CHAPTER 3

THREATS TO THE ENVIRONMENT OF GULF ST VINCENT

3.1 The Conservation Council of South Australia identified 4 major ongoing impacts on the ecological sustainability of Gulf St Vincent.[1] These are:

- pollution;
- direct habitat damage and destruction;
- overharvesting of living marine organisms; and
- introduced marine pests.

3.2 Evidence was provided to the Committee of likely future impacts on the Gulf, including the remobilisation of existing pollutants, the management of fisheries, the effects of contentious developments and the scenario for regional areas around the Gulf.

Pollution

3.3 One of the highest-priority marine pollution issues in Gulf St Vincent is the discharge of excess nutrients into the marine environment from littering, sewage outfalls, stormwater and agricultural runoff

Sewage outfalls

3.4 Metropolitan Adelaide has 4 major sewage treatment works (Bolivar, Port Adelaide, Christies Beach and Glenelg) which provide secondary treatment and discharge 80 000 megalitres of wastewater per year to the sea. This wastewater contains, on average, 2 736 tonnes of nitrogen and 495 tonnes of phosphorus. There are other wastewater treatment plants such as Heathfield, but the volumes of wastewater discharged from these is a fraction of that discharged from the major plants (although the effects on the environment differ only in scale).

3.5 Until 1993 sewage sludge was also discharged to the sea from the Glenelg and Port Adelaide plants. It is now disposed of on land because of the severe effect it was having on the seagrasses. The sludge issue provides a good example of how the harmful practices of the past can be reconsidered and can provide positive effects. In the past, the dumping of sewage sludge devastated large tracts of seagrass. Now at Bolivar where sludge is processed, digester gas is produced from the raw sludge and

1 Conservation Council of South Australia, Submission 47.

provides 60% of the power requirements for the entire Bolivar site. The dried sludge is stockpiled on site and can be reused for agriculture.[2]

3.6 Sewage effluent contains high levels of nutrients - primarily nitrogen and phospherous. South Australian waters are naturally low in nutrients and so the introduction of the effluent has a large impact on ecosystems.

Seagrass

3.7 Seagrass meadows are of fundamental importance to the Gulf ecosystems. They bind the sediments and provide nurseries and safe habitat for marine organisms. The State of the Environment Report for South Australia 1998 estimates that over 5000 hectares of seagrass have been lost since 1935 in the Adelaide metropolitan area. There is evidence, from a site survey in February 1998, of regrowth and recolonisation of seagrass in previously denuded areas near Glenelg. This regrowth is attributed to the closure of the Semaphore sludge outfall in 1993.[3] In general, however, seagrass beds do not readily regenerate.

3.8 The overall loss of seagrasses is not centred around any single land-based discharge point except in the case of the Glenelg and Port Adelaide sludge outfalls. Possible factors causing this loss include algal epiphytism due to nutrient enrichment; toxic components of, and suspended solids in, land-based discharges; coastal processes such as sand erosion or deposition; and spoil dumping offshore of Outer Harbor and Barker Inlet.[4]

3.9 It is well known that sewage effluent has a detrimental effect on seagrass beds. According to the South Australian Environment Protection Agency the process is poorly understood but turbidity, nutrients and epiphytes, and sediment loss all play a role.

Turbidity[5]

3.10 Sewage discharges, stormwater, dredging, land reclamation works and changes in land use can cloud the water, allowing less light to reach seagrasses and decreasing photosynthesis. This increases the stress on the plants.

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2 United Water, General Information, Treatment Process, Bolivar Wastewater Treatment Plant, http://www.uwi.com.au/general/bolivar_wwtp.html

3 State of the Environment Report for South Australia 1998, pp 148-149.

4 City of Salisbury, Submission 12, Attachment, Seagrasses, Mangroves and Samphires of the Barker Inlet Region, Dr David Blackburn.

5 *Changes in Seagrass Coverage*, Environment Protection Agency, Government of South Australia, September 1998, pp 2-3.

Nutrients and epiphytes

3.11 Nutrients discharged into the marine environment can increase algal growth. Algae can be free floating - and add to water turbidity - or can grow as epiphytes - which attach to leaves and stems. Epiphytic algae can reduce the diffusion of gasses and nutrients to seagrass leaves, shade leaves and thereby reduce photosynthetic activity, and can increase the weight on the seagrass leaves. This additional weight can cause seagrass leaves to break from the stem. Depending on the species, this can lead to irreversible damage or, if the species can regrow, valuable reserves of energy may be used up in the process.

Sediment loss

3.12 Loss of seagrass creates a cycle of further seagrass loss. As sediments become dislodged and resuspended, light penetration in other seagrass areas is further reduced. Once sand erosion begins seagrass is rapidly lost. Severe erosion can result in healthy plants being dislodged and washed ashore. Some of the sand erosion problems associated with metropolitan Adelaide beaches, are due to seagrass losses and the reduced ability of the meadows to bind sediment together. According to the Environment Protection Agency, there has been a total decline opposite Glenelg where the seagrasses have disappeared - the sediment has disappeared and only the underlying rock remains.[6]

3.13 Gulf St Vincent supports both commercial and recreational fisheries. Seagrass loss has a negative impact on these. Mr Jeff Wait from the South Australian Fishing Industry Council told the Committee:

> Where I have concerns is the seagrass degradation which has caused the erosion of the soil, or should we say the mud or the sand or whatever it is – the shale that is in the Gulf. It is causing a northward movement. I see areas out there now that are basically deserts. I have been fishing there for 40 years and where I used to walk around on nice seagrass meadows it is now barren sand. Three years ago there was an area where I could not work my nets because of razor fish. There is nothing there now. It is barren. It is like Semaphore Beach; it has just gone. …
>
> My fishery, the marine scale fishery, is an inshore shallow water fishery. Those fish have to have habitat. It is a shallow water fishery; they need the habitat. Eventually when the habitat is all gone, the fishery is all gone. In terms of sustainability maybe the fish might still be sustainable – I do not know – but I would be very concerned now. I have vented feelings about my concerns many times over a period of 25 to 30 years now to government institutions.[7]

6 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 9.

7 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 39.

Stormwater runoff

3.14 Stormwater is the water that flows into drains and waterways during and after rainfall in urban areas. Stormwater pollution comes from both point and non-point sources. Point sources are those where water is discharged from a single location such as a factory, although the Environment Protection Agency in South Australia does not legally permit any discharge into the stormwater system.

3.15 Non-point, or diffuse sources of stormwater, are those where the polluted water is generated across a large area and flows into an outlet from multiple points. Many of Adelaide's creeks have been lined with concrete and diverted to act as conduits for stormwater to move more quickly to the sea and to reduce flooding. There are also numerous stormwater outlets of varying sizes which direct urban runoff untreated to the sea.

3.16 Pollutants in urban stormwater include sediments, nutrients, oxygen-demanding materials, metals, toxic organic wastes, pathogenic micro-organisms, hydrocarbons and litter.[8]

3.17 The Committee received evidence that indicated that stormwater and probably turbidity may have contributed to seagrass loss.[9] Stormwater discharges are associated with high turbidity, as well as nutrients and other toxicants from the urban catchment. Such discharges have been reported to contribute to a dirty plume of water that persists along the coastline for several weeks following heavy rainfall events. Large discharges of stormwater are generally associated with the cooler months of the year.[10]

3.18 According to the South Australian Environment Protection Agency:

> [The process of seagrass loss] seems to be an interactive system between nitrogen causing epiphytism, the stormwater effects which possibly are causing light reduction at critical times of the year which affects recruitment of these seagrass seedlings and, thirdly, an erosion effect caused by wave action, which is a natural effect, but the interaction of that natural effect with these other two effects is causing decline. We do not fully understand it. Until we do it is hard to know what action we can take, if any.[11]

8 Cooperative Research Centre for Catchment Hydrology, *Urban Stormwater Pollution*, Industry Report, July 1997, pp 3-5.

9 Government of South Australia, Submission 45, pp 7 & 8.

10 Government of South Australia, Submission 45, p 8.

11 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 9.

Litter

3.19 Litter enters the Gulf through stormwater as well as from boats and ships. Plastics, rope, netting and fishing gear entangles seabirds, seals and dolphins and can be ingested by them.

Industrial pollution

Thermal pollution

3.20 Water is taken from the Port River and used for cooling in the Torrens Island Power Station. It is then discharged as heated effluent into the Angas Inlet. According to the Conservation Council of South Australia, approximately 3.9 million cubic metres of heated effluent is discharged per day and has changed the fish composition at Barker Inlet.[12]

Oil pollution

3.21 Mobil Australia operates the Port Stanvac Refinery which supplies much of South Australia's petrol and diesel needs. On 28 June 1999 there was a 270 000-litre oil spill which caused an oil slick of up to 3 km long, with some oil washing ashore at Silver Sands. On 24 September 1996 there was a 10 000-litre oil spill. Oil entered the Port Noarlunga aquatic reserve.

3.22 According to the Conservation Council of South Australia, there are on average 3 spills annually in the order of 1000 litres of oil.

> The long-term, chronic effects of the frequent minor spills at the oil-handling facilities at Port Stanvac on the surrounding environment and nearby reef systems are unknown. The amount of oil entering the marine environment from unmonitored sources may also be significant.[13]

3.23 Monitoring by the South Australian Research and Development Institute (SARDI) of the effects of oil spills in 1991 and 1992 in the Port River and upper Spencer Gulf indicates that 23 hectares of mangroves were killed or totally defoliated in the heavily affected areas and show no signs of recovery.[14]

3.24 Gulf St Vincent is part of a geological formation known as the Gawler Craton. This area has attracted some interest for mineral and petroleum exploration. Two

12 Conservation Council of South Australia, Submission 47, paragraph 3.1.3.

13 Conservation Council of South Australia, Submission 47, paragraph 3.1.1.

14 State of the Environment Report for South Australia, 1998, p 151.

exploration wells have been drilled but since no petroleum has been detected, there has been no mining in the Gulf area.[15]

Heavy metals and organochlorines

3.25 According to the Conservation Council of South Australia, fish, squid and crustaceans show elevated levels of lead, copper and zinc in the Port River region while pesticide and organochlorine residues exceed national health standards for Blue Crabs and snook, and are elevated in dolphins. There are ecologically-significant levels of heavy metal contamination in sediments and biota, particularly in the upper part of the Gulf and the Port River area.[16]

3.26 In September 1999 test results showed that a dolphin found shot dead the previous year, recorded elevated levels of mercury. Dr Mike Bossley from the Australian Dolphin Foundation stated that the levels, 40 times higher than any other bottlenose dolphin tested in Australia, were the highest recorded in the world. The South Australian Environment Protection Agency, whilst acknowledging that any level in a dolphin is not a good level, did not agree that the levels were the highest in the world nor that South Australia has a unique problem as regards the accumulation of toxins in the food chain. [17]

Barker Inlet and Port River Estuary

3.27 Barker Inlet is a natural sink because of its low topography, very sheltered waters and its orientation which respects the prevailing winds. The Committee was told "… pretty well everything that floats past in the Gulf finishes up there, including old thongs, plastic bags and anything else that the boaties drop overboard".[18] As a consequence of its sink status, it is facing serious deterioration in its ecosystems. The Chair of the Barker Inlet Port Estuary Committee, Mrs Pat Harbison, believes that this is of concern not just in relation to the immediate area but to Gulf St Vincent as a whole:

> … I think that Barker Inlet is simply a microcosm of the northern half of Gulf St Vincent. Because it is so small and because the impacts have been more intense, it has been affected in a shorter period of time but I am quite sure that it is simply an early warning system of what will happen to the Gulf.[19]

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15 Government of South Australia, Submission 45, p 24.

16 Conservation Council of South Australia, Submission 47, paragraph 3.1.3.

17 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 15.

18 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 82.

19 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 81.

3.28 There are four catchments which drain into the Port River and environs. Along with stormwater runoff, sewage effluent and the effects of development, the Port River Estuary has been subjected to pollutants from paint factories, chemical dumping, landfill sites, asbestos factories, sugar refineries, ship oil, thermal effluent, mercury, soda ash, chlorine, polychlorinated biphenyls (PCBs) and assorted heavy metals.[20] As a result, sediments at the margins of the estuary are polluted with metals and nutrient enriched waters support blooms of nuisance algae, and at times, toxic dinoflagellates.[21]

3.29 Much of the industry in the Port Adelaide area is not connected to the sewage system but uses septic systems. These are prone to overflow into the surrounding waterways. They can also have an impact on the groundwater, which is close to the surface in this area. There are thousands of industries in the Port River area. It is a very industrialised area. The Environment Protection Agency is currently investigating some of the industries for polluting practices and believes that some of its findings give cause for concern. [22]

3.30 According to Mrs Harbison, the high content of nutrients released into the Barker Inlet from the Bolivar Waste Water Treatment Plant has promoted the growth of macroalgae such as cabbage weed or sea lettuce. It grows in vast quantities off the shore at St Kilda and is washed onto the mangroves and onshore where it piles up and rots. It contributes to very high levels of organic matter in sediments and the sediments in Barker Inlet have an organic content of around 90 per cent.[23]

> This very high organic content in turn results in generation of hydrogen sulphide by bacteria in the anaerobic muds and it leads to depletion of oxygen in the shallow waters of the Inlet during the night particularly. I have stood in the shallows in Barker Inlet all night measuring dissolved oxygen and when the dissolved oxygen concentration reaches its lowest level, which is usually just before dawn, you actually see by torchlight the large shoals of juvenile fish about this long drop their tails, put their mouths to the surface and start swimming around in a vertical position, gasping. Then they die and you are surrounded, for a short period, by dead juvenile fish in those shallow waters. Then, as soon as it is light, the seagulls come in and the evidence disappears. This is due to the high organic content of those sediments which is in turn due to the fertiliser that is poured into the Gulf, enhancing the growth of algae which then wash into the Inlet.[24]

3.31 Mrs Harbison fears that in 50 years' time northern Gulf St Vincent, because it is an inverse estuary and acts as a trap for everything which goes into the Gulf, will be

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20 Community Action for Pelican Point, Submission 21, p 1.

21 Barker Inlet Port Estuary Committee (BIPEC), Submission 32, p 4.

22 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 7.

23 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 82.

24 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 82.

like Barker Inlet is now - a eutrophic environment with very severe oxygen depletion at night.[25]

3.32 The Port River is a major urban waterway that has suffered from inappropriate practices which have had a variety of impacts on the local environment. Of particular significance are the effects of nutrient rich discharges - sewage effluent and stormwater runoff. Red tides by the toxic dinoflagellate *Alexandrium minutum* were first recognised in the Port River area in October 1986. This species now produces annually recurrent red water blooms in the period September-November.

3.33 Wild mussels from the Port River area can be highly toxic to humans, but no commercial shellfish farms are located in the affected area. Plankton and cyst surveys in the Port River in 1983 failed to detect *A. minutum* in an area which now has recurrent blooms. This result has led to speculation that *A. minutum* could be an introduced species, and genetic studies using ribosomal DNA sequencing have confirmed a close affinity between Australian and Spanish isolates of this species complex.[26]

3.34 The Barker Inlet and Port River area has a substantial population of resident dolphins. This alone appears to make the area internationally unique in maintaining dolphins so close to a city of a million people. The continued presence of the dolphins in these waters is uncertain however, and will almost certainly depend on the extent to which pollution is controlled in this environment.[27]

Other

3.35 Algal blooms have been reported around Gulf St Vincent though they have been infrequent and at irregular intervals. Areas affected have included new oyster farming areas on the western shore of the Gulf and the eastern shore, north of the Adelaide metropolitan area.[28]

Garden Island Landfill

3.36 Elevated levels of nutrients, particularly ammonia and oxidized nitrogen, are characteristic of the Port River Estuary. Interstitial waters in Angas Inlet have high concentrations of ammonia close to the margin of the landfill. The concentrations of ammonia found in clean, sandy sediments on the south eastern side of the landfill are

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25 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 82.

26 *Marine phytoplankton communities in the Australian region: current status and the future threats*, State of the Marine Environment Report for Australia, Technical Annex: 1, Gustaaf M. Hallegraeff, http://www.environment.gov.au/marine/publications/somer/somer_annex1/som_ann8.html

27 The Australian Dolphin Research Foundation, Submission 27.

28 Government of South Australia, Submission No. 45, p 11.

difficult to explain except by movement of groundwater from a source of ammonia, such as the landfill on Garden Island.[29]

Antifoulants

3.37 Antifoulants are paints used to prevent marine organisms from attaching themselves to surfaces, such as boats and aquaculture farming equipment. They contain various compounds, many of which are highly toxic. These compounds, for example metals and organotin chemicals, leach slowly from the paint and bio-accumulate in organisms. This adversely affects the growth, reproduction and population numbers of marine organisms.

3.38 Tributyl tin (TBT) is a highly toxic chemical used in antifoulants. It accumulates in the food chain and contamination may be a health hazard for humans. It can concentrate in molluscs up to 250 000 times higher than surrounding sediment or seawater and can force a sex change (imposex) and infertility in female snails.[30] 100% of populations of the gastropod *Lepsiella venosa* show severe reproductive abnormalities (ie neogastropod imposex) in the Port River.[31]

3.39 In South Australia all vessels are allowed to use TBT containing paints. However, commercial boatyards and slips are licensed with the condition that they do not allow application of antifouling paints containing TBT with a release greater than 5 micrograms per centimetre per square per day.[32] The Committee notes that many countries have prohibited the use of TBT on small craft since the early 1990s. In the Committee's view such a prohibition is necessary in South Australia.

Recommendation 1

The Committee recommends that the South Australian Government prohibit the use of Tributyl tin (TBT) on small craft.

Sedimentation

3.40 Sedimentation is an ongoing problem in Gulf St Vincent. It is due to particulates from stormwater, river catchment outflows and other land-based discharges associated with coastal development and soil mobilisation. The impacts of

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29 *An investigation of the marine surface and interstitial waters around Garden Island to determine the impact of landfill activities on water quality,* Results of analysis and outcomes of investigation, pH environment for Rodenbury Davey and Associates Pty Ltd, September 1999, p 16.

30 *Minimising the Effects of Antifouling Paints such as TBT, The ANZECC Code of Practice*, Brochure, Environment Protection Agency, Government of South Australia.

31 Conservation Council of South Australia, Submission 47, paragraph 3.1.4.

32 *Minimising the Effects of Antifouling Paints such as TBT, The ANZECC Code of Practice*, Brochure, Environment Protection Agency, Government of South Australia.

sedimentation include decreased water quality, smothering of benthic organisms and potential degradation of macroalgal reefs. The Conservation Council of South Australia, in its submission, refers to evidence which suggests that turbidity has caused changes to the species composition of near-shore reefs in the metropolitan area.[33]

3.41 A study of Adelaide's coastal reefs has shown that some have suffered severe degradation over the past three years. An indicator of reef health is its brown algae coverage. Noarlunga Reef and Horseshoe Reef have suffered degradation and Semaphore Reef and Broken Bottom Reef off Glenelg are under stress. The degradation is attributed to increasing urbanisation in the southern suburbs and the accompanying impact of stormwater runoff and effluent disposal.[34]

3.42 Specifically, Reef Watch workers have noted problems with sedimentation and reef smothering in the mid-coast area, probably due to dredging at Port Stanvac. Also, benthic smothering occurred on Marino Rocks reef as a result of a housing development of vacant land where there was runoff following rain. The Conservation Council of South Australia suggests that this type of impact is probably a regular occurrence in parts of the Gulf but it goes largely unnoticed and unattended by regulatory authorities.[35]

Habitat Damage and Destruction

3.43 Aside from the loss of seagrass beds, mangrove forests and reef habitats from eutrophication and sedminentation, there are other causes of habitat damage. Urban development of the foreshore has had a significant effect on coastal processes. The southern section of the coastline, from Marino to Outer Harbor was originally backed by sand dunes, punctuated only by the outlet of Sturt Creek.

3.44 Since the 1930s increased urbanisation has significantly altered coastal dynamics. Large proportions of sand dunes have been built on and breakwaters have been constructed. The River Torrens has been diverted to an artificial outlet at West Beach and numerous stormwater drains have been constructed which discharge directly to the sea. These changes have combined to alter the dynamics of the near-shore coastal environment, reducing its capacity to absorb wave energy and increasing erosion and sediment movement. As the Government of South Australia recognised in its submission, these processes determine the capacity of seagrass communities to colonise and persist.[36]

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33 Conservation Council of South Australia, Submission 47, paragraph 3.1.6.

34 Offshore reef's health plunges, *Adelaide Advertiser*, 25 January 2000.

35 Conservation Council of South Australia, Submission 47, paragraph 3.1.6.

36 Government of South Australia, Submission 45, p. 6.

3.45 Mangroves in the Barker Inlet region have been extensively cleared by port developments with the main areas being cleared after about 1962 in the Gillman to Wingfield regions. Samphire areas have declined due to the construction of the Penrice salt fields (particularly after 1950). A study of the Bolivar area reveals that samphire communities have declined from about 200 hectares in 1949 to about 70 hectares in 1997 due to their replacement by mangroves and the prevention of further landward colonisation by Penrice seawalls.[37]

3.46 The Conservation Council of South Australia asserts that there have been several major developments, including marina and harbour constructions, which have not had environmental impact assessments. The Conservation Council provides the example of Marina St Vincent which caused the loss of a major squid breeding ground. Ongoing coastal development, including large scale foreshore condominium and boat harbour developments, are causing environmental damage through sand dune loss and dredging activities.

3.47 The West Lakes development is a waterfront residential development constructed on former reedbeds behind the coastal dunes. In the past the reedbeds filtered run-off prior to it reaching the Gulf. Now, after heavy rains, the water in West Lakes is unfit for swimming for several days and shellfish are contaminated with metals.

3.48 Construction of causeways associated with electricity transmission lines and embankments has caused disruptions to tidal movements and has led to mangrove dieback.

3.49 Since 1954, 25% of the original mangrove forests, 80% of saltmarshes and samphire, and 100% of the saltwater tea tree community have been lost from the Barker Inlet and Port Estuary area. According to the Environment Protection Agency:

> The primary impacts on mangrove communities have been through land reclamation, land being cut off so that you do not get tidal drainage and simply land clearance. Most of that occurred prior to 1960 – 1950, possibly – and I could not tell you overall what percentage loss of mangroves there has been in Adelaide.[38]

Mangroves

3.50 Mangroves have both conservation and economic value. They are generally highly productive and provide important habitats for both bait-fish and table fish.

3.51 Mangrove forests in South Australia are composed solely of one species, the grey mangrove (*Avicennia marina* var. *resinifera*). South Australia has the only case

37 City of Salisbury, Submission 12, Attachment, Seagrasses, Mangroves and Samphires of the Barker Inlet Region, Dr David Blackburn.

38 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 8.

of sewage-induced mangrove loss in Australia.[39] There has been significant mangrove dieback in the shallow tidal flats between St Kilda and Port Gawler adjacent to the Bolivar sewage outfall. Approximately 250 hectares of mangroves have been lost since 1956 and a much larger area is in poor health in the region immediately adjacent to the outfall.

3.52 Research indicates that increased nutrient levels have affected the mangroves. Large drifts of sea cabbage (*Ulva*), promoted by excess nutrients, prevent or retard the establishment and growth of young mangrove seedlings and choke established trees by smothering and eventually killing their aerial roots.[40] According to the Environment Protection Agency, however, there has not been the same level of decline attributable to pollution in mangroves as there has been in seagrasses.[41]

3.53 There are some signs that seagrass decline can contribute to mangrove decline:

> … once the seagrass goes it destabilises the sediment and under storm conditions you get movement of sediment inshore which could suffocate the pneumatophores.[42]

3.54 The loss of habitat is the most significant threat to biodiversity world-wide. Because of the inter-relationships of species in an ecosystem, habitat destruction can have surprising effects. One example is the generally unexplained exponential growth in the last 5 years of the mosquito population in the Barker Inlet Area. The Mayor of the City of Salisbury, Mr Zappia, told the Committee that this was due to the loss of mangroves and the subsequent deterioration of the breeding grounds for fish and other wildlife. The mosquito larvae are the basic unit of the food chain that exists in a mangrove ecosystem. A reduction in the number of fish in the area directly results in a proliferation of mosquitoes.[43]

3.55 Research undertaken by the Mosquito Control Research Unit at the University of Adelaide established that 95 per cent of the mosquitoes that are breeding are saltwater mosquitoes. This means that they must be breeding along the coastline where the salt water is[44] and not in the freshwater wetlands which some believed were the source of the mosquito explosion.

3.56 Not only is there mangrove loss along the coastline, but the mangroves are growing further inland. The landward accession is probably related to local subsidence which results in a reduction of the slope of the intertidal areas, allowing the widths of

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39 Conservation Coucnil of South Australia, Submission 47, para 3.1.2 (b).

40 State of the Environment Report for South Australia 1998, p 151.

41 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 8.

42 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 9.

43 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 73.

44 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, pp 76-77.

mangrove zones to increase.[45] The city of Adelaide is sinking, partly because of the pumping of water.[46] There needs to be land available for mangroves to move inland - especially with the prospect of sea level rise and subsidence of the Peninsula. The old Multi-Function Polis Corporation, in a far-sighted move, set aside land as mangrove retreat areas. The Committee was alarmed to hear one witness suggest that there will be a lot of pressure on those areas to be developed.[47] The Conservation Council of South Australia asserts that in the north of the Gulf industrial development is restricting the "landward march" of mangroves.

3.57 Mangroves are under threat from small scale coastal urban developments including boat ramps, marinas and land reclamation. Saltmarsh too is being degraded and removed due to agricultural, industrial and urban use and developments.

Beach erosion

3.58 The Committee heard that there is a perennial problem with beach erosion on metropolitan beaches. On the eastern side of the Gulf sand moves in a northerly direction. Sand needs to be carted from the north of the Gulf to replenish the southerly beaches. It has reached the stage however, where the replenishing sand is now too fine and an alternative supply is required.

3.59 The Environment Protection Agency informed the Committee that:

> The beaches are only there because they are managed by the Coast Protection Board. If they did not manage them there would not be beaches. A lot of people do not understand that. It is an artificial, managed system. The seagrass decline will make it harder and harder to manage those beaches, for a variety of complex hydrodynamic reasons.[48]

3.60 In 1997 the Coast Protection Board took 600 000 cubic metres of sand from the sea floor and dumped it at Brighton Beach at a cost of $2.9 million. This sand would last approximately 6 years before requiring replenishment. Several submissions discussed the cost of beach replenishment programs:

> The transport of sand places a huge economic strain on this State. Research should be urgently undertaken to examine the economic viability of this practice.[49]

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45 City of Salisbury, Submission 12, Attachment, Seagrasses, Mangroves and Samphires of the Barker Inlet Region, Dr David Blackburn.

46 Australia's response to Global Warming Inquiry, Environment, Communications, Information Technology and the Arts References Committee, *Proof Committee Hansard*, Melbourne, 20 March 2000, p 118.

47 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 92.

48 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 9.

49 Henley and Grange Residents Association Inc, Submission 39, p 4.

> Sand carting is a costly option that treats the effects without really coming to grips with the causes.[50]

3.61 An average of $1.4 million is spent each year on minor sand replenishment programs such as trucking small quantities of sand from Semaphore to eroded beaches. Adelaide's worst eroded beaches include Tennyson, Semaphore Park, Somerton and Henley Beach, while a build-up of sand has to be removed each year at Glenelg, West Beach and areas north of Semaphore and the southern side of the Torrens outlet.[51]

3.62 Adelaide's main source of sand to replenish eroding beaches has been exhausted. Between 1989 and 1997 sand was taken from the seabed off Port Stanvac to replenish metropolitan beaches. Mr Rob Tucker from the Coast Protection Board is reported as saying that dredging from this area cannot continue without damaging the ecosystem.[52]

3.63 The City of Onkaparinga is concerned about sand dredging off its coast. The Council is strongly opposed to investigations by the Coast Protection Board into possible sand sources off Moana, and any potential sand dredging activities in the area. Whilst the recent impacts of sand dredging are still being evaluated, some of the concerns raised by the Council include: the prevention of further damage to the reef and its inhabitants; a questioning of the expert opinion which assured the Council that there was no environmental risk in dredging the beaches; and action to be taken by the State Government to fix the problems.[53]

3.64 Increased erosion of the beach face occurs partly because the buffering capacity of seagrass meadows has been reduced. Seagrass decline has altered the flux of sediment transported along the coast. Sand movement is modified by offshore seagrasses filtering water currents in the wave zone and onshore seagrass binding sediments and inhibiting the action of wind. Increased erosion now occurs along the metropolitan beaches because natural replenishment processes have been modified by urban development.[54]

3.65 Another possible cause of increased beach erosion is increased stormwater flows piped to form point source discharges along the coast. Some of the smaller discharges deliver large volumes of stormwater during flood flows directly at the back of the living dune system. It was thought that these discharge points would be soakage areas where water could seep through relatively porous sand and recharge local aquifers. This does not occur during high storm flows however, where extensive

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50 Henley & Grange Dunecare, Submission 22, p 1.

51 City beach sand stocks drying up, *The Advertiser* (Adelaide), 13 September 1999, pp 4-5.

52 City beach sand stocks drying up, *The Advertiser* (Adelaide), 13 September 1999, p 4.

53 City of Onkaparinga, Submission 36.

54 Henley & Grange Dunecare, Submission 22, p 1.

undermining of the dunes takes place, creating mass movement of sand along the coast.

3.66 The Committee heard of the demise of a dune revegetation project due to stormwater runoff:

> There are parts of the dune that we cannot work on because we know that it will be washed away the next year or next storm … A [dune rehabilitation] group had just started up and it was their first planting and we planted two, three, four hundred seedlings … Several weeks later we came back to check on their progress and there was nothing there. You know the normal, everyday concrete-lidded street drain. It was only about three metres away from the front of the dune and it drained off about a hundred-metre section of the esplanade in that vicinity, so not a very big catchment at all, and it wiped out three or four metres of dune.[55]

3.67 Witnesses voiced their concerns at the effects of dredging for sand replenishment programs and the use of rock groynes:

> What we have is continuous dredging taking place in the Holdfast Shores development, at the mouth of the Patawalonga and at the West Beach boat harbour. This dredging has disastrous effects on our marine waters and coastline … We are seriously concerned that a system of further groynes will be constructed along the coastline. This will create pocket beaching, a system where sand is collected and held between the groynes, making steep beaches and interrupting the natural flow of sand.[56]

3.68 Mr Jack Moller, a former lecturer at the South Australian Institute of Technology, attributed the continuing erosion of the coastal sand dunes to fluctuations in the pressure and flow of groundwater. Interference with the flow causes an incursion of sea water which introduces pockets of salt and brackish water to the dunes resulting in a loss of vegetation. Without the vegetation to stabilise the dunes they disperse.

3.69 In the past, rain and surface runoff contributed to the groundwater of the coastal dunes. Dunes presented a barrier to surface outflow of permanent groundwater from natural aquifers at various depths. This process enabled the dunes to support extensive coastal vegetation as part of a natural cycle of regeneration. Springs, which were visible at low tide, carried surplus water to the sea.

3.70 In recent times these sources of fresh water deposits in the coastal and dune areas have been severely limited by diversion of stormwater directly to the sea from

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55 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 59.

56 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 55.

widespread roadworks, housing construction, and general urban development, and also by pumping from bores for domestic and other purposes.[57]

3.71 Mr Moller had several recommendations aimed at addressing these issues:

- a research program to determine the extent to which seawater has encroached on the fresh groundwater outflow of the Adelaide Plains through the estuarine plains to the coastal dunes;
- a complete embargo on pumping from wells or bores on coastal dunes and adjacent regions;
- strict controls on pumping of groundwater from endangered aquifers at all levels;
- containment of stormwater and surplus rainwater from houses, roads and paved areas by undergrounding on site; and
- replication and extension of existing programs for vegetation regrowth on the coastal dunes and sand conservation.[58]

3.72 Henley & Grange Dunecare echoed some of these recommendations in its submission:

> Refined techniques for engineering soakage pits and aquifer recharge are being developed elsewhere but this situation should be of immediate concern along the Adelaide Metropolitan coast.[59]

3.73 According to the State of the Environment Report for South Australia, groundwater use in the Northern Adelaide Plains, Barossa Valley, Southern Vales and Angas-Bremer areas is either at or above resource capacity. In 1995 water use in the Northern Adelaide Plains was more than twice the estimated sustainable resource capacity. Groundwater quality is declining in some parts of the South East.[60] Adelaide itself is sinking partly because of the pumping of water. This is a matter of grave concern to the Committee and in our view a precautionary approach should be adopted. Accordingly,

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57 Mr JM Moller, Submission 14, p 1.

58 Mr JM Moller, Submission 14a, p 7.

59 Henley & Grange Dunecare, Submission 22, p 1.

60 State of the Environment Report for South Australia 1998, Summary Report, http://www.dehaaa.sa.gov.au/ser/index.html

Recommendation 2

The Committee recommends an embargo on pumping from wells or bores on coastal dunes and adjacent regions until an investigation into the groundwater reservoirs has been undertaken.

Prawn Trawling

3.74 Gulf St Vincent supports a Western King Prawn fishery which is worth approximately $10M to the State. The vessels work grounds greater than 10 metres deep in Gulf St Vincent and Investigator Strait. The majority of the fishing effort is concentrated in a small number of productive areas in the Gulf. Approximately 10 to 15 per cent of the Gulf is accessible to the trawlers.

3.75 The main prawn nursery areas are in the shallow waters at the northern end of the Gulf. The largest concentrations of juveniles generally occur on the eastern side of the Gulf from Barker Inlet north to Port Wakefield, and around to Price and Ardrossan on the western side. Juveniles are also found in a number of areas north of Black Point, through to Port Vincent, Stansbury and Edithburgh. There are also several nursery areas in the bays on the northern side of Kangaroo Island, such as Eastern and Western Cove.[61]

3.76 Prawn trawling can have a marked effect on the benthic environment as trawls are dragged across the sea bed. Although no objective studies of trawling have been completed in South Australia, the Conservation Council of South Australia cited increasing evidence from other temperate ecosystems that benthic trawling can have significant negative impacts on habitat quality and benthic biodiversity. Sites which are undisturbed by trawling have higher biomass, species abundance, and species diversity than disturbed sites.

3.77 The Committee also heard that prawn trawling is like a kind of agriculture. It smooths out the sea bed and facilitates the growth of the target species. According to Mr Martin Smallridge from the Prawn Industry South Australia "… once you do start working in an area … that area becomes more productive and that is why the fleet has remained in a relatively small area of the Gulf. Those areas are now productive on an ongoing basis."[62]

Overharvesting of Living Marine Organisms

3.78 The State of the Environment Reports have recognised that most fisheries are operating at or above resource capacity. The status of knowledge for management is

61 South Australian Government, Submission 45, p 9.

62 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 42.

considered adequate for only 5 of 27 fisheries in South Australia. Ongoing expansion of recreational fishing is placing additional pressure on fish stocks.

3.79 There has been increasing recreational fishing effort, both in the number of fishers and in their efficiency and increased access to fisheries through technological advances. Collection of molluscs and worms for bait is extensive but unquantified.

3.80 Other commercial impacts on marine resources include the aquarium industry that targets a number of species including the protected leafy seadragon.

3.81 The selective extraction of species, whether targeted or as bycatch, can put selective pressure on fish populations to alter their genetic composition. This can be seen in the reduced size of maturity of King George Whiting as well as a lower annual growth rate of abalone populations.

3.82 A decline in the abundance of a species may reduce it to a non-viable population and can make it more vulnerable to environmental changes, particularly for sedentary or long living fish. Although a series of management and monitoring programs has been introduced to ensure sustainable use of the resource, catch figures suggest that most marine fisheries continue to operate at capacity.[63]

3.83 By-catch is an issue in prawn trawling with some fisheries having a ratio of non-target discards to prawns as high as 8:1 by weight.[64] Mr Smallridge informed the Committee that the by-catch in the Gulf St Vincent prawn fishery is c 1:1 which is low by world standards. He attributed this to the lower diversity of species in temperate as opposed to tropical regions.[65]

3.84 Despite the State of the Environment Report asserting that the exploitation rate for the Gulf St Vincent prawn fishery is currently higher than the target reference point proposed in the draft management plan, Mr Smallridge assured the Committee that the fishery was sustainable. Given the importance to South Australia, of the prawn fishing industry, the Committee believes that an independent assessment of the effects and future potential of prawn fishing should be carried out.

Recommendation 3

The Committee recommends that an independent assessment of the effects and future potential of prawn fishing in the Gulf St Vincent area should be carried out.

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63 State of the Environment Report for South Australia 1998, http://www.dehaa.sa.gov.au/ser/estuaries.html.

64 State of the Environment 1996, p 8-14.

65 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 41.

3.85 The selective harvesting of one or more components of a marine community also affects an animal's predators, competitors and prey, thus disrupting the food chain. Ecosystems can become unbalanced as a result. At present stock assessments to evaluate whether a fishery is sustainable are only done on the target species. This is not enough to fulfil ecologically sustainable development requirements. To fulfill these it is necessary to monitor the health of the environment as well.[66]

3.86 Although the State of the Environment Report says that most marine fisheries continue to operate at capacity, stock assessment reports from SARDI indicate that most species harvested within the Gulf in a commercial sense are sustainably harvested. SARDI only recommends reducing the take of mud cockle adjacent to Outer Harbor.[67] Mr Jeff Wait from the South Australian Fishing Industry Council made the point, however, that it is not only fishing mortality from commercial fishing operations which needs to be considered. To ensure sustainability of the fishery, the entire ecosystem, including further inroads into the habitat of that ecosystem, needs to be taken into account.[68]

3.87 Mr Wait believes that the major threat to sustainability of fisheries in the Gulf is sewage effluent. It has caused the loss of seagrass, the loss of mangroves and the build-up of mud areas.[69]

Introduced Marine Pests

3.88 Disruptions to the natural ecology can provide conditions for introduced marine pests to become established. There have been 25 species of introduced marine species identified in South Australia. Most of these are located in the Port River-metropolitan Adelaide region where shipping activity has been high. They are introduced through the discharge of ships' ballast water and/or from the external surfaces of the hulls. Some marine pests have become established.

3.89 Exotic species can increase the occurrence of marine diseases. They can also flourish in their new homes, forming dense communities and forcing out native populations. Dinoflagellates can be introduced in ballast and form algal blooms in favourable conditions. Red tides have been implicated in fish kills. Coastal dune environments are inundated with exotic species. More than 40% of the species in the Normanville Dunes are exotic.

3.90 The Mediterranean fan worm was first detected in 1975 in Port Phillip Bay, Victoria and has gone on to occupy almost one-third of the Bay. It forms dense monospecific stands and effectively alienates all native species. In 1986 it was

66 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 23.

67 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 38.

68 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 38.

69 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 39.

confirmed as being established in the Port Adelaide River/West Lakes system. It is now found throughout much of the waters of the eastern Gulf St Vincent. The implications for the Gulf from the Port Phillip Bay experience are severe.

3.91 Control of ballast water discharge is a particularly difficult problem because most of the methods and chemicals suggested for control are also harmful to the environment. Solutions such as discharge only in ocean areas and heat treatment are being considered.[70]

3.92 So far as existing surveillance, monitoring techniques and programs are concerned, South Australia has limited capability and relies on the Australian Quarantine and Inspection Service (AQIS) which, according to Mr Robert Thomas, the Executive Director of the Environment Protection Agency, "does not do a great deal" in this area.[71] The Committee was concerned to hear this. Given the Gulf's exposure to potential marine pests and the devastating effects they can have on the Gulf waters and its environment, the Committee believes that more should be done by AQIS to monitor and control the extent of the problem.

Recommendation 4

The Committee recommends that the Australian Quarantine and Inspection Service (AQIS) take an active role in monitoring the possible introduction of marine pests from visiting vessels in the Gulf St Vincent area and that it take appropriate action to minimise the problem.

Future Impacts

Dormant/suspended pollution

3.93 According to Mrs Pat Harbison from the Barker Inlet Port Estuary Committee, if all polluting practices to the Gulf ceased now the historic load of pollutants in the sediments of Barker Inlet is so great that the effects will persist for a long time.[72] Councillor Barry Nottle too raised the issue of ongoing pollution:

> I think some of the contaminants that I see, as in effluent or whatever from septic systems, will probably take – again I am only a lay person – 30 to 50 years to get from the septic tank which is positioned a considerable distance from the Gulf, to reach the Gulf. So by the time it gets to the Gulf you have another X amount of years of it coming through. I do not think the

70 South Australian Fishing Industry Council Inc, Submission 33, p 15.

71 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 13.

72 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 82.

> safeguards are there at the moment to stop a problem that is going to carry on for a long time after it is identified. [73]

3.94 Mr Jeff Wait from the South Australian Fishing Industry Council, echoed these ideas:

> Within the shallow waters, where we have the phosphates and the nitrogens, et cetera – nitrates – they are there. If we turn the tap off today, every time we have a storm they just get regenerated and redistributed throughout the Gulf. Eventually, if we keep going and keep allowing more and more – even though they are slowing it down, it is still there and is still happening – it will then spread throughout the whole Gulf. I notice it right now because I am in the thick of it but it is spreading and it has not stopped spreading since I first noticed it 30 or 40 years ago.[74]

Fishing

3.95 Fisheries in South Australia are managed through various fishery management committees, such as the Prawn Fishery Management Committee and the Marine Scale Management Committee. These are government appointments and have a varying range of interests within the particular committees. They are charged with managing the resource.[75]

3.96 The Committee heard that most fisheries in the Gulf are managed with input controls rather than output controls. Input controls regulate the number of fishing vessels, the number of licences, the amount of gear they can use, closed seasons and closed areas. Output controls would regulate the amount of fish allowed to be caught.[76]

3.97 The recreational sector is managed through bag and boat limits and size limits. Slot limits in certain range for snapper also apply. Currently the recreational sector is developing a five-year management plan which is going out for public comment.[77]

3.98 The fishing industry believes that it is operating in a sustainable way.[78] Its primary concerns for the future are the effects on fisheries from outside influences:

> … our fundamental concern is one of looking for coordination, and greater effort being placed into implementing what are known technologies, known practices, to decrease the amount of pollution, to decrease the impact still

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73 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 33.

74 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 40.

75 *Proof Committee Hansard,* Adelaide, 3 February 2000, pp 37-38.

76 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 39.

77 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 37.

78 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 38.

> being felt through coastal development and discharge sewerage on the ecosystem and, in particular, the nursery areas for the prawn fishery.[79]
>
> What we are saying [in our submission] is not only fishing mortality from commercial fishing operations needs to be looked at, but the whole of the ecosystem needs to be looked at for that sustainability to remain at its present level. If we make any further degradation or any further inroads into the habitat of that ecosystem we are therefore jeopardising the sustainability of the fishery.[80]

3.99 These threats to sustainability originate not only from the polluted Adelaide Coastal Waters. Coastal towns such as Edithburgh, Stansbury, Port Vincent and Coobowie on the Yorke Peninsula do not have a common effluent infrastructure. Discharge points into the Gulf have a high environmental impact.[81]

Prawn Fishing

3.100 According to Mr Martin Smallridge from the Prawn Industry South Australia, there has been a 30 year effort in ensuring the sustainability of the prawn catches.[82] The fishery was closed in 1991-92 and 1992-93 to allow stocks to recover and the number of commercial fishers was reduced to 10. The fishery operates under five-year management plans with good coordination with the government through management committees responsible for the management of the fishery. The total take of prawns has varied between 250 and 350 tonnes. Mr Smallridge believes it has a sustainable potential of becoming a 400-tonne fishery.

3.101 Mr Smallridge informed the Committee that there is now a significant amount of work being done into assessing, reducing and improving the survival rate of the bycatch. Over the last two years the fishers have changed their gear configuration and gear size and had up to 97 per cent reduction in the amount of bycatch of some particular species.[83] Bycatch reduction devices which are most suitable to conditions within the fishery will be assessed as part of a national research program being carried out by the CSIRO (Marine Division) in collaboration with the South Australian Research and Development Institute (SARDI).[84]

3.102 At present the boats that are used in the Gulf St Vincent prawn fishery are smaller vessels than those used in most other prawn fisheries in Australia. Because of the sustainability of the fishery in the last six years, a decision has been made to improve the efficiency of the industry by changing to larger vessels. Over the next two

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79 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 37.

80 *Proof Committee Hansard,* Adelaide, 3 February 2000, pp 38-39.

81 Yorke Regional Development Board, Submission 31, p 8.

82 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 37.

83 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 41.

84 Government of South Australia, Submission 45, p 10.

to five years there will be a move towards the same systems as are in place in all other prawn fisheries.

3.103 Mr Smallridge informed the Committee that this would provide a higher quality, higher value product. Improving efficiency allows fewer trawl shots or shorter trawl shots as well as a reduction in fishing nights. Changing the mesh size and sorting on the vessel to enable any of the by-catch species to be kept alive and to be returned to the water alive are also being considered.[85]

Aquaculture

3.104 The Committee was informed that there is potential for aquaculture ventures to be established in Gulf St Vincent. The success of these ventures depends very much on access to unpolluted waters but in turn they have been implicated in introducing excess nutrients to the marine environment through waste products. There is also concern that diseases could be introduced which could affect wild fish stocks. Although there are more aquaculture ventures taking place in Spencer Gulf than in Gulf St Vincent, aquaculture in the Gulf is seen as a fast growing area with job and wealth creation potential.

3.105 Parts of the Gulf are now being allocated for aquaculture operations. Oyster leases have been approved near Edithburg and others are being considered in the vicinity of Stansbury on the western side of the Gulf. The aquaculture industry has developed rapidly to satisfy increasing demand for quality stock. It is becoming increasingly important economically and for this reason it is expected that more ventures will be established in the Gulf.

3.106 According to the State of the Environment Report for South Australia, there is little data on the impact of aquaculture operations in the marine environment.[86] Environmental concerns include: waste discharges, marine mammal entrapment, potential feral populations and ecological sustainability of the industry. Caged fish are particularly vulnerable to toxic or harmful algal blooms as they cannot swim away from them. There have been suggestions too, that the waste products from the aquaculture industry itself can induce algal blooms.[87]

3.107 The impact on Gulf St Vincent will very much depend on developments operating under strict guidelines and management plans which include adequate monitoring and transparent recording. Caution is advised because the impacts of aquaculture are not well documented in any of the monitoring publications.[88]

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85 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 43.

86 State of the Environment Report for South Australia 1998, p 157.

87 *The Cells from Hell*, Quantum, ABC TV, 23 March 2000, transcript at http://www.abc.net.au/quantum/stories/s112832.htm.

88 South Australian Fishing Industry Council Inc, Submission 33, p 14.

Contentious developments

3.108 During its inquiry the Committee's attention was drawn to some controversial development decisions made by the State Government and which are expected to have significant impacts on Gulf St Vincent. It is disturbing that for all the resources being poured into improvement programs and for all the environmental strategies being written, these developments continue to proceed. It raises the question whether the State Government has a greater commitment towards rhetoric and motherhood statements than to genuinely addressing the issues facing the Gulf.

3.109 Developments which are of particular concern are the Barcoo Outlet, the Pelican Point power station and the Port Adelaide sewage plant upgrade.

Barcoo Outlet

3.110 In the past, the Patawalonga Lake was used for recreational activities such as boating and swimming but in recent times it has become too polluted for such primary contact. As part of a series of proposals to develop the Glenelg Foreshore and Environs, the State Government has determined to "return the Patawalonga Lake to a condition suitable for primary contact recreation and useable for planned community events on a more reliable basis, particularly through the summer months".[89]

3.111 The State Government, using a proportion of Federal funds, is going to construct a stormwater control weir to divert stormwater flows from most rainfall events directly to the Gulf. The weir will have flap valves in it to enable south-north tidal circulation. The Barcoo Outlet will consist of a new watercourse and a buried duct that will run under the sand hills and the beach, and out to sea. It will release stormwater about 200 metres offshore. The proposal will cost approximately $15-$16.8 million.

3.112 In light of all of the evidence on the effects of urban runoff and sewage effluent on the Gulf environment, it seems to be a backward step to be constructing yet another stormwater outlet to the Gulf. According to Councillor Harold Anderson from the City of Charles Sturt:

> This proposal is akin to mending a broken leg by bandaging its big toe.[90]

3.113 The State Government and other supporters of the proposal, argue that at the present time, the pollution to the Gulf is worse without the Outlet. This is because bio-available toxicants from sediments in the Patawalonga Lake are re-mobilised during storms and then overflow to Gulf St Vincent from the Lake. Less environmental harm

89 Fourth amendment to the assessment report for the Environmental Impact Statement (as amended) for the Glenelg Foreshore and Environs, Barcoo Outlet Proposal (West Beach), Minister for Transport and Urban Planning, January 2000, p 5.

90 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 47.

will be created by a combination of catchment works to improve stormwater quality and direct discharge of stormwater to the sea.[91]

3.114 Mrs Pat Harbison from pH Consulting, however, asserts that there has been no data collected on the concentration of bio-available pollutants in the Patawalonga Lake or in the water that is released from the gates. She told the Committee that the model used to predict the concentration of pollutants may or may not apply in the Patawalonga situation.[92]

3.115 The Committee heard that the Patawalonga Lake and the Torrens Lake are two major retention basins in the catchment. Both of these serve a great purpose as sedimentation ponds. However, according to the State Government, the Patawalonga Lake is about one-tenth the size it should be to operate as a sedimentation pond without being overloaded.

3.116 According to Mrs Harbison, the proponent predicts that an improvement in the quality of run-off discharged to the Gulf through the Barcoo Outlet will occur. This improvement however will depend on the provision of adequate wetlands or sedimentation basins at the end of the catchment, the upkeep of these wetlands to maintain their capacity and minimise resuspension, and the ability of sediment traps to capture and retain fine particles. She told the Committee:

> It has already been established that adequate wetlands cannot be constructed at the end of the catchment because of the airport bird strike issue, and the inability of sediment trap devices, unless they are extremely large, to capture and retain the finest fractions which carry the highest concentration of pollutants, is widely recognised. The Patawalonga Basin is the only sediment trap at the bottom of the catchment which is large enough to settle the very fine silt and clay fractions and protect the Gulf from this input.[93]

3.117 Submissions to the Committee canvassed alternatives to the Barcoo Outlet which they said were not given full consideration. Mrs Harbison believes that water quality in the Patawalonga Lake could be improved by a seawater flushing system, with salt water brought in through a pipeline at the north end of the Lake. It would mix with any stormwater that came in from the catchment, and run out at the southern end of the Lake.[94]

3.118 The City of West Torrens, in association with a number of other organisations, has for a couple of years been investigating the feasibility of returning the Patawalonga waters to the Adelaide Parklands via an underground pipeline. The

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91 Patawalonga Catchment Water Management Board, Submission on the Third amendment to the Assessment Report for the Environmental Impact Statement (as amended) for the Glenelg Foreshore and Environs, Barcoo Outlet Proposal, in Appendix B to the Fourth amendment, January 2000.

92 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 49.

93 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 49.

94 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 50.

stormwater could then be used for irrigation and perhaps ponded and used to irrigate golf courses, the Morphettville Racecourse, the Adelaide Airport, the Weigall Oval, the West Adelaide Football Club and many other areas.[95]

3.119 Witnesses thought the $15 million would be better spent upgrading the Heathfield Waste Water Treatment Plant. This Plant discharges secondary treated effluent into Sturt Creek which flows into the Patawalonga Lake. Witnesses were highly critical of the Plant for its high levels of nutrients released to the environment.

> … they talk about the four sewage works that live in Adelaide. They do not talk about the Heathfield works which is at the top of Sturt River and runs in through the Patawalonga. That has very high levels of nutrients in it, far higher than the metropolitan ones have. Eventually it ends up in the Gulf.[96]

3.120 Mrs Harbison, does not believe that Heathfield is a direct problem for Gulf St Vincent in the current situation because the treated effluent is held in the Patawalonga. She thinks that Heathfield is a real problem for water quality in the Patawalonga because it contributes nutrients and organic matter but compared with what goes into the Gulf from other sewage treatment works, it is only a small part of the problem in the Gulf.[97] Presumably, if the Heathfield Plant were upgraded and other catchment works were undertaken, the Barcoo Outlet would not be necessary in order to improve water quality in the Lake.

3.121 There has been pressure since the early 1990s, and indeed provision has been made in SA Water's capital works plan for the financial years 1996-'97 and 1997-'98, to upgrade the Heathfield Plant. Witnesses expressed frustration to the Committee that no physical works have yet been done. According to the Patawalonga Catchment Water Management Board newsletter, however, SA Water has committed $550 000 for the first stage of the upgrade of the Heathfield Plant. This money is to be spent this financial year.[98]

3.122 Evidence provided to the State Environment, Resources and Development Committee inquiry into the Environment Protection Agency by Henley and Grange Residents Association suggests that although agreement has been reached between SA Water and the Environment Protection Agency that the Heathfield Waste Water Treatment Plant needs to be upgraded, there is disagreement over the timing and the extent of the upgrade. SA Water will need to expand its plant within around five to 10

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95 City of West Torrens, Submission 46, pp 1-2.

96 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 46.

97 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 52.

98 *Patawalonga Water*, News from the Patawalonga Catchment Water Management Board, December 1999, p 5.

years to meet population growth requirements. It has indicated that it would prefer to delay any upgrade in treatment effectiveness to coincide with that expansion.[99]

Pelican Point power station

3.123 Most of Adelaide's electricity is presently generated at the Torrens Island Power Station. This power station uses water from the Port River for cooling and discharges heated water back into the river via the Angas Inlet. This discharge causes thermal pollution that encourages algal growth and causes changes to the fish species composition in the area.

3.124 A paper by the South Australian Research & Development Institute indicates that certain species of fish avoid the area of the discharge in the summer/autumn months but are attracted to it in the winter/spring months. The warmer waters provide an extensive growing season, significantly higher growth rates and promote premature movement out of the inner estuary for different fish species.

> These latter effects may alter the population structures of these species by increasing their vulnerability to heavy localized fishing intensity, aggregation of natural predators and point-source pollution.[100]

3.125 The paper also mentions the possible indirect effect on fish from the disappearance of seagrass beds in the thermally affected area. There is no information, however, on the distribution of seagrasses within Barker Inlet prior to the installation of the Torrens Island power plant.

3.126 The decision which has concerned various groups is the approval of a new 500 megawatt gas fired power station at Pelican Point near the mouth of the Port River. Concerns were raised over the proximity of the new source of thermal pollution to the container wharf. There is increased risk of introduced marine pests from ballast water becoming established in the warmer waters.

3.127 Discharges from the plant could have a more intrusive effect than even the existing Torrens Island power station because the new station is to be situated at the mouth of the river and this could act as a barrier to marine fauna migrating past this point. According to the Australian Dolphin Research Foundation, the full effects of the thermal discharge into the river are not known.[101]

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99 Environment, Resources and Development Committee, transcript, p 178 (provided to the Senate Committee).

100 *Nearshore Fish Community of the Port River-Barker Inlet Estuary, South Australia. I. Effect of Thermal Effluent on the Fish Community Structure, and Distribution and Growth of Economically Important Fish Species*, GK Jones, JL Baker, K Edyvane and GJ Wright, Marine and Freshwater Research 47, pp 785-799.

101 The Australian Dolphin Research Foundation, Submission 27.

3.128 Concerns were also raised about the amount of water to be used by the new power station:

> At this stage we believe there has been insufficient investigation of the amount of cooling water required in relation to the total river flow. Particularly at times of dodge tide when there is reduced flow a significant proportion of the plankton entering and leaving the estuary will pass through the cooling system.[102]

3.129 According to Community Action for Pelican Point:

> The new power station will contribute thermal pollution and chemical pollution to a recognised dolphin breeding ground and important entrance to South Australian fish breeding grounds … The thermal pollution will also become another source of altered fish type patterns and algal blooms in combination with sewage nutrients … The power station will significantly add to existing cumulative air pollution levels …The development has not been subject to a community or public environmental consultation process … no testing or studies have been done by the State government as to the expected impact on marine or human health.[103]

3.130 Ms Gwen Moore from Community Action for Pelican Point told the Committee that the builders of the new power station have been forced in other locations, such as in Hazelwood in Victoria, to change the design of their plant from the deep water diffusion method. This was because of the impact of this method on the marine environment. Ms Moore continued:

> So we are particularly concerned that they have been forced to use the better technology in other locations but it seems to be okay to use the lesser technology in this location. We do believe, as we said, that with the combination of the dodge tides and with the shipping channel being right through the area where the heated water would be and the possibility of introduced species in the area with the warm water and the nutrients from the sewerage plant not far away, that that is actually a recipe for disaster and we feel that we cannot risk that in this particular area.[104]

3.131 The Committee strongly deplores the decision to go ahead with the new 500 megawatt gas fired power station in such a potentially attractive area as Pelican Point. The Committee is concerned that the power plant will have negative consequences on marine life in the area and on the local dolphins in particular.

3.132 As part of its site inspections, the Committee passed the 180 megawatt Osborne Cogeneration Plant - also on the Port River. This Plant uses air cooling rather than water cooling and therefore does not produce the thermal pollution of the existing

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102 Port Adelaide Resident's Environment Protection Group, Submission 24.

103 Community Action for Pelican Point, Submission 21, pp 2-3.

104 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 90.

plant and that proposed for the new plant. At the very least, the Committee believes that the State Government needs to make it a requirement of the new power station licence that thermal pollution prevention measures be included in the design.

Recommendation 5

The Committee recommends that the licence to be issued to the Pelican Point Power Station be made conditional on measures being taken to prevent thermal pollution.

Port Adelaide Waste Water Treatment Plant Upgrade

3.133 The Port Adelaide Waste Water Treatment Plant is scheduled to be upgraded. It currently discharges into the Port River and has been implicated in providing the nutrients for the red tides which occur in spring every year. The microalgae which include toxic dinoflagellates and a range of other species are introduced in ballast water. The algal blooms are so large because of the nutrients that are fed to them through the Port Adelaide sewage treatment plant and a couple of other industries in the area.[105]

3.134 A number of upgrade options are being investigated and the Committee was told of concerns with an outfall into the Port River being considered as part of the upgrade - despite all of the evidence of the effects of pollution in the area from existing outfalls.

3.135 The Port Adelaide Resident's Environment Protection Group believes that:

> … zero discharges is the way this should be handled. The reason we say this is that everybody says, 'We can get down to 10 milligrams per litre here and we can get down to 15 milligrams per litre over in Bolivar,' but there is no real basis for saying what the effects of this reduction are going to be. Nobody has gone out there and said, 'Look, if we drop our level of nutrients down to a certain level we are going to see this sort of effect on the environment.' In fact nobody seems to look at the environment at all. They seem to look inside the plant and at what the plant is capable of, rather than what the final effect is. [106]

3.136 The Committee was told that one of the problems with the Port Adelaide system is that it is an old system in a very low lying area and many of the pipe systems are below the watertable which is highly saline. There is infiltration through

105 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 7.

106 *Proof Committee Hansard,* Port Adelaide, 4 February 2000, p 88.

leaky joints and things of that nature which elevates the salinity to above levels that are normally able to be used for irrigation or other reuse purposes.[107]

3.137 Because of this high salinity, only 30 per cent of the flow from a portion of the drainage area can be reused. The Environment Protection Agency is proposing to divert that portion to the Bolivar Waste Water Treatment Plant and then make it available for irrigation in the Virginia area of South Australia.

3.138 The Committee heard that it is possible for the saline waters to go through a modern plant and then undergo some tertiary treatment in saline wetlands.[108]

3.139 According to the City of Port Adelaide Enfield, five new options for the Port Adelaide Plant are currently being reviewed due to the level of community activism over Pelican Point issues. The Council's preferred position is that the plant be upgraded to a standard where it is not going to be discharging effluent. Any clean water can then be pumped to the Bolivar plant so that it can be used as part of the Bolivar irrigation program.

3.140 The Committee cannot help but agree with the Mayor of the City of Port Adelaide Enfield who said:

> It just seems to me to be unsatisfactory to do a major upgrade and still include an outfall either to Gulf St Vincent or within the enclosed river system. I was astounded to see that they would even consider an outfall within the river system. [109]

3.141 Mr Tony Bazeley from Port Adelaide Residents Environment Protection Group expressed a similar opinion:

> The problem of the saline effluent has not been solved. There are various solutions – to pipe it here, to pipe it there and to pipe it somewhere else – but essentially it is going to go into the marine environment. … we think zero discharges is the way this should be handled. [110]

3.142 The Committee was told of an innovative project in Griffith, New South Wales where treated effluent is run underneath what is effectively a standing cereal crop. The cereal crop takes up the nutrients and then the polished effluent is discharged. [111]

> What we are asking for is that somebody should sit down and look at some of these alternatives. People are not; it is not familiar territory to them. They

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107 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 14.

108 *Proof Committee Hansard,* Port Adelaide, 4 February 2000, p 87.

109 *Proof Committee Hansard,* Port Adelaide, 4 February 2000, p 80.

110 *Proof Committee Hansard,* Port Adelaide, 4 February 2000, p 88.

111 *Proof Committee Hansard,* Port Adelaide, 4 February 2000, p 88.

> are involved in the design of sewerage plants. There are not the resources or the willingness within the state to look at those sorts of alternatives. We think it is very important because there must be lots of saline effluence throughout Australia. It must be a problem that is occurring in a lot of coastal areas. We think it would be a good role for the Commonwealth in this case to sponsor a reputable organisation, such as the CSIRO or one of the cooperative research centres, to have a look at the feasibility of setting up a facility to provide zero base discharge in this case.[112]

3.143 In the Committee's view every effort should be made to investigate successful land-based sewage treatments in operation both in Australia and overseas in order to adopt the most appropriate approach for the Port Adelaide Waste Water Treatment Plant with a view to minimising sewage discharge into the Gulf.

Recommendation 6

The Committee recommends that the South Australian Government consider off-budget construction options for the upgrading of the Port Adelaide Waste Water Treatment Plant utilising land-based disposal of sewage effluent.

Regional areas

3.144 Whilst the degradation of the marine environment appears to be mainly on the eastern side of the Gulf, around metropolitan Adelaide, this does not mean that the western side will necessarily escape the effects of population as a matter of course. It seems that away from the metropolitan area, little is known about the state of the Gulf. According to Mr Robert Veitch from the Wakefield Regional Council:

> In terms of the Wakefield Regional Council area it is almost out of mind, out of sight once you get further north from Adelaide in terms of media and, in the past, grants for looking at that sort of thing. It is not in the media a lot so it is not in the public eye a lot. It is a case of where the population is, that is where the focus tends to be. There is no hard data that will help with saying it is in a bad state in the top of the Gulf. As a council we tend to find as you get further north there is less known about the problems up that way.[113]

3.145 There do not seem to be procedures in place to avoid the sorts of problems that will inevitably occur with population increases. Regional areas serve as popular tourist destinations with populations swelling during summer and on weekends. This characteristic of the area is bound to have an impact on the Gulf.

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112 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 88.

113 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 33.

> But some of these [impacts] take a while, like the tourism side and the development. Whilst we only have 31,000 people that are permanent residents, we have a lot of people visiting on weekends. They come Friday night and go back Sunday night. The actual coast road carries more traffic than national Highway 1 does on weekends. You have a travelling population into there growing on a very rapid basis, so I believe we should not wait until something actually collapses before we try to fix it. We should be there trying to fix it before the seagrasses die.[114]

3.146 The Committee heard that on the western side of the Gulf the amount of building activity has increased between 10 and 25 per cent in coastal towns over the past 10 years. This increase does not take into account the majority of tourists that visit the peninsula who travel in caravans and are camping.[115] Few regional towns have a common effluent drainage scheme and they generally use septic systems. Shacks, houses and other buildings may be situated on the edge of rivers and the coast. This proximity to the water can result in polluted runoff from septic systems flowing untreated into waterways.

3.147 There are plans to convert towns but a lack of resources means that this will take time. The Committee was told that the State government has allocated approximately $3 million to a Septic Tank Effluent Disposal (STED) Scheme in country areas such as the towns along the Yorke Peninsula coast. The Scheme enables all of a town's septic tanks to be pumped into a common storage area for treatment.

3.148 However, there are only sufficient funds to put in about one STED Scheme for a town of 1,100 per year. Towns are therefore ranked according to their need for a STED Scheme based on factors such as the number of people in the town, the soil types, the effectiveness of septic tanks in terms of drainage, whether they have to be pumped out or not because the water does not drain away from them because of the nature of the soil. One of the most critical factors is whether they can demonstrate faecal contamination in aquaculture areas. [116]

3.149 The Committee heard that:

> … the town of Coffin Bay on the west coast recently jumped to the top of the priority list because it was found that on the porous Aeolianite limestone all around the bay, when they had their annual influx of 10,000 visitors in the holiday season, the septic tank effluent was simply just running straight into the bay right on top of the oyster lease which was at the top end of the bay. Coffin Bay immediately went to the top of the list for the STED Scheme and other places which had been on the list for a long time went down.[117]

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114 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 33.

115 *Proof Committee Hansard*, Adelaide, 3 February 2000, p 33.

116 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 85.

117 *Proof Committee Hansard*, Port Adelaide, 4 February 2000, p 86.

3.150 The order of priority means that it is not necessarily those towns that have waited the longest who will become beneficiaries of the Scheme.

Landfills

3.151 The Committee received a number of submissions, along with approximately 279 form letters, voicing concerns about proposed landfills at Dublin and Inkerman on the north-eastern side of the Gulf. These landfills are, in part, to replace the waste repository at Wingfield, Adelaide and other existing landfills. There are fears that toxins from the waste will leach into the water table and find their way to the Gulf, jeopardising ecosystems and one of the State's valuable fish breeding grounds.

Dublin

3.152 A proposal for a balefill landfill site has been approved in the Mallala Council rural area 3 km south of Dublin. According to the Council:

> Gulf Saint Vincent forms the entire western boundary of the Mallala District Council area. Its conservation significance can only be described as outstanding due to the high diversity of sea grass and other marine species some of which have survived from earlier tropical periods due to the warmer temperatures sustained in the shallow waters.
>
> … The dump site is within 4 kilometres of the Gulf and immediately abuts a Coastal Zone. A portion of the subject land also contains samphire wetlands.[118]

3.153 The Council is concerned that leachate from the facility could contaminate aquifers and eventually enter Gulf waters with subsequent environmental degradation. It asserts that the facility breaches standards set for assessing proposals for landfill dumping facilities throughout the State and that balefill cells will be embedded approximately 2 metres beneath the level of the seasonal groundwater table.[119]

3.154 The Dublin & Districts Ratepayers Association too is concerned that the landfill is located close to the Gulf and that waste will be dumped directly into groundwater. The Association has undergone a long and frustrating experience in trying to stop the landfill from going ahead. It asserts that:

> The Public consultative process has been ignored and the investigation process has been extremely biased. We have been accused of suffering from the NIMBY syndrome (Not in My Backyard Syndrome) which has been

118 District Council of Mallala, Submission 42, p. 1.

119 District Council of Mallala, Submission 42, p. 1.

> used for far too long by Government departments to negate and trivialize people's very real concerns for the environment and for their future.[120]

3.155 This issue of bias was also raised by the Council:

> The operation of bias seriously favouring the Developer's perspective has been identified both in the assessment of this facility and the development of policies to guide the assessment and development of future landfill dumps. Such bias has been at the cost of environmental factors particularly in respect of increasing the risk of ground water contamination with potential implications for the waters of the Gulf of Saint Vincent. [121]

3.156 The Dublin & Districts Ratepayers Association raises the issue of disease transmission from the landfill to feedlot sheep, cattle for export, piggeries, poultry sheds, cereal growing and grazing and private dwellings in the area. This could occur through the droppings of birds, through foxes and through vermin whose numbers will increase as a consequence of their attraction to the site.[122]

Inkerman

3.157 At Inkerman one landfill has been approved with a further four awaiting development applications. Inkerman is a broad acre farming area with a small population. It is situated 15 km south of Port Wakefield and contains coastal swamplands, mangroves and tidal channels, aeolian sand dunes with a high risk drift potential, and has highly saline underground water. It is registered by the Soil Board as a high-risk wind erosion area.

3.158 Members of the Inkerman Proposed Landfill Action Group drew the Committee's attention to the pristine condition of the environment at the northern end of the Gulf with mangroves, samphire and fish breeding grounds and abundant bird life. The waters at the top of the Gulf move in a circular motion and therefore do not flush readily.[123]

3.159 The Group is concerned at the gases which landfills produce as well as the possibility of leachate contaminating the Gulf. It suggested that the clay which is to be used to provide a 1 metre liner for the landfill to prevent leachate will be ineffective if on-site clay is to be used. The Group provided the Committee with a dramatic demonstration of the unsuitability of the local clay if it is used without an additive - a plug of clay which came out of a test hole on the landfill site was placed in a glass of water and immediately dissolved when it came in contact with the water.

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120 Dublin & District Ratepayers Association, Submission 11, p 3.

121 District Council of Mallala, Submission 42, p 2.

122 Dublin & District Ratepayers Association, Submission 11, p 10.

123 *Proof Committee Hansard,* Adelaide, 3 February 2000, p 67.

3.160 The landfills are also of concern to industry that relies on the purity of the Gulf waters for its business. Cheetham Salt Limited, which is located across the Gulf at Price, informed the Committee:

> The quality of the water pumped from the Gulf St Vincent … determines our ability to produce a product which is acceptable for human consumption both here and overseas. Contamination, by any pollutants, of the water would affect our ability to meet domestic and export demand.[124]
>
> The world is demanding food which is free of contaminants and Australia is in a strong position to fill this demand.[125]

Environment Protection Agency response

3.161 The South Australian Environment Protection Agency assured the Committee:

> Both landfills will have a one metre thick, low permeability, compacted clay liner. On top of the liner there will be a drainage layer to collect any leachate that may form. Modelling using the US EPA hydrological evaluation of landfill proposals, otherwise known as HELP, and local climatic data has indicated the amount of leachate generated under the proposed operating conditions and following closure is minimal. This is a function of the low rainfall and high evaporation rate common in the area, the proposed liner and leachate collection systems and the final capping system.
>
> Investigations at both sites have indicated that there are no continuous high permeability soil layers that could provide a direct connection to the Gulf. Ground water modelling has indicated there are no risks to human health of the Gulf and, furthermore, I should point out that stage 1 of the integrated waste services landfill proposed near Dublin is six kilometres from the coast. Stage 9, which is some 60 to 80 years away, after commencement would be three kilometres from the coast. The Pathline proposal near Inkerman: the closest distance to the coast is 3.7 kilometres and this is a conservative distance, given the interpreted north-westerly ground water flow direction which suggests a flow path distance of nine kilometres. So, given the distance, the security systems and the very low level of leachate generated, the risk of contamination is zero.[126]

3.162 The Committee understands that only one of the landfills is in operation at the moment, and there are no demonstrable impacts on the Gulf at the present time. The Committee notes the evidence given by the South Australian Environment Protection Agency that there is no risk of contamination from the proposed landfills.

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124 Cheetham Salt Limited, Submission 28, p 2.

125 Cheetham Salt Limited, Submission 28, p 3.

126 *Proof Committee Hansard,* Adelaide, 3 February 2000, pp 15-16.