Proposed Beenyup wastewater ocean outlet duplication into Marmion Marine Park

Report and Recommendations of the Environmental Protection Authority

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Summary and recommendations

The proposal, by the Water Authority of Western Australia, consists of a preferred option of constructing a 1420 mm diameter pipeline from the Water Authority of Western Australia's property adjacent to the Ocean Reef Boat Harbour, out to sea for a distance of 1800 m. This proposal will increase the capacity to dispose of treated wastewater from the current level of 54 Megalitres per day (ML/day) to a maximum of 150 ML/day. The secondary treated effluent will be discharged into the ocean via some 50 individual ports (~125 mm diameter) located laterally along the last 200 m of the pipe. This section of the pipeline is known as the diffuser. At this point the water depth is about 10 m and as the effluent rises to the surface from each port, it mixes with the surrounding seawater. The initial dilution is estimated to be approximately 50 times and further dilution is achieved by dispersion through wind driven currents. Bacterial concentrations are also reduced by die-off due mainly to the action of ultraviolet light. The proposed outlet is required by the winter of 1992 and this implies a launch date of March 1992, on the basis of a bottom-pull method of construction.

The Environmental Protection Authority recognises that the preferred option of this proposal has no precedent in Western Australia in that it concerns the discharge of up to 150 ML/day of secondary treated wastewater into a marine park. The marine communities of the Marmion Marine Park are important recreational and educational resources and, furthermore, the waters and reefs of this area support intensive recreational and professional fishing. The high conservation value and accessibility of these natural resources require careful management based on an understanding of the dynamics of the key marine communities.

For this reason the Environmental Protection Authority considers it essential that studies of the impact of discharges into the marine environment be initiated. It is therefore recommended that the Water Authority of Western Australia be required to undertake intensive studies to determine the impacts of the current and predicted capacity discharges into the Marmion Marine Park. Phase I of these studies should begin as soon as possible and should be completed by June 1992.

With regard to the present proposal, the lack of detailed information makes it impossible for the Authority to judge with any certainty the environmental acceptability of the proposed increases in nutrient loadings on the marine environment. However, from the limited information presently available, the Environmental Protection Authority acknowledges the Water Authority of Western Australia's claim that there is no evidence of gross environmental impact from the existing outfall. The Environmental Protection Authority has therefore concluded that the proposed second outfall would be environmentally acceptable provided that total annual nutrient loadings from the two outfalls do not exceed the maximum levels originally proposed, and already approved, for the single existing outfall (in the case of total phosphorus, the Environmental Protection Authority considers a loading within 10% of the existing outfall approved loading would be acceptable). Should the Water Authority of Western Australia wish to increase the loadings beyond those levels, the Environmental Protection Authority will be prepared to formally assess such a proposal, accompanied by evidence, including results of the Phase I studies, to indicate the environmental acceptability of such an increase.

The Environmental Protection Authority also sees a need for a longer term assessment of the capacity of nearshore waters of metropolitan Perth to assimilate predicted discharges of wastewater, and to this end recommends that the Water Authority of Western Australia be required to complete such a study to the Environmental Protection Authority's satisfaction by December 1994.

Recommendation 1

The Environmental Protection Authority has concluded that the the Water Authority of Western Australia's proposal to construct and operate an 1800 m offshore pipeline for ocean disposal of treated domestic wastewater into Marmion Marine Park is only environmentally acceptable provided that the combined nutrient loadings from both offshore pipelines from the Beenyup Wastewater Treatment Plant do not exceed the maximum loads set for the original single outfall. In the case of phosphorus loadings, the Environmental Protection Authority considers loads within 10% of the maximum loads to be acceptable. The environmental acceptability of loadings beyond these levels will require further assessment by the Environmental Protection Authority. The Authority recommends that the proposal could proceed subject to the proponent's commitments and the recommendations contained in this report. Details of the plant performance in relation to the mean monthly nutrient concentrations in the wastewater should be forwarded to the Environmental Protection Authority by September 1 each year.

Recommendation 2

The Environmental Protection Authority

recommends that the Water Authority of Western Australia be required to undertake the following studies to determine the impacts of the Beenyup outfalls.

(a) A study to determine the water circulation in the region of the outlets in order to determine the flushing characteristics of the receiving water body. A complete range of conditions should be sampled to enable calibration of a numerical model.

(b) A study to determine the effects of nutrient loading on the local marine communities. This programme should involve 3 years of intensive effort (Phase I) and 2-3 years of reduced effort (Phase II).

These studies should commence in the 1989/90 financial year and should be formulated in direct consultation with, and to the satisfaction of, the Environmental Protection Authority and the Marine Research Group at the Department of Conservation and Land Management. A Technical Advisory Group should be established to co-ordinate these studies. Representatives from the Water Authority of Western Australia, the Environmental Protection Authority, and the Department of Conservation and Land Management should be included in the Technical Advisory Group.

Recommendation 3

The Environmental Protection Authority recommends that, in addition to the proposed studies, the Water Authority of Western Australia should continue the present monitoring programme. If existing water quality criteria for bacteria are exceeded, the Water Authority of Western Australia should be required to further treat the effluent to reduce bacterial concentrations to levels acceptable to the Environmental Protection Authority. If bacterial concentrations in Marmion Marine Park waters are found to be unacceptable to marine mammals, the Water Authority of Western Australia will be required to reduce bacteria concentrations to acceptable levels.

Recommendation 4

The Environmental Protection Authority recommends that the Water Authority of Western Australia undertakes a survey of heavy metal and pesticide contamination of biota, particularly of the harvestable fish species in the area. This should involve establishing current levels of contamination of a suite of heavy metals, pesticides and possible by-products of the chlorination process in a range of species before the 1992 launch date with follow-up surveys every 3 years with a review after 12 years.

These studies should commence in the 1989/90 financial year and should be formulated in direct consultation with, and to the satisfaction of, the Environmental Protection Authority, the Marine Research Group at the Department of Conservation and Land Management and the Fisheries Department. Results of these surveys should be forwarded to the Department of Conservation and Land Management, Fisheries Department, and to the Environmental Protection Authority within 6 months of the sampling date.

Recommendation 5

The Environmental Protection Authority recommends that the Water Authority of Western Australia continues to investigate alternatives to ocean disposal of wastewater and present the conclusions of these investigations to the Environmental Protection Authority by December 1994.

Recommendation 6

The Environmental Protection Authority recommends that the Water Authority of Western Australia undertakes studies to determine the capacity of the waters of metropolitan Perth to assimilate the combined wastewater discharges predicted to occur by the year 2040. These studies should be completed to the satisfaction of the Environmental Protection Authority by December 1994.

Recommendation 7

The Environmental Protection Authority considers that underwater blasting is environmentally unacceptable in a marine park and recommends that an alternative method of rock removal be used. This alternative method should be approved by the Environmental Protection Authority prior to construction commencing.

Recommendation 8

The Environmental Protection Authority recommends that the Water Authority of Western Australia surveys the flora and fauna in the path (~10 m wide) of the pipeline as well as those to be overtopped by the pipeline before construction commences. This survey should be carried out in consultation with the Marmion Marine Park Manager and under the direction of the Marine Research Group at the Department of Conservation and Land Management. In the event that the survey identifies an area of high conservation value or sensitivity, the Environmental Protection Authority may require the Water Authority of Western Australia to modify the design of the outfall.

Recommendation 9

The Environmental Protection Authority recommends that the Water Authority of Western Australia rehabilitates the onshore site to the satisfaction of the Environmental Protection Authority following construction and launching of the pipeline.

1. Introduction

In Australian coastal cities, the discharge of effluent into the ocean is the most common form of domestic wastewater disposal and is usually discharged following some form of treatment; either primary, secondary or tertiary. Primary treatment mainly involves screening and settling to remove solids. Secondary treatment further reduces suspended solids, and also reduces the biological oxygen demand, oil & grease, nutrients and bacteria. Tertiary treatment involves further stripping of nutrients from the effluent. Heavy metals are also present in low concentrations in domestic sewage and although some metal concentrations are reduced slightly by secondary treatment, most remain unchanged. Tertiary treatment does not reduce heavy metal concentrations any further.

At present about 200 million litres (ML) of domestic wastewater (80 ML of primary treated wastewater and 120 ML of secondary treated wastewater) are discharged daily into the ocean off Perth through three submarine pipelines located off Cape Peron, Swanbourne and Ocean Reef. The diffusers are located in water depths ranging from 10 to 20 m and from 1-4 km offshore. No industrial waste or sludge is discharged through these outfalls. By comparison, the three shoreline outfalls off Sydney discharge 1000 million litres of wastewater each day comprising about 50% primary treated wastewater & sludge and about 50% industrial waste.

The Water Authority of Western Australia plans and manages water services and water resources throughout the state under the Water Authority Act 1984. The rapid urban development of Perth, especially in the northern corridor, places ever increasing demands on water and wastewater treatment resources. As a result the Beenyup Wastewater Treatment Plant and its effluent disposal system (Fig. 1) which services the northern suburbs of Perth, require expansion. This involves increasing the capacity of the treatment plant at Beenyup and providing an additional ocean outlet at Ocean Reef. Extensions to the treatment plant were authorised by the Minister for Water Resources in July 1986. These works have commenced and will be confined to the Beenyup Wastewater Treatment Plant TP site south of Ocean Reef Road. The Water Authority has submitted a Public Environmental Report to the Environmental Protection Authority seeking approval for a duplication of the existing ocean outlet off Ocean Reef. This report assesses this proposal and outlines the recommendations made by the Environmental Protection Authority.

2. The proposal

The proposal consists of a preferred option of constructing a 1420 mm diameter pipeline from the Water Authority of Western Australia's property adjacent to the Ocean Reef Boat Harbour, out to sea for a distance of 1800 m (Alternative 1 in Fig. 1). This proposal will increase the disposal capacity from the current level of 54 megalitres per day (ML/day) to a maximum of 150 ML/day. The secondary treated effluent will be discharged into the ocean through some 50 individual ports (~125 mm diameter) located laterally along the last 200 m of the pipe. This section of the pipeline is known as the diffuser. At this point the water depth is about 10 m and as the buoyant effluent rises to the surface from each port, it mixes with the surrounding seawater. The initial dilution is estimated to be approximately 50 times and further dilution is achieved by dispersion through wind driven currents. In the case of bacteria levels, further reductions are caused by die-off due mainly to the action of ultraviolet light. The proposed outlet is required by the winter of 1992. This implies a launch date of March 1992, on the basis of a bottom-pull method of construction.

3. Environmental considerations

The Environmental Protection Authority recognises that the preferred option of this proposal has no precedent in Western Australia in that it concerns the discharge of up to 150 ML/day of secondary treated wastewater into a Marine Park. The following section addresses the specific environmental issues of this proposal.

3.1 Long-term considerations

(i) The effects of nutrient loadings on the local marine communities of Marmion Marine Park.

(ii) The effect of bacterial contamination of waters in relation to public health and ecological considerations.

(iii) Heavy metal and pesticide contamination of local biota.

(iv) Alternative ocean outfalls

These points are discussed in detail below.

(i) Nutrient loading

The waters of the Marmion Marine Park are primarily designated Beneficial Use 7(2) (Environmental Protection Authority Bulletin 103) which recommends that: "*The loads of nutrients and other biostimulants to receiving waters should not cause excessive or nuisance growth of algae or other aquatic plants, or deleterious reductions in dissolved oxygen concentrations in those waters.*"

Nutrients are essential to plant growth and the major nutrients, nitrogen and phosphorus, are found in variable concentrations in all marine waters. At the design discharge level of 150 ML/day the combined outlets will discharge substantial loads of nitrogen

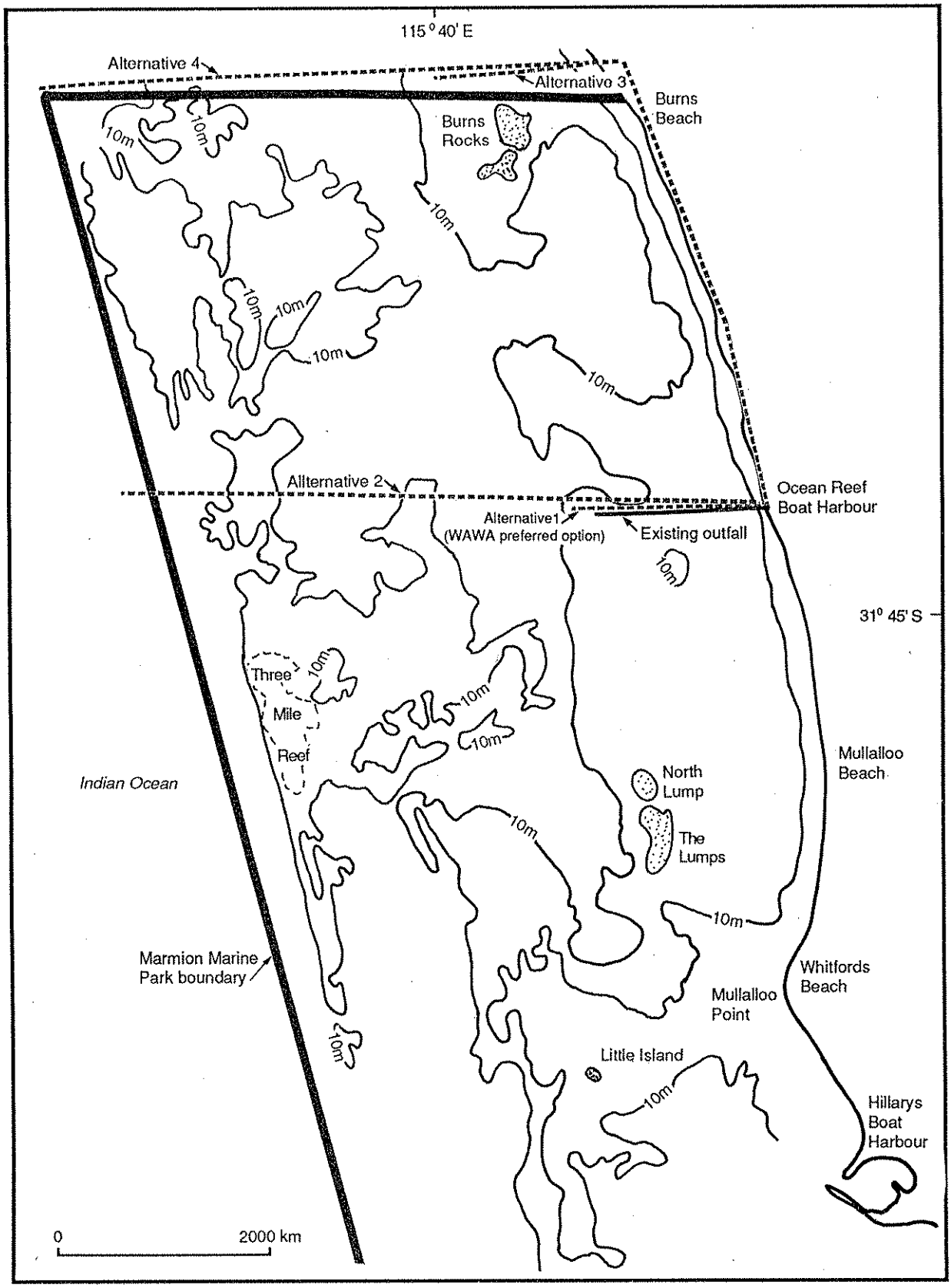


Figure 1. Location map of the area off Ocean Reef showing the existing, proposed and alternative ocean outfalls.

and phosphorus into the waters of Marmion Marine Park. Secondary treated wastewater contains about 52 mg/L of total nitrogen and 12 mg/L of total phosphorus. At a capacity flow of 150 ML/day, this will result in a daily discharge of 7.80 tonnes of nitrogen and 1.80 tonnes of phosphorus.

From July 1986 to June 1987 (ie 1986/87) the mean flow was 40 ML/day and the mean daily loads of total nitrogen and total phosphorus were 2.08 and 0.48 tonnes respectively. As a result of improved denitrification in 1987/88, average total nitrogen loads were reduced to 1.32 tonnes/day even though the mean flow increased to 47 ML/day. Average total phosphorus loads, however, increased to 0.56 tonnes/day as a result of the increased flow. The Water Authority of Western Australia predicts that the flow to the treatment plant will increase at the rate of 10% per annum over the next three years and if the current level of denitrification continues, the mean daily load in 1991/92 will then be about 1.98 tonnes of total nitrogen and 0.88 tonnes of total phosphorus. These loads are 55% and 106% of total nitrogen and total phosphorus respectively of the approved daily loads of the existing pipeline at capacity flow (ie 69 ML/day) and represent an annual load of about 720 tonnes of total nitrogen and 320 tonnes of total phosphorus (Fig. 2).

Severe ecological problems developed over a number of years in Cockburn Sound following increases in nitrogen loading to over 1.0 tonne/day. However, Cockburn Sound is a semi-enclosed deep-water basin in comparison to the topographically more complex, shallower, 'pseudo-lagoonal' area off Ocean Reef. As a result the flushing characteristics of these two areas are likely to be quite different. Furthermore the marine communities are dissimilar, making meaningful comparisons of the likely effects of nutrient loading between these two areas even more difficult. However, the vulnerability of aquatic systems to excessive nutrient loads has been demonstrated repeatedly in Western Australia and, as a result, a cautious approach is necessary.

The flushing characteristics of the receiving waters in the Ocean Reef area are poorly understood and with the past high nutrient loading into these waters significant deleterious effects on the local marine communities may have occurred in the past, may be occurring now or could occur in the future. In the PER the Water Authority of Western Australia states that no significant adverse visible effects of the existing outfall have occurred after 10 years of operations. It is the Environmental Protection Authority's view that this assessment is superficial and that the effects of past and current nutrient loadings to these communities are unknown. Comparisons with other ocean outfalls around Perth are also of limited use because, again, relevant studies at the biological community level have not been undertaken.

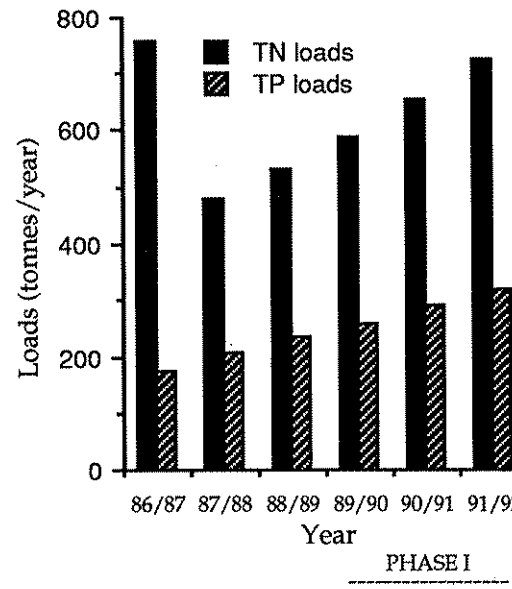


Figure 2. Annual loads of total nitrogen and total phosphorus to the waters of Marmion Marine Park to the end of Phase I of the proposed studies (Information supplied by the Water Authority of Western Australia).

With nutrient loading to the nearshore marine environment off Perth predicted to increase rapidly over the next 10 years, the Environmental Protection Authority considers that studies at the biological community level need to be undertaken urgently to determine the effects under existing loads and to predict the likely effects under capacity loads. The Water Authority of Western Australia has made a strong commitment to undertake these studies. In addition the Water Authority of Western Australia has agreed to continue to limit total nitrogen concentrations in the effluent to less than 30 mg/L until at least July 1992 (until Phase I of the studies are complete). The Environmental Protection Authority commends the Water Authority in recognising its responsibility to determine the effects of these outfalls on the local marine communities of the Marmion Marine Park. Furthermore, in the event that these loadings are causing or likely to cause unacceptable impacts, the Water Authority of Western Australia has given a commitment to further reduce nutrients in the effluent to an acceptable level.

The proposed studies are briefly outlined below.

(a) A study to determine the water circulation in the region of the outlets in order to determine the flushing characteristics of the receiving water body. A complete range of conditions will be sampled to enable calibration of a numerical model.

(b) A study to determine the effects of nutrient loading on the local marine communities. This programme will involve 3 years of intensive

effort and 2-3 years of reduced effort.

These studies will commence in the 1989/90 financial year and will be formulated in direct consultation with, and to the satisfaction of, the Environmental Protection Authority and the marine research group at the Department of Conservation and Land Management.

Recommendation 2

The Environmental Protection Authority recommends that the Water Authority of Western Australia, as a matter of high priority, undertakes the following studies to determine the impacts of the Beenyup outfalls.

(a) A study to determine the water circulation in the region of the outlets in order to determine the flushing characteristics of the receiving water body. A complete range of conditions should be sampled to enable calibration of a numerical model.

(b) A study to determine the effects of nutrient loading on the local marine communities. This programme should involve 3 years of intensive effort (Phase I) and 2-3 years of reduced effort (Phase II).

These studies should commence in the 1989/90 financial year and should be formulated in direct consultation with, and to the satisfaction of, the Environmental Protection Authority and the Marine Research Group at the Department of Conservation and Land Management. A Technical Advisory Group should be established to co-ordinate these studies. Representatives from the Water Authority of Western Australia, the Environmental Protection Authority, and the Department of Conservation and Land Management should be included in the Technical Advisory Group.

Following the completion of Phase I in June 1992, if the Water Authority of Western Australia wishes to increase nutrient loadings, such a proposal will be formally assessed by the Environmental Protection Authority in the light of the current impacts and the impacts predicted to occur at capacity loads.

(ii) Bacterial contamination

In the PER mathematical models were used to predict likely initial dilution and subsequent dispersion of bacteria from the combined outfalls. These models, in addition to the results from the monitoring programme of the existing outfall, were used to assess whether bacterial concentrations from the combined outfalls would exceed the various Beneficial Use criteria prescribed for these waters. The Environmental Protection Authority agrees with the Water Authority of Western Australia that the mathematical models should only be used as a guide due to the uncertainty of some of the input parameters, in particular mean current speed and direction. Furthermore the Environmental Protection Authority agrees that the results of the monitoring programme for the existing outfall are likely to be more useful in assessing bacterial dispersion and die-off of the combined outfalls than the model predictions presented in the PER.

The results of the monitoring programme indicate that the initial dilution, dispersion and die-off of bacteria from the existing outfall is extremely rapid and suggest that, under most conditions, bacterial contamination of waters, apart from in the immediate vicinity of the outfalls, should stay below the levels prescribed for the Beneficial Uses of the surrounding waters. As a result health risks to the public, either from direct contact with the water or as a result of ingestion of bacteria through the consumption of seafood, are very low. However if the on-going monitoring programme indicates that bacterial contamination of the waters or biota exceeds, or is likely to exceed, the levels designated under the Beneficial Uses, then the Water Authority of Western Australia will be required to further treat the effluent to reduce bacterial concentrations to acceptable levels.

Under calm conditions an effluent boil can be seen in the immediate vicinity of the existing diffuser. This is usually a patch of turbid water approximately 150 m X 80 m in diameter. With the additional outfall this area is likely to at least double in size. However as the proposed diffuser will be located 1.6-1.8 km from the shore, the Environmental Protection Authority does not consider this to be a significant aesthetic problem.

The ecological effects of bacterial contamination of the marine environment from ocean disposal of domestic wastewater are poorly understood. As a result, little can be said in relation to the effects on marine animals. However recent studies, both local and overseas, have highlighted the possibility of transferring diseases from human and industrial wastes to marine wildlife, particularly marine mammals. Sewage contamination of the marine environment at Monkey Mia was implicated in the death and disappearance of 7 bottlenose dolphins in January/February 1989. Similarly, the devastation of the North Sea sealion population in 1988 was attributed to a disease introduced via waste disposal.

Two groups of marine mammals are common in the Marmion Marine Park; Australian sealions and a

resident group of bottlenose dolphins. Unlike the sealions, the dolphins breed in the Park. Faecal bacteria and viruses in the waters of the Marmion Marine Park are a potential source of disease to these animals. In Western Australia, water quality criteria in relation to bacterial or viral infection of marine mammals do not exist; a deficiency which is currently being addressed. With wastewater flows increasing rapidly over the next ten years, the potential for infection of marine mammals in the Park is likely to increase significantly.

Recommendation 3

The Environmental Protection Authority recommends that, in addition to the proposed studies, the Water Authority of Western Australia should continue the present monitoring programme. If existing water quality criteria and proposed water quality criteria (in relation to marine mammals) for bacteria are exceeded, the Water Authority of Western Australia will be required to further treat the effluent to reduce bacterial concentrations to levels acceptable to the Environmental Protection Authority.

(iii) Heavy metal and pesticide contamination

Secondary treated wastewater contains low levels of heavy metals and may contain pesticides as a result of illegal dumping. These pollutants can accumulate in animals, especially filter feeders such as mussels. Previous experience with the Point Peron pipeline, which discharges primary treated wastewater into Sepia Depression (in 20 m depth), indicates that the contamination of biota in this area has been minimal. Although the Beenyup outfalls will discharge secondary treated effluent into shallower and more confined waters than in the Sepia Depression, it is reasonable to assume that significant heavy metal and pesticide accumulation in the biota is unlikely to occur in the short term. However, as intensive professional and recreational fishing occurs in the area some monitoring of heavy metal and pesticide contamination of biota, particularly of the harvestable fish species, should be undertaken. This should involve establishing current levels of contamination of a suite of heavy metals and pesticides in a range of species before the 1992 launch date with follow-up surveys every 3 years with a review after 12 years.

Recommendation 4

The Environmental Protection Authority recommends that the Water Authority of Western Australia undertakes a survey of heavy metal and pesticide contamination of biota, particularly of the harvestable fish species in the area. This should involve establishing current levels of contamination of a suite of heavy metals, pesticides and possible by-products of the chlorination process in a range of species before the 1992 launch date with follow-up surveys every 3 years with a review after 12 years.

These studies should commence in the 1989/90 financial year and should be formulated in direct consultation with, and to the satisfaction of, the Environmental Protection Authority, the Marine Research Group at the Department of Conservation and Land Management and the Fisheries Department. Results of these surveys should be forwarded to the Department of Conservation and Land Management, Fisheries and to the Environmental Protection Authority within 6 months of the sampling date.

(iv) Alternative ocean outfalls

Several alternative outfalls are considered in the PER (Fig. 1). These options include a 5.5 km pipeline out from Ocean Reef (Alternative 2), and 2 km (Alternative 3) and 5.8 km (Alternative 4) pipelines out from Burns Beach. Unlike the preferred option which flows by gravity these three alternatives require pumping. As a result each of these alternatives requires an additional emergency overflow facility in the event of power failures. During such an emergency, effluent would be discharged into the nearshore marine environment with minimal initial dilution and restricted flushing. All of these options are considerably more expensive than the preferred option. Thus the increased costs of these alternatives has to be weighed against the possible environmental advantages of discharging the effluent into these respective locations. These advantages are, at the moment, impossible to quantify.

Alternative 3, discharging about 2 km off Burns Beach, would simply transfer any problems 6 km further north, although the pipeline but not necessarily the effects, would be outside the marine park. The two longer (deeper) alternatives (2 and 4) would obviously provide better initial dilution and dispersion than the two shorter alternatives but the diffusers would be closer to the extensive limestone reefs that occur about 5 km offshore. Furthermore, the case for dispersing the effluent through two more separated outfalls (eg existing and alternative 3) may have advantages or disadvantages over attempting to restrict the area of impact by locating the two outfalls close together (ie the preferred option). However the relative merits of these options are not precisely known.

In summary, the absence of relevant data on the effects of the existing outfall and the flushing characteristics of the alternative locations preclude

any meaningful consideration of the relative merits of the three alternative outfall locations and, once again, underlines the importance of the studies proposed by the Water Authority of Western Australia in the PER.

3.2 Long-term implications of ocean disposal

Ocean disposal of wastewater in the Perth metropolitan area began in 1927 through the Swanbourne ocean outlet. Since then a total of almost 56 000 tonnes of total nitrogen and 13 000 tonnes of total phosphorus have been discharged into Perth metropolitan waters through the Swanbourne, Woodman Point, Ocean Reef and Cape Peron outlets.

Currently wastewater in the Perth metropolitan area is discharged to the ocean via three main outfalls. Primary treated sewage (80 ML/day) is discharged through the Point Peron pipeline into Sepia Depression. At Swanbourne and Ocean Reef approximately 60 ML/day and 54 ML/day respectively of secondary treated sewage is discharged into the ocean each day. The current proposal is to increase the discharge rate of secondary treated sewage at Ocean Reef to 150 ML/day. Water Authority predictions indicate that by the year 2000, an additional pipeline capable of discharging 125 ML/day will be needed at Point Peron and that the Alkimos outfall, about 15 km north of Ocean Reef, will be discharging a further 10-20 ML/day into the ocean. By the year 2000 about 350 million litres of domestic wastewater will be entering the marine environment between Rockingham and Yanchep each day (Fig. 3); that is a daily load of about 18 tonnes of total nitrogen and 4 tonnes of total phosphorus. At this rate of discharge it would take about 8 years to discharge a total nutrient load equivalent to the total load discharged over the 60 odd years between 1927 and 1989.

The scale of this increase raises several important environmental issues. First, what are the short-term and cumulative effects of these outfalls on the receiving environment? Secondly, are the effects of each of these outfalls sufficiently localised to be considered independently as a series of point sources or should these outfalls be considered as a diffuse source effecting part or all of a much larger system? Finally, is ocean discharge an appropriate long-term solution to the problem of domestic wastewater disposal for Perth?

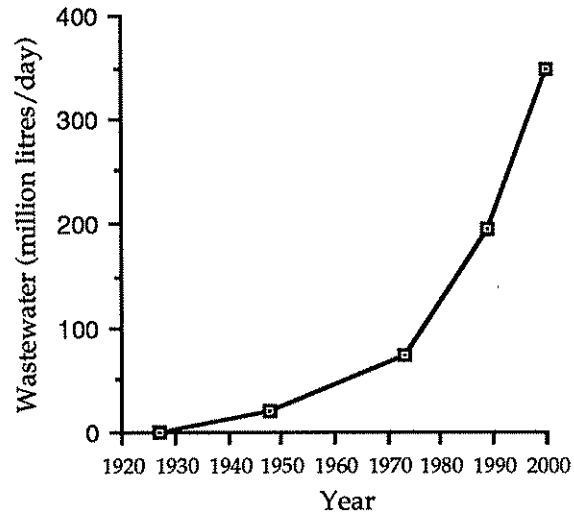


Figure 3. Historical and predicted domestic wastewater discharge to Perth metropolitan waters. (Information supplied by the Water Authority of Western Australia).

In the concept approval by the Department of Conservation and Environment (now the Environmental Protection Authority) of the first stage ocean outlet at Ocean Reef, the Water Authority was urged to address the viability of re-use techniques (as possible alternatives to ocean disposal) as a matter of utmost priority. The Water Authority has pursued this through the Canning Vale Groundwater Study. According to this study two major constraints preclude the use of domestic wastewater to recharge groundwater aquifers as a cost effective alternative to ocean disposal. First, the availability and the cost of suitable land which, for outfalls of this size (ie 150 ML/day), is approximately 15 km^2 and secondly, the cost of treating effluent to a level that ensures no contamination of the groundwater by either nutrients, bacteria or viruses. Thus, according to the Water Authority of Western Australia, groundwater recharge as an alternative to ocean disposal would significantly increase costs to the public as well as increasing the potential for adverse effects on the groundwater which is being used increasingly as a source of freshwater for Perth. These disadvantages have to be balanced against the possible short and long-term deterioration of the marine environment as a result of ocean disposal and the acceptability of discharging two valuable resources, freshwater and 'fertiliser', into the ocean. The Environmental Protection Authority considers that the re-use of wastewater is more desirable, in the long term, than ocean disposal and again stresses that the Water Authority of Western Australia should continue to investigate the possible re-use of wastewater as a matter of high priority.

Recommendation 5

The Environmental Protection Authority recommends that the Water Authority of Western Australia continues to investigate possible alternatives to ocean disposal of wastewater and present the conclusions of these investigations to the Environmental Protection Authority by December 1994.

The Water Authority of Western Australia states in the PER that no obvious detrimental effects on the marine communities have occurred over the 12 years that the existing outfall has been operating. The Environmental Protection Authority regards this as a superficial assessment and in reality it simply means that no catastrophic losses of the more obvious communities have been observed. Sub-lethal or cumulative effects have not been considered in the PER and these effects may be considerably more widespread and ecologically more significant than the often localised catastrophic effects. In addition these effects are rarely observed until the biological system is in an advanced state of change; at which time it is often too late to arrest these changes.

To use the apparent lack of obvious adverse effects of the existing outfall as a basis for suggesting that the combined detrimental effects of the existing and proposed outfalls will also be minimal is unjustified in the absence of relevant data. Furthermore, cause and effect in nature are rarely linear and it is unlikely that the effects of the existing outfall, if they were known, would simply be doubled if the outfall is duplicated.

In the PER the Water Authority of Western Australia suggests that, after examining the possible alternatives for the re-use of domestic wastewater at Beenyup, ocean disposal remains the most cost effective and environmentally safe option. The Environmental Protection Authority, in the absence of evidence demonstrating that significant detrimental effects have occurred in the past, cannot refute this suggestion. These gaps in knowledge, in relation to the effects of ocean disposal of domestic wastewater, underline the importance and urgency in undertaking the studies proposed by the Water Authority of Western Australia in the PER. A full assessment of the true 'cost' of ocean disposal can only be made when the short-term and cumulative effects on the marine environment are known.

The Water Authority estimates indicate that by the year 2000, approximately 350 million litres of domestic wastewater will be discharged daily into the nearshore waters of metropolitan Perth. These outfalls are located within 20 km of each other and as such, a potential exists for the effects of adjacent outfalls to overlap. The waters off metropolitan Perth have a finite capacity to assimilate waste without serious deterioration of the local marine communities. This 'assimilative capacity' is related to the amount of exchange with other nearshore water bodies to the north and south of Perth and with the open ocean. It is also related to the responses of the local biological communities to chronic nutrient loading. At present, these physical and biological processes are poorly understood.

The assimilative capacity should be known well before it is reached so that the suitability of ocean discharge as a long-term solution to domestic wastewater disposal can be assessed and at a time scale appropriate to the consideration and implementation, if necessary, of alternatives. With these considerations in mind, the Environmental Protection Authority believes that a study into the likely environmental impacts of the combined wastewater discharges into the waters of metropolitan Perth over the next 50 years is both necessary and timely.

Recommendation 6

The Environmental Protection Authority recommends that the Water Authority of Western Australia undertakes studies to determine the capacity of the waters of metropolitan Perth to assimilate the combined wastewater discharges predicted to occur by the year 2040. These studies should be completed to the satisfaction of the Environmental Protection Authority by December 1994.

3.3 Short-term considerations

(i) Underwater blasting

In the PER the Water Authority of Western Australia states that "*...should any blasting be required it would be carefully controlled to limit the effect on the marine environment.*". Very little is known about the effects of blasting on the marine environment apart from causing the destruction of habitat and the death of animals, such as fish, in the immediate vicinity. The Environmental Protection Authority considers that blasting in a Marine Park is environmentally unacceptable and that alternative methods of rock removal should be used. These alternative methods should also be environmentally acceptable to Environmental Protection Authority.

Recommendation 7

The Environmental Protection Authority considers that underwater blasting is environmentally unacceptable in a marine

park and recommends that an alternative method of rock removal be used. This alternative method should be approved by the Environmental Protection Authority prior to construction commencing.

(ii) Push-pull construction

The Environmental Protection Authority considers that the push-pull method of construction will cause considerable modification to the seabed and damage to the marine communities along the pipeline route. The existing flora and fauna in the path (~ 10 m) of this pull, and those to be overtopped by the pipeline, should be surveyed carefully before work begins. This should be carried out in consultation with the Marmion Marine Park Manager and under the direction of the Marine Research Group at the Department of Conservation and Land Management.

Recommendation 8

The Environmental Protection Authority recommends that the Water Authority of Western Australia surveys the flora and fauna in the path (~10 m wide) of the pipeline as well as those to be overtopped by the pipeline before construction commences. This survey should be carried out in consultation with the Marmion Marine Park Manager and under the direction of the Marine Research Group at the Department of Conservation and Land Management. In the event that the survey identifies an area of high conservation value or sensitivity, the Environmental Protection Authority may require the Water Authority of Western Australia to modify the design of the outfall.

(iii) Onshore site modification

The onshore works programme will be undertaken on Water Authority land. The Water Authority of Western Australia has given a commitment in the PER to rehabilitate the onshore site following construction and launching of the pipeline.

Recommendation 9

The Environmental Protection Authority recommends that the Water Authority of Western Australia rehabilitates the onshore site to the satisfaction of the Environmental Protection Authority following construction and launching of the pipeline.

4. Conclusion

The lack of detailed information makes it impossible for the Authority to judge with any certainty the environmental acceptability of the proposed increases in nutrient loadings on the marine environment. However, from the limited information presently available, the Environmental Protection Authority acknowledges Water Authority of Western Australia's claim that there is no evidence of gross environmental impact from the existing outfall. The Environmental Protection Authority has therefore concluded that the proposed second outfall would be environmentally acceptable provided that total annual nutrient loadings from the two outfalls do not exceed the maximum levels originally proposed, and already approved, for the single existing outfall (in the case of total phosphorus, the Environmental Protection Authority considers a loading within 10% of the existing outfall approved loading would be acceptable). Should the Water Authority of Western Australia wish to increase the loadings beyond those levels the Environmental Protection Authority will be prepared to formally assess such a proposal, accompanied by evidence, including results of the Phase I studies, to indicate the environmental acceptability of such an increase.

5. Summary of submissions

A total of six submissions on the proposed outfall were received. Four submissions were from State Government Departments, one from the City of Wanneroo and one from the Western Australian Recreational and Sportsfishing Council Inc. Each submission is briefly outlined below.

List of submissions

- The City of Wanneroo
- Western Australian Recreational and Sportsfishing Council Inc
- State Planning Commission
- Fisheries Department
- Department of Conservation and Land Management
- Department of Marine and Harbours

Issues raised in submissions

- In relation to the large volumes of water that will eventually be discharged into the ocean, further consideration should be given to possible re-use of wastewater.
- The impacts of nutrient loads and toxic waste accumulation were not addressed adequately in the PER and that predicted impacts should be

determined with more certainty before approval is given.

- There should be liaison with local government on the construction of the outlet particularly in regard to blasting.
- The Water Authority of Western Australia should be responsible for removal of algae in the event of a build-up on the shoreline as a result of nutrient enrichment from the outfall .
- Irreparable damage may occur to local marine life.
- Approval should not be given until adequate data are available to make an informed assessment of the likely impacts and until alternatives to ocean disposal are considered 'seriously'.
- Rehabilitation of the onshore site should be undertaken.
- Little is known in relation to the impacts of nutrient enrichment in these waters and that a comprehensive study should be carried out before approval is given.
- Any loss of seagrass in the marine park as a result of this outfall would increase the potential for shoreline erosion of adjacent beaches.
- It appears that the outlet will not cause any problems to the surrounding beneficial uses that involve fisheries.
- The commitment in the PER for additional monitoring is supported.
- Underwater blasting within the Marmion Marine Park is unacceptable.
- The flora and fauna in the path of the pipeline should be surveyed.
- In a conservation area established to preserve the existing ecosystem, alteration of the ecosystem towards luxuriant growth is as undesirable as an alteration towards depressed growth.
- The proposed studies and monitoring programmes must be on the parameters of interest, the distribution and abundance of the Park's flora and fauna.
- The need for an increased role of the Department of Conservation and Land Management in the developing of new monitoring protocols.
- No objection to the proposal provided that the work is carried out in accordance with the undertakings given in the PER.
- Need to keep affected organisations advised of the construction programme so that they can advise the public of navigation matters during the construction period

Appendix 1

An Approach to Control Pollution of the Environment

Assimilative Capacity and Beneficial Use as a Guide to Limits to Waste Disposal in Western Australia.

Introduction

The primary functions of the Environmental Protection Authority are environmental impact assessment and pollution control. The Environmental Protection Act was amended in 1986, giving the Environmental Protection Authority substantially increased powers to carry out these tasks. Although these powers provide a formal framework to combat pollution, the Environmental Protection Authority believes that the environment of Western Australia cannot be adequately protected without the co-operation and participation of the whole community. The Environmental Protection Authority believes that its role is not well understood by the general community and that a much better understanding of the philosophy it employs to control pollution of the environment is necessary to foster a more co-operative 'whole-community' approach to environmental protection in Western Australia. With this objective in mind, the following discussion paper outlines the Environmental Protection Authority's approach to waste discharge to the environment of Western Australia.

Waste generation and disposal

Population growth and the constant pursuit of improved living standards result in escalating consumption of material goods. As imports rise and industrial development expands to meet this demand, an ever-increasing amount of industrial and domestic waste is produced. Every piece of food, every article of clothing and every household appliance that is manufactured or imported eventually ends up as domestic waste. The cost involved in disposing of these goods is rarely included in the overall cost of production or consumption. Consequently the producers and consumers, who generate the waste, feel little responsibility for the impacts of its disposal on the environment.

The task of disposing of all this waste has traditionally been left to 'someone else', usually state or local government authorities. To avoid accumulating vast 'mountains' of waste and to minimise costs, these authorities, in the past, used disposal methods that permitted large quantities of waste to be disposed of quickly and cheaply with little consideration for the environmental consequences. Today, in Australia, ocean discharge and landfilling are standard disposal methods for sewage and household rubbish respectively. Similarly, waste gases from industry are routinely discharged to the atmosphere and other industrial wastes are commonly dumped on the land or discharged to the ocean. All of these methods were, and some still are, considered to be cheap and seemingly 'harmless' to the environment, giving rise to "an out of sight, out of mind" philosophy.

Environmental consequences

In Western Australia the full environmental consequences of these methods of waste disposal have only begun to be realised in the last 10 or so years. Toxic substances leaching from rubbish tips over many years have contaminated parts of the Swan River and industrial and domestic wastes were discharged into Cockburn Sound and Princess Royal Harbour, near Albany, for over 20 years before severe environmental problems became obvious. Nutrients from septic tanks and market gardens have leached, via the groundwater, into many local wetlands around Perth resulting in blooms of aquatic plants clogging these lakes. Consequently, the intrinsic, commercial and recreational values of many of these important local water bodies have been significantly reduced.

Past methods of waste disposal are now being questioned and some are clearly unacceptable. For example the controversy over the Sydney sewage outfalls has made many people question the sense in discharging sewage to the ocean, especially if it contains large quantities of toxic industrial waste. Similarly the infilling of wetlands, formerly thought of as 'useless swamps', with domestic rubbish is no longer acceptable to communities that now recognise the value of these areas and the potential that exists for contaminating local groundwater supplies with toxic substances that leach from landfill sites. With the growing desire for a cleaner environment, communities are demanding more environmentally acceptable methods of disposal. Furthermore, with the increasing public acknowledgement of global environmental threats such as the Greenhouse Effect, some of the misconceptions concerning the earth's ability to absorb constant environmental abuse are beginning to crumble. The realisation that the earth has a finite capacity to absorb waste is gradually replacing the popular belief that the atmosphere and, in particular, the oceans are 'bottomless pits'.

Unfortunately the popular perception that waste disposal is someone else's problem is still prevalent. The community expects the standard of living to be improved constantly while also expecting to live in a cleaner environment. Without a significant change in attitude to waste generation and disposal these expectations will inevitably conflict. Until the community accepts responsibility for the waste it generates, no significant improvements in problems associated with waste disposal will be made and the environment will continue to deteriorate.

Solutions to the Problem

The best and most obvious ways to reduce the amount of waste produced are to lower the overall consumption of goods, use resources more efficiently and increase recycling. The alternative is to improve waste treatment and disposal technology, but this approach has several disadvantages. Advanced treatment and disposal will inevitably become more and more expensive and the waste produced by these systems, which is more concentrated and often more toxic, must still be disposed of to the environment. If communities want a clean environment they must make a choice: an increased commitment to more efficient use and recycling of resources or to pay more for waste treatment and disposal with some environmental consequences. Until improved efficiency and increased recycling are widely practised, waste levels will not be reduced significantly and disposal of industrial and domestic waste to the environment will continue to increase.

No matter how environmentally efficient the production, consumption and recycling of goods becomes, some waste will always be generated and must, eventually, be disposed of to the environment. How can this be done so that the environment does not deteriorate? In Western Australia the Environmental Protection Authority has the responsibility for ensuring that all waste material is disposed of in an environmentally acceptable way. To avoid a repetition of past problems and to provide a balance between the conflicting community expectations of a high standard of living and a clean environment, the Environmental Protection Authority is promoting a strategy based on the concepts of **'Assimilative Capacity'** and **'Beneficial Use'**.

Assimilative capacity

The *'assimilative capacity'* is defined as **the capacity of the receiving environment to absorb waste without causing long-term damage.** This concept is based on the proposition that all natural systems in the ocean, in the air or on land, have some capacity to disperse, breakdown and absorb waste materials. This capacity, however, is limited. The discharge of wastes, therefore, is not necessarily detrimental to the environment and only becomes harmful when the type and amount of wastes discharged can not be absorbed or broken down (ie assimilated). These wastes then begin to accumulate and, eventually, have deleterious effects on the receiving environment.

An example of the *assimilative capacity* of a biological system being exceeded with serious consequences is Cockburn Sound, just south of Fremantle. For many years less than 1000 kg per day of nitrogen (a plant nutrient) was discharged into Cockburn Sound and was assimilated without any serious effects. However, when nitrogen loads increased to about 2000 kg per day serious problems developed almost immediately (ie the *assimilative capacity* was exceeded). The increased nutrient availability caused excessive growth of marine plants that grew on the leaves of the seagrasses. As a result, almost 90% of the seagrass communities in Cockburn Sound were eventually lost due to shading and smothering by these plants and many of the dependent animal communities were seriously affected. Today the waters in Cockburn Sound are still cloudy and the remaining naturally occurring plant communities are in a poor state, a far cry from the clear waters and luxuriant seagrass meadows of yesteryear.

The *assimilative capacity* of different 'environments', for example a freshwater lake or air over a city, will vary according to the types and amounts of wastes being discharged, the types and responses of the biological communities present and the physical dimensions and characteristics of the 'environment' in question. The *assimilative capacity* can, therefore, be considered as a finite though renewable resource to be used like any other resource. Thus the maximum allowable level of waste discharged into a particular environment will be determined by knowing its *assimilative capacity*. Obviously this requires an understanding of the functioning of the environmental systems in question. While the *'assimilative capacity'* provides an upper limit to permissible levels of waste discharge, the Environmental Protection Authority believes that any unnecessary 'consumption' of the *assimilative capacity* is undesirable and that 'polluters' would be expected to use 'all reasonable and practicable means' to minimise waste discharge to the environment.

Who pays?

The Environmental Protection Authority considers that the responsibility for determining the *assimilative capacity* of a particular biological system lies with the users; that is a **"user pays"** approach. Who are the **users**? The answer depends on the type of waste being discharged. For example, in the case of a sewage discharge to the ocean, the user is the general community who produce the sewage in the first place. In the case of an industrial discharge, the user is the industry. Should the industry that produces a product be responsible for the wastes generated during production as well as for its disposal after use? Or, alternatively should the consumer bear the total cost of disposing of the waste generated in production and consumption since the producer would not exist if there was no consumer demand? How is this responsibility shared equitably among

users? The Environmental Protection Authority considers that whenever an impact occurs on the environment a user can be identified. For example if, in the manufacture of a consumer product, the industry generates waste that is discharged to the environment, it is a user. When the product is eventually disposed of by the consumer, the consumer, in turn, becomes a user.

The Environmental Protection Authority believes each user's share in the cost of determining the *assimilative capacity* of the receiving environment should be directly proportional to the percentage of the *assimilative capacity* consumed. Where it can be demonstrated that a single user is likely to consume a large percentage of, or even possibly exceed, the *assimilative capacity*, then a case can be made for that user to determine the *assimilative capacity* before the environmental acceptability of the proposal is considered. For example if the ocean is used as a dumping ground for domestic sewage then the user is the community. The community should then bear the cost of determining the *assimilative capacity* and for treating the sewage to a level that ensures the *assimilative capacity* of the receiving environment is not exceeded. In the case when many users each consume only a small proportion of the *assimilative capacity* then, again, the responsibility can be shared on a *pro rata* basis.

In the special case where areas that were, historically, used for industrial purposes becoming enclosed by urban development, and where the receiving environment changes from having a lower to a higher conservation value as a result of increased recreational usage or changing community attitudes, a co-operative approach between all users is appropriate. This approach would involve community (through local authorities) and industrial users collaborating with the Environmental Protection Authority to determine, retrospectively, the assimilative capacity of the receiving environment. This approach would only be employed to redress past mistakes and to arrest further deterioration in an already degraded receiving environment. Examples of this type are the Albany Harbours and Cockburn Sound.

The *assimilative capacity* is concerned with the long-term effects of pollution at an ecosystem level. Different types of pollutants affect the ecological viability of biological systems in many ways and to varying degrees. Some threaten the whole ecosystem with 'collapse' ('system threatening' pollutants) while the effects of others are confined to contamination of the local receiving environment ('subsystem threatening' pollutants). For example nutrient enrichment of waters or *eutrophication* has resulted in serious deterioration of the biological communities in the Albany Harbours, whereas heavy metal contamination of fish in Princess Royal Harbour led to the closure of the western end of the harbour to fishing but is not considered to have contributed significantly to the decline of the seagrass meadows. Although 'subsystem threatening' pollutants do not, by definition, threaten the whole ecosystem individually, the cumulative effect of these types of pollutants can threaten the ecosystem if total loads exceed certain levels. In Western Australia however, this has rarely been the case. For example, Cockburn Sound, Peel-Harvey Estuary and the Albany Harbours have all been badly affected by pollution and, in all cases, the ecosystem deterioration was caused by one type of pollutant (ie nutrients) rather than by a 'cocktail' of pollutants.

Once the criteria that constitute significant undesirable change to an ecosystem are determined, the *assimilative capacity* for each 'system threatening' pollutant in pristine biological systems can be determined and has an 'absolute' value. Thus the *assimilative capacity* provides an upper limit to the discharge of these types of pollutants and ensures that the ecosystem remains intact. How then do we limit the discharge of 'subsystem threatening' pollutants to acceptable levels? This can be achieved by employing the concept of **'Beneficial Use'**.

Beneficial use

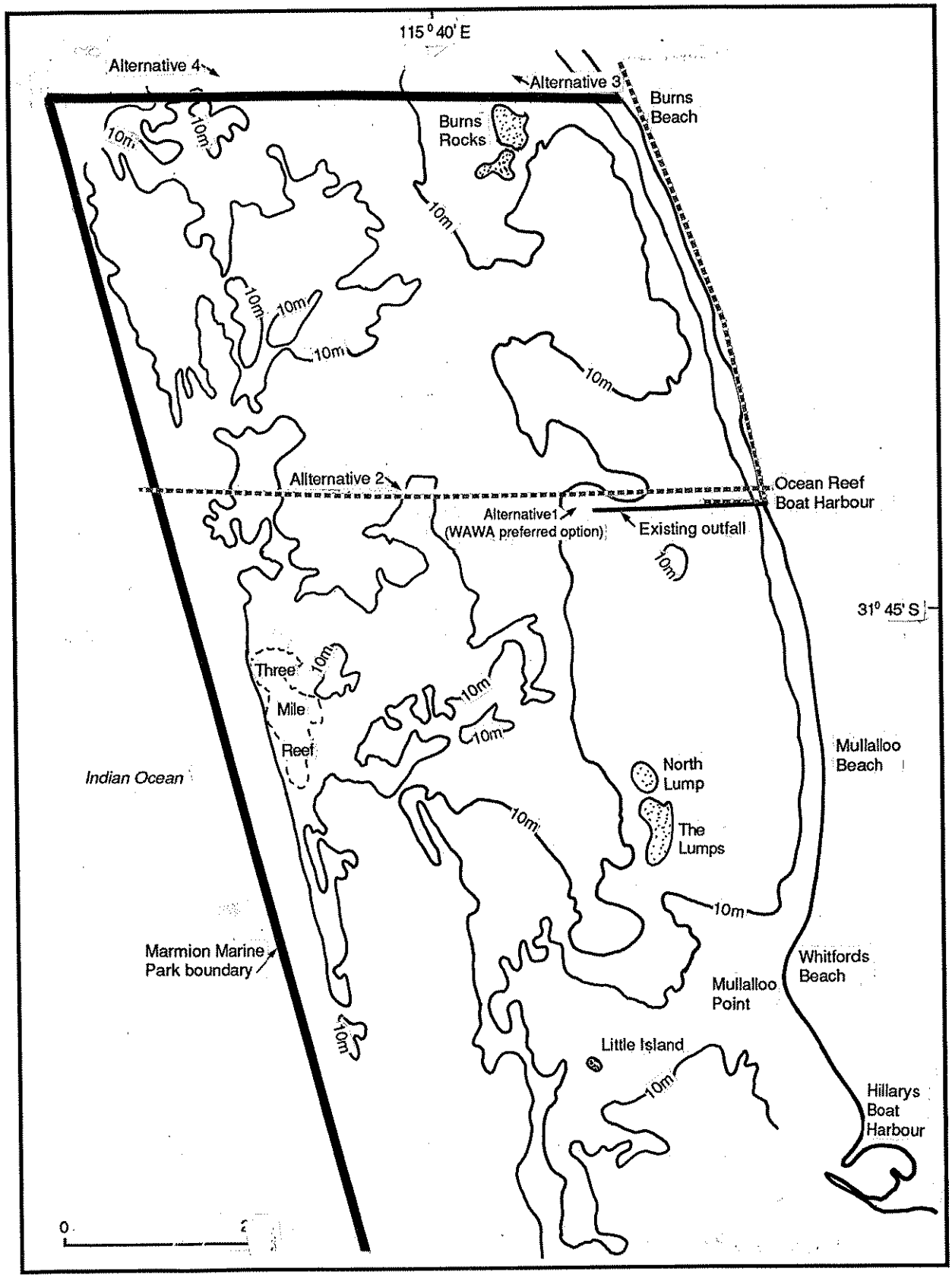
A *'beneficial use'* of the environment is defined as **a designated use of a specified part of the environment for the overall benefit of the community**. For example a particular part of Cockburn Sound might be designated for direct contact recreation such as swimming or wind-surfing. The *beneficial use* of another area might be for industrial purposes. *Beneficial uses* can also be applied as a planning tool to partition use and minimise conflict when proposed uses of the receiving environment are incompatible. For example the discharge of an abattoir effluent into a body of water precludes direct contact recreation such as swimming. Each *beneficial use* has a unique set of environmental quality criteria that must be adhered to. For example the water quality criteria for direct contact recreation specifies a very low level of faecal bacteria contamination for human health reasons. That same level would be unnecessary if the waters were for industrial purposes only. Similarly the permissible level of sulphur dioxide in the air over an industrial estate would be much higher than the levels allowable over urban areas.

Thus *beneficial use* is concerned mainly with maintaining a designated environmental quality at a sub-ecosystem level. In contrast to *assimilative capacity* which has an 'absolute' value, *beneficial use* of a particular area of the environment has a 'relative' value and it depends on the perceived most appropriate use for that part of the environment at

that point in time. *Assimilative capacity* and *beneficial use* are synonymous, however, where the conservation of an ecosystem is a criterion for designating *beneficial use.*

Summary

The Environmental Protection Authority considers that more efficient use and increased recycling of available resources should be the primary strategy to reduce the problems associated with waste disposal. More advanced waste treatment and disposal should only be employed as a secondary strategy to minimise pollution. Until more efficient use and recycling of resources are in widespread use, unnecessarily large quantities of industrial and domestic wastes will continue to be discharged to the environment in the foreseeable future. The Environmental Protection Authority considers that the disposal of waste *per se* does not have to lead to long-term deterioration of the environment. By embracing the twin concepts of **Assimilative Capacity** and **Beneficial Use**, as outlined above, to control the discharge of waste to the environment, the Environmental Protection Authority considers that sustainable economic development and a high quality of living **are** compatible with maintaining a clean environment in Western Australia. To achieve this goal the community must accept full responsibility for the waste it generates, and be prepared to accept the economic and social costs of disposing of this waste in a manner that ensures the long-term protection of Western Australia's unique natural environment.


115° 40' E
Alternative 4
Alternative 3
Burns Beach
Burns Rocks
10m
Allternative 2
Alternative1 (WAWA preferred option)
Existing outfall
Ocean Reef Boat Harbour
31° 45' S
Three Mile Reef
Indian Ocean
North Lump
The Lumps
Mullaloo Beach
Marmion Marine Park boundary
Whitfords Beach
Mullaloo Point
Little Island
Hillarys Boat Harbour
0