Proposed Collie Power Station

State Energy Commission of Western Australia

and
Comment on Energy Issues for WA

Report and Recommendations of the Environmental Protection Authority

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Preface

In recent years, the State Energy Commission of Western Australia (SECWA) has been reviewing power supply options for the State to determine what technology is currently available and which option(s) would best suit the State's needs. Consequently a great deal of public debate has occurred on the energy demand and supply issue. Much of this debate has focussed on whether a coal-fired or gas-fired base load power station should be built. This focus has, in part, been caused by the referral to the Environmental Protection Authority of two coal-fired base load power stations for environmental impact assessment

One proposal involved a private coal-fired power station (The Hill River Project), 28km north-east of Jurien. The other proposal came from the State Energy Commission of WA which proposes to develop a coal-fired power station in the State's south-west, 8km east-north-east of Collie.

Both power stations could provide SECWA's forecast energy requirements beyond 1995. However, SECWA has decided that the Hill River Project option could not provide an economically competitive supply of power when compared with other alternatives at this time. Nonetheless, both proposals are being assessed by the Environmental Protection Authority under the provisions of the Environmental Protection Act, 1986.

These proposals have raised a number of environmental issues related to the State's energy supply and demand policies. These issues have been addressed in Part A of this Report. The Authority considers these issues to be of fundamental importance to the State's future energy planning policy.

The Authority has provided its advice on these issues prior to a Government decision on the form the State's next base load power station will take so that it is available for the Government's consideration when making its decision.

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Summary and recommendations

The State Energy Commission of WA (SECWA) has proposed to establish a second coal-fired base load power station 8km east north east of Collie (Figure 1). The proposal includes the construction of two 300 megawatt power generating units and associated infrastructure that will occupy 388 hectares of land. The proposed site is located on the edge of the Collie Coal Basin (Figure 2) which is an area that contains the mineable coal reserves in the Collie region.

The Environmental Protection Authority determined that this proposal would have significant environmental implications and that an Environmental Review and Management Programme would be required. As part of the Authority's environmental assessment process the ERMP was made available for a 10 week public comment and review period during April and May 1990 .

An integral part of the environmental impact assessment process includes the need to consider all facets of the proposal that may have, cause or lead to a significant environmental impact. These proposals have raised a number of environmental issues related to the State's energy supply and demand policies which have been addressed in Part A of this Report.

The Authority has provided its advice on these issues prior to a Government decision on the form the State's next base load power station will take so that it is available for the Government's consideration before making its decision.

Part A Energy issues for Western Australia

The Environmental Protection Authority considers it essential that the Government should be guided in its choice of options for meeting the State's demand for power by the relative environmental acceptability of those options.

General Recommendation 1

The Environmental Protection Authority recommends that in making decisions about how to meet the State's demand for power the Government should give the greater weight to the options which are environmentally preferable. In declining order of environmental preference the Authority ranks the major options as follows:

- **conservation and efficiency improvements;**
- **renewable energy sources such as wind and solar energy;**
- **gas, including combined cycle, turbines;**
- **new technology coal plants;**
- **old technology coal plants; and**
- **petroleum fuel plants.**

The Authority considers that conservation and efficiency improvements with regard to demand management strategies have the potential to significantly retard the growth in demand for energy if given sufficient priority. The Authority endorses and supports SECWA's initiative in establishing a Demand Management Committee.

General Recommendation 2

The Environmental Protection Authority recommends that the Demand Management Committee established by SECWA should be given sufficient resources and independence to accomplish its objectives and that it should report its progress and findings directly to the Government, and the reports made public.

Furthermore, the Authority makes specific recommendations on the two high priority alternatives from general recommendation 1 to ensure that they are kept at the forefront of public and Government agency decision making processes.

General Recommendation 3

The Environmental Protection Authority recommends that SECWA prepares, with public review, and subsequently implements a Demand Management Programme. The Programme should include targets and timetables, for power conservation and efficiency options within Western Australia and be provided to Government by the end of 1991.

General Recommendation 4

The Environmental Protection Authority recommends that SECWA prepares, with public review, and subsequently implements a Renewable Energy Development Programme within Western Australia. The programme should include specific targets and timetables and be provided to Government by the end of 1991.

The next environmentally preferable option considered in general recommendation 1 is gas. The Authority has made two Recommendations. The first identifies a clear strategy for the use of gas within the State and the second is an endorsement of the Harman Committee's findings.

General Recommendation 5

The Environmental Protection Authority recommends that, subject to availability, gas should be used in order of preference, first for direct delivery to users, second for power generation in more densely populated areas, and third for power generation in other parts of the State.

General Recommendation 6

The Environmental Protection Authority recommends that if the State Government decides that a new base load power station is needed then a combined cycle gas turbine power station is preferable on environmental grounds.

Finally, the Authority recommends that if the Government should approve a new base load power station, then it should only approve a 300MW plant.

The Authority considers that the implementation of demand management strategies should provide significant reductions in energy demand, below current estimates, and secondly that newer, more environmentally friendly power generating options could more realistically be considered if the State does not commit to develop a short to medium term excess of generating capacity.

General Recommendation 7

The Environmental Protection Authority recommends that if a decision is taken to proceed with a new base load power station then its capacity should not be more than 300 megawatts.

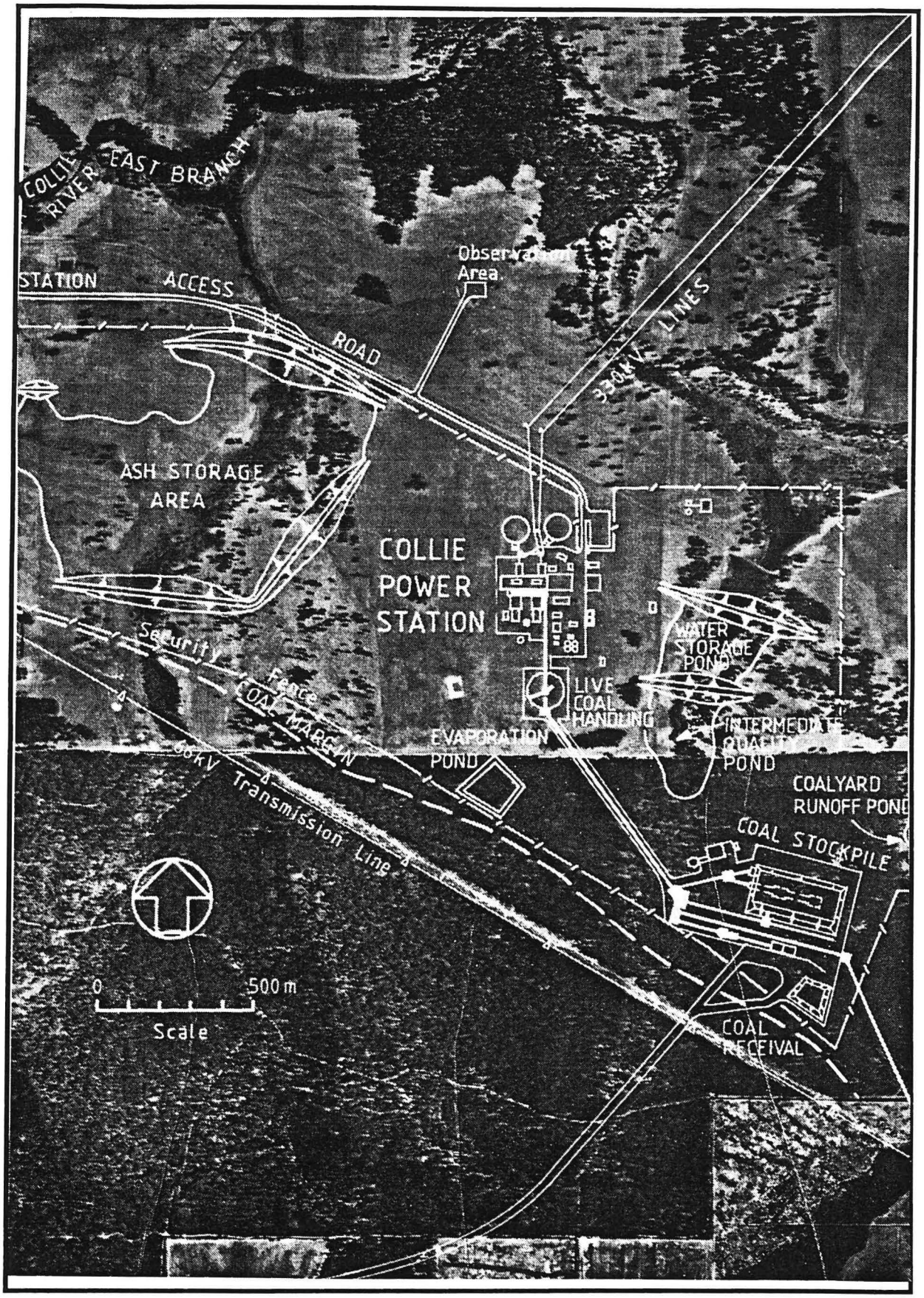

Figure 1: Regional map identifying the preferred site (Courtesy of SECWA's ERMP).

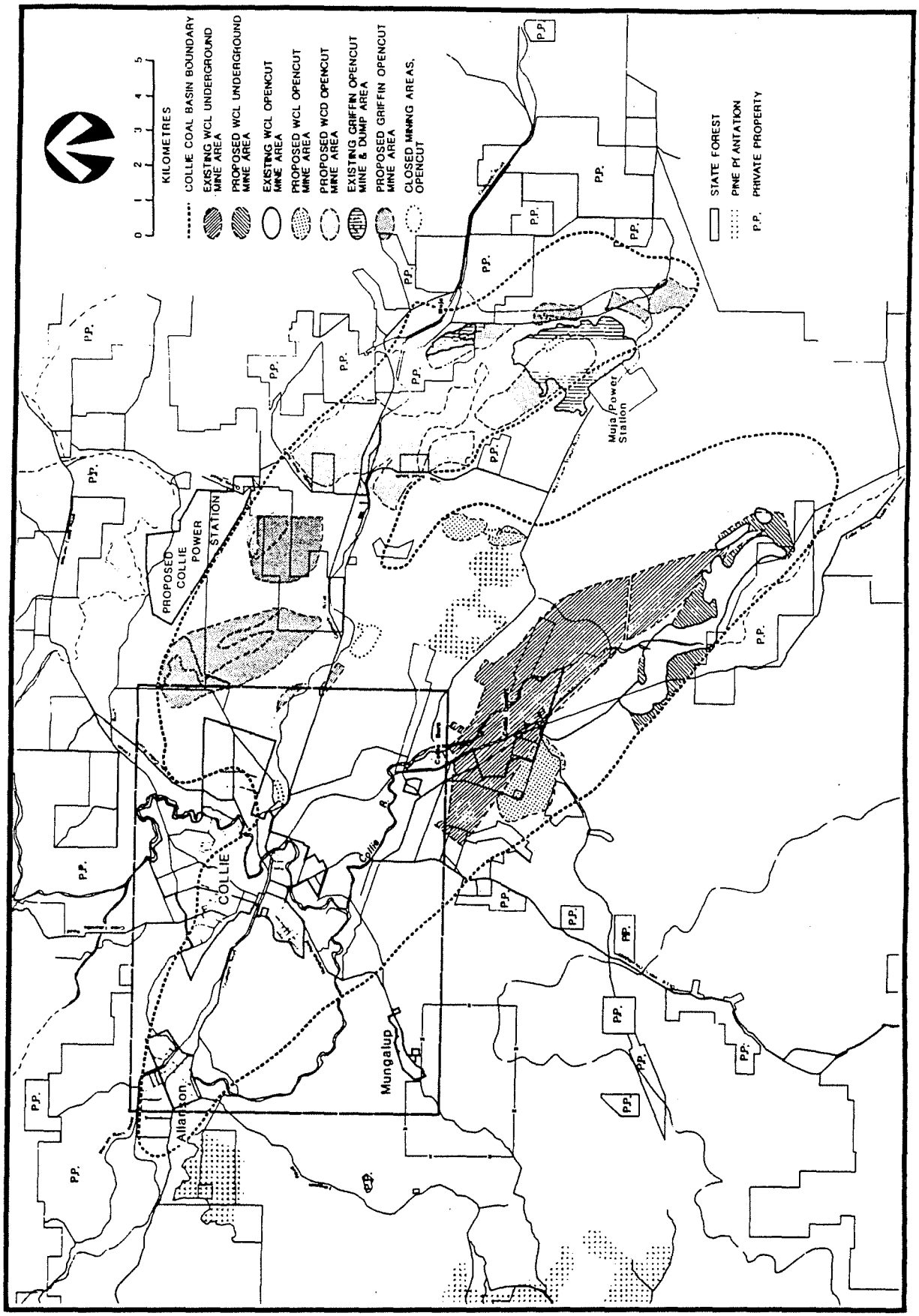

Figure 2: The Collie coal basin (Courtesy of SECWA's ERMP).

Part B The proposed Collie power station

In Part A of this Report the Authority concludes that a coal-fired power station is one of the least preferable options from an environmental viewpoint. The Authority also notes that if a base load power station were required then a combined cycle gas turbine power station with a maximum 300MW capacity would be the appropriate choice from an environmental viewpoint.

However, the Authority still has an obligation to assess SECWA's proposal for a 600MW coal-fired power station and has provided that assessment as Part B of this Report.

The Authority considers that it is important to note that the conclusions and recommendations in Part B, which would be equally relevant to a 300MW coal-fired plant, should not be read so as to detract from the general recommendations in Part A.

Part B of the Authority's Report presents the Authority's assessment of the Collie power station proposal. Nine recommendations are included in the Authority's assessment of local and regional potential environmental impacts of the power station proposal (Section 5).

The Authority concludes that if the Government were to approve a coal-fired base load power station at Collie, the proposal would need to include a number of stringent environmental conditions in order to minimise local and regional environmental impacts.

Recommendation 1

The Environmental Protection Authority has concluded in Part A of this Report that a coal-fired power station is one of the least environmentally acceptable options for meeting the State's future energy needs. However, the Authority has an obligation to assess the proposal as referred by the State Energy Commission of WA which is for a 600MW coal-fired power station at Collie. Accordingly, should the Government approve a coal-fired power station at Collie up to a maximum capacity of 600MW, then the Authority recommends that in order to minimise local and regional potential environmental impacts, the proposal should only proceed in a manner consistent with the ERMP and subject to the proponent's consolidated list of commitments, responses to issues raised during the public review period and the Authority's Recommendations in Part B of this Report.

SECWA has covered most of the potential air emission issues with management commitments which the Authority considers, if implemented, should ensure no significant local or regional environmental impacts occur. However, in relation to sulphur dioxide emissions the Authority has recommended that SECWA determine an appropriate buffer zone to guard against inappropriate developments within areas near the power station that are subject to sulphur dioxide emission levels unacceptable for residential purposes. SECWA has purchased land for this purpose. The Authority recommends that appropriate planning mechanisms should be put in place to control development on that land to ensure its effectiveness as a buffer.

Recommendation 2

The Environmental Protection Authority recommends that prior to any residential, commercial or industrial developments progressing on the 1500ha of land owned by the State Energy Commission of Western Australia adjacent to the proposed power station, the proponent should liaise with relevant planning authorities to establish a buffer zone adequate to maintain appropriate air quality objectives to the satisfaction of the Environmental Protection Authority.

The Authority's third recommendation relates to potential noise impacts. The recommendation identifies noise emission levels below which no unacceptable environmental impacts are expected to occur, and recommends that a noise monitoring programme be set up to ensure on-going compliance with the specified levels.

Recommendation 3

The Environmental Protection Authority recommends that the maximum noise levels at residential premises surrounding the proposed power station should not exceed:

50dB(A) from 7am-7pm, Monday to Saturday
45dB(A) from 7am-7pm, Sunday
45dB(A) from 7pm-10pm, every day; and
40dB(A) from 10pm-7am, every day.

Recommendation 4

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia prepare, submit and subsequently implement proposals for monitoring and managing noise impacts as part of the Environmental Management Programme (Recommendation 9), to the satisfaction of the Minister for the Environment on advice from the EPA.

In order to ensure that any unacceptable environmental impacts on the local vegetation are identified and mitigated, SECWA has committed to develop a vegetation monitoring programme to monitor the effects of air emissions on the local vegetation. The Authority supports this commitment, but in view of the cumulative environmental impacts that may eventuate from the close proximity of two operational base load power stations and a need to ensure corrective actions are taken if unacceptable impacts are detected, recommends that the programme should be prepared to the satisfaction of the Minister for the Environment on advice from the EPA.

Recommendation 5

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia prepare, submit and subsequently implement a vegetation monitoring and management proposal as part of the Environmental Management Programme (Recommendation 9), to monitor the effects of air emissions and ensure appropriate management responses, to the satisfaction of the Minister for the Environment on advice from the EPA.

SECWA has identified two water supply sources that have already proved acceptable for the Muja power station. These sources are associated with mine dewatering and groundwater abstraction activities. The Authority recommends that SECWA should prepare a power station water resource(s) management proposal, as part of its Environmental Management Programme, to ensure that any environmental consequence of extracting large volumes of groundwater is readily detected and to ensure that appropriate management plans are developed and implemented as required.

Recommendation 6

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment, permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia should prepare, submit and subsequently implement a power station water resource(s) management proposal as part its Environmental Management Programme (Recommendation 9), to the satisfaction of the Minister for the Environment on advice from the EPA and the Water Authority of WA.

The major solid and liquid waste discharges associated with the power station are from its flyash and wastewater treatment and disposal activities. However, the Authority has been prevented from assessing the potential environmental impacts associated with these activities because SECWA is still deciding which waste treatment options to employ. Nevertheless, SECWA has provided sufficient information for the Authority to be assured that an environmentally acceptable alternative is achieveable

Accordingly the Authority has included the following recommendation in order to complete its assessment of this proposal.

Recommendation 7

The Environmental Protection Authority recommends that prior to the clearing of land and any siteworks directly associated with flyash and wastewater treatment and disposal activities, the State Energy Commission of Western Australia refers its final flyash and wastewater treatment and disposal proposals to the Environmental Protection Authority for separate and additional environmental impact assessment.

Another outstanding issue in the ERMP relates to SECWA's proposal to clear a large tract of jarrah/marri forest and seasonally inundated wetlands. The Authority is not convinced that SECWA has fully established the environmental value of these areas and recommends the following.

Recommendation 8

The Environmental Protection Authority recommends that prior to the commencement of siteworks associated with the site layout plans, the State Energy Commission of Western Australia should:

(a) undertake a wetland survey to identify the environmental significance of the 13ha of seasonal wetlands and to develop alternative wetland habitats to replace their lost values;

(b) consult with the Department of Conservation and Land Management to minimise both the area and potential impacts associated with clearing the proposed 60ha of forest: and

then re-assess the site layout plans to reflect the information provided by (a) and (b) above to the satisfaction of the Minister for the Environment on advice from the EPA.

The Authority has concluded its assessment of SECWA's proposal by recommending that an Environmental Management Programme is prepared by SECWA to ensure the co-ordination of environmental monitoring, management and auditing activities.

Recommendation 9

The Environmental Protection Authority recommends that prior to commissioning of the power station the SECWA prepares, submits and subsequently implements an Environmental Management Programme (EMP) that addresses, where appropriate, the monitoring, management and auditing requirements of the following issues:

- **Atmospheric emissions;**
- **Noise emissions;**
- **Vegetation protection;**
- **Water supply;**
- **Social amenity;**
- **Greenhouse gases; and**
- **Solid and liquid waste discharges,**

to the satisfaction of the Minister for the Environment on advice from the EPA.

Furthermore, upon commissioning of the power station, this EMP should be revised and updated on a yearly basis to the satisfaction of the Environmental Protection Authority.

The Authority has concluded that a conventional coal-fired power station is one of the least acceptable options from the environmental viewpoint. It has also identified its support for the Harman Committee's recommendation that a combined cycle gas turbine power station should be developed as the State's next base load power plant. Furthermore, irrespective of which fuel is employed, the Authority has recommended that the State's next base load power station, to meet its short to medium term energy demand requirements, should not exceed 300MW capacity thus allowing greater flexibility in energy planning.

However, if for reasons other than environmental the Government approves a coal-fired power station then the Authority considers Collie to be an appropriate location and has assessed SECWA's proposal for a 600MW plant in Part B of this Report and made recommendations to minimise local and regional environmental impacts. These recommendations would be equally applicable if only one of the two 300MW units were installed.

Part A

Energy issues for WA

Energy issues

The Government of Western Australia (SECWA) is currently considering what form the next base load power station should take to supply the State's power requirements into the 1990s. A number of alternatives have been proposed. However, only coal fuelled options have so far been referred to the Environmental Protection Authority.

In parallel with its assessment of individual proposals, the Authority identified several matters of broad principle requiring consideration because of their environmental significance. These matters relate to the Greenhouse Effect, the place of demand management and the alternative strategies available for meeting the State's need for electricity.

The Greenhouse Effect

The Greenhouse Effect is caused by the selective retention of heat by gases in the earth's atmosphere. While the Greenhouse Effect is a natural phenomenon, which allows life to flourish on earth, it has been enhanced since the Industrial Revolution by the increasing release of Greenhouse gases as a consequence of human activity. Greenhouse gases include carbon dioxide, methane, oxides of nitrogen and chlorofluorocarbons. Power generation by fossil fuel burning adds to the Greenhouse Effect by releasing some of these gases, principally carbon dioxide (SECWA's activities currently contribute some 20% of the State's total carbon dioxide emission levels, SECWA Report, BD 90/12 Table 4.5).

The United Nations Organisation established an Intergovernmental Panel on Climate Change (IPCC) in 1988 to review the "enhanced", or human-induced, Greenhouse Effect and to report on the level of scientific understanding of it, its likely impacts and the action nations should take to manage it. The issue was further considered at the Second World Climate Conference in Geneva in November 1990.

The IPCC predicted that the global mean surface temperature could rise during the next century by about 0.3°C per decade (IPCC, Sundsvall, Sweden,1990). The panel said this warming would cause changes to the global climate, but was uncertain as to how significantly local regions would be affected. The IPCC then commented that "human-induced climate change due to continued uncontrolled emissions will accentuate (damaging) impacts".

The Panel went on to say that climate change would not be steady and surprises could not be ruled out. These changes could include an alteration in the frequency and intensity of floods, drought, cyclones, storms and heatwaves. Clearly such outcomes would impact on the environment, the economy and our lifestyles.

A representative of the Environmental Protection Authority chairs the State's Greenhouse Effects Committee which has the function of ensuring that Western Australian State and relevant Federal Government agencies represented in Western Australia coordinate their understanding and responses to the Greenhouse Effect. Through the Committee, the Environmental Protection Authority has contracted the CSIRO Division of Atmospheric Research to report upon the prospects of a changing climate in this State.

In 1988 a number of developed nations, including Australia, participated in establishing a notional target, known as the Toronto Goal, which called for a 20% reduction in national carbon dioxide emissions by the year 2005.

The Federal Government has recently adopted as an interim planning target the stabilization of the emission of Greenhouse gases (including carbon dioxide, methane and nitrous oxide, but not including chlorofluorocarbons) at 1988 levels by the year 2000. Additionally the Policy seeks to reduce these emissions by 20% on 1988 levels by the year 2005.

In light of this information the Environmental Protection Authority considers it would be complacent to plan for the future in the hope that the potential impacts of Greenhouse induced climate change will be insignificant. Accordingly, it is prudent to plan ways to reduce the build-up of Greenhouse gases in order to ameliorate any undesirable changes. This position is strengthened by the associated environmental benefits which would flow from reduced emissions, such as reduced output of other air pollutants, and the encouragement of renewable power generation options.

Greenhouse objectives for Western Australia

The Environmental Protection Authority has been instrumental in identifying the need to understand and respond to Greenhouse-induced climate change and its likely impacts upon Western Australia.

The Authority has done this in a number of ways, principally by co-hosting the 1988 Greenhouse Conference, and assisting in other information-generating seminars and meetings. In addition the Authority has set a policy requiring that all proposals for major developments which are likely to emit gases into the environment, should include a Greenhouse gas audit.

The role of a Greenhouse gas audit is to compare the emissions of today with those likely in the future and to identify ways in which gas emissions can be reduced. The audit identifies both the type and quantity of Greenhouse gas emissions by either direct measurement or calculation. In this context the Environmental Protection Authority has supported the establishment of the Greenhouse Coordination Council which has already published (November 1989) both a Discussion Paper on the Greenhouse Effect, and a Greenhouse Gas Audit for this State.

In December 1988, the Western Australian Government adopted a policy position on Greenhouse gas emissions targeting a 20% reduction in overall emissions by the year 2000. The Greenhouse Gas Audit indicates the ways that this can be achieved, particularly through the abandonment of chlorofluorocarbons and the tapping of methane from land fills. Methane recovery is already taking place at one industrial site and the State Energy Commission is exploring land fill methane as a primary gas source.

The Greenhouse Coordination Council is shortly to publish its Greenhouse Strategy for Western Australia, and this report is consistent with the thrust of the Strategy.

The Strategy will address the twin objectives of:

- reducing the State's contribution to the Greenhouse Effect by controlling our emissions of Greenhouse gases; and
- planning how to minimise the effects of climate change, and to change any problems into opportunities.

Choosing alternatives

Given the far reaching implications of Greenhouse policies, decisions about major proposals that have the potential to increase the Greenhouse Effect are properly made by the State Government. Since a new power station has significant Greenhouse implications, the Authority has provided this report to Government to enable it to give due consideration to the implications for human-induced climate change when decisions are made about future power supplies.

Historically the energy planning approach used to forecast the State's energy requirement has used supply-side management as its fundamental foundation. The forecasts have been based on econometric models that consider population growth, economic growth, the cost of fuel and the amount of energy traditionally consumed by various customer groups. This energy supply approach has resulted in a large capital investment in power generating plant. However, recent analysis of demand management strategies both overseas and by the Federal Government has demonstrated that energy conservation is the most cost effective form of supply (e.g. $5.00 invested in improving efficiency avoids the need for spending $15.00 on new supplies, Deni Greene Consulting Services, February 1990).

Coal-fired power stations represent one of a number of ways in which power needs can be met in the medium term. It is also one of the least acceptable options environmentally.

To assist the Government in its decision making process the Authority has ranked the major power alternatives in order of environmental preference, in General Recommendation 1 below. This ranking is based on a number of environmental criteria including the potential disturbance or destruction of valuable ecosystems associated with developing large fuel resources and the discharge of gaseous, liquid and solid wastes such as sulphur dioxide, oxides of nitrogen, Greenhouse gases, wastewater and flyash.

General Recommendation 1

The Environmental Protection Authority recommends that in making decisions about how to meet the State's demand for power the Government should give the greater weight to the options which are environmentally preferable. In declining order of environmental preference the Authority ranks the major options as follows:

- **conservation and efficiency improvements;**
- **renewable energy sources such as wind and solar energy;**
- **gas, including combined cycle, turbines;**
- **new technology coal plants;**
- **old technology coal plants; and**
- **petroleum fuel plants.**

Demand management

The State's current energy planning initiatives include demand management strategies (Energy Policy and Planning Bureau, 1990). Instead of always planning to meet demand with increases in supply, demand management implies that steps will be taken to actually reduce or at least slow the growth of demand. Such a strategy defers the need for capital investment in new plant, effectively "supplying" power availability for new consumers at the marginal cost of maintaining existing equipment. Indeed "one potential benefit of energy demand management is savings in interest if SECWA's capital program for a base load coal-fired power station could be postponed. These savings are potentially many millions of dollars"(Energy Policy and Planning Bureau, 1989). The Commission has recently stated that "SECWA recognises that demand management techniques offer a significant opportunity to defer new plant construction, improve overall efficiency and meet increasing environmental responsibilities" (SECWA, pers comm).

The Authority considers that active incorporation by SECWA of demand management in all of its policy and development decisions should be supported. In recognition of the importance of this issue, the Authority will ensure that when it assesses major proposals that have large power demands, the proponent will be required to demonstrate that demand management has been incorporated in the design and alternative power supply methods have been evaluated.

The Authority notes that SECWA has recently established a Committee to investigate and implement demand management strategies. The Authority fully supports this initiative.

General Recommendation 2

The Environmental Protection Authority recommends that the Demand Management Committee established by SECWA should be given sufficient resources and independence to accomplish its objectives and that it should report its progress and findings directly to the Government, and the reports made public.

To successfully promote demand management strategies SECWA must gain the understanding and support of the general public.

Part of the process of establishing public support includes the development of an on-going and credible demand management programme.

Part of this programme should address the historical energy planning approach employed by SECWA, any problems with it, proposed solutions and new initiatives.

The Environmental Protection Authority considers that SECWA should provide the opportunity for public input to the development of its demand management programme.Given the importance of this new initiative, the Authority considers that the proposed demand management strategies should be made available for public comment and review within the next 12 months.

General Recommendation 3

The Environmental Protection Authority recommends that SECWA prepares, with public review, and subsequently implements a Demand Management Programme. The Programme should include targets and timetables, for power conservation and efficiency options within Western Australia and be provided to Government by the end of 1991.

Renewable energy options

The Authority considers that the Government should also ensure strong support is provided to develop renewable energy technologies, through fiscal and economic incentives, since these technologies have the greatest potential to offer significant long term reductions in Greenhouse gas emissions.

International experience suggests that renewable energy technologies can provide considerable economic benefits through increased employment and revenue, with only small cost increases to consumers. The Authority therefore makes the following recommendation.

General Recommendation 4

The Environmental Protection Authority recommends that SECWA prepares, with public review, and subsequently implements a Renewable Energy Development Programme within Western Australia. The programme should include specific targets and timetables and be provided to Government by the end of 1991.

Alternative fuels

On the issue of the use of alternative fossil fuels for electricity generation, the following advice is offered.

As an integral part of SECWA's energy allocation strategies the Authority considers that the Commission should;

- favour the most efficient use of gas by direct supply to houses and industry;
- locate gas fired plant rather than coal fired plant in or near more densely populated regions to reduce the potential additive impacts on regional air quality; and
- subject to availability, use gas in preference to coal for power generation in other parts of the State to reduce Greenhouse gas emissions.

General Recommendation 5

The Environmental Protection Authority recommends that, subject to availability, gas should be used in order of preference, first for direct delivery to users, second for power generation in more densely populated areas, and third for power generation in other parts of the State.

The next power increment

The Environmental Protection Authority has considered the environmental impacts of the impending decision about the next increment of base load power generating capacity to be constructed in Western Australia and makes the recommendations below.

The Authority notes that the Harman Committee found that combined-cycle gas turbines have environmental advantages and improved efficiencies over coal-fired plant. Accordingly, the Authority believes that, if the State Government approves the development of a new base load power station now, combined cycle gas turbine technology would be preferable environmentally.

General Recommendation 6

The Environmental Protection Authority recommends that if the State Government decides that a new base load power station is needed then a combined cycle gas turbine power station is preferable on environmental grounds.

The Authority considers that demand management strategies could significantly reduce actual energy demand below present estimates. Consequently, the Authority considers that SECWA should receive support for a review of its energy demand forecasts, and should review the current proposals for the simultaneous installation of two 300 MW power generating units,taking into account any reduction in demand likely once demand management becomes effective.

The Authority considers that the installation of both 300 MW units may well work against the successful implementation of SECWA's demand management strategies and pre-empt other options, such as gas or developing new technologies, for base load power supply. Consequently, should the Government decide to proceed with a base load power station, it should not approve the second 300 MW unit until a need for it can be demonstrated in the context of implemented demand management strategies and the best use of available gas and other technologies.

General Recommendation 7

The Environmental Protection Authority recommends that if a decision is taken to proceed with a new base load power station then its capacity should not be more than 300 megawatts.

Conclusion

The Environmental Protection Authority considers that the Western Australian Government is poised to make a significant decision that will influence the State's overall effectiveness in managing the Greenhouse Effect. Initiatives for the conservation of energy, which will help to manage the Greenhouse Effect, will also be beneficial in their own right.

The Environmental Protection Authority believes that programmes for the development of renewable energy sources and demand management should be put in place at the same time as a decision is taken on whether coal or gas will be used to fuel the next base load power station.

If after considering the alternative power options available to the State, the Government decides that further base load generating plant is required, the Authority considers that a combined cycle gas turbine power station would be environmentally preferable to a coal fired station. The Authority notes further that irrespective of fuel source, not more than 300 MW of capacity should be installed now to avoid pre-empting the ongoing development of other environmentally preferable alternatives.

Part B

Proposed Collie Power Station

1. Introduction

The State Energy Commission of Western Australia (SECWA) proposes to construct a conventional coal-fired base load power station 8 kilometres east north east of Collie and located on the northern edge of the Collie Coal Basin (Figures 1&2).

The proposed power station site covers 388ha and consists of 315ha of cleared land under pasture, 58ha of jarrah-marri forest and 13ha of seasonally inundated wetlands. SECWA also owns 1500ha of land adjacent to the site which has the potential to provide a buffer area around the power station.

In 1987 the WA Government endorsed a report by the Collie Land-Use Working Group which recommended that:

> *"As a general principle in land use planning in the Collie Coal Basin, mining is recognised as the primary land use;...".*

The Environmental Review and Management Programme (ERMP) prepared by the SECWA was released for public review and comment starting 30th April 1990 and ending 6th July 1990. Twenty seven submissions were received during this period (Appendix 4). Some of these submission suggested that the ERMP was incomplete and should not have been approved for release. The Authority approved the ERMP for release at this time to ensure its review coincided with the review period of the Hill River project which also included a coal-fired power station component and raised the same energy supply and demand issues.

The Authority has already indicated in Part A above that a conventional technology coal-fired power station is one of the least environmentally preferred options for meeting the State's energy needs and that the choice of other options is recommended.

Nonetheless, should the State Government approve the Collie power station proposal then this assessment will ensure that its local and regional environmental impacts are properly managed notwithstanding other broader implications.

2. The Proposal

2.1 General Description

The proposed coal fired power station at Collie would consist of two generating units, each 300MW and having a combined capacity of 600MW. The potential to expand this site to accommodate 1000-1200MW of generating capacity was identified by SECWA should the State require it. The following facilities would be required for the proposed 600MW plant:

- two power generating units, comprising boilers and turbo-generators, each with a capacity of 300MW;
- on-site coal receival, crushing, storage and handling facilities;
- off-site water supply and water storage facilities;
- cooling water system;
- ash handling, storage, transport and disposal systems;
- power substation;
- wastewater management system(s); and
- ancillary facilities (water treatment plant, workshops, roads, car park and offices).

2.2 The Collie coal basin

The Collie Coal Basin (Figure 1) is recognised as a significant Western Australian coal reserve. However, its low specific energy value renders it unsuitable for export. Nonetheless, the coal is usable for local base load power generating plant with the added advantages of low average sulphur (0.7% by weight) and ash (10% by weight) contents.

For many years Collie coal was transported by rail to other parts of the State for power generation, but in 1971, to make better use of the significant coal reserves in the Basin, the WA Government constructed the Muja coal-fired base load power Station.

In August 1983, Government approved the establishment of a Collie Land-Use Working Group whose tasks included preparing overall land-use plans for Collie and designating land use priorities. The working group presented a Report to Government in June 1987 which was subsequently adopted, with minor amendments, in November 1988.

The Report included a number of significant recommendations. The most relevant recommendation identified coal mining as the primary land use within the Basin. The basin covers 226km^2, contains 482 million tonnes of demonstrated extractable coal and has an expected field life of over 100 years. The priority of this land-use was considered to be conditional upon the coal reserves being used for domestic electricity generation and that if this changed then the land-use should be reassessed.

Following this decision, Government established the Collie Basin Management and Planning Group to ensure the co-ordinated management and planning of the area throughout the life of the coal field. This Group released a draft Structure Plan for the Collie Coal Basin Area in December 1989.

The Environmental Protection Authority provided its advice on the Structure Plan, raising concerns regarding two Heavy Industry Sites proposed for the area, the number of new service corridors proposed in the area, and underground mining activities proposed between Collie and Allanson which may adversely impact on the Westralia block (System 6 Recommendation C88). A revised Structure Plan is still being prepared.

The Collie coal basin is currently a primary source of coal for the State's power generating requirements. Therefore, the Authority's attention in assessing proposals to mine coal within the Basin is properly directed towards ensuring coal mining operations are carried out in an environmentally acceptable manner. Any new coal mine proposals directly associated with the proposed power station will therefore be assessed, under the provisions of the Environmental Protection Act 1986, in this context.

2.3 The preferred site

SECWA states that the proximity to the fuel source was an important factor in determining the preferred site since it would have significant cost advantages compared with one at some distance. Furthermore Collie is surrounded by existing mining and support infrastructure.

SECWA's final studies concluded that the siting of a new base load power station at Collie was preferable due to the following factors:

- it is consistent with the Government's energy policy to locate new thermal power stations so as to deliver the lowest cost electricity; and
- it would be preferable on environmental grounds to site a new base load power station in the Collie area due to its location remote from major population centres and the availability of sites free from insurmountable environmental constraints.

Based on economic, environmental, geotechnical and land use factors several specific sites around the Collie Coal Basin were assessed. The selection of the final site (Figure 2) was based on its proximity to the prospective coal mining areas, availability of suitable flyash disposal areas, accessibility, topography and surrounding land use.

3. Environmental impacts identified by the proponent and their proposed management methods

Potential environmental impacts were identified by the proponent in the ERMP for both the construction phase and operational phase of this proposal. The proponent's commitments for the management of impacts are listed in Appendix 1

3.1 Construction phase environmental impacts

The construction phase includes site preparation and plant construction activities. It includes the clearing of land for the power station and associated facilities. Other areas will also be cleared for construction activities and to minimise the risk of bushfire damage to installations. This phase is expected to take 5 years to complete.

The erection of major equipment will commence following the completion of the appropriate siteworks and the installation of concrete foundations. Once the equipment is on site, erection of this equipment is estimated to take 3 years.

a) Site clearing activities

Initially, site preparation activities will have the greatest impact on the proposed site, affecting some 200ha, and continuing for about 24 months. This area includes the ash and water storage areas, coal receival/stockpile area and an allowance for access roads within the site area.

About 129ha of this area is already cleared and pastured, but 58ha of jarrah marri forest and 13ha of wetland vegetation are also to be cleared.

Surveys for the proposed site have identified no rare or endangered flora or fauna species. Consequently, SECWA contends that:

> *"whilst loss of habitat, and death or displacement of some of the fauna from within the site will unavoidably result from site preparation, these are clearly negligible effects on a regional scale."*

The Authority is not convinced that the environmental values of the wetland and forest areas have been fully considered and this issue is addressed in Section 5.5 of this Report.

Additional comments made by SECWA suggest that the clearing of 60ha of forest may act to increase the recharge of sedimentary aquifers within the Basin given that none will be lost by the forests natural transpiration processes. SECWA also suggests that because the majority of the site is already cleared, the additional clearing is not expected to impact upon the runoff water quality.

Although the Authority agrees that there may be a net increase in the Basin's groundwater recharge value, it is not convinced by the assertion that there will be no appreciable impact on the runoff water quality. Since the runoff water quality has the potential to impact on the Wellington Dam Catchment, the Authority considers that this aspect of the proposal should be further considered by the Environmental Protection Authority on advice from the Water Authority of WA.

b) Dust emission and soil erosion

SECWA proposes to manage dust emission and soil erosion issues with conventional dust control measures (watering of dry areas) and drainage control measures respectively. Also a number of commitments (numbers 10,11 & 12 in Appendix 1) address these issues. The Authority considers that the implementation of these measures should ensure no unacceptable environmental impacts occur.

c) Jarrah dieback disease

SECWA has identified that stringent forest hygiene procedures will need to be implemented in accordance with the Department of Conservation and Land Management's requirements to minimise the potential to spread jarrah dieback disease. The proponent's commitment number 15 should be adequate to address this issue .

3.2 Operational phase environmental impacts

SECWA has identified a number of issues with the potential to cause unacceptable environmental impacts once the plant is commissioned. These issues are discussed separately below with their proposed management methods.

a) Air emissions

A coal-fired power station will release gases and particulates into the atmosphere through its waste gas stack as a result of its fossil fuel combustion processes.

SECWA undertook ambient air quality computer modelling for sulphur dioxide, nitrogen oxides and particulate matter emissions both in isolation and in combination with other regional sources. The modelling results presented in the ERMP indicated that the maximum predicted sulphur dioxide ground level concentrations within the periphery of the power station would be 382 micrograms per cubic metre for a one hour averaging period when considered in isolation, and 408 micrograms per cubic metre for a one hour averaging period when modelled with other discharge sources including Muja power station. The predicted ground level concentrations of nitrogen oxides and particulates were also presented in the ERMP and have been assessed by the Authority and are considered to be acceptable.

In response to environmental concerns associated with these local emissions, SECWA has addressed sulphur dioxide, nitrogen oxides and particulate emissions with specific management commitments (numbers 1,2,3 & 16).

The Authority has reviewed the above commitments and considers them sufficient, if implemented, to prevent unacceptable environmental impacts from occuring. The Authority has further considered the global issue of sulphur dioxide emissions which are of particular concern in Europe and North America in respect of acid rain. However, there is no evidence to hand that similar problems are an issue in Australia and it is also unclear as to whether southern hemisphere emissions contribute to northern hemisphere levels. Consequently there is no scientific knowledge available upon which the Authority could base a recommendation at this time.

The wider considerations related to greenhouse gas emissions are addressed in Part A of this Bulletin. SECWA will also be required to include a Greenhouse gas audit with its on-going environmental management programme.

The proponent has addressed the issue of dust control during the operational phase with appropriate management commitments (numbered 10 & 12 in Appendix 1), however the Authority has concluded that the noise emission issue should be considered further and has addressed this issue in Section 5.1 of this Report.

b) Water supply

SECWA has identified two sources for its water supply requirements: mine water from the dewatering of an operating coal mine and groundwater from deep aquifers within the Collie Coal Basin.

The abstraction of groundwater has the potential to lead to groundwater drawdown effects. To minimise the potential drawdown impacts SECWA has undertaken to use coal mine water in preference to groundwater abstraction providing it can meet certain water quality requirements. In making this commitment SECWA will minimise any potential for additional environmental impacts other than those already associated with the existing coal mine activities. Recently, Muja power station has been able to use mine water to supply some 70 percent of its water requirements.

The Authority considers that this undertaking together with the proponent's environmental management commitments on this issue (numbers 18 & 19) provide a level of environmental protection. However in order to achieve a sufficient level of environmental protection from potential drawdown impacts especially outside the Basin, the Authority has addressed this issue further in Section 5.2 of this Report.

c) Flyash disposal

SECWA has not finally decided on its preferred flyash disposal method. Two methods are currently being investigated and each involves the deposition of the ash within a storage impoundment designed to contain surface and sub-surface water movements.

The Authority considers that the flyash disposal methods being investigated must ensure that leachate migration into underlying soils and groundwater, and particulate loading of surface waters is prevented both during and after commissioning.

SECWA has also identified that the requirements of the Water Authority of WA, which relate to its strategy to significantly improve the quality of water stored within Wellington Dam, restrict any water discharge from the power station site unless that discharge is of a potable standard or better.

SECWA proposes to meet these requirements partly by reducing the quantity of potentially contaminated water produced by flyash disposal activities. This is to be achieved by the construction of bypass drains around the disposal area to isolate stormwater runoff from deposited flyash, construction of a containment pond to store stormwater runoff or excess water and to enable evaporation to dryness of the collected water, and the progressive rehabilitation of the landfill surface.

In order for the assessment of this proposal to be completed, the Authority has addressed this issue further in Section 5.3 of this Report with an appropriate recommendation.

d) Waste-water disposal

SECWA has not finally decided on its preferred wastewater disposal method. Two methods are currently being investigated and either is likely to be environmentally acceptable.

These alternatives are briefly discussed latter. However, as with the flyash disposal technique in order for the Authority to finalise its assessment Report an appropriate recommendation has been included in Section 5.3 of this Report.

e) Electric and Magnetic fields

The transmission of electric current through a linear conductor generates both electric and magnetic fields in the space surrounding the conductor. In recent years the possibility that electro-magnetic fields may have definable ill effects on human health has received considerable research attention. The location of residential dwellings in close proximity to high voltage transmission lines, and associated facilities, has been one area of concern.

SECWA considers that the location of such transmission lines in a 60 metre wide standard easement within which no dwellings or prolonged human activity will be permitted is an appropriate level of management. The Environmental Protection Authority considers that these measures are adequate.

4. Public and Government agency submissions

The ERMP was released for a 10 week public review and comment period commencing 30th April 1990 and ending 6 July 1990. The Authority has included a matrix of issues raised versus major submission groups (general public, conservation groups, and Government agencies) in Appendix 3 of this Report. Twenty seven submissions were received in the review period and three after the close of submissions (Appendix 4).

As part of its assessment of the proposal the Environmental Protection Authority wrote to SECWA during the review period on a number of issues that were not fully explained in the ERMP. SECWA's responses were received after the public review period had ended. These responses are available to read in the Authority's Reading Room, Environment House 1 Mount Street, Perth as attachments to the Authority's library copies of the ERMP.

4.1 Issues raised in public submissions and the proponent's response

The main issues raised in submissions were the Greenhouse Effect, demand management strategies, alternative energy options, and potential water supply and air emission impacts.

Other issues raised in the submissions included:

- coal mining impacts;
- solid and liquid waste management impacts;
- SECWA demand forecasting methods;
- transport route impacts;
- the use of old coal technology for a modern plant;
- flora and fauna studies; and
- jarrah dieback disease.

The Authority reviewed these submissions and formulated a list of questions to reflect the environmental issues expressed. This list of questions and the proponents responses have been included in Appendix 2 of this Report which is divided into two sections (Section 1 - The biophysical environment and Section 2 - The social environment).

5. Environmental Protection Authority's review of potential environmental impacts

In Part A of this Report the Authority's position is clearly stated and concludes that a coal-fired power station is one of the least preferable options from an environmental viewpoint. The Authority has also noted that if a base load power station were required then a combined cycle gas turbine power station and a maximum 300MW capacity would be the appropriate choice from an environmental viewpoint.

However, as noted previously, the Authority still has an obligation to assess SECWA's proposal for a 600MW coal-fired power station and has provided that assessment as Part B of this Report.

The Authority considers that it is important to note that the conclusions and recommendations in Part B, which would be equally relevant to a 300MW coal-fired plant, should not be read so as to detract from the general recommendations in Part A.

5.1 Proposed Collie power station

The Authority considers that Collie has considerable advantages over other more environmentally sensitive locations. These include the regional community's acceptance of both coal mining and power station activities, the distance to densely populated areas, and that the region's existing environment is not presently suffering any major unacceptable environmental impacts from power generation.

The Environmental Protection Authority notes that some aspects of the proposal have not yet been finalised and some aspects of environmental management are still to be addressed. Nevertheless, the Authority considers that the proposal has developed to a stage that allows the Authority to progress its assessment of the proposal. The proponent's Environmental Review and Management Programme has addressed many of the potential environmental impacts by providing management commitments.

Further to the Authority's conclusions in Part A of this Report, the Authority considers that the following aspects of this proposal have the greatest potential to cause unacceptable local and regional environmental impacts:

- air emission impacts from sulphur dioxide, nitrogen oxides, particulates, and noise;
- water supply impacts from the drawdown effect of groundwater abstraction;
- impacts from various solid and liquid waste discharges e.g. flyash and wastewater; and
- the disturbance or destruction of wetland and forest areas associated with the proposed plant's coal stockpile, water storage and waste disposal areas.

The Authority has considered the ERMP based on its own investigations, the proponent's responses to issues raised in submissions and other information provided by the proponent and in the submissions.

Recommendation 1

The Environmental Protection Authority has concluded in Part A of this Report that a coal-fired power station is one of the least environmentally acceptable options for meeting the State's future energy needs. However, the Authority has an obligation to assess the proposal as referred by the State Energy Commission of WA which is for a 600MW coal-fired power station at Collie. Accordingly, should the Government approve a coal-fired power station at Collie up to a maximum capacity of 600MW, then the Authority recommends that in order to minimise local and regional potential environmental impacts, the proposal should only proceed in a manner consistent with the ERMP and subject to the proponent's consolidated list of commitments, responses to issues raised during the public review period and the Authority's Recommendations in Part B of this Report.

The Authority considers that if this proposal has not been substantially commenced within five years of the date of this Report, then any environmental approval should lapse. After that time, further consideration of the proposal should only occur following a new referral to the Authority.

Furthermore, the Authority considers that subsequent statutory approvals for this proposal should make provision for minor and non-substantial changes, where it can be shown that the changes are not likely to have an unacceptable environmental impact.

5.2 Atmospheric emissions

The Authority has considered a range of air emissions in its assessment of this proposal. These emissions were identified by the proponent and comparable with all stations that employ this type of fossil fuel combustion process.

a) gaseous and particulate emissions

The combustion of coal produces gaseous and particulate emissions which, under certain conditions, can be harmful to human health and/or the environment.

Three principle emissions, sulphur dioxide, nitrogen oxides and particulates, are routinely considered in assessing the potential environmental impacts of atmospheric emissions from coal-fired power stations.

In determining the likely impacts of these emissions, mathematical atmospheric dispersion models were employed to help predict the extent to which the emissions may spread around the project area.

The Authority has reviewed the modelling work carried out by the proponent and, based on the assessment of the data provided by SECWA, concluded that the emission levels of sulphur dioxide, nitrogen oxides and particulates are unlikely to cause a significant environmental impact either in isolation or in combination with other regional emission sources, e.g. Muja Power Station.

The Authority has considered the above computer modelling and SECWA's management commitments (numbered 1,2,3 & 16 in Appendix 1) and considers that, if they are implemented, they should be adequate to manage the air emission issues, subject to Recommendation 2 below.

In respect of sulphur dioxide emissions the most recent data available indicates that peak ground level concentrations of sulphur dioxide greater than 500 micrograms per cubic metre could occur within about 3km of the station. These emission levels were modelled on a stack height of 130 metres and the Authority will be reviewing the adequacy of the stack height and design parameters at the Works Approval and Licensing stage of this proposal.

In view of the Authority's air quality objectives for residential areas contained in its draft Environmental Protection Policy for Kwinana, and the fact that the ERMP does not identify any planning constraints for SECWA's 1500ha of property. The Authority considers a specific recommendation is necessary to

ensure that future residential developments are not allowed to proceed in areas that may be subject to air emission levels unacceptable for residential areas. This action should ensure that future developments are not adversely impacted upon by the operations of the power stations. Accordingly, the Authority recommends the following.

Recommendation 2

The Environmental Protection Authority recommends that prior to any residential, commercial or industrial developments progressing on the 1500ha of land owned by the State Energy Commission of Western Australia adjacent to the proposed power station, the proponent should liaise with relevant planning authorities to establish a buffer zone adequate to maintain appropriate air quality objectives to the satisfaction of the Environmental Protection Authority.

b) Noise emissions

SECWA's predicted noise emission and noise propagation levels were made using computerised mathematical modelling techniques for the dispersion of sound.

The results of that work indicated a worst-case noise level of 40.4dB(A) at a point 2.2km south-east of the proposed site. The Environmental Protection Authority considers that the following levels will ensure no unacceptable environmental impact occurs at the closest existing residence.

Recommendation 3

The Environmental Protection Authority recommends that the maximum noise levels at residential premises surrounding the proposed power station should not exceed:

50dB(A) from 7am-7pm, Monday to Saturday
45dB(A) from 7am-7pm, Sunday
45dB(A) from 7pm-10pm, every day; and
40dB(A) from 10pm-7am, every day.

The Authority recognises that SECWA has purchased land to provide an effective noise buffer area around the power station in the hope that it may not need to implement costly noise attenuation measures at the plant.

However, the land purchased may prove to be inadequate for its intended purpose and given that there are no planning controls proposed in the ERMP to cover the use of SECWA's 1500ha of land, the Authority considers that in order to prevent inappropriate developments being approved within areas that could be subject to unacceptable noise emission impacts, a specific recommendation is necessary.

Accordingly, the Authority considers that SECWA should comply with the above noise level requirements, and that a regular monitoring programme should be implemented to supplement SECWA's commitments which are limited in their scope.

Recommendation 4

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia prepare, submit and subsequently implement proposals for monitoring and managing noise impacts as part of the Environmental Management Programme (Recommendation 9), to the satisfaction of the Minister for the Environment on advice from the EPA.

c) Dust emissions

In response to the dust emission issue associated with the proposed power station, the Authority considers that the commitments numbered 10, 12 and 21 in Appendix 1. will ensure dust emission levels are adequately managed. Consequently, no recommendation is considered necessary to cover this issue.

d) Impacts on vegetation

SECWA has committed to develop a vegetation monitoring programme to measure the effects of atmospheric emissions. The Authority considers that such a programme could significantly increase the State's understanding of these effects. Consequently, the following recommendation is proposed to supplement SECWA's commitment in order to ensure that both monitoring and management components are integral parts of the programme.

Recommendation 5

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia prepare, submit and subsequently implement a vegetation monitoring and management proposal as part of the Environmental Management Programme (Recommendation 9), to monitor the effects of air emissions and ensure appropriate management responses, to the satisfaction of the Minister for the Environment on advice from the EPA.

5.3 Groundwater abstraction

If the drawdown effect from groundwater abstraction is greater than recharge, there could be significant environmental impacts on the existing local environment.

The Authority requested more information on this issue during the public submission period of the ERMP. The information supplied showed, among other things, that SECWA's groundwater consultants have been investigating the Collie Coal Basin's groundwater resource for more than 12 years and consequently have an experienced working knowledge of the area.

The hydrology of the Collie Basin is highly complex as the following extract from a report prepared for SECWA in 1985 shows. "The conclusion from the above observations is that there is not generally a direct hydraulic interconnection between the surficial aquifers and wetlands on the one hand, and deeper aquifers within the basin on the other. Although undoubtedly such connection does exist in some areas, albeit an indirect connection, it cannot be assumed that wherever the deeper Permian aquifers sub-crop beneath a wet land, that such interconnection will exist. Consequently, the areas where drawdown will occur as a result of pumping, and also the magnitude of any drawdowns, cannot be predicted for specific sites."

SECWA proposes to use mine dewatering water whenever possible and has committed to install observation bores which will be used to monitor groundwater levels and act as an early warning system for any potential environmental impact from groundwater abstraction practices.

In view of these commitments the Authority considers that the issue of groundwater abstraction impacts has now been adequately addressed and potential environmental impacts can either be managed or have been demonstrated, from experience, to be within acceptable limits subject to the following recommendation.

Recommendation 6

The Environmental Protection Authority recommends that within 36 months of any approval granted by the Minister for the Environment, permitting the implementation of a coal-fired power station at Collie, the State Energy Commission of Western Australia should prepare, submit and subsequently implement a power station water resource(s) management proposal as part its Environmental Management Programme (Recommendation 9), to the satisfaction of the Minister for the Environment on advice from the EPA and the Water Authority of WA.

5.4 Flyash and wastewater disposal

Currently in Western Australia power generating utilities dispose of their fossil fuel combustion waste (flyash) in secure landfills as is the common practice around the world. This type of waste disposal site is regularly monitored to ensure that it does not contaminate the environment through the leaching of potentially harmful chemical elements.

SECWA has proposed two possible flyash disposal options, dry and wet slurry disposal of the flyash waste. This does not exclude other options being investigated (e.g. return of the flyash material to the overburden dumps at the coal mine).

The Authority understands that SECWA is still considering its options on this issue and that a final decision will be based on the results of continuing investigations.

To assist SECWA in this decision the Authority advises that the selected flyash waste disposal option needs to be environmentally as good or better than the secure landfill option (i.e. a landfill with an impermeable liner, divided into a number of separate cells, and incorporating a leachate collection and recycling system) and provide a walk away solution to the problems associated with flyash disposal techniques at the end of the station's life.

SECWA has similarly not determined its preferred option for its wastewater treatment activities.

One option being considered is for ocean pipeline disposal. The Authority agrees with SECWA in that the most significant potential environmental impacts of this option would be associated with the clearing of vegetation to provide an open corridor to the sea, and the effects the wastewater may have on the receiving ocean water quality.

The second option includes a sidestream softener/brine concentrator. SECWA considers that seepage from the saline concentrate evaporation pond presents this option's greatest potential to cause a significant environmental impact.

The Authority considers that either option could be environmentally acceptable. However, this will need to be subject to a more detailed assessment by the EPA once SECWA selects its preferred option.

Recommendation 7

The Environmental Protection Authority recommends that prior to the clearing of land and any siteworks directly associated with flyash and wastewater treatment and disposal activities, the State Energy Commission of Western Australia refers its final flyash and wastewater treatment and disposal proposals to the Environmental Protection Authority for separate and additional environmental impact assessment.

5.5 Proposed plant layout

The proposed plant layout has been designed to allow for the potential to double the plant's power generating capacity at a latter date if required.

The Authority would expect, subject to the caveat of 5 years associated with this assessment, that any expansion of the power stations capacity, beyond that approved by the WA Government or in excess of the capacity reviewed in this assessment Report, would be referred to it under the provisions of the Environmental Protection Act, 1986.

The Authority is presently concerned about provisions in the current site layout plans (Figure 3), to clear 58ha of jarrah-marri forest and, 13ha of seasonal wetland the significance of which has not been assessed.

Therefore, the Authority considers that before the final plant layout or site boundaries are determined SECWA should determine the environmental values of these areas.

Recommendation 8

The Environmental Protection Authority recommends that prior to the commencement of siteworks associated with the site layout plans, the State Energy Commission of Western Australia should:

(a) undertake a wetland survey to identify the environmental significance of the 13ha of seasonal wetlands and to develop alternative wetland habitats to replace their lost values;

(b) consult with the Department of Conservation and Land Management to minimise both the area and potential impacts associated with clearing the proposed 60ha of forest: and

then re-assess the site layout plans to reflect the information provided by (a) and (b) above to the satisfaction of the Minister for the Environment on advice from the EPA.

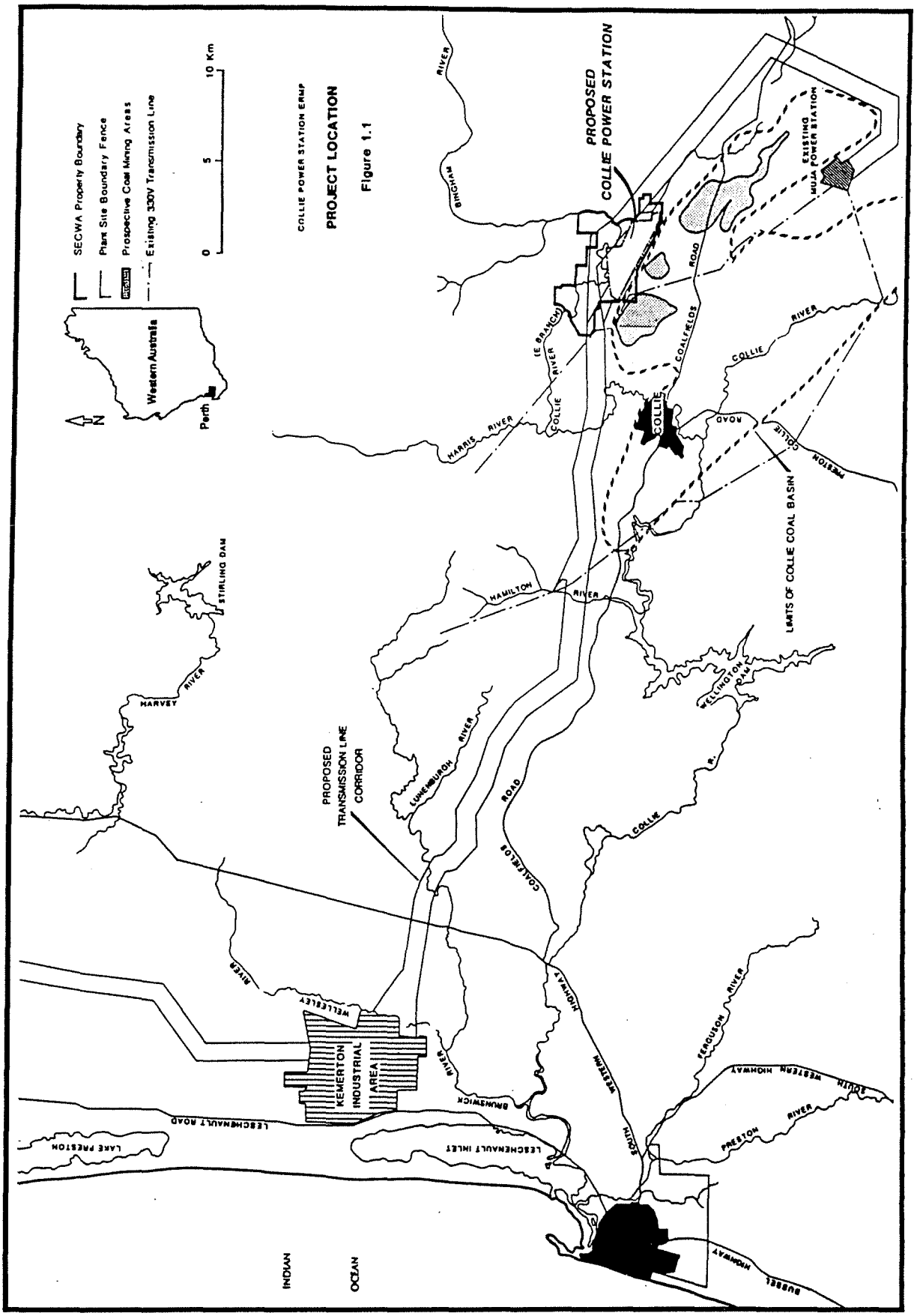

Figure 3: Site layout plan (courtesy of SECWA's ERMP).

6. Social impacts

6.1 Construction Phase

The construction period will last six years and the peak construction workforce is estimated at 820. The non local construction workforce, which is estimated to be 330, is to be accommodated in construction camps (70%) and in temporary accommodation in the area (30%). The use of temporary accommodation for construction workers will maintain the current high utilisation rate of "tourism"accommodation by Collie workers. Should an unacceptable conflict with tourism accommodation occur, SECWA has undertaken to consider the provision of extra construction camp accommodation.

The construction workforce will, during its peak, have an impact on local services and facilities in the Collie area. However, services and facilities in the area have historically been accustomed to fluctuating levels of population and are unlikely to be viewed by the local community as being seriously affected.

Estimates by SECWA on the impact on local housing, services and facilities are based on the premise that no other proposals involving significant workforces will commence during the construction period of the power station. Should other projects go ahead there would be a cumulative impact on housing, services and facilities which may present problems. SECWA is committed to monitoring the situation and supporting the implementation of corrective action where necessary (see section on Environmental Monitoring Programme).

6.2 Operational Phase

The operational workforce is estimated at 150. The total increase in population in the local area will be about 250. SECWA has undertaken to review the availability of SECWA sponsored land and housing in the area to accommodate this increase in population.

Concrete plans for housing the operational workforce are limited and this area will require careful management. It is considered inappropriate for any of the operational workforce to be accommodated in temporary (ie. tourism) accommodation. This should be avoided through ongoing monitoring and management of the housing situation in the local Collie area, and in the wider Preston subdivision.

6.3 Impacts on Nearest Neighbours

SECWA has purchased 1900 ha of land for the proposed Collie power station. Some 1500 ha will form a buffer zone around the power station site. This large buffer zone should ensure that neighbouring properties do not suffer devaluation due to the proposal and that neighbours are protected from nuisance effects (dust,noise etc).

6.4 Transport

SECWA has cited a preferred transport route for traffic to and from the power station. Impacts on residents along that route and users of the route will be satisfactorily mitigated by road upgrades, speed limits and planting of vegetation along the route where necessary.

There was some public concern shown regarding the preferred route. Further public consultation during the final planning of the route is recommended to ensure that the characteristics of the transport route meet local requirements.

6.5 Community Acceptance

The local community, in recognition of the importance of mining and power related industry to the local area, has shown a high level of acceptance for the project and has actively lobbied to support the project.

6.6 Social monitoring

SECWA has suggested that monitoring of social impacts through the construction period be carried out by the formation of a local group. The group would have local representation and provide the mechanism to identify concerns and propose solutions to problems.

SECWA has recognised the potential for cumulative impacts and the shared responsibility for those impacts. In response to this, SECWA has undertaken to invite the proponents of other proposals to be involved in the monitoring exercise.

The Environmental Protection Authority endorses SECWA's commitment to undertake social monitoring and recommends that its results are included in SECWA's periodic monitoring reports to the Authority.

7. Environmental management programme

To ensure the ongoing environmental monitoring, management and auditing of this proposal, the Authority makes the following recommendation.

Recommendation 9

The Environmental Protection Authority recommends that prior to commissioning of the power station the SECWA prepares, submits and subsequently implements an Environmental Management Programme (EMP) that addresses, where appropriate, the monitoring, management and auditing requirements of the following issues:

- **Atmospheric emissions;**
- **Noise emissions;**
- **Vegetation protection;**
- **Water supply;**
- **Social amenity;**
- **Greenhouse gases; and**
- **Solid and liquid waste discharges,**

to the satisfaction of the Minister for the Environment on advice from the EPA.

Furthermore, upon commissioning of the power station, this EMP should be revised and updated on a yearly basis to the satisfaction of the Environmental Protection Authority.

Appendix 1

Consolidated list of commitments made by the State Energy Commission of Western Australia

SUMMARY OF CONSOLIDATED ENVIRONMENTAL MANAGEMENT COMMITMENTS FOR PROPOSED COLLIE POWER STATION

GENERAL COMMITMENTS

1. The proponent will adhere to the proposal as assessed by the Environmental Protection Authority and will fulfil the commitments made below.

2. The power station will be constructed and operated according to relevant Government statutes and agencies' requirements, including those of the following:-

   - Environmental Protection Authority;
   - Water Authority of WA;
   - Department of Conservation and Land Management;
   - Department of Occupational Health, Safety and Welfare; and
   - Shire of Collie.

DESIGN AND PLANNING

The proponent is committed to:-

1. The removal of all fly-ash particulate matter in excess of $0.08 g/m^3$ (12% CO_2 reference level, dry at 0°Celsius and 101.3kPa), which is a National Health and Medical Research Council (NH&MRC) Guideline for New Plant (1985), from the boiler exhaust gases by the use of electrostatic precipitators, to the satisfaction of the Environmental Protection Authority.

2. The design of the power station boiler to limit nitrogen oxide (NO_x) emissions to $0.8g/m^3$ (calculated as NO_2 at a 7% oxygen reference level, dry, at 0°Celsius and 101.3kPa), which is the NH&MRC Guideline for New Plant (1985), to the satisfaction of the Environmental Protection Authority.

3. The design of the power station and a suitably constructed chimney stack to limit the ground level concentrations of sulphur dioxide (SO_2) to comply with Victorian Environmental Protection Authority's Acceptable level of $486\mu g/m^3$ (at 0°C, 101.3kPa, dry), one hour average (not to be exceeded on more than 3 days per year), and the NH&MRC's ambient air quality goal of $60\mu g/m^3$ (at 0°C, 101.3kPa, dry), annual average.

4. Planning and design of the power station to limit noise emissions beyond the power station property boundary to 40dB(A) at the nearest residence, to the satisfaction of the Environmental Protection Authority.

5. The design of a coal ash disposal method which will meet the environmental management requirements established in the licence conditions set by the Water Authority of Western Australia for the Wellington Dam Catchment.

6a. The design of a waste water management process which will meet effluent discharge quality criteria consistent with achieving the water quality objectives for the Wellington Reservoir which have been defined in the Draft Water Resources Management Strategy for the Collie Coal Basin. These criteria will allow no discharges with salinity in excess of 550mg/L TDS to be discharged into the surface waters of the coal basin, to the satisfaction of the Water Authority of Western Australia.

6b. Should an ocean pipeline be identified as a means of removing from the Collie Basin saline waste water produced by power generation, the proponent shall seek full environmental approvals for the proposal, to the satisfaction of the Environmental Protection Authority.

7. Minimise the visual impact of the power station by the engagement of a landscape architect early in the design phase and prior to commencement of construction.

8. Taking account during design stages, of forest hygiene requirements, to avoid, where practicable, sites and routes that involve a high risk of the spread of dieback into previously unaffected areas, by early consultation with, and to the satisfaction of, the Department of Conservation and Land Management.

CONSTRUCTION PHASE

The proponent is committed to:-

9. Conducting a social monitoring programme during the construction and operations phase and liaising with the Deputy Premier's Department Social Impact Unit, South West Development Authority, Collie Shire Council and social welfare groups to assist in the resolution of any housing, education and social welfare issues that arise from this proposal to the satisfaction of the Local Authority and the Environmental Protection Authority.

10. Controlling dust nuisance by water application via sprinkler or truck in areas of heavy traffic or soil storage, to the satisfaction of the Environmental Protection Authority.

In the event of complaint relating to nuisance dust from construction activities, the proponent will investigate and take appropriate remedial action to the satisfaction of the Local Authority and the Environmental Protection Authority.

11. Minimising water erosion due to surface runoff during earthworks by ensuring that earthworks construction contracts will include provision for control of drainage. Diversion channels above and below batters and around the perimeter of cleared areas will assist erosion control and allow turbid runoff to be diverted to sediment traps to the satisfaction of the Environmental Protection Authority.

12. Minimising ongoing dust potential, erosion and visual impact by stabilisation or restoration of disturbed areas as soon as possible following construction, to the satisfaction of the Environmental Protection Authority and other relevant authorities.

Measures implemented will include:-

(i) Minimisation of the areas of disturbance.

(ii) Proper storage and management of recovered and returned topsoil.

(iii) Replanting of disturbed areas with appropriate species.

13. Initiating investigations and issuing a report to the Western Australian Museum in the event that any archaeological sites are revealed during construction. If appropriate, permission to proceed will be obtained before construction commences.

14. Revegetating and stabilising temporarily disturbed areas, and contributing to reforestation of the Wellington Dam Catchment, in accordance with its obligation under the Country Areas Water Supply Act, 1976, to the satisfaction of the Water Authority of WA.

15. The incorporation of dieback hygiene procedures within all earthworks construction specifications in areas of dieback infection, and protectable forest in accordance with and to the satisfaction of the Department of Conservation and Land Management.

OPERATIONS PHASE

The proponent is committed to:-

16. An emissions and ambient air monitoring programme.

The emissions monitoring programme will confirm that stack emission specifications for particulates and nitrogen oxides (NO_x) comply with the relevant guidelines as expressed under commitments 2 and 3. Measured levels of SO_2 will also be taken at the stack.

The ambient air monitoring programme will be affected by the establishment of an automated monitoring station equipped with a continuous sulphur dioxide monitor and high volume sampler to measure particulate concentrations.

The resulting levels of sulphur dioxide and particulates measured will be used to validate computer model predictions of ambient air quality for sulphur dioxide and particulates.

The above monitoring programme will be to the satisfaction of the Environmental Protection Authority. In the event that relevant guidelines for ambient air quality are not complied with, the proponent will develop operational strategies to mitigate unacceptable air quality events to the satisfaction of the Environmental Protection Authority.

17. Installing networks of groundwater observation bores around the ash disposal pond and storage ponds containing saline water. Monitoring will be conducted at intervals agreed to by the Water Authority of WA. In the event that monitoring indicated leakages that could have significant environmental impact, remedial strategies will be formulated and implemented to the satisfaction of the Water Authority of WA and the Environmental Protection Authority.

18. Extending the existing network of regional groundwater observation bores in the Collie Basin as necessary to cater for the proposed new borefield and to ensure groundwater levels are monitored in those areas that have been identified as being at risk from drawdown. The monitoring programme and reporting of results will be to the satisfaction of the Water Authority of WA. In the event that monitoring indicated drawdown is occurring to the detriment of either existing groundwater users or to local wetlands, remedial strategies will be developed by SECWA to the satisfaction of the Water Authority of WA and the Environmental Protection Authority.

19. Establishing monitoring transects and reference quadrats in wetland areas identified to be at most risk from drawdown and assessed at appropriate intervals to determine whether changes to species composition or structure are occurring. Should significant detrimental changes to wetland vegetation be indicated by monitoring, remedial strategies will be formulated by SECWA

to the satisfaction of the Department of Conservation and Land Management and the Environmental Protection Authority.

20. Developing a vegetation monitoring programme to measure the effects of atmospheric emissions from the power station on the surrounding forest. In the event that monitoring identifies unacceptable detrimental effects, remedial strategies will be formulated by SECWA and implemented to the satisfaction of the Department of Conservation and Land Management and the Environmental Protection Authority.

21. Controlling dust nuisance from the on-site coal storage and crushed coal stockpiles by the use of water sprays.

22. Maintaining an annual audit of the greenhouse gas, carbon dioxide, which results from the burning of Collie coal, to the satisfaction of the Environmental Protection Authority.

23. Implementing a noise survey following commissioning of the power station to confirm model predictions of noise levels established at various locations outside the SECWA property boundary. If the survey indicates that noise levels are excessive, remedial strategies will be formulated and implemented to the satisfaction of the Environmental Protection Authority.

DECOMMISSIONING

24. The usual life expectancy for a coal fired power station is 30 - 40 years. Once decommissioned the power station will be used for public purposes which have yet to be determined. Rehabilitation of the site including appropriate management of solid and liquid wastes will be a pre-requisite to future use of the area and will be carried out to the satisfaction of the Environmental Protection Authority.

Appendix 2

Questions and issues raised in public and Government agency submissions and SECWA's reponses

Section 1. Biophysical environment

Section 2. Social environment

Section 1

Biophysical environment

QUESTIONS AND ISSUES RAISED IN PUBLIC AND GOVERNMENT AGENCY SUBMISSIONS .

Greenhouse Gases

1.0 Has SECWA answered the right questions on greenhouse gas emissions? We should be asking "why we are unnecessarily increasing the carbon dioxide level in the atmosphere" when there are other less polluting means of generating power, and not by how much the power station will increase the level.

2.0 What proportion of carbon dioxide emissions can be attributed to power generation activities in Western Australia, and is this a significant amount? If the answer is yes, why is SECWA proposing a coal fired power station, instead of gas or other options, for the next base load generating plant?

Demand Management

3.0 To what extent has SECWA considered demand management, especially energy efficiency/conservation in developing its power generation policy?

4.0 How do these considerations affect the predictions for power generation capacity, and the need for a new power station?

Alternative Energy Options

5.0 If a new base load power station is required by the mid 1990's please outline the consideration that has been given to an alternative fuel source eg. gas. SECWA should table the advantages and disadvantages of each energy supply source so that the general public can gauge the differences?

6.0 SECWA has described some of the more common alternative energy supply options in the attachment to their ERMP and rejected them without any detailed discussion. Can SECWA identify alternative energy supply options which are currently operated on a commercial basis around the world and explain why they could not be utilised in Western Australia eg. wind and solar?

7.0 What measures are being taken by SECWA to develop a demand management strategy to address:

- the publics and industries role and significance in demand management; and
- research, development and implementation of alternative energy production options?

8.0 In SECWA's opinion are the following estimates, for the amount of power that alternative energy options could provide, realistic? Does SECWA consider that these technologies could be developed in the next five years in order to postpone the need for a base load power station?

o Cogeneration	700MW
o Efficient end-use equipment	1000MW
o Demand levelling	500MW
o Renewables	200MW

9.0 Can SECWA explain what is meant by "developing advanced, more efficient coal fired power stations and utilising the gas reserves in a more efficient manner"?

Water Supply Impacts/Management

10 Predictive modelling for groundwater abstraction is required to adequately assess any impacts. Will SECWA provide this modelling work before EPA assess the proposal?

11 Can SECWA estimate the volume of water from mine dewatering versus groundwater supply to be used at the station? What proportions has the Muja power station operated on over its lifetime?

12 Wellington Dam contains an abundant water supply which would probably only need minor treatment to make it of a suitable quality for use at the station. Can SECWA give a detailed explanation on why this source has not been proposed?

13 Given that the intermediate quality pond is expected to contain water with a higher salt content (2,000 to 4,000mg/L) than that accepted by the Water Authority of WA (550mg/L) does SECWA propose to line this pond?

Coal Supply

14 SECWA should discuss the coal supply issue more fully and explain why coal supply proposals will be separately assessed by the EPA?

Waste Management (solid and liquid)

15 Flyash disposal methods have been discussed in the ERMP, but no final method decided upon. Nonetheless, the proposed siting of the flyash dam should be investigated further. Has SECWA considered the impacts of the long term integrity of the dam and its proximity to the east branch of the Collie river and the ecological importance of the "wetlands" that will be affected by the dam?

16 Are there any alternative uses or disposal methods for the flyash waste? The successful rehabilitation of existing flyash disposal areas in Western Australia has not been demonstrated. Does SECWA propose to rehabilitate the proposed flyash disposal area and if so, how?

Air Emissions

17 SECWA states that "there appears to be no difficulty for the proposed power station when considered in isolation to meet any annual, 24 hour or short-term sulphur dioxide air quality concentration." To what extent does this change if, the emissions from Muja and Worsley are taken into account? How significant is the sulphur dioxide and oxide of nitrogen emission issues in the Collie region and could these emissions be removed from the vented gases?

Transport Route

18 Are the road alignments for the Collie Bypass road the most up to date. Will SECWA address this and any difference it may have on its conclusions?

19 Are the existing road systems through Collie Town capable of handling the amount of truck traffic envisaged, this answer should also take into account overdimension (and possibly overweight) trucks?

20 Preferred transport route B, has a number of 90 degree turns within residential areas. Route A, appears more suitable. Can SECWA expand on its reasoning for preferring route B?

Power Station (proposed technology)

21 How does SECWA justify the use of traditional coal burning technology when new more efficient lower polluting technologies eg. combined cycle coal gasification or fluidised bed systems are currently available?

Flora and Fauna Studies

22 What impact(s) does SECWA consider atmospheric emissions will have on the regional flora?

23 Does SECWA consider that it has adequately addressed the environmental impacts of the proposal on the local fauna?

Your Ref:
Our Ref 1/32/96
Enquiries Mr J Robinson
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SECWA

25 October 1990

Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

ATT: Mr S Watson

Dear Sir

RE: SECWA's Response to Public Submissions - Collie Power Station ERMP

Please find enclosed SECWA's response to the questions raised by your department on behalf of public submissions regarding the above project.

We have attempted to answer all questions fully, without including unnecessary technical detail.

For simplicity, where there has been an overlap in questions, SECWA's answers have been grouped together under appropriate headings.

I trust that SECWA's responses are self-explanatory. However, should you require further clarification, please contact this office.

Yours faithfully

per **A J BEAUMONT**
MANAGER SYSTEM PLANNING
enc.
SD 7052

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RESPONSE TO THE PUBLIC'S QUESTIONS REGARDING THE PROPOSED COLLIE POWER STATION ERMP

1. GREENHOUSE GASES

The question of greenhouse gas emissions is a complex one and does not have a simple answer. It is rather simplistic to suggest that a new coal-fired power station will "unnecessarily" increase carbon dioxide levels in the atmosphere.

The combustion of any carbon based fuel, be it coal, oil or gas, will release carbon dioxide. The actual amount per useful energy converted to power depends on the fuel itself.

The alternative energy conversion technologies for the production of electricity which have been considered are discussed in detail in Section 3.

To meet the electricity demands of our State, it is necessary to rely on fossil fuel generation. The question of which fuel to use in a new power station needs to consider also the economics, resource availability, strategic impacts and wider (even global) resource utilisation issues.

Western Australian Greenhouse Gas Emissions

The Greenhouse Effect is a global issue with contributions to greenhouse gases on a global scale. Emissions of carbon dioxide from a localised power station in Western Australia, or even the total emissions from Western Australia, are not going to have a direct local effect. They must be considered in a global context.

Of the total annual worldwide carbon dioxide emissions, which are estimated to be some 30 Gt, Western Australia, in total, contributes 0.03 Gt (about 0.1%). SECWA, representing about 70% of WA power generation activities, produces 0.006 Gt (0.02%). This proportion is smaller by several orders of magnitude than the uncertainty in

arriving at the global value. Thus, mathematically it can be stated that such a contribution has little significance.

The effect of a new 600MW coal fired power station would be to add approximately 0.003 Gt/annum to global CO_2 emissions. A similar sized gas station (combined cycle) would add about 0.002 Gt/annum if it produced the same amount of electricity. Neither of these two emission rates, nor the emission saving in going to the gas option are significant in a global sense.

The above discussion considers the emissions of additional power plant in isolation. In reality, however, the next elements of generating plant are only the first in an ongoing development programme. It is likely that the selection of future elements of power plant will consider a sensible balance between the use of various fuels, for strategic reasons.

Being a global issue, the Greenhouse Effect must be addressed on a global scale to achieve meaningful gains. It makes little sense to attempt to decrease an insignificant factor when it may impose a detriment to the people of Western Australia. Although there is a moral obligation to minimise greenhouse emissions in WA, this should be considered relative to the economic impact. It must be considered in its proper place, at the right level of significance, with all the other factors which dictate the need for a coal-fired power station option for Western Australia.

While Western Australia's coal is not suitable for export, much of the natural gas produced but not used in Western Australia is exported overseas. This export income is of significant benefit to the State and, of course, the balance of payments.

2. DEMAND MANAGEMENT

Over the last 12 months, SECWA has become increasingly active in implementing Demand Management strategies as an integral part of its power planning policy. The general objectives of SECWA's Demand Management activities have been to promote consumer awareness on energy use and efficiency, and reduce peak demand on the inter-connected system. SECWA's on-going demand management programme has been included in current electricity demand forecasts.

To further develop SECWA's demand management activities, a Demand Management Committee was established in 1989 to investigate the potential for increased demand management activity in SECWA. The committee recently presented their findings and recommendations in an internal report which was reviewed by an independent energy consultant.

As a result of the committee's recommendations, SECWA has formed a Demand Management Branch under the Business Development Division. The Demand Management Branch will be responsible for researching potential demand management areas and implementing formal demand management programmes.

Energy Efficiency and Conservation

The promotion of natural gas in the domestic sector has been particularly successful in improving the end use energy efficiency of consumers. The use of natural gas instead of electricity for space heating, water heating and cooking gives a more direct usage of available energy. Overall energy utilisation efficiency is up to 80% for gas, compared to approximately 30% efficiency for the equivalent electricity use.

SECWA is supportive of the Government energy conservation initiative, and as such has attempted to improve public awareness of efficient energy use and conservation through the following activities.

- The energy labelling of appliances. This concept has been strongly supported by SECWA and has already led to a marked improvement in the efficiency of a wide range of domestic market products and motors manufactured in this country, as well as encouraging the public to consider energy efficiency when purchasing appliances.

- The establishment of the Energy Information Centre. The Centre provides advice relating to domestic energy use and efficiency.

- The support of energy management courses at TAFE.

- The conducting of preliminary energy audits.

- The conducting of seminars and the dissemination of information regarding energy use and efficiency.

- The provision of technical support to consultant engineers and companies specialising in energy management.

- The establishment of the Energy Managers Group (Perth). This has provided a forum for discussion and a means of investigating and reporting on elements of energy management.

- The undertaking of various demonstration projects in order to demonstrate the technical feasibility of new technologies and to obtain experience in their use. These have included innovative solar-thermal power stations, photo-voltaic cells, the testing of alternative fuels in motor vehicles and wind turbine installations.

Reducing Maximum Demand

By reducing the maximum electricity demand in the South West Interconnected Electricity Grid, SECWA has been able to both delay and reduce the additional power generating plant needed. SECWA has significantly reduced the maximum electricity demand through the following activities.

° The promotion of natural gas in the domestic sector has had the additional effect of reducing maximum demand on SECWA's electrical system. In 1988/89 the cold weather maximum demand would have been at least 260 MW higher. The active promotion of natural gas in the residential sector has therefore reduced the need for power generating plant by 260 MW.

° The use of time-based demand and energy tariffs for large loads, with different costs for off peak and on-peak energy. This has encouraged a shift in electricity usage from on-peak times to off-peak times for commercial and industrial consumers, thereby reducing the need for additional power generating plant.

° The introduction of a trial horticultural tariff. During the past two years a reduced tariff during off peak periods has been offered to horticulturalists on a test basis. The information obtained from this exercise is currently being assessed and will provide SECWA with information regarding the potential for an expanded time-of-use tariff for primary producers.

° Tariff reform. SECWA is currently revising the time-of-use based tariff. An extension to the time-of-use tariffs and additional incentives for the wise use of energy are envisaged.

° The interruptible supply arrangement with the Barrack Silicon smelter. This is a good example of Demand Management working to the advantage of SECWA, the customer and the public.

SECWA is now operating with minimum sensible plant reserve margins and current fuel supply contracts are being fully utilised. Future increases in electricity demand will require additional operating plant and additional fuel purchases. There is therefore positive economic incentive for SECWA to succeed with current and future demand management projects.

3. ALTERNATIVE ENERGY OPTIONS

As the authority responsible for the supply and distribution of power to Western Australia, SECWA is continuously investigating and assessing the development and potential of a wide range of fuel and energy sources.

SECWA has considered the possible use of all fossil fuel types to supply the 600 MW base load power station proposed.

Gas is an option under consideration and in the event that gas can be supplied to meet power station requirements at a competitive price, further gas fired plant may be installed. For further details regarding natural gas use as a fuel, please refer to sections 4.3 and 4.4 in Power for Western Australia.

Table 1 below presents the major advantages and disadvantages of the main fuel types and energy sources.

TABLE 1

A COMPARISON OF THE ENERGY SOURCES CURRENTLY AVAILABLE

ADVANTAGES	DISADVANTAGES
Coal	
Currently recoverable coal reserves are sufficient to economically supply fuel for the life of a power station, and beyond.	Although Collie Coal is low in sulphur content, compared with other Western Australian coals, its combustion does produce sulphur dioxide gas.
Coal is currently cheaper than other forms of fuel, such as oil or gas, and its use therefore produces cheaper electricity.	Combustion of coal produces solid ash waste which must be disposed of.
Coal supply can be guaranteed at a nominated price.	

ADVANTAGES	DISADVANTAGES
Natural Gas	
Gas combustion does not produce sulphur dioxide or solid wastes.	No gas supplier, either alone or in combination with others, has been able to demonstrate sufficient gas reserves to guarantee enough gas to supply existing and currently planned plant as well as a large new station. Gas combustion produces significant amounts of nitrogen oxide gases. Gas is more expensive than coal.
Fuel Oil	
Oil is easily transported and flexible to to use - making it ideal for power station initial start-up and emergency purposes.	Oil reserves in Western Australia are small. Oil is relatively expensive, compared to coal or gas. Oil has a high sulphur content - producing significant quantities of sulphur dioxide gas on combustion.
Uranium for Use in Nuclear Power Generation	
Western Australia and the Northern Territory have large reserves of Uranium Oxide and Thorium.	Enriched Uranium, the feedstock for power plants, is not produced in Australia. Very high capital cost to construct nuclear power stations. For nuclear power plants to be economic, they must be large (greater than 1,000 MW). There is doubt concerning the integrity of long term disposal of highly radioactive spent fuel rods.
Wind Energy	
Wind, the energy source, is renewable. No gaseous or solid wastes are produced during operation.	Fluctuation in winds makes wind energy an unreliable source which cannot meet a continuous demand. For this reason, wind turbine installations require 100% capacity back up by conventional generators.

ADVANTAGES	DISADVANTAGES
Wind Energy	
	The high capital cost of wind turbine installations and the fact they need conventional back up makes wind generated electricity 2 - 3 times more expensive than conventionally generated electricity. The largest wind turbines currently available are in the 1-2 MW range.
Solar Thermal	
Solar radiation, the energy source, is renewable. No gaseous or solid wastes are produced during operation.	Solar thermal installations are variable in their efficiency, due to the seasonal change in solar radiation intensity. Solar thermal installations have a low capacity factor, about 20%. The high capital cost of solar thermal installations makes solar generated electricity 2 times more expensive than conventionally generated electricity.
Solar Photovoltaics	
Reliable source of renewable energy. No gaseous or solid wastes are produced.	Solar thermal installations are variable in their efficiency, due to the seasonal change in solar radiation intensity. Solar thermal installations have a low capacity factor, about 20%. The very high capital cost of these installations makes photovoltaic generated electricity 5-10 times the cost of conventionally generated electricity.
Hydro Energy	
The energy source is renewable. No gaseous or solid waste are produced. Some potential for development in the northern areas of the State to supply local power demand.	The low rainfall and subdued topographic relief of Western Australia, particularly the south-west, limit the opportunity for development. The cost and environmental implications are dependent upon the selected site.

ADVANTAGES	DISADVANTAGES
Tidal Energy	
The energy source is renewable. No gaseous or solid wastes are produced. Potential for development on the north-west coast of the State.	The north-west coast of Western Australia has a large tidal range (about 11m) and therefore the potential for tidal energy development. The distance between suitable locations in the north-west, and the power demand centre in south-west makes this energy source economically unviable. Environmental impact of such a development is unknown.
Wave Energy	
The energy source is renewable. No gaseous or solid wastes are produced.	Possible sites near the power demand centre do not have the necessary wave climate. Technology is not sufficiently developed to provide large scale base load power. The fluctuation in wave patterns and strengths make this energy source unreliable, and unable to meet a continuous demand. High capital cost.
Geothermal Energy	
Energy source is renewable. No gaseous or solid wastes are produced.	Western Australia's geothermal energy sources are low grade (50 to 140^{o}C) with gradients in the Perth basin of about 25^{c}/km and cannot be used to provide base load power. Usable energies exist, in depths of 1,500 m to 4,000 m, if end uses could be found that justified the capital cost.

Renewable Energy Options

The use of plant generating electricity from renewable sources is currently used by SECWA in some remote locations, not connected to the central electricity grid. However, the use of renewable energy sources to generate base load electricity supplying the interconnected grid poses many problems.

The two renewables that are closest to offering economic prospects for contributing significant amounts of energy to the State, are wind and solar thermal.

Other sources, such as tidal, wave, and solar voltaics, although available in significant quantities, are far more expensive than wind and solar thermal at this time.

A small energy source that has a significant impact on the greenhouse effect, is methane from landfills. This will be systematically developed over the next few years but will not impact on the need for large power stations.

To explain the current position of wind and solar thermal systems, it is convenient to examine the situation in California, where both technologies lead the world in installed capacities. 1400 Megawatts (MW) of wind and 300 MW of solar thermal has been installed in California. The current cost, delivered at the facilities terminals, for solar thermal is about 10¢ Australian, per kWh. Our work to date indicates that wind will deliver energy at about 10 to 12¢ Australian per kWh and this is confirmed by the prices currently being payed by utilities for power from wind farms in California. However, the strength and frequency of surface wind is unpredictable. This is why wind farm generation capacity is always backed up, or duplicated 100%, by conventional generators.

The LUZ solar thermal system is being developed for larger scale systems and they predict that a 274 MW system will deliver energy at 7.5¢ Australian per kWh.

Wind on the other hand, has developed to the point where there is little prospect of a price reduction within the next few years.

How do these systems operate in California? The answer is complex but has its route in Federal Legislation, through the Public Utilities Regulatory Policies Act 1978 (PURPA), State Legislation and Commissions, such as, Federal Energy Regulatory Commission (FERC) and Federal and State bodies such as the Californian Energy Commission (CEC) and Californian Public Utilities Commission of California (CPUC).

These initiatives resulted in projects in California that were based on a contract known as the Interim Standard Offer 4 (SO4). The SO4 was only available for a short period up until April 1985, when it was withdrawn by the CPUC because of over subscription.

The contract offered:-

1. 30 year's power purchase;

2. 10 year's fixed power purchase price based on the current (1985) utilities avoided costs. At the time, these were about 10¢ Australian per kWh;

3. Access to the transmission system; and

4. Five year's from the signing of the contract to develop the project. In some cases this period was later renegotiated to longer times to forestall all the generation coming on at the same time.

Up until 1986, various tax incentives were available as follows:-

1. Federal renewable rebate of 15%;

2. Federal general machinery rebate of 10%; and

3. State rebates of 25%.

The only one remaining is the State rebate now set at 15%.

These tax initiatives helped, but it was the price paid per kWh and the development period, that has allowed wind and other renewables to continue to be developed up until recently. The current picture is not so clear as the price offered is now about 3 to 4¢ Australian per kWh.

Two final points that have to be considered if the example of a system such as California is to be considered as a model:-

1. The characteristics of the electrical system; and

2. The local environmental conditions.

The Californian electrical system is over 40,000 MW and is heavily interconnected with adjoining states. The local air quality of the major cities of Los Angeles and San Francisco are very poor and is partly brought about by the geographical features of the area. The result is a major incentive to clean up the local air which has led to many initiatives including those just discussed.

If Denmark, or any other similar situation, is closely examined, the same sort of initiatives will be found to have taken place to allow conventionally uneconomic renewable energy sources to be developed beyond the demonstration stage.

In addition to the pure economic cost of power from these two sources, their ability to contribute to other important aspects of a comprehensive supply system has to be examined.

SECWA's system is small by world standards and it is totally isolated, there is no neighbour to save the situation if there is an energy deficit because the mix of energy sources is not right.

Wind is totally unpredictable from a power generation point of view. It is just as likely to be operating at full capacity in the small hours of the morning when it is not needed or not at all in the middle of the afternoon when there would be a greater demand. The exact opposite is also true. Solar thermal is more predictable but suffers from a low capacity factor (about 20%). It does, however, deliver its best performance in the summer months when it is coincident with SECWA's peak summer loads.

However, because of the variable nature and generally poor capacity factors, these sources need to be supplemented by schedulable, reliable systems which can in fact supply the whole need of the State when the renewables are unavailable. Consequently, these systems, and especially because of the small size of the Western Australia's system, can only be credited with the avoided fuel costs and in the case of Western Australia this is coal and gas.

In any event they cannot be relied upon to an extent which would enable them to make any contribution to a proposal to forestall or obviate the need for additional, reliable and schedulable generation.

Research and Development of Alternative Energy

SECWA has recently combined several areas of its expertise to form the Renewable Energy Branch. The main scope of the branch is to research and investigate the viability of renewable and alternative technologies, and assess their possible use in the various electricity demand situations found in Western Australia.

The Renewable Energy Branch is actively researching the following projects.

1. The cost effectiveness of renewable and alternative technologies for remote area (those isolated from the interconnected power grid).

2. Wind power installations in remote locations, and also on the interconnected system.

3. Possible expansion of the Esperance wind farm.

4. Land Fill Gas (LFG). LFG is methane produced by decomposing refuse in rubbish tips. LFG has been collected and used for power generation and, after treatment, has also been injected into gas distribution systems in the USA and Europe.

   The Renewable Energy Branch intends to assess, drill bores and run production tests at refuse sites in the metropolitan area.

   Using data from the production tests, through computer modelling, an estimate of the total resource can be obtained.

SECWA, through the Renewable Energy Branch, participates on committees of the Mineral and Energy Research Institute of Western Australia and the Renewable Energy Advisory Council.

SECWA', through this Branch, also funds the Murdoch University Energy Research Institute (MUERI) for research into:-

- remote area power stations;
- battery storage for renewable energy sources;
- solid state power conversions (AC/DC converters);
- remote applications of photovoltaics for desalination; and
- specially designed appliances for remote Aboriginal communities.

It is difficult to estimate the amount of power which alternative energy options could possibly provide in the future.

Western Australia's installed co-generation capacity is currently 396MW, which is substantial considering the small industrial base in the State. SECWA is currently negotiating with several large industrial customers to further expand the State's co-generation capacity.

As already stated, SECWA actively supports the use of efficient end use equipment through the energy rating system and advisory services. It is, however, very unlikely that more efficient end use equipment will reduce demand significantly in the next five years. This is because new efficient end-use equipment will only be put into service by customers when present equipment is at the end of its usable life, and thus requires replacement. One would expect, therefore, that replacement of present equipment with more efficient equipment will occur progressively over a long period of time. The reductions in power demand realised by this upgrading of equipment are very difficult to forecast and equally difficult to measure retrospectively.

SECWA has been innovative and active in pursuing the development and greater use of renewable energy sources. SECWA developed the first large wind farm in Australia, the 360kW Esperance wind farm. This wind farm is still the largest wind farm in Australia. As discussed, SECWA is currently investigating the possibility of further expanding the Esperance wind farm, and the potential for similar wind farms in the State.

4. POWER STATION TECHNOLOGY

In the last decade, a great deal of research and development has been undertaken to improve the efficiency and pollution control aspects of fuel burning and power generation technology. As well as improvements in conventional fuel burning technology, several alternative fuel burning technologies have been developed to the demonstration stage. The more promising of these technologies are described below.

Fluidised Bed Combustion (FBC)

The FBC system uses air to agitate a bed of solid particles, within which the fuel is dispersed, in the combustion chamber or boiler. Limestone or a similar sorbent is added to the bed to facilitate ash removal and also acts to absorb sulphur compounds in the combustion process.

Combustion in the boiler is maintained at a low temperature, with longer residence time than conventional boilers. Operation at this lower temperature inhibits the production of NO_x.

The main advantage of this type of system is that low grade fuels with high sulphur content can be burnt and produce only low sulphur dioxide and NO_x emissions. However, this type of system is only available in relatively small units (maximum 150MW) at high capital cost.

The principal application of this technology is the combustion of difficult to burn coals with high ash and sulphur content. Collie coals are easy to burn coals with very low sulphur (0.7%) and relatively low ash content.

It has been demonstrated (see Section 7 of the ERMP) that the burning of Collie coal at the proposed site will not produce ambient SO_2 levels above the relevant ambient air quality standards.

This technology, therefore, does not confer any advantage for the Proposed Collie Power Station, but does impose a higher cost which would be reflected in the cost of electricity to the customer.

Pressurised Fluidised Bed Combustion (PFBC)

PFBC combines a steam cycle together with a gas turbine cycle in such a manner to maximise efficiency.

The concept of a PFBC power plant comprises a pressure vessel with a fluidised bed boiler as the main component. The fuel, together with limestone, is pumped into the pressurised fluidised bed and mixed with compressed air (from the gas turbine). The combustion temperature is maintained at 850 - 950°C. Heat is removed from the bed by tube banks which produce steam to run the steam turbine-generator set.

Hot gas leaving the bed is cleaned to remove particulates, and advanced to the expansion section of the gas turbine, where expansion of the gas drives the gas turbine, producing approximately one third of the plant's electric power. As well as driving the electricity generator, the gas also drives an air compressor which pumps air into the boiler to maintain the required pressure.

The designers of PFBC power plant hope to achieve operating efficiencies of around 40% (on a sent out basis), as compared to the 34% efficiency of conventional coal fired steam plant.

The low combustion temperature (approximately 900°C) and high pressure in the pressurised fluidised bed inhibits NO_x formation and enhances sulphur reaction and retention with the limestone.

The PFBC technology is still in the development stage but has been demonstrated in test and pilot facilities. Three 70MW units are now under construction, one each in Sweden, USA and Spain. The operational flexibility and reliability aspects of these plants will be demonstrated by these installations currently under construction.

Like FBC, the main use of PFBC is for difficult to burn coals with high sulphur and ash content.

PFBC is not yet commercially proven, and thus has unknown operating reliability.

Because the south west electricity system is an isolated system, without back-up or support from other electricity supply authorities, any major electricity generating plant commissioned by SECWA must be commercially proven with known high availability and reliability.

Integrated Gasification Combined Cycle (IGCC)

The IGCC process again combines a steam cycle together with a gas turbine cycle to maximise efficiency. Prior to combustion the coal feed is chemically reacted to produce combustible gases which become the fuel source for the plant.

In the coal gasification process, coal is reacted with a gasifying agent, such as oxygen and steam, to produce the combustible synthetic gases (syngas) carbon monoxide, hydrogen and methane. The downstream process cools and cleans the syngas, removing toxic trace compounds and sulphur. Up to 99% of carbon in the coal is converted to the syngas.

The clean syngas is then advanced to the conventional combined cycle gas turbine plant described on the next page. The IGCC plant can generate electricity at a net efficiency of about 42%.

In addition to greater efficiency, this plant can be operated with minimal polluting emissions. Sulphur compounds in the coal are converted to H_2S and CO_S and are 99% removed by gas scrubber systems. In the gasification stage, the coal ash is melted and leaves the bottom of the gasifier as an inert glass-like material.

The technology of coal gasification combined cycle plants has been demonstrated briefly by the Cool Water Coal Gasification programme which successfully operated for 3 years in California. This 100MW

power plant is regarded as the cleanest in the United States, but because of its design it has a net efficiency of only 32%. A different method of cleaning the gas is now being developed for the IGCC and this will improve the net efficiency of the plant.

IGCC is not yet a proven technology. The main theoretical benefits of IGCC are that (1) very low quality high sulphur coal can be used, and (2) overall efficiency of the system can be as high as 42%.

However, these benefits are not applicable to Western Australia. Firstly, Collie Coal has a very low sulphur content. Burning Collie Coal at the proposed site will not produce ambient SO_2 levels above the relevant air quality standards.

Secondly, the current gas cleaning systems which are an intrinsic part of the IGCC significantly reduce the overall efficiency of the power station. Improved gas cleaning systems and thus higher efficiency are expected to be available in the late 1990s.

Combined Cycle Gas Turbine

The combined cycle gas and steam turbine plant combines a gas turbine and steam turbine cycle to again maximise efficiency.

This combination of plant is not new, but has benefited in recent years from continued development and commercial competition.

In essence, the process recovers the waste heat from conventional gas turbine plant in a waste heat boiler, and utilises this heat in conventional steam cycle plant to generate further electricity.

The combined cycle plant, through recovery of heat which would otherwise be lost in the exhaust, can produce approximately 50% more electric energy at the same fuel consumption.

Combined Cycle Gas Turbines are not applicable to a power station in Collie because they require premium fuels such as gas or oil, which are more expensive than coal and not currently available in sufficient quantities.

Combined Cycle Gas Turbines are suitable for the south west electricity system and are being considered as an alternative to the Proposed Collie Power Station.

It should be noted that boiler design for efficiency and NO_x and SO_2 control will be an important component considered in the selection of plant used at the Proposed Collie Power Station.

5. WATER SUPPLY IMPACTS AND MANAGEMENT

The major concern when considering the possible impact of the proposed groundwater development on the basin hydrology is the possible de-watering of shallow aquifers, which presently support both natural vegetation and agriculture and may be necessary for the area's ongoing potential for pine forestry.

Any production bores installed would be constructed to produce principally from aquifers below about 100m, and the proposed bore design would include features to exclude production from the shallow depths. Thus any effect on surface vegetation will be minimised.

SECWA maintains an ongoing groundwater monitoring programme utilising the expertise of groundwater consultants with specialist experience in the Collie Basin groundwater field.

After 7 years of groundwater draw-down monitoring and investigative predictive modelling, the consultants concluded

> "... that there is not generally a direct hydraulic inter-connection between the surficial (upper) aquifers and wetlands on the one hand, and deeper aquifers within the basin" (from which groundwater is abstracted).

This suggests that groundwater abstraction from the deeper water resource will have little or no direct effect on the shallow and surface groundwater resource.

As requested by the EPA, SECWA asked the specialist groundwater consultants whether the methods and accuracy of groundwater/water table impact prediction could be improved by the use of a Collie Basin Water Balance groundwater model. Australian Groundwater Consultants (AGC) have previously developed localised water balance models but they considered it impractical to model the Collie Basin groundwater system with any degree of accuracy because:-

- The basin structure is complex with numerous interburden and aquifer layers, folded and faulted into the tri-lobed basin (Cardiff, Shotts and Muja sub-basins).

- The area (230 km^2) and depth (up to 1,500m) of the basin are large to model.

- The mining and water management activities are variable over time, the releases to surface water courses crossing the Collie Coal Basin also vary seasonally and have complex surface-water/ groundwater interactions.

- All the above conditions dictate a need for a large and complex computer model. Perhaps the most comparable example familiar to water resources managers in Western Australian would be the Perth Urban Water Balance Model which was doubtless extremely costly to produce and yet lacks the sort of definition required of a useful computer model of the Collie Coal Basin's groundwater system.

AGC and others have applied complex three-dimensional numerical modelling to mine dewatering and wellfield design problems within the Collie Basin. In the preparation of the 1985 report, AGC used analytical and finite-difference models for such purposes. However, these are valid as 'tools of the trade' for groundwater projects but are not the sort of numerical model that can be used to out-put scenario predictions of the impact of wellfield abstractions on the water-table and surface vegetation

It is SECWA's intention, in conjunction with the coal mining companies, to adopt the recommendations expressed in the Water Authority's "Collie Coal Basin Water Resources Management Strategy" (1988). SECWA will use suitable mine water in preference to independent supply wellfields for power station water supply. Recent mine water supply projections from the Collie Coal companies indicate that mine water abstraction will be sufficient to supply all of the proposed power stations water requirements.

The relative proportion of mine water and bore water use at Muja Power Station has varied greatly over the life of the station. In the last 12 months, mine water has supplied 70 - 80% of Muja Power Station's requirements. Bore water has supplied the remaining 20 - 30% of water required.

Several in-house studies have examined, in detail, the possible use of Wellington Dam water for the proposed Collie Power Station.

Wellington Dam water has been used for cooling at Muja Power Station. The pipeline to Muja supplies only 10% of the power station needs. Upgrading or replacement of the pipeline would require large capital expenditure. This cost alone makes the project uneconomic, and this is even more so when the cost of the water itself is considered.

Although the use of Wellington Dam water has been considered, the development of a suitable pumping system would be expensive and supply is subject to other use restrictions.

The water requirement of the Proposed New Collie Power Station is approximately 25,000 m^3/day. The cost of the water alone, at the current tariff rates, makes this highly uneconomic. Mine water can be treated to a reasonable quality for a fraction of this cost.

Furthermore, the Water Authority is committed to supply the Great Southern Town's water scheme from the pipeline which passes the proposed power station site. The Water Authority has indicated that they would not be able to guarantee the supply of water. Thus, for maintenance or in the event of drought, the power station's water supply would be restricted. The operation of the power station would similarly be restricted.

Intermediate Quality Pond

The intermediate quality pond will be lined. The single membrane system depicted in the attached diagram is the most likely arrangement of the many systems being considered. The single membrane incorporates the following features:-

1. The upper sand layer will be sloped to allow drainage to collect by gravity into collection sumps. A crushed rock or gravel layer may be used on top of the High Density Poly Ethylene (HDPE) layer. Collection pipes would be embedded in the crushed rock. The spacing of the embedded pipes will be designed to limit the depth of the leachate.

2. The thickness of the HDPE liner will be determined by engineering design, but is expected to be in the range of 1 - 2mm.

3. The collected leachate will be recycled, by pumping, back into the pond. This process greatly reduces the hydrostatic head pressure upon the pond lining.

4. The HDPE liner will be seal welded and hydrostatically tested to ensure "water tightness".

5. Monitoring bores will be installed to detect any breach of the pond lining.

6. Interceptor bores are a further enhancement which may be added if design or operational requirements dictate.

The lining system outlined represents the ultimate solution for lining the pond. Other less sophisticated and less costly methods are currently being evaluated. The choice of which system will be made after detailed, rigorous engineering analysis has been carried out.

6. COAL SUPPLY

Additional mine development would be required if the Collie Power Station is developed, though there would be some opportunity to supply the new power station from existing mines during the first years of operation.

Three new open cut mine areas have been proposed as possible sources of coal for the new station. Two of these areas are owned by the Griffin coal Mining Co. (Ewington and Premier) and the third is owned by Western Collieries Ltd (Premier). All three areas are situated in State Forest, due east of Collie, and immediately to the south of the proposed power station.

Any one of these areas could supply all the station's coal requirements for the 30 year life of the station, so the supply source will be chosen on the basis of price, coal quality (ash and sulphur content and specific energy) and ability to provide a consistent quality product over the life of the project. The offered coal price will contain a component for rehabilitation plans. Environmental aspects of existing and future coal mining operations in the Collie Coal Basin are covered by Agreement Acts between the Government and relevant mining companies as well as by the provisions of the Environmental Protection Act. The mining companies are responsible for seeking environmental approvals for proposed mines.

Both Griffin and Western Collieries have discussed their long term mine development proposals with the Collie Basin Management and Planning Group for the purpose of developing an integrated structure plan for the Collie Basin. EPA were invited to inspect the plans and to comment on the open cut mine areas proposed. It is understood that the Manager of the Environmental Assessment Branch at EPA has retained a copy of the plan.

7. WASTE MANAGEMENT (Solid and Liquid)

For the proposed Collie Power Station two methods of on-site ash disposal are being considered; a dry ash disposal method, and a dense phase slurry disposal method. Off-site disposal, where ash is combined with mine overburden, is also an option. These disposal methods are characterised by low hydrostatic head, limiting the potential for leachate leakage. The pozzolanic nature of the fly ash results in hardening of the deposited ash, which will further inhibit leachate seepage.

Fly Ash Dam Siting

SECWA has thoroughly investigated the siting of the fly ash dam with respect to the geotechnical and environmental considerations. As part of these investigations, SECWA commissioned specialist consultants to investigate the flood characteristics of the Collie River East Branch and associated implications for the ash disposal area.

The study determined rainfall intensity on the local catchment for storms of varying durations and return periods. The probable maximum precipitation (PMP) and temporal distribution of rainfall intensity on the catchment for storms of varying duration were also ascertained. This data, together with catchment and sub-catchment characteristics was entered into the runoff routing programme, RORB-Version 4 (RORB). The RORB programme was run to assess the peak discharge which would result from the PMP on the catchment and sub-catchments above the proposed ash storage area. Flood levels in the river were calculated using a microcomputer based programme. This programme incorporates the Manning formula to calculate stage discharge relationships and uses the standard step method to establish backwater effects. The flood levels in the river resulting from storm events with an annual exceedance probability of 1 in 200 years and 1 in 100 years were determined.

These investigations concluded that the dam would be well clear of flood levels associated with a 1 in 200 year flood. Thus flood waters will not have an effect on the integrity or stability of the dam.

Furthermore, the ash dam will be designed to ensure that over-topping or breaching by flood waters does not occur. The design will take into account loads caused by extreme flood events and seismic loads.

The proposed ash storage area has been subject to recurring long term disturbance through cropping, grazing of farm animals and erosion. Hence, the area consists mainly of grazed pastures dominated by alien grasses and legumes. Within this area, particularly close to the river, there are isolated Wandoo trees and remnant pockets of bulrush and sedge swords. The remnant vegetation closest to the river is outside the ash storage area and therefore need not be removed.

A flora survey of the proposed site in 1984 found that none of the rare or restricted flora, which may have originally occurred in the area, were present.

Potential Uses of Fly Ash

There are possible alternative uses for fly ash, particularly in construction works, which SECWA's Corporate Development Branch has been investigating for several years. SECWA will be supplying approximately 18,500 tonnes of fly ash to be combined in roller compacted concrete for use in the Victoria Dam project beginning in 1991.

SECWA is currently trying to further develop the use of fly ash in other building materials, including readymix concrete, building bricks and pozzolanic cement.

Rehabilitation of Fly Ash Disposal Areas

The successful rehabilitation of previous fly ash disposal areas at South Fremantle and Turkey Point, Bunbury has been carried out by SECWA. The methods employed are selected to achieve stabilisation as quickly as possible, with due consideration to the use of native and,

where appropriate, local flora. The basic procedure used to achieve acceptable rehabilitation is as follows:-

1. Fly ash ponds are often subdivided into smaller ponds so that each small pond can dry out and rehabilitation commence while the remaining ponds are being filled.

2. Following drying, the surface of the pond is recontoured to produce natural and stable contours and drainage lines.

3. Suitable topsoil is overlain, and combined to a depth of approximately 300 mm.

4. Surface ripping is then undertaken to a depth of approximately 700 mm, thus minimising surface and subsurface run off and erosion.

5. Suitable ground covers, shrubs and trees are planted and tended until finally established.

In addition to the techniques outlined above, SECWA will investigate additional methods which may be employed to enhance the success of rehabilitation. The capping of the dried fly ash area with a compacted clay layer (or other appropriate material) is sometimes used to prevent rainfall infiltration and subsequent contamination. This is one method which will be investigated, however, the disposal method selected will also play a role in determining the appropriate rehabilitation methods used. Similar methods will be used to rehabilitate the Muja Power Station ash disposal area.

8. AIR EMISSIONS

To assess the impact of the Proposed Collie Power Station on the local air quality, two sets of predictive air emissions modelling work were conducted:-

(i) emissions from the Proposed Collie Power Station were considered in isolation; and

(ii) other sources of airborne emissions in the region were taken into account.

Apart from the emission data, input of environmental information to the model includes actual wind speed, direction, atmospheric stability and temperature data measured over a period of 12 months at a meteorological base station in the Collie Basin area.

Model predictions of the annual, 24-hour and 1-hour SO_2 dispersion patterns, taking into account emissions from other major sources in the area, are shown in Figures 7.1 to 7.3 in the ERMP. The highest predicted annual average concentration is 7 $\mu g/m^3$ and highest 24 hour concentration is 75 $\mu g/m^3$. As before, there is no threat to the annual or 24 hour standards. However, the 1 hour Victorian Environmental Protection Authority (VEPA) acceptable level of 486 $\mu g/m^3$ is approached with the maximum predicted concentration of 408 $\mu g/m^3$ reached in the buffer zone adjacent to Muja Power Station.

Since the VEPA acceptable level is permitted to be exceeded on up to three days per year, it can be considered that the impact will be within the VEPA criterion. The levels are well within the US EPA 3-hour standard of 1,300 $\mu g/m^3$. Two further considerations, discussed below, show that there is no cause for concern.

Firstly, Table 2 shows the frequency of occurrence of ground level concentrations in various concentration ranges for the receptor with the highest predicted hourly concentration. This demonstrates that high concentrations are rare events.

Secondly, as may be seen from Figure 7.3 in the ERMP, the location of the peak SO_2 prediction is immediately north of Muja Power Station and can be demonstrated to result mainly from the operation of Muja units C and D. The predicted capacity factor of these machines is only 70% (not 100% as modelled). A model run, including these capacity factors and realistic weekly load cycles for each month, resulted in a reduction at the same location to 317 $\mu g/m^3$ (i.e. approximately 20% lower).

TABLE 2

FREQUENCY OF OCCURRENCE OF 1-HOUR CONCENTRATION ESTIMATES

CONCENTRATION ug/m^3	NO. OF OCCURRENCES PER YEAR
450 - 500	1
400 - 450	1
350 - 400	2
300 - 350	3
250 - 300	10
200 - 250	24
150 - 200	64
0 - 150	8,304

More recent detailed air emissions modelling work of the Proposed Collie Power Station has confirmed previous results that the ground level concentrations of sulphur dioxide at the nearest private properties and the Collie township are well below the relevant standards. This modelling also indicated that the plumes from the power stations and the Worsley Alumina refinery do not overlap significantly.

9. TRANSPORT ROUTE

Collie Bypass Road

The proposed road alignment for the Collie Bypass Road has changed to avoid sterilisation of the local coal resources. The suggested realignment now deviates from Coalfields Road on the west side of Allanson, and is located further north of Collie town. The proposed alignment is therefore closer to the Proposed Collie Power Station site. The final proposed alignment of the Collie Bypass Road will not be known until the Collie Development Structure Plan is finalised and published by the Department of Planning and Urban Development.

Existing Roads

The existing roads through Collie are structurally capable of handling the amount of truck traffic envisaged. Surface upgrading of some roads will be carried out to improve road surfaces, and minor repairs will be required from time to time. The transport of coal and over-dimension loads does presently occur through the town on a regular basis.

The movement of oversized loads will be strictly controlled by the Main Roads Department and, in discussions held to date, no problems are envisaged. There will be some instances when special provisions for the movement of loads will be required, this is especially true for the heavier loads. However, such moves will be few in number, strictly controlled and undertaken at times to minimise impact on the local community.

Preferred Route B

SECWA engaged a specialist traffic consultant group to address all factors of traffic safety and the impact of increased traffic volume on the local community. The group assessed all facets of the existing and projected traffic flows along the alternative routes. In particular, the group scrutinised the alternative routes to highlight structural deficiencies requiring upgrading of roads and geometric deficiencies of intersections and road shoulders.

All of these factors were considered in SECWA's assessment and choice of the preferred route. Route B was determined to be the preferred route for the following reasons:-

(i) Route B is significantly shorter and cheaper.

(ii) Route B avoids any crossing with a coal haulage road, thus keeping general access to the site completely separate from coal haulage routes and mining areas.

(iii) Route B does not require passage through State Forest.

(iv) The route of the proposed Collie by-pass road which has been incorporated into the Collie Town Planning Scheme is consistent with the preferred route. The future construction of the by-pass would confer further advantage to the preferred route, by removing power station traffic from the town and residential area.

Traffic impact upon residences will be minimised by:-

(i) Completely sealing the road surface to reduce dust generation;

(ii) Upgrading roads and intersections, and providing passing lanes to improve safety and minimise congestion;

(iii) Applying suitable traffic speed limits to improve safety; and

(iv) Planting of vegetation along verges to reduce dust and noise.

Modification of some intersections has been allowed for in the cost estimate and choice of Route B as the preferred option. The modification of right angle intersections may be performed to smooth out intersections. Structural barriers may also be employed at some intersections.

Modification and upgrading of roads and intersections will be negotiated with the Main Roads Department and the Collie Shire Council.

10 FLORA AND FAUNA STUDIES

Atmospheric Emissions and Regional Flora

Many studies have been carried out in Australia, North America and Europe to assess the effects of industrial atmospheric emissions on agricultural crop species and natural vegetation. SECWA itself has funded research at Murdoch University into the effects of sulphur dioxide gas, a power station emission, on native vegetation.

Not surprisingly, the results of such research has shown that the effects of sulphur dioxide emissions on plant species is species-dependent and varies depending upon the concentration of sulphur dioxide.

The responses of crop species exposed to sulphur dioxide concentrations of about 13, 138 and 285 $\mu g/m^3$ for 8 hours per day throughout the life of the plants was variable. Some crop species appeared to be sensitive to the higher sulphur dioxide conditions, showing yield reductions of 5% and 25%. Other crop species appeared to be less sensitive, showing a positive yield increase of 10% at moderate sulphur dioxide concentrations, and no change in yield at the highest sulphur dioxide concentrations.

A more recent study, carried out by Murdoch University researchers in 1989, investigated the effects of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) on vegetation native to the south west of the State. The study screened a diverse range of native plant species for sensitivity to SO_2 and NO_x. The plants were subject to the most realistic worst case pollution conditions practically feasible, simulating exposure under temperature inversion break-up conditions for 2.5 hours per day.

The study results suggested that native plants show variable responses to SO_2 and NO_x, the major emissions from a coal fired power station. A small percentage of the plants screened in the study did exhibit moderate visible injury to the combined worst case SO_2 and NO_x conditions. The study concluded that the native plants

appear to be relatively tolerant to the pollutants, in comparison with known sensitive species.

Given that most studies of this nature:-

(i) expose the plants to consecutive periods of worst case pollution conditions; and

(ii) indicate that native plant response is fairly minor, though variable;

it is expected that the emissions of the Proposed Collie Power Station, in combination with other local emission sources, will not have any significant impact on the local vegetation.

Effect of the Project on Local Fauna

In general, the diversity of animals in an ecosystem is correlated with the ecosystems habitat diversity, particularly the stratification and structure of the vegetation.

The greatest concentration and diversity of life are found on the ground layer and just below it.

Fallen logs, rocks and dense undergrowth provide shelter for ground-dwelling animals. Dense leaf litter and bark are utilised by many soil invertebrates, and hollow branches provide specialised niches for nesting birds and small mammals.

Previous fauna surveys indicate that in the Northern Jarrah Forest, wetlands, particularly streams and areas of swamp and swamp edge vegetation, are the major habitats for a large proportion of vertebrate animal populations.

Streams and swampy areas provide combinations of water, shelter and food supplies not found elsewhere. Insects living in the streams, vegetation and litter layer are important, both as a part of the diet of insectivorous vertebrate animals and also as part of the litter

decomposition cycle. Many species of reptiles, amphibians, birds and mammals are dependent on stream and swamp vegetation for nests, and shelter in the trees and understorey.

The vast majority of the power station site and buffer zone has been continuously disturbed over a long period. Most native vegetation, and hence habitat diversity, has been removed. As a farm, the ground has been cultivated and fertilised, sown with alien crop species and harvested, and grazed by sheep. The habitat diversity and animal niche density of the area has thus been significantly decreased.

However, although disturbed, the river bank vegetation of the Collie River East Branch would probably still provide sufficient diversity for many animal species habitats. The vegetation along the river banks will not be disturbed by the power station construction and operations.

The earthworks associated with construction of the power block and ash and water storage areas will certainly impact upon soil invertebrates found in those localised areas. However, disturbance of the majority of the site from fertilising, harvesting and grazing of sheep will be removed.

The removal of these disturbances, combined with planned revegetation and planting, may actually increase the habitat diversity and quality of the site, thereby encouraging the return of some animal species and numbers.

Section 2

Social environment

PROPOSED COLLIE POWER STATION - SOCIAL

Following is a summary of the social issues raised, together with questions to be asked of the proponent.

HOUSING/LAND

The ERMP identified a potential conflict between accommodation for workers and tourism accommodation. The analysis estimated that 30% of the construction workforce will reside in temporary accommodation in either Bunbury or Collie. Further clarification of these points is required.

The ERMP identifies the housing requirements for the operations phase and outlines SECWA's special purchasing agreements. The adequacy of these measures to handle the projected needs is questioned.

The possible impact of nuisance effects on the value of properties nearest to the project was raised in submissions.

QUESTIONS

What is the nature of the "temporary accommodation" referred to? What arrangements have been made to monitor the effects on tourism accommodation throughout the construction phase? What measures will be employed to ameliorate such a conflict should it occur?

What is the extent of SECWA's provision of land and housing in the Collie township for operational personnel? What is the estimated shortfall in required housing in Collie? What will the effects of this shortfall be on adjacent areas? What arrangements have been made to monitor the need for housing in the area?

What arrangements will the proponent put in place to monitor and mitigate impacts on land values adjacent to the project?

NOISE

The applicability of the noise predictions shown in Figures 8.1 and 8.2 was questioned. In particular it was questioned if the correct location of the plant within the site and the effects on local topography were included in the noise modelling.

The possible effects of noise on the nearest residents and on property values were raised.

QUESTIONS

Are the figures relating to noise consistent with the plant site layout shown in Figure 4.2? Were local topographical features included in the noise modelling? What will be done if noise levels are found to be unacceptable?

ACCESS ROUTE/TRAFFIC

The statement that the preferred route B was shorter (than route A) was questioned. It was suggested that the location of the power station within the site may effect the distance comparison.

It was put that route B has several characteristics that should be noted:

- a 90 degree turn from Coalfields Highway within a residential area,
- a 90 degree turn from Palmer Road into Williams Road within a residential area (with a Kindergarten at the corner), and
- a number of steep hills on the route.

It was maintained that these characteristics would lead to unacceptable noise and vehicle emissions within residential areas.

The need for road upgrading to utilise route B was also raised.

It was also suggested that an extension of Mornington Road could be utilised to divert traffic north of the Collie townsite and avoid further pressures on existing road systems. The impact on Mornington Road (from South West Highway through to Collie), by construction workers, visitors etc. coming from the north (Perth) was also raised. It was put that any increased traffic on the Harvey end of this road might warrant its upgrading.

QUESTIONS

To what extent were the factors mentioned above considered in the selection of the preferred access route? What arrangements have been made to monitor the impacts of the access route on residents along the route? What measures are planned to manage any possible impacts?

What arrangements have been made for the required upgrading of roads?

What are the predicted impacts on Mornington Road? What arrangements have been made to manage and monitor any possible impacts on Mornington Road?

REPORTING

The commitment to regular reporting does not specifically refer to reporting on the social monitoring programme or impacts on infrastructure, facilities and services.

QUESTIONS

How will SECWA monitor and report on the social effects of the project?

OTHER

Other issues raised included the location of the substation and transmission lines and the impacts of site and route selections. Impacts to be considered included the influence of these sitings on the access route selection and the effect on access by future mining operations to Collie Airstrip.

QUESTIONS

What arrangements have been made to assess and manage the potential impacts raised above?

Your Ref
Our Ref
Enquiries
Telephone

1/32/96
Mr J Robinson
326-4180

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SECWA

16 November 1990

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

ATT: Mr S Watson

Dear Sir,

RE: Proposed Collie Power Station - Social Issues

Please find enclosed, SECWA's responses to public submissions regarding social effects of the Proposed Collie Power Station. Your recent informal assessment advice has been taken into account and amendments made accordingly.

I trust the attached response meets with your approval.

Should you have any queries, please contact Mr J Robinson on 326-4180.

Yours sincerely

A J BEAUMONT
MANAGER SYSTEM PLANNING
encl.

SD 7052 & 7057
\L\227.bsc

NEW COLLIE POWER STATION - SOCIAL ENVIRONMENT

GENERAL

The potential social impacts of construction of the new Collie Power Station may best be monitored and addressed by forming a suitable working group in Collie. The group should consist of representatives of agencies directly involved or affected, in the local sense. This may also include representatives of other major local industries. Shire Councillors may be valuable representatives as they are directly accessible by the local community. The group could meet at regular intervals during the first three years of construction and as required for the remainder of the construction period.

The group could best act by hearing concerns from the public regarding the social effects of power station construction, identifying possible solutions and providing a mechanism to convey these to the proponent and other authorities who may be able to implement corrective action.

Reporting of social issues may be included in the annual report from SECWA, which comprises data from the various biophysical monitoring programmes undertaken by the proponent (see section 9.5.7 in the ERMP). This annual report will be sent to the relevant authorities, including the Environmental Protection Authority.

The concept of the working group has been discussed informally with the Collie Shire, who agree that this is an appropriate mechanism.

Relevant groups who will be invited to provide representation for the working group may include the following:

- Proponent (or main contractor)
- SECWA Generation Division
- Shire of Collie
- Collie Tourist Bureau
- Homeswest
- South West Development Authority
- Shire Councillors
- Social Impacts Unit

HOUSING/LAND

It is estimated in the ERMP (section 8.3.1) that 30% of the non-local construction work force will reside in temporary accommodation. This equates to an estimated 110 persons seeking temporary accommodation in Collie, Bunbury and surrounding regions.

The temporary accommodation referred to includes hotels, motels, guest houses and caravan park sites.

It is worth noting that the number of hotel/motel rooms in Collie is expected to increase by approximately 80 rooms, according to current development plans in the town. Furthermore, the occupancy rate of hotels, motels and guest houses in Bunbury during 1988/89 was 55.8% of an available 1375 beds (Australian Bureau of Statistics). The use of such accommodation by 30% of the non-local construction work force is unlikely to clash with tourist demand for this accommodation.

However, the establishment of the working group should identify any conflict in temporary accommodation use during construction. One possible solution which may be considered in the event of potential conflict in temporary accommodation use may be the provision of further construction camp accommodation.

SECWA currently owns 120 houses in Collie which are occupied by some of the 205 salaried staff of Muja.

The plan to purchase further housing for personnel of the proposed Collie Power Station is still in the process of being developed. It may be expected that the purchase of further housing will approximate the current house to staff ratio of one house to two staff, however this will be determined at a time closer to commissioning of the proposed station. The number of houses required will depend on the number of non-local personnel employed and the market availability of housing at that time. Any shortfall in housing provided and the effect on adjacent areas would be monitored by the working group discussed.

SECWA has purchased a total 1900 ha of land for the proposed Collie power station. As stated in the ERMP 388 ha of this land will form the power station plant site. A further 1500 ha of land owned by SECWA will form a buffer zone around the site. The purpose of this buffer zone, some of which will be reforested, is to isolate the power station operation from immediate neighbours and further minimise any possible noise or other impacts upon adjacent properties. There should not, therefore, be any cause for significant changes in land values adjacent to the project. However, this is an area the suggested working group may also monitor.

NOISE

There have been some refinements in design and plant layout since the noise study was performed for the power station site in 1984, but these modifications are not expected to significantly change the overall noise emissions from the site. The noise study included both prevailing weather conditions and topographic features of the site as an integral component to estimating noise emissions from the site.

The emission and propagation of noise from the proposed power station was predicted using computerised mathematical modelling techniques. Detailed noise source data, local weather conditions and topographic relief were measured and mathematically entered into the computer model to ensure accurate noise predictions were produced.

Noise source data was compiled by measurement at Kwinana and Muja power stations and also from the Electric Power Plant Environmental Noise Guide (Bolt, Beranek and Newman Inc. 1978).

Detailed data on local weather conditions were recorded for the Bureau of Meteorology at the Collie Post Office for 19 years. Wind speed, wind direction and ambient temperature effect the propagation of noise from a site. From the Bureau's recorded data, worst case conditions (calm night-time summer conditions with a thermal inversion) were used for the noise modelling to predict the worst possible noise propagation from the site.

The undulating topography of the site was measured and together with the vegetation cover and other surface obstructions, was input into the computer model using accepted attenuation factors.

The results of the mathematical modelling were used to produce a noise level contour map over a 56 km^2 area surrounding the power station site. These results (Table 8.3 and Figure 8.1 in the ERMP) indicated that the worst case noise levels would exceed the allowable noise levels at three privately owned locations.

Noise control measures for significant noise sources were investigated. Their application was included in a second mathematical noise modelling prediction which indicated that the use of these controls on noise producing plant reduced noise levels at the three locations to below the Assigned Outdoor Neighbourhood Noise Level of 30 dB(A), as applicable under the Noise Abatement (Neighbourhood Annoyance) Regulations, 1979.

As an additional safeguard, SECWA purchased two of the effected properties as they became available on the free market. The remaining property is owned by Griffin Coal Mining Company Ltd.

The power station will be a "prescribed premise" licensed according to the Environmental Protection Act (1986). As such, the station must comply with Assigned Outdoor (Neighbourhood Annoyance) Regulations, 1979.

As environmental commitment number 23 in the ERMP states, SECWA will perform a noise survey following commissioning of the power station to confirm the model predictions. Should the survey indicate noise levels to be excessive, remedial strategies will be implemented to the satisfaction of the Environmental Protection Authority.

If noise emissions outside the station are above the Assigned Outdoor Neighbourhood Noise levels and are the subject of consistent complaints by neighbours, then several options are available to reduce the noise levels and thus remove the nuisance. Firstly, proven plant noise control equipment can be applied to the offending sources of noise in the station, thus reducing the noise emitted from the treated plant item. Secondly, if necessary, sound proofing measures can be applied to individual residences to greatly reduce audible noise.

ACCESS ROUTE/TRAFFIC

SECWA engaged a specialist traffic consultant group to address all factors of traffic safety and the impact of increased traffic volume on the local community. The group assessed all facets of the existing and the projected traffic flows along the alternative routes. In particular the group scrutinised the alternative routes to highlight structural deficiencies requiring upgrading of roads and geometric deficiencies of intersections and road shoulders.

All of these factors were considered in SECWA's assessment and choice of the preferred route. Route B was determined to be the preferred route for the following reasons:

(i) Route B is significantly shorter and cheaper.

(ii) Route B avoids any crossing with a coal haulage road, thus keeping general access to the site completely separate from coal haulage routes and mining areas.

(iii) Route B does not require passage through State Forest.

(iv) The route of the proposed Collie by-pass road which has been incorporated into the Collie Town Planning Scheme is consistent with the preferred route. The future construction of the by-pass would confer further advantage to the preferred route, by removing power station traffic from the town and residential area.

Traffic impact upon residences will be minimised by:

(i) Completely sealing the road surface to reduce dust generation.

(ii) Upgrading roads and intersections, and providing passing lanes to improve safety and minimise congestion.

(iii) Applying suitable traffic speed limits to improve safety, and

(iv) Planting of vegetation along verges to reduce dust and noise.

Modification of some intersections has been allowed for in the cost estimate and choice of route B as the preferred option. The modification of right angle intersections may be performed to smooth out intersections. Structural barriers may also be employed at some intersections.

Modification and upgrading of roads and intersections will be negotiated with the Main Roads Department and the Collie Shire Council.

Mornington Mills Road is not considered a viable alternative route to by-pass the Collie town site.

Monitoring of traffic impact upon the town and its residents could be performed by the working group already discussed, and through the Shire Council. Monitoring of traffic flow and volume will be the responsibility of the Main Roads Department.

OTHER

The transmission lines and works required to integrate the proposed power station within the south west supply grid have previously been addressed and released for public review, as two separate Public Environmental Reports*, and assessed and approved by the Environmental Protection Authority.

Construction of the transmission lines and works will be in accordance with (i) the conditions detailed in the respective Public Environmental Reports, and (ii) the conditions of approval as set by the Minister for the Environment.

Furthermore, during early planning and prior to the centre-line survey stage, the Transmission Branch of SECWA will notify and negotiate with local Members of Parliament, local authorities, community groups and all potentially affected landowners to identify the optimal centreline of the transmission line.

It should be noted that since the release of the abovementioned Public Environmental Reports detailing the transmission line works, SECWA has modified the proposed line route in many areas in response to public submissions and requests from potentially affected landowners.

* SECWA (1985) Proposed Transmission Line Interconnections for Proposed Aluminium Plant (Kemerton); Public Environmental Report. Report No. SD 88, March 1985

  SECWA (1988) Proposed Harvey-Kwinana 330kV Transmission Line Public Environmental Report. Report No. SD 233, February 1988.

In general it is considered that the formation of a small working group, as previously discussed, may provide the best opportunity for the community to express relevant concerns via Shire Councillors. Further, this group would put in place a mechanism to refer social concerns and needed actions to the proponent, or other responsible authorities.

The Social Impact Unit will be invited to have representation on the proposed working group, and their advice will be sought with respect to particular problems, their solutions and an appropriate means of reporting.

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Appendix 3

Matrix identifying issues raised during the review period against major submission groups

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Matrix identifying issues raised during the review period against major submission groups

ooo	Issues see I1 to I13	SUBMISSION No	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13
		General Public													
I1	Greenhouse Gases	1	x	x			x								
I2	Demand Management	2	x	x					x	x			x	x	
I3	Alternative Energy Options	3		x	x				x	x	x			x	
I4	Water Supply/Impacts/Management	4									x				
I5	Coal Supply/Impacts/Management	5	x	x											
I6	Waste Management (solid & liquid)	6				x	x	x	x						
I7	Air emissions (non-greenhouse)	7		x											
I8	SECWA's forecasts overestimated	8		x	x										
I9	Transport Route	9			x										
I10	Old Technology Plant, Why ?	10		x	x		x		x						
I11	Flora/Fauna Studies	11			x										
I12	Jarrah Dieback	12			x										
I13	Cumulative Effects (eg with Muja Power Station)	13	x	x	x	x			x						
		14	x												x
		15		x						x					
		16		x	x				x	x					
		Conservation Groups													
		17	x	x	x					x					
		18	x	x	x	x		x	x	x		x			
		19	x	x		x		x				x	x		
		20	x	x	x										
		21	x	x											
		22	x		x	x		x	x						
		23	x	x	x	x			x				x	x	
		Government Agency's													
		24									x				
		25						x							
		26	x	x							x				
		27				x		x							

Appendix 4

List of organisations and people that made submissions

Appendix 4

List of organisation and people that made submissions

Mr A. Murphy
C. Mary Gray
Dr Thomas Popp
Mr C. Macintyre J.P.
Mr K. Devereux
CRA Business Development (W.A.)
K.J. lowe
P.R. Nolan
E.A. Spreugel
P. Thwaites
M. Derry
M. Connors
N.H. Packer
Black Velvet Angus Stud
M.J. Wheeler
Eero and Kate Tarik

Friends of the Earth
Conservation Council of Western Australia Inc.
Australian Conservation Foundation
Western Australian Naturalists' Club (Inc.)
Busselton Peace and Environment Group (Inc.)
Statewide Network of Action Groups
Wildflower Society of Western Australian (Inc.)

Main Roads Department
Fisheries Department
Waterways Commision
Department of Mines Western Australia
Water Authority of Western Australia
Department of Conservation and Land Management
Department of Resources Development