EIS 392

AB019079

Tomaree Sewerage Scheme : environmental impact statement

HUNTER DISTRICT WATER BOARD

TOMAREE SEWERAGE SCHEME

ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 1987

Prepared by: Sinclair Knight & Partners Pty Ltd

For: Public Works Department NSW

On Behalf Of: Port Stephens Shire Council and Hunter District Water Board

L87-792

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Report No. HSP 8725

HUNTER DISTRICT WATER BOARD

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ENVIRONMENTAL IMPACT STATEMENT

This is to certify that this Environmental Impact Statement has been prepared in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

R D CROOKS

Manager - Environmental Services
Sinclair Knight & Partners Pty Ltd

November 1987

SCHEDULE TO CLAUSE 57 MATTERS
(Environmental Planning and Assessment Regulation, 1980)

The matters required by Clause 57 (2) of the Environmental Planning and Assessment regulation, 1980 to be included in the EIS are addressed, inter alia, in the following sections of this EIS.

	MATTER	SECTION
a)	A full description of the proposed activity.	Chapter 5
b)	A statement of the objectives of the proposed activity.	2.2
c)	A full description of the existing environment likely to be affected by the proposed activity if carried out.	Chapter 3 Sections 5.5,7.3 8.2, 8.3, 8.4
d)	Identification and analysis of the likely environmental interactions between the proposed activity and the environment.	Chapters 6,7,8
e)	Analysis of the likely environmental impacts or consequences of carrying out the proposed activity (including implications for use and conservation of energy).	Chapters 6,7,8 and Sections 1.9, 5.6
f)	Justification of the proposed activity in terms of environmental, economic and social considerations.	Sections 1.9, 2.3, 4.2, 5.6, 7.2, 7.3, 8.2, 8.4
g)	Measures to be taken in conjunction with the proposed activity to protect the environment and an assessment of the likely effectiveness of those measures.	Chapters 6,7,8
g1)	Details of energy requirements of the proposed development and measures to be taken to conserve energy.	5.6
h)	Any feasible alternatives to the carrying out of the proposed activity and the reasons for choosing the latter.	Chapter 4
i)	Consequences of not carrying out the proposed activity.	4.5.6

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Exhibits

Abbreviations

ADWF	Average Dry Weather Flow
AHD	Australian Height Datum
DEP	Department of Environmental & Planning
BOD	Biochemical Oxygen Demand
dB(A)	Decibel (A weighted)
EIS	Environmental Impact Statement
E.P.	Equivalent person - basic measurement unit for sewage loadings
EPA Act	Environmental Planning and Assessment Act 1979
HDWB	Hunter District Water Board
IDO	Interim Development Order
kL	kilolitre
km	kilometres
L	Litre
LEP	Local Environmental Plan
m	metres
mg/L	milligrams per litre
N	Nitrogen
NPWS	National Parks and Wildlife Service
org/mL	organisms per millilitre
P	Phosphorus
pa	per annum
ppt	parts per thousand
PSSC	Port Stephens Shire Council
PWD	Public Works Department NSW
PWWF	Peak Wet Weather Flow
SEPP	State Environmental Planning Policy
SPCC	State Pollution Control Commission
S.T.W.	Sewage Treatment Works
ug/L	micrograms per litre
%	percentage

1 Summary

1.1 INTRODUCTION

This Environmental Impact Statement (EIS) addresses the proposed Tomaree Sewerage Scheme, being part of the Hunter Sewerage Project. The Hunter Sewerage Project is a joint undertaking by the State Government, the Hunter District Water Board and local Councils, aimed at substantially reducing the sewerage backlog in the Hunter Region over about ten years. As part of this project, high priority has been given to providing adequate sewerage services on the Tomaree and Tilligerry Peninsulas, within Port Stephens Shire.

The authorities involved in the Tomaree Sewerage Scheme are:

- Hunter District Water Board (HDWB) - the Nominated Determining Authority for the scheme and the authority responsible for water and sewerage services for the Tomaree Area;
- Public Works Department (PWD) - as constructing authority; and,
- Port Stephens Shire Council (PSSC) - controlling local government authority in which the proposed scheme is located.

Preparation and public exhibition of the EIS is part of the overall environmental assessment process set out under the Environmental Planning and Assessment Act 1979 (as amended). The process requires that the EIS is advertised and placed on public display and that submissions from the public are called for. Under Section 110A of the Environmental Planning and Assessment Act, the Hunter District Water Board has been nominated as the Nominated Determining Authority. A decision whether to implement the scheme will be made following exhibition of the EIS and consideration of all submissions.

The following sets out a summary of the EIS.

1.2 NEED FOR THE PROPOSAL

The popularity of the Study Area for residential development and as a holiday destination has resulted in significant population growth. This growth has been predicted to continue with ultimate permanent population figures estimated at 48 800 and peak tourist population at approximately 94 000. Such increases in population will result in increases in sewage loadings in the Study Area. Existing sewerage facilities are now operating at capacity and cannot accommodate increased sewage loadings. This, together with the potential problems associated with septic tank systems (eg potential to be poorly managed, thus contributing to pollution of groundwaters, watercourses and wetlands), has resulted in a need to develop a sewerage scheme for the study area which will protect public health, the natural environment and scenic qualities in the area.

1.3 THE PROPOSED SCHEME

A sewerage strategy concept report has been prepared by the PWD for the Tomaree area. This study developed and investigated various sewerage scheme options. The development of these options revolved around the disposal of effluent via a combination of the disposal methods determined as being appropriate for the study area in terms of protecting public health, meeting relevant State Pollution Control Commission requirements, and protecting the natural environment and the scenic quality of the area. The proposed disposal methods include land disposal via infiltration ponds at a site south of Tanilba Bay and disposal via an ocean outfall. The two possible locations suggested for ocean outfalls were Anna Bay (Birubi Point) and Boulder Bay. Eight sewerage strategy options were developed, five of which were short listed for more detailed assessment on both economic and environmental planning grounds. A summary of the assessment of short listed options is provided in Table 1.1 and depicted in Exhibit 1.1.

The estimated cost advantage of Option 2B, combined with the other advantages listed in Table 1.1 were considered to outweigh its comparatively limited disadvantages. Option 2B was therefore recommended as the preferred scheme.

The preferred scheme, depicted in Exhibit 1.2 involves:

. sewerage reticulation for the areas on both Tilligerry and Tomaree Peninsulas;

. collection of sewage from reticulated areas on the Tilligerry Peninsula for secondary treatment and disposal of effluent via infiltration ponds on a site south of Tanilba Bay;

. collection of sewage from the existing and proposed reticulated areas on Tomaree Peninsula and transport to a milliscreening plant at Boulder Bay replacing an existing shoreline outfall presently discharging effluent to ocean waters. Disposal of effluent following milliscreening will be via an extended deep water ocean outfall.

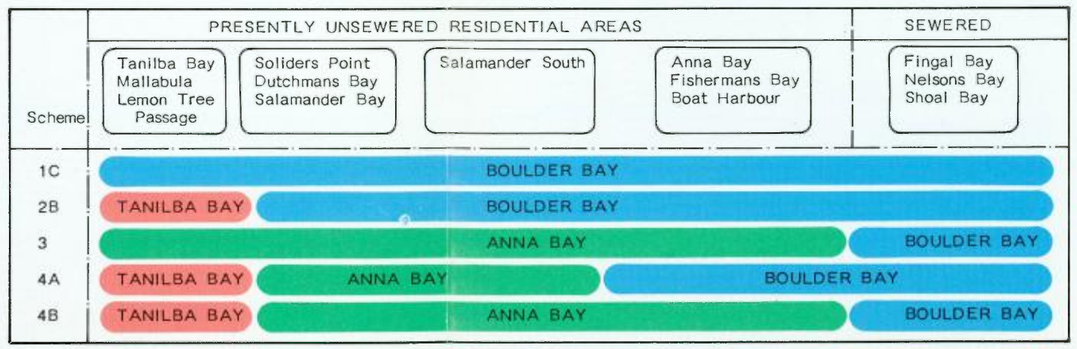
Assessment of the potential impacts and discussion of possible safeguards for the preferred scheme were separated into those impacts associated with:

- reticulation
- transport treatment and disposal on Tilligerry Peninsula, and
- transport treatment and disposal on Tomaree Peninsula.

TABLE 1.1 COMPARISON OF CANDIDATE SCHEMES

Scheme No	Scheme (Option) Description	Costs $m Financial			Present Worth Analysis (Includes Operation Cost) Total Present Worth Cost			Advantages of Scheme	Disadvantages of Scheme	Ratings
		Initial Capital Costs	Future Capital Costs	Ultimate Capital Costs	5%	10%	15%			
1C	Sewage from all townships to be transported to Boulder Bay for treatment and disposal to coastal waters.	18.1	2.7	20.8	35.5	25.6	22.7	. a single treatment plant would simplify operations and maintenance . less land is required	. Submarine crossing of Tilligerry Creek may be perceived as undesirable due to remote possibility of pipe breakage . more expensive than scheme 2B for no additional environmental benefit	2
2B	Sewage from Tanilba Bay, Mallabula and Lemon Tree Passage to be treated locally with land disposal of effluent. Sewage from all remaining areas to be transported to Boulder Bay for treatment and disposal to coastal waters.	17.2	3.7	20.9	32.7	23.9	21.2	. lowest initial capital cost . no submarine crossing of Tilligerry Creek is required thus eliminating the remote possibility of raw sewage leaking to the Creek from a break in the pipeline . increased flexibility. Either Tomaree or Tilligerry peninsulas could be separately advanced for sewering . the most economic scheme	. more land is required for this than 1C . location of a treatment plant at Tanilba Bay could impose limitations on possible future land use around it	1
3	Sewage from the existing sewered townships of Nelson Bay, Shoal Bay and Fingal Bay will continue to be transported to Boulder Bay for treatment and disposal. Sewage from all remaining areas to be transported to Birubi Point for treatment and disposal to coastal waters.	19.1	4.1	23.2	36.3	29.0	23.8	. no advantages over scheme 2B except no limitations imposed on possible future land use around Tanilba Bay treatment plant site	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . more expensive than scheme 2B for no additional benefit . submarine crossing of Tilligerry Creek may be perceived as undesirable due to remote possibility of pipe breakage	5
4A	Sewage from Tanilba Bay, Mallabula and Lemon Tree Passage to be treated locally with land disposal of effluent. Sewage from Anna Bay, Boat Harbour and Salamander south also to be treated locally with effluent disposal to coastal waters of Birubi Point. Sewage from remaining areas to be transported to Boulder Bay for treatment with coastal waters discharge.	22.3	6.7	29.0	37.0	30.1	26.2	. no submarine crossing of Tilligerry Creek is required thus eliminating the remote possibility of raw sewage leaking to the creek from a break in the pipeline . increased flexibility. Either Tomaree or Tilligerry peninsulas could be separately advanced for sewering	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . three treatment work sites are required, increasing complexity and land needs . more expensive than scheme 2B for no additional benefit	4
4B	Option 4B is similar to Option 3 except for local treatment and disposal of sewage from Tanilba Bay, Mallabula and Lemon Tree Passage.	17.8	4.8	22.6	31.4	25.4	21.6	. no advantages over scheme 2B	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . location of a treatment plant at Tanilba Bay could impose limitations on possible future land use around it . more land is required than Scheme 1C	3

SUMMARY OF EFFLUENT DISPOSAL LOCATIONS FOR EACH SCHEME



The environmental impact is summarised in Sections 1.6, 1.7 and 1.8.

1.4 OBJECTIVES OF THE PROPOSAL

The objectives of the proposed scheme are to enhance the environment of Tomaree and Tilligerry Peninsulas by overcoming problems associated with the existing lack of adequate sewerage facilities while providing for anticipated future population growth. Particular problems to be addressed are:

- septic tanks systems have potential to leak, can be poorly managed and emptied infrequently and can contribute to pollution of groundwaters, watercourses and wetlands;

- a potential conflict arising due to the discharge of increasing quantities of effluent into Port Stephens and the need to maintain recreational, ecological and commercial values in the waterway;

- the aesthetic problems associated with the present shoreline discharge of raw sewage into Boulder Bay; and,

- the limited capacity of existing treatment works at Salamander Bay and Anna Bay.

1.5 THE EXISTING ENVIRONMENT

Located on southern foreshores of Port Stephens the Study Area, comprising Tomaree and Tilligerry Peninsulas, is bisected by Tilligerry Creek a tidal estuary. The area is characterised by spectacular isolated rocky peaks lined by generally deep and extensive sand deposits along with urban areas concentrated along the shorelines of Port Stephens, Fingal Bay, Boat Harbour, Anna Bay and Tilligerry Peninsula. Areas within the sand deposits are of interest due to current and possible future heavy mineral and silica sand mining.

The low lying nature of much of the study area has resulted in the development of significant areas of estuarine and freshwater wetlands, many of which are listed as significant under State Environmental Planning Policy 14.

The Peninsula supports a diverse vegetation that is typical of that found on quaternary sand deposits along the NSW coast. The majority of these areas of vegetation are contained within the extensive HDWB Water Catchment Area on the eastern end of Tomaree Peninsula and within Tomaree National Park along the rocky ocean coast of the Tomaree Peninsula. Of the species affected by the proposed scheme, none are considered rare or endangered on a statewide basis and indeed they are common and widespread.

The marine environment potentially affected by the proposal comprises the coastal waters particularly in the vicinity of Boulder Bay (where an existing shoreline outfall presently discharges raw sewage) and the waters within Port Stephens. Treated and raw comminuted sewage is presently discharged into Port Stephens at three locations within the study area. Maintaining good water quality within the waterways of Port Stephens is important to protect both its recreational amenity and its important oyster industry. Oyster producing areas are located westward from Corlette Point.

The major land uses within the area comprise:

- HDWB Water Catchment Area
- Tomaree National Park
- urban development along the foreshores of Port Stephens, and
- vacant Crown land.

1.6 IMPACT ASSESSMENT AND ENVIRONMENTAL SAFEGUARDS : RETICULATION

The principal adverse impacts of the reticulation scheme in any area will be associated with construction. Impacts could include temporary disturbance to roads, road shoulders, footpaths during pipe laying and construction noise. Proposed restoration and noise control measures will ensure that impacts associated with construction of the reticulation schemes will be minimal.

With operation of the scheme potential for overflows would only occur during malfunctions or extended power failures. Overflows will be designed to satisfy State Pollution Control Commission requirements. They are a necessary feature of a sewerage system and are provided to minimise impacts on persons, property and the environment.

1.7 IMPACT ASSESSMENT AND ENVIRONMENT SAFEGUARDS : TILLIGERRY PENINSULA

The major potential impacts and proposed safeguards for the Tilligerry Peninsula component of the overall scheme are outlined below:

Transport System

The proposed rising mains transporting sewage from the urban areas on Tilligerry Peninsula will be located within the easements of Lemon Tree Passage Road and the proposed access road into the Treatment Plant site. There will be no significant adverse impact.

Treatment

The major potential impacts from the proposed secondary treatment plant on the Tanilba Bay site relate to the visual impact of the plant and effects of clearing on the ecology of the area. Approximately eight hectares of the 12 hectare site will require clearing for the construction of the treatment plant and infiltration ponds. The preliminary layout of the plant has been designed to minimise impact on the significant vegetation communities including the open forest along the southern boundary of the site and the open scrub/heath communities. The majority of these communities will be retained in the proposed visual vegetation buffer surrounding the site. This vegetation buffer will provide sufficient screening of the site from areas readily accessible to the public on Tilligerry Peninsula. The proposed treatment works plant will not create any constraints on existing or anticipated future uses of surrounding land.

Disposal

The proposed method of disposal of effluent on Tilligerry Peninsula is via infiltration ponds. The effluent will seep down to the groundwater which flows to Tilligerry Creek. Concerns primarily related to the potential to effect the existing water quality of the Creek particularly in relation to salinity changes, increases in bacterial and viral concentrations and increases in nutrients levels.

Detailed investigations established that pathogenic organisms in the sewage (i.e. bacteria and viruses) will be removed through the secondary treatment process and in the infiltration process. Bacterial and viral concentrations will be reduced to a level which will not pose a health risk within 50 metres of the infiltration ponds and no adverse impacts will be registered in Tilligerry Creek.

The predicted changes in salinity levels within Tilligerry Creek (0.2 parts per thousand) are not significant and will not pose a problem to the oyster industry. Based on the levels of nitrogen and phosphorus predicted to discharge to the Creek from the infiltration ponds and the tidal flushing characteristics of the Tilligerry Creek, nutrient levels will increase over long periods to an equilibrium level. Maximum increases above background nutrient levels predicted were estimated at 67 micrograms per litre for nitrogen and 34 micrograms per litre for phosphorus. Such increases are not anticipated to cause eutrophication problems within Tilligerry Creek, although monitoring of possible localised effects may be necessary to validate the modelling results.

1.8 IMPACT ASSESSMENT AND ENVIRONMENTAL SAFEGUARDS : TOMAREE PENINSULA

The major potential impacts associated with the Tomaree Peninsula component of the overall scheme primarily relate to the transport system, the proposed extended deep water outfall and the effects on Tomaree National Park. Potential impacts associated with the proposed milliscreening plant are considered minor.

Transport System

The majority of the proposed transport pipeline will be laid within existing road easements and unsealed tracks. The route has been located to avoid significant wetland areas on the Tomaree Peninsula, particularly those covered by State Environmental Planning Policy 14. Consequently the major potential impacts associated with the pipeline are restricted to a section (less than two kilometres) through uncleared bushland within the Hunter District Water Board Water Catchment Area and approximately 400 metres through Tomaree National Park in the vicinity of Boulder Bay. Potential impacts along this section relate to possible ecological effects of clearing a three to four metre wide easement and potential erosion problems, associated with opening up additional tracks for authorised use by off-road vehicles.

No significant or endangered vegetation or fauna will be effected by the proposed pipeline easement, and the cleared three to four metre wide easement and proposed maintenance track through the HDWB area will not significantly restrict existing faunal movement patterns. The section of the pipeline through the Tomaree National Park will be revegetated upon construction of the pipeline and no long term detrimental effects are anticipated.

It is proposed to provide a fence and/or gates to restrict vehicle access along the proposed pipeline maintenance track to authorised vehicles only. Protection measures will be undertaken to reduce the potential for erosion.

Extended Ocean Outfall at Boulder Bay

The existing shoreline outfall discharging raw sewage at Boulder Bay will be replaced by an extended outfall discharging approximately 560 metres offshore at a depth of 12.5 metres. Impacts associated with the construction of the outfall are not considered to be significant, particularly as Boulder Bay is over one kilometre from the nearest residence. Investigations of the marine ecology of Boulder Bay over a twelve year period indicates that re-establishment of the marine communities affected by the construction of the outfall will be rapid.

To ensure that water quality, ecological and public health impacts are controlled, the outfall has been designed to meet all SPCC requirements for the ocean outfalls as defined in Environmental Guide WP1 (refer Appendix D) which are:

- the maintenance of ocean waters visually free of oil grease and other floatable material

- the protection of beaches in the interests of public health and to maintain a high degree of aesthetic satisfaction

- the protection of ocean waters to retain a natural and diverse but not necessarily unchanged variety of marine life.

The location and design of the outfall plus provision of an equalisation tank within the treatment plant will provide dilution factors sufficient to ensure the effluent discharged will not affect the amenity of Boulder Bay or the nearshore environment.

Faecal coliform concentrations expected to occur as a result of the proposed outfall were calculated by computer modelling for both Fingal Beach and One Mile Beach (refer Table 1.2). Predicted coliform concentrations were well below the standards set by the SPCC for the protection of beaches in the interests of public health and to maintain a high degree of aesthetic satisfaction.

TABLE 1.2 - FAECAL COLIFORM PREDICTIONS WITH PROPOSED OUTFALL OPERATION

Percentile	Fingal Beach organisms/100 ml		One Mile Beach organisms/100 ml		SPCC Standards organisms/100 ml
	Existing	Predicted	Existing	Predicted	
50% (Geometric Mean)	14	14	0	0	200
90%	86	130	2	50	400

Results from a 12 year program monitoring the effects of the existing raw sewage outfall have indicated no detrimental effects on the marine environment within and adjacent to Boulder Bay.

Based on these investigations, the ultimate effluent discharge volumes anticipated for the outfall will meet SPCC requirements.

Potential Effects on Tomaree National Park

Under the preferred scheme, the final section (approximately 400 metres) of the pipeline to Boulder Bay would pass through Tomaree National Park. Both the potential impacts of a pipeline crossing the National Park and the relationship or "nexus" between the proposed sewerage scheme and the purposes or objectives of the National Park were considered.

Impacts would be short term as the section of the pipeline through the Park will be revegetated. During construction the route would be temporarily fenced to restrict disturbances to within the easement. To prevent access to the pipeline route a gate and/or fence will be constructed. The gate could also provide an opportunity to restrict public access to existing four-wheel drive tracks if the National Parks and Wildlife Service (NPWS) so required.

The proposed sewerage scheme, of which the length of pipeline through the National Park is an integral part, will enhance both the conservation and recreation objectives of the Park in several ways including:

- the provision of a continuity of foreshore vegetation communities between the two separate parts of the Park through the rehabilitation of the HDWB site at Boulder Bay;
- improvement of the visual amenity of the Boulder Bay area and its surrounds through construction of the extended outfall and Boulder Bay treatment plant;
- an opportunity for further control of vehicle access to the National Park with construction of the proposed development;
- the control of the aggressive weed, Bitou bush within the Boulder Bay area; and
- elimination of odours from the Boulder Bay area.

1.9 BENEFITS OF THE PROPOSED SEWERAGE SCHEME

The proposed sewerage scheme meets both the environmental and economic objectives required of the sewerage scheme while enhancing the environment of the Study Area. The major benefits of the preferred scheme include:

- removal of the need for septic tank systems and the associated potential problems these systems possess;
- the cessation of current sewage effluent discharges to Port Stephens thereby removing potential threats to the oyster industry and recreational amenity of the waterway;
- improvement of the amenity of Boulder Bay by removing the shoreline discharge of effluent;
- rationalisation of the existing six reticulated sewerage schemes thus enhancing control over sewage treatment and disposal;

- allowance for future development within the Study Area; and
- provision of methods for effluent disposal which have less impact on the environment than at present.

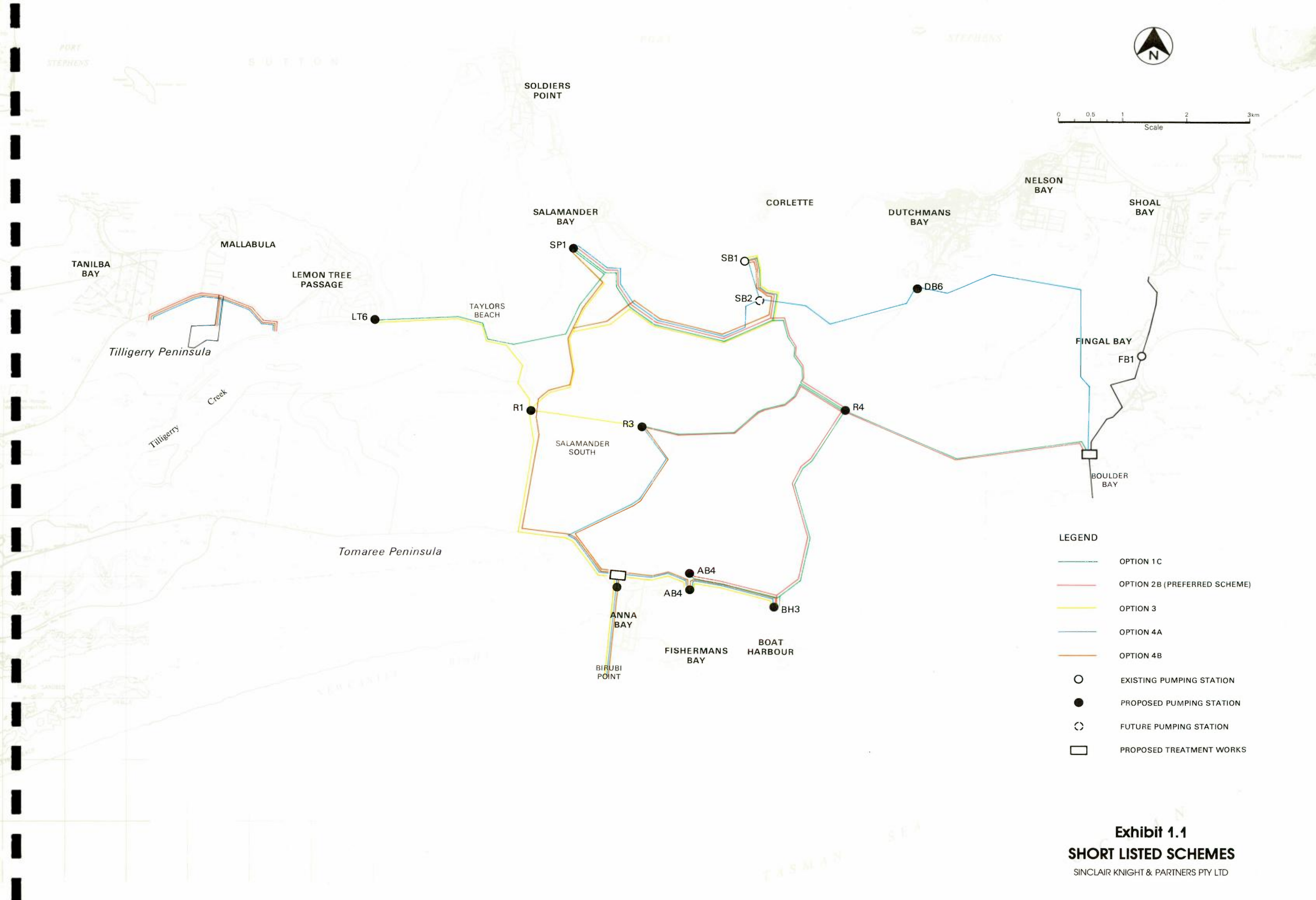


Exhibit 1.1
SHORT LISTED SCHEMES
SINCLAIR KNIGHT & PARTNERS PTY LTD

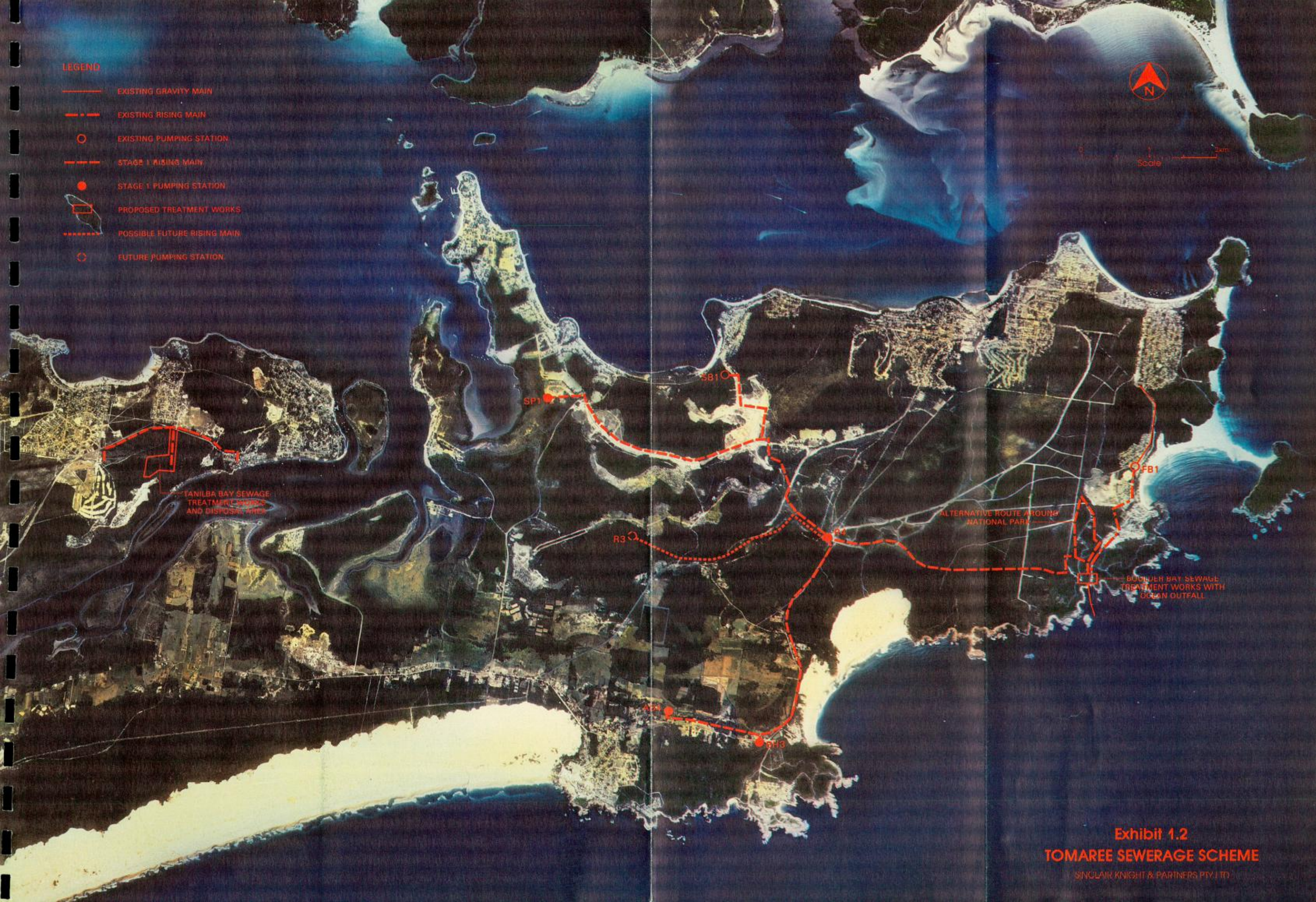


Exhibit 1.2

TOMAREE SEWERAGE SCHEME

SINCLAIR KNIGHT & PARTNERS PTY LTD

2. Introduction

2.1 THE STUDY AREA

This Environmental Impact Statement addresses the proposed Tomaree Sewerage Scheme, covering a study area located on the southern shores of Port Stephens, 30 kilometres north east of Newcastle. The study area incorporates a major portion of the Port Stephens Shire (refer Exhibit 2.1).

The study area encompasses both the Tomaree and Tilligerry Peninsulas and comprises the following urban areas (refer Exhibit 2.2).

- Shoal Bay
- Nelsons Bay
- Dutchmans Bay
- Corlette
- Salamander Bay
- Soldiers Point
- Anna Bay
- Boat Harbour
- Fingal Bay
- Lemon Tree Passage
- Mallabula
- Tanilba Bay

Tilligerry Creek, which drains into Port Stephens, separates the two peninsulas. For the purpose of this report the study area is collectively referred to as the Tomaree area.

2.2 OBJECTIVES OF THE PROPOSAL

The Tomaree Sewerage Scheme, forming part of the Hunter Sewerage Project, is a joint undertaking by the Public Works Department, the Hunter District Water Board and Port Stephens Shire Council, aimed at augmenting sewerage facilities within the study area over about the next ten years.

Most of the existing urban development on the Tomaree area rely on septic tanks with on-site effluent disposal or pump-out services, with existing community sewerage schemes servicing approximately 25 percent of the population.

The existing situation creates the following problems:

- septic tank systems have potential to leak, can be poorly managed and emptied infrequently, can contribute to pollution of groundwaters, watercourses and wetlands;

- a potential conflict due to the discharge of increasing quantities of effluent into Port Stephens and the need to maintain recreational, ecological and commercial values in the waterway;

- aesthetic problems associated with the shoreline discharge of sewage into Boulder Bay;

- existing treatment works at Salamander Bay and Anna Bay are of limited capacity.

The objectives of the proposed scheme (refer Exhibit 2.3) are to substantially enhance the environment by overcoming these existing problems and ensuring that any future population growth in the study area will not have an adverse environmental impact due to the inadequacy of the sewerage system.

2.3 THE NEED FOR THE PROPOSAL

The Port Stephens area, and in particular the southern shores of Port Stephens which are included in the study area, has experienced some of the highest population growth rates (approximately 5.0%) in New South Wales, without a concurrent growth in community services. Consequently the study area constitutes one of the largest areas of urban development within New South Wales which does not have full access to a community sewerage scheme.

The existing sanitary services for the area include six sewerage schemes servicing very small areas. Three of these dispose effluent of varying quality into Port Stephens, one to the ocean via a shoreline outfall at Boulder Bay, with the remaining two disposing of effluent via infiltration or irrigation. The majority of the Tomaree area relies on septic tanks with on-site disposal or pump out systems. Details of the above schemes are provided in Section 3.15.

Predicted population growth rates for the study area range between 1.7% and 3.8% per annum, depending on methodology adopted (refer Section 4.2.3). The existing sewerage facilities are now operating at capacity loading and could not accommodate increased sewage loadings associated with the anticipated population growth without adverse effects on the environment.

To ensure that public health, the natural environment and scenic qualities of the study area are protected the Public Works Department in conjunction with the Hunter District Water Board and Port Stephens Shire Council has placed a high priority on developing a sewerage scheme for the Tomaree area.

2.4 ENVIRONMENTAL ASSESSMENT PROCEDURES UNDER THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT (1979)

Under the Environmental Planning and Assessment Act 1979, State Environmental Planning Policies (SEPP) can be formulated for matters of State wide significance or to deal with issues where State wide application of policy is necessary.

Under an amendment, dated 7 October 1983, to "State Environmental Planning Policy No 4 - Development without Consent", sewage treatment works are not subject to consent procedures, through the submission of a development application. In addition, under Clause 44 of Interim Development Order No. 23 of Port Stephens Shire Council, development consent is not required for the proposed sewerage transport pipelines as they will be below the surface of the ground. In such instances, (where local planning consent is not required), the determining authority is required under Section 111 of the Environmental Planning and Assessment Act to take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. Further, under Section 112, if the authority considers that the activity is likely to significantly affect the environment, (by consideration of factors listed in Clause 56 of the Regulation of the Environmental Planning and Assessment Act), then a decision to proceed with the development shall not be made until an EIS has been prepared and publicly examined.

Following preliminary studies, including the preparation of a Concept Report (Reference 23) investigating the development of a sewerage scheme for the Tomaree Peninsula, the PWD in association with HDWB and Port Stephens Shire Council determined that such a development would have the potential to significantly affect the environment. As a consequence, and in accordance with Section 112 it was resolved to prepare this EIS.

In respect of Section 110A of the Act, the Hunter District Water Board, (HDWB), is the nominated determining authority. The HDWB will make a determination after consideration of submissions received in response to public exhibition of this EIS. This determination will be made after consultation with the PWD and Port Stephens Shire Council.

The EIS has been prepared in accordance with Clause 57 of the Regulation and the Director of the Department of Environment and Planning's requirements pursuant to Clause 58. The Director's requirements are included under Appendix A.

Following the decision to prepare the EIS, formal consultation was carried out with relevant government authorities and interested organizations. A summary of the responses is given under Appendix B.

Submissions will be invited and are to be submitted within the exhibition period. The assessment and determination procedures under Section 113 of the Act will then be followed.

Following exhibition and receipt of submissions the HDWB will prepare and publish a report pursuant to clause 64 of the Environmental Planning and Assessment Regulation, outlining its examination and consideration of the EIS and of any submissions received.

2.5 SCOPE AND CONTENT OF THE EIS

The EIS has been compiled by Sinclair Knight and Partners acting as consultant to the N.S.W. Public Works Department. To assist in the preparation of the EIS a number of specialist studies were commissioned. These included:

- **Landscape Investigation of Treatment Works Sites at Tanilba Bay and Boulder Bay and Pipeline Routes.** This study, undertaken by the Accommodation and Landscape Section (NSW Public Works Department) in association with Mr R Stewart and Mt King Ecological Surveys, addressed the biophysical and cultural environment and associated effects of the proposal (Reference 20).

- **Archaeological Investigation of Treatment Works Sites at Tanilba Bay and Boulder Bay and Pipeline Routes.** (Undertaken by Ms Mary Dallas, Reference 4).

- **Ocean Outfall Investigation**, assessing the suitability of a coastal waters discharge site at Boulder Bay and the ability of the outfall to meet the State Pollution Control Commission's guidelines. (Prepared by Consulting Environmental Engineers, Reference 2).

- **Boulder Bay Geology Report** investigating the suitability of Boulder Bay area for coastal waters discharge with regard to geology of the area. (Prepared by the Geotechnical Centre of the PWD, Reference 19).

- **Marine Biology Report** investigating aquatic communities of the proposed discharge point at Boulder Bay and the likely short and long term effects on marine biology by the proposed discharge of treated effluent. (Prepared by J H & E S Laxton - Environmental Consultants P/L, Reference 12).

- **Hydrogeology Investigation addressing the feasibility of land disposal of effluent from Tanilba Bay Treatment Plant.** (Prepared by Mackie Martin P/L, Reference 14).

- **Wetlands Investigation addressing the guidelines for construction of those aspects of the scheme adjacent to significant wetlands** (prepared by Shortland Wetlands Centre, Reference 21).

- **Investigation into the phosphorus removal capacity of soils at the proposed Tanilba Bay Treatment Works site** (undertaken by Sinclair Knight & Partners, Reference 25).

- **Flushing Study of Tilligerry Creek** investigating the potential effects of increased freshwater groundwater and nutrient inflows into the creek from the proposed Tanilba Bay treatment works site, (undertaken by Sinclair Knight & Partners, Reference 24).

Information obtained from these specialist studies has been used in the compilation of the EIS. The following describes the structure of the EIS:

Chapter 3 - Existing Environment, describes both the biophysical and cultural environment on a regional basis.

Chapter 4 - Development of the Preferred Scheme, describes the development of the various sewerage scheme options and their assessment.

Chapter 5 - Detailed Description of the Preferred Scheme, provides a detailed description of the preferred sewerage scheme.

Chapter 6 - Impact Assessment and Environmental Safeguards: Reticulation, discusses the potential beneficial and detrimental impacts associated with the reticulation component of the scheme on both the Tomaree and Tilligerry Peninsulas.

Chapter 7 - Impact Assessment and Environmental Safeguards Tilligerry Peninsula, discusses the potential benefical and detrimental impacts associated with the Tilligerry Peninsula component of the scheme.

Chapter 8 - Impact Assessment of Environmental Safeguards: Tomaree Peninsula, discusses the potential benefical and detrimental impacts associated with the Tomaree Peninsula component of the scheme.

Exhibit 2.1
REGIONAL LOCATION
SINCLAIR KNIGHT & PARTNERS PTY LTD

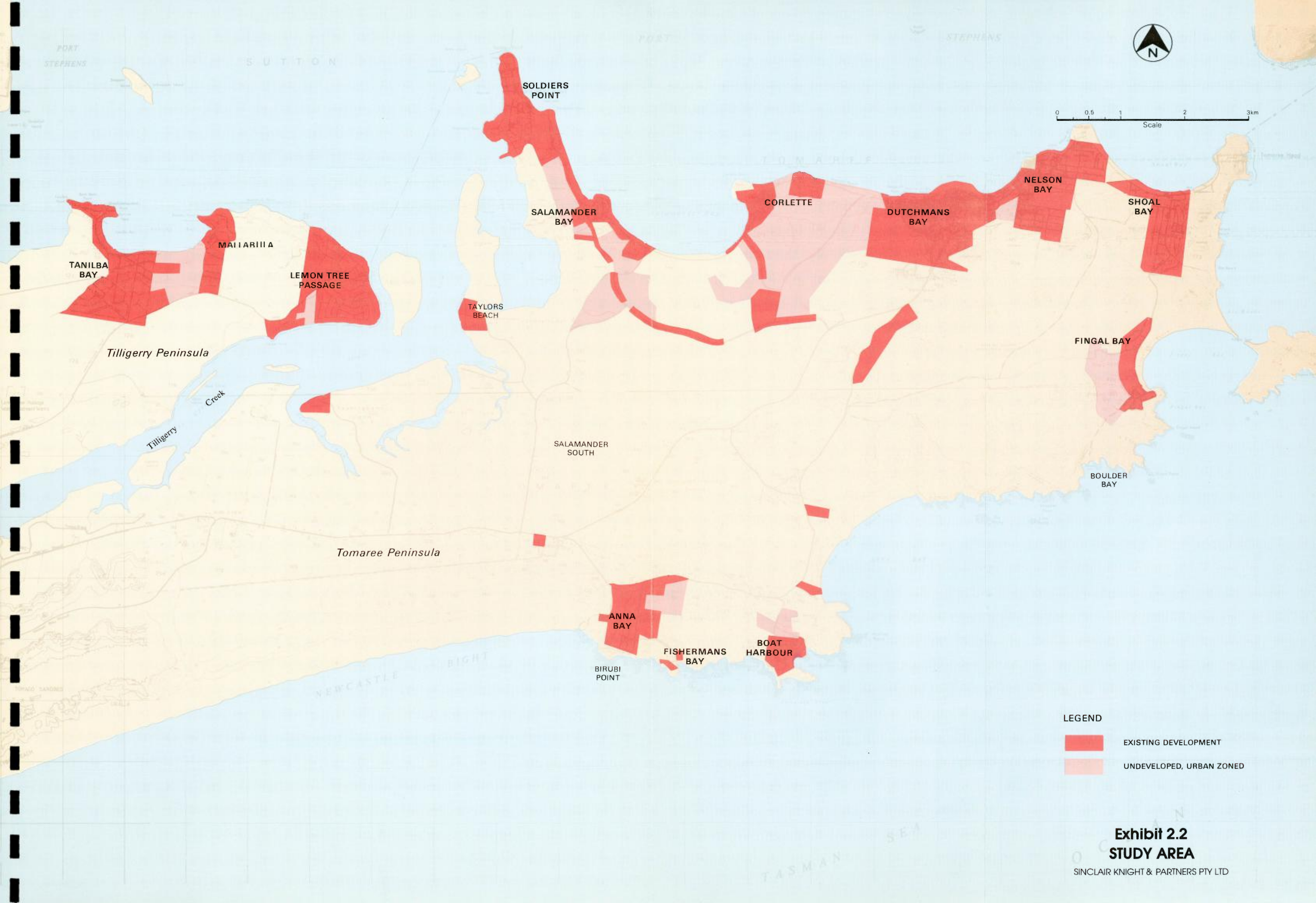
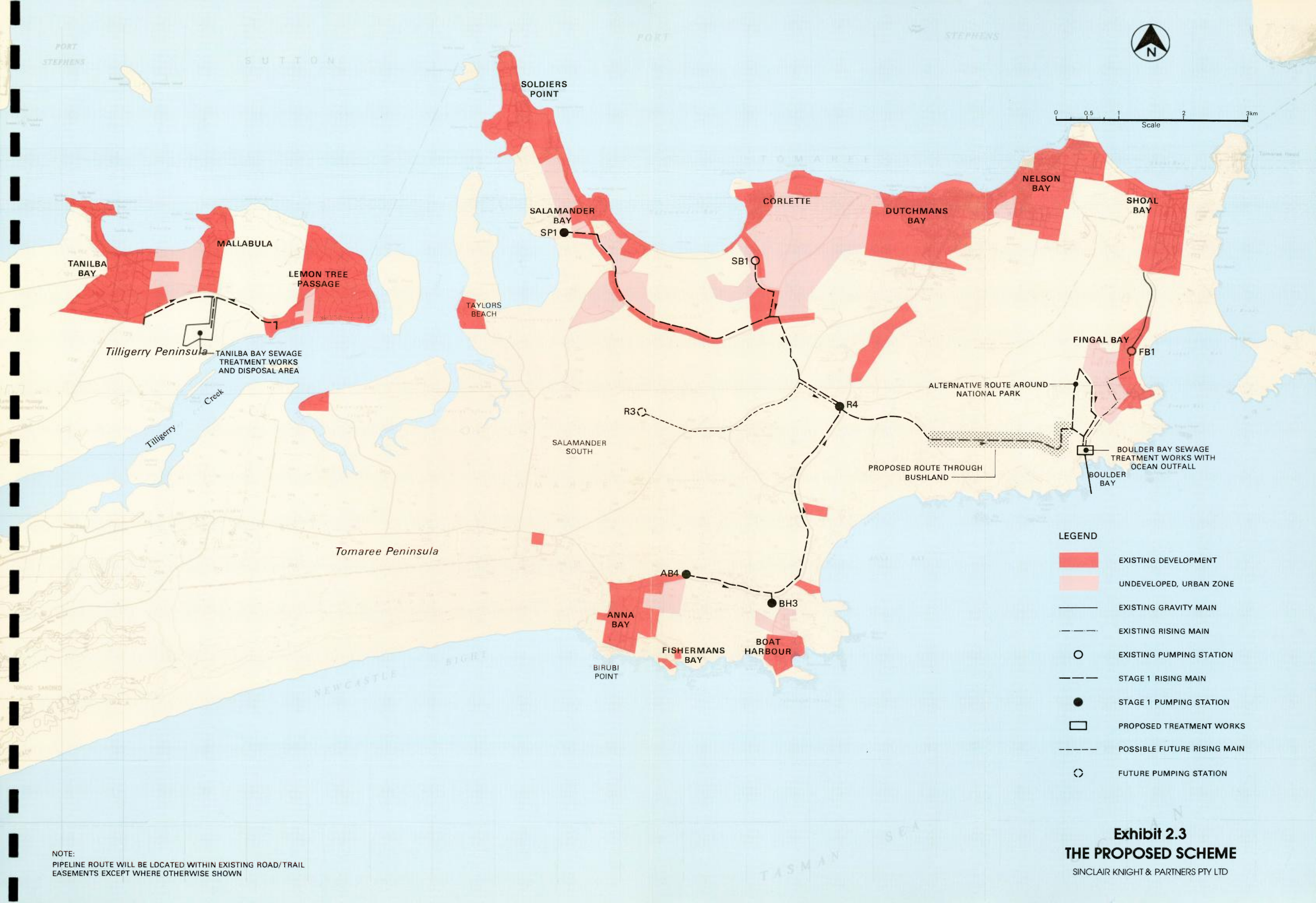


Exhibit 2.2
STUDY AREA
SINCLAIR KNIGHT & PARTNERS PTY LTD



NOTE:
PIPELINE ROUTE WILL BE LOCATED WITHIN EXISTING ROAD/TRAIL EASEMENTS EXCEPT WHERE OTHERWISE SHOWN

Exhibit 2.3
THE PROPOSED SCHEME
SINCLAIR KNIGHT & PARTNERS PTY LTD

3. Existing Environment

This section describes both the biophysical and cultural environment of the study area. The various attributes of the area are presented on a regional basis with details being presented where relevant on the specific sites potentially affected by the preferred scheme; (i.e. Tanilba Bay Treatment Works Site, Boulder Bay treatment works site and outfall and the transport system).

3.1 CLIMATE

Being close to the sea, the study area has a humid temperate climate which is frost free. The average rainfall is 1 325 mm per annum. Rain falls throughout the year but there is a tendency for maximum rainfall during the winter period. Records from Williamtown Airbase indicate an average yearly pan evaporation rate of 1770mm.

On-shore breezes dominate in summer with westerly winds generally prevailing during winter. Throughout the year southerly winds can be expected, usually accompanying storms. Due to the relatively uniform terrain, localised reduction in exposure to prevailing winds is minimal.

3.2 GEOMORPHOLOGY

The Tomaree area occupies part of the north-eastern edge of the Sydney Basin and contains features that are characteristic of a drowned coast. The area has an interesting and complex geomorphic history. It is characterised by spectacular isolated rocky peaks linked by generally deep and extensive sand deposits. These peaks are residuals of lava flows following approximately one million years of weathering. During eruption, the rock was shredded into minute shard-like fragments which became welded together upon reaching the ground. This is the only place on the NSW coastline where such rock formations appear.

An inner dune barrier was formed during an interglacial period in the late Pleistocene when the sea level dropped by as much as 120 metres, causing rivers in the area, such as the Hunter and Karuah, to cut through a series of beach dunes or beach ridges to access the sea.

About 17,000 years ago, the sea level started to rise and transgress the sub-aerial Pleistocene dune surface. It stabilised at its present level about 3000 to 4500 years ago. More recently, an outer dune barrier was formed by the accretion of multiple beach ridges.

3.3 SOILS

The soils of the area reflect their geomorphic origin. Those found on the volcanic peak outcrops are generally shallow and of a clayey consistency. Dune based soils consist of uniform sands, which are in areas indurated (induration is a process by which soft sediment becomes hard or comparatively hard). The induration process is the origin of the "coffee rock" which occurs commonly in the area. In swampy areas, an acidic organic soil has developed as a result of the accumulation of organic matter from the associated wetland vegetation.

Soil types within the study area can generally be divided into three broad units based on their origin:

- outer coastal sand barrier
- fluvial (river) and estuarine deposits
- inner coastal sand barrier and terrestrial dune sands.

Characteristics of these units are outlined below.

3.3.1 Outer Coastal Sand Barrier

This soil category is found fronting the Newcastle Bight between Newcastle Harbour and Morna Point. These soils comprise sand layers to a depth of approximately 12 metres merging into bands of grit and shells.

3.3.2 Fluvial (River) and Estuarine Deposits

Located on southern side of Tilligerry Creek this unit lies adjacent to the outer coastal sand barrier unit. The unit comprises areas of wetland and areas covered by a veneer of rich alluvial soils.

3.3.3 Inner Coastal Sand Barrier and Terrestrial Dune Sands

This unit comprises an undulating area of alternating flat stretches of freshwater swamp less than 8 metres above sea level and low sandy rises usually less than 15 metres but occasionally rising 30 - 45 metres above sea level. The Inner Coastal Sand Barrier deposits comprise the major part of the Tilligerry Peninsula with the Terrestrial Dune Sand linking the volcanic peaks in the eastern extremity of Tomaree Pensinsula.

The top two metres of these soils have a typical humus podsol profile. Over quite a large area of the peninsula, it is common to find two organic hardpan horizons, the upper one within 1.5 metres of the soil surface and a lower much thicker horizon just above sea level. These layers may indicate two separate stages in the building up of the sand beds.

The hardpan is commonly referred to as "Woolloomooloo Rock" or "Coffee Rock" and varies in thickness and depth below the surface, occurring close to the surface in the lower-lying flatter areas but at a greater depth (1.5 - 3 metres) on the top of the sandy rises. The indurated layer in places represents an important control on groundwater movement due to its comparative impermeability.

3.4 EXTRACTIVE RESOURCES

The Department of Mineral Resources has advised that the study area is of particular interest with regard to current and possible future heavy mineral and silica sand mining. Tomaree Peninsula is the subject of one Exploration Licence (88Ne (EL 2683) - held by Rutile and Zircon Mines Ltd) and various mining titles for rutile and zircon (refer Exhibit 3.1). In addition, silica sand deposits are known to exist on Tilligerry Peninsula. One area south of Tanilba Bay is subject to an existing extraction operation under a permissive occupancy from the Department of Lands (PO 86/27), (refer Exhibit 3.1). This sand extraction area lies adjacent to the proposed Tanilba Bay sewage treatment plant site. Under Clause 65 of Interim Development Order No. 23 of Port Stephens Shire Council, no development in this area shall be approved without the preparation of an Environmental Impact Statement and the concurrence of both the Department of Environment and Planning and the Department of Mineral Resources.

The Department of Mineral Resources and the abovementioned mining companies place high priority on minimising the risk of sterilisation of resources by future development.

3.5 HYDROLOGY

3.5.1 Surface Hydrology

Regionally, the study area forms the most easterly edge of the drainage basins of the Karuah River, and the Hunter River.

Due to the permeable nature of the underlying sands and the moderate topography, very few defined watercourses drain the area. The main water course is Tilligerry Creek, a small estuarine creek separating Tomaree and Tilligerry Peninsulas. Other defined watercourses, including Bobs Farm Creek, Fenninghams Island Creek, and Wallis Creek are all tributaries of Tilligerry Creek.

While the Hunter and it's tributaries have long been subjected to extensive flooding, the Peninsula does not suffer from significant flooding problems. A one in 100 year flood area extends from the shores of Fullerton Cove to the south-westerly edge of Tilligerry Creek, (outside the study area) and during the floods of 1955, a flood path was reported to have formed between Fullerton Cove and Port Stephens, via Tilligerry Creek. Some localised ponding and waterlogging may occur for short periods, mainly in wetland areas, after heavy rain.

The Port Stephens Shire Council has advised that during a one in 100 year flood and with a storm surge to 1.0 metres Australian Height Datum (AHD), the level of inundation in the vicinity would be to 2.0 metres AHD. Flooding is not a constraint on the scheme.

3.5.2 Regional Groundwater Hydrology

Large areas, mainly on the eastern side of the Tomaree Peninsula (Nelson Bay/Anna Bay Sandbeds) and on Tilligerry Peninsula (Tomago Sandbeds) are defined water catchments under the Clean Waters Act 1970 (refer Exhibit 3.2). Major parts of these catchments are declared water reserves and are managed by the Hunter District Water Board. The coastal dunes on the south west of the study area are reserved for future water extraction. The Nelson Bay Sandbeds currently supply, and are expected to continue to supply (in association with the Tomago sandbeds), the potable water requirements of the Tomaree Peninsula. Water is extracted from these beds by a series of bores within the water reserves.

Urban development in water reserves is not permitted, and the permission of the Hunter District Water Board is required for any proposed works in these areas. In addition, discharges with potential to affect the quality of groundwater within the catchment areas are subject to strict conditions particularly in the vicinity of extraction bores.

3.6 WETLANDS

The low lying nature of much of the study area has resulted in the development of significant areas of estuarine and freshwater wetlands. The estuarine wetlands fringe Tilligerry Creek, Cromartys Bay and Salamander Bay, with freshwater wetlands being located further inland. There is increasing evidence that wetlands provide a wide range of vital functions which are of economic, ecological, recreational, educational, scientific and aesthetic value and there has been growing pressure to protect remaining areas of coastal wetlands in N.S.W.

State Environmental Planning Policy (SEPP) 14 was gazetted by the Government to provide a means for controlling the extent of wetlands disturbance in NSW. SEPP 14 included a schedule of designated wetlands (as amended 26 June 1987) throughout the State. A number of the wetland areas within the study area have been listed under SEPP 14 as shown in Exhibit 3.3. They had a major bearing on the layout of the proposed sewerage transportation scheme. SEPP 14 is discussed further in Section 3.13.2.

Vegetation within wetland areas is specially adapted to a moist soil environment. Wetland plant communities also exhibit zonation, which reflects gradients in environmental factors. The most apparent gradients are related to soil moisture content, salinity, microclimate, fire history, and exposure. Soil moisture content is usually predominant.

3.7 LANDSCAPE AND VISUAL QUALITY

3.7.1 Introduction

The visual character of the study area stems from the interacting factors of geomorphology, soils, drainage and climate. These factors have resulted in a landform being dominated by:

- remnant volcanic peaks;
- estuarine wetlands;
- coastal and terrestrial dune systems; and
- ocean and Port Stephens shoreline.

This varied landscape is the predominant reason why the study area has long been appreciated for its scenic qualities.

The visual character of the Tomaree Peninsula has been the subject of several studies in recent years, the most significant being the Lower Hunter Landscape Improvement Study by the NSW Department of Environment and Planning (Reference 6), and the National Trust's Tomaree Peninsula Landscape Study (Reference 15).

The National Trust Study has largely been adopted as a basis for discussion in this report.

3.7.2 The National Trust Study

The National Trust Study perceived the Peninsula as a primarily natural area interspersed with patches of urban development, so that the "broad patterns" of the landscape, i.e. coastlines, swamps, hills and lowland forests, are easily identifiable.

A number of physical "land systems" which displayed uniform topographical and bio-physical characteristics were identified. These land systems reflect the environment in its natural or semi-natural state. The National Trust's Study did not extend to include the Tilligerry Peninsula, however the same methodology has been adopted to describe land systems over this area.

Following is a review of the visual quality of the land systems in which the proposed sewerage scheme will be located.

Anna Bay Land System

This system is by far the largest area of uniform natural land and is widespread throughout the peninsula.

The system was identified in the Study as undulating sand dunes covered with open forest which is visually dominated by the foliage of the Angophora trees. The rather open character of the forest and the often reduced understorey permit views from roads for considerable distances into the forest.

The system provides a natural backdrop to urban areas and its consistency provides a strong unifying visual element. Breaks in the natural topographic and vegetative landscape surface, such as those of artificial origin, i.e. roads, cuttings, clearing and large structures, assist in cumulatively weakening this uniformity, hence impairing the degree of scenic quality.

Tomaree Land System

This system designates steep conical volcanic hills supporting woodland vegetation, and as such, this system is the most visually prominent in the generally flat landscape of the study area.

Gan Gan Land System

This system comprises heavily forested slopes which provide a visual transition between volcanic peaks and the surrounding lowlands. These areas are especially conspicuous in their upper limits where they often form the skyline linking the volcanic peaks of the Tomaree System.

Salamander Land System

This system comprises estuarine wetland areas and provides a backdrop to residential areas. The mangroves and saltmarshes of this system create complex patterns incorporating areas of open water and tidal creek. The system is very conspicious from waterways of Port Stephens and Tilligerry Creek.

Mambo and Cromarty Land Systems

Both of these low lying swamp systems are of importance visually since they are conspicuous from many roads. The isolated wetlands contrast with adjoining forested systems and, as such, act as visual "holes" in the forested landscape. The swamp forests provide a strong sense of enclosure with continuous canopy and dense tree cover. Perforations in this enclosure, either natural or man-made (i.e. road and service easements) have a significant detrimental effect in disrupting and weakening the sense of enclosure and degree of naturalness.

3.8 TERRESTRIAL ECOLOGY

3.8.1 Vegetation - A Regional Perspective

The Tomaree area supports a diverse vegetation that is typical of that found on quaternary sand deposits all along the NSW coast. The sheer size of the Tomaree Peninsula has resulted in a variety of ecosystems from rocky headlands and volcanic outcrops, through sand dunes and dune swale swamps, to estuarine environments. Despite modification and disturbance, these ecosystems still support quite large areas of vegetation of high regional conservation value.

Table 3.1 lists the dominant species for each structural type based on the particular landform type on which it occurs. A detailed vegetation checklist is provided in the Landscape Investigation report (Reference 20). Of the species of the Tomaree area affected by the scheme, none are considered rare or endangered on a statewide basis and indeed they are common and widespread.

3.8.2 Fauna - A Regional Perspective

Mammals

The range of mammals known from the district is typical of many areas in eastern Australia. A list of mammals which could inhabit the area is provided in Reference 20. Not all mammals listed have been located in the Port Stephens district but all would be expected to occur. Several small mammals have been located in the district (Brown Antechinus, Common Dunnart, Swamp Rat and New Holland Mouse) as well as three macropod species (Red-necked Wallaby, Eastern Grey Kangaroo and Swamp Wallaby). Arboreal mammals from the district include the Koala and the Common Brushtail Possum. These species, and the others listed in Reference 20, would use the range of habitats available within the study area.

There are no mammals known from the district that can be considered as having a low population status i.e. less than moderately common, throughout their range. The New Holland Mouse was once considered as being rare but as a consequence of detailed surveys is now regarded as a common inhabitant of heathlands along the Central Coast of N.S.W. The Koala in NSW is considered to be vulnerable due to its limited distribution and habitat preferences and to current land use practices. Several of the tree species located in the study area are preferred Koala habitat e.g. Blackbutt and Grey Ironbark. The National Parks and Wildlife Service of N.S.W. has reported the existence of Koalas in the Nelson Bay-Shoal Bay area.

TABLE 3.1 LANDFORM AND VEGETATION OF THE STUDY AREA.

LANDFORM	Terrestrial Dunes	Volcanic Hills	Volcanic Hills & Mantling Sands	Estuarine Deposits	Dune Swampland
STRUCTURAL TYPE	Forest & Woodland	Woodland	Forest & Woodland	Low Forest/Herbfield Open & Closed Forest Closed Sedgeland, closed scrub	Open & Closed forest, scrub & sedgeland
DOMINANT SPECIES					
Trees:	Smooth-barked apple (Angophora costata) Blackbutt (Eucalyptus pilularis) Bloodwood (e.gummifera) Saw-Toothed Banksia (Banksia serrata) Forest Oak (Casuarina torulosa)	Scribbly Gum (Eucalyptus haemastoma) Bastard mahogany (E. umbra)	Blackbutt (Eucalyptus pilularis) Bloodwood (E.gummifera) Smooth-barked apple (Angophora costata) Bastard mahogany (E. umbra) Saw-Toothed Banksia (Banksia serrata)	Grey mangrove (Avicenna marina) Prickly-leaved paperbark (Melaleuca styphelloides) Cabbage Palm (Livistona australis) Swamp Oak (Casuarina glauca) Tuckeroo (Cupaniopsis anarcardioides)	Swamp Mahogany (Eucalyptus robusta) Broad-leaved paper-back (Melaleuca quinquenervia) Prickly-leaved paperbark (M. styphelloides) Snow in Summer (Melaleuca Linarlifolia)
Shrubs:	Sydney Golden Wattle (Acacia longifolia) Sweet scented wattle (Suaveloens) Broad-leaved Geebung (Persoonia laevis) Paperbark Tea Tree (Leptospermum attenuatum) Prickly Tea Tree (L. juniperinum)	Banksia spinulosa Honeyflower (Lambertia formosa)	Oxylobium lilcifolium Honeyflower (Lambertia formosa) Geebung (Persoonia laevis, P. lanceolata) Silky Hakea (Hakea servicea) Christmas Bush (Ceratopetalum gummiferum)	River Mangrove (Aegiceras corniculatum) Native Hibiscus (Hibiscus diversifolius) Melaleuca sieberil	Swamp Paperbark (Melaleuca ericifolia) Prickly Teatree (Leptospermum juniperinum) Paperbark TeaTree (Attenuatum) Slender Wattle (Acacia elongata) Thyme honeymyrtle (Thymifolia) Red Bottle Brush (Callistemon citrinus) Green Teatree (Leptospermum liversidgei) Thick-leaf Bottle Brush (Callistemon pachyphyllus)
Herbs:	Wedding Bush (Ricinocarpos pinifolius) Bloodroot (Haemadorum sp.) Gymea Lily (Doryanthus excelsa)	Gymea Lily (Doryanthus excelsa) Christmas Bell (Blandfordia grandiflora) Prostanthera densa	Wedding Bush (Ricinocarpus pinifolius) Bloodroot (Haemadorum sp.) Gymea Lily (Doryanthus excelsa)	Salt couch (Paspalum paspalodes) Saltwort (Sarcocornia quinqueflora) Sporobolus virginicus Sugeda australis Triglochin striata Isolepis nodosa Samolus repens Swamp Fern (Blechnum indicum) Baumea rubiginosa Cutty Grass (Gahnia Sieberana) Lepironia articulate	Swordgrass (Gahnia sieberana) Restio (Restio spp) Christmass Bells (Blandfordia grandiflora) Milk Maids (Dichopogon fimbriatus) Swamp Fern (Blechnum indicum) Coral Fern (Gleichena discarpa) Forked Burmannia (Burmannia disticha) Spaghnum moss Vanilla plant (Sowerbaea juncea)

Avifauna

The birds located within the Port Stephens district (refer Reference 20) also represent a range of species typical of the Central Coast of N.S.W. Of the 171 bird species expected in the district (65 are known) many are associated with water bodies and wetlands. Of these, 48 species can be considered as preferring wetlands habitat. Many of these birds are migratory waders associated with the littoral zones of swamps and beaches. Other bird species located in the district include raptors associated with water (Osprey and White-bellied Sea-Eagle) and with timbered habitat (Whistling Kite). There is also a range of bird species found associated with timbered habitat such as honeyeaters, tree-creepers and parrots.

The population status of nearly all birds known from the district is relatively high i.e. greater than moderately common. Fourteen species are considered scarce in the Newcastle region but 13 have a higher status throughout the state and/or Australia. The Osprey has a rare status within N.S.W. and is included within Schedule 12 (part 2: Vulnerable and Rare Fauna) of the National Parks and Wildlife Act (1974). The White-bellied Sea-Eagle and Glossy Black-Cockatoo are listed in Part 1 (Fauna of Special Concern) of the Schedule. The status of the Glossy Black Cockatoo is regarded as being of special concern because of the loss of their preferred habitat of stands of Casuarina.There are some species that have a limited distribution and/or are threatened by loss of habitat. These include pigeons usually associated with rainforest e.g. Topknot and White-headed Pigeon and several species inhabiting wet grasslands e.g. Golden-headed Cisticola, White-fronted Chat.

3.9 FIRE REGIME

Based on the methodology developed by the N.S.W.Department of Environment and Planning, (Reference 7) the majority of the Tomaree area falls into a fire hazard rating of medium to high.

Fire hazard assessments are based on the State Fire Zone in which the study area falls, together with identification of vegetation type and slope, and assuming a maximum fuel load.

As the Tomaree area is in the Eastern Fire Zone of the State and is vegetated predominantly with dry sclerophyll forest and dry heath the area is rated medium where slope ranges from - 20% (downslope) to +5%, or high where the slope is from +5% to more than +30%.

3.10 THE MARINE ENVIRONMENT

3.10.1 Ocean Coast

The ocean foreshores within the study area generally comprise a line of rocky headlands of moderate relief, broken by small curved embayments containing cobble and boulder beaches and large embayments containing sandy beaches. Popular swimming beaches are shown on Exhibit 3.2 and include Stockton Beach, Fishermans Bay, Little Kingsley Beach, Boatharbour, One Mile Beach, Fingal Beach, Box Beach and Wreck Beach.

Boulder Bay, one of the small embayments, is typical of this section of the ocean coast and is the site of an existing shoreline sewage outfall servicing the urban areas of Shoal Bay and Fingal Bay. Boulder Bay is also the preferred site for the ocean outfall for the proposed scheme (refer Section 5.3.4). Small volumes of raw sewage (current average dry weather flow is approximately 800kL/day) have been discharged into Boulder Bay since 1975.

For a number of years the Hunter District Water Board has been monitoring the effect of the sewage outfall at Boulder Bay on water quality and the marine community (see References 8 and 9). Results of this monitoring program indicate that surface waters at Boulder Bay have similar physical and chemical characteristics to surface water offshore of this section of the coast except for dissolved oxygen concentrations, nutrient levels and faecal coliform bacteria concentrations. Water at all depths within Boulder Bay was often super-saturated with oxygen due to the prolific benthic algal growth within the Bay. Nutrient levels including ammonia, organic nitrogen, oxidized nitrogen and phosphorus are higher than for typical offshore waters. The higher faecal coliform levels within Boulder Bay are a result of contamination from the outfall. Monitoring studies indicate a high degree of dilution outside Boulder Bay. Faecal coliform levels at nearby bathing beaches do not pose any health risks and are well within the State Pollution Control Commission (SPCC) requirements.

Coastal waters within the study area have been classified as "Class O - Ocean Waters" by the SPCC under the Clean Waters Act 1970 (refer Exhibit 3.2).

3.10.2 Port Stephens

The waters within Port Stephens, including Tilligerry Creek, are of high quality and have been classified by the SPCC under the Clean Waters Act, 1970, as either "Class P - Protected Waters" or "Class C - Controlled Waters". The requirements for discharges into classified water when discharges are permitted by licensing, are contained in Clause 8 of the Regulation of the Clean Waters Act (refer Appendix C).

The limits of the Class P waters are shown on Exhibit 3.2 and include:

- the waters of Port Stephens in Salamander Bay between Corlette Point and Wanda Wanda Head;
- all waters of Port Stephens and its tributary inflows west of a line drawn in a northerly direction from Soldiers Point to the northern shores of Port Stephens; and,
- all waters of Port Stephens on any lands leased from time to time for an oyster farm under Part V of the Fisheries and Oyster Farms Act, 1935, as amended, and all waters within 100 metres from the boundary of any such lease.

The remainder of the waters of Port Stephens (that is waters not classified as Protected Waters) are classified as Class C (refer Exhibit 3.2). A small area around West Point has been given the classification R - Restricted Waters as discharge of comminuted raw sewage currently takes place there.

Treated and raw comminuted sewage is presently discharged into Port Stephens at three locations, Wanda Head, Sandy Point and Nelson Bay. Biological monitoring studies (References 8 and 9) of these outfalls sites have been undertaken on behalf of the HDWB. These investigations showed the following:

- Nelson Bay outfall - the sea bed along the pipeline at Nelson Bay was richly colonised by sedentary organisms. From low tide level to a depth of 7.6 m, algae dominated the benthic community. At the base of the algal dominated rock slope was an area of coarse sand. During the course of the work at this locality, this sand became colonised by three species of sea grass. From 7.6 m to 19 m, sponges, ascidians, coelenterates and polyzoans dominated the community. When compared to benthic communities in adjacent unaffected areas it was concluded that the discharge of the effluent had little influence on the benthic community.
- Wanda Head - The intertidal portion of the rocky shore at Wanda Head was considered to have changed little since the initial damage from construction was repaired. The pipeline itself provided substrate for a variety of species of plants and animals. Between 1977 and 1982 these organisms grew prolificly. No effluent discharge related effects were detected at this small outfall.
- Sandy Point - The benthic community in the vicinity of the outfall was found to be impoverished due to the very mobile nature of the bottom in this area. The use of concrete settlement surfaces laid to the east and west of the outfall showed that both plants and animals would settle and grow near the discharge point. Moving sand, however, buried these surfaces several times during the study, destroying the developing community.

These outfalls are discussed further in Section 3.15.1.

3.10.3 Tidal Exchange

Tides within Port Stephens are semidiurnal and exhibit lags of 16 mins for the Higher High Water (HHW) and 17 mins for Lower Low Water (LLW) compared to Fort Denison. The following values (based on Port Stephens Harbour Datum) have been calculated or obtained:

Highest Astronomical Tide	HAT	:	+1.9m
Mean Higher High Water	MHHW	:	+1.6m
Mean Sea Level	MSL	:	+0.9m
Mean Lower Low Water	MLLW	:	+0.4m
Lowest Astronomical Tide	LAT	:	+0.0m

Tilligerry Creek drains into the upper reaches of Port Stephens (refer Exhibit 2.2). A dispersion study on Tilligerry Creek was undertaken (Reference 23) based on the parameters of:

- the creek's geometry
- magnitude of tidal flows
- the river flow

Tilligery Creek is considered to be a well mixed estuary with an exchange of total water volume within the Creek occurring over a period of less than two tidal cycles. The high exchange rate and well mixed nature indicates the Creek has good flushing characteristics maintaining a high water quality.

Salinity levels decrease towards the head of Tilligerry Creek due to freshwater inflow. Salinity levels in the lower parts of the estuary (ie in the vicinity of Mud Island) range between 27 and 35 parts per thousand (ppt). The lower salinity values occur generally after periods of rain.

3.10.4 The Fishing and Oyster Industry

Port Stephens is one of the major fishing ports in NSW. The Fishermens Cooperative in Nelson Bay Boatharbour acts as a base and handling facility for the fishing fleet operating the trawling grounds on the continental shelf in this area of the coast.

Port Stephens is regarded as one of the most important oyster producing areas in NSW supplying both mature oysters and oyster spat. Local production is valued at $8 million annually. The area has traditionally supplied the NSW oyster industry with approximately 70% of its spat requirements. Salamander Bay has long been famous for its consistent high productivity as a spat producing area, and as such the intertidal foreshores are dominated by commercial spat catching leases. As shown on Exhibit 3.2, major oyster growing areas extend from Salamander Bay around the foreshores into Cromartys Bay and along almost the entire reach of Tilligerry Creek.

A potential problem to the oyster industry in Port Stephens is the introduction of the Pacific oyster. The Pacific oyster (**Crassostrea gigas**) has become well established in the inner harbour of Port Stephens since the summer of 1984-85. These oysters, originating from Japan, grow more rapidly than Sydney rock oysters (**Saccostrea commercialis**) and therefore interfere with the conventional stick culture in Port Stephens by overgrowing native oysters. In 1985 the Pacific oyster was declared a noxious fish making the cultivation and presence of this oyster on leases an offence. The shipment of oysters out of Port Stephens is now tightly controlled to prevent a further spread of Pacific oysters into other estuaries. Oyster farmers in Port Stephens must obtain approval from their local Fisheries Inspector before moving any oysters out of the Port for cultivation.

3.11 ARCHAEOLOGICAL BACKGROUND

The Port Stephens area was traditionally occupied by the Worimi tribe. The Worimi comprised 4 or 5 hordes each with a defined territory, but which interacted extensively. The Worimi spoke the "Kutthung" language in common with the tribes in adjoining territories.

Knowledge of the prehistory of the Port Stephens region has been largely the result of accidental site discovery and only recently through systematic archaeological survey. Even these have been limited to small areas or were not fully comprehensive.

The pattern of site occurrence known to date appears to be similar to the pattern discerned for the north coast of NSW. Site type and landscape associations known are:

1. surface or thinly stratified occupation sites containing mainly marine shellfish and fish remains in the coastal dunes and landward of the foredunes, particularly near fresh water resources;

2. thin to substantial midden deposits along the rocky coast and rock platforms.

3. commonly substantial occupation sites at the interface of open coast and estuarine zones.

4. scarred trees, although having poor survival rates in this region are likely to be located almost anywhere and most likely relate to the need for shelter and potable water.

The sites known are clearly only a fraction of the potential resource in the region (Reference 4). Only the location and supply of fresh water is likely to have greatly affected the duration of occupation and the size and range of populations and their movements.

On the basis of the environmental setting of the study area, existing archaeological information and site types known to occur in similar settings the following site types could be expected to be located by survey:

- occupation sites including middens and open camp sites;
- burials;
- scarred or carved trees.

3.12 EUROPEAN SETTLEMENT

The first permanent European settlers arrived in the early 1820's with a view to establishing an agricultural industry. Following the demise of these agricultural ventures the timber trade gained dominance. Oyster farming was established in the 1870's and quickly grew in importance.

From the early 1900's to World War II picnic excursions to Port Stephens from Newcastle were quite popular with three steam ships regularly employed for this purpose. World War II saw major changes to the Port Stephens area, which became a focus for military activities. The improved access roads, power and water which followed made the area much more attractive for development. Consequently from that time on the popularity of the area as a tourist centre increased. (Reference 15).

3.13 LAND USE PLANNING

3.13.1 Existing Development and Land Use

The existing pattern of development within the study area is shown on Exhibit 3.2. A major proportion of the area is undeveloped and under the control of various Government Authorities. Large areas, mainly on the eastern side of the Tomaree Peninsula (Nelson Bay/Anna Bay Sandbeds) and on Tilligerry Peninsula (Tomago Sandbeds) are defined as water catchments. Major parts of these catchments are declared water reserves and are managed by the HDWB. The coastal dunes on the southwest of the study area are reserved for future water extraction. To protect the quality of the groundwater, urban development within the water reserves is not permitted and the permission of the HDWB is required for any proposed works within these reserves.

The majority of the coastal strip from Anna Bay to Tomaree Head has been included in the Tomaree National Park. The National Park plays an important role in the conservation of the coastal heath communities typical of this area of the New South Wales Coast. In addition the Park provides for recreational activities such as rock fishing, swimming, camping and sightseeing. These activities are concentrated along the rocky ocean foreshores and beaches along this section of the coast. Access to this section of the coast has traditionally been via off road vehicle tracks. The uncontrolled proliferation of these tracks has in places resulted in severe erosion problems in both the National Park and the Water Catchment Area. The National Parks and Wildlife Service has put forward proposals to include additional areas in Tomaree National Park, and these proposals are presently under discussion.

The remainder of the undeveloped land which is not freehold is Crown land, some of which has been the subject of Aboriginal land claims by the Worimi Land Council. Areas that have been granted to the Worimi Land Council and areas pending approval procedures are shown on Exhibit 3.2.

3.13.2. Local Implications of State Planning Policies

The most significant State Planning Policy affecting the study area is State Environmental Planning Policy No. 14 - Coastal Wetlands (SEPP No. 14). Many of the wetland areas mentioned in Section 3.6 are considered to contain significant wetland communities, and have subsequently been listed under SEPP No. 14. This policy applies to specified wetlands within local government areas along the NSW coast (excluding those in the Sydney Metropolitan Area), and is accompanied by a series of maps which identify the lands to which the Policy applies. The Policy makes the following developments designated developments, pursuant to Section 29 of the Environmental Planning and Assessment Act, 1979:

- clearing of the land;
- constructing a levee on the land;
- draining the land;
- filling the land.

Those areas affected by SEPP No. 14 are shown on Exhibit 3.3.

3.13.3 Regional Planning

The Hunter Regional Environmental Plan No 1 (Reference 5) gazetted in March 1982, was one of the first to be finalised under the Environmental Planning and Assessment Act, 1979. The Plan applied to 13 local government areas, divided into sub-regions:

> **Lower Hunter Sub-Region** - Cities of Cessnock, Lake Macquarie, Maitland and Newcastle, and Shire of Port Stephens; and
>
> **Upper Hunter Sub-Region** - Shires of Dungog, Gloucester, Great Lakes, Merriwa, Murrurundi, Muswellbrook, Scone and Singleton.

The plan provided an overall long term strategy for the development of the Hunter Region. It established a settlement pattern for anticipated population growth and identified likely requirements for the provision of transport, community facilities and the like, but did not dictate in any detailed way the manner in which these facilities would be provided. It did, however, establish a framework for further action by relevant public authorities.

Recently a revised Draft Hunter Regional Plan 1987 (Reference 8) was exhibited. There were a number of reasons why the DEP undertook to review the original plan including:

(a) continuing matters of concern required stronger action and new issues were identified;

(b) the background report was out of date in some regards and required revision to maintain the Plan's usefulness;

(c) new information permitted the strengthening of policies and incorporation of additional provisions;

(d) additional urban land is required; and

(e) the Plan should apply to the City of Greater Taree to reflect the decision of the Minister for Planning and Environment in December, 1984 to include Taree in the Hunter Region.

Two other Sub-regions have been identified in the draft Plan due to differences in the relative importance of issues and determinants of growth. The sub-regions are the Northern Hunter Sub-region comprising the Shires of Dungog, Gloucester and Great Lakes and the City of Greater Taree, and the Upper Hunter Sub-region comprising the Shires of Merriwa, Murrurundi, Muswellbrook, Scone and Singleton.

The Plan deals with social, economic, settlement, access, natural resources and ecological issues, as they relate to the use of land for public and private purposes.

With regard to the Port Stephens Shire, the draft Plan states:

> Port Stephens Shire is projected to continue its strong growth with increasing emphasis on Tomaree Peninsula where there is currently capacity for more than 4 000 lots in zoned vacant land. The Peninsula is likely to continue in its role as a holiday/retirement area, but is rapidly becoming an important commuter outlier to Newcastle. Although less accessible to Newcastle than most of the proposed growth areas, the attraction of Port Stephens and the coast offsets, to some extent, the travel disadvantages. Nevertheless, any major expansion of this area will require monitoring to guard against adverse environmental impacts.

3.13.4 Local Planning

Statutory planning on the Peninsula, in the past, has been under Interim Development Order No. 23, a deemed environmental planning instrument supplemented by a number of amending Local Environmental Plans (LEP). A consolidation LEP has now been exhibited which incorporates IDO No. 23 and the various amending local environmental plans. The draft LEP (LEP 1987) is expected to be gazetted in the near future. The LEP does not provide additional urban zonings. Future population growth for the next 20-25 years is expected to be accommodated in existing urban areas. The Council, however, has identified some parcels of land which it considers would be suitable for future urban development if the need arises. In addition the Crown Lands Office at Maitland currently has a registered interest over areas of land to the south and east of Salamander Bay which includes a small area to the north of Nelson Bay Road adjacent to the HDWB catchment and the Gan Gan Military Area (Commonwealth).

Discussions with the Maitland Office of the Department of Housing confirmed that it considers such areas as suitable for future residential subdivision and that it has carried out concept planning for that section of land closest to the existing Salamander Estate development to the north and west of Gan Gan Military Camp.

These areas are not currently zoned for urban development and prior to any development taking place appropriate rezoning procedures would be necessary including detailed investigations into the suitability of these areas for urban development.

3.14 POPULATION OF THE STUDY AREA

Both Tomaree and Tilligerry Peninsulas are established tourist areas, and as such, the population in the area fluctuates during the year, peaking during holiday periods. For these reasons two population estimates were developed:

- Permanent Population - the population normally residing in the area.
- Peak Population - which is the sum of the permanent population and the tourist population, assuming that all tourist accommodation is fully occupied.

In order to establish current population numbers and to develop growth models, the following data were analysed:

- ABS census data 1976 and 1981.
- Population data and projections by Port Stephens Shire Council (PSSC).
- Population projections by Department of Environment and Planning (DEP).

- Building application statistics.

- Results of a house count carried out as part of the Concept Report investigations (Reference 23).

The following discussion on existing and projected population estimates are based on the findings of the Concept Report.

3.14.1 Existing Permanent Population

The existing population in the study area was estimated by adopting the 1981 census population figures and allowing for population increase in accordance with the number of dwellings added since then, derived from the house count and from building application statistics.

After discussions with Town Planners at Port Stephens Shire Council, the following assumptions were made in the estimates:

- all building applications eventuated in dwellings built;

- ninety percent of new dwellings are permanently occupied;

- no allowance was made for the conversion of holiday houses to permanent dwellings;

- the occupancy rate in new dwellings is 2.9 residents/dwelling, in line with PSSC estimates.

Table 3.2 lists the estimated population in the various localities of the study area.

TABLE 3.2 ESTIMATED PERMANENT POPULATION

Locality	New Dwellings 7/81-12/86	Population Increase 81-86	1981 Census Population	Estimated Population 31/12/86
Nelson Bay	569	1 383	4 030**	5 413
Shoal Bay	244	593	1 206**	1 799
Fingal Bay	89	216	435**	651
Corlette	75	182	652	834
Soldiers Point & Salamander Bay	221	537	1 593*	2 130
Tanilba & Mallabula	354*	860	1 381	2 241
Lemon Tree Passage	207*	503	888	1 391
Anna Bay	135*	328	796	1 124
Boat Harbour	31	75	507	582
	1 925	4 677	11 488	16 165

* Based on house count December 1986. Other figures are based on Building Applications approved by PSSC.

** Including permanent population in caravan parks.

3.14.2 Existing Peak Population

Tourist population was estimated by applying occupancy rates for holiday accommodation as follows:

- Caravan Parks — 3 tourist persons per caravan site
- Motels/Hotels — 2 tourist persons per room
- Holiday Dwellings — 4 tourist persons per dwelling
- Occupied Dwellings — 1.1 tourist persons per dwelling (in addition to 2.9 resident persons per dwelling)

Table 3.3 details the estimated tourist population at the peak tourist seasons, and Table 3.4 gives the peak population.

TABLE 3.3ESTIMATED TOURIST POPULATION (1986)

Location	Holiday Dwellings	Caravan Sites	Motel Rooms	Occupied Dwellings	Total Tourist Population
Nelson Bay	813	180	173	1 916	6 246
Shoal Bay	343	230	92	644	2 954
Fingal Bay	104	400	0	249	1 890
Corlette	168	0	18	307	1 046
Soldiers Pt & Salamander	333	535	60	753	3 885
Tanilba & Mallabula	173	0	0	783	1 553
Lemon Tree Passage	169	82	10	530	1 525
Anna Bay	141	60	0	364	1 144
Boat Harbour	75	0	0	197	517
Total Estimated Tourists					20 760

TABLE 3.4 ESTIMATED PRESENT PEAK POPULATION

Locality	Existing Permanent Population	Existing Tourist Population	Existing Peak Population
Nelson Bay	5 413	6 246	11 659
Shoal Bay	1 799	2 954	4 753
Fingal Bay	651	1 890	2 541
Corlette	834	1 046	1 880
Soldiers Pt & Salamander	2 130	3 885	6 015
Tanilba & Mallabula	2 241	1 553	3 794
Lemon Tree Passage	1 391	1 525	2 916
Anna Bay	1 124	1 144	2 268
Boat Harbour	582	517	1 099
Total	16 165	20 760	36 925

As shown in Table 3.4, the estimated peak population is more than twice the estimated permanent population.

3.15 EXISTING SEWERAGE FACILITIES

Six sewerage schemes are currently serving parts of the study area. The majority of the existing development in the area relies on septic tanks with on-site disposal or pump-out systems.

3.15.1 Existing Reticulated Sewerage Schemes

Exhibit 3.4 shows the areas where reticulated sewerage is available. There are six existing schemes as follows:

Shoal Bay - Fingal Bay
This is the biggest scheme in the area, serving approximately 1 500 dwellings. Sewage disposal occurs to the ocean via a shoreline outfall at Boulder Bay. Current Average Dry Weather Flow (ADWF) is 800 kL/day.

Nelson Bay
This scheme serves some 600 dwellings at Nelson Bay. Sewage is comminuted and discharged to Port Stephens via a 200 metre long pipeline off West Head at a depth of approximately 15 metres. Current ADWF is 400 kL/day. There is rapid water movement at the discharge site generated mainly by tidal exchange. The HDWB has plans to amalgamate this scheme with the Shoal Bay - Fingal Bay scheme.

Wanda Head
This scheme was constructed in 1978 as a temporary service to a subdivision on Wanda Head. Sewage is treated in a package treatment plant and effluent is discharged to Port Stephens at a depth of 6 metres via a 70 metre long submarine outfall. Current ADWF is 30 kL/day.

Sandy Point
This scheme services approximately 200 dwellings at Corlette. Sewage is treated in a package treatment plant and effluent is discharged to Port Stephens at a depth of 6 metres via a 300 metre long submarine outfall. Current ADWF is 100 kL/day.

Salamander
The scheme was constructed in 1986 as a temporary measure to enable development of Salamander Estate. A package treatment plant and an infiltration disposal pond have been constructed to serve up to 1 000 EP.

Birubi Point
This scheme is a temporary one, constructed in 1983 to serve a new subdivision at Anna Bay. A package treatment plant treats the sewage generated by some 60 houses. Effluent disposal is by means of underground pipework within a grassed area for transpiration and percolation. Current ADWF is 25 kL/day.

3.15.2 Septic On Site Systems

Where reticulated sewerage is not available, septic tanks are used for the treatment of sewage.

Depending on soil conditions, effluent from septic systems is either disposed by transpiration and percolation on site, or pumped out and tankered to a centralized disposal location. At present, approximately 90% of unsewered houses in the study area have on-site diposal systems and the rest are being pumped out.

Whilst a properly maintained septic system can provide many years of trouble free service, these systems suffer from the following disadvantages, in addition to the problems outlined in Section 2.2:

- maintenance is sometimes neglected by owners, causing system failure (e.g. leakage);
- for on-site disposal, pollutants (mostly nutrients) can ultimately be flushed into waterways, affecting the environment;
- illegal discharge to stormwater drains from pump-out systems is a not uncommon occurence;
- there is odour and fly nuisance potential.

3.15.3 Implications of Future Population Growth

Even with the most conservative estimates for population growth the existing sewerage schemes outlined above could not accommodate the anticipated sewerage loadings without significant effects on the environment. In particular, increased discharge of effluent to Port Stephens should not be considered without significantly higher level of treatment. This aspect is discussed in detail in Section 4.4.2.

SOLDIERS POINT

SALAMANDER BAY

CORLETTE

DUTCHMANS BAY

NELSON BAY

SHOAL BAY

MALLABULA

TANILBA BAY

LEMON TREE PASSAGE

TAYLORS BEACH

88Ne

Tilligerry Peninsula

FINGAL BAY

Creek

Tilligerry

SALAMANDER SOUTH

BOULDER BAY

93 Ne

Tomaree Peninsula

ANNA BAY

FISHERMANS BAY

BOAT HARBOUR

BIRUBI POINT

95Ne

N

0 0.5 1 2 3km

Scale

LEGEND

EXPLDRATION LICENCE

EXPLORATION LICENCE APPLICATION

MINING LEASE

PERMISSIVE OCCUPANCY 86/27 FOR SAND EXTRACTION

Exhibit 3.1
EXTRACTIVE RESOURCES

SINCLAIR KNIGHT & PARTNERS PTY LTD

SOLDIERS POINT

SALAMANDER BAY

CORLETTE

DUTCHMANS BAY

NELSON BAY

SHOAL BAY

FINGAL BAY

BOULDER BAY

MALLABULA

TANILBA BAY

LEMON TREE PASSAGE

TAYLORS BEACH

Tilligerry Peninsula

Tilligerry Creek

SALAMANDER SOUTH

Tomaree Peninsula

ANNA BAY

FISHERMANS BAY

BOAT HARBOUR

BIRUBI POINT

N

0 0.5 1 2 3km
Scale

LEGEND

- EXISTING DEVELOPMENT
- UNDEVELOPED, URBAN ZONE
- NATIONAL PARKS
- CROWN LAND
- EXISTING PARKLAND & RECREATIONAL AREAS
- ABORIGINAL LAND CLAIMS
  A – UNDER CONSIDERATION
  B – TO BE GRANTED
  C – GRANTED
- CLASS P (PROTECTED) WATERS
- CLASS C (CONTROLLED) WATERS
- CLASS R (RESTRICTED) WATERS
- CLASS O (OCEAN) WATERS
- OYSTER LEASES
- HDWB WATER CATCHMENT BOUNDARY
- PROPOSED EXTENSION TO WATER CATCHMENT
- RECOGNISED COASTAL BATHING BEACHES

Exhibit 3.2

LAND USE AND WATER CLASSIFICATION

SINCLAIR KNIGHT & PARTNERS PTY LTD

N

0 0.5 1 2
Scale

759
SOLDIERS POINT
SALAMANDER BAY
CORLETTE
DUTCHMANS BAY
NELSON BAY
760
SHOAL BAY
796
795
TANILBA BAY
MALLABULA
LEMON TREE PASSAGE
768
766
TAYLORS BEACH
761
762
763
764
765
765a
FINGAL BAY
775a
772
Tilligerry Peninsula
775
769
771
774 Creek
Tilligerry
810
809
808a
767
SALAMANDER SOUTH
808
806
805
BOULDER BAY
Tomaree Peninsula
ANNA BAY
FISHERMANS BAY
BOAT HARBOUR
BIRUBI POINT

LEGEND

WETLANDS

SEPP No 14 AREAS

WETLAND AREAS INTERPRETED FROM AERIAL PHOTOGRAPHY

SEPP NO. 14 BOUNDARIES INTERPRETED FROM 1:25000 DEP SEPP 14 COASTAL WETLAND MAPPING

Exhibit 3.3
WETLANDS

SINCLAIR KNIGHT & PARTNERS PTY LTD

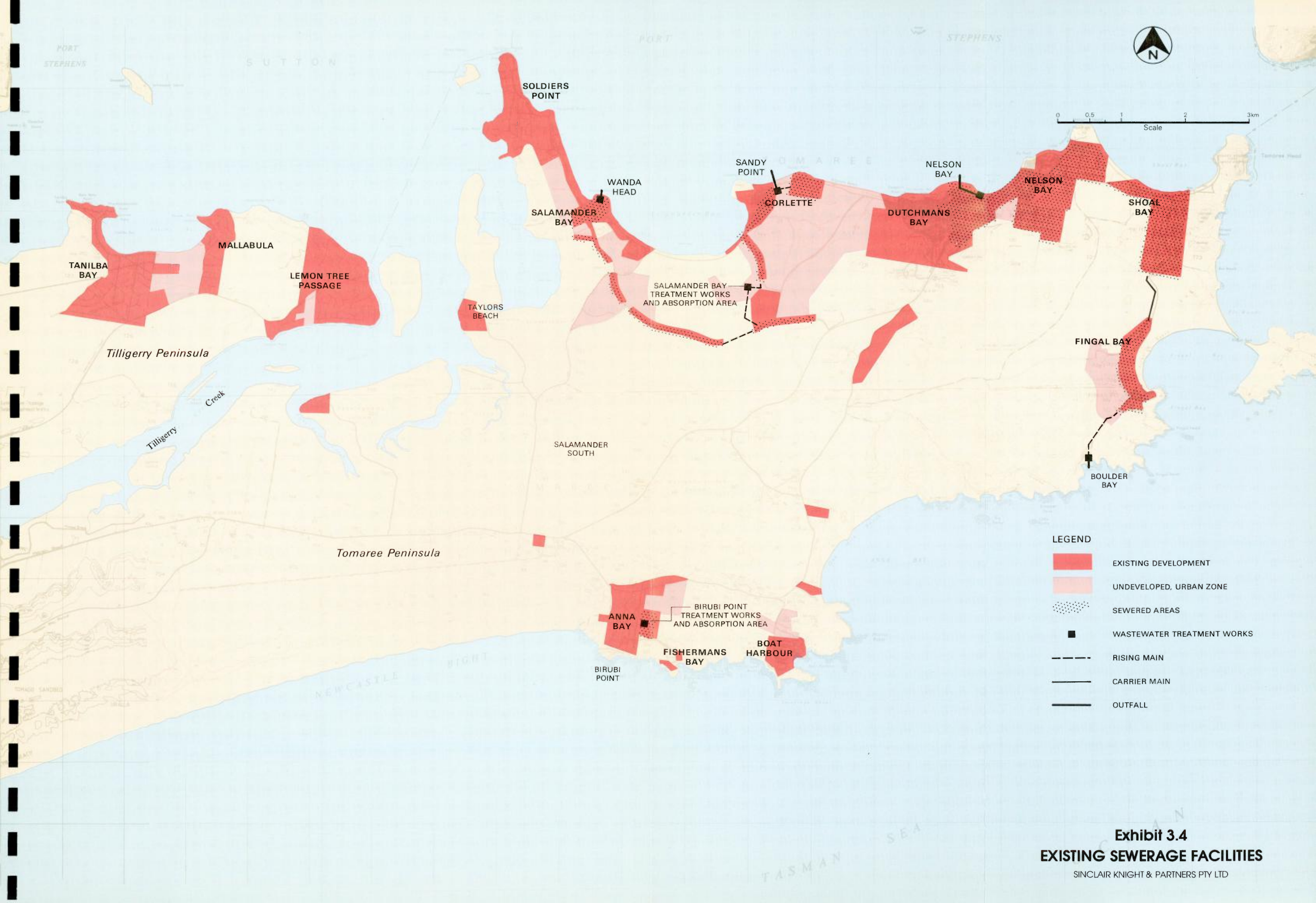


Exhibit 3.4
EXISTING SEWERAGE FACILITIES
SINCLAIR KNIGHT & PARTNERS PTY LTD

4. Development of the Preferred Scheme

This chapter describes the development of the various sewerage scheme options and their assessment. In Chapter 5 the preferred scheme is described in more detail along with alternatives being considered for various components of the scheme.

4.1 BACKGROUND

A sewerage strategy concept report has been prepared (Reference 23) by the Public Works Department for the Tomaree area.

The objectives of the study were:

- to determine the optimal sewerage scheme to serve possible ultimate development of the Tomaree area
- to define an initial sewerage scheme to serve existing townships on the Tomaree area
- to propose a sewerage strategy which is staged to cater for future development
- to recommend further studies which would be required for implementation of the sewerage scheme.

4.2 SEWERAGE LOADINGS

To develop an adequate sewerage strategy requires a reasonable estimation of the rate of growth of the area to be served by the sewerage scheme. The rate of growth in sewerage loadings of an urban area is related to the population growth and development in that area. The rate of growth in demand for sewerage capacity, can thus be estimated from population projections and consideration of related development. In areas such as Tomaree area, where industry is not a heavy water user and serves only the local area, it is also assumed that the growth rate of non-domestic demand for sewerage services is similar to that for domestic growth.

The existing population figures (including permanent and tourist), were discussed in Section 3.14.

4.2.1 Ultimate Permanent Population

As part of the preliminary investigations for the Tomaree Sewerage Scheme, a Concept Report (Reference 23) was commissioned by the Public Works Department. In order to devise an augmentation strategy that ensured an adequate sewerage capacity, the study estimated population growth and associated sewerage loadings for the study area.

Ultimate permanent population in this study is defined as the population at the point of full development of areas which are:

- currently zoned for development, and
- not zoned, but have potential for future development.

It was considered desirable to adopt such criteria for design purposes to ensure that capacity of the proposed scheme (in particular the size of rising mains) was adequate for sewage loadings from ultimate population estimates, therefore minimising the potential for future upgrading of the scheme.

The ultimate population, as defined in this report, is equivalent to the population expected in the study area in approximately fifty years time, which was proposed as the design period for the Concept Report. The factors which will govern development beyond this time span cannot be confidently predicted at this stage.

It is assumed that ultimately all dwellings will be permanently occupied. All undeveloped land was assumed to have a capacity of 10 dwellings per hectare.

Whilst the occupancy rate observed in the study area has been around 2.9 occupants per dwelling in the last two census, there is a trend towards generally lower occupancy rates due to reducing family size and a higher incidence of single parent families. This trend is expected to continue for many years to come.

In addition, the study area is expected to continue to attract retirement accommodation which generally exhibits a small number of occupants per dwelling.

No long term estimates of occupancy rates exist, but the Department of Environment and Planning expects the rate to drop to 2.6 occupants per dwelling at the turn of the century. The Department of Environment and Planning further estimates that the decline in the occupancy rate will level off at around 2.5. Therefore, an occupancy rate of 2.5 occupants per dwelling was adopted for assessing ultimate permanent population. The resulting estimate was 48 800 persons, as shown in Table 4.1.

4.2.2 Ultimate Peak Population

Future tourist population is more difficult to predict than permanent population due to the greater uncertainty of the factors that govern tourist activity. Past trends indicate significant growth (6 - 7%pa) in guest nights, but there is no certainty that these trends will continue. Furthermore, the tourist authorities' main effort is to increase tourism during low tourist seasons. The growth registered in guest nights may represent largely low season increases, which does not affect the peak population.

Tourist accommodation in the study area is based mainly on holiday houses, caravan parks and small motels (up to 40 rooms). The development of large, resort type motels can significantly increase the accomodation capacity. On the other hand, increasing demand for retirement accommodation may lead to an overall decrease in tourism in the area.

Present estimates of peak population suggest a peak to permanent population ratio of approximately 2.2. However, this ratio is expected to decrease in the future with the increase in the permanent population. An estimate of probable ultimate tourist population suggests that the ratio will drop to approximately 1.9. This estimate is based on the assumption that during peak holiday periods, residential dwellings would be occupied by four persons, and likely tourist establishments would be fully occupied.

Table 4.1 lists the ultimate permanent and peak population envisaged in the study area. Detailed estimates of the projected tourist accommodation in each area are provided in the Concept Report (Reference 23).

TABLE 4.1 ESTIMATED ULTIMATE POPULATION

Locality	Permanent Population	Peak Population
Nelson Bay (excluding Dutchmans Bay)	2 000	5 400
Shoal Bay and Fingal Bay	10 000	20 300
Dutchmans Bay, Corlette and Salamander	8 600	16 300
Soldiers Point	5 330	10 700
Tanilba and Mallabula	4 930	8 700
Lemon Tree Passage	3 230	5 600
Anna Bay	3 360	5 800
Boat Harbour	1 350	4 000
Possible New Areas (Salamander South)	10 000	17 000
Total	**48 800**	**93 800**

4.2.3 Population Growth Rates

Port Stephens Shire in general, and the Tomaree area in particular, has experienced in the last ten years an accelerated rate of growth, as compared with most other areas in the country.

Table 4.2 shows typical local growth rates recorded during the period 1976 - 1985.

TABLE 4.2 AVERAGE ANNUAL POPULATION GROWTH RATES 1976 - 1985

Area	Percentage Increase (%)
Port Stephens	5.0
Coastal NSW	3.0
Australia	1.3
NSW	1.1
Sydney	0.9

Source: Australia's Population Trends and Prospects 1986
Department of Immigration and Ethnic Affairs, Canberra.

The study area experienced growth rates of over 6.8% from 1976 to 1986. The general drift of Australian population to the coastal areas, combined with the ageing population and the attraction of Tomaree as a retirement area, suggest that growth in the study area will continue.

Exhibit 4.1 depicts historical population growth and compares two population projections prepared for Port Stephens Shire and for the study area.

Data available for the study area before 1976 are incomplete, as only Nelson Bay (including Shoal Bay, Fingal Bay, Corlette and Soldiers Point) had sufficient population to be listed in the ABS 1966 Census data. Lemon Tree Passage (including Tanilba Bay) is listed as of 1971.

The DEP has prepared three population estimates for Port Stephens Shire which include the study area as well as other areas with a reduced growth potential. For clarity, only the "medium" estimate is shown on Exhibit 4.1. DEP's "High" estimate is close to the PSSC forecasts, but the two refer to different areas. Both estimates assume that growth, both in percentage terms and in absolute numbers, will decline with time. The rates range from 3.8% pa (short term "high" estimate) to 1.7% pa (long term "low" estimate).

The PSSC's estimate for the study area assumes an approximate constant absolute growth. The growth rates are estimated to decline from 3.6% pa in the short term, to 2.9% pa in the long term.

It is proposed that for the purpose of sewerage development, the growth projections developed by PSSC be adopted. These projections are shown on Exhibit 4.1 and are summarized in Table 4.3 Projected Population.

TABLE 4.3 PROJECTED POPULATION

Year	Permanent Population	Peak Population
1986	16 165	36 925
1996	23 100	47 800
2006	30 400	60 300
Ultimate	48 800	93 800

4.2.4 Implications for Future Development

It should be noted that the projected population figures adopted are based on the fact that with existing and anticipated growth rates, existing areas zoned for urban development will be fully developed within approximately 20 years. Limiting the planning time-frame to only 20 years was not considered desirable for designing for ultimate sewerage capacity requirements. Following discussions with PSSC, the only area identified as having potential for long term development was the Salamander South area. All other areas within the study area were considered inappropriate as they were low lying or did not comply with recommendations with the Hunter Valley Regional Environmental Plan No. 1 (Reference 5) and the Draft Hunter Regional Environmental Plan 1987 (Reference 8). For sewerage scheme design purposes, and as shown in Table 4.1, estimated permanent and peak populations in the Salamander South area, were 10 000 and 17 000 respectively. These figures are considered maximum figures which may reduce somewhat subject to full environmental planning studies.

4.2.5 Sewerage Loading Estimates

The capacity of treatment works is expressed in terms of EP (Equivalent Persons). One EP is the contribution by an "average" single resident.

Sewage loadings generated by semi-permanent residents, such as tourists, are lower than those contributed by permanent residents.

The sewage loadings were estimated as follows:

. 1.0 EP for every permanent resident
. 0.67 EP for every tourist

Based on the above information and population projections for the area treatment loadings were calculated and are presented in Table 4.4.

TABLE 4.4 - ESTIMATED TREATMENT LOADINGS

Locality	Loadings (EP) 1986	1996	2006	Ultimate
South Salamander	-	-	-	14 690
Nelson Bay (excluding Dutchmans Bay) Shoal Bay Fingal Bay	12 680	15 050	20 150	21 180
Corlette Salamander (inc Dutchmans Bay)	4 148	5 850	7 550	13 760
Soldiers Point	4 733	5 780	7 470	8 920
Tanilba & Mallabula	3 282	5 140	6 020	7 460
Lemon Tree Passage	2 413	3 760	4 450	4 820
Anna Bay	1 890	2 630	3 240	5000
Boat Harbour	928	1 450	1 560	3 130
Total EP	**30 074**	**39 660**	**50 440**	**78 970**

4.3 DESCRIPTION OF A SEWERAGE SYSTEM

A sewerage system can be considered as having two main components: a collection system and a treatment/disposal system.

Collection systems for sewage include reticulation pipework (small diameter pipelines to which individual houses are connected), manholes, pumping stations, pressure pipelines (rising mains) and transport systems which include larger pipelines conveying sewage from a particular area or catchment to a treatment works.

Within the study area it is proposed that reticulated sewerage will normally be provided to all premises in residential subdivisions and developed areas. It will not be provided to premises in rural areas where the low density of development would mean very high reticulation costs. Additionally, in such rural areas alternate means of treatment/disposal are usually satisfactory.

The collection system conveys sewage to treatment plants. Processes at the treatment plant treat the sewage and produce an effluent suitable for disposal.

4.4 OPTIONS FOR EFFLUENT DISPOSAL

In developing a sewerage scheme for the study area, the options for the disposal of treated effluent were the primary determinants of viable sewerage strategies for the region. After discussions with the State Pollution Control Commission (SPCC) the following effluent disposal options were considered potentially feasible and were addressed in the Tomaree Peninsula Concept Report (Reference 23).

- disposal via an ocean outfall;
- disposal into Port Stephens;
- land disposal (including effluent re-use); and,
- disposal to wetlands.

4.4.1 Ocean Disposal

The ocean coast of the Tomaree Peninsula comprises Tomaree National Park, urban settlements such as Anna Bay, Fishermans Bay, Boat Harbour and Fingal Bay, existing recreational areas and popular bathing beaches (refer Exhibit 3.2). Due to potential conflicts with these land uses (particularly urban areas the National Park and beaches), only two areas were considered appropriate for disposal of effluent via an ocean outfall:

- Boulder Bay area; and
- Birubi Point to Boat Harbour area

The Concept Report (Reference 23) utilised the following information to undertake a preliminary assessment of the feasibility of an ocean outfall in these two areas:

- drogue studies in Boulder Bay carried out by the HDWB from May 1974 to December 1985;
- bathymetry data for Boulder Bay;
- Naval charts; and,
- Lands Department aerial photographs.

Although it was noted that more detailed information would be required to justify effluent disposal at either site, the preliminary assessment indicated that both areas would be potentially suitable as ocean outfall sites.

The SPCC Environmental Design Guide WP-1 for ocean discharge of effluent is attached to this report in Appendix D. The following summary outlines the requirements with regard to disposal location and level of treatment necessary to achieve WP-1 standards.

- the maintenance of ocean waters visually free of oil, grease and other floatable material;

- the protection of ocean waters to retain a natural and diverse, but not necessarily unchanged, variety of marine life;

- the protection of beaches in the interests of public health and to maintain a high degree of aesthetic satisfaction.

4.4.2 Disposal to Port Stephens

Disposal of effluent to Port Stephens was considered less favourable than ocean disposal due to the high level of treatment required to meet SPCC criteria, prior to discharging effluent to the waterway.

As discussed in Section 3.10.2 the waterways within Port Stephens are classified under the Clean Waters Act, 1970 predominantly as either 'Class P - Protected Waters' or 'Class C - Controlled Waters'. The relevant discharge standards are contained in the Regulations of the Clean Waters Act, (1970) (refer Appendix C).

The Class P waters were excluded from consideration as a potential receiving water after advice from the SPCC that it would not support such a proposal and an expectation that neither the public nor the fishing/oyster industry would support such a proposal.

The possibility of discharging to the Class C waters was investigated further.

The SPCC general requirements for discharge into Class C waters are included in Appendix C. Specifically, with respect to discharge of treated effluent into 'Class C' waters within Port Stephens, the SPCC requirements, included:

- discharge at depth (not shoreline);
- phosphorus removal may be required;
- ratio total nitrogen : total phosphorus should be 15 : 1 (this implies a phosphorus limit of 1 mg/L which is very low);
- guidelines on bathing water bacteriological criteria would need to be considered; and,
- studies on the ability of the Port to assimilate and disperse any treated effluent which would need to be undertaken and the results considered before any final decision is made.

Disposal to these waters was considered at the following discharge points:

- existing or modified outfall off Sandy Point; and,
- new outfall off Soldiers Point or Kangaroo Point.

Disposal into Port Stephens at these two locations would necessitate large sewage treatment plant(s) to meet the SPCC discharge criteria. Significant landuse constraints exist with respect to the location of such treatment plant sites in the vicinity of the outfall sites at Sandy Point or Soldiers Point. These constraints primarily relate to the extensive areas of urban development and areas zoned for urban development along the Port Stephens foreshores and land use restrictions associated with the water catchment areas (refer Exhibit 3.2). The only potential area for such a treatment plant was in the vicinity of Salamander South. However, as the Salamander South area is located approximately equidistant from the Port Stephens waterway to the north and the ocean to the south, and as ocean disposal was considered a superior disposal option, both economically and environmentally, disposal to Port Stephens was discounted.

4.4.3 Disposal to Land

In Section 3.5 the Tomago Sandbeds, Coastal Water Reserves Sandbeds and Nelson Bay Sandbeds were described. Discharge of effluent to these areas is subject to the criteria for underground protected waters under the Clean Waters Act, 1970. These criteria make it impractical to discharge sewage effluent to these areas.

Disposal to land elsewhere in the study region is subject to the provisions of the Environmental Design Guides WP-6 (1979) and WP-7 (1986) issued by the SPCC. (References 26 & 27). These guides provide criteria relating to

- loading rates and water balances;
- land requirements; and,
- treatment requirements.

Following preliminary application of these criteria two potential land disposal sites were identified:

- an area southwest of Lemon Tree Passage and southeast of Tanilba Bay; and,

- an area to the south and west of Salamander Estate. One site within this area, directly south of Wanda Wanda Head, had been the subject of an earlier study for land disposal of effluent (Reference 13).

Further invesigations indicated that the area south and west of Salamander Estate was not suitable for a variety of reasons including, importantly, the lack of a suitable site for a treatment works.

The Tanilba Bay site was assessed as being feasible for disposal of effluent from the Tilligerry Peninsula alone as:

- it had sufficient land under estimated sewage loadings from the Tilligerry Peninsula for a sewage treatment plant and associated land disposal system;

- it was sufficiently removed from existing and proposed urban development;

- a site within the area had been acquired by the HDWB for future use as a treatment works site.

However, it was noted in the Concept Report that more detailed investigation of the site would be necessary to guard against either adverse effects on groundwater reserves or subsurface short circuiting to protected waters.

4.4.4 Disposal to Wetlands

Disposal to wetlands was not considered because:

- the SPCC indicated that a policy regarding discharge to wetlands is in the process of being developed. In general, the policy is expected to disallow discharge of sewage effluent to wetlands where no such discharge is currently taking place, unless it can be shown that no adverse environmental impact will occur.

- where potentially suitable wetlands occur in the area, they are located next to Class P (protected) waters necessitating nutrient removal. Since the nutrient removal capability of wetlands is uncertain, it is unlikely that the SPCC would accept such wetlands as providing suitable pretreatment to enable discharge to Class P waters. Nutrient removal could be undertaken at the treatment plant but at a high cost.

- wetlands existing in inland areas are not considered to be suitable for disposal, since the effluent could alter the water balance and thus potentially affect the ecology of the wetlands.

4.4.5 Selected Disposal Options

Following the above investigations, the disposal locations considered as acceptable for inclusion in developing sewerage scheme options were:

- ocean outfall in the Boulder Bay or the Birubi point to Boat Harbour areas; and,

- partial land disposal within the site identified on the Tilligerry Peninsula south west of Lemon Tree Passage and south east of Tanilba Bay.

4.5 SEWERAGE SCHEME OPTIONS

4.5.1 Introduction

The following four disposal options based on the above disposal locations were developed:

1. ocean outfall at Boulder Bay;
2. ocean outfall at Boulder Bay and land disposal at Tanilba Bay;
3. ocean outfalls at Boulder Bay and Anna Bay (Birubi Point);
4. ocean outfalls at Boulder Bay and Anna Bay with land disposal at Tanilba Bay.

These sewerage scheme options generally recognised that the study area comprises two distinct geographical units (Tomaree Peninsula and Tilligerry Peninsula) which could be treated as separate units or amalgamated in any sewerage strategy.

In all the scheme options, sewage from the existing Shoal Bay/Fingal Bay schemes would be transported to Boulder Bay by the existing system.

Several treatment and transport options were developed and considered for each disposal alternative (refer Exhibit 4.2).

4.5.2 Reticulation

Reticulation catchments for each township were identified in the Concept Report (Reference 23) and preliminary minor transportation system layouts were provided. Final layouts will not be prepared until a sewerage strategy has been adopted. For the purpose of comparing sewerage scheme options reticulation forms a common element of all strategies.

4.5.3 Transport

Due to the topography and long distances between townships in the study area transport systems in the form of rising mains and pumping stations are required to transport sewage from reticulation systems to treatment and disposal facilities.

Following preliminary analysis the Concept Report identified the following potential constraints on the transport system routes:

- urban development areas
- wetlands
- high ground, steep slopes
- creeks and other waterways
- private land
- Tomaree National Park

When developing transport route options for the four identified disposal options the priority was to minimise impact on or intrusion into these land use areas and geographic features.

In all, eight transport options were evaluated in the Concept Report and their respective costs estimated (refer Exhibit 4.2).

4.5.4 Treatment

Boulder Bay
The treatment options considered for this ocean outfall location included:

- preliminary treatment (milliscreening) combined with a long ocean outfall;
- secondary treatment combined with a short outfall (shoreline); and,

. primary treatment and short outfall (for low sewerage loading scenarios only).

Broad based advantages and disadvantages of each of these options are presented in Table 4.5. It should be noted that the adoption of Boulder Bay as a treatment site may impact on adjoining land in the future should the SPCC change its discharge requirements. The environmental advantages associated with the option combining milliscreening and long outfall were considered more significant than for the combinations of secondary treatment/shoreline outfall and primary treatment/shoreline outfall (low sewerage loadings only). The potential implications of this combination are discussed in detail in Section 8.4.

A submarine pipeline although more expensive was preferred to a land pipeline along the western shoreline of the Bay, having less potential environmental impact. However, further studies were recommended in order to confirm assumptions made regarding a submarine outfall at Boulder Bay. The findings of these studies are detailed in Chapter 8.

TABLE 4.5 - TREATMENT - OPTIONS FOR BOULDER BAY

	Advantages	Disadvantages
Preliminary Treatment/ Long Ocean Outfall	. Small land area required for treatment plant . Improved visual amenity of Boulder Bay . Increased dilution potential due to offshore deep water location	. Construction difficulties and high cost associated with deep water outfall
Secondary Treatment/ Shoreline Outfall	. High quality effluent would be discharged . Improved visual amenity of Boulder Bay	. Larger land area required for treatment works . Visual Impact of treatment works
Primary Treatment/ Short Outfall (low loading scenarios only).	. Less land requirements for treatment works than secondary treatment works	. Limited flexibility of outfall capacity . Visual impact of shoreline discharge of primary treated effluent.

Anna Bay
The treatment options considered for this ocean outfall location included:

- milliscreening combined with a long outfall; and,
- secondary treatment and shoreline discharge off the headland at or near Birubi Point.

Milliscreening and a long outfall were considered to have similar environmental and economic advantages to those described for the Boulder Bay option. However, as was the case for Boulder Bay, if an outfall at Anna Bay was included in the preferred scheme, further studies were recommended.

Tanilba Bay
The proposed method of disposal by infiltration, dictated that secondary treatment be adopted so as to meet the design guidelines outlined by the SPCC. (Refer References 26 and 27).

4.5.5 Selection of a Short List

A preliminary environmental assessment was undertaken of the disposal options and the associated treatment and transport options which included:

- ocean outfall at Boulder Bay
- ocean outfall at Boulder Bay combined with land disposal at Tanilba Bay
- ocean outfalls at Boulder Bay and Anna Bay (Birubi Point)
- ocean outfalls at Boulder Bay and Anna Bay with land disposal at Tanilba Bay.

The assessment concluded that there were no absolute environmental constraints which precluded any of the options. As all options were considered to have broadly similar environmental impact potential following preliminary assessment, the most economic option was short-listed from each of the various disposal options for more detailed consideration, with both variations of Alternative 4 being included. The short listed or candidate schemes are depicted in Exhibit 4.3. They included:

Option 1C — A single treatment and disposal location at Boulder Bay which would serve the entire study area with raw sewage from Tilligerry Peninsula being piped across Tilligerry Creek. Sewage would be transported via a central route through Tomaree Peninsula.

Option 2B — Two treatment and disposal sites. Sewage from Tilligerry Peninsula would be treated locally and disposed of by land infiltration at the Tanilba Bay sewage treatment plant site. Sewage from the balance of the study area would be transported via a central route through Tomaree Peninsula to Boulder Bay for treatment and disposal to coastal waters.

Option 3 — Two treatment and disposal sites; at Boulder Bay and near Anna Bay. The Boulder Bay disposal site would serve Nelson Bay, Shoal Bay and Fingal Bay, and sewage from the remainder of the study area would be treated near Anna Bay with coastal waters discharge of effluent off Birubi Point.

Option 4A — Three treatment and disposal locations. Sewage from Tilligerry Peninsula would be treated and disposed of locally. A sewage treatment works near Anna Bay would serve the communities of Anna Bay, Boat Harbour and possible future Salamander South development, with discharge of effluent to coastal waters off Birubi Point. Boulder Bay would serve the areas currently served by the Nelson Bay/Shoal Bay Scheme, Soldiers Point and Salamander.

Option 4B — Three treatment locations. This option is similar to Option 3 except for local treatment and disposal of sewage from Tilligerry Peninsula avoiding the need to pipe raw sewage across Tilligerry Creek.

4.5.6 Comparison of Candidate Schemes

Table 4.6 compares the advantages and disadvantages of the schemes, the initial and future capital costs of the schemes, treatment and transport costs as well as their ultimate present worth costs. When comparing the options on present worth cost basis, it was evident that Option 2B was the most economical option. Options 1C and 4B are the next most economical on present worth basis, approximately 6.5% higher than Option 2B. Options 3 and 4A are the most expensive schemes. Due to the levels of accuracy adopted for the preliminary cost estimates it was recognised in the Concept Report that selection of preferred option between schemes 1C, 2B and 4B should not be based on economic grounds only.

Less tangible benefits and costs of these options were taken into account to select a preferred option. Broad advantages and disadvantages for all schemes are listed in Table 4.6.

In addition to the candidate schemes, the cost to the community of not undertaking a regional reticulated sewerage scheme was estimated.

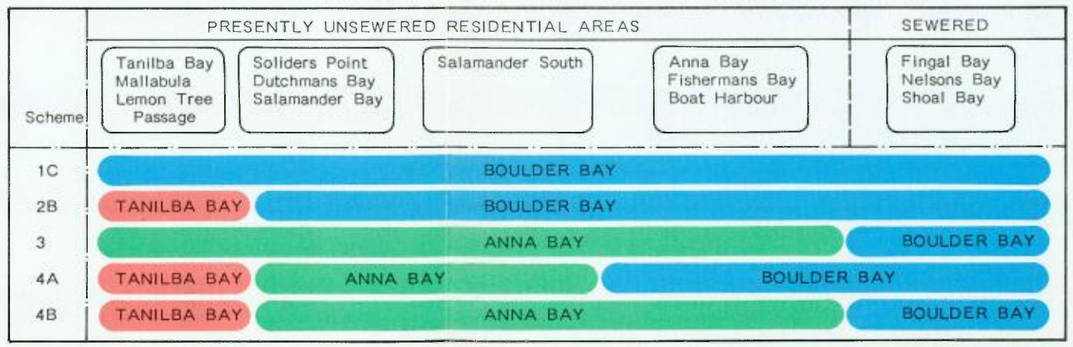
To provide a comparison to the candidate schemes in economic terms, a "no build" scenario was developed assuming all future dwellings would be provided with septic pump-out systems or with septic transpiration systems at the existing ratio of 8% pump-out and 92% transpiration (Reference 23). Based on the above the "no-build" option was estimated at $22 900 000, which is more expensive than Option 2B (the most economical scheme). This fact combined with the potential environmental disadvantages associated with septic systems listed in Section 3.15.4 ruled out the "No Build" option as a viable option.

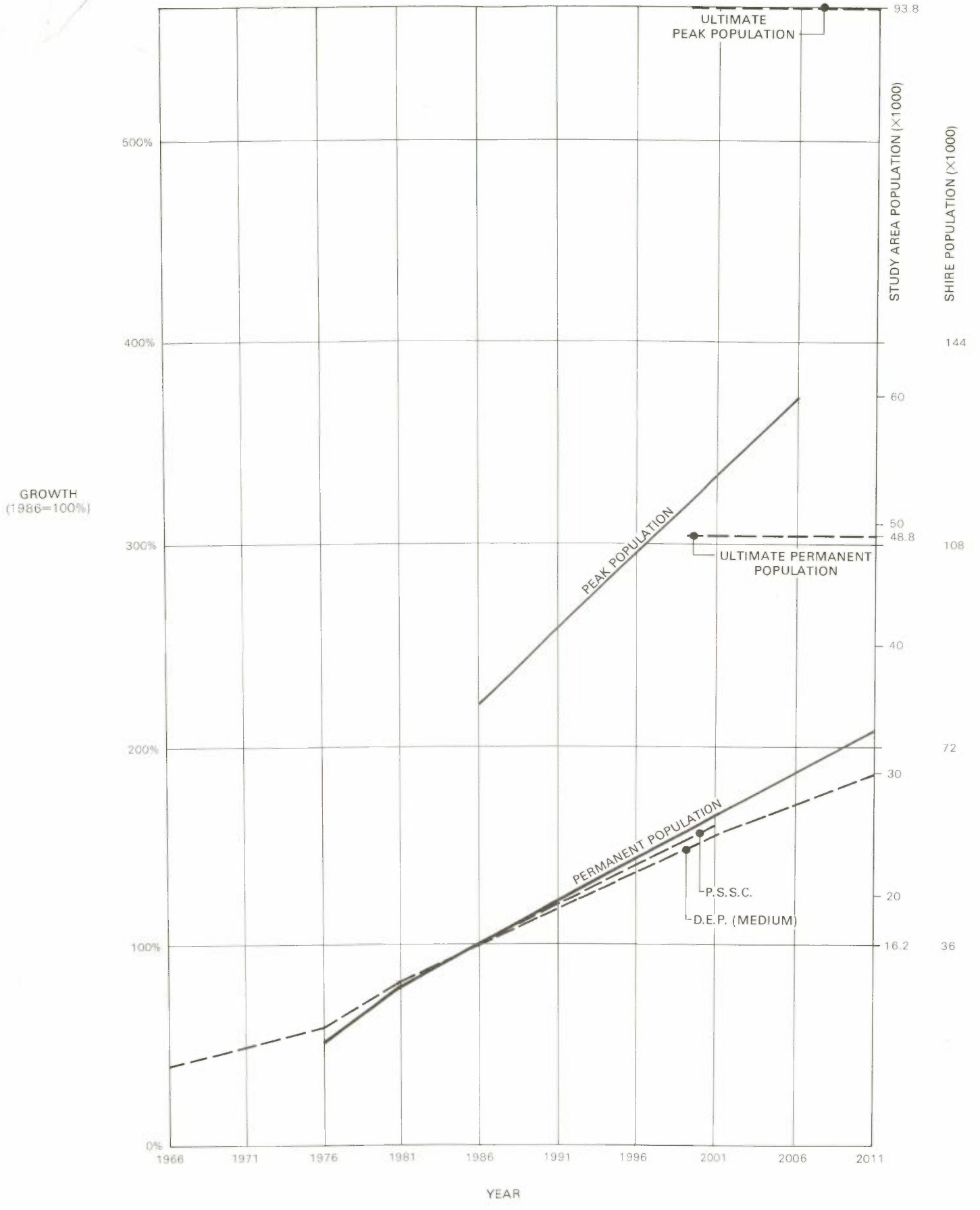
It was considered that the estimated cost advantage, combined with the other advantages as listed in Table 4.6, outweigh the comparatively limited disadvantages of Option 2B. Option 2B was therefore recommended as the preferred scheme. This recommendation was accepted by the Hunter District Water Board 19 June 1987 and Port Stephens Shire Council on 24 June 1987.

TABLE 4.6 COMPARISON OF CANDIDATE SCHEMES

Scheme No	Scheme (Option) Description	Costs $m Financial			Present Worth Analysis (Includes Operation Cost) Total Present Worth Cost			Advantages of Scheme	Disadvantages of Scheme	Ratings
		Initial Capital Costs	Future Capital Costs	Ultimate Capital Costs	5%	10%	15%			
1C	Sewage from all townships to be transported to Boulder Bay for treatment and disposal to coastal waters.	18.1	2.7	20.8	35.5	25.6	22.7	. a single treatment plant would simplify operations and maintenance . less land is required	. Submarine crossing of Tilligerry Creek may be perceived as undesirable due to remote possibility of pipe breakage . more expensive than scheme 2B for no additional environmental benefit	2
2B	Sewage from Tanilba Bay, Mallabula and Lemon Tree Passage to be treated locally with land disposal of effluent. Sewage from all remaining areas to be transported to Boulder Bay for treatment and disposal to coastal waters.	17.2	3.7	20.9	32.7	23.9	21.2	. lowest initial capital cost . no submarine crossing of Tilligerry Creek is required thus eliminating the remote possibility of raw sewage leaking to the Creek from a break in the pipeline . increased flexibility. Either Tomaree or Tilligerry peninsulas could be separately advanced for sewering . the most economic scheme	. more land is required for this than 1C . location of a treatment plant at Tanilba Bay could impose limitations on possible future land use around it	1
3	Sewage from the existing sewered townships of Nelson Bay, Shoal Bay and Fingal Bay will continue to be transported to Boulder Bay for treatment and disposal. Sewage from all remaining areas to be transported to Birubi Point for treatment and disposal to coastal waters.	19.1	4.1	23.2	36.3	29.0	23.8	. no advantages over scheme 2B except no limitations imposed on possible future land use around Tanilba Bay treatment plant site	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . more expensive than scheme 2B for no additional benefit . submarine crossing of Tilligerry Creek may be perceived as undesirable due to remote possibility of pipe breakage	5
4A	Sewage from Tanilba Bay, Mallabula and Lemon Tree Passage to be treated locally with land disposal of effluent. Sewage from Anna Bay, Boat Harbour and Salamander south also to be treated locally with effluent disposal to coastal waters of Birubi Point. Sewage from remaining areas to be transported to Boulder Bay for treatment with coastal waters discharge.	22.3	6.7	29.0	37.0	30.1	26.2	. no submarine crossing of Tilligerry Creek is required thus eliminating the remote possibility of raw sewage leaking to the creek from a break in the pipeline . increased flexibility. Either Tomaree or Tilligerry peninsulas could be separately advanced for sewering	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . three treatment work sites are required, increasing complexity and land needs . more expensive than scheme 2B for no additional benefit	4
4B	Option 4B is similar to Option 3 except for local treatment and disposal of sewage from Tanilba Bay, Mallabula and Lemon Tree Passage.	17.8	4.8	22.6	31.4	25.4	21.6	. no advantages over scheme 2B	. envisaged firm public opposition, particularly due to the proximity of the possible outfall at Anna Bay to urban development areas . location of a treatment plant at Tanilba Bay could impose limitations on possible future land use around it . more land is required than Scheme 1C	3

SUMMARY OF EFFLUENT DISPOSAL LOCATIONS FOR EACH SCHEME





LEGEND

STUDY AREA POPULATION (P.S.S.C.)

STUDY AREA POPULATION (PROJECTION)

SHIRE POPULATION

Exhibit 4.1
ESTIMATED POPULATION GROWTH

SINCLAIR KNIGHT & PARTNERS PTY LTD

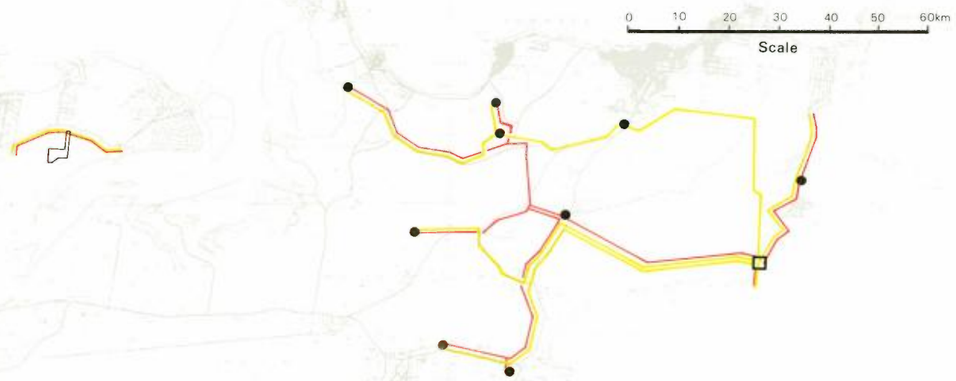
DISPOSAL SCHEME 1

OPTION 1A

OPTION 1B

OPTION 1C

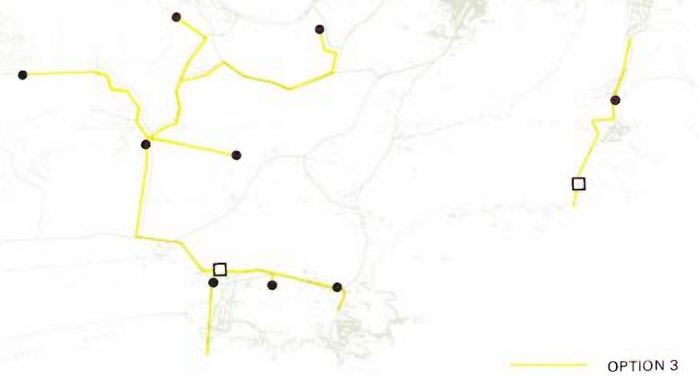
DISPOSAL SCHEME 2



OPTION 2A

OPTION 2B

DISPOSAL SCHEME 3



OPTION 3

DISPOSAL SCHEME 4

OPTION 4A

OPTION 4B

Exhibit 4.2
SEWERAGE SCHEME OPTIONS
SINCLAIR KNIGHT & PARTNERS PTY LTD

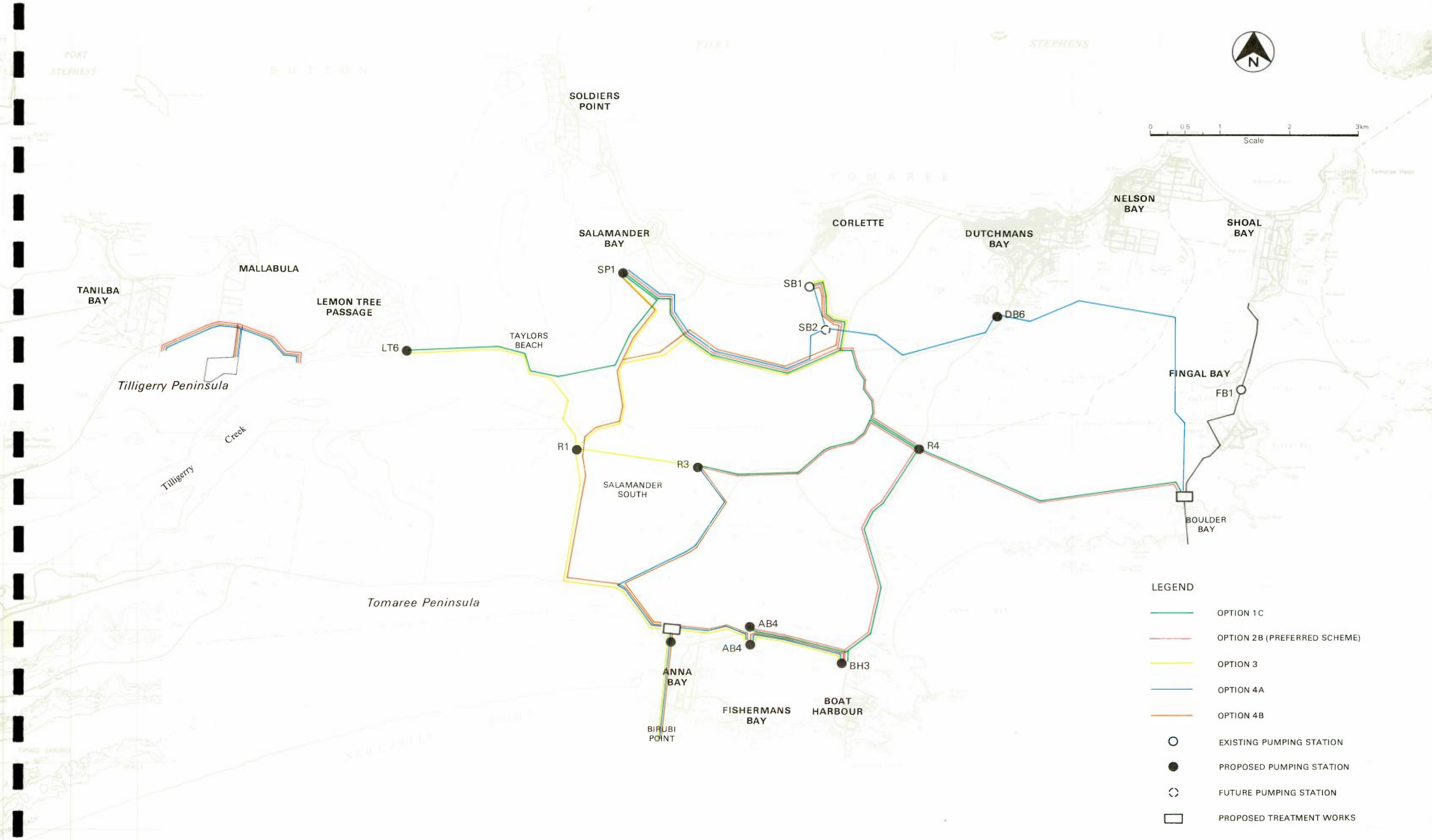


Exhibit 4.3
SHORT LISTED SCHEMES
SINCLAIR KNIGHT & PARTNERS PTY LTD

5. Detailed Description of the Preferred Scheme

5.1 GENERAL

The proposed scheme (refer Exhibit 5.1) comprises:

- sewer reticulation of the development areas (existing and proposed) of both the Tilligerry and Tomaree Peninsulas;
- transport of sewage on the Tilligerry Peninsula from reticulation to a local treatment plant and land disposal system;
- transport of sewage on the Tomaree Peninsula, from the reticulation to a sewage treatment plant and ocean outfall at Boulder Bay.

The proposed scheme achieves:

- the cessation of sewage effluent discharge to Port Stephens thereby removing potential threats to the oyster industry and the recreational amenity of the waterway;
- improvement of the amenity of Boulder Bay by removing the shoreline discharge of effluent;
- the rationalisation of the existing six reticulated sewerage schemes thus enhancing control over sewage treatment and disposal;
- removal of the need for septic tank systems and the associated potential problems these systems possess;
- allowance for future development within the Study Area;
- provision of suitable methods for disposal of effluent.

The components of the preferred scheme are described below:

5.2 RETICULATION

Reticulation systems (collection) for sewage include reticulation pipework (small diameter pipelines to which individual houses are connected) manholes, pumping stations and trunk sewers which are larger diameter pipelines conveying sewage from a particular area.

Reticulation will be installed in all areas to be sewered within the study area which are developed and occupied. Due to topography and economics, systems will include some pumping stations and pressure mains to lift sewage from low areas. The sizes of sewerage pipes and pumping stations will generally be calculated on the basis of standard Public Works Department design criteria as set out in the Sewer Design Manual (Reference 22). All pipelines where practicable will be laid in trenches within road easement and appropriate restoration undertaken.

Typically pumping stations within reticulation systems will be underground and comprise pumping units in cylindrical concrete cells. Above ground a small cubicle, vent shaft and concrete slab will be visible.

Reticulation catchments for each township were identified in the Concept Report (Reference 23) and preliminary minor transportation system layouts were provided. Final layouts will not be prepared until a decision on the overall scheme is made. After that time further survey and investigation will be undertaken to provide a basis for detailed final design.

5.3 TILLIGERRY PENINSULA

5.3.1 Transport System

The transport system for Tilligerry Peninsula incorporates underground rising mains to transport the raw sewage from the reticulation network (including gravity mains, small diameter rising mains and small pumping stations) servicing the urban areas of Tanilba Bay, Mallabula and Lemon Tree Passage. These will all feed south to connect with the major rising mains in the vicinty of Lemon Tree Passage Road. The rising mains will run adjacent to Lemon Tree Passage Road turning south to enter the proposed treatment works site (refer to Exhibit 5.1). It is envisaged that the pipeline route will be located within the easement of Lemon Tree Passage Road.

Septicity control measures may be required when sewage is transported in pipelines over long distances resulting in long detention times. Long detention times may result in the sewage becoming septic and in sulphide generation. The sulphides generated include hydrogen sulphide (H_2S) which is a highly toxic malodorous gas. H_2S reacts with oxygen to form sulphuric acid which is highly corrosive and may accelerate deterioration of structures. Control measures such as oxygen injection can be used to inhibit the sewage becoming septic.

Due to the short distances between the townships of Lemon Tree Passage, Mallabula, Tanilba Bay and the proposed sewage treatment works site it is not envisaged that septicity control measures will be required in the mains.

5.3.2 Treatment

A site, approximately 12 hectares in area, within the area identified as being suitable for land disposal of effluent (refer Section 4.4.3) is already owned by the Hunter District Water Board, immediately south east of Tanilba Bay. The proposed site is located about 300 m. north of Tilligerry Creek (refer Exhibit 5.1) and immediately north of an area currently being sand mined under a permissive occupancy from the Maitland Lands Office (refer Section 3.4).

The sewage treatment plant proposed will be specifically designed to reduce the organic content and particulate matter in the sewage to a low level suitable for disposal onto the land. The design will be submitted to the SPCC for approval prior to construction. This level of treatment is known as "secondary treatment" and will produce a treated effluent with a biochemical oxygen demand and suspended solids lower than 20mg/L and 30 mg/L, respectively. Secondary treatment also substantially reduces (around 99%) the levels of faecal coliform bacteria. These organisms are used as a measure of bacterial contamination.

Construction of the treatment plant will be staged to have a total design capacity of 12 300 EP, the ultimate population projected for the Tilligerry Peninsula.

Pending the results of detailed design and costing, the basic process proposed for the treatment works is the extended aeration system, a well established process which produces a reliable high standard of effluent.

An extended aeration plant would typically comprise the following:

- inlet works
- aeration tank) may be combined in one unit for
- clarifier) intermittent extended aeration
- sludge lagoons
- amenities building.

Disposal of effluent for the Tanilba Bay Treatment Plant would be by infiltration ponds.

Approximately seven to eight hectares will be required to be cleared to accommodate the proposed works.

The inlet works for the plant would be a concrete structure containing a screen to remove rags, pieces of wood etc.

Aeration tanks are large low profile concrete structures where air (oxygen) is introduced to the incoming sewage to promote bacterial action which degrades the organic material in the sewage. Sewage is retained in the aeration tanks before being discharged to the clarifiers.

The clarifiers are where the solids in the sewage are separated from the liquid which has at this point received secondary treatment and is fit for disposal. The effluent at this stage will comprise a virtually clear liquid. The solid material or sludge which settles to the floor of the clarifiers is withdrawn and returned to the aeration tank. Some of this "sludge" will be pumped to the sludge lagoons for temporary storage prior to ultimate disposal to landfill every few years.

A preliminary layout for the treatment works is depicted in Exhibit 7.3.

The entire plant area will be well screened from the main road by existing and planted vegetation. The plant area also will be landscaped to ensure a high level of aesthetic amenity (refer Section 7.3.7).

5.3.3 Disposal

Treated effluent will be disposed of in two 1.5 hectare sandy bottom infiltration ponds, and will require licensing by the SPCC.

The following operational parameters generally apply to the design of infiltration ponds.

- Infiltration occurs as vertical flow through the floor of a pond and this flow is progressively deflected to horizontal groundwater flow by the water table and/or soil horizons of low permeability. The pond dimensions must be sufficient to ensure vertical flow through the floor for a continuous hydraulic load and with sufficient buffer capacity for peak load conditions.

- The floor of each pond acts as a filter and with time, the floor permeability can be expected to decrease as a result of suspended solids, algae, etc. settling out and binding sand grains, thus causing infiltration rates to decrease. Various techniques, such as cycling usage of the ponds for wet and dry periods and periodic mechanical workover when empty will maintain permeabilities and provide a measure of denitrification.

Sizing and location of the infiltration ponds was determined from a study undertaken of the hydrogeology of the Tanilba Bay area (Reference 14).

Field studies were undertaken to determine the insitu permeability of sands, depth of sand layers and water table levels. Soil samples were taken for chemical analysis.

In order to determine optimum pond size and loading, a design water level in the ponds equivalent to ground level at the sewage treatment works site was assumed. A finite element computer model was established. The model was calibrated and infiltration rates were determined for variable pond dimensions. The analysis indicated that only minor increases in infiltration capacity could be achieved beyond a pond size of 20 000 square metres.

The proposed ponding scheme would comprise two 150 m x 100 m ponds separated by about 50 m and located along the southern boundary of the STW site.

Each pond would be excavated to approximately 0.5 m below ground level with the excavated sand material being used to establish bund walls above existing ground level. One pond would be utilized for average dry weather flows with both ponds in use for transient peak weather flow conditions. The maximum theoretical infiltration flux for one pond in operation is in the order of 1 800 kL/day to 2200 kL/day. These infiltration rates equate to anticipated loads for 1996 (ADWF 2100 kL/day). Ultimate loading of the ponds cannot be infiltrated, according to the model without ponds flooding during summer months with peak population loading. Implications of the proposed infiltration process on groundwater levels and quality is discussed in detail in Section 7.3.2 and 7.3.3.

It should be noted that the computer modelling is based on conservative values of permeability and hydraulic parameters. It is possible that ultimate loading may be accommodated via the proposed ponds if field data obtained at lesser loadings (ie the earlier stages of treatment plant operation) proves favourable. If field monitoring indicates that ultimate flows could not be accommodated an alternative augmentation pond a short distance south of the site could take ultimate flows (Reference 14). This land is Crown land part of which is presently being mined for silica sand (refer Section 3.4). The mining operation is anticipated to be completed in this area within the next couple of years and would therefore not pose a constraint to any possible extension of the treatment plant site. Also opportunities exist on the Tilligerry Peninsula for reuse of effluent which would decrease flows to the infiltration ponds. Any overflow from the infiltration ponds would be designed to meet SPCC requirements.

5.4 TOMAREE PENINSULA

5.4.1 Reticulation

The reticulation (collection) system proposed for the Tomaree Peninsula comprises similar components to that described in Section 5.1.

Again, preliminary reticulation catchment layouts were identified and preliminary minor transportation layouts were developed in the Concept Report. Final layouts will not be prepared until a decision on the overall scheme is made. After that time, further survey and investigations will be undertaken to provide a basis for more detailed design.

5.4.2. Transport System

The transport system for the Tomaree Peninsula area will comprise rising mains and pumping stations transporting raw sewage from the townships on the Peninsula to the ocean outfall at Boulder Bay.

The preferred route for the pipeline is shown on Exhibit 5.1. The main elements are as follows:

- a regional pumping station at Salamander Bay (SP1), linking with the existing pumping station at Corlette, (SB1). The rising main from pumping station SP1 will run south east along Soldiers Point Road then turning east along Salamander Way to the new Salamander Centre shopping complex. At this point it may join or run parallel with the rising main running south along the road leading from Corlette and pumping station SB1. From Salamander Centre the rising main will turn south east following unsealed tracks though undeveloped land (comprising predominantly bushland and wetlands), intersecting with Nelson Bay Road near Gan Gan Military Camp. Running south along Nelson Bay Road for approximately 200 metres the rising main turns south-east following an unsealed track (paralleling a transmission line) running adjacent to the southern boundary of Gan Gan Military Camp where it will feed into pumping station R4 on the western side of Gan Gan Road adjacent to the Anna Bay Water Treatment Plant.

- a rising main to Boulder Bay from pumping station R4 within the HDWB Water Catchment Area running adjacent to the southern boundary. For approximately 1.7 kilometres the proposed route of the rising main, running approximately in a south-east direction from pumping station R4, will follow existing unsealed tracks within the HDWB catchment area; it then turns due east through uncleared bush. Although a number of unsealed tracks run through to Boulder Bay, it was not considered desirable to follow these tracks for their entire length for two main reasons:

  - most tracks at some point cross into Tomaree National Park and it was desirable to minimise impact within the National Park,

  - The level of the rising main could not exceed 35 m ASL in order to maintain sufficient hydraulic head without the need for another pumping station along this section of the route. The proposed rising main has been routed to meet this criterion.

  To minimise potential impacts on the Water Catchment Area, including the HDWB extraction bores, design and construction of this section of the pipeline will meet HDWB requirements.

The final portion of this section of the route will necessitate an approximately 400 metre long crossing of the Tomaree National Park immediately adjacent to Boulder Bay. An alternative route for the final section of the pipeline into Boulder Bay was investigated to determine the implications of avoiding the 400 (approx) metre crossing of Tomaree National Park. To avoid the National Park it would be necessary to construct in excess of two kilometre of additional pipeline in the Water Catchment Area adjacent to the northern boundary of the National Park (refer Exhibit 5.1). The primary reason for considering an alternative route around the National Park was to avoid the potential ecological impacts associated with clearing the easement. As the alternative route would require approximately two kilometres additional clearing and an increased capital outlay of around $1.3 million dollars, this alternative was not considered desirable.

Port Stephens Shire Council is presently investigating the possibility of constructing a tourist road through the HDWB catchment linking Nelson Bay Road (in the vicinity of proposed pumping station R4) to Fingal Bay (refer Reference 16). If the tourist road were to proceed the proposed rising main would be routed within the road easement, thereby restricting disturbance through the HDWB water catchment area to a single corridor.

- pumping stations AB4 and BH3 at Boat Harbour to pump sewage from Boat Harbour and Anna Bay to pumping station R4

- future pumping station at Salamander South R3, will pump sewage from that area to R4. The actual location of the R3 pumping station and pipeline to R4 have not been fixed, due to the uncertainty with respect to the appropriateness and/or extent of future urban development in the Salamander South area.

The existing sewerage system will continue to service the townships of Dutchmans Bay, Nelson Bay, Shoal Bay and Fingal Bay, which includes both gravity and rising mains pumping sewage to the Boulder Bay outfall.

As outlined above and shown on Exhibit 5.1 the majority of the route is located within road easements or follows the route of existing unsealed tracks. Of the proposed route with a total length of around 20 kilometres, only approximately 2 kilometres will be through uncleared bushland.

Long detention times in rising mains may result in the sewage becoming septic and in sulphide generation, a reaction due principally to anaerobic bacterial reduction of sulphates contained in the sewage. The sulphides generated are a mixture of hydrogen sulphide (H_2S) and HS^- ion. Hydrogen sulphide is a potentially toxic, malodourous gas. It reacts with oxygen to form sulphuric acid which is corrosive and may accelerate deterioration of structures.

There are several methods to overcome septicity problems. They include dosing with oxygen or chemicals for the prevention of septicity; dosing with oxygen or chemicals for eliminating the sulphides; and the removal of odours at the point of discharge. The need for and method of overcoming such problems would be determined during detail design.

5.4.3 Treatment

As discussed in Section 4.5.4, it is proposed to adopt preliminary treatment with an extended outfall pipeline. The proposed treatment plant would be subject to detailed design and costing but nominally would comprise a milliscreening plant consisting of a series of rotating fine screens designed to remove all discrete floatable materials, suspended materials, and a small amount of oil and grease. Final design would be subject to SPCC approval and licensing. The screenings removed from the flow will be compacted and dewatered within the plant, and disposed to local sanitary landfill as required. A typical layout for such a plant is shown on Exhibit 5.2 and comprises:

- **Inlet Structure** - designed for the ultimate peak wet weather flow rate. The pumped inflow would provide sufficient pressure to lift the sewage over the screens.

- **Flow Dividing Structure** - a flow divider would divide flow between the various screens. In addition a bypass channel including manually raked screening for emergency situations.

- **Screens** - milliscreens of 1.0 mm aperture to remove grit (80-90% removal), oil and grease (30% removal) and floatable solids (90-95% removal) from the raw sewage. Screens would be arranged to provide for all screens operating at the ultimate peak wet weather flow. During dry weather flow conditions standby capacity is available.

- **Screenings Conveyor and Press** - to dewater and compress screenings to a solids content of 20% to 30% for ultimate disposal off-site. Filtrate would be returned to the effluent channel.

- **Equalisation tank** - storage to accept pumped flows during dry weather conditions and limit outflow to average dry weather flow rates. During periods of peak wet weather, when sewage is diluted approximately 7:1 with stormwater/groundwater, overflow of the equalisation tank to the outfall occurs.

- **Building** - a building is proposed to contain the plant and equipment for corrosion protection; improved working conditions; aesthetics; and noise reduction. Selection of building materials would be subject to detail design and investigation but typically the building would comprise a brick/block section housing amenities and laboratory, and a metal clad section housing the operational plant. The building would include a gantry for screen installation and maintenance. The building would measure approximately 13 m x 38 m x 7 m and will be located in a topographic depression midway along the western boundary of the HDWB site at Boulder Bay (refer Exhibit 5.3).

- **Ventilation and Odour Control** - would be provided for the building, since raw sewage has some odour producing potential and also to protect against the development of corrosive conditions.

- **Effluent Structure** - pipework/channels to connect into the outfall line.

The design capacity of the plant would be suitable for the ultimate sewage loadings estimated at 19.0 megalitres per day.

The existing treatment plant (refer Exhibit 5.3) located at the end of the access track to Boulder Bay will be decommissioned and the area rehabilitated.

5.4.4 Disposal

The treated effluent will be disposed of via an ocean outfall. The SPCC requirements for the design of ocean outfalls are outlined in their Environmental Guide WP-1 (refer Appendix D), which has the following specific objectives for the control of pollution.

- the maintenance of ocean waters visually free of oil grease and other floatable material

- the protection of ocean waters to retain a natural diverse but not necessarily unchanged variety of marine life

- the protection of beaches in the interests of public health and to maintain a high degree of aethetic satisfaction.

With adoption of milliscreening and an extended outfall the existing shoreline outfall will be replaced. The most appropriate location of the extended outfall with respect to meeting the SPCC criteria, was determined from a study undertaken of the Boulder Bay nearshore environment (Reference 2).

The principal factors influencing selection of outfall options are seabed conditions, current patterns and outfall discharge performance. Diffusers for outfalls must be placed on a flat area to avoid non-uniform flow over the range of effluent discharge flows, and possible salt water intrusion into the outfall pipeline during periods of low flows.

As discussed in Section 3.10.1 Boulder Bay is typical of the small rocky embayments along this section of the coast. Mapping of the bathymetry of the bay and an underwater video of the bed of the bay was undertaken. From this information it was determined that there are three flat areas in which an outfall diffuser could be located:

- Option 1 is just beyond the inshore reefs. The diffuser could be located at the end of a 350 m long outfall, with a discharge port depth of 8 m.

- Option 2 is on the plateau to the east of the island between the 12.5 and 15 m depth contours, where the diffuser could be located at the end of a 560 m long outfall, with an average port depth of 12.5 m.

- Option 3 is on the plateau offshore from Boulder Bay at the base of the 27.5 m depth contour. A long diffuser could be constructed at the end of a 800 metre long outfall, with an average port depth of 27 m.

Outfall pipeline alignments were selected to connect to these three diffuser location options while maintaining a general downward slope on the pipeline. The approximate proposed outfall alignment and diffuser options, and the seabed profile in cross sections along the proposed alignment are shown in Exhibit 5.3.

To determine the impacts on beaches from the proposed outfall the following data collection work was undertaken:

- drogue experiments (April, May 1987) within Boulder Bay to reinforce previous drogue studies undertaken by the Hunter District Water Board from May 1974 to December 1985

- installation of a current meter within Boulder Bay to monitor continuously current speed and direction in the area for a period of three weeks

- a study of general water movement patterns in the area

- a continuous dye dispersion experiment over three hours. The dispersion of the dye was tracked using drogues and a helicopter.

The above information was utilised to calibrate a computer model. Initial and subsequent dilutions for varying flows were calculated for each outfall option. The model indicated that SPCC guidelines for water quality at bathing beaches could be achieved for outfall options 2 and 3.

Reference 2 noted the following with respect to the criteria to maintain ocean waters visually free of oil, grease and other floatable matter:

- Option 1 would produce low dilutions and would not meet the criteria
- Option 2 would pass the criteria if an onshore equalisation tank was incorporated to attenuate dry weather flows (refer Section 5.4.3)
- Option 3 was satisfactory for all flows.

As Option 2 was considered equal in performance to Option 3 and it was some $2 million less in cost, it was selected as the preferred outfall option.

Investigation was also undertaken on the most appropriate outfall diameter (Reference 2). The outfall diameter is based on the need to maintain a minimum flushing velocity in the pipeline of 0.6 to 0.7 m/s at least once per day, while providing adequate capacity to transfer flows, and also limiting construction difficulties and costs.

Suitable steel pipe sizes with adequate strength and corrosion resistance have internal diameters of 625 mm, 665 mm, and 730 mm.

The investigation showed that the best balance between flushing velocity and hydraulic capacity is achieved with a 625 mm diameter pipe. This pipe could discharge all flows under gravity for at least the next 20 years. After this time a separate wet weather pipeline would be constructed to operate during peak wet weather events.

5.5 PLANNING IMPLICATIONS

As mentioned in Section 3.13 the current planning instrument applying to the Study Area is Interim Development Order No. 23 and in the near future a consolidation Local Environmental Plan will be gazetted (LEP 1987). As outlined above the majority of the rising main will be within road easements and are not subject to zoning restrictions. The zonings (under IDO 23 and draft LEP 1987) for those areas affected by the scheme outside road easements are provided below.

	Zoning IDO No. 23	Draft LEP 1987
Tanilba Bay Treatment Works Site	Non Urban 1(A)	Rural 1A
Boulder Bay Treatment Works Site	7(f1) - Rural Environmental Protection - Coastal lands Protection	7(f1) - Environmental Protection - Coastal lands Protection
Pipeline Route : Salamander Way - Nelson Bay Road	Non Urban 1(a) Non Urban 1(b)	Rural 1 (a) 7(c) Environmental Protection - Water Catchment
Pipeline Route : Nelson Bay Road - Gan Gan Road	Special Use 5(a) - Water Supply	7(c) Environmental Protection - Water Catchment
Pipeline Route : Gan Gan Road - Boulder Bay	Special Uses 5(a) Water Supply	7(c) Environmental Protection - Water Catchment

All aspects of the Tomaree Sewage Scheme are permissible within the affected zones under both IDO No. 23 and draft LEP 1987.

5.6 ENERGY REQUIREMENTS AND ENERGY CONSERVATION

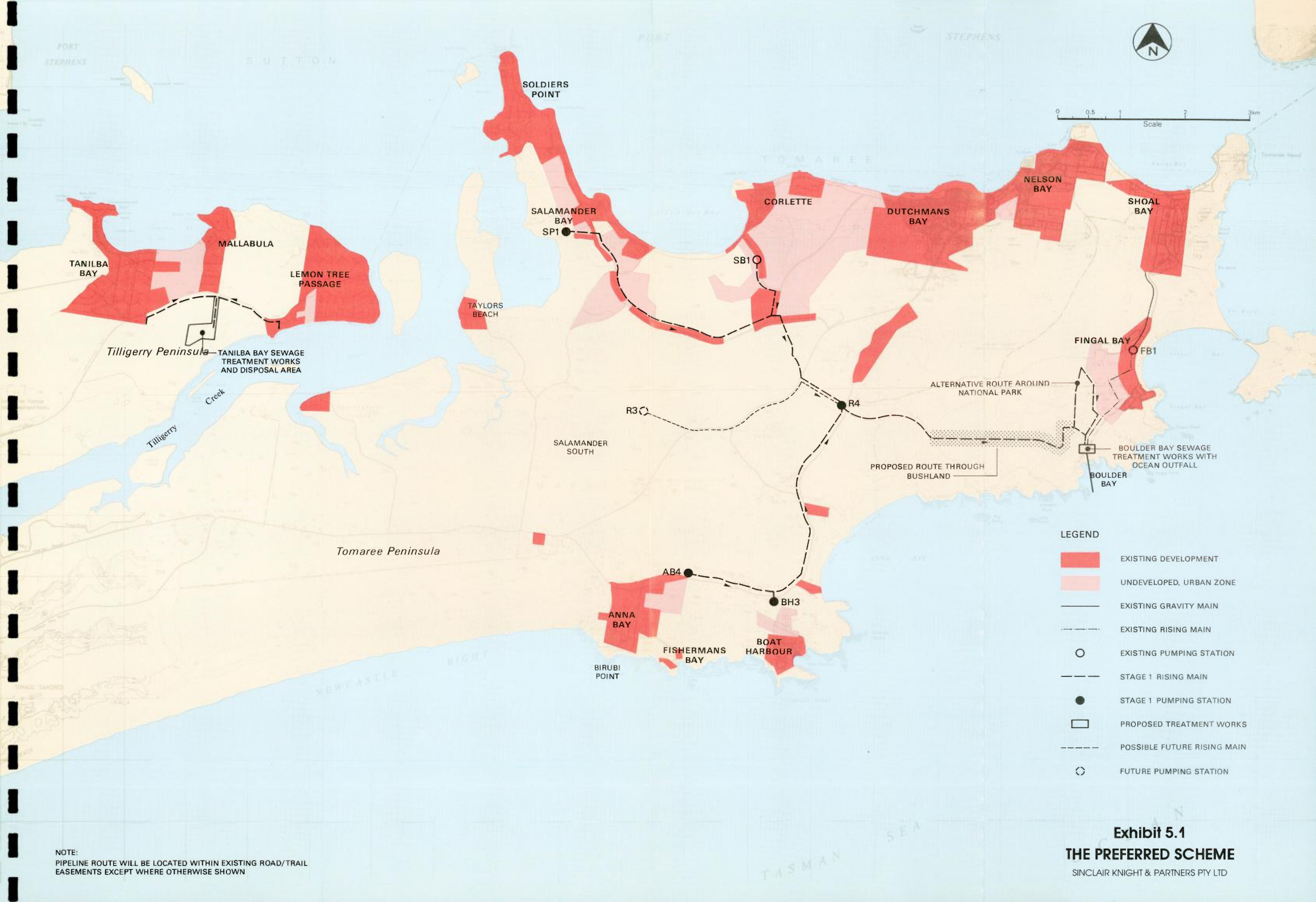
Energy use and power costs for reticulation, effluent pumping stations, and the proposed treatment works at Boulder Bay and Tanilba Bay were estimated and detailed in the Concept Report (Reference 9).

Table 5.1 summarises energy requirements and power costs for the scheme. Energy costs were arrived at by multiplying the number of Kilowatt hours per year by a unit rate of $0.13/kWhr. Both energy and power costs were estimated using a constant flow for each stage. The constant flow was taken as the average between the flow at the beginning of each stage and the flow at the end of it.

All components of the scheme will be designed to minimise energy consumption thereby ensuring efficient use of energy and minimising operating costs.

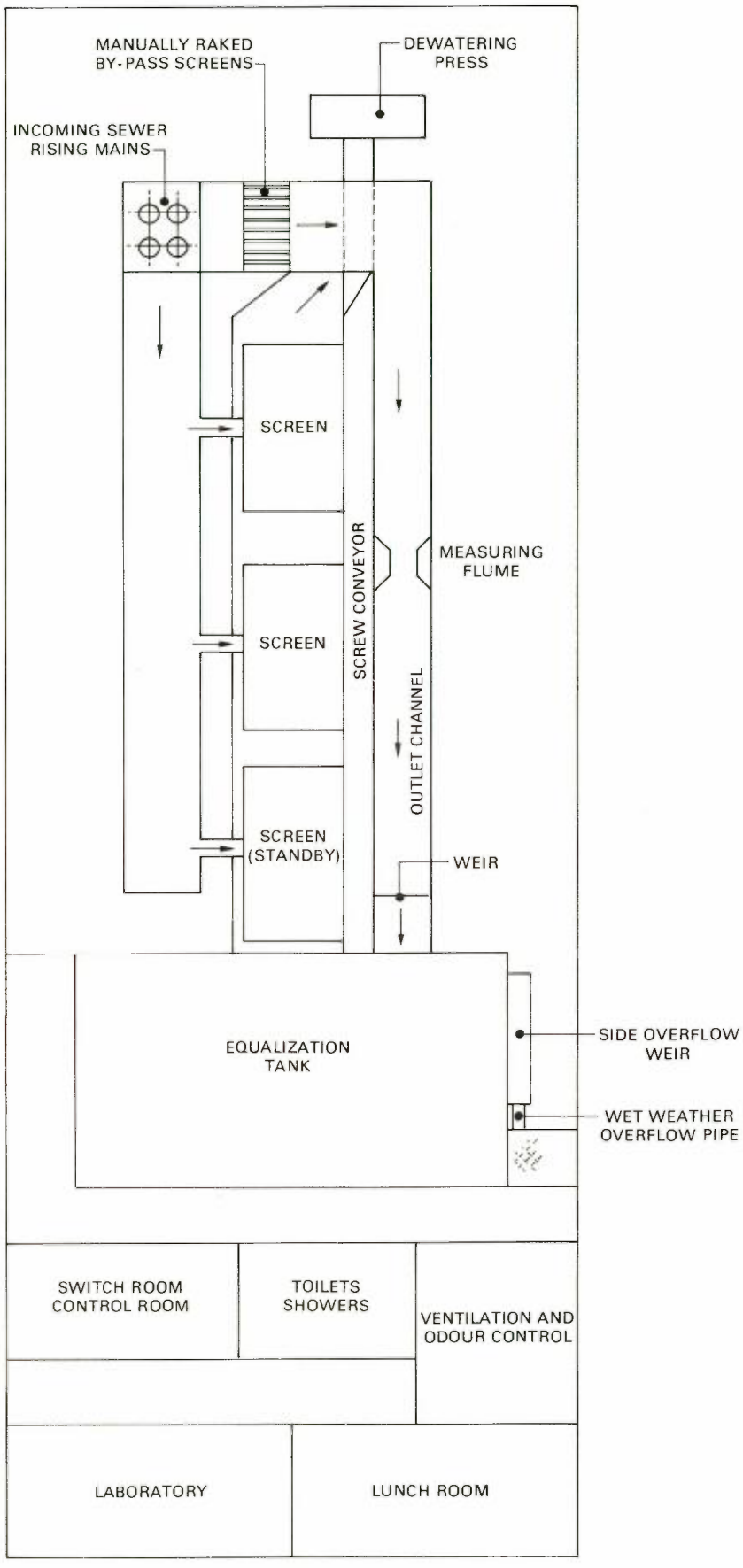
TABLE 5.1 - ENERGY REQUIREMENTS AND POWER COSTS

	Ultimate kW Hrs/day	Annual Power Cost
Reticulation	1 032	$ 49 250
Regional Pumping Stations (R4, BH3, AB4, R3, SP1, SB1)	6 575	$311 690
Treatment		
Boulder Bay	316	$ 15 000
Tanilba Bay	1 055	$ 50 000
Total	8 978	$425 940



NOTE:
PIPELINE ROUTE WILL BE LOCATED WITHIN EXISTING ROAD/TRAIL EASEMENTS EXCEPT WHERE OTHERWISE SHOWN

Exhibit 5.1
THE PREFERRED SCHEME
SINCLAIR KNIGHT & PARTNERS PTY LTD

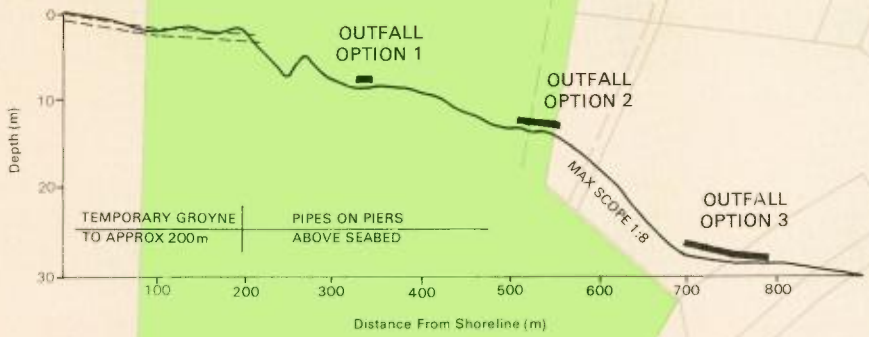


THIS DRAWING IS NOT TO SCALE

Exhibit 5.2

POSSIBLE LAYOUT FOR BOULDER BAY MILLISCREENING PLANT

SINCLAIR KNIGHT & PARTNERS PTY LTD



FINGAL BAY

To FINGAL BAY

PROPOSED
MILLISCREENING PLANT

EXISTING
SCREENING PLANT

EXISTING
OUTFALL

OUTFALL OPTION 1

OUTFALL OPTION 2

OUTFALL OPTION 3

LEGEND

TOMAREE NATIONAL PARK

APPROXIMATE LOCATION
OF OUTFALL OPTIONS

0 100 200 300m
Scale

Exhibit 5.3
BOULDER BAY TREATMENT WORKS SITE AND OUTFALL OPTIONS

SINCLAIR KNIGHT & PARTNERS PTY LTD

6. Impact Assessment and Environmental Safeguards: Reticulation

Chapters 6, 7 and 8 discuss the potential environmental effects of the components of the proposed development, reticulation (for both Tilligerry and Tomaree Peninsulas) and the transport treatment and disposal components on Tilligerry and Tomaree Peninsulas and, as appropriate, prescribes environmental safeguards.

Where necessary, the description of the existing environment (Chapter 3) is supplemented in the discussion by more detail on specific site aspects to provide a basis for finely resolved impact assessment and safeguard specification.

6.1 GENERAL

The potential impacts of reticulation on the Tilligerry and Tomaree Peninsulas will be similar. The reticulation works will primarily be located in developed urban areas and the adverse impact potential is low. Pipeline routes and pumping station locations are chosen to avoid disruption to properties and follow road reserves, boundaries and existing easements where practicable. Routes will be affected by the requirements of other authorities and will be subject to discussion and agreement with them. Where possible, particularly sensitive areas will be avoided.

The design and construction of pumping stations will be site specific but will be consistent with other pumping stations within the Shire.

New sewer systems are designed to exclude infiltration and stormwater flows but an allowance is made for wet weather flows of approximately seven times average dry weather flows. This sizing provides a factor of safety and permits storage within the pipes, minimising potential for overflows occurring during wet weather events.

Potential effects of reticulation primarily relate to temporary disturbance during construction with minor potential for some operational effects.

6.2 CONSTRUCTION

The principal adverse impacts of the reticulation system in any area will be during construction. All pipelines will be laid in trenches and backfilled and the scope of works involved will be similar to routine urban infrastructure development activity.

The installation of pipelines will cause some inconvenience and disturbance to the public, principally when road crossings and laying through residential areas occurs. The inconvenience will be short term lasting 2-3 weeks in any one locality and the normal safeguards (temporary access, road diversions, trench crossings etc.) will be adopted.

The impacts of pumping station construction on the public will be small. The bulk of the pumping station will be below ground, with above ground works normally comprising an electrical cabinet and a vent stack. The visual and noise impacts of such stations are slight.

In dry and windy weather airborne dust can be generated as a result of clearing and the traffic of construction equipment. Pipeline construction involves minimal clearing and will not involve major heavy earthmoving equipment. The effect would be short term and localised and would be controlled by watering as required.

Construction noise will be generated during weekday working hours (7 am - 6 pm). Dewatering equipment where necessary for construction will run for intermittent periods during day and night. Equipment will be muffled or screened to prevent excessive noise. This impact will be short term as construction progresses through an area.

Current restoration methods will be adopted to reduce the impacts of construction. Specific restoration procedures will be detailed and enforced by the construction contract documents.

Construction contracts would be written to include a number of standard clauses to control construction in such a way as to reduce disruption and impacts on the public. Standard clauses would cover issues such as Safety, Site Control, Preservation of Environment, Interruption to Existing Services, Working Hours, Traffic Control and Code of Conduct.

6.3 POTENTIAL OPERATIONAL EFFECTS

Potential operational effects relate primarily to the small reticulation pumping stations. Noise and odour problems are the principal potential impacts.

Noise generated from the pumping stations will be inaudible at distances in excess of 5 metres as the pump will be underground as described in Section 5.2.

In cases where particular local conditions may lead to potential odour problems special design provisions can be made to control such problems. Control measures which have previously been adopted by the HDWB include, lime dosing, oxygen injection or the use of activated carbon. These measures will be incorporated into the scheme during the design phase as required.

6.4 MALFUNCTIONS

The possibility of malfunction of the reticulation pumping stations, leading to overflow, will be significantly reduced by the proposed inclusion of a standby pumping unit.

In the event of extended power failures, localised flooding of pumping stations may result after the storage capacity within the pumping station and reticulation is exceeded. To minimise the effects of such rare events, careful consideration will be given during the detail design phase to the location of the pumping station with respect to potential overflow drainage paths. It will be ensured that all aspects of design satisfy SPCC requirements. It should be noted, in cases where overflows occur that ponding effects are limited and short term, as overflow would readily seep away.

Impacts of pumping stations are minimised by proper maintenance and regular inspection of equipment to reduce the possibility of breakdowns and to ensure efficient operation.

7. Impact Assessment and Environmental Safeguards : Tilligerry Peninsula

7.1 GENERAL

The scheme will:

- provide a sewerage service to the existing and future urban areas of the Peninsula which presently rely on septic tank systems;
- not require the acquisition of any land as the treatment and disposal system will be accommodated in a site previously acquired by the HDWB.
- accommodate the proposed facilities without being visually intrusive;

An assessment of potential impacts of the Tilligerry Peninsula component of the overall scheme and measures recommended to mitigate impacts are described in detail below:

7.2 TRANSPORT PIPELINE

7.2.1 Potential Ecological Effects

The proposed rising mains leading from reticulation to the treatment plant site (refer Exhibit 5.1) are located within the easement of Lemon Tree Passage Road or on residential streets leading off it. The affected areas are all grassed or otherwise ecologically disturbed and there is little potential for adverse impacts on flora and fauna.

Construction of the access road and rising main into the treatment site will necessitate clearing of a narrow strip through woodland and open scrub communities (refer Exhibit 7.1). The access easement is approximately 20 metres wide however the full width would not require clearing. The vegetation to be disturbed is not of conservation significance and there will be no significant adverse impact.

7.2.2 Potential Visual Effects

The rising main and treatment works access road will be linear developments located near ground level. Their visual accessibility will be low and, with the adoption of normal restoration procedures (grassing and fertilising) the residual visual impact will be minor. The final twenty metres of the access road will be angled into the site so as to inhibit direct line of sight to the treatment plant from Lemon Tree Passage Road.

Pumping stations feeding the rising mains will be similar in design to the reticulation pumping stations described in Section 5.2

7.2.3 Potential Noise and Odour Effects

Construction of the rising main would be a short term operation with construction activities only being carried out during weekday working hours (7am - 6 pm). Dewatering equipment, however, where necessary for construction will run during day and night. Machinery will be fitted with appropriate muffling equipment and noise impacts during construction will be short term as construction progresses through an area.

As discussed in Section 5.3.1, long detention times in rising mains may result in sewage becoming septic and in sulphide generation, which in turn can result in the production of malodorous gas. As the length of rising mains on Tilligerry Peninsula will be short, sewage detention times will be minimal therefore treatment for odour control is not proposed. In the early days of operation of the plant when flows are low detention times may be sufficient to create problems. Odour control methods will be adopted (eg lime dosing) for this period. No adverse odour impacts are anticipated.

7.2.4 Malfunction Risk Potential

The primary source for malfunction of the transport system is failure of the contributing pumping station. To reduce the possibility of sewage overflow due to pump failure, standby pump capacity will be installed in each station. However, in the event of an extended power failure (blackout) overflow of the pumping station could occur after the storage capacity within the pumping station and reticulation is exceeded. Such overflows will be designed to meet SPCC requirements and to minimise damage and inconvenience to people and property.

7.3 TREATMENT AND DISPOSAL

This section addresses the major environmental issues for the proposed treatment and disposal site namely:

- the physical suitability of soils at the site for receiving the effluent;
- effects on adjacent extractive industries;
- effects on the groundwater resource (physically and chemically);
- potential adverse indirect effects on nearby oyster farming areas and Tilligerry Creek generally;
- potential effects on site ecology;
- visual impacts;
- impacts on adjacent land uses; and,
- impacts on adjacent water uses.

7.3.1 Implications of Site Geomorphology

The proposed Tanilba Bay Sewage Treatment Works and infiltration pond site lies within a sand dune system (refer Section 3.3.3).

The soil stratigraphy (Reference 14) comprises Pleistocene sands generally leached of calcareous matter offering a clean, often bleached appearance. Dark coloured organics are present at a shallow depth in some areas and cementation of grains has resulted in the localised and sporadic development of indurated zones (coffee rock). Volcanics and other more impermeable hardrocks occur beneath the sands. The most permeable sands are located along the southern boundary of the site.

Site soil stratigraphy has a major influence on the feasibility of the proposed infiltration method of effluent disposal. The infiltration ponds will be located along the southern boundary of the site where the most permeable sands are located. The floor of the infiltration ponds would consist of medium to fine grained sand, with high permeability. Consequently, the site is well suited for the proposed disposal method.

However, since the floor of a pond acts as a filter, its permeability can be expected to decrease over time as a result of suspended solids, algae etc. settling out and binding sand grains. Various techniques, such as cycling of wet and dry periods and occasional mechanical workover, will maintain permeabilities and it will be necessary to adopt such management techniques during operation to maintain the disposal system. The provision of two separate ponds which can be used alternately will enable implementation of such management strategies.

Soil stratigraphy in the vicinity of the proposed infiltration pond has a major influence on the levels of nutrients (specifically nitrogen and phosphorus) reaching Tilligerry Creek. The process expected to reduce nitrogen levels between the Infiltration ponds and the Creek are governed by the ability of the soils initially to oxidise ammonia in the effluent (ie nitrification) and then through a process known as denitrification involving certain autotrophic bacteria to reduce the nitrate. The conditions needed to produce this reaction require the presence of organic material for bacterial decomposition and the absence of oxygen both apparently encountered in the soil profile at depth (Reference 14). The main mechanism for phosphorus removal in soils is by adsorption of the phosphate ion onto vacant cations associated with clay soil particles. Tests on soil samples in the vicinity of the proposed ponds indicated that the phosphorus removal capacity across the site varies due to variations in soil composition (Reference 25). Due to these variations, 50-60% of all phosphorus would be removed from the infiltration effluent up to the year 2006 after which the soils capacity to adsorb the phosphorus will decrease to approximately 15-20% as it becomes saturated with phosphorus, at which time phosphorus removal may be necessary in the plant itself if the increased nutrient levels cause problems in Tilligerry Creek (refer Section 7.3.4).

7.3.2 Potential Effects on Groundwater Levels

The Existing Situation
The groundwater system at the site is part of an extensive and hydraulically continuous aquifer contained within the underlying permeable sands. As shown in Exhibit 7.2 the surface level of the groundwater table decreases towards Tilligerry Creek indicating a groundwater flow in that direction. The regular gradient of the water table contours indicates that the water table is continuous.

Groundwater flow is maintained by recharge and infiltration of rainfall.

The level of the water table may increase by between 0.5 and 1 metre during peak wet seasonal conditions, however recovery of regional levels is expected to be fairly rapid due to the prevailing favourable permeabilities of the clean sands existing in the area (see Reference 14).

Assessment of Effluent Disposal Effects on Groundwater Levels
Effluent from the ponds will initially move vertically downwards beneath the infiltration area and then be deflected as it meets the general groundwater flow. The effluent will act as a localised recharge of the water table, creating a mounding of the water table beneath the ponds. The dimensions of the mound are determined by subsurface permeabilities, hydrogeologic boundaries and regional flows. After it meets the water table, the effluent will flow in the same direction as the regional groundwater flow, that is, to the south towards Tilligerry Creek.

The effect of the effluent inflow on the groundwater regime was assessed for a range of flows using computer modelling techniques.

For 1996 Average Dry Weather Flows, water table rises beneath the pond area are close to the surface during peak tourist seasonal local conditions, subsiding to below pond floor levels in off peak periods. Elsewhere levels remain below the surface, however, short duration high intensity rainfall is likely to induce local surface pooling. Runoff will redistribute some pooling to more permeable sandy areas where reinfiltration will occur.

An extreme wet weather event (such as a 1 in 20 year storm) will lead to some surface flooding.

For year 2006 ADWF flows, water table rises were generally found to be about 20% greater than the 1996 scenario, however, resultant levels remained below the surface with the exception of the immediate pond area and a small area south of the site (see Exhibit 7.2).

Again extreme wet weather events would induce some surface flooding.

As stated in Section 5.3.3 the proposed infiltration system (ie two 1.5 hectare ponds) may not accommodate the anticipated ultimate sewage loadings of 3000 kL/day. The maximum infiltration rate anticipated for the proposed ponds is between 1800-2200 kL/day. This assumption is based on conservative values of permeabillty used in the computing modelling (Reference 14). Consequently the proposed infiltration system may prove capable of accommodating ultimate flows. As stated in Section 5.3.3 if field monitoring of the earlier stages of treatment plant operation indicates that ultimate flows could not be accommodated other opportunities exist to cater for excess flows such as effluent re-use or construction of an additional infiltration pond. As discussed in Section 5.3.3 vacant Crown land exists immediately south of the Treatment Plant site which may be suitable for an additional pond.

In summary, it is assessed that effluent infiltration from ponds at the treatment plant site will result in localised increases in the level of the water table but these will neither interrupt nor alter the overall regional groundwater flow.

7.3.3 Potential Effects on Groundwater Quality

The Existing Situation
Chemical analysis of the groundwater showed that it is of very low salinity, typical of groundwater recently recharged from rainfall in a coastal envlronment. This is expected to be maintalned to within a few metres of Tilligerry Creek.

The high quality of the groundwater in the area is also shown by the fact that the HDWB presently extracts water from a bore adjacent to the Tanilba Bay Golf Course to supply water to the urban areas of Lemon Tree Passage, Mallabula and Tanilba Bay. Thls bore is approximately one kilometre away from the infiltration ponds and is supplied by groundwater flows which will not be contaminated by effluent from the ponds.

Assessment of Effluent Disposal Effects on Groundwater Quality
Potential groundwater pollution during effluent migration include increases in:

- bacteria or viruses which constitute health risks,
- biological oxygen demand,
- heavy metals, which cause toxicity in high concentrations,
- nitrogen (N) and phosphorus (P), which in high concentration may cause eutrophication.

Current research and reported case histories relating to effluent infiltration through sand beds indicate that bacterial and viral counts are generally reduced to near background levels within 2 to 3 metres of the infiltration area. No studies so far have indicated the presence of significant bacterial or viral concentrations at distances beyond 50 metres.

Processes leading to significant reduction in bacterial and viral concentrations include filtering, natural die-off due to changed environment (eg aerobic to anaerobic conditions, loss of nutrients), dilution, dispersion and adsorption processes. On the basis of the available data, a minimum 50 metres subsurface migration will be required to produce a biologically safe product (ie to reduced bacterial and viral concentrations to levels which will not pose a health risk). As Tilligerry Creek is 350 metres from the proposed infiltration ponds it is considered that bacterial or viral concentrations from the infiltration ponds would not be registered in the creek.

Biological Oxygen Demand (BOD) is reduced to insignificant levels by infiltration. Separate field trials have shown that sand infiltration removes more than 90% of the BOD - with final BOD levels below 1 mg/L. Such levels would have no measurable impact on the receiving waters.

Heavy metals, such as zinc, copper, lead etc., are generally adsorbed during infiltration. In any event, as the flows from industry on the Tilligerry Peninsula are minimal, and are anticipated to remain so, heavy metal concentration is not expected to constitute a health risk.

As discussed in Section 7.3.1, both nitrogen and phosphorus will be removed to some extent during the infiltration process. Total concentrations of nitrogen are anticipated to be reduced in the effluent during the process although the level of reduction is uncertain. It is estimated phosphorus levels will be reduced by 50-60% upto the year 2006 after which phosphorus removal will decrease to 15-20% (Reference 22).

Based on the above and assumed inflow quality levels Table 7.1 summarises expected resultant groundwater 50m distant from the ponds.

TABLE 7.1 - ESTIMATED RESULTANT GROUNDWATER QUALITY

	Pond	Groundwater
Biochemical Oxygen Demand (5 day)	< 20 mg/l	< 1 mg/l
Non-filterable Residue	< 30 mg/l	Nil
Total Nitrogen	< 10 mg/l	< 5-10 mg/l
Total Phosphorus	< 10 mg/l	< 5 mg/l
Faecal Coliform Bacteria	< 100000/100 ml	< 10/100 ml

Seepage to Tilligerry Creek will occur over a wide frontage of more than 800 metres and over depths ranging from the shoreline high water mark to the floor of the Creek.

7.3.4 Potential Effects on Tilligerry Creek

The proposed disposal of treated effluent via infiltration will result in changes to the quantity and quality of groundwater discharging to Tilligerry Creek. In turn, such changes could result in potential decreases in salinity and increases in nutrient levels in Tilligerry Creek. An investigation was undertaken to assess the potential effects on the Creek (Reference 24).

As stated in Section 7.3.3, the proposed infiltration of effluent will effectively reduce levels of pathogenic organisms to background levels prior to discharge to Tilligerry Creek, and consequently will not pose a health risk.

Under ultimate sewage loadings predicted for the infiltration ponds the peak increase in discharge to Tilligerry Creek is anticipated to be less than 3000 kL/day during dry weather conditions (Reference 24). Under such conditions the maximum change in salinity to the estuary will be in the order of 0.2 ppt. This predicted decrease in salinity in the Creek is small relative to the natural variations in salinity within the estuary (refer Section 3.10.3) and is not expected to have any detrimental effect on the Creek.

Existing background levels of nitrogen (nitrate) and phosphorus in Tilligerry Creek are quite low ranging between 14-33 micrograms per litre (ug/L) for nitrate and 1-18 (ug/L) for phosphorus. To estimate the potential increase in nitrogen levels in the Creek and consequential affects it was necessary to assume a total quantity of nitrogen discharging into the Creek originating from the infiltration ponds (ie excluding the effects of dilution in the groundwater). It is anticipated that the level of nitrogen in the effluent will be reduced through the process outlined in Section 7.3.1. combined with proper management of the infiltration ponds (i.e. using the infiltration ponds alternately - one wet, one dry maintaining their nitrogen removal capacity). However, the actual level of nitrogen removal which will be achieved is uncertain. Therefore in order to assess potential effects of increased discharge of nitrogen to Tilligerry Creek, a worst case scenario of no nitrogen removal was assumed. Therefore the total quantity of nitrogen discharged into Tilligerry Creek was assumed to be equal to that discharged into the ponds (i.e milligrams for every litre of effluent infiltrated through the ponds). Levels of phosphorus removal through infiltration have been estimated at 50-60% and therefore the total quantity of phosphorus discharge to the Creek was estimated to be 5 milligrams for every litre of effluent infiltrated through the ponds.

Based on the above levels of nitrogen and phosphorus discharging to the Creek from the infiltration ponds and the tidal flushing characteristics of Tilligerry Creek (refer Section 3.10.3), nutrient levels will increase over long dry periods to an equilibrium level. These changes will occur over the full length of the Creek, however the greatest impact will occur adjacent to the point of discharge. The effect of the discharge will diminish away from the discharge source. Following extended wet weather nutrients originating from the ponds would be flushed from the Creek.

The predicted changes in nutrient levels after extended dry periods are summarised in Table 7.2

TABLE 7.2 PREDICTED INCREASES IN NITROGEN AND PHOSPHORUS IN TILLIGERRY CREEK (AFTER EXTENDED DRY PERIODS)

	Existing Background Level	Maximum Increase in Background Level
Nitrate ug/L	14 to 33	67
Phosphorus (ug/L)	1 to 18	34

Potential problems associated with increased nutrient levels in waterways primarily relate to eutrophication particularly in waterways with low water exchange rates (flushing). There are currently no widely accepted criteria against which changes in nutrient concentrations, particularly in estuaries, can be judged. Individual estuaries have their own characteristics making it difficult to draw assumptions from observed effects of nutrient increases in other estuaries. However, from the body of information currently existing on the effects of nutrient increases, the Australian Environment Council tentatively has concluded that the visual evidence of eutrophication is likely to occur when total nitrogen concentration is within or exceeds the range of 400 - 600 ug/L and/or total phosphorus concentration is within or exceeds the range of 40 - 60 ug/L (Reference 1).

Consequently the anticipated increases in nitrogen levels within Tilligerry Creek, even for the worst case situation when no nitrogen is removed during the infiltration process, are well below the 400 - 600 ug/L mentioned above. Based on the Australian Environment Council's indicator of 40 - 60 ug/L for phosphorus the predicted maximum increase for phosphorus in Tilligerry Creek (refer Table 7.2) could be considered marginally significant. Given the good flushing characteristics of the Creek, however, and the fact that the predicted maximum increase will only occur after prolonged dry periods, the increased phosphorus levels are not anticipated to have a detrimental effect on Tilligerry Creek as a whole. Localised affects of increased nutrient levels particularly in the confined channel behind Mud Island will need to be monitored as tidal flushing in such areas may be minimal.

7.3.5 Potential Effects on the Oyster Industry

The oyster industry is potentially vulnerable to the possible changes to groundwater discharging to Tilligerry Creek following construction of the infiltration ponds. However, the minor increases in nutrient levels anticipated will not create a problem for the oyster leases along the foreshore of the Creek in the vicinity of the proposed treatment works, or leases elsewhere in the Creek. In fact minor increases in nutrients could result in increased micro-algae production which is a valuable food source for the filter feeding oysters.

The major potential detrimental effect of the proposed infiltration system would be if significant long term decreases in salinity occurred in Tilligerry Creek as a result of the increased groundwater flows. Recent research (Reference 16) has revealed that the Pacific oyster (Crassostrea gigas) is more adaptable to lower salinity regimes than the Sydney rock oyster (Saccostrea commercialis). As stated in Section 3.10.4 the Pacific oyster has been declared a noxious fish, making the cultivation and presence of this oyster on leases an offence. Officers from the Fisheries Division, Department of Agriculture have advised if there was a long term drop in salinity levels in Tilligerry Creek in excess of 2 ppt, it is likely that the occurrence of the Pacific oyster would increase resulting in major problems for the oyster industry. As the changes in salinity levels within the Creek have been predicted to be no more than 0.2 ppt, (Reference 21) no adverse effects on the oyster industry are anticipated.

7.3.6 Potential Effects on Ecology of the Treatment Works Site

Existing Site Ecology

Three vegetation communities were observed on the Tanilba Bay site, with a further two communities, swamp scleropyhil forest and sedgeland adjacent to the site (refer Exhibit 7.1). Detailed descriptions of these vegetation communities are provided in Reference 20. An outline of the communities on site are provided below:

1. Open forest dominated by Blackbutt (Eucalyptus pilularis), Red Mahogany (E. resinifera) and Smooth-barked Apple (Angophora costata). This community occurs on higher ground towards the south-eastern corner of the site and probably occurred previously on the southern part of the site, but has been cleared by sand mining operations.

2. Woodland dominated by Red Bloodwood (E. gummifera) and Smooth-barked Apple. This community occurs over most of the site in situations where the water table is relatively lower than areas supporting the open scrub community.

3. Open scrub dominated by Leptospermum attenuatum, Melaleuca nodosa, M. sieberi, Banksia aemula and B. oblongfolia. This community occurs on sites where the higher water table inhibits the growth of the tree species which typify the woodland community.

The proposed site comprises two main faunal habitats:

- timbered habitat including open forest and woodland; and
- heath

Both are important habitats for wildlife for different reasons. The timbered habitat contains a good diversity of faunal species, because of the structural and botanical diversity of the vegetation. However, this type of habitat is widespread throughout the Central Coast as well as much of eastern Australia and most of the fauna expected in this habitat are not considered rare or endangered. Although open scrub/heath habitats do not have as high a faunal diversity as forested habitats, they provide a habitat for several species which are considered rare. In addition, the distribution of heath along the NSW coast is limited and decreasing because of land clearing.

The vegetation communities within the site are suitable habitat for koalas.

Assessment of Potential Effects on Site Ecology

Of the species considered from previous studies to be significant plant species of the Tomaree & Tilligerry Peninsulas, five occur on the Tanilba Bay site. Three of these (Baeckea imbricata, Hakea dactyloides, Melichrus urceolatus) were observed in scattered locations in woodland and heath communities at both Tanilba Bay and along the rising mains route through the Water Catchment land. None are considered rare or endangered on a statewide basis and indeed they are common and widespread species. Accordingly it is not considered that special measures will be required for their protection where they are threatened by the proposed development.

The other two species are Blandfordia grandiflora, a Protected Plant under the National Parks and Wildlife Act, and Gompholobium pinnatum. The former was recorded in the north western part of the site and Gompholobium pinnatum was found near an access track close to the north eastern edge of the site (Red Bloodwood-Smooth-barked Apple woodland community). Whilst neither of these species is listed as being rare or endangered on a state wide basis, Blandfordia grandiflora (Christmas Bell) has a spectacular flower and may be vulnerable in the long-term due to excessive collecting. Attention has been paid to avoid populations of these species when locating facilities on the site (refer Exhibit 7.3). It should be noted populations of both species exist outside the site within the district and it is considered that the proposed development is unlikely to have a significant impact on the local conservation status of these species.

The proposed infiltration ponds at the Tanilba Bay site would have the effect of increasing the height of the water table in the area around the ponds (refer Exhibit 7.2). The water table predicted for the year 2006 (ADWF) would rise 3.0 m in the area immediately adjacent to the ponds with the extent of the rise decreasing with increasing distance from the ponds.

The impact this would have on vegetation around the site can be assessed by an analysis of the vegetation currently occurring in the area as it appears that the distribution of vegetation is generally related to the depth to the water table.

Analysis of topographic and regional water table maps suggests that the open forest/woodland boundary occurs where the depth to water table is approximately 5 metres and the woodland/open scrub boundary occurs at approximately 3 metres.

It would appear that trees of the open-forest community such as Blackbutt (Eucalyptus pilularis) and Red Mahogany (E. resinifera) are less tolerant of high water tables than trees in the woodland community such as Red Bloodwood (E. gummifera) and Smooth barked Apple (Angophora costata) which in turn are less tolerant than open scrub species such as the paperbarks (Melaleuca spp) and banksias.

Analysis of the water level rises predicted to occur due to generation of the infiltration ponds (Exhibit 7.2) and topographic maps indicates that the only vegetation community within the site which may be subject to long term vegetation change, would be the woodland community (refer Exhibit 7.1). As this vegetation community will be substantially cleared for construction of the site and is not considered to be of regional or statewide significance, no significant impact on vegetation within or surrounding the site is anticipated as a result of predicted water table rises.

The vegetation within the Tanilba Bay treatment plant area is part of a continuous layer of forested habitat along the Peninsula. Fragmentation of this habitat by excessive clearing of the area may result in the loss of wildlife corridors and the disruption of movement patterns in this district.

The development will result in the loss of some vegetation and consequently some part of the two main faunal habitats. Most of the area comprises timbered habitat and, so long as the clearing of this habitat is kept to a minimum, its loss should not significantly affect the overall status of any faunal species found in this area. With the exception of a small patch on the south-western corner the treatment plan layout depicted in Exhibit 7.3 has avoided the majority of the open scrub/heath community within the site. Tree removal can be selective; koala food trees where practicable will be retained and preference given to the removal of younger trees. Older gum trees usually contain a number of nest holes for arboreal mammals and birds.

7.3.7 Potential Visual Impacts

The Existing Visual Environment & Visual Access
The proposed Tanilba Bay Treatment Works site is located within the Anna Bay landsystem (refer Section 3.7.2) in flat and featureless terrain. Due to the lack of topographical enclosure, the proximity of urban development, and the potential of overviews from local viewpoints, the issue of site visibility and the significance of that visibility is important.

From a broad perspective, views into the site from the Tilligerry Creek waterway, isolated urban settlements on Fennighams Island, Bobs Farm Creek and the eastern and southern foreshore of Tilligerry Creek are effectively limited by a 10 metre high consolidated dune adjacent to the south eastern boundary of the site.

The southern portions of the Tanilba Bay township and Mallabula township are within one kilometre of the site and at a similar elevation. Views are only partially limited by the thick growth of native vegetation both on the site and adjacent to the north and west.

Views from the larger centre of Lemon Tree Passage are restricted by topographical rises and almost intact forest canopies.

The site is overviewed from the highpoint on the peninsula, a hill rising to 62 metres above sea level between Lemon Tree Passage and Mallabula. Since this highpoint is not used by the public, the significance of this overview is negligible.

Close to the site, views from Lemon Tree Passage Road to the west and north of the site are partially restricted by site vegetation, although the lack of significant roadside vegetation allows lateral views to the edge of the site, and in some locations, into the site itself. The boundaries of the site cannot be seen from urban areas by any break in vegetation, although the top of the high eucalypt canopy on the southern section of the site is visible from urban areas and the public road.

Recent sand extraction activities have depleted the forest canopy on the southern and eastern site boundaries, as well as reduced the effective height of the dune ridge by 1.5 metres on average. Such disturbances have reduced the bulk of the natural backdrop to the site when viewed from Lemon Tree Passage Road and Mallabula township. As such, the visual access from this road and the adjacent townships is considered significant. There are no other points of site visibility that are considered significant.

Assessment of Potential Effects on the Visual Environment
The major determinant of the visual impact of the proposal relates to the extent of vegetation removal within the site and the scale and composition of proposed structures.

As highlighted above views from nearby urban areas to the north and north west are only partially limited by low, open scrub/heath vegetation, adjacent to and within the site. A reduction in the density of such vegetation within the site and possible future agricultural landuse of adjacent land in Aboriginal ownership could result in the sewerage plant becoming visible to both the townships and vehicles on Lemon Tree Passage Road.

Although structures proposed in the treatment plant will not have substantial profiles, it is likely that some proportion of them will remain visible. In the context of an urban environment; the significance of this visibility would be minimal. However, in the context of the natural landscape surrounding the site, the intrusion of man-made structures could be visually intrusive.

The visual intrusion of structures associated with the plant would be due to:

- reduction in the contrast between urban and natural areas due to extension of buildings into a visible natural setting;
- a reduction in the perception of the landscape surrounding the plant as a 'natural' area;
- the creation of a contrast with adjoining natural areas due to building scale, texture, colour and materials.

Such potential impacts could be mitigated by reducing the visibility of the development from nearby townships and Lemon Tree Passage Road.

Visual Environmental Design Strategies

The exact nature of the proposal in terms of site clearing requirements or building size, colour and texture has not yet been defined. However, there is a range of effective safeguards which, if applied, would satisfactorily control any adverse visual impacts. These are listed below.

- Containment of site clearing to minimum, with clearly defined and fenced builders compound, stockpile areas, etc.
- Site planning and design of earthworks and structures to allow for retention of a substantial periphery of vegetation, within the following constraints.
  - Retention of 30 metres minimum periphery on the north western boundary, facing the golf course and Tanilba Bay township.
  - Retention of minimum 50 metres periphery on the north eastern, eastern and southern boundaries, to retain significant canopy trees and understory planting.

- Fencing of landscape protection zones at the commencement of construction and prohibition of any access into or disturbance of these zones during the term of construction.

. Retention of significant trees or groupings of trees as far as practicable within the construction zone and protection of those trees during construction.

. Supplementary planting of indigenous vegetation within all landscape protection zones to re-establish a natural character and assist in screening views from urban areas.

. Selected planting within the construction zone to reduce the visual/physical contrast with the adjacent protected periphery, and to provide shade, shelter and spatial definition within the site.

. Establishment of a schedule of colour and materials for new construction sympathetic with the surrounding natural landscape.

. Provide a professional architectural input into the siting, design and finish of structures proposed.

Exhibit 7.3 illustrates a possible application of these visual design strategies.

7.3.8 Potential Archaeological and Heritage Effects

A preliminary archaeological survey was undertaken over the proposed treatment works site (Reference 4). The survey did not locate any sites within the area to be developed. However, as stated in Section 3.11 there is potential for the existence of unidentified archaeological sites due to the environmental setting of the Tilligerry and Tomaree Peninsulas. If any undetected sites or relics are unearthed during the construction phase at the Tanilba Bay Site the Regional Archaeologist of the NSW National Parks and Wildlife Service would be notified immediately.

7.3.9 Potential Effects of Surrounding Land Use

Exhibit 3.2 shows existing land use on the Tilligerry Peninsula in vicinity of the proposed treatment works site. Land uses surrounding the site include residential, golf course, sand extraction, oyster lease work depots and undeveloped Aboriginal land vacant Crown Land.

The site is well located in respect of residential land use. Generally, a 400 - 500 metre wide buffer area is preferred between sewage treatment plants and residential areas for reduction of noise and odours. The Tanilba Bay site is approximately one kilometre from existing residential areas or areas zoned for residential development thus providing adequate buffer distances for the treatment works under normal operation conditions.

The Tanilba Bay Golf Club is currently expanding to an 18 hole golf course. The proposed sewage treatment plant would not have any detrimental effects on the proposed expansion or users of the course, as buffer distances of in excess of 600 metres are available.

The existing sand extraction operations south of the site will not be affected by the development as it is anticipated that the lease will have been exhausted prior to construction of the proposed plant.

Within the area granted to the local Aboriginal community, the Worimi Land Council proposes to undertake agricultural activities of an as yet undefined nature. The Worimi Land Council have advised that it would not be opposed to the construction of the treatment works and have indicated its interest in the possible use of the treated effluent for irrigation purposes.

The remaining land around the proposed treatment works site is vacant Crown Land. The Crown Lands Office has undertaken an assessment study of the Crown land in the Port Stephens Shire (Reference 3). This study assessed the land in the vicinity of the site as being suitable for 'multiple use'. This category has been used primarily in the situation of urban fringe Crown land or as a buffer between conflicting uses. Therefore, the proposed treatment works would not be in conflict with such a land use category.

The remaining land use, that of oyster lease works depots along the northern foreshores of Tilligerry Creek, is not anticipated to be affected by the proposal. The treatment works site is separated from these work depots by a high sand ridge, and as discussed in Section 7.3.5 the proposed disposal of effluent by infiltration is not anticipated to have any significant effect on oyster production with the Creek.

In summary, the proposed treatment work site will not create any constraints on existing or anticipated future uses of surrounding land.

7.3.10 Potential Noise and Odour Effects

The State Pollution Control Commission require that facilities such as sewage treatment plants should not produce noise levels in excess of 5 dBA above the existing measured background level. Sewage treatment plants are not a major noise source. So as not to impact upon existing or possible future residential areas, the final design of the treatment plant will incorporate measures to meet these requirements.

Extended aeration secondary treatment plants like the type proposed for the Tanilba Bay site do not generate significant odours when operating normally. The potential for odour problems would only arise on the infrequent occasions when aerators malfunction or during extended power failures. When the aerators are not operating the sewage can become septic with time creating odour problems. Once aerators are operational again odour problems will quickly diminish.

In any case the separation distances between the site and existing and proposed residential areas is adequate to mitigate potential odour problems. During summer north easterly sea breezes prevail. The urban areas of Lemon Tree Passage, Mallabula, and Tanilba Bay will be upwind of the plant under these circumstances. In winter, westerlies prevail, increasing the likelihood of odour related problems particularly for Lemon Tree Passage. However, a ridge shields these urban areas significantly which in combination with the separation distance will render the risk negligible.

7.3.11 Potential Construction Impacts

The principal construction activities anticipated at the Tanilba Bay site would include:

- vegetation clearing and disposal;
- topsoil stripping and stockpiling;
- excavation of structure foundations and embankment formation;
- concrete laying;
- provision of power and water supply;
- process pipework installation;
- mechanical and electrical equipment installation;
- site surface formation and roadworks, topsoil respreading, grassing and landscaping; and
- building construction.

The minimum area necessary for construction of the treatment works roadways, power and water supply and effluent rising main will be cleared of vegetation with areas identified as being particularly sensitive to disturbance being fenced during the construction period. Topsoil will be stripped and stockpiled for use in rehabilitation of disturbed areas after construction.

Exhibit 7.1

TANILBA BAY TREATMENT WORKS SITE VEGETATION

SINCLAIR KNIGHT & PARTNERS PTY LTD

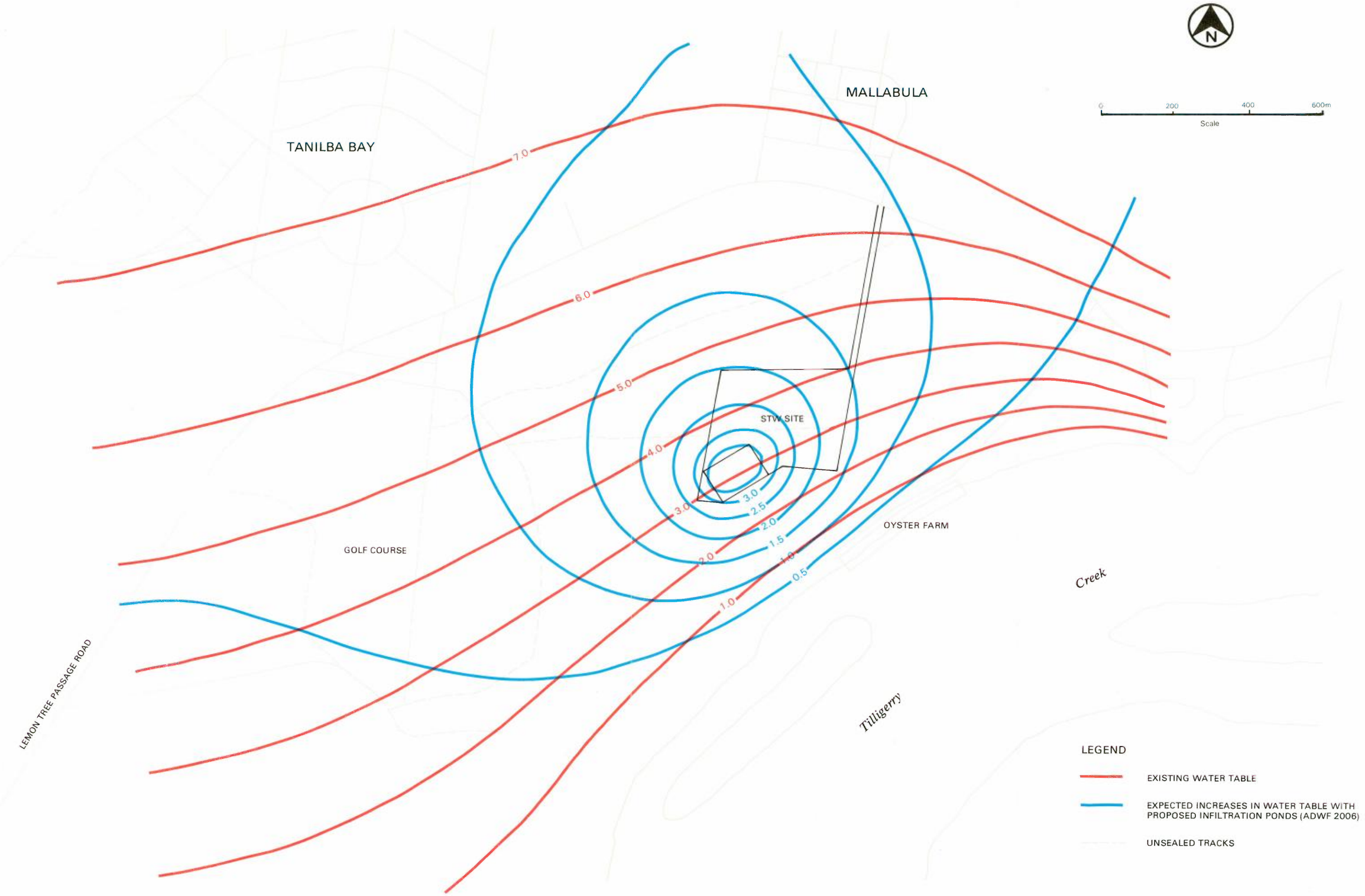
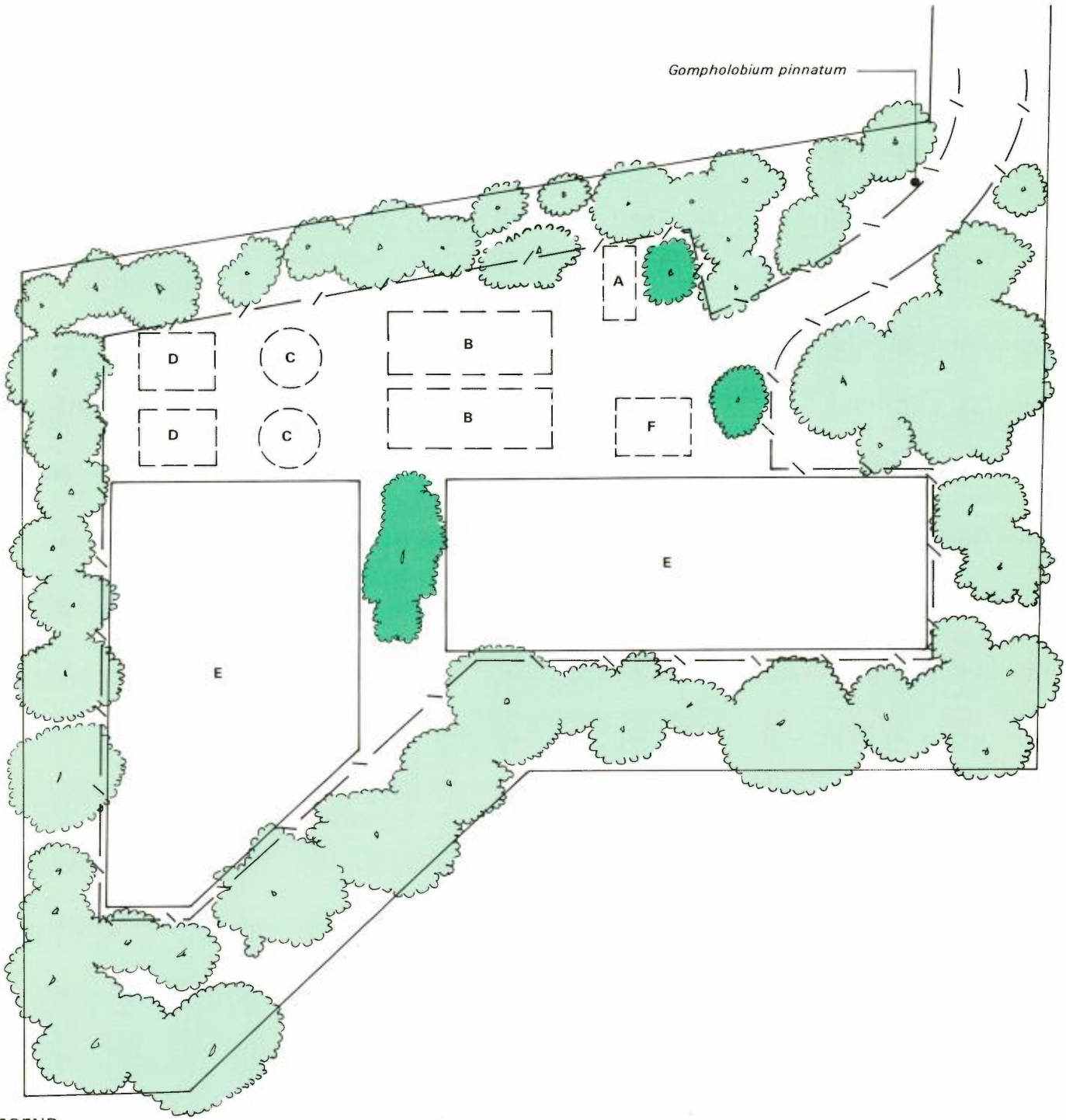


Exhibit 7.2

REGIONAL WATER TABLE: EFFECT OF INFILTRATION PONDS

SINCLAIR KNIGHT & PARTNERS PTY LTD



LEGEND

- LANDSCAPE PROTECTION ZONE, SUPPLEMENTARY PLANTING AS REQUIRED
- FENCING OF PROTECTION ZONE
- POSSIBLE FACILITIES (POSSIBLE LOCATIONS)
- SUPPLEMENTARY PLANTING
- A INLET WORKS
- B AERATION TANK
- C CLARIFIER
- D SLUDGE LAGOONS
- E INFILTRATION PONDS
- F AMENITIES BUILDING

0 40 80 120 160m

Scale

Exhibit 7.3
VISUAL MITIGATION MEASURES TANILBA BAY SITE

SINCLAIR KNIGHT & PARTNERS PTY LTD

8. Impact Assessment and Environmental Safeguards - Tomaree Peninsula

8.1 GENERAL

On Tomaree Peninsula the proposed sewerage scheme encompasses reticulation (discussed in Chapter 6), transport pipelines, primary treatment plant and effluent disposal via ocean outfall. The scheme will:

- rationalise the six existing small scale sewerage schemes and provide a sewerage service to cater for the needs of existing urban areas (and anticipated expansion of these areas) on the Peninsula which presently rely on septic systems;
- eliminate discharge of effluent to Port Stephens;
- provide a transport pipeline route that minimises impacts on natural areas as the majority of the route will lie within existing road easements;
- meet SPCC requirements with respect to maintainance of water quality for swimming beaches;
- substantially improve the amenity of Boulder Bay by replacing the existing shoreline discharge with an extended deep water outfall;
- provide for the construction of a primary treatment plant within the HDWB site at Boulder Bay thus enabling the dismantling of the existing treatment plant and restoration of the area. This will provide an improved link for Tomaree National Park along the Boulder Bay foreshores.

8.2 TRANSPORT PIPELINE

The proposed rising main routes to transport sewage to Boulder Bay are shown on Exhibit 5.1. Assessment of potential impacts of the proposed rising mains, has been restricted to those sections of the route not within existing road easements. Potential impacts associated with sections of the route within road easement would be similar to those discussed in Section 6.2 for reticulation, and include:

- erosion hazard
- extractive resources
- ecological effects
- archaeological impact
- visual impacts, and
- landuse impacts.

8.2.1 Potential Erosion Hazards

Erosion hazard refers to the susceptibility of land to the prevailing agents of erosion and is dependant on climatic factors, landform, soils and landuse. Sections of the rising main route between pumping station R4 and Boulder Bay will be within areas having a moderate to high erosion hazard rating, primarily

due to the presence of sandy structureless soils and slopes of up to 20%. Within the Water Catchment Area, erosion has been increased by uncontrolled four wheel drive vehicles and trail bikes resulting in a proliferation of tracks through previously undisturbed areas.

Potential erosion hazards resulting from the proposed rising mains could occur due to:

- pipeline construction; and
- increasing vehicle access to undisturbed areas.

The intended use of existing tracks for access will minimise the potential for erosion resulting from the construction of the rising main pipeline through the Water Catchment Area. For those limited sections of the route through undisturbed bushland, construction techniques will be required to minimise erosion susceptibility. Such techniques will include restricting clearing to a maximum width of three to four metres where practical and constructing a gravel based access track along the easement to reduce exposure of the sandy soils while permitting access for maintenance vehicles. Revegetation of the pipeline easement will be undertaken along the section of the route through the Tomaree National Park, (refer Section 8.2.8). Potential impacts to the National Park are discussed in more detail in Section 8.2.7.

So as not to encourage further uncontrolled vehicle access within the Water Catchment Area access will be restricted to maintenance vehicles only. Appropriate signs and/or fences and gates will be erected for this purpose at both ends of the proposed route through the undisturbed areas.

8.2.2 Potential Effect on Extractive Resources

The pipeline route does not affect any of the existing rutile and zircon mining titles or sand extraction activities existing or proposed.

8.2.3 Potential Ecological Effects

The HDWB Water Catchment Area provides a defacto conservation role as it is a large area of natural bushland which is continuous with Tomaree National Park. Providing the mitigation measures outlined in this section are implemented the ecological values of the Water Catchment Area and the National Park will be maintained.

Flora Along the Rising Main Route

This section describes the vegetation communities likely to be affected by the construction of the rising main between Gan Gan Road and the proposed Boulder Bay Sewage Treatment Works site, including two route options near Boulder Bay. The following five vegetation communities were identified (refer Exhibit 8.1)

1. Open Forest dominated by Blackbutt, Smooth-barked Apple and Red Bloodwood. This community occurs on well drained soils of the Anna Bay and Gan Gan land systems.

2. Woodland/Low Woodland dominated by Blackbutt, Smooth-barked Apple and Red Bloodwood. The presence of this community is dictated by soil fertility, depth to water table and, possibly, fire frequency. Whilst the dominant species are identical to the open forest community, the woodland community tends to have a greater proportion of red Bloodwood and a lesser proportion of Blackbutt.

3. Open Scrub (Heath) dominated by Wallum Banksia, Melaleuca nodosa, Leptospermum attenuatum and Melaleuca seiberi. This community often occurs downslope from the woodland/low woodland community, suggesting a relationship with the height of the water table. Other factors which may be operating include soil fertility, possibly related to the development age of the sand deposits, and low fire frequency.

4. Sedgeland dominated by Leptocarpus tenax, Hypolaena fastigata, Restio pallens and Juncus usitatus. This community occupies a wet, low, lying site just west of Gan Gan Road. It is fringed by a woodland dominated by Broad-leaved Paperbark (Melaleuca quinquinervia). This latter community occupies such a small area that it is impractical in terms of this survey to separate it from the sedgeland community. A few emergent shrubs are present, including Acacia elongata and Callistemon citrinus.

5. Grassland dominated by Blady Grass. This community occupies disturbed sites, the largest stand lying west of Gan Gan Road within a transmission line easement.

Potential Effects on Flora

With the exception of Xylomelum pyriforme (Woody Pear), a protected plant under the National Parks and Wildlife Act 1974, none of the remaining species found in the vegetation communities along the rising main route are considered rare or endangered on a state-wide basis. All but Acacia elongata are found in communities which are widespread in the Water Catchment area and these species are not considered under threat of local extinction from the development. No special measures are necessary to reduce impact upon these species.

Acacia elongata is a widespread species but is usually restricted to wet ground and is therefore uncommon along this section of the route. The potential impact of the rising mains on this species and the wetland with which it is associated, could be reduced by siting the route along the upper edge of the wetland west of Gan Gan road, or if this is not feasible, by constructing the route along the existing track which separates the small sedgeland area north of the transmission line from the extensive sedgeland area to the south-west. With respect to the protected plant Xylomelum pyriforme identified in the

woodland/low woodland community, individuals of the species will be identified and where practicable will be avoided during final routing and construction of the rising main. If it is necessary to remove such a plant a licence for removal will need to be obtained in accordance with Section 116 of the National Parks and Wildlife Act, 1974.

The National Parks and Wildlife Service (NPWS) expressed particular concern with respect to the pipelines potential effect on the species Melaleuca groveana. The detailed floristic survey of the proposed route did not identify any examples of this species of Melaleuca. In addition the NPWS were concerned with possible maintenance clearing practices of extensive clearing and burning of vegetation along the proposed route. Maintenance clearing will be restricted to the actual width of the easement (ie 3-4 metres) through the Water Catchment Area with full revegetation of the section of the route through the National Park. Controlled burning practices along the route will not be necessary.

Fauna - Potential Effects of the Rising Main

The impact of the construction of a pipeline upon fauna cannot be considered as having any major effect upon the overall population status of the species known from the district. The initial ground clearing and trench construction may cause movement problems for some small animals eg. lizards and mice. Larger animals, such as wallabies, may also find their movements temporarily restricted.

Within the timbered areas, a narrow strip of forest and closed heath will have to be removed. This cleared strip will have a temporary impact upon native fauna in that movement patterns will be disrupted. Studies have shown that small forest mammals very seldom venture onto roads which were over 15 m wide and some species may be inhibited from crossing roads as narrow as 3 m. However, after a period of time, natural regeneration of the middle and lower storey vegetation will recreate conditions approximating that which originally occurred.

It has been shown that the clearing of a narrow strip of timber can be beneficial to some native fauna, particularly birds. The cleared strip creates a diversity of vegetation structure which is attractive to some bird species. Cleared areas within dry sclerophyll can support more species and individual birds than the uncleared surrounding forest.

Removal of individual trees from this section of the route should not affect the overall status of any species. No arboreal mammals of conservation significance could be expected along this part of the route, and the loss of a narrow strip of trees should not be detrimental to any Koalas in the district. Ospreys build their nests on rocky foreshores, cliff faces, an exposed fork of a dead tree, an isolated beach and occasionally a transmission tower. No Ospreys or their nesting sites were observed along the rising mains route.

Mitigation Measures to Minimise Impact on Fauna
The impact from the construction of the rising main upon the fauna in the Water Catchment Area and Tomaree National Park can be reduced by:

- keeping the amount of clearing of the route and access tracks to a minimum;

- encouraging the regrowth of native vegetation along that section of the route through the Tomaree National Park;

- supervision by the construction staff of the open trenches. The staff should endeavour to catch and release to nearby habitat, any native animals caught in the trench;

- the length of trench opened at any one time should be minimised. The trench should be ramped at each end to allow fauna to move in and out of the trench.

8.2.4 Potential Effects on Wetlands

The most significant biological resource on the Peninsula is the wetlands, most particularly those covered by SEPP 14 but other wetland areas have value as well(refer Exhibit 3.3).

The primary safeguard adopted to minimise impacts on wetlands was to locate the route so as to avoid them and this objective was completely achieved. However, there are several locations where the route passes close by designated wetlands and it will be necessary to exercise care in the location and construction of the mains in these areas. An ecologist's report on the necessary safeguards was commissioned (Reference 21) from which the comments below have been summarised.

A total of eight areas requiring attention were identified:

Pumping Station SP1 and Salamander Estate
- this site is adjacent to saltmarsh community SEPP 14 No 766 (refer Exhibit 3.3).
  In order to minimise the potential for discharge to the wetland from pumping station SP1 overflow controls will be constructed to meet SPCC requirements.

Salamander Pumping station (SB 1)
- if practicable this should be designed to minimise potential for discharge to the adjacent wetland, SEPP 14 No 761, Mambo Swamp;

- all drainage controls will comply with SPCC requirements;

Salamander Drive to Nelson Bay Road

- wherever practicable construction activity should be limited to the width of the existing track formation;

- the boundary of SEPP 14 wetland No 762 to be delineated along this section of the proposed route, by a wetland ecologist. Where possible measures should be adopted (eg fencing or pegging) along the delineated boundary to protect the wetland during construction.

- care should be taken during construction and rehabilitation to minimise the potential for further sedimentation of the existing intermittent watercourse draining to SEPP 14 wetland No 762 in the vicinity of the disused quarry.

Crossing Nelson Bay Road

- care should be taken to avoid where possible the sedgeland northeast of the intersection point. (This wetland, on commonwealth land, is not covered by SEPP 14);

- care should be taken to avoid SEPP 14 wetland 765a. The wetland boundary as presently drawn includes a generous 'buffer' of Eucalyptus pilularis/Angophora costata dry forest. If the main can be constructed along the edge of Nelson Bay Road formation, trenching can follow the formed track leading off to the west of Nelson Bay Road without closely approaching the wetland margin until some 100 metres from the sealed Nelson Bay Road.

Nelson Bay Road to Gan Gan Road

- where practicable the rising main should follow the existing road throughout rather than the electricity easement.

- wherever practicable trenching and pipe placement should be within the actual road formation rather than damaging either the dry forest on the upland side or the wetland on the lowland side.

- through the sections actually abutting the nearby SEPP 14 wetland No 805, the wetland boundary should be delineated by a wetland botanist or ecologist. Safeguards will be incorporated into the construction contract so that the construction activity does not encroach into the wetlands.

Gan Gan Road/Pumping Station R4

- the pumping station should be sited on the high ground immediately south of the track;

- provision for emergency discharge overflow control measures would comply with SPCC requirements.

Gan Gan Road Between R4 and Anna Bay
The pipeline should be located along the edge of the existing road formation to avoid any intrusion into wetland 805 which is bisected by the road.

Hunter District Water Board Land

- the rising main should be aligned to minimise intrusion into small wetlands which are not identified by SEPP 14;

- sectors of the route through or adjacent to wetlands will be delineated prior to construction on the advice of a wetland ecologist so as to minimise potential impacts on such wetland. Wherever possible construction activity should be excluded from the wetland.

The discharge of overflows would be an infrequent event only occurring during extended power failures when storage capacity within the pumping station and pipelines is exceeded.

In addition to observing these safeguards, minimising long term impacts depends chiefly on a clean and speedy construction phase through restoration followed by establishment of a protective management regime which excludes vehicle access in order to minimise vegetation and soil damage.

The construction site will also be secured from unauthorised vehicle access and rehabilitation after construction will be protected by exclusion of off-road vehicles, and fostered by periodic maintenance.

Observation of these safeguards will ensure that no significant adverse impact on wetlands will result from the proposed development.

8.2.5 Archaeological Impacts

The rising main routes and pumping station sites have been surveyed by an archaeologist (Reference 4) and no sites or relics were found. No adverse impacts are expected. If any undetected sites or relics are unearthed during construction the Regional Archaeologist of the NSW National Parks and Wildlife Service would be notified immediately.

8.2.6 Landuse Impacts

The major existing and likely future land uses along and adjacent to the proposed routes of the rising mains are shown on Exhibit 3.2. The principal land uses which could be influenced by the proposed development are:

- existing and possible future urban development areas;

- Aboriginal land claim areas presently under consideration;

- proclaimed HDWB water catchment areas.

Potential impacts on these existing and possible future land uses are discussed below. However, as a general overall observation, the impact potential of the rising mains and pumping stations on land usage is low provided good standards of construction, site restoration and maintenance are adopted.

Impacts on Urban Land Use

Potential impacts on existing urban areas would mainly arise due to the proximity of pumping stations to residential houses. Impacts on future urban areas are of less significance since future urban developments can be designed to ensure that adequate separation distances from pumping stations are maintained to provide a buffer for odour control in the event of system malfunction. Noise from submersible pumping stations has been shown not to be noticeable at a distance of 5 metres from the stations.

In terms of existing urban developments, two pumping stations (SP1 at Soldiers Point and AB4 at Anna Bay) are located within 100 metres of existing residences. An environmental impact potential could arise in the event of an extended power failure resulting in an overflow from the station and the resultant generation of odour.

The level of risk is low, since unscheduled power outages are not common, and overflows would only occur after the storage capacity in the pumping station and pipelines is exceeded. In comparison to the benefits of the proposed development the risk is considered to be acceptable. Emergency overflow relief structures will be designed to meet SPCC requirements and to minimise inconvenience to persons, damage to property and impact on the natural environment.

Impacts on Aboriginal Land Claim Area

A substantial area of land in the Salamander South area is under consideration as an Aboriginal land claim. The rising mains which would be constructed initially if the scheme is approved will not pass through the land claim area and there is no potential for any adverse impact. However, and as shown on Exhibit 5.1 provision is made in the scheme for a possible future pumping station (R3) in the Salamander South area if required to service future urban developments in the vicinity. The likelihood of such urban development proceeding will depend on a variety of factors including the outcome of the land claim. The need for pumping station R3 and associated rising mains is therefore uncertain.

Impacts on Water Catchment

A substantial length of rising main east of pumping station R4 will be located within land reserved by the HDWB as water catchment. Design, construction and maintenance of the pipeline through the water catchment area will be carried out to meet HDWB requirements so as to ensure protection of the groundwater resource.

8.2.7 Impact on Tomaree National Park

Under the preferred scheme, the final section (approximately 400 metres) of the rising main route leading to the proposed Boulder Bay sewage treatment plant would pass through Tomaree National Park.

Two aspects need consideration to determine the effect of a development such as is proposed on a National Park:

- firstly, the question of the actual impact needs to be considered; and
- secondly, the relationship or "nexus" there is between the proposed development and the purpose or objectives of the National Park.

The following discussion relates primarily to the question of the nexus. In the course of the discussion, actual environmental impacts are also discussed.

Tomaree National Park was established with the primary intention of conserving the vegetation communities within it and the secondary intention of preserving the coastline as a recreational resource.

It is considered that the proposed sewerage scheme, of which the length of pipeline through the Park is an integral part will enhance both the conservation and recreation objectives of the Park in several ways including:

- the provision of continuity of foreshore vegetation communities between the two separate parts of the Park;
- the improvement of the visual amenity of the Boulder Bay area and its surrounds;
- the opportunity for further control of vehicle access to the National Park;
- aid in the control of aggressive weeds; and
- elimination of odours from the Boulder Bay area.

These effects will arise as a direct result of the following proposed works:

Rehabilitation/Landscaping Works
At present, the foreshore section of Tomaree National Park between Boat Harbour and Fingal Bay is divided into two parts by the HDWB site at Boulder Bay (refer Exhibit 3.2). This division is both a physical separation and an ecological separation as the majority of the HDWB site has been denuded of vegetation or has been invaded by the aggressive weed Bitou Bush. The proposed sewerage scheme, however, will involve the rehabilitation of the foreshore section of the HDWB site including the removal of Bitou Bush and revegetation with coastal heath species.

This will eventually provide both an ecological link between the separated portions of the National Park and the creation of a continual strip of natural coastal vegetation.

Thus, the proposed development will provide an opportunity for improving the Park by linking its two presently separated parts.

Construction of the Pipeline to Boulder Bay
Construction of the section of the pipeline through the National Park will take approximately 2-3 weeks. During construction the easement through the National Park would be temporarily fenced to restrict disturbances to within the easement. Subsequent revegetation would then be undertaken to the satisfaction of the NPWS. Unlike the section of the pipeline traversing the HDWB Water Catchment Area where a narrow maintenance track will be maintained, total revegetation of the section through the National Park will be undertaken.

The rising main will approach the treatment works site near an existing four wheel drive track which leads through the National Park to Snapper Point and Skate Bay. This track intersects the northeastern corner of the HDWB site and is frequently used by off-road vehicle enthusiasts. The uncontrolled use of such tracks has caused erosion problems within the National Park and the adjoining Water Catchment Area (refer Section 3.13.1).

To prevent public access to the pipeline route and associated maintenance track a gate and/or fence will be constructed. The gate could also provide the opportunity to restrict public vehicle access to the existing four-wheel drive track if the NPWS so required.

Hence, the proposed development provides an opportunity and justification for controlling a problem (unrestricted access by four wheel drive vehicles) which is damaging the Park.

Improved Discharge Quality
The proposed development will result in an improvement in discharge quality in the Boulder Bay area. In turn, this will enhance aesthetic values from the nearby coastline, most of which is within the National Park. This is also consistent with the aims and objectives of the Park.

Control of Aggressive Weeds
The proposed rehabilitation of the HDWB site will enable the removal of the aggressive weed Bitous Bush and revegetation with coastal heath species. The eradication and future control of Bitou Bush will result in the site no longer being a source for the spread of Bitou Bush into the National Park.

Odour Control
The proposed treatment plant and extended deep water outfall will significantly reduce potential for odour problems to arise. This will improve the recreational amenity of Boulder Bay, its foreshores and the National Park in the vicinity of Boulder Bay.

Assessment of Impact
Construction of a pipeline for a distance of approximately 400 metres through the National Park raises three potential impacts:

- increased public access;
- increased opportunities for "weed" invasion; and,
- erosion.

The risk of increased public access will be reduced by the proposal to provide locked gates at either end of the easement. As previously discussed, an opportunity will also be created to restrict existing access to the Park as well.

For the purposes of National Park management, a weed is a persistant plant which is not native to the area. Any disturbed area provides an opportunity for weed invasion, particularly if fertilisers are used in rehabilitation works. However, there is now a solid body of experience which shows that the detrimental effects of fertilisers cease when they cease to be applied.

The intention to use only appropriate native species in rehabilitation works will provide an effective control on weed invasion since they have a competitive ecological advantage on their preferred sites. Provided rehabilitated areas are patrolled annually for two to three years after completion of works until the native species achieve a substantial degree of cover, it is unlikely that weed species will be able to establish.

Effective control of erosion is essentially a matter of close supervision of construction activities to limit the extent of disturbance followed by effective rehabilitation. Both are achievable in the proposed development area. Provided both objectives are achieved, the erosion hazard will be low.

Summary of Impacts on the National Park
The actual impact potential of the proposed development on the National Park is low. In addition, it is considered that there is a case to establish a nexus betwen the proposed development and the Park insofar as the development will provide a range of benefits for the Park which will improve its management and enhance the purposes for which it was created.

8.2.8 Visual Impacts

The rising mains and pumping stations will be located within the following landscape units identified by the National Trust on Tomaree Peninsula (refer Reference 15):

- urban areas unit (generally in the vicinity of SP1);
- rural/urban fringe unit (vicinity of AB4 and BH3); and,
- the natural landscape unit (the majority of the system including R3 and R4 and rising mains through to Boulder Bay).

The rising main routes, with the exception of the two kilometre section within the HDWB water catchment area and 400 metre crossing through Tomaree National Park are all located within or adjacent to the alignments of existing public roads or formed access tracks and no additional visual impact will be registered by these components of the proposed development. The visual impact of the cleared easement through Water Catchment Area will be insignificant as its visibility from public observation points will be minimal. The proposed revegetation of the section through the National Park will ensure visual intrusion will only be short term.

The main source of visual impact potential arises from the pumping stations although the potential is minor due to the limited amount of above ground works required at each site, comprising a small building to contain electrical controls.

Pumping station R4 will be located adjacent to Gan Gan Road. However, there is a substantial amount of regrowth eucalypt vegetation between the road and the site which will shield the pumping station from views from the road.

Stations AB4 and BH3 are adjacent to Anna Bay Road within the rural/urban fringe landscape unit. The National Trust (Reference 15) recommended that developments in such areas should make provision for setbacks, landscaping and colour control on structures. These guidelines will need to be taken into account in the detail design of stations AB4 and BH3.

The remaining station of significance is SP1, located in an area identified by the Trust as providing an important link between valued natural areas. In this particular case, the linkage is a view from Soldiers Point Road over an estuarine wetland. To maintain existing views, attention will need to be given to the detail location of the above ground structure of SP1 to minimise its visual impact. Perimeter landscaping will also be required.

8.3 TREATMENT

As discussed in Section 5.4.3, it is proposed that the Boulder Bay sewage treatment plant will be located in a timbered area within a dune swale to the immediate north east of the existing plant. The latter will be dismantled and the site rehabilitated following commissioning of the proposed treatment plant.

8.3.1 Potential Erosion Hazards

The treatment plant site is located on unconsolidated dune sands of low nutrient status and comparatively high susceptibility to erosion, particularly wind erosion. However, the site is completely surrounded by dense, low dry sclerophyll forest which will provide comprehensive protection from the wind thereby minimising erosion potential during construction.

Additional control will be achieved by minimising the extent of clearing and the application of Standard Soil Conservation Service rehabilitation procedures for coastal dunes. Due to the location of the site adjacent to the boundary of Tomaree National Park, liaison with the NPWS regarding species selection will be undertaken to avoid any risk of invasion of adjacent areas by any exotic species.

The surroundings of the existing treatment plant have been badly eroded due to the combined effects of uncontrolled vehicular and pedestrian access and exposure to wind and salt spray.

Following dismantling of the existing plant it is proposed that a vehicle turning circle will be established for visitors and the remainder of the site rehabilitated.

This will provide a major benefit to the area from a soil erosion point of view as well as aesthetically and ecologically.

No major adverse soil erosion impact is anticipated as a result of the proposed development.

8.3.2 Potential Ecological Effects

Existing Site Flora
A detailed vegetation survey of the site showed that the vegetation consists of a woodland community dominated by Smooth-barked Apple (Angophora costata). The exotic weed, Bitou Bush (Chrysanthemoides morilifera) is common in nearby disturbed areas. No significant plant species were recorded from this site.

The existing treatment plant is substantially devoid of vegetation apart from some closely cropped exotic grasses on the margins of the area and extensive marginal infestations of Bitou Bush.

Potential Impacts on Flora
Some localised clearing (approximately 15 x 40 metres) of existing native vegetation will be required at the plant site. No rare, endangered or vulnerable species will be affected.

Provided care is taken to ensure that the site is not infested by Bitou Bush following completion of construction, no adverse impacts on flora conservation will result. Bitou Bush is controllable provided persistant on-going treatment is applied.

Additional Bitou Bush control within the HDWB site will be undertaken as a part of the rehabilitation of the existing plant site. Along with formalisation of both vehicular and pedestrian access this will provide an opportunity for suppressed native species to recolonise the area.

On balance, floral impacts are assessed as being neutral.

Impacts on Fauna
The extent of clearing will be minor and no adverse effects on fauna will be registered.

8.3.3 Visual Impacts

Impact Potential
The scope of development required at Boulder Bay is minor and the potential for detrimental visual impacts is limited.

The major issue relates to reducing visibility and positioning of the proposed building within the available site such that it cannot be seen from urban expansion at Fingal Bay, and does not dominate the visual environment within the Boulder Bay visual catchment area.

Views into the site from urban areas are restricted. Views from the surrounding National Park are possible, but their significance is minimal in light of the very limited numbers of people having access to the highpoints within the Park.

Future public access into the site is also relevant in assessing the impact of the plant. Existing site vegetation is not high enough to screen views of the building structure fully from the present access road to Boulder Bay.

Account will need to be taken of this in developing a detailed site landscaping plan.

Visual access from the ocean is less of a constraint since near-shore navigational hazards prevent most boats from venturing close to the coast. This will provide attenuation of visual impact due to sight distance. However, further visual control could be achieved by locating the plant as far from the foreshore as possible, and close to the protective backdrop of the adjoining landform, so as to increase visual absorption. Judicious selection of construction materials will provide additional control.

Therefore, it is concluded that there is a good basis for the development of a low visual impact treatment plant provided that, in detail design, the range of safeguards listed further below are adopted.

The proposed development also provides a basis for a major improvement in local visual quality due to dismantling of the existing plant, which is highly visible. Restoration of the surrounding area within the HDWB site which has been degraded by uncontrolled access, and future protection by the establishment of a vehicle turning area will provide additional benefits.

Visual Environmental Design Strategies
To provide for a low visual impact development at the treatment plant site the following design criteria should be observed:

- consideration in site planning of the position of the development so as to benefit from natural site containment through topography and vegetation;
- minimisation of site disturbance from both construction activities and plant access requirements;
- provision of a fenced landscape protection zone surrounding the construction site to ensure retention of vegetation and prevention of unnecessary disturbance and access;
- complete demolition and site rehabilitation of existing outfall plant;
- supplementary planting and bushland restoration of areas not effected by the proposal and within the site;
- establishment of a schedule of materials and colours for new constructions sympathetic with the surrounding landscape;

- careful consideration and integration of any proposed structure, so as to minimise detrimental visual impacts of emergent structures above the natural vegetation canopy;

- maintain building profiles sympathetic with the gradients and slopes of surrounding topography;

- define and encourage rational vehicle access and circulation using the existing road easement and established access corridors.

Exhibit 8.2 shows the main elements of the design strategy.

8.3.4 Potential Archaeological Effects

An archaeological survey of the site located no aboriginal sites (Reference 4). A previously identified site (No. 38-5-45) located to the north of Boulder Bay will not be affected by the proposed development.

If any undetected sites or relics are unearthed during the construction phase the Regional Archaeologist of the NPWS will be notified immediately.

8.3.5 Impacts on Land Use

The treatment plant site is on land owned by the HDWB surrounded on all sides by Tomaree National Park. The only other known existing use of the site is as direct foreshore access for fishermen or for longshore access by fishermen and four wheel drive enthusiasts via a vehicular track to Snapper point, to the west of Boulder Bay. Existing and potential future residential areas in Fingal Bay are located approximately one kilometre to the north of the site and will not be directly impacted.

Impact on the National Park
The treatment plant will not extend into the Park and hence will have no direct adverse impact. The range of potential indirect impacts includes visual (Section 8.3.3), noise/odour (Section 8.3.6), potential restrictions on access and the provision of linkage between the two sections of the Park separated by the HDWB site (Section 8.2.7).

In terms of access, the proposed treatment plant site intersects with a four wheel drive track to Snapper Point. In places, the track is severely eroded and it is also used to access points deeper into the Park. One side track leading into the Park is grossly eroded and constitutes a major scar on the landscape.

The proposed development may provide an opportunity to block or at least control vehicular access to the Snapper Point track. A final decision on any control or restriction would be a matter for determination by the NPWS in light of its overall management priorities. Such management could provide an effective means of control and hence its impact could be seen as being potentially beneficial.

In terms of linkages between the two separated parts of the Park, rehabilitation of the HDWB's site as a result of the proposed development would appear to be beneficial. A substantially degraded and weed infested area will be replaced by a rehabilitated area much more in keeping, visually and ecologically, with adjacent National Park areas.

Again, the impact of the proposed development is seen as being beneficial.

Impact on Foreshore Access
Existing foreshore access opportunities in Boulder Bay will not be reduced under the proposed development. Rehabilitation works, including the provision of a formal vehicle turning circle will improve the quality of access available.

8.3.6 Noise and Odour Impacts

The nearest existing and likely future residential areas to the site are at Fingal Bay, more than one kilometre north of the site. Potential noise and odour generation are only likely to be a problem during plant malfunction and then the buffer distances to the nearest residences are adequate to mitigate the effects of such events.

Noise levels within the adjacent National Park will not be significantly increased since all plant equipment will be located within a structure, the walls of which will provide adequate noise attenuation.

Potential impact from odour generation is considered to be insignificant due to the distances between the proposed plant and urban areas at Fingal Bay. In addition the proposed treatment plant will be housed in a building providing the opportunity for odour control methods to be employed.

8.4 DISPOSAL

As described in Section 5.4.4, the proposed disposal scheme comprises a 560 metre long submarine outfall pipeline with a diffuser located at a depth of approximately 12.5 metres below mean water level. Potential environmental impacts may arise during both construction and operation.

Final outfall construction would be subject to detailed design and costing but typically the outfall pipeline would be laid in a trench from the treatment plant to the edge of an existing rock platform which projects approximately 200 metres into the Bay. Further offshore, the outfall pipe would be supported by piers anchored into the seafloor. The outfall will be located fully below the ground surface or low water level throughout its length. This contrasts with the existing outfall which is laid on the surface of the rock platform with its small terminal outlet also being exposed at low tide.

8.4.1 Impacts of Construction

Proposed Construction Sequence
The section of pipeline from the treatment plant to high water mark will be laid in a trench to be established by excavator plus additional blasting as required. Subsequent sections will be constructed by two different methods.

For the first 200 metres, the construction sequence would be based on progressive extension of a rubble groyne to provide a working platform as follows:

- blast or rock pick a trench of 1 to 1.2 m depth ahead of the groyne;
- construct the groyne over the full length to about high tide level using locally available materials (boulders, rocks, smaller rocks in gabions, and possibly sand bags in the core of the groyne).
- working during periods of low tides, excavate trench in the groyne for each pipe length, and join to the preceding pipe. Backfill with pebble gravel and cover top of pipe with concrete to original seabed level.
- reinstate groyne as required. (Repairs will be required to the groyne after major storms.)
- on completion of the landward section, remove the groyne.

The typical method of construction for the remainder of the outfall would involve:

- survey the alignment, mark the sites for the piers;
- drill and install piers;
- lay pipe using barge. Secure pipe using metal straps to the piers.

The major impacts of construction will be in the categories of erosion, noise, water quality, marine ecology and visual impact.

Soil Erosion

A soil erosion risk will arise during the laying of the outfall pipeline in a trench between the treatment plant and the beach.

The hazard will not be great since clearing will be linear and over a distance of only 100 metres. Guidelines established by the Soil Conservation Service for rehabilitation of coastal sands are the most appropriate for this location. It will also be desirable to limit access for plant and equipment to a single route and limit the extent of site disturbance as much as practicable.

Pipe route restoration would be undertaken as part of an overall site rehabilitation.

No adverse long term soil erosion impact is expected.

Acoustic Impact

The major acoustic impact will arise due to the use of equipment such as excavators, rock breakers and an expected need to blast to create the trench to accommodate the outfall pipeline across the rock platform.

The nearest residential area is in Fingal Bay and the minimum separation distance from the site of construction activities is approximately one kilometre.

In Table 8.1, typical sound power levels for the major noise generating items of plant and equipment are shown along with the calculated resultant noise level at the nearest house. The predicted levels are very conservative since they take no account of the noise attenuating effect of intervening topography between the site and the nearest houses. The effect could be expected to reduce resultant noise levels by between 5 and 10 dBA.

TABLE 8.1 - PREDICTED NOISE LEVELS

Noise Source	Sound Power Level (dBA re 1pW)	Resultant Noise Level (dBA)
Front End Loader	110	44
Crane	105	39
Air Compressor	100	34
Rock Breaker	120	54

The significance of the predicted noise levels can be gauged by comparing them with existing background noise levels. The Fingal Bay area has a residential land use with very low traffic levels. The background noise level is expected to be approximately 30 dBA although on windy days or when a sea is running, the level could increase to in the order of 35 dBA.

The SPCC's Environmental Noise Control Manual recommends that, for construction periods of between one and six months, construction noise should not exceed the background level by more than 10 dBA.

Construction of the outfall could take up to 8 months with the major noise generating activities occurring during the initial few months. Actual noise levels to be anticipated during this period will be dependant on the detail design and construction methods to be employed. As there will be considerable topographic attenuation of construction noise, it will be possible to implement construction techniques so the resultant noise levels during construction will not be intrusive to residents at Fingal Bay.

Noise levels from possible blasting cannot be predicted in the absence of blast design information particularly likely charge weights. However, it is expected that only small charges would be used due to the fragmented nature of the rocks (Reference 19) and the likelihood of noise from blasting being intrusive is considered to be low.

Water Quality

The main risk of a water quality impact during construction will arise due to construction of the groyne to provide a working platform for initial pipe laying. The groyne will be constructed from local material (eg foreshore rubble).

After placement, finer material (eg sand) may be subject to suspension due to wave action. However, the sand is very coarse (fine sands generally are not deposited on the foreshore due to the high energy wave climate) and will settle quickly. Impacts are likely to be localised and of minor significance.

Marine Ecology

Construction activity will destroy all organisms living in the region of the proposed groyne and piers to carry the pipeline. The seabed in the region of the proposed causeway is composed of boulders embedded in coarse sand. In the intertidal zone molluscs present include Littorinid snails, limpets and Melanerita. In the sub-littoral zone turfing algae are the most conspicuous inhabitants.

The results of monitoring programmes carried out over a 12 year period (see Section 8.4.3) show that recolonization of the damaged seabed will occur rapidly much in the same way it does after a severe storm.

Damage to the marine community in the outer part of Boulder Bay due to the construction of the supporting piers will be negligible and quickly repaired.

Visual Impacts

There will be a reduction of existing visual quality within Boulder Bay for the duration of construction operations due to the presence of plant and machinery, construction huts and the carrying out of earthmoving activities.

The visual impact will be restricted due to the lack of general visual access to the Bay from other than immediately adjacent parts of Tomaree National Park.

8.4.2 Impacts of Outfall Operation

Background

As stated in Section 4.4.1 the SPCC requirements for the design of ocean outfalls are outlined in their Environmental Guide WP1 (Refer Appendix D) which has the following specific objectives for the control of pollution:

- the maintenance of ocean waters visually free of oil greases and other floatable material;
- the protection of beaches in the interests of public health and to maintain a high degree of aesthetic satisfaction.
- the protection of ocean waters to retain a natural diverse but not necessarily unchanged variety of marine life.

Visibility

The visibility of an effluent field is dependent on the initial dilution of the sewage and subsequent dispersion. Initial dilution refers to the quantity of seawater which mixes with the discharged effluent in the area above the diffuser. Many parameters affect the initial dilution including the effluent density, ocean water stratification, discharge port size, discharge velocity, length of diffuser, depth of ocean water above the diffuser and ocean current velocity.

A computer programme was used to calculate initial dilution based all of the above factors.

An initial dilution of 80:1 during dry weather conditions was set as a minimum aesthetic requirement to meet SPCC guidelines (Reference 1). This ratio was based on observations of other milliscreened outfalls in Australia and overseas and a review of available literature.

Results from the computer programme indicated that for the preferred outfall location near Option 2 with a 60 m diffuser, port diameter of 12 cm and an average port depth of 12.5 m, an initial dilution of 80:1 could be achieved for flows equal to or less than 210 L/s.

This limit can be achieved with installation of an equalization tank in the Boulder Bay treatment plant (refer Exhibit 5.2) The equalization tank will provide storage to accept pumped flows during dry weather flow conditions and limit overflow to less than or equal to 210 L/s. During periods of peak wet weather when sewage is diluted approximately seven to one with stormwater/groundwater overflow of the tank directly to the outfall will occur. Due to the dilution with stormwater and initial dilution, aesthetics of the area will not be detrimentally effected.

After initial dilution subsequent reductions in the effluent concentrations occur due to dispersion and sedimentation.

Coastal Vegetation

Damage to foliage can be observed commonly in coastal vegetation, particularly after storms. This damage is often attributable to the effects of sea spray. Coastal vegetation communities are complex with species differing in their ability to resist the effects of sea spary. Species which exist in areas subject to these effects do so by having the ability to control the entry of salt (sea spray) to their foliage or by growing in relatively sheltered conditions.

With the advent of detergents (surfactants) there have been claimed instances of increased damage to coastal vegetation communities in the vicinity of sewage outfalls. The surfactant in itself does not cause damage, rather if in high enough concentrations it facilitates penetration by the salt water carried to the leaves in spray.

Investigations into this phenomenom have indicated that a problem could exist where sewage is discharged at the shoreline, in large quantities, with a high surfactant concentration. If there is a large industrial component in the sewage flow, then surfactant concentrations could be high. Industrial detergents are not readily biodegradable.

The operation of the Boulder Bay outfall is not expected to increase the natural die-off of coastal vegetation from salt spray effects as:

- The discharge volume is small (ultimately a few percent of the flow where claimed problems have been observed)
- The discharge is to be offshore from a well designed diffuser - minimum dilution of 80:1
- The surfactant concentration will be low comprising primarily biodegradable domestic detergents (virtually no industrial components).

Protection of Bathing Beaches

The key mechanism for determining the status of any water body from the health point of view is the use of bacterial indicators (faecal coliforms).

The real concern is for pathogenic (ie disease causing) bacteria or viruses which are intermittently present in sewage and although reduced by treatment may still be present in effluents. Their presence or otherwise is a reflection of the general level of the community's health.

These pathogenic organisms are admitted to the wastewater system by infected persons or carriers, and the normal intestinal bacteria which are harmless and perform an essential function for man greatly outnumber the pathogens.

Faecal coliforms are one type of these harmless bacteria which live in the intestines of humans and other mammals. They occur in very great numbers and it is relatively easy to detect and measure them in water samples using analytical methods. They are therefore used worldwide as indicators of the level of water quality.

The general philosophy in using indicator bacteria is that if it can be shown that faecal contamination of the water has occurred, then pathogenic organisms may also be present. It is generally assumed that by the time the indicator organisms have died off in water, any pathogenic micro-organisms will also have lost their viability. However, this assumption is by no means always true.

The NSW limits for faecal coliforms are set by the SPCC in consultation with the Department of Health at levels which are considered appropriate for the waters concerned. The requirements are similar to those used elsewhere in Australia and could be considered strict by international standards.

The SPCC requirements for the protection of bathing waters in terms of public health are as follows; within designated bathing areas, the geometric mean faecal coliform concentration resulting from the operation of the proposed outfall shall not exceed 200 organisms/100 ml for any month. This is equivalent to a "50 percentile" requirement.

Additionally, the faecal coliform concentration is not to exceed 400 organisms/100 ml in more than 10 per cent of the samples taken in a designated bathing area.

It is assumed that the sandy beaches of Fingal Bay and One Mile Beach are designated as bathing areas. The reductions needed to meet the above faecal coliform criteria can be achieved by a combination of: (1) initial dilution; (2) subsequent dilution resulting from lateral and vertical mixing of the effluent field; and (3) coliform die-off. Oceanographic studies undertaken (Reference 2) provide specific local data to allow predictions to be made of coliform levels of the discharge and these predictions are used as a basis for design. A computer model was used to model coliform concentrations taking account of a

wide range of variables including; initial coliform concentration, initial dilution, subsequent dilution, die-off of coliforms, travel time, probability of reaching shore. The variability assumptions were based on published research results and relevant laboratory testing.

Fingal Beach represents the nearest bathing beach east of the outfall. Similarly One Mile Beach is the nearest bathing beach west of the outfall. Obviously the achievement of bathing beach standards at these beaches implies the achievement of standards at beaches further from the outfall.

The results of the faecal coliform predictions are summarised in Table 8.2

TABLE 8.2 - FAECAL COLIFORM PREDICTIONS WITH PROPOSED OUTFALL OPERATION

Percentile	Fingal Beach organisms/100 ml		One Mile Beach organisms/100 ml		SPCC Standards organisms/100 ml
	Existing	Predicted	Existing	Predicted	
50% (Geometric Mean)	14	14	0	0	200
90%	86	130	2	50	400

The existing values represent long term conditions based on 48 samples collected over four years.

Predicted coliform concentrations were well below the standards set by the SPCC for the protection of beaches in the interest of public health and to maintain a high degree of aethetic satisfaction.

In addition, of course, the proposed development will result in termination of usage of the existing near-shore outfall in Boulder Bay.

Marine Ecological Effects

Existing Situation

The marine ecology of Boulder Bay has been studied by way of field sampling and observation over a 12 year period supplemented by more intensive work over the last two years during feasibility analysis of the proposed development.

Two marine environments were studied in Boulder Bay:

- The intertidal rocky shore; and,
- The subtidal rocky bottom.

The intertidal section of the rocky shore at Boulder Bay was confined to the steeply sloping parameter of the two coves (north and south) which together make up Boulder Bay or, to the boulder areas at the landward end of each cove.

The intertidal shore of both north and south cove is composed of very hard jagged rock and is subjected to very heavy wave attack at the seaward end of the Points. Wave attack is gradually reduced towards the inner sections of the coves.

The supra-littoral zone at the very top of the intertidal shore is sparsely colonised by orange, grey and brown lichens. Below the lichen zone in the upper littoral zone, numbers of the small snail Melaraphe unifasciata is present. The mid-littoral zone is particularly impoverished and contains only small patches of barnacles and the gastropods Melanerita atramentosa, Cellana tramoserica and Bembicium nanum.

The lower littoral zone is inhabited by turfing algae. Pterocladia capillacea, Coralline algae and Lithothamnion were present.

At the landward end of each cove is a steeply sloping boulder beach. Rocks in the supra-littoral zone are partly covered by lichens. Below the lichen zone is a bank of rounded boulders in which no microscopic plants or animals were found to live. In the lower littoral zone the boulders are much larger than those of the upper and mid-littoral zone and they are embedded in coarse sand. Sparse turfing algae live upon this type cover most of the floor of South Cove out to the first platform reef. The inner rocks are partly colonised by turfing algae while the outer ones are colonised by turfing algae and Ecklonia radiata.

The top of the first platform reef is dotted with large specimens of the cunjevoi Pyura praeputialis and the sides are covered by algal turf and Ecklonia radiata plants.

The sub-tidal rocky bottom of Boulder Bay has been investigated annually since 1975. Three zones of organisms were distinguished. The upper zone is composed of turfing algae (Pterocladia capillacea, Coralline algae, Lithothamnion, Zonaria spp. Sargassum spp. and Cystophora sp.) some Ecklonia radiata and Phyllospora comosa.

The middle zone is composed of Ecklonia radiata forest with an understory of turfing algae.

The lower zone is composed of Lithothamnion pavement and grazing urchins and molluscs.

The floor of the outer coves (seawards of the platform reefs) is composed of closely spaced boulders and mounds of exposed bed rock. Algae and some sponges are the dominant inhabitants of these areas of the seabed. At no time during the 12 year monitoring period have abalone been found in the Boulder Bay area.

Assessment of Impact

Twelve years of discharge of 800 kL per day of coarse screened sewage into the inner part of south cove has been shown to have had no detectable effect on the structure of the benthic community. There are two probable reasons for this. The first is that waters in the discharge zone are shallow so enough light always reaches the seabed to ensure that algae are able to maintain their competitive edge over filter feeding animals. The second reason is that the sewage-seawater mixture is carried rapidly out of the inner cove by the wave-induced current. Although much greater volumes of effluent will be discharged into Boulder Bay in the proposed scheme, the effluent will contain much less solid material and will be discharged in a manner and at a place to achieve maximum possible dilution and dispersion.

Under these conditions it is expected that algae will continue to dominate benthic communities living in 10-15 metres of water in south cove. In deeper water just outside north and south cove where sponges and other filter feeding organisms already form a significant proportion of the benthos, some changes may occur as a result of the increased effluent volume. Light intensity at the seabed may be reduced to a level where some species of algae are unable to compete successfully with other algal species or suspension feeders. This may eventually lead to a community structure in which suspension feeders become the dominant component over a limited area adjacent to Boulder Bay.

The discharge of milliscreened sewage effluent into Boulder Bay has the potential to affect the marine environment in several other ways. They are:

- change the salinity regime of water over a limited area;
- change the chemical composition of the receiving water particularly in respect of the concentration of soluble plant nutrients;
- provide a supply of substances which may be utilized as food by birds or fish;
- change the bacteriological quality or receiving waters; and,
- industrial component effluent.

Salinity Changes in Receiving Waters

A pumped jet outfall or a diffuser system mixes the effluent with as large a volume of seawater as possible. Salinity changes of the receiving water will be quite small and insignificant in ecological terms.

Changes to the Chemical Composition of Receiving Waters
The maximum concentration of restricted substances in the effluent field after initial dilution cannot exceed the values listed in WP-1. As the outfall for the Tomaree Peninsula will discharge predominantly domestic wastewater, the criteria for restricted substances will be met for the minimum dilutions set.

The SPCC requirements are that the pH value of the effluent shall not be less than 6.5 or more than 8.5. The discharge shall not induce a variation in the pH of more than 0.1 units, nor a variation in dissolved oxygen of more than 0.2 mg/L in any waters outside the initial dilution zone. With the minimum dilution of 80:1 set, pH and dissolved oxygen criteria, will be satisfied.

Milliscreened sewage effluent contains high concentrations of plant nutrients. Nitrogen in the form of ammonia and phosphorus as orthophosphate is present. If sufficient light is present these nutrients have the potential to stimulate plant growth in and around the outfall. Both phytoplankton and benthic algae may be affected.

Slight increases in mean phytoplankton standing crop have been recorded around outfalls operated by the HDWB so it is expected that the same effect will occur around the proposed Boulder Bay outfall when effluent discharge commences.

Nutrients in the effluent may also affect the growth of benthic algae in the lower littoral and sublittoral zones. Experience has shown that benthic algal growth may become more luxurious on the rock faces as a result of effluent discharge although the total cover of these plants should not increase because they always occupied almost all of the rock surfaces.

At some outfall locations in N.S.W. it would appear that nutrients in secondary treated effluent may have promoted the growth of dense beds of the green algae Ulva sp. and Enteromorpha intestinalis on intertidal rock platforms.

The geology of the intertidal rock areas at Boulder Bay is not suitable for the growth of Ulva and Enteromorpha because of the lack of a film of standing water at low tide.

Presence of Particles in Effluent that Serve as Food for Fish and Birds
Milliscreened sewage may contain minute particles of fat which may attract birds and fish to the discharge zone. Otherwise, this material has no adverse environmental impact.

The SPCC requirement is that no appreciable accumulation of solids shall occur on the shore or on the ocean floor within a distance of 1000 m from the shore or in any area where the water depth is less than 10 m. Diver investigations of the existing raw sewage outfall at Boulder Bay have shown that prevailing turbulence levels and currents in the proposed discharge zones are sufficiently strong and persistent to prevent accumulation for more than a day or two of solids discharged with the effluent, since the discharge of higher quality effluent is proposed then there will not be any appreciable accumulation of solids in the nearshore areas defined above.

Changes to the Bacterial Quality of Water in the Discharge Zone
Milliscreened sewage contains large numbers of bacteria such as the faecal coliform bacteria. As well as these harmless bacteria there may also be pathogens and viruses at much lower concentrations.

The bacteria form part of the food of suspension feeding animals living in the discharge zone. Some suspension feeding animals concentrate living bacteria in their bodies and, if eaten by sensitive predators, sickness may occur. This is particularly important in the case of oysters that are eaten alive by humans.

Oyster numbers are very low at Boulder Bay so human consumption of them is unlikely to cause problems when effluent discharge commences at the new location.

Commercial abalone fishing grounds are not found in the vicinity of Boulder Bay and as the proposed treatment plant and outfall will meet all SPCC criteria, no adverse effects on abalone are anticipated as a result of the scheme.

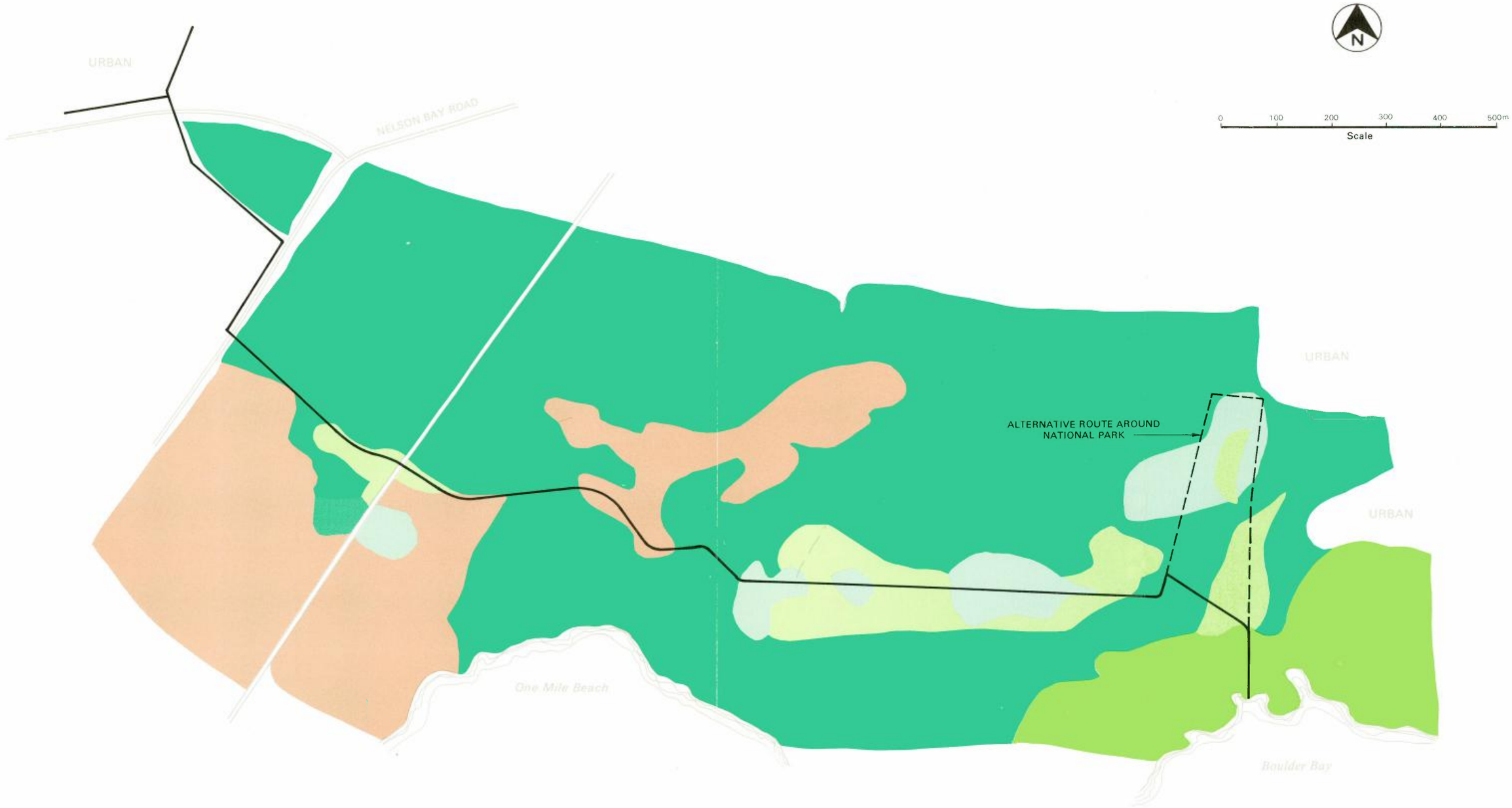
The Effect of Industrial Waste on Marine Biology
The areas to be sewered in the Tomaree Sewerage Scheme are almost completely residential so industrial effluent will form a very small proportion of the total volume of sewage treated by the milliscreening process. As industrial components or prescribed substances will be present in very small concentrations they are unlikely to harm marine communities in the discharge zone.

8.4.3 Impact on Recreational Amenity

The Bay itself is not suitable for water based recreation due to the high energy wave environment, tidal and other currents and the presence of numerous rocky reefs. The proposed development will not adversely affect water based recreational amenity in the Bay.

The existing outfall is of some interest to fisherman due to the suspected locally increased fish population induced by the effluent.

Access to the foreshore under the proposed development will not be restricted, rather it would be controlled by the proposed rehabilitation of the HDWB site and provision of a walking track to the foreshore.



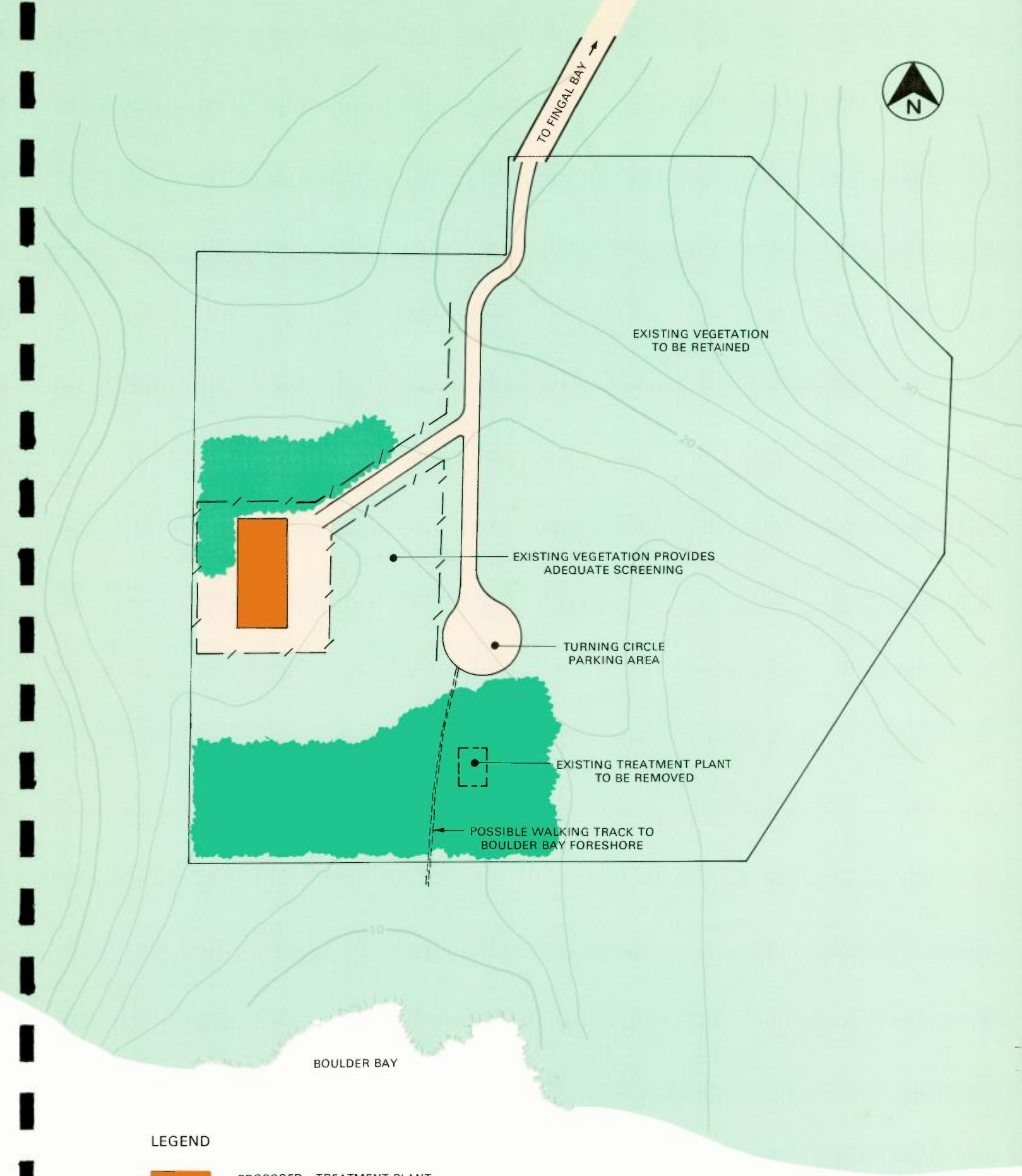
LEGEND

- OPEN FOREST
- WOODLAND/LOW WOODLAND
- OPEN SCRUB
- SEDGELAND
- GRASSLAND
- CLOSED HEATH
- APPROXIMATE ROUTE OF MAINS

Exhibit 8.1

GAN GAN ROAD – BOULDER BAY VEGETATION

SINCLAIR KNIGHT & PARTNERS PTY LTD



LEGEND

- PROPOSED TREATMENT PLANT
- REHABILITATION PLANTING
- SUPPLEMENT EXISTING VEGETATION TO ENHANCE SCREENING
- SITE FENCING

Exhibit 8.2

VISUAL MITIGATION MEASURES
BOULDER BAY SITE

SINCLAIR KNIGHT & PARTNERS PTY LTD

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Publication WP7

Appendices

Appendix A
Requirements of the Director of the Department of Environment and Planning

New South Wales Government

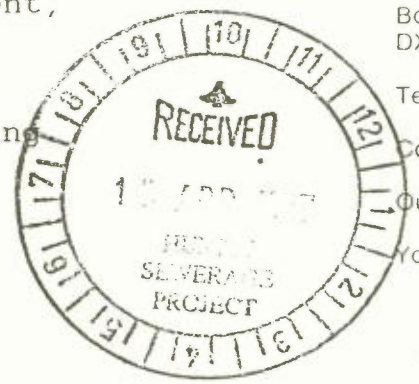
Department of Environment and Planning

Remington Centre
175 Liverpool Street, Sydney 2000
Box 3927 G.P.O. Sydney 2001
DX. 15 Sydney

Telephone: (02) 266 7111 Ext 490
Contact: M. Vincent
Our reference: 86/2537z3
Your reference: SGE-6237/8

Public Works Department,
P.O. Box 4886,
NEWCASTLE. NSW. 2300.

Attention: Mr. K. Young



02 APR

Dear Sir,

RE: HUNTER SEWERAGE PROJECT:TOMAREE PENINSULA SCHEME.

Thank you for your letter of 12th February, 1987, indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. An EIS is required to be prepared where the proposal is an activity referred to in Section 112(1) of the Environmental Planning and Assessment Act, 1979. The EIS shall be prepared in accordance with clause 57 of the Environmental Planning and Assessment Regulation 1980, as amended and shall bear a certificate required by clause 59 of the Regulation (see Attachment No.1).

3. In addition, pursuant to clause 58 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

. The EIS should provide sufficient information to identify the areas affected by each option in relation to wetlands proclaimed in the State Environmental Planning Policy No. 14.

. The EIS should include a discussion of the environmental implications of the proposal including, but not limited by the following:-

(i) a description of the design features of the proposal and measures to be taken to guard against actual or potential disturbances to flora, fauna, water quality and hydrological regime.

(ii) a discussion of environmental safeguards and proposals to monitor short term effects on marine biota including oyster production areas of Port Stephens.

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. Notwithstanding a decision being taken to adopt a particular option for sewerage treatment and disposal, the PWD should design to prevent nutrients from urban areas entering wetlands and should assess the preferred option in such terms.

4. Attachment No.2 is a guide to the type of information most likely to be relevant to the development you propose; not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal; equally, the guide is not exhaustive.

5. When an adequate EIS has been prepared for the subject proposal, as determining authority, you should then proceed with the matter in accordance with Sections 112 and 113 of the Act, and place the document on public exhibition. The procdures for public display that are to be followed by the proponent and/or determining authority are as in clause 60 to 64 of the Environmental Planning and Assessment Act Regulation, 1980.

6. When the EIS is completed, three copies should be forwarded to the Secretary pursuant to Section 112(2) of the Act, as well as details of the exhibition period and public display locations.

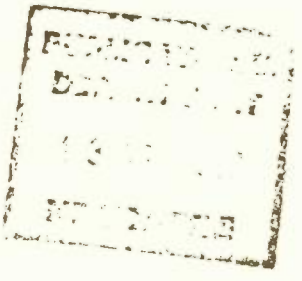
7. Should any submissions be made during the period of public exhibition, it is advised that such submissions should be forwarded to the Secretary in accordance with Section 113(3) of the Act. In the event of issues of interest to the Department being raised in any submissions received, the Department will advise you accordingly.

8. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully,

B. Adams

B. Adams.
Acting Manager,
Assessments Branch.
Delegate for the Director.



DEPARTMENT OF ENVIRONMENT AND PLANNING
ATTACHMENT No.1

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS.

In accordance with Part V of the Environmental Planning and Assessment Act,1979, an environmental impact statement (EIS) must meet the following requirements:

Pursuant to clause 57 of the Environmental Planning and Assessment Regulation,1980, as amended:

(1) An environmental impact statement referred to in section 112 (1) of the Act shall be prepared in written form and shall be signed by the person who has prepared it.

(2) The contents on an environmental impact statement refered to in subclause (1) shall include the following matters:-

(a) a full description of the proposed activity;

(b) statement of the objectives of the proposed activity;

(c) a full description of the existing environment likely to be affected by the proposed activity, if carried out;

(d) identification and analysis of the likely environmental interactions between the proposed activity and the environment;

(e) analysis of the likely environmental impacts or consequences of carrying out the proposed activity (including implications for use and conservation of energy);

(f) justification of the proposed activity in terms of environmental, economic and social considerations;

(g) measures to be taken in conjunction with the proposed activity to protect the environment and assessment of of the likely effectiveness of those measures;

(g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;

(h) any feasible alternatives to the carrying out of the proposed activity and the reasons for choosing the latter;

(i) consequences of not carrying out the proposed activity.

The EIS must also take into account any matters required by the Director of Environment and Planning pursuant to clause 58 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 59 of the Regulation.

DEPARTMENT OF ENVIRONMENT AND PLANNING
ATTACHMENT NO. 2

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR A REGIONAL SEWERAGE SCHEME

State Environmental Planning Policy No. 4 Amendment No. 1 provides for the construction of sewage treatment works without development consent. Accordingly, the determination of such proposals are governed by the provisions of Part V of the Environmental Planning and Assessment (EPA) ACT, 1979. In this regard, it is the responsibility of the determining authority to decide if an EIS is required. Pursuant to S.112(1)(a) of the EPA Act, 1979 as amended, where a proposal is likely to significantly affect the environment a determining authority must, before deciding whether to proceed with the proposal, consider an EIS prepared in respect of the proposal.

In general, sewerage schemes, including sewage treatment works, have the potential to raise issues of concern for local residents and landholders such as: priorities of service to cater for current needs for sewerage and future development demands, treated effluent standards and proposals for discharge to receiving waters, proposals for solids retention and disposal, ability to cater for emergencies and abnormal conditions, ability to cater for initial operating conditions, utilisation of existing facilities, proposals to mitigate adverse effects of pumping stations and treatment plants on nearby residential development such as odours and noise etc., and the need to ensure effective monitoring etc. Furthermore, effective environmental management of the construction phase is also an important consideration.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for a sewerage scheme including a sewage treatment works. It is intended to assist the preparation of the EIS. It is the applicant's responsibility to identify and address, as fully as possible, the matters relevant to the specific development proposal in complying with the statutory requirements for EIS preparation (see Attachment 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of the construction and operation of a sewerage scheme. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

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Information provided should be clear, succinct and objective and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the determining authority and the Department of Environment and Planning to properly understand the environmental consequences of the proposed development.

1. SUMMARY

This should contain a brief synopsis of the proposed scheme and proposals for its implementation, covering important points of each section of the impact statement. It should be succinct and capable of being read separately and without need to refer to the impact statement itself except for detailed subject matter. Sufficient information should be provided to obtain a ready appreciation of the scale and nature of the proposed scheme, the key physical/economic/environmental and social issues involved, alternative options considered, and the major reasons for their rejection.

2. INTRODUCTION

This should provide suitable background information on the proposals and relevant decisions taken by the authorities concerned, together with some indication of future studies, reports and decisions required for the scheme to proceed. It should also refer to any other reports which may need to be taken into account with the impact statement when the matter is determined.

3. NEED FOR THE PROPOSED WORKS

Basic information should be provided of existing septic tank/night soil services in the region together with details of any existing sewerage reticulation system and associated sewage treatment plants including facilities for effluent disposal. Comment should be provided on the inadequacies of the existing system to meet current and future demands including any relevant water quality problems, sufficient to justify the need for new proposals and to define the consequences of not taking action.

4. STATEMENT OF OBJECTIVES

An explanation should be given of the basic objectives of the proposed works. A clear statement is required of the priorities for reticulation and treatment to justify the project design standards and programme schedule proposed to meet current problems, environmental constraints and future demands (domestic, commercial, industrial and recreational) within the likely limitations of project finance available. A brief description of the scope of the proposed scheme should be provided including basic information on staging, timing and funding, including provisions in flexibility of design to cater for possible future changes in demand and funding availability.

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5. PROJECT DESIGN CRITERIA

A clear statement should be given of basic criteria adopted for the design of the scheme which should include for the following:-

- Design flow rate: equivalent domestic, commercial, industrial and recreational demands including for peak and seasonal loadings, likely increases in per capita water consumption, storm flows and infiltration, allowances for regional growth.

- Principles of sewerage design: demand requirements and distribution, priorities of service, potential for utilisation and upgrading of existing facilities, separate catchment strategies versus single regional scheme, topographical and geotechnical constraints for pumping stations and treatment plants, water quality/effluent discharge limitations in regard to inland and/or ocean waters disposal, capital/operating cost criteria.

- Design safeguards for pumping and treatment plant malfunctions: including power and mechanical failure, industrial disruption, overloading/storm infiltration, overflows, abnormal extremes in chemical loading and flooding.

- Future staging: additional sewerage/treatment plants, treatment plant expansion and changes in effluent disposal requirements for increased flow rates.

- Flexibility in design: ability to cater for possible future changes in loading parameters.

References: State Pollution Control Commission Guidelines

1. Environmental Design Guide WP-1. Design Criteria for Ocean Discharge.

2. Environmental Design Guide WP-2. Design Criteria for Effluent Re-use.

3. Environmental Design Guide WP-3. Treatment Processes for Water Pollution in NSW.

4. Publication WP-4. Guidelines for the Use of Package Wastewater Treatment Facilities.

5. Publication WP-5. Guidelines for the Disposal of Wastewaters by Land Application.

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6. Publication WP-6. Design Guide for the Disposal of Wastewaters by Land Application.

7. Environmental Design Guide WP-7. Water Conservation by re-use. Guidelines for the use of recycled water in NSW.

6. DESCRIPTION OF EXISTING ENVIRONMENT

This section is required to identify the total environment affected by the proposed scheme. Subject matter should be restricted to those elements likely to be affected by the proposal or which have a direct or indirect influence on it. Where the influence of or on the proposal could be significant, the description should be sufficiently comprehensive to allow subsequent assessment of impact appropriate to the level of influence. For instance, this would apply particularly to the location of sewage treatment plants and the disposal of treated sewage effluent. Where influence is likely to be small, an outline description only will suffice.

- Geography and demography of region to be serviced.
- Topograhy.
- Geology and soils including exploitable mineral deposits, potential for erosion, landslips and and subsidence, soil types and geotechnical properties/ characteristics.
- Meteorology including precipitation/evaporation, temperature variations, winds, fogs, inversions, bushfires, etc. including frequency of same.
- Hydrology including catchments, surface drainage patterns, natural waterbodies and beaches, reservoirs, runoff and flooding potential, groundwater characteristics, flow rates and water quality.
- Air quality.
- Ambient noise levels.
- Aesthetics.
- Flora and fauna including an outline description of vegetation communities and wildlife species and habitats.

- Environmentally sensitive areas including lakes, marshlands, wetlands*, estuaries, oceans (coastal beaches), floodplains and flood retention areas, groundwater recharge, forests and woodlands, steep slopes, rare habitats, prime agricultural areas, archaeological/historic sites, existing and potential areas for outdoor recreation/vistas/national parks/wilderness, water storage, etc.

- Existing land use both urban and rural including residential, commercial, industrial, recreational, agricultural, mining and quarrying, forestry, natural area reservation, historic.

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- Transportation and Communications.
- Utilities and services particulary sewerage/sewage disposal, water supply and power.
- Tourist industry particularly seasonal impacts.
- Development trends.

* Note: Possible application of State Environmental Planning Policy No. 14 - Coastal Wetlands to any proposals that may result in clearing, constructing a levee, draining or emplacing fill on land to which the subject policy applies.

7. EXISTING DEVELOPMENT AND FUTURE GROWTH PROJECTIONS

This section should examine the distribution of existing development in the region to be sewered, and provide appropriate information on future growth projections, including for planning provisions, areas zoned or considered suitable for potential development, likely types of future development with emphasis on probable sewage loadings.

Estimates of equivalent population contributions from future domestic, commercial, recreational and industrial demands should then be presented for each reticulated area and treatment plant, and appropriate design flow rates and loadings derived therefrom using data presented in Section 5. Allowance should be made for variation in growth rates to provide for maximum and minimum requirements, and adequate evidence provided to support the predictions made.

Information provided in this section should establish the basis for justifying proceeding with the proposal.

8. ALTERNATIVE STRATEGY OPTIONS

A clear statement of the various strategy options available should be provided including bulk estimates of capital and operating costs. The strategies should then be reviewed and their advantages and disadvantages (both in the short and long term) compared, having regard for their ability to meet the objectives identified in Section 4, and sufficient to justify the proposed scheme in terms of relevant environmental economic and social considerations. This section of the EIS will be critical to a proper evaluation of the subject proposal.

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9. ENVIRONMENTAL STUDIES/INVESTIGATIONS

This section should state the results of all field and laboratory studies and investigations carried out for the design of the proposed sewerage scheme particularly with regard to effluent disposal to coastal lakes, ocean outfalls, etc. Sufficient information should be provided to permit adequate subsequent assessment of environmental impact. Synopses of relevant reports may be provided as appendices.

10. DESCRIPTION OF PROPOSED WORKS

Sufficient information should be provided about the proposed scheme to enable a ready appreciation to be obtained of the major components of the sewerage system, sewage treatment plans and facilities for disposal of liquid effluent and solid wastes. This should include any proposals for integration with, upgrading or phasing out of existing systems.

In addition, some indication should be given of the quantities, problems and techniques involved in the construction of the scheme; details of priorities and proposals for staging. Much of this information can be presented in the form of adequate maps and drawings. These should include longitudinal sections of the trunk sewer system including gravity/pumping mains and major pumping stations, and through the treatment plans and outfalls. All major components of the sewerage system and treatment plants should be adequately dimensioned and relevant hydraulic data for such dimensioning presented so that their ability to deal with equivalent population flows at critical time intervals can be demonstrated with the minimum of interpretation.

Environmental safeguards including subject matter appropriate for consideration for approvals required under the Pollution Control Acts and the Clean Waters Act in particular, have been allocated a separate section in this brief. However, there is no objection to including this information in this section if it is found more appropriate to do so.

- Collection System: Details of gravity reticulation and minor pumping systems within local/sub-regional drainage basins.

- Transfer System: Details of gravity and pumping systems required to transfer sewage from drainage basins to treatment plans, including details of major pumping stations.

- Treatment Plants: Details of facilities to treat and process liquid wastes to acceptable disposable standards including firm proposals for stabilisation and storage of solid wastes. Details of preliminary, primary, secondary and (if necessary) tertiary treatment processes based on design criteria identified in Section 5 and including for storm bypass arrangements and plant expansion.

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- Treated Waste Disposal: Details of firm proposals for disposal of liquid and solid wastes and gaseous emissions.

- Integration with Existing Facilities: Proposals to utilise and/or upgrade existing plant and facilities either temporarily or permanently including proposals for temporary discharge if any.

- Construction: Description of proposed construction management programme, manpower requirements, plant/materials/storage/work camp requirements, disposal of wastes, standards/methods/operations, sources of construction materials, traffic access, site clearance, earthworks, tunnelling, blasting, drainage, structures, restoration, etc.

- Future Staging: Proposals for future expansion of facilities and subsequent staging necessary to meet future needs.

ENVIRONMENTAL SAFEGUARDS

Information required in this section should justify the design adopted for the sewage treatment works and sewerage systems, drawing attention to those details of the proposals which significantly affect environmental impact, and including provisions incorporated in the design to cater for emergencies and abnormal conditions. Information should also be provided on safeguards proposed for the construction phase. Matters requiring consideration should include for the following:-

- Construction Phase

  Proposals for environmental management for construction phase.

  Safeguards envisaged for construction works should include for the following:-

  Measures to deal with access, construction camp and storage facilities, site clearing and disposal of vegetation, disposal of spoil, site drainage including proposals to cater for storm runoff/erosion/siltation of waterways, dust emissions, exhaust fumes, noise generation and vibration including safeguards for blasting, disposal of litter, traffic, public disturbance/inconvenience/safety, borrowing of natural materials, public and private property improvements, etc., clean up and progressive restoration, etc.

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- Operational Phase:

  Proposed priorities of service. Ability of construction programme to adequately cater for current needs for sewerage and future development demands.

  - Treated Effluent Disposal and Effluent Standards. Because of their inter-relationship both these subjects should be considered together. Evidence is required of ability to discharge treated effluent into receiving waters (inland/coastal or ocean) or for re-use to meet the requirements of the Clean Waters Act Regulations Part III and Environmental Design Guides WP-1 and WP-2. Reference should be made to back-up investigations/studies carried out for this purpose.

    Because of limitations in funding, there may also be a need to justify the costs of providing high quality treatment and effluent standards at the expense of meeting urgent sewerage requirements.

  - Solids Retention and Disposal. Details should be provided of firm proposals to collect and dispose of screenings and sludge and evidence presented that such matters can be dealt with in an environmentally acceptable manner.

  - Gaseous Emissions. Safeguards incorporated in the design of equipment and plant to minimise or eliminate odour problems, together with details of any proposals to utilise waste gases for fuel burning.

  - Emergencies and Abnormal Conditions. Evidence of ability of plant to cater for power and mechanical failure, industrial disruptions, overloading, storm infiltration, storm overflows, abnormal chemical loadings on biological processes particularly with regard to toxic/high organic/other prohibited wastes, flooding and runoff.

  - Initial Operating Conditions. Ability to cater for low initial flows particularly in gravity mains and pumping stations sized for ultimate flows, including ability to cater for sewage septicity.

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- Utilisation of Existing Facilities. Proposals to satisfactorily utilise and/or upgrade existing plant either temporarily or permanently, including safeguards required for continued or additional temporary discharge pending completion of new outfalls and connection to new system, short term proposals to cater for existing unsatisfactory sewage disposal systems including septic tanks and tanker services pending connection to new system and taking into account current potential for risks to public health.

- Monitoring. Proposals for monitoring including source controls for abnormal or prohibited discharges to system, effluent quality, receiving water quality objectives, short and long term effects on marine biota, etc.

- Amenities and Aesthetics. Proposals to mitigate adverse effects of pumping stations and treatments plants, etc. on neighbouring residential development including planning provisions for zoning, buffer zones, utilisation of topography for siting of plant, landscaping, screening, etc.

  Noise. Safeguards to mitigate impact of noise from mechanical plant.

10. INTERACTIONS AND IMPACT ON THE ENVIRONMENT

This section should define all the important interactions on the environment arising from the construction and operation of the sewerage scheme and, taking into account the safeguards incorporated in the design and construction programme, provide an evaluation of the resultant impact on the environment, both detrimental and beneficial and in the short and long term. Information should be divided into two parts: Construction and operation under the following headings:-

- Land use.
- Processes including water runoff, floods, erosion, stability, subsidence, etc.
- Air quality.
- Water quality.
- Noise environment.
- Flora and fauna.
- Amenities and aesthetics.
- Public health.
- Socio-economic including potential for future development, employment opportunities, etc.
- Traffic and transportation.
- Other utilities and services.
- Emergencies and abnormal conditions.
- Effects of restrictions in funding.
- Existing sytems for sewerage and sewage disposal.

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11. CONCLUSIONS

12. BIBLIOGRAPHY

13. APPENDICES

Synopses of supplementary reports on relevant environmental studies/investigations, feasibility studies, etc.

14. FIGURES/MAPS/DRAWINGS

15. CONTACT WITH RELEVANT GOVERNMENT AUTHORITIES

In preparing the EIS, it is suggested that authorities such as those listed below, should be consulted and their comments taken into account in the EIS:

- The relevant local council(s) and regional planning authorities with regard to development and project requirements.
- The Public Works Department with regard to project design and funding.
- The State Pollution Control Commission with regard to air, water and noise impacts and relevant pollution control legislation requirements, especially effluent discharge criteria.
- The Soil Conservation Service with regard to erosion control.
- The Department of Agriculture with regard to impact on agricultural activities.
- The Maritime Services Board with regard to navigation of waterways.
- The Department of Mineral Resources with regard to mineral sterilisation and subsidence.
- The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State.
- Any servicing authorities which may be required to supply water, power, etc.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

Appendix B
Summary of Consultation Responses

COMMONWEALTH GOVERNMENT

Telecom Australia
Telecom advised that it has no objection in principle to the proposed works. Telecom expressed concern however that pumping stations and associated power supply network be designed so as to avoid excessive levels of harmonics which may cause telephone interference.

STATE GOVERNMENT

Department of Agriculture : (New England, Hunter & Metropolitan Region)
From a land-based agricultural aspect the Department of Agriculture had no objections or specific comments concerning pipeline routes and the location of the treatment/disposal facilities.

Department of Agriculture (Fisheries Division)
The Fisheries Division expressed concern regarding potential problems with existing bacteria counts, presumably from septic tank sources, particularly within Salamander Bay. In relation to the proposed ocean outfall at Boulder Bay, the Fisheries Division requested that the effects on the inshore rocky reef environment in general and the commercial abalone resource in particular should be addressed.

In general the Fisheries Division prefer to have treatment works and discharges as far from the land/water interface as possible.

Department of Agriculture : Brackish Water Fish Culture Research Station
The Research Station is responsible for the administration of oyster purification in oyster producing areas and advised its only concern would be leakage of sewage into the waters of Port Stephens.

Catchment Areas Protection Board
The Board advised that no "protected lands" or "prescribed streams" would be affected by the project.

Crown Lands Office
The Office provided detail information on affected Crown land in the area as well as the preferred landuses. The Office also requested that the EIS investigate a range of issues including:

- vegetation clearing and rehabilitation;
- visual impacts;
- constraints on future development of affected and adjacent lands;
- impacts on underground water reserves; and,
- impacts on SEPP No 14 wetlands and protective measures

The office advised that the alternative pipeline route at Fingal Bay is not favoured as it would infringe upon proposed future residential and community development at the rear of the existing urban area. It was considered that environmental impacts of this alternative are greater than would result from the crossing of the Tomaree National Park.

The office also advised that the alternative pipeline route from Lemon Tree Passage to Salamander Bay across Tilligerry Creek is not favoured because it would significantly affect Crown lands, particularly:

- public access to, and the visual amenity of the foreshore reserve fronting Tilligerry Creek;
- the SEPP No 14 Wetlands on Bulls Island
- in the vicinity of Taylors Beach Road

Electricity Commission of NSW
The Commission advised that it has no high voltage transmission lines or other major installation within the study area and hence offers no formal comment on the proposed augmentation.

Department of Environment and Planning
The Department provided details of the Director's requirements for the form and content of their environmental impact statement. (Refer Appendix A)

Heritage Council of New South Wales
No reply received.

Department of Housing
No reply received.

Department of Health, NSW
The Department advised of a number of issues and requirements requiring special attention in the environmental impact statement including:

- effects on major oyster growing areas particularly adjacent to Tanilba Bay, Mallabula and Lemon Tree Passage;

- no discharge of effluents into waters where oysters are grown;

- careful examination of exfiltration beds of the Tanilba Bay site should be made due to high ground water table which could adversely effect the disposal area, particularly during periods of heavy rain;

- possible bacterial contamination of bathing beaches due to discharge of large volumes of screened raw sewage off Boulder Bay. Consideration be given to providlng adequate treatment of sewage prior to discharge;

- possible wash back of effluent to Boulder Bay and adjoining areas even with extended outfall; and,

- consideration of ocean flow patterns under all weather conditions from the proposed outfall.

Department of Main Roads
The Department advised that it has no road widening proposals under consideration at present. However a section of the proposed sewerage scheme between Anna Bay and Gan Gan would possibly conflict if there is any future position to upgrade MR108 in this vicinity.

Maritime Services Board
The Board advised that there were no objections from a navigational viewpoint subject to compliance with the normal standard conditions. Appropriate licences would be required with regard to the alternative of a submarine pipeline crossing of Tilligerry Creek.

Department of Mineral Resources
The Department advised that the environmental impact statement should address the likely impact that the sewerage scheme will have on current or possible future heavy mineral and silica sand mining on the Tomaree Peninsula. The Department provided information on current mining titles, extraction licences and applications. The proposed Tanilba Bay treatment works and disposal areas are located in an area of silica sand deposits which should be detailed in the EIS with analysis of effects.

National Parks and Wildlife Service
The Service's policy on alien developments in National Parks states that the Minister and the Director are precluded from approving developments which have no nexus with the purposes for which the land was reserved, which do not meet normal visitor requirements and do not improve the protection of the area. Consequently the EIS should indicate whether the proposed pipeline crossing Tomaree National Park meets the above criteria.

In addition the EIS should examine:

- an assessment of the reasons for crossing the Park;
- any alternatives which do not cross the Park;
- relative costs of each option;
- the existing natural, cultural and recreation environment of the Park and how the proposal effects these values;
- the possible occurrence of Melaleuca groveana, a tea tree known to occur in Tomaree National Park;
- proposals to reduce the impact;
- rehabilitation, landscaping of proposed works including the facility at Boulder Bay;
- proposals to upgrade visitor access to Boulder Bay and visitor enjoyment of the area;
- methods to minimise water pollution and details of treatment facilities at Boulder Bay;
- rehabilitation of existing degraded areas in the Park adjacent to the proposed works;
- an assessment of visual impact of the proposed pipeline and treatment facilities of the Park;
- an archaeological survey for Aboriginal sites along the entire length of the pipeline and facilities;
- means to control access by vehicles of maintenance tracks;
- the time needed to construct a pipeline in the Park and construction methods involved.

The Service is also concerned at the proposed scheme's potential implications for management of the Hunter District Water Board Water Catchment Area and the adjoining National Park. In addition, the Service would prefer the sewage be treated to the highest level possible prior to ocean discharge at Boulder Bay.

Royal Botanic Gardens Sydney (National Herbarium of NSW)
Advice received supported the extension of the existing outfall pipeline and also the option to route the pipeline around the Tomaree National Park. Disturbance of the National Park should be avoided. The Herbarium of NSW has undertaken monitoring of algal growth in the vicinity of sewerage outfalls on the NSW coastline which clearly shows that a more thorough treatment of the sewage greatly reduces the deleterious environmental effects. The alternative scheme of transporting all sewage to an ocean outfall appears to be advantageous however since even after secondary treatment and disposal on filtration beds large increases in organic matter and salts could be released into the estuary. This would affect the fauna and flora of an area which has already suffered considerable environmental change. A decrease in productivity of flora and fauna of the estuary should be avoided.

Soil Conservation Service
The Service advised that the proposal has no direct affect on its operations, however, the following information and requirements were provided:

- the siting of any major sewerage pipelines and treatment plants to take account of land capability and erosion hazard, and that appropriate erosion and sedimentation control measures are implemented both during construction and on completion of any such works; and,

- design criteria for the exfiltration beds should consider such factors as: area of stabilizing native vegetation to be disturbed, provision for sand drift and erosion control during and after construction and revegetation of the exfiltration beds taking account of watertable depth and wind erosion hazard.

State Pollution Control Commission
The Commission has provided detailed information and assistance throughout the study. The major issues of concern to the Commission include:

- assessment of the likely impact of groundwaters from land disposal;

- ocean disposal of effluent must meet SPCC criteria and this issue should be thoroughly addressed in the EIS particularly with respect to bathing waters;

- The Commission is not in favour of the alternative of a submarine pipeline crossing of Tilligerry Creek even if duplication of pipelines is provided. Assessment should be made of the impact of a possible breakage and subsequent escape of raw sewage would have on adjacent waters, in particular the likely effect on the beneficial uses to which those waters are put:

- an assessment of construction and operational noise impact; and,

- assessment of air pollution impacts.

LOCAL GOVERNMENT

Shortland County Council
The impact of the electrical loads of the scheme are presently being studied by the Council. No major difficulties are envisaged in providing supply to the facilities. Problems of voltage flicker from starting of pump motors will be addressed to ensure compliance with Councils service rules.

NON GOVERNMENT

National Trust of Australia
The Trust advised of a number of concerns regarding the planning content of the development within the region and the major threat to the long term environmental quality of the area. In particular the provision of upgraded services for the area will both promote further urban development and, through the alignment of the main, guide the release of new areas. The current options will promote the release of land adjacent to wetlands including those identified by SEPP14. An alternative route was proposed by the Trust which would avoid the impact on the wetlands and would promote urban development in areas where the consequent environmental impact would be less. The alternative route would go directly south from the area of Lemon tree Passage, preferably along the existing road easement, to Nelson Bay Road, then along Nelson Bay Road to Anna Bay. This would promote development in the Bobs Farm area which would be preferable to development in the areas south of Cromartys Bay and Salamander Bay and would eliminate the need for the mains through Taylors Beach and south of Cromartys Bay which would have to cross SEPP14 wetlands.

Other issues raised by the Trust include:

- no alternatives have been put forward for the proposed pumping station R3. This site lies within significant areas of SEPP4 wetlands and outside areas currently zoned for urban development. This pumping station is ahead of any identified need or any environmental assessment of the impacts of developments which would arise as a consequence of the pumping station;

- alternative ocean outfall sites need to be addressed, as well as assessment of impacts on the aquatic environment;

- impacts on Tomaree National Park and Hunter District Water Board lands needs to be addressed including direct and indirect impacts, weed invasion and illegitimate access by off road vehicles;

- alteration of drainage patterns affecting wetlands;

- incorporation of adequate buffer zones around affected wetland areas;

- disposal of effluent onto exfiltration beds is of concern with respect to possible effects on wetlands, important fishing and oyster growing areas. The Trust is opposed to the use of natural wetlands for the disposal of sewage effluent and recommends the development of artificial wetlands for such purposes; and,

- assessment and evaluation of both wetland and terrestrial systems along all proposed routes.

The Trust also provided information regarding their recent Tomaree Peninsula Landscape Study.

Nelson Bay and District Chamber of Commerce
The Chamber of Commerce acknowledged the benefit of the overall scheme but were concerned with potential rate increases to cover the scheme and the implications of such increases on the high proportion of retired people in the area.

The Chamber also expressed concern with the ocean outfall at Boulder Bay due to the problems associated with the Sydney and Newcastle outfalls. Consequently the re-use of effluent was encouraged by the Chamber of Commerce.

PROGRESS ASSOCIATIONS

Birubi Point, Fishermans Bay Progress Association
The association expressed concern regarding the proposed Boulder Bay sewerage outlet. Particular concerns included:

- possible pollution of the beaches in the immediate area; One Mile Beach, Boat Harbour, Fishermans Bay and Newcastle Blight; and,

- prevailing winds are a major factor contributing to effluent distribution once discharged and should receive careful consideration in the EIS.

Corlette Progress Association
The association have always been interested and concerned with the problems associated with effluent disposal and the inadequacy of septic systems. It is considered by the association that the discharge of either treated or untreated effluent into an enclosed water system which is noted for its popularity and usage is unsatisfactory. Every effort should be made to eradicate this potential health hazard as soon as possible however regard must be taken of the financial burden placed on residents. Specific comments on the development were provided and include:

- assessment of environment effects and efficiency of exfiltration beds at Tilligerry Peninsula is of vital importance. Such examination would influence any decision as to whether the alternative of directing all sewage to a common outfall at Boulder Bay;

- the Boulder Bay outfall should be upgraded and extended regardless of which alternative is decided upon;

- more specific information is required regarding sewage schemes at Corlette, Dutchmans Bay outlet, Wanda Head plant and extension of the proposal to Soldiers Point; and,

- it is difficult to justify the significant extension of the pipeline to avoid a crossing of Tomaree National Park due to the fact that the environmental effects of the pipeline would be consistent no matter which authority administers each land parcel.

The association conceded that there are problems in implementing the scheme however the environmental benefits to be gained, particularly the removal of a major pollution problem far outweigh the disadvantages. It was further stressed that funding of the scheme be assessed to ensure a fair and equitable cost to users.

Fingal Bay Progress Association
The association stressed the importance of the tourist industry being the mainstay of the local economy as well as other industries including fishing and building. It is essential therefore to protect tourist attractions such as beaches in particular Fingal Bay Beach.

Lemon Tree Passage Progress Association
No reply received.

Salamander Bay- Soldiers Point Progress Association
The association has long recognised the urgent need for an adequate sewage disposal system due to the pollution of drains and beaches caused mainly by inadequate disposal system. The association prefers the disposal of effluent by inland methods as opposed to ocean disposal. An issue of concern is that the financial contribution of local residents for the proposed works needs to be in keeping with similar developments in other cities. The proposed works should also be carried out in such a way as to minimise the disturbance to beach fronts and parks and to avoid any unpleasant odours.

OTHER ORGANISATIONS

The Glass Sand Association
The Association does not oppose the project. At present the Tanilba Bay treatment area encroaches onto the Association's Permissive Occupancy 86/27 which is currently mined and will continue to be mined for a further 12 months. If preparatory work for the project commences prior to the Association completing mining the access roads should be left unhindered.

Worimi Local Aboriginal Land Council
The Council has no objections to the proposed sewerage facilities for the Tanilba Bay, Mallabula and Lemon Tree areas however the Council is deeply concerned as to the disposal methods. It is considered that the disposal of the effluent, even if treated, by ocean outfall is totally unacceptable. Disposal by inland exfiltration beds appears to be the most acceptable method. The Council does not see any problems in the proposed works being surrounded by land held by the Council and would be interested in negotiations with the Public Works Department with regard to water for the purposes of pasture irrigation.

Appendix C
Regulation 8 Under Clean Water Act, 1970

Regulation 8 under the Clean Waters Act, 1970,
Prescribed Classes of Waters.

8. For the purpose of Section 11(1) of the Act, waters shall be classified as follows:—

CLASS S: *Specially Protected Waters* — waters into which —

(a) no wastes are to be discharged; and

(b) only Class P waters flow.

CLASS P: *Protected Waters* — waters into which —

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of a sewer;

(c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged;

(d) organic wastes are not to be discharged unless they are so treated that the resulting effluent has —

  (i) where the relative proportion of water to the wastes is 19:1 or more — a biochemical oxygen demand of not more than twenty milligrams per litre and a non-filtrable residue of not more than thirty milligrams per litre; or

  (ii) where the relative proportion of water to the wastes is less than 19:1 and the oxygen content of the waters is, or is likely to be, reduced as a result of the discharge — such a lower biochemical oxygen demand and non-filtrable residue as may be approved;

(e) wastes are not to be discharged unless the concentration of plant nutrients in the wastes is controlled so as to prevent excessive plant growth in, abnormal variation in dissolved oxygen or pH levels in, or degradation of the appearance of, the waters;

(f) infectious wastes or wastes in which faecal coliforms are likely to be present are not to be discharged unless —

  (i) the wastes are treated in an approved manner; and

  (ii) in the case of waters likely to be used for bathing — the faecal coliform density as determined in an approved manner after sampling at an approved location does not exceed 200 per 100 millilitres;

(g) wastes are not to be discharged unless they are visually free of grease, oil, solids and unnatural discolouration and free of settleable matter;

(h) wastes are not to be discharged if the resulting concentration of the wastes in the waters —

  (i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;

  (ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals; or

  (iii) in the case of fresh water, is likely to affect the use of the waters for human consumption, domestic or industrial purposes, watering of stock or the irrigation of land;

(i) wastes are not to be discharged if the concentration of any restricted substance in the wastes exceeds the concentration specified opposite that substance in Schedule 2;

(j) wastes are not to be discharged into the waters if the pH value of the wastes is less than 6.5 or more than 8.5 or if the discharge induces a variation in the pH value of the waters of more than 0.2;

(k) wastes are not to be discharged if the radioactivity level of the wastes exceeds the levels specified in Schedule 3;

(l) thermal wastes are not to be discharged into the waters.

CLASS C: *Controlled Waters* – waters into which –

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of a sewer;

(c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged into the waters except in accordance with approved conditions;

(d) organic wastes are not to be discharged unless they are so treated that the resulting effluent has –

(i) where the relative proportion of water to the wastes is 19:1 or more – a biochemical oxygen demand of not more than twenty milligrams per litre and a non-filtrable residue of not more than thirty milligrams per litre; or

(ii) where the relative proportion of water to the wastes is less than 19:1 and the oxygen content of any portion of the waters is, or is likely to be reduced as a result of the discharge to, less than 70 per cent of saturation during average dry weather conditions for the area in which the waters are located – such a lower biochemical oxygen demand and non-filtrable residue as may be approved;

(e) wastes are not to be discharged unless the concentration of plant nutrients in the wastes is controlled so as to prevent excessive plant growth in, abnormal variation in dissolved oxygen or pH levels in, or degradation of the appearance of, the waters;

(f) infectious wastes or wastes in which faecal coliforms are likely to be present, are not to be discharged unless –

(i) the wastes are treated in an approved manner; and

(ii) in the case of waters likely to be used for bathing or recreational purposes – the faecal coliform density as determined in an approved manner after sampling at an approved location does not exceed 200 per 100 millilitres;

(g) wastes are not to be discharged unless they are visually free of grease, oil, solids and unnatural discolouration and free of settleable matter;

(h) wastes are not to be discharged into the waters if the resulting concentration of the wastes in the waters –

(i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;

(ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals; or

(iii) in the case of fresh waters, is likely to affect the use of the waters for human consumption, domestic or industrial purposes, watering of stock or the irrigation of land;

(i) wastes containing a restricted substance are not to be discharged into the waters if the discharge would result in the concentration of that restricted substance in any part of the waters exceeding the concentration specified opposite that substance in Schedule 2.

(j) wastes are not to be discharged into the waters if the pH value of the wastes is less than 6.5 or more than 8.5 or if the discharge induces a variation in the pH value of the waters of more than 0.5;

(k) thermal wastes are not to be discharged into the waters except in approved cases and subject to approved conditions;

(l) wastes are not to be discharged if the radioactivity level of the wastes exceeds by more than ten times the levels specified in Schedule 3 and the radioactivity level of the receiving waters beyond the approved zone is caused by that discharge to exceed the levels specified in that Schedule.

CLASS R: *Restricted Waters* — waters into which —

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of a sewer;

(c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged except in accordance with approved conditions;

(d) organic wastes are not to be discharged unless they are so treated that the resulting effluent has —

(i) where the relative proportion of the water to the wastes is 9:1 or more but not more then 19:1 — a biochemical oxygen demand of not more than twenty milligrams per litre and a non-filtrable residue of not more than thirty milligrams per litre or such other biochemical oxygen demand or non-filtrable residue as may be approved;

(ii) where the relative proportion of water to the wastes is less than 9:1 and the oxygen content of any portion of the waters is, or is likely to be reduced as a result of the discharge to, less than 60 per cent of saturation during average dry weather conditions for the area in which the waters are located — such a lower biochemical oxygen demand and non-filtrable residue as may be approved; or

(iii) where the relative proportion of water to the wastes is more than 19:1 and the oxygen content of the waters is, or is likely to be maintained after the discharge at, more than 75 per cent of saturation during average dry weather conditions for the area in which the waters are located — such a higher biochemical oxygen demand and non-filtrable residue as may be approved;

(e) infectious wastes or wastes in which faecal coliforms are likely to be present are not to be discharged unless —

(i) the wastes are treated in an approved manner; and

(ii) in the case of waters likely to be used for recreational purposes — the faecal coliform density as determined in an approved manner after sampling at an approved location does not exceed 1,000 per 100 millilitres as determined otherwise than during a period of rainfall run-off and within an approved period thereafter;

(f) wastes are not to be discharged unless they are visually free of grease, oil, solids and unnatural discolouration and free of settleable matter;

(g) wastes are not to be discharged if the resulting concentration of the wastes in the waters —

(i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;

(ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals;

(iii) is likely to affect the subsequent use of those waters for watering stock or the irrigation of land; or

(iv) gives rise to or is likely to give rise to abnormal plant or animal growth;

(h) wastes containing a restricted substance are not to be discharged into the waters if the discharge would result in the concentration of that restricted substance in any part of the waters exceeding the concentration specified opposite that substance in Schedule 2;

(i) wastes are not to be discharged if the pH value of the wastes is less than 6.5 or more than 8.5 or if the discharge induces a variation in the pH value of the waters of more than 0.5;

(j) thermal wastes are not to be discharged except in approved cases and subject to approved conditions;

(k) wastes are not to be discharged if the radioactivity level of the wastes exceeds by more than ten times the levels specified in Schedule 3 and the radioactivity level of the receiving waters beyond the approved zone is caused by that discharge to exceed the levels specified in that Schedule.

CLASS O: *Ocean Outfall Waters* — waters into which —

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) wastes are so discharged that the rate and volume or the nature and concentration thereof will not adversely affect beaches;

(c) wastes are to be so discharged that the maximum effect of the wastes on the waters shall be confined to an approved zone (in this classification referred to as the "mixing zone");

(d) wastes are not to be discharged —

(i) unless the wastes are visually free from grease, oil and solids and free from settleable matter; and

(ii) where the pH value of the wastes is more than 8.5 or where the discharge induces a variation of more than 0.1 in the pH value of any waters outside the mixing zone;

(e) wastes are not to be discharged if the resulting concentration of the wastes in the waters—

(i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;

(ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals; or

(iii) gives rise to or is likely to give rise to abnormal plant or animal growth.

CLASS U: *Underground Protected Waters* — waters into which —

wastes shall not be discharged unless the discharge is an approved discharge by reason of its not being likely to reduce the quality of the waters below an approved level.

Schedules 2 and 3 of the Regulations under the Clean Waters Act, 1970
(Referred to under Class 'P', Class 'C' and Class'R' Waters.)

SCHEDULE 2.

RESTRICTED SUBSTANCES.

Column 1. Substance	Column 2. Not in excess of	
Arsenic	0.05	milligrams per litre
Barium	1.0	milligrams per litre
Boron*	1.0	milligrams per litre
Cadmium	0.01	milligrams per litre
Chloride*	250	milligrams per litre
Chromium (hexavalent)	0.05	milligrams per litre
Copper	1.0	milligrams per litre
Cyanide	0.05	milligrams per litre
Fluoride*	1.5	milligrams per litre
Iron (filtrable)	0.3	milligrams per litre
Lead	0.05	milligrams per litre
Manganese (filtrable)	0.05	milligrams per litre
Mercury	0.001	milligrams per litre
Methylene blue active substances	0.5	milligrams per litre
Nitrogen (ammonia)	0.5	milligrams per litre
Nitrogen (nitrate plus nitrite)	10.0	milligrams per litre
Pesticides (individual or total in group)		
Endrin, chlordane, toxaphene	0.001	milligrams per litre
Other organochlorides	0.01	milligrams per litre
Organophosphates	0.05	milligrams per litre
Carbamates	0.1	milligrams per litre
Fluorinated hydrocarbons	0.001	milligrams per litre
Substituted phenols and cresols	0.001	milligrams per litre
Weedicides including 2,4-D (including salts and esters), 2,4,5 - T (including salts and esters,) Phenylureas, Triazines, Amides, Quaternary salts, Dipyridyls, Acrolein	0.1	milligrams per litre
Phenolic compounds	0.001	milligrams per litre
Selenium	0.01	milligrams per litre
Silver	0.05	milligrams per litre
Sulphate*	250	milligrams per litre
Uranyl ion	5.0	milligrams per litre
Zinc	5.0	milligrams per litre

*Limits indicated do not apply to these substances in regard to tidal waters.

SCHEDULE 3.

RADIOACTIVE SUBSTANCES.

Gross alpha activity: Not to exceed 3 picocuries per litre.

Gross beta activity: Not to exceed 30 picocuries per litre.

Schedule of Restricted Substances for Ocean Outfall Waters

Substance	Maximum allowable concentration at the boundary of the initial dilution zone (mg/L)
Arsenic	0.1
Cadmium	0.2
Total Chromium	0.02
Copper	0.2
Lead	0.1
Mercury	0.001
Nickel	0.1
Silver	0.02
Zinc	0.3
Cyanide	0.2
Phenolic compounds	0.5
Total chlorine residual	1.0
Ammonia (expressed as N)	5.0
Total identifiable chlorinated hydrocarbons	0.002

NOTE: This schedule appears in the Commission's "Design Criteria for Ocean Discharge" (WPI). It is not part of the Regulations under the Clean Waters Act.

Appendix D
Design Criteria for Ocean Discharge
State Pollution Control Commission
Environmental Design Guide WP-1

STATE POLLUTION CONTROL COMMISSION

Design criteria for Ocean Discharge

Introduction

The Clean Waters Act, 1970, provides that all works from which it is proposed to discharge pollutants into any waters must be approved by the Commission before they are constructed, and that all drains for discharge of pollutants into waters shall be licensed by the Commission. Such works include ocean outfall sewers with associated treatment works used for discharging wastes, whether at the shoreline or offshore by means of submarine pipelines.

The purpose of this Design Guide is to outline the criteria to which the Commission will have regard in reviewing applications for approval to discharge pollutants into ocean waters. It does not apply to wastes from vessels, or to authorised disposal of wastes conveyed by vessels.

Ocean Waters

For purposes of this Guide, "ocean waters" are defined as unconfined coastal waters that are exposed to ocean waves. Bays, harbours, coastal lagoons and estuaries are not unconfined coastal waters.

Classification of Waters

In the case of an application for approval of a major discharge of wastes into ocean waters, the Commission will examine the location and determine the appropriate classification for the waters in that location. Where the receiving waters are already classified, the Commission may review such classification in the light of the proposed discharge, and may reclassify such waters.

In deciding what is a major discharge, the Commission will take into account the volume of the discharge, its pollution load and its effect upon the beneficial uses of the receiving waters. Ocean outfall sewers discharging municipal sewage from urban communities will be regarded as major discharges, as will discharges from industrial plants which, even though minimal in volume, may have deleterious effects on aquatic life and the marine environment. Isolated discharges from small communities, caravan parks, motels and the like will not be regarded as major discharges.

In respect of such waters, an area referred to as an "initial dilution zone" will be defined for purposes of reference. The "initial dilution zone" is a designated volume of the receiving waters near the point of discharge within which the wastes are initially diluted with sea water due to the momentum of the discharge and to the difference in density between the wastes and the receiving waters. The designated "initial dilution zone" will be the plan dimensions of the envelope of spatial positions within which the initial dilution is achieved.

Conditions of Approval of Works

The conditions to be imposed in approving works will be determined by the Commission having regard for the classification of the receiving waters and for specific objectives for the control of pollution, such as:

- The maintenance of ocean waters visually free of oil, grease and other floatable matter.
- The protection of ocean waters to retain a natural and diverse, but not necessarily unchanged, variety of marine life.
- The protection of beaches in the interests of public health and to maintain a high degree of aesthetic satisfaction.

In order that these objectives may be met, an applicant seeking approval of works must demonstrate the basis on which it can be anticipated that the specified conditions will be achieved.

In order to meet the specified conditions, an applicant may propose any combination of treatment and outfall arrangements considered satisfactory. In demonstrating that the outfall has been satisfactorily designed and located, the applicant may take into account the initial dilution of the wastes due to jet mixing, subsequent dilution as a result of dispersion and tidal mixing, and bacterial die-off or decay between the outfall and position being considered.

The applicant must specify the initial dilution ratio expected in the circumstances and the plan dimensions of the "initial dilution zone" as defined.

Removal of Floatables

Treatment must be provided prior to the discharge of wastes such that the receiving waters remain visually free of oil, grease and floatable matter.

For control purposes, such substances may be restricted by reference to the maximum permitted concentrations in the effluent before discharge.

Conditions for Source Control of Matter in the Discharge

All wastes intended for discharge must be controlled at their source so that the concentrations of restricted substances specified in the attached Schedule, or of any other deleterious substance occurring in the waters at the boundary of the initial dilution zone as a result of such discharge, shall not exceed the concentrations prescribed in that schedule or as may be specified in the licence.

Wastes are not to be discharged if their pH value is more than 8.5, or if the discharge induces a variation of more than 0.1 in the pH value of any waters at the boundary of the initial dilution zone.

Control of Biochemical Oxygen Demand

Other than in exceptional circumstances, no requirement will be made in respect of the biochemical oxygen demand of wastes discharged to the ocean, provided the wastes are properly dispersed in the receiving waters in accordance with approved dilution ratios and other relevant criteria.

Removal of Settleable Matter

Discharge of settleable solids will not be permitted unless the applicant can demonstrate that no significant accumulation will occur within a distance of 1000 metres from any shoreline or in any area having a depth of less than 10 metres. Satisfactory evidence must also be provided that any deposition of settleable matter occurring outside this area will not result in significant adverse effects on the benthos.

Protection of Beaches

For these purposes, "beaches" are defined as the sands in the tidal shoreline and the waters adjoining such shoreline extending out to 100 metres from the mean high water shoreline, or to 3 metres in depth, whichever is the furthest point, and, where limited by rocky shorelines, to 50 metres beyond either end of such sands.

The geometric mean of the number of faecal coliform bacteria resulting from the operation of the proposed ocean outfall in any part of the waters of the beach is not to exceed 1000/100ml, and where such waters are designated by the Commission as a bathing area, is not to exceed 200/100ml. This is to be based in each case on not less than five water samples taken within a 30-day period. Additionally, faecal coliform densities are not to exceed 2000/100ml or 400/100 ml respectively in more than three samples taken during the period specified below.

The requirement specified above in respect of waters designated by the Commission as a bathing area will apply during the months of November to May of each year, or during such other period as may be specified by the Commission.

- Effluent quality specification.
- Water quality objectives.
- Source control
- Short and long-term effects on marine biota.

The Commission will review this information from time to time to determine the efficacy of the control programme and to guide the conditions of renewal of the licence.

SCHEDULE OF RESTRICTED SUBSTANCES FOR OCEAN OUTFALL WATERS

Substance	Maximum Allowable Concentration at Boundary of Initial Dilution Zone mg/l
Arsenic	0.1
Cadmium	0.2
Total Chromium	0.02
Copper	0.2
Lead	0.1
Mercury	0.001
Nickel	0.1
Silver	0.02
Zinc	0.3
Cyanide	0.2
Phenolic compounds	0.5
Total chlorine residual	1.0
Ammonia (expressed as N)	5.0
Total identifiable chlorinated hydrocarbons*	0.002

*Footnote: Total identifiable chlorinated hydrocarbons shall be measured by summing the individual concentrations of DDT, DDD, DDE, aldrin, BHC, chlordane, endrin, heptachlor, lindane, dieldrin, polychlorinated biphenyls, and other identifiable chlorinated hydrocarbons.

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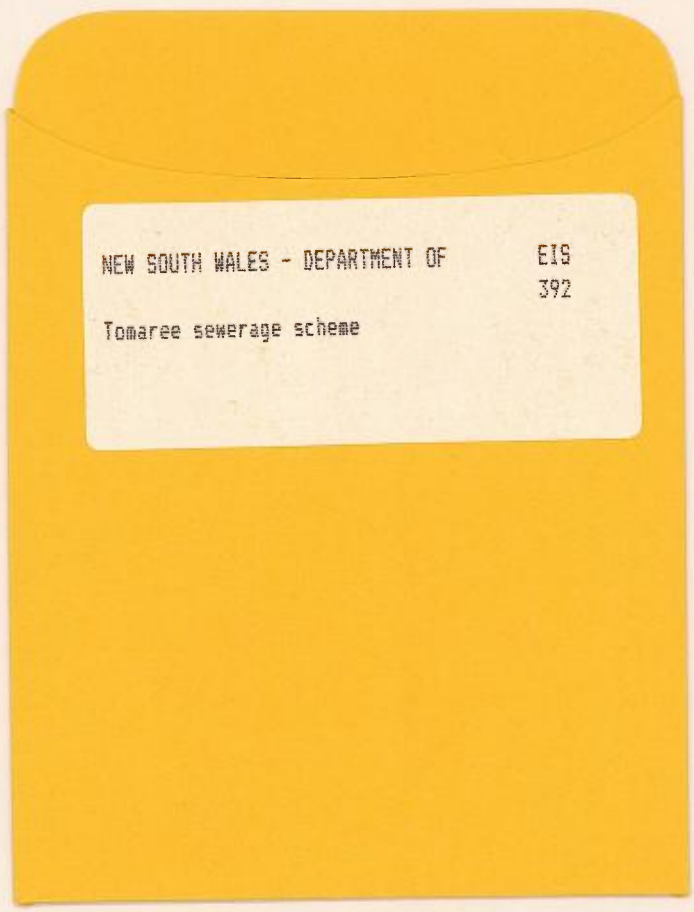
Tomaree sewerage scheme

Borrower's name	Date	Ext

RAECO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