PROPOSED ADELAIDE DESALINATION PLANT

EIS – Chapter 6
Energy, Sustainability and Climate Change

Government of South Australia

SA Water

Securing tomorrow's water today

Contents

6.1 Introduction

This chapter assesses sustainability, greenhouse gas emissions and energy consumption associated with the construction and operation of the proposed Desalination Plant. It also outlines the relevant legislative framework, describes climate change implications in relation to the operation of the Desalination Plant and discusses options to achieve carbon neutrality.

The State Government has committed the Adelaide Desalination Plant to be 'carbon neutral', including requirements to operate the plant and delivery pipeline with renewable energy or the purchase of carbon permits and/or offsets as desalination is energy intensive.

Strategies are being developed to manage the greenhouse gas emissions associated with the construction and operation of the ADP.

For the purposes of the ADP, the definition of 'renewable energy' is consistent with that of the (national) Mandatory Renewable Energy Target (MRET) definition.

According to this definition, renewable energy sources include, hydro, wave, tide, ocean, wind, solar, geothermal-aquifer, hot dry rock, energy crops, wood waste, agricultural waste, waste from processing of agricultural products, food waste, food processing waste, bagasse, black liquor, biomass-based components of municipal solid waste, landfill gas, sewage gas and biomass-based components of sewage and any other source prescribed by regulation. Any of these sources is able to create Renewable Energy Certificates.

SA Water remains committed to the environment and to its sustainability policy which allows for an energy procurement plan that incorporates the purchase of renewable energy for the Desalination Plant and other operations for the ADP.

Environmental benefits include reduced dependence on the River Murray and reduced pumping and water treatment of River Murray water, currently powered by standard grid electricity.

Electricity for the Desalination Plant will be supplied by the energy retailer purchasing electricity from the national grid.

6.2 Sustainability

SA Water's Sustainability Policy Framework sets out the conditions for SA Water to manage its design, construction and operation within the areas of environment, economic and social needs.

6.2.1 Greenhouse Management in Design

A sustainable structure is one that meets the requirements of its design life, is adaptable and has a low ecological footprint. The design phase of the project has recognised the need to minimise energy usage over the life of the ADP, including the selection of materials and equipment.

6.2.2 Greenhouse Management During Construction

The incorporation of environmental management and mitigation measures in the planning phase will reduce environmental impacts during construction. Although the operational phase of the project is the dominant challenge, construction impacts are also being assessed in relation to greenhouse gas emissions and energy consumption.

The selection of materials should be based on a life cycle assessment, including raw material requirements, delivery issues, ease of construction, maintenance costs, recycling and reuse. Section 4.3 of the State Government's Renewable Energy, Energy Supply and Greenhouse Gas Emissions Strategy provides specific values for the indirect energy estimates associated with emissions from materials used in both the construction and operation phases. Where possible, materials will be sourced locally to ensure the minimisation of transportation and fuel costs.

The Desalination Plant buildings have been designed to create the optimum working environment with minimum energy use.

6.2.3 Greenhouse Management During Operation

The procurement strategy for energy supply, use of chemicals and consumables will contribute to the extent to which the Desalination Plant will be assessed as sustainable.

6.3 Energy Management

6.3.1 Energy Requirements

The following table outlines initial estimates of energy consumption for the Desalination Plant for both the construction and operations phases for the 50 GL per annum Desalination Plant.

Table 6.1 Indicative Energy Consumption Estimates.

Components	Estimated Energy Consumption at 50 GL/a
Total construction energy	60 GWh
Operations energy per year (excl. transfer pumping)	250 GWh per year

6.3.2 Annual Energy Scenarios

The Desalination Plant infrastructure and pipeline capacities are being designed to accommodate further expansion that would result in a proportional linear increase in operational energy requirements. Table 6.2 provides the indicative load requirements for the Desalination Plant, taking into consideration possible capacity increases.

Table 6.2 Indicative Energy Consumption Estimates at Various Capacity Levels.

Component	50 GL p.a.	75 GL p.a.	100 GL p.a.
Desalination Plant	250 GWh	375 GWh	500 GWh

6.4 Energy Efficiency

Maximising energy efficiency is a key driver of the ADP as it helps to minimise the size of the potential greenhouse footprint. The total energy required per volume of drinking water delivered, which is generally given as kilowatt hours per kilolitre of water produced (kWh/kL), is typically regarded as a measure of energy efficiency in a reverse osmosis desalination plant. Some care is required, however, as there are differences between plants at different locations because of the nature of inlet and delivery pumping requirements, as well as seawater quality. The energy consumption for the proposed Port Stanvac Desalination Plant has been estimated by Connell Wagner to be approximately 5 kWh of energy for every kL of water produced.

The energy consumption for seawater reverse osmosis desalination plants varies within a range from around 3.5 kWh to 5.5 kWh and there are numerous contributing process-related factors that impact the energy use. These include:

- Seawater temperature and salinity;
- Drinking water quality targets (in particular, salinity, boron and bromide);
- Type of energy recovery system employed (turbines versus work exchangers and pressure exchangers);
- Type and size of pumps and motors;
- Operational flexibility and plant operating modes e.g. full load or part load;
- Site elevation above sea level and site topography;
- Energy required for pumping the treated (drinking) water into the system; and
- Innovative process plant layouts.

The final contracted energy consumption for the proposed Desalination Plant will depend on the above factors. With improvements in reverse osmosis membrane energy and production efficiency, combined with optimised process design, energy usage is decreasing.

Embodied energy is the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery. The selection of material with low embodied energy and a long design life is being considered to provide a long term usage of the materials, services and resources used during construction and operation of the Desalination Plant, therefore minimising energy. It is essentially an accounting methodology which aims to find the total energy required from raw material extraction to transport, manufacturing, assembly and installation, as well as the capital and other costs of a specified material to produce a service or product and finally its disassembly, deconstruction and/or decommissioning.

6.4.1 Desalination Technologies and Energy Efficiency

Production of drinking water from seawater using reverse osmosis technology is energy intensive. However, significant gains in efficiency have been achieved since the early 1990s and these technological advancements are outlined below.

6.4.1.1 Reverse Osmosis Efficiency

Early reverse osmosis membranes required higher pressures had low productivity (flow per unit area) and the amount of salt diffusion was unacceptable for drinking water quality. Technological advances in membrane chemistry over the past three decades have resulted in dramatic improvements in reverse osmosis membranes.

All recently constructed or proposed large-scale desalination plants in Australia use reverse osmosis technology, as it is more energy efficient and cost effective than thermal and other desalination processes. SA Water undertook a consultancy to assess the different technologies available for large-scale desalination and confirmed that reverse osmosis was the most energy and cost efficient technology currently available.

Thermal desalination processes require large amounts of energy, and in general, are only viable in areas where waste heat in the form of low to medium pressure steam or cheap electricity is available such as is the case in the Middle East and North Africa. The energy used in a thermal distillation plant would be at least five times higher than a reverse osmosis desalination plant. For the rest of the world, membrane based desalination processes dominate. The main reason for this is that membrane processes, including reverse osmosis, require significantly less energy than distillation and use electricity, which is more readily available than steam.

6.4.1.2 Energy Recovery

The energy costs of reverse osmosis desalination can represent more than one third of a membrane's system operating costs, most of which is via electric motors that operate the high pressure feedwater pumps. Energy recovery devices provide the opportunity to use energy more than once, reducing overall energy needs and greenhouse management costs.

The proposed Desalination Plant is being designed to incorporate energy recovery. The energy recovered from the high pressure saline concentrate is used to supplement the reverse osmosis inlet flow, allowing a smaller high pressure inlet pump to be used than would otherwise be required. It is anticipated that the power requirement of the first pass reverse osmosis process can be reduced by up to 40% using this energy recovery system.

6.4.1.2.1 Energy Recovery Devices (ERDs)

Energy recovery devices that are currently available can be broadly classified in two categories according to the operating principles: centrifugal devices and positive displacement devices. Centrifugal devices include reverse running pumps (Francis turbine), Pelton impulse turbines, hydraulic turbochargers and hydraulic pressure boosters and positive displacement devices, including pressure exchangers and dual work exchangers.

6.4.1.2.2 Potential for Hydro Power Device

Separate investigations are being undertaken into the feasibility of including a hydropower device in the reject stream for the additional energy recovery arising from the static head of the Desalination Plant above sea level. However, there are competing uses for the discharge energy as a certain amount is required to assist in dispersion and mixing of the saline concentrate discharged to Gulf St Vincent. Any surplus energy recovered would be used on site for ancillary services (such as lighting, tools, heating, etc), thereby reducing the quantity of energy required from the grid.

6.4.2 Maximising Permeate Production

The desalination process will also be designed to maximise permeate production from reverse osmosis trains, which are typically between 40 and 45% of the seawater feed. Any improvement in the recovery rate from the membranes can reduce the volume of seawater pumped to the Desalination Plant, resulting in a reduction in pumping costs, pump requirements and pre-treatment.

6.4.2.1 Other Opportunities for Energy Conservation

Approximately 96% of flushing water from the pre-treatment and filtration stages can be recovered and reintroduced to the works to reduce the overall inlet flow requirements. This has the advantage of decreasing the intake pumping power requirements and chemical treatment requirements.

In addition, the available size and sloping topography of the project site has enabled the Concept Design of the proposed Desalination Plant to allow for the intake stream to pass through the pre-treatment plant under gravity rather than using pressure filters and localised pumping between plant elements. This not only simplifies the process but also reduces potential bottlenecks and maintenance needs, reducing the total ADP energy requirements.

The operational timeframe of the Desalination Plant (approximately 2010 to 2035) allows for consideration of other energy technology advances, which may achieve commercial viability during this time.

Appropriate measures to incorporate energy efficiency into the construction of the proposed Desalination Plant, including reserve osmosis plant and other associated infrastructure, will be undertaken by the Contractor. Systems and protocols will be put in place to promote the efficient use of energy.

6.5 Options for Electricity Supply

6.5.1 Standard Grid Electricity

Standard grid electricity is available through all energy retailers and comprises the full suite of energy generation sources that feed into the electricity grid. The greenhouse gas emissions associated with standard grid electricity are currently assigned by the Department of Climate Change (DoCC), as an overall average of State emissions intensity from all sources. At standard grid intensity, greenhouse gas emissions are treated as part of Australia's total emissions and managed only to the extent of the national response to climate change. Standard grid electricity will also be subject to the costs of Australia's proposed Carbon Pollution Reduction Scheme (CPRS).

6.5.2 Renewable Electricity

For the purposes of the ADP, renewable energy will be defined as it is for the purposes of the (national) Mandatory Renewable Energy Target (MRET). This definition is set out in s.17 of the *Renewable Energy (Electricity) Act 2000* (Cwth).

Recognising strong community concerns about climate change and its impacts on water supply, there is a strong preference for the proposed Desalination Plant and associated infrastructure to be powered by renewable energy sources.

Direct on-site power generation at the scale of operation required for the Desalination Plant, without a grid firming up mechanism, is not feasible due to site constraints and the intermittency of such energy sources. However, there is opportunity to incorporate limited on-site renewable energy to meet small scale needs and to demonstrate and explore renewable technology options.

Off-site renewable energy generation provides the opportunity to enter into supply contracts at a greater scale sufficient to meet operating needs. The following off-site renewable energy sources were investigated and the outcomes of the investigations are outlined in more detail in the following sections:

- Wind energy;
- Hydro energy;
- Solar energy;
- Geothermal energy; and
- Other technologies.

6.5.2.1 Wind Energy

South Australia is well suited to wind farms and more wind power is generated in South Australia than any other Australian state or territory. There is currently 388 MW of wind farms in operation and, based on construction estimates, this is expected to increase to 730 MW by the end of 2008, representing nearly 20% of the State's installed electricity generating capacity.

The variability of wind power and local conditions prohibit direct connection of the proposed Desalination Plant to large wind turbines at the proposed site. Other wind energy sources in South Australia are available at a sufficient scale to provide renewable energy supply for Plant operation requirements. A wind generating facility or multiple facilities can be connected to the electricity grid in South Australia (or interstate as a second preference).

Supply variability can be managed by the energy retailer through a firming up mechanism.

Alternatively, standard grid electricity and renewable energy products could be sourced separately. However, this would result in certainty that SA Water would be paying for both carbon permits associated with standard grid electricity, as well as Renewable Energy Certificates (RECs).

6.5.2.2 Hydro Energy

There is currently one mini hydro energy facility in South Australia, which recovers only 6 GWh per annum and is not accredited as Green Power beyond 2008[1]. While larger accredited hydro generating facilities exist in the eastern states of Victoria and New South Wales, SA Water is committed to making the best endeavours to source renewable energy from within South Australia to meet SA Water's procurement objectives, so this energy source is not an option for the Desalination Plant.

6.5.2.3 Solar Photovoltaic Energy Sources

Photovoltaic solar panels typically generate between 70 to 200 Watts per panel, so a very large number of solar panels would be required to address the load requirements of the proposed Desalination Plant. At present, installations cost significantly more than alternative sources of renewable energy and do not provide a cost-effective option for the ADP.

6.5.2.4 Small Scale Solar Photovoltaic and Wind Opportunities

Recognising the limitations on solar photovoltaic production and wind turbines at the site, there are opportunities to include small scale on site systems to potentially cover office requirements, cathodic protection systems and efficient lighting systems. These opportunities will be explored with a view to arranging separate contracts from the major energy procurement process. To incorporate the connection of such small scale systems, it will be essential to ensure the inverters and protection devices are fully integrated within the site and that cabling is appropriately sized.

[1] In 1997, the Sustainable Energy Development Authority (SEDA) in NSW established the GreenPower Accreditation Program to accredit electricity retailers' Renewable Energy products.
The program is now offered nationally through joint collaboration by participating jurisdictions, collectively known as the National GreenPower Steering Group (NGPSG).
As of March 2005, any organisation (including non-licensed energy retailers) that is eligible to purchase Renewable Energy Certificates are eligible to develop a product for accreditation as a GreenPower Product.

6.5.2.5 Geothermal Energy

This potential form of renewable energy is based on hot fractured rock (HFR) geothermal energy and is the focus of much activity, particularly in South Australia. One of the more advanced companies, Geodynamics, is developing a 50 MW plant capable of delivering power to the electricity market by 2012 and targeting production of more than 500 MW by 2016. At this stage, no reliable cost estimates are available, although Geodynamics asserts that $40/MWh is achievable based on a 300 MW plant.

Currently Australia has only a handful of geothermal systems, with the most significant being located in Western Queensland in the Great Artesian Basin.

As is the case with hydro energy, SA Water has a preference to source renewable energy from within South Australia and due to the lack of geothermal systems currently available in South Australia, this potential energy source is not currently an option for the proposed Desalination Plant.

6.5.2.6 Other Renewable Energy Technologies

Wave energy and solar convection towers are examples of other potential energy sources that are not currently available as an option to power the Desalination Plant. SA Water will continue to take an interest in new technologies as they develop, to provide solutions for future energy procurement contracts.

6.6 Relevant Strategies and Legislation

In response to the challenges of climate change, international, national, state and local governments have developed and implemented strategies to reduce greenhouse gas emissions. In South Australia, *Tackling Climate Change: South Australia's Greenhouse Strategy 2007-2020* sets out the key policy framework for the State's response to the risk of climate change.

An overview of the key National and State related legislation and policies applicable to the ADP is outlined in the following sections.

6.6.1 South Australia's Strategic Plan

The South Australian Government first released South Australia's Strategic Plan (SASP) in March 2004, with an update released in January 2007. SASP is the overarching document influencing the direction of South Australia. It seeks to deliver a range of economic, environmental and social outcomes to benefit the residents of the State and contains some 84 targets (most of which are to be reached within a 10-year time frame) aimed at achieving the following key objectives:

1. Growing prosperity;
2. Improved wellbeing;
3. Attaining sustainability;
4. Fostering creativity and innovation;
5. Building communities; and
6. Expanding opportunity.

Of these 6 objectives, the one most relevant to the proposed Desalination Plant is that of 'Attaining sustainability'. This objective identifies the State's water supply as the most critical environmental issue facing South Australia and highlights the need to focus on securing water supplies for the future.

6.6.2 South Australia's Greenhouse Strategy

Tackling Climate Change: South Australia's Greenhouse Strategy 2007-2020 was released in May 2007 and is South Australia's long-term response to climate change. The strategy provides a framework for the State to adapt to climate change and reduce greenhouse emissions.

The strategy contains a Government Action Plan, which is a framework to guide the activities of government agencies in implementing the strategy for South Australia to meet its commitment to achieve the Kyoto emissions reduction target within the first commitment period of 2008-2012. A major priority of South Australia's Strategic Plan is to achieve the Kyoto target by limiting the State's greenhouse gas emissions to 108% of 1990 levels during 2008-12, as a first step towards reducing emissions by 60% (to 40% of 1990 levels) by 2050.

6.6.3 *Climate Change and Greenhouse Emissions Reduction Act 2007*

The *Climate Change and Greenhouse Reduction Act 2007* (SA) sets out three targets:

- To reduce greenhouse gas emissions within the State by at least 60% to an amount that is equal to or less than 40% of 1990 levels, as part of a national and international response to climate change by 31 December 2050;
- To increase the proportion of renewable electricity generated so it comprises at least 20 per cent of electricity generated in the State by 31 December 2014; and
- To increase the proportion of renewable electricity consumed so that it comprises at least 20 per cent of electricity consumed in the State by 31 December 2014.

The legislation requires the Government to establish climate change sector agreements with Government business enterprises to support the objectives of the *Climate Change and Greenhouse Reduction Act 2007.*

6.6.4 National Greenhouse and Energy Reporting Act

The *National Greenhouse and Energy Reporting Act 2007* (Cwth) (*NGER Act*) was passed on 29 September 2007 and introduces a single national reporting framework for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy consumption and energy production by Australian corporations.

Reporting obligations commenced on 1 July 2008 and are mandatory for SA Water as it exceeds threshold energy use and greenhouse gas emissions.

The key features of the Commonwealth *NGER Act* are:

- Reporting on greenhouse gas emissions, energy consumption and production by large corporations;
- Public disclosure of corporate level greenhouse gas emissions and energy information; and
- Consistent and comparable data available for decision making, in particular the development of the Australian Emissions Trading Scheme.

Under the Commonwelth *NGER Act*, relevant corporations are required to report their Scope 1 (direct emissions) and Scope 2 (electricity related indirect emissions) under the National Greenhouse and Energy Reporting System. Scope 3 (other indirect emissions) may be reported on a voluntary basis and some are required of Greenhouse Challenge Plus members, of which SA Water has been a member since 2003.

There are three main pieces of subordinate legislation that support the functioning of the *NGER Act*; the *National Greenhouse and Energy Reporting Regulations 2008*, the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and the *External Audit Legislative Instrument*.

6.6.5 Proposed Carbon Pollution Reduction Scheme (CPRS)

The Commonwealth Government has announced that it will implement an emissions trading scheme in 2010 as its key mechanism for achieving substantial mitigation of greenhouse gas emissions. On 16 July 2008, the Commonwealth Government issued a CPRS Green Paper setting out its proposed approach to the emissions trading scheme. SA Water and other water utilities have made submissions on the Green Paper and contributed to an Industry submission via the Water Services Association of Australia.

The scheme will have an indirect impact on the cost of electricity, resources and services that pass through cost of emission permits. The greatest potential impact of the CPRS to SA Water will be on the cost of electricity.

The extent to which SA Water may avoid the cost of CPRS permits when it procures renewable electricity depends on commercial negotiations between SA Water and its suppliers. It is not yet certain as such pricing mechanisms have not been used in the past. Should SA Water enter into separate contracts for standard grid and renewable energy, it would pay for the cost of CPRS permits and a premium for renewables. In a combined renewable energy and standard grid energy contract, some if not all of the CPRS permit costs may be avoided.

6.7 Greenhouse Gas Emissions Management

Managing greenhouse gas emissions first requires a preparation of a greenhouse inventory, and in the case of desalination plants that are energy intensive, it is the ongoing electricity requirement that makes up the largest potential source of greenhouse gas emissions.

6.7.1 Emission Classification

Figure 6.1 summarises Scope 1, 2, and 3 emissions as described by the *National Greenhouse and Energy Reporting System – Reporting Guidelines (2008)*.

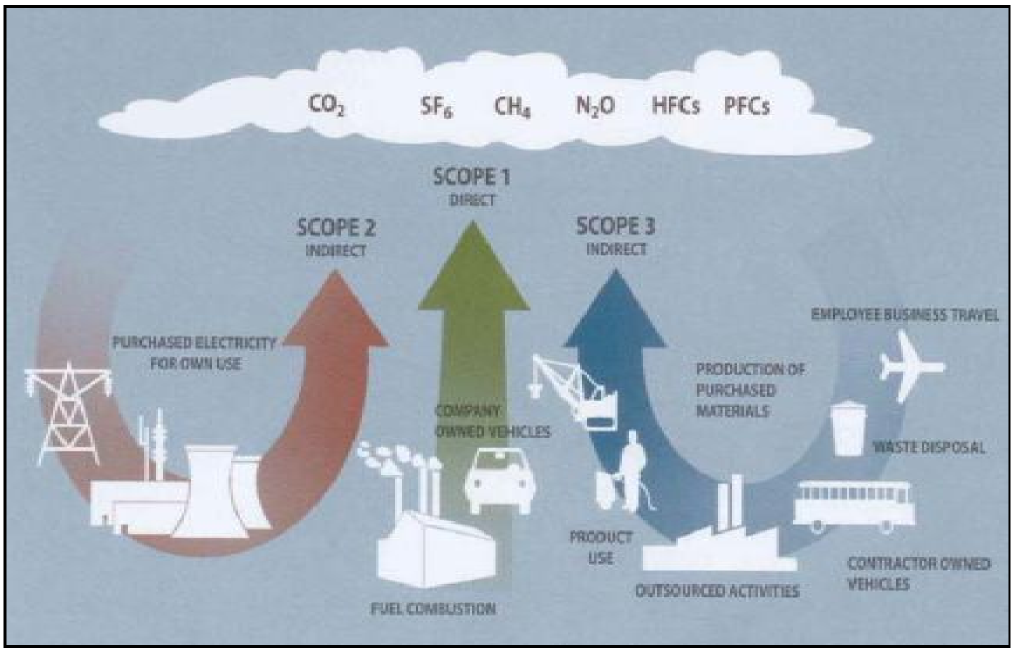

Figure 6.1 Emissions described under the National Greenhouse and Energy Reporting System.

The National Greenhouse Accounts (NGA) Factors (2008) has been used as the basis for Scope 2 and Scope 3 emissions factors relating to electricity use.

6.7.2 SA Water Greenhouse Monitoring and Reporting

SA Water monitors and reports greenhouse gas emissions associated with providing water and wastewater services to South Australian customers. This reporting covers direct emissions and significant indirect and outsourced emissions, enabling a holistic assessment of the greenhouse impacts of our services.

SA Water has monitored and reported its Scope 1, 2 and significant Scope 3 emissions since joining the Greenhouse Challenge in 2003 and is subject to independent verification and audit through both the Greenhouse Challenge and National Water Initiative requirements.

SA Water is also liable for mandatory reporting of its Scope 1 and 2 emissions under the *NGER Act*.

6.7.3 Preliminary Indicative Estimate of Potential Greenhouse Gas Emissions

Table 6.3 summarises the current preliminary estimates of greenhouse gas emissions to date and includes data on construction steel, concrete and excavation quantities and other inputs.

Table 6.3 Preliminary Potential Greenhouse Gas Emissions Estimate.

	Resources	Yearly Resource inputs annualised over 20 year asset life	Yearly Greenhouse gas emissions annualised over 20 year asset life (tonnes CO_2-e)	Scope of Emissions
Operations	Electricity - Treatment	250,000 MWh	240,000	2&3
	Electricity -Pumping	35,000 MWh	35,000	2&3
	Chemicals	Range of chemicals	13,000	3
	Membranes	5 yr changeover	TBA	3
Construction	Electricity – Construction	3,050 MWh	2,900	2&3
	Diesel		TBA	1&3
	Concrete	55,000 m^3	TBA	3
	Steel	10,500 tonnes	TBA	3
	Copper		TBA	3
Other	Minor and unknown GHG emissions	Estimate	TBA	
	Annual Emissions Potential		275,000 to 300,000 tonnes CO_2-e	
	20 Year Emissions Potential		5.5M to 6MT tonnes CO_2-e	

Notes:

Steel: Including an allowance for reinforcement and steel in the transfer main. Steel in pumps, valves, floor mesh, staircases, handrails and other structures to be quantified.

Copper To be quantified (currently based on preliminary information provided by University of NSW, Currie & Brown and SA Water)

Chemicals: The University of New South Wales will provide the embodied greenhouse rates for all chemicals use in the operation of the Desalination Plant enabling the confirmation of this aspect.

Excavation: Includes all site excavation through boring (shafts to intake pump station, inlet, outlet and boring of the intake & outfall pipelines) and excavation through dredging (dredged intake & outfall pipe).

Membranes: To be quantified (currently based on preliminary information).

6.7.4 Greenhouse Management Commitments

The State Government has committed the ADP to be 'carbon neutral' including requirements to operate the proposed Desalination Plant and delivery pipeline with renewable energy or the purchase of carbon permits and/or offsets as desalination is energy intensive.

Strategies are being developed to manage the greenhouse gas emissions associated with the construction and operation of the ADP. For the operation of the Desalination Plant, it is anticipated that emissions will be managed through the purchase of accredited renewable energy such as Green Power or through the purchase of carbon permits and/or offsets.

SA Water remains committed to the environment and to its sustainability policy which allows for an energy procurement plan that incorporates the purchase of renewable energy for the operation of the ADP. This will have a substantial impact on the greenhouse gas emissions from the ADP.

Environmental benefits include reduced dependence on the River Murray and reduced pumping and water treatment of River Murray water, currently powered by standard grid electricity.

6.7.4.1 Greenhouse Management During Construction

A Sustainability Management Plan will be developed by the Contractor and will outline the key sustainability commitments to be met by the Contractor and will ensure that accountability and transparency is maintained during the construction of the Desalination Plant. The plan will meet SA Water's Corporate Environmental Policy, which provides a framework for SA Water to set and review its environmental objectives and targets.

Energy consumption during the construction phase is not significant considered against the energy requirements over the total life of the asset.

Equipment, materials and transportation with a low embodied energy or carbon footprint should be selected where efficiency is not significantly compromised, in order to maximise the life of the proposed Desalination Plant during both construction and operation.

More sustainable construction techniques can be achieved through the use of self-compacting concrete, formwork that can be re-used with minimum waste and environmentally friendly chemicals.

In calling for expressions of interest, SA Water required that reductions in greenhouse emissions achieved through design and construction be identified and quantified.

Beyond the reductions achieved through materials selection and construction efficiencies, SA Water is currently investigating opportunities to offset construction greenhouse gas emissions. This approach would use accredited offset mechanisms, such as forestry offsets or voluntary surrender of CPRS permits pending confirmation of voluntary mechanisms, and carbon neutral standards by the Federal Department of Climate Change.

6.7.4.2 Greenhouse Management During Operations

The greenhouse gas emissions associated with the operation of the Desalination Plant and the Transfer Pipeline, make up approximately 90% of the ADP's potential greenhouse gas emissions footprint. However, it is intended that this footprint will be avoided/offset by the procurement of accredited renewable energy and offsets to operate the Desalination Plant.

To achieve this outcome, SA Water has established a procurement strategy and is working through market sounding and procurement processes.

6.7.4.2.1 Other Operational Phase Considerations

To maintain the process capacity and quality of the treated water it is required that some items of the main process be replaced on a routine basis. Membranes should be supplied with a minimum 5 year lifespan and may last longer if operated and maintained in an adequate manner. The membranes cannot be recycled or reconditioned for further use and although there is a small but expanding market for second hand membranes they are normally disposed of to landfill.

The proposed Desalination Plant is designed to enable flexible operation and to shut down if required. If the reverse osmosis membranes are taken out of service for more than a few days they will require flushing using sodium metabisulphite. For longer shutdown periods, it is likely that the membranes would be cleaned in place and preserved.

A Sustainability Management Plan will be developed by the Contractor, which outlines the key sustainability commitments to be met by the Contractor during the operation of the Desalination Plant.

6.7.4.3 Achieving Carbon Neutrality

The State Government has committed the Adelaide Desalination Plant to be 'carbon neutral' including requirements to operate the plant and delivery pipeline with renewable energy or the purchase of carbon permits and/or offsets as desalination is energy intensive.

Standards for achieving carbon neutrality and voluntary mechanisms that will complement the Federal Government's proposed Carbon Pollution Reduction System (including the future of renewable energy to voluntary customers to avoid greenhouse gas emissions) are not yet confirmed. Pending the above, SA Water has, however, commenced market sounding for the use of renewable energy to cover plant operations in advance of these outcomes.

6.8 Climate Change

6.8.1 Introduction

Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC, CSIRO, 2007) as:

> 'a change in the state of the climate that can be identified (eg. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings or to persistent anthropogenic changes in the composition of the atmosphere or inland use'.

The IPCC also notes that the UNFCCC, in its Article 1, defines climate change as:

> 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'.

The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes.

The evidence of warming of the Earth's climate system is unequivocal and climate change has been identified as one of the greatest challenges facing human societies, governments and nations in future decades. Climate scientists have warned that rising temperatures are likely to affect the environment in a number of ways, including rising sea levels, increasing intensity and frequency of storms and general changes in weather patterns. Climate change could lead to significant changes in resource use, production and economic activity.

On the historical average, approximately 60% of Adelaide's water supply is sourced from Mount Lofty Ranges and this is supplemented by water pumped from the Murray River system (40%). During periods of drought, however, up to 90% of demand is met from the River Murray.

Reductions in rainfall, or increases in rainfall variability, higher evaporation rates due to climate change in South Eastern Australia and the Murray-Darling Basin will impact on the reliability of Adelaide's water supply. Consequently, consideration of Adelaide's water security cannot only be based on 1950-2000 long-term average conditions.

6.8.2 Climate Change and Variability Towards 2030

Climate variability across years, decades and periods of decades is well understood and is the baseline consideration for planning water supply systems. Historical evidence suggests the potential continuation of current dry conditions is plausible under natural variability, and has been experienced in similar droughts including the drought dominated period in Southern Australia from the 1890s to mid 1900s.

Climate change should be considered as an additional impact on natural variability. With increased average temperature and evaporation adding to drought conditions, climate change has the potential to enhance all types of extreme weather events such as flooding and wildfires. Climate change may also trigger conditions for stepped changes to different climate behaviour.

The impacts of average climate change by 2030 are projected to be less than the impacts of natural variability that have been experienced over the past decade. However, it must be noted that it is the combination of both climate change and natural variability that will be experienced.

6.8.2.1 Adelaide Climate Towards 2030

In 2007, CSIRO modelled climate change for the year 2030 using emissions scenario A1B developed by the Intergovernmental Panel on Climate Change (IPCC), Special Report on Emission Scenarios (SRES). The A1B model (and other climate change scenarios) show global temperature at approximately 1 degree above 2000 levels by 2030.

The specific changes in climate predicted under the SRES A1B model for Adelaide in 2030 are presented in Table 6.4.

Table 6.4 Specific Changes in Climate Predicted under the SRES A1B Model for Adelaide.

		Climate change scenarios taken from CSIRO, 2007 based on the SRES A1B		
Indicator	Season	10th percentile	Median ("best estimate")	90th Percentile
Temperature	Annual	+0.6	+0.9	+1.3
	Summer	+0.6	+0.9	+1.4
	Autumn	+0.6	+0.9	+1.3
	Winter	+1.5	+0.8	+1.2
	Spring	+0.6	+0.9	+1.3
Rainfall %	Annual	-11	-4	+2
	Summer	-14	-2	+11
	Autumn	-11	-1	+9
	Winter	-15	-6	+2
	Spring	-19	-8	+3
Evaporation (%)	Annual	0	+2	+4
	Summer	0	+2	+5
	Autumn	+1	+3	+5
	Winter	+1	+5	+12
	Spring	-1	+1	+3
Sea surface temperature	Annual	+0.3	+0.6	+0.9

The range in climate change values are based on the 10th percentile model outputs, the median or best estimate (where most models agree with the outcome) and 90th percentile model outputs. The effects of climate change relevant to the ADP can be considered in the context of these variables, which include temperature, rainfall and evaporation.

Rainfall and evaporation predictions are more relevant to expected changes in surface water drainage. For the median case, there is a decrease of 1-8% in rainfall and an increase of 1-5% in evaporation rates for all seasons, suggesting that there would be a minor decrease in resultant surface water runoff. The assessment indicates a greater decrease in rainfall for the 10th percentile (11-19 %) and an increase for the 90th percentile (2-11%) suggesting a decrease and increase in runoff respectively.

It is considered that the management measures proposed for the site will be able to deal with the potential increase in rainfall if the 90th percentile eventuates.

6.8.2.2 Murray-Darling Basin Sustainable Yields (MDSY) Project

In 2007 the National Water Commission commissioned the CSIRO to report on current and future water availability in the Murray-Darling Basin to 2030 (Murray-Darling Basis Sustainable Yields (MDSY)). The results of the MDSY project will assist SA Water in planning its infrastructure and developing contingencies to deal with the worst case scenario outcomes.

According to the modelling undertaken, by the year 2030, under the higher dry extreme, average surface water availability for the MDB would fall by 37%.

The ADP provides the opportunity for a different source of water that is independent of the River Murray and without any risk of a water allocation being unavailable or curtailed.

6.8.3 Climate Change and Variability Towards 2100

A longer-term view on the impact of climate change to 2100 and beyond has an impact on planning the types of infrastructure and systems that are being proposed at present.

Beyond 2030, the impact of climate change on both the River Murray System and Mount Lofty Ranges catchments is likely to become more pronounced. Future water infrastructure for Adelaide will need to provide water security during conditions of a growing average water deficit.

Using the IPCC emission scenarios as the starting point for national and regional downscaled models, it is important to consider the most plausible scenario or several scenarios that will ensure that the risks are managed for potential impacts.

The IPCC Special Report on Emissions Scenarios (SRES) shows simulations of the impact of human behaviour on global average temperature. The modelling reflects what happens as nations pump more or less greenhouse gas emissions into the atmosphere. The following chart is taken from the IPCC 4th Assessment Report

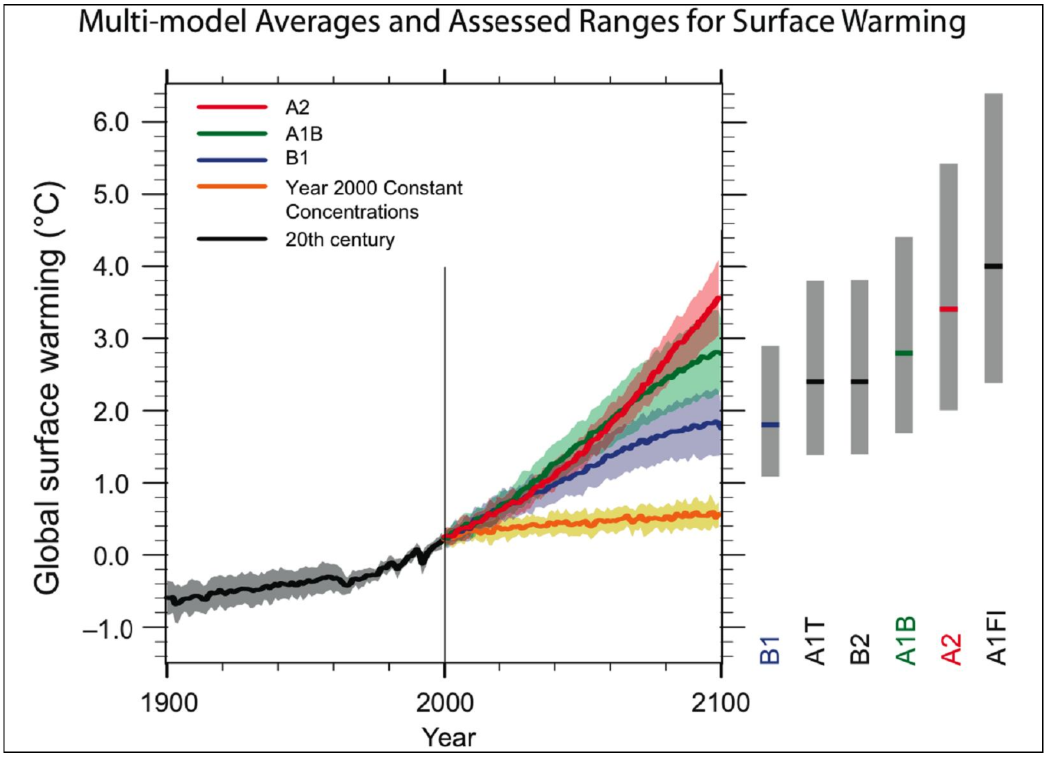

Figure 6.2 Multi-model Averages and Assessed Ranges for Surface Warming.

The scenarios describe IPCC Emission storylines on how greenhouse gas emissions will change as the world continues to develop. Chapter 10 (IPCC 2001b) of the AR4 Working Group 1 report covers details about how the scenarios should be interpreted.

As a basis for policy and planning for South Australia in the longer term, SA Water is working with other agencies and experts in the field to:

- Consider which is the most likely scenario group and scenario family to plan towards;
- Develop contingency plans to deal with the temperature range within plausible emission scenarios; and
- Decide on the signals that might take place in the political/policy arena that would signal a global shift from one scenario to another.

6.8.3.1 Fossil Intensive Behaviour (A1FI)

In looking at the different emission scenario story lines (IPCC 2001a), it can be argued that current global behaviour is best aligned to the A1FI Emission Scenario. This scenario has the greatest impact on water supply and is therefore important in considering the development of long life infrastructure systems and contingency planning.

It is hoped that human behaviour will shift away from A1FI behaviour scenario at some point in the near future, towards an A1B scenario if there is global progress to implementing alternative technology scenarios at a scale that might negate the impacts of fossil fuels usage. When such a change may take place, however is hard to predict.

6.8.4 Implications of Sea Level Rise on the Desalination Plant

Climate change is a major threat facing coastal areas throughout Australia and probably the most significant dynamic element that needs to be managed in the coastal environment. There are a number of consequences directly related to the ocean as a result of climate change brought about by global warming including sea level rise, rising sea temperatures (causing thermal expansion of the upper layers of the oceans), changes in rainfall and winds, changes in upwelling events, impacts to fisheries productivity and alterations of currents, which are expected to impact on marine, coastal and estuarine ecosystems.

In this regard, the Coast Protection Board recommends that on top of the 100 year average return interval (ARI) extreme water level (calculated by taking into account site specific factors such as wave set-up, run-up and stormwater heights during extreme tides), a mid-range sea level rise of 0.3 metres by the year 2050 be adopted for most coastal planning and design, which represents a continuation of the present rate rise (and is not additional to it).

Beyond 2050, projections to 2100 are less certain. Notwithstanding this uncertainty, the Board has adopted a further rise of 0.7 metres (i.e. 1.0 metre total) to the year 2100 for development that cannot be reasonably protected by the further rise in sea level.

Similarly, the Inter Governmental Panel on Climate Change in its 4th Assessment suggests that sea level rise of approximately 0.5 metres is plausible by 2100. Localised amplification effects are used to translate changes in mean sea level to changes in sea level rise, tide heights and storm surges for a particular location.

SA Water is also aware of emerging rapid losses of Arctic ice and other physical global events that are of concern to scientists, which are likely to trigger a review of the rate of anticipated sea level rise projections to 2100 in the near future.

Considering potential climate change factors on sea level and recognising that the Desalination Plant infrastructure that is established in 2010 is likely to be required beyond the nominal asset life, SA Water has made provision to cope with a 3.0 metre localised increase in storm surge severity. The Desalination Plant site is located at least 30 metres above sea level. The performance criteria specifies that no infrastructure is to be located within the coastal cliff or intertidal zone. No impacts to Desalination Plant infrastructure are expected to occur due to predicted sea level rise.

6.8.5 Climate Change and Impacts on Coastal/Marine Environments

Climate change is expected to have considerable impacts on marine life and marine ecosystems. Impacts of climate change on marine biodiversity have been observed throughout the world, however evidence from Australian waters is sparse due to the lack of long-term data collection.

While the global implications of climate change are becoming better understood, the predictions of the effects of climate change at a regional or local scale are not as advanced as the global models. Notwithstanding, CSIRO and the Australian Bureau of Meteorology have invested significant effort in developing models that predict the potential range of changes in temperature and rainfall intensity and timing that are likely to occur in the future as a result of climate change at a regional level.

The marine investigation and impacts associated with the proposed Desalination Plant are outlined in detail in Chapter 7 and include consideration of climate change.