WESTERN TREATMENT PLANT SALINITY MANAGEMENT PLAN

A PLAN TO MANAGE SALINITY IN RECYCLED WATER FROM WESTERN TREATMENT PLANT TO FACILITATE SUSTAINABLE WATER RECYCLING

22 December 2004

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Executive Summary

The Victorian Government White Paper: *Our Water Our Future* states in Action 5.32:

Melbourne Water and City West Water will develop a salinity reduction strategy for the Western Treatment Plant this year. A key outcome will be fit-for-purpose water for the Werribee Irrigation District Recycled Water Scheme.

1. Context

The region around Western Treatment Plant provides a good opportunity for sustainable recycling with significant residential development, horticulture, agriculture and industry. Sustainable water recycling in the region can provide for a number of opportunities including:

- Conserving the Werribee River water resource and environmental flow by substituting suitable quality recycled water for surface water irrigation,
- Reducing the demand for potable water in new urban developments by using recycled water for appropriate uses such as toilet flushing and garden watering,
- Improving the marine environment by reducing the quantity of treated effluent discharged to the bay, and
- Providing broader social, economic and environmental benefits through regionally integrated water resource projects using recycled water.

These opportunities are constrained by the current level of salinity in the water available for recycling from Western Treatment Plant. It is therefore appropriate to develop a salinity reduction strategy.

Investigation has demonstrated that for the most appropriate uses of recycled water, the salinity of delivered water should be approximately 550 mg/l TDS for sustainable use. This target has been adopted as part of the strategy, it betters the 40 per cent reduction target published in the Government's White Paper and will provide a 'fit-for-purpose' supply for the Werribee Irrigation District. It should be noted however, that higher salinity levels in recycled water may be adequate for some purposes.

2. Sources of Salinity

The typical salinity level of sewage flowing to the Western Treatment Plant is 1050 mg/l total dissolved solids (TDS). This relatively high level is generated largely by industry discharges (44 per cent), which raises the salinity of sewage entering Western Treatment Plant to double that of domestic sewage. Sources of salinity in sewage flows to the Western Treatment Plant are shown in Figure I.

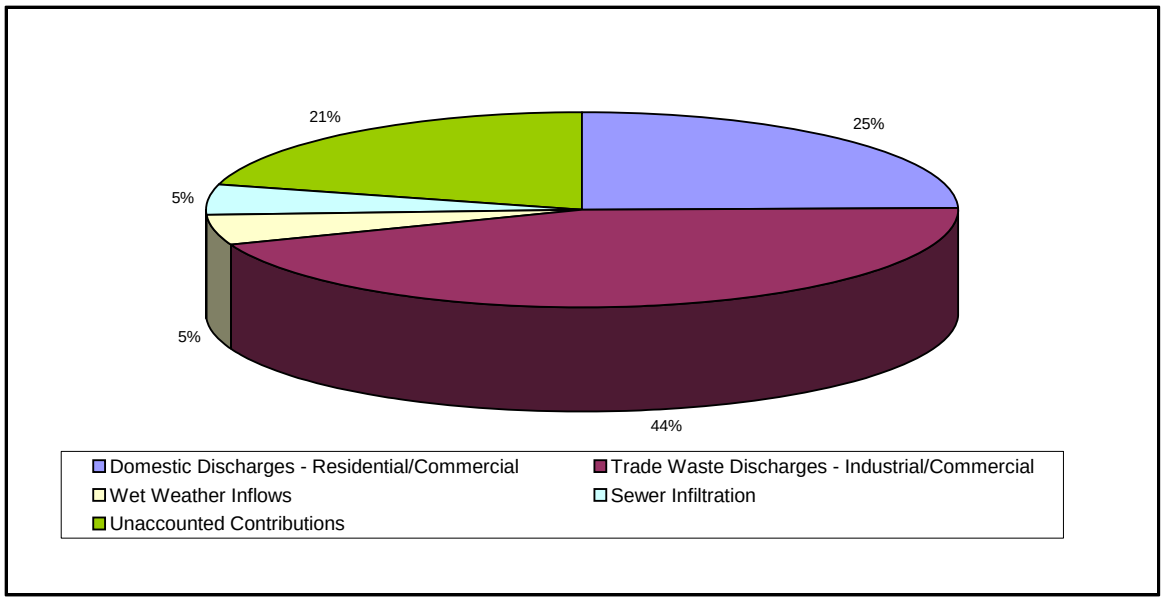

Figure I: Sources of Salinity in Flows to the Western Treatment Plant

The relatively high salt content of sewage flowing to the Western Treatment Plant from industry is a result of typical urban growth patterns and Government priorities over the past 100 years. Government planned for and encouraged heavy industry to locate in the west and the western sewage treatment plant was part of the plan. The typically saline-rich discharges from industry were accommodated satisfactorily following an accepted 'treat and discharge' policy until recent years as water security issues have heightened.

However, community attitudes have changed over the past 10 years, with an increasing recognition of the need to conserve drinking water. This has created a community expectation that water recycling has a high priority.

Government and industry are now working to meet these community expectations and reducing salinity in treated effluent is a vital element in improving the quality of the recycled water from the Western Treatment Plant, and ensuring that it is attractive for a wide range of applications.

The lagoon treatment processing of sewage at the Western Treatment Plant does not target salinity reduction and hence does not reduce the salinity level in the effluent leaving the plant. Accordingly, a strategy is required to reduce the salinity to a level that enables sustainable long-term water recycling.

3. Implementation Issues

The proposed salinity reductions will provide immediate benefits for recycling on Western Treatment Plant grazing land as well as for off-site recycling proposals. Projections for 2005/2006 indicate 94 per cent of the effluent available for recycling will be used to irrigate existing grazing land at the Plant. Any at-source reduction in the salinity of the recycled water will enhance productivity of pasture and hence improve the viability of the Werribee agriculture cattle grazing business.

For off-site recycling to primary production businesses, the amount of salinity reduction necessary is dependent upon the nature of the recycled water scheme and at-source salinity reduction will not be sufficient for sustainable use.

4. Salinity Reduction Options

When developing recycled water schemes, the salinity can be managed by:

- Reducing the salinity of the recycled water, or
- Diluting the recycled water with other low salinity water, or
- A combination of these.

The salinity management options considered for recycling of treated effluent from Western Treatment Plant were:

- Diluting the effluent with lower salinity potable water or surface water from the Werribee River to provide a blended water with suitable salinity;
- Reducing the salinity of inflow from industrial processes by treatment of the waste discharge at each large industrial plant;
- Reducing the salinity of inflow from industrial processes by encouraging industry to adopt ‘cleaner’ production practises;
- Reducing the salinity of inflow from domestic activity by converting consumers to lower salt domestic detergents;
- Introducing separate treatment at Western Treatment Plant for the portion of the sewage inflow that has the highest salinity;
- Diverting the high salinity portion of the inflow to the Altona Treatment Plant.
- Introducing new desalination treatment for the effluent sufficient to achieve the recycled water target salinity; and
- Reducing saline groundwater infiltration into the sewerage system.

A Consultant was appointed to review and rank these options to achieve recycled water at the targeted salinity level. The Consultant’s recommendations were:

- Implement a cleaner production strategy with City West Water industrial trade waste customers and target an overall 20% reduction in salinity concentration of their discharges by 2009;
- Implement an education program with consumers and manufacturers to encourage a change to lower salinity domestic laundry detergents; and
- Utilise a desalination process at Western Treatment Plant to make up the shortfall in achieving the targeted 550mg/l TDS salinity.

5. Assessment of Consultant's Salinity Reduction Recommendations

5.1 Reductions at Source

5.1.1 City West Water Industry Cleaner Production Strategy

A fundamental element of the salinity reduction strategy is the program being undertaken by City West Water to reduce pollutant loads at source before disposal to sewer. The major focus of this initiative is on reduction of salinity loads by 49 tonnes/day TDS by 2009. This represents a 20 per cent reduction on 2003 trade waste TDS concentration from the City West Water trade waste customers.

The program is shown diagrammatically in Figure II and the activities involved can be summarised as follows:

- Available industry salinity contributions will be analysed to confirm the largest contributors of total dissolved solids (TDS).
- Monitoring of these industries will continue to confirm salinity contributions.
- Additional City West Water personnel will be engaged to work with trade waste customers to assist in preparation of salinity and resource management plans.
- The plans will identify issues and develop sustainable solutions that take account of impacts on industry product quality and on production costs.
- Research will be commissioned, as necessary, to overcome any technical barriers to implementing effective solutions.

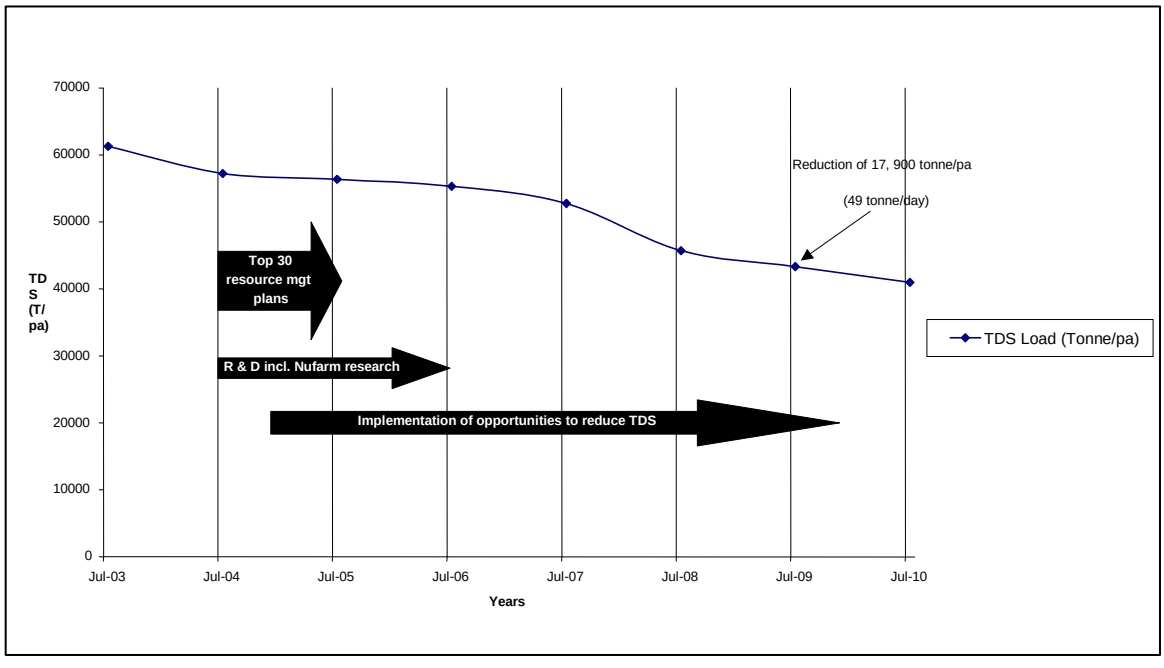

Figure II: City West Water Cleaner Production Program

There is an opportunity to achieve a significant but lesser salinity reduction at source through Yarra Valley Water trade waste customers. City West Water is collaborating with Yarra Valley Water to pursue this opportunity.

5.1.2 Pollution Load Pricing

In parallel with the Cleaner Production Strategy, Melbourne Water is seeking to implement charges for wholesale sewage treatment services based on pollution load, rather than the historic charges for sewage volume, from 2005/06. This proposal has been submitted to the Essential Services Commission and will include a cost reflective salinity charge, which provides an important mechanism for the retail water businesses to signal, through their trade waste charges to their customers, the costs and risks of accepting industrial wastes. The proposed sewage charging structure should encourage a focus on salinity reduction at source.

5.2.3 Domestic Detergent Substitution

Laundry detergents contribute approximately 23 per cent of the salinity in domestic sewage and therefore form the major focus for salinity reduction in domestic sources.

The water industry, through the Water Services Association of Australia, is continuing to consult with the detergent manufacturing industry to identify possible ways to reduce the salinity contribution from detergents. An assessment of the viability of this approach together with an implementation plan, are targeted for completion by December 2004.

The Water Industry, through both Water Services Association of Australia and the Department of Sustainability and Environment, is investigating ways to introduce product labelling and community education programs to encourage consumers to choose detergents with lower salt content.

5.2 Reduction by Desalination

Despite significant advances in recent years, the life cycle cost for desalination remains relatively high. The factors that impact on the cost of desalination include:

- The type of technology used;
- The salinity level of feed water;
- The salinity level of product water;
- Available energy sources; and
- The short and medium term demand for recycled water.

It is therefore important to thoroughly investigate and confirm that desalination is the best way to deliver recycled water at the target salinity of 550 mg/l TDS. Most technologies for desalination are sensitive to the characteristics of the feed water and therefore a proto-type demonstration process is required to identify feasible technologies. The quantification of other factors will involve monitoring, consultation and data modelling as part of the concept design process.

These investigations and trials will take at least 12 months, and will run in parallel with, as well as providing input to, the preparation of a Business Case for the desalination plant. These combined activities are scheduled for completion by December 2005 and can be accommodated within the timeframe for achieving the targeted salinity reduction by 2009 at latest.

6. Fit-for-purpose Recycled Water for Werribee Irrigation District

The initial opportunity for large scale water recycling outside the Western Treatment Plant is the Werribee Irrigation District, which is a major provider of horticulture produce for local, national and export markets. On average, the district utilises 13.5GL of irrigation water each year made up of 8 to 10GL from its Werribee River entitlement, up to 2.5GL from River 'sales' water and 1.5 to 3 GL from groundwater. The river water entitlement is available in 96 years out of 100 and some sales water is available in 85 years in 100. Groundwater has been used to meet shortfalls in supply.

The recent low rainfall years have reduced the availability of river water, thus increasing the opportunity to substitute recycled water for river water and highlighting the need to develop a water resource plan for the western region. To take advantage of this opportunity, there is a need to manage the salinity level in the water offered for substitution.

- It is possible to immediately supply water at the sustainable salinity target of 550 mg/l TDS by blending the recycled water from Western Treatment Plant with Werribee River water. However, until all the Werribee Irrigation District irrigators transfer from river water onto recycled water, the common channel delivery system will have to be used on alternate days for the two distinct water supply options. This inefficiency, combined with the variation in river water salinity in a typical year, will limit the use of recycled water to 2 GL per year.
- Historically, growers have used high salinity water in times of shortage. It is possible to continue this practice and immediately supply blended irrigation water that mimics the historical salinity when river water availability is low. In the short term, this optimises use of recycled water and increases security of supply when water is most needed. In years when no sales water is available, up to 6.7GL per year (all customers accepting recycled water) of recycled water could be supplied.
- In the event that river water supply is less than the water right during low rainfall years, then a 'top-up' from potable supplies could be used as a contingency plan. This would also allow more recycled water to be used in these years.
- The volume of recycled water blended into the supply could be increased, by reducing the salinity of the river water so that the blending is more effective. This option will require a change to catchment management practises upstream and may still require 'top-up' from potable water supplies from time to time. These options could be used to further improve the security of supply or increase the savings in surface water.
- To maximise recycled water supply and therefore maximise reductions in river water use, the salinity of recycled water from Western Treatment Plant could be reduced to 550 mg/l TDS using desalination processes. This would ultimately allow up to 10 GL per year of recycled water to be used in preference to other supplies.

7. Other Water Demands Influencing Salinity Reduction

In addition to the Werribee Irrigation District, there is potential to substitute recycled water for up to 36.7 GL per year of surface or potable water within the Werribee Plains Region. However, at this stage only the Werribee Irrigation District supply and residential dual pipe scheme in the Wyndham region have sufficient commitment to consider including in demand projections for recycled water.

Recycled water schemes will each be supported by a business case based on recycled water supply at an assumed salinity level. The options to achieve the assumed salinity levels will include:

- Blending of recycled water with lower salinity sources where this is feasible;
- Desalination at the project site;
- Desalination at Western Treatment Plant.

Salinity reductions achieved through source reduction will benefit each scheme.

8. The Strategy and Accompanying Actions

Salinity reduction at source through cleaner production practises in industry and substitution of high salinity detergents with low salinity detergents in households has the potential to make a significant and cost effective reduction in the recycled water salinity. Further salinity reductions are required to meet the targeted recycled water salinity of 550 mg/l TDS.

The strategy proposed by Melbourne Water and City West Water to achieve Action 5.32 described in the White Paper, *Our Water Our Future*, is:

8.1 Short-term management of WID Recycled Water Scheme to 2009

- Collaborate with Southern Rural Water to blend recycled water and river water so as to maximise the supplied volume of recycled water whilst maintaining salinity levels below the normal seasonal salinity range historically experienced in the river.

  Actions: Provide recycled water to Werribee Irrigation District from December 2004 and collaborate with Southern Rural Water for blending with river water up to the allowable salinity content. Co-ordinate with Southern Rural Water to manage shortages of river water or elevated river water salinity, from time to time.

  Review the entitlement, tariff and restrictions policies that will apply in low rainfall years to provide irrigators with future security of supply and surety of pricing.

  Investigate the impact of other major water resource initiatives across the State or any opportunities to trade water entitlements to overcome resource restrictions.

- Investigate ways to manage the river catchment with a view to reducing river water salinity and enabling a greater volume of recycled water to be included in the blend.

  Action: Investigate the resource management options for the Werribee River, as well as adjacent catchments, to determine the optimum use of water resources to achieve Government's environment and consumptive objectives over a 100-year horizon to cover all natural event cycles.

8.2 Long-term Salinity Reduction

- Investigate all factors that affect the size and cost of a desalination plant and develop a capital investment program that can accommodate on-going reductions in salinity at source, as well as achieving the target salinity reduction in recycled water by 2009.

  Actions: Develop a business case for a desalination plant including provision to supply recycled water for future development schemes in the Werribee Plains. Incorporate a triple bottom line economic assessment and a financial (affordability) assessment incorporating the outcomes from the following investigations:

  - Alternative desalination technologies;
  - Options for reducing the natural salinity of the Werribee river;
  - The optimum salinity levels required for the sustainable use of recycled water in the range of soils in the Werribee Plains;
  - Benefits associated with upgrading the irrigation channel system to minimise seepage losses.

  The outcomes from these investigations will determine a preferred plan for staged delivery of a desalination plant to achieve the volumes of recycled water needed to offset river water use as well as to develop recycling for the broader Werribee Plains Vision.

- Work with key industries to implement the "*Cleaner Production Strategy*" and maximise salinity reduction at source.

  Action: The Victorian Water Trust has allocated $1million for Water Smart Industry Demonstration Projects aimed at achieving reductions in salt and other pollutants, reductions in the use of potable water and an increase in the effective uses of recycled water. This initiative will support and accelerate the City West Water Cleaner Production Strategy.

- City West Water to collaborate with Yarra Valley Water for the purpose of extending the cleaner production strategy to Yarra Valley Water trade waste customers.

  Actions: Agree on collaborative program with Yarra Valley Water to extend the salinity reduction strategy to their trade waste customers.

  Both City West Water & Yarra Valley Water to pursue salinity source reduction plans and confirm the reduction levels that could be achieved in the medium and long-term horizons.

- Work with Water Services Association of Australia to:
  - Encourage detergent manufacturers to reduce the salt content in laundry products;
  - Consider a product labelling program with a view to informing consumers and allowing them to choose domestic detergents with lower salt content.

  Actions: Participate as a stakeholder in the Water Services Association of Australia working committees to assist in the development and implementation of salt reduction programs.

  Work with Department of Sustainability and Environment to:
  - Investigate ways to introduce product labelling;
  - Investigate ways to introduce a community education program.

- Continue monitoring of sewage flows throughout the network to determine the sources of currently unaccounted salinity contributions.

  Action: Improve the sewage load estimates methodology through a working group with the retail water companies.

- Review this strategy at the conclusion of the investigations outlined above and update it as necessary by 31 December 2005.

  Action: Melbourne Water and City West Water to convene quarterly meetings to review actions and to maintain progress towards agreed target dates and outcomes.

8.2 Implementation Program

Figure III, below, sets out the sequence and timing of the actions described in this strategy.

ID	Task Name	Dur	Start	Finish
1	**Salinity Management for WID**	**1011 d**	**Mon 20/12/04**	**Fri 02/01/09**
2	**Start Supply to WID**	0 d	Mon 20/12/04	Mon 20/12/04
3	**Recycled Water/River Water Blending Completed**	0 d	Fri 02/01/09	Fri 02/01/09
4	**Implement & Assess Cleaner Production Strategy**	**1032 d**	**Fri 19/11/04**	**Fri 02/01/09**
5	**Start Cleaner Production**	0 d	Fri 19/11/04	Fri 19/11/04
6	**Produce Top 30 Resource Management Plans**	146 d	Fri 19/11/04	Wed 29/06/05
7	**Research and Development**	1032 d	Fri 19/11/04	Fri 02/01/09
8	**Implementation of Cleaner Production Opportunities**	886 d	Thu 30/06/05	Fri 02/01/09
9	**2009 Cleaner Production Outcome**	0 d	Fri 02/01/09	Fri 02/01/09
10	**Prepare Desalination Plant Business Case**	**240 d**	**Fri 19/11/04**	**Wed 09/11/05**
11	**Board Approval for Preconstruction Expenditure**	**0 d**	**Fri 19/11/04**	**Fri 19/11/04**
12	**Confirm Recycled Water Demand**	**168 d**	**Fri 19/11/04**	**Fri 29/07/05**
13	**Regional Salinity Environment Investigations**	**140 d**	**Fri 19/11/04**	**Tue 21/06/05**
14	**Forecast Salinity Reduction Required**	**10 d**	**Thu 23/06/05**	**Wed 06/07/05**
15	**Technology Demonstration Projects**	**220 d**	**Fri 17/12/04**	**Wed 09/11/05**
16	**Concept Design for Desalination Plant**	**60 d**	**Tue 26/04/05**	**Tue 19/07/05**
17	**Assess Costs and Benefits**	**130 d**	**Tue 29/03/05**	**Tue 27/09/05**
18	**Document Business Case**	**110 d**	**Tue 26/04/05**	**Tue 27/09/05**
19	**Desalination Plant Delivery**	**822 d**	**Wed 28/09/05**	**Fri 02/01/09**
20	**Present Business Case to MW Board**	**17 d**	**Wed 28/09/05**	**Thu 20/10/05**
21	**Present Business Case to DTF**	**1 d**	**Fri 21/10/05**	**Fri 21/10/05**
22	**Concept Design & Functional Requirements**	**110 d**	**Fri 21/10/05**	**Mon 10/04/06**
23	**Update Salinity Reduction Forecast**	**5 d**	**Wed 09/08/06**	**Tue 15/08/06**
24	**Tendering Process**	**100 d**	**Tue 11/04/06**	**Thu 31/08/06**
25	**Approval Process**	**100 d**	**Fri 01/09/06**	**Mon 05/02/07**
26	**Board Approval for Construction Contract**	**0 d**	**Mon 05/02/07**	**Mon 05/02/07**
27	**Confirm Pilot Plant Requirements**	**15 d**	**Tue 06/02/07**	**Mon 26/02/07**
28	**Pilot Testing**	**220 d**	**Tue 27/02/07**	**Fri 04/01/08**
29	**Construction and Commissioning**	**260 d**	**Mon 07/01/08**	**Fri 02/01/09**

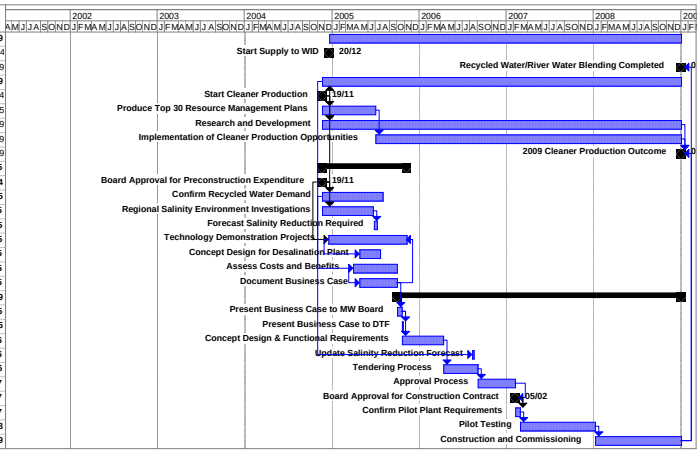

Figure III: Western Treatment Plant Salinity Reduction Action Plan

1 Background and Terms of Reference

The Victorian Government White Paper: *Securing Our Water Future Together* states in Action 5.32:

Melbourne Water and City West Water will develop a salinity reduction strategy for the Western Treatment Plant this year. A key outcome will be fit-for-purpose water for the Werribee Irrigation District Recycled Water Scheme.

This strategy, jointly developed by Melbourne Water and City West Water, assesses a range of salinity management options required to reduce the salt content of recycled water from the Western Treatment Plant by 40 per cent by 2009 at latest. The plan is focused on the requirements of the Werribee Irrigation District but the technical solution will facilitate future expansion to provide additional desalination if required for other recycled water schemes in the Werribee Plains region.

1.1 Meeting demand for water in a dry region

During the past eight years, Victoria has been hit by one of the most prolonged droughts in its history. This drought has forced us to look at how we use water.

In the dry Werribee Plains region, there are many competing demands for water. These demands are becoming more difficult to meet as the region's population increases. A lack of water is a constraint on growth in the region.

The major water sources in the Werribee Plains are drinking water drawn mainly from the eastern side of Melbourne (for business and urban use) and water extracted directly from rivers (for agriculture and limited urban use following treatment).

Rivers in the region are stressed because of these water extractions, and a significant increase in the use of groundwater towards the end of 2003 contributed to the reduced security of this vital resource.

The Victorian Government's vision is to transform the Werribee Plains into an internationally recognised 'green' region revolving around sustainable agriculture, urban development, industry, tourism and environmental management.

Central to the vision is an abundant supply of clean, high quality recycled water from the Western Treatment Plant at Werribee, which will help generate new economic and employment opportunities, and provide an alternative resource to reduce stress on existing water supplies.

1.2 How water recycling creates new opportunities

Water recycling is a key part of creating a sustainable water supply for Melbourne – it reduces the discharge of treated effluent to bays and the ocean, creates an opportunity for economic growth, and conserves drinking water, which can defer the need to build further water storages.

As a community, we are beginning to realise the opportunities provided by recycled water. We can no longer afford to regard recycled water as a waste product; it is a valuable resource.

Water recycling schemes have been developed using treated effluent from Melbourne Water's Eastern and Western Treatment Plants for agriculture, horticulture and vineyards, and to irrigate golf courses and sporting fields.

In the west, these schemes include the Werribee Tourist Precinct for the Werribee Zoo, Werribee Mansion, Werribee Park Golf Course and the National Equestrian Centre.

In 2003/04, some 11.5 per cent of the total discharge from the Eastern and Western Treatment Plants was recycled – well on the way to meeting the Victorian Government's target of 20 per cent by 2010.

A $124 million upgrade of the Western Treatment Plant – the most significant since the plant was established more than 100 years ago – is ensuring that all sewage is treated to a high standard that opens up new opportunities for water recycling both on and off the Western Treatment Plant site.

However, a significant impediment to water recycling west of Melbourne is the relatively high salt content of sewage flowing to the Western Treatment Plant.

1.3 Water Recycling from the Western Treatment Plant

The region around Western Treatment Plant provides a significant opportunity for sustainable recycling with significant residential development, horticulture, agriculture and industry. Sustainable water recycling in the region can provide a number of benefits including:

- increasing potable water resource and environmental flow by supplementing surface water irrigation with suitable quality recycled water,
- reducing the demand for potable water in new urban developments by using recycled water for appropriate uses such as toilet flushing and garden watering,
- improving the marine environment by reducing the quantity of treated effluent discharged, and
- providing broader social, economic and environmental benefits through regionally integrated water resource projects using recycled water.

In January 2004 the Government announced the Werribee Irrigation District recycled water scheme to supply Class A recycled water for horticulture. Works are in

progress to disinfect the treated effluent to Class A quality and to provide the required delivery infrastructure to service the scheme from December 2004.

Other schemes under consideration for the Western Treatment Plant region include:

- Wyndham Residential Development dual pipe scheme
- Recycling opportunities for the West of Melbourne including Balliang, Bacchus Marsh and Moorabool Valley regions.

Under these schemes there is potential to substitute recycled water for up to 46GL per year of surface or potable water with 8.5GL the likely demand for the Werribee Irrigation District by 2009 and a further 6.5GL per year utilised by 2010. However, this opportunity is constrained by the current salinity levels of the treated effluent from Western Treatment Plant.

2 What is the Current Salinity Level in Western Treatment Plant Recycled Water?

The Western Treatment Plant inflow catchment includes half of Melbourne's households and most of Melbourne's industry that generates 'trade wastes'. The large trade waste contribution results in sewage that has double the salinity level of domestic sewage.

The salinity of raw sewage treated at Western Treatment Plant typically varies from 1,000 to 1,150 mg/l TDS with testing indicating little variation in salt levels on a daily basis.

Historical variation in raw sewage salinity is shown in Figure 1 below.

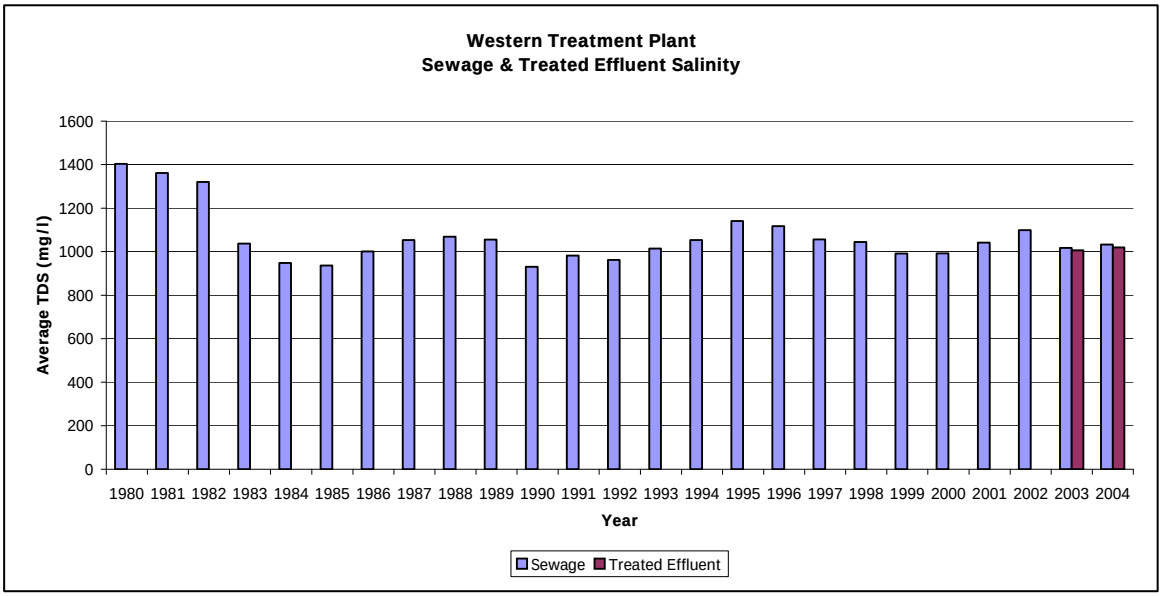

Figure 1: Historical Sewage and Treated Effluent Salinity

Trade waste guidelines were introduced in 1980 with a significant impact on salinity by 1983. Since then the salinity level has cycled between 900 mg/l and 1,150 mg/l TDS. There is some suggestion of a rising trend with higher values since 1995,

however this may be the effect of the extended period of drought and associated water conservation activities that have concentrated the TDS.

Western Treatment Plant uses lagoon systems to treat the sewage. Some of the salinity is organic (approximately 20%) and is broken down by the natural biological processes in the lagoons. The remaining salinity is inorganic and mostly passes through the lagoon process unchanged.

The outcome is treated effluent with an average salinity of 950 mg/l TDS over the year or 1,000 mg/l TDS over the irrigation season (October to March).

For comparison, the salinity of seawater is between 30,000 – 35,000 mg/l TDS and the salinity of Melbourne's drinking water is 25 – 85 mg/l TDS.

The seasonal variation in salinity is shown in Figure 2 below.

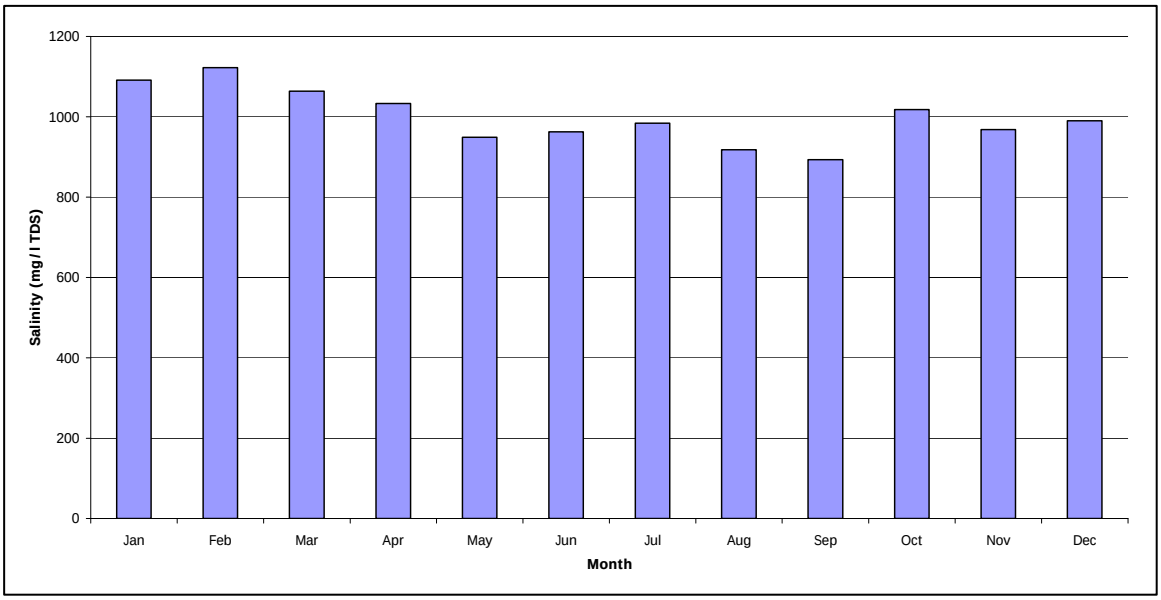

Figure 2: Seasonal Treated Effluent Salinity

Short-term variations in raw sewage salinity are smoothed out as the water spends 30 to 60 days passing through the treatment lagoons.

The seasonal variation in salinity arises from variation in evaporation and rainfall. Five to ten per cent evaporation from the treatment lagoons during summer concentrates the salinity. Rainfall during winter dilutes the incoming raw sewage and also dilutes the water in the lagoons.

The net result is recycled water with salinity during summer similar to the raw sewage.

2.1 Effect of Water Conservation

The target for 15 per cent reduction in per capita water consumption has the potential to reduce the water component of sewage, which would result in increased salinity. Current salinity levels are around 10 per cent above "normal" levels due to the prolonged drought and water restrictions.

It seems reasonable therefore to conclude that water conservation will not increase sewage salinity by more than 5 per cent above the current, already elevated, levels.

Conclusion 1

In the absence of salinity reduction activities the salinity of recycled water from Western Treatment Plant will be 1,050 mg/l TDS during the summer irrigation season.

3 Sources of Salinity in Sewage Effluent

Salinity can enter the sewerage system from our bathroom, laundry, toilet and kitchen waste, through discharges from industry and commercial enterprises and from surface (inflow) and groundwater (infiltration) that may leak into the sewerage system.

Figure 3 below summarises the contribution each of these sources makes to the salinity of sewage treated at Western Treatment Plant.

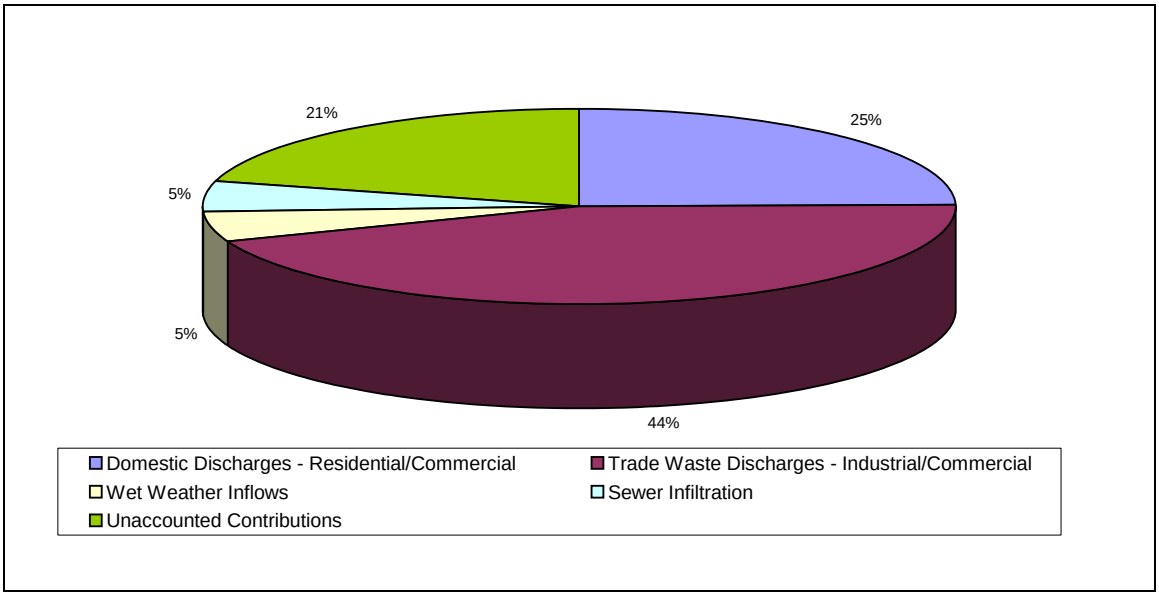

Figure 3: Contributions to Salinity Input to the Western Treatment Plant

Current estimates of the contribution from each source do not account for all the salinity that arrives at Western Treatment Plant. Further work is required to better quantify the contribution from each source.

3.1 Trade Waste Discharges

Industry contributes almost half (44 percent) of the salinity to Western Treatment Plant, which raises the salinity of sewage entering Western Treatment Plant to double that of domestic sewage. The relatively high salt content of sewage flowing to the Western Treatment Plant from industry is a result of typical urban growth patterns and Government priorities over the past 100 years. Government planned for and encouraged heavy industry to locate in the west and the western sewage treatment plant was part of the plan. The typical saline-rich discharges from industry were accommodated satisfactorily following an accepted 'treat and discharge' policy until recent years as water security issues have heightened.

Major contributors include the chemical manufacturing, textile, and food manufacturing industries and industrial waste treaters. Many manufacturers produce salt as a by-product of their operations, and others such as tanneries use pure sodium chloride. Caustic soda is widely used in manufacturing businesses – from cleaning in the food industry to neutralising industrial effluent in other manufacturing businesses to meet trade waste standards, adding to the salinity of trade waste.

The ten largest industrial customers discharge more than half of the total salinity contribution from industry.

Management of salinity from major industry discharges has the potential to significantly reduce the salinity load.

3.2 Domestic Discharges

Domestic discharges contribute 25 per cent of the salinity to Western Treatment Plant. The relative contributions to domestic salinity in the Western Treatment Plant Catchment are shown in Figure 4 below.

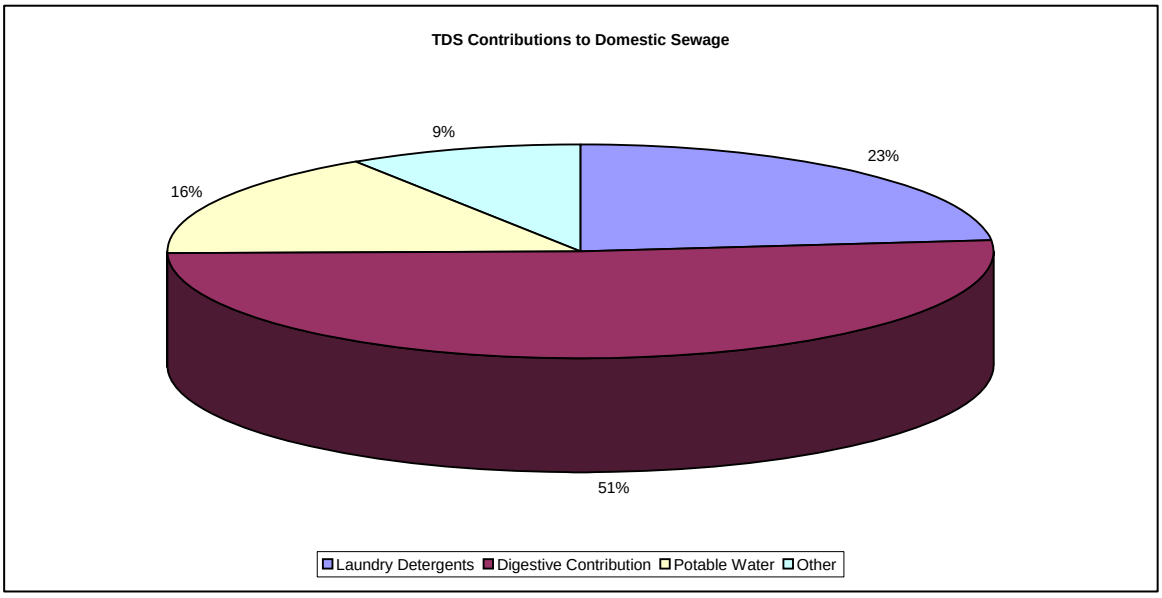

Figure 4: TDS Contributions to Domestic Sewage

Most of the salt in food we eat is excreted. Salt from our diet contributes approximately half of the salinity in domestic sewage. Laundry detergents contribute an additional 23 per cent.

A significant amount of the salinity in laundry detergents is included in fillers used in powdered detergents. Concentrated detergents or liquid detergents have significantly lower salt content but are not commonly used in domestic clothes washing machines.

3.3 Inflow/Infiltration

Rainwater and groundwater can enter the sewerage system through illegal connections or through leaking joints and cracks in the pipes.

Rainwater has low salinity and in fact inflow during rainfall events dilutes the sewage providing a benefit from a salinity perspective.

Groundwater can have higher salinity. Saline infiltration can occur if there are significant leaks in a sewer below the groundwater level. Current estimates do not indicate that this is a significant contribution. In addition sewer rehabilitation to control infiltration is extremely costly and has limited success. Infiltration control is not considered a viable salinity reduction option.

Conclusion 2

Industrial and domestic inputs with 44 per cent and 25 per cent of the overall salinity respectively are the major contributors to sewage salinity. These should be the major focus for salinity reduction.

Conclusion 3

Current information on sources of salinity cannot account for 21 per cent of the salinity in the sewage that flows to Western Treatment Plant. The understanding of sources of salinity needs to be improved to ensure salinity reduction is correctly focussed.

4 What Salinity Level is Necessary for Sustainable Recycling?

Recycled water salinity requirements depend on the nature of the water recycling scheme. Factors to be considered when setting salinity targets for primary production include:

- Availability and sources of water;
- Impacts on crop type and soil suitability;
- Environmental impacts from soil and drainage salinity;
- The land management effort required to manage salinity; and
- The ability of the landholder to manage the impacts.

4.1 Onsite Irrigation

Some 6000 Ha of land at Western Treatment Plant will be used to grow fodder for a livestock business from December 2004. This land is irrigated using recycled water and is more tolerant of salinity than most off-site applications since the soils are well drained and the irrigation management and receiving environment allows a significant drainage fraction to wash salt through the soil. The saline drainage discharges to a marine environment where downstream environmental impacts are limited.

There is currently no need to reduce the level of salinity in the recycled water for on-site irrigation practises. However, reductions in salinity could reduce the drainage fraction required to wash salt through the soil and may also improve the productivity of pasture and other fodder crops.

4.2 Off-site Irrigation

4.2.1 Horticulture

For horticulture applications with salt sensitive crops like lettuce, (a specialty crop for the Werribee Irrigation District), typical irrigation water salinity levels need to be below 550 mg/l TDS for optimum crop yield. This protects sensitive crops from reduced yield caused by soil salinity, and avoids leaf burn that reduces crop value. Occasional higher levels of salinity can be managed by increasing application of calcium nitrate and gypsum and irrigating more frequently to keep the soil and plants wet. This is not a sustainable practice because it increases chemical and water use and increases cost. The irrigation water supply needs to be managed to keep typical salinity below 550 mg/l TDS.

4.2.2 Irrigation of Broad Acre Crops.

Opportunities have been identified for the application of recycled water to higher value broad acre crops, such as lucerne, particularly in the Balliang region to the north west of Western Treatment Plant.

These crops are more salt tolerant so could be grown for a limited period with recycled water at the current salinity. Over time soil salinity would increase and the availability of recycled water would be the catalyst for transition to higher value horticulture and viticulture enterprises in the region. These are more salt sensitive crops and are also likely to require irrigation water salinity of 550 mg/l TDS. It is

estimated that the transition to horticulture and viticulture would occur after 10 years at which point the recycled water salinity would need to be reduced to meet the more sensitive crop irrigation requirements. The minor increase in soil salinity over the ten-year period would not impact on soil structure or crop viability.

4.3 Residential Uses

Dual supplies of potable and recycled water in urban developments such as Manor Lakes replace potable water use for gardens, toilets and landscaping with recycled water.

Specific salinity requirements will depend on the particular scheme, however, based on soil studies in adjacent regions, a salinity of 550 mg/l TDS should be sufficient. The corrosion impact on pipes and valves is mitigated by the reduced salinity in recycled water. The reduced salinity is required from commencement of any dual pipe scheme.

Conclusion 4

There is currently no need to reduce the level of salinity in the recycled water for on-site irrigation practises at Western Treatment Plant.

Conclusion 5

Water with salinity greater than 550 mg/l can be used for horticulture but requires management practises for salinity impacts and is not sustainable in the long-term. Supply of water with a salinity of 550 mg/l TDS will avoid long-term environmental impact for the majority of potential uses of recycled water from Western Treatment Plant.

5 Salinity Reduction Options

When developing recycled water schemes, the salinity can be managed by:

- reducing the salinity of the recycled water, or
- diluting the recycled water with other low salinity water, or
- a combination of these.

The salinity management options considered for recycling of treated effluent from Western Treatment Plant reduce salinity of recycled water in the longer term by either reducing the salt discharge at the source, separating the saline water, dilution with other low salinity water or by treating the effluent.

Dilution:	Option 1
Reduction at Source:	Options 2, 3 and 4
Separation:	Option 5, 6 and 7
Treatment:	Option 8

Option 1: Dilution

In this option the effluent is diluted with lower salinity potable water or surface water from the Werribee River to provide blended water with suitable salinity.

Option 2: Customer Treatment at Premises

In this option each industry treats its own highly saline industrial waste stream onsite and discharges the salt removed to a dedicated salt disposal pipeline.

Option 3: Cleaner Production

In this option the Retail Water Companies assist industry with the adoption of cleaner production practises that result in less chemical usage and therefore less salt discharge to sewer. City West Water has been proactive in seeking to implement a cleaner production strategy within its catchment.

Option 4: Domestic Detergent Product Substitution

In this option, low-salt household detergents are promoted in the community by means of community awareness programs and with detergent manufacturers are encouraged to reduce the amount of salt entering the sewerage system.

Option 5: Separate Saline Treatment Stream at Western Treatment Plant

In this option a pipeline is built and dedicated to transfer only highly saline industrial waste streams to Western Treatment Plant for treatment in an existing but separate lagoon system. This stream would not be used for recycling.

Option 6: Salt Stream Diversion to the Altona Treatment Plant for Separate Treatment

In this option a pipeline is built to transfer highly saline industrial waste streams to the Altona Wastewater Treatment Plant. The Altona Wastewater Treatment Plant primarily becomes a 'high-salinity' wastewater treatment facility. This effluent would not be used for recycling.

Option 7: Precinct Treatment Plant

In this option a dedicated wastewater treatment plant for highly saline industrial waste is built in the Altona-Laverton North industry precinct so that highly saline wastewater can be treated and potentially recycled locally.

Option 8: Desalination at Western Treatment Plant

In this option a portion of the treated effluent at Western Treatment Plant is treated in a desalination plant and mixed back into the main treated effluent flow required for recycling at the necessary salinity levels.

A further option that considered reducing saline groundwater infiltration into the sewerage system was eliminated during a preliminary assessment because the cost was prohibitive and the salinity reduction uncertain.

A Consultant was appointed to estimate the net present cost[+] and assess the potential salinity reduction for each option as shown in Figure 5 and Figure 6[*].

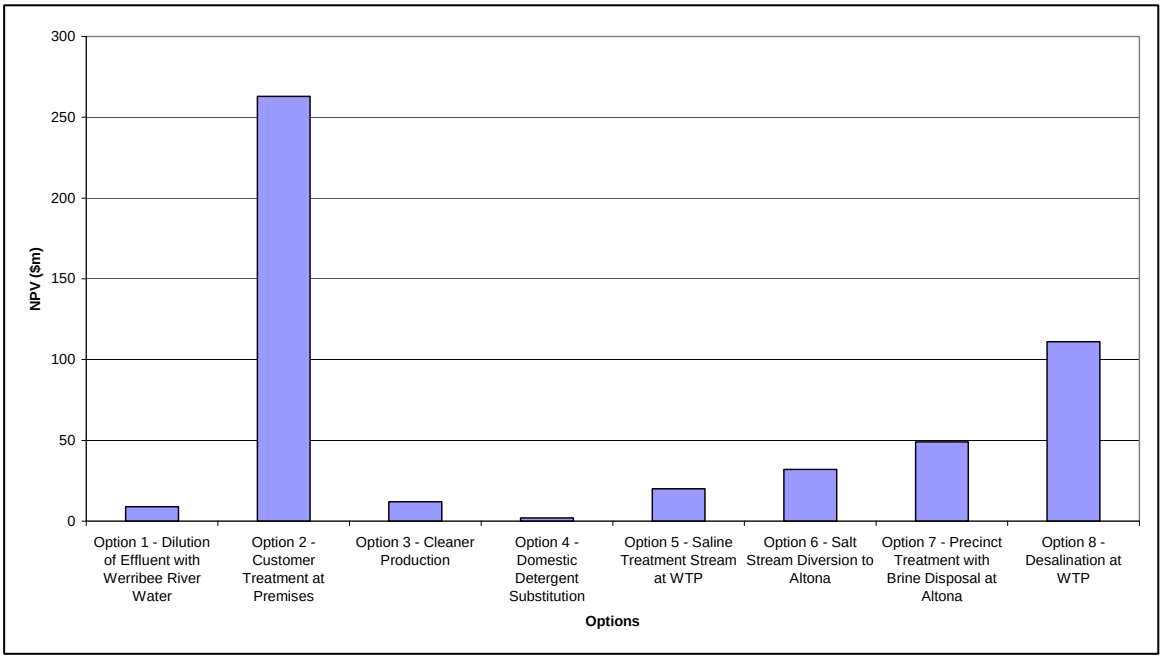

Figure 5: NPV for Each Option

Customer Treatment at Premises (Option 2) is substantially more expensive than the other options followed by Desalination at Western Treatment Plant (Option 8). The least expensive option is Domestic Detergent Substitution (Option 4) followed by Dilution with Werribee River Water (Option 1) and Cleaner Production (Option 3).

[+] $AUD 2003

[*] Option 3 – Cleaner Production and Option 4 – Domestic Detergent Substitution were identified by the Consultant as priority options. Adjustments to the above chart have subsequently been made for these options to reflect further investigations beyond the scope of the desktop study that more accurately determine the potential salinity reductions.

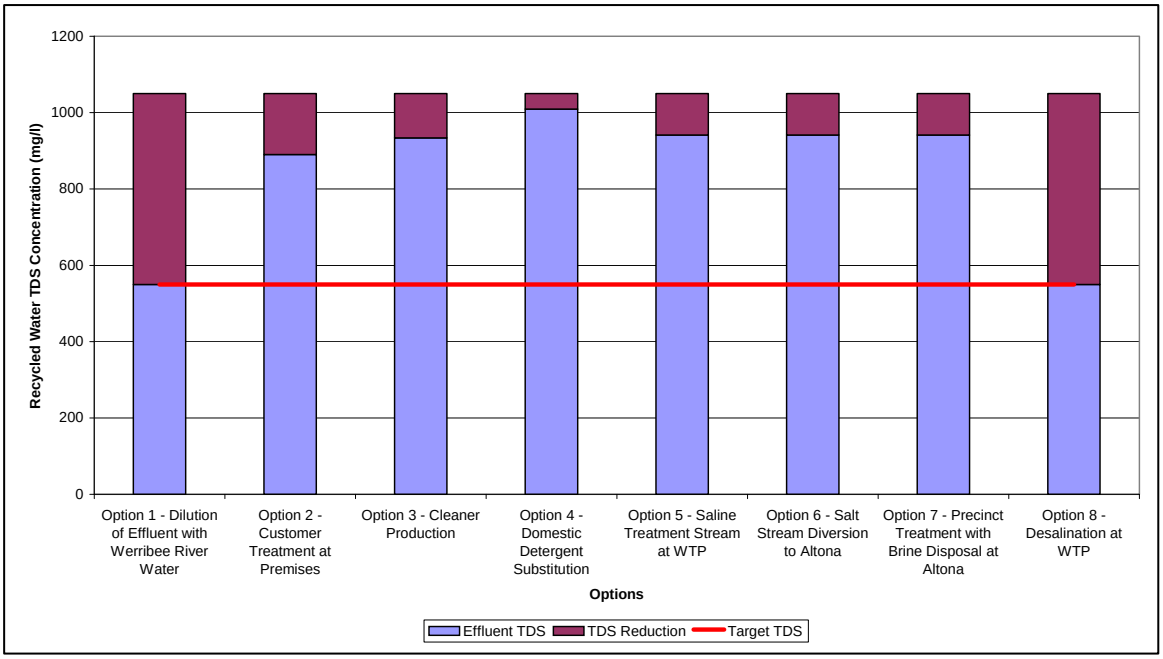

Figure 6: Salinity Reduction for Each Option*

Only dilution with river or potable water (Option 1) and desalination at Western Treatment Plant (Option 8) can provide the required salinity reduction as stand-alone options. Dilution with river water and/or potable water (Option 1) will manage salinity but does not provide the long-term sustainable benefits targeted in the Government's White Paper. Desalination removes almost all the salt from the treated water. By desalinating a portion of the effluent stream and remixing with the by-passed stream, the recycled water can be tailored to meet any salinity target.

The remaining options can only achieve part of the required salinity reduction, so a combination of these would need to be implemented. Customer Onsite Treatment (Option 2), Cleaner Production (Option 3), Saline Treatment Stream at WTP (Option 5), Salt Stream Diversion to Altona (Option 6) and Local Treatment with Brine Disposal at Altona (Option 7) focus on large salinity contributing industries so are limited to a partial reduction of the 44 per cent trade waste contribution. Detergent substitution (Option 4) is limited to a partial reduction of the 25 per cent domestic contribution.

The Consultant reviewed and ranked the salinity management options with a triple bottom line assessment using the Draft Guidelines for Planning and Reporting Recycled Water Programs (DSE 2003) and the Guidelines for Investment Evaluation (DTF 1996). The Consultant used a multi-criteria decision analysis for scoring options against individual criteria.

Scorings are weighted depending on the relative importance of each criterion to obtain an overall score for the individual option.

The adopted weightings are shown in Table 1 below.

Table 1: Triple Bottom Line Criteria Weighting

Criteria Weightings	*Assigned Weight*	*Weight (%)*
1. Environment	100	16%
2. Water Resources	100	16%
3. Regional Development	100	16%
4. Social Factors	100	16%
5. Economic Costs	75	12%
6. Other Business Costs	75	12%
7. Risk Outcomes	75	12%
Total	**625**	**100%**

Key impacts considered in the triple bottom line analysis included the cost per kilogram of salt removed, energy requirements, greenhouse gas impacts, water resource and waste minimisation impacts and odour and amenity impacts. This was a relative assessment using desalination at Western Treatment Plant (Option 8) as the baseline with a score of zero.

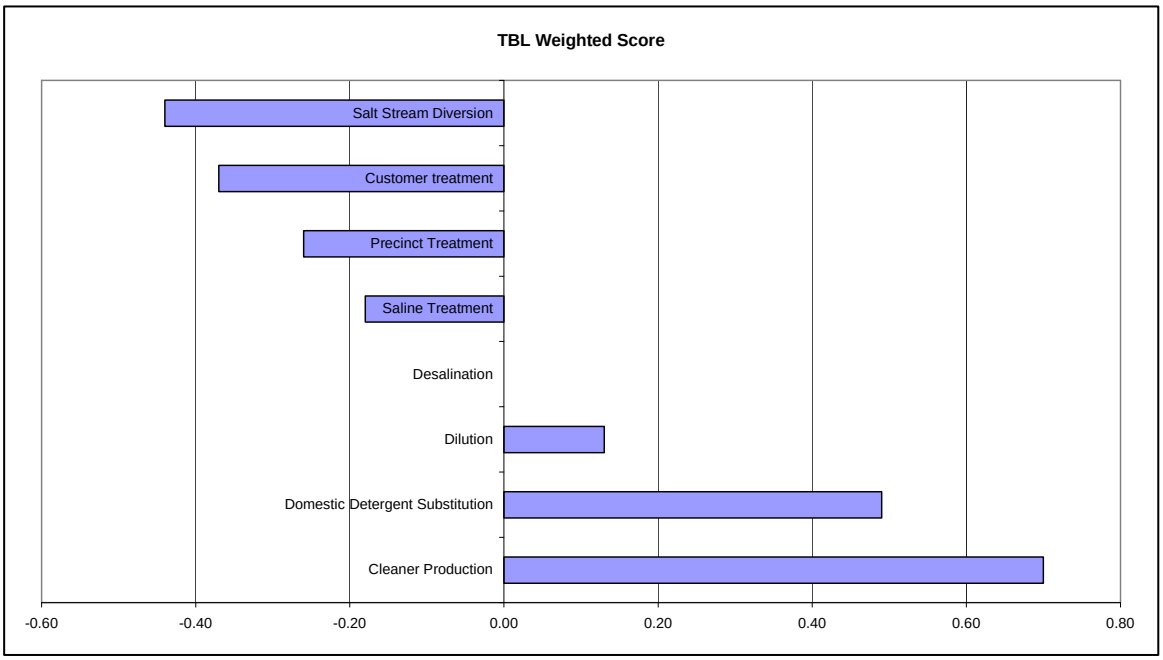

Figure 7: Triple Bottom Line Assessment of Salinity Reduction Options

The triple bottom line assessment favoured the management at source options particularly Cleaner Production (Option 3) and Detergent Substitution (Option 4). These options reduce resource impacts and are the most cost effective. The next favoured option was then desalination prior to recycling (Option 8).

Accordingly the Consultant's recommendations were:

- Implement a cleaner production strategy with City West Water industrial trade waste customers and target an overall 20 per cent reduction in salinity concentration of their discharges by 2009;
- Implement an education program with consumers and manufacturers to encourage a change to lower salinity domestic laundry detergents; and
- Utilise a desalination process at Western Treatment Plant to make up the shortfall in achieving the targeted 550mg/l TDS salinity.

Conclusion 6

A Consultant ranking of options recommended source reduction through Cleaner Production and Detergent Substitution as the preferred mechanisms for reducing salinity in the recycled water. Desalination treatment was proposed to achieve the shortfall in targeted salinity levels. Dilution with river water and/or potable water will manage salinity initially but does not achieve Government's long term water conservation goals in the Werribee Plains.

6 Reductions at Source – Cleaner Production and Detergent Substitution

Until recently, the salinity level in Western Treatment Plant's treated effluent was considered acceptable. Without water recycling, salinity did not have a significant impact on sewage treatment, it simply passed through the lagoon or land treatment processes and returned to the ocean. Consistent with this situation, Melbourne Water and the Retail Water companies (City West Water, South East Water & Yarra Valley Water) managed salinity with an objective to maintain status quo rather than to reduce the salinity level.

The focus on water recycling and the need for lower salinity water to make this sustainable has changed this situation.

6.1 City West Water Industry Cleaner Production Strategy

A fundamental element of the salinity reduction strategy being implemented by City West Water is to reduce pollutant loads at source before disposal to sewer. The Strategy aims to co-operatively work with trade waste customers to reduce water use as well as total dissolved solids and other substances of concern to recycling such as heavy metals.

Dissolved solids, especially sodium based salts, are used or created widely in industry as a result of manufacturing processes. Caustic soda is widely used in manufacturing businesses – from cleaning in the food industry to neutralising industrial effluent in other manufacturing businesses to meet trade waste standards. Many manufacturers produce salt as a by-product of their operations, and others such as tanneries use pure sodium chloride.

The Strategy, developed with input from EPA Victoria, aims to achieve these reductions through:

- customer trade waste and water resource management plans;
- research and development;
- co-investment with industry to provide incentives for industry to invest in cleaner production solutions;
- reward and recognition for excellent performers; and
- sharing of information.

The major focus of this initiative is on reduction of salinity loads by 49 tonnes/day TDS by 2009. This represents a 20 per cent reduction on 2003 trade waste TDS concentration from the City West Water trade waste customers and a 10 per cent reduction in effluent salinity.

The approach is to work with the top 55 trade waste customers who contribute most to salinity. This will be more efficient than working across the whole customer base, and still targets the majority of the TDS load. Table 2 shows the salinity contribution to Western Treatment Plant from City West Water's trade waste customers.

Table 2: **TDS loads from City West Water trade waste customers**

Number of Customers	**Average daily load (Tonnes/day)**
All 5400 Trade waste customers	168
Top 120	126
Top 55	123

City West Water's customer research found that the main barriers to customers implementing cleaner production were a lack of specialised resources to investigate and research cleaner production solutions and inadequate financial return on investment into solutions. City West Water has developed initiatives to overcome technical barriers to effective solutions. For example, industry must meet certain pH limits as part of their trade waste agreements. Many businesses need to use more salt to ensure their trade waste meets these pH limits. An investigation involving City West Water, RMIT University and Melbourne Water, has been commissioned to determine whether these limits could be adjusted without compromising the structural integrity of sewers and other infrastructure and Occupational Health and Safety standards.

The Cleaner Production Strategy also includes direct assistance for industry to implement solutions. Victorian Government funding of $1 million from the Victorian Water Trust has been allocated to support local water authorities develop Water Smart industry demonstration projects that aim to reduce salt and save water in 2004/05.

The projects will be applicable to all industry water and sewerage customers and reduces demand for water through on-site treatment and recycling.

The program is shown diagrammatically in Figure 8 and the activities involved can be summarised as follows:

- Available industry salinity contributions will be analysed to confirm the largest contributors of total dissolved solids (TDS).
- Monitoring of these industries will continue to confirm salinity contributions.
- Additional City West Water personnel will be engaged to work with industrial customers to assist in preparation of salinity and resource management plans.
- The plans will identify issues and develop sustainable solutions that take account of impacts on industry product quality and on production costs.

- Research will be commissioned, as necessary, to overcome any technical barriers to implementing effective solutions.

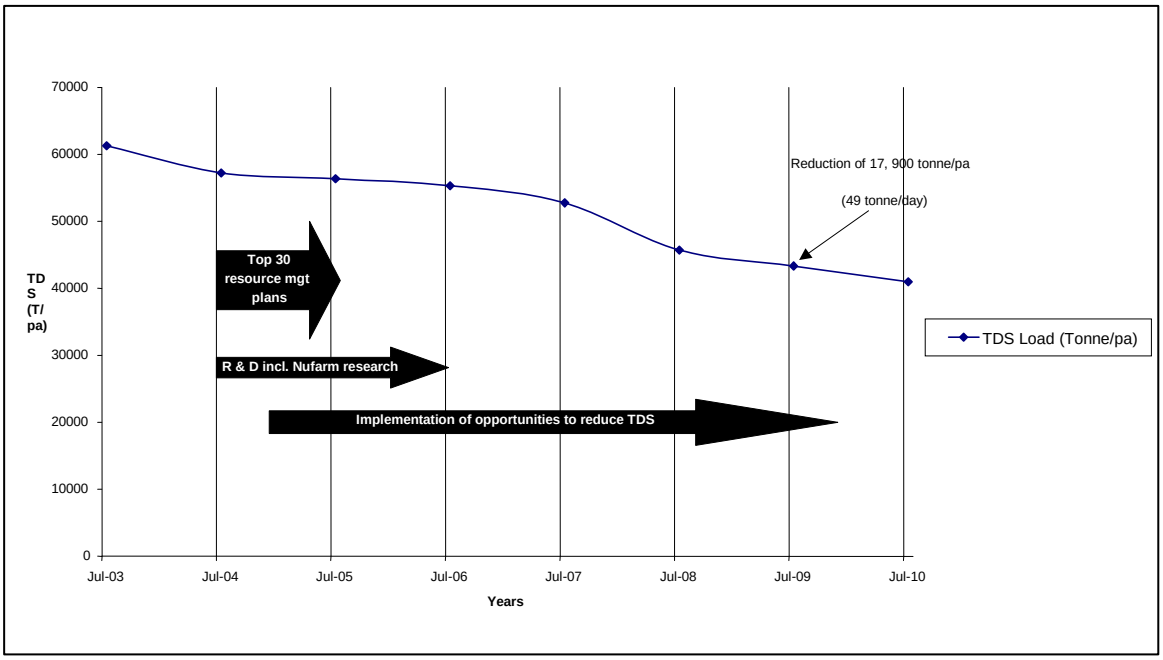

Figure 8: City West Water Cleaner Production Program

City West Water estimate that the Cleaner Production program has the potential to reduce the average effluent salinity at Western Treatment Plant by approximately 10 per cent to 950 mg/l TDS. Similar cleaner production approaches from the other two retail water companies could reduce the salinity at Western Treatment Plant further. To this end, City West Water is collaborating with Yarra Valley Water to extend the Cleaner Production Strategy to Yarra Valley Water trade waste customers. Due to the much smaller trade waste contributions in the Yarra Valley Water customer base only 2 per cent salinity reduction in the effluent could be achieved for the same 20 per cent trade waste salinity reduction target.

6.2 Pollution Load Pricing

In parallel with the Cleaner Production Strategy, Melbourne Water is seeking to implement charges for wholesale sewage treatment services based on pollution load, rather than the historic charges for sewage volume, from 2005/06. This proposal has been submitted to the Essential Services Commission and will include a cost reflective salinity charge, which provides an important mechanism for the retail water businesses to signal, through their trade waste charges to their customers, the costs and risks of accepting industrial wastes. The proposed sewage charging structure should encourage a focus on salinity reduction at source.

6.3 Detergent Substitution

Laundry detergents contribute 23 per cent of the salinity in domestic sewage and therefore form the major focus for salinity reduction in domestic sources. Overall, powdered laundry detergents contain higher salinity loads than liquid laundry detergents largely due to the filler substance being made up of salts for powdered laundry detergents and water for liquid detergents. By promoting low-salt household detergents in the community, salinity at source may be reduced. The potential reduction is limited to approximately 50mg/l TDS, giving an average effluent salinity at Western Treatment Plant of 1000 mg/l TDS, as domestic detergents constitute 4 to 5 per cent of the effluent salinity at Western Treatment Plant.

The water industry through the Water Services Association of Australia is developing broad based approaches to reduce the salinity contribution from detergents in consultation with the manufacturing industry. An assessment of the viability of this approach together with an implementation plan, are targeted for completion by December 2004. The following is an extract from the Water Services Association of Australia *Salt from Domestic Detergents in Wastewater* strategy paper dated November 2004:

- Moving from the current proportion of powdered and liquid detergents to all liquid based detergents, would lower detergent sodium levels by 75 per cent, ie an overall reduction of 8 to 10 per cent in domestic catchments.
- It should be noted that in Israel, where wastewater re-use is widely practiced and salt is a major issue, sodium in detergents was legislatively limited to 4 gm per kg detergent in 2001. This is an order of magnitude lower than sodium levels in current liquid detergents in Australia and if adopted would virtually eliminate sodium salts from domestic detergents.
- Discussions with the Australian Consumer Specialty Products Association have indicated that detergent manufacturers have concerns about regulating lower levels of salt in detergents. However, Australian Consumer Specialty Products Association members have indicated they wish to work with Water Services Association of Australia to examine options for lowering salt levels in detergents.
- Water Services Association of Australia will write to the Australian Consumer Specialty Products Association to request the examination and implementation of options to reduce salt levels in detergents. It is noted that the major sources of salt in detergents are sodium carbonate (23 per cent), sodium sulphate (18.6 per cent) and sodium tri-polyphosphate (12 per cent).
- It is proposed that Water Services Association of Australia discuss the issue with the relevant national agencies (Department of Environment and Heritage and Department of Industry) to gain federal government support.
- It is proposed that Water Services Association of Australia support utilities to commence a concerted community education campaign to raise awareness of the salt issue which may include discussions with supermarkets, information on water accounts and general advertising, the use of Choice Magazine information etc…

- It would be hoped that Australian Consumer Specialty Products Association members would assist in this campaign including the provision of salt information on detergent labels. Should this information not be available, utilities could use publicly available information (eg Lanfax Laboratories) to provide information to consumers on salt levels in detergents.
- It would be hoped that these efforts are successful in material terms and failing their success, legislated lowering of salt levels in detergents may need to be examined as is in Israel.

6.4 Cleaner Production and Detergent Substitution in Parallel

Cleaner Production and Detergent Substitution may be implemented in parallel as they target different sources of salinity. It is estimated that they have the combined potential to reduce salinity by 150 mg/l TDS, which gives an average salinity of 900 mg/l TDS in the total effluent.

Conclusion 7

City West Water is implementing strategies to reduce industrial salinity contributions by 20 per cent (49 tonnes/day) through cleaner production, which is estimated to reduce average salinity by 100 mg/l TDS to 950 mg/l TDS by 2009. Similar approaches from the other two retail companies are being encouraged.

Conclusion 8

Melbourne Water is seeking to implement charges for wholesale sewerage services based on pollution load rather than sewage volume commencing 2005/06. This will include a cost reflective salinity charge, which should encourage salinity reduction at source.

Conclusion 9

Substitution of domestic detergent with low-salt alternatives in the household has the potential to reduce average salinity of domestic sewage by 50 mg/l TDS to 1000 mg/l TDS.

Conclusion 10

Broadly based approaches to reduce the salinity contribution from detergents in consultation with the manufacturing industry could reduce the salinity in domestic sewage. An assessment of viability and an implementation plan are targeted for completion by December 2004.

Conclusion 11

By reducing industrial and domestic waste streams from all Western Treatment Plant customers it is feasible to reduce the recycled water salinity to an average salinity level of 900 mg/l TDS.

7 Reduction by Desalination

Desalination involves separating salt from water to provide a high-salinity brine stream and a very low-salinity water stream. The high-salinity stream is further treated for disposal and the low-salinity stream used for water recycling. The low-salinity stream produced by desalination has salinity levels much lower than that required for recycled water applications. Therefore this stream can be mixed with recycled water to the required sustainable salinity level, which reduces the volume of water that must be treated by desalination.

Desalination is required to reduce the recycled water salinity from 700 mg/l TDS, the expected level achieved by reduction at source, to 550 mg/l TDS, the adopted target for sustainable recycling. The life cycle cost for desalination is relatively high and this option must therefore be introduced as cost effectively as possible.

The factors that impact on the cost of the desalination include:

- The type of technology used;
- The level of salinity of feed water;
- The level of salinity of product water;
- Short term and medium term demand for recycled water.

7.1 Desalination Technologies

Salt is removed from water either by boiling the water and leaving the salt behind (distillation), by passing the water through a filter fine enough to remove the salts (reverse osmosis, electrodialysis) or by removing the salts from water and binding them to a solid resin (ion exchange). The preferred technology depends on feed and product water quality, specific site conditions and the cost and type of energy available. The two proven technologies are distillation and reverse osmosis.

- Distillation is favoured where waste heat can be used at low cost and low environmental impact (i.e. adjacent to power stations).
- Reverse osmosis is favoured where low cost renewable electricity is available and where salt concentrations are relatively low.

For Western Treatment Plant the preferred technology will be influenced by the quality of feed water, ongoing development of electricity supply and power generation and the ultimate recycled water demand profile. A demonstration process is therefore required to identify feasible technologies extending over at least 12 months in order to gain a statistically significant data set. For functional design of the preferred technology, a pilot plant will be used to verify design parameters.

Conclusion 12

An integrated assessment of feed water quality, energy sources, desalination technology and recycled water demand is required to determine the most appropriate desalination technology for Western Treatment Plant.

8 Implementation Issues

The salinity reductions at source will provide immediate benefits for both on-site and off-site recycling proposals. Projections for 2004/2005 indicate 94 per cent of the recycled water from the Western Treatment Plant will be used to irrigate on-site, existing grazing land. Reduced salinity in this recycled water will enhance productivity of pasture and hence improve the viability of the grazing business. The gradual improvement in salinity will provide corresponding benefits.

For off-site recycling to primary production businesses, the salinity reduction necessary is dependent upon the nature of each recycled water scheme. For urban recycled water use, a step change reduction in salinity is also required.

8.1 Fit-for-purpose Recycled Water for the Werribee Irrigation District

8.1.1 Water Usage

The initial opportunity to substantially utilise recycled water outside the Western Treatment Plant is for the Werribee Irrigation District, which is a major provider of horticulture produce for local, national and export markets and relies on surface water from Werribee River water rights, Werribee River water 'sales' and groundwater pumped from the underlying aquifer. In general terms, total water demand in the district averages 13,500 ML per annum made up of 8,000 to 10,000 ML from its Werribee River entitlement, up to 3,000 ML from river 'sales' water and 1500 to 3000 ML from groundwater. In 'high' rainfall years, total demand decreases to 9,000 ML per annum and increases to 19,000 ML per annum for 'low' rainfall years. Supply has historically been very secure with full allocation of water right expected in 96 years out of 100 and some sales water available in 85 years in 100.

During 2003/2004, exceptionally dry conditions resulted in river water availability decreasing to 30 per cent of water right and the ground water supply was exhausted. To offset this shortage, water was transferred from the Macalister Irrigation District allocation in Gippsland to the Werribee Irrigation District via Melbourne's potable water supply system. This supply offset is continuing until the recycled water supply is substituted.

8.1.2 Supply of Recycled Water

In future, existing irrigation water supplies are unlikely to supply the same historical degree of security. Groundwater usage has been restricted while the aquifer level and its salinity recovers. Southern Rural Water has made a commitment, in consultation with Melbourne Water, to supply recycled water from Western Treatment Plant if growers forego access to sales water, which is typically available in addition to their river water right. An opportunity therefore exists for up to 2,500 ML per annum of recycled water to be supplied to the Werribee Irrigation District. Additional recycled water is not required except in years of extreme low rainfall or in the event that the river water rights are reduced by Government.

A major scheme is currently under development to provide recycled water as a supplement for the district by December 2004. This scheme will feed into the existing open channel distribution system and could substitute for up to 8500 ML per annum to replace river water rights and sales.

Until all growers in the Werribee Irrigation District choose to purchase recycled water, the supply of blended water will be delivered separately from the river water supplied to customers who choose not to purchase recycled water. In order to facilitate this requirement in the common open channel distribution system, the channels will need to be operated under a 'split-running' mode with some days of the week allocated to growers taking only river water followed by days allocated to growers who have accepted the recycled water. This operating regime therefore imposes a limit on the amount of recycled water that can ultimately be supplied to the district.

In typical years, the delivery of recycled water will be limited by its salinity to 2,000 ML per year. Operation under 'split running' further limits delivery of recycled water to less than 1,500 ML per year.

8.1.3 Options for the Werribee Irrigation District

The amount of recycled water that can be used in the Werribee Irrigation District is limited by its salinity. Options to maximise recycled water use whilst managing the salinity are:

8.1.3.1 Blending with River Water to Achieve 550 mg/l TDS at All Times

In the short term it is possible to supply water at the 550 mg/l TDS salinity level by blending the recycled water from Western Treatment Plant with Werribee River water.

The river water salinity varies significantly with rainfall but regularly approaches the irrigation water target of 550 mg/l TDS and occasionally exceeds this level. Under typical river conditions, the current recycled water salinity and stop-start delivery methods, less than 2,000 ML per year can be blended with the river water without exceeding the salinity target. It is clear that 8500 ML per annum of recycled water cannot be achieved by solely diluting salinity with river water.

Growers who choose to purchase a recycled water allocation will be required to forego access to sales water, which is typically available in addition to their river water right. Sales water use is 25 per cent of the river water right or 2500 ML. Access to groundwater is also currently restricted while the aquifer level and salinity recover. Until further salinity reduction measures are implemented the growers who choose to purchase a recycled water allocation will have partial access to sales water in sufficient amounts to ensure equity of water supply with customers who have not chosen to take recycled water.

8.1.3.2 Blending with River Water to Achieve Historical River Water Salinity Levels

Historically, growers have used high salinity water in times of shortage. Therefore, based on historical water usage salinity levels, it is possible to continue this practice and immediately supply blended irrigation water that mimics the historical salinity when water availability has been low. In the short term, this maximises the substitution of recycled water and increases

security of supply when water is most needed. In years when no sales water is available, up to 6,700 ML (all customers accepting recycled water) per year of recycled water could be supplied. Only 2,900 ML can be supplied under stop-start delivery.

The temporary increase in salinity and the associated management techniques required would need to be assessed and approved by EPA Victoria as part of the Environment Improvement Plans for the scheme and for each customer.

8.1.3.3 Blending with Potable Water

The existing temporary potable water supply could be extended, if necessary, to provide dilution for the recycled water. To achieve the target recycled water usage with the current recycled water salinity this would require a 50:50 shandy of potable water and recycled water. Potable water use would range from 5,000 to 9,000 ML per annum. On this scale a new storage would be required at the point of supply of potable water to manage peak demand.

The revenue foregone for this potable water would amount to $3.3M to $5.9M per annum. A storage to meet peak demand would cost an additional $5M to $10M. With this cost approaching the cost for other options and effectively involving replacement of river water use with potable water, this is not considered a sustainable long-term option. The temporary potable supply will however continue to provide an option for additional dilution of recycled water if additional dry years occur before salinity is reduced in the recycled water.

8.1.3.4 Reducing the Salinity in the Werribee River

The volume of recycled water blended into the supply could be increased, by reducing the salinity of the river water so that the blending is more effective. This option will require an investigation of the feasibility of affecting the river water salinity. If feasible, this option would require a change to catchment management upstream and may still require 'top-up' from potable water supplies from time to time. This option could be used to further improve the security of supply for drought years or increase the savings in surface water.

8.1.3.5 Utilising a Desalination Process

To maximise recycled water supply and therefore maximise reductions in river water use, the salinity of recycled water from Western Treatment Plant could be reduced to 550 mg/l TDS using desalination processes. This would ultimately allow up to 10,000 ML per year of recycled water, on average, to be used in preference to other supplies.

Conclusion 13

The proposed supply arrangements for Werribee Irrigation District from 2005-2009 provide the opportunity to replace up to 2,500 ML per annum of river water 'sales' with recycled water. Additional recycled water is not required except in years of extreme low rainfall

Conclusion 14

The potential recycled water demand for the Werribee Irrigation District is 2,500 ML per annum but could increase to 8500 ML per annum by 2010 and ultimately 10,000 ML per annum if river water rights are reduced.

Conclusion 15

In typical years, the volume of recycled water used in the Werribee Irrigation District will be limited by stop-start delivery methods, to less than 2,000 ML unless all growers choose to take recycled water.

Conclusion 16

Dilution with river water does not meet the Government's long term water conservation goal. To achieve the projected recycled water usage of 8,500 ML per year for the Werribee Irrigation District, by 2010, the irrigation water would need to be predominantly recycled water.

Conclusion 17

Dilution with river water provides an interim option while recycled water demand is developed and allows time for recycled water salinity to be reduced.

9 Other Water Demands Influencing Desalination

In addition to the Werribee Irrigation District, the potential to substitute recycled water within the Werribee Plains Region is under investigation. Ultimately, up to 46GL per year is currently under consideration with up to 15GL per year projected by 2010. Table 3 shows the schemes being considered and the projected volumes that they may potentially require.

Table 3: Proposed Recycled Water Schemes

Scheme	Projected 2010 Demand (ML per annum)	Projected Ultimate Demand (ML per annum)
Werribee Irrigation District	8500	10000
Werribee Technology Precinct	270	600
Werribee Tourist Precinct	500	500
Wyndham Third Pipe	650	1560
Balliang Irrigation District	250	20,000
Bacchus Marsh Irrigation District	0	4,000
Moorabool Irrigation District	5000	10,000
Total	**15,170**	**46,660**

At this stage only the Werribee Irrigation District supply and residential dual pipe scheme in the Wyndham region have sufficient commitment to consider including in demand projections for recycled water.

Each scheme benefits from the salinity reductions achieved through source reduction (Cleaner Production and Detergent Substitution). A blending strategy will be adopted, where feasible, to further achieve desired salinity levels in the short term.

Conclusion 18

There is potential to substitute recycled water for up to 46GL per year of surface or potable water within the Werribee Plains Region with 15GL per year possible by 2010.

10 The Strategy and Accompanying Actions

Salinity reduction at source through cleaner production practises in industry and substitution of high salinity detergents with low salinity detergents in households has the potential to make a significant and cost effective reduction in the recycled water salinity. Further salinity reductions are required to meet the targeted recycled water salinity of 550 mg/l TDS.

The strategy proposed by Melbourne Water and City West Water to achieve Action 5.32 described in the White Paper, *Our Water Our Future*, is:

10.1 Short-term management of WID Recycled Water Scheme to 2009

- Collaborate with Southern Rural Water to blend recycled water and river water so as to maximise the supplied volume of recycled water whilst maintaining salinity levels below the normal seasonal salinity range historically experienced in the river.

  Actions: Provide recycled water to Werribee Irrigation District from December 2004 and collaborate with Southern Rural Water for blending with river water up to the allowable salinity content. Co-ordinate with Southern Rural Water to manage shortages of river water or elevated river water salinity, from time to time.

  Review the entitlement, tariff and restrictions policies that will apply in low rainfall years to provide irrigators with future security of supply and surety of pricing.

  Investigate the impact of other major water resource initiatives across the State or any opportunities to trade water entitlements to overcome resource restrictions.

- Investigate ways to manage the river catchment with a view to reducing river water salinity and enabling a greater volume of recycled water to be included in the blend.

  Action: Investigate the resource management options for the Werribee River, as well as adjacent catchments, to determine the optimum use of water resources to achieve Government's environment and consumptive objectives over a 100-year horizon to cover all natural event cycles.

10.2 Long-term Salinity Reduction

- Investigate all factors that affect the size and cost of a desalination plant and develop a capital investment program that can accommodate on-going reductions in salinity at source, as well as achieving the target salinity reduction in recycled water by 2009.

  Actions: Develop a business case for a desalination plant including provision to supply recycled water for future development schemes in the Werribee Plains. Incorporate a triple bottom line economic assessment and a financial (affordability) assessment incorporating the outcomes from the following investigations:

  - Alternative desalination technologies;
  - Options for reducing the natural salinity of the Werribee river;
  - The optimum salinity levels required for the sustainable use of recycled water in the range of soils in the Werribee Plains;
  - Benefits associated with upgrading the irrigation channel system to minimise seepage losses.

  The outcomes from these investigations will determine a preferred plan for staged delivery of a desalination plant to achieve the volumes of recycled water needed to offset river water use as well as to develop recycling for the broader Werribee Plains Vision.

- Work with key industries to implement the "*Cleaner Production Strategy*" and maximise salinity reduction at source.

  Action: The Victorian Water Trust has allocated $1million for Water Smart Industry Demonstration Projects aimed at achieving reductions in salt and other pollutants, reductions in the use of potable water and an increase in the effective uses of recycled water. This initiative will support and accelerate the City West Water Cleaner Production Strategy.

- City West Water to collaborate with Yarra Valley Water for the purpose of extending the cleaner production strategy to Yarra Valley Water trade waste customers.

  Actions: Agree on collaborative program with Yarra Valley Water to extend the salinity reduction strategy to their trade waste customers.

  Both City West Water & Yarra Valley Water to pursue salinity source reduction plans and confirm the reduction levels that could be achieved in the medium and long-term horizons.

- Work with Water Services Association of Australia to:
  - Encourage detergent manufacturers to reduce the salt content in laundry products;
  - Consider a product labelling program with a view to informing consumers and allowing them to choose domestic detergents with lower salt content.

  Actions: Participate as a stakeholder in the Water Services Association of Australia working committees to assist in the development and implementation of salt reduction programs.

  Work with Department of Sustainability and Environment to:
  - Investigate ways to introduce product labelling;
  - Investigate ways to introduce a community education program.

- Continue monitoring of sewage flows throughout the network to determine the sources of currently unaccounted salinity contributions.

  Action: Improve the sewage load estimates methodology through a working group with the retail water companies.

- Review this strategy at the conclusion of the investigations outlined above and update it as necessary by 31 December 2005.

  Action: Melbourne Water and City West Water to convene quarterly meetings to review actions and to maintain progress towards agreed target dates and outcomes.

10.3 Implementation Program

Figure 9, below, sets out the sequence and timing of the actions described in this strategy.

ID	Task Name	Dur	Start	Finish
1	**Salinity Management for WID**	**1011 d**	**Mon 20/12/04**	**Fri 02/01/09**
2	**Start Supply to WID**	0 d	Mon 20/12/04	Mon 20/12/04
3	**Recycled Water/River Water Blending Completed**	0 d	Fri 02/01/09	Fri 02/01/09
4	**Implement & Assess Cleaner Production Strategy**	**1032 d**	**Fri 19/11/04**	**Fri 02/01/09**
5	**Start Cleaner Production**	0 d	Fri 19/11/04	Fri 19/11/04
6	**Produce Top 30 Resource Management Plans**	146 d	Fri 19/11/04	Wed 29/06/05
7	**Research and Development**	1032 d	Fri 19/11/04	Fri 02/01/09
8	**Implementation of Cleaner Production Opportunities**	886 d	Thu 30/06/05	Fri 02/01/09
9	**2009 Cleaner Production Outcome**	0 d	Fri 02/01/09	Fri 02/01/09
10	**Prepare Desalination Plant Business Case**	**240 d**	**Fri 19/11/04**	**Wed 09/11/05**
11	**Board Approval for Preconstruction Expenditure**	**0 d**	**Fri 19/11/04**	**Fri 19/11/04**
12	**Confirm Recycled Water Demand**	**168 d**	**Fri 19/11/04**	**Fri 29/07/05**
13	**Regional Salinity Environment Investigations**	**140 d**	**Fri 19/11/04**	**Tue 21/06/05**
14	**Forecast Salinity Reduction Required**	**10 d**	**Thu 23/06/05**	**Wed 06/07/05**
15	**Technology Demonstration Projects**	**220 d**	**Fri 17/12/04**	**Wed 09/11/05**
16	**Concept Design for Desalination Plant**	**60 d**	**Tue 26/04/05**	**Tue 19/07/05**
17	**Assess Costs and Benefits**	**130 d**	**Tue 29/03/05**	**Tue 27/09/05**
18	**Document Business Case**	**110 d**	**Tue 26/04/05**	**Tue 27/09/05**
19	**Desalination Plant Delivery**	**822 d**	**Wed 28/09/05**	**Fri 02/01/09**
20	**Present Business Case to MW Board**	**17 d**	**Wed 28/09/05**	**Thu 20/10/05**
21	**Present Business Case to DTF**	**1 d**	**Fri 21/10/05**	**Fri 21/10/05**
22	**Concept Design & Functional Requirements**	**110 d**	**Fri 21/10/05**	**Mon 10/04/06**
23	**Update Salinity Reduction Forecast**	**5 d**	**Wed 09/08/06**	**Tue 15/08/06**
24	**Tendering Process**	**100 d**	**Tue 11/04/06**	**Thu 31/08/06**
25	**Approval Process**	**100 d**	**Fri 01/09/06**	**Mon 05/02/07**
26	**Board Approval for Construction Contract**	**0 d**	**Mon 05/02/07**	**Mon 05/02/07**
27	**Confirm Pilot Plant Requirements**	**15 d**	**Tue 06/02/07**	**Mon 26/02/07**
28	**Pilot Testing**	**220 d**	**Tue 27/02/07**	**Fri 04/01/08**
29	**Construction and Commissioning**	**260 d**	**Mon 07/01/08**	**Fri 02/01/09**

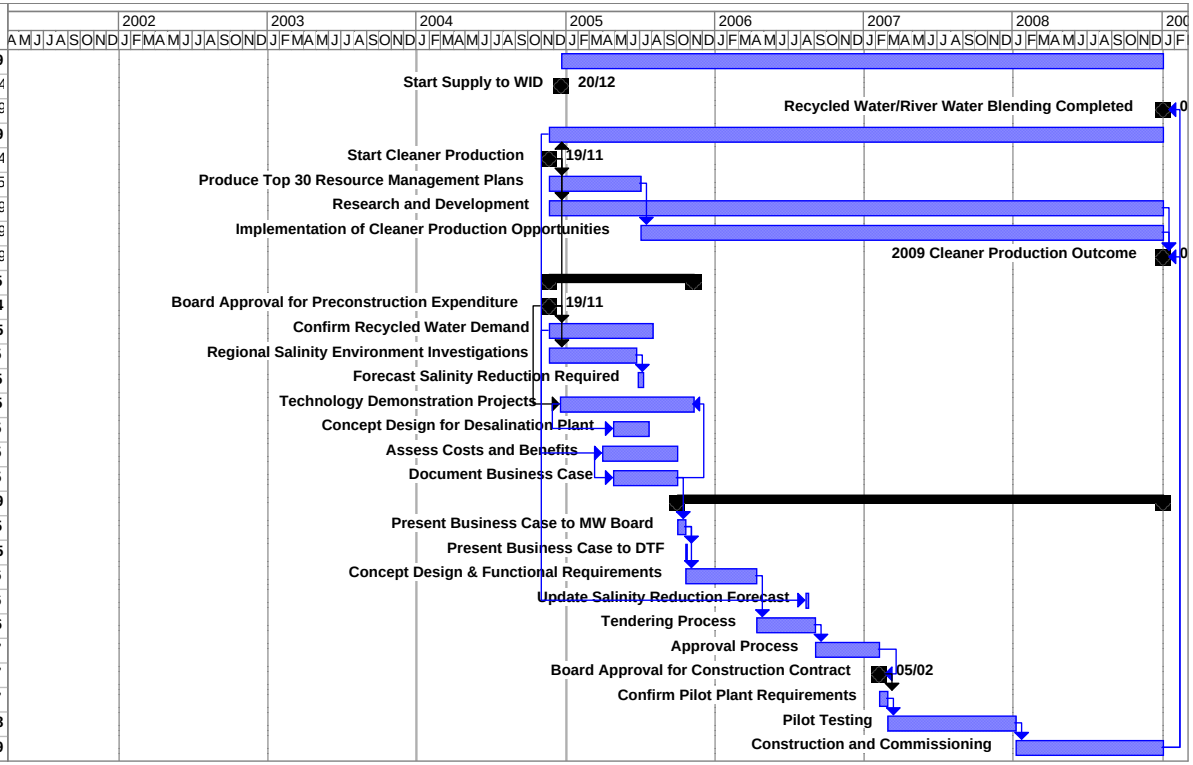

Figure 9: Western Treatment Plant Salinity Reduction Action Plan