

Department of Sustainability and Environment

Latrobe Aquifer Impact Investigations

Information on Assistance Measures

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Executive Summary

I. Assessing Impacts of Declining Groundwater

Levels of groundwater extraction from the Latrobe Aquifer, in Gippsland, are well in excess of annual recharge. Monitoring of groundwater levels indicates that, as a result, there has been a regional decline of approximately 1 metre per year over the last 30 years (SKM, 2004). It is forecast that this rate of decline will continue for at least the next thirty years.

The Department of Sustainability and Environment (DSE) received support as part of the National Water Initiative to co-fund a program of investigations focussed on the Latrobe Aquifer, including hydrogeological, monitoring and impact investigations.

RM Consulting Group (RMCG) was engaged to complete the impact assessment. The objectives were to:

- Assess the socio-economic impacts on Yarram irrigators and the region from falling groundwater levels;
- Investigate alternative models for possible measures to assist irrigators impacted by falling water levels in the Yarram Region; and
- In consultation with stakeholders, develop detailed options for assistance measures for presentation to Government.

II. Socio Economic Impact Assessment

Yarram is a small farming community in Gippsland, 58km south of Traralgon. The main use of groundwater is for irrigation of dairy pastures, and for stock and domestic purposes. This study identified that approximately 55 irrigators are being impacted by the declining groundwater levels. Their licensed volume totals 18,614ML, with annual usage of around 8,500ML.

The falling levels have increased the costs that these irrigators face in accessing the groundwater resource. The increased costs reflect four issues:

- The need to lower pumps within existing bores;
- The need to increase the size of pumps due to the greater head now faced;
- The need to replace bores that are no longer deep or wide enough to allow the groundwater to be accessed; and
- Increased pumping costs due to the greater distance that the water needs to be lifted to the surface.

An estimate has been made of the total costs that the irrigators have faced in the past and are liable to face over the next thirty years. It is estimated that the capital cost of pump and bore replacement represents a figure of \$4.2M, while the increased pumping costs comprise a far larger cost at around \$8.6M. This gives a total cost to the regional irrigation community of around \$12.8M, as a cost spread over a sixty-year period.

The proposed assistance package aims to offset a percentage of this total socio economic impact.

III. Alternative Assistance Measures and Approaches

A range of alternative approaches could be adopted as the basis for possible assistance measures for irrigators impacted by declining groundwater levels:

1. Direct financial impacts relating to the increased cost of groundwater extraction;
2. Loss in the value of the property or the water entitlement;
3. The cost of obtaining an alternative supply;
4. The loss of income arising from reduced access to the water resource;
5. The lost opportunity to use the water for future irrigation development or enterprise diversification.

A review of these alternatives confirmed that the first approach is optimal and meets key principles for government assistance programs.

IV. Outline of Preferred Approach

The preferred approach to assistance has been determined based on the outcomes of case studies with licence holders and discussions with the Latrobe Reference Committee and the Yarram Water Supply Protection Area (WSPA) Committee.

It proposes off-setting a percentage of the additional costs incurred by irrigators due to the continued decline in the Latrobe aquifer system. The package includes two key components:

- Infrastructure or capital costs; and
- Pumping or operating costs.

Consistent formulas are proposed for the calculation of each component. These do not require licence holders to provide actual receipts, but reasonable evidence relating to impacts occurring would be required to qualify for assistance.

Details relating to the package are provided in Section 5.

a) Infrastructure Component

- **New Pump &/Lower Pump:** For all licence holders with bores in place, assistance would be based on the cost of a new pump and/or the lowering of pumps. The package proposes the following payments:
 - \$200/ML based on licensed volume; with
 - A cap at a maximum of \$25,000 per bore.
 - On the few properties where no groundwater decline has occurred to date it is proposed that pumping infrastructure assistance is discounted by 50%.
- **New Bore:** The package proposes the following payments where new bores have been installed or are required in the future:
 - \$400/ML for the active portion of licensed volume (based on volume used in 2004);
 - \$200/ML for the inactive portion of licensed volume;
 - A cap at a maximum of \$125,000 per bore;

- Where a property does not need to replace a bore no assistance will be received.

b) Pumping Component

It is proposed that the assistance package for pumping costs could be determined as follows:

- Active volume in 2004:
 - Receive historic pumping costs ranging from \$0.23/ML to \$181/ML dependent on the licence holders starting date;
 - Receive future pumping costs including the impact to date. These range from \$155/ML to \$272/ML again dependent on the start date;
 - The level of assistance for future pumping costs is discounted due to uncertainty relating to future water use and to ensure assistance is commensurate with the value of groundwater.

There is no formal principle for determining the level of discount to be applied. This package proposes a discount of 50% on the difference between pumping cost with impact to date and pumping cost without impact to date.

- Inactive volume in 2004: Receive future pumping cost without the costs related to the previous regional decline between 1975 and 2004. This equates to a figure of \$153/ML.

Pumping costs are based on:

- An average cost for power of \$0.70/ML/m.
- An average decline of 1m/yr in all areas of the Latrobe and Balook aquifers;
- The figures to be calculated in today's dollars;
- An end date of 2034 to cover a 30 year future period from 2004;
- A start date based on bore installation or property purchase date (whichever is later);
- Usage volumes based on 2004 records, reducing back to one-third of this volume at the start date.
- Where no impact has been experienced to date on a property, calculation of assistance for pumping will be undertaken as per inactive use (i.e. no historical pumping costs or impact to date will be included);

c) Evidence Required

Irrigators would need to provide reasonable evidence to qualify for assistance.

Analysis of the estimated cost of the assistance package (refer to Section 7) identified that it is most sensitive to the number of bores that need to be replaced. As a result, this is the key area where specific evidence would be required and a technical assessment of individual properties is proposed.

Evidence would also be required to show that an impact has occurred to date. It was considered important by the steering committee to have some way of excluding those few properties where it is known that a decline has not occurred to date because of local drawdown peculiarities. The assistance proposal assumes that all irrigators will in future experience the regional drawdown. However, this will need to be confirmed.

d) Other Issues

Although outside the scope of the original brief, consultation with stakeholders identified that the regional groundwater decline is impacting irrigators outside the Yarram area and also some stock and domestic, and dairy wash-down users. As a result, these groups have been considered and a possible response is included in Section 8.

V. Estimate of Total Costs

The estimated total cost of implementing the proposed package of assistance measures for all licence holders is \$7.8M (refer to Section 7). This is equivalent to an average of \$417/ML for the current licensed volume (18,614 ML).

This figure can be compared with the projected total costs the community will face from additional infrastructure and pumping costs of \$12.8M (refer to Section 9). The cost of the proposed assistance package represents 61% of this total cost.

The cost of implementation is estimated to be in the range of \$200,000 - \$300,000 (refer to Section 10.2). This is equivalent to 2.5 – 4% of the total cost of assistance.

The package proposed has been checked against the value of groundwater and the costs of alternative supplies to ensure it is reasonable and that it provides the most cost-effective option (details are provided in Appendix 6).

VI. Implementation

Consideration has been given to a possible methodology for implementation of assistance measures (refer to Section 10).

A key recommendation is that a package of information (or letter) is sent to all licence holders regarding the:

- Elements of the assistance package, including key determinants of eligibility;
- The process involved in determining individual assistance;
- The formulas to be used in calculating assistance;
- Information that will be required from those applying.

A notice could also be placed in the local press to inform the wider community.

VII. Risk Assessment and Mitigation

An assessment has been undertaken of the risks surrounding the proposed package of assistance measures and of the actions that can be taken to minimise or mitigate those risks.

The key risk associated with the project is that, until an assessment of each property is carried out, it will be difficult to accurately determine the exact cost of assistance. However, the case-study investigations provide a robust basis for determining the probable level of assistance that will be required. The 50% discount applied to additional pumping costs and the provision of a cap on infrastructure costs, limits the exposure of government funding.

1 Introduction

1.1 Background/Context

Levels of groundwater extraction from the Latrobe Aquifer, in Gippsland, are well in excess of annual recharge. Monitoring of groundwater levels indicates that, as a result, there has been a regional decline in the level of the aquifer of approximately 1 metre per year over the last 30 years (SKM, 2004). This report assumes that water levels will continue to decline over the coming 30 years as current levels of activity are projected to continue.

One major result of this decline is that irrigators in the Yarram region face additional costs for their farming businesses due to having to enlarge and replace bores and pumps and from higher pumping costs.

The Department of Sustainability and Environment (DSE) received support as part of the National Water Initiative to co-fund a program of investigations focussed on the Latrobe Aquifer. There are three elements to the investigations:

- **Hydrogeological** – improved understanding of the hydrogeology of the area including the impacts on groundwater of oil, gas and coal production;
- **Monitoring** – an upgraded bore monitoring network to ensure that an appropriate monitoring regime is established to effectively track the state of the groundwater resource; and
- **Impact Assessment** – assessment of the socio economic impacts and review of possible assistance measures to mitigate the impacts of falling groundwater levels.

1.2 Impact Investigations Project

RM Consulting Group (RMCG) was engaged to complete the third element of the program, i.e. the 'Impact Assessment'. The objectives of the project were to:

- Assess the socio-economic impacts on Yarram irrigators and the region from falling groundwater levels;
- Investigate alternative models for possible measures to assist irrigators impacted by falling water levels in the Yarram Region; and
- In consultation with stakeholders, develop detailed options for assistance measures for presentation to Government.

The project was undertaken in three phases:

1. **Investigation of Assistance Measures: Issues and Principles:** a desktop study was completed of local issues and an assessment undertaken of assistance measures provided by government elsewhere. A suite of decision principles was developed to help steer a robust decision. Discussions were also held with a Reference Committee and key irrigators;
2. **Case Studies:** case studies were developed for a number of representative properties to confirm the range of costs imposed on local irrigators from falling groundwater levels. The case study outcomes were used to inform the assessment of possible

assistance measures to ensure that they were appropriate for this specific farming community and aquifer;

3. **Development of Preferred Assistance Measures:** based on the outcomes of the above tasks, a package of preferred assistance measures was developed for review by the Reference and Steering Committees. The package included information on implementation costs, applicability of options, methodology for implementation, and community engagement.

A detailed outline of the process undertaken is provided in Appendix 1.

1.3 This Report

This paper reports on the key outcomes of the project. The report includes the following aspects:

- Assessment of the socio-economic impacts of the falling groundwater levels;
- Review of alternative approaches to the provision of assistance measures;
- Identification of a preferred package of assistance measures;
- Assessment of the costs of implementing the various elements of the package;
- Assessment of the applicability of the proposed options to the Yarram community;
- Development of a methodology for implementation;
- Identification of any knowledge gaps and further investigations required;
- Identification of issues for implementation and project management;
- Recommendation of a suitable community engagement process.

2 Objective and Scope

2.1 Objective

The objectives for this project were to:

- Assess the socio-economic impacts on Yarram irrigators and the region from falling groundwater levels;
- Investigate alternative models for possible measures to assist irrigators impacted by falling water levels in the Yarram Region; and
- In consultation with stakeholders, develop detailed options for assistance measures for presentation to Government.

2.2 Scope

The scope of the project includes:

- To provide an analysis of the various options that can be used to assess the impacts of falling groundwater levels on Yarram irrigators (refer to Section 4);
- To select a preferred option and use this to assess the impact on representative (case study) businesses (refer to Sections 5 and 6);
- To use the data obtained from the above exercise to determine an estimate of total assistance for all irrigators across the district (refer to Section 7);
- To outline an implementation plan, including a schedule of information required from irrigators for assessment of their assistance (refer to Section 10).

2.3 Groundwater Use in Yarram

Yarram is a small farming community in Gippsland, 58km south of Traralgon. Groundwater has been used in the region for many years from a number of different aquifer systems. There are a total of 85 separate groundwater licences covering uses such as irrigation, industrial, urban, aquaculture and stock watering. The major uses are for irrigation of dairy pastures, and for stock and domestic purposes.

This study has identified that approximately 55 irrigation licence holders are impacted by the declining groundwater levels. Their licensed volume totals 18,614ML, with annual usage of around 8,500ML (based on 2004 figures).

Besides irrigators in the Yarram region, others that could be impacted by declining groundwater levels, include:

- 'Stock and domestic' and dairy wash-down users accessing the Latrobe and Balook aquifers; and
- Irrigators accessing the Latrobe Aquifer outside the Yarram WSPA.

Further details are provided in Appendix 2.

3 Impact of Regional Groundwater Decline

3.1 Extent of Groundwater Decline

Groundwater extraction from the Latrobe Group aquifer system in Gippsland is reasonably well known and totals about 120,000ML per year (Hatton, 2004). Whilst detailed estimates vary, the proportions extracted by different users are estimated to fall into three broad categories (Hatton, 2004, Fig. 1):

- 85,000 ML from oil and gas production in the Bass Strait;
- 25,000 ML for coal mine stability purposes in the Latrobe Valley; and
- 10,000 ML for irrigation and industrial purposes, mainly in the Yarram area.

These levels of extraction are well in excess of the annual recharge to the aquifer system and, as a result, groundwater levels in the Latrobe Aquifer have been declining by approximately 1 metre a year over the last 30 years (SKM, 2004).

Declines in aquifer pressures were observed by the early 1970s and were documented by Walker in 1992, based on 15 deep monitoring bores spread over 140km of the coast. These trends have continued to date, with no indication of the aquifer having reached a new equilibrium (Hatton, 2004). This report assumes that water levels will continue to decline over the coming 30 years as current levels of activity are projected to continue.

The area impacted is within the Yarram Water Supply Protection Area and relates to the Latrobe Group and the Balook Formation aquifers. It does not include the Boisdale Formation.

The area around Yarram also has a significant local cone of depression caused by the concurrent pumping of irrigation bores. A Groundwater Management Plan is under development for the area and is being designed to deal with these local drawdown and interference issues.

3.2 Socio Economic Impact Assessment

The falling levels have increased the costs that irrigators face in accessing the groundwater resource. The increased costs reflect four issues:

- The need to lower pumps within existing bores;
- The need to increase the size of pumps due to the greater head now faced;
- The need to replace bores that are no longer deep or wide enough to allow the groundwater to be accessed; and
- Increased pumping costs due to the greater distance that the water needs to be lifted to the surface.

These additional costs impact on business profit and viability.

An estimate has been made of the total costs that the irrigators have faced in the past and are liable to face over the next thirty years. It is estimated that the capital cost of pump and

bore replacement represents a figure of \$4.2M, while the increased pumping costs comprise a far larger cost at around \$8.6M. This gives a total cost to the regional irrigation community of around \$12.8M spread over a sixty-year period (see Section 9).

The proposed assistance package aims to offset a percentage of this quantifiable socio economic impact.

If no decline had been experienced to date it is likely that greater development of the groundwater resource would have occurred in the Yarram WSPA, which would have increased the value of agricultural production. This increase cannot be quantified, but should be noted as a part of the community impact.

3.3 Other Potential Impacts

Other potential impacts of declining groundwater levels include:

- **Subsidence:** The progressive dewatering of the Latrobe Group and Balook Formation Aquifers has the potential to cause compression of the overlying clays resulting in land subsidence. However, there has been no measured land subsidence within the Yarram WSPA to date and the risk of subsidence remains academic;
- **Seawater intrusion:** Water obtained from the aquifer is typically below 500 mg/L. However, previous studies have identified the coastal area between Port Albert and Port Welshpool as being at risk of saline intrusion as the potentiometric surface has been lowered below sea level. The inland hydraulic gradient at Port Welshpool is believed only to have been established recently and if seawater intrusion is occurring, it is likely that any effects on existing irrigation bores would not be noticed for many years.
- **Reduced streamflow:** Groundwater and surface water are generally interconnected and as a result the declining groundwater levels may also be impacting on streamflows. However, the extent of this impact is still to be determined.
- **Groundwater supply running out:** In locations where the aquifer is shallow (eg. Hedley Dome, Alberton Block), the decline in groundwater levels may result in supplies running out for some licence holders. In these circumstances an alternative option would need to be found by the user. It is assumed that water trading will be possible in the near future (following finalisation of the groundwater management plan). Therefore licence holders impacted by supplies running out will be able sell their licensed volume to users in other locations still able to access the resource. This should generate funds sufficient to cover costs in providing for alternative supplies such as additional bought-in feed. The one issue remaining relates to the sunk cost of the bore infrastructure that will be lost if groundwater can no longer be accessed.

These potential impacts have not been considered as part of this study.

They are, however, being given consideration in the hydrogeological and monitoring investigations that comprise the other elements of the program focused on the Latrobe Aquifer.

4 Assessment of Assistance Measures

4.1 Examples of Assistance Elsewhere

A review has been undertaken of examples of assistance that have been provided (either by the State or Commonwealth Governments) to other farming communities faced by similar impacts. A summary is provided in Appendix 3.

The key principles derived from this review are that:

- Government has provided assistance measures in the past to offset negative impacts on water resources;
- The extent of assistance has generally been related to the level of costs or losses incurred;
- Rights to access the assistance measures have been generous – i.e. where there is doubt regarding eligibility for assistance rulings are generally in favour of the applicant;
- A distinction has been made between legal water entitlement and history of water use, with the second category eligible for a higher level of assistance;
- Late entrants have been included but at a discounted rate of support;
- Both capital and operating costs have been considered within assistance measures.

4.2 Alternative Assistance Measures and Approaches

A range of alternative approaches could be adopted to assess costs or losses, in developing possible assistance measures for irrigators impacted by declining groundwater levels:

1. Direct financial impacts relating to the increased cost of groundwater extraction;
2. Loss in the value of the property or the water entitlement;
3. The cost of obtaining an alternative supply;
4. The loss of income arising from reduced access to the water resource;
5. The lost opportunity to use the water for future irrigation development or enterprise diversification.

A review of these alternatives indicated that the first approach is preferred, as discussed in the following paragraphs.

The last three approaches all assume that the irrigator has lost access to the resource entirely. However, in most areas there is several hundred metres of available drawdown and so groundwater can continue to be accessed by the irrigator, albeit at an increased cost. Alternative supplies will, therefore, generally not be needed and loss of income will not occur. Equally, opportunities for diversification will remain.

Finally, relating assistance measures to property values is problematic. There is an accepted inverse correlation between the level of costs of accessing groundwater and asset values. When costs of extraction rise, there is an off-setting reduction in the value of the water

entitlement. Equally, the value of a property takes account of the productive capacity of the enterprise. This is a function of the level of potential revenues and costs.

However, the correlation is not exact and values are also affected by a range of other factors. Basing measures on costs incurred will be a more direct and exact basis for any assistance. Accepting both as relevant would involve double-dipping.

It is proposed, therefore, that any assistance measures could generally be based on direct financial impacts (i.e. the first approach). However, some consideration could be given to the impact on groundwater value if inactive licence volume is to be included in the scheme.

In addition, the value of groundwater and the costs of alternative supplies have been assessed to ensure the use of direct financial impacts provides the most cost-effective option.

4.3 Principles for Decisions

In considering assistance measures the following principles have been taken into account:

- The approach must be economically efficient, that is it must generate outcomes that promote better and more productive use of resources;
- The approach must meet principles of horizontal equity, i.e. persons in similar circumstances should be treated in a similar way;
- The principle of vertical equity requires that persons in differing circumstances should be treated differently but in a commensurate fashion that is pro-rata to their circumstances;
- Assistance should not create perverse outcomes by rewarding sub-optimal prior commercial decisions;
- The overall quantum of assistance should be appropriate to the scale of the enterprise;
- The approach adopted should be easily understood by the participants and have the support of key stakeholders and the wider regional community;
- The costs of implementing the scheme should not be disproportionate to the size of the assistance being provided; and
- Public funds should be allocated on a conservative basis, taking account of uncertainty and risk.

4.4 Transaction Costs

When considering the appropriate method for calculating direct financial impacts it is also necessary to assess the costs of implementation, commonly known as transaction costs. There are a number of options between two extreme points:

- Requiring detailed receipts and other equivalent evidence to prove actual costs incurred by individual licence holders based on their specific circumstances – this would involve high costs to implement as it would require detailed critique and analysis of evidence. It would also be difficult as:
 - A significant portion of the proposed assistance measures relates to future impacts and therefore no records can exist.
 - Data from case studies suggests that information is limited, with best estimates having to be used in a number of situations. This is not surprising given the long period of time being assessed.

- Use of actual records does not take into account the marginal cost impact of the groundwater decline (eg. What portion is due to the decline versus the farmer needing to upgrade technology or capacity?)
- The option chosen by the licence holder may not have been the most cost effective solution.
- Setting a single, average, standard figure to cover the widely divergent costs of all irrigators irrespective of the actual costs incurred. This would be cheap and easy to administer – but it would be perceived as inequitable between irrigators and poor stewardship of public funds as it would make payments to irrigators who do not need to replace bores or to those who have not been impacted to date.

It is proposed to target a mid-way point between these extremes, by splitting the costs into the key components and then using a consistent formula to calculate each component.

The use of limits and discounts for the various elements aims to minimise the risk that some licence holders may get more than they deserve. Licence holders would also have to provide some level of evidence that the impacts have occurred or are likely to occur.

4.5 Timeframe for Assistance

An announcement relating to possible future assistance measures for irrigators was made by the former federal government in September 2004. This date, therefore provides a watershed in decisions on any assistance measures.

The regional decline has been occurring since at least the mid 1970s and irrigation licences have been granted at various times before and after. Any assistance relating to impacts occurring prior to the announcement will need to consider the time at which each licence was granted.

Any commercial decisions made post 2004, about the purchase of land or the installation or refurbishment of groundwater bores, can be considered to have taken into account the possibility of future assistance measures.

It is proposed that future impacts are considered over a period of 30 years from 2004. The total level of groundwater extraction is not expected to decrease within this time period and therefore groundwater decline is expected to continue. Also, when using present values any period over 30 years becomes irrelevant.

The assistance is expected to be provided as a one-off lump sum payment, to cover the impact of regional groundwater decline over a period of up to 60 years.

A precedent for assistance relating to impacts over a period of time is provided by the Mitta Mitta Ex Gratia Payment, which was announced in 2000. Construction of Dartmouth Dam has resulted in reduced flow in the Mitta Mitta River. The payment recognised impact over a period dating back to 1978 when the dam was commissioned.

5 Preferred Assistance Measures

5.1 Outline of Preferred Measures

The preferred approach to assistance is based on off-setting a percentage of the additional costs incurred by irrigators due to the continued decline in the La Trobe aquifer system. The package includes two key components:

- infrastructure or capital costs; and
- pumping or operating costs.

Details relating to each component are described in the following sections.

The package would apply to irrigators within the Yarram Water Supply Protection Area and relates to the Latrobe Group and the Balook Formation aquifers. It does not include the Boisdale Formation as there is no evidence of decline in this system.

This preferred option has been determined based on the outcomes of the case studies undertaken with licence holders and discussions with the Latrobe Reference Committee and the Yarram WSPA Committee.

The package proposed has been checked against the value of groundwater and the costs of alternative supplies to ensure it is reasonable and that it provides the most cost-effective option (details are provided in Appendix 6).

5.2 Assessment against Principles

The proposed approach meets the core principles and criteria for the project:

- The approach is economically efficient. Assistance is in line with actual impacts on irrigators and will support continued high value productive dairy farming in the region;
- The approach meets principles of horizontal and vertical equity. The process for assessment will treat similar irrigators in a consistent way and identify differences between users, so that assistance can be targeted appropriately;
- A check has been made against alternative options to ensure the proposed measures are cost-effective;
- The focus on costs incurred minimises risks of double-dipping;
- The overall quantum of payments has been assessed against the scale of average enterprise activity and a discount on payments proposed as a result;
- The proposed approach is easy for participants to understand and has the support of a local Reference Committee;
- A simple, low cost implementation process is recommended that involves reasonable transaction costs; and
- A conservative approach has been taken to reflect uncertainties as to future water use and costs incurred.

5.3 Infrastructure Component

5.3.1 Cost Impacts

As groundwater levels decline, infrastructure changes or upgrades are required as follows:

- Pumps need to be lowered within existing bores so that water can continue to be extracted. Costs are incurred relating to crane hire and the extension required for the rising main (which brings water from the pump to the surface);
- Larger pumps/motors are required to lift the water the extra distance to the surface; and
- Bore replacement is required when a pump can no longer be lowered as the width of the casing in the bore is limited.

The new bore would have a wider diameter casing to a greater depth. The average life of a bore is 100 years and the current bores have only been installed in the last 10 – 30 years. The groundwater decline is resulting in new bores being required, long before failure of the existing bores.

All irrigation licence holders with bores installed will have to lower pumps and/or replace pumps at some point during the assessment period to retain access to groundwater. However, not all properties need to replace bores, as those constructed in more recent years, have generally been designed to cope with the declining levels.

5.3.2 New Pump &/ Lower Pump

For all licence holders with bores in place, assistance would be based on the cost of a new pump and/or the lowering of pumps.

The case studies identified a range for these costs of \$10,000 to \$90,000, without consideration of potential future costs. These figures need to be discounted to account for the marginal cost difference between the new larger pump and the previous pump, the expended life of the existing pump (lifespan is 20 – 30 years) and the improved system (better technology) installed when replacement occurs. As a result a significant discount is required. Using a discount of 75%, the range reduces to \$2,500 to say \$30,000 (if future costs are included).

The package proposes the following payments:

- \$200/ML based on licensed volume in 2004. This results in payments of \$2,000 for a 10ML licence compared to \$20,000 for 100ML. For simplicity the figure is applied to the full licensed volume. The active and inactive portions could be treated differently (as for a new bore in 5.3.3), however this is not considered necessary, given the large level of discount already applied;
- A cap at a maximum of \$25,000 per bore (assuming each bore requires a pump).
- On the few properties where no decline has occurred to date it is proposed that assistance relating to pumping infrastructure is discounted by 50% as only the future impact is relevant.

5.3.3 New Bore

The approach proposes a higher payment for the commonly used (active) portion of the water entitlement as this is more likely to trigger additional costs. A lower figure is proposed for the currently unused (inactive) portion of the water entitlement to recognise that irrigators will face higher costs than they would have done otherwise if and when they do expand production to the full entitlement.

The package proposes the following payments where new bores have been installed or are required in the future:

- \$400/ML for the active portion of licensed volume (based on volume used in 2004). The case studies identified a range in the unit costs of sinking a new bore from approximately \$150/ML (for large users) up to \$750/ML (for small users) including a 20 – 30% discount for the expended life of a bore. For very small irrigation users an alternative supply (eg. increasing the level of feed imported) is likely to be more cost effective than sinking a new bore and therefore the upper figure is not considered appropriate. The lower unit costs for larger users are addressed through the cap on the level of assistance per bore proposed below;
- \$200/ML for the inactive portion of licensed volume. This accounts for the potential use of the bore, or opportunity cost as licence holders are expected to install a bore with capacity for their full water entitlement. However, a discount has been proposed by comparison to active use. There is no formal principle for determining the level of discount to be applied. This package proposes a discount of 50%;
- A cap at a maximum of \$125,000 per bore – this reflects the economy of scale available for large users;
- If it is determined that a bore needs to be replaced at some future date, then the costs and the cap on payments will be discounted to a present value at a discount rate of 4%¹ as per the following example:

– Year 1	\$125,000
– Year 5	\$102,741
– Year 10	\$84,446
– Year 15	\$69,408
– Year 25	\$46,890

These figures have been discounted for the expended life of the existing bore and the improved system (better technology) installed when replacement occurs.

- Where a property does not need to replace a bore, no assistance will be received for this component.

¹ The discounting mechanism takes into account the time value of money. Assistance paid now can be invested and thereby earn interest which will help to cover the cost of pumping in the distant future. A present value calculation converts the future cost of a bore into today's value using the rate of return that should be earned on an investment.

Consideration is also given to inflation through the use of a low discount rate of 4%. For commercial infrastructure projects, the discount rate is usually 8 – 10%.

5.3.4 Points of Proof

To receive assistance relating to infrastructure, licence holders must provide the following points of proof:

- Evidence relating to the number of bores in place (eg. bore construction licence);
- Evidence that groundwater decline has occurred on the property. This requires a comparison between the current standing water level (measured via an airline) and the water level when the bore was installed (from bore construction logs) or at some other point in the past (from records of pump depths or airline monitoring). The level of decline needs to be greater than 0.5m/year over the period since the bore was installed. Whilst this is a crude measure it is impossible to accurately know what every person's decline is – however it was considered important by the steering committee to have some way of excluding those properties where it is known that a decline has not occurred to date because of local drawdown peculiarities. The assistance proposal in this report assumes that all irrigators will in future experience the regional drawdown. However, this will need to be confirmed.
- Evidence to show that a new bore has been installed in recent years by the current owner (eg. a bore construction licence);
- Evidence that a new bore is required in future (eg. bore construction logs, depth monitoring records including original water level). The level of detail needs to be sufficient to satisfy a technical person that it is a reasonable estimate.

5.4 Pumping Component

Previous investigations relating to the impact on irrigators, have tended to focus on infrastructure (i.e. capital) costs. However, it has been identified (in SKM 2001, by the local VFF branches and through this study) that pumping (i.e. operating) costs are equally or more important.

A precedent for assistance relating to operating costs is provided by the Mitta Mitta Ex Gratia Payment, which was made by MDBC as a result of construction of Dartmouth Dam. The payment calculation was based on the likely capital and operating costs for installing sufficient irrigation capability so as to restore affected land to pre-dam productivity. Refer to Appendix 3 for details.

Operating costs are also considered in compensation cases relating to loss of agricultural land as a result of freeway construction. They are paid as either an estimate of future costs or are translated into a devaluation of the land asset.

5.4.1 Cost Impacts

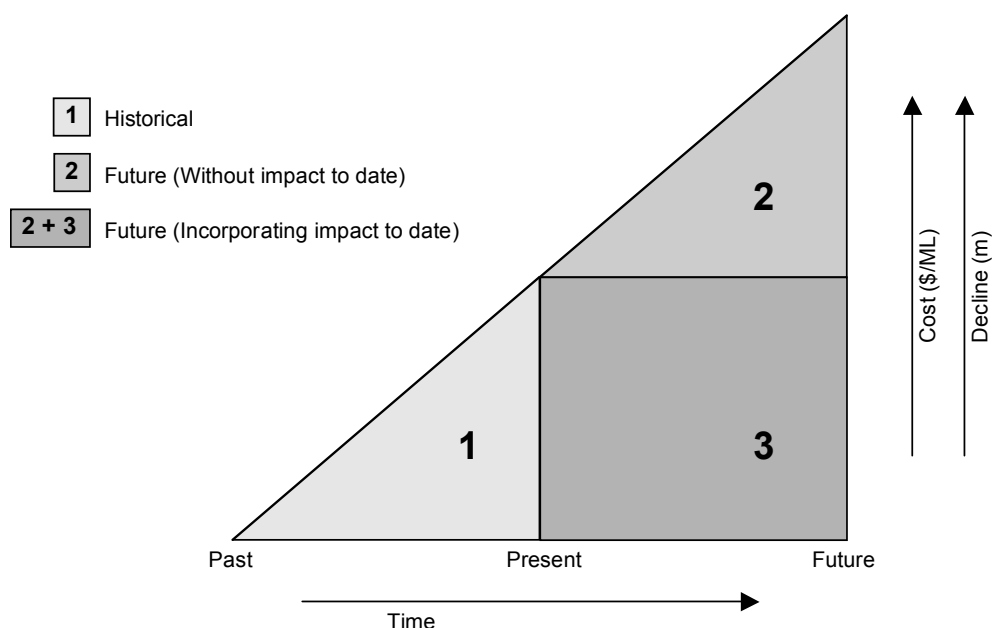
As the groundwater level declines, greater energy is required to lift water to the surface and the cost of pumping is therefore increased.

Increased pumping costs can be split into three components:

- Historical extra pumping cost – the cost already incurred to date;
- Future additional pumping costs incurred from 2004, assuming this date as a baseline;
- Additional pumping costs incurred in the future related to the decline that occurred between 1975 and 2004.

These are illustrated in the diagram below.

Figure 5-1 Impact of Decline on Cost of Pumping



5.4.2 Proposed Approach

A number of issues need to be considered in determining an appropriate level of assistance for pumping costs:

- Not all the licensed volume of groundwater has been used in the past. Even in 2004 actual usage was only 45% of total entitlement;
- There is uncertainty regarding the level of use that will occur in the future;
- The cost (or value) of land and water may have already been discounted to account for the decline that has occurred in the past. As a result, recent purchasers of groundwater licences should not be assisted for the full impact into the past;
- Irrigators made commercial decisions based on the level of the groundwater at the time of bore installation, or when they increased the volume pumped;
- Additional pumping costs represent a very significant additional cost imposed on local irrigators that is far larger in scale than any additional infrastructure costs.

It is proposed that the proposed assistance package for pumping costs should be determined as follows:

- Active use in 2004:
 - Receive historic pumping costs (Area 1 in Figure 5-1) ranging from \$0.23/ML to \$181/ML dependent on the licence holders starting date.
 - Receive future pumping costs including the impact to date (Areas 2 & 3 in Figure 5-1). These range from \$155/ML to \$272/ML again dependent on the start date;
 - The level of assistance for future pumping costs is discounted due to uncertainty relating to future water use and to ensure assistance is commensurate with the value of groundwater.

There is no formal principle for determining the level of discount to be applied. This package proposes a discount of 50% on the difference between pumping cost with impact to date (Areas 2 & 3 in Figure 5-1) and pumping cost without impact to date (Area 2 in Figure 5-1).
- Inactive use in 2004: Receive future pumping cost without the costs related to the previous decline between 1975 and 2004 (Area 2 in Figure 5-1). This equates to a figure of \$153/ML.

5.4.3 Basis for Calculation

Calculation of pumping figures will be based on:

All impacted licence holders:

- An average cost for power of \$0.70/ML/m. This figure accords with actual costs from the case study properties and with average costs for groundwater pumping in other areas of the state;
- An average decline of one metre per year is assumed for all areas of both the Latrobe and Balook aquifers;

- The proposed figures should be calculated in today's dollars:
 - An interest rate of 4% could be applied to historical expenditure to cover the cost of debt (the properties could have borrowed to cover the additional pumping cost). However, a conservative approach has been suggested by the WSPA committee and interest has not been applied.
 - Future costs are discounted to the present value at a real discount rate of 4% (assistance paid now can be invested and thereby earn interest which will help to cover the cost of pumping in the distant future).
- An end date of 2034 to cover a 30 year future period from 2004;

Active portion of licensed volume (based on 2004 records):

- A start date calculated from bore installation or property purchase date (whichever is later);
- Usage volumes based on 2004 records, reducing back to one-third of this volume at the start date. Actual usage figures have not been metered over the entire history of pumping. The reduction to one-third of 2004 records at the start date is considered a conservative approach.
- Where no impact has been experienced to date on a property, calculation of assistance for pumping will be undertaken as per inactive use (i.e. no historical pumping costs will be included);
- A discount for future pumping assistance associated with active use in 2004 to account for uncertainty relating to future water use and to ensure assistance is commensurate with the value of groundwater. The discount proposed is 50% of the difference between pumping cost with impact to date (Areas 2 & 3 in Figure 5-1) and pumping cost without impact to date (Area 2 in Figure 5-1).

5.4.4 Points of Proof

To receive assistance relating to pumping costs for active use (i.e. historical pumping and future pumping with impact to date), licence holders must provide proof that they have incurred an impact. Detail relating to evidence required is provided in Section 5.3.4 (second dot point).

5.5 Change of Ownership

Where properties have changed hands since the announcement of assistance in 2004, they will still be eligible.

The proposed approach is that all current irrigation licence holders will be eligible for:

- New pump costs.
- New bore costs if they can prove they have already made the upgrade (i.e. it wasn't undertaken by the previous owner) or they need to in future;
- Future additional pumping costs without impact to date (for properties that have changed hands since 2004 it is assumed that the entire licensed volume was unused in 2004 as the current owner was not on the property).

In comparison, those who were active users in 2004 and remain licence holders will also receive assistance relating to historic pumping costs and future pumping costs taking into account the decline to date.

6 Calculations for Case Studies

The proposed assistance package outlined in Section 5 has been applied to the case study examples.

Total assistance calculated for case study properties (not including domestic and stock case study) is \$1.53M, with individual licence holders ranging from \$16,007 to \$426,625. This is a range in unit cost of \$247/ML - \$796/ML.

The calculations using the proposed assistance package reflect the estimates made using actual information from the case studies (i.e. actual bore costs/quotes and actual decline measured by irrigators). The assistance package calculations result in a total figure that is 88% of the total figure using the actual case studies.

Example calculations are provided in the table below.

Table 6-1 Example Assistance Calculations

Parameter	Calculation/Notes	Case Study C	Case Study G
Background Information			
Licence Allocation	A	440 ML	180 ML
Water Use 2004	B	90 ML	0 ML
Start Date	C	1987	1989
No. of Bores	D	2	1
Bore/s need replacing	Initial assessment only	Yes * 2	No
Future Discount Rate	E	4%	4%
Unit Pumping Cost	F	\$0.70/ML/m	\$0.70/ML/m
Groundwater Decline	G	1 m/yr	1 m/yr
Infrastructure Component			
New Pump/s	= \$200 * A up to max \$25,000 * D	\$50,000	\$25,000
New Bore/s	= \$400 * B + \$200 * (A - B) up to max \$125,000 * D	\$106,000	-
Pumping Component			
Historical	Refer to Note 1.	\$5,229	-
Future for Active Use	Refer to Note 2.	\$19,748	-
Future for Inactive Use	Refer to Note 3.	\$53,498	\$27,513
Total Assistance Calculated		\$234,475	\$52,513

Notes:

- Historical pumping cost = $\sum Q \times D \times 0.7$, for each year from the start date to 2004, where:
 - Q is volume used and varies (linearly) from 2004 usage back to one-third of this volume at the start date.
 - D is the depth of decline. The decline increases by 1m each year. However in the equation there is a need to use the full decline at the start date and decrease it as you

move towards 2004. This is because the volume used at the start date (30 ML in Case Study C) has experienced the full decline between the start date and 2004 (17m in Case Study C), while the volume used the year after has experienced a lesser decline (16m in Case Study C).

- 0.7 is the unit pumping cost (i.e. \$0.70/ML/m)
2. Future pumping cost for active use is $PV_1 + PV_2 + PV_3 + \dots + PV_n$, with a discount applied to the result which is 50% of the difference between future pumping cost for active use and future pumping cost for inactive use. Details relating to the calculation are:
- n is number of years from start date up to and including 2004 (for case study C this is 18),
 - $PV_1 = \sum Q_1 \times D_1 \times 0.7$, $PV_2 = \sum (Q_2 - Q_1) \times D_2 \times 0.7$, $PV_3 = \sum (Q_3 - Q_2) \times D_3 \times 0.7$ and so on.
 - These present values (PV) are calculated over a 30-year period at a discount rate of 4%.
 - In each calculation the volume, Q, is constant over the 30-year period and the depth, D, varies, increasing by 1m/year.
 - Q_1 is volume used at start date, which is one-third usage in 2004. The volume used in each year following (ie. $Q_2, Q_3, Q_4 \dots$) increases linearly up to the 2004 usage.
 - The starting figure for D is depth of decline that has already occurred up to and including 2004. For D_1 this is from the start date to 2004 (for case study C this is 18m). D_2 is 1m less than D_1 , D_3 is 1m less than D_2 and so on. As stated above, these depth figures then increase by 1 m/year over the 30-year period.
 - This accounts for both the changing groundwater level over time and the changing water use over time.
 - The future costs with impact to date does use the 2004 usage volume over the full 30-year future period (ie. Case Study C is 90ML). The complexity is that the impact to date for each ML varies according to when the irrigator started to pump it. In Case Study C, the volume pumped in 1987 was 30ML, and up to 2004 this has experienced an impact of 18m. The additional 4ML pumped from 1988 experiences only a 17m decline up to 2004 (and so on for all the following increases). These metres of decline up to and including 2004 impact on the starting point for calculations of future pumping costs and thereby the calculated cost.
3. Future pumping cost for inactive use is $PV = \sum Q \times D \times 0.7$ over a 30 year period at a discount rate of 4%, where:
- Q is inactive volume in 2004 (i.e. licence volume minus 2004 usage)
 - D is depth of decline, which starts at zero and increases by 1 m/year
 - For all users this results in a figure of \$153/ML.

To simplify the calculation process for historical pumping cost and future pumping cost for active use, the costs per ML can be calculated for each start date, as these remain consistent no matter what the volume of usage. Appendix 5 provides a summary of these figures.

7 Estimate for All Irrigation Licence Holders

The estimated total cost of implementing the proposed package of assistance measures for all licence holders, based on the approach described in Section 5, is approximately \$7.8M. This is equivalent to an average of \$417/ML for the current licensed volume (18,614 ML).

The estimate is based on the following assumptions:

- Costs for the case-study properties are the actual costs identified;
- Costs for all other irrigation licence holders are based on the assumption that one bore is replaced per property unless licensed volume is less than 50ML or the bore was installed in the period from 1995 onwards²;
- Where the aquifer accessed is unknown irrigation licence holders are included. Where the Boisdale aquifer is accessed, licence holders are not included.
- The start date for calculation of pumping costs is based on bore installation dates provided in the SKM 2001 report *Gippsland Declining Levels – Impacts on Irrigators*. Where no date is available a start date of 2001 was assumed.

An assessment has been made of the confidence range for the costs relating to the proposed assistance package. It has been determined that:

- Cost estimates relating to the case studies are relatively robust given the larger amount of information available for these licence holders.
- The greatest unknown is the number of bores that need to be replaced and costs are therefore most sensitive to this element. The cost for the bore infrastructure component could be ±\$0.75M
- The need for pump replacement is impacted by the number of operational bores in place. Information available is from 2001 and may therefore be outdated. Costs for this element may be ±\$0.2M.
- Pumping costs are based on actual SRW metering records for the 2003/04 irrigation season and in terms of ML pumped they will be relatively accurate. The potential for change relates to the starting date used which may be later than estimated due to properties having changed hands since bore installation (which is what the current estimates are based on). For the active volume - historical pumping costs could decrease by \$0.02M, and future pumping costs with impact to date could decrease by \$0.1M. For the inactive volume there is unlikely to be any change.

As a result of the above, the assistance package could range from \$6.7M (-14%) to \$8.7M (+12%).

² This leads to an estimate of 32 bores being replaced out of 56. Advice from irrigators on the reference committee is that this may be an over estimate.

8 Other User Groups

Although outside the scope of the original brief, consultation with stakeholders identified that the regional groundwater decline is impacting irrigators outside the Yarram area and also some stock and domestic, and dairy wash-down users. As a result, these groups have been considered and a possible response is outlined below.

8.1 Bairnsdale Irrigators

Southern Rural Water has advised that there are four irrigation licence holders in the Bairnsdale area who also access the Latrobe Aquifer and are impacted by the regional groundwater decline. The total licensed volume is 469ML. However, details relating to the number of bores and level of usage are unknown.

An estimate of the level of assistance required to extend the scheme to these irrigators has been made using the calculation methods outlined in Section 5. This calculation generates a total estimate of \$0.28M, assuming:

- Three of the four licence holders require bores replaced;
- All licences were actively using half their licensed volume in 2004;
- Licences have been held since the mid 1990s.

8.2 Stock, Domestic and Dairy Licences

The impact of the groundwater decline on 'stock and domestic' and dairy wash-down users is much smaller in terms of the costs imposed, than for irrigators. If assistance measures were to be provided to these users, the proposed package would be as follows:

- Applicant must prove they are accessing the Latrobe or Balook aquifers and are therefore impacted by the decline;
- All users would then receive the following to cover increased pumping costs and/or cost of lowering the pump:
 - \$1,000 for stock & domestic users;
 - \$2,000 for dairy wash-down users.
- If a new bore is required, the additional assistance provided would be:
 - \$10,000 for stock & domestic users;
 - \$20,000 for dairy wash-down users;
 - The applicant would need to have evidence that a new bore is required;

The issue with stock and domestic users is that they do not need to be licensed. As a result the exact number of bores intersecting the Latrobe and Balook aquifers is unknown. However, it is understood that the majority of stock and domestic bores in the Yarram area are mainly shallow bores screened within the Haunted Hills aquifer and these are not considered to be affected by declining groundwater levels.

An estimate of the total cost of assistance for 'stock and domestic' and dairy wash-down users is \$0.21M. This assumes the following:

- Of the 17 licensed dairy wash-down bores, 5 are assumed to need replacing;
- An estimate of 30 unlicensed stock & domestic users has been made for the Latrobe/Balook aquifers and of these 5 are assumed to need bores replaced.

9 Assistance Package vs Total Cost to District

This section provides information relating to the total cost likely to be incurred by the Yarram irrigation community as a result of the declining groundwater levels. This indicates the contribution that will be made by the community and provides a reference comparison against which to compare the level of assistance proposed.

Infrastructure Costs

Infrastructure costs are calculated as per the assistance package as the cost to the community is no greater than the sum of the costs for individuals. This results in a total infrastructure cost of approximately \$4.2M.

This estimate is based on the following assumptions:

- Costs for the case-study properties based on costs incurred or calculated following discussions with landholders;
- All other irrigation licence holders are assumed to replace one bore per property unless licensed volume is <50ML or the bore was installed in the period from 1995 onwards (in which case no bores are replaced).

Pumping Costs

A decline of 1 m/yr is applied to the licensed volume (rather than the active volume) over the full 60-year period of regional decline. This accounts for the impact on the value of the groundwater over the full period of the regional decline (rather than assessing the impact on cost for individual irrigators).

The licensed volume is assumed to be 1000 ML in 1975, increasing in a linear manner to the current 18,614ML. The licensed volume is assumed to be capped at the current amount for the 30-year period into the future.

The total resulting pumping cost is approximately \$8.6M.

This takes into account a discount rate of 4% for future expenditure. There is no interest rate applied to historical expenditure. If an interest rate of 4% were applied³, the pumping cost would increase to \$9.5M.

Total Cost

Combining infrastructure and pumping costs results in a total cost to the community of \$12.8M.

The estimate of the cost of the proposed assistance package at \$7.8M comprises 61% of this total community cost (refer to Section 7 for details).

If no decline had been experienced to date it is likely that greater development of the groundwater resource would have occurred in the Yarram WSPA, which would have

³ The properties could have borrowed to cover the additional pumping cost. Application of an interest rate to historical expenditure would cover the cost of debt.

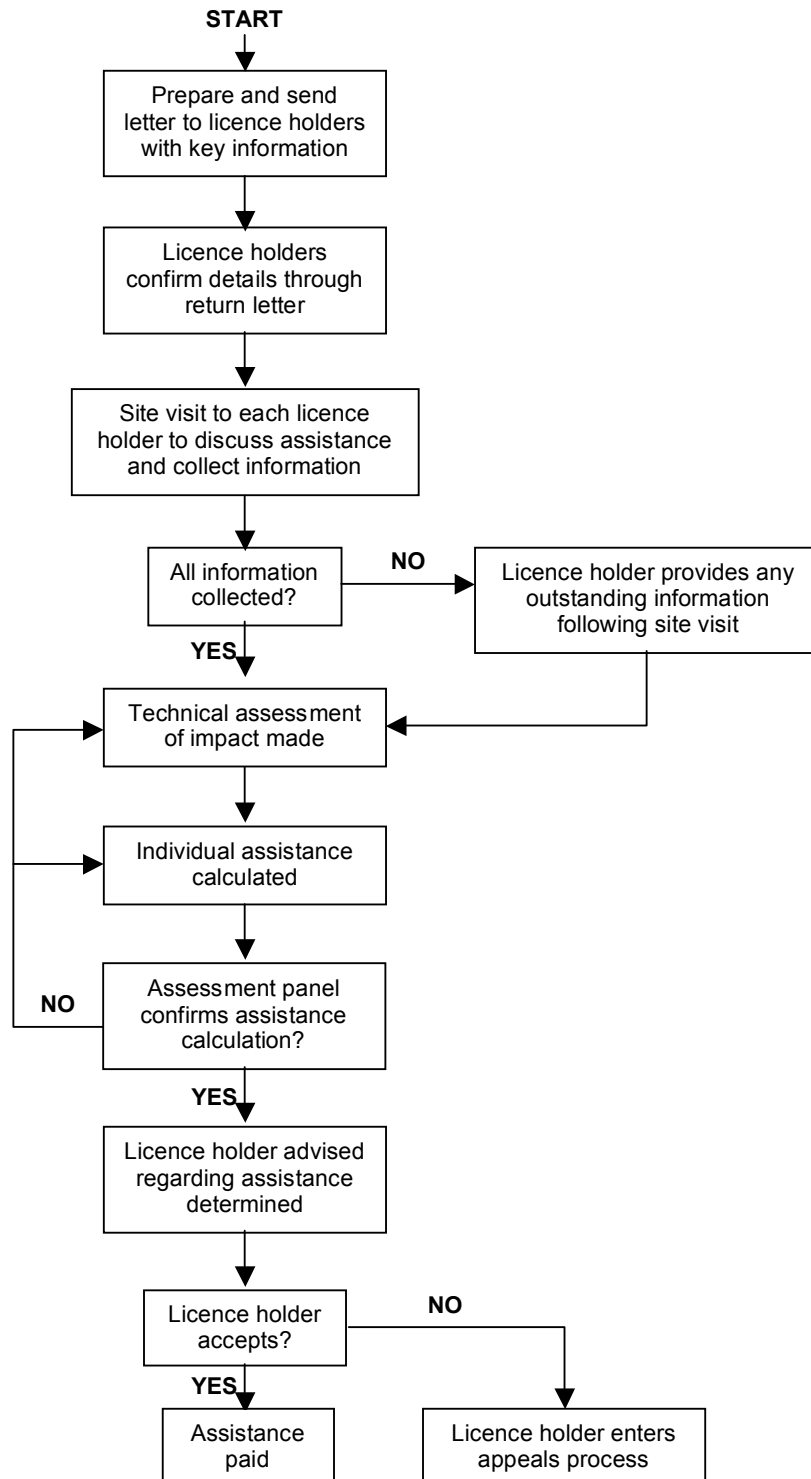
increased the value of agricultural production. This increase cannot be quantified, but should be noted as a part of the community impact.

10 Implementation

10.1 Proposed Methodology

The proposed implementation process for the assistance package is outlined below.

Figure 10-1 Process for Implementation



Further explanation regarding elements of the implementation process is as follows:

- Key information to be provided to licence holders – licensed volume, level of usage in 2004, date of purchase or bore installation, aquifer accessed. The majority of this will be sourced from Southern Rural Water;
- Information to be provided by licence holders – refer to section 5.3.4;
- Technical assessment of impact – desktop assessment to determine need for bore replacement and whether impact has occurred to date. This could be undertaken by Southern Rural Water or an appropriately qualified consultant;
- Individual assistance calculated – details relating to this element are outlined in Figure 10-2. This process could be completed by Southern Rural Water, Rural Finance or an appropriately qualified consultant;
- Payment of assistance – administration of money could be undertaken by Southern Rural Water or Rural Finance;
- Appeals process – licence holders wishing to appeal their assistance determination would need to make a submission to the Assessment Panel which includes all evidence supporting their circumstances.

10.2 Cost of Implementation

The total cost of implementation is estimated to be in the range of \$200,000 - \$300,000. This includes:

- Individual site visit assessments and verification of data. This is calculated as 60 licence holders at \$1,200 each, plus \$25,000 to cover difficult cases (total of \$97,000);
- Design of a calculation spreadsheet model (\$5,000);
- Community engagement (\$5,000);
- Project administration and management (\$60,000 – \$80,000);
- Auditing of assistance provided (\$40,000)

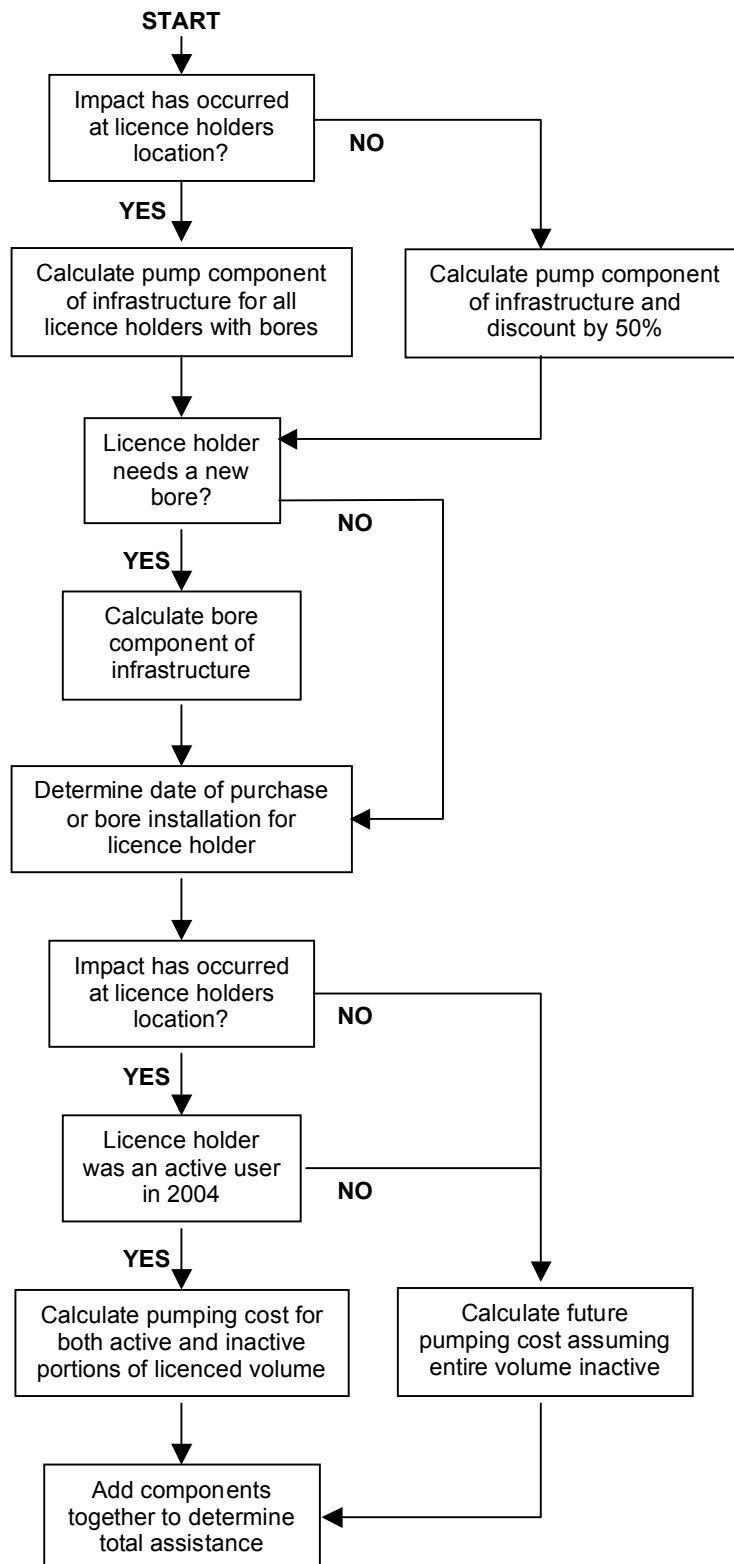
This implementation cost is equivalent to 2.5 – 4% of the total cost of assistance.

10.3 Governance

The existing Steering Committee for the Latrobe Aquifer Investigations could continue to oversee the process of determination and provision of assistance.

Executive support and/or project management could also continue to be undertaken by DSE, on behalf of the Steering Committee.

Figure 10-2 Process for Calculation of Assistance



10.4 Community Engagement Process

The Yarram community has already been engaged in the process through a public meeting and via contributions of community members on the Yarram WSPA committee and the project Reference Committee.

As such, the engagement process proposed is focussed on informing the community about the proposed assistance package and the steps that need to be taken to be included.

It is recommended that a package of information (or letter) is sent to all licence holders regarding the:

- Elements of the assistance package, including key determinants of eligibility;
- The process involved in determining individual assistance;
- The formulas to be used in calculating assistance;
- Information that will be required from those applying.

A notice could also be placed in the local press to inform the wider community.

(Note it is proposed that individuals will have the right to appeal their level of assistance through the appeals process outlined in 10.1).

10.5 Supporting Government Programs

Consideration has been given to existing State or Commonwealth Government programs that could support implementation of the proposed assistance package. The following have been identified:

- Hydrogeological and monitoring investigations that comprise the other elements of the program focused on the Latrobe Aquifer (funded through NWI).
- Centrelink program providing advice on farm business planning could assist licence holders with management of funds received as a result of the assistance package;
- The Groundwater Management Plan will provide certainty and enable licence holders to make informed decisions;
- Incentives available through DPI in regards to farm planning and improving irrigation efficiency may also help to reduce groundwater extraction costs (through reduced usage) and/or increase unit production.

11 Risk Assessment and Mitigation

An assessment has been undertaken of the risks surrounding the proposed package of assistance measures and of the actions that can be taken to minimise or mitigate those risks.

11.1 Licence Holder Responses

Licence holders may not accept the proposed approach:

- Licence holders may object to having to demonstrate the level of impact to date through provision of evidence as outlined in Section 5. However, given the level of assistance that they are likely to receive it is considered appropriate that they have to prove it is required;
- Licence holders may perceive that a level of decline of 1m/year is not sufficient in their particular circumstances. This is due to not understanding the difference between local and regional impacts. The information provided as part of the engagement process (see section 10.4) should include a thorough explanation of this aspect.

11.2 Community Response to the Package

The community may not accept that the package is reasonable and fair:

- Large users may be perceived to be getting an overly generous level of assistance, even though the \$/ML sums available decline as usage increases. Caps are proposed for the infrastructure components of assistance to account for economies of scale. The level of technical assessment proposed for determination of assistance is also considered to be sufficiently rigorous to ensure licence holders don't get more than they are entitled to.
- Potentially there will be a perception in the community that irrigators are receiving a hand out with limited justification. The proposed assistance package targets a modest portion of the total cost (61% of the total community cost outlined in section 9) and, as stated above, includes a technical assessment that is considered sufficiently rigorous to ensure licence holders don't get more than they are entitled to.

11.3 Risks to Government

The key risk associated with the project is that, until an assessment of each property is carried out, it will be difficult to accurately determine the exact cost of assistance. However, the case-study investigations provide a robust basis for determining the probable level of assistance that will be required. The 50% discount applied to additional pumping costs and the provision of a cap on infrastructure costs, limits the exposure of government funding.

11.4 Knowledge Gaps

There are also knowledge gaps regarding aspects of the groundwater system and its use. However, it is judged that these are largely peripheral to the core decisions for the proposed assistance measures and do not challenge the validity of the proposed package.

An area where further investigation is required relates to properties accessing the Latrobe or Balook aquifers where no impact has been experienced to date (evidence from the case studies is that a few properties may not have been affected due to local drawdown peculiarities). It is proposed that these properties will not be eligible for assistance relating to historical impacts. The outstanding issue is whether they will be impacted in future and, if so, how will assistance be calculated. The proposal outlined in Section 5 and cost estimates in Sections 6 and 7 assume that all irrigators will in future experience the regional drawdown of 1m/year. However, this will need to be confirmed.

Other knowledge gaps that will impact on the total assistance package are:

- Number of bores that will need to be replaced on non case-study properties;
- Number of unlicensed stock and domestic users accessing the Latrobe and Balook aquifers (if assistance is to be provided to these users).

In addition it is assumed that:

- The groundwater management plan will continue to be developed;
- Investigations (or monitoring) will continue in regards to the potential for subsidence, saltwater intrusion, impacts on streamflows and the likelihood that supplies will run out where the aquifer is comparatively shallow.

References

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Yarram WSPA Committee (2006) *Draft Groundwater Management Plan for the Yarram Water Supply Protection Area*, Draft 2, June 2006.

Appendix 1: Process for Development

Phase 1: Investigation of Issues and Principles

Inception Meeting

An initial meeting was held with DSE to confirm the project approach, timing and deliverables and to ensure the project objectives and scope were clear.

As a result of the meeting, the approach to the project was altered to include a greater level of consultation and greater emphasis on the case studies (i.e. Phase 2, as outlined below, was added to the process).

Literature Review and Background Research

A desktop study was undertaken to investigate models to assist irrigators affected by declining groundwater levels. This included consideration of the following aspects:

- The farming community affected by the declining groundwater levels and the sorts of assistance measures that may be considered useful to that community;
- Principles that could underpin the development of assistance measures;
- Examples of assistance measures that have been provided (by either State or Commonwealth Governments) to other farming communities.

Meeting with Irrigators on Reference Committee

To ensure a thorough understanding of the Yarram area and potential irrigator concerns, a meeting was held with the two irrigators on the Reference Committee. This also helped to determine the range of case studies required in Phase 2.

Discussion Paper on Principles, Issues & Proposed Case Studies

A discussion paper was prepared to outline findings of the literature review, background research and meeting with the irrigators. This is entitled *Latrobe Aquifer Impact Investigations: Discussion Paper – Principles and Issues Relating to Assistance Measures* (RMCG, Oct. 2007). It became the basis for discussion in the workshops as outlined below.

Workshops - Phase 1

Two separate workshops were run with the Reference Committee and the Yarram Water Supply Protection Area (WSPA) Committee to discuss the issues and principles relating to assistance measures for the Yarram Irrigators.

As a result:

- The selection of case studies was finalised;
- Agreement was reached regarding the majority of principles, with remaining areas identified for further consideration;
- A public meeting was held (December, 2007) to inform the community about project progress and the proposed principles.

Phase 2: Case Studies

Case Studies

A total of 8 case studies were undertaken to test the principles identified in the desktop study, and to collect information relating to the cost impact of groundwater decline.

Farms used for the case studies were selected in consultation with the reference committee to ensure good representation of the local issues was achieved. A selection of WSPA committee members were included in the case studies, to assist in building their understanding of the assistance measures being considered.

Outcomes of the case studies were used to revise the principles that underpin the development of assistance measures so as to ensure they are applicable to this specific farming community and aquifer.

Workshops - Phase 2

Two separate workshops were run with the Reference Committee and the Yarram WSPA Committee to discuss the case study findings and determine the preferred approach for assistance.

Discussion Paper on Case Study Outcomes

A discussion paper was prepared to outline findings of the case studies and the workshops. This included an initial outline of the preferred assistance measures. The paper is entitled *Latrobe Aquifer Impact Investigations: Discussion Paper – Case Study Outcomes and Possible Options* (RMCG, Jan. 2008).

Reference Committee Meeting

The preferred assistance measures proposed in the case study discussion paper were refined through consultation with the reference committee.

Phase 3: Development of Package of Assistance Measures

Draft Reports

Based on the outcomes of the above tasks, a draft package of assistance measures was developed and outlined in a draft report, which was provided to the Reference Committee for review.

Following initial feedback a second draft was submitted to the Reference Committee for further review. Final comments were received through a meeting with the committee.

Final Report

Following review of the draft reports and approval of the preferred package of assistance measures a Final Report has been produced and is outlined here.

Appendix 2: Groundwater Use in The Yarram Region

Introduction

The following sections provide details relating to groundwater use within the Yarram area. The aim is to understand the types of users that will be affected by the declining groundwater levels. This enables the assistance measures to be tailored to suit local conditions and to meet the real impact of groundwater decline.

Analysis is based on the best information currently available.

Overview of Groundwater Use

Yarram is a small farming community, 58km south of Traralgon. Groundwater has been used in the Yarram Water Supply Protection Area (WSPA) for a number of different purposes and from different aquifer systems. These mainly include irrigation of dairy pastures, and stock and domestic purposes. A summary is provided in the following table.

Table A211-1 Licences and Use in the Yarram WSPA (Source: Southern Rural Water)

		Irrigation	Domestic & Stock	Dairy	Commercial/ Industrial	Other
Total	No. Licences	61	47	42	4	5
	Licensed Volume	20,408.1	340.55	50.45	2,752.6	1,743.7
	No. Bores in Use	31			1	1
	Volume Used	8,535			1,345	15.2
Latrobe	No. Licences	32	20	15	3	2
	Licensed Volume	12,139.7	133	18	2740.8	75
	No. Bores in Use	21			1	1
	Volume Used	6,175			1,345	15.2
Balook	No. Licences	16	8	8		
	Licensed Volume	5,345	96.25	9.65		
	No. Bores in Use	9				
	Volume Used	2,327				
Boisdale	No. Licences	6	3	2		
	Licensed Volume	1,794	18.5	2.4		
	No. Bores in Use					
	Volume Used					
Unknown	No. Licences	7	16	17	1	3
	Licensed Volume	1,129.4	92.8	20.4	11.8	1,668.7
	No. Bores in Use	1				
	Volume Used	31				

There are a total of 85 separate licences, with the majority licensed for more than one use (i.e. most irrigation licences also include stock, domestic and/or dairy usage).

Volume used is the average over seasons 2001/02, 02/03 and 03/04. While this appears to be several years ago, it is appropriate in that assistance is likely to date from the funding announcement made in 2004.

It appears that only four licence holders own more than one licence. However, this does not include licences that may be in different names but used by the same business.

The commercial/industrial use category includes extraction by Esso for its Longford Gas Plant. Esso is the largest individual licence holder with 2,640 ML.

The category "Other" includes licences for urban (60 ML), aquaculture (1,567.5ML), dewatering (100ML) and miscellaneous (15ML) type extraction. Of these licences only the miscellaneous one is in use – the former Won Wron Prison run by the Department of Justice.

In this area, bores in the Boisdale aquifer are not affected by declining groundwater levels. The licences for this aquifer have not been considered as part of the assistance package. The relevant licence holders will need to be informed of this issue.

Metered use is significantly less than the licensed allocation. However, additional allowances must be made for domestic and stock use, which equates to around 1,300ML/a, and non-metered dairy bores (Draft Groundwater Management Plan, 2006).

In addition to the licensed uses outlined in Table A2-1, there are a large number of unlicensed stock and domestic bores within the Yarram WSPA boundary. These are mainly shallow bores screened within the Haunted Hills aquifer and are assumed to have only a small yearly extraction volume of typically 2ML/year each. These are not considered to be affected by declining groundwater levels.

There are also a small number of irrigators who access the Latrobe Aquifer outside the Yarram WSPA area. These licence holders are located in the Bairnsdale area and it is understood that they are being affected by declining groundwater levels in a similar manner to the Yarram irrigators.

Categories of Use

Licence holders can be split into the following categories and sub-categories:

1. Irrigators:
 - Active (31 licences)
 - Inactive (24 licences)
1. Stock, Domestic & Dairy:
 - Those associated with Active Irrigation Licences (18 licences)
 - Those associated with Inactive Irrigation Licences (15 licences)
 - Licensed for Stock, Domestic and/or Dairy only (17 licences)
 - Unlicensed
2. Other:
 - Active (2 licences including Esso & Won Wron Prison)
 - Inactive (7 licences including Commercial, Urban, Aquaculture)

The focus for development of assistance measures is the irrigators within the Yarram WSPA. However, other user categories could also be affected by declining groundwater levels. Information is therefore provided regarding possible assistance measures for:

- Stock, domestic and dairy users accessing the Latrobe and Balook aquifers;
- Irrigators accessing the Latrobe Aquifer outside the Yarram WSPA.

Distribution of Irrigation Licences

An assessment has been made of the distribution of volume across the irrigation licences (both active and inactive). This does not include the Boisdale aquifer, as it is not affected by declining groundwater levels.

Table A2-2 Distribution of Irrigation Licences (Source: Southern Rural Water)

Licensed Volume (ML)	No. of Licences	Total Volume (ML)	% Total Volume	No. Active	Volume Used (ML)	% Volume Used
< 10	1	8	0.04%	0	0	0
10 - 50	7	153	0.8%	1	23	0.3%
50 - 100	4	314	2%	3	88	1%
100 - 200	12	1,771	10%	6	651	8%
200 - 500	20	6,786	36%	11	1,837	22%
500 - 1000	9	6,355	34%	8	3,262	38%
> 1000	2	3,228	17%	2	2,674	31%

Volume used is the average over seasons 2001/02, 02/03 and 03/04.

The majority of the water (51%) is owned by only a small proportion of licence holders (11 customers). 10 of these customers also use nearly 70% of the total annual usage.

If assistance is proportional to the licensed volume held or used, the majority of assistance will go to only a few irrigators – the large users.

Type of Irrigation

Discussions with irrigators in the Yarram area have identified that the types of irrigation occurring are as outlined in Table A2-3. Note that this only considers irrigation licences that are in use, which is ~50% of total irrigation licences.

Table A2-3 Type of Irrigation

Type of Irrigation	No. of Customers
Dairy	22
Beef/Fodder	4
Nursery	1
Golf Course	1
Potatoes	2
Carrots	1
Unsure	2

Notes:

1. The potato growers are brothers and it is thought that they have sold to the nursery.
2. One property has both beef and dairy irrigation under one licence, but from two bores. This has been counted as two customers in the table above.

Within the group of active irrigators, the main use is for dairy pastures. Other uses include a nursery, a golf course, beef/fodder properties and vegetable growers.

Age of Bores

The table below provides information on the age of the bores in place in the Yarram area.

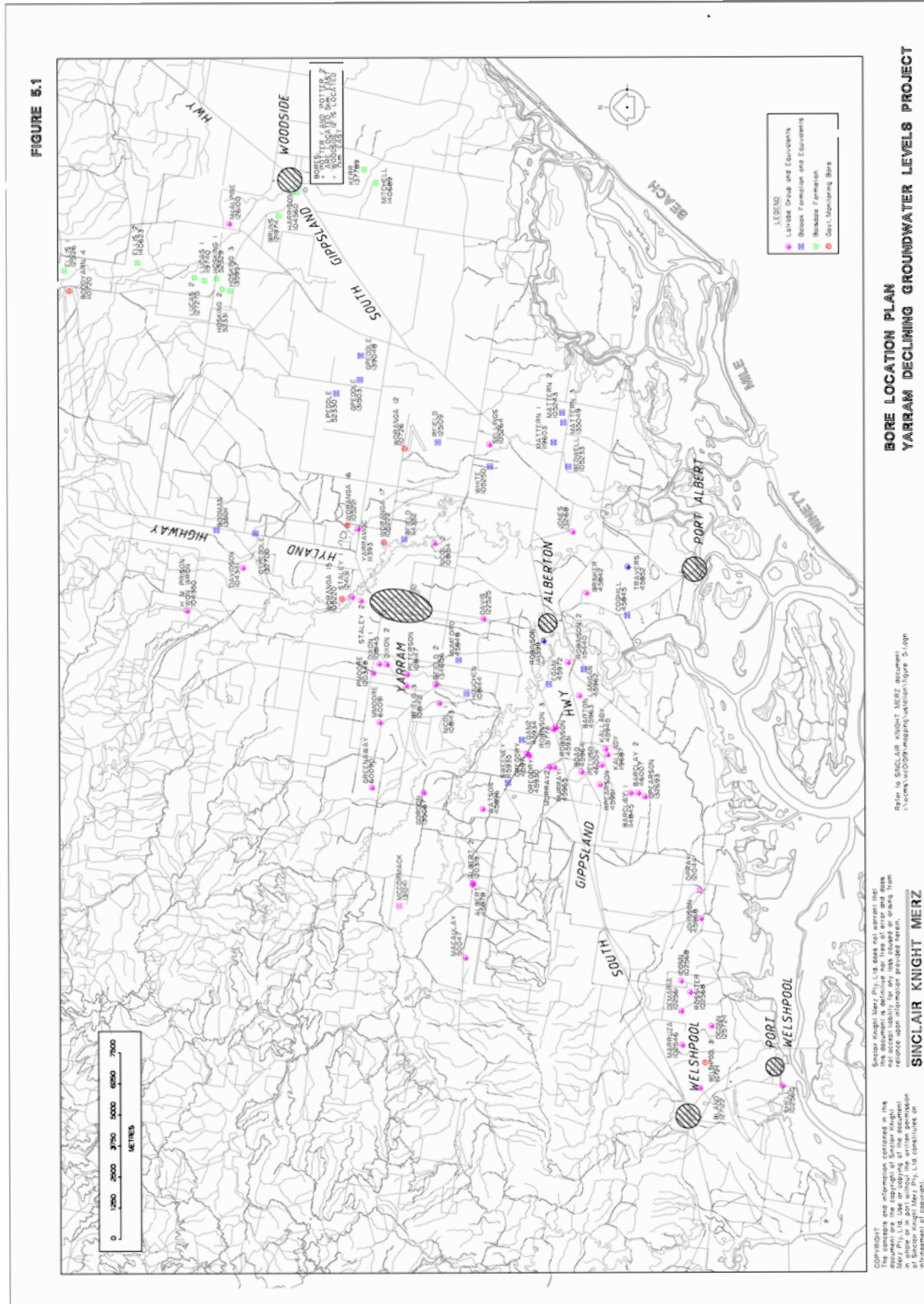
Table A2-4 Age of Bores (Source: SKM, 2001)

Age	Active Irrigators	Inactive or Unmetered
< 10	6	1
10 – 20	12	10
20 – 30	9	13
> 30	3	11
Unknown	3	16

The majority of the bores are identified on the map overleaf (based on 2001 data).

Map of Bores

(Source: SKM, 2001)



Appendix 3: Examples in Other Farming Communities

Mitta Mitta Ex Gratia Payment

Dartmouth Dam is located in North East Victoria. It was constructed across the Mitta Mitta River and was commissioned in 1979. Following construction, the reduction in the river's flow adversely affected pasture productivity on properties downstream of the dam.

The Murray-Darling Basin Commission (MDBC) is responsible for the operation of the dam. In March 2000, the MDBC recognised the adverse effects of the dam by offering to landowners a once-only ex gratia payment, without admission of any liability for damage or loss caused.

The landowners did not suffer a loss of any of their land, however the reduction in the pasture productivity of the land resulted in a permanent reduction in the value of their properties. The ex gratia payments were made in respect of this permanent reduction in the value of the properties.

The calculation of the payment for each landowner, was based on the likely cost of installing and operating sufficient irrigation capability so as to restore their affected land back to pre-dam productivity.

Key learnings from this example:

- Duration of Impact - The payment recognised that landowners who had been operating in the valley prior to 1978 had experienced the full impact of the changed river regime. Adjustments to prices and values had occurred since 1978 and those who had purchased land in more recent years had the opportunity to adjust the purchase price in consideration of the altered pasture production environment. Payments were discounted to reflect emerging knowledge of the changed environment and consequential adjustment in purchase price.
- Both the recurrent costs and the capital costs of irrigation infrastructure were considered.
- Recurrent costs were calculated based on a 20-year future period.

Mildura Horticultural Region

The Mildura horticultural region produces a range of viticultural, citrus, other trees and vegetable crops. The 2006 predicted farm gate prices for most major crops were depressed. This was causing widespread concern about the impact on individual producers and the overall regional economy. Therefore, the Mildura Rural City Council and Wentworth Council instigated a study to better understand these impacts and to assist in identifying possible strategies to improve the regional outlook (*Economic Sustainability Study for the Mildura Horticultural Region*, RMCG, March 2006).

Rising input costs and falling returns (declining terms of trade) along with the cyclical nature of prices are facts of life in agriculture and growers have adapted to this by increasing efficiency, improving yields, adding value and expanding to achieve economics of scale. When terms of trade decline gradually or are confined to one crop then this can be managed. Growers respond by investing capital in expansion and new technology to remain competitive.

But in 2006, across the board price reductions, were resulting in declining property values and high operating losses. This meant that access to capital became difficult even for the most viable of businesses.

Addressing this problem was fundamental to the region's recovery. Assistance was required to enable horticulturists to adjust by:

- Expanding to achieve economies of scale.
- Adopting more efficient technology to reduce costs; and this also requires adequate scale.
- Where appropriate, adopting systems that improve yield (not usually for wine grapes).
- Adding value to existing product or moving to higher value products (not usually for wine grape growers).
- Providing emergency financial relief to survive the exceptional conditions.

As a result of the study and lobbying for assistance, the Department of Agriculture Fisheries and Forestry provided funding for four projects; namely:

- Improving Industry Performance Co-ordination
- Sustainable Enterprises for Horticulture properties
- Industry Collaboration – Options for Achieving Economies of Scale for Horticulturalists
- Scoping, Value Adding and Regional Diversification.

NSW Achieving Sustainable Groundwater Entitlements

A Water Sharing Plan has been developed for the Lower Murray Groundwater Source to determine how water is to be shared between the environment and water users as well as different types of water users such as towns, stock and domestic users and irrigators. The Lower Murray Groundwater Source is over-allocated and entitlements need to be reduced to the sustainable yield of the aquifer.

For some groundwater irrigators this will mean that they will not be able to extract as much water as they have used in the past. To assist affected groundwater irrigators and local communities in adjusting to the impacts of these changes, the Commonwealth and State Governments have agreed to provide \$110 million in financial assistance under the Achieving Sustainable Groundwater Entitlements Program. The program aims to ensure the long term sustainability of the six major inland groundwater systems in NSW and a healthy and sustainable groundwater irrigation industry.

The general basis of the groundwater valuation model to calculate financial assistance was to:

- Calculate what the groundwater was worth before the water sharing plans (WSP) came into place;
- Calculate what the groundwater was worth after the WSPs were in place;
- Make the difference the lost value (where the value pre WSP was greater than post WSP);
- Share the loss of value – one third each between Commonwealth, NSW and irrigators.

Key learnings from this example relate to the principles included – everyone has a right; history of use is recognised; and late developers are recognised.

Land Acquisition and Compensation in Victoria

Under the provisions of the Land Acquisition and Compensation Act 1986, land required for a public purpose can be acquired/resumed by government departments and agencies. This can be done either compulsorily or by negotiation, and the legislation sets out the process to be followed and how compensation is to be determined.

Properties are acquired, either in total or in part, by the State for purposes such as new roads/freeways, road widening/deviations, parks, reservoirs, sewerage works, drainage reserves and so on.

Compensation takes into consideration the market value of the land, any special value to the claimant and any loss attributable to severance and/or disturbance.

Specific examples are not included here, as RMCG experience in this area has been with cases that have settled out of court and thus include confidentiality clauses. However, it is noted that consideration has been given to:

- Future loss of production value or increased costs – the actual and potential capacity of the land to yield a monetary return;
- Operating costs – paid as either an estimate of future costs or translated into a devaluation of the land asset. An example is the cost of travelling extra distance to get between areas of a property that has been split as a result of road development.

Appendix 4: Case Study Outcomes

Background

The key aims of the case studies were to:

- Determine the characteristics of active versus inactive properties;
- Determine the productive benefit of water for those properties irrigating;
- Investigate alternatives to irrigation where there is potential for supplies to run out;
- Compare the level of impact for irrigators operating over different periods of time, from different aquifers and at different scales;
- Investigate different types of irrigators who are likely to receive assistance;
- Investigate additional costs and alternative forms of supply for dairy, stock and domestic users.

In total eight case studies were completed. This included a stock & domestic user, an inactive licence holder, a range of irrigators (very small to very large, in various locations, Balook and Latrobe aquifers) and types of irrigation other than dairy pastures.

Information collected included:

- Licence volumes and usage;
- Groundwater decline to date;
- Groundwater access costs - bore depths, pump depths, water level, money spent over years;
- Type of irrigation system in place and the associated costs;
- Production data as a result of irrigation and as a proportion of the whole business.

Summary of Outcomes

This section provides a summary of the key outcomes or findings arising from the case studies. Detailed results, including costs associated with the regional decline, are included in the following sections.

Increased Cost of Extraction

The impact of the decline on the cost of groundwater extraction can be split into components as follows:

- Infrastructure
 - Lower pump: As groundwater levels decline, pumps can be lowered within existing bores so that water can continue to be extracted. Case study costs for this component ranged from \$4,000 - \$30,000, or a unit cost of \$8/ML - \$63/ML (licensed volume).
 - New bore – larger diameter: Bore replacement is required when a pump can no longer be lowered (depth of the widest casing in the bore is limited). Case study costs ranged from \$80,640 - \$127,500, or a unit cost of \$47/ML - \$567/ML (licensed volume).

- New pump/motor – larger size: Required to lift the water the extra distance to the surface. Case study costs ranged from \$6,000 - \$15,000, or a unit cost of \$5/ML - \$31/ML (licensed volume).
- Pumping – as groundwater levels decline, greater energy is required to lift the water to the surface and the cost of pumping is therefore increased. This increase can be split into three sections:
 - Historical: The cost already incurred. Case study costs ranged from \$320 - \$62,026, or a unit cost of \$11/ML - \$177/ML (active volume in 2004)
 - Future – used portion: Future cost based on current water use continuing. Case study costs ranged from \$724 - \$321,969, or a unit cost of \$153/ML - \$407/ML (active volume in 2004)
 - Future – unused portion: Potential increased cost for currently unused water. Accounts for impact of declining levels on the value of the groundwater. The unit cost estimated was \$153/ML (licensed volume)

The total increased cost of extraction calculated for the case study properties ranges from \$764 to \$514,159. The range in unit cost is \$153/ML to \$1,078/ML (licensed volume).

Need for Bore Replacement

Not all properties need to replace bores, as:

- Those constructed in more recent years, have generally been designed to cope with the declining levels.
- The pumps required for stock and domestic bores are much smaller than for irrigation and can therefore generally be lowered without the need for bore replacement.

Economy of Scale for Bore Installation

Irrigators with relatively small licensed volumes (100ML) need to install a bore at a cost of around \$100,000, or \$1,000/ML.

By comparison a bore for a large irrigator (say 750ML) may cost \$150,000, or \$200/ML. Even in the event of requiring three bores (for say 1,500ML) at \$130,000 each, the cost is still only \$260/ML.

Discount for Expended Life

The assistance provided for replacement of infrastructure (i.e. new pumps or bores) needs to take into account the life already spent of these assets. The new infrastructure will now last beyond the life of the old.

The average life of a bore is 100 years, while pumps have a lifespan of approximately 20 years.

Range in Decline

Information collected in the case studies suggests that the rate of groundwater decline to date may range from 0.1m/yr up to 1.8m/yr.

This range may in part be due to poor transmissivity across the aquifer, resulting in different rates of decline at different locations. In addition for pumped bores it is more difficult to separate the regional impact from local impacts (eg. over-pumping of that particular bore, or interference from others nearby).

It is proposed that the average regional decline used to determine assistance is based on monitoring bore records rather than individual irrigation bores, which may be inaccurate. The average regional decline is 1 m/yr (SKM, 2004).

The case studies indicate that some properties may not have experienced much decline to date (although the decline is still expected to occur in future). There is a need to ensure the assistance package takes this into account so that irrigators are not receiving assistance when no impact has occurred. It is proposed that evidence will need to be provided relating to historic decline.

Pumping Costs

For the case study properties, pumping costs ranged from \$0.57 - \$0.72 per ML per metre pumped. This aligns with an average unit cost of \$0.70 per ML per metre known to apply in other areas.

This assumes that the power supply is electricity. There may be some properties still using diesel, which would increase the unit cost considerably. However, the assistance should be based on the most cost effective system. In the case of power supply this is electricity.

Note that the unit cost does not increase with depth provided an appropriate pump is installed.

Inactive Licence Holders

For inactive licence holders the key concern is the impact of the regional groundwater decline on the value of groundwater. Infrastructure costs may also be applicable if a bore has been installed.

Stock, Domestic and Dairy Users

The increased cost for stock, domestic and dairy users is minimal, due to the low usage volumes. The concern for these users is continued access to the aquifer, as alternative water supplies are limited or costly.

Calculation of Cost Components for Case Studies

The table on the previous page provides a summary of the increased cost of extraction as a result of the groundwater decline that has occurred on the case study properties. Details relating to the various components included in the table are outlined below.

Infrastructure

Lower Pump

As groundwater levels decline, pumps can be lowered within the existing bores so that water can continue to be extracted.

Costs involved relate to crane hire and the extension required for the rising main. Based on the case studies, the cost varies from \$1,500 to \$5,000 each time the pump is lowered.

Assumption in SKM report (*DNRE Gippsland Declining Levels: Impacts on Irrigators*, SKM 2001) is that the maximum depth that a pump can be lowered on each occasion is 20m. As a result lowering may be required more than once, as has occurred for several of the case study properties.

Consideration will need to be given as to whether a discount is required as lowering will in part be due to the localised impacts of increasing seasonal drawdown as irrigation usage has increased over time.

For the case study properties, total costs for pump lowering (where required) ranged from \$4,000 - \$30,000, or a unit cost of \$8/ML - \$63/ML (licensed volume).

New Bore – Larger Diameter

Bore replacement is required when a pump can no longer be lowered (depth of the widest casing in the bore is limited). The new bore would have a wider diameter casing to a greater depth.

The average life of a bore is 100 years and the current bores have only been installed in the last 10 – 30 years. The groundwater decline is resulting in new bores being required, long before failure of the existing bores.

Figures are based on actual cost of bores installed recently, or quotes received for bores planned in near future. These figures are then discounted to allow for the life already spent of the previous bore (i.e. the new bore will now last beyond the life of the old one).

For the case study properties, total costs for bore replacement (where required) ranged from \$80,640 - \$127,500, or a unit cost of \$47/ML - \$567/ML (licensed volume).

Not all properties need to replace bores, as:

- Those constructed in more recent years, have generally been designed to cope with the declining levels.

- The pumps required for stock and domestic bores are much smaller than for irrigation and can therefore generally be lowered without the need for bore replacement.

Issue: Economy Of Scale For Bore Installation.

Irrigators with relatively small licensed volumes (100ML) need to install a bore at a cost of around \$100,000, or \$1,000/ML.

By comparison a bore for a large irrigator (say 750ML) may cost \$150,000, or \$200/ML. Even in the event of requiring three bores (for say 1,500 ML) at \$130,000 each, the cost is still only \$260/ML.

New Pump/Motor – Larger Size

As the groundwater level declines, larger pumps/motors are required to lift the water the extra distance to the surface.

Figures provided are based on actual cost of recently replaced pumps, or quotes received for planned changes. They are then discounted to the marginal cost difference between the new larger pump and the previous pump, which had already expended part of its life.

For the case study properties, total costs for larger pumps (where required) ranged from \$6,000 - \$15,000, or a unit cost of \$5/ML - \$31/ML (licensed volume).

Increased Pumping Cost

As the groundwater level declines, greater energy is required to lift it to the surface and the cost of pumping is therefore increased.

Increased pumping cost has been split into three sections:

- The cost already incurred – historical extra pumping cost;
- The cost expected to be incurred – future extra pumping cost based on current water use continuing;
- The potential increased cost for currently unused water – this accounts for the impact of declining levels on the value of the groundwater.

Historical Extra Pumping Cost

The calculation for this component considers the additional cost of pumping based on the actual rate of decline for each case study property.

Figures are based on an average unit cost of \$0.70 per ML per metre, and are calculated from the date the first bore was installed on the property or the date the decline started to occur (whichever is later). Usage is assumed to have increased over the historical period, based on properties starting at a third of their 2004 usage.

Figures are in today's dollars. An interest rate of 4% would be appropriate for historical expenditure to cover the cost of debt (the properties could have borrowed to cover the additional cost). However, a conservative approach has been suggested by the WSPA committee and interest has not been applied.

For the case study properties, the historical extra pumping costs ranged from \$320 - \$62,026, or a unit cost of \$11/ML - \$177/ML (active volume in 2004).

Future Extra Pumping Cost – Used Portion

For the future pumping costs the average rate of decline used is 1m/year and the period assessed is 30 years.

Figures are again based on an average unit cost of \$0.70 per ML per metre. They are also discounted to the present value (assistance paid now can be invested and thereby earn interest which will help to cover the cost of pumping in the distant future).

The calculation also takes into account the decline that has already occurred on the property. In other words the extra costs are calculated from the original water level, rather than the current water level.

For the case study properties, the future extra pumping costs for water currently in use, ranged from \$724 - \$321,969, or a unit cost of \$153/ML - \$407/ML (active volume in 2004).

Future Extra Pumping Cost – Unused Portion

These costs are calculated as per the future costs for the used portion of the water. However, they do not take into account the decline that has already been incurred. This is because the future value of the groundwater will be compared to the current value, rather than the historical value.

The potential future pumping cost for currently unused groundwater is \$153/ML.

Total Increased Cost

For the case study properties the total increased cost of extraction ranges from \$764 to \$514,159. The range in unit cost is \$153/ML to \$1,078/ML (licensed volume).

Appendix 5: Data for Assistance Calculations

Infrastructure

New Bore

\$400 per ML used
\$200 per ML unused
up to \$125,000 per bore

Future costs discounted to present value at 4% as per following example.

Year 1	\$125,000
Year 5	\$102,741
Year 10	\$84,446
Year 15	\$69,408
Year 25	\$46,890

New Pump & Lower Pump

\$200 per ML up to \$25,000

Pumping

Inactive Volume

\$152.85 (Future increased pumping cost without impact to date)

Active Volume

Start Date	Historical	Future with Impact to Date
pre 1975	\$180.83	\$271.81
1975	\$166.83	\$267.77
1976	\$155.63	\$263.73
1977	\$144.82	\$259.70
1978	\$134.40	\$255.66
1979	\$124.37	\$251.62
1980	\$114.72	\$247.58
1981	\$105.47	\$243.55
1982	\$96.60	\$239.51
1983	\$88.12	\$234.56
1984	\$80.03	\$231.53
1985	\$72.33	\$227.49
1986	\$65.02	\$223.46
1987	\$58.10	\$219.42
1988	\$51.57	\$215.39
1989	\$45.42	\$211.35
1990	\$39.67	\$207.32
1991	\$34.30	\$203.28
1992	\$29.32	\$199.25
1993	\$24.73	\$195.22
1994	\$20.53	\$191.18
1995	\$16.72	\$187.15
1996	\$13.30	\$183.11
1997	\$10.27	\$179.08
1998	\$7.62	\$175.04
1999	\$5.37	\$171.01
2000	\$3.50	\$166.97
2001	\$2.02	\$162.94
2002	\$0.93	\$158.90
2003	\$0.23	\$154.87

Appendix 6: Checks to Ensure Assistance Appropriate

Purpose

The following sections consider:

- The value of groundwater – as a sanity check for determining whether the preferred assistance package appears reasonable.
- The costs associated with alternatives to the use of groundwater – to determine if the alternatives would be more cost effective and thereby place a limit on the level of assistance that should be provided.

Value of Groundwater

Market Value

Permanent trading of groundwater is currently not possible in the Yarram WSPA. However a market value can be placed on the groundwater through the following means:

- Through conversion of the value of temporary water trading in the area into a capital value;
- By comparison to other areas where permanent trading is taking place;

Temporary Trading

The case studies did identify that some temporary trading of groundwater does occur in the Yarram WSPA. The price for this trade is in the vicinity of \$50 - \$60 per ML per annum. A figure of \$55 will be used here.

Temporary trading price can be converted to a capital value in a similar manner to the leasing price for land. Generally the temporary price is equivalent to 5% of the capital value.

Assuming a temporary trading price of \$55/ML, the capital value of groundwater in the Yarram WSPA is \$1,100/ML.

Value in Other Areas

The price of water in areas where permanent trade does occur is in the vicinity of \$1,000 – \$1,500 per ML. This is approximately half the cost of channel water and reflects the additional cost involved in extraction.

Permanent trading of water in all areas occurs within an immature market, which has developed significantly under drought conditions. The current prices may therefore not reflect the long-term value of the water.

Impact of Declining Levels

As discussed in Section 5.4, consideration has been given to the future increased cost of pumping assuming a 1 m/year decline in groundwater levels and taking into account a

portion of the decline that has already occurred (for active use only). The resulting unit figure determined ranged from \$153/ML to \$272/ML.

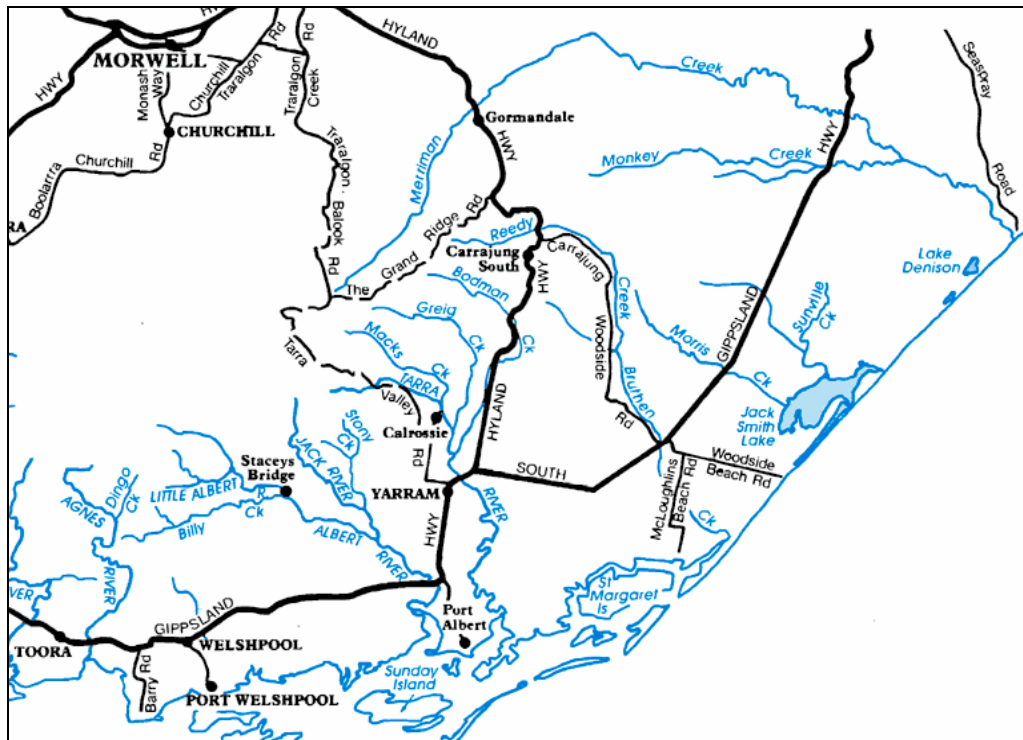
As a result of this additional cost, the value of groundwater should decrease into the future by a similar amount. Assuming the value is currently in the vicinity of \$1,200/ML, a \$275/ML decrease is equivalent to 23%. This appears reasonable given the 60-year period associated with groundwater decline.

Cost of Alternatives

Alternative Water Source

A number of rivers and creeks traverse the Yarram WSPA region, as shown in the following diagram. Potentially surface water could be sourced from these rivers and creeks as an alternative to groundwater.

Figure A6-1 Streams in the Yarram Area



Water available for use from these streams is based on a Sustainable Diversion Limit (SDL).

The SDL of a catchment is the volume of water than can be diverted in the winter fill period (July to October inclusive) before the risk of environmental degradation is considered unacceptable. SDL volumes have been calculated for 1600 catchments across Victoria (*Recommendations for Sustainable Diversion Limits over Winter fill Periods in Unregulated Victorian Catchments*, SKM, 2001). Figures for catchments in the Yarram area are provided in Table A6-11-5, along with the current licensed volume.

Table A6-11-5 Surface Water Availability

	SDL (ML)	Current Use (ML)	Available (ML)
Agnes River	1403.6	858.2	545.4
Albert/Jack River	3258	1685.9	1572
Tarra River	1896.1	1663	233.2
Bruthen Creek	558.7	677.7	-119
Merriman Creek	1268.2	1196.3	71.9
TOTAL	8384.6	6081.1	2303.5

Note that figures above are for the whole of each catchment and apply to the end of the mainstream. The catchments are also split into reaches (or sections of waterway) and these are attributed a portion of the SDL. Licencing aims to work within the SDL for each reach, as well as the catchment as a whole.

Current groundwater use (~8,500ML/annum – irrigation only) and the total licensed volume (~18,600ML/annum – irrigation only) for the Latrobe and Balook aquifers far exceed the availability of surface water in the area.

Surface water can also only be accessed in the winter period, requiring construction of storage to hold water until it is needed in summer. The cost of construction is in the order of \$3,000 - \$5,000 per ML. Infrastructure (pumps/pipelines) for accessing water from the river/creek would also be required.

There may be some savings in pumping costs by comparison to groundwater, but the cost is still expected to far outweigh the increased cost of groundwater extraction due to declining levels.

Alternative Feed Source

For dairy farmers there is the option of accessing an alternative feed source (rather than alternative water). This can be achieved by:

- Purchasing or leasing more land (dryland);
- Importing feed (hay and grain).

Discussions during the case studies identified that values for land and improvements are in the order of \$7,500 - \$10,000 per hectare for dryland property in the Yarram area. Based on a leasing rate of 5%, these figures can be annualised to \$375 - \$500 per hectare. In the Yarram climate, dryland areas produce 5 – 6t/ha (in an average year). The cost per tonne of dry matter is therefore \$63 - \$100. Added to this is the cost of harvesting (hay/silage), as the additional land is unlikely to be within walking distance of the dairy for grazing. This brings the total cost to ~\$100 - \$140 per tonne of dry matter.

Imported feed costs in 2006/07 ranged from \$300 - \$450 per tonne of dry matter for the case study properties.

By comparison the approximate cost of irrigation is as outlined in the table below.

Table A6-11-6 Annual Cost of Irrigation

Component	Approximate Annual Cost (\$/ha)
Pumping	200 – 300
Labour	100 – 300
Annual water charges	15 – 25
Repairs & maintenance	20 – 50
Infrastructure	200 – 350
Capital cost of groundwater	275
Total	810 – 1300
Cost per Tonne Dry Matter	135 – 217 (\$/tonne)

Based on the case study properties it is estimated that production from irrigated areas ranges from 10 – 12t/ha, while dryland areas produce 5 – 6t/ha (in an average year). If it is assumed that irrigation increases production by 6t/ha, the annual cost ranges from \$135 - \$217 per tonne of dry matter.

Comparing these irrigation costs with alternative feed suggests:

- Purchasing/leasing additional dryland is cheaper than irrigation by an average of ~\$50 per tonne DM, which equates to \$60/ML (assuming average irrigation of 5ML/ha).
- Importing feed is more expensive than irrigation by ~\$200 per tonne DM, which equates to approximately \$240/ML.

These figures apply on an annual basis. The total cost/(saving) for the next 30-year period, is (\$1,050/ML) for purchasing/leasing additional dryland and \$4,150/ML for importing feed (assuming a present value is calculated using a discount rate of 4%).

Sunk costs need to be incorporated as outlined below, prior to making a final conclusion.

Sunk Costs

In moving from irrigation with groundwater to an alternative option, sunk costs need to be taken into account, in addition to the cost of the alternative.

Sunk costs include:

- Groundwater bores, pumps and potentially distribution pipelines, when changing to surface water supply. An approximate range for these sunk costs is \$500/ML – \$1,500/ML.
- Groundwater bores, pumps, distribution pipelines, irrigation infrastructure and balancing storages, when moving to an alternative feed source. An approximate range for these sunk costs is \$3,500/ML – \$6,000/ML (based on similar figures to those outlined for infrastructure in Table A6-11-6).

When combined with the cost of alternatives (or the saving in the case of purchasing/leasing additional dryland) outlined in previous sections, these figures far exceed the increased cost of groundwater extraction.

Conclusions

Alternatives to irrigation with groundwater include:

- Access to surface water at a cost exceeding \$3,000/ML – \$5,000/ML, plus sunk costs of \$500/ML – \$1,500/ML.
- Purchasing/leasing additional dryland at a saving of \$1,050/ML, but sunk costs of \$3,500/ML - \$6,000/ML turn this into an overall cost of \$2,450/ML - \$4,950/ML.
- Importing feed to replace irrigation at a cost of approximately \$4,150/ML, plus sunk costs of.

These alternative costs are well in excess of the additional cost of extraction associated with declining groundwater levels. Therefore the assistance package proposed appears appropriate.