculated by adding the return on assets (the rate of return multiplied by the regulatory asset value), depreciation and operating costs;
- The cost of service is projected for the next 50 years and then smoothed over that period;
- The annual cost of service for each dam is then, where appropriate, reduced by the assumed recreational value;
- The remaining cost is allocated between the Corporation, Harvey Water (irrigation) and Harvey Water (non-irrigation) on the basis of assumed usage of each dam;
- The charge to Harvey Water has been separated into a charge for each irrigation district. Dam safety costs are identified separately to other costs.

Both the Corporation and Harvey Water were given opportunities to review the model and provide comments to the Authority. The comments were largely in relation to the inclusion of a positive initial regulatory asset value for Harvey Water's non-irrigation customers (the Authority had initially included a zero initial value) and to the method of assigning the volumes from each dam to the respective customers. These changes were discussed in chapters 2 and 4, respectively.

Total Revenue Requirement

In calculating the revenue requirement for the Corporation, the Authority has used the following values:

- A zero initial asset value as at 30 June 1995 for the purpose of calculating the dam storage charges for Harvey Water's irrigation water and the written down replacement value for the purpose of calculating the dam storage charges for Harvey Water's non-irrigation water;
- $11.5 million of the dam safety capital expenditure for Waroona Dam has been added to the regulatory asset value (as discussed in Chapter 3 above);
- The future dam safety capital expenditure that is added to the regulatory asset value includes all of Wellington, Stirling, Drakes Brook and Samson Brook dams (subject to the reassessments discussed in Chapter 3 above);
- The productivity rate applied to the Corporation's operating expenditure is 1.88 per cent (as discussed in Section 5.2.1 above);
- The rate of return on the regulatory asset value is 5.6 per cent (pre-tax real) (as discussed in Section 5.2.1 above);
- The value placed on recreational benefits at Logue Brook Dam is assumed to be 20 per cent of the revenue required to provide the dam service in 2007/08 and zero per cent thereafter on the assumption that recreational use is prohibited once the water is traded with the Corporation. The foregone recreational benefits are assigned as a cost to the Corporation (as discussed in Chapter 4 above);
- The value placed on recreational benefits at Waroona, Wellington and Drakes Brook dams is assumed to be 20 per cent of the cost; and
- The dam safety and other costs attributed to customers are allocated on the basis of water allocations, other than for Stirling Dam which is allocated to Harvey Water on the basis of the share of its allocation in the Stirling, Harvey and Wokalup system (as discussed in Chapter 4 above).

The Corporation's revenue requirement equates to a present value (at a discount rate of 5.6 per cent) of $159.1 million over the period from 2007/08 to 2016/17.

The derivation of this revenue requirement is summarised in the following table.

Table 5.2 Corporation Total Revenue Requirement from Operating the South West Irrigation Dams

	Value ($ million, real dollar values of 30 June 2006)									
Asset Account	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Opening Asset Value	252.0	259.2	255.6	290.3	286.8	282.8	336.1	331.4	328.2	323.8
Capital Expenditure	10.5	0.0	38.2	0.5	0.1	57.3	0.0	1.5	0.4	1.1
Depreciation	-3.4	-3.5	-3.5	-4.0	-4.0	-4.0	-4.7	-4.7	-4.7	-4.7
Closing Asset Value	**259.2**	**255.6**	**290.3**	**286.8**	**282.8**	**336.1**	**331.4**	**328.2**	**323.8**	**320.2**
Cost of Service	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Operating Expenditure	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.4
Depreciation	3.4	3.5	3.5	4.0	4.0	4.0	4.7	4.7	4.7	4.7
Return on Assets	14.1	14.5	14.3	16.3	16.1	15.8	18.8	18.6	18.4	18.1
Total Revenue Requirement (unsmooth)	**19.2**	**19.7**	**19.5**	**21.9**	**21.7**	**21.4**	**25.1**	**24.8**	**24.6**	**24.3**
Cost of Service	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Total Revenue Requirement (smoothed over 50 years)[98]	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**	**21.2**

[98] The smoothed revenue requirement assumes that the residual value of the assets at the end of the period will be recovered thereafter.

The allocation of the revenue requirement among the beneficiaries of the Corporation's dam services assumes that costs are allocated according to the volumes used from each dam, after an allowance for recreational benefits has been made.

The derivation of the total cost of service attributed to Harvey Water differs between the options discussed in Chapter 3. Option 1 is to apply the ANCOLD framework and pass through to customers the costs of complying with ANCOLD. Option 2 is to apply the ANCOLD framework for the purpose of setting the dam safety programme of works, but only pass through to customers a subset of this expenditure, with the difference funded by a CSO payment to the Corporation. This second option would result in the costs associated with Wellington Dam only being passed through to customers.

Cost Allocation to Harvey Water Under Option 1

The derivation of the total costs attributed to Harvey Water under Option 1 is shown in the following table.

Table 5.3 Derivation of Total Cost Attributed to Harvey Water Under Option 1

	Value ($ million, real dollar values of 30 June 2006)									
	07/08	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Total Cost of Service	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2
Less CSO payment for zero initial asset value	-2.7	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9
Less CSO payment for recreational benefits	-1.8	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
Less costs attributed to Corporation local and IWSS customers	-13.0	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1
Total cost attributed to Harvey Water	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**
	07/08	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Costs attributed to Harvey Water's non-irrigation customers	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Costs attributed to Harvey Water's irrigation customers	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total cost attributed to Harvey Water	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**

The costs attributed to Harvey Water for dam safety and other services are shown in the following table.

Table 5.4 Dam Safety and Other Costs Attributed to Harvey Water Under Option 1

	Value ($ million, real dollar values of 30 June 2006)									
Harvey Water Irrigation Customers	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Other services	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total cost attributed to Harvey Water Irrigation Customers	**3.3**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**
Harvey Water Non-irrigation Customers	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Other services	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total cost attributed to Harvey Water Non-irrigation customers	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**
Total Harvey Water	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Other services	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total cost attributed to Harvey Water customers	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**

The dam safety cost of $3.0 million in 2007/08 compares to the payment for dam safety made by Harvey Water in 2004/05 of $0.4 million (in real dollar values of 30 June 2006). The other services cost of $0.7 million in 2007/08 compares to the payment for other services by Harvey Water in 2004/05 of $0.25 million.

Price Path for Harvey Water Under Option 1

Given that the costs attributed to Harvey Water, which are approximately $3.6 million per year, are significantly higher than the current charges to Harvey Water, which are approximately $0.7 million, the Authority considers that it would be appropriate to phase-in the charges over a reasonable period, such as ten years. The phase-in would be funded by a CSO payment to the Corporation.

The total revenue requirement from Harvey Water under the assumption that the new charges are phased-in over a period of ten years is shown in the following table.

Table 5.5 Derivation of Revenue Requirement from Harvey Water Under Option 1

	Value ($ million, real dollar values of 30 June 2006)									
Customer	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Total cost attributed to Harvey Water	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Less CSO payment for phasing-in new charges	-2.3	-2.1	-1.8	-1.5	-1.3	-1.0	-0.8	-0.5	-0.3	-
Total revenue requirement from Harvey Water	**1.3**	**1.6**	**1.8**	**2.1**	**2.3**	**2.6**	**2.8**	**3.1**	**3.3**	**3.6**

The average charge per ML per irrigation district is projected to increase in the manner shown in the following table.

Table 5.6 Average Charge to Harvey Water Irrigation Customers Under Option 1

	Average Charge ($ per ML)									
Irrigation District	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Harvey		7.24	9.52	11.80	14.08	16.36	18.65	20.93	23.21	25.49	27.77
Waroona		30.67	40.32	49.97	59.63	69.28	78.94	88.59	98.24	107.90	117.55
Collie		2.43	3.20	3.97	4.73	5.50	6.27	7.03	7.80	8.56	9.33
Average	**5.40**	**7.89**	**10.37**	**12.85**	**15.33**	**17.82**	**20.30**	**22.78**	**25.27**	**27.75**	**30.23**

It should be noted that the total charge to irrigation customers has two components: a charge for water storage services provided by the Corporation and a charge for distribution services provided by Harvey Water, which is in the order of $43 per ML. Under Option 1, the water storage charge increases from 11 per cent of the total charge to irrigators in 2006/07 to 41 per cent in 2016/17.

Recommendation

19) The storage charges to Harvey Water should be phased-in over a period of ten years.

Cost Allocation to Harvey Water Under Option 2

Under the second option discussed in Chapter 3 above, the only dam safety costs that are recovered from customers are those associated with Wellington Dam and the first stage of Waroona Dam. This option reduces the total costs attributed to Harvey Water by approximately $1.9 million per year.

The derivation of the total costs attributed to Harvey Water under Option 2 is shown in the following table.

Table 5.7 Derivation of Total Cost Attributed to Harvey Water Under Option 2

	Value ($ million, real dollar values of 30 June 2006)									
	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17
Total Cost of Service	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2
Less CSO payment for dam safety capital expenditure	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9
Less CSO payment for zero initial asset value	-2.7	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9
Less CSO payment for recreational benefits	-1.2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Less costs attributed to Corporation local and IWSS customers	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6
Total cost attributed to Harvey Water	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**
	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17
Costs attributed to Harvey Water's non-irrigation customers	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Costs attributed to Harvey Water's irrigation customers	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Total cost attributed to Harvey Water	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**

The costs attributed to Harvey Water for dam safety and other services are shown in the following table.

Table 5.8 Dam Safety and Other Costs Attributed to Harvey Water Under Option 2

	Value ($ million, real dollar values of 30 June 2006)									
Harvey Water Irrigation Customers	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other services	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total cost attributed to Harvey Water Irrigation Customers	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**
Harvey Water Non-irrigation Customers	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total cost attributed to Harvey Water Non-irrigation customers	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Total Harvey Water	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Dam safety	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other services	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total cost attributed to Harvey Water customers	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**

The dam safety cost of $1.0 million in 2007/08 under Option 2 compares to the payment for dam safety made by Harvey Water in 2004/05 of $0.4 million (in real dollar values of 30 June 2006). The other services cost of $0.7 million in 2007/08 compares to the payment for other services by Harvey Water in 2004/05 of $0.25 million.

Table 5.9 Derivation of Revenue Requirement from Harvey Water Under Option 2

	Value ($ million, real dollar values of 30 June 2006)									
Customer	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Total cost attributed to Harvey Water	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Less CSO payment for phasing-in new charges	-0.9	-0.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	-
Total revenue requirement from Harvey Water	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**

Price Path for Harvey Water Under Option 2

Under Option 2, the average charge per ML per irrigation district is projected to increase in the manner shown in the following table, assuming that the charges are phased-in over a period of ten years.

Table 5.10 Average Charge to Harvey Water Irrigation Customers Under Option 2

	Average Charge ($ per ML)										
Irrigation District	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Harvey		1.91	2.19	2.48	2.76	3.05	3.33	3.61	3.90	4.18	4.47
Waroona		8.49	9.76	11.02	12.29	13.55	14.82	16.08	17.35	18.61	19.88
Collie		3.99	4.58	5.17	5.77	6.36	6.95	7.55	8.14	8.74	9.33
Average	**5.40**	**6.35**	**7.30**	**8.24**	**9.19**	**10.13**	**11.08**	**12.03**	**12.97**	**13.92**	**14.86**

The average storage charge to irrigators ends up being approximately half of the charge that would apply under Option 2. Under Option 2, the water storage charge increases from approximately 11 per cent of the total charge to irrigators in 2006/07 to 25 per cent (compared to 41 per cent for Option 1).

6 Structure of Charges

6.1 Terms of Reference

The Authority is to consider and develop findings on:

> the most appropriate level and structure of water storage charges to the South West Irrigation Cooperative (Harvey Water).

6.2 Background

The water storage charge to Harvey Water has a fixed component (in the form of a fixed annual charge) and a variable component (a price per ML of water used). In 2005/06, the fixed charge accounted for 30 per cent of the total charge.

Harvey Water comments on the origin of the current price structure:

> The 1996 BWSA agreed that the payment would be structured such that there was a fixed component (about 50%) and a component related to the volume of water drawn from the dam (about 50% but varying each year according to the amount taken). This structure arose because there was lack of clarity at the time of the agreement about whether or not Water Corporation was a bulk water supplier to Harvey Water and, if so, then it made logical sense to charge on the basis of volume of water drawn.
>
> However this is not actually the case and Water Corporation only provides water storage services to Harvey Water in which our water is stored in their dams, and naturally a fee is payable. The problem with the original structure is that it has led far too many people to conclude that Harvey Water is buying water off Water Corporation when this has never been the case. (Harvey Water submission on Issues Paper, pp28-29)

The structure of water storage charges to irrigators has been considered as part of reviews in other States. For example, IPART reviewed the prices of bulk water services provided by the State Water Corporation (**State Water**) and the Department of Natural Resources (**DNR**).[99] As part of the review, IPART assessed the appropriate balance between entitlement charges (fixed fees per ML of water entitlement) and usage charges. Submissions to the IPART inquiry raised various issues regarding tariff structures, including the price signals sent to users through usage charges, and the sharing of volumetric risk between users and the community:

- environmental groups were in favour of making the usage component as large as possible;
- some irrigators favoured a move towards a larger usage component on the grounds that it would provide better signals for water conservation; and
- other users argued that a larger usage component would increase the variability in State Water's revenue and impact on its infrastructure maintenance.

[99] IPART (May 2006), *Bulk Water Prices for State Water Corporation and Water Administration Ministerial Corporation from 1 August 2006 to 30 June 2010*. State Water provides mainly river operation activities such as water delivery, asset management of dams and weirs, and flood mitigation. DNR carry out water resource management activities and licensing activities. The DNR administers the Water Administration Ministerial Corporation, which is the legal entity that provides these services.

For regulated rivers, State Water's Operating Licence requires it to move from a ratio of 50:50 to a ratio of 40 per cent fixed fee to 60 per cent usage charge.

In June 2006, the Essential Services Commission of Victoria released its final decision for its review of rural water prices.[100] The review covered the prices to be levied by the five Victorian rural water businesses for the two years from 1 July 2006.[101] However, as this was the first independent review of rural water prices, it was limited to the determination of efficient revenues for the service providers, and did not address the structure of prices, which will be covered in the next price review.

6.3 Analysis

Water storage costs incurred by the Corporation are by nature largely fixed and therefore the costs of operating a dam are generally independent of the volume of water. Indeed, once the dam and catchment are established, the cost of supplying an additional megalitre of water is dependent on rainfall rather than on any significant production process (therefore marginal costs are very low).

The Corporation's submission reflects this view and considers that the water storage charges should be largely fixed, and notes that any increase in the proportion of volumetric charges relative to fixed charges would transfer risk to the Government.

> The current structure of the water storage charge between the fixed and volumetric component was determined to match Harvey Water's tariff structure to their customers. The objective of this structure was to minimise the risk to Harvey Water in the case where water sales fell due to low water demand or availability. This should be considered as a transition measure that is no longer required. The services provided by the Corporation are largely fixed cost in nature. The structure of the water storage charge should, therefore, be predominantly fixed. The call for a greater volumetric component to encourage water conservation in misdirected in this case. Water that is not consumed does not become available to other customers and either augments Harvey Water's future entitlements or results in storages overtopping. A greater volumetric charge would transfer volumetric risk to the Water Corporation and to the Government without a corresponding increase in revenue. The potential for water trading is a greater incentive to encourage water use efficiency. (Corporation submission on Issues Paper, p11)

> The ERA should note that the pricing structure will impact directly on the Government through the impact on CSO payments. The Government therefore takes the risk associated with the proportion of the charge that is volumetric. As such, the structure of the charge is more of an issue for the Government than the Water Corporation. (Corporation submission on Draft Report, p16)

Harvey Water submitted that charges should relate to the capacity shares of water held in the dams:

> One point of view is that if it is a storage charge then it should be a fixed charge because the costs of operating the dams are essentially the same if the dams are full or empty. Another point of view is that the charge should relate to the maximum volume of water stored in the dam by Harvey Water as a percentage of the total storage.
>
> This cost relates to the capacity share arrangement with Water Corporation which has been developed in Stirling dam and is now developing in Samson dam. In future it may

[100] ESC (June 2006), *Rural Water Price Review: Rural and Urban Water Businesses' Water Plans 2006-07 to 2007-08, Final Decision*.

[101] The five regional water providers are Goulburn-Murray Water, Grampians Wimmera Mallee Water (GWMWater), Lower Murray Water, First Mildura Irrigation Trust (FMIT) and Southern Rural Water.

> also apply to Logue Brook dam and Wellington dam. Harvey Water believes that the costs of water storage in the dams should be related to the capacity sharing of water approach and would like to work with ERA and others to develop this. (Harvey Water submission on Issues Paper, p29)

Harvey Water did not express any views in its submission in response to the Draft Report regarding the structure of charges.

It is likely that the structure of water storage charges is not relevant for ensuring water is allocated to its most valued use because an effective water trading market will achieve this result. In other words, an effective water trading market would signal the value of the water and Harvey Water would decide whether it is in its best interest to utilise the water or elect to trade it to others.

While the water trading market operating within the co-operative appears to be working well, the market operating between the co-operative and other potential purchasers, such as the Corporation, could be more effective. For example, the trade under negotiation between the Corporation and Harvey Water is administratively cumbersome because it requires the Department of Water to reduce Harvey Water's water allocation and to increase the Corporation's allocation, rather than a straight forward exchange of water rights. In addition, the water entitlements are held by the co-operative rather than individual water users, which limits the potential for individuals to trade water outside of the co-operative. The Government has announced that it intends reviewing the current water trading legislation.[102]

Given that the water trading market is under review with a view to it being enhanced, there is probably no need for the Government to prescribe the structure of the charges that the Corporation applies to Harvey Water. Rather, the structure of charges could be left to the Corporation and Harvey Water to negotiate commercially, given that the mix of fixed and variable charges is primarily an issue to do with managing the risk of uncertain annual inflows.

In relation to environmental considerations, the need to provide an adequate flow of water for environmental purposes is currently a factor that affects the amount of water allocated to irrigation use. Increasing the usage charge relative to the fixed charge would affect the amount of water used by farmers because the cost-effectiveness of implementing on-farm measures to save water would increase. However, if there is an effective water trading market operating, a farmer's decision to implement water efficiency measures will be influenced by the price on the water trading market and not just the price of the water from the dams.

It should be noted that the BWSA currently allows non-irrigation customers to be charged at a higher rate. This revenue is currently collected by Harvey Water and passed onto the Corporation. This issue was considered in Chapter 4 where it was concluded that non-irrigation parties should pay for their share of the costs of providing the water.

[102] Water Reform Implementation Committee (July 2006), *A Draft Blueprint for Water Reform in Western Australia: Discussion Paper.*

Recommendation

20) Given that the mix of fixed and variable charges is primarily a commercial issue to do with managing the volume risk of uncertain annual streamflows, it is probably unnecessary for the Government to prescribe the structure of charges that the Corporation applies to Harvey Water.

7 Impact on Harvey Water

7.1 Terms of Reference

The Authority is expected to consider and develop findings on:

> The ability of South West irrigation farmers and Harvey Water to meet their share of the costs determined from 1 and 2 above, and the impact on customers of the rate of change of an increase in prices (if any).

7.2 Background

There are a number of issues to be considered in the assessment of the impact of water cost increases on Harvey irrigators. The relative impact of a change in water charges will depend on a number of factors, including the scope for future productivity improvements and cost savings in the industry, the prices of outputs on the domestic and international markets, the ratio of water costs to total farm costs and farm profitability.

The Authority has undertaken an investigation of the dairy industry in Western Australia to assist in the impact assessment using the charges to Harvey Water recommended in Chapter 5 above.

There are an estimated 240 dairy farms currently in Western Australia, with around 70 dairy farms in the Harvey-Waroona area. The two major regions for dairy production in Western Australia are the Harvey and Boyanup regions, which together provide around 70 per cent of Western Australia's milk production.

In Western Australia the majority of milk is produced for consumption in the local market. In comparison, 70 per cent of Victorian dairy production is exported as manufactured milk products. Traditionally Western Australia has engaged in more water-intensive all-year milk production to meet local demand, with associated higher production costs. Over recent years there has been an increase in productivity (associated with larger dairy herds) and a move to more seasonal production in the Harvey region.

Further background information on the dairy industry in the South West, in relation to the domestic and international market for Australian milk and dairy products, is presented in Appendix 3.

7.3 Analysis

7.3.1 Dairy Farm Productivity

The number of dairy farms in the Harvey-Waroona area has significantly decreased since deregulation in 2000 (from 120 to around 70 currently). However, given an increase in average herd size and productivity, milk production has remained relatively constant.[103]

Harvey Water dairy irrigators (currently around 50 farms) primarily use flood irrigation techniques, with an estimated average annual return (gross profit) to water in the range of $35-87 per ML (average to high pasture productivity). In comparison, Boyanup and Scott

[103] Dairy Australia (June 2006), *Dairy 2006: Situation and Outlook*.

River dairy irrigators, who utilise underground water supplies, predominately use the more water-efficient sprinkler system and have higher pasture productivity. Returns to dairy production in the Boyanup and Scott River regions were estimated at $102 and $259 per ML, respectively.[104,105]

There appears to be potential for Harvey dairy farmers to improve pasture productivity (and milk production per ML) and increase net business profits. However this outcome would depend on a number of factors, including an increase in the average size of farms and substantial capital investment (e.g. on sprinkler irrigation, larger sheds).[106]

Conversion from flood irrigation to more efficient spray irrigation could potentially save up to 17 GL/year in the South West Irrigation Area.[107]

7.3.2 Income and Costs

Information on the production and cost structures of dairy farms in Western Australia since 2000/01[108] has been augmented with Australian Bureau of Agricultural and Resource Economics (**ABARE**) data on surveyed dairy farms in the Harvey region for 2003/04 to 2005/06. This data indicates that water costs for an average irrigated dairy farm is $20,000 per annum, or around 4.3 per cent of operating costs. There are also more intensive operations in the Harvey region where water costs were on average $38,000 per annum, or 9.4 per cent of operating costs.

For dairy farms in the Harvey region, milk sales average nearly 75 per cent of total sales, with the majority of the balance being beef and dairy cattle sales.[109]

7.3.3 Milk Prices

Harvey Water queried the constant real milk price assumed in the baseline scenario in the Draft Report and quoted ABARE forecasts which predict falling world prices for dairy products:

[104] Brennan, D. (2006), "Current and future demand for irrigation water in Western Australia", Department of Agriculture and Food Western Australia, May 2006.

[105] These results are consistent with a 2006 National Water Commission Report (*Investing in Irrigation: achieving efficiency and sustainability*) which contained a case study on the adoption of centre pivot irrigation in Harvey. The trial results showed that sprinkler irrigation (and improved water management) produced three times the value of milk production/litre compared to surface (flood) irrigation. These results are also consistent with the Water & Rivers Commission Report (*South West Yarragadee Economic Issues Study – Dairy*), which estimated average farm profits (per litre of milk) for a large dairy farm (500 milkers) in the Harvey area to be around 40 per cent of those in the Boyanup region. The major water costs incurred by irrigators in the Boyanup region are the power costs for pumping underground water. The report estimated the irrigation power costs at $220/ha, which equate to around 50 per cent of the Harvey irrigators water cost. Even if further water charges were introduced in Boyanup to equate irrigators' total water costs across the two regions, net profits for Boyanup dairy farms would still be higher than Harvey dairy farms.

[106] See for example, Moore, K., Chester, D., Kuzich, R., Nandapi, D. and Rivers, M. (2006), *Changing Irrigation Systems and Management in the Harvey Water Irrigation Area: Final Report, Project daw45*, Department of Agriculture WA.

[107] McCrae A.F. and M.R. Rivers (2004),*Sustainable Irrigation – a Collective Effort for Regional Development*, Department of Environment WA.

[108] Includes information from ABARE (October 2006), *Australian Dairy: Production Systems, Productivity, Profit and Technology, Australian Dairy 06.1*. and previous *Australian Dairy* issues.

[109] Although dairy farms carry relatively few beef cattle, they contribute almost 20 per cent of total Australian cattle slaughter (beef cattle and dairy cattle) [ABARE (June 2005), *Australian Beef 05.1*]. Note that relative to other states, Western Australia dairy farms have historically carried a significantly higher number of beef cattle and derive a higher percentage of their total receipts from beef cattle sales.

> The ABARE latest outlook (2006) anticipates some severe reductions in returns for dairy products. "Between 2005-06 and 2010-2011, world prices for the main dairy commodities are projected to fall in real terms by as much as 25 per cent, as growth in export supplies outstrip import demand" (page 84). "Butter prices are expected to fall 23 per cent; skim milk powder 22 per cent, whole milk powder 19 per cent; and cheese 25 per cent. The domestic milk price is expected to fall 12 per cent" (page 85). (Harvey Water submission on Draft Report, p14)

The Authority has further investigated forecasts of international and domestic dairy prices. Although dairy export prices, in US dollars, are expected to decline in the medium term, exchange rates impact on farm gate prices. Both ABARE and the U.S. Food and Agricultural Policy Research Institute (**FAPRI**) forecast a decline in the value of the Australian dollar, which will effectively offset any decrease in the (US dollar) dairy export price.[110] Following further discussions, Harvey Water has indicated that it accepts the Authority's assumptions. For further details on milk prices see Appendix 3.

7.3.4 Dairy Farm Profitability

Regarding the affordability of price increases by irrigators, Harvey Water submitted that:

> …an increase of each $75,000 for [dam safety] costs applied to Harvey Water will have to be passed on to irrigators and will result in the increase of fixed costs for water of $1 per megalitre. Irrigators currently pay $43.59 per megalitre of which $22.05 per megalitre is a fixed charge. The issue of whether this is a high or low price for water must be considered against the returns and profits made by irrigators from that water. Harvey Water believes that market conditions are such at present that profitability is low in irrigated agriculture and so further cost increases need to be kept to a minimum.
> …
> It needs to be clearly recognised and can be stated again that irrigators do not have the ability to simply pass on production cost increases down the supply chain as can occur in many other industries and businesses. They have to try to absorb them as the oligopoly in retail food prevents irrigators obtaining a reasonable share of profits in the supply chain. (Harvey Water submission on Draft Report, p13)

ABARE analysis[111] indicated that in 2004/05 the bottom 25 per cent of Australian dairy farms (carrying less than 160 milkers) were not profitable. In contrast, the top ranked farms (with more than 230 milkers) had a net profit over $150,000 per annum. Given recent milk prices and farm costs, around 50 per cent of all Western Australia dairy farms were assessed to be unprofitable.[112] With limited growth in domestic and export demand over the next five years average farm gate prices for milk products is not expected to increase[113] and rationalisation of the industry will continue.[114]

7.3.5 Impact Analysis

The analysis in Chapter 5 indicates that water storage charges (reflecting the $2.7 million annual dam safety cost under Option 1) to Harvey Water would be around $5 per ML in 2006/07 and increase to $30 per ML by 2016/17. On the assumption that Harvey Water's

[110] The U.S. Food and Agricultural Policy Research Institute (**FAPRI**) is internationally recognised for its annual agricultural economic forecasting. The 2006 Outlook accounts for macroeconomic and policy variables, including exchange rate changes, subsidies and tariffs.

[111] ABARE (October 2006), *Production Systems, Productivity, Profit and Technology, Australian Dairy 06.1*.

[112] ABARE (March 2006), *Australian Farm Survey Results 2003-04 to 2005-06*.

[113] ABARE (Jan 2005), *A Review of the Australia Dairy Industry, Report 04.25*.

[114] ABARE (October 2006), op.cit.

current charge of $43.59 per ML[115] does not increase (in real terms), the cost of water to irrigated farms would then be around $49 per ML in 2006/07 and increase to $74 per ML in 20016/17.

Under Option 2, water storage charges (reflecting the $1 million annual dam safety cost under Option 2) to Harvey Water would also be around $5 per ML in 2006/07. The $15 per ML increase in charges by 2016/17 is lower than the cost increase associated with Option 1. With the additional Harvey Water charge of $43.59 per ML, the cost of water would then be around $49 per ML in 2006/07 and increase to $58 per ML in 20016/17.

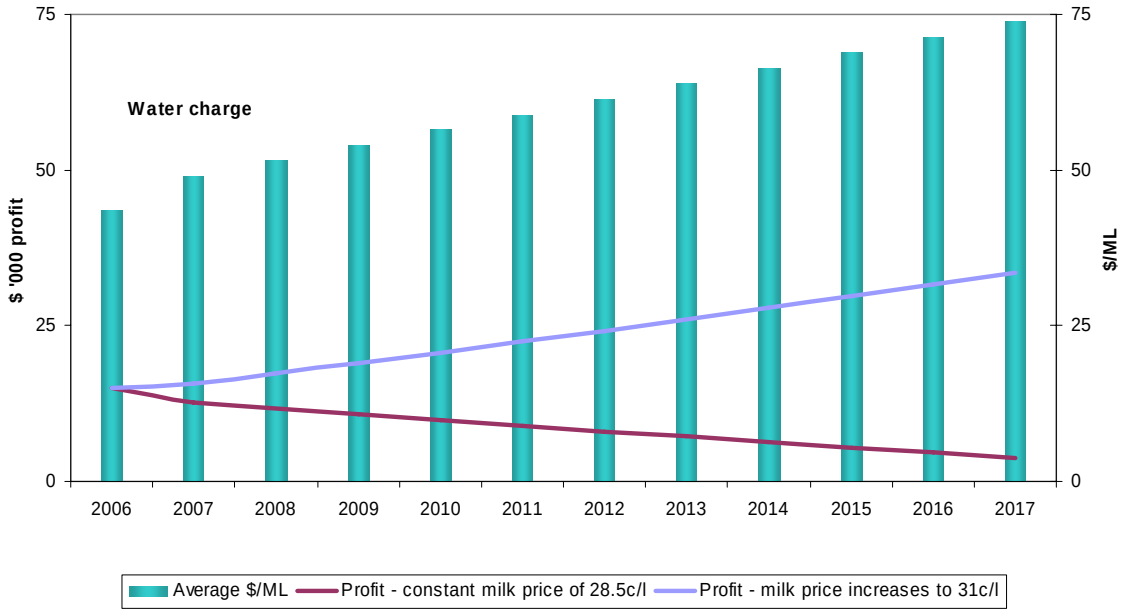
The Authority has modelled the potential impact on Harvey Water irrigators of an increase in water storage charges (reflecting the analysis in Chapter 5). The assumptions incorporated into the impact model are consistent with ABARE information on the dairy industry. Total water efficiency gains of 5 per cent until 2016-17 and constant production levels and costs (except water storage charges) have been incorporated into the impact model. The additional assumptions for each option are as follows:

- Options 1 and 1a:
  - water storage charges are the charges derived from the Option 1 analysis (see Chapter 3) whereby the costs of complying with ANCOLD are passed through to customers.
  - Option 1 – constant milk prices of 28.5 c/litre.
  - Option 1a – milk prices increase to 31 c/litre.
- Options 2 and 2a:
  - water storage charges are the charges derived from the Option 2 analysis (see Chapter 3) whereby only a subset of the costs of complying with ANCOLD are passed through to customers.
  - Option 2 – constant milk prices of 28.5 c/litre.
  - Option 2a – milk prices increase to 31 c/litre

[115] Harvey Water has advised that $40.95 per ML is paid to SWIAC and SWIMCO (Harvey Water) for asset management, water distribution and research and development in the irrigation area, while an average $2.64 per ML is paid by Harvey Water to the Water Corporation.

Figure 7.1 Harvey Dairy Farmers Impact Analysis - Options 1 and 1a

Net Profit to Harvey Dairy Farmers: under constant Milk Price assumption of 28.5 cents per litre and Milk Price increasing to 31 cents per litre: (Real Dollar Values of 30 June 2006)



Source: ABARE farm survey data, Department of Agriculture (WA) dairy farm survey data, with Authority analysis

Figure 7.1 shows the effect of increasing water charges to $74 per ML over the ten year period to 2016/17. For both Options 1 and 1a, average water costs increase to around $29,000 per farm (from around $18,000 presently, in real dollar values of 30 June 2006). These irrigation costs then represent an increase from the initial five per cent of total operating costs to nine per cent of operating costs. Under Option 1, farm business profit (net of operator earnings and structural adjustment payments[116]) would fall from $15,000 to $4,000. In contrast an increase in the milk price to 31c/litre would result in average annual business profits increasing to $34,000.

[116] Dairy Structural Adjustment Program and Supplementary Dairy Assistance Scheme payments.

Figure 7.2 Harvey Dairy Farmers Impact Analysis - Options 2 and 2a

Net Profit to Harvey Dairy Farmers: under constant Milk Price assumption of 28 cents per litre and Milk Price increasing to 31 cents per litre: (Real Dollar Values of 30 June 2006)

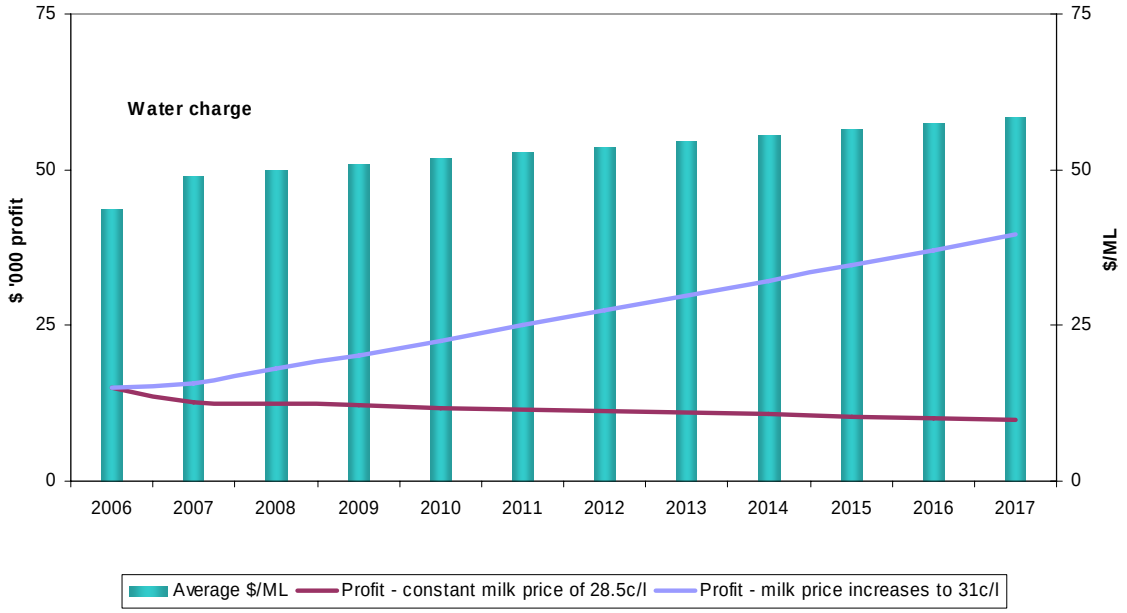


Figure 7.2 reflects the alternative option, whereby the only dam safety costs that are recovered from customers are those associated with Wellington Dam and the Stage One improvement for Waroona Dam. Under this option water charges increase to $58 per ML over the ten year period to 2016/17. For both Options 2 and 2a, average water costs increase to around $23,000 per farm, representing an increase from the initial five per cent of total operating costs to seven per cent of operating costs. Under Option 2, farm business profit would fall from $15,000 to $10,000. In contrast, higher milk prices would result in average annual business profits increasing to nearly $40,000.

The results illustrate the sensitivity of the impact analysis to the choice of forecast assumptions. However, the model results are also reflective of significant historical inter-year variations in dairy industry profits[117], largely reflecting variations in product and feed prices. In Western Australia, average dairy farm business profits since 2001 have varied from less than $1,000 in 2003/04 to a high of $51,550 in 2005/06. Future industry profits in the dairy industry depend not only on product prices but also on farm productivity. Contributing factors in future efficiency and productivity gains include farm consolidation, herd size increases, the adoption of more intensive farming systems and higher average milk yields.[118]

In addition, it should be noted that farm business profit is not the only indicator of farm wealth. At June 2006, average farm equity (capital minus farm debt) for dairy farms in

[117] For more information, see Appendix 3.

[118] ABARE (March 2006), *Dairy Outlook to 2010-11*, Australian Commodities, vol. 13 no. 1, March quarter 2006.

Western Australia was $5.9 million. The recent increase in farm equity reflects a strong rise in land values in Western Australia.[119]

Findings

21) Under Option 1:

a) average irrigation costs for dairy farms in the Harvey region increase to around $29,000 per farm (from around $18,000 presently, in real dollar values of 30 June 2006);

b) the total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $73.82 per ML (in real dollar values of 30 June 2006).

22) Under Option 2:

a) average irrigation costs for dairy farms in the Harvey region increase to around $23,000 per farm (from around $18,000 presently, in real dollar values of 30 June 2006;

b) the total charge, including Harvey Water's charge for distribution costs, would increase from an average of $48.99 per ML to $58.45 per ML (in real dollar values of 30 June 2006).

[119] ABARE (March 2007), Australian Commodities, vol. 14 no. 1, March quarter 2007.

8 Impact on Government Finances

8.1 Terms of Reference

The Authority is expected to consider and develop findings on:

> The impact on the State Government's net financial position associated with the recommended price level and structure.

8.2 Analysis

The Authority does not currently have the capacity to model the impacts of the recommendations on the State Government's net financial position. However, the financial model developed as part of this inquiry provides a reasonably accurate indication of the impact on CSOs.

The CSOs provided to the Corporation differ under the two options discussed in Chapter 3. There are four components to the CSOs provided to the Corporation:

- The CSO associated with setting the initial asset value at zero, which applies under Options 1 and 2;
  - The Authority has set the value of the initial asset base on 30 June 2005 at zero for the purpose of calculating Harvey Water's irrigation charges and at the written down replacement value for the purpose of calculating Harvey Water's non-irrigation charges. This approach differs to the asset value in the Corporation's statutory accounts, which is the written down replacement value. The difference in the valuation of the initial asset base results in a notional CSO.
- The CSO for recreational benefits, which applies under Options 1 and 2;
- The CSO for phasing-in the new charges, which applies (but differs) under Options 1 and 2; and
- The CSO for reimbursing the Corporation for dam safety expenditure that is not funded by customers, which applies under Option 2 only.

The break-down of the total CSO payment under Option 1, which reduces from $7.0 million to $4.5 million over the ten year period, is shown in Table 8.1. In comparison, the current annual CSO payment to the Corporation for the purpose of providing a dam storage service to Harvey Water is approximately $3.2 million.[120]

[120] Source: Water Corporation.

Table 8.1 Annual CSO Payments to the Corporation Under Option 1

	Value ($ million, real dollar values of 30 June 2006)									
CSO Payment	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Zero initial asset value	2.7	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Recreational benefits	1.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Phasing-in new charges	2.4	2.1	1.8	1.6	1.3	1.1	0.8	0.5	0.3	-
Total CSO	**7.0**	**6.6**	**6.4**	**6.1**	**5.8**	**5.6**	**5.3**	**5.0**	**4.8**	**4.5**

Under Option 2, the total CSO payments would be as shown in Table 8.2. The CSO associated with phasing-in the new charges would be less (the CSO in 2007/08 would be $0.9 million rather than $2.4 million). In addition, there would be a CSO to fund the costs related to funding the dam safety capital expenditure programme that is incurred but not recovered from customers (this includes all dam safety expenditure other than for Wellington Dam and the first stage of Waroona Dam)[121]. The CSO payments for recreational benefits are lower under Option 2 because recreational users are treated as customers, and the amount of cost to be recovered from customers is reduced.

Table 8.2 Annual CSO Payments to the Corporation Under Option 2

	Value ($ million, real dollar values of 30 June 2006)									
CSO Payment	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**
Zero initial asset value	2.7	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Recreational benefits	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Phasing-in new charges	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	-
Dam safety capital expenditure	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Total CSO	**8.8**	**8.7**	**8.6**	**8.5**	**8.4**	**8.3**	**8.2**	**8.1**	**8.0**	**7.9**

[121] In calculating the reimbursement to the Corporation for the dam safety cost that is not recovered from customers, the Authority has assumed a smooth payment that has the same net present value as the lumpy capital expenditure programme over the life of the assets.

Findings

23) Under Option 1, annual CSO payments to the Corporation for providing a dam storage service would reduce from $7.0 million in 2007/08 to $4.5 million in 2016/17 and remain at $4.5 million thereafter.

24) Under Option 2, annual CSO payments to the Corporation for providing a dam storage service would reduce from $8.8 million in 2007/08 to $7.9 million in 2016/17 and remain at $7.9 million thereafter.

APPENDICES

Appendix 1: Terms of Reference

HARVEY WATER BULK WATER PRICING INQUIRY
TERMS OF REFERENCE

I, ERIC RIPPER, Treasurer, pursuant to section 32(1) of the *Economic Regulation Authority Act 2003* (the ERA Act), request that the Economic Regulation Authority (the Authority) undertake an inquiry and make recommendations on the most appropriate level and structure of water storage charges to the South West Irrigation Cooperative (Harvey Water). In doing so the Authority is expected to consider and develop findings on:

1. The cost of operating and maintaining the irrigation dams, based on:

    a. a "renewal costing" methodology which carries forward the model used for the 1996 Bulk Water Agreement;

    b. a "full costing" methodology, consistent with National Water Initiative pricing principles, including efficient operating costs and capital expenditure requirements and a suitable rate of return on past and future investment in storage and distribution assets owned by the Water Corporation.

2. The additional costs associated with maintaining and improving dam safety for the Water Corporation's South West Irrigation Dams. This should include consideration of:

    a. the requirements of the current Australian National Committee on Large Dams (ANCOLD) dam safety guidelines and the requirement for the Water Corporation to manage their dams to these guidelines; and

    b. the overall merits, for all parties, of alternatives to the ANCOLD dam safety guidelines.

    These considerations should utilise existing studies, including:

    a. Marsden Jacob Associates August 2003 *"Review of Dam Safety Program Relating to South West Irrigation Dams"*; and

    b. Snowy Mountains Engineering Corporation July 2006 "*Evaluation of Alternative Risk Management Strategies*"

3. The cost sharing arrangements between beneficiaries of the South West irrigation dams, including:

    a. customers that benefit from the water stored in the dams and how this may change over time with water trading;

    b. the recreational and other social benefits to the community of the dams; and

    c. the beneficiaries of dam safety expenditure, including an assessment of those who benefit from the use of the dams and those that benefit from a reduced risk of flooding.

4. The ability of South West irrigation farmers and Harvey Water to meet their share of the costs determined from 1 and 2 above, and the impact on customers of the rate of change of an increase in prices (if any).

5. The impact on the State Government's net financial position associated with the recommended price level and structure.

The Authority is to have regard to the Government's social, economic and environmental policy objectives.

The Authority will release an issues paper as soon as possible after receiving the reference. The paper is to facilitate public consultation on the basis of invitations for written submissions from industry, government and all other stakeholder groups, including the general community.

A draft report is to be made available by 30 November 2006 for further public consultation on the basis of invitations for written submissions.

A final report is to be completed by no later than 1 March 2007.

Appendix 2: Health and Safety Expenditure in Other Sectors

In other areas of public expenditure, such as public health, aviation, roads and rail, the assessment of the costs and benefits of health and safety programs aimed at reducing fatalities often requires a value to be assigned to the saving of a life. This "value of life" is the value that society places on the saving of an unknown life (or statistical) in a given population.[122] To calculate the Cost Per Statistical Life Saved (**CPSLS**) of an expenditure on safety improvement, the expenditure is divided by the number of statistical lives it is expected to save.[123] These costs and impacts are spread over time, so discounting is applied to determine a present value estimate. Comparison of CPSLS can then be made across different areas of public safety expenditure to assess cost effectiveness.

Although there is no generally agreed value of life in Australia, there are numerous examples of the use of different value of life estimates to guide decisions on public health and safety expenditure in Australia, as shown in Table . This analysis shows that the value of life estimates used in Australia range between $1 million and $2.7 million (2006 dollars).

Table A2.1 Value of Life Estimates Used in Cost Benefit Studies of Health and Safety Expenditure in Australia

Year of Study	Authors/Agency	Issue	Value of Life ($2006)	Benefit/Cost Ratio
Public Policy				
2003	Abelson, P.[124]	Survey of international VOSL estimates. Recommended a VOSL of $2.5 mil for public policy in Australia	$2.7 million	
2005	Registry of Births, Deaths and Marriages[125]	Impact statement on amendments to births, deaths and marriages regulations, re: the reporting of child deaths	$2.7 million	More than 10
Transport				
2000	Bureau of Transport Economics[126]	Cost of road crashes in Australia	$1.7 million	
2004	Bray, D., for the National Transport Commission[127]	Survey of risk tolerability approaches used in rail safety evaluations in Australia		
2006	Bureau of Transport and Regional Economics[128]	Cost of aviation accidents and incidents in Australia in 2003/04	$2.2 million	

[122] Depending on the study, the value of life may be termed the Value of a Statistical Life (VOSL) or the Value of Preventing a Fatality (VPF).

[123] The term "statistical life" is used to denote the averaging of risk statistics across a population – the risk of fatality due to a particular cause will vary from person to person.

[124] Abelson, P. (2003), "The value of life and health for public policy", *Economic Record*, vol:79, S2-S13.

[125] Registry of Births, Deaths and Marriages (2005), *Regulatory Impact Statement: Births, Deaths and Marriages Registration (Amendment) Regulations*, Department of Victorian Communities.

[126] Bureau of Transport Economics (2000), *Road Crash Costs in Australia*, Report 102.

[127] Bray, D. (2004), *Risk Tolerability in Rail Safety Regulation: Issues Paper*, report for the National Transport Commission.

[128] Bureau of Transport Economics (2006), *Cost of Aviation Accidents and Incidents*, Report 113.

Table A2.1 ctd. Value of Life Estimates Used in Cost Benefit Studies of Health and Safety Expenditure in Australia

Year of Study	Authors/Agency	Issue	Value of Life ($2006	Benefit/Cost Ratio
2006	The Allen Consulting Group, for the Civil Aviation Safety Authority[129]	Cost/benefit study of introducing drug and alcohol programs and random breath tests in the aviation sector.	$2.7 million	3.12 to 4.55
Health				
2003	Applied Economics, report for the Commonwealth Department of Health and Ageing[130]	Cost/benefit analysis of displaying larger and more graphic health warnings on tobacco products	$1.6 million	More than 2
2003	Potter-Forbes, M. and Aisbett, C.[131]	Costs of work-related injury in NSW 1998-1999	$1.4 million	
2003	Commonwealth Department of Health and Ageing[132]	Returns on investment in public health	$1.1 million	
2004	NSW Injury Risk Management Centre, University of NSW[133]	Estimate of lifetime cost in NSW of work-related injuries and illnesses in 2000-2001	$2.7 million	
2005	Applied Economics, for Commonwealth Department of Health and Ageing[134]	Economic evaluation of the costs of Hepatitis C in Australia	$2.7 million	
2007	The Allen Consulting Group, for WorkSafe Victoria[135]	Regulatory impact statement	$2.6 million	

A further guide to the value of life used to guide resource allocation in the health sector is the upper threshold on the cost per life year gained for pharmaceuticals in determinations made by the Pharmaceutical Benefits Advisory Committee (**PBAC**). While there is no explicit threshold, a review of submissions to the PBAC in 2001 found that the PBAC was unlikely to approve

[129] Allen Consulting Group (August 2006), Drug and Alcohol Testing for the Aviation Sector: Cost Benefit Analysis, Report to the Civil Aviation Safety Authority.

[130] Applied Economics (2003), *Cost-Benefit Analysis of Proposed New Health Warnings on Tobacco Products*, report for the Commonwealth Department of Health and Ageing.

[131] Potter-Forbes, M. and Aisbett, C. (2003), *Injury Costs: A Valuation of the Burden of Injury in New South Wales 1998-1999*, NSW Injury Risk Management Research Centre, University of NSW.

[132] Commonwealth Department of Health and Ageing (2003), *Returns on Investment in Public Health: An Epidemiological and Economic Analysis*, report by Applied Economics.

[133] http://www.nisu.flinders.edu.au/index.php.

[134] Applied Economics (2005), *Economic Evaluation of Hepatitis C in Australia*, report for Commonwealth Department of Health and Ageing

[135] The Allen Consulting Group (2007), Regulatory Impact Statement: Proposed Occupational Health And Safety Regulations 2007, Proposed Equipment (Public Safety) Regulations 2007: Public comment.

drugs which cost more than $96,000 per life year gained.[136] This equates to a value of life in 2006 dollars of $1.9 million.[137]

ACIL Tasman have also provided comparative indicators, utilising the concept of CPSLS. Some comparisons are as follows:[138]

- UK HSE guidelines have a CPSLS threshold of $2.5 million (based on a straight exchange rate conversion)[139]
- The National Road Safety Strategy, issued by the Council of Australian Transport Ministers in 2001, cites figures supporting a CPSLS, again calculated at a 5 per cent discount rate, as follows:
  - from general investment in road improvements – $2.5 million; and
  - from investment targeted at 'black spots' – $0.25 million.
- The Federal Department of Health and Aging has published guidelines for assessing environmental health interventions, including guidance for the conduct of cost-benefit assessments involving differences in risk of death and morbidity.[140] The guidelines support, based on assessment of a wide range of studies, an indicative figure for the average value of a statistical life in Australia of $2.5 million, suggesting that public health measures with a CPSLS greater than $2.5 million would not be deemed cost effective under these guidelines (unless justified by other injury and damage benefits, that could be significant for dams, as they would be for car accidents etc).
- The results of a Monash University Centre for Health Program Evaluation assessment of the consistency of Australian pharmaceuticals approval processes across the period 1991-1996 suggest an implicit value of a statistical life underpinning decisions on pharmaceutical approvals in the order of $2 million.[141]

A comprehensive survey of value of life estimates used internationally was carried out by Peter Abelson in 2003.[142] Abelson found higher estimates in the United States (e.g. the Environment Protection Agency in 2000 used a value of life of $A6.6 million) than in European countries, where value of life estimates were around A$2.5 million. He recommended a value of life of $2.5 million for the public policy purposes in Australia (which equates to around $2.7 million in 2006 dollars). Many recent public policy studies have used the value of life estimate proposed by Abelson (2003), adjusted for inflation.

Based on the above analysis, the ANCOLD Guidelines appear to lead to a substantially greater amount spent on dam safety than on other areas of safety improvement.

[136] George, B., Harris, A. and Mitchell, A. (2001), "Cost-effectiveness analysis and the consistency of decision making: evidence from pharmaceutical reimbursement in Australia (1991 to 1996)", *Pharmacoeconomics*, vol.19, no.11, pp.1103-1109.

[137] This assumes a life expectancy of 40 years and a 5 per cent discount rate. There has been considerable debate about the appropriate discount rate to use when evaluating public health programs. Public finance agencies often recommend a discount rate set at the opportunity cost of capital (around 7 to 8 per cent). However, private individuals receive a lower real rate of return, due to taxation, and therefore discount future marginal consumption at around 3 to 4 per cent. Many studies in this area choose a compromise rate of return between the social and private discount rates, with sensitivity analyses at higher and lower rates.

[138] ACIL Tasman (2006), *Harvey Water Supply System: Safety Standards & Compliance*, Paper 1 of 4 prepared for the Authority, published on the Authority web site.

[139] The HSE uses an equivalent concept of the Value of Preventing a Fatality (VPF), and adopted a VPF of £1 million in 2001, based on HM Treasury Guidelines.

[140] enHealth (January 2003), *Guidelines for Economic Evaluation of Environmental Health Planning and Assessment. Volume 1 – The Guidelines.*

[141] See ACIL Tasman (November 2006), *Harvey Water Supply System: Safety Standards and Compliance*, Paper 1 of 4 prepared for the Authority, published on the Authority web site, pp18-19

[142] Abelson, P. (2003), "The value of life and health for public policy", *Economic Record*, 79, S2-S13.

Appendix 3: Dairy Industry Overview and Modelling Assumptions

Irrigated Agriculture in the South West Irrigation Area

There are 771 shareholders in the South West Irrigation Area (**SWIA**) with a total irrigation entitlement of 152 GL, which represents around 65 per cent of the volume in South West irrigation dams. Around 50 per cent of these shareholders are in the Harvey area and have a total entitlement of 68 GL (equates to an average entitlement per shareholder of 173 ML).

Water use in the SWIA is primarily directed towards dairy and beef pasture production.[143] In comparison, for the total south-west region, around 65 per cent of on-farm water use is directed to horticulture production.[144] Studies on estimated water values indicate that the asset value of water (i.e. the value of output per volume of water required to produce that output) to the dairy industry in Western Australia to be in the range of $300-600 per ML. In contrast, the asset value for horticulture in southern regions of Western Australia is around $7,600 per ML. On average, returns to beef production Australia-wide from irrigation are marginal.[145]

The major water shares in the SWIA in 2005/06 were 48 per cent for dairy, 30 per cent for beef and 11 per cent for horticulture and viticulture. Irrigation per hectare for the major industries amounted to 11 ML for dairy, 9 ML for beef and 14 ML for vegetable production.[146]

The Dairy Industry in the South West Irrigation Area

Milk production for an average farm in the South West Irrigation Area is around 1.2 million litres per annum (yield per milker of 6000 litres per year). Pure fresh milk consists of 55 per cent of the Western Australia's total production. A further 25 per cent of production earns $80 million in export sales.[147]

Total milk production for Western Australia in 2006 was around 400 million litres,, which is 4 per cent of national milk production. There are around 240 dairy farms in Western Australia (with around 50 in the SWIA). Dairy properties are primarily in the coastal agricultural areas from 60 km south of Perth down to Augusta and Albany. The most common production system in the region is based on year-round calving on 51 per cent of farms, while split and batch calving is used on 34 per cent, and seasonal production is used on 15 per cent of farms.[148] About half the Western Australia dairy farmers incorporate some type of irrigation.[149]

Australian Dairy Products on the World Market

The dairy industry is Australia's third largest rural industry with a gross value of production of around $3 billion (at the farm gate).[150] The Australian dairy industry uses almost 20 per cent of

[143] Brennan, D. (2006), "Current and future demand for irrigation water in Western Australia", Department of Agriculture and Food Western Australia, May 2006.

[144] Brennan, D. (2006), op cit.

[145] Brennan, D., Dunlop, M. and Foran, B. (2006), *Water Futures Workshop: Issues and Drivers: Report III of IV in a Series on Australian Water Futures.* (www.cse.csiro.au/publications/2001/wateruse-r3-01-04.pdf).

[146] Harvey Water data.

[147] http://www.dairy.com.au/consumers/content/view/138/146/

[148] Dairy Australia (2006), *Dairy 2006 Situation and Outlook*.

[149] http://www.dairyingfortomorrow.com/aboutdairying/regional.php

[150] ABARE (December 2006), Australian Commodities, vol. 13 no. 4, December 2006.

the water utilised by agriculture.[151] Dairy production is more water-intensive than broadacre farming, while rice production is the most water-intensive sector.

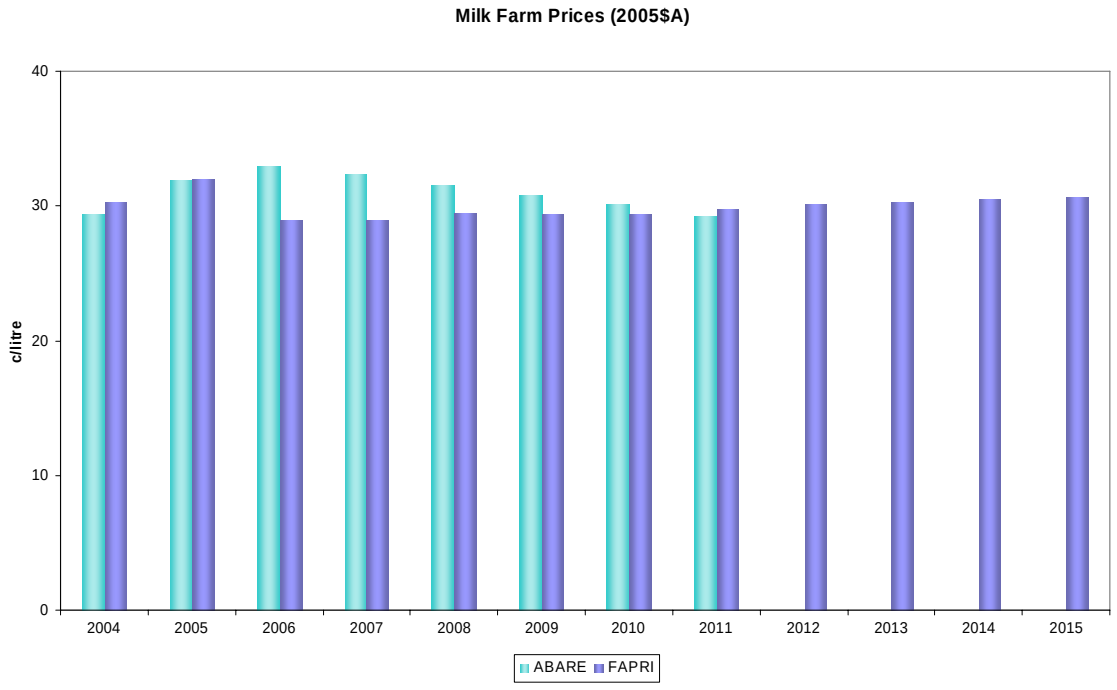
Australia's dairy farms are internationally competitive, with only New Zealand and a small number of South American countries having lower production costs. The industry in the south-east of Australia is orientated towards seasonal milk production for the export of milk products into the Asian market. In 2005/06, 50 per cent to 85 per cent of each dairy product (namely butter, cheese and milk products) were exported. In comparison the majority of Western Australian production is supplied into the domestic market.

The world dairy market is characterised by export subsidies for dairy products and limited market access, reflecting factors such as tariffs and tariff quotas. Current global trade reform agendas (including the World Trade Organisation and Free Trade Agreements) are expected to improve market access and remove export subsidies, with related benefits to the Australian dairy industry. Given the complex interaction of these trade agendas, the realised commercial benefits are difficult to forecast. Studies suggest that a 10 per cent to 15 per cent increase in international dairy prices is possible from the implementation of improved market access arrangements.[152]

The outlook for the global dairy market is for continued growth in demand, with total exports forecast to be around 50 per cent higher by 2015. Australia is expected to increase its market share of world exports from an estimated 13 per cent in 2006 to 15.5 per cent in 2015.[153] The European Union will have the greatest decline in global export share.

Price Forecasts for Milk and Dairy Products

Figure A3.1 Milk Farm Prices



*Source: ABARE (2006), Dairy 2006: Situation & Outlook; U.S. Food and Agricultural Policy Research Institute (**FAPRI**), Outlook 2006.*

[151] Toth, J. (2007), *Water Use and Regulation*, Economics@ANZ January 2007.

[152] Dairy 2006: Situation & Outlook, http://dairymovingforward.org.au/News%20and%20Reports/Dairy_2006_Situation_&_Outlook/dairy_outlook_2006.htm

[153] FAPRI (2006), *2006 Outlook.*

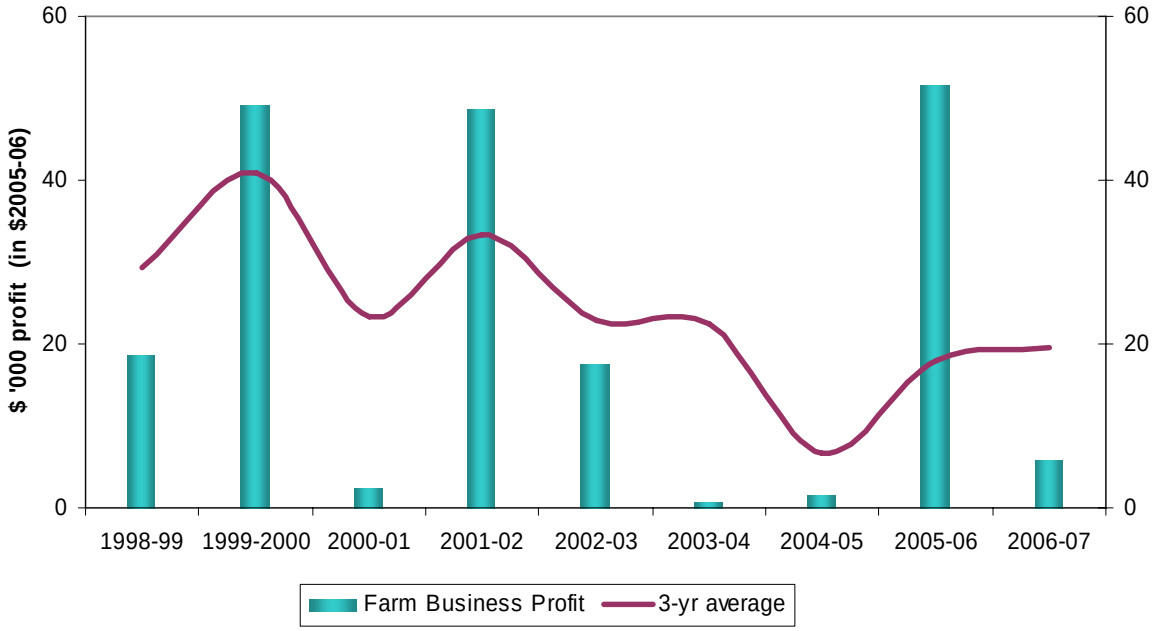
Although dairy export prices, in US dollars, are expected to decline in the medium term, exchange rates impact on farm gate prices. Both ABARE and FAPRI forecast a decline in the value of the Australian dollar which would effectively offset any decrease in the dairy export price (in US dollars).[154]

FAPRI forecasts that average Australian prices (in real 2005 Australian dollars) for all exported dairy products and for domestic milk will remain relatively constant over the period 2006 to 2015. The average Australian farmgate price for domestic milk should therefore remain around the current 31c per litre (see Figure A3.1).

Profitability in the Dairy Industry

Historically, there is considerable variation in annual dairy farm business profits. Annual profits (along with the 3-year average) for dairy farms in Western Australia are illustrated in Figure A3.2.[155] The average annual business profit for the period 2003/04 to 2006/07 is $14900 (in 2005/06 dollars). This value is taken as the starting point in 2005/06 for business profit in the impact analysis (Section 7.3.5).

Figure A3.2 Farm Business Profits : WA Dairy Farms



Future industry profits in the dairy industry will depend not only on product prices but also on farm productivity. Contributing factors in future efficiency and productivity gains include farm consolidation, herd size increases, the adoption of more intensive farming systems and higher average milk yields.[156] The trend toward fewer, larger dairy farms and new investment is expected to continue over the medium term. ABARE forecasts that the total dairy herd and milk yields will rise by 12 and 7 per cent respectively between 2007/08 and 2011/12.[157]

[154] FAPRI (2006), ibid..

[155] Data compiled from various ABARE publications

[156] ABARE (March 2006), *Dairy Outlook to 2010-11*, Australian Commodities, vol. 13 no. 1, March quarter 2006.

[157] ABARE (March 2007), *Dairy Outlook to 2011-12*, Australian Commodities, vol. 14 no. 1, March quarter 2007.

ABARE analysed Australian dairy farm financial performance for seasonal and year-round calving for 2004/05. On average, net profits are higher for seasonal calving compared to year round calving (the major production system in South West Irrigation Area). Net profits (earnings before interest and tax, less financing costs) in 2004/05 for year round calving was 6.5 c/litre compared to 7.2 c/litre for seasonal calving (around 11 per cent higher).[158]

The ABARE analysis included a breakdown of dairy farms performance by herd size and feeding intensity. The analysis shows that although high intensity production systems (more typically year-round production) have higher milk yields per cow, these systems have higher variable costs (e.g. through greater use of grain and concentrates). For larger herds (more than 140 cows) with low feeding intensity, there is little difference in net profit rates between seasonal and year round producers. However, as the use of purchased feed intensifies, the profit margin between seasonal and year round producers increases. For high feed intensity dairy farms in 2004/05, the average profit margin per litre for year round producers was 6 c/litre compared to 8.2 c/litre for seasonal producers.[159]

There has been an increase in average dairy farm cash income in recent years, resulting from improved seasonal conditions and higher prices. The increase in average dairy farm cash income also reflects the exit from the industry of higher cost producers. Regarding Australian dairy farm profitability, ABARE survey data shows that average farm business profit, with the exception of 2001/02 and 2005/06, has remained below $30,000 per annum (in 2006 dollars) over the past three decades.[160] In Western Australia average farm cash income in 2005/06 at $114,000 was 55 per cent higher than the previous year, while average dairy farm business profit increased to $51,550.

[158] Includes split calving pattern farms.

[159] ABARE (October 2006), *Production Systems, Productivity, Profit and Technology, Australian Dairy 06.1*.

[160] ABARE (March 2007), op. cit..

Appendix 4: Glossary

Term	Definition
ABARE	Australian Bureau of Agricultural and Resource Economics
Act	*Economic Regulation Act 2003*
ALARP	As Low As Reasonably Practicable
ANCOLD	Australian National Committee on Large Dams
Authority	Economic Regulation Authority
BWSA	Bulk Water Supply Agreement
Corporation	Water Corporation
CPSLS	Cost Per Statistical Life Saved
CSO	Community Service Obligation
CSSL	Cost of Saving a Statistical Life
DNR	Department of Natural Resources - NSW
DORC	Depreciated Optimised Replacement Cost
DSC	Dam Safety Committee - NSW
FAPRI	U.S. Food and Agricultural Policy Research Institute
GL	Giga Litre (1,000,000,000 litres)
Harvey Water	South West Irrigation Cooperative
HSE	Health and Safety Executive - UK
IWSS	Integrated Water Supply System
MJA	Marsden Jacob Associates
ML	Mega Litre (1,000,000 litres)
MOL	Mean Operating Level
NWI	National Water Initiative
PAR	Population at Risk
PBAC	Pharmaceutical Benefits Advisory Committee
PFRA	Portfolio Risk-Based Approach
PLL	Probable Loss of Life
SMEC	Snowy Mountains Engineering Corporation
State Water	State Water Corporation - NSW
SWIA	South West Irrigation Area
VOSL	Value Of Saving A Life