Parliament of South Australia

Environment, Resources and Development Committee

Submission to Inquiry into Desalination

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1 PREFACE

1.1 Introduction

This submission builds on evidence given by Pat Harbison President of Friends of Gulf St Vincent (FGSV) on 8th October to the Parliament of South Australia Environment, Resources and Development Committee (ERDC) Inquiry into Desalination and documented in the Official Hansard Report [6] of that public hearing and contains further supporting information placed for the ERDC committee to consider in the interest of the public and the environment in which we live.

1.2 Friends Gulf St Vincent

The FGSV was formed five years ago primarily to stand up for the conservation of Gulf St Vincent (GSV). The current membership of approximately 92 people is made up of people with a passion for the gulf and the membership includes retired scientists and people who have worked in marine fields, some in government but all with an interest and passion for the health and vitality of GSV.

The aim of FGSV is to unite all of the community around the coast of GSV and to inform them about the natural history of GSV so that they will readily recognise threats to the gulf and lobby more effectively against them.

FGSV runs forums at least twice a year in various centres around the gulf, with a selection of speakers on various aspects of the natural history of the gulf i.e. the seagrasses, fish, the oceanography and various current issues. Forums have been held at Port Vincent, Middle Beach, Normanville, West Beach, Henley Beach, Semaphore and most recently at Port Wakefield on 12th October 2008. The Friends try to spread their activities right around the gulf, so that the whole gulf community will have an opportunity to access at least one of our forums.

2 EXECUTIVE SUMMARY

The Friends of Gulf St Vincent are very concerned that the discharge of waste brine from a desalination plant could have serious impacts on marine life in the region of the discharge particularly on the extensive reef systems in the adjacent waters.

We believe that a less costly strategy to fully consider other viable options such as harvesting and reuse of stormwater and waste water could make a significant contribution to meeting most of Adelaide’s water needs, with the additional benefit of preventing the continued degradation of the gulf by stormwater and waste water discharges.

All existing sources of water and the strategies identified in Water Proofing Adelaide (WPA) 2005 should be fully investigated and re-assessed before creating a new and unproven water source by large scale desalination of seawater from GSV. Key points of FGSV's submission are as follows:

a. The impact of highly saline discharges on marine life in GSV is unknown, and needs to be widely and fully investigated before the desalination proposal is authorised to go ahead. An example of the effect of high salinity on marine life is as follows:

   i. Research at Pt Lowly in Spencer Gulf, the site of another desalination proposal and a spawning site for the Australian giant cuttlefish, has shown that embryos in the eggs of these marine animals do not survive in salinities greater than 50 parts per thousand (ppt). The study concludes that brine discharges from a desalination plant in that area pose a threat to this unique spawning aggregation of that cuttlefish (Sepia apama). (J. Dupavillon, University of Adelaide 2008).

b. GSV is a sheltered, inverse estuary which is already severely damaged by waste water (nitrogen) and stormwater (turbidity) discharges. (findings of Adelaide Coastal Waters Study (ACWS) 2007)

c. Nitrogen discharges from Bolivar, Penrice, and Glenelg have been responsible for the loss of more than 5000 hectares (ha) of seagrass in Adelaide’s coastal waters (ACWS 2007).

d. The turbidity from stormwater discharges persists along the coast because these waters are confined to the near shore zone by prevailing winds and north-south tidal movements. The turbidity is remobilized by prevailing winds and wave action, and reducing the light available for growth or regrowth of seagrasses (ACWS 2007).

e. The total volume of this annual discharge of stormwater and waste water is similar to Adelaide’s total annual consumption of water of 216 GL. Stormwater runoff to the gulf ranges from 50 GL in a dry year to 160 GL in a wet year (Water Proofing Adelaide 2005).

f. The position of FGSV is; why not harvest and use this resource, rather than rely on a very costly desalination plant with its considerable environmental risks, which after construction will also be costly to operate and maintain idle during seasons when additional water will not be required i.e. during wet periods?

g. There are still some areas of land on the Adelaide plains which are suitable for harvesting this runoff for aquifer recharge and storage. These areas, such as Cheltenham Park should be identified now as a strategic priority of government**,** and reserved for future water collection, rather than be developed for housing.

h. The reuse of stormwater and wastewater has the potential to meet most of Adelaide's water requirements, and have the additional benefit of protecting our coastal waters from the degradation caused by the existing discharges which is in fact an environmental disaster. The recently published The Natural History of Gulf St Vincent 2008 estimates the seagrass losses over the last 70 years to be in the order of 9,000 ha [2].

i. A desalination plant of 50 GL per year that has the capability of being expanded to 100 GL per year will only add to the mix of polluted water entering the gulf from metropolitan Adelaide and will not reduce those volumes of polluted water but add to those volumes. For a 50 GL per year plant, the hyper saline discharges will be in the range of 65 to 95 GL per year and for a 100 GL plant in the range of 120 to 190 GL per year [8].

j. A long term objective of no runoff to GSV should be adopted by Government to ultimately restore this unique marine environment, which flourished at a time when runoff from the Adelaide hills and plains was intercepted by the lagoons and swamps behind the coastal dune system and the natural flow of stormwater to the sea was significantly less.

k. The pressures of increased population, the effects of urbanisation and climate change taken together mean that the importance of government decisions has never been greater.

l. If the wrong strategic decisions are made the current government will be poorly judged by future generations as there are many indications that the climate and the environment are severely stressed by man's activities such as the condition of the Murray Darling Basin and in particular the Lower Lakes and Coorong [5].

m. This submission also suggests that desalination is not independent of management stewardship and technology given the methodology adopted by the Government and the commitment it has already given to fast tracking the desalination plant before all the feasibility studies and environmental impact assessments have been completed. As a result there is significant risk in not achieving the right outcome for future generation of South Australians and the marine environment.

n. It is time for GSV to be treated as a precious resource instead of as a dumping ground.

3 SUPPORTING INFORMATION

3.1 Gulf St Vincent Uniqueness

The Natural History of Gulf St Vincent 2008 is published by the Royal Society of South Australia [2] and this substantive volume of 496 pages illustrates the richness of GSV. To quote their website:

"The Natural History of Gulf St Vincent captures all that is known about the waters of Gulf St Vincent and Investigator Strait was launched May 26th 2008 by the Minister for Agriculture, Food and Fisheries, Rory McEwen. It summarises decades of work by marine scientists, ornithologists, oceanographers, and geologists and provides the first ever review of knowledge of Gulf St Vincent and Investigator Strait, and will be a valuable reference for the future management of the gulf. Chief Editor, Dr Scoresby Shepherd, said: “Quite simply, we believe it will be the definitive work on the gulf, we think, for at least the next 30 years.”

Comprising 38 detailed chapters, its contents cover a wide variety of physical and biological topics from geology, to oceanography, fringing mangroves and salt marshes, and fauna and flora from plankton to dolphins, whales and seabirds. More than 58 scientists have contributed to the book. The book has been produced by the Royal Society of South Australia in collaboration with SARDI, PIRSA, Department for Environment & Heritage and the Adelaide and Mt Lofty Ranges NRM Board, and with support from the Friends of Gulf St Vincent.

The publication objectively considers the changes that have taken place since settlement, along with the impacts of fishing and the status of the State’s nine most important fisheries in the gulf. Scientists lay out a prognosis for the gulf in the future. The book, which includes line drawings and beautiful photographs, highlights the substantial progress achieved toward ecosystem-based management that places South Australia at the forefront of sustainable fisheries management."

Dr Scoresby A. Shepherd AO of SARDI Aquatic Sciences provided the following comments about the uniqueness of both GSV and Spencer Gulf:

a. They are the only protected bodies of water along an otherwise exposed coast. So they have become the major nurseries for many important fish species (whiting, snapper and garfish).

b. Being calm water bodies, they are places where very large seagrass beds flourish (among the largest in the world). All this primary production is like a vast grassland that supports large numbers of seabirds, acts as a nursery for many species of fish, and provides food for their predators i.e. dolphins, seals, sharks and rays, as well as many rare species. The biodiversity is extraordinarily high, in fact higher than any other part of the world.

c. The gulfs support many diverse recreational fisheries, and approximately 26% of the SA population engages in recreational fishing activity.

d. They are rare examples of what are called reverse estuaries i.e. there is little or no freshwater input, and the upper parts of the gulfs heat up in summer and become hyper saline. The warmer waters allow tropical species to flourish (western king prawns, blue swimmer crabs and mangroves etc) - something which is astonishing for a cool temperate region of the world.

3.1.1 Seagrass – Old Growth Forests

Scoresby A. Shepherd AO of SARDI Aquatic Sciences has also provided the following comments about seagrass:

"Seagrass beds are like an old-growth forest. The seagrass sheds it blades every year just as the forest sheds it leaves, and both grow new ones. The forest has accumulated old growth as wood, over many years, and similarly the seagrass accumulates an underground root system over thousands of years. When both are destroyed it takes centuries for recovery to take place. Seagrass expansion rates are about 2-3 cm a year - this is the rate of growth of rhizomes from which the blades sprout. Hence in Botany Bay when amphibious vehicles left tracks in the Posidonia seagrass (destroying it), during wartime exercises, the tracks can still be seen today on aerial photographs. Similarly, in upper Spencer Gulf when a trench was dug across the gulf in which to lay the Murray water pipeline during the 1950s, and then back-filled, the trench line through seagrass beds is still there, with no evident growth back of seagrass."

The NHGSV 2007 devotes an entire chapter to seagrasses which are true flowering plants and quoting from [NHGSV:p132]:

"Seagrass beds form a vital component of marine ecosystems and have long been recognised for their ecological and economic importance. Together with coral reefs and mangroves, seagrasses are thought to represent one of the world's most productive coastal habitats. Seagrass beds not only play a critical role in primary production and nutrient recycling, but they also provide habitat for a diverse array of marine organisms as well as increasing the stability of the seafloor through the growth of extensive rhizome mats."

Species of seagrass have been found as deep as 40 metres. In terms of seagrass losses it goes onto say [NHGSV: p139]:

"GSV has suffered some of the largest areas of human-related seagrass loss in Australia. Over the last 70 years, it is estimated that about 9,000 ha of seagrasses have disappeared from the metropolitan coastline. Much of the loss has been attributed to coastal inputs of treated wastewater and stormwater."

According to the journal Bioscience 2006 "A global crisis for seagrass ecosystems" the primary productivity from seagrasses are similar to or higher than many cultivated terrestrial ecosystems.

3.2 Adelaide Coastal Waters Study

The ACWS 2005 was a study coordinated by the CSIRO and involved the application of considerable scientific and technical resources as evidenced by the twenty technical reports that underpin this study. The potential effects of a desalination plant were not addressed by the ACWS 2005 [1].

FGSV is very concerned that the Government has chosen to announce plans for a desalination plant which is a new pollutant input into the Adelaide coastal ecosystem without formulating a response to this landmark study, a study that involves a number of members of FGSV.

To quote the study objectives [ACWS: p7]

"The Adelaide coastal ecosystem is unique because of potential large–scale interactions between seagrasses, beach and near–shore morphology, benthic biota, nutrients and toxicants, and water quality. In 2001, the SA government initiated the Adelaide Coastal Waters Study (ACWS) to redress knowledge deficiencies and develop an integrated understanding of the coastal system from which to guide future management actions. An integrated view of the ecosystem will allow the community and managers to assess ecological priorities in the light of practical, economic, and social objectives; it will help gauge suitable trade–offs while minimising the risk of unintended or irreversible (and possibly costly) damage to another part of the ecosystem."

The key recommendations that support the thrust of this submission are as follows [ACWS: p 41-43]:

"Recommendation #1

As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater, and industrial inputs into Adelaide's coastal environment. This should be done within the context of an overarching strategy designed to remediate and protect the metropolitan coastal ecosystem.

Recommendation #2

The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2400 tonnes).

Recommendation #3

Commensurate with efforts to reduce the nitrogen load, steps should be taken to progressively reduce the load of particulate matter discharged to the marine environment. A 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load will also contribute to improved water quality and aesthetics.

Recommendation #4

To assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of CDOM (coloured dissolved organic matter) in waters discharged by rivers, creeks, and stormwater drains.

Recommendation #5

While the available data suggests that toxicant levels in Adelaide's coastal waters pose no significant environmental risk, loads from point sources such as the Port River, WWTPs, and drains should continue to be reduced. Routine monitoring of toxicant loads and concentrations should be undertaken every 3–5 years.

Recommendation #13

Undertake an audit of key environmental assets in the southern metropolitan coastal region, identify risks to those assets, and develop an integrated management plan to mitigate the risks. The applicability of management actions developed in response to the findings of this study to halt and reverse ecosystem degradation in the northern regions should be investigated with a view to adopting it (possibly with modification) in the southern region.

Recommendation #14

Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability, and water re–use."

3.2.1 Adelaide Coastal Waters Study Technical Report No. 3

This technical report was prepared for the ACWS Steering Committee and is entitled "Audit of contemporary and historical quality and quantity data of stormwater discharging into the marine environment, and field work programme" by the Department of Environmental Health, Flinders University of South Australia [12].

The following paragraph from page 10 & 11 of the report gives an indication of the extent of the natural systems that existed prior to European settlement that effectively minimised the amount of stormwater entering GSV from metropolitan Adelaide:

"The Patawalonga Sysem

Before European settlement, the Patawalonga outlet was the only break in sandhills extending from the Outer Harbour south to Seacliff (Lewis, 1975). At that time the Sturt River, Brownhill and Keswick Creeks flowed into an extensive area of swamps behind sandhills, where the water either seeped out beneath the sandhills or via the outlet (Lewis, 1975). The swamps were drained and filled in the mid 1950s and efficient networks of storm drains established. The completion of the concrete lining of the suburban Sturt River channel effectively replaced an efficient stormwater detention and settlement system that discharged at a low and steady rate with a rapid transit system delivering large slugs of turbid freshwater to the coastal zone after each significant rainfall event."

3.3 ERDC Coastal Development Inquiry

A key finding of the 61st Report of the Parliament of South Australia ERCS Coastal Development Inquiry [7] was as follows:

"Water quality is the biggest single issue threatening marine habitats, and the Committee supports strongly all strategies to prevent nutrient-rich and sediment-laden water from entering marine systems. This might include water reuse, reduction of nutrients and sediment loads, and storm water retention. Cleaning up and reusing storm water and waste water is critical for drought-proofing South Australia, but is also critical for the survival of valuable marine ecosystems."

Section 4.11.4 did discuss Desalination Plants and this is reproduced here:

"With continuing drought in much of south-eastern Australia, and increasing population pressure in coastal areas, there has been much discussion of the need for desalination plants in the media. While an extensive discussion of the pros and cons of desalination are outside the scope of this report, the following points were raised by respondents:

The solution being proposed more frequently is desalination of sea water. At first sight, this is an attractive option, and still may be. However, desalination on this scale is not without problems. The assumption seems to be that it is environmentally benign - the plant will just be `putting back what it took out of the sea'. In fact, the chemical composition of the brines from desalinators can be quite different from the mix of salts in the sea. Add extra compounds necessary to prevent build up of biological films in the plant, or otherwise to promote its operation, and the effluent can be noxious to local marine life (Friends of Gulf St Vincent Submission p. 6).

The Committee asked the Friends of Gulf St Vincent if it would not be preferable to put a desalination plant near a source such as sewage waste or stormwater, and desalinate that, rather than using highly saline sea water. Mrs Pat Harbison replied:

There are a lot of options with desalination. One is to desalinate groundwater, which is just slightly too saline for use, and is much more economic than treating seawater … basically, we should not need it. If we are discharging it at an equivalent volume to our requirements, why do we need to look for other sources? We should be using those sources, not discharging them to the gulf. The gulf receives the same amount of water annually as Adelaide uses. So, we are looking at the prevention of all run-off to the gulf, and also the protection of the sand dunes (Hansard p. 46).

In fact, most respondents felt that options for water reuse had not been fully explored, and that until it had, desalination plants, which use huge amounts of energy, were not an ecologically sustainable option. Figures provided by Professor Cheshire also indicated that reuse was viable:

SA Water treats 95 gigalitres of water a year. On its own web site it says: '*This waste water from homes and businesses is generally 99.9 per cent water, with the remaining 0.1 per cent made up of dissolved or suspended waste material*' … I really struggle today to understand, when water is at such a premium, why we put 95 gigalitres of 99.9 per cent pure water into the coast every year (Hansard p. 33).

Currently, about 20% of South Australia's effluent is reused, a higher proportion than any other state. Clearly reuse prevents the need for more energetically expensive options, like desalination of sea water, and solves many of the problems associated with the disposal of hypersaline brine into receiving waters, and more could be done in exploring these options."

The ERDC committee made the following recommendations in relation to Marine Water Quality:

"57. The Committee recommends that the Government continues to resource the seagrass restoration project off metropolitan Adelaide.

58. The Committee recommends that the Minister for Environment requires the Environment Protection Agency to immediately review the existing South Australian water quality trigger values.

59. The Committee recommends that the Government ensures that adequate resources are provided for raising awareness of the environmental threats to marine habitats, and for community education, monitoring and mitigation programs.

60. The Committee recommends that the Government ensures that ongoing assessments of reef health are continued.

61. The Committee recommends that the Government adopt a target of zero waste water being discharged to marine environments by 2012.

62. The Committee recommends that the Government adopt a target of zero stormwater runoff to marine or estuarine environments for up to one in ten year flood events by 2012.

63. The Committee recommends that the Government continues to explore all possible options for stormwater capture, retention, cleansing and reuse.

64. The Committee recommends that the Government continues its policy of mandatory rainwater tanks on all new houses built with rebates to encourage existing home owners to install water tanks.

65. The Committee recommends that the Government investigates the technical feasibility of using constructed wetlands and reedbeds to purify stormwater prior to discharge on all new developments."

3.4 Water Proofing Adelaide

The following statement made by the Premier of South Australia Mike Rann is contained on the front page of the Water Proofing Adelaide [9] website:

"Water Proofing Adelaide is the South Australian Government's 20-year blueprint for a sustainable water supply in our State. The plan demonstrates how all of us – through innovation, sensible management and greater efficiency – can make sure our precious water resources are protected for future generations.

We've worked with the people of South Australia to develop this plan – as well as 63 specific strategies aimed at fostering responsible water use, better managing existing resources and securing additional water supplies.

Water Proofing Adelaide outlines the things we must do – now and in the future – to ensure our people, industries and environment continue to have a safe and reliable water supply. This website will keep you posted on the practical work that is being done.

I thank those who have contributed to the development of the Water Proofing Adelaide strategy, and I commend it to all South Australians.

http://www.waterproofingadelaide.sa.gov.au/WPA/

Water Proofing Adelaide assessed the following options in 2005 and the text of the information provided for the seawater desalination can be found at Appendix A all of which where rejected by Water Proofing Adelaide: A thirst for change 2005 – 2025 [9]:

a. Buying water from the River Murray (to increase drinking water supplies)

b. Cloud seeding

c. Domestic aquifer storage and recovery

d. Evaporation management

e. Greywater recycling

f. Icebergs

g. Increasing storage in existing reservoirs

h. Industry demand management

i. Large scale water supply schemes (including the Bradfield, Clarence River, Ord River and Great Artesian Basin schemes)

j. Localised wastewater recycling

k. Management of the Adelaide Hills water resources

l. New reservoirs in the Adelaide Hills

m. On-site wastewater treatment/reuse

n. Reducing water losses in the bulk water system

o. Sealed catchments

p. Seawater desalination

q. Sewer mining

r. South east surface water or groundwater transfer

s. Sustainable water use for agricultural industries

3.5 Report on Sustainable Water Options for Adelaide

This 33 page Report on Sustainable Water Options for Adelaide was produced by Sustainable Focus with Richard Clark and Associates [3] and came to the following conclusions and recommendations:

"Section 6 of this report provides a ranking of the urban water supply options for Adelaide against the sustainability criteria and identifies that a mix of the higher ranking options that could form the basis of a new generation water supply system conforming to sustainability principles and public expectations.

It is concluded that demand management, stormwater harvesting, improved efficiency of existing catchments, wastewater reuse and rainwater tanks can supply all of Adelaide’s water requirements with excellent environmental, social and financial outcomes into the foreseeable future.

Desalination and/or increasing reservoir storage do not fit with the sustainable directions outlined.

Climate change is a reality and the focus needs to shift from knee-jerk drought response to long term planning under expectations of a changing climate and future population growth. This is a time of great opportunity to move to more productive and efficient water systems. The State and Federal governments have recognised that Adelaide is facing a water crisis and are prepared to invest in new infrastructure.

It is recommended that the following actions be undertaken in parallel as a matter of the greatest urgency:

- Establish a comprehensive long term demand management program with a residential target of 140 litres/person/day and a commercial/industrial target of 20% improvement in water use efficiency. As part of this, change the pricing structure for water by increasing the volumetric costs and reducing other charges to provide more incentive for users to reduce their demand to meet the overall target levels.
- Undertake an assessment of the capacity of the aquifers beneath Adelaide to support temporary groundwater 'mining', with treatment as necessary, as an emergency water supply, and commence determination of the limits of the aquifers for storing and recovering bulk water harvested from treated stormwater and wastewaters. Research means for exploring and raising the limits, as warranted.
- Commence implementation of a major metropolitan-wide stormwater harvesting program in partnership with local governments and SA Water.
- Identify and pursue strategies for making the total flow of treated wastewater acceptable for urban or peri-urban water supplies in a manner that directly or indirectly reduces the demand by the urban users on non-sustainable water sources by an amount equal to the total of the wastewater flow.
- Provide a single State government department with responsibility for multi-purpose, participatory, total water cycle planning, within the context of the State Water Plan. The Plan to cover the whole gamut of natural and engineered water systems. The department to be responsible for the immediate Water Security investigations.
- Broaden the present Water Security investigations to better define the costs and benefits of the long-term water options for Adelaide using total water cycle principles and judged on sustainability criteria as laid out in this report, but with a greater level of resourcing including:
    - consultation with Local Government and others who have successfully initiated and developed the more sustainable options to date; and
    - a program of information and consultation with the broader community on the implications, benefits and costs of the options as they emerge and progress.
- Put on hold funding proposed for desalination and reservoir storage and redirect to more sustainable options once the above assessments have confirmed the preferred options as feasible.
- Protect and improve existing catchments.
- Prescribe quaternary aquifers to prevent excessive extraction (this will be a specific issue as other sources of water become more scarce)."

3.6 Wetlands in the Torrens and Patawalonga Catchments

The following information was sourced from "Waterwatch Adelaide and Mount Lofty Ranges" home page which includes a drawing of the Lower Torrens before urban development sourced from "Patawalonga Catchment Water Management Plan Accompanying Report" May 1997 by BC Tonkin & Associates.

"A brief history

It is estimated that 70% of wetlands in South Australia have been destroyed since European settlement. Natural wetlands were once a significant component of fresh water environments across the Adelaide Plains. Before European settlement swamps and marsh areas (known as the Reed Beds), once spanned an area from Glenelg to Port Adelaide. Water travelling down the River Torrens was filtered through the Reed Beds before dispersing north into the Port River or south into the Patawalonga and the sea. These areas were altered during the early 1900's when many natural wetlands were filled in to create dry land for housing, and water flows were redirected through constructed channels and drains.

Urban development, such as the construction of roads, houses, car parks, shopping centres and businesses, has increased the amount of stormwater runoff in our cities and suburbs. Hard surfaces absorb very little rainfall so stormwater gutters, channels and drains were developed to move stormwater runoff as quickly as possible from our neighbourhoods to rivers and the sea. As a result, pollutants such as litter, nutrients, faeces, silt, dirt, oil, and leaf litter flows unfiltered into the Patawalonga, Torrens and Port rivers and Gulf St Vincent."

http://www.waterwatchadelaide.net.au/index.php?page=our-local-wetlands

3.7 Storm Water - A Precious Resource

The Western Adelaide Coastal Residents Association (WACRA) held a Community Curry Night on 20th September 2008 to hear Colin Pitman Director of City Projects for the City of Salisbury give a talk entitled "Storm Water - a precious resource". The following are some notes from that talk:

Since 1988 the City of Salisbury has created 53 wetlands using 320 Hectares of land at a cost exceeding $16 million to establish 9 Aquifer Storage and Recharge (ASR) schemes and 1 Aquifer Storage Transfer and Recharge (ASTR) scheme. Information about these schemes is available from the City of Salisbury website.

These schemes are expected to produce a recycled water yield of more than 20,000 million litres (20 GL) per year by 2010 using captured stormwater. In an average year Adelaide uses approximately 80 GL from the River Murray as part of a total water consumption of approximately 220 GL. Against this Adelaide discharges into the sea approximately 170 GL of stormwater and 70 GL of wastewater per annum.

According to Mr. Pitman if 60% of Adelaide’s stormwater was recycled, then 102 GL of stormwater would be produced across Adelaide, for approximately $300 million compared to the South Australian Government proposed 50 GL desalination plant that is expected to cost $1,100 million ($1.1 Billion) for the private sector to design and build, not including the cost of the private sector to operate and maintain. All that the South Australian Government is providing is public finance.

One of the significant areas in Adelaide's western suburbs that could be used as wetlands to recycle stormwater is the former Cheltenham racecourse which was sold for around $85 million by the South Australian Jockey Club to developers with the consent of the South Australian Government in November of 2007. When responding to a question about the potential water production capacity if the whole of Cheltenham Park was used as a wetland area Colin Pitman said "if we could get water there, of the order of 20 to 30 GL or over 30% of Adelaide's consumption". He further stated this isn't going to happen as a wetland of only 5 to 6 hectares is planned for Cheltenham Park.

By way of comparison; Adelaide's Kangaroo Creek Reservoir has a storage capacity of 19.2 GL and a water surface area of 103 Hectares. Who in their right mind would drain Kangaroo Creek Reservoir to build houses and yet this is exactly what is being planned for Cheltenham Park right in the heart of the western suburbs of Adelaide. The South Australian Government supported by the opposition and Commonwealth Government would rather build a 50 GL desalination plant (which may be doubled in size) which is going to add a further 65 to 95 GL to the 220 GL of storm and waste water going into GSV each year from metropolitan Adelaide.

3.8 River Murray – An Important Resource

The Senate Committee Report Rural and Regional Affairs and Transport has produced the first report "Water management in the Coorong and Lower Lakes" [5]

The following sections have been selected and reproduced here to understand the potential water availability to Adelaide and to recognise that water used by urban and domestic consumers is insignificant when compared to the water used by irrigation and there is a need for a rethink and prioritisation of the allocations of the Murray Darling Basin:

"2.21 The Murray-Darling Basin (the Basin) covers approximately 1 059 000 square kilometres or 14 per cent of Australia’s land area. Two million people (10 per cent of Australia’s population) live in the Basin and are dependent on it for their drinking water, as are another 1.1 million residents of the city of Adelaide.

2.23 The estimated long term average annual runoff into all rivers in the Basin is approximately 23 609GL which is approximately 4 per cent of the average annual rainfall of 530 618GL. There is considerable variation in runoff from one part of the Basin to another.

2.28 To regulate the River Murray system, River Murray Water utilises four major storages, sixteen weirs, five barrages and numerous other smaller structures. Major storage capacity in the Murray system (Dartmouth, Hume, Lake Victoria, and Menindee) is approximately 9000GL and in all Basin storages is approximately 23 000GL.

2.29 The total net open water evaporation from major water bodies within the Basin is in the order of 3000GL/year. Of this, the Menindee Lakes account for about 460GL/year, Lake Victoria 120GL/year, and Lake Hume accounts for about 60GL/year of evaporation. The Lower Lakes account for net evaporation of approximately 700-950GL per year, almost a third of the total estimated evaporation.

2.33 Irrigated agriculture covers a total of almost 1.65 million hectares in the Basin and is the single greatest water user. Average annual diversions in the Basin are about 11 500GL per year; about half of the annual flow in the Basin. Around 95 per cent of this diversion is for irrigation. In 2006-07, water diverted from the Murray, Murrumbidgee and Goulburn Rivers accounted for about 72 per cent of all the water diverted in the Basin.

2.34 Irrigation within the Basin can be broadly characterised by several main industries with different patterns of water use. These are:

- pasture in the southeast which is often flood-irrigated and occurs throughout much of the year (17 per cent);
- rice in the Murray and Murrumbidgee which is flood-irrigated (standing water) for about three months in the summer (16 per cent);
- dairy farming (17 per cent);
- cotton in the northern Basin catchments which is flood-irrigated for about three months in the summer (20 per cent); and
- Horticulture, including grapes, other fruit, nuts and vegetables (13 per cent).

2.43 Under the basic sharing provisions of the Agreement, SA is entitled to receive a minimum volume of 'entitlement' water from the upper States (1859GL per year).

2.50 Approximately 350GL of River Murray Water is used by urban and domestic consumers each year. The largest consumer of this water in dry years is SA (200GL), near the end of the River Murray.

3.5 The current dry period and low water availability can be put into perspective by comparisons with similar extended droughts in the early and mid-twentieth century. The average annual Murray inflow of 3800GL/yr during the current drought (2002 to 2008) is lower than that experienced in the previous worst two droughts on record – 4900GL/yr in 1897 to 1904, and 5600GL/yr in 1938 to 1946."

3.8.1 Finding Innovative Ways To Reduce Water Use By 30 To 50%

Professor Wayne Meyer presented data on water extraction from the Murray Darling Basin at The University of Adelaide Water Wednesday held on 15th October 2008 [10] and conclusions that are documented on the presentation slides and posted on the web site:

Table 1. Water Extraction in the MDB

	Irrigation (GL)	Other (GL) Urban & Stock Watering
Total MDB		
2001/02	10,960	607
2006/07	4667	567
SA		
2001/02	494	127
2006/07	377	250
Adelaide		
2001/02		82
2006/07		203

"MDB water used in SA

- Adelaide’s water requirement is small relative to the MDB resource and other current uses.
- Water restrictions in Adelaide will not “save the Murray”
- Significant reductions in water use for irrigation will be necessary.
- This is the purpose of the Australian Government’s “water buyback” scheme."

3.9 Desalination Risks

3.9.1 Limitations of Current Marine Research

Dr Tony Bolton, Scientist and Director Lincoln Marine Science Centre gave an excellent insight into the risk of establishing a large scale desalination plant in the gulfs as the following extract from evidence presented to the ERDC committee on the 8th October 2008 [6] illustrates:

"The first is that there are actually no long-term studies of environmental impacts of desalination plants anywhere in the world. Of the studies that are there, many of them are actually produced from government reports and so forth and have not been subject to the peer review process. So of the studies that are there, very few of them have actually been subject to peer review. What does exist is actually only looking at very short-term effects, so we are looking at periods of a month to a year in most cases.

Some of the studies do seem to indicate impacts of salinity, or increased salinity on marine biota, but there are plenty of other studies that show no impacts, but this is problematic for a number of reasons, and I will come back to that shortly. The really important point about this is that all of the investigations that have gone on to date are really at inappropriate time scales; temporal scales.

So we really do not know, firstly, what the long-term impacts of these plants are. Importantly, these are long-term developments, particularly in the case of BHP—it is at least 50 years, but probably much more than that once you get an increase in population on the peninsula. The other thing that worries me is that there are really no experts in this area globally, so who are we consulting as experts on the impacts of desalination plants? There have not been sufficient studies to make those sorts of claims.

What we do know, as I said before, is that in many cases desalination plants are not benign in terms of their environmental impacts, but what it does depend on is the scale of the desal plant. It depends on the processes employed, and also the location of the plant. There are some risk-based generalisations that are generally accepted in the literature with respect to location. Inappropriate locations are generally ones that have environments with high ecological value—those that provide lots of environmental services; also, environments that have high biodiversity and, in particular, estuarine environments because of, firstly, their high productivity but, also, in many cases, their high salinity, certainly in cases of inverse estuaries like we have here; and, also, because we have low oceanographic exchanges in relation to more open areas of coast.

So, what we do know is that the best locations are areas of open coast that have plenty of flow going on which would enable that brine to be dispersed much more quickly. Interestingly—obviously, I suppose—Spencer Gulf falls into the locations on the left-hand side of that chart. It is a region that has high ecological value; it definitely has high biodiversity; it is an inverse estuary; and, as I will come to, it does have low oceanographic water exchange.

The other problem, as was alluded to by the previous speaker, is that the investigations have never been conducted at appropriate spatial scales. So, when we talk about pilot studies, they are generally on small scales and, in the case of the one proposed for Port Stanvac and also Point Lowly, they are really there to test the engineering aspects of the scheme rather than environmental impacts. Even so, even if you were to put those sorts of processes there and look at the impacts, you will still not be able to look at them over the relevant temporal scales.

BHP presented some data on toxicology experiments in which they essentially had a series of organisms in beakers in which they increased the salinity, and they looked at whether the animal died or whether there was a change in behaviour. That was used as a basis for testing the toxicity of the salt. It requires a leap of faith to make conclusions about what would happen in a natural system from what actually happens in the beaker.

The reason is that the beaker just is not a good approximation of the open ocean because you have a much more complex system and it is on a much different scale. You are also looking at a whole range of different life history stages of organisms. So we are looking at the gametes (the eggs and the sperm), we are looking at the larval stages that most marine invertebrates certainly have, and we are looking at a whole range of ecological interactions that are still pretty poorly understood in southern Australia.

There is quite extensive literature now, much of which has come out of Australia, looking at the problem of detecting human impacts on marine systems. There is a whole raft of experimental and statistical issues with this, and what you need is studies which have replicated sites in which there are no impacts and replicated sites in which there is an impact. The sites need to be comparable, otherwise you are confounding the conclusions you come to because of differences between the sites, and that is extremely difficult in ecology. You also need, generally, a study that looks at the system before the impact has begun, looking at it afterwards, and comparing that to replicated control sites."

3.9.2 Emerging Trends In Desalination: A Review

This National Water Commission 2008 report [8] Section 1.6.2 addresses brine disposal which is reproduced here:

"The desalination plants constructed in Australia use reverse osmosis membranes to separate seawater into a high quality product stream and a concentrated salt stream. The ratio of concentrate to product typically ranges from 1.2 to 1.9. Consequently, to produce 1 L of potable water it is necessary to draw 2.2 to 2.9 L of seawater from the ocean.

The environmental impact of brine discharge into marine environments is a key issue for coastal desalination plants. However, the majority of current international knowledge relates specifically to a few heavily impacted and relatively enclosed water bodies, including:

- the Mediterranean Sea
- the Red Sea
- the Persian Gulf

Many marine organisms are highly sensitive to variations in salinity. For example:

- echinoderms appear to have been severely impacted in an area close to a Mediterranean SWRO discharge
- seagrasses such as Mediterranean Posidonia and their associated ecosystems appear to have been impacted in some regions

Because a dense, hypersaline plume will tend to sink and disperse slowly, biota likely to be affected are bottom-dwelling or non-mobile species that live on or are physically attached to the reef . These include fan corals, sponges, stalked and sessile ascidians, anemones and attached algae.

At present, there is little information available on the salinity tolerances of these species or their responses to chemicals contained in the discharge plume. The impacted zone for a 500 ML/d plant under quiescent conditions is assumed to be about 0.5 hectares.

In some circumstances, brine plume density may lead to increased stratification reducing vertical mixing, which may reduce dissolved oxygen levels, with ecological implications. This possibility was raised as a particular concern during the planning and assessment for the Perth Seawater Desalination Plant discharging into Cockburn Sound, a large semi-enclosed embayment.

However, detailed modelling and site investigation concluded that the anticipated brine discharge is unlikely to contribute to the exacerbation of low-oxygen conditions in this case. Nonetheless, an on-going dissolved oxygen monitoring program has been installed since construction of the plant."

3.9.3 Project And Technical Risks

A common perception promoted by advocates of desalination is that it will provide a climate independent source of drinking water. The largest desalination plant currently operating in Tampa Bay California in the Unites States took ten years to commission and has a yearly capacity of 35 GL.

However as the following sources from the web indicate, technology coupled with the scale of the plant and the complexity of interfacing with what is a complex living system, the marine environment is a recipe for considerable project risk and in the end political risk for the government advancing its use. A comprehensive and high quality methodology is required to mitigate those risks not only to the environment but to the reputation of the state. This reputation is already sullied by plans by the government to build a weir at Wellington and abandon the Lower Lakes and Coorong [11], wetlands of international significance and described as the lungs of the Murray Darling system. The methodology needs to include as a minimum:

a. Comprehensive and scientific peer reviewed environmental studies that are completed before any major project decisions are taken.

b. Small scale demonstration plant to trial the technology and qualify the likely environmental impacts.

An example of a sound methodology is provided by the City of Santa Cruz and Soquel Creek Water District in California (United States) who are planning to build a 912.5 million gallon per year (3.45 GL per year) desalination plant as this extract from their web site provides perhaps a result of comprehensive laws to protect the marine environment Appendix B:

"Project Schedule

A decision by the governing bodies of the City of Santa Cruz (SCWD) and Soquel Creek Water District (SqCWD) for the construction of a full-scale desalination plant is dependent upon the successful completion of the pilot test program, technical review of the data collected, and environmental approval and permitting of a full-scale plant design.

Additional studies will investigate the location and design of the proposed full-scale plant's intake system and focus on water quality/biological issues to ensure the plant would not have an adverse impact on the environment.

A Pilot Test Program at Long Marine Lab is currently underway and will be conducted for a minimum of 12-months to evaluate the best and most cost-efficient desalination technologies and provide water quality data to regulatory agencies."

"Below is the preliminary project schedule, which is subject to change.

- Pilot Plant Testing — January 2008-January 2009

- Pilot Test Program Technical Review — December 2008 - February 2009
- Full-Scale Plant Design — 2010-2013
- Full-Scale Plant Environmental Impact Report Preparation & Certification — 2009–2012
- Full-Scale Plant Construction — 2012-2015"

http://www.scwd2desal.org/schedule.html

Dr Kirsten Benkendorff in evidence presented to the ERDC committee on the 8th October 2008 [6] illustrated these risks when explaining to the committee that the Cockburn Sound desalination plant in Western Australia had been down-regulated to operate at only about 12% of its capacity due to the problems with pooling of deoxygenated water produced by the desalination plant.

3.9.3.1 Ocean Desalination: A Technology With Many Pitfalls

"A number of coastal regions in California are exploring the use of desalination to supplement their drinking water supplies. Desalination is an expensive, energy-intensive technology that separates salt from seawater in a process called "reverse osmosis." The process discharges a thick, soupy brine that can be toxic to aquatic life. Desalination is also used in inland areas to treat brackish or polluted water.

But desalination may be more speculative boondoggle than panacea. A plant developed by Poseidon Resources in Tampa Bay, Florida, has been shut down due to poor performance. Taxpayers put up $85-million of the plant's $110-million price tag. This may prove to be a cautionary tale for other cities considering desalination as a quick fix to their water shortage problems. Conservation and recycling programs may be a much less expensive and less risky alternative to building desalination plants.

The California Coastal Commission has released a report that takes a probing look at all aspects of ocean desalination, including environmental concerns and privatization of public water supplies. The report, a first of its kind for a state agency, also examines how international trade and investment agreements could affect the commission's ability to implement the Coastal Act when reviewing permit applications for new facilities." (regarding international trade see page 50)

http://www.citizen.org/california/water/desal/

3.9.3.2 Tampa Bay Desalination Plant Rises Again

David Ehrlich *Cleantech Group* 28th January 2008

"The largest seawater desalination facility in the U.S. was beset by developer bankruptcies and plant design problems. Clearwater, Fla.-based Tampa Bay Water reopened a 25 million gallon per day desalination plant, putting to rest a more than 10 year odyssey marked by developers filing for bankruptcy protection and problems with the plant design. The $158 million reverse osmosis facility, up from an original cost of $110 million, is expected to cover at least 10 percent of the drinking water needs of the more than 2.4 million people in the Tampa Bay area." (Equivalent to a 35 GL per year plant)

http://www.cleantech.com/news/2369/tampa-bay-desalination-plant-rises-again

3.9.3.3 Desalination History

Tampa Bay Water

"Tampa Bay Water's Master Water Plan is the blueprint to meet the region's water needs. The first configuration of Master Water Plan projects was approved for construction in October 1998. This first set of projects was needed to offset major reduction in groundwater pumping from long-producing wellfields and to meet the region's growing water needs through the development of geographically diverse, alternative drinking water sources. "

http://www.tampabaywater.org/watersupply/tbdesalhistory.aspx

3.9.3.4 Desalination, With A Grain Of Salt

A California Perspective

Long considered the Holy Grail of water supply, desalination offers the potential of an unlimited source of fresh water purified from the vast oceans of salt water that surround us. The public, politicians, and water managers continue to hope that cost-effective and environmentally safe ocean desalination will come to the rescue of water-short regions. While seawater desalination plants are already vital for economic development in many arid and water-short areas of the world, many plants are overly expensive, inaccurately promoted, poorly designed, inappropriately sited, and ultimately useless. To avoid new, expensive errors, policymakers and the public need to take a careful look at the advantages and disadvantages of desalination and develop clear guidance on how to evaluate and judge proposals for new facilities.

http://www.pacinst.org/reports/desalination/index.htm

3.9.3.5 Avoid Risk Repeating California's Desal Debacle

Greens call on Iemma and Debnam to scrap desal plans 22nd March 2007

"Following revelations of California's disastrous experiences with proposed desalination plants, Greens MP Lee Rhiannon is challenging both Premier Iemma and Opposition leader Peter Debnam to announce they will scrap the desalination plant if elected. "The Greens challenge Premier Iemma and Opposition Leader Peter Debnam to take a final stand and commit to scrap the desalination plant," said Ms Rhiannon. "Growing opposition to a spate of desalination projects in California has revealed that the technology is fraught with construction problems, breakdowns, cost blowouts, safety concerns and environmental damage. "There are currently 18 proposed desal plants in California with construction costs alone estimated at over US$3 billion. The proposed plants would produce over 1.5 billion litres of drinking water per day (400 million US gallons). "Three construction companies have already gone broke and the costs to complete some plants have spiralled. "Four cities and water companies are facing law suits under the Californian Environmental Quality Act or are facing an appeal to the US Coastal Commission. "Sydney is set to repeat the disastrous desal problems spreading up and down the Californian coastline as water companies cash in on water shortage fears.

https://secure.nsw.greens.org.au/state-election-2007/news-releases/avoid-risk-repeating-californias-desal-debacle-greens-call-on-iemma-and-debnam-to-scrap-desal-plans

4 REFERENCES

4.1 Documents & Publications

	Identification	Issue	Title
[1]	ISBN 1 921125 20 9	CSIRO 2007	Adelaide Coastal Waters Study http://www.clw.csiro.au/acws/
[2]	ISBN 978 0 9596627 8 8	RSSA 2008	Natural History of Gulf St Vincent http://www.adelaide.edu.au/rssa/pub/
[3]	Sustainable Focus Pty Ltd	Sept 2008	Report on Sustainable Water: Options for Adelaide http://markparnell.org.au/campaign.php?campaignn=25
[4]	ISBN 0-646-45013-1	2005	Water Proofing Adelaide Strategy http://www.waterproofingadelaide.sa.gov.au/WPA/Publications/
[5]	ISBN 978-0-642-71992-8	10 October 2008	Senate Committee Report Rural and Regional Affairs and Transport: Water management in the Coorong and Lower Lakes http://www.aph.gov.au/senate/committee/rrat_ctte/lowerlakes_coorong/index.htm
[6]	Hansard Report Parliament of South Australia	8th October 2008	Environment, Resources and Development Committee: Desalination Inquiry http://www.parliament.sa.gov.au/Committees/Standing/HA/EnvironmentResourcesandDevelopmentCommittee/EnvironmentResourcesandDevelopmentCommittee.htm
[7]	61st Report Coastal Development Inquiry	20th November 2007	Environment, Resources and Development Committee: Coastal Development Inquiry http://www.parliament.sa.gov.au/Committees/Standing/HA/EnvironmentResourcesandDevelopmentCommittee/EnvironmentResourcesandDevelopmentCommittee.htm
[8]	Waterlines Occasional Paper No 9	October 2008	Emerging Trends In Desalination: A Review UNESCO Centre for Membrane Science and Technology University of New South Wales http://www.nwc.gov.au/www/html/893-emerging-trends-in-desalination-a-review-.asp?intSiteID=1
[9]		2005	Water Proofing Adelaide: A thirst for change 2005 – 2025 http://www.waterproofingadelaide.sa.gov.au/WPA/
[10]		15th October 2008	The University of Adelaide Water Wednesday http://water.adelaide.edu.au/events/
[11]		2004	A Fresh History of the Lakes: Wellington to the Murray Mouth, 1800s to 1935 by Terry Sim and Kerri Muller. PDF can be downloaded from Goolwa to Wellington Local Action Planning group http://www.gwlap.org.au/publications.php

	Identification	Issue	Title
[12]	ISBN 1 876562 86 2	July 2005	"Audit of contemporary and historical quality and quantity data of stormwater discharging into the marine environment, and field work programme". ACWS Technical Report No.3 http://www.clw.csiro.au/acws/
[13]		5th Sept 2003	California Water Desalination Task Force Draft Issue Papers: Management Practices for Feedwater Intakes and Concentrate Disposal (9/5/03) http://www.owue.water.ca.gov/recycle/desal/Docs/IssuePapers.htm

4.2 Definitions And Acronyms

4.2.1 Definitions

Term	Description
Gigalitre (GL)	One gigalitre is 1,000 ML or 1 billion litres and represents a volume of water one square kilometre by one metre deep. When full, the Hope Valley reservoir holds about 2.8 GL and the Happy Valley Reservoir holds 11 GL.
Hectare	Equivalent to an area of 10,000 m^2 or 2.471 acres
WORD	Microsoft® Word 97, or later, the preferred word processing application.

4.2.2 Acronyms

Acronym	Description
ACWS	Adelaide Coastal Waters Study 2007
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ERDC	Environment, Resources and Development Committee Parliament of South Australia
FGSV	Friends of Gulf St Vincent http://users.sa.chariot.net.au/~littoral/fogsv/index.htm
GSV	Gulf St Vincent
Ha	Hectare
ppt	Parts Per Thousand
WPA	Water Proofing Adelaide

A WPA – DESALINATION OPTION INFORMATION SHEET

Seawater Desalination

Introduction

Desalination of seawater refers to the removal of salt from seawater so that it is drinkable (potable). This process is viewed positively by many in the community because the sea is seen as an abundant source and is located close to the metropolitan area.

A number of private desalination plants are in operation in South Australia to treat brackish groundwater. SA Water's plant at Penneshaw on Kangaroo Island is the only seawater desalination plant currently in operation in South Australia. Large seawater desalination schemes are however in operation throughout the world (eg in Tampa Florida, and the Middle East) in places where conventional water supply is limited or unreliable.

What Could it Involve?

Seawater could be desalinated to potable quality through a treatment plant located on the coast near Adelaide. Treated water could be injected into the current reticulation system for potable use or supplied directly to specific users (eg industrial users requiring high quality water). Treatment technology could either be membrane technology (such as Reverse Osmosis which involves forcing water under high pressure through extremely fine membranes), or a distillation type plant.

The concentrated, highly saline, waste from this process would most likely be discharged to the sea. Provisions would have to be made for significant energy supplies for operation. Energy is a major consideration, with per kilolitre energy usage being in the order of three times that required for to pump River Murray water across the Adelaide Hills. A number of solar desalination technologies have also been proposed but they have yet to be proven on a large scale. Some are likely to be expensive and/or require large areas of land.

What Could This Option Achieve?

There is virtually an infinite quantity of water available, but this is limited by treatment capacity, ability to dispose of waste and the availability of power.

A large desalination plant including all required infrastructure (e.g. pipelines connecting the plant to the water supply system) will typically produce water at around $1.50 to $2.00 per kilolitre.

It is much more costly to desalinate seawater at smaller plants such as Penneshaw. For example, a plant with a capacity of 100 ML a year, or 300 kilolitres a day, produces water at approximately $5.00 per kL.

Key Issues

Environment

The potential impact of sea disposal of brine on the local marine environment will need to be investigated.

Energy requirements for the operation of a desalination plant are very high compared to many alternative water supply options and demand management. Unless these can be met by ‘green’ sources such as wind turbines or hyper saline lakes, green house gas emissions would be significant.

Disposal of chemicals used to clean the equipment may be an issue.

Social

The desalination plant would ideally need to be located within a reasonable distance of the coast and near an existing distribution system.

http://www.waterproofingadelaide.sa.gov.au/WPA/OptionsAssessed/

B CALIFORNIA WATER DESALINATION TASK FORCE – MANAGEMENT PRACTICES

The following extract has been taken from "Management Practices for Feedwater Intakes and Concentrate Disposal for Seawater Desalination", one of the issues papers prepared for the Californian Desalination Taskforce [13] prepared in 2003 which reference comprehensive marine environmental laws:

"Regulation of feedwater intakes and concentrate disposal for seawater desalting in California falls under the authority of several agencies including the California Coastal Commission, the U.S. EPA, the U.S. Army Corps of Engineers, the State Water Resources Control Board and State Regional Water Quality Control Boards, federal and state fisheries agencies and numerous others. As a lead regulatory agency of feedwater intakes and ocean discharge, the California Coastal Commission enforces Section 30230 of the California Coastal Act which states:

"Marine Resources shall be maintained, enhanced, and where feasible restored. Special protection shall be given to areas of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Moreover, Section 30231 of the Coastal Act adds:

"The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment...."

The regulation of desalting feedwater intakes could also fall under similar conditions of the Clean Water Act Section 316(b) which requires that the

"*location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts*".

Although Section 316(b) was originally intended for power plants, comparable regulations for entrainment and impingement of marine life may also apply to seawater desalting intakes. The US Army Corps of Engineers also holds an important regulatory role by issuing Section 10 (Rivers and Harbors Act) and 404 (Clean Water Act) permits pertaining to offshore intakes and waste discharge pipelines."