Kwinana Gas-Fired Power Station

Wambo Power Ventures Pty Ltd

Report and recommendations
of the Environmental Protection Authority

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1. Introduction and Background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors relevant to the proposal by Wambo Power Ventures Pty Ltd (WPV) to construct and operate a 320 megawatt (MW) continuous base load, combined cycle gas turbine (CCGT) power station situated in Kwinana.

WPV's proposal for the Kwinana gas-fired power station (KGPS) is a part of Western Power's South West Interconnected System (SWIS) Power Procurement Process (PPP) Stage 2. This process is part of a Western Power and WA Government strategy to provide extra generating capacity to meet growing demand in the region and to replace aging power plants. Stage 2 of the PPP involves the acquisition of 300-330MW of additional generation capacity to be in service by 2007-2008 (EPA, 2002). WPV is one of three proponents bidding to provide the extra capacity.

The EPA provided advice on Western Power's strategic environmental review (SER) document during Phase 1 of the Power Procurement Process under section 16(e) of the *Environmental Protection Act 1986* (EPA, 2002a). The EPA's advice was intended to guide proponents through the potential environmental issues associated with power generation at a number of sites, including a site in the Kwinana Industrial Area (KIA). Although the proposed site for the Kwinana gas-fired power station was not identified in the SER document, sufficient similarities exist between the Kwinana site reviewed in the SER and the proposed site that the findings of the SER remain valid for the current site.

Based on the information provided in the referral document the EPA considered that, while the proposal has the potential to affect the environment, it could be readily managed to meet the EPA's environmental objectives. Consequently, the proposal was advertised in the *West Australian* newspaper on 30th May 2005 advising that the EPA intended to assess the proposal at the level of Assessment on Referral Information (ARI).

The proponent has submitted a referral document setting out the details of the proposal, potential environmental impacts and appropriate commitments to manage those impacts. The EPA notes that the proponent has consulted with relevant stakeholders including the EPA service unit. The EPA considers that the proposal as described can be managed in an acceptable manner, subject to these commitments and the EPA's recommended conditions being made legally binding.

The EPA has therefore determined under Section 40(1) of the Environmental Protection Act that the level of assessment for the proposal is Assessment on Referral Information, and this report provides the EPA advice and recommendations in accordance with Section 44(1).

2. The Proposal

Wambo Power Ventures Pty Ltd (WPV) proposes to construct and operate a natural gas-fired, combined cycle gas turbine (CCGT) power plant with a nominal generation

capacity of 320 megawatts (MW) on a site located off Leath and Barter Roads on the western edge of the Kwinana Industrial Area (KIA) (Figure 1). The plant could provide approximately 2,800 gigawatt hours (GWhr) of electricity annually into the SWIS electricity market.

The main components of the CCGT power plant will be (Figure 3, Figure 4):

- one natural gas-fired turbine of 160MW nominal generating capacity;
- one 160MW steam turbine;
- one heat recovery steam generator (HRSG);
- air-cooled condenser;
- demineralised water production plant (156 kL/day capacity);
- one 60m HRSG stack; and
- administration, laboratory and control buildings.

The CCGT would be operated in two modes:

- as a base load CCGT providing 240MW of power (65-85% of operating time); and
- with auxiliary duct firing to provide an additional 80MW of power during times of peak demand (10-15% of operating time)

Cooling will be provided by an air-cooled condenser consisting of 20 cells. Seawater cooling is not part of this proposal.

A detailed description of the proposal can be found in the proponent's referral document (ELP, 2005). The main characteristics of the proposal are summarised in the table below.

Table 1: Summary of key proposal characteristics

Element	Description
Project Purpose	To construct, operate and maintain a nominal 320 megawatt base load power station for the South West Interconnected System Grid
Life of the Project	30 years
Power Generating Capacity	320 MW (nominal)
Facility footprint	Approximately 4 ha
Fuel Type Gas Transportation	 Natural Gas Dampier to Bunbury Natural Gas Pipeline
Plant Facilities Gas turbine specifications Steam turbine specifications Heat recovery steam generator (HRSG) Number of stacks Height of HRSG stack Cooling System Liquid fuel storage on site	 1 × gas turbine of 160 MW nominal generating capacity fitted with dry low NO_x burners 1 × single shaft, axial exhaust steam turbine of 160 MW nominal steam generating capacity. 100% steam turbine bypass. 1 × dual pressure HRSG with horizontal gas path and supplementary firing One 60m Air cooled, 20 cells. ~7 cells to be operated during night time conditions ~200L diesel for emergency shut-down generator. Diesel will not be used as a generating fuel.
Thermal Efficiency Thermal Efficiency based on nett higher heating value	 Approximately 47.3%
Plant operation	Base load (65-85% of operation time) plus peaking capacity (10-15% of operation time)
Operation Hours Operation without duct firing Operation with duct firing	Available 24 hours, 365 days/year Approximately 5600-7500 hours/year (65-85% ACF) Approximately 1000-1300 hours/year (10-15% ACF)
Chemical Storage	All chemical/storage areas will be bunded and all chemical use areas will be paved
Inputs Natural Gas Process water	 ~55 Terajoules per day ~137 ML/year, supplied by Water Corporation
Outputs Waste water Waste water fate Waste water composition	 Approximately 5.5 ML/year Contained in Evaporation Pond or removed from site Salty water (max TDS 15000mg/L). Some inorganic salts and residual acids/alkalis may be present in the waste water.
Air Emissions Oxides of Nitrogen (NO_x) Sulphur dioxide (SO_2) Carbon Dioxide (CO_2 equivalent) Carbon Monoxide (CO) VOCs PAHs Benzene, toluene, xylene	 25- >31ppmv 0.27ppm @ 15% dry O_2 0.38 g/s 0.38 tonnes CO_{2e}/MWh at full load 50ppm (dry 15% O_2) 10 ppm (vol/vol, dry, n-propane equivalent, 15% O_2) negligible negligible
Predicted Noise Emissions	36.8 dB(A) at nearest residential premises 46.5 dB(A) at nearest commercial property 46.5 dB(A) at nearest accommodation facility
Other Additional infrastructure	 Control building, laboratory, electrical switchrooms, stores and workshops

Abbreviations

ACF	annual capacity factor
CO_{2e}	carbon dioxide equivalent units
dB(A)	decibels (A weighted)
g/s	grams per second
ha	hectares
HRSG	heat recovery steam generator
ML	megalitres
MW	megawatts
MWh	megawatt hours
NO_x	oxides of nitrogen
O_2	oxygen
PAHs	polycyclic aromatic hydrocarbons
ppm	parts per million
ppmv	parts per million by volume
Terajoule	10^{12} Joules (units of energy)
VOCs	volatile organic compounds

The potential impacts of the proposal are discussed by the proponent in the referral document (ELP, 2005).

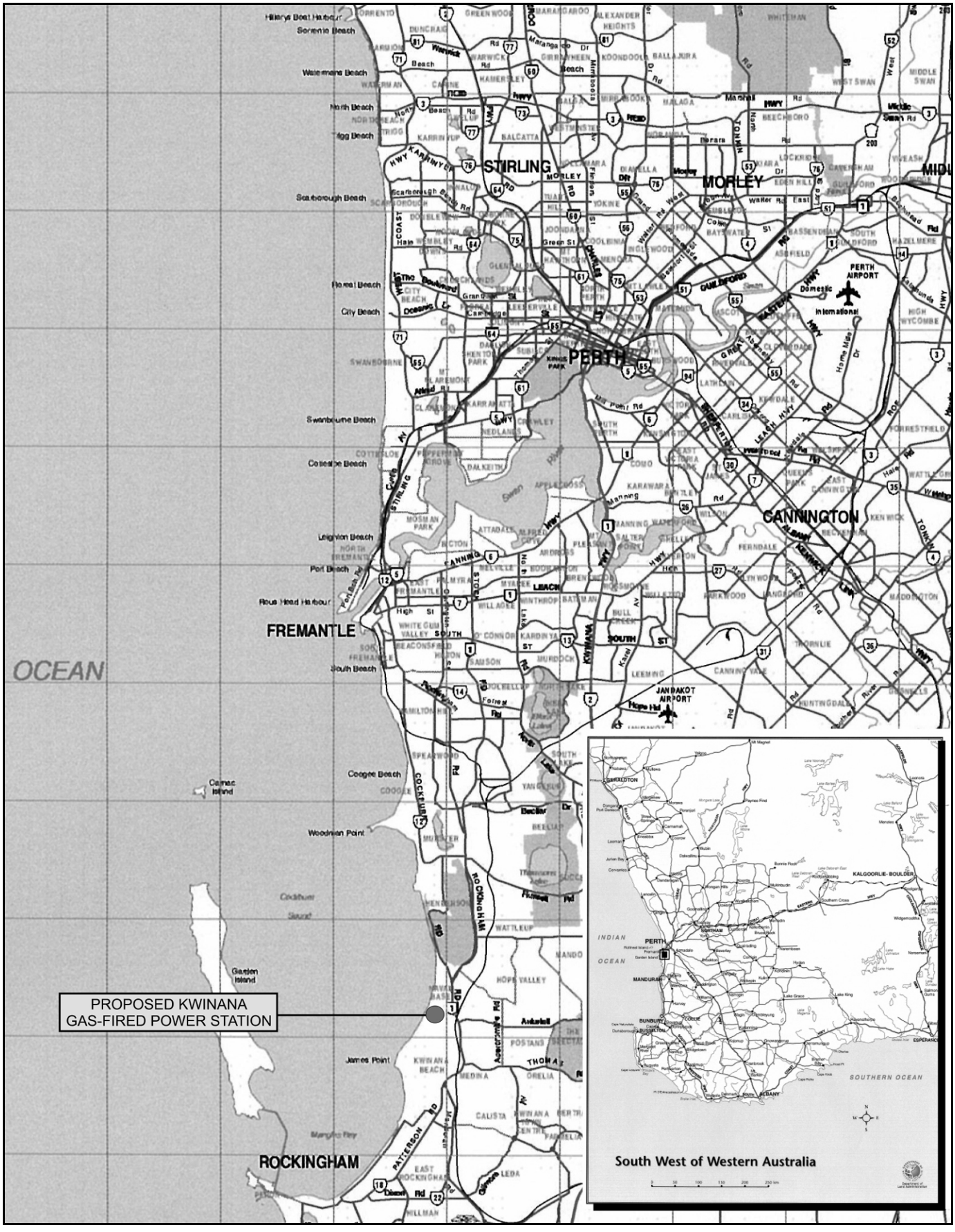

Figure 1: Regional Location (ELP, 2005)

Figure 2: Location in Kwinana Industrial Area (ELP, 2005)

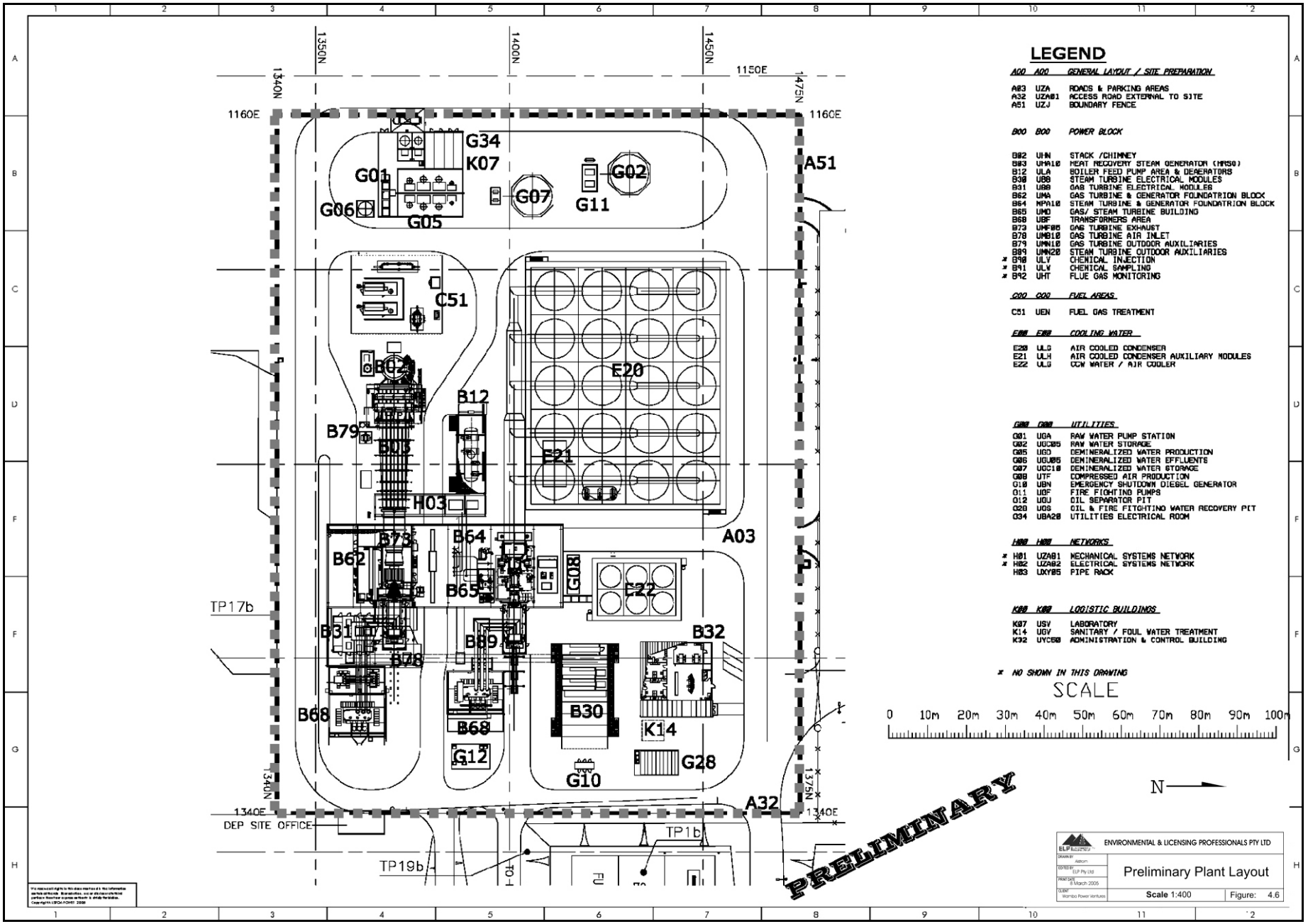

Figure 3: Proposed Kwinana Gas-Fired Power Station Site layout (ELP, 2005)

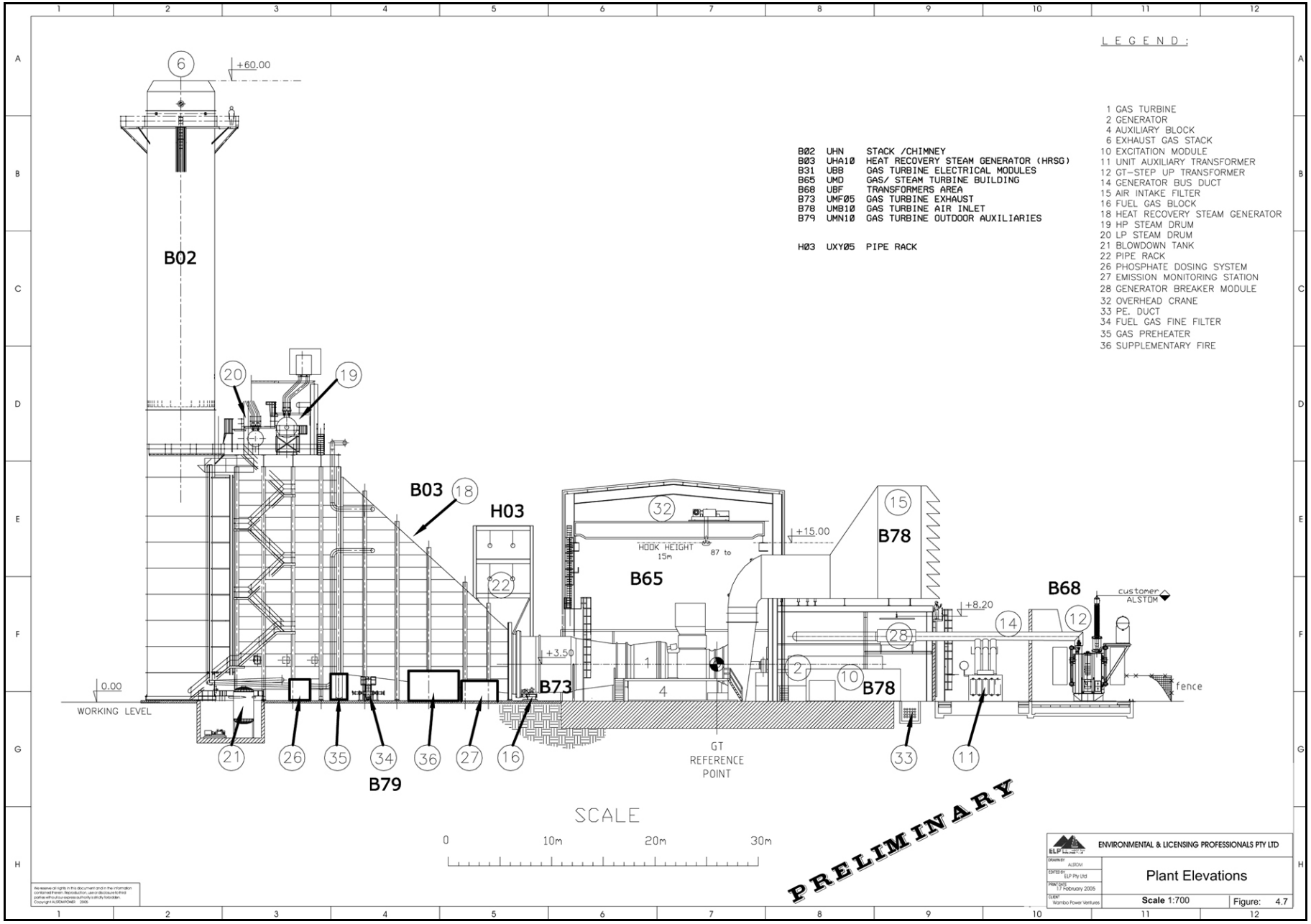

Figure 4: Proposed Kwinana Gas-Fired Power Station plant elevations (ELP, 2005)

3. Consultation

The proponent has advised that consultation has occurred with a targeted group of stakeholders. The consultation was undertaken in three stages over a period of four months (January 2005–April 2005) to gather feedback on key community issues at an early stage of the project and incorporate these issues into the design. The consultation process was designed in accordance with the requirements of the Department of Environment's (DoE) Community Involvement Framework (DoE, 2003a) and Interim Industry Guide to Community Involvement (DoE, 2003b).

Stage 1 of the consultation process was designed to brief stakeholders on the project and the SWIS procurement process, with stage 2 expected to provide more detailed information to those interested parties who desired more information on key environmental issues of the project. However due to a site change between stages 1 and 2, comments (on the new site) were again requested during stage 2. A third stage was added to the consultation to allow the proponent to respond to the stakeholders' comments on the new site and provide noise and air quality modelling results for the new site to the stakeholders.

Stakeholders were consulted in a series of meetings. These meetings served to introduce the project and its key characteristics and environmental impacts, as well as arrange follow-up meetings and establish if there were any additional stakeholders. Stakeholders were provided with written briefing notes outlining the project's progress and actions taken as a result of the initial meetings and had the opportunity to make written comment on the information prior to another round of meetings being conducted.

The following groups were included in the consultation process:

- Kwinana Industries Council;
- Kwinana Industries Coordinating Council;
- Conservation Council;
- City of Cockburn;
- City of Rockingham;
- Town of Kwinana;
- Department of Indigenous Affairs;
- WA Council of Social Services;
- Local Member for Cockburn;
- Local Aboriginal Groups; and
- Kwinana, Cockburn and Rockingham based community action groups

A number of environmental issues were raised by the stakeholders during the consultation. Table 2 summarises the main issues raised and details the actions taken by WPV to address the issues raised by the stakeholders.

Table 2: Proponent actions addressing community concerns (ELP, 2005)

Issue	Action Taken by WPV
Natural gas CCGTs are the most preferable fossil fuel generation method available in Kwinana however people should be encouraged to use less power rather than build new stations.	A communication strategy may be developed and implemented advocating for gas-fired power stations in WA. Comments made in the referral document about the advantages of gas-fired power.
Air quality issues including the need for more detailed particulate and odour modelling and monitoring.	Air quality study conducted and technical information provided to stakeholders. $PM_{2.5}$ and PM_{10} comments added to air report, odour assessment and health risk comments added to referral document.
Noise issues focussed on the cumulative effects of noise in the KIA and the noise levels at the Naval Base Hotel.	Noise impact study conducted and technical information supplied to stakeholders. Night time limits and tonal characteristics included in report. WPV to provide data to cumulative noise study being undertaken. Appropriate acoustic attenuation measures will be included in the final design to ensure that noise regulations are met.
The site should be vegetated using a planting strategy.	If bid is successful, a greening strategy will be developed in partnership with Naragebup Rockingham Environment Centre.
The potential for environmental improvement opportunities with other industries (e.g. use of waste heat from the power station by another industry) should be investigated.	WPV advises that environmental improvement opportunities and efficiencies will be reviewed throughout the project life.
The use of reclaimed water should be considered.	If bid is successful, the possibility of using reclaimed water on-site will be examined.
Various greenhouse gas issues including life cycle analysis and carbon offsets.	Greenhouse gas study conducted. Commitment from WPV to greenhouse gas minimisation in referral document.

The proponent has advised that if the bid to construct and operate the power station is successful, all of the issues raised by the stakeholders that can be addressed by the proponent would be addressed by the agreed strategy and action. The results of actions taken would be communicated to the stakeholders.

The EPA considers that the consultation process has been appropriate and that reasonable steps have been taken to inform the community and stakeholders on the proposed development.

4. Relevant Environmental Factors

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

It is the EPA's opinion that the following environmental factors relevant to the proposal require evaluation in this report:

(a) Nitrogen oxides.

(b) Greenhouse gas emissions.

(c) Noise.

Details on the relevant environmental factors and their assessment are contained in Sections 4.1 - 4.3. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

4.1 Nitrogen Oxides (NO_x)

Description

The KGPS is expected to have a NO_x emission rate of:

- 30.8 parts per million by volume (ppmv) when operating at the nominal capacity of 320MW (10-15% of operation time); or
- less than 25ppmv when the plant is operating at a lower load (without duct firing) (15% oxygen reference level, dry, at STP).

The cumulative impact of the proposed plant was evaluated by modelling NO_2 at seven nearby ambient air quality monitoring stations by combining its emissions with those from existing and approved (but not operational) industries. Under worst case conditions, the highest predicted ground-level concentration of NO_2 was 216.8μg/m^3, which is 88% of the National Environment Protection Measure (NEPM) standard (246μg/m^3). Under more realistic model conditions, the highest predicted ground-level concentration of NO_2 was 155.0μg/m^3, which is 63% of the NEPM (ELP, 2005).

Assessment

EPA objective

The EPA's environmental objective for this factor is to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of the people and land uses by meeting statutory requirements and acceptable standards.

EPA guidance statement number 15 *Guidance Statement for Emissions of Oxides of Nitrogen from Gas Turbines* provides assessment guidance and criteria for the management of NO_x emissions. For this proposal the relevant maximum emission level is 0.07g/m^3 or 34ppmv NO_x at 15% dry oxygen and STP reference level (EPA, 2000a). This is an upper limit and the EPA considers that proponents should use best practicable technology to better these limits.

Consistent with the EPA's strategic advice to bidders in the power procurement process, the EPA expects the best practice of low- NO_x burners to be installed in all gas turbines (EPA, 2002a).

The EPA notes that the relevant criterion for ambient air quality is the NEPM standard of 0.12ppmv NO_2 (246μg/m^3, 1 hour average) and 0.03ppmv NO_2 (61 μg/m^3, 1 year average). The cumulative effect of NO_2 emissions from the Kwinana gas-fired power station and surrounding industries should not exceed this standard.

Relevant Proposal Characteristics
The proponent advises that the KGPS would not exceed the EPA's guideline level of 34ppmv during normal operations. Model results show that emissions will be less than 31ppmv under all operating loads with the exception of start-up. During periods of low operating loads (65-85% of operations), emissions of NO_x will be less than 25ppmv (ELP, 2005).

The Kwinana gas-fired power station will utilise dry low-NO_x burners. The EPA considers that the use of low-NO_x burners demonstrates the implementation of best practicable technology.

Air dispersion modelling results provided in the referral document show that the proposed Kwinana gas-fired power station will contribute a minor amount to existing ambient NO_2 levels in the Kwinana Industrial Area and that the NEPM standard for cumulative NO_2 is not likely to be exceeded (maximum 88% of the 1-hr averaged standard and 39% of the 1-year averaged standard).

The EPA recommends that the proponent be required to design and implement a stack emissions monitoring strategy in accordance with recommended condition 7 attached in Appendix 2 of this bulletin.

The EPA notes that the proposal will only use natural gas as a fuel. Liquid fuel will not be used for generation (ELP, 2005).

Summary
Having particular regard to the:

- results of the dispersion modelling, which indicates that it is unlikely that the NEPM ambient air quality standard would be exceeded by the proposed power plant;
- proposed design and construction of the KGPS, particularly in relation to the installation of dry low-NO_x burners; and
- recommended condition number 7, which requires the proponent to prepare and implement a monitoring strategy to gauge in-stack air emissions,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

4.2 Greenhouse Gas Emissions

Description
The proposed CCGT plant would emit approximately 842,000 tonnes of carbon dioxide (CO_2) per year. The plant would also emit small amounts of methane and nitrous oxide. The total carbon dioxide equivalent (CO_{2e}) is approximately 846,000 tonnes per year. Based on emissions data from the year 2000, this represents approximately 0.2% of the national CO_2 emissions. Western Australia's greenhouse emissions were last compiled in 1995 and based on these data, the CO_2 equivalent emitted from the KGPS would represent approximately 2% of Western Australia's

emissions (AGO, 1998). Using 1995 data, the implementation of the KGPS would increase Western Australia's total CO_{2e} from 49.3 million tonnes to 50.1 million tonnes.

The proposed plant has a net total energy efficiency of 47.3% (based on net higher heating value, modelled at 15ºC). World's best practice total efficiency for a combined cycle gas turbine plant adjusted for Australian conditions is (AGO, 2001):

- 52.0%, for a plant of capacity greater than 250MW; or
- 46.7% for a plant of capacity less than 250MW.

The predicted average carbon intensity of the KGPS operating at full load is 0.39 tonnes carbon dioxide per megawatt hour (CO_{2e}/MWh). The average carbon intensity of Western Power's SWIS during the year 2002 was 0.92 tonnes CO_{2e}/MWh. Table 16 in the proponent's referral document (ELP, 2005) quotes best practice carbon intensity for a combined cycle gas turbine plant as approximately 0.4 tonnes CO_{2e}/MWh (NSW Government, 2004).

Assessment

EPA requirements

The EPA's objective for greenhouse gases is to ensure that:

- Best practicable measures are applied to maximise energy efficiency and minimise emissions;
- Comprehensive analysis is undertaken, where residual impacts occur, to identify and implement appropriate offsets; and
- Proponents undertake an on-going programme to monitor and report emissions and periodically assess opportunities to further reduce greenhouse gas emissions over time.

EPA guidance statement number 12 *Guidance Statement for Minimising Greenhouse Gas Emissions* outlines the EPA's expectations for the minimisation of greenhouse gas emissions from new proposals. The EPA expects the proponent to use best practicable measures to maximise energy efficiency and minimise greenhouse emissions to the lowest practicable level (EPA, 2002b).

Western Power will impose conditions on the preferred bidder in the PPP as stated in the SER (Western Power, 2002). Western Power advise that the following conditions are relevant to a gas bidder in the PPP:

- Become a signatory to the Greenhouse Challenge; and
- Implement best practicable thermal efficiency design and operating goals.

Relevant Proposal Characteristics

Western Power require 300-330MW of new capacity to meet the demand of the SWIS. This presents a problem for a bidder proposing a CCGT since gas turbines are manufactured in standard sizes such that it is difficult to generate at high thermal efficiency at capacities other than those favoured by the standard gas turbine sizes.

The KGPS will utilise a standard 160MW gas turbine. In CCGT configuration, this turbine is typically arranged to generate 240MW using the 160MW gas turbine in combination with an 80MW HRSG and steam turbine. To meet the required 300-330

MW, WPV propose to use the 160MW gas turbine with a 160MW steam generator and steam turbine, resulting in 320MW capacity.

The larger steam generator and turbine results in a lower overall thermal efficiency as additional gas is required to heat the water and create the steam needed to drive the steam turbine (duct firing). The proponent advises that this is the reason that the Kwinana Gas-Fired Power Station is less efficient than world's best practice (WBP) for a CCGT of capacity greater than 250MW (i.e. 47.3% compared to WBP 52.0% sent-out thermal efficiency).

The proponent advises that the demand for power fluctuates throughout the day, and that the base demand for electricity can be met by a 240MW capacity plant for the 65-85% of the time that the plant is operating in CCGT mode. Duct firing will only be required during peak load periods, which corresponds to 10-15% of the time (note that these estimates incorporate a worst-case scenario during which the plant is anticipated to be off line and hence the numbers do not always add to 100%). The KGPS is intended to operate as a 240MW capacity plant for 65-85% of the time, and would exceed world's best practice thermal efficiency for a plant of that size (WBP is 46.7% sent-out thermal efficiency) during that time .

The EPA notes that the proposed CCGT combination results in a loss of thermal efficiency but also notes that such a combination is significantly more efficient than either coal fired or open cycle gas turbine power stations. The EPA understands that the proposed combination represents best practice given the constraints imposed by the load required by the SWIS.

The EPA notes that the proposed KGPS has a greenhouse gas intensity that is 41% of the average greenhouse gas intensity of Western Power's operations and will result in a small net average reduction in the greenhouse gas intensity of the SWIS if constructed (EPA, 2002b).

The EPA notes that the proponent has made a commitment to become a signatory to the Greenhouse Challenge which requires the proponent to undertake annual emissions reporting to the Greenhouse Office and operational performance monitoring of combustion to ensure that power generation meets the design criteria (Commitment number 2).

The EPA notes that the proponent has not committed to offsetting any of its carbon emissions. The EPA understands that the proposed CCGT combination represents the best practicable means of meeting the demand required by the SWIS. While the efficiency of the combination is less than a wholly CCGT plant, the EPA is satisfied that it represents best practice for the load required. CCGT plants are more efficient than open cycle gas or coal plants and EPA does not require offsets to approve this proposal. However the EPA would encourage the proponent to consider carbon sink projects during the life of the project.

The EPA recommends that the standard ministerial condition (i.e. Condition 6 in Appendix 2 of this report) applied to all proposals with large greenhouse gas inventories be imposed on the proposal. This condition requires a greenhouse gas emissions management plan to be prepared and implemented.

Summary

Having particular regard to the:

- constraints on thermal efficiency imposed by the required 300-330MW capacity;
- proponent's optimised configuration and plan to minimise duct firing, allowing the proponent to meet world's best practice thermal efficiency for a <250MW CCGT unit 65-85% of the time;
- proponent's commitment to participate in the Greenhouse Challenge; and
- Recommended condition requiring the development and implementation of a greenhouse gas management plan;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

4.3 Noise

Description

Noise modelling was undertaken to predict noise levels at the nearest residential premises (Hope Valley; ~1km east of the site) and the nearest commercial premises (Naval Base Hotel; ~200m from the site boundary).

Results from the modelling are compared with the relevant noise regulations (*Environmental Protection (Noise) Regulations 1997)* in Table 3 below:

Table 3: Predicted noise levels and compliance with regulations (ELP, 2005)

Location	Predicted Noise in dB(A)	Max allowable in dB(A)
Hope Valley	36.8	41
Naval Base Hotel (accommodation in use)	46.5	50
Naval Base Hotel (accommodation not in use)	46.5	55

The modelling results predict that the noise regulations would be met.

The proposed plant design includes housing the gas turbine in an enclosure (0.75mm Al cladding) and locating the turbine in a turbine hall. The ventilation air louvers, fans and ducting would have silencers installed to restrict noise breakout from the building. The noise controls assumed in the modelling are outlined in the noise report in appendix E of the referral document (ELP, 2005).

Assessment

EPA requirements

The EPA's objectives for this environmental factor are to ensure that:

- Noise levels from construction activities comply with the requirements of Australian Standard 2346-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites;* and

- Noise levels from the proposed power station comply with the *Environmental Protection (Noise) Regulations 1997*.

Relevant Proposal Characteristics
The EPA notes that the proposed power station will comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* at the nearest sensitive premises.

The EPA notes that the proponent advises that construction work will be carried out in accordance with the requirements of the *Environmental Protection (Noise) Regulations 1997* and hence noise will comply with Australian Standard 2346-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites.* The proponent further advises that a Construction Noise Management Plan will be prepared and implemented.

The proponent has committed to participate in the cumulative noise model being developed by the Kwinana Industries Council (KIC) by providing results of noise modelling and noise monitoring conducted.

Summary
Having particular regard to the:

- Results of noise modelling which indicate that the proposed plant will comply with the requirements of the *Environmental Protection (Noise) Regulations 1997*;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

5. Other Advice

5.1 Site Contamination

The two existing ash disposal dams on the proposed site are a potential source of soil and groundwater contamination. The volume of ash in the ponds is estimated to be between 11,000 and 15,000m^3. Ash is known to contain concentrations of metals and polycyclic aromatic hydrocarbon compounds (PAHs).

A preliminary inspection of the site found that there may be contamination issues to consider. Staining on the walls of the pond suggests that leachable concentrations of metals, other chemicals and possibly acid may be present in the ash (ELP, 2005).

WPV will lease the site from Western Power. Western Power will ensure that the site is of a suitable standard for industrial use as part of the lease arrangement with WPV.

The EPA's objective for site contamination is to ensure that:

- the nature and extent of soil contamination is fully determined so that appropriate remedial and management measures can be implemented for the rehabilitation of the site;

- the rehabilitation of the site is to an acceptable standard that is compatible with the intended land use, consistent with appropriate criteria; and
- the remediation strategy is consistent with the objectives of the EPA's hierarchical approach for site remediation (EPA Guidance Statement No 17).

EPA Guidance Statement No 17 *Guidance Statement for Remediation Hierarchy for Contaminated Land* states that the EPA's preferred hierarchy for site remediation is for contaminated material to:

- be treated on-site and the contaminants reduced to acceptable levels; or
- be treated off-site and returned for re-use after the contaminants have been reduced to acceptable levels.

The DoE's *Contaminated Sites Management Series* provides assistance in the identification and remediation of contaminated sites. The EPA expects that these guidelines would be applied to potentially contaminated sites such as the Kwinana gas-fired power station site.

WPV advise that the site will be cleaned to a standard that is suitable for industrial use. Western Power own the site and will ensure that the site has been investigated and the necessary remediation undertaken to allow development as part of the lease arrangements with WPV. The EPA expects that the remediation strategy should give consideration to the DoE's *Contaminated Sites Management Series* and the EPA's hierarchy for contaminated land (EPA, 2000b) by considering a range of treatment options before a decision is made to remove the material from the site.

WPV advise that groundwater monitoring will be undertaken to ensure that contamination issues from either entering the site's groundwater from outside influences or from failure of processes on the site are picked up quickly. WPV advise that they will work with the DoE to identify a suitable monitoring and reporting program for the site.

6. Conditions and Commitments

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

6.1 Proponent's Commitments

The proponent's commitments as set out in the Referral document and subsequently modified, as shown in Appendix 2, should be made enforceable.

7. Conclusions

The EPA has considered the proposal by WPV to construct and operate a 320MW continuous base load CCGT power station in Kwinana.

Nitrogen Oxides (NO_x)
Predicted ground level NO_x concentrations obtained from cumulative air modelling for the KGPS are below the relevant National Environmental Protection Measure (NEPM) standards. Dry low-NO_x burners will be used in the proposed plant. The EPA concludes that the proposal can be managed to meet the EPA's environmental objective for this factor.

Greenhouse Gas Emissions
The EPA is aware that demand for electricity in Western Australia will continue to grow, and considers that the greenhouse intensity of supplies should continue to be reduced. The EPA notes that the KGPS will reduce the greenhouse intensity of the SWIS if constructed.

The EPA notes that the predicted thermal efficiency of the Kwinana Gas Fired Power Station (47.3%) is less than the world's best practice (WBP) efficiency for a plant of capacity ≥ 250MW (52.0%) (AGO, 2001). However the EPA also notes that the Kwinana Gas-Fired Power Station will operate as a 240MW power station for 65-85% of the time. World's best practice for a plant of capacity <250MW is 46.7%, so the Kwinana Gas-Fired Power Station will exceed WBP thermal efficiency during the majority of its lifetime. Duct firing will only be used to accommodate peak loads (10-15% of the time). During this time the plant will operate at less than WBP thermal efficiency for a CCGT.

The EPA considers that the measures taken by the proponent to achieve maximum efficiency are satisfactory given the constraints imposed on the proponent by the demands of the SWIS.

The EPA concludes that the proposal can be managed to meet the EPA's environmental objective for this factor provided that recommended condition 6 is imposed upon the proponent.

Noise
The EPA notes that noise modelling suggests that the *Environmental Protection (Noise) Regulations 1997* will not be exceeded at the closest noise sensitive premises to the Kwinana Gas-Fired Power Station. The EPA concludes that the proposal can be managed to meet the EPA's environmental objective for this factor.

The EPA has concluded that the proposal is capable of being managed in an environmentally acceptable manner such that it is most unlikely that the EPA's

objectives would be compromised, provided there is satisfactory implementation of the recommended conditions and proponent's commitments set out in Section 5.

8. Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the proposal being assessed is for the construction and operation of a nominal 320 MW combined cycle gas turbine power plant in Kwinana, Western Australia;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 4;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 2, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 2 of this report.

Appendix 1

References

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Appendix 2

Recommended Environmental Conditions and Proponent's Consolidated Commitments

RECOMMENDED CONDITIONS AND PROCEDURES

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

KWINANA GAS-FIRED POWER STATION, KWINANA

Proposal: The construction, operation and maintenance of a nominal 320MW combined cycle base load power plant at Kwinana, as documented in schedule 1 of this statement.

Proponent: Wambo Power Ventures Pty Limited

Proponent Address: PO Box 98
Kenmore Qld 4069

Assessment Number: 1569

Report of the Environmental Protection Authority: Bulletin 1174

The proposal referred to above may be implemented by the proponent subject to the following conditions:

1 Implementation

1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions of this statement.

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under

section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

- the environmental factors of the proposal have not changed significantly;

- new, significant, environmental issues have not arisen; and

- all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

- the status of implementation of the proposal as defined in schedule 1 of this statement;

- evidence of compliance with the conditions and commitments; and

- the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

5-2 The proponent shall submit a performance review report every five years after the start of operations, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, which addresses:

- the major environmental issues associated with the project; the targets for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those targets;

- the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;

- significant improvements gained in environmental management, including the use of external peer reviews;

- stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and

- the proposed environmental targets over the next five years, including improvements in technology and management processes.

5-3 The proponent may submit a report prepared by an auditor approved by the Department of Environment under the "Compliance Auditor Accreditation Scheme" to the Chief Executive Officer of the Department of Environment on each condition/commitment of this statement which requires the preparation of a management plan, programme, strategy or system, stating that the requirements of each condition/commitment have been fulfilled within the timeframe stated within each condition/commitment.

6 Greenhouse Gas Emissions

6-1 Prior to commencement of construction of the power station, the proponent shall prepare a Greenhouse Gas Emissions Management Plan to:

- ensure that through the use of best practice, the total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product from the project are minimised; and

- manage "greenhouse gas" emissions in accordance with the *Framework Convention on Climate Change 1992*, and consistent with the National Greenhouse Strategy;

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1 calculation of the "greenhouse gas" emissions associated with the proposal, as advised by the Environmental Protection Authority;

Note: The current requirements of the Environmental Protection Authority are set out in: *Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors, No. 12* published by the Environmental Protection Authority (October 2002). This document may be updated or replaced from time to time.

2 specific measures to minimise the total net "greenhouse gas" emissions and/or the "greenhouse gas" emissions per unit of product associated with the proposal using a combination of "no regrets" and "beyond no regrets" measures;

3 estimation of the "greenhouse gas" efficiency of the project (per unit of product and/or other agreed performance indicators) and comparison with the efficiencies of other comparable projects producing a similar product, both within Australia and overseas;

4 actions for the monitoring and annual reporting of "greenhouse gas" emissions and emission reduction strategies;

5 a target set by the proponent for the reduction of total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product and as a percentage of total emissions over time, and annual reporting of progress made in achieving this target. Consideration should be given to the use of renewable energy sources such as solar, wind or hydro power;

6 consideration by the proponent of entry (whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate) into the Commonwealth Government's "Greenhouse Challenge" voluntary cooperative agreement program. Components of the agreement program include:

- an inventory of emissions;
- opportunities for abating "greenhouse gas" emissions in the organisation;
- a "greenhouse gas" mitigation action plan;
- regular monitoring and reporting of performance; and
- independent performance verification.

Note: In (2) above, the following definitions apply:

1. "no regrets" measures are those which can be implemented by a proponent and which are effectively cost-neutral.
2. "beyond no regrets" measures are those which can be implemented by a proponent and which involve additional costs that are not expected to be recovered.

6-2 The proponent shall implement the Greenhouse Gas Emissions Management Plan required by condition 6-1.

6-3 Prior to the commencement of construction, the proponent shall make the Greenhouse Gas Emissions Management Plan required by condition 6-1 publicly available.

7 Stack Emissions

7-1 Prior to construction of the power station, the proponent shall prepare a Stack Emissions Management Plan, to:

- Ensure that best available practicable and efficient technologies are used to minimise total air emissions from the power station;

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall address:

1 specific measures to minimise total air emissions from the power station to meet emission limits consistent with best practicable technology and current industry standards;

2 monitoring of air emissions; and

3 public reporting of air emissions and any complaints about air emissions.

7-2 The proponent shall implement the Stack Emissions Management Plan required by condition 7-1.

7-3 The proponent shall make the Stack Emissions Management Plan, required by condition 7-1 publicly available.

Procedures

1 Where a condition states "to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environmental Protection for the preparation of written advice to the proponent.

2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3 Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment.

Notes

1 The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

2 The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.

3 Within this statement, to "have in place" means to "prepare, implement and maintain for the duration of the proposal".

Schedule 1

The Proposal (Assessment No. 1569)

Wambo Power Ventures Pty Ltd (WPV) propose to construct and operate a natural gas-fired combined cycle gas turbine (CCGT) power plant with a nominal generation capacity of 320 megawatts (MW) on a site located off Leath and Barter Roads on the western edge of the Kwinana Industrial Area (location shown in Figures 1 and 2).

Table 1 – Key Proposal Characteristics

Element	Description
Life of the Project	30 years
Power Generating Capacity	320 MW (nominal)
Facility footprint	Approximately 4 ha
Fuel Type Gas Transportation	 Natural Gas Dampier to Bunbury Natural Gas Pipeline
Plant Facilities Gas turbine specifications Steam turbine specifications Heat recovery steam generator (HRSG) Number of stacks Height of stack Cooling system Liquid fuel storage on site	 1 × gas turbine of 160 MW nominal generating capacity fitted with dry low NO_x burners 1 × single shaft, axial exhaust steam turbine of 160 MW nominal steam generating capacity. 100% steam turbine bypass. 1 × dual pressure HRSG with horizontal gas path and supplementary firing One 60m Air cooled, 20 cells Approximately 200L diesel for emergency shut-down generator.
Thermal Efficiency Percentage Thermal Efficiency based on nett higher heating value	 Approximately 47.3%
Plant operation	Base load (65-85% of operation time) plus peaking (10-15% of operation time)
Operation Hours Percentage operation without duct firing Percentage operation with duct firing	Available 24 hours, 365 days/year Approximately 5600-7500 hours/year (65-85% ACF) Approximately 1000-1300 hours/year (10-15% ACF)
Chemical Storage	All chemical/storage areas will be bunded and all chemical use areas will be paved
Inputs Natural Gas Process water	 55 TJ per day 137 ML/year, supplied by Water Corporation
Outputs Waste Water	 Approximately 5.5 ML/year Contained in Evaporation Pond or removed from site
Air Emissions Oxides of Nitrogen (NO_x) Carbon Dioxide	 Approximately 25- >31ppmv Approximately 845 000 tonnes per year

Abbreviations in Table 1

ACF	annual capacity factor
ha	hectares
HRSG	heat recovery steam generator
ML	megalitres
MW	megawatts
MWh	megawatt hours
NO_x	oxides of nitrogen
ppmv	parts per million by volume
TJ	Terajoule (10^{12} Joules)

Figures (attached)

Figure 1 – Regional location
Figure 2 – Location in Kwinana Industrial Area
Figure 3 – Proposed Kwinana Gas-Fired Power Station Site Layout
Figure 4 – Proposed Kwinana Gas-Fired Power Station plant elevations

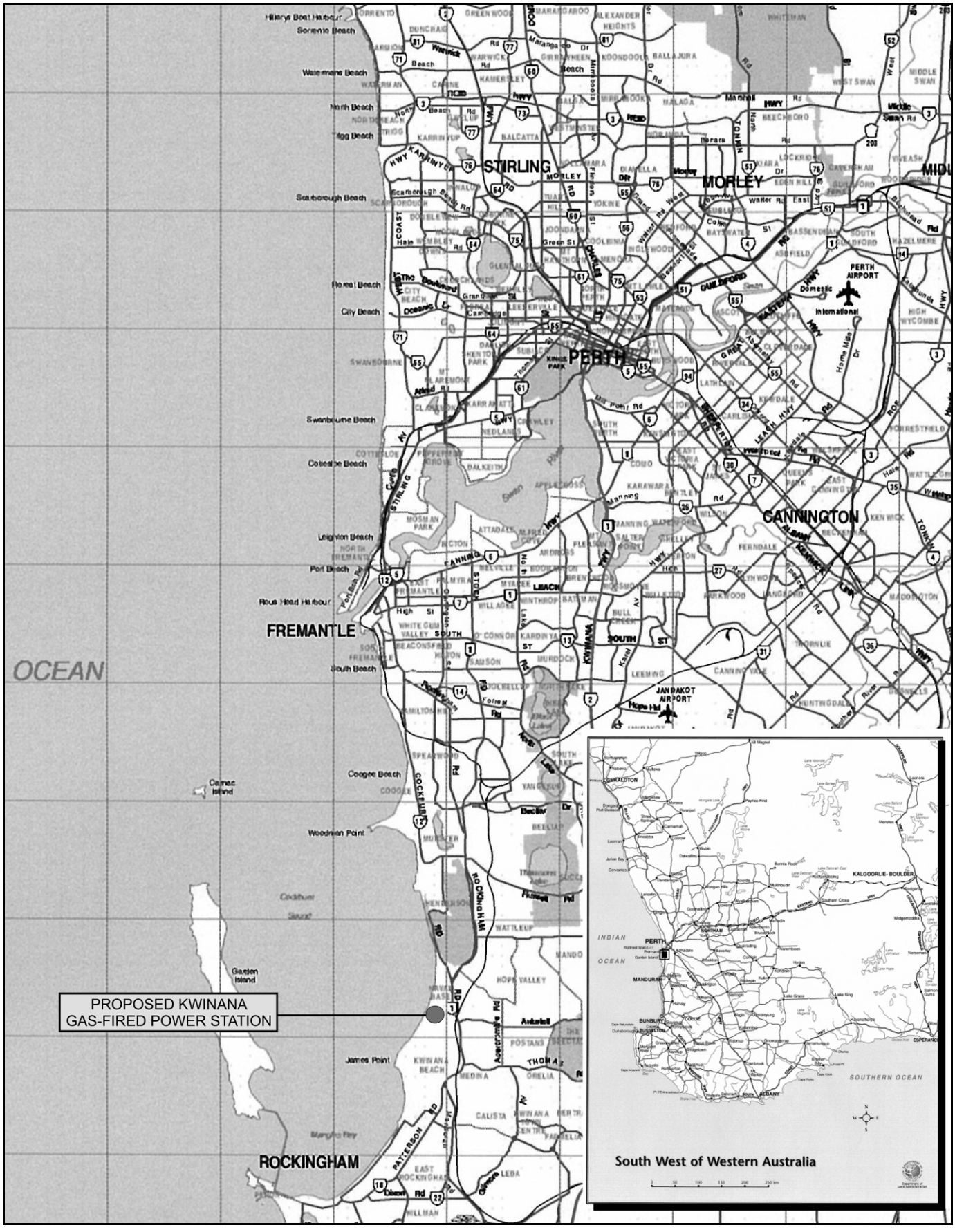

Figure 1: Regional location

Figure 2: Location in Kwinana Industrial Area

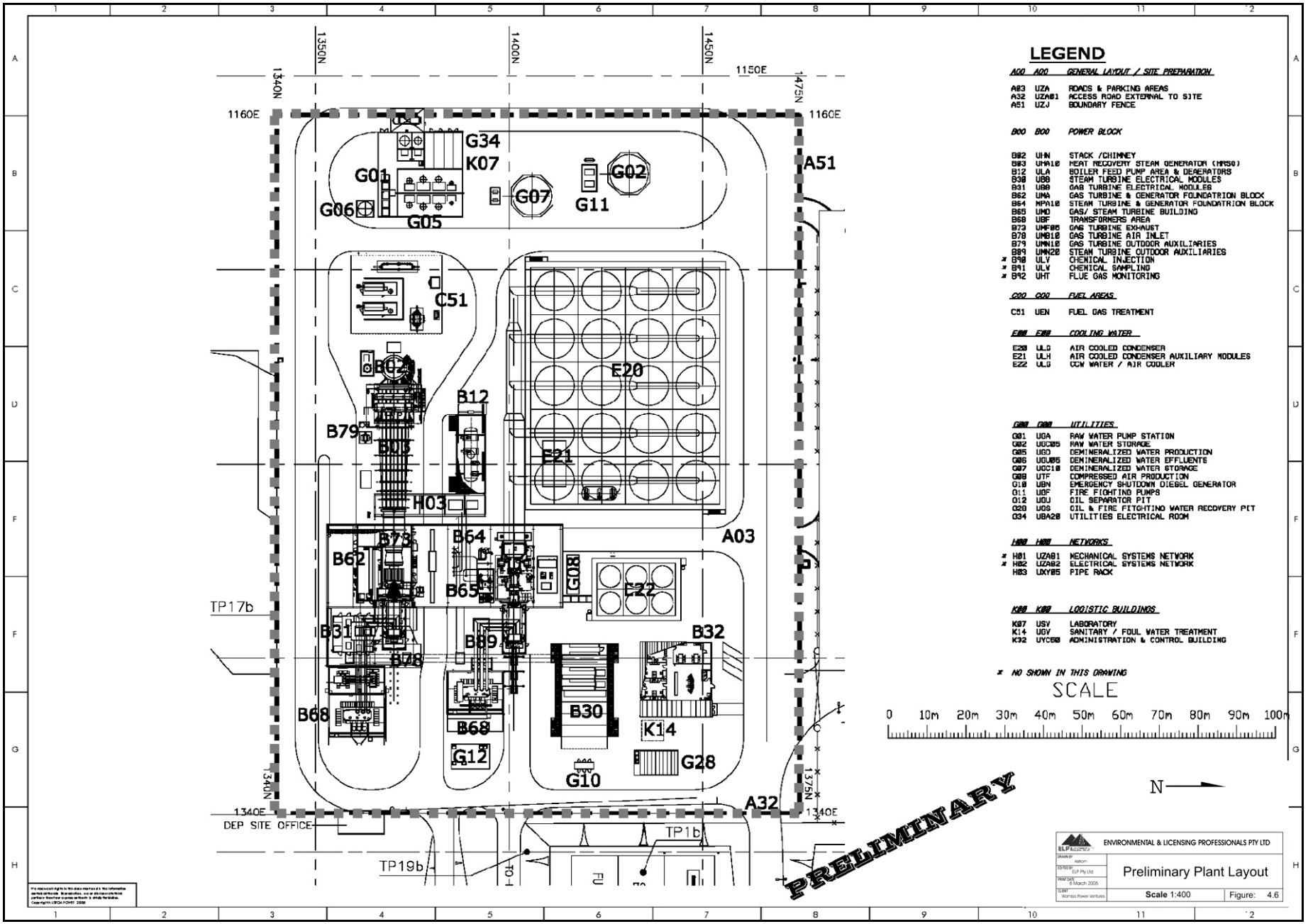

Figure 3: Proposed Kwinana Gas-Fired Power Station Site Layout

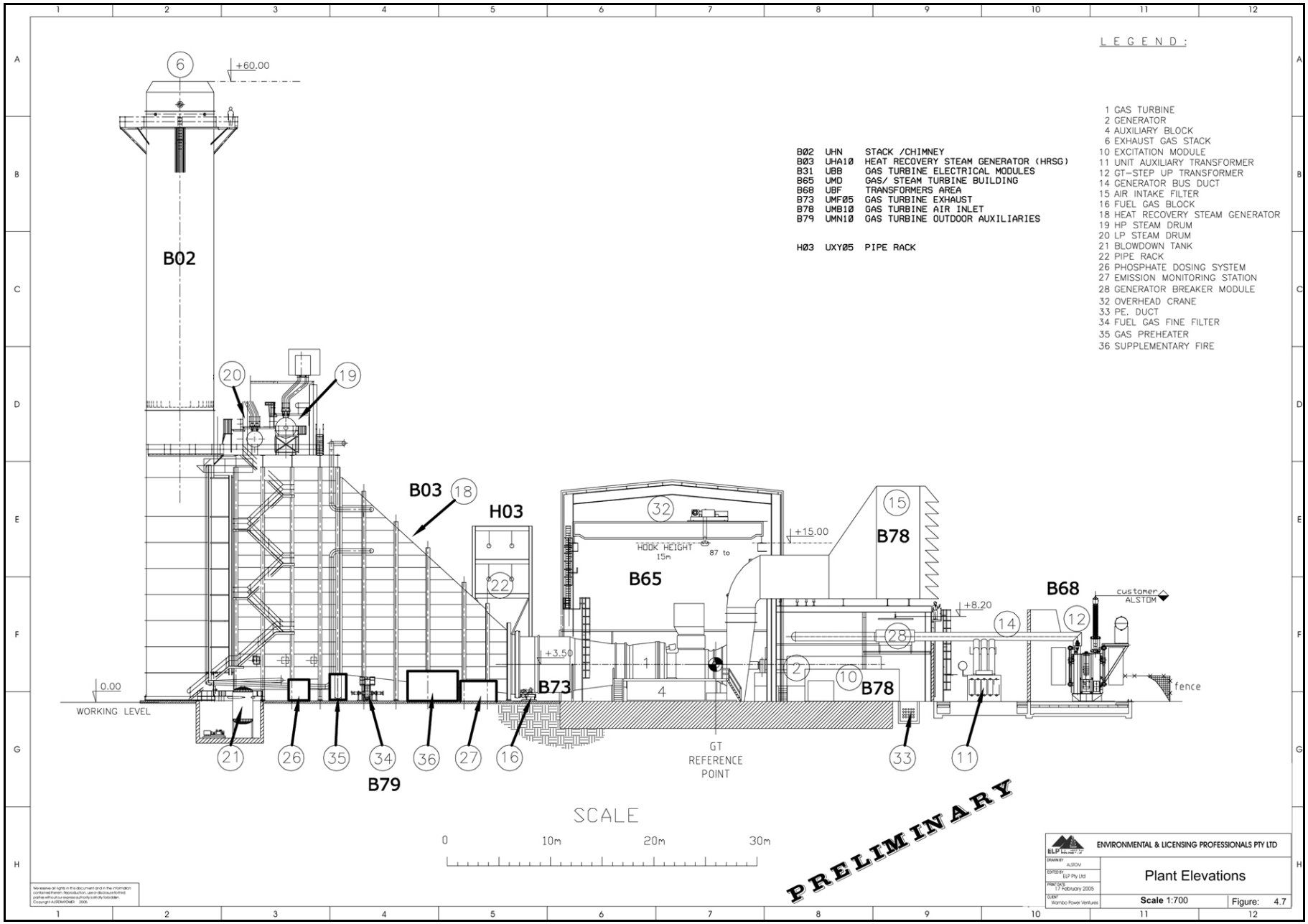

Figure 4: Proposed Kwinana Gas-Fired Power Station plant elevations

PROPONENT'S CONSOLIDATED ENVIRONMENTAL MANAGEMENT COMMITMENTS
KWINANA GAS-FIRED POWER STATION
(Assessment No. 1569)

Note: The term "commitment" as used in this schedule includes the entire row of the table and its six separate parts as follows:

- a commitment number;
- a commitment topic;
- the objective of the commitment;
- the 'action' to be undertaken by the proponent;
- the timing requirements of the commitment; and
- the body/agency to provide technical advice to the Department of Environment.

Proponent's Consolidated Environmental Management Commitments (Assessment No. 1569)

	Topic	Objective	Action	Timing	Advice
1	Flora and Fauna	To ensure no disturbance of dune/native vegetation along the western boundary of the site	1.1 The remnant vegetation within one metre of the western boundary of the site will not be disturbed by construction activities.	1.1 Construction	
2	Greenhouse Gases	To ensure that emissions are within the greenhouse gas guidelines	2.1 Become a signatory to the Greenhouse Challenge programme	2.1 Project Design	Australian Greenhouse Office

Appendix 3

Summary of identification of relevant environmental factors

Preliminary Environmental Factors	Proposal Characteristics	Government agency and Public Comments	Identification of relevant environmental factors
BIOPHYSICAL			
Flora	The site is predominantly cleared with a narrow strip of coastal dune vegetation along the western boundary of the site. Five native species were identified on site, none of which are listed as declared rare or priority flora. Potential for significant species occurring on site is low due to highly degraded nature of site. Vegetation on site has no local or regional significance.	**WPV consultation process:** Greening of the sites ought to be considered with a planting strategy developed and implemented.	WPV will develop a greening strategy for the site in partnership with Naragebup Rockingham Environment Centre. WPV advises that the vegetation on the western edge of the site will not be disturbed. The EPA considers that the concern raised has been adequately addressed. Due to the highly degraded nature of the site, the EPA considers that this factor does not require further evaluation.
Fauna	No declared rare or priority species were observed on site, and the potential for species of conservation significance to utilise the site is low given the high level of disturbance and lack of suitable habitat. Dune vegetation adjacent to the western edge of the site is likely to be of value to fauna, and may contain the priority 3 species Black-striped Snake and the Perth lined Lerista.	No specific concerns were raised in the submissions received	WPV advises that the vegetation on the western edge of the site will not be disturbed. The EPA considers that this factor does not require further evaluation.
POLLUTION			
Greenhouse gas emissions	The Kwinana gas-fired power station will generate up to 842 351 tonnes of CO_2 per year. This is approximately 0.2% of national CO emissions (based on 2000 emissions) Other greenhouse gas levels provided are: CH_4 – 2 711 CO_2 equivalent and N_2O– 500 CO_2 equivalent.	**ACF/Conservation Council WA** The proponent should be required to offset 100% of their greenhouse emissions associated with this project. Rockingham Gnaregebup Environment Centre Consideration should be given to potential for co-generation and molten carbonate fuel cell technology **City of Rockingham** The proposal should consider some sort of carbon offset program	In view of the significant quantity of greenhouse gas that would be emitted by the proposed power station, the EPA considers that greenhouse gas emissions is a relevant environmental factor.
Atmospheric Emissions	Dispersion modelling has been undertaken for NO_2, SO_2, PM_{10} and odour. Maximum 1-hr average concentrations are as follows:	**WPV consultation process** Emissions need to be considered in terms of potential health impacts Odour may be an issue	The EPA is satisfied that the levels of PM_{10} and SO_2 have been adequately modelled and shown to comply with the relevant standards. Similarly odour has been modelled according to EPA guidance statement 47 and the shown to comply with the

	NO_2: 217µg/m^3 (86% of NEPM standard) SO_2: 0.8% of Kwinana EPP standard PM_{10}: 2% of Kwinana EPP standard (24hr average) $PM_{2.5}$ estimated to be approx 4% of the NEPM $PM_{2.5}$ advisory standard Odour modelling shows that a maximum odour concentration of around 0.9 odour units (3min average) could occur as a result of the power station. The EPAs odour guideline requires a maximum odour concentration of 2 OU (3min average, 99.5th percentile) and 4 OU (3 min average, 99.9th percentile) Predicted levels of other pollutants are as follows: CO: 50ppmv VOCs: 10ppm PAHs: negligible These levels are low due to the high combustion efficiency of gas turbines Levels of other organics (e.g. benzene, toluene, xylene) are expected to be negligible as long-chain hydrocarbons are removed from the gas by the Wesfarmers LPG plant upstream of the proposed power station uptake.	Measurement of particulates should be provided in greater detail Will emissions be worse at the new site than at the Donaldson Road site? **Kwinana Progress Association/ Conservation of Rockingham's Environment** Requests for a commitment for continuous on-line NO_x, SO_2 and $PM_{2.5}$ monitoring **ACF/Conservation Council WA** Note that the levels of NO_x and SO_2 are low for this proposal.	requirements of this document. These emissions do not require further evaluation by the EPA. Due to the significant quantity of NO_x that will be emitted from the proposed power station, the EPA considers that Nitrogen Oxides are a relevant environmental factor.
Liquid and Solid Waste Disposal	The major sources of wastewater are HRSG boiler blowdown water, sampling drain streams and demineralisation plant water. Total waste water generated is expected to be 15kL/day or 5.5 ML/year. Wastewater is to be contained in the existing Western Power evaporation pond.	No specific concerns were raised in the submissions received	Wambo Power Ventures expects to be able to contain all wastewater in the evaporation pond. If disposal is required, the preferred option is disposal via the Water Corporation's Sepia Depression line. Blowdown water:The blow-down water is originally from a demineralization plant and is of very low salinity and very low total dissolved solids (TDS). To control corrosion and scaling in the boiler, boiler feed water is conditioned with small amounts of ammonia, hydrazine and tri-sodium phosphate. The blow-down waste water is sent to the evaporation pond if its TDS level becomes too high. The salinity level of this waste water typically would be less than potable water for example, 1000 mg/L TDS.

			Demineralization plant water: This waste goes through a neutralization process prior to being sent to the Evaporation Pond. A strong acid (typically sulphuric acid) is used to regenerate the cation exchange resin while a strong alkali (typically sodium hydroxide) is used to regenerate the anion exchange resin. Combining the wastes from these processes neutralizes some of the waste.The waste from the demineralization regeneration process will consist of the cations and anions removed from the input (scheme) water (and sorbed onto the ion exchange resins) plus the residual acid and alkali used during regeneration. The regeneration waste will therefore contain inorganic salts such as sodium, potassium, magnesium, calcium, suplhate, chloride and carbonate/bicarbonate. The maximum salinity expected from this source is expected to be no more than 15,000 mg/L TDS. This factor does not require further evaluation by the EPA.
Surface water and Groundwater	The Kwinana gas-fired power station will require about 137ML/yr of water to be sourced from the Water Corporation. Groundwater at the site is unlikely to be pristine due to other contaminating sources in the vicinity. However no further contamination should result from the power station. The proponent advises in their EMP that any potentially contaminated surface water runoff will be retained on site and treated before release to the environment.	No specific concerns were raised in the submissions received	The proponent advises that water use is low due to the operation of a blow-down water recovery system. WPV has had discussions with the Water Corporation regarding the use of recycled water sourced from the Kwinana wastewater recycling plant. The proponent advises that all areas that can potentially be contaminated with hydrocarbons or chemicals will be contained with bunding and/or drainage systems. The proponent will comply with the relevant Australian Standard for hydrocarbon storage and handling (AS1940). The proponent has developed preliminary environmental management plans (EMPs) for the storage and handling of chemicals (section 6.9, appendix L of referral document), waste and saline water (section 6.7, appendix L), and sediment control, hydrocarbon and water quality management (section 6.2, appendix L). Monitoring is included in these EMPs. This environmental factor does not require further evaluation by the EPA.
Noise	Construction and operation of the Kwinana gas-fired power station has the potential to affect	**WPV consultation process** Concerns about the cumulative effects of	Noise modelling predicts that the proposed Kwinana gas-fired power station will not exceed the *Environmental Protection*

	existing noise levels in the KIA	noise in the KIA and the noise from air cooling. **ACF/ Conservation Council WA** Consider that the EPA must be satisfied that the applicable noise restrictions will be met prior to approving this proposal **City of Rockingham** Various questions relating to noise (see referral document p.110). Can works be offered to the Naval Base Hotel to improve soundproofing of the rooms? Will vibrations be a concern?	*(Noise) Regulations1997* at any location except the Naval Base Hotel when accommodation is in use. As the noise regulations are predicted to be exceeded, the EPA considers that noise is a relevant environmental factor.
Site contamination	Two ash ponds on site are used by Western Power to dispose of ash from the Kwinana Power Station. Wambo has accepted responsibility for the remediation of the ponds prior to construction commencing. Visual inspection of the ponds led the consultant to suspect that the ponds were contaminated with metals, other chemicals and possibly acids. PAHs are also known to occur in ash dams.	**Department of Environment** Further investigations of the ponds are required to determine if the ponds are contaminated. Further inspections should be carried out in accordance with the DoE's *Contaminated Sites Management Series.*	The proponent has proposed to remediate the site by dewatering the ash and evaporating the liquid after removing as many suspended sediments as practicable. It is proposed to dispose of the remaining ash in a licensed facility. The nature and extent of the contamination is not known and the EPA considers that site contamination is a relevant environmental factor.
SOCIAL SURROUNDINGS			
Aboriginal Culture and Heritage	A desktop survey did not identify any Aboriginal heritage (archaeological or ethnographic) sites on the proposed site. Four archaeological and six ethnographic sites were located within 5km of the site however the proposed power station is highly unlikely to impact any of these sites.	No specific concerns were raised in the submissions received	The proponent has developed a heritage environmental management plan to ensure that heritage objects or artefacts that may be found on site are appropriately managed (section 6.10, appendix L of referral document). This environmental factor does not require further evaluation by the EPA.
Non-indigenous Heritage	A search of the Register of the National Estate did not identify any registered sites of interest on the proposed site. The Heritage Council of WA identified one site of interest 2km from the proposed power station site however this will not be impacted by the proposed power station.	No specific concerns were raised in the submissions received	The proponent has developed a heritage environmental management plan to ensure that heritage objects or artefacts that may be found on site are appropriately managed (section 6.10, appendix L of referral document). This environmental factor does not require further evaluation by the EPA.
Visual Amenity	The most significant visual impact of the Kwinana gas-fired power station will be the 60m tall stack. Surrounding land is zoned industrial	No specific concerns were raised in the submissions received	The proponent has made a commitment to minimise the visual impacts of the power station and has developed an environmental management plan to achieve this (section 6.5.2

	and two similar power stations (one existing, one proposed) are adjacent to the site.		appendix L of the referral document). Stack is similar height or lower than surrounding industries. Stack will not be visible at closest residential area (Hope Valley). This environmental factor does not require further evaluation by the EPA.
Recreational Activities	The Kwinana gas-fired power station is unlikely to have an impact on recreational activities in the general area	No specific concerns were raised in the submissions received	This environmental factor does not require further evaluation by the EPA.