STATE ENERGY COMMISSION OF WESTERN AUSTRALIA

COLLIE POWER STATION

WASTE WATER MANAGEMENT AND DISPOSAL SYSTEM

CONSULTATIVE ENVIRONMENTAL REVIEW

December 1994

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December 1994

HOW TO MAKE PUBLIC SUBMISSIONS

The Environmental Protection Authority (EPA) invites submissions on this proposal.

Following receipt of comments from government agencies and the public, the EPA will discuss the issues raised with the proponent, and may ask for further information. The EPA will then prepare its assessment report, which will make recommendations to Government, taking into account issues raised in the public submissions.

WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received will be acknowledged. Submissions will be treated as public documents and may be quoted in full or in part in each report unless specifically marked confidential. If you wish your submission to be kept confidential, please mark it clearly with the word 'CONFIDENTIAL'.

DEVELOPING A SUBMISSION

You may agree or disagree, or comment on, the general issues associated with the proposal or with specific issues. It helps if you give reasons for your conclusions, supported by relevant data.

You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific issues:

- clearly state your point of view
- indicate the source of your information or argument if this is applicable
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed.

Attempt to list points so that the issues raised are clear. A summary of your submission is helpful. Refer each point to the appropriate section, chapter or recommendation in the document describing the proposal. If you discuss sections of the proposal, keep them distinct and separate so there is no confusion as to which section you are considering.

Attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Please indicate whether your submission can be quoted, in part or in full, by the EPA in its assessment report. A list of those groups or individuals making submissions will be included in the EPA's assessment reports, unless there is a specific request that the group or individual not be listed.

REMEMBER TO INCLUDE YOUR NAME/ADDRESS/DATE.

SUBMISSIONS SHOULD BE ADDRESSED TO:

The Chairman
Environmental Protection Authority
Westralia Square
141 St George's Terrace
PERTH WA 6000

Attention: Mr G. Mueller

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SUMMARY

The State Energy Commission of Western Australia (SECWA) is proposing to build a new coal-fired power station (the Collie Power Station) at a site located 10 km north-east of Collie, Western Australia. A proposal to build a power station producing a nominal 600 MW of electricity received environmental approval from the Minister for the Environment in June 1991. A condition of the approval was that SECWA submit a detailed strategy for water management for separate environmental approval.

Following a review of the State's power needs, the State Government decided to stage the development of the Collie Power Station. The initial stage, which would have a nominal capacity of 300 MW of electricity, is planned to be operational in 1998. SECWA, however, wishes to obtain environmental approval for the water management strategy associated with the ultimate (600 MW) development of the proposed Collie Power Station.

In accordance with the provisions of the *Environmental Protection Act 1986*, SECWA referred this aspect of the project to the Environmental Protection Authority (EPA) in July 1994. Subsequently, the EPA determined that the appropriate level of assessment for the water management strategy was a Consultative Environmental Review (CER). This document has been prepared in accordance with the EPA's requirements, and presents details of the proposed strategy, the alternatives that were examined, the potential environmental impacts of the proposal and the proposed management measures and commitments to minimize these impacts.

THE PROPOSED WATER MANAGEMENT STRATEGY

The 600 MW Collie Power Station would require approximately 28,000 m^3/d of water for its operation. This would be supplied through a combination of rainfall collected from the plant hardstand areas, mine dewatering and a dedicated borefield.

Wastewater would be generated from a variety of processes at the power station. The water management system for the power station would incorporate recycling and reuse of water wherever possible, but approximately 6,700 m^3/d moderately saline water would be produced that could not be recycled or reused without further treatment. This water would consist primarily of cooling tower blowdown, cooling tower sidestream filter backwash and boiler water treatment plant saline wastes. Blowdown and filter backwash would be discharged to prevent the excessive build-up of dissolved solids, particularly silica, caused by evaporation in the cooling towers. This water would lead to scaling of equipment if it were concentrated further by the evaporative cooling process.

The management of this moderately saline water is considered to be the most significant issue associated with the water management strategy for the proposed Collie Power Station. The prime consideration for management of this saline water is to assist the Water Authority of Western Australia (Water Authority) in its long term objective of returning the water in Wellington Dam to potable quality by not discharging water with a salinity greater than 550 g/m^3 total dissolved solids (TDS) into the Wellington Dam catchment.

Reliability and the cost of construction and operation are also of importance to SECWA. Consequently, the water management strategy must provide a means of managing the saline water that is environmentally acceptable as well as reliable and cost effective.

SECWA proposes to dispose of the saline water via a pipeline to the ocean at the northern end of the Leschenault Peninsula north of Bunbury. The saline water to be discharged would have a TDS level of 3,200–5,000 g/m^3, would be clear and have an ambient temperature. The main constituent would be sodium chloride or common salt. This water, although unsuitable for the power station, could be used by other industrial users where the concentration of salt or silica is not a limiting factor.

Before discharge from the power station, the saline water would be treated with lime and filtered to remove heavy metals and suspended material. Skimmers and below-surface suction pipes would be used to prevent the discharge of floating material, including oil, in the extremely unlikely event that such material ever entered the saline water system.

The saline water would be pumped from the power station to the ocean outfall location via a 68 km pipeline. The 300–375 mm diameter pipeline would be constructed of rigid plastic, ductile iron or steel. It would generally be buried below ground with a minimum soil cover of 600 mm. For river crossings, the pipeline would be enclosed in a steel pipe and either supported on trestles, suspended across the river or attached to existing road bridges.

The proposed pipeline route would follow almost entirely existing mostly cleared service corridors such as transmission line corridors, property boundaries and road reserves. In the initial section, the proposed route would utilize existing transmission line corridors and road reserves through farmland, private natural bushland and State Forest. The route would also utilize the existing but largely redundant Wellington to Collie water pipeline. The route would then proceed to the township of Burekup on the South Western Highway inside cleared property boundaries along Coalfields Road.

From Burekup, the pipeline would follow Raymond, Alma and Victoria Roads, the Perth–Bunbury highway and Buffalo Road to the top of the Leschenault Peninsula. For part of the distance, the saline water pipeline would run alongside the Water Authority's Kemerton Industrial Park water supply pipeline, inside private property. The pipeline would discharge the saline water into the ocean north of the Leschenault Peninsula approximately 710 m offshore, 500 m away from an existing SCM Chemicals Ltd (SCM Chemicals) outfall, through a diffuser located at a depth of approximately 10 m.

The power station would also produce wastewater from a number of other sources. Oily sludges produced from treating rainfall runoff from plant hardstand areas and boiler acid cleaning wastes produced following construction would be disposed of at a licensed off-site facility. Treated sewage would be used to irrigate an on-site blue gum plantation.

ALTERNATIVES EXAMINED

SECWA believes that the proposed water management strategy, and particularly the disposal of saline water via a pipeline to the ocean, provide the best means of achieving the project's objectives. The benefits of the proposed strategy are that it:

- meets the Water Authority's objective of removing saline water from the Collie basin;
- is a long-term solution that would not require on-going management following decommissioning of the power station;
- is simple, cost effective and highly reliable;
- requires relatively little energy;
- uses water in such a way that it has potential for industrial reuse;
- does not preclude the possibility of future reuse of the water at the power station;
- ensures potential environmental impact is low.

An extensive programme of public consultation was undertaken to seek comment and input on the proposal, and as a result a number of alternatives were examined. These included the following:

- recovery of water with on-site salt storage;
- recovery of water with trucked discharge of salt from the site;
- disposal of saline water by deep aquifer recharge;
- piped disposal of saline water to surface waters, including the Collie River upstream and downstream of Wellington Dam;
- disposal of a smaller volume of more concentrated saline water;
- piped disposal of saline water to the Bunbury inner harbour;
- co-disposal with other saline water.

However, with one possible exception, each of these alternatives was less acceptable on environmental, technical and economic grounds than the proposed option. Discharge of the saline water to the Collie River downstream of Wellington Dam, at a location near Burekup, could be environmentally acceptable. However, additional studies, regarding impacts upon the ecology of the lower reaches of the Collie River, particularly during summer when natural flows are low, would be required to remove uncertainty before this alternative could be adopted.

A number of alternatives for parts of the proposed pipeline route to the Leschenault Peninsula were also examined. However, each of these had greater environmental or social impacts than the chosen route.

POTENTIAL ENVIRONMENTAL IMPACTS AND THEIR MANAGEMENT

On-site storage

Construction of the water storage reservoir and the saline water disposal pond on the power station site would convert a large part of an existing wetland into a permanent lake. The ecological value of the wetland would be maintained by establishing fringing vegetation in the reservoir and by allowing some water to flow to the shallow wetland flats below the empondment.

The risk of leakage from the saline water disposal pond would be minimal as the ponds would be lined with a highly impermeable liner.

Saline water pipeline

The major potential impacts of the construction and operation of the pipeline carrying saline water to the outfall off the Leschenault Peninsula are the clearing of vegetation along the route, disruption during construction and the potential effects of a pipeline rupture on wetlands and other areas along the route.

By laying the pipeline along existing, mostly cleared service corridors and cleared land, and avoiding remnant bushlands, wetlands and other environmentally important or sensitive areas wherever possible, vegetation loss and other impacts would be minimized. By burying the pipeline, there would be no impediment to stock or traffic movements after construction and there would be negligible visual impact. Procedures would be implemented to eliminate the possible spread of weeds and dieback from infected areas to disease-free and weed-free areas. Strict fire precautions would be observed during construction.

Dust, noise and disruption would be caused by the construction of the pipeline owing to the personnel and heavy machinery required. Disruption to access and stock movement may be significant in certain areas, but would only be of minimal duration. Where necessary, dust would be controlled with water sprays from tankers. Little if any blasting of rock would be required, and any impacts would be minimized by limiting blasting to daylight hours and calm conditions, and by using the minimum charge required.

The width of area disturbed would be approximately 11 m, but only a 5 m easement would be required for long-term access. Restoration of excavated areas and repair of any damage to property would be undertaken progressively and as soon as possible after construction. Adequate compensation would be made for any damage or loss of production. Disturbed areas would be revegetated with appropriate species.

Rigorous engineering design would ensure that pipeline ruptures, especially major ones, would be extremely unlikely. Pressure break tanks and pressure relief valves would be installed at various points along the pipeline route to minimize the potential for pipeline rupture. The pipeline would be under automatic control and flowmeters would be installed to monitor the flow continuously. An alarm would be raised immediately a significant difference in the flow between any of the meters was detected, and the pumps would be automatically shut down. Check valves would be installed at regular intervals along the pipeline to limit the extent of saline water leakage in the event of a pipeline rupture. Periodic inspections of the pipeline would be conducted to ensure the integrity of the system. The cause of any failure would be investigated and procedures instigated to prevent a recurrence.

In the unlikely event of a pipeline rupture, there would be little impact, either in the short term or in the long term, as much of the environment through which the pipeline would pass is either adapted to moderate salinity or could tolerate its one-off application.

The most significant impact would be the discharge of saline water into a wetland. Although most are avoided, the pipeline crosses or passes a number of wetlands on its route to the ocean. Of most significance are the Collie, Hamilton and Brunswick Rivers, seven small wetlands on the Swan Coastal Plain, and the Leschenault Inlet and associated samphire flats. There are also two wetlands on the power station site.

The Collie, Hamilton and Brunswick Rivers seasonally receive waters of greater salinity and volume than would occur in the unlikely event of a pipeline rupture. Any saline water resulting from a rupture (and its salt load) would be transferred rapidly downstream to estuarine environments and there would be no lasting adverse impact.

The Leschenault Inlet and associated samphire flats are likely to be of a much higher salinity than the saline water and therefore the impact of a pipeline rupture on them would be minor. The two wetlands on the power station site are also moderately saline to brackish, so the impact of a pipeline rupture on them would also be minor.

The one-off release of moderately saline water into the other wetlands along the route as a consequence of a pipeline rupture is unlikely to have long-term adverse consequences. Much of the wetlands' biota would be salt adapted or avoidant, or would be tolerant to short-term increases in salinity. Salt-intolerant species would re-colonize the wetland as the salt would be flushed out naturally.

Rare isolated ruptures or slow leakage would pose little threat to native vegetation, pasture or stock along the route, as these would be able to tolerate one-off applications or slow leakage of moderately saline water, provided the water drained quickly. Any impacts would be rapidly reversed once the saline water was flushed from the soil by drainage, rain or fresh water applied after a rupture. Lime or gypsum could be added to soils to assist drainage if required.

Ocean outfall

Construction or operation of the outfall off the northern end of the Leschenault Peninsula is not expected to cause any adverse impact on the marine environment.

The proposed outfall would be located in an area of relatively low conservation value. Seagrass and macroalgae near the location of the proposed outfall are sparse and patchy, and most patches could be avoided during the siting and laying of the outfall pipe and associated diffuser.

The reef, seagrass and algal meadows of the inshore area adjacent to the Leschenault Peninsula provide a poor habitat for flora and fauna. Consequently, inshore waters adjacent to the Leschenault Peninsula are not of major significance to commercial or recreational fisheries. The area's productivity is very low although some beach fishing and netting, crabbing and lobster potting occur in shallow areas.

The coastline to the north of Bunbury is highly energetic, and rapid initial mixing and dispersion of wastewater from the proposed outfall would occur. The proposed diffuser would readily achieve an initial dilution of 100 times. With such a dilution, the expected composition of the diluted saline water (including heavy metals) would fall well within the EPA's guidelines for the protection of aquatic ecosystems within 10 m of the outlet. Mixing would also rapidly dilute any temperature and salinity differential between the saline water and the ocean.

The predicted nutrient discharge is low. Within 20 m of the outfall, the levels of nutrients would be close to background concentrations, and they would be expected to have minimal impact on the coastal environment off the Leschenault Peninsula.

Since the nearby existing SCM Chemicals outfall (which discharges highly saline water similar in composition to that from the power station) has not had any measurable impact on the marine environment, it is expected that the saline water from the power station would have a similarly negligible effect. Further, it is expected that there would be no interaction or overlap of effects between the waters discharged by the proposed and existing outfalls because of the distance between them.

MONITORING

A monitoring programme would be implemented to address the following aspects of the water management system:

- leakage of on-site storage ponds
- quality of saline water discharge
- flow and integrity of the pipeline
- verification of dispersion at the outfall
- quality of the ocean-receiving environment before and after saline water discharge.

The monitoring programme would include the following elements:

- parameters to be measured
- sampling locations
- sampling frequency
- reporting to the EPA.

If monitoring of the ocean near the proposed outfall detected an adverse environmental impact as a result of the power station saline water discharge, disposal procedures would be reviewed and appropriate changes implemented.

1 INTRODUCTION

1.1 BACKGROUND

The State Energy Commission of Western Australia (SECWA) is proposing to build a new coal-fired power station (the Collie Power Station) at a site located 10 km north-east of Collie, Western Australia. The location of the proposed Collie Power Station is shown in Figure 1.1 and the residences and land use surrounding the site are shown in Figure 1.2. Figure 1.3 shows the general area around Bunbury and Collie.

An Environmental Review and Management Programme (ERMP) for the proposed Collie Power Station producing a nominal 600 MW of electricity was released for public review in May 1990 (SECWA 1990) . This proposal received environmental approval from the Minister for the Environment in June 1991. A condition of the approval was that SECWA submit a detailed proposed strategy for water management for separate environmental approval.

Following a review of the State's power needs, the State Government decided to develop the Collie Power Station in stages. The initial stage, to be constructed by the ABB-ITOCHU Consortium, would have a nominal capacity of 300 MW of electricity. It is planned to be operational in 1998.

SECWA wishes to obtain environmental approval for the water management strategy associated with the ultimate development of the proposed Collie Power Station which has a nominal capacity of 600 MW of electricity. In this regard, and in accordance with the provisions of the *Environmental Protection Act 1986*, SECWA referred this aspect of the project to the Environmental Protection Authority (EPA) in July 1994. Subsequently, the EPA determined that the appropriate level of assessment for the water management strategy was a Consultative Environmental Review (CER).

A 600 MW power station would require approximately 28,400 m^3/d of water for its operation. This would be supplied through a combination of mine dewatering and a dedicated borefield. On average, approximately 6,700 m^3/d of wastewater would be generated by the 600 MW power station from a variety of processes, and would consist of moderately saline water arising primarily from cooling tower blowdown and boiler water treatment plant wastes. A 300 MW power station would require approximately half the amount of water and produce approximately half the amount of wastewater. It is proposed to dispose of this clear, moderately saline water via a pipeline to the ocean north of Leschenault Peninsula near Bunbury (see Figure 1.3).

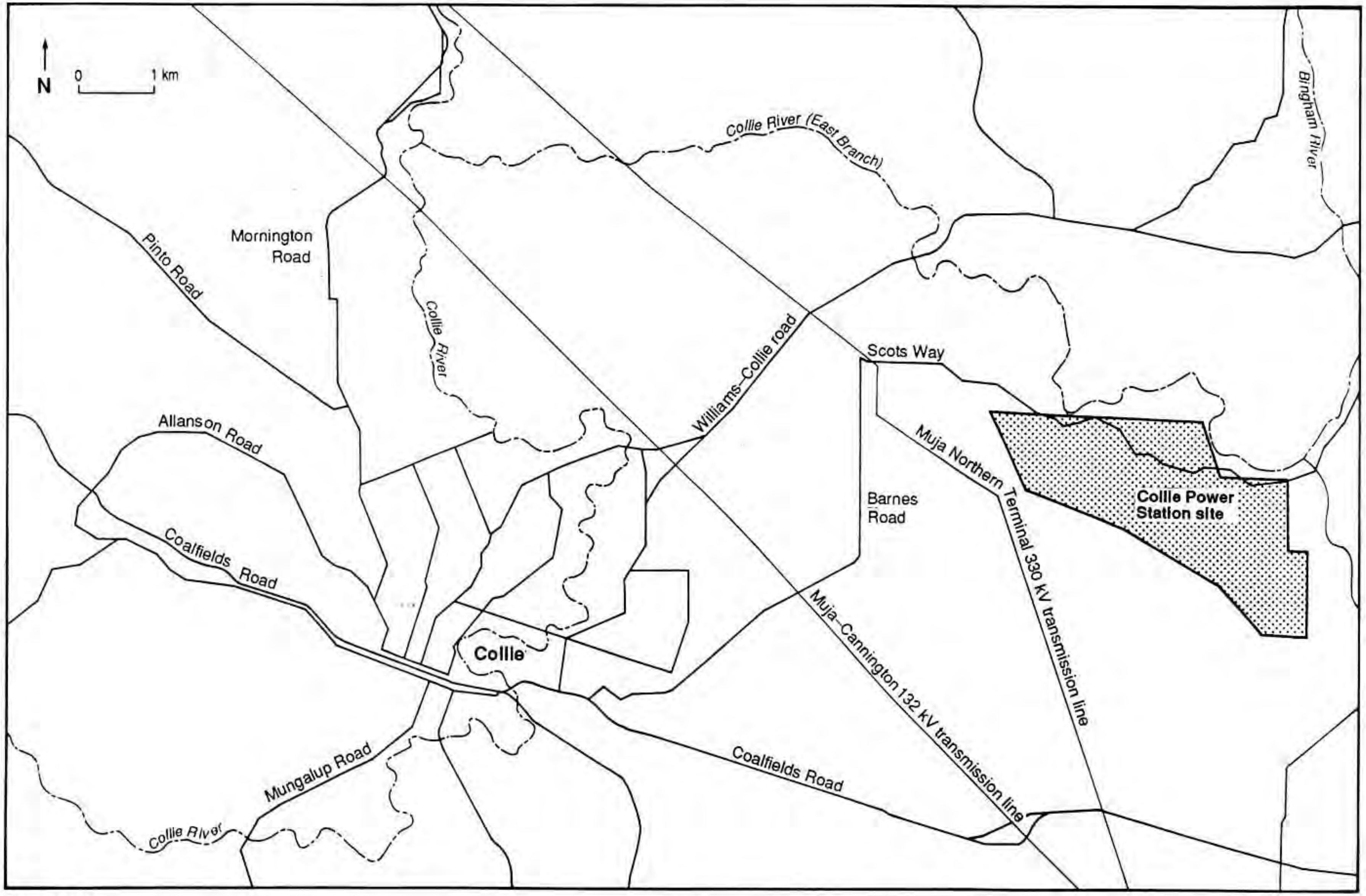


Figure 1.1
MAP OF COLLIE AREA

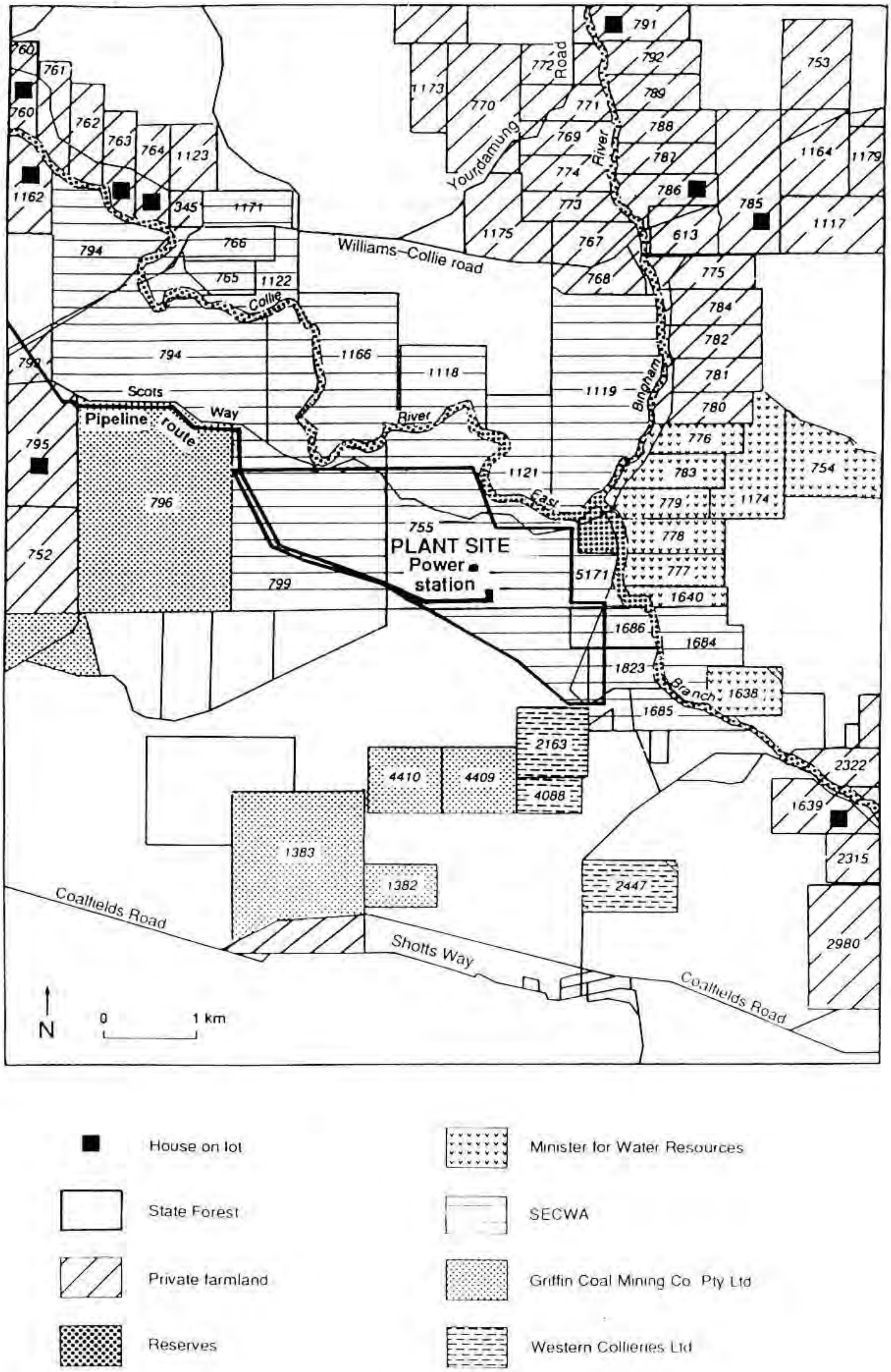


Figure 1.2

RESIDENCES AND LAND USE SURROUNDING THE COLLIE POWER STATION SITE

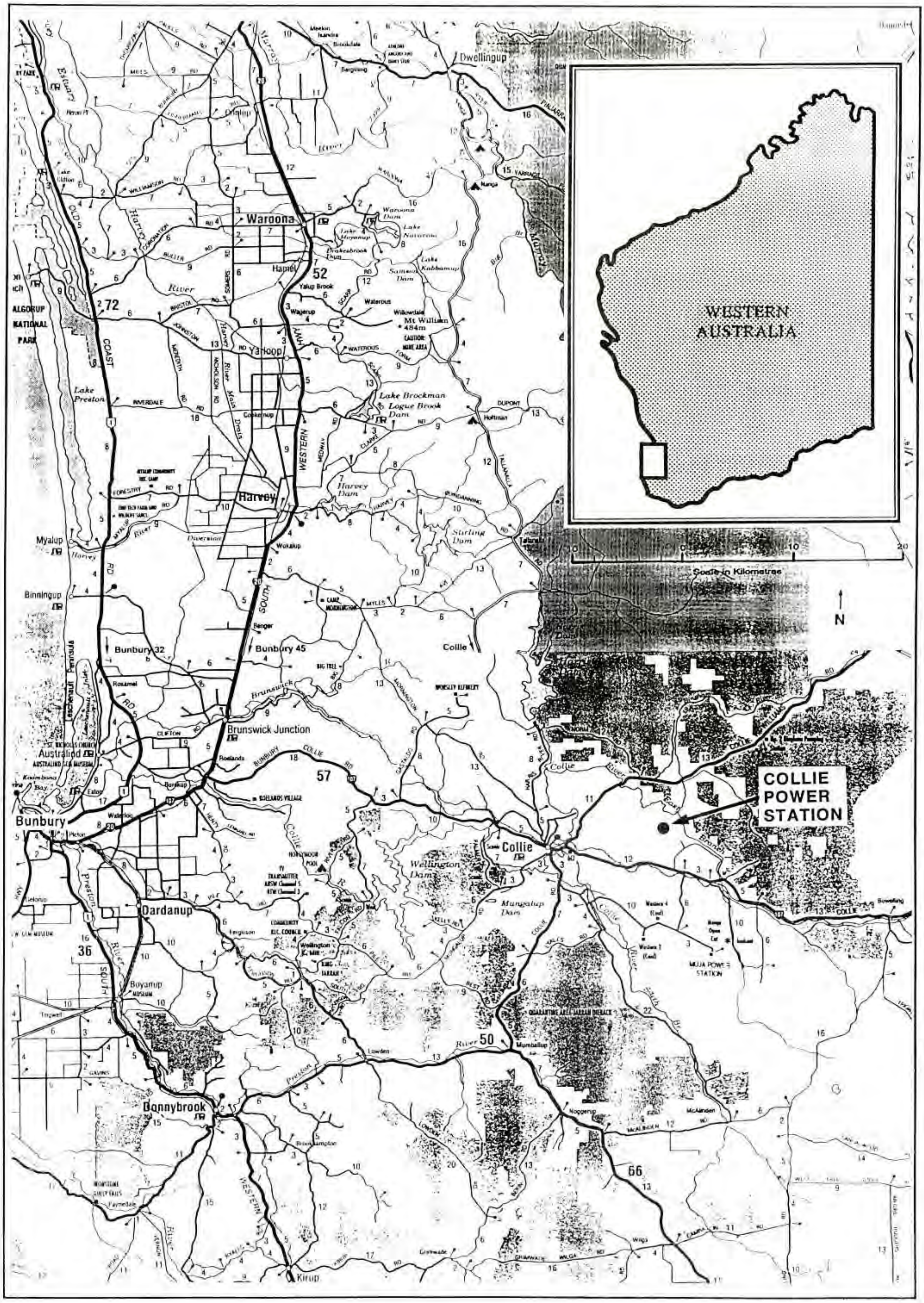


Figure 1.3

MAP OF BUNBURY–COLLIE AREA

1.2 SCOPE OF THE CER

The purpose of this CER is to facilitate the EPA's assessment of the environmental implications of the strategy proposed for the management and disposal of water associated with the Collie Power Station nominally producing 600 MW of electricity, and to allow comment by affected parties. The CER has been prepared in accordance with the guidelines issued by the EPA (Appendix A), and its scope is limited to examining areas that would be directly or indirectly affected by the proposed water management strategy. A glossary, listing unfamiliar terms, is included as Appendix B.

The CER provides details of the proposed water supply, water management and wastewater disposal strategy, identifies the potential environmental impacts, and outlines the proposed management measures and commitments to minimize these impacts.

1.3 THE PROPONENT

The proponent for the water management strategy associated with the Collie Power Station is SECWA.

1.4 SCOPE AND TIMING OF THE PROJECT

Subject to meeting all the necessary approval requirements, construction of the water management and disposal system is currently planned to commence in 1997 and to be commissioned in 1998.

1.5 ENVIRONMENTAL ASSESSMENT PROCESS

The CER is intended to provide the public and the State Government with an understanding of the proposal and its environmental implications. Following EPA approval for the release of the CER for public review, written submissions from affected groups and government departments can be made to the EPA during the four-week review period.

The proponent is then given an opportunity to respond to the points raised in these submissions. The proponent's responses will be incorporated into the EPA's assessment of the proposal. The EPA will recommend to the Minister for the Environment that the project is:

- environmentally acceptable
- acceptable subject to certain conditions, or
- environmentally unacceptable.

1.6 STRUCTURE OF THE CER

The CER presents the following information:

- an outline of the project and details of the proposed water management system (Section 2);
- a detailed description of the preferred water management strategy with piped disposal to an ocean outfall (Section 2);
- a description of the proposed pipeline route to the outfall (Section 2);
- an evaluation of alternatives for water management (Section 3);
- an outline of the development and analysis of the public consultation programme (Section 4);
- a description of the existing environment (Section 5);
- an evaluation of the potential environmental and social impacts of the water management strategy and their minimization (Section 6);
- the proposed monitoring programme (Section 7);
- a summarized list of environmental commitments (Section 8).

2 PROJECT DESCRIPTION

The proposed Collie Power Station would require water for a variety of purposes, and would generate wastewater from a number of processes during its operation. This section describes the individual elements of the proposed water management system and their interrelationship in the overall water management strategy for the 600 MW Collie Power Station.

2.1 WATER SUPPLY

As described in SECWA's ERMP (SECWA 1990) and SECWA's power station water resources management proposal (SECWA 1994), the water required for the operation of the power station would be drawn from the following sources:

- rainfall runoff from the power station hardstand areas
- mine dewatering operations
- groundwater from a dedicated borefield.

Surface water resources in the Collie region are already heavily committed for agricultural and domestic purposes, and many are generally too saline to be used by the power station. Water from Wellington Dam and the Collie River East Branch, for example, is generally high in total dissolved solids (TDS). In addition, the flow of the Collie River East Branch is considered too highly variable to be suitable as a reliable water supply. These sources would only be considered if no suitable alternative was available.

Large quantities of water are potentially available from mine dewatering from collieries likely to supply the power station. However, some of this water is also required for the operation of Muja Power Station, and until the collieries' future mining plans are further advanced, the quantity of mine dewatering water available for use by the Collie Power Station is uncertain.

Because of the uncertain availability of supplies of mine dewatering water, a dedicated borefield would also be developed at Cardiff East to supply groundwater to the power station from deep aquifer bores. Water supplies would also be supplemented by rainfall runoff from hardstand areas within the power station site. The above-mentioned sources of water would ensure that sufficient water supplies were available for the ongoing operation of the power station. However, a limited quantity of water from the Harris River Dam would be utilized during the construction stage.

Indications to date are that mine dewatering water would be suitable for use by the power station after treatment. However, because of the uncertainty regarding the source of mine dewatering water, the quality of water to be used by the power station is as yet undetermined. For the purposes of this CER, the water management strategy has been based on the likely worst quality water. The water quality has implications for the quantity of water required by the power station, since the water would be reused a number of times until its quality was such that it could not be used further and it would require disposal. Generally, the number of times the water can be reused depends on its levels of TDS and silica, scaling occurring in pipework if the silica exceeds a certain concentration.

The quality of water from the various sources likely to be used by the proposed Collie Power Station is summarized in Table 2.1. The water from Chicken Creek is considered to be representative of the worst quality likely to be supplied to the Collie Power Station. If better quality water were used, a lesser quantity would be required since greater reuse would be possible within the power station before silica levels became excessive.

Table 2.1 **Quality of various waters likely to be used by the Collie Power Station**

Water source	Silica (g/m^3)	Total dissolved solids (g/m^3)
Chicken Creek mine dewatering	12	393
Cardiff East borefield	15	350
Premier mine dewatering	13	310
Ewington mine dewatering	5	320

Whatever the source, mine dewatering water and borewater would be treated at the point of abstraction by aeration and lime dosing to pH 7 in order to precipitate iron and other metals, to remove hydrogen sulfide and to reduce carbon dioxide. Solids would be allowed to deposit in a settling basin before the treated water was pumped to the power station. At the power station, the water would be treated by dissolved air flotation to remove suspended solids before it was stored in the water supply reservoir.

2.2 POWER STATION WATER MANAGEMENT SYSTEM

The power station would require water for the following:

- cooling tower make-up
- boiler water make-up
- ash transport
- fire-fighting
- washdown
- potable purposes.

A schematic water flow diagram for the 600 MW power station operating under average conditions is shown in Figure 2.1.

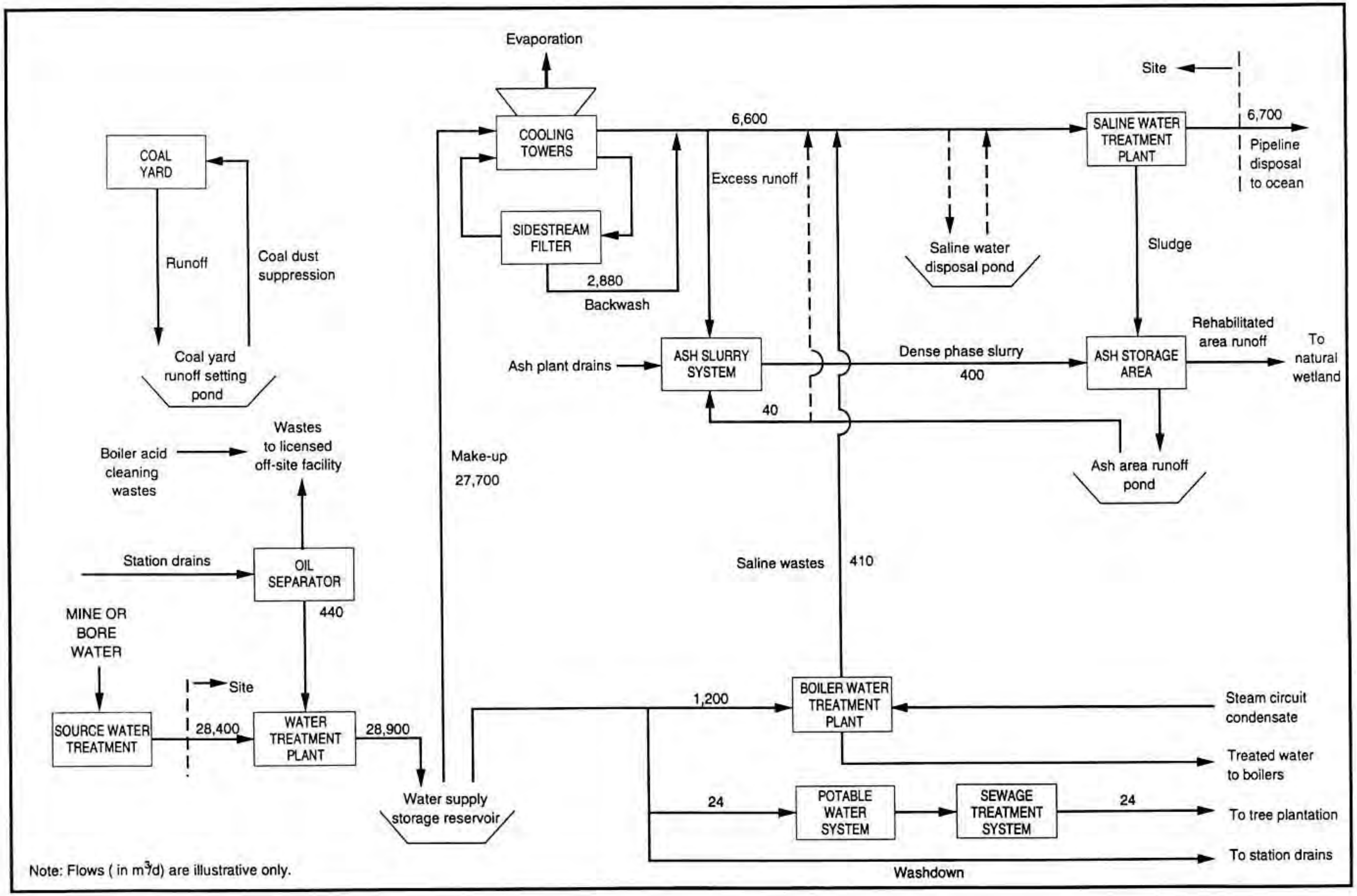


Figure 2.1

600 MW COLLIE POWER STATION AVERAGE WATER FLOW DIAGRAM

2.2.1 WATER REQUIREMENTS AND TREATMENT

The various uses of the water required by a 600 MW power station are shown in Table 2.2, indicating that a maximum of about 30,000 m^3/d would be required during summer peak periods. On average, about 28,000 m^3/d would be required and the total annual water requirements would be about 10,700,000 m^3.

Table 2.2 **Maximum water uses during summer for a 600 MW station**

Use	Volume (m^3/d)
Cooling water make-up	28,500
Boiler water make-up	1,200
Potable water	24
Service and fire water	200
Total	**29,920**

Water would be transformed to high-pressure steam in the power station boilers. After generating power in the turbo-generators, the steam would be condensed in a recirculating cooling water system utilizing mechanical draft cooling towers. The cooling towers would be the largest users of water in the power station, as make-up water would be required to replace that lost by evaporation during the cooling process. Make-up water would also be required to replace the amount lost from the boilers, including that lost during blowdown.

Water used in the cooling water circuit to cool steam would be treated with alkaline chemicals to control pH and acidity. Sodium hypochlorite or other disinfectant chemicals as well as dispersants would be added to control biofouling of the cooling towers. Water to be used as boiler make-up would be filtered using a microfilter, and demineralized through a combination of reverse osmosis and ion exchange units. Water to be used for potable purposes would be minimally chlorinated or treated by ultraviolet light after microfiltration prior to its discharge into the water supply system.

Waters of similar quality generated or collected on site would be treated together to avoid degradation of high-quality water. Boiler blowdown is relatively pure water and would be recycled for further use. Rainfall runoff from plant hardstand areas would be collected and directed to the station drains settling pond and would be treated using an oil separator before reuse by the station. Areas of the plant where high levels of oil, grease or chemical contamination could be expected would be bunded and drained to a separate area for collection and disposal. Coal yard rainfall runoff would be collected and used for dust suppression purposes. Any excess would be reused in other areas of the power station.

2.2.2 GENERATION OF WASTEWATER

Wastewater would be generated from a variety of sources within the Collie Power Station (see Figure 2.1). The major types and destinations of wastewater that would be generated are shown in Table 2.3.

The largest quantities of wastewater would be cooling tower blowdown and cooling tower sidestream filter backwash. Moderately saline water from both these sources would be discharged to prevent the excessive build-up of dissolved solids in the cooling towers, particularly silica, resulting from evaporation in the towers. This water would cause scaling of equipment if it were concentrated further by the evaporative cooling process.

Table 2.3 **Destination of wastewater generated by the 600 MW Collie Power Station**

Type of wastewater	Destination
Cooling tower blowdown	Saline water pipeline
Cooling tower sidestream filter backwash	Saline water pipeline
Boiler water treatment plant saline wastes	Saline water pipeline
Water treatment plant wastes	Recovered for reuse
Saline water treatment plant wastes	Ash storage area
Active ash storage area rainfall runoff	Ash storage area
Treated sewage wastewater	Tree plantation on site
Boiler acid cleaning wastes	Licensed off-site facility
Oily sludges	Licensed off-site facility

Boiler water treatment plant saline wastes would result from the removal of the dissolved salts in the water supply to produce demineralized water for the boilers.

It is proposed to dispose of ash from the burning of coal at the power station as a slurry containing about 30% water. The slurry would be produced by mixing a small amount of saline water derived from cooling tower blowdown or boiler water treatment plant saline wastes with the ash. The ash would be dosed with lime and pumped to a storage area on the power station site, where it would be discharged into clay-lined compartments of about 2–3 ha in size. The slurry would flow out onto the storage area in 20–30 mm thick layers to form an advancing beach, coming to rest at a very shallow angle. Because of the high solids content of the ash slurry, there would be very little free water in the slurry; during dry periods, nearly all the water in the slurry would evaporate.

The design of the ash storage area incorporates collection and reuse of leachate, supernatant and rainfall runoff from active ash storage areas to transport the ash. The average net rainfall runoff from active ash storage areas between April and October is expected to be 70 m^3/d. The ash storage area would be designed so that it would be capable of handling infrequent heavy storms. Only during extremely heavy rainfall would it be necessary to dispose of any ash storage area rainfall runoff along with saline water discharges. In such a situation, the runoff would be likely to have a low salinity, and would not contain any heavy metals.

Wastewater from the dissolved air flotation process used to treat the incoming water supply would be allowed to settle and the clarified water would be reused within the power station. Solid or slurry wastes arising from the on-site treatment of water or wastewater streams, such as cooling tower sidestream filter backwash, settled water treatment plant solid waste and saline water treatment plant wastes, would be disposed of with the ash in the ash storage area.

Boiler acid cleaning would generate highly saline wastewater during power station commissioning and then very infrequently, if ever.

The disposal of the various wastewater streams from the power station is further described in Sections 2.3 and 2.4.

2.2.3 ON-SITE WATER STORAGE PONDS

The approximate capacities of the various water and wastewater storage and disposal ponds are shown in Table 2.4, while the locations of the major ponds are shown in the site layout in Figure 2.2.

Table 2.4 **Pond capacities**

Pond	Capacity (m^3)
Water supply storage reservoir	160,000
Saline water disposal pond	20,000
Coal storage area runoff collection pond	1,000
Ash storage area runoff collection pond	1,000
Station drains settling pond	1,000

The water supply storage reservoir and coal storage area runoff collection pond would contain water with low TDS levels and would be free of most contaminants except suspended solids. The ash storage area runoff collection pond and the station drains settling pond would contain water with relatively low TDS levels, but may contain other contaminants including oil. The saline water disposal pond may hold water with a TDS level between 2,500 g/m^3 and 5,000 g/m^3 (from cooling tower blowdown), and up to 20,000 g/m^3 (from boiler water treatment plant saline wastes), for short periods.

The ponds would be lined either with clay with a permeability of 1×10^{-8} m/s or with high density polyethylene (HDPE) to minimize the leakage of water to the surrounding environment. Ponds lined with clay would contain a small volume of water at all times to prevent the clay liner drying out and cracking.

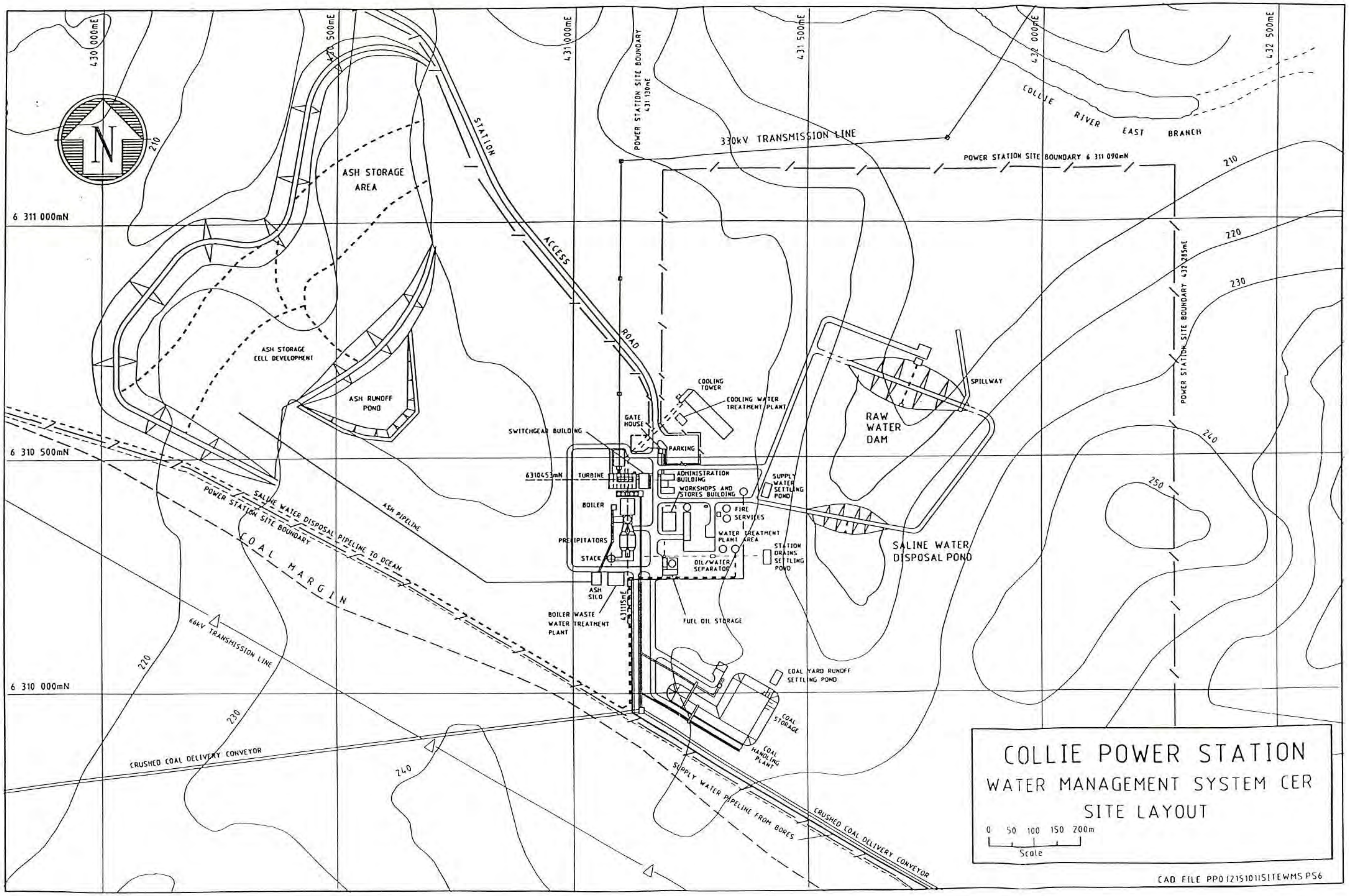


Figure 2.2
COLLIE POWER STATION—SITE LAYOUT

When the power station is decommissioned, the ponds would be drained and allowed to dry by solar evaporation. The pond contents would be removed and placed in the ash storage area. The ponds would then be restored to their former use, namely part of the original wetland system on the site.

The solids which accumulate in the settling basins near the mine dewatering and borewater on-site treatment plants would require periodic removal. Since this solid material would consist predominantly of iron oxides, it is expected that it would be suitable for disposal in an uncontrolled landfill.

2.3 DISPOSAL OF SALINE WATER

2.3.1 QUANTITY AND QUALITY OF SALINE WATER

On average, the 600 MW station would generate approximately 6,700 m^3/d of moderately saline water which would require disposal. This would consist primarily of cooling tower blowdown, cooling tower sidestream filter backwash, boiler water treatment plant saline wastes and excess rainfall runoff from the ash storage area.

It is proposed to dispose of this moderately saline water by discharge to the ocean via a pipeline. Before its discharge from the power station, the saline water would be dosed to pH 8 with lime to precipitate heavy metals. It would then be filtered to remove the precipitate and other suspended solids. The heavy metals precipitated and removed by this process would be disposed of in the ash storage area. Skimmers and below-surface suction pipes would be incorporated into the cooling tower basin and wastewater collection basins to prevent the discharge of floating material, including oil, in the extremely unlikely event that such material should ever enter the saline water disposal system.

If a failure of the saline water disposal system should occur, the proponent would direct the water to the saline water disposal pond until the fault was rectified to the satisfaction of the EPA (Commitment 2).

This saline water disposal pond would have sufficient capacity to hold at least three days' production of saline water, which would allow the fault to be repaired without disruption to the operation of the power station. Subsequently, the collected saline water would be pumped to the ocean, resulting in a slight increase in the nominal discharge rate.

Because the saline water would predominantly comprise cooling tower blowdown and boiler water treatment plant saline wastes, the water discharged into the ocean would have a composition similar to, though more concentrated than, that of the water supply to the station.

The levels of some heavy metals in the saline water would be lower than those in the water supply because of treatment of the supply water before use in the power station, by precipitation in the cooling water circuit and by treatment of the saline water before disposal (Sorg et al. 1978; Boling et al. 1992).

The likely chemical composition of the saline water is shown in Table 2.5. These data show that the saline water would have a design TDS level of 3,200 g/m^3 and have a density of 1,002 kg/m^3 compared to the density of seawater of 1,024 kg/m^3; however, the TDS could be as high as 5,000 g/m^3 if a water supply with a lower silica level than that listed in Table 2.5 was used. The main constituent of the saline water would be sodium chloride. The saline water would also contain low levels of heavy metals, but radioactivity and biocide levels would be negligible. The saline water, although no longer suitable for cooling purposes in the power station, could be used by other industrial users, particularly for 'once through' cooling or other purposes where the concentration of silica is not a limiting factor.

The proponent would ensure that the water discharged into the ocean would be clear, moderately saline, at ambient temperature and free of any objectionable or unsightly material, to the satisfaction of the EPA (Commitment 1).

Table 2.5 **Likely composition of water supply and saline water discharged into the ocean**

Parameter*	Water supply	Saline water
pH	5.2	8.0
Sodium	100	815
Potassium	4	29
Calcium	8	231
Magnesium	14	91
Iron	4	0.3
Manganese	5	0.1
Chloride	210	1,732
Sulfate	18	244
Bicarbonate	7	39
Silica	12	78
TDS	393	3,200
Suspended solids	10	0.2
Phosphate (as phosphorus)	0.03	0.2
Nitrate (as nitrogen)	0.16	1.4
Cadmium	0.001	0.01
Chromium	0.001	0.01
Cobalt	0.001	0.01
Copper	0.02	0.15
Lead	0.06	0.01
Mercury	0.0002	0.002
Nickel	0.008	0.05
Zinc	0.02	0.15
Hydrocarbons (total)	0	0.11
Carbon dioxide	30	1
Dissolved oxygen	0	8

* *g/m^3, except in relation to pH.*

2.3.2 PIPELINE ROUTE

It is proposed to pump the saline water from the power station through a pipeline for approximately 68 km to an ocean outfall location at the northern end of the Leschenault Peninsula. The proposed route is shown in Figure 2.3 and Appendix C, while a profile of the route is shown in Figure 2.4. Details of the properties along the route are shown in Table 2.6.

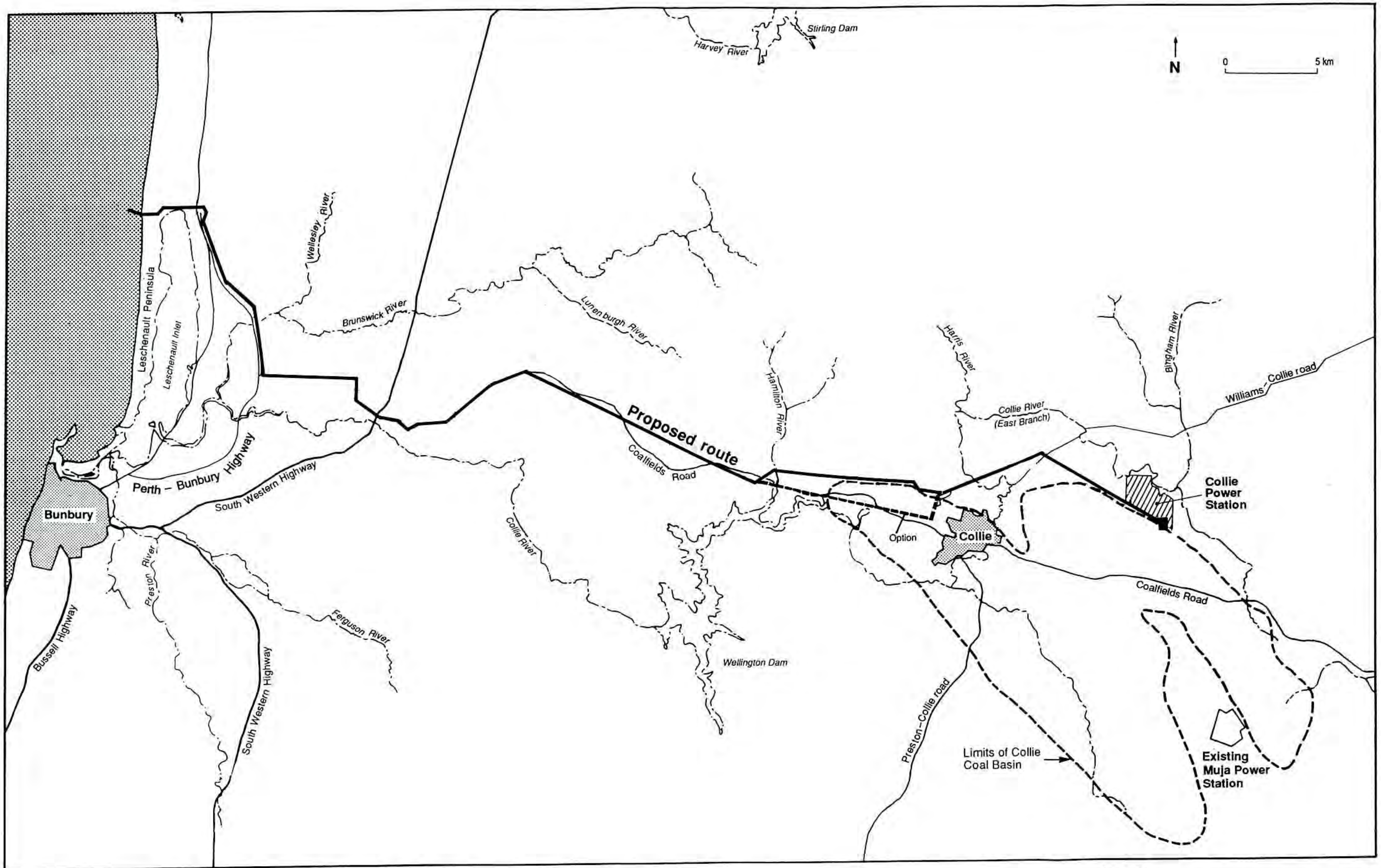


Figure 2.3
PROPOSED PIPELINE ROUTE FROM COLLIE POWER STATION TO THE OCEAN

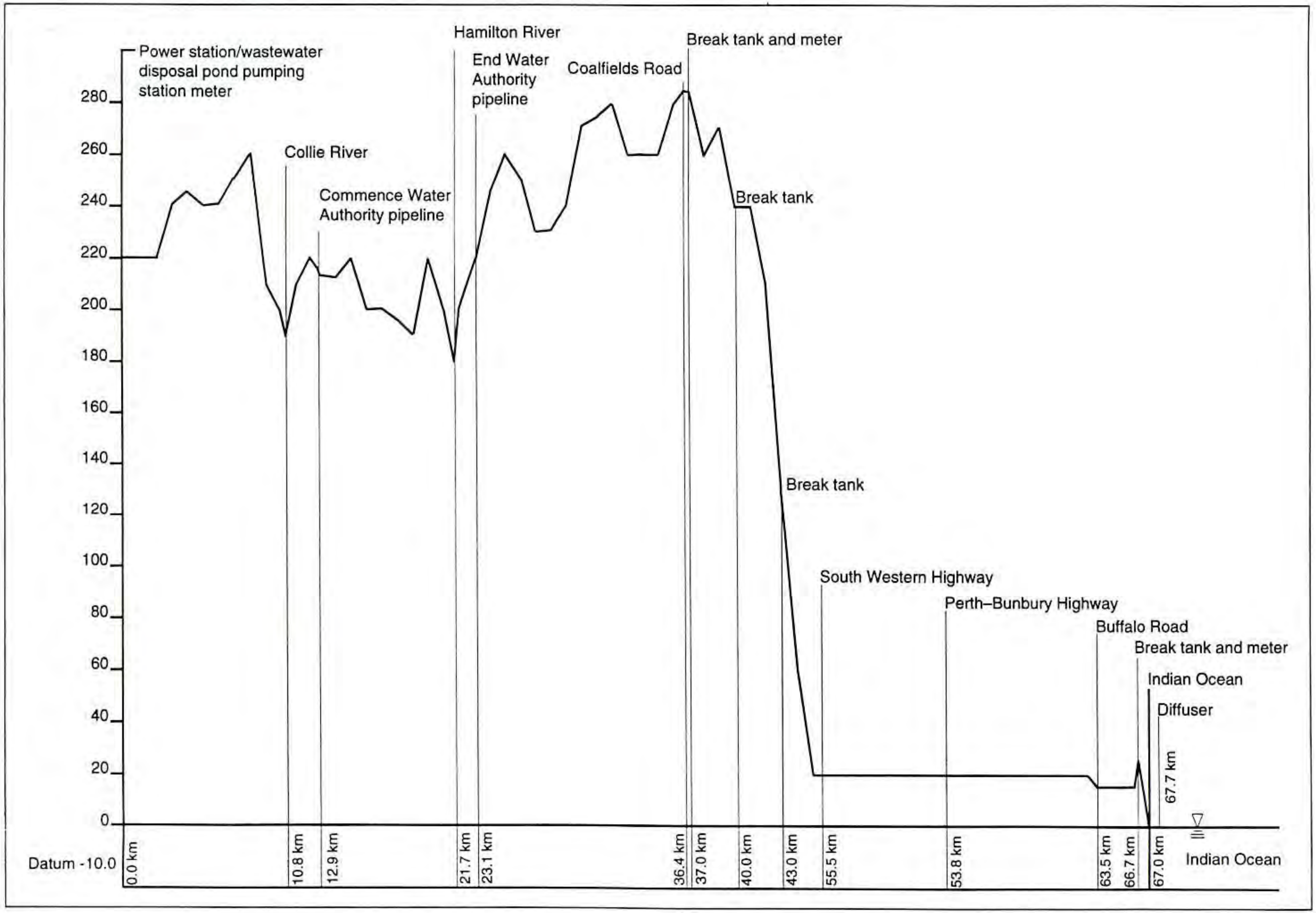


Figure 2.4

PROFILE OF PROPOSED PIPELINE ROUTE

Table 2.6 **Proposed pipeline route property details**

Sector (km)	Alignment	Easement	Adjoining property
0.0–4.0	–	Private property	SECWA buffer zone
4.0–6.5	66 kV line	Transmission line	Farmland
6.5–8.5	66 kV line	Transmission line	State Forest No. 15
8.5–12.9	66 kV line	Transmission line	Farmland
12.9–23.1	Water Authority pipeline	Pipeline	Town site, farmland
23.1–36.4	66 kV line	Transmission line	Private, State Forest No. 25
36.4–45.5	Coalfields Road	Private property	Farmland and tree plantation
45.5–46.0	South Western Highway	Road reserve	Farmland
46.0–47.5	Raymond Road	Road reserve	Farmland
47.5–49.3	Alma Road	Road reserve	Farmland
49.3–53.8	Victoria Road	Road reserve	Farmland
53.8–63.3	Perth–Bunbury Highway	Private property	Farmland
63.3–65.5	Buffalo Road	Private property and road reserve	Farmland/public open space
65.5–67.7	SCM Chemicals' wastewater pipeline	None	Public open space

From the power station, the pipeline would pass through State Forest and farmland north of Collie, through the outskirts of the townships of Collie and Allanson, and then to the edge of the Darling Scarp. From there, the pipeline would proceed to the township of Burekup and cross the coastal plain to the north of the Leschenault Peninsula mainly through farming properties. The pipeline would almost entirely follow existing mostly cleared service corridors such as transmission line corridors, access tracks, property boundaries and road reserves.

In the initial section, from the power station to the 10.8 km mark, the proposed route would pass through farmland, private natural bushland and State Forest, utilizing SECWA's existing cleared 66 kV transmission line corridor (Figure 2.5). The pipeline would cross the Collie River near the existing 66 kV alignment (Figure 2.6), and continue along the south side of Hull Road, crossing to the north side to avoid disturbing numerous trees on the southern side. At the 12.9 km mark, the pipeline would intersect with the existing but largely redundant Water Authority of Western Australia's (Water Authority's) Wellington to Collie water pipeline. The saline water would flow through this pipeline from the Hull and Mornington Road intersection near Collie to Coalfields Road near Wellington Dam at the 23.1 km mark (Figure 2.7).

In the next section, from 23.1 km to 36.4 km, the saline water pipeline would again largely follow the existing cleared 66 kV transmission line corridor, passing through farmland and State Forest, and crossing the Coalfields Road twice (Figure 2.8). At several locations in private property between the 27.6 km and 28.3 km marks, the pipeline would deviate from the transmission line corridor in order to avoid areas of granite and wet ground. The pipeline would follow cleared property boundaries and a partially cleared track, and would pass through about 25 m of uncleared State Forest. Some clearing of State Forest would be required.

From the 36.4 km mark to the township of Burekup on the South Western Highway at the 45.5 km mark, the pipeline would pass inside the property boundary alongside Coalfields Road.

There are several options for the pipeline route from the west of Burekup to Marriott Road, Kemerton (46 km to 63 km). This section of the Swan Coastal Plain has been predominantly cleared and is under cultivation, with many irrigation channels, drains, roads and transmission lines crossing the area.

The proposed route would follow Raymond, Alma and Victoria Roads, and the Perth–Bunbury Highway. Most of the route between Burekup and the Perth–Bunbury Highway would follow cleared road reserves or private property. However, some clearing would be required east of the junction of Victoria Road with the Australind Bypass (Figure 2.9), as this section of the route does not follow an existing road. The pipeline would then follow the eastern side of the Perth–Bunbury Highway (Figure 2.10). As the Highway may be upgraded to a freeway in the future, Main Roads Western Australia have advised that no services would be permitted inside the road reserve. Consequently, the pipeline would be constructed within adjacent private farming properties. Land along the Australind Bypass south of Clifton Road is predominantly cleared pasture, while the land north of Clifton Road is predominantly uncleared grazing land. The pipeline would cross the Brunswick River supported from the road bridge.

Between Victoria Road and Stanley Road, the pipeline would be parallel and adjacent to the Water Authority's Kemerton Industrial Park water supply pipeline which has recently received environmental approval (EPA 1994). The two pipelines could share the same easement and possibly even the same trench.

The final alignment of the pipeline route in the area between the South Western Highway and Marriott Road would avoid remnant bushlands, wetlands and other environmentally important or sensitive areas where possible and would depend on specific negotiations with land owners and service authorities.

Between Kemerton and the ocean, the proposed pipeline route would be parallel and adjacent to SCM Chemicals Ltd's (SCM Chemicals') existing pipeline for much of the route. The pipeline would be in cleared private property along the eastern side of the Perth–Bunbury Highway, and partly in cleared private property and partly in the road reserve along the southern side of Buffalo Road. The pipeline would utilize an existing cleared access track and partly revegetated pipeline route through the dunes (Figure 2.11) at the northern end of the Leschenault Peninsula, and terminate adjacent to SCM Chemicals' existing outfall (Figure 2.12).

2.3.3 CONSTRUCTION OF THE PIPELINE

The saline water pipeline would be made from either unplasticized polyvinyl chloride (UPVC), HDPE, ductile iron or cement-lined steel and would be 300–375 mm in diameter. For major river crossings (e.g. the Collie River), the pipeline would be enclosed in a steel pipe and either supported on trestles, suspended across the river or

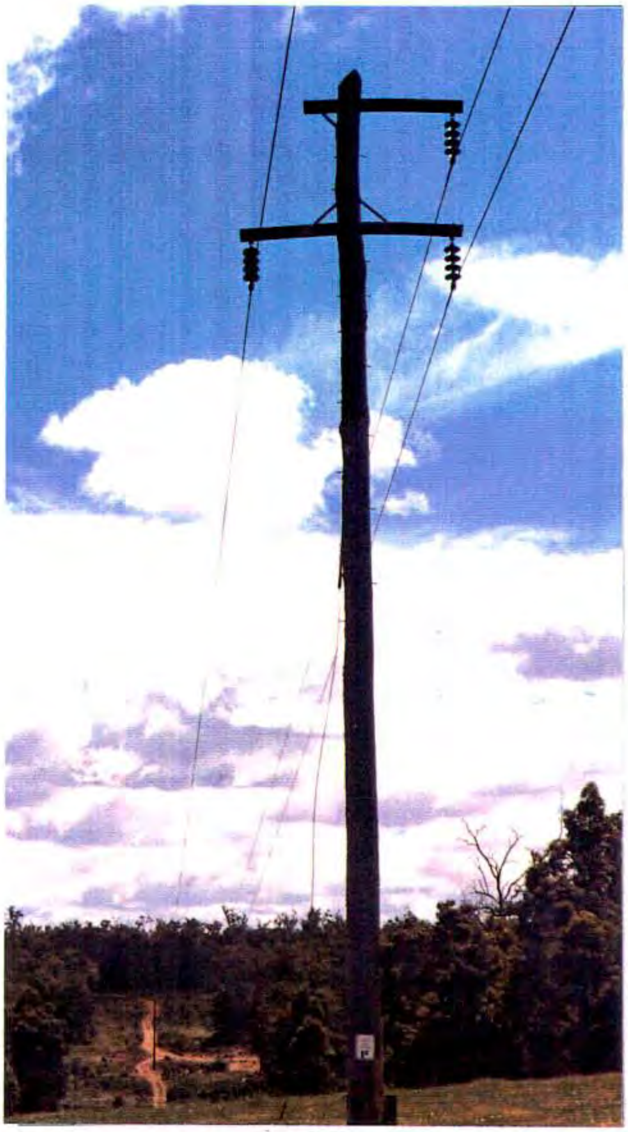


Figure 2.5
**7 KM MARK—
COLLIE–WILLIAMS ROAD
CROSSING**

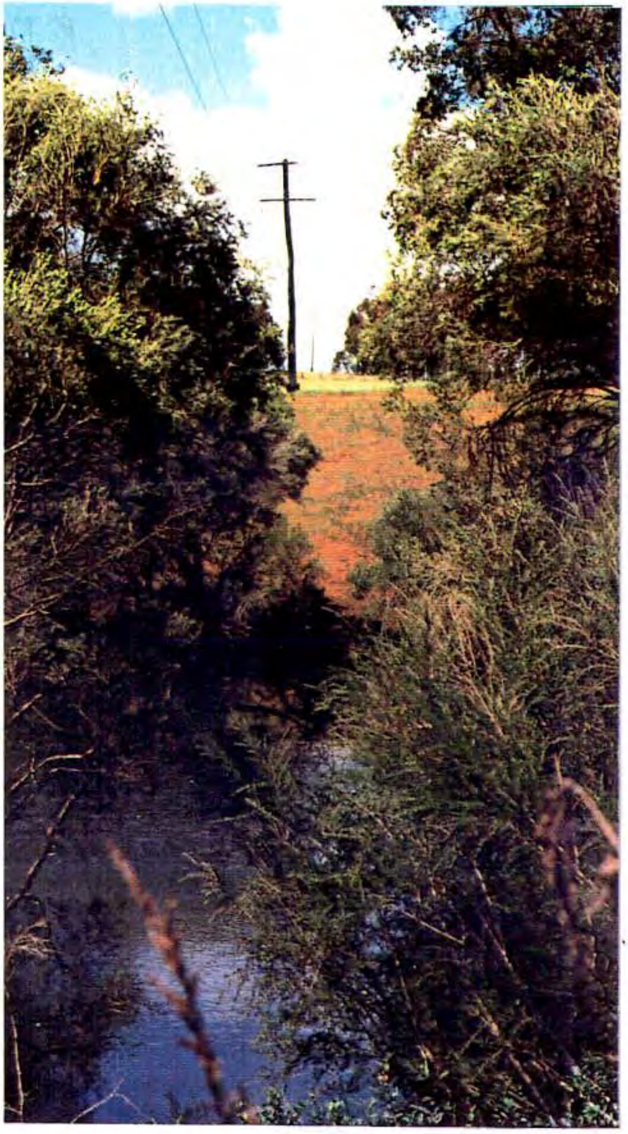


Figure 2.6
**10.8 KM MARK—
COLLIE RIVER CROSSING**

Figure 2.7
23.1 KM MARK—WELLINGTON TO COLLIE PIPELINE

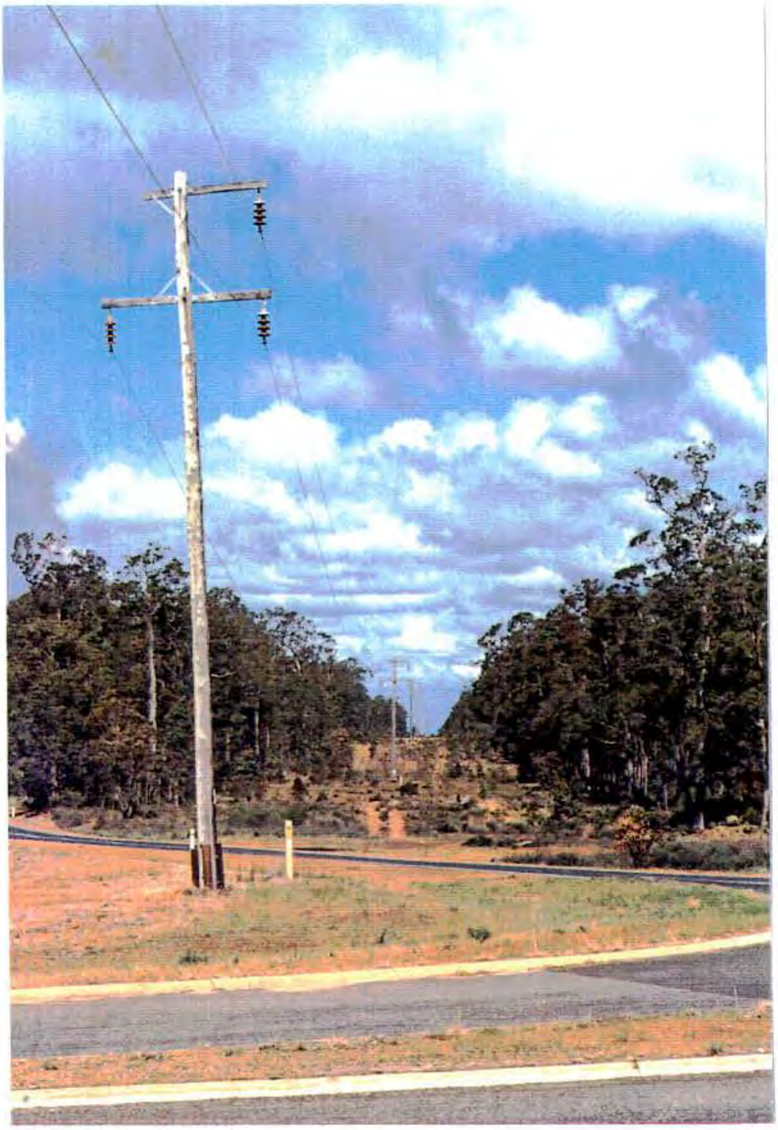


Figure 2.8
25 KM MARK—COALFIELDS ROAD CROSSING

Figure 2.9

51.5 KM MARK—BALACLAVA AND VICTORIA ROADS INTERSECTION

Figure 2.10

55 KM MARK—PERTH–BUNBURY HIGHWAY

Figure 2.11
66 KM MARK—SCM CHEMICALS' PIPELINE

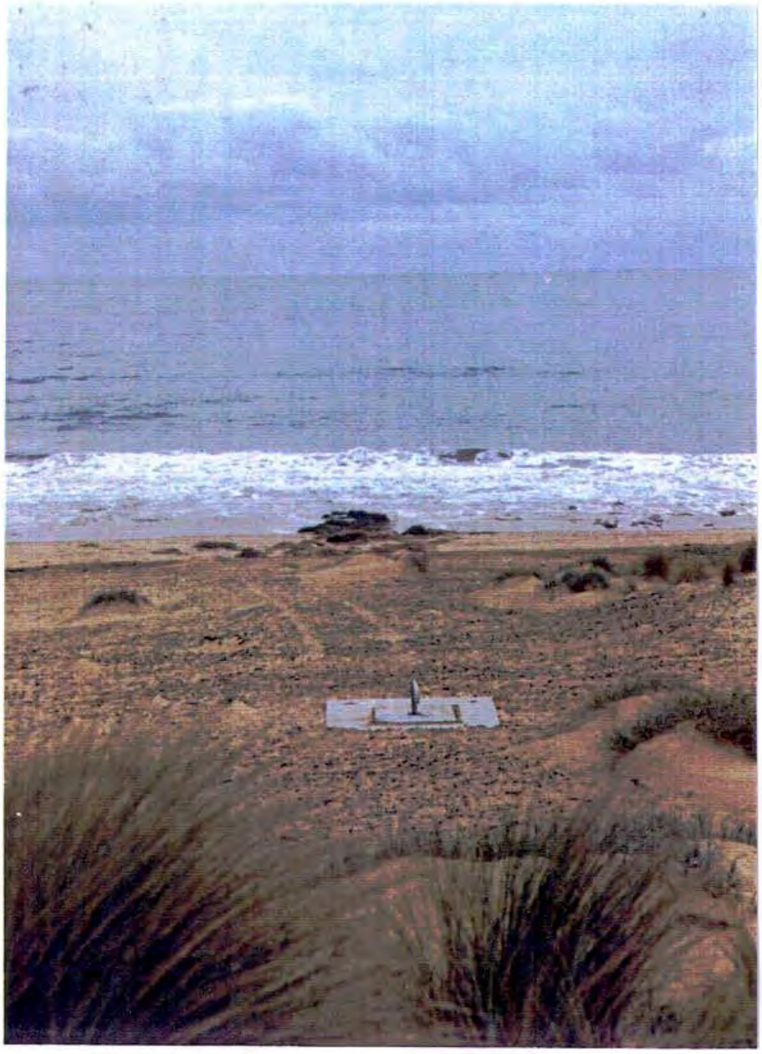


Figure 2.12
**66.7 KM MARK—
SCM CHEMICALS'
OCEAN OUTFALL**

attached to existing road bridges. At road or stream crossings the pipeline would be constructed from ductile iron or cement-lined steel. Where the pipeline was constructed of ductile iron or cement-lined steel and ran in proximity to a transmission line, it would be earthed to prevent induced current problems.

The pipeline would generally be buried below ground with a minimum soil cover of 600 mm. Under roads and where required for agricultural or other purposes, it would be buried deeper. Thrust boring techniques would be used to install the pipeline under major roads and railways to avoid disruption to traffic. Where the pipeline was required to cross irrigation channels, the pipeline would be enclosed in a steel pipe and bridge the channel so as not to affect the integrity of the side walls.

Surface ground conditions do not indicate the presence of rock along most of the proposed route. However, laterite and coffee rock exist along certain sections of the route on the western edge of the Darling Scarp, and blasting would be required if the rock could not be ripped out with a bulldozer.

Construction in typical cleared SECWA transmission line corridors and other cleared corridors is shown in Figure 2.13. The maximum width of area that would be disturbed is approximately 11 m (which includes an access track), but only a 5 m easement would be required for long-term access. Negotiations would be held with land owners to obtain this easement.

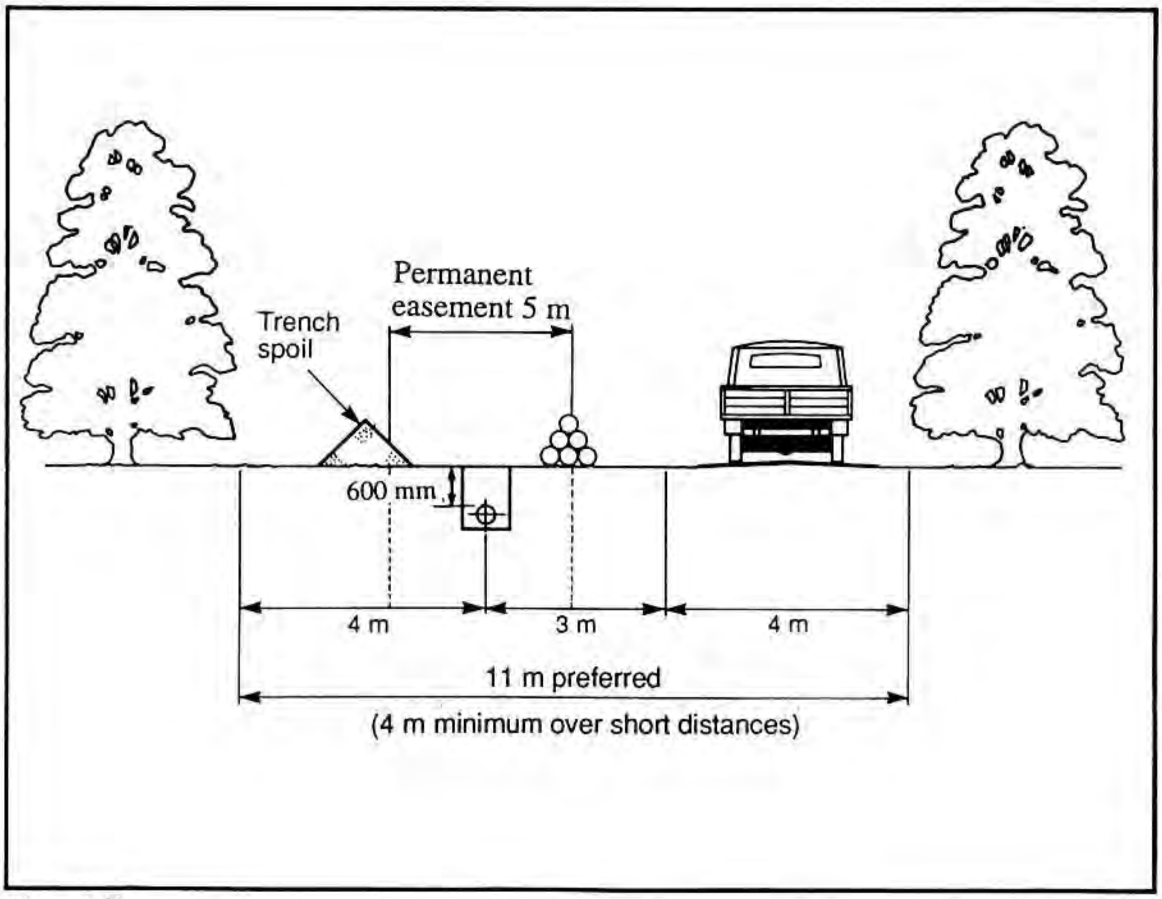


Figure 2.13
TYPICAL CONSTRUCTION CORRIDOR

It is currently planned that there would be one pumping station at the power station site; however, this would depend on final engineering design. Depending on the pipeline material chosen, pressure break tanks would probably be installed at (approximately) the 37 km, 40 km, 43 km and 67 km marks (as shown in Figure 2.4) to relieve pressure build-up. It is proposed that these tanks be above-ground steel structures, some 3 m high and 3–7 m in diameter. They would be located on high ground, but would be painted dark green and shielded from direct view to minimize visual intrusion. Automatic pressure relief valves would also be installed along the pipeline to prevent it from becoming overpressurized.

The pipeline would be under automatic control and three flowmeters would be installed, one at the power station, one at the top of the Darling Scarp and one at the ocean outfall, to continuously monitor the flow. A telemetry or land wire system would be installed to notify the control centre and raise an alarm immediately a significant difference in flow between any of the meters, was detected. The pumps would shut down automatically.

Solar panels would be used as power sources for the telemetry system if there was not an existing secure power source nearby.

Methods to reduce the volume of water lost in the unlikely event of a pipeline rupture are being investigated. The favoured option is to install check valves, which would isolate sections of the pipe, limit the volume of water released and facilitate repair procedures. In addition, manual isolating valves would be installed at regular intervals, discharge tanks would be installed at high points, and scour valves would be installed at low points in the pipeline profile. Fresh water would be used to scour the pipeline if required, and the resulting water would be discharged into the natural drainage system.

The route would be well marked with appropriate signs at strategic locations. It is also proposed to place readily visible tape above the pipeline in the trench, and to place above-ground markers at each change of direction of the pipeline and at regular intermediate intervals. These precautions should minimize the chances of accidental damage to the pipeline.

Access to the pipeline would be maintained to facilitate inspections and to minimize delays in reaching the pipeline if repairs were required.

2.3.4 OCEAN OUTFALL

The ocean outfall would be sited in an area that:

- has a barren ocean floor
- is of low fisheries significance
- has maximum dispersion/dilution characteristics.

It is proposed to locate the ocean outfall off the Leschenault Peninsula near an existing outfall operated by SCM Chemicals. It would begin within 100 m of SCM Chemicals' outfall and would discharge approximately 710 m offshore, 500 m away from, and 190 m to the north of, the SCM Chemicals discharge point.

The proposed ocean outfall would be similar in construction to that of SCM Chemicals, and would consist of a 250 mm (approximate) diameter welded HDPE pipe buried in a trench, secured by concrete anchor blocks. It would have 750 mm of sand cover and scour protection through the beach and surf zone to enable the pipeline to withstand near-shore wave action. A multiport diffuser would be located at a depth of approximately 10 m. Diffuser design studies indicate that, with such a diffuser, a dilution of at least 100 times would be achieved within 6 m of the outfall. A back pressure gauge would be installed near the onshore break tank in order to detect any potential rupture of the outfall pipe or diffuser.

Construction of the ocean outfall would proceed in a similar manner to that adopted for the construction of the SCM Chemicals outfall. The cutting of a trench in the rock platforms in the nearshore zone would be undertaken using a combination of dozers and underwater excavators and/or excavators mounted on barges. Some blasting of rock may also be required.

The outfall pipeline would be welded together on the beach and prepared for floating into position. Immediately prior to launching the pipe a trench in the nearshore sand beds would be excavated so that the pipeline would be buried below the sea bed wherever possible.

The outfall pipeline would then be launched and towed into position before being sunk and stabilized with concrete weights. Construction would be completed by installation of the diffuser and removal of construction material from the beach.

2.4 DISPOSAL OF OTHER WASTEWATER

Sewage would be treated in a package sewage treatment plant. Treated sewage wastewater, because of its high nutrient content, would be used to irrigate an on-site eucalyptus plantation.

Clean rainfall runoff from the general site area and the rehabilitated ash storage areas would be directed to silt traps where, after settling to reduce turbidity and suspended solids, the rainfall runoff would be discharged into the local natural stream system.

Oily sludges generated by leaks and spills or by treatment of rainfall runoff from plant hardstand areas would be collected and transported in road tankers for disposal at a licensed treatment plant.

The cleaning of boilers at the end of construction, and infrequently thereafter, the cleaning of membranes used in the desalination of water for use as boiler make-up, and the use of solutions for the preservation of these membranes, would result in the production of concentrated wastes containing a variety of chemicals such as hydrochloric, citric, or phosphoric acids, ammonium salts and inhibitors. These wastes would be collected in road tankers, as they were produced, for disposal at a licensed treatment plant.

3 JUSTIFICATION FOR THE SALINE WATER DISPOSAL STRATEGY AND EVALUATION OF ALTERNATIVES

The disposal of moderately saline water is considered to be the most significant issue associated with the water management strategy for the proposed Collie Power Station. This section discusses the need for disposal of this saline water and describes the objectives of the water management strategy. The benefits of the proposal and the consequences of not proceeding are also outlined, together with an evaluation of feasible alternatives to achieving the objectives. These alternatives are compared with the preferred alternative of piping the saline water for disposal into the ocean north of the Leschanault Peninsula.

3.1 OBJECTIVES OF THE WATER MANAGEMENT STRATEGY

The water management system for the power station would recycle and reuse water where possible. However, as indicated in Section 2, the power station would produce moderately saline water that could not be recycled or reused without further treatment.

The prime consideration for management of this saline water is to assist the Water Authority in its long-term objective of returning the water in Wellington Dam to potable quality by not discharging water with a salinity greater than 550 g/m^3 TDS into the Wellington Dam catchment (Water Authority 1988). Consequently, the discharge of saline water into the Collie River upstream of Wellington Dam is not an acceptable option.

Reliability and the cost of construction and operation are also of importance to SECWA. Consequently, the water management strategy can be summarized as having the following objectives:

- to provide a means of managing the disposal of saline water that is environmentally acceptable;
- to provide a means of managing the disposal of saline water that is reliable and cost effective.

SECWA believes that the proposed water management strategy, and particularly the disposal of saline water via a pipeline to the ocean, provide the best means of achieving the above objectives.

3.2 BENEFITS OF THE PREFERRED STRATEGY AND THE CONSEQUENCES OF NOT RECEIVING APPROVAL

3.2.1 BENEFITS OF THE PREFERRED STRATEGY

The benefits of piping the saline water for disposal into the ocean north of the Leschenault Peninsula are that this preferred strategy:

- meets the Water Authority's objective of removing saline water from the Collie Basin;
- is a long-term solution that would not require ongoing management following decommissioning of the power station;
- is simple, cost effective and highly reliable;
- requires relatively little energy;
- uses water in such a way that it has potential for industrial reuse;
- does not preclude the possibility of future reuse of the water at the power station;
- ensures the potential environmental impact is low.

3.2.2 CONSEQUENCES OF NOT RECEIVING APPROVAL

If the preferred water management strategy was not approved, there would be a need to adopt one of the alternative strategies, some of which would require long-term management following decommissioning of the power station. In addition, the other alternatives would be more expensive. If none of the alternative means of managing the water produced by the power station was considered acceptable, the station's operation would be severely hampered and the entire Collie Power Station project would probably not be able to proceed.

3.3 ALTERNATIVES TO OCEAN DISPOSAL

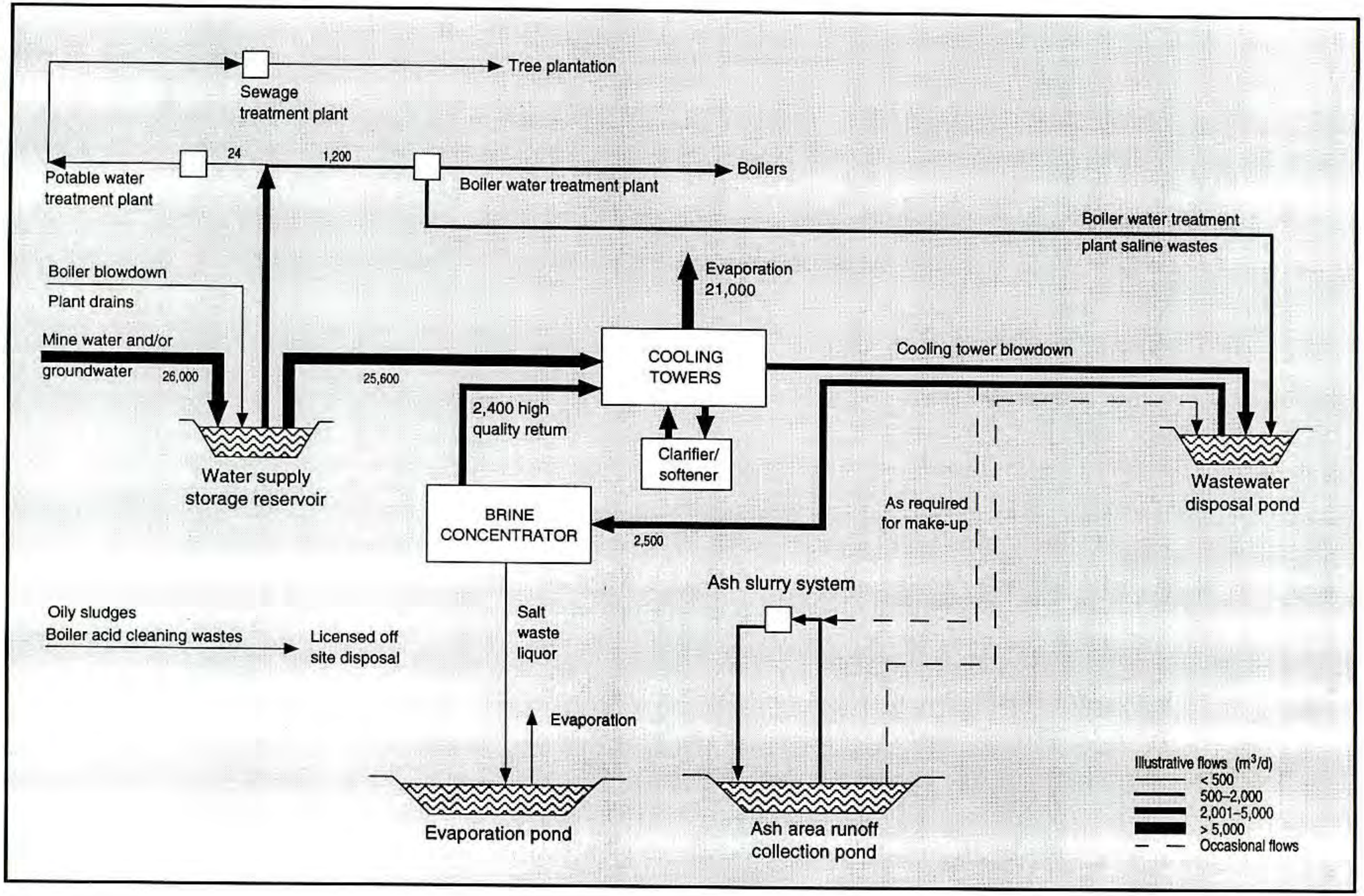
3.3.1 RECOVERY OF WATER WITH ON-SITE SALT STORAGE

The proposed water management system includes the most cost effective means of recycling and reusing water. To further recycle and conserve water, and reduce or eliminate the need to dispose of water from the site, constituents that limited the number of times the water could pass through the cooling tower circuit, such as salt and silica, would need to be removed by treatment.

SECWA has conducted a number of studies on possible water management systems for the power station (Kinhill Engineers Pty Ltd 1988, 1989a). These studies examined a variety of different treatment processes in order to develop a system in which all the water would be recovered and nothing would be discharged from the site. These studies indicated that the most appropriate processing option would be a combination of a clarifier/softener and a brine concentrator (Figure 3.1). In this process, part of the

Figure 3.1

WATER MANAGEMENT SYSTEM—WATER PROCESSING WITH ON-SITE SALT STORAGE



cooling tower blowdown would be treated with lime in a clarifier/softener to remove silica. The treated water would be recycled to the cooling towers, resulting in a substantial decrease in the volume of cooling tower blowdown. The lime sludge produced by the clarifier/softener would require disposal either on site in the ash storage area or at a landfill.

The considerably reduced quantity of cooling tower blowdown, as well as boiler water treatment plant saline wastes, would be treated in a brine concentrator to produce distilled water for use in the boiler and in the cooling towers. The resulting salt slurry from the brine concentrator, containing up to 220,000 g/m^3 TDS, could be disposed of on site in two ways. It could be sent to a dedicated on-site evaporation pond for drying and permanent storage, or it could be disposed of in the ash storage area.

Long-term storage of salt on site would require a secure structure to prevent further salinization of the Wellington Dam catchment or the local groundwater through leakage of salt. The construction cost of such a structure would be high and there would be a need to undertake long-term monitoring and management to ensure that leakage of the salt did not occur. The potential for damage to on-site wetlands is also significant.

The overall capital and operating costs of this option would be high and it would be energy intensive. A large evaporation or storage area for the salt slurry would also be required which may not be available on the existing site. While the system would be able to conserve water and prevent off-site discharge of saline water, the savings made through water conservation might be nullified by increased energy consumption. In addition, although these systems are proven in practice, they are complex and operationally demanding, and their complexity inherently decreases their reliability. Such systems would thus require considerable additional support in the form of holding ponds, an increase in operational staff, and specialist personnel for maintenance.

An additional concern in relation to this option is the potential environmental impacts associated with the long-term storage of salt on site which would continue long after the power station ceases operation. It is primarily on this basis, as well as on technical and economic grounds, that this option is not favoured by comparison to ocean disposal via a pipeline.

3.3.2 RECOVERY OF WATER WITH TRUCKED DISCHARGE OF SALT FROM THE SITE

As indicated in Section 3.3.1, the treatment of wastewater in a brine concentrator would result in a salt slurry containing up to 220,000 g/m^3 TDS. This slurry could be transported directly to a suitable off-site location for disposal. Alternatively, the slurry could be sent to an on-site evaporation pond for drying, with a lesser quantity of dry salt subsequently transported to a suitable off-site location for disposal.

A variety of off-site disposal locations for the salt or slurry, including Lake Norring and Lake Grace North, have been considered. Lake Norring, 16 km south of Wagin, and Lake Grace North are salt lakes, and, while not classified as nature reserves, they are important feeding or breeding grounds for waterbirds. Lake Norring forms part of a complex of interconnected salt lakes in the area, some of which are nature reserves, and Lake Norring may overflow into them during heavy rainfall. The lake is also a popular recreation destination and is used for sailing, skiing and swimming. A number of small nature reserves are located close to Lake Grace North, and these are connected to the lake by several intermittent watercourses. Disposal of the salt slurry or sludge from the brine concentrator in either of these lakes could therefore have a number of adverse environmental and social impacts.

Lake Norring is 120 km by road from the Collie Power Station site, while Lake Grace North is a further 120 km away. While transport of the salt slurry or sludge to either of these locations by truck is technically feasible, there would be a number of environmental and social impacts associated with the increase in heavy traffic that would need to be considered, especially if the power station was expanded. In addition, this option would be considerably more expensive than a pipeline to the ocean. For these reasons, this option is not favoured on environmental or economic grounds.

The salt produced by processing the saline water from the power station could be sold. However, the quality of the salt produced would be highly variable, and the possibility of being able to sell the salt is considered remote. Further, the return from selling the salt would not justify the installation of the water processing system. Hence, this option is not favoured.

3.3.3 DISPOSAL OF WATER BY DEEP AQUIFER RECHARGE

Saline water or the salt slurry produced by the process described in Section 3.3.1 could be disposed of by injection into a suitable confined aquifer inside or outside the Collie Basin.

The Collie Power Station site straddles a boundary separating areas of complex geology and groundwater hydrology. South of the boundary is the Collie Coal Basin, which consists of alternating sequences of coal, shale and sandstone. Studies undertaken by the Water Authority show that these layers extend to a depth of 1,500 m (Water Authority 1988). The shale prevents the movement of water between adjacent sandstone aquifers (Australian Groundwater Consultants Pty Ltd 1985). However, vertical movement of water can occur between adjacent sandstone aquifers where the intervening shale thins out or is broken by geological faults.

Saline water or salt slurry could be injected into the deepest of the aquifers underlying the power station site. It is expected that the saline water, being of higher salinity and density than the natural groundwater, would not mix with the less dense fresh water above it. However, the Collie Coal Basin is considered to be the largest single groundwater resource in the south-west of the State east of the Darling Fault. Considering the importance of the groundwater source, the complex geology and hydrology of the basin, the possibility of contaminating the groundwater and the technical difficulties and cost of drilling to such depths, this option is not considered acceptable on environmental or technical grounds.

North of the boundary and outside the Collie Coal Basin, groundwater is unconfined; that is, it does not exist in aquifers capped by impermeable shales but exists in fractures in the basement rocks and in pore spaces in the overlying lateritic soils. Disposal into these aquifers is also considered unacceptable on both environmental and technical grounds.

3.3.4 PIPED DISPOSAL OF SALINE WATER TO SURFACE WATERS

The saline water could be discharged out of the Collie Basin by disposal into one or other of a number of rivers in the area, including the Collie River downstream of Wellington Dam.

Preliminary studies for discharge of the saline water into the Collie River along Treendale Road downstream of Burekup or near the Australind Bypass bridge were conducted (see Figure 3.2 and Appendix D). These locations are at least 4 km downstream of a proposed Water Authority water supply weir at Rose Road, about 700 m downstream of the South Western Highway at Burekup, which would supply water to the Kemerton Industrial Park (Water Authority 1993b) and has recently received environmental approval.

A preliminary survey indicated that the bottom water of the Collie River was saline at least as far upstream as the Australind Bypass bridge, while the surface water was brackish (see Appendix D). The river in this area has a depth of 3–4 m, and a width of 10–20 m.

SCM Chemicals has been discharging saline water into the Collie River near Australind for some years without any noticeable environmental impact (SCM Chemicals 1986; Kinhill 1990b and 1994). Discharge of the saline water from the power station into the Collie River could thus also be environmentally acceptable. However, despite a lower construction cost than a pipeline to the ocean, this option is not preferred because:

- it may cause potential conflicts with the proposal by the Water Authority to extract water from the Collie River near Burekup;
- there is uncertainty regarding impacts upon the ecology of the lower reaches of the Collie River, particularly during summer when natural flows are low;
- there is uncertainty regarding potential impacts on the Leschenault Inlet.

Discharge into the Harvey River diversion drain was also considered, but discounted because the water in the drain may be used for irrigation purposes and because of its distance from the power station.

3.4 ALTERNATIVE OCEAN DISPOSAL OPTIONS

3.4.1 DISPOSAL OF CONCENTRATED SALINE WATER

The quantity of saline water requiring disposal could be reduced by concentrating it using a desalination technique such as reverse osmosis or electrodialysis. This would separate the salt from the water by passing it through a special membrane at high pressure or under the influence of an electric current. Relatively fresh water (which would be reused as cooling tower make-up) would be produced together with a smaller quantity of highly saline water, which would be disposed of via a smaller pipeline to the ocean.

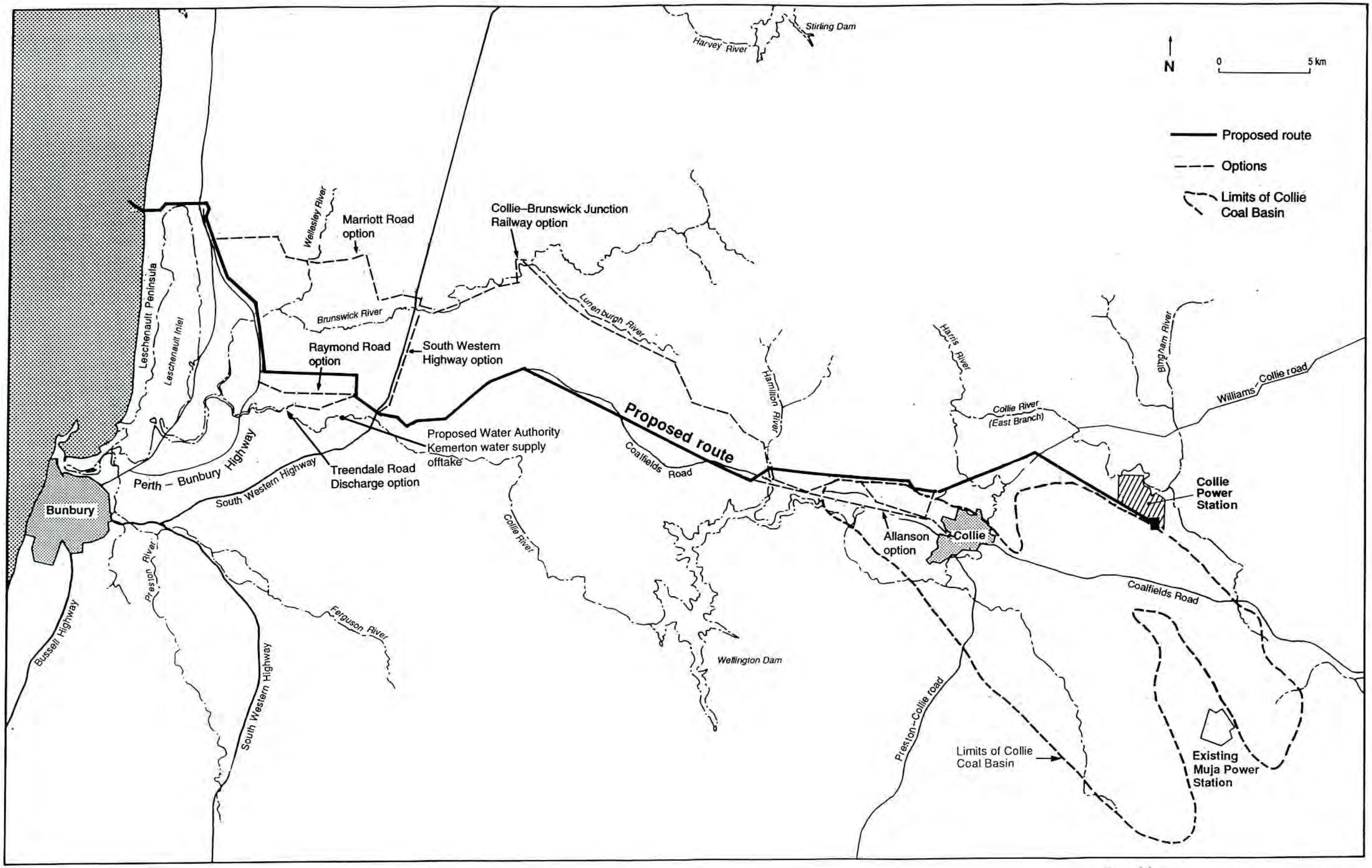


Figure 3.2
ALTERNATIVE PIPELINE ROUTES FROM COLLIE POWER STATION

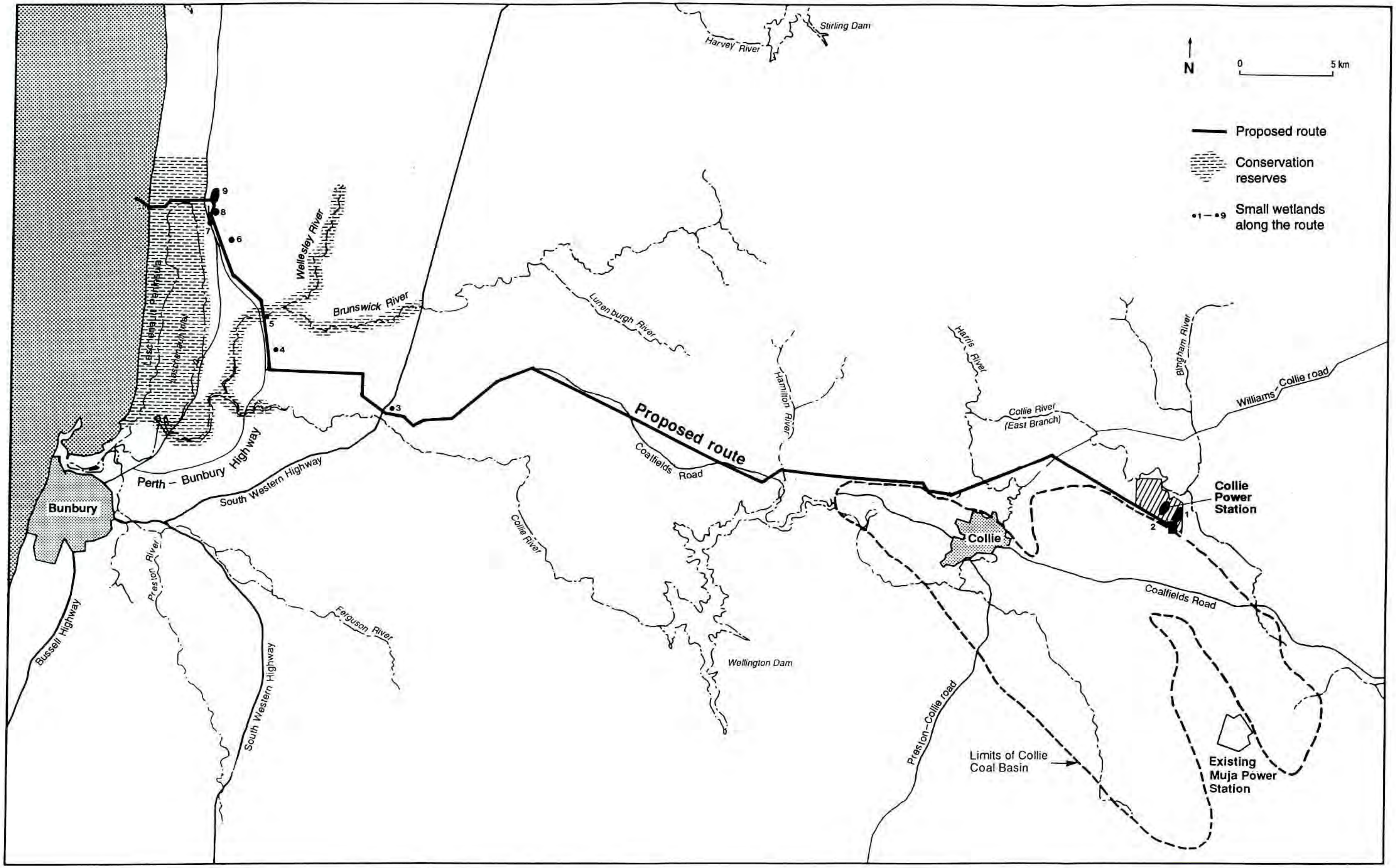


Figure 5.1

LOCATION OF WETLANDS ALONG THE PROPOSED PIPELINE ROUTE

The capital and operating costs of this system would be relatively high and it would also be energy intensive. The savings associated with a smaller pipeline would be more than offset by the cost of the additional treatment required. Furthermore, the highly saline wastewater would have very limited potential for use by industries located in the Kemerton area. Consequently, this option is not favoured by comparison with the preferred strategy.

The salt or salt slurry produced by processing the saline water generated by the power station, as described in Section 3.3.1, could be transported by truck to an ocean disposal location for discharge. Discharge would involve the dissolution of the salt or dilution of the slurry with fresher water prior to disposal, in order to reduce the salinity to a level comparable to that in the ocean. While transport of the salt slurry or sludge by truck is technically feasible, there would be a number of environmental and social impacts associated with the increase in heavy traffic that would need to be considered, especially if the power station was expanded. In addition, this option would be considerably more expensive than a pipeline to the ocean. For these reasons, this option is not favoured.

3.4.2 ALTERNATIVE OCEAN DISPOSAL LOCATIONS

The saline water could be discharged at a number of alternative ocean locations in the Bunbury region, including the Bunbury inner harbour or offshore either north or south of Bunbury.

The Bunbury Port Authority has indicated they are not opposed in principle to disposal of saline water to the inner harbour. However, studies (Kinhill Stearns 1984) indicate that the Bunbury inner harbour is not a suitable location for discharge of moderately saline water because of poor mixing characteristics and poor dispersion. Discharge of moderately saline water would result in the formation of a surface lens with a salinity lower than seawater. The heating of the lower water and the decrease in oxygen levels produced as a consequence would adversely affect marine organisms living within the inner harbour area. Hence, disposal of saline water into the Bunbury inner harbour is not considered acceptable on environmental grounds.

However, mixing offshore in the Bunbury coastal region is excellent. This results in excellent dispersion and the area is suitable for the establishment and operation of an outfall. An outfall could therefore be constructed south of Bunbury, rather than north of the Leschenault Peninsula as proposed.

Nevertheless, an outfall north of the Leschenault Peninsula has several advantages compared with an outfall located south of Bunbury. First of all, the pipeline route would be direct and would traverse less populated areas. Secondly, there is an existing outfall at the Leschenault Peninsula, which has known mixing characteristics. In addition, there is no proposed urban development in the vicinity of the existing or proposed outfall. Finally, the pipeline would pass close to Kemerton, an area that has limited water supply sources. The moderately saline wastewater has some potential for future use for industrial or cooling purposes by current and proposed industries located in the Kemerton area. For these reasons, an area north of the Leschenault Peninsula is the favoured location for the pipeline outfall.

3.4.3 CO-DISPOSAL WITH OTHER SALINE WATERS

There is an existing ocean outfall and pipeline to the Leschenault Peninsula from the Kemerton area, operated by SCM Chemicals. However, initial indications are that the pipeline does not have the capacity to take additional saline water. In addition, responsibilities for management and monitoring would need to be closely defined. Consequently, SECWA would prefer a separate dedicated pipeline to dispose of the saline water from the Collie Power Station.

The Muja Power Station, which is 12 km south-east of the proposed Collie Power Station, also generates saline water as a result of the operation of the power station. The water management strategy at Muja Power Station is presently being enhanced to comply with more stringent Water Authority requirements, but there is no plan for disposal of saline water off-site via a pipeline to the ocean. It is also desirable, for management reasons, to keep the two water management systems separate. Thus, the co-disposal of saline water from the Muja and Collie Power Stations is not favoured.

3.5 ALTERNATIVE PIPELINE ROUTES

The preferred water management strategy is to pump the saline water via a pipeline approximately 68 km to an ocean outfall north of the Leschenault Peninsula. The proposed pipeline route is described in detail in Section 2.3.2 and is shown in Figure 3.2. Figure 3.2 also shows a number of feasible alternative routes which are described below.

One option for part of the proposed pipeline route would be to follow a 66 kV transmission line through the southern outskirts of the township of Allanson rather than utilizing the Water Authority's Wellington to Collie pipeline on the northern outskirts of Allanson. However, this would cause considerable disruption because a large number of residential properties would be affected, construction of a new pipeline would be required, and sections of the pipeline would pass through the centre of some properties. In addition, this development would alienate some sections of land from possible future land uses identified in the *Collie Basin structure plan* (Department of State Development 1992). The Water Authority has indicated that it has no objections to the use of the Wellington to Collie pipeline, provided SECWA install a small diameter plastic pipeline to supply a secondary source of water to the Allanson area (Goodall 1994). Since there are no environmental or economic benefits to this option, it would only be considered further if future studies show that use of the existing pipeline is not technically feasible.

An alternative route for the pipeline through the Darling Range and down the Darling Scarp is to follow the Collie–Brunswick Junction railway. However, the railway has a very narrow reserve and there is insufficient space along many of the cuts and embankments to accommodate a pipeline. In addition, the railway line does not have a maintenance road directly alongside it. The use of existing service road alignments to provide access to the route would require numerous crossings of the railway line and considerable clearing to widen the existing corridors and connect existing tracks. A pipeline following this route would therefore have a greater environmental impact than the proposed route.

There are several options for the pipeline route from the west of Burekup to Kemerton. This section of the Swan Coastal Plain has been predominantly cleared and is under cultivation, with many irrigation channels, drains, roads and transmission lines crossing the area. The final route chosen would depend on negotiations with land owners and service authorities to minimize interference during construction.

The route proposed in this CER would follow Raymond, Alma and Victoria Roads and the Perth–Bunbury Highway. An alternative for this section of the route is for the pipeline to follow Raymond Road to the intersection with the Perth–Bunbury Highway. However, this would require considerably more clearing of trees and would require the crossing of a larger number of irrigation and drainage channels.

A further alternative is for the pipeline to follow the South Western Highway or the railway, through Brunswick Junction, to Marriott Road. However, road and railway reserves in this area are narrow with many utilities on both sides. Consequently, indications are that disruption would be considerable; as a result this route is not favoured.

4 PUBLIC CONSULTATION

This section outlines the programme of public consultation undertaken by SECWA and identifies the issues raised during the consultation programme.

4.1 PUBLIC CONSULTATION PROGRAMME

SECWA has undertaken an extensive programme of public consultation to inform, and seek comment from, relevant government agencies, interest groups, land owners and the general public regarding the pipeline proposal. The public consultation programme involved the following activities:

- discussions with individual land owners
- presentations to local community leaders
- public information days
- other activities.

The broad objectives of these activities have been to:

- provide details of the proposal
- outline the activities being undertaken by SECWA
- identify and address issues of concern raised during public consultations.

Descriptions of the public consultation activities are provided below.

4.1.1 DISCUSSIONS WITH INDIVIDUAL LANDOWNERS

SECWA identified all land owners whose property may be affected by the proposed route of the pipeline. A total of forty-two land owners were identified, with consultation undertaken with all but five, who were unavailable. Contact was made to outline the proposal and identify issues of concern and all land owners were issued with a copy of a SECWA brochure which contained information on the proposal. Where land owners were not available, notifications were issued inviting them to contact SECWA at a later date to discuss the proposal, since discussions with land owners are ongoing.

4.1.2 PRESENTATIONS TO LOCAL COMMUNITY LEADERS

SECWA made two presentations to identified community leaders of local organizations that may be interested in the proposal. These presentations were held at the offices of the Shire of Collie in Collie (between 10.00 a.m. and 2.30 p.m) and at the Lord Forrest

Hotel in Bunbury (between 4.00 p.m. and 5.15 p.m.) on 12 October 1994. A list of the organizations invited to these presentations is provided in Appendix E.

The Collie presentation was attended by fourteen people, while sixteen people attended the Bunbury presentation. At each presentation, SECWA outlined details of the proposal and then provided an opportunity for comments to be made or issues of concern to be raised by participants.

4.1.3 PUBLIC INFORMATION DAYS

Pubic information days were held at the following venues:

- Collie—Boulevard Shopping Centre between 10.00 a.m. and 4.00 p.m. on 2 November 1994;
- Bunbury—Centrepoint Shopping Centre between 9.00 a.m. and 12.00 noon on 3 November 1994;
- Australind—Australind Village Shopping Centre between 1.00 p.m. and 4.00 p.m. on 3 November 1994;
- Harvey—Harvey Foodland Shopping Centre between 10.00 a.m. and 3.00 p.m. on 4 November 1994.

These public information days enabled land owners and other interested people to familiarize themselves with details of the proposal and provided an opportunity for the public to make comment or raise issues of concern in relation to the proposal. Copies of the SECWA brochure on the proposal were also distributed to the public. A SECWA representative was in attendance to explain the proposal and answer questions.

The public information days were advertised in the following local newspapers:

- *Collie Mail*—27 October 1994
- *South West Times*—27 October and 1 November 1994
- *Bunbury Mail*—26 October and 2 November 1994
- *Harvey Reporter*—25 October and 1 November 1994.

At each public information session, information, presented on a series of panel displays, included the following:

- background to the proposal
- alternative disposal options considered
- details of the proposal, including a map of the proposed pipeline route
- the environmental assessment process
- key environmental issues and their management.

Although the panel displays were exhibited in prominent positions at each venue, the number of people who stopped to discuss the proposal or to ask questions was limited.

Estimated attendance at each public information session was 24 at Collie, 16 at Bunbury, 20 at Australind and 4 at Harvey.

4.1.4 OTHER ACTIVITIES

Other public consultation activities were undertaken by SECWA. These included:

- arranging meetings with interest groups and government agencies
- contacting interested parties by telephone
- distributing copies of the SECWA brochure by mail or in person.

A list of organizations and interest groups contacted by SECWA is provided in Appendix F.

4.2 ISSUES RAISED DURING PUBLIC CONSULTATIONS

The public consultation programme indicated that in general, the proposal was favourably received by the land owners, the local communities and by government agencies.

The issues raised during the public consultations, and the section(s) of the CER in which each issue is addressed, are listed below. This list represents a summary or consolidation of all issues raised; it is not presented in order of the frequency with which issues were raised or their perceived importance.

Pipeline route

Issues raised in relation to the pipeline route included the following:

- Clarification of specific pipeline route in relation to private properties and road reserves (Sections 2.3.2 and 6.1.2).

- Future developments in the vicinity of the pipeline route—e.g. residential and rural subdivisions, roadworks, Port Kemerton (Section 6.3).

- Ground conditions along the pipeline route—e.g. wetness, subsurface granite (Sections 2.3.2 and 2.3.3).

- Pipeline route to be outside the Australind Bypass road reserve (Section 2.3.2).

- Utilization of SCM Chemicals' pipeline between Kemerton and the ocean (Section 3.4.3).

Pipeline design

Issues raised in relation to pipeline design included the following:

- Aspects of pipeline design—e.g. dimensions, discharge rate, construction material, depth of burial (Sections 2.3.1 and 2.3.3).

- Emergency back-up systems to be implemented (Section 2.3.3).

Alternative disposal options

Issues raised in relation to alternative disposal options included the following:

- Alternatives to ocean disposal that have been considered (Section 3.3).
- Feasibility of co-disposal with Muja Power Station (Section 3.4.3).
- Feasibility of making saline waters available for industrial use at Kemerton (Section 3.4.2).
- Implementation of water conservation measures (Sections 3.3.1 and 3.3.2).

Environmental and social impacts

Issues raised in relation to environmental and social impacts included the following:

- Employment opportunities (Section 6.3).
- Maintenance of water supply to Allanson/Collie residents if the section of Water Authority pipeline is utilized (Section 6.3).
- Water quality of the saline water, including heavy metal concentrations and radioactivity levels (Section 2.3.1).
- Management of heavy metals at the power station (Section 2.3.1).
- Monitoring of ocean waters around the outfall (Sections 6.2.3 and 7.3).
- Need for any restrictions on recreational or professional fishing activities near the outfall (Section 6.3).
- Payments to land owners for pipeline easements (Section 6.3).
- Avoidance of trees along route and during construction (Section 6.1.2).
- Maintenance of fencelines and access to private properties (Section 6.1.2).
- Effect on proposed tourism development near Wellington Dam (Section 6.3).
- Risk of erosion in susceptible areas along pipeline route (Section 6.1.2).
- Necessity for and effectiveness of rehabilitation along pipeline easement, particularly in coastal sands and near wetlands (Section 6.1.2).

5 EXISTING ENVIRONMENT

This section describes the environment at the power station site, along the pipeline route and at the ocean discharge site which may be affected by the proposed water management system. Of particular importance is the presence of wetlands and other areas of conservation significance. This section also describes aspects of the coastal circulation near Bunbury which would influence the dilution and dispersion of any discharge to the ocean.

The anticipated environmental impacts of the proposal are discussed in Section 6.

5.1 WETLANDS

The pipeline may impact upon wetlands located along the proposed route. Those wetlands identified along or close to the proposed route (see Figure 5.1) are as follows:

- two wetlands on the Collie Power Station site;
- one small wetland along Coalfields Road near the South Western Highway;
- two small wetlands along the Perth–Bunbury Highway near Victoria and Clifton Roads;
- several small lakes and other wetlands along the Perth–Bunbury Highway near Buffalo Road;
- Leschenault Inlet;
- samphire flats at the northern end of Leschenault Inlet;
- the Collie, Hamilton and Brunswick Rivers.

The presence and location of wetlands along the proposed pipeline route was determined using the following sources:

- Department of Land Administration (DOLA) Miscellaneous Plan 1700 Swan Coastal Plain Wetlands, sheets 18, 20 and 21;
- DOLA South-West Land Division, South-West Mineral Field, cadastral sheets for the Lake Preston, Bunbury, Harvey, Burekup and Collie regions;

- Water Authority, Wetlands of the Swan Coastal Plain, Area II: Coastal wetlands from Pinjarra to Dunsborough (draft, 1993a);
- site inspection.

There are two wetlands on the power station site. In a recent survey (Dames and Moore 1994), the western wetland was assessed as being of higher conservation value than the eastern wetland, primarily because of the greater richness of species, the greater diversity of habitats and its less disturbed nature. The western wetland supports a small seasonal pool or lake, and areas of flooded gum, paperbark forest, open jarrah forest and native grasses of particular conservation importance. Of conservation value in the eastern wetland are the flooded gum and paperbark communities, and the tall shrub overstorey.

The water quality of both wetlands is influenced by salinity and nutrient inputs as a result of agricultural activities in the surrounding catchment, and their TDS levels vary from 3,500 g/m^3 to 12,600 g/m^3 (Streamtec 1991). There are other wetlands in the surrounding area influenced by runoff from agricultural activities that are likely to have similar nutrient levels and salinities.

Seven small wetlands occur in close proximity to the proposed route on the coastal plain between the Darling Scarp and the Leschenault Inlet, all of which are subject to the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPA 1993a). Wetlands protected by this policy (regardless of their wetland evaluation management category) have the highest level of protection under the *Environmental Protection Act* (1986) and any unauthorized filling, mining, or discharge into these lakes is prohibited. These wetlands occur as either 'sumplands', which are seasonally inundated with water, or as 'damplands', which are seasonally waterlogged (Water Authority 1987).

Although detailed information on the habitats of each of these wetlands is not available, they are of local significance and, despite some degradation from land clearing and grazing, are likely to support a rich invertebrate fauna. The sumplands along the route are likely to be characterized by the presence of woodland, forest, sedgelands and heath (Water Authority 1987). They may also provide habitat for avifauna, waterbirds and other fauna such as kangaroos and long-neck tortoises. The damplands along the route are likely to be characterized by heath, scrubland, herbland and sedgelands. They may provide habitat for various avifauna, marsupials, amphibians, reptiles and invertebrates. The salinity of these wetlands is unknown, but is likely to vary from very low in winter to moderate in summer.

Leschenault Inlet is currently classified as a recommended conservation area (C66) in the EPA System Six Red Book (Department of Conservation and Environment [DCE] 1983). The area is considered to be of high conservation value due to the presence of samphire, sedgeland and woodland communities at the northern end of the inlet. The inlet itself represents an important water-bird habitat, particularly the northern end which is used as a refuge by several species of water-fowl during mid and late summer (DCE 1983). The shallow waters of the inlet are saline and provide an important nursery ground for numerous commercial species of fish and crustaceans. The samphire flats at the top of Leschenault Inlet are connected to the inlet and would periodically contain moderate to high salinity estuarine water.

The proposed pipeline route would also cross the Collie River near Collie, the Hamilton River near Wellington Dam and the Brunswick River along the Perth–Bunbury Highway. The pipeline would cross the Brunswick River in a recommended conservation area (C67), which extends downstream from Brunswick Junction (DCE 1983). This area has also been recommended for Regional Park status as part of the System Six Red Book Status Report (EPA 1993c), because it has high conservation and recreational values.

The three rivers that would be crossed by the pipeline would contain waters of varying salinities and volumes, depending upon the season.

5.2 OTHER CONSERVATION AREAS

The proposed route from Burekup to Buffalo Road is situated mainly in areas which are classified as 'palusplain', that is, areas that are typically seasonally waterlogged and are characterized by woodland of *Melaleuca preissiana* (Water Authority 1987). Over 95% of palusplains in the Perth–Bunbury region have been cleared and can be identified as waterlogged pasture with remnant stands of *M. preissiana*. Areas of palusplain provide a habitat for invertebrates and feeding ground for water birds (Water Authority 1987).

Vacant Crown land on the western side of the northern end of Leschenault Peninsula (in which the last section of the proposed pipeline would be situated) is currently recommended as a Class C Reserve for Conservation of Flora and Fauna to be vested in the National Parks and Nature Conservation Authority (EPA 1993c).

5.3 OCEAN-RECEIVING ENVIRONMENT

The saline water would be discharged into the ocean offshore from the Leschenault Peninsula. The area around the proposed outfall consists of a gently sloping sea bed (Figure 5.2). The depth of the water increases gradually to reach a depth of about 20 m, approximately 6 km offshore. The sea bed then remains relatively flat up to the edge of the continental shelf which is approximately 90 km offshore.

Although a study by Meagher and LeProvost (1975) reported the existence of four small reefs extending northwards from Bunbury to Binningup about 5–6 km offshore, there are no well-developed reefs in the immediate vicinity of the proposed outfall.

A survey of the offshore area in the vicinity of the proposed outfall indicates that the major benthic habitats are as follows:

- gently rippled bare sand;
- deeply rippled bare sand;

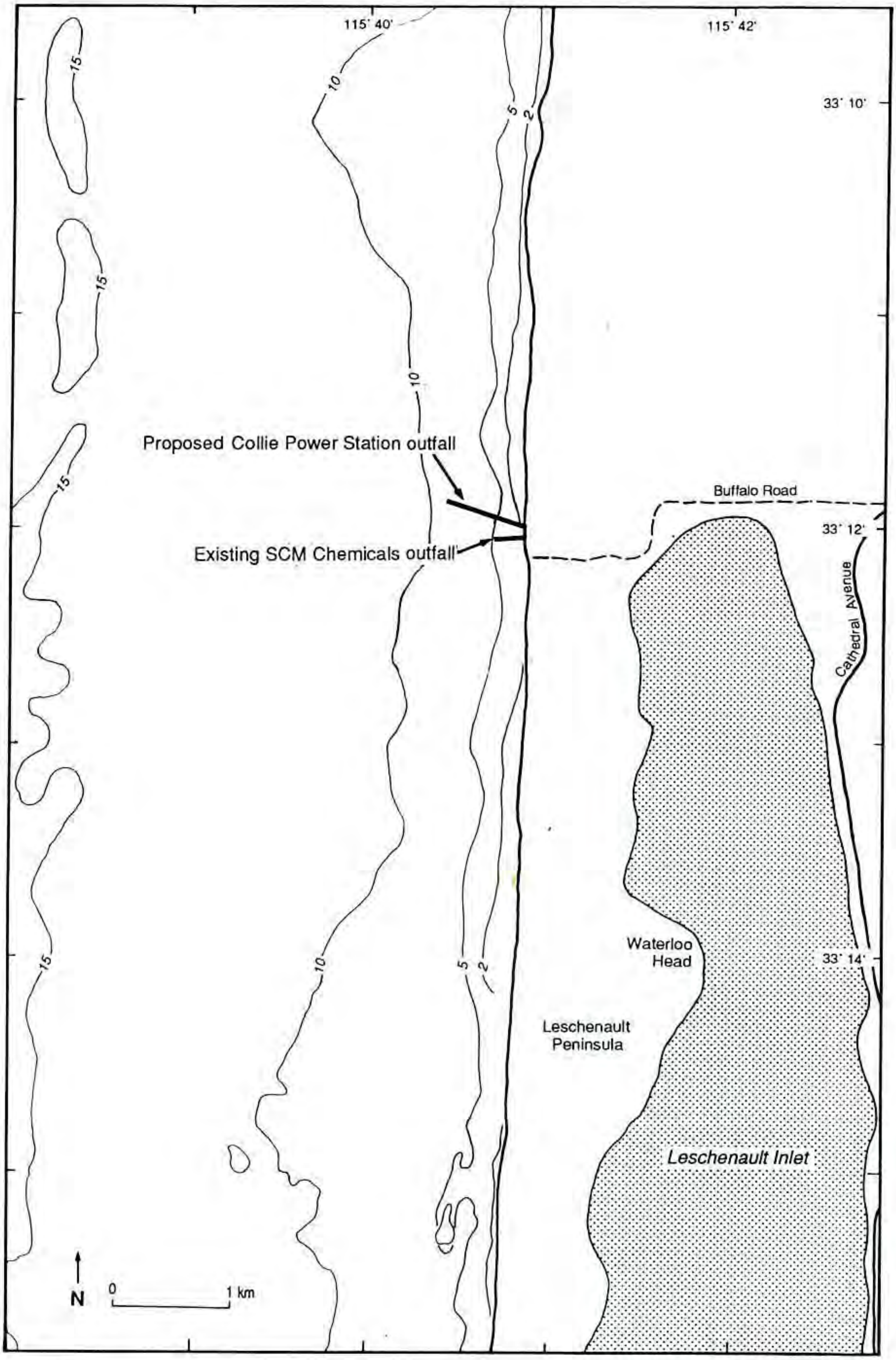


Figure 5.2

LOCATION OF THE PROPOSED COLLIE POWER STATION WASTEWATER OUTFALL

- limestone pavement covered in a thin veneer of sand with associated macroalgae;
- exposed limestone pavement with rocky outcrops and associated macroalgae;
- limestone pavement covered in a veneer of sand of varying thickness with patches of seagrass.

The area of gently rippled bare sand occurs at depths of about 6 m approximately 150–250 m offshore. The terrain seaward of this area and extending to approximately 650 m offshore largely consists of exposed limestone pavement interspersed with rocky outcrops. Some of these outcrops are colonized by red and brown macroalgae. Occasional patches of healthy seagrass (*Posidonia sinuosa*) occur in sand of varying thickness overlying the limestone pavement. The seagrass patches range from 1–10 m^2 in area and generally appear as mounds which are raised from the bottom. The seagrass patches appear to be more common directly west of the existing SCM Chemicals outfall and occur progressively less frequently further north.

Macroalgae, as large continuous areas of sparse to moderate density, also occur on limestone pavement with a thin veneer of sand in areas extending up to approximately 650 m offshore.

Near the proposed location of the SECWA saline water outfall, 650–750 m offshore, the sea bed consists predominantly of deeply rippled bare sand at depths of 9–10 m, occasionally interspersed with limestone pavement and associated macroalgae.

Because of the high energy nature of the coastline, the mosaic of coarse and fine-grained sands continually shift (Kinhill Engineers Pty Ltd 1991a, 1991b). For the same reason, turbidity in the water column is generally high all year round as the fine-grained sediments and other particulate matter are continually resuspended.

Most of the reef, seagrass and algal meadows of the inshore area adjacent to the Leschenault Peninsula provide a poor habitat for flora and fauna, and the area does not show any marked variation in species composition and abundance. Its relative productivity in terms of benthic commercial species has been described as very low (Meagher and LeProvost 1975).

Consequently, the inshore waters are not of major significance to commercial or recreational fisheries. Commercial fishing centres around beach netting for small fish such as whitebait (various *Atherinid* or *Clupeid* species) and mullet (*Mugil cephalus*). A low level of potting for Western rock lobster (*Panulirus cygnus*) occurs around reef areas. Further offshore, trawling for scallops and gill-netting for shark occur, although neither is a major industry.

Recreational fishing is not intense, although some beaches are fished regularly. Fishing intensity increases closer to Bunbury. Beach fishing is often restricted to points near vehicle access to the beach; however, many fishers travel further afield in four-wheel drive vehicles. Oceanic species that live in or migrate along nearshore areas are commonly targeted. Important commercial fish species such as Australian salmon (*Arripis trutta*) and Australian herring (*Arripis georgianus*) migrate seasonally through the offshore waters of Bunbury and Geographe Bay. Some crabbing and potting for crayfish from small boats in shallow areas occur seasonally.

5.4 COASTAL CIRCULATION ADJACENT TO BUNBURY

If saline water from the power station were discharged from an ocean outfall located off the Leschenault Peninsula, its subsequent mixing and dispersion would largely be affected by the prevailing ocean conditions.

The coastline to the north of Bunbury is highly energetic, resulting in rapid initial mixing and dispersion of any water discharged into it. Wind and wave action would ensure adequate mixing and dilution, even at a short distance from the shore.

Winds in the Bunbury region are predominantly southerly, with directional changes occurring seasonally. During winter easterly winds generally occur at night, while westerly winds are common in the afternoon. During night-time in summer, strong south-easterly winds are common, turning south-westerly in the afternoon.

Tidal currents in the nearshore area are very weak, so that currents are wind dominated. This results in a distinct daily oscillation of current flow, which may also be influenced by the swell and by sea surface waves (Imberger and Pattiaratchi 1990). However, the predominantly southerly component of the sea breeze results in a northerly transport of waters and sediments along the shore.

The movement of coastal waters further offshore is also dominated by wind-driven currents. During the summer months, surface waters tend to move northwards over the continental shelf. A flow reversal usually occurs during the winter months, with water movement following a southerly direction past Cape Naturaliste and Cape Leeuwin, as part of the Leeuwin current.

Offshore surface currents exert a minimal influence on the movement of inshore waters off Bunbury (Steedman and Associates 1980). These currents would, therefore, have little immediate effect on the transport of saline water discharged inshore at the proposed outfall.

It is expected that dispersion of the saline water after discharge and initial mixing would thus be variable both seasonally and annually, depending on the prevailing wind-induced currents. In general, the flow would be mainly northwards (parallel to the coast) with occasional flow reversals during winter storms that have prevailing northerly winds.

6 ENVIRONMENTAL AND SOCIAL IMPACTS AND THEIR MANAGEMENT

This section describes the potential environmental impacts associated with the proposed water management system and the management measures proposed to alleviate them. Issues relating to the construction of the proposed system are treated separately from operational issues.

6.1 CONSTRUCTION ACTIVITIES

6.1.1 ON-SITE WATER STORAGE PONDS

Construction of the water storage reservoir and the saline water disposal pond on the power station site would convert a large part of the middle of the existing eastern wetland into permanent lakes. The area to be inundated has little regional conservation value, but does provide a habitat for macro-invertebrates, areas of emergent vegetation and open water for local animals to drink. The ecological value of the wetland would be maintained or enhanced by establishing fringing vegetation around the perimeter of the water storage reservoir. This would provide a habitat for macro-invertebrates that would form part of the food chain for waterbirds attracted to the reservoir because of the extensive area of open water.

The shallow wetland flats downstream of the dam wall would be preserved and a source of water to the East Collie River maintained by constructing cut-off channels around the empoundment to collect and divert natural runoff.

The western wetland would not be directly affected by this proposal, and the only potential impacts are those that might arise from a pipeline rupture or slow leak, the probability of which would be unlikely (see Section 6.2.2).

Construction activities associated with the proposed on-site water storages would be typical of moderate scale earth-moving projects. The sites would initially be stripped of vegetation and topsoil, which would be stockpiled for future use on the site. Earth embankments would be constructed using a combination of excavators, scrapers and rollers which would provide the compaction required for the embankments.

Construction activities would conclude with the installation of impermeable liners, pipework, control structures and commissioning.

Normal dust control measures utilizing water sprays would be employed until the disturbed surfaces have been stabilized. Noise impacts on the nearest residences are unlikely to be an issue because of the remoteness of the site and the restriction of construction activities to daylight hours.

6.1.2 PIPELINE

The potential impacts of pipeline construction would include the following:

- disturbance or destruction of vegetation
- disturbance of wetlands
- disturbance of seagrass and macroalgae at the outfall
- increased risk of the spread of dieback and weeds
- erosion
- increased fire risk
- disruption of access for people and stock
- direct construction impacts from dust and noise.

The pipeline would pass through cultivated pasture lands, tree plantations, State Forest and public open space. However, by using the proposed route which almost entirely follows existing roads, cleared land, mostly cleared service corridors and an existing pipeline, vegetation loss would be minimized.

During construction, all possible efforts would be made to minimize adverse impacts on the surrounding vegetation. Alternative alignments that deviate slightly from the proposed route would be used wherever possible, avoiding the need to clear sensitive areas or those containing rare and endangered flora.

Waterbodies and other wetlands would be avoided where possible. Several deviations from the most direct route along cleared service corridors have already been made to avoid a number of wetlands. In those areas where additional wetlands exist directly along the proposed route, the pipeline would pass around them where practical. If this was not possible, the pipeline would cross them either on trestles or in a trench. None of the wetlands subject to the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 or the EPA System Six Red Book would be disrupted during construction of the pipeline.

The proponent would ensure that, where practical, the pipeline would pass through existing cleared service corridors and avoid remnant bushlands, wetlands (including small confined waterbodies) and other environmentally important or sensitive areas, to the satisfaction of the EPA and on the advice of the Department of Conservation and Land Management (CALM) (Commitment 5).

Construction would occur during summer to reduce the risk of soil erosion and the spread of dieback. In addition, all construction and maintenance crews would conform with accepted CALM procedures for minimizing the spread of dieback and weeds.

The proponent would implement policies to eliminate the possible spread of dieback and weeds during construction from infected areas to disease-free and weed-free areas, to the satisfaction of CALM (Commitment 6).

Increased fire risk caused by movement and construction activities of personnel and equipment would be minimal as construction would mainly be confined to cleared or mostly cleared corridors.

The proponent would implement strict fire precautions during pipeline construction to the satisfaction of CALM (Commitment 7).

Dust, noise and disruption of access would be caused by the construction of the pipeline owing to the personnel and heavy machinery required. In addition, blasting might be required in areas of laterite or coffee rock. The extent of these impacts would be dependent upon the length of time involved in constructing the pipeline. The pipeline would be completed progressively by construction in discrete sections which would involve excavation, installation, pressure testing, backfilling and progressive rehabilitation. Generally, construction would be rapid so that interference would be kept to a minimum. Typical periods of disturbance would be 1–3 weeks for individual pipeline sections. Road and river crossings would take longer because of the extra work involved. It is expected that construction of the entire pipeline would require six months.

The proponent would utilize dust suppression measures, such as water sprays from tankers, to minimize dust generation during pipeline construction, to the satisfaction of the EPA (Commitment 9).

The proponent would minimize the impact of blasting by limiting blasting to daylight hours and calm conditions, and by using the minimum charge required, to the satisfaction of the Department of Minerals and Energy (Commitment 10).

By burying the pipeline wherever possible, there would be no impediment to agricultural activity or stock and traffic movements after construction, and there would be negligible visual impact.

The proponent would ensure that disruption to access and stock movement during construction would be of minimal practical duration (Commitment 8).

Interference with the lining of irrigation channels would be avoided by routing the pipeline over the top of the channel rather than below ground. Access to property through which the pipeline passes would be via currently cleared access roads and easements. Wherever possible, a single gate in a fence would be used for initial and ongoing access to both the pipeline and other services such as transmission lines.

The proponent would develop site-specific mitigation or management plans by negotiating with individual land owners before commencing construction of the pipeline (Commitment 11).

Restoration of excavated areas and reparation of any damage to property would be undertaken progressively and as soon as possible after the completion of construction. Adequate compensation would be made to land owners for any damage or loss of production. Disturbed areas would be revegetated with appropriate species such as pasture or low shrubs. Particular attention would be paid to rehabilitation on coastal sands, near wetlands and in areas that may be susceptible to erosion, such as steep slopes.

6.1.3 OCEAN OUTFALL

Benthic flora and fauna could be disrupted during the construction of the outfall. However, seagrass and macroalgae near the location of the proposed outfall are sparse and patchy, and most patches could be avoided during the siting and laying of the outfall pipe and associated diffuser. Disturbance of existing seagrass and macroalgae during construction would therefore be minimal. Disturbance would be further reduced by routing the outfall at an angle to the shore, so that the diffuser would be located approximately 710 m offshore in an area of low seagrass occurrence.

The proponent would site the ocean outfall off the Leschenault Peninsula in an area of low conservation value to minimize the effects of the discharge on the surrounding environment, to the satisfaction of the EPA (Commitment 16).

The outfall site is sufficiently remote from residences for special measures to manage dust and blasting during construction not to be required. Construction activities within the water would generate a plume of turbid water. However, the impacts of this plume would be limited because of the naturally high turbidity levels in the area (see Section 5.3) and by restricting construction to calm periods.

6.2 OPERATION OF THE WATER MANAGEMENT SYSTEM

The potential impacts during operation of the water management system include impacts associated with:

- leakage from on-site water storage ponds
- potential pipeline leaks or ruptures
- discharges into the ocean.

6.2.1 ON-SITE WATER STORAGE PONDS

The environmental impact of leakage from the on-site water storage ponds would be dependent upon the quantity and quality of the water reaching the groundwater. In turn, the amount of water leaking from the ponds would be dependent upon the permeability of the pond liner and would be proportional to the depth of water stored in the pond.

The saline water disposal pond would be lined with a highly impermeable liner such as clay or HDPE. It would normally hold only a small quantity of saline water, if any, in order to maintain the integrity of the liner. The pond would be full only in the unlikely event of a problem with the saline water pipeline. The quantity of any leakage from this pond would therefore be negligible. Further, any overflow or leakage would drain into the power station water supply reservoir downstream of the saline water disposal pond rather than entering the environment.

The water supply storage reservoir and coal storage area runoff collection pond would contain water with low TDS levels and would be free of most contaminants except suspended solids. The quantity of water leaking from these ponds would be small and the impact of any leachate would be negligible.

The proponent would construct and line on-site storage ponds to limit seepage into local groundwater systems, to the satisfaction of the EPA and on the advice of the Water Authority (Commitment 3).

If any of the on-site storage ponds was found to leak and cause an environmental impact (as defined by the EPA), the proponent would implement procedures to identify the reasons for the leakage and prevent a recurrence, to the satisfaction of the EPA and on the advice the Water Authority (Commitment 4).

6.2.2 PIPELINE

The primary concerns with operation of the pipeline are the prevention of pipeline ruptures and major leaks, and the action that would be taken to ensure minimal environmental damage and rapid repair in the very unlikely event of a rupture occurring.

Pressure testing would be conducted during construction to identify and rectify potential problems and minor leakage. During operation, the slow leakage of saline water from joints and fittings could go undetected for some time, but would be discovered and repaired during periodic maintenance.

The proponent would conduct periodic inspections of the pipeline and its components and undertake periodic maintenance to ensure system integrity, to the satisfaction of the Water Authority (Commitment 13).

Because of the remote location of much of the pipeline, the risk of pipeline damage or failure as a result of third party mechanical damage would be minimal. To further reduce this risk, appropriate signs would be placed at strategic locations along the pipeline route and buried marker tape would be installed in the excavation above the pipeline.

A further possible cause of pipeline rupture would be seismic events. The Earthquake Risk Map of Australia (AS2121–1979) identifies three principal zones of differing earthquake risk. In decreasing order of risk, these are Zone 2, Zone 1 and Zone A; all areas not otherwise zoned are included in Zone 0, which is the lowest risk zone classified. The area between Collie and the coast north of Bunbury, i.e. the area through which the pipeline passes, is included in Zone 0. These data indicate that the chance of the pipeline rupturing because of an earthquake is remote.

Various safety devices would be installed to reduce damage to the environment in the unlikely event of a rupture occurring. These devices and the management measures associated with them are described in Section 2.3.3. In addition, in sensitive areas, such as near wetlands, the pipeline would be encased or enclosed within another pipe.

The proponent would install safety devices to reduce the potential for and impact of pipeline rupture. These devices would be installed to the satisfaction of the EPA and on the advice of the Water Authority (Commitment 12).

The proponent would institute measures so that an alarm would be raised and the pumps shut down automatically if a significant leak in the pipeline was detected. These measures would be implemented to the satisfaction of the EPA and on the advice of the Water Authority (Commitment 14).

The consequences of pipeline rupture and leakage during operation depend on the severity and location of the rupture or leak. Certain areas would be more susceptible to damage from the release of moderately saline water into the surrounding environment than others. The effect of heavy metals in the saline water would be negligible because of their low concentrations.

The most significant impact would occur in the unlikely event of a pipeline rupture into a wetland. The presence of pressure break tanks and check valves would, however, prevent the full volume of saline water in the pipeline draining out. The quantity of water that would leak would also depend on the location of the rupture because of the pipeline profile (see Figure 3.4). In the worst case, it is estimated that approximately 500 m^3 of water would be released.

The major confined wetlands within 200 m of the proposed pipeline route are the wetlands on the power station site, several small wetlands around the Perth–Bunbury Highway near Buffalo Road and the samphire flats at the top of Leschenault Inlet.

The salinity of the wetlands near the power station site varies between 3,500 g/m^3 and 12,600 g/m^3, which is significantly greater than that of the saline water (Streamtec 1991). Consequently, the impact of a pipeline rupture or slow leakage into these wetlands is likely to be minor.

The salinity of wetlands along the Perth–Bunbury Highway and Coalfields Road is likely to vary from low in winter to moderate in summer. The largest of these wetlands along the Perth–Bunbury Highway is on the opposite side of the road to the proposed pipeline alignment and would, therefore, be protected from a pipeline rupture. Smaller wetlands on the same side of the road as the pipeline would be completely covered by moderately saline water in the event of a major rupture.

Aquatic and fringing plants and macro-invertebrates are the most salt-sensitive biological communities in wetlands. Studies undertaken by Hart et al. (1991) have shown that, for the most salt-sensitive species, direct adverse affects could occur when salinity is increased to around 1,000–2,000 g/m^3 TDS, with more subtle sub-lethal effects possible at salinities below this level. Nevertheless, there is considerable variation in salt sensitivity among and between species, and many species of Australian freshwater flora and fauna appear to be tolerant of a wide range of salinities. Further, in wetlands that experience fluctuations in salinity, either as a result of drying up in summer or inflow of more saline waters, much of the biota would either be salt adapted or avoidant, or there would be a succession of species as salinities change.

The extent and severity of the impact of the release of moderately saline water from a one-off pipeline rupture would be dependent upon the volume of fresh water into which the saline water is released. In most cases, there would be considerable dilution of the saline water, and the resultant salinity would probably be less than 2,000 g/m^3 TDS. The accidental release of saline water into relatively fresh waterbodies along the route may thus deplete salt-intolerant species for a short period, but these would subsequently recolonize the wetland as the salt from a one-off release would probably be flushed from most waterbodies by rainfall or runoff, or would be lost to groundwater. The release of moderately saline water as a result of a one-off pipeline rupture is thus likely to have no long-term adverse consequences on fresh waterbodies along the route.

The samphire flats at the top of the Leschenault Inlet routinely receive waters of similar or greater salinity to that of the saline water from the estuarine waters on which they are sited. These wetlands are also periodically exposed to fresh water from rainfall and runoff. Therefore, the impact of a pipeline rupture or slow leakage into these wetlands is likely to be negligible.

The Collie, Hamilton and Brunswick Rivers seasonally receive waters of greater salinities and volumes than would occur during a rupture of the pipeline. As these are waterways rather than lakes, the saline water (and its salt load) resulting from a rupture would be transferred rapidly downstream to estuarine environments. There would be no lasting adverse effects from such an event.

Rare isolated ruptures or leakage of small quantities of saline water would pose little threat to native vegetation, tree plantations, pasture or stock. Many native plants of the jarrah forest and pasture species can utilize soil water and groundwater of very high salinity. Jarrah, for example, can tolerate TDS levels of up to 100,000 g/m^3 in the pore water (I. Loh 1992).

Many plants can be irrigated with moderately saline water, provided that the water drains into the soil relatively rapidly and the soil does not become waterlogged. The vegetation along the proposed pipeline route would therefore be able to tolerate one-off applications or slow leaks of moderately saline water, provided that the water drained quickly. There might be some temporary leaf burn or stunted growth, but this would be reversed rapidly once the wastewater was flushed from the soil by drainage, rain or fresh water.

Consequently, in the unlikely event of a pipeline rupture or slow leakage of moderately saline water, the impact on vegetation is likely to be minor and short-lived.

In the rare event of a pipeline rupture or major leak, SECWA would repair any damage to the surrounding environment. This could include collecting any standing saline water, applying fresh water to the area affected to flush out any remaining saline water, or applying lime or gypsum to clay soils in order to flush sodium from the saline water off the clays to prevent them becoming impermeable and to assist drainage.

The proponent would repair any damage to the surrounding environment in the event of a pipeline rupture or leak, to the satisfaction of the EPA (Commitment 15).

6.2.3 OCEAN OUTFALL

The proposed outfall would be located in an area of relatively low conservation value, and the relevant guidelines for water quality in the region adjacent to it would largely be those listed in 'Summary guidelines for protection of aquatic ecosystems', in EPA's Bulletin No. 711 (EPA 1993b). In areas around the shoreline near the proposed outfall and, to a lesser extent, at distances further seaward, 'Guidelines for the protection of human consumers of fish and other aquatic organisms' (EPA 1993b), may also apply.

Numerical modelling of the outfall discharge, based on the design of a diffuser capable of handling a similar flow rate and the results of dye tracer tests examining the dilution achieved by the SCM Chemicals outfall (Kinhill Engineers Pty Ltd 1991b), indicate that a 100-fold dilution of the saline water is possible within 6 m of the outfall.

In Table 6.1, the composition of the saline water after a 100-fold dilution with seawater is compared with the composition of seawater as well as the relevant water quality guidelines. These data indicate that the chemical composition following dilution (including heavy metals) would fall within the limits specified by the EPA for the protection of aquatic ecosystems and human consumers of fish and other aquatic organisms.

The only impacts requiring more detailed discussion are the following:

- effects of low salinity water on the nearshore environment
- temperature
- nutrient loading.

The effects of relatively low salinity water from the power station on the nearshore environment are expected to be minimal, considering the area's history of exposure to waters of similar salinity from river systems to the north and south of the outfall, and from outflows of groundwater. Consequently, the marine ecosystem in this coastal area is likely to be tolerant of frequent inundation with lower salinity water. In addition, at distances more than 20 m from the outfall, a change in salinity is likely to be difficult to detect and well within the area's capacity to tolerate without noticeable effects.

Bottom water temperatures in the vicinity of the proposed outfall vary from 19–25°C during summer to 16–19°C during winter (Kinhill 1990a,1991a). Upon discharge to the ocean, the temperature of the saline water would be close to the ambient temperature of the soil beneath the pipeline along its terrestrial route (15–20°C at 600 mm below the surface). In winter, therefore, the saline water temperature would be very close to the ocean temperature, while during summer it would be lower. In the well-mixed nearshore waters off the Leschenault Peninsula, mixing would rapidly diminish any temperature differential created by the saline water discharge. The environmental impact of the temperature of the saline water would therefore be minimal.

The nitrate concentration in the saline water from the power station is expected to be 6.2 g/m^3 (1.4 gN/m^3). This translates into a discharge of 9.4 kg/d of nitrogen into the inshore waters off the Leschenault Peninsula. The concentration of phosphorus in the saline water from the power station is expected to be 0.2 g/m^3. This translates into a

Table 6.1 **Marine and estuarine water quality guidelines and likely composition of Collie Power Station saline water after 100-fold dilution**

Parameter*	Saline water after hundred-fold dilution	Water quality guideline**	Seawater *** typical
pH	8.0	8.0–8.4	8.2
Sodium	10,400	NC	10,500
Potassium	376	NC	380
Calcium	398	NC	400
Magnesium	1,387	NC	1,400
Iron	0.01	NC	0.01
Manganese	0.003	NC	0.002
Chloride	18,830	NC	19,000
Sulphate	2,428	NC	2,450
Bicarbonate	139	NC	140
Silica	6.8	NC	6
TDS	34,187	32,800–36,200	34,500
Suspended solids	10	<10% change	10
Phosphate (as phosphorus)	0.01	0.001–0.01	0.01†
Nitrate (as nitrogen)	0.03	0.04–0.26	0.02†
Cadmium	0.0002	0.0002†††	0.0001
Chromium	0.0004	0.002†††	0.00005
Cobalt	0.0005	NC	0.0004
Copper	0.004	0.004†††	0.003
Lead	0.0001	0.001†††	0.00003
Mercury	0.00006	0.0001	0.00005††
Nickel	0.0025	0.015	0.002
Zinc	0.01	0.02	0.01
Hydrocarbons (total)	0.001	0.01	0
Dissolved oxygen	7	>6	7

* g/m^3, *except in relation to pH.*

** *Source: EPA 1993b, Table 2.2 (except as noted).*

*** *Source: Fairbridge 1972.*

† *Source: South West Development Authority 1992.*

†† *Source: Riley and Chester 1971.*

††† *Source: EPA 1993b, Table 2.7.*

NC *No criteria set.*

discharge of 1.3 kg/d of phosphorus. Within 20 m of the outfall, the levels of these nutrients would be close to background concentrations, and neither of them would be expected to have any significant impact on the coastal environment off the Leschenault Peninsula.

The coastal waters to the north of Bunbury are well mixed due to their exposure to high energy wind-driven waves and currents. Even during periods of lower coastal energetics, and hence reduced mixing and circulation, rapid initial mixing and dispersion of the saline water would occur. The saline water is not expected to impact on the immediate environment since it contains low levels of nutrients and other constituents. Consequently, even if the proposed outfall was located only a short distance from the shore, wind and wave action would ensure adequate mixing and dilution.

In view of the above, it is expected that the saline water from the Collie Power Station discharged about 700 m offshore would be readily and safely assimilated by the inshore waters. The hydrodynamics of the coastal waters would ensure adequate mixing, dilution and transport of the saline water away from the nearshore zone so that it would have a negligible effect on the marine environment.

In addition, it is expected that there would be no interaction or overlap of effects between the waters discharged by the Collie Power Station outfall and the existing SCM Chemicals outfall because:

- the distance between the outfalls is approximately 500 m
- neither contains significant loadings of toxic substances
- mixing and dispersion would be fairly rapid upon initial discharge.

Consequently, it is expected that the saline water from the power station would have a negligible effect on the marine environment.

Should monitoring of the ocean near the outfall detect an adverse environmental impact as a result of the saline water discharge, SECWA would review the operation of the water management system and implement changes which could include a reduction in the quantity of saline water discharged, provision of better mixing, or further treatment of the saline water.

Should monitoring of the ocean near the outfall detect an adverse environmental impact as a result of the saline water discharge (as defined by the EPA), the proponent would review the operation of the saline water management system and implement changes, to the satisfaction of the EPA (Commitment 17).

6.3 SOCIAL IMPACTS

The social impacts of the water management system would be minimal for the following reasons:

- the saline water pipeline route avoids heavily populated areas and has been chosen to minimize disruption or inconvenience to affected land owners;

- normal farming operations, such as grazing and controlled cropping would be permitted within easements, although the construction of buildings, excavation, changes in land levels and drains would not be permitted;

- almost the entire length of the pipeline would be buried, so that traffic would not be impeded and visual impacts would be negligible;

- during construction of the pipeline, excavated areas would be progressively rehabilitated or restored and any damage to property rectified or repaired;

- the saline water in the pipeline would not be hazardous to humans or animals;
- land owners would be compensated for the easements to be acquired, with payments based on advice from the Valuer General's Office.

Some of the specific social issues raised during the public consultation activities (see Section 4) are addressed below.

Some limited employment opportunities would be generated during the construction of the pipeline. It is anticipated that a construction workforce of 10–15 would be required; however, the size of the workforce would be dependent on the construction contractor. It is expected that many of the construction workforce would be recruited locally. The impact of this workforce on local infrastructure and services would be minimal, particularly if local recruitment is high. Employment opportunities during operation would be incorporated within the Collie Power Station workforce.

Public consultation and discussion with relevant authorities indicate that several future developments are proposed in the vicinity of the pipeline. These include a subdivision near the Australind Bypass and upgrading Coalfields Road. Only preliminary details of these proposals are available. However, since the pipeline would be in a proposed service corridor, paralleling the road reserves or property boundaries, the effects on these proposed developments would be minimal.

As previously indicated, the utilization of the section of the Water Authority's Wellington to Collie pipeline between Mornington Road and Coalfields Road is dependent on further engineering studies. Should this section be used, water supply would be maintained to existing Allanson and Collie households, which currently rely on water delivered from this source, through the provision of an appropriately sized replacement pipeline by the Water Authority. This replacement water supply pipeline would be installed prior to the commissioning of the saline water disposal pipeline. Water supply to households would therefore not be affected by the utilization of the section of the Water Authority pipeline.

The saline water pipeline would not impact on the possible future tourism or recreational development being considered at Potters Gorge near Wellington Dam. One of the issues raised during public consultation related to the effect of the pipeline on existing water supply to any future development. SECWA would consult with the Water Authority, as part of the feasibility study into use of the existing Wellington to Collie water supply pipeline, to ensure potential long-term developments at Potters Gorge are not precluded.

Recreational and professional activities near the proposed ocean outfall would not be restricted. Recreational activities in the area are sightseeing, shore and boat based fishing, swimming and diving; none of these would be affected by the outfall. Professional fishing activities, such as rock lobster fishing, would similarly be unaffected. Trawling is not undertaken in the region of the outfall, and because of the exposed nature of the coastline, large fishing vessels do not make anchorage in the area. The presence of the outfall is expected to be marked on future navigational charts for the area. The depth of the outfall would be sufficient to ensure that any large vessels passing over it would not be at risk.

The possibility of constructing a port to service Kemerton is currently being investigated. However, it is likely to be located well north of Leschenault Inlet, so would not be affected by the saline water pipeline or outfall.

7 MONITORING PROGRAMMES

Operation of the proposed water management system would involve regular monitoring. This monitoring would be designed to detect any impacts on the environment in the vicinity of the power station, along the pipeline route and at the ocean outfall.

The general principles of the monitoring that would be conducted are set out in this section. A detailed programme would be developed in consultation with relevant government authorities and the EPA. The proposed programme would be included in the environmental management plan for the Collie Power Station, which would be submitted to the EPA for approval before plant commissioning.

7.1 ON-SITE OPERATIONAL MONITORING

Before discharge from the power station, the saline water pumped to the ocean would be analysed regularly for parameters considered to be of potential environmental concern. These would include TDS, pH, total suspended solids, temperature, clarity, nutrient content and heavy metal concentrations. Flow rate and a number of parameters such as pH, conductivity and clarity would be monitored continuously.

A series of observation bores would be constructed in strategic locations to detect whether any of the on-site water storage ponds were leaking and to assess the quantity and quality of any leachate.

7.2 MONITORING OF PIPELINE INTEGRITY

The pipeline would be under automatic control and the flow rate would be monitored continuously using a number of flowmeters installed along the pipeline. A telemetry system would be installed to notify the control centre immediately a significant difference in flow between any of the meters—indicating a possible break or leak in the line—was detected. In addition, a back pressure gauge would be installed near the onshore break tank in order to detect any potential rupture of the outfall pipe or diffuser.

Annual or biannual visual inspections of the pipeline route and pipeline components would be undertaken to ensure the system's integrity. Leakage would normally be detected by monitoring the flow, but visual inspections of the soil and vegetation around the pipeline would be undertaken to ensure that significant leakage was not going undetected.

7.3 MONITORING OF THE OCEAN-RECEIVING ENVIRONMENT

Prior to construction of the ocean outfall, a baseline survey of the environment in the area near the ocean outfall would be undertaken, consisting of the following activities:

- measurement of physical and chemical water quality parameters including nutrient and heavy metal concentration, turbidity and the vertical profile of temperature, salinity, dissolved oxygen and pH, at various distances from the outfall;
- measurement of physical and chemical sediment quality parameters including sediment grain size, organic and inorganic carbon content and heavy metal content, at various distances from the outfall;
- a description of the marine flora and fauna in the area, including the collection of benthic samples.

A study would be conducted to determine the dilution of the saline water plume exiting the outfall diffuser to verify the dispersion modelling. This study would include accurate numerical modelling of the initial dilution and the spread of the plume under a series of wind and current regimes. The models would be tested using dye tracers that could detect the direction of plume movement and could be used to determine the dilution of the saline water with distance from the outfall.

After construction, periodic monitoring of the environment surrounding the ocean outfall would be undertaken. This would determine whether the saline water discharge had had a significant impact on water and sediment quality and on the marine biota in the vicinity of the outfall, the extent of any impact and its possible cause.

The proposed monitoring would involve sampling on an annual basis or at other suitable intervals agreed to by the EPA. Monitoring would include the following activities:

- measurement of physical and chemical water quality parameters including nutrient and heavy metal concentration, turbidity and the vertical profile of temperature, salinity, dissolved oxygen and pH at several locations at various distances from the outfall, to be compared with baseline data;
- measurement of physical and chemical sediment quality parameters including sediment grain size, organic and inorganic carbon content and heavy metal content at several locations at various distances from the outfall, to be compared with baseline data;
- the observation of the nearby benthic flora and fauna for noticeable change from the baseline data.

Because of the predicted low levels of heavy metals to be measured, special precautions would be taken in both the baseline and monitoring studies in order not to contaminate water samples during their collection. In addition, special handling and analytical techniques would be used to acurately quantify the heavy metals at the low levels expected in the waters surrounding the ocean outfall.

The results of the monitoring activities would be incorporated into an annual report outlining the status of the receiving environment. The reporting would be consistent with the requirements of the EPA.

The details of the monitoring programmes to be undertaken would be submitted to the EPA for approval before commissioning of the water management system.

As part of the environmental management programme to be prepared for the Collie Power Station, the proponent would submit and subsequently implement a monitoring programme to the satisfaction of the EPA (Commitment 18). The monitoring programme would address the following aspects of the water management system:

- **leakage of on-site ponds**
- **quality of saline water discharge**
- **integrity of the pipeline**
- **verification of dispersion at the outfall**
- **quality of the ocean-receiving environment.**

Reports on the results of the monitoring programme would be submitted regularly to the EPA and would be made publicly available, to the satisfaction of the EPA.

8 SUMMARY OF ENVIRONMENTAL COMMITMENTS

This section presents a summary of the commitments made by SECWA in the preceding sections. Each commitment is numbered to assist with referencing.

8.1 WATER MANAGEMENT SYSTEM

Commitment 1	The proponent will ensure that the water discharged into the ocean will be clear, moderately saline, at ambient temperature and free of any objectionable or unsightly material, to the satisfaction of the EPA.
Commitment 2	If a failure of the saline water disposal system should occur, the proponent will direct the saline water to the saline water disposal pond until the fault is rectified, to the satisfaction of the EPA.
Commitment 3	The proponent will construct and line on-site storage ponds to limit seepage into local groundwater systems, to the satisfaction of the EPA and on the advice of the Water Authority.
Commitment 4	If any of the on-site storage ponds is found to leak and cause an environmental impact (as defined by the EPA), the proponent will implement procedures to identify the reasons for the leakage and prevent a recurrence, to the satisfaction of the EPA and on the advice the Water Authority.

8.2 SALINE WATER PIPELINE

Commitment 5	The proponent will ensure that, where practical, the pipeline will pass through existing cleared service corridors and avoid remnant bushlands, wetlands (including small confined waterbodies) and other environmentally important or sensitive areas, to the satisfaction of the EPA and on the advice of CALM.
Commitment 6	The proponent will implement policies to eliminate the possible spread of dieback and weeds during construction from infected areas to disease-free and weed-free areas, to the satisfaction of CALM.

Commitment 7 — The proponent will implement strict fire precautions during pipeline construction to the satisfaction of CALM.

Commitment 8 — The proponent will ensure that disruption to access and stock movement during construction is of minimal practical duration.

Commitment 9 — The proponent will utilize dust suppression measures, such as water sprays from tankers, to minimize dust generation during pipeline construction, to the satisfaction of the EPA.

Commitment 10 — The proponent will minimize the impact of blasting by limiting blasting to daylight hours and calm conditions, and by using the minimum charge required, to the satisfaction of the Department of Minerals and Energy.

Commitment 11 — The proponent will develop site-specific mitigation or management plans by negotiating with individual land owners before commencing construction of the pipeline.

Commitment 12 — The proponent will install safety devices to reduce the potential for and impact of pipeline rupture. These devices will be installed to the satisfaction of the EPA and on the advice of the Water Authority.

Commitment 13 — The proponent will conduct periodic inspections of the pipeline and its components and undertake periodic maintenance to ensure system integrity, to the satisfaction of the Water Authority.

Commitment 14 — The proponent will institute measures so that an alarm will be raised and the pumps shut down automatically if a significant leak in the pipeline was detected. These measures will be to the satisfaction of the EPA and on the advice of the Water Authority.

Commitment 15 — The proponent will repair any damage to the surrounding environment in the event of a pipeline rupture or leak, to the satisfaction of the EPA.

8.3 OCEAN OUTFALL

Commitment 16 — The proponent will site the ocean outfall off the Leschenault Peninsula in an area of low conservation value to minimize the effects of the discharge on the surrounding environment, to the satisfaction of the EPA.

Commitment 17 — Should monitoring of the ocean near the outfall detect an adverse environmental impact as a result of the saline water discharge (as defined by the EPA), the proponent will review the operation of the saline water management system and implement changes, to the satisfaction of the EPA.

8.4 MONITORING

Commitment 18

As part of the environmental management programme to be prepared for the Collie Power Station, the proponent will submit and subsequently implement a monitoring programme to the satisfaction of the EPA. The monitoring programme will address the following aspects of the water management system:

- leakage of on-site ponds
- quality of saline water discharge
- integrity of the pipeline
- verification of dispersion at the outfall
- quality of the ocean-receiving environment.

Reports of the results of the monitoring programme will be submitted regularly to the EPA and will be made publicly available, to the satisfaction of the EPA.

Appendix A

EPA GUIDELINES

GUIDELINES

CONSULTATIVE ENVIRONMENTAL REVIEW

WASTE WATER DISPOSAL FROM COLLIE POWER STATION

Overview

In Western Australia environmental reviews are conducted to protect the environment. The fundamental requirement is for proponents to describe what they propose to do, to identify and discuss the potential environmental impacts of the proposal, and then describe how those impacts will be managed so that the environment is protected.

If the proponent demonstrates that the environment will be protected the proposal will be environmentally acceptable. If the proponent cannot show that the environment would be protected or demonstrate that the proposed environmental management strategies would be effective, the Environmental Protection Authority (EPA) will recommend against the proposal.

Throughout the process, it is the aim of the EPA to advise and assist the proponent to improve or modify the proposal in so the environment benefits or is protected. However, under the Western Australian process of environmental review, the proponent is responsible for identifying the potential environmental impacts, and designing and implementing strategies which protect the environment.

For this proposal, protecting the environment means disposing of waste water from the Collie power station so that the natural and social environments of the area are improved or maintained. Where this objective cannot be readily achieved, strategies to mitigate any potential impacts will be required.

Similarly, technologies employed to dispose of waste water from the station should be sited and operated to ensure that the natural and social environments of the area are protected.

These guidelines identify issues that should be addressed within the Consultative Environmental Review (CER). They are not exhaustive and the proponent may consider that other issues should also be addressed in the document. The format of the CER is the proponent's responsibility but care should be taken to ensure that topics such as the existing environment and project description are adequately addressed.

The CER is a public document and should be easily readable by the general public. Its purpose should be explained, and its contents should be concise and accurate. Specialist information or technical descriptions should not be included in the body of the document unless considered crucial to an issue. It is appropriate to include ancillary or lengthy technical information in appendices.

Environmental issues

The Environmental Protection Authority considers that the following issues are likely to be the most important environmental issues relating to this proposal:

<u>At Collie:</u>

- water requirements for power station operation;
- sources of water;
- protection of surface and groundwater resources.

<u>Along the pipeline route:</u>

During construction:

- dust;
- noise;
- spread of dieback
- disruption to access for people and stock; and
- increased fire risk.

During operation:

- impacts associated with pipeline ruptures;
- disturbance or destruction of wetlands; and
- maintaining access;

Ocean outfall:

- effects of effluents on the marine environment;
- interactions between effluents from the power station and other wastes discharged in the vicinity; and
- effects of the ocean outfall on the substrate and biota.

The CER should include sufficient information to enable the EPA to assess the proposed option for disposing of waste water from the station, and any likely environmental impacts. In particular the EPA considers that the proponent should:

- provide details of waste water management (minimisation, reuse and treatment) strategies;

- provide concise flow diagrams of waste water streams, showing flow rates and mass balance information; and

- identify all known or potential issues that (from experience of the processes elsewhere or in trials) may result in environmental impacts.

The following issues should be addressed:

Land use issues:

- location of structures to be built on the Collie site;
- provision of services and drainage;
- cadastral information; and
- adjacent land uses.

Water management issues:

- potential and impacts of disposal options considered on ground water (eg. salinity or competing uses);
- ground or surface water processing requirements/impacts; and
- constituents of waste water.

Operational management issues:

- pollution controls (dust, noise and waste controls);
- impact of project workforce during construction and operations; and
- preventing spread of dieback during pipeline construction.

Issues associated with piping waste water to the ocean outfall:

- pipeline route selection ;
- potential social and environmental impacts, and their management;
- safety features built into the pipeline, including procedures for shutting down the system in the event of a break in the line and methods to reduce water loss in the event of a pipeline rupture;
- details of provisions for diffusing effluent at the ocean outfall; and
- details of the receiving environment, and likely impacts of this manner of effluent disposal.

Any other relevant issues should also be included.

Public participation and consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent and the objectives of those activities. It should be cross referenced with the "environmental issues" section and should clearly indicate how community concerns have been addressed. Where these concerns are dealt with by government agencies or procedures outside the EPA process, these should be noted and referenced.

Monitoring programmes

The proponent should recognise that periodic and long-term monitoring is likely to be required for certain aspects of this proposal (eg. pipeline integrety and effects of discharges on the receiving environment) and commit to putting a programme in place to address such issues.

Environmental management commitments

The commitments being made by the proponent to protect the environment should be clearly stated and separately listed. The list will then be included as an attachment to the Minister for the Environment's conditions of approval if the proposal is found to be acceptable.

Where an environmental problem has the potential to occur, there should be a commitment to rectify it. They should be numbered and take the form:

- who will do the work;
- what will be done;
- when will it be carried out; and
- to whose satisfaction will it be carried out.

All actionable and auditable commitments made in the body of the CER should be numbered and summarised in this list. Where the EPA considers that the issues covered by commitments can be managed under the Works Approval and Licence conditions of the Environmental Protection Act (eg. noise and dust) these commitments will be identified by the EPA in order to prevent unnecessary duplication of the commitment in the environmental conditions issued by the Minister for the Environment.

Appendix B

GLOSSARY

Appendix B
GLOSSARY

Abstraction	The process of obtaining groundwater and drawing it to the surface for use.
Aeration	The process of introducing air into a liquid by, for example, forcing air through water or agitating water to promote surface absorption of air.
Ambient temperature	The temperature of air or soil surrounding the activity of interest.
Aquifer	A permeable soil or rock formation which stores and transmits groundwater.
Avifauna	The birds of an area.
Biofouling	The fouling or clogging of structures by organisms in water.
Biota	The animal and plant life of an area.
Blowdown	Water discharged to prevent the build-up of scaling and other constituents, normally from the cooling tower.
Brine concentrator	Equipment that produces pure water and a concentrated salt sludge from wastewater by boiling or evaporation.
Brine	Very salty water.
Clarifier/softener	Equipment used to soften water (i.e. remove calcium and magnesium) and allow suspended material to settle out.
Coffee rock	A type of consolidated rock material which appears like gravel conglomerate.
Confined aquifer	An aquifer which has impermeable layers as its upper and lower boundaries.

Cooling tower sidestream filter backwash	Waste arising from cleaning of filters designed to remove suspended solids from cooling tower recirculating flow.
Damplands	Wetlands that are only seasonally waterlogged.
Dedicated borefield	A set of groundwater bores established for the purpose of providing groundwater to a single operation or facility.
Desalination	The process of removing salts from salty water to produce fresh water.
Dieback	A plant root disease caused by fungi which affects species such as jarrah and eventually results in their death.
Diffuser	A structure which allows fluid to be discharged and maximizes dilution in the receiving environment.
Dispersion modelling	Calculation of the dilution and mixing of a pipe or stack discharge into the air or water environment using a computer model.
Dissolved air flotation	A process to remove suspended matter from water by floating it to the surface attached to air bubbles forced into the liquid under pressure.
Ductile iron	Cast iron which has a high ability to retain strength and integrity when its shape is altered.
Easement	A legal right of way over land owned by another person for a public purpose.
Electrodialysis	Removal of salts from a solution by an electric field.
Flowmeter	A meter used to measure the rate of flow of material, normally a fluid.
Gill-netting	A method of fishing that employs a mesh net hung between floats and weights and captures fish by entanglement.
Hardstand areas	Areas of artificial and normally impervious material at ground level, such as bituminized car parks.

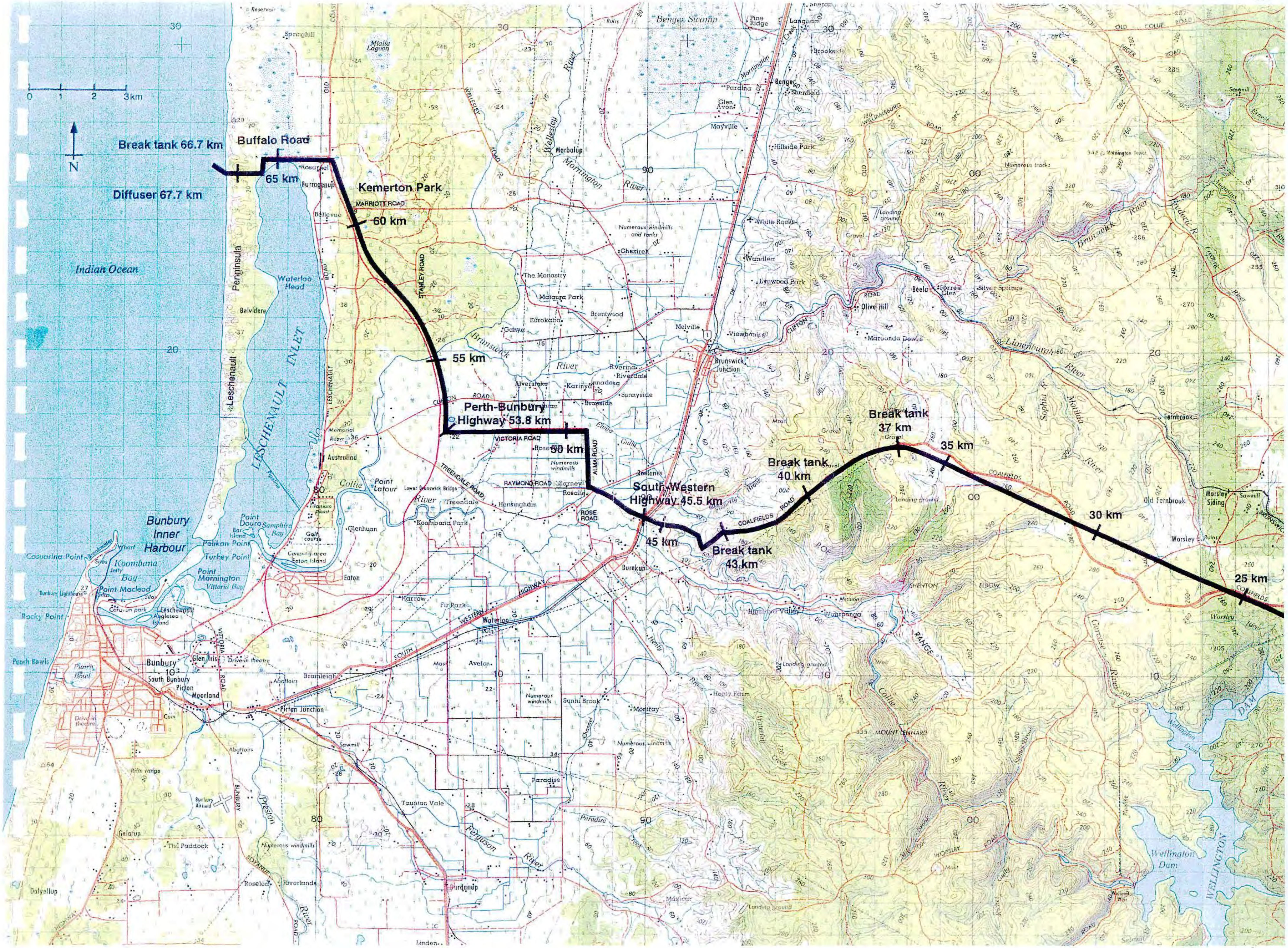
Ion exchange units	Units that remove salt from solution by passing it through resins to which the salt adheres. Used in water softening, desalination and a wide range of industrial processes.
Landfill	An area for disposal of wastes by burial.
Laterite/lateritic soils	Residual soil formed under certain conditions by the weathering of igneous rocks.
Leachate	Liquid that has percolated through the soil or other medium, usually from a landfill.
Lime dosing	A means of precipitating heavy metals (as insoluble salts) from water through the addition of lime.
Macroalgae	Seaweeds large enough to be seen easily with the naked eye, e.g. kelp or sea-lettuce.
Macro-invertebrates	Animals without backbones large enough to be seen easily with the naked eye e.g. mussels or prawns.
Make-up water	Water added to replace that lost by evaporation, blowdown or other processes.
Mechanical draft cooling tower	A type of cooling tower that incorporates a fan to generate air movement to assist cooling processes.
Microfiltration	The process of separating very small particles from a suspension or solution by passing it through a sheet of material with fine pores.
Mine dewatering water	The groundwater abstracted in advance of and during mining near or below the water table.
Package sewage treatment plant	A self-contained system which treats sewage on site.
Palusplain	Areas of the Swan Coastal Plain that are marshy or seasonally waterlogged and are characterized by the presence of paperbarks.
pH	Relative acidity or basicity of water on a scale from 0 (very acid) to 14 (very alkaline).
Pore water	The water in the soil around soil particles.
Potable water	Water that is of sufficient quality to make it suitable for human consumption.

Precipitate	The result of a process of forming an insoluble solid by a reaction which occurs in solution.
Pressure break tank	A tank with an open top, into which water flows to relieve pressure before exiting from the bottom.
Pressure relief valve	An automatic device that will open to relieve excessive pressure.
Reverse osmosis	Removal of salts from water, by forcing the water under pressure, through a membrane which does not allow the impurities to pass.
Road reserve	The area set aside for roadways and associated requirements.
Samphire	A salt-tolerant succulent plant which grows along the edges of estuaries and other saline waterbodies.
Seagrass	Marine flowering plants that often form large meadows on the sea bed in shallow water.
Sedentary invertebrates	Animals without backbones that permanently attach themselves to surfaces, e.g. barnacles on pylons.
Sedgelands	A wetland habitat primarily composed of coarse grass-like plants.
Service corridors	Land set aside for infrastructure services such as transmission lines, water pipelines and underground telecommunications.
Silt traps	Structures that capture and settle suspended sediments contained in runoff.
Slurry	A thin paste (produced by mixing some material, such as ash, with water) which is sufficiently fluid to flow by gravity.
Streamflow	The down-gradient flow of water in a stream.
Sumplands	Wetlands which are only seasonally inundated with water.
Supernatant	The surface liquid that results from the settling out of solids.
System 6 areas	Areas of the south-west of Western Australia that have been identified as having some conservation

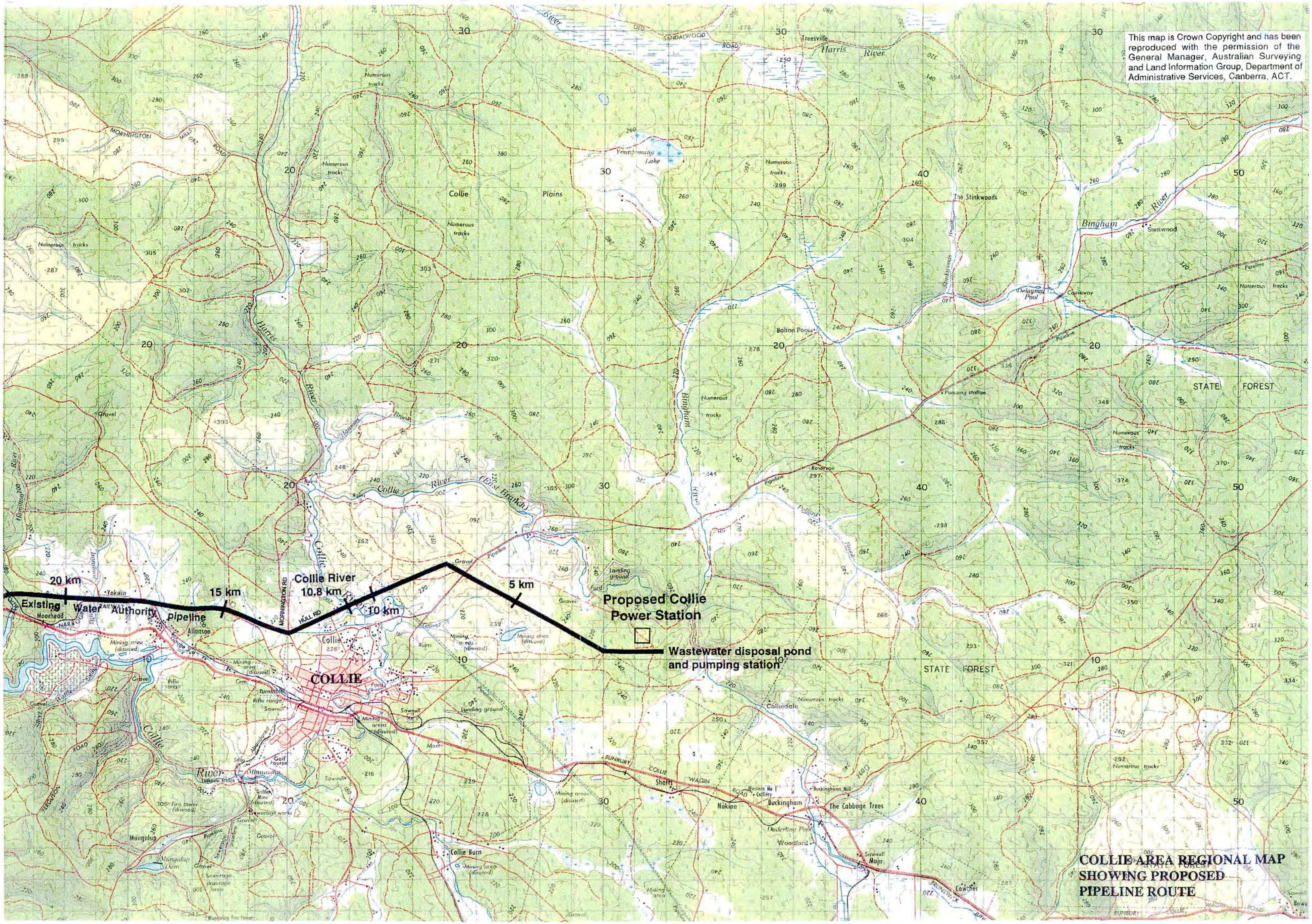
	value and have been recommended for reservation in the conservation estate in Western Australia.
Telemetry system	Means of transmission over a distance using a suitably coded modulation, e.g. amplitude, frequency, pulse, used in telecommunications.
Total Dissolved Solids (TDS)	The concentration of salt and other dissolved matter in water.
Turbidity	Measure of the clarity of a liquid, normally water, which is used in assessing water quality.
Unplasticized polyvinyl chloride (UPVC)	A rigid form of vinyl plastic, used in pipework and ducts.
Wetlands	An area of permanent, seasonal or intermittent inundation, whether natural or otherwise, fresh, brackish, or saline, static or flowing.

Appendix C

PROPOSED PIPELINE ROUTE



0 1 2 3km
N
Break tank 66.7 km
Buffalo Road
65 km
Diffuser 67.7 km
Kemerton Park
60 km
55 km
Perth-Bunbury Highway 53.8 km
50 km
South-Western Highway 45.5 km
45 km
Break tank 43 km
Break tank 40 km
Break tank 37 km
35 km
30 km
25 km
Indian Ocean
Leschenault Inlet
Bunbury Inner Harbour
Koombana Bay
Bunbury
Wellington Dam



COLLIE AREA REGIONAL MAP SHOWING PROPOSED PIPELINE ROUTE

Appendix D

DISPOSAL OF SALINE WATER INTO THE COLLIE RIVER

Appendix D
DISPOSAL OF SALINE WATER INTO THE COLLIE RIVER

BACKGROUND

Discharge to the Collie River was one of a number of options explored for disposal of moderately saline water from the Collie Power Station. Possible discharge sites identified were along Treendale Road downstream of Burekup and near the Australind Bypass bridge.

Preliminary investigations were undertaken to determine the viability and environmental impacts of saline water discharge at these locations. This investigation included assessment of available streamflow and water quality data for the Collie River and a limited water quality survey of sections of the Collie River near the Australind Bypass bridge. The following sections summarize the findings of these investigations and identify issues which would require further investigation should this disposal option be considered further.

STREAMFLOW

The Collie River is described as a salt wedge estuary. Studies indicate the presence of a strong tidal influence which, along with seasonal changes, affects river flow and consequently temperature and salinity stratification (SCM Chemicals 1986 and Kinhill 1994). At least as far as 500 m upstream of the Australind Bypass bridge, the Collie River has a saline wedge and is tidal (SCM Chemicals 1986).

Historical river flow data for the Collie–Brunswick system indicate that periods of lowest river flow occur occur during January to March, and periods of highest flow during July to September. Streamflow data at Shenton's Elbow approximately 8 km upstream of Burekup, the Water Authority gauging station on the Collie River nearest to the proposed discharge points, between 1969 and 1976 (the only data available), indicate that minimum streamflows during the summer months are of the order of 1,000–5,000 m^3/d. Discharge of saline water from the power station into the Collie River, particularly during late summer when natural streamflows are low, could therefore substantially increase the present flow of the river.

The Water Authority proposes to supply water to the Kemerton Industrial Park from a proposed weir at Rose Road, 700 m downstream of the South Western Highway at Burekup. This proposal involves the release of water from Wellington Dam which would result in a slight rise in water level and an increase in streamflow upstream of Burekup (Water Authority 1993b). Damming of the Collie River at Wellington Dam has resulted in a reduction in streamflow downstream of the dam compared with that prior to its construction. Combined with the Water Authority's water supply proposal, discharge of saline water from the power station downstream of Burekup could thus be potentially beneficial if original flow conditions were restored.

WATER QUALITY

The results of preliminary salinity profile measurements undertaken at eight sites in the Collie River in October 1994 are shown in Table D1.

Table D1 **Temperature and salinity data for eight sites along the Collie River**

Site	Depth (m)	Surface Salinity (g/m^3)	Surface Temp (°C)	Bottom Salinity (g/m^3)	Bottom Temp (°C)
Confluence with Brunswick River	1	1,000	21.0	20,000	21.5
1400 m downstream of Australind Bypass bridge	3	2,000	21.5	25,000	21.0
1050 m downstream of Australind Bypass bridge	3	2,000	21.5	25,000	21.0
700 m downstream of Australind Bypass bridge	4	1,500	21.5	25,300	21.0
350 m downstream of Australind Bypass bridge	3	1,500	21.5	24,800	21.0
Australind Bypass bridge	4	1,750	21.5	24,500	21.0
250 m upstream of Australind Bypass bridge	3	1,750	21.0	22,900	22.0
500 m upstream of Australind Bypass bridge	3.5	1,500	21.0	23,500	21.5

These data indicate that the bottom layer of water in the Collie River from the Brunswick River to 500 m upstream of the Australind Bypass bridge is highly saline with salinities in the order of 23,000–25,000 g/m^3 TDS. Surface waters were brackish with salinities in the order of 1,000 to 2,000 g/m^3 TDS. Little difference in salinity occurred between the sites except for minor variations in bottom salinities which is probably a reflection of differences in depth—this reach of the river is between 3 m and 4 m. The lower salinities at the confluence of the Brunswick and Collie Rivers are probably a result of shallow water and the input of fresher water from the Brunswick River. Little difference occurred between surface and bottom water temperatures between the eight sites, which were relatively constant at 21–22°C.

These results are generally in agreement with salinity data obtained in periods of low flow in the vicinity of the existing SCM Chemicals discharge outfall in the Collie River approximately 1 km downstream of the Brunswick River. This indicates that the estuarine region of the Collie River is characterized by a high degree of vertical density stratification, with a sharp halocline separating the upper (fresher) and lower (salty) layers (SCM Chemicals 1986).

CONSERVATION VALUES

The Collie River from its mouth at the Leschenault Inlet to approximately 4 km upstream is classified as part of the C67 conservation area and is currently recommended for regional park status in the System Six Red Book (DCE 1983). The locations of the potential saline water discharges at the Australind Bypass bridge and Treendale Road are located upstream of the western edge of the C67 boundary. However, numerous sites further upstream of this boundary have a significant recreational value and may also contain indigenous flora, fauna and other natural features of conservation significance.

The Collie River between Rose Road and the Australind Bypass bridge varies in width from approximately 10–20 m, and is lined with a mixture of paperbarks (*Melaleuca raphiophylla*), flooded gums (*Eucalyptus rudis*) and other fringing vegetation typical of riverbanks. Benthic invertebrate prey species are in relatively low abundance. Despite this and the fluctuating salinities in the river, the Collie River has considerable ecological significance as a fish habitat, including several species of major commercial and/or recreational importance (SCM Chemicals 1986).

CONCLUSIONS

SCM Chemicals has been discharging water with a much higher salinity than the saline water from the proposed power station into the Collie River for some years without any noticeable environmental impact on invertebrate fauna or fish (Kinhill 1989b, 1990b, 1994). Indeed, ongoing studies of the impact of the SCM Chemicals discharge indicate that seasonal changes in river flow (and consequently temperature and salinity stratification) provide the major effect on water quality in the river adjacent to the outfall. Seasonal differences have been shown to be far greater than any small, localized fluctuations in temperature and salinity caused by the discharge of SCM Chemicals' saline water.

Although the Collie River is wider and shallower near the existing SCM Chemicals outfall than near Treendale Road or the Australind Bypass bridge, the benthic flora and fauna in both locations would be essentially the same. Thus, it seems unlikely that discharge of saline water from the power station into the Collie River upstream of the Australind Bypass bridge would have a significant environmental impact.

Discharge of the saline water from the power station into the Collie River upstream of the Australind Bypass bridge could thus be not only environmentally acceptable, but also beneficial if river flow is returned to a more natural regime. However, more detailed studies of the ecology of the receiving waters and flow characteristics in the immediate vicinity of the proposed discharge points would be required to enable the potential benefits and impacts to be quantified.

Appendix E

ORGANIZATIONS INVITED TO SECWA PRESENTATIONS

Appendix E

ORGANIZATIONS INVITED TO SECWA PRESENTATIONS

Representatives of organizations invited to the SECWA presentation in Collie and in Bunbury are listed separately below.

Collie

- Shire of Collie
- Griffin Coal Mining Co. Pty Ltd
- Water Authority of Western Australia
- Worsley Alumina Pty Ltd
- *Collie Mail* newspaper
- Collie Business Centre
- Western Collieries Ltd
- Department of Conservation and Land Management
- State Energy Commission of Western Australia (Muja Power Station, Collie Depot)
- Collie Chamber of Commerce and Industry Inc.
- MLC—Southwest.

Bunbury

- Bunbury Port Authority
- City of Bunbury
- Shire of Harvey
- *Bunbury Mail* newspaper
- Golden West Network
- *South Western Times* newspaper
- MLA's—Bunbury and Mitchell
- South West Development Commission
- Department of Land Administration.
- State Energy Commission of Western Australia (Bunbury Power Station, Picton Depot)
- Waterways Commission
- Department of Environmental Protection
- Water Authority of Western Australia
- SCM Chemicals Ltd
- Western Australian Farmers Federation.

Appendix F

ORGANIZATIONS AND INTEREST GROUPS CONTACTED BY SECWA

Appendix F

ORGANIZATIONS AND INTEREST GROUPS CONTACTED BY SECWA

The organizations and interest groups contacted by SECWA included the following:

- All land owners
- MLA's—Harvey, Collie
- Shire of Harvey
- Shire of Collie
- City of Bunbury
- Collie Basin Management Committee
- South West Development Commission
- Leschenault Inlet Management Committee
- Leschenault Catchment Co-ordinating Group
- Kemerton Advisory Group
- Conservation Council of Western Australia
- Department of Conservation and Land Management
- Water Authority of Western Australia
- Main Roads Western Australia
- LandCorp
- Department of Minerals and Energy
- Department of Land Administration
- Westrail
- Department of Resources Development
- Department of Agriculture
- Department of Planning and Urban Development
- Valuer General's Department—Bunbury
- Department of Environmental Protection—Bunbury
- Collie Power Station Task Force.

Appendix G
ABBREVIATIONS

Appendix G
ABBREVIATIONS

General

CALM	Department of Conservation and Land Management
CER	Consultative Environmental Review
DCE	Department of Conservation and Environment
DOLA	Department of Land Administration
EPA	Environmental Protection Authority
ERMP	Environmental Review and Management Programme
HDPE	High density polyethylene
SECWA	State Energy Commission of Western Australia
TDS	Total Dissolved Solids
UPVC	Unplasticized polyvinyl chloride

Measurements

g/m^3	gram(s) per cubic metre
gN/m^3	gram(s) of nitrogen per cubic metre
ha	hectare(s)
kg/d	kilogram(s) per day
km	kilometre(s)
kV	kilovolt
m	metre(s)
m/d	metre(s) per day
m^3/d	cubic metre(s) per day
mm	millimetre(s)
MW	megawatt(s)
°C	degree(s) Celsius

Appendix H
REFERENCES

Appendix H
REFERENCES

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