Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the EPA Service Unit project officer would be most welcome.

Alcoa World Alumina Australia proposes to expand the Wagerup refinery through the construction of a third production unit. The proposed expansion would increase the capacity and efficiency of existing components of the refinery through the installation of new equipment and upgrades to some existing components. In accordance with the Environmental Protection Act, an Environmental Review and Management Programme (ERMP) has been prepared which describes this proposal and its likely effects on the environment. The ERMP is available for a public review period of 10 weeks from Monday 16th May, closing on Monday 25th July 2005.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

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

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the ERMP or the specific proposal. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable. When making comments on specific elements of the ERMP:

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

Points to keep in mind

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

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the ERMP;
- if you discuss different sections of the ERMP, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether and the reason why you want your submission to be confidential.

Information in submissions will be deemed public information unless a request for confidentiality of the submission is made in writing and accepted by the EPA. As a result, a copy of each submission will be provided to the proponent but the identity of private individuals will remain confidential to the EPA.

The closing date for submissions is: 25th July 2005

Submissions should ideally be emailed to

peter.walkington@environment.wa.gov.au

OR addressed to:

Environmental Protection Authority

PO Box K822	OR	Westralia Square
PERTH		141 St George's Terrace
WA 6842		PERTH WA 6000

Attention: Peter Walkington

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EXECUTIVE SUMMARY

Alcoa's Wagerup Alumina Refinery (the refinery) is located 120 kilometres (kms) south of Perth, 2 kms north of Yarloop and approximately 7 km south of Waroona. The Wagerup refinery currently has two production units and Alcoa is proposing the addition of a third production unit, which is the subject of this ERMP.

The Wagerup Refinery currently has environmental approval to produce 3.3 million tonnes per annum (Mtpa). However, its current capacity is approximately 2.6 Mtpa of alumina. Production is limited to 2.5 Mtpa by environmental licensing.

Alcoa considers its Wagerup refinery to be the most environmentally advanced alumina refinery in the world. Expansion at Wagerup is one of several world-wide options currently being considered by Alcoa to provide additional capacity to meet increased global demand for alumina.

The proposed Wagerup expansion (the Proposal) will increase the capacity and efficiency of existing components in the refinery through the installation of new equipment and upgrades to some existing equipment. The additional new plant and modifications will occur across the refinery. Table E1 lists the key characteristics of the Proposal:

Proponent

Alcoa of Australia Limited, trading as Alcoa World Alumina Australia, is the Proponent for the Proposal. Alcoa World Alumina Australia is one of 25 Alcoa Inc business units, and is the world's leading producer of alumina. Alcoa's alumina refineries at Kwinana, Pinjarra and Wagerup have a combined annual production capacity of 7.8 Mtpa, equivalent to some 15% of world demand.

Alcoa Inc is the world's leading producer and manager of primary aluminium, fabricated aluminium and alumina facilities, and is active in all major aspects of the industry.

Proposal Schedule

It is anticipated that the engineering design phase of the Proposal will take approximately 6 to 12 months with preliminary design and feasibility work already underway. Construction is scheduled to commence in late 2005, subject to the Proposal receiving all necessary government and Alcoa approvals. A 27 month construction period is expected, with the newly expanded Wagerup refinery reaching full production mid 2008.

Table E1: Key Characteristics of the Proposal

Characteristic	Units	Current Refinery	Expanded Refinery
Alumina Production	Mtpa	Approx 2.4	Approx 4.7
Refinery Operations		Continuous operation	Continuous operation
Bauxite Mine		Continuous operation	Continuous operation
Bauxite Mining Rate	Mtpa	9	16
Proposal Life	yrs	>60	>35
Capital Investment	A$	-	1.5 billion
Refinery Footprint	ha	183	183
Construction Period	months	-	27
Workforce (peak construction)	persons	-	>1,600
Workforce (operation) (Refinery + mine)	persons	900	1,050
Bauxite Residue	Mtpa	4.8	9.6
Noise		Regulation 17 application under the *Protection (Noise) Regulations 1997* is being considered by the Minister for Environment	No increase in noise impacts on surrounding residents
Particulates	tpa	60	65
Oxides of Nitrogen (NOx)	tpa	1005	1974
Sulphur Dioxide (SO_2)	tpa	70	113
Volatile Organic Compounds (VOCs) [1]	tpa	78	93
Greenhouse Gases	tpa	1,342,000	2,255,000 (cogeneration) 2,544,000 (boilers)
Greenhouse gas emission intensity	$kgCO_2/t$ alumina	557	480 (cogeneration) 541 (boilers)
RAW MATERIALS			
Caustic Soda (dry)	tpa	141,000	282,000
Lime	tpa	110,000	200,000
Water	MLpa	4,800	9,600

Note[1] : Total VOCs is the sum of Acetone, Acetaldehyde, 2-butanone, Benzene, Toluene, Xylenes, Acrolein, Ethylbenzene, Methylene Chloride, Styrene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene & Vinyl chloride

Proposal Area

The Wagerup refinery and associated residue drying area (RDA) is located on Alcoa owned industrial-zoned land. Surrounding the refinery is approximately 6,000 ha of Alcoa freehold property, which is predominately operated as a beef farming enterprise by “Alcoa Farmlands”. The surrounding landuse is predominantly rural, with most of the region cleared for agriculture.

The Proposal boundary is defined as the existing Wagerup refinery boundary (located on the east side of the South Western Highway) and the residue operations (located on the west side of the South Western Highway). The additional refining infrastructure required for the Proposal will all be located within the existing refinery boundary and will occupy an area less than 10% of its total size.

The existing residue area will be expanded in accordance with the Wagerup refinery Long Term Residue Management Strategy (LTRMS) to accommodate increased residue production. Further modification to the residue area over the life of the Proposal will be considered and assessed through future reviews of the LTRMS.

Alcoa presently exports all alumina from the Wagerup refinery through its Bunbury Port facilities. Some modifications will be made to the existing port facilities to improve loading and unloading efficiencies however, the port facility has the capacity to accommodate increased production as a result of the Proposal.

On referral of the Proposal to the EPA, the EPA advised that bauxite mining is not considered within the scope of this ERMP. The acceptability of mining within the lease is approved by the Minister for Resource Development via the Mining and Management Program Liaison Group (MMPLG).

Proposal Benefits

There are a number of significant socio-economic benefits to be gained from the Proposal. The Proposal will entail a capital expenditure of over A$1.5 billion and is expected to earn approximately A$17 billion over 30 years in new export revenues. The proposal will deliver substantial economic benefits to the region, the State of Western Australia and the Commonwealth of Australia. Implementation of the Proposal will increase production capacity from around 2.6 Mtpa to a total of approximately 4.7 Mtpa, which equates to an 81% increase in current annual alumina capacity from the refinery. The Proposal is expected to increase the value of Western Australian alumina exports by over A$550 million per year.

Direct economic benefits to the local community, State and the Peel and South West Regions will be delivered through increased Commonwealth and State royalties, 150 permanent Alcoa positions and an estimated 3,000 direct and indirect employment opportunities within Western Australia. It is estimated that the Proposal will generate around 1,500 new jobs in the Peel and South West Regions during the operational phase. During the construction period, the workforce will peak at approximately 1,600 employees, which is the equivalent of around 500 full time jobs during the entire 3 year construction period.

Air Quality

Air quality in populated areas near the Wagerup refinery has been an issue of importance since the mid 1990s with some members of the local community reporting odour, dust and health concerns as a result of refinery emissions. These concerns reached a peak in 2001 and 2002 with high numbers of complaints lodged with Alcoa, particularly for odour. Since this time the number of environment related complaints has fallen steadily in response to further emission control works and Alcoa's land management strategy. However, community complaints remain an important issue and emissions management, air quality monitoring, air quality modelling and health risk assessment are important parts of this ERMP.

A study was undertaken in 2004 to provide detailed information on the ambient air quality in the region surrounding the Wagerup alumina refinery, including the townships of Waroona and Yarloop and the associated rural environment.

The overall air quality was found to be typical of rural environments in both the nature and the levels of chemical compounds detected, except for acetaldehyde which was at levels more typical of urban environments. All of the compounds detected were at levels well below applicable environmental and health standards.

The main chemical compounds detected are all known to be present in refinery emissions. The levels found in the ambient environment are generally many times greater than the predicted refinery influence for each compound based on dispersion modelling of refinery and RDA emissions. All compounds were detected at concentrations well below levels normally considered to be of concern from a human health perspective.

Air dispersion modelling was used to predict the ground level concentrations (GLC's) of a suite of compounds emitted from the refinery processing area and the RDA. The substances selected for dispersion modelling, and the prediction of GLCs from refinery sources, account for approximately 96% of the total mass of refinery emissions, with no individual source in the remaining 4% representing 1% or more of point source emissions.

A specific investigation program was undertaken to quantify the relevant emissions from diffuse sources (such as residue drying beds, run-off collection areas and the cooling pond). Both point (refinery) and diffuse (RDA) emissions were modelled and combined to generate contour maps of the GLCs for both the current refinery and expanded refinery scenarios. This allowed comparison of the predicted GLCs against air quality and health criteria and evaluation of the potential air quality impacts from the proposed expansion, compared to the current refinery. This work also provided the compound concentration data to enable a quantitative health risk assessment to be conducted as part of the ERMP.

Evaluation of the predicted GLCs, for a range of compounds, at adjoining residences and in nearby townships found that the Proposal is predicted to generate GLCs less than the applicable air quality standards.

Short-term emission exposures

This air dispersion modelling work also included estimation of potential short-term maximum GLCs from refinery emissions; at three-minute and ten-minute timescales. The maximum three-minute average concentrations predicted by modelling were found to be all substantially less than the ambient guidelines for longer averaging periods. This strongly suggests that short-term exposures for these compounds are unlikely to result in health effects. This conclusion holds for the base case and the two expansion scenarios. Evaluation of the potential for short-term emission impacts also included statistical analysis of an extensive data base of six-minute field data for oxides of nitrogen and particulate matter. This work concluded there is no evidence that complaints are due to an irritant response to alkaline particles.

Alcoa recognises the issue of air quality will remain important to members of the local community, as it does for the company, and this ERMP includes an Air Quality Management Plan which will be used to help guide air quality investigations into the future.

Odour

Predicted odour emissions from both the current and expanded refinery and residue areas were estimated following field sampling exercises. This allowed the potential change in ground level odour concentrations to be evaluated.

This work found that while odour from the refinery may still be detected in surrounding areas, under certain meteorological conditions, there is expected to be a significant decrease in the predicted peak odour concentrations at ground level as a result of the Proposal. The two expansion scenarios modelled as part of this ERMP predict reductions for both the 99.5th and 99.9th percentile ground level odour concentrations. It is therefore considered that the Proposal satisfies the EPA's guidance statement requiring no deterioration of amenity values from expanded facilities and Alcoa's public undertaking that the Proposal will result in no increase in odour impacts on surrounding residents.

Health Risk Assessment

A quantitative health risk assessment (HRA) has been conducted by a specialist consultants. The HRA process examines the potential health impact of refinery and RDA emissions on the nearby population using a comparison of the predicted ground level concentrations (GLC) of selected compounds to their accepted health guideline levels. This occurs for the individual compounds and the combination of all selected compounds. For the combined suite of modelled compounds this includes evaluation of acute hazard and chronic hazard risks as well as the incremental carcinogenic risk.

The HRA concluded:

- the potential for emissions from the existing or expanded Wagerup refinery to cause acute health effects is low;
- the potential for emissions from the existing or expanded Wagerup refinery to cause chronic non-carcinogenic health effects is very low; and
- the potential for emissions from the existing or expanded Wagerup refinery to contribute to the incidence of cancer based on inhalation exposure is below USEPA *de minimis* threshold of one in a million (i.e. 1 x 10-6) at all of the residential receptors considered.

Furthermore, to ensure that potential risks are not underestimated, uniformly conservative assumptions were used to characterize exposure and toxicity in the HRA. Due to the resultant compounding of conservatism, the quantitative risk indicators should be considered as over-estimates of potential health risks associated with emissions from the Wagerup refinery.

Community Health Status Survey

A health survey of local community members will be undertaken prior to commissioning the Proposal, if approved. The survey will aim to measure the current health status of local community members to enable a comparison to Western Australia wide health results.

The main aspects of the proposed health status survey are:

- A cross-sectional survey method used to capture "a point in time" data;
- Random sample selection of the populations of Yarloop, Hamel and nearby townships;
- Statistically valid sample sizes;
- The Computer Assisted Telephone Interview (CATI) technique will be used;
- The WA Health and Wellbeing Questionnaire developed by the Department of Health will be used for the survey ;
- Statistical analysis applied to detect associations between various aspects of the survey results, such as the likelihood of chronic health conditions and location, health risk factors and health enhancing factors. This will allow comparison with the State-wide database

Refinery Noise Emissions

Alcoa recognises that refinery noise is also an issue of considerable importance to some neighbours and noise complaints are logged by Alcoa along with other environment related complaints. In recent years Alcoa has also invested significantly in noise control measures and provided ameliorative work at relevant nearby residences. Noise complaints peaked during 2002 and have subsequently declined during 2003 and 2004. Noise modelling and a framework for noise emission management are important parts of this ERMP.

Analysis of the monitoring data suggests that there has been no increase in the refinery contribution to ambient noise levels over the past three years and that the actual refinery sound power level (noise emission) is relatively constant. Occasional variations are primarily caused by meteorological conditions.

In February 2002, Alcoa submitted an application for a variation to the assigned noise levels, under the provisions of Regulation 17 of the Environmental Protection (Noise) Regulations. This variation provision was included in the Regulations in recognition that some facilities might not be able to comply with the newly introduced and more stringent assigned noise levels. On referral of the proposal to expand the Wagerup refinery, the EPA determined that the Regulation 17 assessment should be incorporated into the EPA's assessment of the proposed upgrade of the Wagerup refinery (this ERMP).

Alcoa has undertaken to ensure that there is no increase in noise impacts from the refinery area on surrounding residents. This ERMP outlines work conducted to characterise and understand refinery noise emissions as well as a noise modelling that has been used to assess the implications of expansion. The ERMP also outlines a management program, including a Noise Management Plan, which will be used to ensure the Proposal is implemented in a way that ensures the public undertaking is met.

Energy Requirements

The Wagerup refinery is recognised as one of the most technologically advanced and energy efficient alumina refineries, when compared with international benchmarks. The Proposal will result in the installation of current best practice energy efficient processes. There will be an overall increase in energy consumption at the refinery, however with improved energy efficiency; energy consumption per tonne of alumina produced will decrease.

Currently two options are being considered to meet the additional energy requirement for the Proposal. Either two additional boilers and two turbine alternators will be constructed in the existing powerhouse, or two additional turbine alternators will be constructed in the existing powerhouse and a new Cogeneration facility will be developed by a third party. The relevant environmental aspects of both options are considered in this ERMP.

Water Supply

The refinery's current total water requirement is 9,460 MLpa, of which 4,800MLpa is obtained from licenced surface water sources. The Proposal will take the total water requirement to approximately 14,900 MLpa in a dry year. The refinery's surface water requirements will vary each year depending on annual rainfall, requiring approximately an additional 4,800 MLpa in a dry year or 1,100MLpa in an average rainfall year, from external water sources.

Alcoa commissioned an analysis of the water supply options and water conservation opportunities, which were identified through a process of consultation with key stakeholders including Alcoa staff, local community representatives, Harvey Water, Water and Rivers Commission (DoE) and Agriculture WA. Several water supply options are considered in this ERMP, including additional surface water supply and efficiency improvement options.

Community Consultation

Alcoa developed and implemented a comprehensive community consultation process for the Proposal, which recognised existing community consultation networks and the considerable interest members of the local community have in the operations of the Wagerup refinery. Following an Open Space Forum in September 2004, five working groups were formed to enable consultation on detailed aspects of the Proposal. The existing Wagerup Community Consultative Network (CCN), established in 1994, monitored the process to ensure openness and transparency. This process enabled community members to participate in the identification, assessment and potential management of environmental factors associated with the Proposal, whilst also monitoring the consultation process. A broader range of stakeholders have been involved through regular communications, such as newsletters, press articles, a designated website and a public open day during the preparation of this ERMP.

In addition to providing a range of communication tools to meet stakeholder needs, Alcoa aimed to achieve a high 'level' of community involvement, particularly for those stakeholders seeking active involvement.

Over 120 people attended an Open Space Forum to start the community involvement process. A report of their proceedings was collated and distributed on the final day of the forum. One outcome of the forum was the identification of key topics for further discussion. This assisted in the formation of the working groups which formed a key part of the community involvement program.

Five independently facilitated working groups were established in mid-October to examine and comment on the detailed content of Alcoa's proposal to expand the Wagerup refinery and to address the ongoing issues and opportunities identified at the Open Forum.

The groups established were: Emissions & Health; Transport & Noise; Residue & Water; Social & Economic; and Land Management. The use of multiple, topic specific working groups allowed concurrent examination of issues, rather than one group needing to cover all topics.

Each of the five working groups considered key aspects (including technical investigations) of the project relevant to their subject area and had an opportunity to provide feedback on how opportunities could be optimised and issues or concerns managed. As part of the ERMP assessment process, around 60 community working group meetings were held, totalling more than 200 cumulative hours of consultation.

Informing Stakeholders

Alcoa staff met with and briefed a range of stakeholders including employees, unions, affected shires, local development commissions, chambers of commerce and business groups, stakeholder groups, peak industry groups and relevant State government departments within the planning, environment, health and industry sectors.

An Open Day, attended by more than 1,000 people, was held at the Wagerup refinery on 10 October 2004 to provide further information on the Proposal and Alcoa attended displays with current project information at the Harvey and Waroona Shows in October and November, 2004, the Harvey Harvest Fair and Waroona Autumn Fair in mid-March and early April 2005.

Other tools to inform the community have included two advertising series (17 full-page advertisements to date), a monthly newsletter produced from August 2004 provided to 3,500 local households, 350 key stakeholders and refinery employees, the bi-monthly internal newsletter Alcoa News, and a dedicated Wagerup Unit Three website. An Information Day will be held in the local area following the ERMP being published and another Wagerup Refinery Open Day will also be held later in 2005.

Sustainability framework

Building on its values, Alcoa's sustainability objective is to "achieve simultaneously financial success, environmental excellence, and social responsibility through partnerships in order to deliver net long-term benefits to our shareholders, employees, customers, suppliers, and the communities in which we operate"

Alcoa's sustainability framework, which complements national and State sustainability principles, is based on eight principles:

- Respect for people.
- Building community experience and well-being.
- Long-term economic benefit.
- Efficient resource use and cleaner production.
- Ecological integrity and biodiversity.
- Meeting the needs of current and future generations.
- Stakeholder involvement.
- Accountability and governance.
- Identification of Environmental factors

Alcoa commenced the identification of key environmental factors very early in the Proposal planning stages. The Proposal will be developed at the site of the existing Wagerup refinery which has been operational since 1984. There is therefore a good understanding of the natural and cultural environment within which the Proposal is located.

Of particular significance in understanding issues of community interest has been the community involvement framework established for the Proposal. This framework has provided many opportunities for community input during the development of this ERMP. This has occurred through an initial stakeholder forum that identified issues and opportunities of significance and also through the five working groups established for ERMP consultation.

This community involvement framework has allowed ongoing identification and refinement of environmental issues during development of the ERMP.

The key environmental factors and issues that are considered to be significant in the assessment of the environmental impacts of the Proposal are presented in Table E2.

Table E2: Environmental Factors

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Integration					
Biodiversity	*To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystem they form, at the levels of genetic, species and ecosystem diversity.*	The Wagerup operations are in the majority surrounded by paddocks, used mainly for grazing of livestock.	No remnant native vegetation will be cleared and there is not expected to be any impact on biodiversity from what little clearing or disturbance takes place.	Alcoa will keep vegetation clearing for the Proposal to a minimum and will rehabilitate the residue area with native flora indigenous to the area. This will prevent any adverse impact on biodiversity.	No adverse impact to biodiversity.
Sustainability	*To ensure as far as practicable that the proposal meets or is consistent with the sustainability principles in the National Strategy for Ecologically Sustainable Development (C'wealth 1992)*	Alcoa's sustainability framework, which complements national and State sustainability principles, is based on eight principles: • Respect for people. • Building community experience and well-being. • Long-term economic benefit. • Efficient resource use and cleaner production. • Ecological integrity and biodiversity. • Meeting the needs of current and future generations. • Stakeholder involvement. • Accountability and governance.	Poor design and management of a development could result in unacceptable economic, environmental and social impacts. Conversely, protection of the environment and social values needs to take into account consideration of economic constraints.	Alcoa's sustainability principles have been and will continue to be applied to the Proposal. Alcoa has also recently developed a socio-economic booklet describing ideas that could contribute to a sustainable future for the region. Two of these initiatives include a regional sustainability fund and a regional learning centre. In the following months, during the Government's formal assessment phase, Alcoa will further examine the ideas proposed.	Project is consistent with sustainability principles in the National Strategy for Ecologically Sustainable Development and Alcoa's sustainability principles.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Biophysical					
Flora and Vegetation	*Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.* *Avoid adverse impacts on biological diversity, comprising of different plants and animals and the ecosystems they form at the levels of genetic, species and ecosystem diversity.*	The Wagerup operations are in the majority surrounded by paddocks, used mainly for grazing of livestock. In the vicinity of the residue area the paddocks have generally been levelled to allow even water flow and are irrigated by an extensive system of drains. Vegetation in this area consists of pasture grasses and a mixture of *Eucalyptus* spp. trees and shrubs.	No significant remnant native vegetation will require clearing and none of the Threatened Ecological Communities (TECs) or locally significant vegetation communities identified in the vicinity of the refinery will be affected (either directly or indirectly) by the expansion of the refinery or RDAs.	Alcoa will keep vegetation clearing for the Proposal to a minimum and will rehabilitate the residue area with native flora indigenous to the area.	No impact to flora and vegetation.
Fauna - Specially Protected (Threatened) Fauna	*Protect Specially Protected (Threatened) Fauna species and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950.* *Avoid adverse impacts on biological diversity, comprising of different plants*	No specially protected fauna are known to occur within the area impacted by the proposal.	It is not expected that changes to the refinery as a result of the Proposal will result in any additional impacts to the native fauna in the area. Fauna occurring near the residue areas may be disturbed during construction of the new RDAs during the life of the Proposal, and to a lesser extent during operation. However, this disturbance is not expected to	Alcoa will minimise clearing of vegetation to minimise the impact on native fauna habitats. Alcoa will establish a wildlife corridor on rehabilitated residue areas and land along existing and planned drainage lines to promote recolonisation of these areas by native fauna, establish native fauna habitats, and increase the biodiversity of these	No impact on fauna.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
	and animals and the ecosystems they form at the levels of genetic, species and ecosystem diversity.		adversely impact any fauna species in the area as no areas of remnant vegetation will be cleared).	communities.	
Pollution Management					
Air quality – refinery gaseous and dust emissions	*To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards.*	The overall ambient air quality was found to be typical of rural environments in both the nature and the levels of chemical compounds detected, except for acetaldehyde which was at levels more typical of urban environments. All of the compounds detected were at levels well below applicable environmental and health standards.	The Proposal will result in no increase in odour or dust impacts. The combination of new infrastructure, increased production and emission control works results in emissions from some sources increasing and others decreasing. There will be an overall increase in particulates, NOx, SO_2, and VOCs through the Proposal, but these all remain well below applicable environmental and health standards.	Alcoa will implement the Air Quality Management Plan as detailed in this ERMP. Measures taken to manage emissions will include: • A Regenerative Thermal Oxidiser (RTO) on the liquor burner; • An RTO on oxalate process emissions; • Improved calciner performance; • Low NOx burners in new boilers; • Redirection of calciner low volume vent emissions for destruction; • Reduction in cooling tower VOC emissions; • Reduced emissions from causticisation; • Sealing of some additional tank vents; • Green liquor filter upgrades, and	No increase in odour or dust emissions impacts. Air dispersion modelling shows emissions from the proposal are within applicable air quality criteria. Health risk assessment found the potential for the existing or expanded refinery to: - Cause acute health effects is low; - Cause chronic non-carcinogenic health effects is very low; and - Contribute to the incidence of cancer is below the “one in a million” threshold. The maximum short-term emission

Environmental Factor	**EPA Objective**	**Existing Environment**	**Potential Impact**	**Environmental Management**	**Predicted Outcome**
				• Upgraded sprinkler system for the RDA. In the event of engineering design changes, appropriate emission controls or other measures will be implemented to deliver equivalent environmental outcomes A community health status survey will be undertaken prior to commissioning the Proposal, on approval	concentrations (3 minute) were found to be all substantially less than the ambient guidelines for longer averaging periods. This indicates that short-term exposures are unlikely to result in health effects.
Air quality – RDAs and Cooling Ponds, Gaseous and Dust emissions	*To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards*	Sources of fugitive particulate emissions from the refinery operations are from dust lift off from residue areas, uncontrolled sources such as vehicles on paved and unpaved roads, dust from the material handling operations such as stacking and reclaiming at the bauxite stockpiles and wind generated dust.	Without emission control measures the Proposal offers potential to impact detrimentally on surrounding air quality through increased emissions of various types and compounds.	The RDA sprinkler system will be upgraded to significantly improve dust control.	No increase in dust emission impacts from RDA. Gaseous emissions from the RDA were combined with refinery point sources and input into the health risk assessment (see above).
Air Quality – Bunbury Port	*To ensure that emissions do not adversely affect*	The main potential sources of dust at Alcoa's port operations are ship	Potential deterioration in air quality due to emissions.	Existing procedures are in place at Alcoa's Bunbury Port operations for	After inclusion of alumina from the Proposal, Alcoa's Bunbury Port

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
	environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards	loading activities, conveyor operations and filling of the alumina bins.		controlling dust emissions (Document No. 44146 Minimising Dust During Shiploading). .	facility will be operating within its current capacity. No increase in dust impacts are expected at the Alcoa port operations.
Air quality – Construction Dust	*To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards*	Refinery area is highly modified including extensive paved areas.	Dust emissions arising from construction activities could reduce air quality	Dust suppression measures during construction	No unmanageable dust impacts are predicted from construction.
Greenhouse Gas Emissions	*To minimise emissions to levels as low as practicable on an on-going basis.* *To ensure that potential greenhouse gas emissions from the proposed project are adequately addressed and best practicable measures and technologies are used.*	The refinery currently emits 1,342,000 tonne of greenhouse gas carbon dioxide equivalents. During the 2004 calendar year the Wagerup refinery operated at an average energy efficiency of 9,195 MJ/t of alumina produced, which is a significant improvement on the World-wide weighted average.	The Proposal would result in GHG emissions rising from 1,342,000 to 2,544,000 tonnes Gg CO_2 equivalents if boilers are installed. The cogeneration option would cause emissions to increase to 2,255,000 Gg CO_2 equivalents, which is significantly higher than the base case, but a reduction over the boiler option. The most significant GHG contribution from the refinery	Implementation of the Proposal is projected to further improve energy efficiency to 8,758 MJ/t with the boiler option and to 7,770 MJ/t with the cogeneration option.	Depending on the power supply option selected, the Proposal is estimated to improve the greenhouse gas emissions intensity by approximately 5% to 541 kg CO_2-e with the boiler option, or by approximately 15% to 480 kg CO_2-e per tonne of alumina produced with cogeneration.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
			arises from the combustion of natural gas.		
Groundwater Quality	*Maintain the quality of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.*	Groundwater quality investigations have identified groundwater contamination in certain locations beneath the refinery and the residue area.	Additional contamination of groundwater.	Alcoa is in the process of implementing a Groundwater Remediation 5 Year Plan (2005-2009) for all of its WA Operations.	No deterioration in groundwater quality as a result of the Proposal.
Surface Water Quality	*Retain the integrity, functions and environmental values of protected wetlands, and to ensure that the EPP lakes are protected and their key ecological functions are maintained.* *Maintain the integrity, functions and environmental values of rivers and ephemeral streams, and to ensure that alterations to surface drainage do not adversely impact native vegetation.*	For the existing refinery, management systems are in place to capture all stormwater runoff and process spill water that is not contained within bunds. The storm sewer and surge pond for the refinery have been designed for a 1:100 year storm. Therefore the risk of contaminated water leaving the property is considered low and manageable.	Monitoring results indicate that the Wagerup refinery operations have had no impact on surface water quality in the vicinity of the Proposal area.	Any new capital project proposed by Alcoa is required to be internally assessed via a comprehensive set of management tools and designed in accordance with appropriate design principles. The design and capacity of the existing stormwater management system at the Wagerup refinery will be reviewed as part of detailed engineering design to ensure the Proposal can be accommodated.	No impact is predicted from the Proposal

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Liquid and Solid Wastes (other than bauxite residue)	*Ensure that liquid and solid wastes do not affect groundwater or surface water quality, nor lead to soil contamination.* *Ensure that the generation of all wastes follows consideration of waste reduction in accordance with the waste hierarchy of reduction, reuse, recycle, treatment and disposal.*	The Wagerup refinery has an existing waste management programme within the EMS. The waste streams are grouped into categories which adhere to Government regulations and internal Alcoa guidelines. The Wagerup waste minimisation program was initiated in 1993 with the objective of characterising and quantifying waste streams and identifying waste minimisation and recycling opportunities. Significant advances have since been made in the area of waste recycling and minimisation. Alcoa has a target of zero non-process waste to landfill by 2008.	Inadequate waste management practices can lead to contamination of soil or water.	Waste management at Wagerup is undertaken in accordance with the Waste Management Procedure (Doc. Number 5102) and specific procedures written for disposal of hazardous wastes.	Waste management will be adequately controlled by existing practices extended to cover the Proposal
Noise – Refinery	*To comply with statutory requirements on a stand-alone basis*	In 2002, Alcoa applied to the Minister for Environment for a variation to the assigned noise levels, as allowed under regulation 17, such that the refinery would be fully compliant with the	If the expansion were implemented with no acoustic controls, offsite noise levels could increase by over 4 dB(A) (i.e., the noise levels will revert to levels similar to those present before the implementation of	An acoustic assessment of the proposed expansion has been undertaken to verify that the noise objective is technically feasible and detail the noise control and management methods required from	If the proposed sound power allocation is implemented there would be no significant change to noise levels experienced by neighbours when compared with the noise levels from the existing

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
		Regulations.	the 2000 and 2001 noise reduction program).	design through to operational phases.	refinery and conveying system.
Noise – Bunbury Port	*To comply with statutory requirements on a stand-alone basis*	The noise emissions from Alcoa's Bunbury Port facility currently comply with the assigned levels in the *Environmental Protection (Noise) Regulations 1997*.	Acoustic consultants have predicted that following the modification to the dust collector fan, current worst-case noise levels will be 32 dB(A) at the south-western residence and 31 dB (A) at the north-eastern residence.		After reviewing the existing model and the design changes associated with the proposed expansion, acoustic consultants concluded that provided low-noise new equipment is selected and the duplicate conveyor is enclosed, the proposed changes to the Alcoa facility should have no noticeable noise impacts at nearby residences.
Water Supply	*To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*	Current refinery and residue water supply comes from : • Rainfall collected in Fresh Water Reservoirs • Rainfall Runoff from Plant Area • Rainfall Runoff & Drainage from Residue & Liquor Pond Areas • Surface Water Sources (Licence) - Nth & Sth Yalup Br (1600MLpa) - Black Tom Br (2500 MLpa) - Harvey R Main Drain (4400MLpa) • Groundwater (550 MLpa)	The water requirement for the Proposal is expected to be an additional 1.1 GLpa under average rainfall and runoff conditions (see Table 4; Section 5.3.3) and potentially up to 4.8 GLpa under drought conditions (see Table 5; Section 5.33). Based on available data, CENRM (2005) estimated that an additional 28 GL allocation is available from the Harvey River Main Drain pumpback station.	Water supplies for the Proposal will be managed in accordance with the Water Supply Management Plan.	Alcoa will ensure additional water sourcing has no appreciable adverse environmental impact on surface or groundwater in the area.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Social Surroundings					
Archaeological Heritage and Ethnographic Issues	*Ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.*	Twenty seven Aboriginal archaeological sites have been recorded within an 8 km radius of the Wagerup refinery. One site is located immediately outside the Proposal area on the southern edge of the existing RDA.	The Proposal will be constructed within the boundary of the existing refinery and will therefore not disturb any known Aboriginal heritage sites. The Proposal will be implemented in accordance with the LTRMS and will not disturb any known Aboriginal heritage sites.		There will be no impact on archaeological heritage and ethnographic issues.
Public Safety Risk	*To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria including Guidelines and Criteria for EIA No 2, Guidance for Risk Assessment and Management: Off-site Individual Risk from Hazardous Industrial Plant.*	A Public Safety risk assessment has been undertaken for the existing Wagerup refinery and the Proposal. This risk assessment focussed on accidental events which may have an acute impact on members of the public.	A range of hazards were identified that had potential consequences outside of the immediate workplace. Analysis determined if these risks offered potential to affect areas outside Alcoa's boundary where the public risk criteria apply. .	The maintenance and performance monitoring of the controls associated with the identified hazards for the existing plant, expansion and on-going operations are addressed within the Wagerup Safety Management System (which meets the requirements of AS 4801 "Occupational Health and Safety Management Systems) and the Alcoa Major Hazard Management System. .	No appreciable increase in public safety risk as a result of the Proposal...
Visual Impact	*Visual amenity of the area adjacent to the Proposal*	Parts of the refinery, especially the 100m tall multiflue stack, are	The footprint of equipment associated with the Proposal will be	Alcoa currently has a Visual Amenity Strategy for the Wagerup	Residue areas will become more visible, especially relating to height.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
	should not be significantly impacted by the proposal.	visible from many areas around the refinery. The residue areas are also visible from some locations. Light spill at night is visible for many kilometres.	within the confines of the existing Wagerup Refinery. Expansion of the refinery will also require expansion of the existing residue area within the proposed 30 year residue footprint, which will be to the west and north of the existing residue area in accordance with the LTRMS. The most obvious difference at the refinery will be the addition of a second tall multiflue stack. If the Cogeneration option is pursued, two cooling towers will be visible from many locations. If the boiler option is selected a 75 m stack will be visible. The most obvious difference in the residue area will be the increase in height from the existing elevation of around 20 m to 40 m above ground level, in accordance with the endorsed LTRMS.	residue area. This strategy will be expanded to consider the future residue areas required for the Proposal. This includes enhancing screening vegetation around the refinery and RDA. Appropriate measures for management of light spill for the Proposal will be selected in consultation with plant operations and maintenance personnel to ensure adequate lighting requirements for safe working are maintained.	A second tall calciner multiflue stack and either a second boiler stack or two powerhouse cooling towers will also be visible from some locations around the refinery.
Transport	*Ensure that roads are maintained and road traffic managed to meet an adequate*	The road freight movements associated with the Proposal represents approximately 12% of	The Proposal will result in an increase of road freight vehicles to a total of around 280 vehicles per week	A transport coordinator will be nominated for the Proposal, whose role will be to evaluate transport	There will be an increase in road and rail movement to and from the refinery. Transport management

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
	standard of level of service and saftey. *Ensure that transportation and storage of fuels/chemicals complies with the Australian Dangerous Goods Code; and* *ensure the requirements of Main Roads Western Australia are met.*	all freight movements, or 1.5% of all vehicle movements on South West Highway in this locality. This represents an average of 167 one-way freight movements. Total one-way train movements average four to seven trains per day.	(one-way). During the construction phase there is the potential for an estimated 400 additional passenger vehicles on average travelling to and from the refinery on a daily basis. Increases in the number of road vehicles, has the potential to increase traffic congestion, risk of accidents along the main transport routes, and road wear. Increases in train length will increase the duration of level crossing times.	routes both on and off the Wagerup refinery site and to ensure that equipment is delivered to Wagerup in a manner that meets all legislative and Alcoa standards. The transport coordinator will prepare the traffic management plan for the Proposal.	plans will minimise this impact.

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME
WAGERUP REFINERY UNIT THREE

for
Alcoa World Alumina Australia ("Alcoa")

1. INTRODUCTION

1.1 BACKGROUND

Alcoa's Wagerup Alumina Refinery (the refinery) is located 120 kilometres (kms) south of Perth, 2 kms north of Yarloop and approximately 7 km south of Waroona. The refinery is positioned close to the foot of the Darling Scarp and is separated from the Wagerup refinery Residue Drying Area (RDA) by the South West Highway and the Perth-Bunbury railway line (refer Figure 1).

Bauxite is supplied to the refinery by overland conveyor from Alcoa's Willowdale bauxite mine located 15 kms to the east. Alumina produced at Wagerup refinery is transported by rail to Alcoa's Bunbury shipping terminal and then exported to overseas markets or to Alcoa's aluminium smelters in Victoria.

Under the requirements of the *Alumina Refinery Agreement Act*, a draft Environmental Review and Management Program (ERMP) for the Wagerup refinery was submitted to the Environmental Protection Authority (EPA) in 1978. The proposal was approved and the documentation formed the basis for Alcoa's environmental management programme across its Western Australian bauxite and alumina operations. The Wagerup refinery has current environmental approval for a capacity of 3.3 million tonnes per annum (Mtpa), although its current capacity, with two production units, is approximately 2.6 Mtpa of alumina. Production is limited to 2.5 Mtpa by environmental licensing.

Alcoa considers its Wagerup refinery to be the most environmentally advanced alumina refinery in the world. Capital works in 2002 incorporating the most advanced available technology have resulted in significant reductions in refinery emissions, including a 90% drop in volatile organic compounds (VOCs) and odour emissions from the refinery's liquor burning plant, reductions in noise levels at the refinery boundary and reduced emissions of oxides of nitrogen from the refinery's power station.

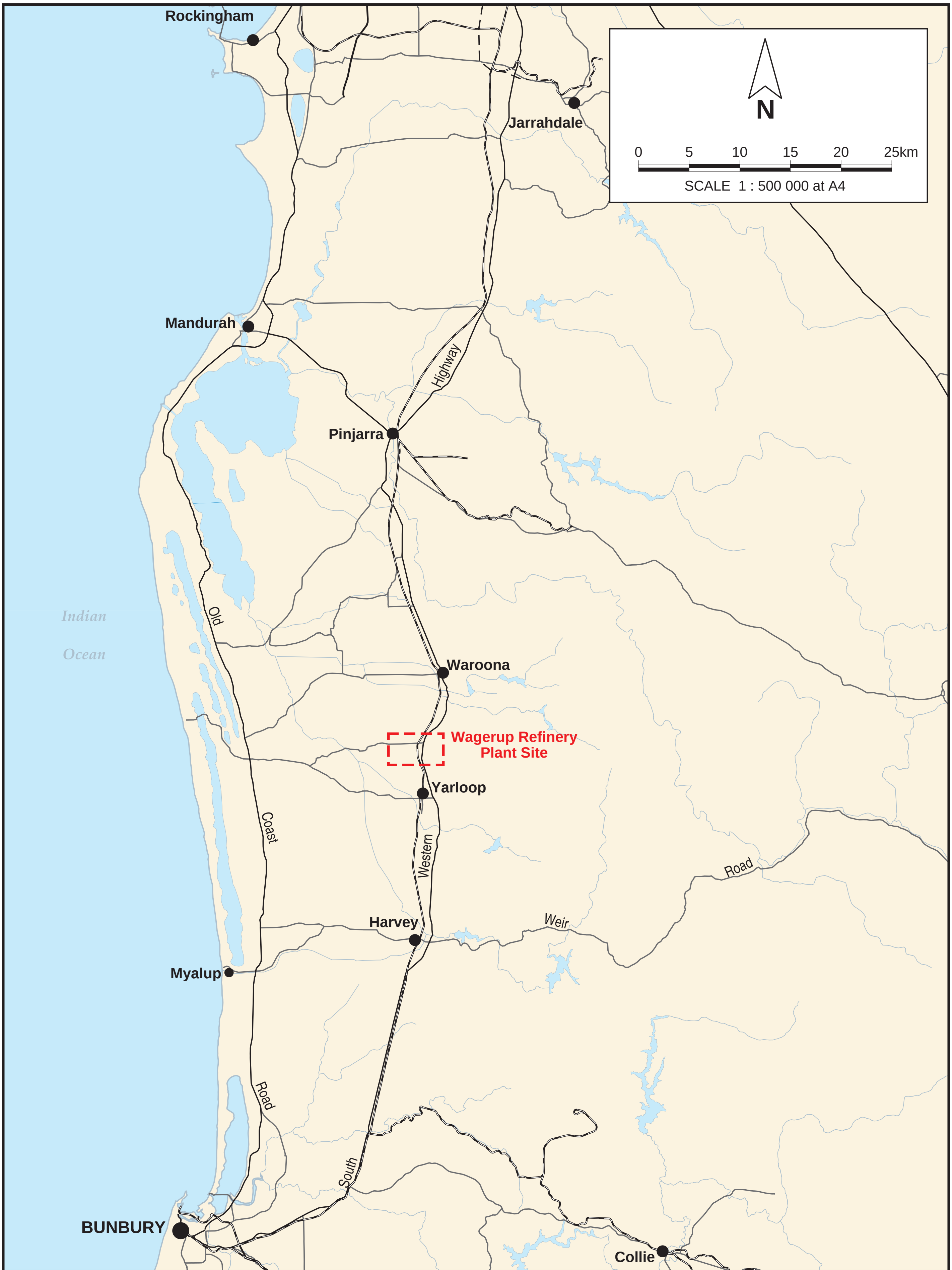
1.2 THE PROPOSAL

Alcoa proposes to expand the refinery through construction of a third production unit. Expansion at Wagerup is one of several world-wide options currently being considered by Alcoa to provide additional capacity to meet increased global demand for alumina. The proposed Wagerup expansion (the Proposal) will increase the capacity and efficiency of existing components in the refinery through the installation of new equipment and upgrades to some existing equipment. The additional new plant and modifications will occur across the refinery with a focus on the following areas:

- Precipitation;
- Calcination;
- Digestion;
- Milling;
- Power generation;
- Conveyor; and
- Residue storage area.

The new equipment and modifications to the refinery associated with the Proposal are further detailed in Section 5.

Alcoa developed and implemented a comprehensive community consultation process for the Proposal. Following an Open Space Forum in October 2004, five working groups were formed to enable consultation on detailed aspects of the Proposal. The existing Wagerup Community Consultative Network (CCN), established in 1994, monitored the process to ensure openness and transparency. This process enabled community members to participate in the identification, assessment and potential management of environmental factors associated with the Proposal, whilst also monitoring the consultation process. A broader range of stakeholders have been involved through regular communications, such as newsletters, press articles, a designated website and a public open day during the preparation of this ERMP.



Alcoa World Alumina Australia
ALCOA WAGERUP REFINERY EXPANSION
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

LOCATION MAP

Figure 1

ENVIRON

Drawn: KP

Date: 04/05

1.3 THE PROPONENT

Alcoa of Australia Limited, trading as Alcoa World Alumina Australia, is the Proponent for the Proposal. The principal shareholders of Alcoa of Australia Limited are:

- Alcoa International Holdings Company (60%); and
- Alumina Limited (40%) (previously WMC Ltd).

Alcoa World Alumina Australia is one of 25 Alcoa Inc business units, and is the world's leading producer of alumina. Alcoa's alumina refineries at Kwinana, Pinjarra and Wagerup have a combined annual production capacity of 7.8 Mtpa, equivalent to some 15% of world demand.

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East Perth WA 6004
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Email: iyull@environcorp.com

1.4 PROPOSAL SCHEDULE

It is anticipated that the engineering design phase of the Proposal will take approximately 6 to 12 months with preliminary design and feasibility work already underway. Construction is scheduled to commence in late 2005, subject to the Proposal receiving all necessary external and internal approvals. A 27 month construction period is expected, with the newly expanded Wagerup refinery reaching full production mid 2008.

The key timing constraints are:

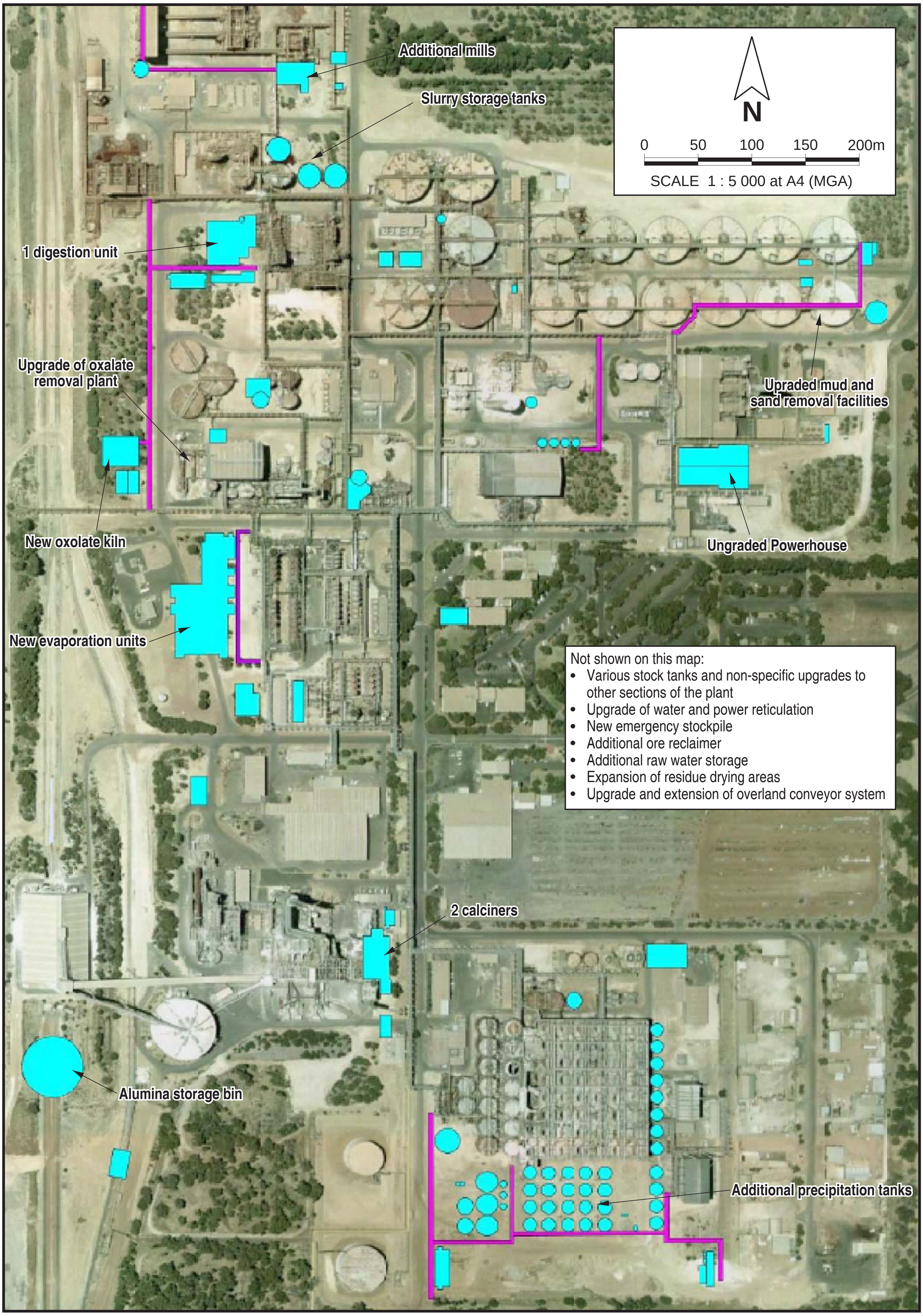
- Environmental assessment of the Proposal, in particular addressing issues raised during the stakeholder consultation period;
- Availability of construction skilled labour, materials, supplies, plant and equipment; and
- Efficiency of construction and commissioning phases (dependent on equipment and personnel availability, weather, environmental constraints, etc.).

1.5 PROPOSAL AREA

The Wagerup refinery and associated residue drying area (RDA) is located on Alcoa owned industrial-zoned land. Surrounding the refinery is approximately 6,000 ha of Alcoa freehold property, which is predominately operated as a beef farming enterprise by “Alcoa Farmlands”. The surrounding landuse is predominantly rural, with most of the region cleared for agriculture.

The Proposal boundary is defined as the existing Wagerup refinery boundary (located on the east side of the South Western Highway) and the residue operations (located on the west side of the South Western Highway), as shown on Figure 1. The additional infrastructure required for the Proposal will all be located within the existing refinery boundary and will occupy an area less than 10% of its total size (refer Figure 2).

The existing residue area will be expanded in accordance with the Wagerup refinery Long Term Residue Management Strategy (LTRMS) to accommodate increased residue production. Further modification to the residue area over the life of the Proposal will be considered and assessed through future reviews of the LTRMS. Currently, the total area designated to the bauxite residue and associated facilities is approximately 546 hectares (to the outer drain). The residue drying areas are contained within an area bordered by McClure Road in the north, Somers Road to the west and Bancell Road in the south.



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ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

PROJECT LAYOUT - PRELIMINARY DESIGN

Figure 2

ENVIRON

Drawn: KP

Date: 04/05

Alcoa presently exports all alumina from the Wagerup refinery through its Bunbury Port facilities. Worsley Alumina presently shares some of Alcoa's port facilities, but is in the process of constructing its own shiploader to handle the transfer of its own product. Some modifications will be made to the existing port facilities to improve loading and unloading efficiencies.

On referral of the Proposal to the EPA, the EPA advised that bauxite mining is not considered within the scope of this ERMP. Mining approval in Mineral Lease 1SA was granted under a State Agreement Act in 1961. The environmental acceptability of mining within the lease is approved by the Minister for Resource Development via the Mining and Management Program Liaison Group. Further details on the environmental approvals for mining are outlined in Section 3.

1.6 LAND USE ZONING

At the State Government level or the West Australian Planning Commission level there are Regional Town Planning Schemes. The Wagerup refinery is contained within the Peel Region Scheme (PRS), which reserves the refinery site for "Industrial" purposes, with the majority of adjoining land uses being reserved for "Rural" purposes.

The Shire of Waroona Town Planning Scheme No.7 is known as the District or Local Planning Scheme and is controlled by the Shire Council. The Wagerup refinery and residue area is zoned 'Special Industry Zone' under the Waroona Shire Town Planning Scheme. This zone enables or permits the refining operations and also enables agricultural use where refinery uses may not be in operation. There are agricultural uses immediately north, west and south of the refinery, and to the east is the Hills Face Zone, a conservation area with large rural holdings (refer Figure 3).

The Proposal lies wholly within the existing "Special Industry" zone of the Wagerup Alumina refinery and the intended land use for the Proposal is consistent with the land's current zoning of 'industrial'. Therefore, planning approval is not considered necessary as part of the environmental approvals process.

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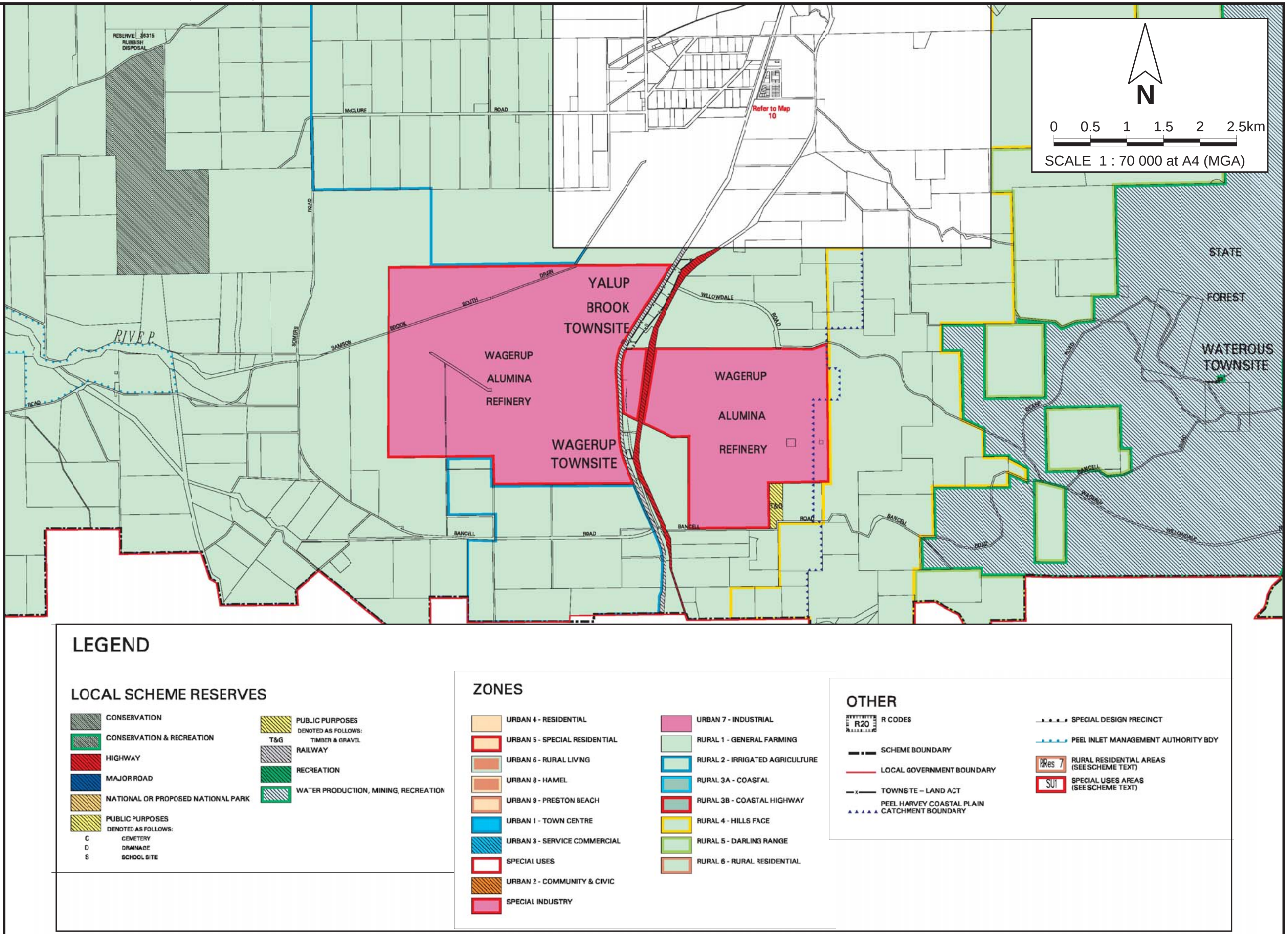
LAND USE ZONING



SOURCE: Shire of Waroona, Town Planning Scheme No. 7.

Figure 3

ENVIRON

Drawn: KP

Date: 04/05

2. PROPOSAL JUSTIFICATION, BENEFITS AND ALTERNATIVES

2.1 THE ALUMINIUM INDUSTRY

World production of alumina is currently around 52 Mtpa, of which Australia produces approximately 33%. Alumina production from other areas of the world includes Latin America (22%), West Europe (12%), North America (11%), East/Central Europe (10%), and Asia (10%).

Metal-grade alumina demand is driven by primary aluminium production, which, in turn, is driven by global aluminium metal consumption. Aluminium metal consumption, and therefore demand, is expected to grow steadily for the foreseeable future, given reasonable levels of world economic growth, and taking increased aluminium recycling into account.

Aluminium products and components are used in aircraft, motor vehicles, beverage cans, building materials, chemicals, sports and recreation, and a wide variety of industrial and consumer applications around the world.

2.1.1 Alcoa's Participation in the World Alumina Market

Alcoa Inc is the world's leading producer and manager of primary aluminium, fabricated aluminium and alumina facilities, and is active in all major aspects of the industry. Alcoa serves the aerospace, automotive, packaging, building and construction, commercial transportation and industrial markets, bringing design, engineering, production and other capabilities of Alcoa's businesses to customers. In addition to aluminium products and components, Alcoa also markets consumer brands including Reynolds Wrap® foils and plastic wraps, Alcoa® wheels, and Baco® household wraps. Among its other businesses are vinyl siding, closures, fastening systems, precision castings, and electrical distribution systems for cars and trucks. The company has 131,000 employees in 43 countries and has been a member of the Dow Jones Industrial Average for 45 years and the Dow Jones Sustainability Indexes since 2001. More information can be found at www.alcoa.com

Alcoa's Australian operations include bauxite mines, alumina refineries and shipping terminals in Western Australia, an aluminium smelter at Point Henry (Victoria) and a power station at Anglesea (Victoria). Alcoa is the major shareholder and manager of the Portland alumina smelter in Victoria.

Alcoa operates three alumina refineries in Western Australia at Kwinana, Pinjarra and Wagerup. The Pinjarra refinery is one of the largest in the world with a capacity of 3.5 Mtpa. An efficiency upgrade is currently underway at Pinjarra, which will result in production rising to over 4 Mtpa. Wagerup has a current capacity of 2.6 Mtpa and Kwinana has a capacity of

2.1 Mtpa. Combined, the three refineries will have a production capacity of approximately 8.7 Mtpa.

Alcoa's mining and refining operations in Western Australia supply alumina to produce approximately 15% of the world's primary aluminium. With assets having a replacement value over A$8 billion in Western Australia, the company directly employs nearly 3,800 people, and contributes around A$1.1 billion each year to the State economy. Most of the alumina produced at the refineries is exported world-wide and generates sales revenues of nearly A$2.2 billion per year.

Alcoa considers the life cycle environmental impact of its products over their entire lifetime, taking into consideration not only the manufacture and use of a product, but its disposal or recycling at the end of its useful life. An Alcoa subsidiary ,Alcoa Australia Rolled Products, with operations in New South Wales and Victoria, is one of the largest purchasers and recyclers of scrap aluminium in the southern hemisphere.

2.2 PROPOSAL JUSTIFICATION

Aluminium metal consumption is expected to grow steadily for the foreseeable future, given reasonable levels of world economic growth, and after taking increased aluminium recycling into account. Alumina is the feedstock for aluminium smelters. As a low-cost alumina producer, with secure access to substantial bauxite reserves, Alcoa's Wagerup refinery is well positioned to capture a share of this expanding market opportunity and to further improve Alcoa's West Australian and global market competitiveness.

Wagerup refinery is one of the most advanced and efficient alumina refineries in the world. The Proposal will lead to further improvements in emission controls and efficiencies per kilogram of alumina produced.

2.3 PROPOSAL BENEFITS

There are a number of significant socio-economic as well as environmental benefits to be gained from the Proposal.

The Proposal will entail a capital expenditure of over A$1.5 billion and is expected to earn approximately A$17 billion over 30 years in new export revenues. The proposal will deliver substantial economic benefits to the region, the State of Western Australia and the Commonwealth of Australia. Implementation of the expansion program will increase production capacity from around 2.6 Mtpa to a total of 4.7 Mtpa, which equates to an 81% increase in current annual alumina capacity from the refinery. The Proposal is expected to increase the value of Western Australian alumina exports by over A$550 million per year.

Direct economic benefits to the local community, State and the Peel and South West Regions will be delivered through increased Commonwealth and State royalties, 150 permanent Alcoa positions and 3,000 direct and indirect employment opportunities. It is estimated that the Proposal will generate around 1,500 new jobs in the Peel and South West Regions during the operational phase.

During the construction period, the workforce will peak at approximately 1,600 employees, which is the equivalent of around 500 full time jobs during the entire 3 year construction period. During 2003, Alcoa spent more than $30 million with local businesses, including engineering and earthworks companies, medical services, sporting clubs, car dealers and contractors in Western Australia. Approval of the Proposal will lead to a further increase in spending in the local community, resulting in greater employment opportunities and returns for local businesses and increased support for partnership training programs and local youth opportunities.

Investment in production and increased efficiency is critical to securing a future for Alcoa's Western Australian operations. The global alumina market is highly competitive and the Western Australian refineries currently satisfy 15% of the global demand for alumina, while being cost competitive and highly reliable. This strategic position will only be maintained with ongoing efficiency improvements and periodic significant investments, such as expansion of the Wagerup refinery. Western Australia receives significant benefits, such as royalties, employment and export earnings through maintaining this competitive position.

Alcoa believes the Wagerup refinery is the most environmentally advanced alumina refinery in the world, containing modern equipment, enabling low emissions and high efficiency. Investment in the Wagerup refinery ensures that growing demand for alumina can be met, in part, by a refinery operating at the highest standard of emission controls and energy efficiency. On a global scale this represents a significant environmental advantage compared with some other expansion options.

2.4 ALTERNATIVES CONSIDERED

2.4.1 No Proposal Option

If the Proposal does not proceed, this will represent:

- a lost market opportunity;
- missed employment opportunities (direct and indirect);
- reduced economic growth in the Peel Region and the West Australian economy; and
- missed opportunity to further improve the environmental efficiency of the Wagerup refinery while increasing alumina production.

2.4.2 Proposal Alternative

The alternatives to the Proposal include:

- the establishment of a new alumina refinery in Western Australia;
- the expansion of other Alcoa alumina refineries within Western Australia; and
- expansion of an existing or construction of a new alumina refinery internationally.

The option for establishing a new refinery within Western Australia was not considered to be viable for the following reasons:

- It would require a duplication of facilities that already exist at Wagerup;
- Difficulty in finding a suitable site close to the existing bauxite reserves;
- A cleared area of approximately 1,050 hectares would be required for a new facility. Consisting of approximately 450 hectares for the refinery plus an additional 600 hectares for bauxite residue storage;
- A site would require sufficient separation distances from neighbouring properties to avoid potential conflicts between industry and other land uses;
- Environmental impacts that may be associated with a greenfields development include:
    - vegetation clearing
    - flora and fauna impacts
    - groundwater and surface water impacts
    - water supply
    - air and noise emissions
    - visual amenity
    - infrastructure requirements
- Increased costs associated with a greenfields site; and
- Potential for significant delays associated with site selection, approvals, design and construction phases.

Further assessment of a new refinery in Western Australia was not undertaken based on the above issues and Alcoa's desire not to duplicate facilities that already exist at Wagerup, therefore increasing the potential for environmental impacts and significantly increased costs.

Alcoa has two other refineries in Western Australia located at Pinjarra and Kwinana. Environmental approval was granted in February 2004 for an efficiency upgrade of the Pinjarra refinery from 3.5 Mtpa to over 4 Mtpa. Construction of the Pinjarra efficiency upgrade has commenced and is expected to be completed at the end of 2005. The Kwinana refinery has a current production capacity of 2.2.0 Mtpa and expansion of this facility to meet global demand would not offer the cost or environmental benefits associated with expansion of the Wagerup refinery.

Alcoa will continue to assess the viability of expanding capacity elsewhere in the world and the Wagerup expansion will need to compete against these projects for funding.

2.4.3 Proposed Wagerup Refinery Unit Three Project

Alcoa believes Wagerup to be the most environmentally advanced alumina refinery in the world and the most suitable site for expansion. The major drivers in selecting Wagerup refinery as the preferred option include the potential for job creation, economic growth and business opportunities in the region and wider economy, the economic feasibility of upgrading the existing refinery to meet market demands, as well as recognition that the Wagerup refinery possesses the most up-to-date technology and high energy efficiency, when compared to alumina refineries internationally.

Expansion of the Wagerup refinery will be contained within the existing refinery boundary and any expansion of the residue area will be on Alcoa's farmlands and in accordance with the LTRMS. The Proposal will result in an alumina production increase of approximately 80%, whilst not increasing impacts on residents from noise, particulate and odour emissions. This is achieved through a combination of improvements to existing environmental controls designed to manage higher production levels, new controls associated with new or upgraded equipment, dispersion and land management practices. The 80% increase in production capacity is achieved through strategic additions of plant equipment and improved efficiency from existing equipment, rather than a proportional (80%) increase in the size of the plant.

3. LEGISLATIVE FRAMEWORK

3.1 PREVIOUS ENVIRONMENTAL APPROVALS

Wagerup refinery was first granted State government approval in 1978 under the *Alumina Refinery (Wagerup) Agreement Act 1978* and *Acts Amendment 1978*. The approval was for a production capacity of up to 2 Mtpa. The first production unit was commissioned in 1984 and had a capacity of 670,000 tpa which was expanded to 840,000 tpa in 1988.

Alcoa's Mineral Lease 1SA (ML1sa), which encompasses an area in the Darling Range from east of Perth to east of Bunbury (refer Figure 4), was granted in 1961 under the *Alumina Refinery Agreement Act 1961*. Alcoa has approval to mine within ML1sa subject to submitting draft five year mine plans and associated environmental management programmes to the State's Mining and Management Programme Liaison Group (MMPLG) on an annual basis. Details of the MMPLG process are provided in Section 4.3. The EPA has advised that mining operations managed by the MMPLG process in ML1sa are addressed by an existing approval process and are not to be included in the ERMP.

In 1989, Alcoa was granted approval to expand production at Wagerup refinery from 840,000 Mtpa to 1.5 Mtpa. The expansion involved the construction of a second production unit which required formal assessment in the form of a Consultative Environmental Review (CER).

In 1995, Alcoa was granted further approval for a third production unit, increasing the maximum capacity from 1.5 Mtpa to 3.3 Mtpa. This expansion was also formally assessed via a CER. Following this approval being obtained, an upgrade of the refinery commenced in 1998-99 taking the total alumina production capability to approximately 2.2 Mtpa. The current operating licence allows an annual alumina production of 2.35 Mtpa, with permission to increase to 2.5 Mtpa subject to certain conditions being met. The refinery has met these conditions and may produce up to 2.5 Mtpa during the licence period, which is due for renewal in August 2005.

While approval exists for a third production unit, this was for an overall production capacity of 3.3 Mtpa. However with advances in technology, the construction of a third production unit would take production to 4.7 Mtpa. Consequently the EPA and the Minister for Environment determined the Proposal should be re-assessed, leading to the preparation of this ERMP.

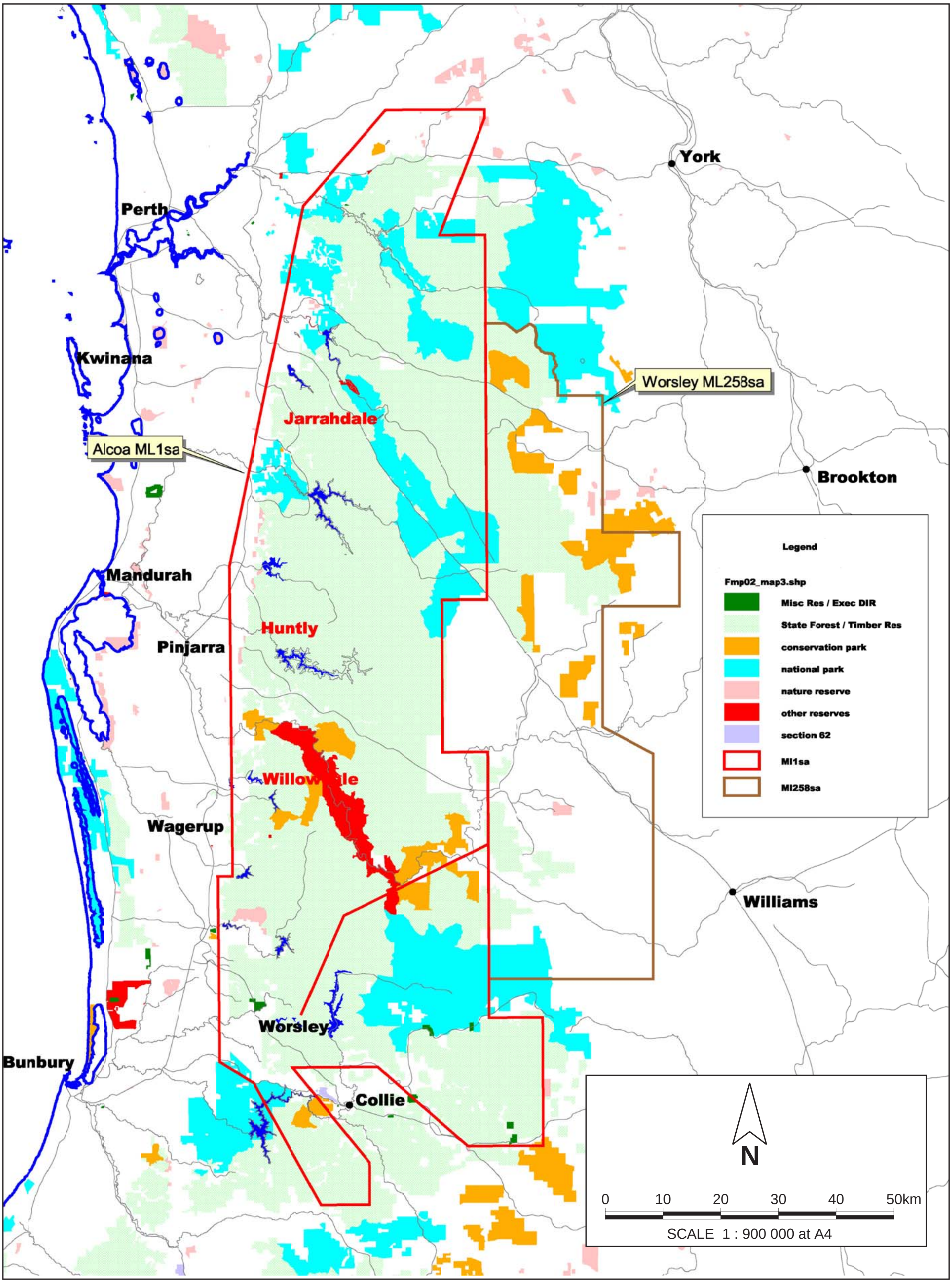


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Figure 4

MINING LEASE ML1sa

ENVIRON

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3.1.1 Long-Term Residue Management Strategy

Alcoa has a Long-Term Residue Management Strategy (LTRMS) in place for each of its Western Australian refineries, including Wagerup. The purpose of the LTRMS is to:

- identify the future residue storage requirements for each refinery;
- ensure that the location and design of new areas is optimised;
- reduce environmental impacts;
- consider long-term land use issues; and
- to outline a closure strategy for the residue storage area.

The LTRMS is prepared through consultation with the local community, local government and the Residue Planning Liaison Group (RPLG), which was set up in 1992 to provide advice to the Minister on residue management issues. The RPLG comprises representatives of government agencies and is chaired by the Department of Industry and Resources (DoIR). The LTRMS is submitted to the RPLG for endorsement and was first accepted by the Minister for the Environment in 1997. A major review of Wagerup refinery's future requirements and long-term alternatives for residue (LTRMS) was undertaken in 2001 and then further updated in 2003. A major review of the LTRMS is planned to commence in 2005 in preparation for submission to the Minister for the Environment in 2006.

The Proposal would see an increase in the rate of residue creation, thereby accelerating the need for long term residue planning. This ERMP recognises and evaluates the environmental implications of accelerated residue creation, however the precise location of future residue drying areas within Alcoa's landholdings will be determined through future LTRMS and associated consultation processes.

3.2 CURRENT APROVAL LEGISLATION

The Alcoa Corporate Environmental Policy and Principles requires the Wagerup refinery to comply with all applicable legislation. A documented process is in place at the refinery to ensure relevant legislation is identified and kept up to date on the site legal register, referred to as the Environmental Legislative Review Manual. This Manual is updated quarterly and a copy of the Manual as well as copies of all relevant legislation is held in the refinery library.

As outlined above, the Wagerup refinery operates under the *Alumina Refinery (Wagerup) Agreement Act 1978* and *Acts Amendment 1978* and is subject to Ministerial conditions pursuant to the Part IV provisions of the *Environmental Protection Act 1986.* The Ministerial conditions were granted in 1995 and subsequently updated in 2001.

Additional environmental approvals and consents include the following:

- Environmental Licence and project Works Approval pursuant to Part V of the *Environmental Protection Act and Regulations (1986, 1987)*;
- Surface and groundwater extraction licences pursuant to *Rights in Water and Irrigation Act 1914*;
- Dangerous Goods Storage Licence pursuant to the *Explosives and Dangerous Goods Act and Regulations (1965, 1992)*;
- Annual approval of mine plans and associated management programs by the Minister for State Development on recommendation from the MMPLG; and
- Development of the LTRMS in consultation with the RPLG and endorsement of these plans by the Minister for Environment.

3.3 STATE GOVERNMENT LEGISLATION

In addition, the following State Government legislation is applicable to the Proposal:

- *Aboriginal Heritage Act 1972;*
- *Agriculture and Related Resources Protection Act 1976;*
- *Bacteriolytic Treatment of Sewage and Disposal of Effluent and Liquid Waste 1985;*
- *Bush Fires Act 1954;*
- *Conservation and Land Management Act 1984;*
- *Contaminated Sites Act 2004*[1]*;*
- *Dangerous Goods (Transport) Act 1998;*
- *Dangerous Goods Regulations 1992;*
- *Dangerous Goods Safety Act 2002;*
- *Environmental Protection Act 1986 (as amended);*
- *Environmental Protection Regulations 1987;*
- *Environmental Protection (Noise) Regulations 1997;*
- *Environmental Protection (Controlled Waste) Regulations 2001;*
- *Environmental Protection Act Amendment Act 2003*
- *Explosives and Dangerous Goods Act 1961;*[2]
- *Health Act and Regulations 1911;*
- *Land Administration (Amendments) Act 1997;*
- *Local Government Act 1995;*
- *Mining Act 1978 (as amended);*
- *Occupational Safety and Health Act 1984;*

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[1] The Contaminated Sites Act 2004 is currently under amendment, scheduled to be finalised early 2005.

[2] The Dangerous Goods and Explosives legislation is currently under review and is expected to be replaced by the new legislation shortly.

- *Rail Safety Act 1998*
- *Rail Freight System Act 2000*
- *Rights in Water and Irrigation Act 1915 (as amended);*
- *Soil and Land Conservation Act 1945;*
- *Waterways Conservation Act 1976;*
- *Water Supply Sewage and Drainage Act 1912;* and
- *Wildlife Conservation Act 1950 (as amended).*

The five-year plan for mining in ML1sa takes into account legislation and policies relevant to the abstraction of bauxite, such as the *Western Australian Wildlife Conservation Act 1950, Conservation and Land Management Act 1984* and the *Soil and Land Conservation Act 1945*.

3.4 COMMONWEALTH GOVERNMENT LEGISLATION

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action requires approval from the Federal Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as:

- World Heritage properties;
- Ramsar wetlands of international importance;
- Listed threatened species and communities;
- Migratory species protected under international agreements;
- Nuclear actions; and
- Commonwealth marine environment.

The Proposal is not considered to trigger the EPBC Act. The agreed mine planning process has not changed and the mining lease is part of prior environmental approvals.

The National Pollutant Inventory (NPI) is a collaborative initiative of the Commonwealth, State and Territory Governments and requires industries across Australia to report emissions data and other details of reportable substances for posting on the Internet for public review. Wagerup refinery is required to report to the NPI on an annual basis, with the first submission of data occurring in October 1999.

Other agreements and treaties that may affect the Proposal are:

- Montreal Protocol on Substances that Deplete Ozone;
- United Nations Framework Convention on Climate Change;
- National Greenhouse Response Strategy;
- National Strategy for Ecologically Sustainable Development;

- "Hope for the Future" - The Western Australian State Sustainability Strategy; and
- Greenhouse Strategy for Western Australia.

Alcoa is a voluntary signatory to the following agreements:

Australian Minerals Industry Code for Environmental Management

Alcoa became a signatory to the Australian Minerals Industry Code for Environmental Management in 1998. Signatories are required to comply with nine key principles, which incorporate public reporting on the implementation of the Code and environmental performance to government bodies, community and within the Company.

Greenhouse Challenge Agreement (via Aluminium Development Council)

Alcoa became a signatory to the Greenhouse Challenge through the Australian Aluminium Council. Alcoa is required to report on greenhouse gas emissions generated and greenhouse sinks created each year. Formal agreement to this program has expired, but Alcoa is continuing to report on greenhouse emissions in accordance with previous commitments.

3.5 KEY DECISION MAKING AUTHORITIES

The key Decision Making Authorities (DMAs) involved in the environmental assessment of the Proposal are the Environmental Protection Authority and the Department of Environment (DoE), which provides advice to the EPA.

Other DMAs involved in the Proposal approvals include the:

- Department of Industry and Resources (DoIR);
- Department of Health;
- Department of Land Information (DLI);
- Department of Planning and Infrastructure (DPI);
- Department of Conservation and Land Management (CALM);
- Water Corporation;
- Harvey Water;
- Shire of Waroona; and
- Shire of Harvey.

3.6 APPROVALS PROCESS

The EPA determined that the Proposal required a formal level of environmental assessment, subsequently set by the Minister for Environment as an ERMP. The process for submission and assessment of an ERMP is outlined below:

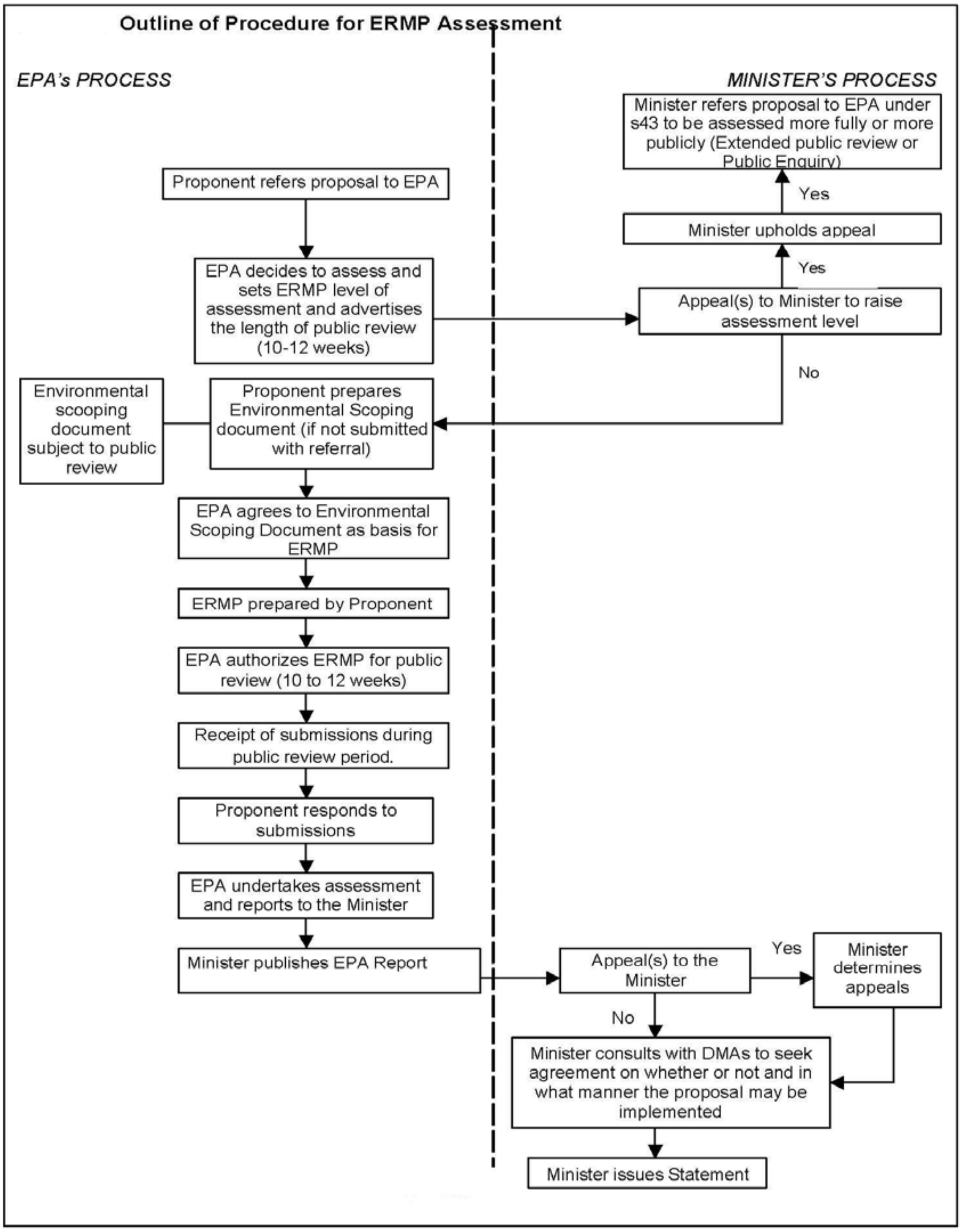
1. The Proponent refers the proposal to the EPA to set the level of assessment;
2. The EPA determines the level of assessment as an ERMP and advertises this decision and the length of the public review period, subject to appeal;
3. The Proponent prepares an Environmental Scoping Document outlining the scope of works for the ERMP assessment;
4. The Scoping document is released for a two week public comment period;
5. The EPA agrees to the Environmental Scoping Document as a basis for the ERMP;
6. A draft ERMP is prepared by the Proponent and submitted to the EPA Service Unit for comment;
7. The final draft of the ERMP (this document) is submitted to the EPA for authorisation to release as a public document;
8. The ERMP is released for public review period of 10 weeks;
9. Any submissions received by the EPA at the end of the review period are provided to the Proponent, for the Proponent to summarise and respond;
10. The EPA undertakes an assessment of the proposal;
11. The EPA 'Report and Recommendations' is published;
12. A two week statutory appeal period commences;
13. The Minister determines any appeals on the EPA's Report and Recommendations, and consults with the key Decision Making Authorities to seek agreement on whether or not, and in what manner the proposal may be implemented;
14. The Minister issues a Statement (provided approval for the Proposal is given).

The ERMP submission and assessment process is also shown as a flow chart in Figure 5 below.

The EPA set the public review period for the ERMP at 10 weeks. In this ten week period, the public can review the potential environmental impacts of the Proposal and the proposed management measures. The public may make submissions in support of the Proposal or to raise concerns with the identified impacts and management of the environmental factors. Guidelines for making a submission are presented in the front of this document.

If approval for the Proposal is obtained under Part IV of the *Environmental Protection Act 1986*, licensing of construction and operations is required under Part V of the Act. This requires a Works Approval Application to be submitted to the DoE prior to commencement of construction.

Figure 5: ERMP Assessment Process



Source: *Environmental Protection Act 1986:* Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002.

4. EXISTING WAGERUP REFINERY

4.1 ALUMINA REFINING PROCESS

As with the majority of other commercial alumina refineries throughout the world, the Wagerup refinery uses the Bayer process to refine alumina from bauxite ore. This involves a number of key steps, including:

- Bauxite grinding;
- Slurry storage;
- Digestion;
- Clarification;
- Precipitation; and
- Calcination.

A simplified process flow diagram of the Bayer process used at the Wagerup refinery is presented in Figure 6.

4.1.1 Bauxite Grinding and Slurry Storage

Bauxite is ground to less than 1.5 mm particle size at the refinery, using semi-autogenous grinding mills (SAG and/or Ball mills) to ensure sufficient solid-liquid contact during the digestion phase, which improves alumina extraction efficiency. A solution of hot concentrated sodium hydroxide (NaOH, i.e. caustic soda) liquor, taken from the recycled caustic liquor circuit, is added to the bauxite during grinding to produce a slurry. The slurry is pumped to a series of holding tanks prior to the next stage of the Bayer process. The holding tanks allow for minor interruptions to the ground bauxite supply and allow desilication (the removal of silica from the liquor) to commence.

4.1.2 Digestion

The bauxite slurry is pumped from the holding tanks to the digestion units where additional hot recycled caustic liquor is added to the ground bauxite slurry. The digestion process removes the hydrated alumina from other insoluble oxides by reacting it with sodium hydroxide according to the following reaction:

$$Al_2O_3.xH_2O + 2NaOH \rightarrow 2NaAlO_2 + (x+1)H_2O$$

The slurry leaves the digestion units containing the alumina in solution (often referred to as green liquor), and other undissolved ore solids.

4.1.3 Clarification

In the clarification stage of the process, undissolved ore solids are separated from the green liquor. This is achieved using large clarification vessels (mud thickeners), which allow the undissolved bauxite solids to settle out. These bauxite solids are then passed through a counter-current washing train (mud washers) using water to recover as much of the caustic as possible to enable it to be returned to the recycled caustic liquor circuit. The washed solids from the counter-current washing train are called process residue and are pumped to the RDA (refer to Section 4.2).

Approximately halfway through the mud washing process the overflow stream is heated and contacted with lime slurry. This is known as the causticisation process, where a portion of the sodium carbonate that is formed in the liquor is converted back to sodium hydroxide. Without causticisation, the refinery would require large quantities of fresh caustic to be added to the liquor for the refinery to remain productive.

4.1.4 Organic Removal

Organic material is naturally present in bauxite ore and in some of the specialised chemicals added throughout the Bayer process (such as flocculants). This organic matter reacts to form various organic sodium compounds and, over time, the level of organics builds up in the recycled caustic liquor circuit, reducing the efficiency of precipitation (see Section 4.1.5). These organic compounds can also adversely affect the formation of alumina tri-hydrate crystals, resulting in poor quality alumina product.

The build up of organics is controlled in two ways. Firstly, sodium oxalate (the most significant organic) is concentrated and removed by a sequence of seeding, precipitating, and washing to produce a wet oxalate cake. This oxalate cake is currently being stored in a secure part of the residue storage area. The Proposal will see the commissioning of oxalate kilns, which convert oxalate to carbonate by thermal decomposition.

Secondly, bulk organics destruction is achieved by taking a small liquor side stream to the liquor burning plant. Here, the liquor is concentrated by evaporation, slurried with fine alumina dust, and combusted in a rotary kiln. The organics are oxidised, and the resulting sodium aluminate is returned to the liquor circuit.

4.1.5 Precipitation

Green liquor is passed to precipitation after being cooled via a heat exchange process. The heat from the green liquor is transferred to the cold spent liquor (i.e. liquor from which the alumina has been removed) that is returned to the start of the digestion process. The cooled liquor is seeded with small crystals of alumina tri-hydrate, which act as nuclei for more alumina tri-hydrate to precipitate. The seeded liquor is passed through a series of large precipitator vessels, where the crystals agglomerate and grow. When the hydrate slurry leaves the last precipitator vessels, it is classified (sorted) by size. The coarser particles are transferred to calcination, and the finer particles are thickened, filtered, and recycled to the start of the precipitation process as seed crystals. The spent liquor which is produced during the classification, thickening, and filtration processes is then recycled to the digestion process and used once more to dissolve fresh alumina.

4.1.6 Calcination

Calcination involves washing and drying the alumina hydrate ($Al_2O_3.3H_2O$), then heating it to about 1,000 °C to drive off chemically combined water. The final product is alumina (Al_2O_3) a dry, pure white, sand-like material, which is the feedstock for aluminium smelters. Particulate emissions from the calciners are currently controlled using an electrostatic precipitator on each calciner.

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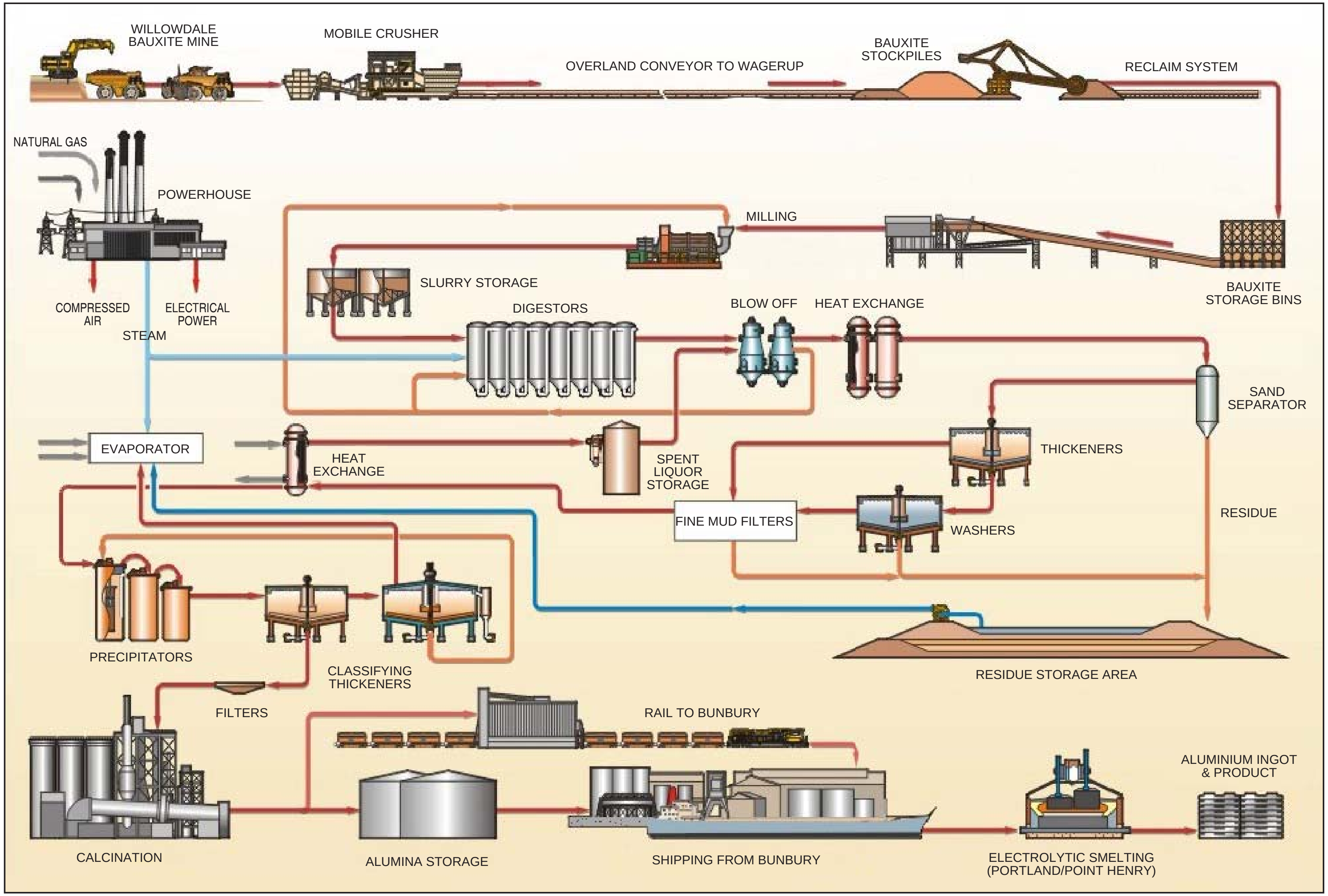
BAYER PROCESS FLOW DIAGRAM



SOURCE: ALCOA, August 2003

Figure 6

ENVIRON

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Date: 04/05

4.2 BAUXITE RESIDUE STORAGESTORAGE AREA

The refining process produces a residue consisting of caustic-insoluble components (predominantly oxides of iron and silicon) which have passed through the Bayer process unaltered, and residual quantities of caustic soda not recovered in the residue washing stage.

The residue is separated into different size fractions as part of the refining process. The coarse fraction is known as the "sand" fraction (approximately 40%) and the fine fraction is known as "mud" (approximately 60%). The sand and mud fractions are currently pumped to the residue area through separate pipelines and are handled separately within the storage operation. As part of this proposal, the mud and sand fractions will be combined prior to pumping to the residue area, and then separated in a sand separation unit within the residue area. Pipelines return cooled liquor and collected runoff water from the residue area back to the refinery for reuse in the process. Residue from Darling Range bauxite is produced at a rate of approximately two dry tonnes per tonne of alumina produced.

Prior to 1991 residue was stored within 'wet lakes': large lined impoundments where the wet residue dried out in the sun and consolidated under its own weight. In 1991, the Wagerup refinery adopted an alternative drying technology termed 'dry stacking'. The residue is pre-thickened then deposited in thin layers which are left to dry in the sun. The solar drying of the residue produces a high density, stable stack of residue, allowing a form of upstream embankment construction to be employed. RDA2 is the only drying area that has not been converted to dry stacking and it is proposed to convert RDA2 to dry stacking as part of the Proposal. Dry residue stacking is now the preferred method of storage and planning of future facilities is based on an extrapolation of Alcoa's current management practices.

The existing residue area covers approximately 546 hectares (ha) (to the outer drain) of which about 170 ha are currently used for active drying of the residue (RDA1-7), 12 ha for the thickener bypass, 69 ha for alkaline water storage and 32 ha for fresh water storage. The existing RDAs are shown in Figure 7.

To manage the long term development and ultimate closure of the residue area, Alcoa has developed a Long Term Residue Management Strategy (LTRMS) in consultation with government agencies and members of the neighbouring community. The LTRMS outlines the strategies to ensure that the residue area at Wagerup will be stable and self sustaining, and will no longer require further management when refinery operations cease. The LTRMS covers the proposed 30 year plan for residue management at Wagerup and is reviewed and updated on a five yearly basis. Further detail on the LTRMS is provided in Section 5.2.

The Residue Planning Liaison Group (RPLG) was formed to facilitate the planning, review and endorsement of the LTRMS developed by Alcoa for submission to the Minister for the Environment. The RPLG has membership from the Department of Industry and Resources, Department of Environment (and Water and Rivers Commission), Ministry of Planning, Agriculture Western Australia, the Peel Development Commission, Department of Conservation and Land Management and Alcoa. As a result of consultation on the LTRMS, the Waroona Shire Council made a request to become a member of the RPLG in July 2003.

Expansion of the residue area within the 30 year plan is an ongoing process with construction work on RDA7 completed during the 2004/5 summer period and construction of RDA8 and a new fresh water detention pond planned for the 2005/6 summer period (Figure 7).

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FUTURE EXPANSION OF THE RDA WITHIN THE 30 YEAR LTRMS

Figure 7

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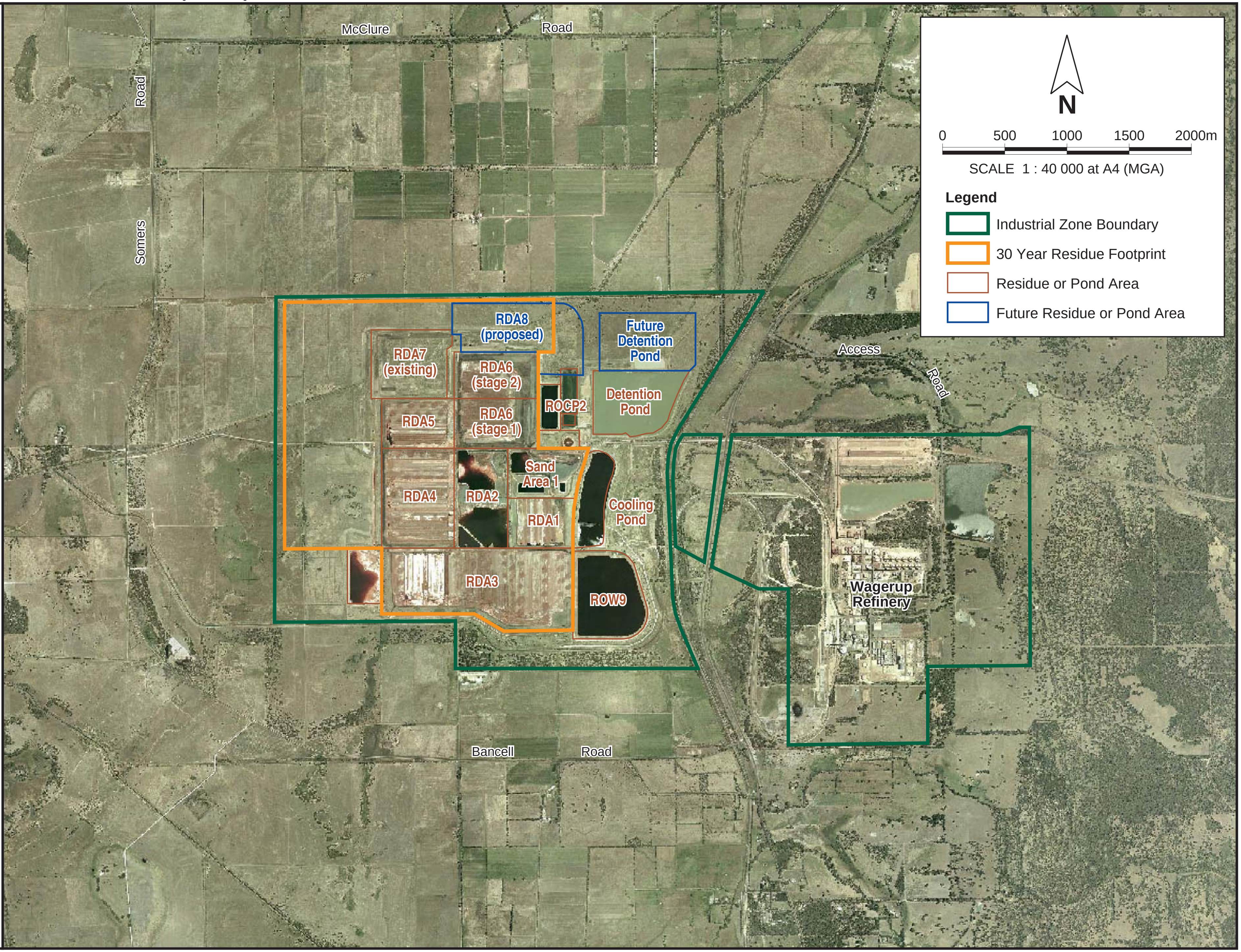

4.2.1 Alternative Uses of Residue

Development of alternative uses for bauxite residue has been one of the major objectives of Alcoa's residue development program since 1978. The primary focus of this work is to demonstrate that bauxite residue is a potentially useful material rather than a waste product, and to investigate whether proposed uses are environmental acceptable and commercially viable. The company recognises that if significant re-use can be achieved, the rate of expansion of the residue area can be slowed.

A number of opportunities for residue re-use are being investigated as a part of Alcoa's research and development program. These include:

- Use of the fine residue fraction (red mud) as a soil amendment within the Peel-Harvey catchment and wider areas;
- Separation of lime residue from the process rather than disposal with the bauxite residue. A range of potential uses for this lime residue are being investigated including its use as agricultural lime and as a raw material in other industries.
- Washing and mineral separation of the coarse residue fraction (residue sand). A number of potential uses for each of the mineral fractions are being investigated including the use of a high silica fraction as a concrete aggregate and a high iron fraction as a low grade feed for iron production.

Much of the research work is being coordinated through the recently formed Centre for Sustainable Resource Processing (CSRP), and is being supported by a range of research groups, Universities and government agencies. Agriculture Western Australia continues to be very supportive of the use of the fine residue fraction as a soil amendment (Alkaloam) with ongoing monitoring of a number of sites within the Peel Harvey Catchment. Ongoing monitoring was a condition of the EPA approval for broad scale application and the results from this monitoring are reported both publicly and to the Department of Environment.

Waste minimisation using methods such as recycling and reuse is a growing trend in industry and also in the general community. In part, this initiative is in response to the increasing cost of land disposal of wastes and the potential adverse environmental impacts. Concepts such as Sustainable Development and Life Cycle Analysis also encourage this approach. By identifying and demonstrating a range of technically and economically feasible alternative uses, bauxite residue may become a resource rather than a waste.

4.3 BAUXITE MINING

Ore for Wagerup refinery is supplied from the Willowdale mine (Figure 4) located east of Wagerup within Mineral Lease 1SA (ML1sa). The current approved five-year mining plan for Willowdale (for 2005-2009) projects the production of approximately 9 Mtpa of bauxite, all of which is currently supplied to Wagerup from the Orion mining region via a system of overland conveyors. The rate of mining will need to increase incrementally from 9Mtpa to approximately 16 Mtpa to support the proposed expansion of Wagerup refinery. This additional ore will be sourced by bringing forward the planned development of mining within the Larego mining region, south of the current mining operations. This will require both an extension and an upgrade of the overland conveyor system. Mining in the Larego region was previously scheduled to commence in around 2017, but will now commence in late 2007 (if the Proposal is approved) and continue for approximately 10 years in tandem with operations at Orion. Subsequent mining operations will be scheduled in regions further to the south and east of Larego.

The EPA has advised that the mining operations within ML1sa, which are managed by the MMPLG process, are addressed by an existing approval process and, with the sole exception of management of noise from overland bauxite conveyors, are not to be included in the ERMP.

4.3.1 Mine Planning and Management

Mining is undertaken in accordance with Alcoa's five-year Mining and Management Program which is reviewed annually by the Mining and Management Program Liaison Group (MMPLG) and approved by the Minister for State Development, who also advises the Minister for Environment. The MMPLG is chaired by the Department of Industry and Resources (DoIR) on behalf of the Minister for State Development. The other state government agencies represented on the MMPLG are Conservation and Land Management (CALM), Water Corporation (WC) and Department of Environment (DoE) (Figure 8).

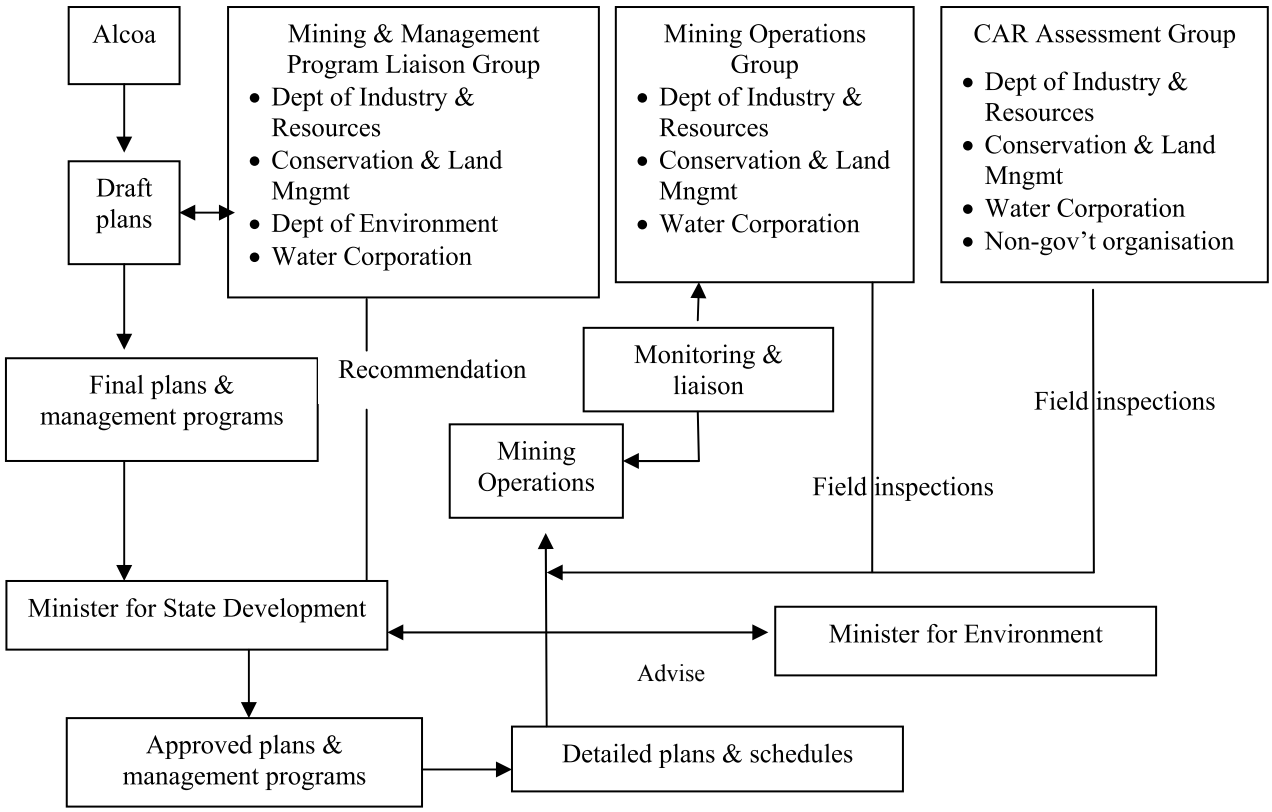

Figure 8: Mine plan approval process through the MMPLG and sub-committees

The Mine Operations Group (MOG) and CAR (Comprehensive, Adequate and Representative) Assessment Group (CARAG) are sub-committees of the MMPLG. The role of MOG is to oversee and report to the MMPLG on the environmental (including forest clearing) and community issues arising from the day to day operational activities conducted at Alcoa's mines. CARAG was set-up as a result of a process being agreed to by the MMPLG and the EPA to evaluate Alcoa's planned incursions into CAR Informal Reserves within Alcoa's mining lease as required under the Regional Forest Agreement. CARAG reports its findings and recommendations to the MMPLG, which in turn makes its recommendation direct to the EPA on the acceptability of Alcoa's proposals.

The annual process for review and approval of the five-year Mining and Management Program (MMP) is as follows and presented in Figure 9:

a. A review of the previous five-year Mining and Management Program is undertaken each July/August;
b. A site visit and presentation is made to Local Government representatives and neighbours in August and September each year;
c. Alcoa prepares a draft five-year Mining and Management Program incorporating feedback from the various stakeholders, and presents it to the MMPLG by 1st October each year;

d. The MMPLG reviews the draft five-year Mining and Management Program and provides feedback to Alcoa by the end of November. The MMPLG meets with Alcoa and visits the site during this process;
e. A final five-year Mining and Management Program, incorporating the MMPLG recommendations is prepared and submitted to the Minister for State Development by late December;
f. The Minister for State Development advises the Minister for Environment and Heritage of the MMPLG recommendations;
g. Approval of the Mining and Management Program by the Minister for State Development is usually issued by the end of January. Approval may be subject to a number of conditions.

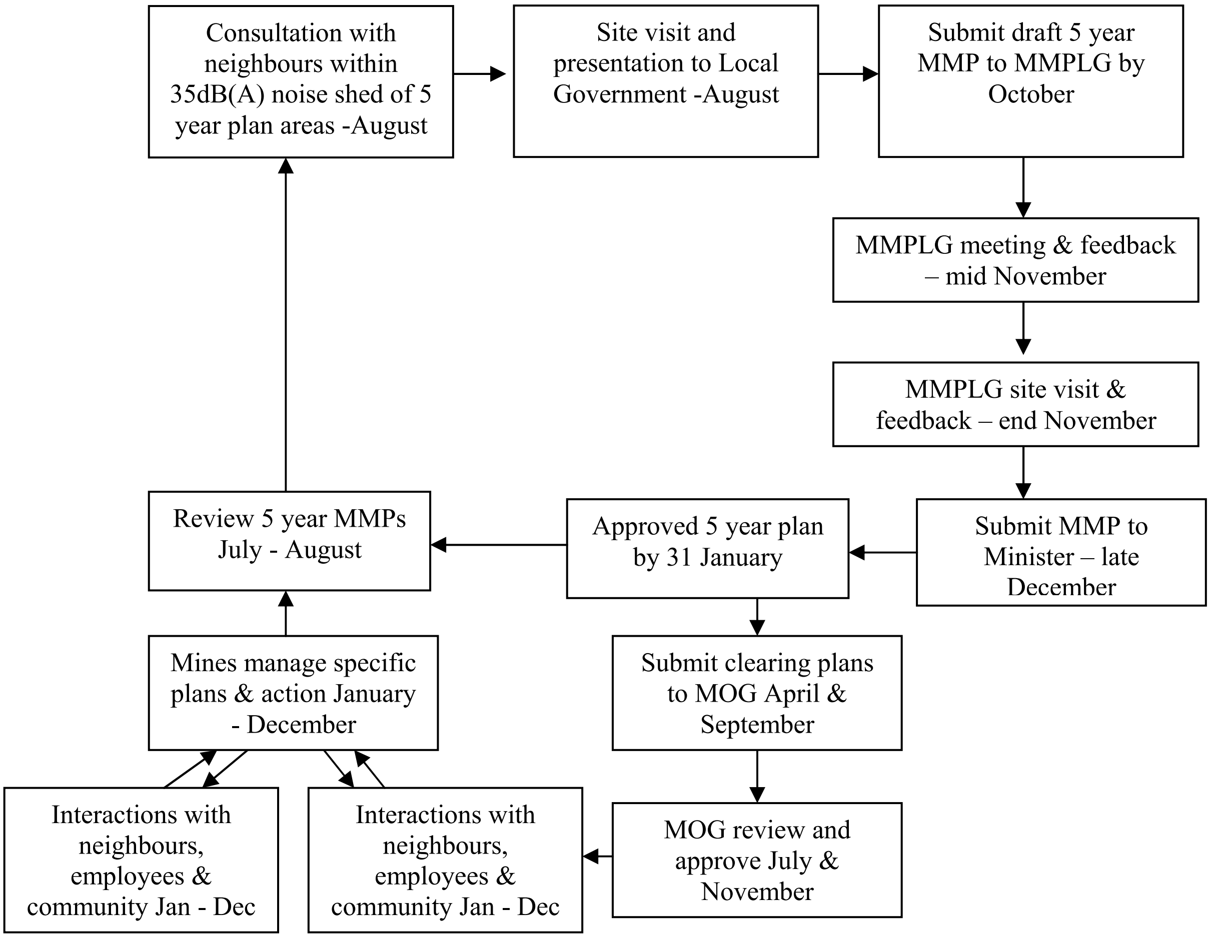

Figure 9: Consultation and reporting process of the Mining and Management Program

The consultation process is facilitated through the Mining Community Relations Officer, who ensures effective two-way communication with the community. This two-way communication includes mail-outs of information to the local community, single issue consultative processes, neighbour visits to discuss Alcoa's operations, mine open days, presentations to neighbour groups and local government, mine tours and information displays at local events.

4.3.2 Working Arrangements

Agreements between Alcoa and government regulators are outlined in the Alcoa/CALM Working Arrangements and the Alcoa/Department of Environment/Water Corporation Water Working Arrangements. The Water Working Arrangements set the framework for cooperative and efficient interaction between Alcoa mining operations at Huntly and Willowdale with the DoE and the WC for water resource management and protection. They complement existing Working Arrangements in place between CALM and Alcoa which define agreed standards and prescriptions for mine rehabilitation and forest management.

The Working Arrangements are written and reviewed jointly by Alcoa and the relevant agencies and are designed to cover a two to five year period, however they may be updated at any time if significant new environmental information becomes available.

The intent of the Working Arrangement is to maintain a coordinated approach to the management of mining operations and the protection of biodiversity and water resources. They provide a clear map of the relationships between Alcoa and the government agencies and the agreed procedures and guiding principles that are to be followed. These Working Arrangements do not cover the detailed management of each of the stages of Alcoa's operations, which are presented in annual Mining and Management Programs and Environmental Management Manuals submitted to Government.

The Working Arrangements do not limit the statutory functions, rights and obligations of CALM, the DoE or the Water Corporation. Where there is a conflict between any practice or activity undertaken pursuant to these Working Arrangements and to the observance of any right or obligation of CALM, the DoE or Water Corporation, the latter prevails.

The EPA has advised that the mining operations which are managed by the MMPLG process in ML1sa, are addressed by an existing approval process and therefore are not to be included in the ERMP.

4.4 SERVICES AND UTILITIES

4.4.1 Raw Materials and Product Transportation

4.4.1.1 Overland Conveyors

Ore is currently transported from the Willowdale mine to the Wagerup refinery by a system of two overland conveyors. Bauxite ore crushed at the mine is discharged onto a conveyor 9.4km long equipped with a 915mm wide belt running at 6.5m/sec with a drive station at Arundel. At this point the ore is transferred to a second conveyor 8.8km long equipped with a

915mm wide belt running at 5.5m/sec with drive stations at Arundel and Bancell. This second conveyor delivers ore to the bauxite stockpiles at the refinery.

4.4.1.2 Rail Transport and Bunbury Port

Alumina is transported by rail from the Wagerup refinery to Alcoa's port facilities at Bunbury and caustic is transported by rail from Bunbury to the Wagerup refinery. Australian Rail Group (ARG) is contracted to provide rail freight of alumina and caustic. ARG operates three sets of alumina trains (one loco and between 34 and 38 wagons each) and one caustic train (one loco and 20 wagons) which provide the daily rail services to and from Alcoa's facilities at Pinjarra, Wagerup, Kwinana and Bunbury.

For Alcoa's Wagerup refinery there are currently three trains, and occasionally four trains transporting alumina each day to the Bunbury Port. Each train is between 34 to 38 wagons in length.

Typically one train, and occasionally two trains, per day is required to carry caustic from Bunbury to the Wagerup refinery. Each train is 20 wagons in length.

ARG is currently reviewing its rail operations and has flagged it intends to operate four sets of alumina trains (one loco and approximately 28 to 32 wagons each) and two sets of caustic trains (one loco and approximately 10 wagons each) from around mid 2005. This will result in an average increase of two alumina trains and one caustic train per day to and from Wagerup, however trains will be shorter.

Alcoa's Bunbury Port facility was opened in 1976 to meet expanding alumina output from the Pinjarra refinery. The port supported expanded production when Wagerup commenced operations in 1984. Worsley also uses Bunbury Port for the export of alumina. In 2003, 8.4 Mtpa of alumina was shipped from Bunbury by Alcoa and Worsley.

4.4.1.3 Road Transport

Currently most vehicle movements to and from the Wagerup refinery are associated with road freight and employee vehicles. The permanent workforce at the refinery results in approximately 450 passenger vehicles per day entering and exiting the site.

Road freight movements associated with deliveries to the Wagerup refinery are estimated at 121 movements (one-way) per week. The majority of these are from the north and travel along the South West highway through the Waroona townsite. There are approximately seven large trucks transporting lime and one general freight semi-trailer into Wagerup every day. Lime movements make up 47% of daily vehicle freight movements into the refinery. The refinery also receives approximately eight general freight vehicles per day, including five tray trucks and three 1-tonne courier vehicles. Nine other movements occur on a weekly or fortnightly basis and are associated with activities such as fuel delivery, laboratory supplies, domestic rubbish collection and recycling.

The road freight movement associated with mining is estimated at 46 freight movements (one-way) per week, made up of fuel and oil transport, general deliveries, explosives, logging and mulch. It should be noted that mining is not included in the assessment of this Proposal, but mining freight movements are described here at the request of the Noise and Transport working group (a local community-based consultation committee).

The road freight movements associated with the refinery and mining represents approximately 7% of all freight movements on South West highway. This is based on Main Roads daily class data giving an average of 36,000 vehicle movements and 4680 freight movements (class 3 to 12) per week.

4.4.2 Energy Requirements

The Wagerup refinery uses natural gas as its main energy source, as it is less expensive and is considered to have less environmental impact than other carbon-based energy sources. The on-site powerhouse boilers produce steam used for heating in the Bayer process, and to generate electricity using turbo-alternators to power the refinery and ancillary facilities. Natural gas is also used as fuel for the calciners, and will be combusted in the oxalate kilns.

Alcoa is constantly examining ways to reduce energy consumption and improve the overall energy efficiency of the refinery including measures such as waste heat recovery. These energy efficiency programs have resulted in Alcoa's Australian alumina refineries making significant energy efficiency improvements.

4.4.3 Refinery Water Supply

Wagerup refinery is almost totally dependent on surface water sources to provide process make-up water. The catchments that provide water for the Wagerup refinery include the refinery site and residue area, and surrounding land including Darling Range and agricultural catchments. Make-up water is taken from three licensed surface water sources: Black Tom Brook, Yalup Brook and the Harvey River Main Drain (refer section 7.5.2). In addition, rainfall runoff and water contained in the caustic soda and bauxite is added to the water circuit. Water is also purchased (700 kL in 2004 and 660 kL in 2003), when required, from Harvey Water.

The RDAs have base drainage systems that collect residue leachate and rainfall infiltration. All rainfall runoff from the refinery, residue area and process water ponds is transferred to the cooling pond or runoff water storage pond during winter and then used as make-up water for the refinery during summer. On average, total water storage in the residue area water circuit is approximately 3,000 ML (averaged over 2002/3).

Annual water consumption is primarily determined by the process conditions and is largely independent of prevailing weather conditions. Overall, the Wagerup refinery uses approximately two kilolitres (kL) of water per tonne of alumina product.

Alcoa has developed a water balance model for the Wagerup refinery to predict water consumption and supply requirements under varying process and weather conditions (refer to Figure 10).

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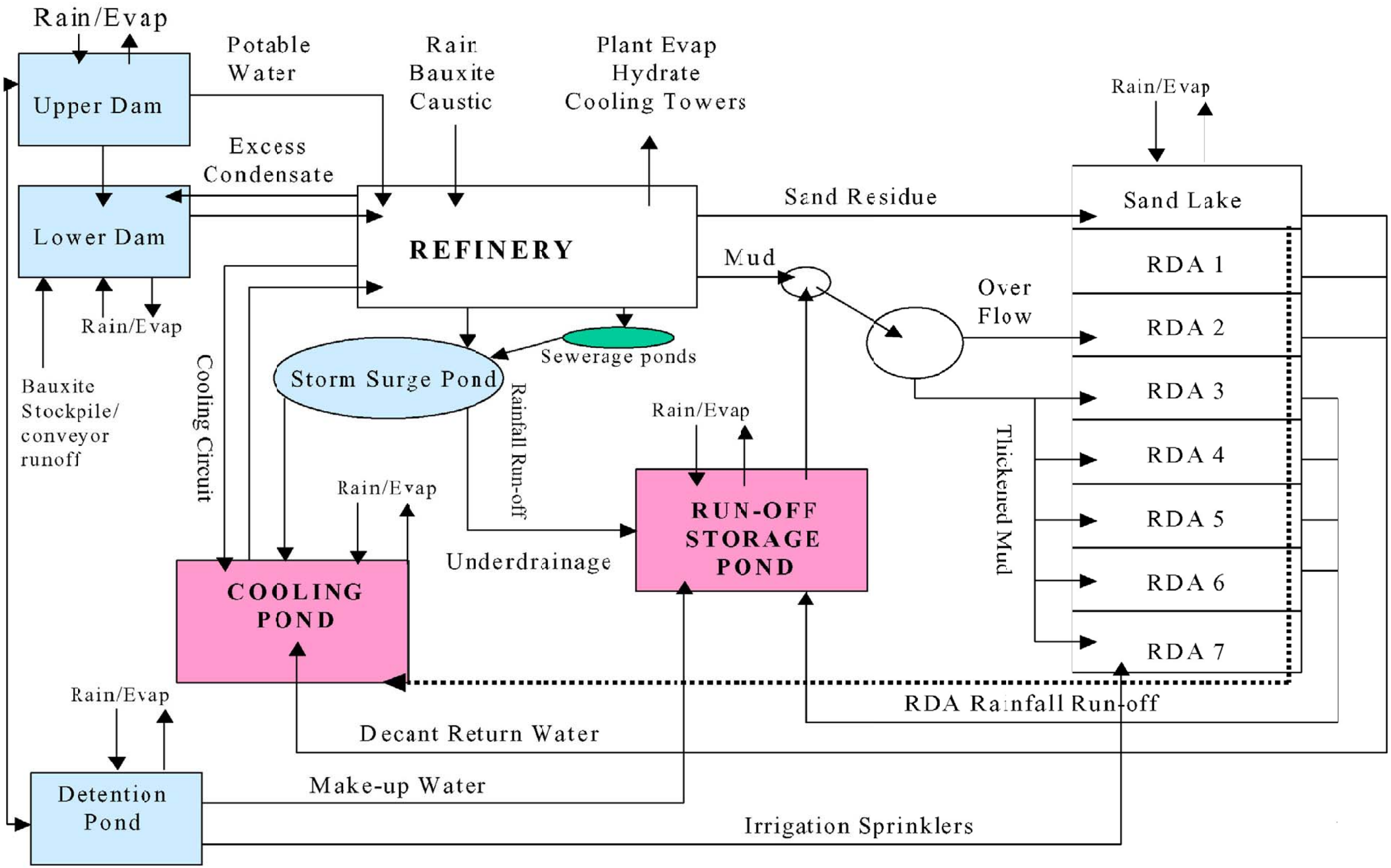
WATER CIRCUIT DIAGRAM



SOURCE: ALCOA Wagerup.

Figure 10

Drawn: KP

Date: 04/05

Table 1 below summarises the existing refinery consumption and supply in average rainfall and runoff years.

Table 1: Refinery Water Consumption & Supply - Average Rainfall/Runoff conditions

Refinery Water Consumption

	Current Refinery (MLpa)
Evaporation Losses from Fresh Water Surfaces	1,400
Evaporation Losses from Liquor Surfaces	1,000
Moisture lost with Stored Residue	2,400
Cooling Evaporation from Liquor Ponds	730
Vapour losses from in- plant processes & vessels (including cooling towers)	1,730
Residue Dust Control Sprinklers	2,200
Total Consumed	**9,460**

Refinery Water Supply

	Current Refinery MLpa
Moisture with Bauxite & Reagents	1,000
Rainfall collected in Fresh Water Reservoirs	700
Rainfall Runoff from Plant Area	270
Rainfall Runoff & Drainage from Residue & Liquor Pond Areas	2,390
Surface Water Sources (Licence) - Nth & Sth Yalup Br (1600 MLpa) - Black Tom Br (2500 MLpa) - Harvey R Main Drain (4400 MLpa)	 1,200 1,500 2,100
Groundwater (550 MLpa)	300
Additional Sources (as identified in this study)	
Total Supplied	**9,460**

Refer to Appendix A for an indication of the Wagerup refinery water consumption and supply under drought conditions. Water requirements and supply alternatives for the Proposal are discussed in Section 5.3.3 and also presented in detail in Appendix A.

5. WAGERUP REFINERY UNIT 3 PROPOSAL DESCRIPTION

5.1 PROPOSAL OVERVIEW

The proposed expansion at Wagerup refinery involves the addition of a third production unit to the two units currently operating, which will almost double production capacity. The Proposal will replicate the existing Bayer process steps from bauxite grinding through to alumina calcination as detailed in section 4.1 and shown in Figure 6. The Proposal will require the addition of some new equipment, but significant production gains will also be achieved through upgrading existing equipment to increase capacity and efficiency. As alumina production increases so too will the requirement for raw materials, water and energy to process the bauxite ore. However, Alcoa intends to maximise efficient use of resources in line with Alcoa's Sustainability Principles (see Section 8.1).

The Proposal will enable the refinery to process an additional 9 Mt of bauxite per year, taking the total annual bauxite throughput at the Wagerup refinery to approximately 16 Mt per year. This will require an increased mining rate within the approved mining areas and as such will reduce the life of the mine. As discussed in Section 4.3.1, mining operations and associated environmental issues will continue to be managed through the existing approvals process and are therefore not included within the scope of this ERMP assessment.

The RDA is currently managed within the approved 30 year Long Term Residue Management Strategy (LTRMS). The increased alumina output from the expansion will increase the active drying area required from approximately 180 ha (current) to a total of 270 ha (proposed). A doubling of the active drying area is not required because improvements in residue management techniques will raise the deposition rate from 14,500 tonnes residue/ha/year ha/year to 16,500 tonnes residue/ha/year, thus limiting the increase in active drying area required.

The increased residue production will require the timing for the proposed construction of drying cells currently approved in the LTRMS to be brought forward. The residue management process is described in more detail in Section 5.2 and requires the strategy to be reviewed on a five-yearly basis with input from key stakeholders.

Alcoa has committed that the Proposal will meet world-class health guidelines and that there will be no increase in odour, dust or noise impacts on residents from the refinery or mine as a result of expansion. Environmental assessment of the Proposal includes a comprehensive and independently reviewed Health Risk Assessment.

5.1.1 Refinery Production Changes

The major components of the Proposal are outlined in this section. Table 2 presents a summary of the key characteristics of the expanded refinery compared with the current refinery.

Table 2: Key Characteristics of the Proposal

Characteristic	Units	Current Refinery	Expanded Refinery
Alumina Production	Mtpa	Approx 2.4	Approx 4.7
Refinery Operations		Continuous operation	Continuous operation
Bauxite Mine		Continuous operation	Continuous operation
Bauxite Mining Rate	Mtpa	9	16
Proposal Life	yrs	>60	>35
Capital Investment	A$	-	1.5 billion
Refinery Footprint	ha	183	183
Construction Period	months	-	27
Workforce (peak construction)	persons	-	>1,600
Workforce (operation) (Refinery + mine)	persons	900	1,050
Bauxite Residue	Mtpa	4.8	9.6
Noise		Regulation 17 application under the *Protection (Noise) Regulations 1997* is being considered by the Minister for Environment	No increase in noise impacts on surrounding residents
Particulates	tpa	60	65
Oxides of Nitrogen (NOx)	tpa	1005	1974
Sulphur Dioxide (SO_2)	tpa	70	113
Volatile Organic Compounds (VOCs) [1]	tpa	78	93
Greenhouse Gases	tpa	1,342,000	2,255,000 (cogeneration) 2,544,000 (boilers)
Greenhouse gas emission intensity	$kgCO_2/t$ alumina	557	480 (cogeneration) 541 (boilers)
RAW MATERIALS			
Caustic Soda (dry)	tpa	141,000	282,000
Lime	tpa	110,000	200,000
Water	MLpa	4,800	9,600

Note[1] : Total VOCs is the sum of Acetone, Acetaldehyde, 2-butanone, Benzene, Toluene, Xylenes Acrolein, Ethylbenzene, Methylene Chloride, Styrene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene & Vinyl chloride

5.1.2 Refinery Modifications

The refinery expansion will be achieved primarily by adding a third unit and upgrading or replacing parts of the existing refinery to improve process efficiencies. Figure 2 presents an aerial photograph of the refinery layout and shows the main modifications proposed for the refinery.

Detailed specifications for the Proposal have not been finalised, as engineering design work will consider the output of the key studies outlined in this report, with the aim of reducing environmental impacts.

The broad infrastructure requirements of the Proposal are separated into the following key areas of the refinery:

- Milling;
- Digestion
- Precipitation
- Calcination
- Power generation
- Conveyor; and
- Residue storage area.

Engineering design work for the expansion has commenced, but is in the preliminary stages. Based on the engineering design work to date, the Proposal is likely to include the following key equipment or modifications as detailed in Table 3 below. As the engineering design becomes more advanced further detailed information will become available and this would be included in future approvals processes, such as works approval.

Table 3: Main Equipment Components of the Proposal

Area	**Existing Refinery**	**Key New and upgraded equipment for the Expanded Refinery (based on preliminary engineering design)**
Milling	• 3 SAG mills	• Increased milling capacity
Ore stockpiles	• Stockpile reclaimer and conveyor • 2 stockpiles plus one emergency	• New reclaimer and conveyors • New dust suppression and cleaning system for conveyor
Slurry storage	• 4 slurry tanks	• New slurry tanks
Digestion	• Digester banks and flash vessels • vapour condenser	• Increased digestion capacity • New and upgraded pumps
Evaporation	• Evaporation units • Heat interchange units	• New evaporation units • New heat interchanger
Lime (place where)	• 1 lime silo	• Upgrade lime storage facilities and associated equipment
Clarification	• Sand removal units	• New filter presses

Area	**Existing Refinery**	**Key New and upgraded equipment for the Expanded Refinery (based on preliminary engineering design)**
	• Washers, thickeners • Filter tanks and presses	• New and upgraded washer facilities • New cyclone system
Residue Area	• Approximately 180 ha required for drying and storing residue	• New sand separation • Additional 80 to 100ha residue drying area • Upgrade RDA sprinkler system
Precipitation	• Precipitators and seed filters • Thickeners and liquor tanks • Cooling towers and cyclone clusters	• New precipitators and seed filters • New thickeners and liquor tanks • Additional cooling capacity • New cyclone clusters
Oxalate Removal	• Decommissioned Oxalate kiln	• Oxalate kilns with RTO (regenerative thermal oxidiser)
Liquor Burning	• Liquor Burner	• Install a RTO.
Calciners	• Four calciner units • 100 m multiflue for calciners 1, 2, 3	• Two new calciners with single multiflue • No.4 calciner to new multiflue
Alumina storage	• Two alumina storage bins and alumina conveyors	• Additional alumina storage • Upgrade or additional conveyor
Powerhouse	• Turbo-alternators and boilers • Gas turbine with steam generator	• New boilers or cogeneration units
Port facilities	• Alumina Storage and handling facilities • Caustic storage	• Upgraded alumina handling facilities
Water supply	• Licenced surface water sources.	• Increased surface water supply

5.1.3 Equipment/process modifications

5.1.3.1 Bauxite Milling

The refinery expansion will include the addition of new milling capacity installed in series with the existing three SAG mills. Bauxite storage may also be increased through the installation of a new bin. The mills are required to grind the bauxite ore to particles of less than 1.5 mm, producing sufficient surface area for the ore to react with the process liquor.

Mill availability will be increased to 95% and mill product pumps will be upgraded. The new mill(s) will have contact heaters to heat the slurry from the mill discharge, and the contact heaters in the existing mills will be upgraded.

Additional slurry storage capacity will be added to the desilication plant to maintain the current holding time for slurry. Vapour emissions will be reduced by 75% through the use of sealed units.

5.1.3.2 Digestion

The two existing digestion units will be upgraded, and an additional unit will be added to carry the increased flow of slurry. The additional unit will consist of additional flash vessels, blow off tanks, heaters, and associated pumps and pipelines. All units will increase the use of indirect slurry heating and reduce the use of direct slurry heating. A new vapour condenser will be installed to minimise emissions of VOCs from the new digester unit.

New evaporation units will be required in addition to the existing seven to provide the increased refinery evaporation.

5.1.3.3 Clarification

The existing clarification process will be upgraded. The additional sand load will be processed via a series of cyclone clusters to supplement the existing rake trains. The mud thickeners and washers will all be upgraded to process the additional load, and one new hi-rate washer will be added. The existing filter presses will be replaced by, or supplemented with new “state-of-the-art” presses.

The mud washers, which recover caustic before the mud is sent to the residue area, will be upgraded by modifying feed wells and piping. New cyclone clusters will be installed, along with feed tanks and pumps, and deaeration tanks.

In the mud thickening process, new feed wells, additional cyclone clusters, feed tanks and pumps will be required, along with additional deaeration tanks. Pumps and piping will also be upgraded.

Mud and sand removal facilities will be upgraded by adding new residue tanks and new cyclone clusters.

The lime storage facilities will be upgraded, with a risk analysis on lime silo requirements and reliability conducted.

5.1.3.4 Precipitation

The upgrade of the precipitation area will involve additional precipitation vessels and associated pumps and piping. Additional thickeners, tanks and cyclones will also be required. The existing hydrate filtration systems will be upgraded or replaced, and additional filtration equipment will be installed. Additional seed filters will be installed on top of the precipitator tanks, and additional coolers will be installed with the new unit.

5.1.3.5 Calcination

There are currently four calciners installed at the Wagerup refinery. Units 1, 2 and 3 have a 100 metre multiflue, whilst calciner 4 has a 49 metre stack. Two additional calciner units will be installed (Units 5 and 6). These units and calciner 4 will be serviced by a second 100metre multiflue and the current calciner four stack removed. Dust emissions from these calciners during normal operation will be controlled by electrostatic precipitators (ESPs) and are expected to be less than 15 mg/m^3 representing improved dust control performance. Calciner 4 will be further upgraded to allow the destruction of low volume vent emissions.

Additional conveyors and a new alumina storage bin, that will allow more rail wagons to be loaded simultaneously, will be installed.

The caustic unloading facility will be upgraded by the addition of improved unloading stations.

5.1.3.6 Impurity removal

The existing Oxalate Removal Plant will be upgraded by converting an existing mud washer to oxalate duty, converting existing mud filters to oxalate duty, and by installing a new drum filter. A new oxalate kiln will be constructed, and the existing kiln will be recommissioned. Both kilns will have a Regenerative Thermal Oxidiser (RTO) installed to control emissions to negligible levels.

The replacement of the liquor burner Catalytic Thermal Oxidiser (CTO) with a RTO will further reduce liquor burner emissions despite higher throughputs.

5.2 BAUXITE RESIDUE AREA

The expansion of the Wagerup refinery will increase production of bauxite residue and therefore require the construction of new drying areas currently approved in the LTRMS to be brought forward. Construction of drying areas within the 30 year plan is an ongoing process, with work on RDA7 completed during the 2004/5 summer period and construction of RDA8 and a new fresh water detention pond planned for the 2005/6 summer period.

A summary of the changes to the residue area during the expansion include:

- Increased production of bauxite residue;
- Expansion of the existing drying area by 80 Ha;
- Conversion of part of the wet lake to dry a storage area
- Earlier construction of residue areas approved in the LTRMS;
- Additional residue transport lines;
- Construction of a Sand Separation facility consisting of new cyclones and associated equipment to manage increased residue production.

The potential for increased dust emissions will be managed through installing an upgraded sprinkler system on all new RDAs. Existing sprinkler systems will be replaced with the new upgraded system on a staged approach, when operationally feasible.

5.2.1 Long Term Surrounding Land Requirements

The long term (>30yrs) operation of the Wagerup refinery is likely to require an expansion of the residue area beyond the existing boundary identified in the LTRMS. Consultation to date on the LTRMS has focused any expansion of the residue area to be in a westerly direction, to:

- preserve the agricultural land to the north and north east of the existing residue areas;
- maintain a minimum 2 km distance between the residue operations and the residences to the north and north east.

Any changes to the existing management and planning for bauxite residue would be undertaken through the LTRMS. Details on the LTRMS process is detailed in section 4.3.1.

5.3 SERVICES AND UTILITIES

5.3.1 Raw Materials and Product Transportation

5.3.1.1 Overland conveyor

Overland conveyors will continue to transport bauxite ore from the Willowdale mine to the refinery. The first conveyor, fed by the existing crushing station at Orion, will not change, however the second existing overland conveyor will be upgraded and extended to a new crushing station at Larego, with a total length of approximately 14km. This conveyor will be upgraded from a 915mm wide belt to 1,050mm wide belt and the speed increased from 5.5m/sec to approximately 5.9m/sec.

The existing subsidiary tail drive for this second conveyor will be relocated from Arundel to Bancell, where it will be located together with the existing main drive station. In addition, a new drive station will be constructed discharge point in the refinery's bauxite stockpile handling area

5.3.1.2 Rail Transport

Alumina will continue to be transported to Bunbury Port by rail. The railway is owned and operated by Australian Rail Group (ARG). To service the Pinjarra and Wagerup operations an increase in rail transport capacity is required. Assuming ARG implement their current revised schedule of four alumina and two caustic train service by mid 2005 (refer section 4.4.1) the increased alumina transport will be managed through increasing the length of the mid 2005 trains from about 28 to 32 wagons to three alumina trains of 46 wagons and one alumina train of 34 wagons.

Caustic shipments from Bunbury Port to Wagerup would increase from around 300,000 tpa to approximately 480,000 tpa, increasing the length of the mid 2005 caustic trains from 10 wagons to approximately 14 wagons. The average number of caustic trains would remain at the mid 2005 level of two per day.

The proposed changes in rail transport associated with the refinery expansion are based on discussions with the operator of the South West Main Line. However these rail movements may change, with other users wanting to access the rail, changing train schedules, and capacity constraints due to the rail line being a single narrow gauge track with a number of crossing loops. Discussions will continue with the railway operator to establish how the Proposal requirements will be handled by the South West Main line.

It is proposed to upgrade the caustic and alumina loading and unloading facilities at the Wagerup refinery and the Bunbury port. To improve train turnaround times, investigations into a new rail loop, upgraded airslide and conveyor systems are underway, which will also assist to minimise dust and noise emissions.

5.3.1.3 Road Transport

Road transport will be required for the Proposal for continued freight of process inputs, transport of construction materials and transport of the construction and operations workforce.

During construction, it is expected that construction materials will be mainly provided from the Perth metropolitan area or Bunbury via the South West Highway. Alcoa has a procurement strategy in place to source from local suppliers where appropriate. Alternative routes that avoid towns along the South West Highway will be considered for heavy haulage vehicles in consultation with the relevant authorities (refer Section 8.8).

The Proposal will increase employment at the Wagerup refinery, both during the construction phase and post construction. The construction workforce is expected to peak at more than 1,600 personnel, in addition to the 650 personnel that currently work at the refinery. There is therefore, on average, the potential for an estimated 400 additional passenger vehicles travelling to and from the refinery on a daily basis during construction. During the peak period of construction this number could increase to approximately 800 additional passenger vehicles travelling to and from the refinery on a daily basis.

To minimise this impact, Alcoa will consider strategies such as using buses to transport personnel from key pick up points in Mandurah, Bunbury and locally (Section 8.8). The number of additional permanent operational personnel is expected to be approximately 150.

Implementation of the Proposal will result in an estimated increase of road freight vehicles to a total of 280 vehicles per week (one-way) as outlined below.

Table 4: Freight Transport requirements for the Proposal

	Proposal Freight Transport requirements
Lime trucks	11 daily
Tray trucks	9 daily
Semi-trailers	2 daily
Couriers	5 daily
Weekly deliveries	13
Mining	78 weekly
Total weekly (one-way)	**280**
Total weekly (two-way)	**560**

Alcoa will consult with the Shire authorities and the local community about traffic movement management. Additional vehicle movements on completion of the Proposal, as a proportion of freight traffic along the South West Highway, are expected to be quite small (approximately 12% of freight and less than 1.5% of all traffic) (Section 8.8). Of the additional freight vehicles required, it is expected that the majority will use the South West Highway route through the Waroona townsite. However, alternative routes are being considered and the Proponent will ensure that, where possible, heavy vehicle traffic through the town of Waroona is minimised.

5.3.1.4 Bunbury Port Operations

Alcoa's Bunbury port facilities consist of:

- An alumina train unloading facility connected to three alumina storage bins via enclosed conveyors;
- A caustic train loading facility;

- A caustic unloading facility on the dock connected to a caustic storage tank via an above ground pipeline;
- A caustic truck loading facility;
- A series of enclosed conveyors connecting the three alumina storage bins with a dock mounted alumina ship loader; and
- Office and maintenance facilities.

The capacity of the alumina train unloading facility will need to increase, possibly through modifying some existing equipment and installing additional conveyors in the existing enclosed conveyor structure. The train unloading and alumina conveying dust collection systems will be reviewed and upgraded, if required, to ensure dust emissions are minimised. It is unlikely that any additional storage capacity will be required, however this is subject to further investigation.

There is no requirement to increase the capacity of the ship loading system, as there will be no increase in alumina shipped from the Alcoa berth. The increase in alumina at the Alcoa berth will be more than offset by the reduction in Worsley Alumina Pty Ltd material passing through the berth. Worsley Alumina Pty Ltd is commissioning a ship loader at an adjacent berth, which will be operational prior to the commissioning of the Proposal, if approved. It is estimated that there will be around 50 additional ships per annum required as a result of the Proposal.

Alcoa and Worsley jointly ship caustic and Worsley is installing a caustic unloading facility at the Bunbury Port. Therefore no changes will be required to Alcoa's existing caustic unloading facility. The existing rail caustic loading facility is considered adequate, however this is subject to further investigation with Worsley and the rail provider as it is a shared facility.

There are several elements of the Proposal which will have potential environmental impacts for the Bunbury Port;

- dust emissions from Alcoa operations at the Port (Section 8.3.12);
- noise impacts from Alcoa's ship loading facility Alcoa Port operations (Section 8.4.6);
- noise from railway associated with Alcoa's port operations (Section 8.4.6).

Consultation in regard to dust and noise emissions at Bunbury Port has been ongoing and will continue beyond the ERMP phase (see Section 6.3).

5.3.2 Energy Requirements

The Wagerup refinery is recognised as one of the most technologically advanced and energy efficient alumina refineries, when compared with international benchmarks. The Proposal will result in the installation of current best practice energy efficient processes. These will include the seed filtration process, and enhanced causticisation that will improve the efficiency of the refinery liquor stream. There will be an overall increase in energy consumption at the refinery, however with improved energy efficiency, energy consumption per tonne of alumina produced will decrease.

Currently two options are being considered to meet the additional energy requirement for the Proposal. Either two additional boilers and two turbine alternators will be constructed in the existing powerhouse, or two additional turbine alternators will be constructed in the existing powerhouse and a new Cogeneration facility will be developed by a third party. The potential impacts of both facilities on air quality have been modelled and assessed in the Health Risk Assessment (refer section 8.3.10).

If the Cogeneration option is selected, it is proposed to have two 140 MW-capacity gas turbine generators and two heat-recovery steam generators (HRSG). Heat from the exhaust gases of each gas turbine will be used in the HRSG units to produce up to 430 tph of high-pressure steam for use in the Powerhouse. The Cogeneration option is expected to:

- have high thermal conversion efficiencies resulting in more efficient use of natural gas resources;
- lower intensity of greenhouse gas emissions than other fossil fuel-based power generation;
- lower intensity of GHG emissions for alumina ; and
- improved efficiency of steam generation and minimised steam demand through improved utilisation of process steam.

The installation of two Natural Gas fired boilers would allow the refinery to operate independently of a third party supplying high pressure steam, and to progress with the Proposal independently of the electricity market timing.

The Wagerup Cogeneration plant would produce about 2,100 GWh of electricity per annum, with any energy surplus to the Wagerup refinery's requirements sold to the South West Interconnected System (SWIS)

5.3.3 Water Supply

The refinery's current total water requirement is 9,460 MLpa (Table 1 – refer Section 4.4.3) of which 4,800MLpa is obtained from licenced surface water sources. The Proposal has a total water requirement of 14,900 MLpa and will require approximately 1,100MLpa in an average rainfall year or 4,800 MLpa in a dry year, from external water sources. The refinery's surface water requirements will vary each year depending on annual rainfall. A summary of the water balance for the Proposal is presented in Table 5 (Case A - average rainfall year) and Table 6 (Case B - low rainfall year).

Table 5: Refinery Water Consumption & Supply - CASE A
Average Rainfall/Runoff conditions

Refinery Water Consumption	**Future Refinery (4.7 Mtpa) (MLpa)**
Evaporation Losses from Fresh Water Surfaces	2,000
Evaporation Losses from Liquor Surfaces	1,300
Moisture lost with Stored Residue	4,500
Cooling Evaporation from Liquor Ponds	900
Vapour losses from in- plant processes & vessels (including cooling towers)	2,700
Residue Dust Control Sprinklers	3,500
Total Consumed	**14,900**
Refinery Water Supply	
Moisture with Bauxite & Reagents	1,890
Rainfall collected in Fresh Water Reservoirs	1,000
Rainfall Runoff from Plant Area	270
Rainfall Runoff & Drainage from Residue & Liquor Pond Areas	3,330
Surface Water Sources (Licence) - Nth & Sth Yalup Br (1,600 MLpa) - Black Tom Br (2,500 MLpa) - Harvey R Main Drain (4,400 MLpa)	 1,200 1,500 4,300
Groundwater	300
Additional Sources (as identified in Appendix A)	**1,110**
Total Supplied	**14,900**

Case B below summarises refinery consumption and supply during dry rainfall and runoff years, based upon 2001 which was the lowest rainfall (and runoff) year in 25 years of records for the Wagerup locality.

Table 6: Refinery Water Consumption and Supply - CASE B
Dry Rainfall/Runoff conditions (Based on driest year on record - 2001)

Refinery Water Consumption	**Future Refinery (4.7 Mtpa) (MLpa)**
Evaporation Losses from Fresh Water Surfaces	2,000
Evaporation Losses from Liquor Surfaces	1,300
Moisture lost with Stored Residue	4,500
Cooling Evaporation from Liquor Ponds	900
Vapour losses from in- plant processes & vessels (including cooling towers)	2,700
Residue Dust Control Sprinklers	3,500
Total Consumed	**14,900**
Refinery Water Supply	
Moisture with Bauxite & Reagents	1,890
Rainfall collected in Fresh Water Reservoirs	680
Rainfall Runoff from Plant Area	180
Rainfall Runoff & Drainage from Residue & Liquor Pond Areas	1,980
Surface Water Sources (Licence)	
- Nth & Sth Yalup Br (1,600 MLpa)	200
- Black Tom Br (2,500 MLpa)	800
- Harvey R Main Drain (4,400 MLpa)	4,400
Groundwater (600 MLpa)	300
Additional Sources (as identified in Appendix A)	**4,770**
Total Supplied	**14,900**

Water Supply Options

Alcoa commissioned an analysis of the water supply options and water conservation opportunities, which were identified through a process of consultation with key stakeholders including Alcoa staff, local community representatives, Harvey Water, Water and Rivers Commission (DoE) and Agriculture WA. Detail of this analysis is presented in Appendix A.

Based on these studies, the preferred future water supply options for the Proposal are:

- Harvey River Main Drain
- Other Local Drains
- Transfer of Part of Alcoa Farmlands Irrigation Water Entitlement
- Irrigation System Efficiency Water

Both the Harvey River Main Drain and irrigation system efficiency options will be further examined before a final option is selected. Analysis by the Centre of Excellence in Natural Resource Management (CENRM) (2005) suggests that a further 28 GLpa of water should be available from the Harvey Main Drain source, which is well above Alcoa's additional water requirement of around 4.8 GLpa. Further information on the water supply options is provided in Section 8.5 and Appendix A.

5.4 CONSTRUCTION AND OPERATIONAL WORKFORCE

Throughout construction of the Proposal an average of 500 additional personnel will be required annually with a peak of approximately 1600 workers. The expanded refinery, when operating would require an additional 150 full time personnel in addition to the 650 employees currently working at the Wagerup refinery.

6. COMMUNITY INVOLVEMENT

Alcoa would like to thank all those who participated in the Unit Three community involvement process for their dedication and commitment. A range of community members gave generously of their time and energy to participate in the process, during which an enormous amount of information was exchanged. It began with discussions with the Wagerup Community Consultative Network (CNN), which led to the Open Forum, attended by over 120 people. The Forum created five working groups which collectively met on over 50 occasions in the preparation of this ERMP; a generous commitment to say the least.

This has been a comprehensive and intensive involvement process and its success has been due to the willingness of people to participate constructively and freely. I believe that the Unit Three project, this ERMP and Alcoa's ongoing relationship with the local community have benefited from this process, particularly the input of such a wide range of interested people, especially those from the townships surrounding the Wagerup refinery. The involvement process that occurred enabled a group of people from varying interests and with differing concerns to discuss these and receive information to answer their questions.

Finally, prior to describing the community involvement framework in detail, particularly the five subject-specific working groups it is important to emphasise that the community-based working groups undertook a consultation role, not an endorsement role. While working group members reviewed various technical reports and provided comment from their own perspective, they were not asked or expected to endorse, approve or "sign-off" on these reports or any component of the ERMP prepared by the proponent. Therefore, unless otherwise indicated, the publication of the various reports contributing to this ERMP does not represent their endorsement by working group members or other groups participating in the ERMP stakeholder engagement process.

Thank you
Bill Knight, Wagerup Refinery Manager

6.1 INTRODUCTION

Alcoa has a long history of community involvement and in recent years has evolved its approach to match changing community expectations.

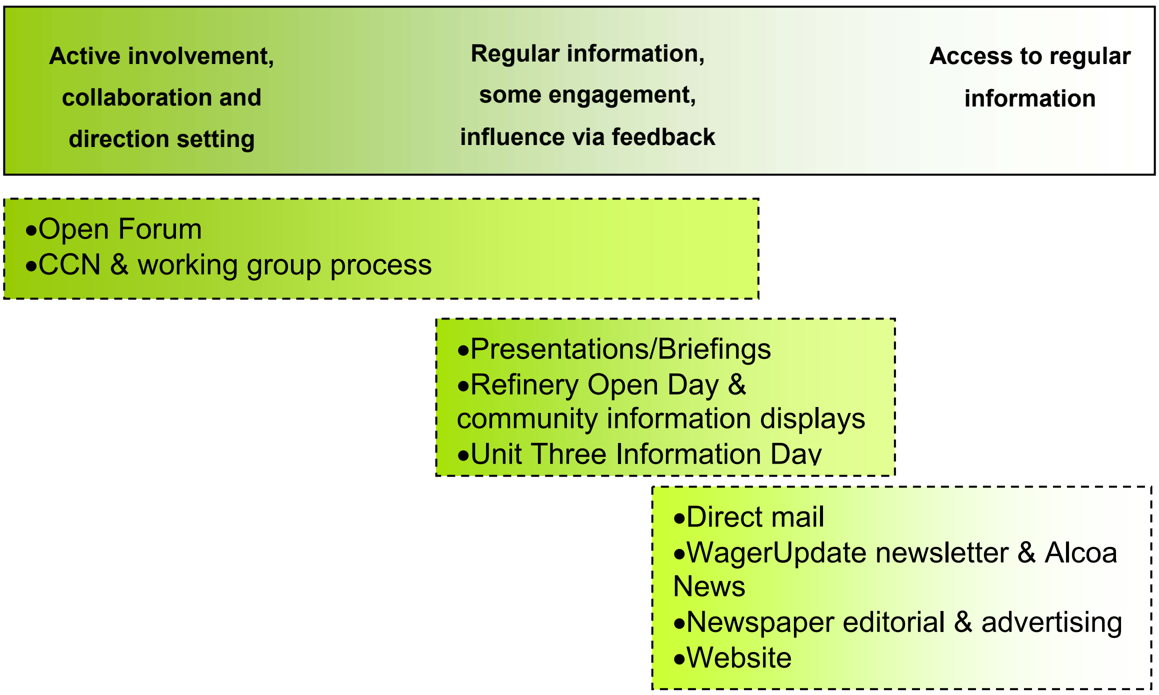
Current involvement mechanisms include a Community Consultation Network (CCN), the Wagerup Tripartite Group, community meetings, local council deputations, presentations, mail-outs, environmental reports, annual reviews and newsletters. Informal engagement through one-on-one discussions with neighbours, involvement in community led committees, initiatives and forums, as well as community partnerships also provide important means of gaining community feedback and participation.

Alcoa recognised that the significance of the Proposal, coupled with its sometimes controversial history with local communities, would require a comprehensive consultation and information program aimed at meeting the varying needs of broad range of stakeholders.

It is well recognised that different stakeholder groups, and individuals, have differing involvement needs, some people want to be actively involved, others will provide occasional feedback and many may simply want to be kept informed of progress.

The involvement strategy developed by Alcoa sought to meet the needs of each category of stakeholders using a range of tools summarised in Figure 11 and described in this section.

Figure 11: Stakeholder Involvement Needs



In addition to providing a range of communication tools to meet stakeholder needs, Alcoa aimed to achieve a high 'level' of community involvement, particularly for those stakeholders seeking active involvement.

The level of community involvement achieved through the involvement process, based on the Spectrum of Community Involvement described by the DoE, ranged from informing to empowering.

6.2 COMMUNICATION AND INVOLVEMENT TOOLS

Each of the main communication tools used to inform and involve stakeholders in relation to the Unit Three proposal is described below.

6.2.1 Open Space Forum

A public forum where approximately 120 participants identified and explored the issues and opportunities associated with the proposal.

Target Audience:	Neighbours	Government representatives
	Employees	Industry stakeholders
	Interest groups	Suppliers
Level of Involvement:	Informing, consulting, involving, empowering	

The intensive community engagement program began with discussions with the Wagerup CCN on how best to involve the community in the environmental assessment process.

The CCN was established in 2000 to be the primary consultation forum for Wagerup. Its open membership includes Waroona, Hamel and Yarloop community representatives, Waroona and Harvey Shire representatives and other interested stakeholders. Any interested person may attend CCN meetings. The group meets monthly to discuss refinery and community issues, with meeting minutes published in the local paper.

The group indicated that community involvement should be invited via some form of community meeting convened on a weekend. This feedback led to an independently facilitated Open Forum, held on the weekend of 11-12 September 2004.

A mail-out to over 3,000 householders in the local district and other stakeholders invited interested people to participate and address the question, "Expansion of the Wagerup Refinery: What are the issues and opportunities?"

The forum used Open Space meeting facilitation which is a methodology suited to situations where there is a real issue of concern, a diversity of interests and stakeholders, a complexity of elements, a presence of passion/conflict, the decision time is limited, public input is desired and communication needs to improve. It allows attendees to set the agenda and move freely between a range of discussions. A recognised expert in this field was invited to facilitate the weekend.

Over 120 people attended the weekend forum and a report of their proceedings was collated and distributed on the final day of the forum (see Appendix B). One outcome of the forum was the identification of key topics for further discussion. This assisted in the formation of the working groups.

For example, one such group was the land management group, which self-formed at the weekend and proactively sought Alcoa's ongoing involvement in discussions on land management issues. The group began meeting immediately after the weekend, independent of the facilitated process offered by Alcoa.

6.2.2 Wagerup CCN & Working Group process

The Open Space forum led to the formation of the project's key involvement mechanism, the five topic-based working groups. This framework allowed independently facilitated working groups to focus on more detailed aspects of the Proposal while the CCN undertook a role to monitor the integrity of the overall consultation process (refer Figure 12).

During the ERMP engagement program, the working groups met regularly (approximately every fortnight), with meeting intensity increasing in the lead-up to the submission of the ERMP. A total of 58 meetings were held with each group meeting at least 10 times between October 2004 and April 2005, prior to the submission of the ERMP.

Target Audience:	Neighbours	Local residents
	Employees	Government representatives
	Interest groups	Suppliers
Level of Involvement:	Informing, consulting, involving, collaborating	

Five independently facilitated working groups were established in mid-October to examine and comment on the detailed content of Alcoa's proposal to expand the Wagerup refinery and to address the ongoing issues and opportunities identified at the Open Forum.

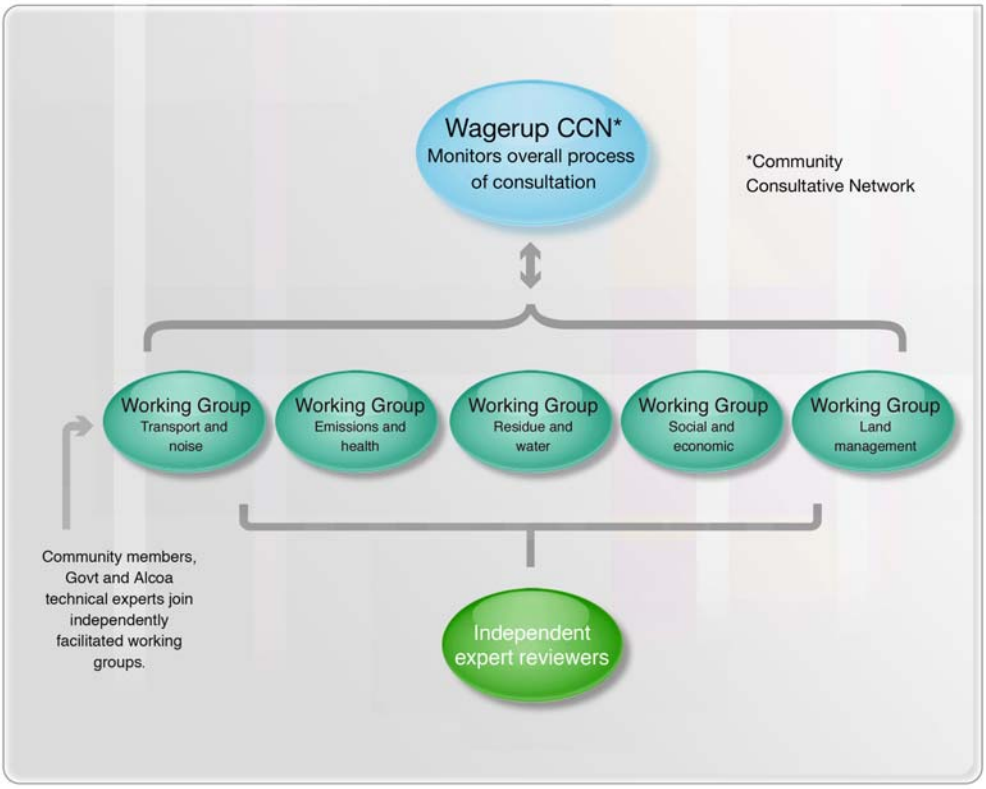
A mail-out after the Open Forum offered interested members of the community an opportunity to nominate themselves or others for membership of the working groups. 48 individuals nominated, including community members from Waroona, Hamel, Yarloop, Cookernup and Harvey, Shire of Waroona and Harvey officers and councillors and State government department representatives.

The working groups included people with a substantial history with Alcoa and individuals joining in consultation with Alcoa for the first time.

Those who nominated were invited to an initial meeting of each group at which those present self selected the membership of the group following the principle of a majority of community members. Alcoa and relevant government representatives were also selected. Those individuals unable to attend the first meeting, but wishing to participate in the process were represented by one of the facilitators during the self selection process.

The groups established were: Emissions & Health; Transport & Noise; Residue & Water; Social & Economic; and Land Management (refer Figure 12).

Figure 12: CCN and Working Group component of the community involvement framework



This approach was an evolution of the Stakeholder Reference Group (SRG) approach applied previously at Alcoa sites, including for the recent Pinjarra Refinery Efficiency Upgrade. The use of multiple, topic specific working groups allowed concurrent examination of issues, rather than one group needing to cover all topics. This provided increased opportunities for:

- working group members to focus on discussions relevant to their area/s of interest;
- working groups to examine a level of detail greater than what would have been practical with only one key consultation group;
- working group members to gain substantial knowledge about a particular topics of interests; and
- more detailed and focussed examination of issues in a set, limited timeframe.

The terms of reference of the working groups, which was agreed in the first meeting of each group, is contained in Appendix C.

The key elements of the working group process are described below:

CCN involvement

During the consultation for the ERMP, the CCN monitored the integrity of the consultation process to help ensure fairness, transparency, openness and inclusiveness. To enable this, working group reports were shared with the CCN at its monthly meetings, with a representative from each working group in attendance on most occasions to answer questions focussed on the engagement process. While the CCN is chaired by a community member, the independent facilitator led discussions relevant to the Proposal during CCN meetings for consistency of process.

Facilitation

Co-facilitation was recommended as the best methodology of meeting facilitation given the historical experience concerning the matters of discussion, the volume of information that needed to be exchanged, and the number and intensity of meetings planned. The co-facilitators worked as a team and were present for almost all meetings, with only occasional exceptions due only to lack of availability.

The use of co-facilitation ensured that the information needs of participants were met while also enabling ongoing monitoring and evaluation to ensure individual working group members participation needs were being met. The process involved regular debrief between co-facilitators and participants, within and after meetings, to assist the process to be continually responsive to the needs and feedback of working group members.

The co-facilitators were charged with ensuring that the consultation was fair, transparent and inclusive, while managing information flow within the identified project timeline. Their observations from working group meetings were a basis for advice to Alcoa representatives on how to provide information to working groups in a way that best met their needs. For example, presentations that were too long, poorly structured or provided too much detail were avoided.

Content

Each of the five working groups considered key aspects (including technical investigations) of the project relevant to their subject area and had an opportunity to provide feedback on how opportunities could be optimised and issues or concerns managed.

As part of this process the members reviewed specific initiatives including reports and environmental modelling used in the development of the ERMP. Questions and suggestions from working group members often challenged and directed studies and information provided in the ERMP. For example, members of the Water & Residue Working Group suggested water supply options for investigation by Alcoa that had not previously been identified.

To help familiarise working group members with Alcoa's operations they were offered a tour of the refinery and provided with a process overview document at the start of the process. A glossary of terms was also provided, which helped familiarise members with a variety of technical terms frequently used in the environmental assessment process.

Alcoa proposed an initial list of items for discussion during the consultation process, based on the technical investigations contributing to the ERMP. However, the process was open and flexible, enabling topics raised by the community to be considered and to allow for changes in timing of the preparation of key reports.

At the beginning of each meeting, following the noting of actions, the agenda for the meeting was agreed by the group. In most cases, key discussion topics were agreed at the previous meeting, but the process allowed any participant to raise a new item of discussion.

Given the limited time for the engagement in the lead up to the submission of the ERMP, some topics raised for discussion not relevant to the ERMP were 'parked' for discussion post-ERMP. How these will be approached in future discussions and the issue will be discussed at the workshop planned for working group and CCN members post ERMP submission.

In addition to the handouts and presentations made during the meetings, a library of other reports and documents of possible interest was also generated. Members were welcome to take information from the library to read and return. Alcoa answered questions and provided copies of documents to members on request. This recognised that a large number of reports were already available that may be of interest to members and relevant to the topics being discussed, examples include previous air quality monitoring studies and bauxite residue reports.

Full meeting reports that provide the details of the working group meetings including information covered are included in Appendix D.

Specialist input and expert review

Where relevant, Alcoa and specialist consultants were invited to attend meetings as observers to present specialist information. For example, CSIRO representatives attended the Health & Emissions Working Group to present information on the refinery modelling the organisation was commissioned to undertake for the ERMP.

In addition, the working groups were able to select an expert to independently review key reports for the ERMP. This process, in effect, allowed for a 'second opinion' on work commissioned by Alcoa for the ERMP.

To facilitate the process, Alcoa generated a list of three to four independent specialists in particular subject areas. Working group members were provided with the biographies of those identified and then the facilitators guided a process for working group members to select an independent expert reviewer.

Expert reviewer comments or findings were forwarded to consultants promptly so that the findings of the reviews could be considered by the consultants undertaking the original study and, where relevant, refinement of to the technical work could be made.

Broader community involvement

To enable broader community involvement in the process, meeting dates and locations were published in the Harvey Reporter along with the meeting outcomes.

The meeting advertisements invited community involvement. They highlighted that community members were welcome to attend any of the working group the meetings as observers and in this capacity could address the meeting through the facilitators.

Reporting & communication

An independent meeting reporter was present for all meetings. Meeting reports were generated on the basis of outcomes, issues or actions from the group. The reports also included process outcomes, including details of presentations made and major discussion topics (this was introduced midway through the consultation based on participant feedback), observer's present and future meeting dates and actions.

At the end of each meeting, the meeting reporter read out the report at which time participants could clarify or add to the notes made. Once the group was happy with a report, it was printed out and a participants' register circulated for signing to mark that each participant endorsed the meeting notes. During the course of the meetings, participants were encouraged to raise items they wanted reported as issues or outcomes.

The engagement was supported by communications aimed at keeping the broader community informed of progress. Transcripts of the outcomes of each working group meeting were published regularly in the Harvey-Leschenault Reporter and full meeting reports of each working group were published on the Alcoa website at www.alcoa.com/wagerup3. Full meeting reports were also made available in hard copy in files located at the Waroona Shire, library and telecentre; Yarloop library; and Harvey Shire, library and telecentre.

To supplement this, a compilation of the meeting outcomes was published in a newsletter distributed in December 2004. The newsletter was mailed to a broad range of stakeholders and made available in local communities. A second newsletter will be published with the Working Groups' Final Outcomes in April.

The details of the meetings for each working group are contained in Appendix D (table of meeting, handouts, issues, outcomes and actions). The final outcomes generated by each working group and Alcoa response are contained in section 6.4.

Alcoa input

The Alcoa team included a specialist representative on each working group. These people were active members of the working groups who contributed to discussions, delivered information, helped identify specialists to address the groups and assisted in the formation of group outcomes.

Alcoa members were supported by the consultation team leader and the Wagerup Unit Three project leader, both of whom were present for most working group meetings as observers. Alcoa technical specialists were also made available for working group meetings when specific technical studies were due for discussion or when working groups required further technical information or explanation.

6.2.3 Presentations and Briefings

Tailor-made briefings were provided to a range of stakeholders when the project was announced and during preparation of the ERMP.

Target Audience:	Employees	Government representatives
	Interest groups	Industry Stakeholders
	Media	
Level of Involvement:	Informing	

The Wagerup Refinery Manager and project representatives met with a range of stakeholders including employees, the Shire of Waroona, Shire of Harvey, City of Bunbury, City of Mandurah, Peel and South West Development Commissions, Peel Area Consultative Committee, the Murray Districts Business Association, Peel Chamber of Commerce, State and Federal politicians, the Peel Economic Development Unit, the CCN and relevant State government departments within the planning, environment, health and industry sectors and certain peak industry groups. Formal presentations made to stakeholder groups included:

The environmental assessment process;

- An overview of the Proposal;
- Diagrams showing structural changes to the Wagerup refinery as a result of the Proposal;
- An overview of Wagerup's current and potential position in the global market
- Alcoa's economic contribution to the local community and the State;
- Benefits of the Proposal;
- Community involvement and the process of stakeholder engagement, and;
- A stakeholder and approvals implementation schedule.

Employee Briefings

A series of briefing sessions were held at both the Wagerup Refinery and the Willowdale mine site to inform employees about the Proposal. These were held over a period of five weeks on rostered Utility Days (regular days set aside for training, briefings, reviews etc) to maximise the potential for employees from all shifts to attend. In total more than 250 employees attended presentations.

Government Agency Briefings

Meetings were held with key government agencies to provide briefings on the Proposal with opportunity for comment and input. Where appropriate this was conducted with both locally-based and Perth-based departments. In many instances these government agencies were briefed on more than one occasion and the Departments of Environment; Health; and Industry Resources were represented on relevant working groups.

Government agencies and politicians were also invited to tour the Wagerup refinery. The visit included a description of current operations and viewing of the areas within the refinery where new equipment would be installed as part of the Proposal.

Bunbury Port

Alcoa representatives attended meetings of the Bunbury Port consultation group on two occasions to discuss relevant aspects of the proposed expansion. In particular, information was provided on structural modifications to Alcoa's facility at the port and the impact of these changes on noise emissions from the facility. Please refer to section 7 and 8 for information on Bunbury Port.

Stakeholder Specific Briefings

Face-to-face meetings were held with representatives from local government authorities and various stakeholder groups during the preparation of this ERMP.

Personal meetings were held with the President and Chief Executive Officer of the Shires of Harvey and Waroona, the Mayor and the CEO of the City of Mandurah, Members of the Legislative Assembly for the Shire of Murray-Wellington, the President of the Legislative Council and the Greens Party. Briefings were also given to full council meetings for both the Shire of Harvey and Shire of Waroona.

Media briefings

Personal briefings were also given to local media (journalists and news program producers) in Harvey, Mandurah and Bunbury, as well as some key media in Perth. These briefings, which were repeated as information became available, were to ensure that media were kept informed about the scope of the project and involvement process, had access to current and accurate information and could contact Alcoa staff to ask questions at any time. A tour of Wagerup refinery was offered to local and State media attending the State Cabinet meeting in Harvey in August 2005 and an open invitation extended to all journalists to arrange personalised tours at their convenience.

6.2.4 Refinery Open Day and Community Information Displays

Over 1,000 people attended a Wagerup refinery Open Day during October 2004, which provided displays and demonstrations of many aspects of refinery and mine site operations, at current production levels and if the Proposal is implemented. This included guided tours of both the refinery and mine site.

Target Audience:	Neighbours	Government representative
	Employees	Industry Stakeholders
	Interest groups	Suppliers
	Broader public	
Level of Involvement:	Informing, consulting	

An Open Day was held at the Wagerup refinery on 10 October 2004 from 10am until 3pm to provide further information on the Proposal.

The event was widely advertised and letters were sent to key stakeholders including refinery neighbours, Shire of Harvey and Waroona community committees, local and metropolitan government agencies and local Members of Parliament.

An Alcoa attended display was also present at the Harvey and Waroona Shows in October and November, 2004. This provided additional opportunity for people from the broader region to consider key aspects of the proposal. Hundreds of people, some from Kwinana, Harvey, Waroona, Mandurah and Bunbury attended the fairs and viewed the display. A similar display with more current information was also present at the Harvey Harvest Fair and Waroona Autumn Fair in mid-March and early April 2005.

The displays provided information on the expansion, the proposed changes to the refinery infrastructure, the environmental approval process, mine site rehabilitation, current environmental issues and proposals to minimise potential impacts, current environmental technical modelling and monitoring techniques used. Staff from Alcoa's project team staff were on hand to answer questions and receive feedback. Contact sheets recorded community comments or issues raised.

Future displays are planned over coming months at the Wagerup refinery, Willowdale mine and within the towns of Waroona and Harvey. Displays are also featured at the Wagerup refinery and at Willowdale mine.

6.2.5 Broad Information Activities

Activities to provide information to the wider community included:

Newspaper editorial and advertising

Two series of advertisements in the local newspaper (over 17 weeks) to inform local communities about the expansion plans and the potential economic, social, benefits, the environmental studies being undertaken and how Alcoa would meet its public health and environmental undertakings.

In addition, a series of new releases were submitted to the local paper, providing information for a wide range of local community members.

WagerUPdate & Alcoa News

A monthly newsletter produced provided to a wide range of stakeholders via a mail drop to 3,500 local households and direct mail to 350 key stakeholders. An example WagerUpdate 7 is shown in Appendix E.

The bi-monthly internal newsletter Alcoa News also provided regular information on the project to the Alcoa employees in Western Australia.

Web site (www.alcoa.com/wagerup3)

A dedicated Wagerup Unit Three website containing the proceedings of all working group meetings and various aspects of project development. This is updated regularly.

Direct mail

Personalised letters were sent to members of the local community and employees during various stages of the project including its announcement and invitation to the Open Space Forum.

The involvement and communication activities have provided information about the project to a broad range of stakeholders via a range of channels including mail outs, presentations, advertising and newsletters and direct stakeholder participation.

6.3 FUTURE INVOLVEMENT

Alcoa has committed to continuing its communication and involvement activities beyond the submission of the ERMP. Stakeholders will continue to be informed of project developments via a range of communication channels including those adopted to date.

Additionally, Alcoa will continue to engage with the community using a framework designed to meet the needs of both the company and community members. It is intended that this will be determined at a workshop in May to bring together the community members engaged in the working group process to date.

An Information Day to provide an opportunity for a broad range of community members to meet face-to-face with Alcoa representatives to ask questions about topics of interest is among the communications to be carried out once the ERMP has been published. Another Refinery Open Day is planned to be held at Wagerup later in 2005.

6.4 FINAL OUTCOMES OF THE WORKING GROUPS

The following sections list the final outcomes from each Working Group's deliberations. These outcomes were developed by an iterative process of generation and review by members, during the final few meetings of each group. This process was facilitated by review of the topics, issues and outcomes of all meetings which led to the identification and framing of final outcomes. Sign-off of the groups' final outcomes occurred with those members present at the last meeting. A response from Alcoa to each outcome is provided, as well as identification of the section of the ERMP which deals with the topic. The words used in the outcomes are those of the working group members.

6.4.1 Emissions and Health Working Group Final Outcomes

We participated in this Working Group as individual community members rather than as community representatives.

- We considered the following topics:
- Wagerup refinery emissions – current state of knowledge
- Current health concerns in the community
- Meteorological and dispersion modelling for Wagerup Three (using TAPM – The Air Pollution Model)
- Expert review of TAPM
- Emissions reductions from previous engineering works at Wagerup
- Proposed emissions control for the expanded refinery
- Health Risk Assessment
  - Review of compound selection
  - Draft contours for current refinery and expanded scenarios (cogeneration and boilers).
- Removal of organic matter from bauxite
- Wagerup Action Plan recommendations
- Odour modelling

We acknowledge the useful dialogue and cooperative approach amongst members individually and with Alcoa personnel.

Due to the highly technical nature of the material, the Group referred much of the information supplied for expert comment and peer review.

We provide the following outcomes to Alcoa for consideration in the ERMP:

Working Group Final Outcomes	**Alcoa Response**
We note Alcoa's positive response to our request for a health survey and request that the scope of the survey be included in the ERMP. We ask that this be conducted by the Department of Health or an independent body with results to be overseen by the Department of Health. This survey should go ahead independent of the expansion.	Alcoa has committed to a local community health survey, should the project proceed, the scope of which has been included in this ERMP as requested (see section 8.3.11). Alcoa will advise the Department of Health of the Working Group's request regarding the implementation of the survey once the ERMP has been submitted. Alcoa notes the Working Group's request for the survey to go ahead independent of the expansion, however, Alcoa considers a main benefit of the survey is establishing a baseline prior to the expansion, if it is approved.
We request that the scope of the survey include: a. Quantifying health impacts within the community, including Multiple Chemical Sensitivity; b. Determining how much of the impact can be attributed to the Wagerup Refinery c. Defining the boundary around the Refinery that is unaffected (pre-expansion) and determining impact post-expansion. Some members requested that the survey be expanded to include people who have left the area so that long term health can be monitored and a register implemented.	The proposal for the health survey is included in section 8.3.11. The following addresses the points raised by the working group: a) The scope of the survey would include gathering data on the prevalence of chronic health conditions and several common symptoms including those often ascribed to multiple chemical sensitivity. Comparisons would then be made with State data. b) The proposed methodology is designed to detect associations between the likelihood of chronic health conditions and several factors including geographic location, health enhancing behaviours, health risk factors, socioeconomic status, psychological distress and demographic variables. The proposed methodology is also designed to detect associations between the likelihood of individual symptoms and the factors listed above.

Working Group Final Outcomes	**Alcoa Response**
	c) The methodology is designed to determine whether chronic health conditions or symptoms are associated with geographic location. People from Yarloop and nearby townships would be interviewed. It is possible that the influence of geographic location may differ among the townships. This might provide some indication of refinery influence, although would not be able to establish cause and effect. The survey would be intended to reflect the current situation and form a baseline for comparison following expansion. It is Alcoa's view that the inclusion of people who have left the area would not aid in these assessments.
Some members stated that the results of the health survey should be available prior to any approval for expansion. Some other members were sympathetic with this view but did not believe that the timeframe would be practical. These members also recognised health surveys to date have been of limited value in establishing a causal link.	Alcoa has committed to undertaking a health survey. It is Alcoa's belief that a comprehensive and useful survey could not be conducted in the timeframe available for assessment of this project, which is based on the project timeline which is aimed at meeting market demand for alumina in 2007/08.
A member raised the possibility of a number of pollution sources within the perched water table of the surrounding area that could be affecting the community. This member requests an environmental investigation be undertaken that could include a geochemical and water sampling program and refers this matter to the Department of	Alcoa is appreciative of the community member's efforts to research this possible scenario and Alcoa draws the Department of Environment's attention to this suggestion as part of this ERMP.

Working Group Final Outcomes	**Alcoa Response**
Environment.	
The Group accepted there have been overall reductions in emissions through engineering solutions since 1997.	There has been ongoing work to reduce emissions at Wagerup and Alcoa is committed to achieving further reductions where reasonably possible. The Proposal will enable some further reductions.
We request that the ERMP contain proposals that will result in a reduction in emissions impacts from already-identified process sources showing that Alcoa will be able to meet the commitment of 'no increase in noise, odour and dust impacts as a result of the expansion'. Some members have concern about the potential for Alcoa not meeting the commitment. Alcoa expressed it wants to be accountable to its commitment.	Alcoa is committed to meeting its objectives of no increase in noise, dust and odour impacts. Section 8 and the management plans outlines strategies to achieve this.
We are concerned that some people are affected by exposure to chemicals at levels that are less than the recommended safe levels. We request the HRA consultant to make some comment on levels of exposure and the range of chemicals that may affect sensitive people.	Alcoa notes the concern of the members of the Working Group and passed this information to the HRA consultant. Please refer to the full text of the HRA Appendix F which, as a result of the working group request, provides commentary on this issue.
A member of the Group investigated the feasibility of removal of organics from bauxite prior to entering Refinery processes and we accept that no further reduction in organics from components of the bauxite is practical and economical at this stage.	Removal of organics is has been a key research area for Alcoa. Alcoa appreciates the additional work of the community member who undertook this investigation. We believe this was been of benefit to other members of the Working Group.
We are concerned about the synergistic effects of chemical compounds. We understand that this is not assessed as part of the HRA and we believe this warrants further investigation. We note that the Department of Health is responding to this	Alcoa notes the concern of the members of the Working Group and passed this information to the HRA consultant. Please refer to the HRA in Appendix F where the issue is addressed.

Working Group Final Outcomes	**Alcoa Response**
issue from the report of the Standing Committee Inquiry. We request that the HRA consultant comment specifically on the issue of Multiple Chemical Sensitivity (MCS) and the synergistic effects of chemical compounds in the Health Risk Assessment (HRA). We acknowledge that he can give an opinion in terms of expertise and the information that is available to him, and that this would not be part of the assessment itself.	Alcoa will advise the Department of Health of the Group's interest in this area when the ERMP is submitted.
A member raised a concern that only 27 out of 261 compounds have been included in the HRA, and they have been selected on the basis of their most likely health impact. We request that the HRA consultant consider whether this list is appropriate.	Alcoa notes the concern of the member of the Working Group and passed this information to the HRA consultant. Please refer to the Air Quality Summary report substance selection report and HRA for further information - Appendix G and Appendix F respectively
We have studied the CSIRO Meteorological and Dispersion Modelling Using TAPM for Wagerup – Phase 1: Meteorology, Phase 2: Dispersion and Phase 3B: HRA (Health Risk Assessment) Concentration Modelling – Expanded Refinery Scenario, which encompass the emissions modelling for the refinery base and expansion cases. Presentations were given by CSIRO, the designers of TAPM (The Air Pollution Model) to the Working Group. These reports were submitted to expert review on our behalf and referred back to CSIRO, who made changes to the original drafts.	Please refer to sections 7.9 and 8.3 for further information on the CSIRO air quality reports.
We refer the air emissions expert review to Alcoa and request that all the matters raised by the expert reviewer be fully addressed, with particular focus on the following two recommendations, which: • "Strongly recommends the maximum exposed location outside Alcoa lease	Alcoa will work with the Department of Environment to determine appropriate actions to address the issues raised in the expert reviews. It is unlikely these will be complete before submission of the ERMP, however Alcoa

Working Group Final Outcomes	**Alcoa Response**
boundary is also presented and the change in impacts for the expansion assessed at this location". • "For the current operation of the refinery impacts in Yarloop, the modelling may have underestimated both short and long term maximum impacts, as data assimilation is not included. We recommend that such modelling be done with data assimilation". We note that the expert reviewer indicates that the question previous posed in the draft report 'is the model predicting the right answer for the right reason?' remains unanswered, suggesting that further verification of the model is required.	will inform the members of the Working Group of the outcomes, which can be fully addressed before a decision is made on the Proposal.
We request that CSIRO and the expert reviewer of the TAPM model comment in the ERMP on the effect and usefulness of the near-completed weather station on the Scarp on the air emissions modelling.	Alcoa recognises that more meteorological data will assist in further verification of the modelling. Please refer to Appendix G (Air Quality Summary Document) for details of the verification that has been taken to date. Alcoa has submitted this request to CSIRO and the expert reviewer and will provide the outcomes to the Working Group members.
Some members are disappointed that the imposed timeframe to contribute final outcomes to the ERMP has not enabled us to consider all the important information we need to assess, in particular the full HRA report and expert review of the HRA. We decided to meet again after the ERMP is submitted, but before its public release, to review these key documents. We request to receive hard copies and electronic	Alcoa recognises that the timeframe in place for the preparation of the ERMP and community input to the process have been challenging. Alcoa believes this Working Group process is one of the most comprehensive undertaken for a major project of this nature in Western Australia. Alcoa believes the process has allowed consultation over far more detailed components than would

Working Group Final Outcomes	**Alcoa Response**
copies of the relevant documents one week prior to our next meeting. We understand that any new outcomes generated by these discussions may be lodged to the EPA as a public submission by the Group during the 10-week public comment period.Ha	occur with a single consultation group. We acknowledge the dedication of the Working Group members who considered extensive technical information and are committed to ongoing consultation.
Some members believe there is a need and an opportunity to continue to meet to address health and emissions issues that this Group was originally set up to consider.	Alcoa will continue to consult and work with interested community members to develop an appropriate framework to consider items of community interest.
Some members of this Group believe that the Wagerup expansion should not proceed until the current outstanding emissions and health issues associated with Wagerup are resolved.	Alcoa acknowledges the concern of some members of the Working Group in this area. However, Alcoa believes the detailed studies undertaken as part of this ERMP, including the HRA, confirms that the Proposal can occur without causing health impacts.

6.4.2 Land Management Working Group Final Outcomes

We note that members of this Group are individuals working towards a solution for the community. We acknowledge that this Working Group is made up of different people seeking different outcomes, and we are not going to be able to address the diverse issues of all individuals. The end of the ERMP process is not the end of the role of the Land Management Working Group.

Working Group Final Outcomes	**Alcoa Response**
We believe that if Alcoa fails to meet its commitment "not to increase in noise, odour and dust impacts" then the Land Management Group would expect to revisit Alcoa's land management policy.	Alcoa is committed to meeting its objective to not increase noise, odour and dust impacts. The air quality management (section 8.3) and Noise management (section 8.4) components of this ERMP demonstrate how the proposal will meet these commitments. Alcoa supports continuing community involvement in relation to land management.
We believe that if increased emissions from an expanded refinery cause an increase in community impacts, then the Land Management Working Group would expect to revisit Alcoa's land management policy.	Please see the above response.
We will continue to examine issues associated with Alcoa's land purchase policy, including valuation methods used to determine market value until we have reached resolution. We will also examine issues affecting property owners outside Area A and B.	Alcoa supports community involvement in developing the land management strategy and will continue to be involved in the examination of these issues.
We agreed that the Baseline Valuations Study should be continued and be broadened to include broad acre and small farms.	Alcoa supports continuing the baseline study and the inclusion of broad acre and small farms. We have worked with members of the community to select the

Working Group Final Outcomes	**Alcoa Response**
	consultant to undertake this work.
We endorse Alcoa's commitment to continue negotiating on a case-by-case basis with property owners outside Areas A and B who believe they are impacted by Alcoa.	Noted.
The Group notes that as a result of discussions Alcoa extended its commitment to property owners in Area B.	Please refer to section 7.12 for further information about Alcoa's land management policy.
Some members of the Group were concerned about a question raised by an observer as to what processes are in place to ensure that decisions made in this Group have broad community support and how can community members provide feedback to the Group on its proposals to Alcoa.	Alcoa supports the need to keep the wider community informed about the deliberations of any community consultation or involvement program. Outcomes from the Land Management Working Group have been published in the Harvey Reporter and on the Alcoa website. Interested members of the community are welcome to attend Working Group meetings. Alcoa will work with the Working Group to develop additional communications if deemed necessary.
A member of this Group expressed the view that if Alcoa were not here then the concerns raised within this and other Working Groups would be redundant.	Alcoa notes this view.
We expect Alcoa to honour its expressed long-term commitment to see the towns of Yarloop & Hamel prosper.	Alcoa believes in the future of Yarloop and Hamel. Each are unique communities with qualities that make them attractive places to live. People have invested, and continue to invest in these communities and want to enjoy the lifestyle Yarloop and Hamel can bring. Our focus is on making sure that Alcoa's presence helps both communities grow and prosper, that we are a good neighbour, and that we are a supportive and responsible member of the community.

6.4.3 Noise and Transport Working Group Final Outcomes

In considering community concerns raised at the Open Space Forum and information on the proposed expansion provided by Alcoa, this Transport and Noise Working Group has discussed issues relating to transport and noise impacts linked to the proposed expansion. We recognise that some of the issues were outside the scope of the ERMP but were considered by the Group because of their importance to the local community. The following points outline the final outcomes of these discussions.

Working Group Final Outcomes - Noise	**Alcoa Response**
We believe that where it is reasonable and practicable, Alcoa should attempt to reduce noise levels further and not just maintain existing noise levels, as specified in Alcoa's commitment of 'no increase in noise impacts' for the proposed expansion.	Alcoa acknowledges the importance of this issue and is committed to noise reductions where reasonable and practicable. As part of this project, the company reviewed the feasibility of a further 4dB (A) overall reduction in the vicinity of the refinery. Based on an assessment of technical feasibility, cost and benefit, Alcoa believes further noise reduction is not reasonable or practicable. Please refer to section 7.14 for further information. .
A Working Group member suggested that it is reasonable and practicable for Alcoa to spend the estimated $21m to achieve a 4dB reduction for the current Refinery. The member believes this will avoid the need for a Regulation 17 variation. The member also believes that even if a Regulation 17 variation is successful, Alcoa should aim to come into compliance with the levels nominated in the Environmental Protection Noise Regulations (1997) by 2010.	Alcoa does not believe that the Wagerup refinery can come into full compliance with the Environmental Protection (Noise) Regulations, 1997. To achieve full compliance with the Regulations a 12 dB (A) reduction is required. Alcoa's believes this is impractical from a technical feasibility perspective; the technology does not exist to deliver this outcome and still have a practical, operable refinery. Assessment has indicated that achieving a 4 dB (A) reduction is not reasonable or practicable.

Working Group Final Outcomes - Noise	**Alcoa Response**
	Please refer to section 7.14 for further information.
We acknowledge that Alcoa is trialling alternative noise monitoring technologies and request it continues to investigate alternative technologies appropriate to the Wagerup surrounds, to provide the most meaningful data. We understand that noise monitoring is being reviewed in consultation with the Tripartite Group. We received a draft version of the Noise Management Plan, which outlines the process from design through to construction, commissioning and operations for achieving project noise emission criteria. We understand and have an expectation that the ERMP will include it in its final form.	As part of its ongoing noise management plan Alcoa has committed to investigate alternative monitoring technologies, where appropriate and relevant to the refinery. Most recently this has included a trial of directional noise monitoring technology, the results of which have been shared with the Tripartite Group. This work will continue, consistent with the intent of the working group request. Please refer to section 10 (Noise Management Plan – ongoing monitoring) for further information.
In our deliberations we've queried the accuracy and limitations of the existing Wagerup noise model. We sent information on the model set-up and the model validation process undertaken to date to an acoustics expert for peer-review. We expect that the expert review will be addressed in the relevant section of the ERMP. Some members request the ERMP specifically address verification of the data that has been collected and used in the modelling process, to confirm the accuracy of the noise model. We recognise that the initial modelling has been undertaken early in the design phase and this has been advantageous as it set a framework for detailed design. The	The expert review the working group refers to specifically focused on revisions C and D of the Noise Model Development Report and the Noise Strategy document respectively. Alcoa and the noise consultants considered the suggestions made by the reviewer and modified the report content accordingly. While not overtly identified, where relevant the suggestions made by the reviewer have been addressed in subsequent revisions of the Noise Model Development Report (Appendix H) and the Noise Strategy document (refer to Appendix I). Alcoa believes that the model inputs used for the ERMP noise modelling are accurate as they have been reviewed by the Department of Environment and by SVT acoustic consultants (commissioned by DoE in 2002) as part of the Regulation 17 application.

Working Group Final Outcomes - Noise	**Alcoa Response**
modelling and peer review process has given the majority of members confidence that the initial work regarding noise management for the Wagerup 3 expansion is reasonable. We understand that the noise model will be reviewed as detailed design progresses. We believe this is important.	While these reviews did not specifically involve the re-measurement of source inputs, far field validation data confirmed that the model is operating to a +/- 3 dB (A) accuracy. This is considered to be within the normal range of accuracy for acoustic models. Further, as part of the expert review, information on the model validation process was provided to the expert reviewer. This compared field measurements to model predictions. On the basis of this document, the expert reviewer concluded that "the noise model is appropriate and . . . validation of the model appears to support this." Please refer to section 7.14 for further information. Please refer to Appendix J for the expert review document and Appendix H for the Noise Model Development Report. As part of the ongoing Noise Management Plan Alcoa will revise and review the acoustic model for the Wagerup expansion proposal during the detailed design, construction, commissioning and operational phases. Please refer to section 10 for the Noise Management Plan.
We recognise that there are areas in the vicinity of the Refinery where the Refinery is in compliance with the Environmental Noise Regulations, but the noise experienced could be a nuisance to some.	Noted.

Working Group Final Outcomes - Noise	**Alcoa Response**
We request the Mining Management Program Liaison Group (MMPLG) consult with neighbours and the broader community about the potential impacts, including noise and transport, from the proposed Larego minesite.	Alcoa is committed to working with the community on the proposed plans for Willowdale mine in relation to the Proposal. Informative displays are planned for various community events throughout the year and information sessions will be provided to interested community members. Willowdale mine neighbours are being consulted on the proposed expansion plans through visits, phone calls and information mail-outs. Neighbours are being encouraged to discuss any questions or concerns they may have relating to the proposed changes with mining representatives. Alcoa also intends to consult the local shires of Waroona and Harvey for their feedback on the proposed plans. An invitation was recently extended to the members of the Working Groups to tour the Willowdale mine. Five members toured the Willowdale mine and discussed the associated plans for the Larego mining region with positive feedback received from the attending members. Free public tours of the Willowdale mine and Wagerup refinery will commence in April. It is hoped that the positive results experienced at the Huntly mine and Pinjarra refinery through public tours providing information and education will assist in further addressing these concerns.
A member of the Group raised particular concerns about whether Alcoa's current blasting management practices are adequate to minimise the impacts on surrounding residents.	Alcoa recognises the requirements of the Environmental Protection (Noise) Regulations (1997) and has established a noise management procedure for mining operations in the vicinity of noise sensitive premises.

Working Group Final Outcomes - Noise	**Alcoa Response**
	The Blast Acoustic Modelling (BAM) system continues to form the basis for predicting noise impacts from cap-rock blasting at the mine. The predictive BAM model is used to assess whether conditions will allow a blast within the noise limit. Blast noise levels are monitored in potentially sensitive locations using hand-held monitors. The main blast is preceded by a pilot-shot and if adverse noise levels are recorded the blast is postponed. Alcoa applies internal noise limits, which are lower than regulatory standards, of 115dB for every blast. Monitoring of Willowdale blasts has shown that the 115 dB internal target was not exceeded for the 87 blasts during 2004 and the 20 blasts year to date in 2005 and by definition no blast exceeded the legal limits. Efforts are continuing to find viable methods to continue to reduce the impact of blasting on neighbours.
Transport	
We believe there is community concern about the South West Highway and its ability to handle current and future traffic, and associated issues of general amenity and safety, capacity and congestion through towns. The Government's commitment to upgrade the Highway should be implemented as a matter of priority.	Alcoa will advise government of this request when the ERMP is submitted.
We request that Alcoa always consider community concerns when dealing with rail transport issues.	Although rail transport is controlled and operated by others, Alcoa is conscious of the concerns of some community members regarding rail transport and has considered these through the consultation process for the ERMP and in relevant decision making for the proposed expansion.

Working Group Final Outcomes - Noise	**Alcoa Response**
We support in principle the Government's intention to transfer freight from road to rail, but it must address community concerns in relation to current and future rail impacts, both environmental and social.	Alcoa will advise government of this request when the ERMP is submitted.
A number of rail noise and associated issues were raised in the Open Space Forum and these important issues have been deliberated in this group. We worked with Alcoa to identify the potential increased rail traffic as a result of the expansion at Wagerup and we requested and reviewed a train noise study to ascertain the noise levels of trains in Yarloop. We also met with representatives from the Australian Railroad Group to discuss the following issues: • Relocating the rail line, • Location of lay by areas, • Rail crossing noise ('clickety clack'), • Rail gradient, • Train horn noise, • Train scheduling opportunities to minimise impacts, • Having longer trains vs more trains, • Choice of locomotives (selection of old vs new locomotives), • Bigger wagons or changing wagons and • Maintenance issues. We recognise most of these issues are outside the scope of the ERMP and therefore we draw these matters to the attention of the Department of Environment for referral to the appropriate government authority for further investigation. We remain concerned about the impacts from current and future rail traffic on the South West	Alcoa is aware of community concern about issues surrounding rail traffic on the South West main line. This was an important issue raised at the Open Forum held in October 2004. Alcoa is committed to working with the rail transport providers and relevant government departments on this issue and wherever practical will encourage improvements via the rail transport providers Rail traffic and rail noise are discussed in sections 7.14 and 8.4 respectively. Alcoa draws DoE's attention to this issue raised during the ERMP consultation.

Working Group Final Outcomes - Noise	**Alcoa Response**
main line, resulting from Alcoa and other operations.	
We request that Alcoa prepare a Traffic Management Plan that covers the construction phase to minimise impact on the community, including consideration of alternate transport routes for heavy vehicles to bypass towns. The Plan should be monitored and reviewed as necessary.	Agreed. A traffic management plan will be developed and managed in conjunction with the relevant stakeholders should the project proceed. It is anticipated that a suitably skilled person will be appointed as Transport Coordinator to manage this process.
We request Alcoa ensure that the estimated road traffic projections related to the proposal are as accurate as possible. Any assumptions behind these projections and the categories they relate to must be clearly presented in the ERMP, to enable the potential impacts to be determined and understood.	Alcoa acknowledges this request. Road traffic projections detailed in section 7.17 and 8.8 are based on current knowledge and previous experience with expansion projects
We request that Alcoa measure traffic movements before, during and after construction, then assess the significance of these numbers (in particular of heavy loads) and adjust the Traffic Management Plan as necessary. We expect that the traffic numbers and any revised plan will be passed on to the relevant local authorities, particularly the local police and the Shires.	Alcoa recognises the importance of traffic management to local communities and in response to this request will monitor traffic entering the refinery via the main access road before, during and after construction. Data gathered from this process will be used as an input to traffic management at the refinery and be shared with the relevant authorities.

6.4.4 Social and Economic Working Group Final Outcomes

We acknowledge the main purpose for convening this Working Group was to collaboratively examine and develop opportunities, initiatives and strategies that relate to the socio-economic outcomes of the ERMP. We note that social and economic factors do not feature heavily in the ERMP and recognise there is potential for this Group to continue past the ERMP process.

At the first meeting we set ourselves the following objectives:

- To provide a process to bring people together to foster community pride and participation.
- To give local people hope through priority in employment and training opportunities.
- To provide a process to identify and implement facilities and service delivery in our communities to meet current and future needs.
- To identify the need and put forward ideas and options for improved social outcomes, including for residents who are impacted by Alcoa's operations.
- To increase participation, especially by the youth and mature-aged, in identifying social and economic options for the region.
- To promote economic activities for long-term sustainability that are not reliant on Alcoa.
- To identify and promote skill-building opportunities for the region (community, industry and government).
- To identify needs and options, and develop a strategy for improved education opportunities in the region, with Wagerup Three as a possible catalyst.

The Social and Economic Working Group outcomes for the ERMP have been developed from within this Group. While they may have some shortcomings, these outcomes have been prepared to the best of our ability in the time available.

Working Group Final Outcomes	**Alcoa Response**
We encourage Alcoa to embrace and help develop new initiatives in community partnership that could be a best practice blueprint for all future developments. We suggest that Alcoa, community, Government and other interested parties engage in further productive discussion regarding the following: a. Seeking out and listening to social and business entrepreneurs, particularly in communities adjacent to the Refinery, with the aim of i. Active engagement with local community and business groups, such as Chambers of Commerce; and ii. Finding local solutions to local problems. b. Infrastructure projects in the communities immediately adjacent to the Refinery (eg., deep sewage, gas, health services, police, street lighting, welfare, education, communications i.e. broadband, tourism, recreation, road upgrades). We feel that the unique problems in Yarloop should be specifically addressed. We also request an urgent audit of all Government services in the Waroona and Harvey Shires. c. Improved health services in the communities surrounding the Refinery. d. Capturing the great opportunity for training and capacity building to meet current and future needs of the nation including, but not limited to, the mining industry. This should evolve into long-term sustainable industry for the region through, e.g. traineeships, apprenticeships and possible School of Mines. e. Community concern that banks are not accepting some local property assets as security for loans.	Alcoa will assist in development of new initiatives that will improve upon partnerships already in place. Alcoa is building on past learnings, particularly from those learnt during the community consultation for the Pinjarra Efficiency Upgrade and will be developing an internal learning package to help transfer these learnings through the organisation. Alcoa has recently produced a socio-economic document as a starting point for consultation which includes ideas for future partnerships, specifically about a new funding partnership for the region. This is a new initiative that is best practice. a. Alcoa has a long history of involvement in local community and business groups and is committed to continuing involvement where appropriate. The Waroona Community Marketing group, Waroona Community Centre and Yarloop Progress Group Inc are examples of organisations we have been or still are involved with. Alcoa is also a member of a local fabricators forum that is supporting regional fabrication businesses. b. Alcoa recognises that infrastructure and services are of key importance to the community and will continue to work in partnership with the relevant stakeholders on this issue. Funding provided by Alcoa through the Community Development Fund ($2 million), sponsorship & donation program and Alcoa Foundation has already provided support to a range of tourism, community development, education and technology initiatives. We are currently investigating ways to help introduce broadband to the area and this is discussed in the document referenced above. We will advise Government of this Outcome when the ERMP is submitted.

Working Group Final Outcomes	**Alcoa Response**
f. Some member's suggested relocation of Alcoa's head office to Yarloop as a demonstration of Alcoa's confidence and commitment to the community. This would be a great opportunity to revitalise the area.	c. We will advise Government of this Outcome when the ERMP is submitted. d. Alcoa's commitment to training and education is discussed below in detail in response to another Outcome from this Working Group. e. Alcoa will seek appointments to brief local banks on the Wagerup Unit Three project and its commitment to the local area once the ERMP is submitted. f. Alcoa is currently investigating the feasibility of relocating some functions of its head office from the Perth metropolitan area to a location in the Peel region. Among the options being considered were the three refineries, but a significant decision-making criteria was a community presence. Details will be available in early May 2005. Alcoa is committed to supporting Yarloop, through measures such as the $1.5 million development fund, through the investment of millions of dollars in reducing emissions from the Wagerup refinery, by extending the offer to purchase land from 'Area B', and has committed to not increase odour, noise or dust impacts from the refinery. Alcoa supports efforts that ensure a strong future for the region. The proposed new regional fund for support of sustainable projects and programs, and the idea of a learning and enterprise centre in the region, are both being put forward to be discussed in the region over the next few months. We hope the community will engage with us in discussing these ideas and together support Yarloop and the towns surrounding the Wagerup refinery.

Working Group Final Outcomes	**Alcoa Response**
The community members of the Group note the participation of government and Alcoa representatives on the Group has been useful and would like to see this support continue. We believe that this Group would have benefited from the participation of local government.	Alcoa is appreciative of the input and time dedicated by all participants during this process. Alcoa will highlight this outcome to government when the ERMP is submitted.
We recommend strong agreements be put in place between Alcoa, State Government and Local Government to ensure immediate and neighbouring communities gain some direct benefit from the income stream generated by the mining and processing activity conducted in their communities.	Alcoa's State Agreement Act (Alumina Refinery (Wagerup) Agreement and Acts 1978) contains requirements for it to support town development. Alcoa is seeking to work with State Government, local shires and members of the community in development of a new model of funding into the region, which is linked to production of the refinery. If agreed upon it will provide for long-term funding of sustainable projects into the region. The socio-economic document has additional information.
We believe there is a need to promote economic activities for long-term sustainability that are not reliant on Alcoa. We believe the increase in economic activity may reduce the high incidence of crime in the area.	Alcoa is supportive of sustainable business growth in the region, and will support ongoing economic development activities as being planned by some members of the Social & Economic Working Group. This support includes development of businesses that are not linked with Alcoa's operations.
We recognise there are social and economic opportunities the Wagerup expansion may provide to communities. Further, there are those opportunities that need to be considered regardless of any expansion. We would like to develop leadership in the wider community and within this Group. As this work evolves, we welcome participation from community members and local shire representatives.	Alcoa supports the ongoing activities being generated by members of this group that contribute to leadership development in this region. A recent initiative to reflect this is support for a South West Leadership Forum and Awards later this year. As part of its support for the Forum Alcoa will offer places to the Forum for some community members.
We believe that building and strengthening existing community organisations to contribute to local sustainability is important to consider alongside community development initiatives. We also consider it important that access to the appropriate support is available when requested by an organisation.	Alcoa has supported work commenced by ECU in 2002, and now under the direction of the Yarloop Learning and Drop-in Centre, aimed at building capacity of people and businesses in the areas to assist them to contribute to local sustainability initiatives. This is an example of Alcoa's commitment in this area. We will work with or support other initiatives that build capacity in the region.

Working Group Final Outcomes	**Alcoa Response**
We recognise the need to increase participation, especially by the youth and aged, in identifying social and economic options for the region. We also suggest Alcoa employ local youth, disadvantaged, and mature-age unemployed as well as people from culturally and linguistically diverse (CALD) backgrounds.	Alcoa recognises the need for workplace diversity to provide opportunities for youth and for mature-aged workers. We currently offer work placement and work experience positions for over 100 young high school students every year, including the Future Women of Industry Program and 'Work @9'. We have also developed accredited training and employment programs in the form of traineeships for: ⇒ the long term unemployed (Mining Traineeships) ⇒ indigenous people (Landcare and Heritage/Guiding Traineeships) ⇒ mature-aged people (Powerhouse Controller and Beef Cattle Production Traineeships) ⇒ School students (Metals and Engineering, Automotive and Clerical Administration school-based Traineeships). The Wagerup refinery has previously provided accredited training for people with disabilities. Its workforce comprises a range of people from diverse cultures and backgrounds. Alcoa will continue to strive for diversity in its workforce by offering employment and training opportunities to a wide cross section of the community.
We suggest the following education and training opportunities be addressed or assisted by Alcoa: • Improved understanding of the importance of regional needs for training and development; • Take into account the factors that are different for Wagerup (compared to Pinjarra), particularly the shortage of skills and capacity; • Consider increasing number of apprentices, particularly mature-age workers, if the refinery expansion goes ahead;	Alcoa agrees education and training opportunities - for youth, mature-aged workers, and for Alcoa's current employees - are very important. Alcoa has a history of involvement in business–education partnerships including WHEB (Waroona Harvey Education Business Partnership) and the Kwinana Industries Education Partnership. These partnerships assist in developing an understanding of regional training and development needs. We also stay connected to the training and development needs at a local, state and national level through our membership on community organisations such as

Working Group Final Outcomes	**Alcoa Response**
• • Run improved programs for mature-age students who are interested in various tertiary study pathways; • Provide retraining for mature-age workers and recognise prior learning; • Enhancing and facilitating access to apprenticeship schemes is vital, particularly preferential treatment towards young people; • Improved connections between Alcoa and learning institutions; • Potential for a school of mines as part of the objective to 'promote long term economic sustainability', servicing this area and Australia.	Fairbridge WA and peak training organisations such as the WA State Training Board, Training Accreditation Council of WA, Chamber of Commerce and Industry's Education and Training Committee and WA Minerals Training Council. The involvement of Alcoa's managers in local chambers of commerce, service organisations, shire council committees and organisations such as the Peel Development Commission provide an important insight to the local community needs in this area. Alcoa is seeking to commence consultation on an idea around a learning and enterprise centre. The education and training opportunities listed in this Outcome will form the basis of detailed research and consultation into the Centre, initially through May – July 2005. Research and local consultation will result in better understanding of the educational and training needs of the local area, which will be an important decision-making tool for educational institutions the Department of Education, the community and Alcoa. The suggested 'School of Mines' Outcome can be discussed in the context of the education and training needs of the region, as above. Further information on this learning and enterprise Centre Idea can be found in Alcoa's socio-economic document. Alcoa is the largest private employer on apprentices in the Peel region. Alcoa continues to enhance and improve on its training and apprenticeship programs, particularly in recognition of the skills shortage which is affecting all of Western Australia. Facilitating access to upskilling and retraining for people in the region will be important for the ongoing sustainability of the region and something Alcoa is addressing as part of its $19million spend on programs every year.
A member suggests that, should the refinery expansion occur, Waroona District High School be upgraded to a Year 12 School to cater for extra children that may move	Alcoa will advise government of this request when the ERMP is submitted.

Working Group Final Outcomes	**Alcoa Response**
into the area. This upgrade should incorporate best practices in both core and vocational subjects that can be provided to students.	
During the course of the Working Group deliberations, a member wrote to the Minister for Environment asking "why the assessment for the Wagerup Refinery 3 expansion is only based on the potential for significant environmental impact but not on the significant impact on the people living in the surrounding communities" and did not receive a clear response. Some members feel that social impacts should be included in the scope of this and future ERMPs.	Alcoa notes the concerns of some Working Group members about the level examination of social impacts in the ERMP. Alcoa is aware that its operations have had an impact on the social structure of the local community in the past and has implemented projects such as the Edith Cowan University partnership and sponsorship of the Waroona Family and Youth Support Service as well as support for the Yarloop Primary School to help to address this. Alcoa will continue to work with the community to identify and implement projects to address social impacts. Please see section 7.15 and 8.17 for a discussion on the social aspects of the local area.
Some members of this Group strongly request that Alcoa enhance current reporting methods by incorporating Triple Bottom Line (environment, economic, social). In particular, these members believe that significant improvements can be made in the social component.	Alcoa's annual Sustainability Report incorporates best practice economic, environmental and social reporting, both quantitative and qualitative ways. The sustainability report content and format is reviewed each year. The 2004 report is currently in final stages of preparation. For the next review at the end of 2005, Triple Bottom Line reporting methods will be considered with particular emphasis on the social component. Please refer to section 8.1 more information about Alcoa's sustainability principles with particular focus on the Proposal.
A member of this Group believes continuous evaluation throughout this consultation	The use of co-facilitation of working group meetings ensured that the information

Working Group Final Outcomes	**Alcoa Response**
process would have added value to the process.	needs of participants were met while also enabling ongoing monitoring and evaluation to ensure individual working group member's participation needs were being met. The process involved regular debrief between co-facilitators and participants, within and after meetings, to assist the process to be continually responsive to the needs and feedback of working group members. Please refer to section 6.2 for more information on meeting facilitation.
The majority of Group members felt reassured by the outcomes of the Health Risk Assessment and able to plan for the future with more confidence. a. We believe that Alcoa should strive to continuously improve and remain at the forefront of current standards. b. A member of the Group also encouraged Alcoa to embrace Health Impact Assessment, which includes a Health Risk Assessment and a social assessment.	Alcoa is pleased that the Health Risk Assessment has provided reassurance to members of the Working Group. a. Alcoa has a policy of continuous improvement and aims to remain at the forefront of current standards. Alcoa believes that recent improvements to the Wagerup refinery mean it is the most environmentally advanced alumina refinery in the world. b. The scop of the ERMP included a Health Risk Assessment (HRA). It is Alcoa's understanding health impact assessment (HIA) is a methodology the government may consider for major projects in the future.
Qest Consulting presented the background, process and findings of the public safety risk assessment for the proposed Wagerup expansion. We heard that hazards are largely of a dangerous-chemicals nature or a process-hazard nature. We note that the Wagerup Refinery is not a major hazard facility by Australian standards, as Alcoa does not store these chemicals in large enough quantities to be classified as such. There are Government regulations in place that require Alcoa manage impacts on site. We advise Alcoa to work with the Local Emergency Management Advisory Committee (LEMAC) in management of public safety risk.	The Wagerup refinery health and safety manager is a member of Waroona LEMAC and Alcoa will continue to work with the group through this relationship. Public safety risk is discussed in section 8.9.

Working Group Final Outcomes	**Alcoa Response**
We recommend that the Local Emergency Management Advisory Committee (LEMAC) and the police services be made aware of Alcoa's expansion plans and the increased numbers of people in the area to address potential problems.	The Waroona Police have been involved in the proposed expansion through involvement on the Transport & Noise Working Group, where the impacts of additional traffic were discussed. Information presented to the Social & Economic Working Group about the increased workforce – construction and permanent – has also been provided to the Waroona Police. This information will be provided to the Yarloop Police and Shires of Harvey and Waroona.
We ask Alcoa to encourage their employees to become involved in emergency services. We believe voluntary emergency service personnel should be treated similarly to army reserves, in that they are not penalised for being involved in an emergency callout. We recognise this as a local issue with Alcoa and request a change in company policy, within reason, to allow employees to attend emergency training courses and callouts on company time.	Alcoa supports employee volunteerism in the community and recognises the contribution its employees make to the emergency services. This is actively promoted through the Alcoa Foundation that provides grants to the organisations to which employees who volunteer their time. In 2004, Alcoa employees contributed more than 70,000 volunteer hours to local community organisations. As part of this, more than 120 emergency services organisations received funding through the Alcoa Foundation. Alcoa's Special Leave Policy covers Reservist leave and has been applied to employees providing volunteer emergency services in the past. For example Wagerup employees were recently involved in the bush fire fighting effort in the Perth hills. Application of the policy for this purpose is at the discretion of the site manager and/or relevant supervisor who can determine whether or not employees can be released.
We note that hospital and emergency services in the region are in decline and not able to cope with current needs: a. We recommend to Government that emergency services be upgraded	Alcoa is aware of this issue as a user of hospital emergency services and through its past involvement in the Shire of Harvey Community Health Services Strategy Group. Alcoa will advise the Department of Health of this outcome when the ERMP is

Working Group Final Outcomes	**Alcoa Response**
prior to any expansion, to cater for the influx of people to the region during and after the expansion; b. We specifically request the Yarloop, Pinjarra and Harvey Hospital's be upgraded before the implementation of Wagerup Stage 3; and c. We request that the local Community Clinic at Yarloop hospital be re-opened.	submitted.
We understand there is a lack of support for people with mental health issues in the surrounding communities and this needs to be addressed immediately by State Government. a. We suggest that a crisis centre be included in hospital upgrades. b. We believe a specialised psychiatric ward should be available in the region, preferably Mandurah or Bunbury. While agreeing, one member would rather have the Mental Health ward located in Pinjarra, Yarloop or Harvey.	Alcoa financially supports the Family and Youth Support Service in Waroona in partnership with the Department for Community Development. This addresses a range of issues including people's ability to cope in the community. We recognise the community's concerns about this matter. We will advise the Department of Health of this outcome when the ERMP is submitted.
We recommend Alcoa, community and government work together to manage the issues associated with any construction and construction workforce. Some of the issues to be addressed include: • Construction impacts e.g. noise, traffic, reduced services such as police, health care; • Anti-social behaviour and crime potentially associated with the construction workforce; • Accommodation and potential impact of an influx of people; • Harnessing the increased economic activity; • Up-skilling and retraining of local labour, including mature-aged apprenticeships. • Impact of requirement of a large construction workforce on other regional industries.	Alcoa will be seeking to work with Government, community members and other relevant stakeholders to manage any issues associated with a construction workforce, and maximise benefits and opportunities that would arise from having additional people in the area, should the expansion proceed. To date, the Waroona police have received information on increased traffic and workforce to assist with planning. The Shires have been briefed on the increased workforce and where requested local businesses have been provided with relevant information to assist with planning. A series of briefings is planned to take place following submission of the ERMP which will provide additional information to relevant stakeholders.

Working Group Final Outcomes	**Alcoa Response**
• Industrial land for new businesses to move into the area and expansion of existing businesses.	Please see sections 8.8 and 8.17 for details of construction traffic and workforce.
We overviewed a range of accommodation options for the construction-related workforce and recognise there are more opportunities to be identified. We are keen to continue to develop business opportunities with both the private sector and community. We also note that in the current State Agreement Act, Alcoa is required to provide accommodation for its construction workforce.	Alcoa is also keen to assist the community in harnessing any opportunities which arise from construction workforce. In research undertaken, it is not anticipated additional accommodation will be required to house a peak construction workforce of approximately 1600.
We endorse Alcoa's Local Content and Local Procurement Policy, and encourage Alcoa and interested stakeholders to expand this across the Peel and South West regions. We recommend that: • Local procurement managers be placed in the region; • A local outlet for employment be established (i.e. like Murray House in Pinjarra); and • Local contractors should be given longer contracts so they have the chance to expand and plan for their growth.	The Local Content and Local Procurement Policy will continue to apply for the construction of Wagerup Unit Three and a procurement manager will oversee implementation of this policy. Alcoa acknowledges it is difficult for people in local towns to travel long distances to register their interest with employment agencies or contract employers not located in the vicinity. We will explore the idea of a new facility or utilising an existing facility to encourage local employment. Alcoa acknowledges that businesses are better able to plan if they have an understanding of Alcoa's requirements and the security of longer contracts. Where possible Alcoa will put in place longer contracts to meet this need, dependent on the nature of the commodity or service being provided, and the current and predicted market conditions.
We suggest that for future residential development in the region, there is a requirement upon the development for fully serviced lots.	Alcoa understands that the Pinjarra to Brunswick Sustainable Community Study includes a recommendation about local serviced residential land. This outcome will be provided to Government when the ERMP is submitted.
We suggest that for future business development in the region, there is a requirement	Alcoa is working with the Shire of Waroona about the possible use of Alcoa owned

Working Group Final Outcomes	**Alcoa Response**
upon fully serviced industrial land to be made available.	land for a light industrial area. Alcoa understands that the Pinjarra to Brunswick Sustainable Community Study includes a recommendation about local serviced industrial land. This outcome will be provided to Government when the ERMP is submitted.
We decided not to examine the visual amenity plan for the ERMP in detail, given the extensive agenda we have already set, and that Alcoa generally has a good record regarding visual screening and so believe this is being adequately addressed by the Company. We are relying on the Residue and Water Working Group to have fully investigated visual amenity of the Residue Drying Areas (RDAs).	The Water & Residue Working Group considered visual amenity for the residue areas and have generated a final outcomes on the topic (see section 6.4.5). Visual amenity is discussed in detail in section 7.18 and 8.15.
We acknowledge community concern about uncertainty of future land use (e.g. 'buffer') in the area surrounding Wagerup refinery. We recommend that this be clarified and communicated more effectively to the public. We are concerned that the following questions are still active in the community and request this be addressed immediately: a. Are the towns of Hamel and Yarloop going to be moved and if so where would they be moved to? b. With Wagerup 3, what is the life of the Refinery? c. If Wagerup 3 is a result of an increased need for alumina, is there a foreseeable need for 'Wagerup 4? d. Will recreation areas be closed as a result of mining expansion (i.e. access to the forest)? e. What happens to former recreation areas when mining is finished and how do people find out about this?	Alcoa has been discussing its land management plan with the Land Management Working Group. a. Alcoa believes in the future of Yarloop and Hamel. Both are unique communities with qualities that make them attractive places to live. People have invested, and continue to invest in these communities and want to enjoy the lifestyle Yarloop and Hamel can bring. Our focus is on making sure that Alcoa's presence helps both communities grow and prosper, that we are a good neighbour, and that we are a supportive and responsible member of the community. b. The life of the Wagerup refinery is based, in part, on known bauxite resources in the Darling Range, and on access to those resources. There are sufficient known bauxite reserves in the Darling Range to supply an expanded Wagerup

Working Group Final Outcomes	**Alcoa Response**
f. Does the State Industrial Buffer Policy have any impact on surrounding towns as a result of the current refinery and future expansion? These questions are important to communicate for common understanding.	refinery for at least the term of Alcoa's Mineral Lease 1SA, which provides Alcoa exclusive rights to mine bauxite within the lease until 2045. c. There is no foreseeable need for Wagerup Unit Four. d. Areas of forest surrounding the Larego crusher location and the associated mining envelope will have restricted access to ensure safe and effective operations. Consideration must also be given to dieback and water catchment management in relation to public access within certain areas of state forest. e. In consultation with CALM and the Water Corporation, previously closed tracks and forest roads in the Arundel mining region can be progressively reopened when the rehabilitation of adjacent mining areas is sufficiently established. Alcoa is currently investigating opening up to the public rehabilitated areas within the previous Arundel Mining Envelope. Local communities can be kept informed through information mail-outs and public notices. f. The State Government currently has two DRAFT buffer policy documents in circulation – one from the WA Planning Commission (Department of Planning and Infrastructure) and another from the Environmental Protection Authority. Questions concerning DRAFT State Industrial Buffer Policy will be referred to Government.
We acknowledge that the community is often unaware of key factual issues relating to the Refinery and operations (such as public safety risk, water use, train noise etc), and it would mutually benefit Alcoa and the community if a more effective communication strategy was developed. We believe Alcoa should continue to	Alcoa accepts this Outcome and also recognises that there is often a lack of understanding among community members about certain issues relating to the refinery. Alcoa appreciates the opportunity the Working Group and other consultation processes allow to provide accurate information to interested community

Working Group Final Outcomes	**Alcoa Response**
improve overall transparency and communication with the public.	members. A series of fact sheets will be produced for distribution in the community based on the key issues identified by the community members through the Working Group process. In addition, an Information Day is being planned for June 2005. This will provide information to the wider communities about issues which arose during the Working Group process.

6.4.5 Water and Residue Working Group Final Outcomes

We participated in this Working Group as community members rather than as community representatives. We noted that the meetings expressed a positive, constructive and creative attitude.

We acknowledge that expert advice was received, made freely available, with specific requests being comprehensively addressed. We thank Alcoa staff, external consultants, and our facilitators, Leigh and Bradley. Increased respect and understanding has developed amongst Group members through this process.

After considering and discussing the information provided, we generated the following outcomes:

Working Group Final Outcomes	Alcoa Response
We request that the assumptions, data and models provided by Alcoa relating to residue for the ERMP are reviewed independently.	Agreed. A number of key reports contained in the ERMP including the air quality modelling and Health Risk Assessment have been subject to independent expert review. Please refer to Sections 7.9 and 8.3 for discussion on the air quality modelling, Health Risk Assessment and independent reviews. Full reviews are contained in Appendix J, L and M. In addition, data inputs used in the modelling have been subject to internal and external review as part of this and previous processes. Finally, the environmental assessment process is a complete and independent review of the information provided in this document.

Working Group Final Outcomes	**Alcoa Response**
We request the complaints response and communication between Alcoa and community members be improved.	We acknowledge this is an important issue to members of the local community. Alcoa has a 24/7 complaints response service linked to a free 1800 number for local community members. When introduced this service was promoted through a letter to local residents accompanied by a fridge magnet with the contact details. The 1800 number is also regularly advertised in the Yarloop Yarning publication. The complaints response procedure is currently being reviewed and updated in response to community feedback including that from this Working Group. Communications regarding the Wagerup refinery have increased during the past 12 months with the introduction of the WagerUPdate and greater use of advertising and direct mail. Alcoa will continue to monitor and review its communications.
We also suggest that Alcoa further liaise with recent complainants about health effects in animals from surrounding farmlands and consider developing an ongoing process to deal with these more effectively.	This has been undertaken through written communications with the neighbour in question. Processes are in place to detail with complaints (including in relation to livestock) and are adapted as required on a case-by-case basis.
Residue-specific outcomes	
We have inspected the Residue Drying Areas (RDAs) and considered • Visual amenity; • Chemical composition and possible related impacts; • Construction of RDAs; • Dust and its suppression;	Alcoa is committed to broad community involvement. We will work with interested community members in the development of the Long Term Residue Management Strategy (LTRMS), identified with the community through an open and transparent process. For further information on the LTRMS, please see section 5.2

Working Group Final Outcomes	**Alcoa Response**
• Water sources; • Water usage and recycling/conservation; • Ground water contamination; • Rehabilitation; • Lowering of pH; • Radiation; • Alternative uses for residue; • Security of the RDAs; • Odour measurement and modelling; • Monitoring; • Diffuse source emissions modelling; • Aspects of the Health Risk Assessment We understand that there is an opportunity, and a desire on Alcoa's behalf, to continue a consultation process beyond the ERMP requirements to address broader issues of residue management. We understand that this includes the Long Term Residue Management Strategy (LTRMS). We request that Alcoa seeks a wide representation of people from the surrounding community.	
We understand Alcoa's plan for dealing with visual amenity for the Residue Drying Area (RDA) is based on the RDA 7 Visual Amenity Plan and the LTRMS. We	Alcoa supports increased wildlife corridor connections that are compatible with the natural landscape and integrated to other plans and activities including those of the

Working Group Final Outcomes	**Alcoa Response**
recommend there be an increase and improvement in wildlife corridor connections. We also identified that visual amenity planning is an ongoing process. In particular we identified that farmland management and ongoing visual amenity are issues to be further addressed in the Long Term Residue Management Strategy (LTRMS).	Alcoa Farmlands, residue operations and environmental group. To this end, a dedicated team is being formed to examine residue visual amenity from a long term perspective. Please see sections 7.18 and 8.15 for information about visual amenity.
We understand that as a result of Wagerup 3, the area of the RDA planned over the next 30 years will be opened within 8 years. Some members of the Group have serious concerns over the increased rate of residue disposal and the height that will result from stage 3 and specifically urge research into alternatives to residue storage. We request that the expansion of the RDA footprint and height, required for the production increase with Wagerup stage 3, be included in the ERMP. We understand that the LTRMS discussion will address these issues.	Residue re-use is a priority for Alcoa. We will continue research programs focussed on residue and the support provided to research organisations focussed on residue research. Key residue programs for 2005 include: • Carbonation to reduce pH • Opportunities for re-use of residue sand • Continued work on Alkaloam use and opportunities Diffuse source modelling for the Proposal has been based on the 30 year residue footprint and a stack height of 40 metres as outlined in the most recent LTRMS. Please refer to section 5.2. This footprint and the stack height were decided following extensive community consultation. Changes to the long-term footprint and stack height will be subject to community consultation in future long-term planning activities.
In response to a concern about asbestos risks, we heard that asbestoform fibres are not existent in bauxite ore and are therefore not a risk. We request that this material	A series of fact sheets will be produced for distribution in the community based on the key issues identified by the community members through the Working Group

Working Group Final Outcomes	**Alcoa Response**
be turned into a fact sheet for communication to the wider community.	process. In addition, an Information Day is being planned for June 2005 to provide information to the wider communities about issues raised during the Working Group process.
A member raised a concern about odour emissions from residue. We request Alcoa continue to research and monitor odour emissions at the RDAs and seek to reduce these in order to satisfy community concerns.	Odour emissions from the RDA have been included in the air quality assessment components of this ERMP (section 7.9 and 8.3). The RDA odour emission predictions have been combined with refinery point source odour emissions to give a combined odour output.
We request Alcoa to detail their oxalate management strategy in the ERMP and pursue alternative uses of oxalate.	Oxalate management is a priority area for Alcoa. The following summarises the oxalate management strategy that was shared with the Working Group, tripartite group and Wagerup CCN. Sodium oxalate is a by-product of the Bayer refining process. At Wagerup, it is currently stored in lined ponds in the residue area. As part of the Proposal, the oxalate kiln at Wagerup would be fitted with a regenerative thermal oxidiser (RTO) and recommissioned. It is also proposed that a second oxalate kiln, with an RTO, would be built. It is anticipated the RTO will achieve greater than 95% VOC destruction through the process of high temperature thermal oxidation, converting the VOCs to carbon dioxide and water.

Working Group Final Outcomes	**Alcoa Response**
	Preliminary results from the Pinjarra refinery where the oxalate kiln, installed with an RTO, was recently recommissioned confirm that this is being achieved. Alcoa is also continuing research into alternative oxalate destruction technology. For the past five years, Alcoa, in conjunction with external experts, has been studying the microbiological and biochemical processes that occur in residue areas. A biological process for Total Organic Carbon (TOC) and oxalate removal utilising the benefits of Alcoa's residue carbonation process has been developed and is currently being trialed at Kwinana.
In response to a question raised about fluoride concentration in bauxite residue we heard that fluoride is present in the residue area but not at a significant level. We request that this material be turned into a fact sheet for communication to the wider community.	A series of fact sheets will be produced for distribution in the community based on the key issues identified by the community members through the Working Group process. In addition, an Information Day is being planned for June 2005 to provide information to the wider communities about issues raised during the Working Group process.
In response to our discussion of the residue dust prosecution case (2002), we noted some concerns about the potential reoccurrence of extreme weather events and the effects of massive dust movement on nearby residents, among whom there is concern about dust composition. In response, Alcoa provided its contingency plan to prepare for extreme weather conditions. We request that • A strategy is developed to evaluate, control and manage the impacts of localised weather events (i.e. whirly-whirly).	High speed, localised wind events such as whirly whirly's are difficult to predict as they are caused by random, short-term meteorological conditions that are not able to be forecast. Alcoa acknowledges that they generate dust that is often visible offsite, however dust monitoring indicates that offsite dust impacts from these occurrences are minimal. Alcoa believes that dust management strategies in place at the RDA including

Working Group Final Outcomes	**Alcoa Response**
• Learning from 2002 dust case, the community receive information about dust events from Alcoa first hand.	sprinklers, bank rehabilitation, mulching and use of dust suppressants on residue roads match current best practice and address these short-term scenarios. We will continue to consider new forecasting and dust management technology as it becomes available. Alcoa acknowledges the need for communications with its neighbours. The extent of communications are decided based on the nature of any event (dust or otherwise) at Wagerup. This may range from informing the Community Consultative Network (CCN) or Tripartite Group, to a press statement to the local paper or a personalised letter to residents in Yarloop and Hamel.
Some community members believe there should be an investigation by the state government to establish whether the fine paid to government can be returned to impacted community, possibly though a partnership between state, government, Alcoa and community.	Alcoa recognises the intent of the working group members in deciding this outcome. However, any change in this regard is a matter for Government to determine.
In response to a concern about insufficient community consultation around mining with regards to the proposed expansion, we request that a more effective forum for community consultation be established to address this need.	Alcoa will work closely with the community about the proposed plans for Willowdale mine in relation to the proposal. Informative displays are planned for various community events throughout the year and information sessions will be provided to interested community members. Willowdale mine neighbours are being consulted on the proposed expansion plans through visits, phone calls and information mail-outs. Neighbours are being encouraged to discuss any questions or concerns they may have relating to the

Working Group Final Outcomes	**Alcoa Response**
	proposed changes with mining representatives. Alcoa also intends to consult the local shires of Waroona and Harvey for their feedback on the proposed plans. An invitation was recently extended to the members of the Wagerup Unit Three Working Groups to tour the Willowdale mine. Five members toured the Willowdale mine and discussed the associated plans for the Larego mining region with positive feedback received from the attending members. Free public tours of the Willowdale mine and Wagerup refinery will commence in April. It is hoped that the positive results experienced at the Huntly mine and Pinjarra refinery through public tours providing information and education will assist in further addressing these concerns.
The community members are concerned about the lack of a process around community consultation for mining. We sought information in relation to Willowdale Mine and received advice from the MMPLG about the • Truck movements; • Use of water for dust control; and • Public notification of blasting. We then received further information from a community member on the following matters • Impacts of truck movements leaving the Willowdale minesite: • Notification of blasting and public access to blast site;	Please refer to response above.

Working Group Final Outcomes	**Alcoa Response**
• Insufficient minesite community consultation for Wagerup Unit Three; • Collection of noise data (dBA) data from the blast radius, as specified in the 1978 Environmental Review and Management Plan. We recognise that these issues are beyond the ERMP but emphasise that this needs immediate attention by Alcoa.	
We request that Alcoa's neighbours' current concerns regarding existing mining operations, that have been the subject of protracted discussions, be addressed immediately by the company. We suggest that an independent mediator may assist to resolve the issues.	Alcoa works one-on-one with neighbours who believe they are impacted by its mining operations. Independent mediators have been offered in the past to assist protracted discussions and this option remains available when it is considered appropriate by both Alcoa and the neighbour concerned.
We recommend that a comprehensive sampling program for dust monitoring at the residue operations be addressed in the ERMP.	The ERMP includes an outline of the dust monitoring program refer to section 7.9.
Some members recommend that roof cavity dust sampling be undertaken in Yarloop, Hamel and Wagerup, as part of the overall dust monitoring program for Wagerup.	Roof cavity dust monitoring has been considered in the past and Alcoa does not believe that undertaking a sampling program will add to the understanding of household air quality conditions in the local communities. Dust accumulating in roof cavities will have come from numerous sources, within and outside the house, many of which are far more likely to have resulted in dust accumulation in Yarloop houses. Therefore, Alcoa believes it is impractical to attempt to identify what contribution might be from Alcoa operations. Alcoa is also not aware of any accepted standard that could be used to compare with the results.

Working Group Final Outcomes	**Alcoa Response**
We believe that the location of two internal dust monitors relative to the height of the RDA should be reviewed to ensure that they continue to provide an effective early warning system.	The internal dust monitors are currently located in an elevated position on the RDA dyke wall to provide early dust detection. As dyke wall height is increased, the position and elevation of the monitors will be reviewed to ensure that appropriate coverage is achieved.
We believe Alcoa should continue to pursue carbonation of residue and we refer it to the LTRMS process. In particular, we request a study of Off-gas from carbonated residue from RDAs, including organo-mercury compounds; Composition of dust from carbonated residue; and The source of carbon dioxide for the process.	Alcoa recognises the potential benefits of residue carbonation and is committed to continuing research into carbonation as a priority. Full scale implementation is proceeding at Kwinana which will provide the basis for more detailed monitoring. The current proposal for Wagerup is to use flue gas from the powerhouse boilers and pilot testing for a scrubber system for capture of the CO2 is planned for Q3 2005. The research areas specified by the Working Group will be considered in the next update of the carbonation research plan.
We understand that the mercury extraction pilot project is underway, is looking promising, and could be introduced in 2 years. We would like the results to be addressed in the ERMP.	The ERMP includes modelling of mercury based on current best estimates for improved mercury capture. Alcoa will continue to look for improvement in this area.
The full HRA is not yet available, however we have seen the results of the contour modelling that indicate that Acute (short-term) Hazard Risk, Chronic (longer-term) Hazard risk and the Incremental Carcinogenic Risk for health, for the current and expanded refinery, meet world class health risk criteria. This information provided a comprehensive picture which increased our confidence in the available knowledge and understanding of health risk. Based on the information presented, we believe this will be reassuring to the community. We believe that the new information provided by HRA modelling may provide a useful contribution to discussions about the buffer and land management around	Alcoa regrets that the full text of the HRA was not available earlier in the involvement process. The full text of the HRA is included in this ERMP (Appendix F) as is the independent expert review of the HRA (Appendix M)

Working Group Final Outcomes	**Alcoa Response**
Alcoa's operations. We request that formal verification of the modelling and the HRA occur and the outcomes of that verification be made available to the community in some format.	
We suggested that the following additional compounds be included in the HRA, or request the reason for their omission be provided in the ERMP: • Composition and particulate size of uranium and thorium; • Aluminium and its related compounds; • Silica; • Oxalate and • Alkalinity of dust particles.	This information was passed to the HRA consultant whose response is included in the HRA text (Appendix F).
We support the ongoing research into dust lift-off, dust deposition and chemical composition of dust and request that it be extended to incorporate Wagerup-specific aspects. We suggest that the outcomes be closely incorporated into Alcoa's overall management program for residue and HRA modelling aspects. This material should be turned into a fact sheet for communication to the wider community.	Alcoa supports this recommendation. The outcomes of the WA Dust Study will be applied to Wagerup when they are available. The study will quantify physical and chemical properties of dust and allow this information to be used in any future modelling and HRA at Wagerup. A fact sheet is in preparation to explain the study to the wider community.
We noted dust control methods at the residue areas, which are • Watering with sprinklers at the newly recommended spacing; • Spreading woodchips; • Use of waste oil on roadways (natural decomposition of oil occurs); • Close meteorological monitoring with automatic sprinkler responses. • Other possible controls are	Alcoa agrees that dust control must remain a high priority and notes the results of the HRA and the ground level concentrations for dust and other substances resulting from the modelling (see section 8.3).

Working Group Final Outcomes	**Alcoa Response**
i. Brush fencing ii. Growing lucerne trees on banks (lucerne is alkaline resistant) iii. Increasing peripheral planting to dense status iv. Carbonation of residue which results in less dust (carbonation also allows natural biological activity below pH 10). Following a tour of the RDA by some members of the Group, those members returned with an increased degree of confidence about dust control. While we see that these techniques have been somewhat effective, we believe that dust control must remain a priority issue for Alcoa to manage in current and future operations. This belief is reinforced by the dust ground level concentrations and the acute hazard index risk contours predicted in the HRA.	
Following a question raised during our Residue Drying Area (RDA) tour about site access security, we received information about Wagerup's risk assessment approach and were satisfied with this response. We acknowledge that action has already been taken on a security issue identified by the Working Group, however we request ongoing monitoring occur.	Alcoa appreciates the community concern surrounding this matter and as highlighted, is improving security around the residue area perimeter. Ongoing monitoring of site access and security will also occur.
On a site tour, some members of the Group witnessed visible dust localised in the bauxite grinding area and this was due to a failure of dust suppression equipment, which has since been rectified. We recommend that improved dust control be evaluated and implemented for the bauxite stockpiles and in the bauxite grinding	A recent investigation was conducted at Wagerup to examine the cause of dust coming from the bauxite stockpiles and identify corrective actions. These include: - Road dust suppression trials - Update of procedure to ensure watering occurs between stockpiles and the

Working Group Final Outcomes	**Alcoa Response**
area.	conveyors when forecast wind is greater than 50 km/hour Make provisions for back-up to any truck/equipment failures preventing dust suppression in stockpile area The dust suppression system will be repositioned further upstream in the bauxite supply system to reduce dust produced at bauxite transfer points.
We recommend that the implementation of the Wagerup Action Plan (WAP) outcomes be incorporated in the ERMP.	The Wagerup Action Plan (WAP) addresses the Recommendations of the Wagerup Air Quality Review 2004. Several aspects of the WAP relate to atmospheric dispersion modelling, and have been incorporated into the modelling used in the ERMP (in particular Recommendations 16 and 17). See section 7.9 and8.3. The recommendation relating to the determination of emission rates form diffuse sources (Recommendation 7) has also been completed as part of the ERMP development. See section 7.9 and 8.3. The other recommendations relate to a range of issues including VOCs, dust, data integrity and new technology for measurement, in particular continuous monitoring and are being addressed on a planned basis, but are not yet complete. Implementation of the plan is incorporated in the Wagerup licence process and the

Working Group Final Outcomes	**Alcoa Response**
	progress against plan is being monitored by the Wagerup Tripartite Group.
We discussed possible alternative uses for residue and recognise that this is a long-term issue for residue management, and therefore did not cover in detail during this Working Group process. We refer this issue to the community group involved in the LTRMS, and in particular, the radiological council's review on the Bayer Process Radiological Evaluation Status Review (2004).	Alcoa will bring this to the attention of community members involved in long-term residue management planning once this process is established.
We would like to see Alcoa supplying sand from residue for road construction, in particular the 2007 Peel Deviation (Perth-Bunbury Highway).	Research into the use of sand for the construction of roads is ongoing. As part of this, testing to demonstrate a viable washing and separation process to produce a clean sand product for general purpose use is continuing through the Centre for Sustainable Resource Processing. A small wet magnetic separation plant has been set up by CSIRO and will be evaluated by mid 2005.
Water-specific outcomes	
We have examined water sourcing, usage and efficiency, quality and monitoring, recycling, geology, impacts and other measures and have come to the following outcomes:	
We received a comprehensive list of water supply options from various sources (including community suggestions) to satisfy the additional 4770 ML per annum maximum required for the expansion and considered the environmental, social and economic impacts of each. We request that Alcoa publish this list to the community.	A series of fact sheets will be produced for distribution in the community based on the key issues identified by the community members through the Working Group process. In addition, an Information Day is being planned for June 2005 to provide information to the wider communities about issues raised during the Working Group process.

<table>
<tr><th>Working Group Final Outcomes</th><th>Alcoa Response</th></tr>
<tr><td>The four short-listed water supply options for Wagerup Unit Three:
Harvey Main Drain – through increased harvesting of winter runoff;
Harvesting winter runoff from other agriculture drains in the area (i.e. South Samson drain, North Samson Drain, Waroona Main Drain);
Irrigation waters gained through efficiency measures;
Transfer a portion of the Alcoa farmlands Irrigation Water Entitlement.
We recognise that Alcoa's preferred option is the Harvey Main Drain Pumpback, as it uses lower quality water that currently discharges to the estuary.
In selecting the preferred option to satisfy their increased maximum water requirements of 4770 ML per annum, we request that Alcoa include consideration of
Future climatic change impact on water availability,
The water requirements of other users,
Ecological Water Requirements,
Use of water that is not valuable for some other use,
Water efficiency measures.
We examined the use of saline water within the refinery process and heard that it was found to be unsuitable.</td><td>The parameters listed for consideration by the Working Group are discussed in section 8.5 of the ERMP.</td></tr>
<tr><td>We request that the ERMP confirm our understanding that none of the water supply options for the refinery will affect the drinking water supplies of Harvey, Yarloop and Waroona, as these have a different allocation from the Water and Rivers</td><td>The DoE representative verbally confirmed this assessment during the consultation process. However, the preferred water supply option will go through specific assessment as part of the Water & Rivers Commission licensing process, separate to</td></tr>
</table>

Working Group Final Outcomes	**Alcoa Response**
Commission.	this ERMP. A key part of this water licensing process is to ensure the licensed option will not impact on other high value uses, such as drinking water supply.
We recommend that Alcoa continue to pursue all water use efficiency options and opportunities including those both process and non-process related: • Vapour condensation recovery; • Non-evaporative cooling (e.g. Fin fan coolers and counter-current heat exchange); • Upgraded sprinkler and meteorological system; • Covers on water storage areas; • Alcoa farmlands On-Farm Irrigation Efficiency Water; • Harvey Water Off-farm Irrigation Efficiency Water; and • Supporting community efforts for efficient water use including education of employees.	Water use efficiency is a priority and will continue to be pursued. Please see section 8.5 for a discussion on water efficiency in relation to the proposal.
We request that Alcoa take all measures to prevent pollution or contamination of surface and ground water, and outline them in the ERMP.	The water quality management measures are summarised in section 8.6 and 8.7 of this ERMP.
We request that Alcoa prepare a fact sheet to distribute to the wider communities, about their water requirements and source options, and how this may affect other users.	A series of fact sheets will be produced for distribution in the community based on the key issues identified by the community members through the Working Group process. In addition, an Information Day is being planned for June 2005 to provide information to the wider communities about issues raised during the Working Group process.

Working Group Final Outcomes	**Alcoa Response**
We request the current water usage and increased water usage for mining be included in the ERMP.	Water usage for mining is managed through the MMPLG process. Please refer to section 4.3.1.
We request that Alcoa review the whole water quality monitoring program, including physical, chemical and biological parameters on site in the Environmental Review and Management Plan (ERMP), particularly freshwater sources at the refinery and downstream from Refinery.	Water quality monitoring undertaken for the Wagerup refinery includes requirements for the environmental licence and that proposed for other purposes. The water quality monitoring program associated with the ERMP assessment is provided in section 8.5.
We request a historical comparison between surface and groundwater quality, including physical, chemical and biological parameters, for the pre-refinery situation, present situation and expanded scenario, are included in the ERMP.	Refer to section 7.5
We request that Harvey Water and the Water Corporation endeavour to ensure that Drakesbrook and Waroona Dams have a minimum level at the end of summer to allow for maximum capacity at the end of winter.	Alcoa will advise Harvey Water and the Water Corporation of this request when the ERMP is submitted.

7. PROPOSAL AREA ENVIRONMENT

7.1 BACKGROUND

The Wagerup alumina refinery has been in operation since 1984 and consequently is contained in a significantly modified environmental setting. The following sections describe the "existing environment" including aspects relating to air quality, noise emissions and water supply.

The refinery and bauxite residue operations are contained within freehold land owned by Alcoa. Land uses on the non-industrial Alcoa owned land and on adjacent properties are primarily agricultural, mainly cattle grazing on dry or irrigated pasture.

7.2 REGIONAL CONTEXT

Wagerup refinery is located on the Pinjarra Plain or more specifically the Ridge Hill Shelf which forms the foothills of the Darling Scarp. This geomorphic unit consists of a series of laterite covered spurs, dissected by numerous small creeks which flow westward. Soils are generally high in iron and aluminium oxides.

The Willowdale mine, which supplies bauxite ore to the refinery, is located on the Darling Plateau in the Jarrah Forest to the east of the Ridge Hill Shelf. The plateau is characterised by an undulating hilly landscape and lateritic uplands with major valleys along the scarp. Mining operations are outside the scope of this ERMP assessment.

The Residue Storage Area is located to the west of the refinery on the alluvial Pinjarra Plain at the foot of the Darling Scarp. The plain is covered with clays and loams in the valley flats and poorly sorted clayey sands and gravels in the piedmont zone (Playford *et al.*, 1976). Drainage lines of various sizes drain across the plain and small seasonal swamps are not uncommon.

7.3 CLIMATE

The Wagerup area is characterised by a Mediterranean climate with mild wet winters and warm dry summers.

A summary of climatic data observed in the year 2004 at the Bancell Road monitoring station, operated by Alcoa and near the Wagerup refinery, is presented in Table 7.

Table 7: Climatic Data for Wagerup Refinery[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Daily Max. Temp (°C)	30.2	30.8	27.7	24.2	19.8	18.0	16.2	15.6	18.1	20.1	23.3	28.7	22.7
Mean Daily Min. Temp (°C)	17.0	18.3	15.2	14.7	11.6	11.9	9.2	8.8	9.3	10.9	13.4	15.1	13.2
Mean 9am Rel. Hum. (%)	49	51	48	57	65	72	73	76	61	62	54	44	59
Mean 3pm Rel. Hum. (%)	36	38	34	44	52	67	62	66	55	56	47	37	49
Monthly rainfall (mm)	1.2	1.0	0.4	17.2	111.2	200.5	127.4	175.6	28.0	59.0	43.2	3.0	767.7
Highest recorded daily rainfall (mm)	1.2	0.6	0.2	5.8	43.0	38.2	26.4	35.6	8.1	17.0	10.7	2.0	-
Mean 9am wind speed (m/s)	3.0	2.9	2.8	2.8	3.2	3.1	3.1	2.9	2.7	2.9	3.6	2.3	2.9
Mean 3pm wind speed (m/s)	3.2	3.1	3.5	2.8	3.0	3.2	2.7	3.3	3.0	3.3	3.1	2.7	3.1

Notes 1. Data collected at Bancell Road for the 2004 calendar year

The nearest Bureau of Meteorology monitoring station to Wagerup is located at Wokalup, approximately 22 km south of the refinery. Records have been collected at the Wokalup station since 1951. Averaged data since that time are presented in Table 8.

Table 8: Climatic Data for Wokalup[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Daily Max. Temp (°C)	30.9	30.8	28.3	24.3	20.2	17.4	16.7	17.1	18.6	21.0	24.0	27.8	23.0
Mean Daily Min. Temp (°C)	15.6	16.1	14.8	12.7	10.6	9.0	8.0	7.9	8.5	9.5	11.4	13.6	11.4
Mean 9am Rel. Hum. (%)	54	56	59	68	77	81	83	79	75	69	63	56	68
Monthly rainfall (mm)	14.0	16.9	21.8	50.5	137.4	193.7	187.7	135.6	93.2	61.7	36.9	14.4	963.7
Highest recorded daily rainfall (mm)	108.6	90.4	79.2	56.0	60.8	63.5	52.3	66.5	49.8	65.6	44.6	35.8	-
Mean 9am wind speed (m/s)	4.1	4.4	4.2	3.4	2.5	2.5	2.7	2.9	3.2	3.4	3.5	3.6	3.4

Notes 1. Averaged data collected by the BOM at Wokalup station since 1951.

7.3.1 Temperature and Humidity

Wagerup temperatures are characteristic of the South West region, with warm to hot summers and mild winters. The warmest months are January and February, with maximum temperatures in these months exceeding 40 °C and averaging over 30 °C. The coldest months are July and August, when the average maximum temperature is 17 °C. Average minimum temperatures range from 8 °C in August to 16 °C in February (Wokalup data). These temperature ranges are very similar to those recorded in Perth.

Humidity at Wagerup tends to reach a peak in the early mornings and drops during the day, with winters being more humid than summers. These effects are common in the South West region, and monthly averages are similar to those recorded at Perth.

7.3.2 Rainfall and Evaporation

Annual rainfall in the vicinity of the Wagerup refinery averages approximately 950 mm, with approximately 75% falling between May and September. However, although most rainfall occurs in winter, the most intense rainfall events tend to occur in the summer months.

Due to orographic (passage of air of a ridge) effects, rainfall is generally lower on the coastal plain to the west of the Darling Range in comparison to that of the Jarrah forest of the Darling Scarp to the east (Anderson 1984:4). Due to the close proximity of the refinery to the base of the Darling Scarp (within 1 km), rainfall is higher here than for much of the coastal plain.

7.3.3 Winds

Winds at Wagerup have previously been categorised by Sinclair Knight Mertz (in SKM, 2001 & SKM, 2003). The following description is based on those reports.

The winds at Wagerup are controlled by synoptic weather patterns and local features such as the topography and sea and land breezes. In the summer the passage of high pressure systems to the south generates synoptic easterlies over the region, whilst in the winter months the passage of cold fronts and low pressure systems results in more frequent westerly synoptic flows between periods of lighter winds. For the Wagerup refinery, at the base of the Darling escarpment, topographical features are particularly important in modifying these larger scale winds. These topographic features tend to:

- Generate very strong local winds during summer, principally at night and in the early morning, which are known as “gully wind” or “foothill winds;
- Create rotors or wind reversals near the foothills under easterly winds;
- Channel or deflect westerly winds near the base of the escarpment along the escarpment; and
- Create light drainage (katabatic flows) down the escarpment.

7.4 TOPOGRAPHY AND GEOLOGY

The Wagerup refinery is located at the foot of the Darling Scarp where the land gently slopes towards the west. Elevation on the eastern side of the refinery and edge of the Upper Dam is 55 mAHD, which drops approximately 40 m to 45 mAHD on the western side of the refinery. The residue storage area and surface water detention pond are constructed on the Pinjarra Plain at an elevation of approximately 15 mAHD on the western side of the residue area and 20 m to 25 mAHD on the eastern side of the residue area.

The area is dissected by North Yalup Brook and Lower Yalup Brook just north of the refinery and Bancell Brook to the south of the refinery. Overflow from the fresh water catchment dams and ponds on Alcoa's property flows into the Black Tom Brook Diversion Drain which flows along the eastern and southern sides of the residue area and drains into South Sampson Drain (Figure 13).

Geology below the refinery is characterised by the superficial Yoganup Formation (leached or ferruiginised beach sand, conglomerate and dunes) which is approximately 15 m thick and includes a variable thickness (of up to 3 m) of surface fill comprising sandy clay and lateritic gravel overlain by sand placed there during refinery construction (Peck and Thomas, 1997). The composition of the superficial formations below the refinery are highly variable, but can be sandy on the lower part of the Yoganup Formation and sandy clays in the upper part of the formation. The superficial formations are underlain by low permeability silty clays possibly from the Cattamarra Coal Measures (Parsons Brinckerhoff/Nield Consulting, 2004).

Below the residue area, the Guildford formation comprising alluvium (mostly clay and sandy clay), which is variably laterised and podsolised, forms the top 5 m to 15 m of the superficial formations and thins out to the east of the residue area, exposing the Yoganup Formation near the South Western Highway. The Yoganup formation dominates the lower superficial formations below and east of the residue area, but is interspersed by the Ascot limestone formation. The Leederville Formation, comprising sand, siltstone, shale and clay lies below the superficial formations in the vicinity of the refinery operations (Parsons Brinckerhoff/Nield Consulting, 2004).

The soils in the vicinity of the Wagerup refinery are described in Churchward and McArthur (1980) as:

- Guildford Unit: flat plain with medium textured deposits, yellow duplex soils;
- Forrestfield Unit: laterised foothills of the Darling Scarp dominated by gravely and sandy soils; and
- Darling Scarp: very steep slopes with shallow red and yellow earths and rock outcrop.

7.5 SURFACE HYDROLOGY

The Wagerup refinery area is within the lower reaches of the Harvey River catchment, which has an area of 2,055 km^2. Approximately 45% (925 km^2) of the catchment is cleared and 29% (605 km^2) is State Forest (Centre of Excellence in Natural Resource Management (CENRM), 2005). The area is the largest catchment draining into the Peel-Harvey Estuary. The main river system in this catchment is the Harvey River, which lies approximately 4 km to the west of the refinery operations and flows in a north-westerly direction, discharging into the Harvey Estuary.

The natural hydrology of the lower Harvey River catchment was comprised of small rivers and streams draining relatively small catchments from the escarpment onto the coastal plain and to the Harvey River (Figure 13). The majority of the natural drainage lines on the coastal plain have been extensively modified by artificial drainage, irrigation, channelisation and clearing of native vegetation. In the early 1900s the development of irrigation and drainage servicing agricultural activities around the towns of Harvey and Waroona altered the surface hydrology significantly. The Harvey River has been significantly modified for agricultural purposes and is now commonly referred to as the Harvey Main Drain.

The main drainage systems within the Harvey River catchment are:

- Harvey River Main Drain;
- Harvey Diversion Drain, diverting overflow from the Harvey and Wokalup rivers (including Wellesley Creek) to the Indian Ocean at Myalup;
- Weekes, Clarke, Logue, Bancell and Yalup brooks, which discharge into Harvey River Main Drain;
- Samson-Waroona-Drakesbrook drainage system, which includes Black Tom and McKnoe brooks and discharges into the Harvey River Main Drain via both Samson River Main Drain and Drakesbrook Drain;
- Mayfield Drain, which discharges into the Harvey River Main Drain, close to Harvey Delta (CENRM, 2005).

Due to extensive clearing for agriculture on the plain, it is estimated that runoff from the lower Harvey catchment is much greater than under pre-European conditions. Current runoff from the plain is estimated to be about 300% greater (i.e. 141 GL/y) than it was prior to settlement. This is reflected in the total annual flow from the Harvey River into the Harvey estuary increasing by approximately 25 to 50% compared to pre-European flows (Water and Rivers Commission, 1998).

However, climate change has also resulted in reduced rainfall in the region (estimated to be 10% over the last 20 years) which has been shown to reduce streamflow in jarrah forest catchments by between 20% and 40%. Approximately 51% (53 GL) of the total mean annual streamflow from the upper Harvey River is diverted for irrigation and town water supplies (Water and Rivers Commission, 1996).

The west and south boundaries of the residue area comprise inner and outer dykes, with an intervening drain which collects surface water runoff and leachate from the dykes. This water is pumped back to the leachate collection ponds. Runoff from the refinery area drains into the Storm Surge Pond. A pipeline carries water from the Storm Surge Pond to the cooling pond, or run-off water storage (ROWS) pond located in the residue area. The pipeline to the storage ponds greatly increases the capacity of the system and minimizes the risk of releasing contaminated water to the environment. An overflow pond is designed to accept overflow from the Storm Surge Pond during extreme rainfall events.

The run-off water collection system for the refinery and residue area was designed and operates as a closed system. The refinery is a net user of water, with the major losses from the system associated with evaporation, cooling and moisture retained in the residue.

7.5.1 Surface Water Quality

7.5.1.1 Harvey River Catchment Water Quality

Runoff from the upper catchment areas of the Harvey River Catchment is low in nutrients due to the ancient weathered rock profile of the Darling Range and retention of nutrients by forested areas (Bunn and Davies, 1990). The lower catchment by comparison is largely cleared for agriculture and cultivated, and consequently has a high nutrient status (Rivers and Clarke, 2003).

Runoff from the upper catchment is highly seasonal with very low or no flow between December and April. The construction of dams on the hills catchments and reduced rainfall in the last 20 years has reduced the input of low-nutrient runoff into the Harvey River drainage system, whilst clearing and cultivation on the coastal plain has increased the volume of nutrient-rich runoff into the Harvey system (CENRM, 2005).

Surface water runoff from the upper catchments now only contributes approximately 16% of total flows to the Harvey Estuary compared with 60% prior to European settlement. Therefore the potential for surface water runoff from the upper catchment to dilute or flush nutrient-rich runoff in the lower catchment has been significantly reduced (Black and Rosher, 1980). River flow and total nutrient input to the Peel-Harvey Estuary is strongly seasonal with approximately 85% of nitrogen and phosphorous loadings occurring during winter (CENRM, 2005).

In the past many seasonal and perennial wetlands within the Harvey catchment acted as nutrient sinks. These have been drained, and riparian vegetation which assists nutrient retention, has been cleared for agriculture. Creation of wetlands and re-establishment of riparian vegetation within the catchment has been identified as a priority by the Department of Environment to assist in the management of nutrient-rich waters.

Assessment of the Harvey Irrigation Area showed that nitrogen in water typically equalled or exceeded the ANZECC Guideline of 0.75 mg/L for total nitrogen in Southwest Australian estuaries, in most samples (Rivers and Clarke, 2003). Drains in the Harvey catchment exhibited similar characteristics but also showed peaks of nitrogen up to 3.0 mg/L.

The estimated historical phosphorus inputs into the Peel-Harvey Estuary are shown in Table 9.

Table 9: Estimated phosphorus inputs into the Peel-Harvey Estuary (after Kinhill, 1988).

Harvey Catchment	**Phosphorus (mg/L)**		**Streamflow (m^3x10^6/a)**		**P Load (t/a)**	
	circa 1930	1977-1986	circa 1930	1977-1986	circa 1930	1977-1986
Hills	0.01	0.01	195	65	2	1
Coastal Plain	0.09	0.46	180	370	16	170
Total	0.10	0.47	375	435	18	171

The increase in nutrient inputs from clearing and agricultural activity is clearly shown and can be compared with the ANZECC Guidelines[1] for total phosphorus in Southwest Australian estuaries of 0.3 mg/L (ANZECC, 1992).

As a result of high nutrient levels in surface water flowing to the Peel-Harvey Estuary, the estuary has suffered massive blue-green algal blooms of *Nodularia spumigena*. The Dawesville Channel, which was constructed and opened in 1995 to allow tidal flushing of the estuary, has reduced the frequency of algal blooms. However, continued urban and rural development within the catchment, including more intensive agricultural practices, continues to threaten the nutrient balance and water quality of the lower Harvey River system.

[1] The ANZECC Guidelines present 'trigger values' which may be used as straight guidelines, or as a starting point to trigger an investigation to develop more appropriate guidelines based on the type of water resource and inherent differences in water quality across regions.

7.5.1.2 Water Quality in Vicinity of Wagerup Refinery

Under its environmental licence (6217/8), Alcoa has implemented a surface water quality monitoring program related to the Wagerup refinery. There are 13 surface water monitoring sites established throughout the surface water systems associated with the refinery operations (Figure 13). Surface water flows and water quality is monitored at these sites on a regular basis. Water quality monitoring includes measurement of pH, electrical conductivity (EC), alkalinity, sodium/chloride ratio and turbidity on a monthly basis and trace elements including aluminium, arsenic, mercury, selenium, vanadium, manganese, molybdenum and uranium are monitored every six months. Surface water monitoring results are collated and reported annually to the DoE.

Surface water monitoring has revealed a high temporal variability of stream-flows and surface water quality in the region, which is primarily linked to agricultural activities. After rainfall events, sharp peaks in flow coincide with sharp dips in salinity due to rainfall dilution, which is a result of clearing for agriculture causing increased surface water runoff (Parsons Brinckerhoff/Nield Consulting, 2004).

Monitoring results from years 2000 to 2003 indicate that the Wagerup refinery operations have not had an impact on surface water quality in the vicinity of the Proposal area (Alcoa, 2003; Alcoa, 2002). Elevated concentrations of sulphate have been found in some agricultural drains in the area. However this appears related to the presence of naturally occurring acid-sulphate soils rather than residue collection (Gerritse and Thomas, 2003).

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LOWER HARVEY RIVER CATCHMENT AREA

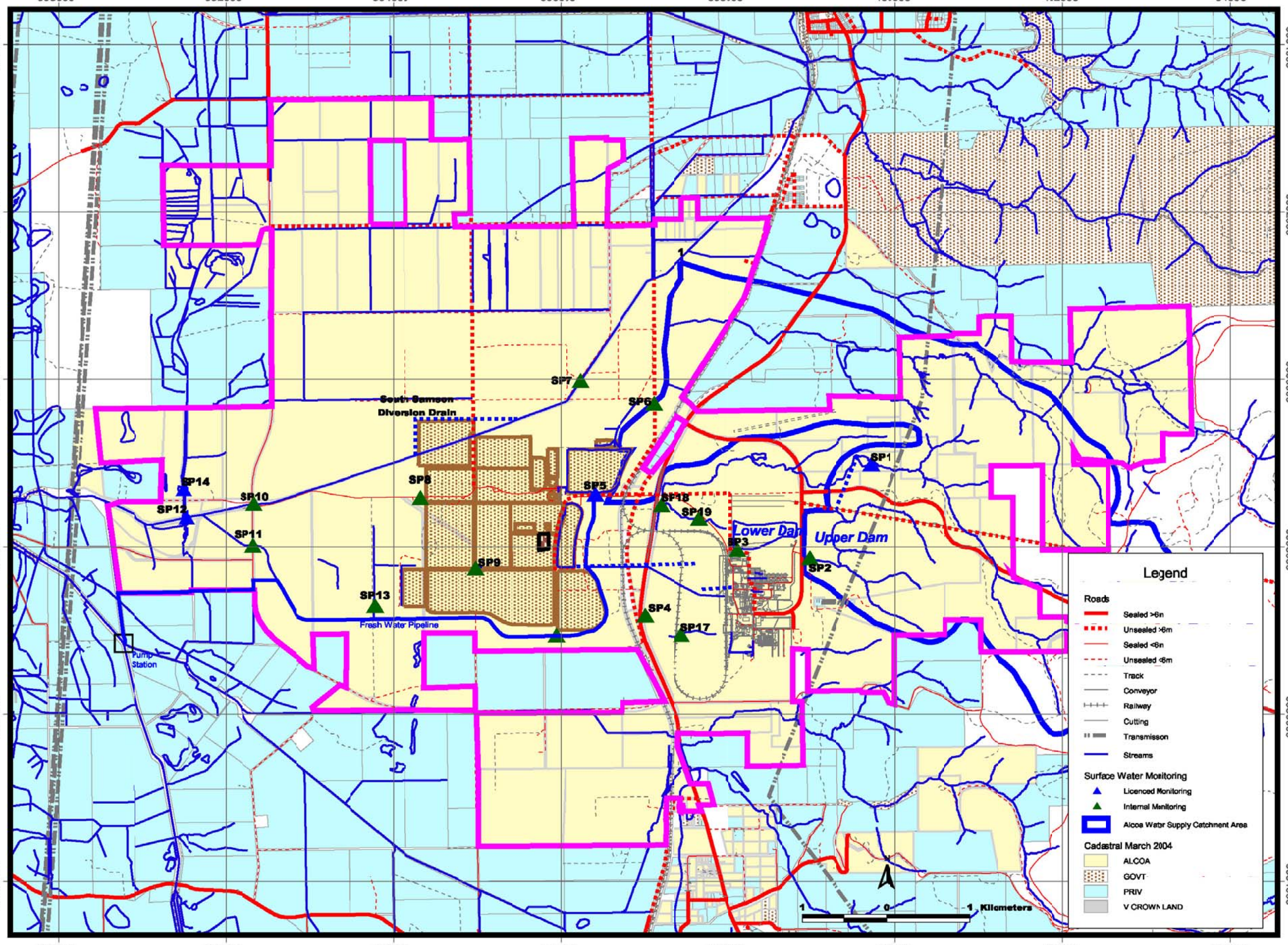

Figure 13

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The minimal impact refinery operations have had on surface water is shown through comparing the water samples collected for the initial environmental assessment of Wagerup refinery in 1978 and the 2004 surface water samples. Table 10 below contains sample data for Samson Brook (or South Samson drain) and Harvey River Main Drain from the 1978 ERMP and 2004 sampling events (average of the April and October monitoring rounds).

Table 10: Comparison of 1978 water sampling and 2004 monitoring data

Parameter	Samson Brook Drain (1978)	SP12 Average of April and Oct monitoring (2004)	Harvey Main Drain (1978)	SP15 Average of April and Oct monitoring (2004)
EC (us/cm)	225 - 2560	395	500 - 1056	561
Calcium	3.1 – 17.7	5.8	8.7 – 19.2	12.0
Chloride	71 - 310	93	78 - 305	250
Hardness	22 - 198	50	66 - 198	84
Iron	< 0.2 – 1.1	0.24	< 0.2 – 0.8	0.41
M Alkalinity	< 1.0 - 28	22.5	2 - 36	44
Manganese	< 0.5 – 0.12	0.042	<0.5 – 0.11	0.053
pH	6.5 – 8.0	7.0	7.4 – 8.1	7.2
Potassium	1.6 – 4.2	1.9	3.8 – 7.1	5.3
Silica	0.04 – 0.20	5.4	0.04 – 0.15	6.8
Sodium	29 - 121	53.4	53 - 125	68.3
Total P	0.001 – 0.393	0.05	0.003 – 0.110	0.19
Total S	< 1.0 - 36	17.8	17 - 52	24.9
Zinc	< 0.05	0.015	< 0.05 – 0.08	0.013

An additional surface water monitoring site was established in 1999 on the ephemeral stream west of the refinery (Figure 13) where there is evidence of very low level alkaline contamination which has resulted from the former hydrate stockpile. Water quality results from this location were reasonably consistent and showed slightly elevated levels of sodium/chloride ratios and alkalinity. The hydrate stockpile was removed in 2000 and monitoring will continue in order to track the fate of the plume.

Wetlands Protected under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992

The *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (Lakes EPP) was developed to protect the environmental values of lakes on the Swan Coastal Plain. The Lakes EPP prohibits any activities which cause the destruction and degradation of lakes without authorisation from the EPA. The area covered by the Lakes EPP extends approximately from Moore River in the north to Eagle Bay in the south and inland to the escarpment.

The Lakes EPP was reviewed in 1999, following which *Draft Environmental Protection (Swan Coastal Plains Wetlands) Policy 2004* (Draft Wetlands EPP 2004) and *Draft Environmental Protection (Swan Coastal Plains Wetlands) Regulations 2004* (Draft Wetlands Regulations 2004) were released by the EPA for public comment on 19 July 2004 until 15 October 2004.

There are no wetlands listed under the Draft Wetlands EPP 2004 in the immediate vicinity of the Wagerup refinery or residue area. There are three small wetlands near Hamel (approximately 4 km north of the refinery), four small wetlands near Yarloop (approximately 3.5 km south of the refinery) and a wetland known as Exelby wetland on the northern side of Bancell Road (near intersection with Hayes Road) which are listed in the Draft Wetlands EPP 2004. Exelby wetland was traditionally an ephemeral wetland, but has now become a permanent water body with in-flows of excess irrigation waters from the surrounding farmlands. However, it is very unlikely that these wetlands would be affected by existing or proposed changes to the refinery or residue area due to the distance of the operations, and the fact that all potentially contaminated surface water runoff or waste water discharges are contained on site for use by the operations.

The Wagerup refinery was designed as a closed system, maximising the recycling of process and other surface waters collected within the refinery and residue areas. This system protects the natural environment from impact. Other controls in place include; the preparation and implementation of a Hazardous Materials and Spill Management Plan in place which is reviewed and updated annually; and environmental awareness training of staff for spill prevention and spill management.

7.5.2 Surface Water Sources

The upper reaches of South Yalup Brook were dammed in 1978 to supply industrial and domestic water for the Wagerup refinery. Today, Alcoa is licensed under the *Rights in Water and Irrigation Act* (1914), to divert water from the Harvey River Main Drain, Yalup Brook and Black Tom Brook for storage and use by the Wagerup refinery. Diverted water is stored in the existing Upper Yalup Dam, lower Yalup Dam and detention ponds located in the residue area.

The refinery operates as a closed system and all rainfall runoff from the refinery, residue area and process water ponds are transferred to the cooling pond or ROWS pond during winter and then used as make-up water for the refining process during summer. The key water losses from the process include:

- final cooling of process liquor to enable the crystallisation of alumina;
- evaporation of stored fresh water;
- evaporation of process liquor storages and tanks;
- vapour released during the drying and calcination of alumina;
- moisture retained in the residue; and
- water used for dust control within the residue drying areas.

The RDAs also have base drainage systems that collect residue leachate and rainfall infiltration which is then fed into the make-up water system. The Wagerup refinery is almost totally dependent on the above surface water sources to provide the additional process make-up water required annually.

Approval to extract excess winter runoff from the Harvey River Main Drain was granted to Alcoa in 2002 by the Water and Rivers Commission. The installation and commissioning of equipment required to extract winter runoff from the Harvey River Main Drain was completed by October 2003. This surface water source was chosen due to the high volume of water available over the winter period and to support the abstraction of lower quality, winter run-off from the Harvey River Main Drain. The abstraction of lower quality winter run-off was seen to have positive environmental benefits for the lower Harvey River Main Drain and to a lesser extent the Harvey Estuary, through potentially reducing nutrient inputs.

The Harvey River Main Drain allocation replaced the licensed allocation from the Samson Brook South Drain and reduced the allocation from Black Tom Brook. The surface water licence allocations and the volumes abstracted by Alcoa in 2004 are presented in Table 11.

Table 11: Surface Water Licence Allocations and Abstraction Volumes for 2003.

Licence No.	**Catchment Location**	**Expiry**	**Licensed Abstraction Volume (ML/year)**	**Volume Abstracted by Alcoa in 2003 (ML/year)**
99246	Black Tom Brook	30/06/2007	2,500	1572
97472	Yalup Brook	30/06/2007	1,600	1174
151027	Harvey River Drain	30/06/2007	4,400	1550

Notes:

1. Water can only be abstracted from the Harvey River (Drain) between May and October.

Alcoa is required to divert surface waters in accordance with licence requirements and the agreed operational strategy that is amended from time to time in consultation with the DoE.

Water conservation is a key focus for the Wagerup refinery, especially with increasing concern over the impacts of climate change. Current models for global warming (CSIRO, 1996; 2000) have predicted an increase in summer rainfall and a decrease in winter/spring rainfall, and a potential increase in the duration of drought events. Water conservation initiatives at the refinery in 2004 concentrated on reducing the volume of water used for dust suppression such as:

- Using wood chips sourced from a local Yarloop timber mill and blue metal on some parts of the residue area instead of water;
- Using waste oil for dust suppression on internal residue roads instead of water;
- Residue area bank stabilisation with tar and bitumen; and
- Ripping of residue drying areas during summer to expose wet mud to lower the water usage required for dust suppression of the mud surfaces.

Alcoa continues to improve the efficient use of water where practicable and has a water efficiency plan in place outlining consumption, water auditing and target reductions in water use across the Wagerup operations.

7.6 HYDROGEOLOGY

Shallow groundwater in the area of Alcoa's Wagerup operations flows westward and eventually discharges into the Harvey River Main Drain.

The superficial geological formations in this region are heterogeneous, comprising zones of very permeability clay, sandy clay, laterite and sand (see Section 7.4). A generalised stratigraphic cross section under the residue area and refinery is presented in Figure 14.

Under both the refinery and the residue area, the superficial formations generally can be divided into an upper, low-permeability layer and a lower layer with higher permeability. For simplicity, these layers are referred to as the upper and lower superficial formations.

At the refinery the superficial formations have a thickness of approximately 15 m. In some parts of the refinery, the lower part of the Yoganup Formation contains sandy, permeable materials and the upper part contains sandy clays with lower permeability. However, the composition of the superficial formations under the refinery area is highly variable. The superficial formations are underlain by low-permeability, silty clays.

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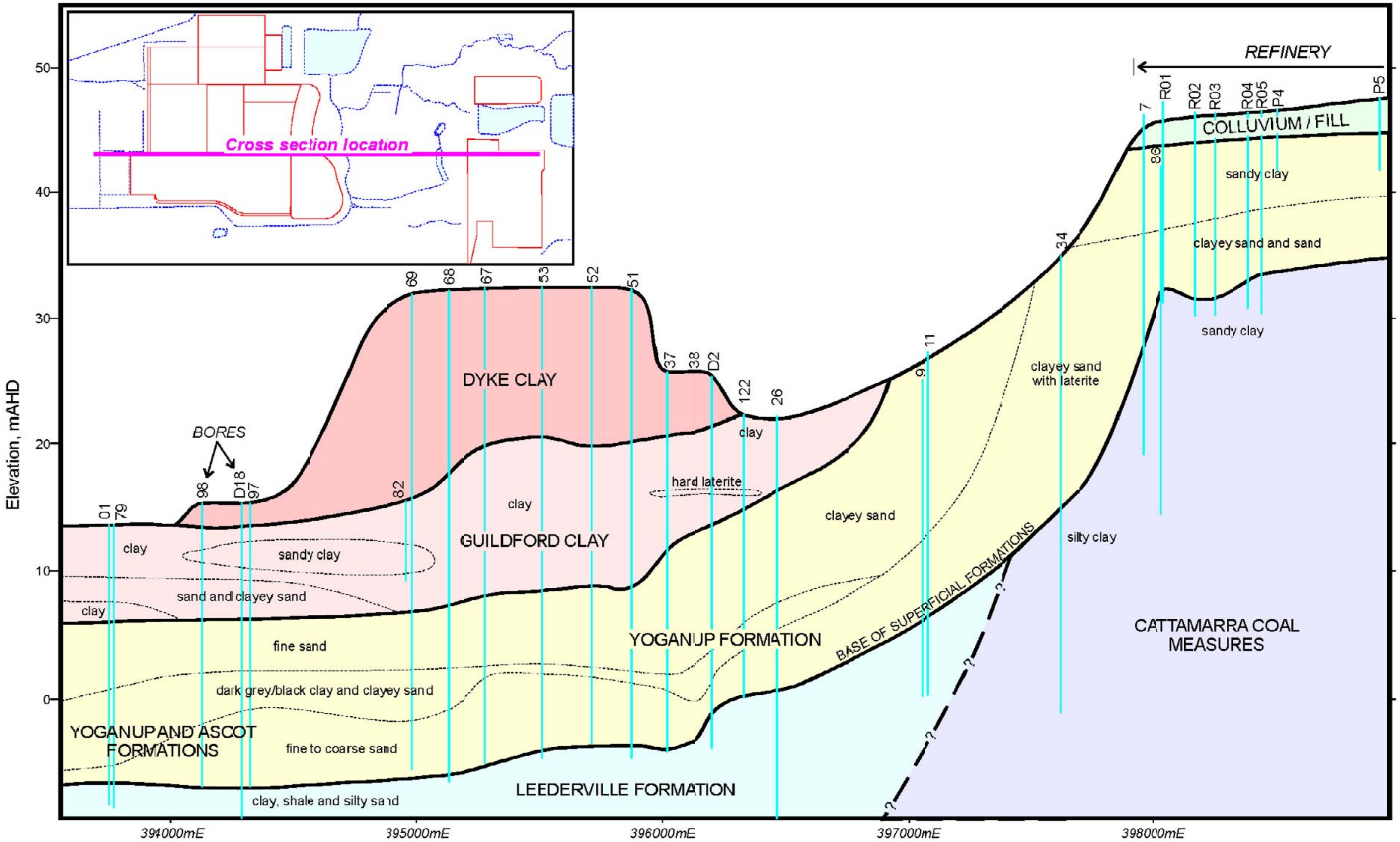
STRATIGRAPHIC CROSS SECTION BELOW THE RESIDUE AREAS AND REFINERY



SOURCE: Parsons Brinckerhoff/Nield Consulting, April 2004.

Figure 14

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Below the residue area, the low permeability clays and sandy clays of the Guildford Formation generally restrict vertical groundwater movement in the superficial aquifer. This is underlain by sands and clayey sands of the Yoganup and Ascot Formations. These sandy formations intercept and together form a regionally continuous aquifer, which is the main conduit for horizontal groundwater movement in the superficial formations. This aquifer is confined by the less permeable, overlying clayey materials of the Guildford Formation.

The contact between the Leederville and Yoganup Formations is generally identifiable due to a layer of carbonaceous or greenish-grey silty clay and shale. This layer restricts the vertical movement of groundwater between the superficial formations and the underlying Leederville Formation.

7.6.1 Groundwater Quality

A comprehensive groundwater monitoring program exists across the Wagerup operations which incorporate approximately 420 groundwater monitor bores. Groundwater quality monitoring is conducted as part of ongoing groundwater quality investigations and is also required by the DoE at several locations across the operations. Most bores are sampled twice yearly around April and November. Parameters monitored include pH, EC, alkalinity, sodium/chloride ratio, standing water level and uranium, in accordance with DoE Licence 6217/8.

Alcoa installed a set of regional groundwater monitor bores into the superficial and underlying formations around the refinery in 2001 (Figure 15). Results from these bores are being used to provide further information on regional groundwater flow, groundwater quality and general hydrogeology of the area (Alcoa, 2003). Monitoring results are reported to the DoE on an annual basis.

Groundwater quality investigations have identified groundwater contamination in certain locations beneath the refinery and the residue area. These investigations are contained in the Wagerup refinery Water Resource Management Plan and areas where most work has been undertaken are outlined below. Additional information is available in the Wagerup Annual Environmental Report, 2004.

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GROUNDWATER MONITORING LOCATIONS IN VICINITY OF REFINERY

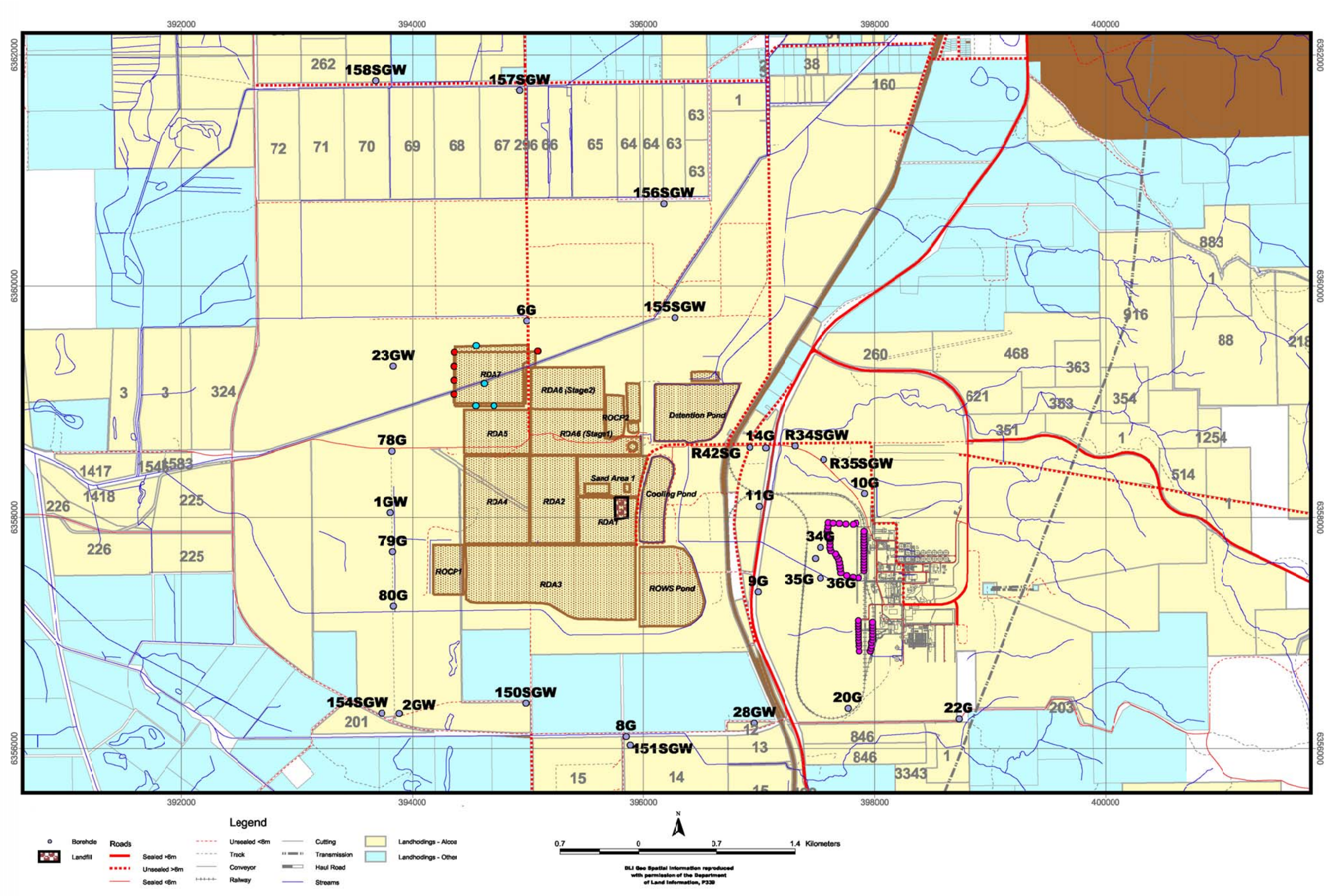

Figure 15

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7.6.1.1 Refinery Groundwater Quality

Monitor bores installed near refinery process buildings into the superficial formations have shown some low level contamination. Plumes of contaminated groundwater extend westwards beyond several process buildings and facilities notably in the area of the:

- northern refinery (Buildings 26, 25A, 30, 30A);
- southern refinery (Buildings 45, 45E);
- caustic unloading facility; and
- hydrate stockpile (now removed).

The highest contamination levels in the lower superficial formations in this zone are evident near the centre of a cluster of bores referred to as R17Y, R21Y and R46G west of Building 45 (Figure 16). Increasing alkalinity at down-gradient bores in 2002 and 2003 is consistent with the passage of a mobile plume with relatively low-level contamination past this point. This plume extends beyond the refinery footprint into adjacent land but has not impacted on surface water or environmentally sensitive areas.

In 2001 and 2002 the source of contamination near Building 45 was identified. A network of temporary monitoring bores were installed west of the northern refinery buildings and the caustic unloading facility in late 2003 to determine the extent of alkaline plumes from these areas. Alcoa review of groundwater data from these monitoring sites has been undertaken and further monitoring and investigations are recommended.

The former hydrate stockpile located in the south-west corner of the refinery was identified as a source of groundwater contamination and was removed in 2000. A series of temporary monitor bores were installed to the west of the hydrate stockpiles to determine the extent of contamination from this area. Since the stockpile removal, groundwater quality in the close vicinity has generally improved, although additional monitoring and investigations are recommended to better define the movement and spatial extent of the plume (Peck and Thomas, 2005). Additional monitoring should be continued to ensure the movement and spatial extent of the plume is well understood.

7.6.1.2 Residue Area Groundwater Quality

Some localised Low level groundwater contamination has occurred beneath the older residue area as a result of seepage from these facilities. Design and construction of the RDAs has improved significantly over time (with a clay seal, geomembrane and underdrain system) however the clay seal of the older RDAs are not 100% impermeable and some seepage may occur over time.

Elevated alkalinity and pH occur naturally in the Leederville Formation and in the superficial formations, due to the natural of weathering reactions of aquifer materials. In the lower superficial formations, a westerly trend of increasing alkalinity and pH is evident from the bores monitored. This trend may be enhanced by up-flow of groundwater from the Leederville Formation and by natural weathering reactions of aquifer materials in the superficial formations rather than due to alkaline contamination from the Wagerup operations. The trend of westerly increasing alkalinity is also evident in bores to the north and south of the residue area. It is very unlikely that these bores have been affected by residue leachate, due to the westerly groundwater flow.

However, below the residue area this natural trend appears to have been enhanced by seepage of residue leachate, particularly below the older residue drying areas (RDAs 1 to 4) (Gerritse and Thomas 2001, Nield Consultants and Parsons Brinkerhoff/Nield Consulting, 2004). The higher levels of contamination beneath RDAs 1 and 2 are in part due to the construction method of the monitor bores installed on the internal dykes, and operational practices. Monitoring bores on these dykes will be decommissioned in accordance with residue planning and groundwater remediation undertaken, if required.

High salinity in shallow groundwater in the vicinity of the residue area is thought to have been present prior to construction of the RDAs, due to extensive clearing for agriculture (intensive irrigation activities) and subsequent rising of the water table and evaporation. These high salinities would buffer the effects of minor leachate seepage on pH, alkalinity and sodium/chloride ratios in the groundwater. However, minor seepage of leachate is implicated by elevated alkalinities in bores around the residue area.

Elevated sodium/chloride ratios occur in numerous shallow bores near the eastern margin of the residue area. However, other chemical parameters indicate either low or negligible levels of contamination. At other bores, the presence of slight contamination may have had a relatively large effect on sodium/chloride ratios, due to the relatively low salinity of the natural water along the eastern margin of the residue area. Near-background water quality is evident in the more transmissive, lower superficial formations in this area (Gerritse and Thomas, 2001; Parsons Brinkerhoff/Nield Consulting, 2004).

Run-off Containment Pond 1 (ROCP1)

RCOP1 was commissioned in early 1992 to receive runoff water from residue deposited in RDA3 (refer to Figure 16). In 1997 it was discovered that an excessive pressure differential between the pond water and the underlying groundwater had caused heaving and rupture of the clay basement seal. This allowed pond water to move into groundwater. Elevated alkalinity (amount of carbonate, bicarbonate and hydroxide present in terms of calcium carbonate) has been observed downstream of ROCP1 in groundwater monitoring results. Low-level alkaline contamination has been recorded in the superficial aquifer beneath the pond and has moved at least 80 m in the near surface aquifer west of the pond. During part of each year a small volume of this contaminated groundwater discharges into shallow drains located 10 m to 20 m west of the pond. Sampling of the farm drains immediately west of ROCP1 and RDA4 and has shown elevated uranium levels (but below guideline values for irrigation and stock water use). Surface water monitoring down gradient of these locations does not show any elevated levels of uranium. Uranite, a natural mineral present in the aquifer is the source of the uranium that has been mobilised by the elevated levels of alkalinity, which are influenced by residue leachate contamination.

Current management includes reduction of seepage from ROCP1 through groundwater abstraction to equalise pressure on the clay seal, and reduced by maintaining low pond levels and reducing leachate inflow into ROCP1. Investigations during 2003 indicated that very low or non-existent contamination from residue sources is present in ground and surface water down-gradient of ROCP1.

Western Dyke of Run-off Water Storage Pond (ROWS).

Groundwater contamination in one of the bores located on the western dyke of the ROWS pond (Figure 16) was first observed in 1999. Further studies indicated that this bore may be acting as a vertical conduit, allowing contamination to move from the residue area into the lower superficial formations. As a result, the bore was sealed and groundwater quality monitoring results have since indicated significantly lower levels of alkaline contamination.

7.6.2 Groundwater Sources

The region along the Darling Range has complex deep hydrogeology due to faulting. At Pinjarra, Alcoa established a major groundwater supply from the Cattamarra Formation at a depth of around 100 m to 200 m. Alcoa undertook a preliminary investigation of groundwater potential in 1979/80 to see if a similar formation occurred at Wagerup. The investigation included the drilling of two exploratory wells to depths of 300 m to 400 m, which encountered low permeability strata and brackish groundwater. It was therefore concluded that a suitable groundwater resource was not likely to exist in the area (Layton Groundwater Consultants, 1980).

Alcoa currently holds a groundwater extraction licence for up to 550 MLpa to allow the operation of depressurising bores around the residue area. Abstraction is carried out under Groundwater Well Licence 102669, issued by the Water and Rivers Commission on 28 May 2001. The use of these bores is minimised in line with their depressurising role and in recent times approximately 250 MLpa has been abstracted and used as part of the refinery process water.

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GROUNDWATER MONITORING LOCATIONS IN VICINITY OF RDA

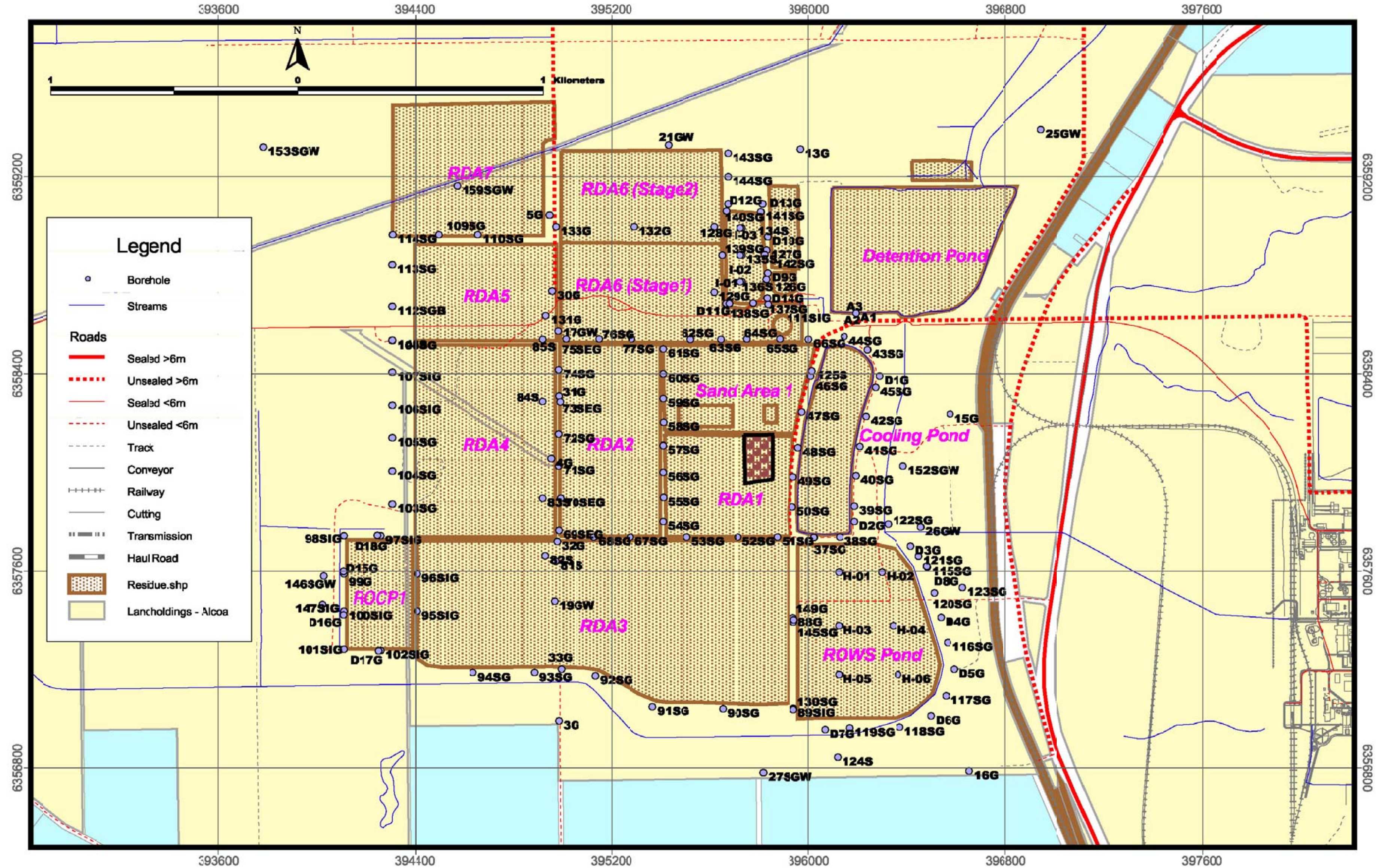

Figure 16

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7.7 FLORA AND VEGETATION

The Wagerup refinery and surrounding Alcoa farmlands is located on the eastern edge of the Swan Coastal Plain within the Pinjarra Plain System and on the Darling Scarp. The area lies on the edge of the Drummond and Dale Botanical Sub-districts within the Darling Botanical District of the Southwest Botanical Province (Beard 1979, 1980, 1981 and 1990). The Pinjarra Plain contains favourable soils for agriculture and extensive clearing following European settlement left very little of the original vegetation.

Prior to extensive clearing, the vegetation in well drained areas consisted of Marri (*Corymbia calophylla*) woodland with some Wandoo (*Eucalyptus. wandoo*) and Jarrah (*E. marginata*) in the higher areas. In lower lying areas subject to flooding, the vegetation would have consisted of *Melaleuca rhaphiophylla* low woodland or forest and thickets of *Melaleuca preissiana* or sedgelands (Beard, 1981).

Heddle *et al.* (1980) and Mattiske and Havel (1998) describe three vegetation complexes within vicinity of the Wagerup refinery:

- Guildford Complex: Dominated by a mixture of an Open Forest, in sections a Tall Open Forest of *Corymbia calophylla* (Marri) – *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* subsp. *marginata* (Jarrah) and Woodland of *Eucalyptus wandoo* (Wandoo).
- Forrestfield Complex: Dominated by an Open Forest of *Corymbia calophylla* (Marri) – *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* subsp. *marginata* (Jarrah) on the heavier gravely soils and of *Eucalyptus marginata* subsp. *marginata* (Jarrah) – *Corymbia calophylla* (Marri) – *Allocasuarina fraseriana* (Sheoak) on sandier soils.
- Darling Scarp Complex: Mosaic of Open Forest of *Eucalyptus marginata* subsp. *marginata* (Jarrah) – *Corymbia calophylla* (Marri), with some admixtures with *Eucalyptus laeliae* in the north, with some *Eucalyptus marginata* subsp. *elegantella* (Jarrah) and *Corymbia haematoxylon* in the south on deeper soils adjacent to outcrops. Woodland of *Eucalyptus wandoo* (Wandoo), low woodland of *Allocasuarina huegeliana* (Rock Sheoak) on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and the lithic complex on or near granite outcrops in all climate zones.

The Wagerup operations are in the majority surrounded by paddocks, used mainly for grazing of livestock. Near the residue area the paddocks have generally been levelled to allow even water flow and are irrigated by an extensive system of drains. Vegetation in this area consists of pasture grasses and a mixture of *Eucalyptus* spp. trees and shrubs. Some stands of native vegetation in good condition are located near the refinery but the majority of the trees located near the residue area have been planted as wind breaks and generally occur along fence lines and roads.

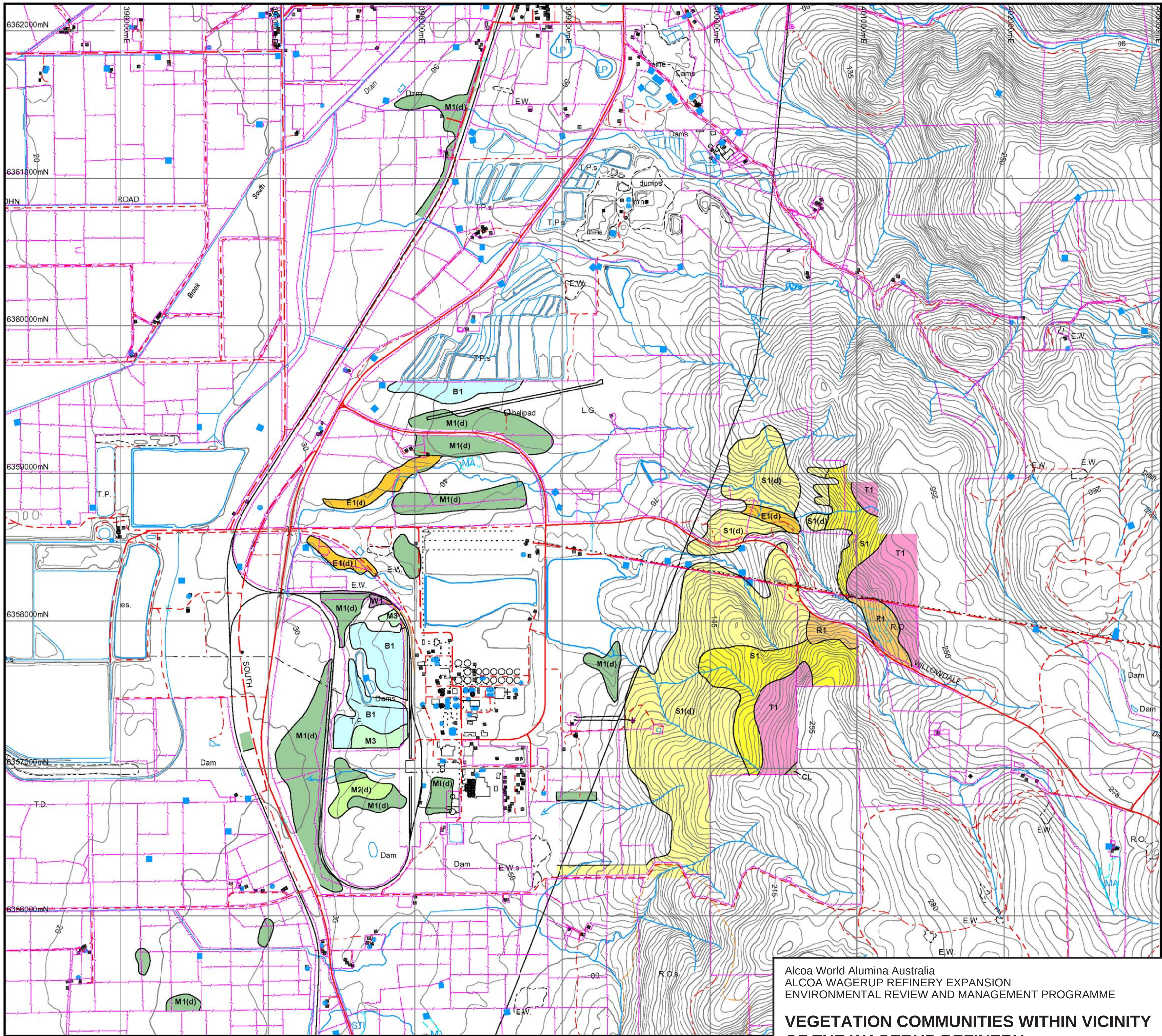
The Alcoa farmlands at Wagerup cover an area of approximately 6,000 ha. Of this approximately 65% is on clay flats and 35% on elevated terrain of the Darling Scarp. Mattiske Consulting was commissioned by Alcoa to undertake a flora and vegetation survey of selected remnant bushland areas on the Alcoa Farmlands adjacent to the Wagerup refinery.

Ten vegetation communities were defined and mapped for the remnant vegetation areas on the Alcoa farmlands, and compared with previous descriptions of vegetation in the area. Overall condition of the vegetation surveyed was very good with the exception of one site which had heavy weed infestation (Mattiske, 2003). Three vegetation communities are considered to be significant in a regional context (Figure 17). These are:

- M2(d): This vegetation community is equivalent to Community 3a defined by Gibson *et al.,* (1994) characterised by *Corymbia calophylla* (marri) – *Kingia australis* woodlands on heavy soil. This vegetation community occurs in a very small pocket southwest of the Wagerup refinery and at the time of the survey was very degraded with only a few native plants remaining. This community is listed as a Critically Endangered Threatened Ecological Community (TEC) at the State level, and Endangered under the *Environmental Protection Biodiversity Conservation Act* (EPBC Act) 1999.

- M3: This vegetation community is equivalent to Community 3b defined by Gibson *et al.,* (1994) as *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils. This community occurs in several small slightly degraded pockets adjacent to community B1. This community is listed as a Vulnerable TEC at the State level

- B1: This vegetation community has a mixture of *Banksia attenuata*, *Eucalyptus marginata* subsp. *marginata* and *Xylomelum occidentale* and is considered by Mattiske (2003) as equivalent to Community 20b described by Gibson *et al*., (1994). This community is listed as an Endangered TEC at the State level.



LEGEND

B1 - Woodland of *Banksia attenuata Eucalyptus marginata* subsp. *marginata* with occasional *Xylomelum occidentale* over mixed understorey on sandy soils (equivalent to the state listed TEC "20b" as defined by Gibson *et al*. 1994 and English and Blyth 1997).

E1 (d) - Woodland of *Eucalyptus rudis Corymbia calophylla* with occasional *Melaleuca rhaphiophylla* over *Taxandria linearifolia* on loamy soils in localized drainage lines.

M1 (d) - Disturbed Open Woodland of *Corymbia calophylla* over the occasional shrub and largely pasture species or loamy-sandy soils.

M2 (d) - Woodland of *Corymbia calophylla* over the occasional *Kingia australis*, shrub species and a range of pasture species understorey on loamy-sandy soils (equivalent to a disturbed variant of the critically endangered state listed TEC "3a" as defined by Gibson *et al*. 1994 and English and Blyth 1997 and the nationally listed endangered TEC EPBC Act 1999).

M3 - Woodland of *Corymbia calophylla Eucalyptus marginata* subsp. *marginata* over mixed shrub species on loamy-sandy soils (equivalent to the vulnerable state listed TEC "3b" as defined by Gibson *et al* 1994 and English and Blyth 1997).

R1 - Open Woodland *Corymbia calophylla - Eucalyptus marginata* subsp. *marginata* over shrub species reflecting shallow gravelly soils over granite such as *Grevillea bipinnatifida* (equivalent to Havel 1975a and 1975b - "R" site-vegetation type).

S1 - Open Forest of *Corymbia calophylla - Eucalyptus marginata* subsp. *marginata* with occasional *Banksia grandis* over mixed understorey on gravelly soils (equivalent to Havel 1975a and 1975b - "S" site-vegetation type).

S1 (d) - Disturbed Open Woodland of *Corymbia calophylla - Eucalyptus marginata* subsp. *marginata* with occasional *Banksia grandis* over mixed understorey on gravelly soils (equivalent a disturbed version of the "S" site-vegetation type as defined by Havel 1975a and 1975b).

T1 - Open Forest of *Corymbia calophylla - Eucalyptus marginata* subsp. *marginata* with occasional *Eucalyptus patens* over mixed understorey on loamy-gravel soils (equivalent to Havel 1975a and 1975b - "T" site-vegetation type).

W1 - Open woodland of *Eucalyptus wandoo Eucalyptus marginata* subsp. *marginata* over mixed understorey on clay-loams.

CL - Cleared Land

NOTES:

Horizontal Datum AMG84 (Zone 50)
Vertical Datum: AHD

This map is to be read in conjunction with Mattiske Consulting Pty Ltd Report numbered ALC0303/034/03

0 250 500 750m
Scale

SOURCE: Mattiske Consulting Pty Ltd, Dwg No. j714veg.dgn.

Alcoa World Alumina Australia
ALCOA WAGERUP REFINERY EXPANSION
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

VEGETATION COMMUNITIES WITHIN VICINITY OF THE WAGERUP REFINERY

Figure 17

ENVIRON

Drawn: KP
Date: 04-05

PINPOINT CARTOGRAPHICS (08) 9277 7763
wag-ERMP-f17.dgn

Three other vegetation communities described by Mattiske (2003) were considered to be locally significant:

- R1: This community is a relatively undisturbed Open Woodland of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* (Jarrah – Marri) over heath species such as *Grevillea bipinnatifida* and *Allocasuarina* species (with some *Banksia grandis* and the occasional *Eucalyptus patens*) on mid and upper slopes of the Darling Scarp. It is considered equivalent to Community R as defined by Havel (1975a and 1975b).

- S1: This is an Open Forest of *Corymbia calophylla – Eucalyptus marginata* subsp. *marginata* on mid and upper slopes of the Darling Scarp. This community is considered equivalent to Community S described by Havel (1975a and 1975b).

- T1: This is a relatively undisturbed Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* (with some *Banskia grandis* and the occasional *Eucalyptus patens*) on mid and upper slopes of the Darling Scarp. Understorey species include *Pteridium esculentum* and *Clematis pubescens*. This community is considered equivalent to Community T defined by Havel (1975a and 1975b).

All three of these communities are present on the Darling Scarp to the east of the refinery.

The remnant bushland areas contained on the Alcoa farmlands are managed in a manner to protect, restore and enhance these areas. This is achieved through planting of native species, fencing of bushland areas, removal of exotic species and working with the local landcare group, Peel Harvey Catchment Council, Harvey River restoration trust, Harvey Water and educational centres.

A total of 58 plant families, 170 genera and 324 plant taxa have been recorded Alcoa farmlands including 34 introduced species. The dominant families are Proteaceae, Myrtaceae, Papilionaceae and Mimosaceae (Mattiske, 2003).

Approved development of the residue area within the 30-year footprint identified in the 2001 LTRMS will occur on Alcoa farmlands, consisting of cleared paddocks with some isolated trees. Therefore the impact on vegetation will be minimal. Any further expansion outside of this existing 30 year footprint and the potential for impact on flora and vegetation will be managed through the Residue Planning Liaison Group (RPLG) and be subject to the requirements of the Minister for Environment (see Section 4.3).

7.7.1 Flora of Conservation Significance

The following three rare species, declared under the *Wildlife Conservation Act* (1950), have previously been located, or potentially could occur, in the Wagerup area:

- *Caladenia huegelii*: A rare orchid recorded on the ridge hill shelf communities by Fermco (1982);
- *Diuris purdiei*: A rare orchid that has been recorded in wetlands between Perth to Waroona, although it is rarely seen because it rapidly establishes after intense fires and then declines;
- *Synaphea stenoloba*: Previously recorded near the Pinjarra refinery and more recently near the old Wagerup townsite. This species may potentially occur in the remnant vegetation areas near Wagerup refinery.

The two orchid species are also listed under the EPBC Act 1999 as 'Endangered' (i.e., taxa which is not critically endangered and is facing a very high risk of extinction in the wild in the immediate or near future).

Based on current information, no Priority species were recorded in the Wagerup refinery area (Mattiske, 2003).

As the residue area will be expanded over the next 30 years in an area predominantly cleared for agriculture, the risk of impact on these species from existing and proposed developments at Wagerup is considered low.

7.8 FAUNA

The endemic fauna of the Swan Coastal Plain have not been well researched as a result of urban and agricultural development in this area occurring prior to extensive scientific fauna surveys being conducted (Anderson, 1984). In 1978, the Western Australian Museum conducted the most detailed fauna survey of the region which included the refinery area. Approximately 33 mammal species were listed including:

- grey kangaroo (*Macropus fuliginosus*);
- wallaby species (*M. irma, M. eugenii* and *Setonix brachyurus*);
- rat kangaroo (*Bettongia pencillatta*);
- possums species (*Trichosaurus vulpecula* and *Pseudocheirus peregrinus*),
- burrowing mammals (eg. *Macrotis lagotis* and *Bettongia lesueur*);
- dingo (*Canis familiaris*); and
- various small mammals including rats, mice and bats.

In addition to the mammals, a total of 223 bird species (including numerous water fowl), 70 species of amphibians and reptiles and 13 species of freshwater fish were recorded has having once occurred on the coastal plain (Anderson, 1984).

7.8.1 Fauna Recorded in the Proposal Area

A number of fauna surveys have been conducted at the Wagerup refinery with the latest being undertaken by Environmental Management and Research Consultants in 2002. The fauna survey was undertaken on the farmlands in the vicinity of the Wagerup refinery (refer to Figure 3).

The survey recorded 14 mammal species, including Grey Kangaroos, Bandicoots, Possums and Wallabies. The Brush-tailed Phascogale, Southern Brown Bandicoot, Brushtail Possums and Yellow-footed Antechinus (Mardos) were all trapped in the remnant jarrah woodland just west of the refinery. Seven introduced mammal species were recorded during the 2002 survey, including fox's, cats, rabbits, rats and mice. Of these, the fox is considered the species of most concern, due to its prevalence throughout the area and predatory nature.

Eighty-six bird species were recorded during the 2002 survey, including the following species, Crebe, Commorant, Heron, Ibis, Duck, Kite, Hawk, Eagle, Cockatoo, Cuckoo, Parrot, Wren, Magpie and Honeyeater.

Eleven reptile species were sighted or trapped in the 2002 survey, with a further eight species reported by Alcoa staff, making a total of 19 recorded species. Eight or possibly 10 frog species were recorded during the survey. Species recorded included Gecko, Lizards, Skinks, Goanna, Tortoises, Snakes and Frogs.

7.8.2 Threatened Fauna

Only one officially gazetted rare species was recorded. Baudin's Cockatoo (formerly named the White-tailed Black Cockatoo) is listed as Vulnerable under the Commonwealth EPBC Act 1999 and 'Rare, or likely to become extinct' under the WA *Wildlife Conservation Act* 1950. This species was recorded in two sites, one at the base of the Darling Escarpment on Yalup Brook. The site is mostly cleared with some remnant trees and tall shrubs along the brook. The second site is further downstream and is mainly cleared with some remnant vegetation along the brook (EMRC, 2002). The expansion of the Wagerup refinery occurs within the refinery's existing footprint and will not impact on the sites where the Baudin's Cockatoo was recorded or other areas of remnant vegetation.

There were no other fauna species recorded at Wagerup in 2002 officially listed as either rare or specially protected under the WA *Wildlife Conservation Act* 1950, or in any category under the Commonwealth EPBC Act 1999 (EMRC, 2002).

7.9 EXISTING AIR QUALITY

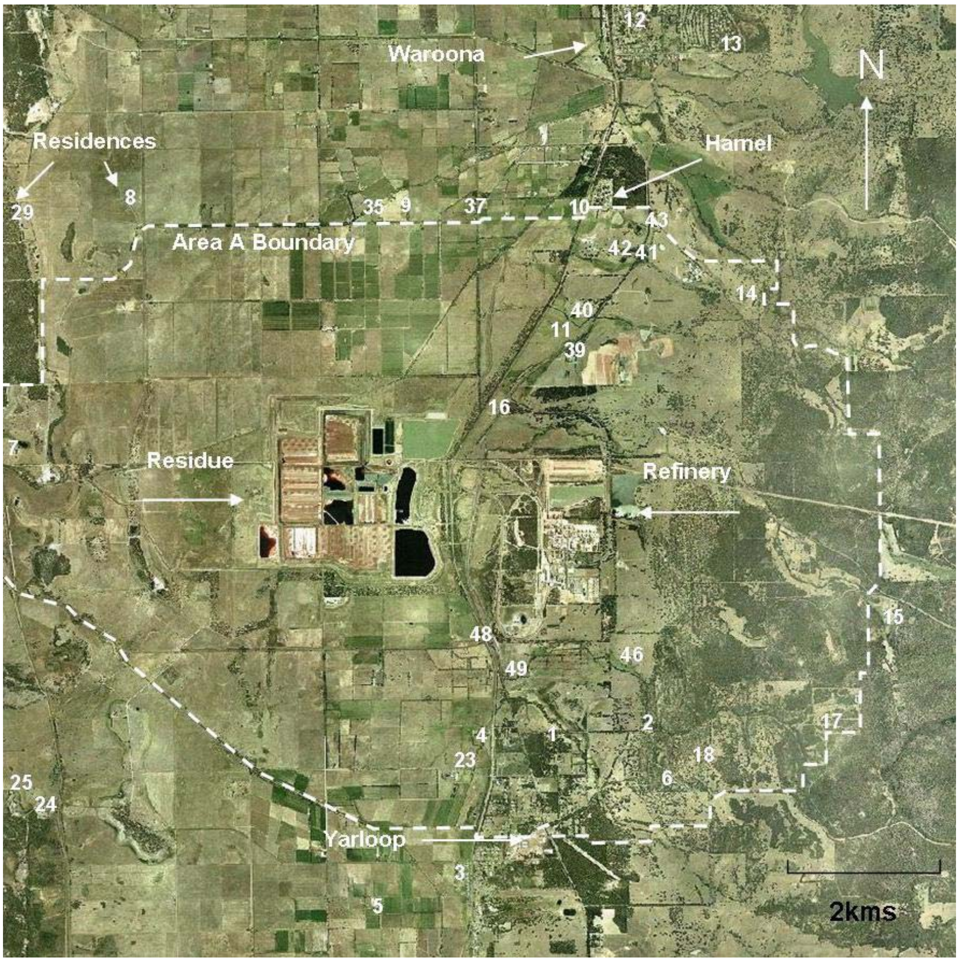
7.9.1 Background

Wagerup has an extensive ambient air monitoring programme in place. This programme has been evolving over several years, in response to concerns and requirements of the community and the environmental regulator. A key role of the ambient monitoring programme is to address the requirements of the environmental licence, which specifies ambient targets and limits for key parameters. In addition Alcoa has undertaken a range of voluntary and joint ambient monitoring projects with DoE, the Chemistry Centre of WA (CCWA), CSIRO and the community. The following sections provide a brief summary of the existing ambient air quality in the vicinity of the Wagerup Refinery with a focus on volatile organic compounds (VOC), odour and dust. More detailed information is available in the Air Quality Summary Report (AQSM) in Appendix G.

Figure 18 shows the base map upon which all modelling results (contours) are overlaid. The following information is shown on the base map:

- Residence locations – shown by white numbers;
- Nearby townsites – Yarloop, Hamel and Waroona;
- Refinery and residue area;
- Area A boundary – shown by dotted white line

Figure 18: Base map outlining the key features for modelling studies



7.9.2 Volatile Organic Compounds

A study was undertaken in 2004 to provide detailed information on the ambient air quality in the region surrounding the Wagerup alumina refinery, including the townships of Waroona and Yarloop and the associated rural environment.

274 volatile chemical compounds were analysed for. Of these, 35 compounds were identified at quantifiable levels, and a further 31 were indicated in some samples but at levels too low to quantify. The compound types identified were: aldehyde and ketones (29 different compounds), aromatics (9), alkanes & cycloalkanes (14), alcohols, phenols & cresols (8), heterocycles (2), organohalides & halides (3) and others (1)

The overall air quality was found to be typical of rural environments in both the nature and the levels of chemical compounds detected, except for acetaldehyde which was elevated. All of the compounds detected were at levels well below applicable environmental and health standards (Van Emden and Power, 2005).

The main chemical compounds detected are all known to be present in refinery emissions. The levels found in the ambient environment are generally many times greater than the predicted refinery influence for each compound based on dispersion modelling of refinery and RDA emissions. Additionally, the chemical compounds detected and their levels in the atmosphere showed little spatial variation and for the most part appeared to be randomly distributed, limiting the ability to attribute specific sources (Van Emden and Power, 2005).

Elevated levels of both carbonyls and VOCs were found at the Waroona and Yarloop township sites, consistent with the effects of human activities associated with the use of fossil fuels. Sampling sites closest to the refinery generally showed lower concentrations of the compounds measured, although indications of higher than average levels of carbonyls were detected at the Boundary Rd and to a lesser extent the Hoffman Rd sites.

The Wagerup Ambient Air Quality Monitoring Programme (Van Emden and Power, 2005) outlines the contribution of refinery emissions to the most prevalent VOC's detected at Boundary Road. All compounds shown in the Table 12 were detected at concentrations typical of rural environments and well below levels of concern. These same compounds are present in refinery emissions, and the ground level concentrations (GLC's) for the compounds have been calculated by Commonwealth Scientific and Industrial Research Organisation (CSIRO) using the The Air Pollution Model (TAPM). It is therefore possible to estimate the approximate contribution of the refinery emissions to the ambient environment for each compound (Van Emden and Power, 2005).

It can be seen (refer to table 12) that the refineries contribution is small in comparison to the background concentrations from other sources, which are likely to be a combination of natural and anthropogenic sources (Van Emden and Power, 2005).

Table 12: Existing Refinery Contribution to Ambient VOC Concentrations at Boundary Rd

	Measured Ambient Levels (over a 6 week monitoring period)		**Refinery Contribution**
	Average [1]	Max Detected	Peak 24hr 95%*
	ug/m3	ug/m3	ug/m3
Formaldehyde	3.3 [2]	6.8	0.06
Acetaldehyde	2.6 [2]	11.4	0.15
Acetone	1.3 [2]	5.4	0.65
Propanal	0.31 [2]	1.0	
Hexanal	0.2 [2]	0.5	
MEK	0.16 [2]	0.6	0.07
Benzaldehyde	0.14 [2]	0.6	
Benzene	non detect	non detect	0.02
Toluene	non detect	non detect	0.05
Acrolein	-**	0.25	

*Peak 24-hour 95th percentile values

**Insufficient data to calculate averages

1 – 6 week means of all samples at the Boundary Rd site.

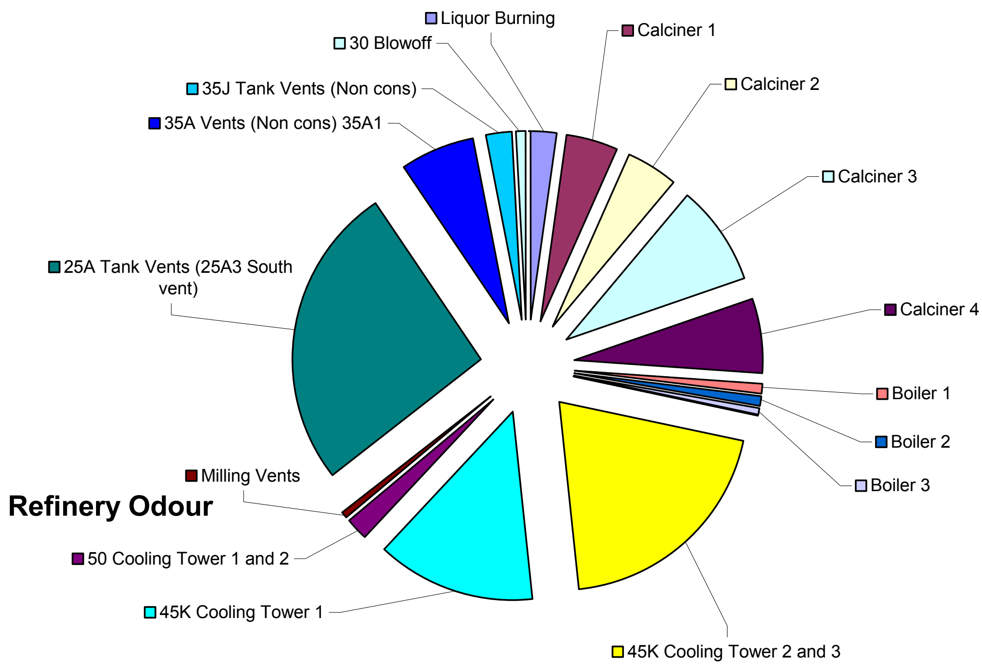
2 - taken as 8 hour sample from 7am to 3pm, 3 days per week

This outcome is consistent with a conclusion that the levels of chemicals in the ambient atmosphere surrounding Wagerup Refinery are dominated by human and natural processes (fires, vehicles, urban activity) other than the refinery operation.

7.9.3 Odour Emissions

The major sources of odour at Wagerup Refinery currently are the calcination stacks, 25A slurry vents, and the precipitation building (45) cooling towers. Liquor burning, digestion (30) and evaporation buildings have been significant sources in the past, but with emission reductions performed over 2000 – 2002 have now been almost eliminated, or reduced to very minor contributors. Less prominent though still significant sources of odour are the green liquor tank (35A) vents and causticisation building (35J) vents. A pie chart showing the breakup of odour contributions for the above sources is given in Figure 19 below:

Figure 19: Wagerup Refinery Odour Source Contributions



The RDA and diffuse area sources including the drying areas, cooling pond, Superthickener, and Lower Dam are additional sources of odour that vary with temperature, time of day, season and wind speed. These sources are discussed fully and presented in the report entitled 'Air Dispersion Modelling of Fugitive Emissions', Wagerup Refinery (Air Assessments, 2005).

There are many potential sources of background odour in the surrounding environment including: -

- rural and agricultural odours related to farming and livestock operations;
- odours related to combustion emissions from vehicle traffic, wood burning heaters, bushfires and prescribed burns;
- natural odours related to biogenic (living trees and plants) emissions from forests and bushland;
- odours related to breakdown and rotting of vegetation in the natural and agricultural environments;
- odours emanating from solid waste storage and disposal activities – both domestic and commercial/industrial;
- odours related to fuel storage and distribution activities; and

- other odours related to human activity such as cigarette smoking, cooking and heating, and recreational activities such as trail bikes, off-road vehicles, power boating and the like.

While background odours would generally be clearly distinguishable from odour of refinery origin when at levels where odour recognition is possible, this will not be the case at odour threshold levels.[2] This means that for odours barely above their detection threshold, the character and origin of the odour can be quite difficult to positively identify. At these sorts of levels there is likely to be some confusion as to the true source of odours, making positive identification of the odour source difficult. Thus an odour needs to be clearly recognisable before its source can be confirmed with any confidence.

The modelled odour levels for the current Wagerup refinery operations (includes RDAs) are shown in Figure 20 and 21. The odour levels have been predicted through dispersion modelling using TAPM for the refinery sources and Calpuff for the RDA and diffuse area sources. Odour emission rates used in the modelling were based upon measured odour emission rates and a odour/VOC regression relationship developed by Alcoa using all available refinery odour and VOC emissions data. The development of the relationship and its statistical properties is described fully in the Air Quality Summary document in Appendix G.

It should be noted, that in a comparison of model performance against measured odour concentrations reported by Sinclair Knight Mertz (2002) found TAPM may over-predict ground level concentrations from low height refinery emission sources, which are important contributors to the modelled ground level concentrations of odour. This could mean the predicted odour contours in Figures 20 and 21 may be higher than what would actually occur for the existing refinery. Discussions on predicted odour concentrations for the Proposal and emission controls works is detailed in section 8.3.8.

[2] By definition the odour detection threshold is the point at which an odour is only just detectable (able to be sensed by 50% of the population, meaning that 50% are not able to sense it).

Figure 20: Average (99.5th percentile) 3-minute odour concentrations for the existing refinery. Contours in odour units/m^3

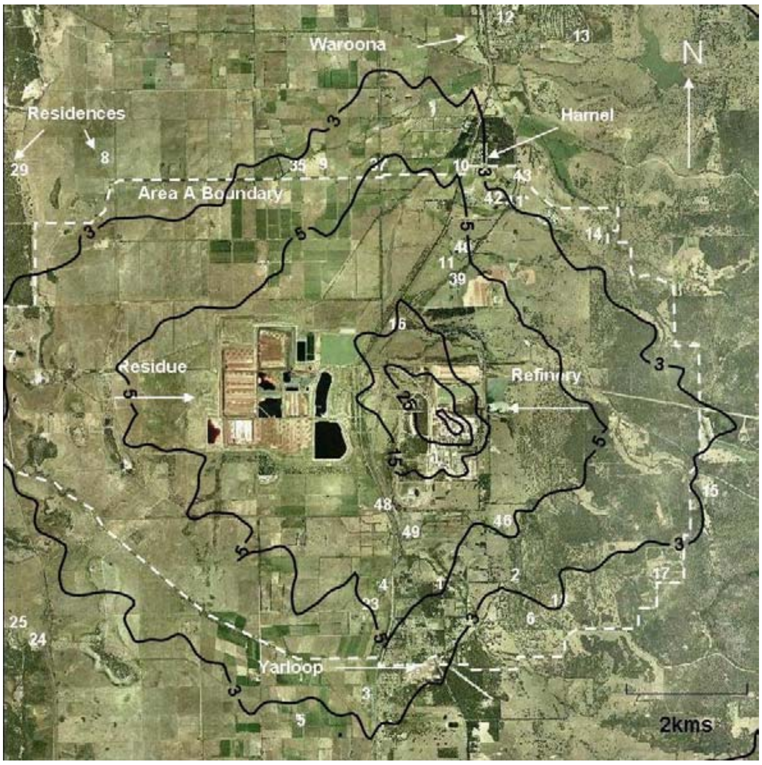


Figure 21: Peak (99.9th percentile) 3-minute odour concentrations for the existing refinery. Contours in odour units/m^3.

Two previous field odour surveys have been carried out in the Wagerup region by Environmental Alliances (Sinclair Knight Merz, 2002; Environmental Alliances, 2003). These surveys attempted to capture information from actual refinery plumes as a function of distance from the refinery. The work was therefore carried out in the winter months under morning conditions when the meteorology was considered conducive to the grounding of the refinery plume. The technique was successful in capturing odour events and tracking the intensity of plumes as at various distances from the refinery. The collected data was used to ground truth predicted odour levels in the vicinity of the refinery from dispersion modelling.

The odour levels predicted and presented in Figures 20 and 21 vary from the previous modelled odour contours predicted by SKM in 2002. The reasons for these differences are outlined following.

1. Odour emission rates used in the 2004/5 dispersion modelling were based on the development of an odour/VOC regression relationship. This is described more fully in an Alcoa report by (Peterson, 2004 – refer Appendix G). The use of a regression relationship improves the statistical validity of odour emission rates derived from VOC emission rates for the following reasons: -

    - Uncertainty for individual and collective odour concentration measurements is higher than that for individual and total VOC and carbonyl species measurements. This is because the accuracy and precision of chemical species measurement is greater than that for dynamic olfactometry;
    - A greater number of VOC and carbonyl monitoring runs performed compared to odour monitoring, especially since late 2002 onwards. This increases the statistical significance and reduces the uncertainty of VOC and carbonyl monitoring results;
    - By extension (through the regression relationship) use of a greater number of VOC monitoring results improves certainty and statistical significance of estimated odour emission rates.
    - Use of a regression relationship also enables prediction of odour concentrations for future emissions knowing what actions and reductions will be achieved in VOC emission rates.

2. For a number of sources the odour emission rates used in modelling the expanded refinery are significantly changed to those previously published and used in past odour modelling. These changes are both positive (reductions) and negative (increases). The overall effect of the changes is an increase in the total refinery odour emission rate estimated for the base case of April 2003 – March 2004.

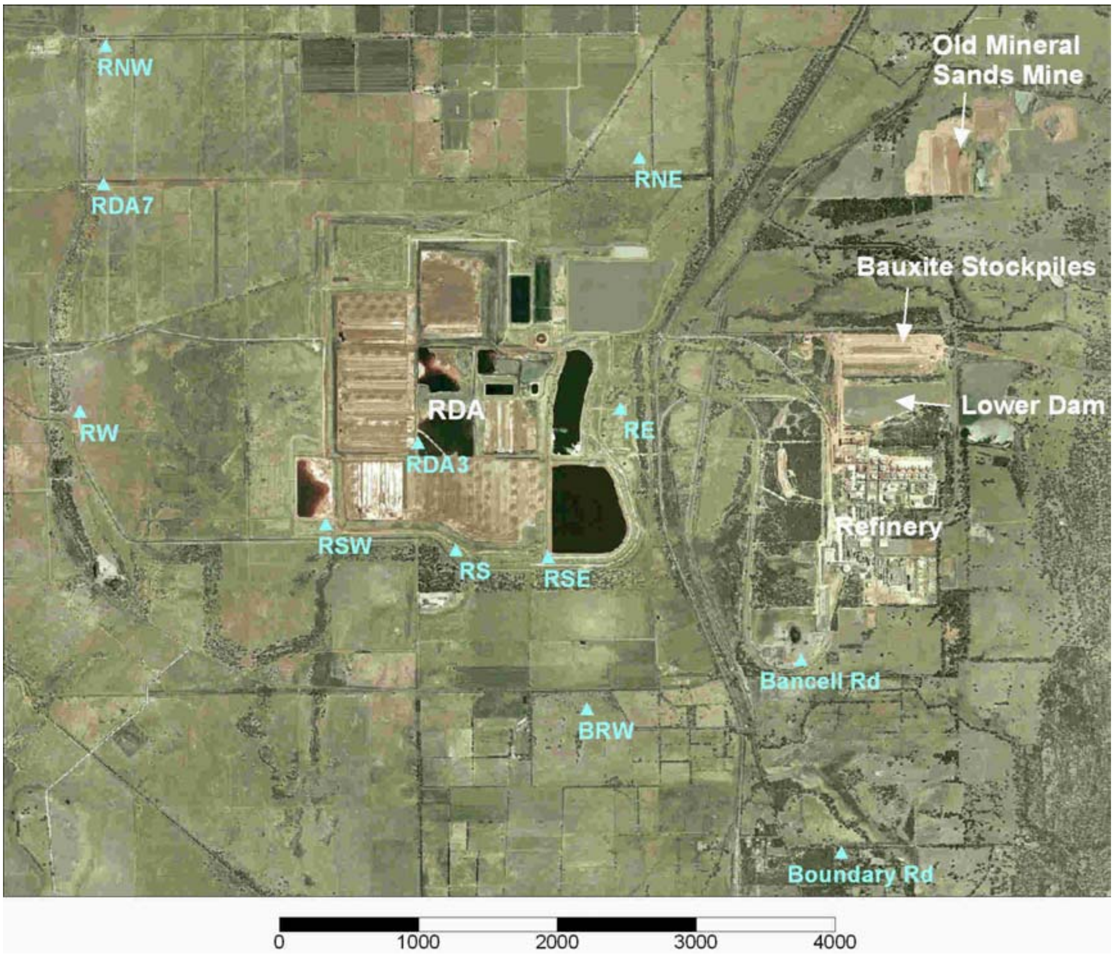
Key sources within the refinery had differing odour emission rates compared to what was modelled in 2001. The most notable differences are related to the following sources, 25A slurry tank vents, the 35A and 35J tank vents, the calciners (2 and 3) and the cooling towers.

Detailed information on the odour modelling is provided in Air Quality Summary Report in Appendix G

7.9.4 Ambient Particulate Emissions

Alcoa has a network of dust monitors (TSP and PM10) located around the Wagerup refinery operations, the locations are shown on Figure 22. The locations have been chosen to provide information on dust levels for all the main wind directions, and the sites are in conformance with AS 2922-1987. Results of the monitoring are given in the Annual and Triennial Environmental Reviews, submitted by Alcoa to the DoE.

Figure 22: Wagerup Refinery Dust Monitoring sites (aerial photo 2003)



A summary of background particulate concentrations represented as Total Suspended Particulates (TSP) and PM_{10} (particulate matter less than 10µm) is provided in Table 13. The data indicate that background TSP levels at Wagerup are low, below the Kwinana EPP standard and limit. For PM_{10} there was 1 day just above the NEPM standard in the 12 month period, but this is well below the goal of no more than 5 exceedances per year. As a comparison to the Wagerup PM_{10} concentrations, the PM_{10} concentrations from the Bluewaters site (5 km NE of Collie) are also presented from SKM (2005a). This shows similar, though slightly higher concentrations than at Wagerup (Air Assessments, 2005).

Table 13: Wagerup Background Particulate Concentrations

Statistic	Wagerup Background TSP	Wagerup Background PM_{10}	Collie (Bluewaters) PM_{10}
Years	4 years (2000/2001 - 2003/2004)	1 year (2004)	3 years (2001-2003)
Maximum	59 - 86 (64)	50.6	73
# of Exceedances of NEPM standard	NA	1	0.66 (ave for 3 years)
90th Percentile	23-31 (26.5)	21.8	23.6
70th Percentile	16-19 (17.8)	15.4	16.0
Average	13.8 - 17.4 (15.3)	12.1	14.1

Notes:

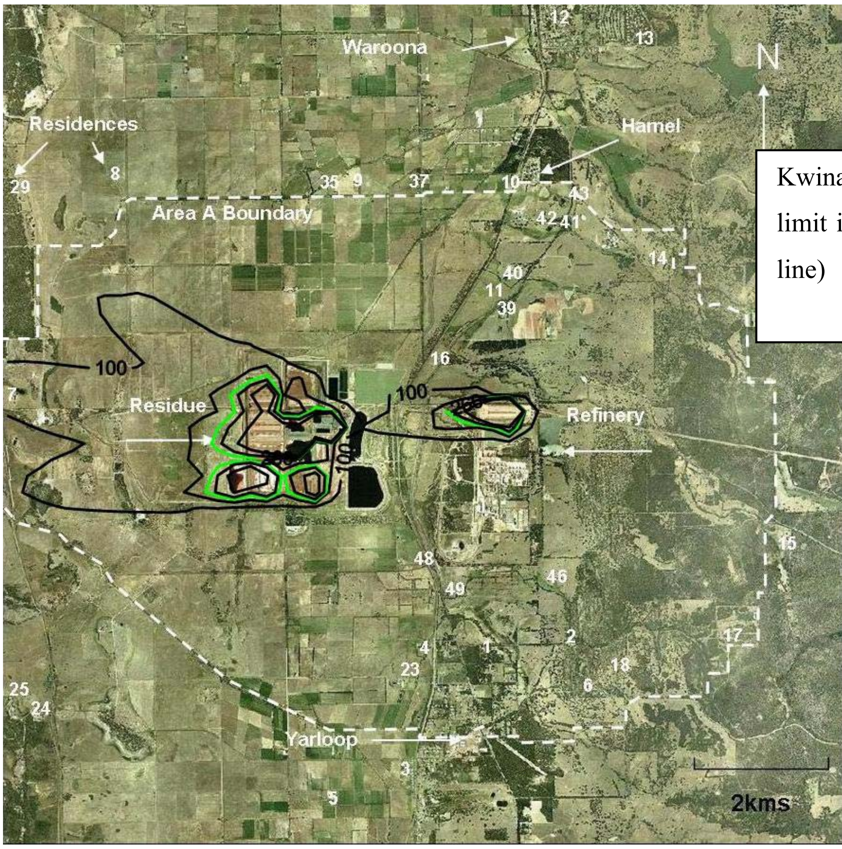
1) Wagerup Background TSP are given for the range of concentrations for the 4 years and for the average of the 4 years (in brackets). Collie (Bluewaters) maximum is the maximum of the 3 years, whilst other statistics are the averages of the three years.

The main source of fugitive particulate emissions from the refinery operations are from uncontrolled sources such as dust from residue drying areas, dust from the material handling operations such as stacking and reclaiming at the bauxite stockpiles and wind generated dust from the stockpiles.

Ambient particulate levels are also influenced by external factors such as the mineral sands mine to the north of the refinery (previously "mothballed" now operational – refer Figure 22), farming operations that dependent on the time of year can be a significant source of dust, and particulates from burning off and wildfires.

Modelled particulate emissions (TSP and PM_{10}) for the current Wagerup refinery operations are shown in Figure 23 and 24. The particulate emissions have been predicted through dispersion modelling using TAPM for the refinery sources and Calpuff for the RDA and diffuse area sources. The RDA and diffuse area sources are the greatest contributors to the Wagerup refinery operations particulate emissions.

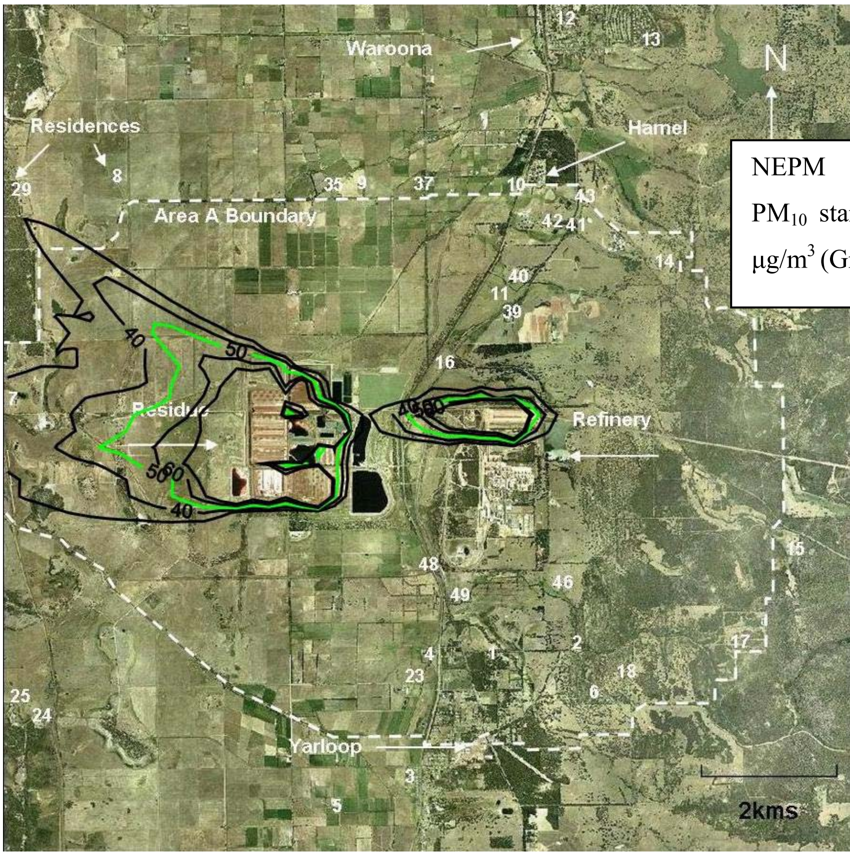
Figure 23: Maximum 24-hour average dust (TSP) concentration for existing Wagerup Refinery Operations. Contours in µg/m^3



Kwinana EPP Area B limit is 260µg/m^3 (Green line)

As can be seen from Figure 23 the refinery contribution to the TSP levels is small and at all receptors well within the 260 µg/m^3 limit identified in the Wagerup Refinery licence and based on the Kwinana EPP

Figure 24: Peak (99.5th percentile) 24-hour average dust (PM10) concentrations for existing Wagerup Refinery Operations. Contours in µg/m³



NEPM 24-hour PM_{10} standard is 50 µg/m³ (Green line)

As can be seen from Figure 24 the refinery contribution to PM_{10} levels is well within the 50 µg/m³ standard identified in the NEPM at all receptors

Detailed information on ambient and modelled dust emissions is provided in Air Quality Summary Report in Appendix G

7.9.5 Bunbury Port Emissions

Alcoa's Bunbury Shipping Terminal is located in the Inner Harbour complex as part of the Bunbury Port Authority facilities. Alcoa's port operations receive, store and transfer alumina to, and caustic from, ships for the Pinjarra and Wagerup refineries, along with handling alumina for the Worsley Alumina Refinery. Caustic soda solution is imported and transported to the refineries by rail from Alcoa's caustic storage facilities at Bunbury Port.

Alcoa has an *Ambient Air Monitoring Strategy* (Document No. 59498) that forms the basis of air quality monitoring programmes at each of its facilities within Western Australia. The strategy is risk based and designed to provide information for location environmental professionals to make the most appropriate decisions regarding air quality. The strategy is a general approach, and specific procedures for dust monitoring and measures to reduce dust at the Bunbury Port are also used.

Dust monitoring at the Bunbury Port consists of a series of strategically placed High Volume Air Sampling (HVAS) units monitoring total suspended particulate (TSP) dust levels and one HVAS unit monitoring dust levels of particulates less than 10 µm (PM_{10}). Data are primarily used for dust control performance monitoring. One TEOM is placed at various sites within the location when high resolution data is required. Monitoring procedures for the HVAS are designed to comply with AS/NZS 3580.9.3:2003: *Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method* and AS/NZS 3580.9.6:2003: - *Determination of suspended particulate matter - PM_{10} high volume sampler with size-selective inlet - Gravimetric method*.

In addition to externally imposed particulate emission standards, Alcoa uses internal standards to measure the performance of control practices on dust levels. The internal standards relating to dust control at the Bunbury Shipping Terminal are 260 ug/m^3. The monitoring locations are provided in Table 14 following:

Table 14: Bunbury Shipping Terminal Monitoring Locations

Monitoring Site Name	Monitoring Site Code	Monitoring Type	Monitoring Site Status	Parameter Measured	Data Type
A1 Conveyor	CA001	HVAS	Active	TSP	24 hours average
	CA002	HVAS	Active	PM_{10}	24 hours average
Worsley	WA001	HVAS	Active	TSP	24 hours average
Hot Water Port	HW001	HVAS	Active	TSP	24 hours average
Port Authority	PA001	HVAS	Active	TSP	24 hours average
NE boundary	BU001	TEOM	Active	PM_{10}	Continuous

The main potential sources of dust at Alcoa's port operations are ship loading activities, conveyor operations and filling of the alumina bins.

Air quality monitoring data indicates 156 results above the 260 ug/m^3 internal standard in 2003, and 95 in 2004. However, due to the close proximity of other dust sources to Alcoa's Port operations it is difficult to know how many of these results were actually caused by Alcoa's operations. During 2004 a significant capital project was completed to upgrade Alcoa's shiploader (installing a Cascade Cleveland Chute) resulting in significantly reduced dust emissions during ship loading. Another significant project is currently underway to reduce dust from the conveyor galleries, mainly for occupational hygiene reasons, but this will also provide environmental benefits.

7.10 COMMUNITY HEALTH

7.10.1 Summary of Health Surveys and Research

University of Western Australia Health Survey, 2001

In August 1999, the Survey Research Centre (SRC) undertook a survey of residents near Wagerup refinery at the request of the Environmental Health Service of the Department of Health of Western Australia (Mercer, 2001). The purpose of the survey was to investigate claims of health effects experienced by residents of the Yarloop area living in close proximity to the Wagerup refinery.

Fifteen families who had made themselves known to the Wagerup Community Health Awareness Group were selected for the study. The families chose to report on 31 out of 44 people, as the 31 were considered by the families to be affected. Fourteen of the 15 residences were located in a small area in the northern corner of Yarloop.

Results of the survey included the following points:

- 23 out of 31 people (74%) said their symptoms started between 1995 and the survey;
- 21 out of 31 people (68%) noticed the symptoms in a particular season, with winter being the most common (61%), followed by autumn (35%);
- 22 out of 31 people (71%) noticed the symptoms under specific conditions in which the winds were from the north or north-east and there was cloud cover or humid/damp atmosphere;
- 10 out of 31 people (32%) reported some symptoms experienced elsewhere, most locations being in Yarloop or near the refinery and the residue area. One person reported experiencing the symptoms in any situation in which there is exposure to pollution or chemicals including cleaning products and synthetic materials;
- 13 out of 31 people (42%) reported experiencing a symptom without an odour being present;
- 18 out of 31 people (58%) reported experiencing a symptom and an odour at the same time. The odours were described as “wet cement”, “caustic smell”, “like Kwinana refinery”;
- 14 out of 31 people (45%) experienced an odour with no symptoms. The odour was described as “caustic”, “sulphur like”, “like lime”; and
- 18 out of 31 people (58%) had sought medical attention related to their symptoms.

Symptoms were categorised by type and frequency.

- 18 out of 31 people (58%) reported 4 or less symptom types;
- 27 out of 31 people (87%) reported at least 1 mucous membrane symptom (eyes, nose, mouth, throat, lower respiratory tract);
- 22 out of 31 people (71%) reported at least 2 mucous membrane symptoms; and

- Approximately 50% reported at least 3 mucous membrane symptoms.

Reports were sought from doctors treating 18 of the 31 people. Eleven reports were returned on 4 people:

- For one person "the doctors considered that the conditions experienced by the subject were not relevant to chemical exposure."
- For one person "although extensive tests were performed no specific diagnosis was proposed."
- For one person "allergic and vasomotor rhinitis were diagnosed."
- For one person "some allergies had been identified and chronic eczema diagnosed." Allergic rhinitis had also been diagnosed.

The conclusions of the study included: "Only two of these subjects appear to have symptoms consistent with existing descriptions of MCS (multiple chemical sensitivity)" and … "It is reasonable to conclude that there is a commonality between the symptoms experienced by the respondents to the questionnaire. It seems that a mucous membrane irritant is present in the atmosphere and is affecting the group of people who live on the northern border of Yarloop. This irritation occurs under certain climatic conditions and is often accompanied by an odour." (Mercer, 2001).

<u>The Medical Practitioner's Forum</u>

The Government of Western Australia established a Medical Practitioners' Forum (MPF) to investigate concerns that emissions from the Wagerup refinery were impacting on community health. The MPF was headed by Professor D'Arcy Holman, Head of the School of Population Health at the University of Western Australia. The MPF included eminent health professionals and representatives from relevant government agencies. The Forum was convened on 19 September 2001 in Perth and 23 October 2001 in Mandurah. Having reviewed the available data and consulted with the medical fraternity and local community the MPF made a series of recommendations to government. Alcoa undertook several measures in response to the recommendations.

1. *Further research into identifying causality is unlikely to be rewarding and hence should not be a major priority. However an open dialogue should be maintained on this issue and it is recommended that a workshop on Multiple Chemical Sensitivity be convened by the Department of Health.*

In February 2002, Professor Mark Cullen visited Western Australia. Professor Cullen is an international expert on multiple chemical sensitivity (MCS). He is Professor of Medicine and Public Health at Yale University and is also Chief Medical Adviser to Alcoa. Professor Cullen discussed the issue of MCS with the Minister for the Environment, health professionals, the MPF, members of the community and government officials.

Professor Cullen provided a report on his investigations into the Wagerup refinery issue and Alcoa has followed his recommendations. This report is described in further detail later in this section.

2. There needs to be improved focus on the clinical management of these affected people. There needs to be a focus on getting affected people out of the exposure situation.

In relation to employees, Alcoa developed appropriate rehabilitation measures which involved alternative duties with minimal exposure to emissions. With regard to community members, the Department of Health operated a community health clinic at Yarloop during the period November 2002 to October 2003. The Community Health Nurse's report is described elsewhere in this document.

3. The Forum supported exposure reduction via a planned buffer zone.

Alcoa had developed a land management strategy with the aim to:

- Give people choice about whether they continue to live where they do;
- Protect property values; and
- Invest in the future of Yarloop and Hamel.

4. The Forum supported exposure reduction via reduction of emissions.

Since 1998, Alcoa has invested over $40 million on emission reduction projects at the Wagerup refinery. These environmental projects included:

- Installation of a Catalytic Thermal Oxidiser and high efficiency scrubber on the liquor burning plant, reducing VOC and odour emissions by over 90%.
- Significant overall reductions in refinery odour emissions, verified by a government-appointed independent auditor in May 2003 and a CSIRO review in May 2004.
- Development of new technology to capture gases from the digestion system.
- Construction of a multi-flue calciner stack to increase dilution and reduce emission ground-level concentrations.
- Installation of low nitrogen oxide burners to reduce power station emissions.
- A significant reduction in refinery noise at the refinery boundary (5 decibels)

Comprehensive ambient air quality data has been collected and analysed. All of the data demonstrates compliance with relevant standards and guidelines such as the National Environmental Protection Measures (NEPM).

5. There be an ongoing commitment to surveillance and monitoring and review process involving this Medical Forum.

The MPF met five times, with the last meeting on 4 June 2003. The various actions and improvements outlined above were considered and discussed.

6. *That further opportunities be explored that will reduce exposure at the individual worker level.*

The extensive emission control measures described above clearly reduced exposures both within the refinery and in the surrounding area

7. *That a delegation of this group, headed by the Chair (Prof. Holman), meet with the community and workers as well as briefing the Ministers for the Environment, Health and Minerals and Petroleum Resources.*

A delegation from the MPF, headed by Professor Holman, met with the Minister for the Environment and the Minister for Health. A Ministerial Council comprising these Ministers and the Ministers for State Development and Consumer and Employment Protection reviewed the Forum's recommendations.

The MPF also undertook consultation with government agencies and the local community. A public information evening was arranged by the Department of Health (DOH) to present and discuss the findings of the MPF with the local community and workers of the refinery. A delegation from the MPF and the DOH also met with representatives from the Waroona Shire and local Members of Parliament to discuss the recommendations of the MPF.

Professor Holman, along with a delegation of medical practitioners and officers from the DOH, presented the recommendations of the MPF at the public meeting.

<u>Professor Cullen's Report</u>

In February 2002, Professor Mark Cullen visited Western Australia. Professor Cullen is an international expert on multiple chemical sensitivity (MCS). He is Professor of Medicine and Public Health at Yale University and is also Chief Medical Officer to Alcoa.

Professor Cullen discussed the Wagerup refinery issue and MCS with:

- Wagerup employees who believed their health was affected
- Members of the community
- The Medical Practitioner's Forum, chaired by Professor D'Arcy Holman
- Dr Moira Somers, who had diagnosed MCS among some Wagerup employees
- Other concerned medical practitioners
- The State Minister for the Environment
- State Health and Environment Authorities
- Union representatives
- Alcoa's senior management team

Professor Cullen provided a report on his investigations into the Wagerup refinery issue, in which he stated:

"It became clear early in my discussions that addressing the social dimension of the physical manifestations of Wagerup health issues was at least as important as (entirely necessary) medical and engineering solutions. The company has by no means ignored the social dimension but appears to have placed greater emphasis on the latter."

He made several specific recommendations:

- With respect to the Workplace

"The aggressive program for rehabilitation of previously affected workers needs to go forward with all deliberate speed."

"Achievement of best results requires open and active cooperation with treating physicians chosen by affected individuals and their representatives."

"As noted previously, acknowledgment by the company of its responsibility for the best outcome, as well as expression of regret for perceived delays and diversions which may have occurred, is essential."

"All health problems and complaints, notwithstanding, it is crucial that Alcoa effectively communicate to its workforce that the Wagerup Refinery is, and has always been, a very well run facility with levels of injury and complaints due to chemicals used in the refining process at, or exceeding, the high standards set by Alcoa for its refineries worldwide. Furthermore, although the liquor burning facility created previously unrecognised odours and irritation because of the unique nature of the bauxite mined in the region, careful assessment of the many dozens of organic chemicals involved in liquor burning emissions, as well as extensive sampling throughout the plant of the levels of these emissions, shows that under no circumstance would these be expected to cause long term harm, such as cancer or injury to major organs, despite the odour and irritation problems which have occurred. Such reassurance, as validated to the extent necessary by the Holman group, is essential for successful abatement of the current situation."

- With respect to the Community

"As expeditiously as humanly possible, the company must complete all emissions abatement measures currently planned. Moreover, at the completion of these measures, a full

environmental assessment must be undertaken to document that the predictions of the models for substantial reduction in all emission levels are substantiated in fact. Furthermore, complete sharing of this data with the Holman group, and timely provision of additional data as requested by members of that group, is also essential to assure independent confirmation of the success of the abatement. Should measured levels, or the Holman group itself, or members of any governmental agency suggest the need to institute additional abatement strategies, consideration of these and the optimal technical means for achieving them must be given the highest priority by professional staff and engineers of the company."

"The additional plan already introduced for land management must be fine-tuned to achieve not only its originally stated goals, but also the perception of fairness and equity for the affected parties. Additional efforts that the company can undertake to support further the infrastructure of the community, such as its education or health resources, would be beneficial."

"As with the rehabilitation of affected workers, full acknowledgment of Alcoa's role and responsibility for effective abatement is essential. As long as it is perceived by any in the community that Alcoa has shirked that responsibility or shunted responsibility to other parties, such as governmental agencies, successful resolution will be negatively impacted."

"As with successful rehabilitation of workers, it is essential that all members of the community, whether affected or not, be reassured that none of the emissions from the plant poses significant long-term health risks. This is based, in my opinion, on knowledge of the toxicology of all chemicals involved which have been carefully speciated, but also knowledge of the doses of these chemicals which fall far below those with toxic effects other than odour and irritation. As with the work force, the role of the Holman group in independently confirming this information is essential to assure the highest level of trust."

"Although it would appear to many involved that the conduct of a health survey by members of the Holman group would increase our overall knowledge of the situation and lead to a better understanding of what aspect of the emissions may have contributed to various symptoms, my considered recommendation is that at the present time such a study not be undertaken. The basis for this is my belief that conditions are adverse for the conduct of a valid study, given the high level of distrust and acrimony. However, if it is the conclusion of appropriate experts on the Holman group that a health study be considered, I would be

personally prepared to participate collegially in such considerations and, if appropriate, its design and conduct to assure the best possible study, with full company cooperation."

Following Professor Cullen's visit, Alcoa improved the rehabilitation of employees with a diagnosis of MCS. Rehabilitation was undertaken in close consultation with employees and their rehabilitation provider, and employees' medical practitioners were included as much as possible. Alcoa made every effort to assist employees in rehabilitation and retraining, or to accommodate individuals in the workplace.

Wayne Osborn, Managing Director of Alcoa World Alumina – Australia stated "The company acknowledges that, while it has implemented a vigorous technical program to reduce odour and emissions from the Wagerup refinery, it has been too slow in moving towards resolution of the concerns of affected Wagerup employees and surrounding community, and regrets the impact this may have had on individuals."

Comprehensive emission controls were completed and thorough ambient air quality monitoring and computer modelling has been undertaken. The details of these programs are listed elsewhere in this document. Wagerup is now the world benchmark for alumina refineries in terms of emission control.

The land management program has been refined and community consultation has been greatly enhanced.

With regard to plant safety and the risk of serious illness Professor Cullen stated:

"It is my opinion, based on the known effects of plant emissions and existing data and patterns of existing data, that the threat of serious illness from the refinery is negligible. If I held any other view I would recommend the immediate closure of the facility – in line with Alcoa values."

"There has been no long term health risk to the vast majority of Wagerup employees and, when plant emissions have been reduced as per plan, the incidence of short term irritation and other chemical sensitivities should also be negligible."

<u>Community Health Nurse Report, 2002 to 2003</u>

The Department of Health operated a community health clinic at Yarloop during the period November 2002 to October 2003 in response to a recommendation from the Medical Practitioners Forum. The Community Health Nurse's report presents descriptive data recorded during this period (Cook, 2003).

Observations from the report included the following:

- During the 12 month period a total of 70 individuals presented to the clinic;
- Over 50 of the 70 people reported dry itchy eyes and fatigue;
- Over 40 people reported sleep disturbances, weeping eyes, headache, worry, sneezing, coughing and sinusitis;
- Over 30 people reported loss of motivation, feeling moody, a dry itchy sore throat, a dry or metallic taste in their mouth, emotional lability, rhinitis, breathing difficulties, night sweats or feeling hot, memory loss at times, dizziness and muscle cramps or spasms;
- 20 people reported 46 symptoms;
- The month of May saw the highest number of complaints regarding health effects with 24 complaints logged by 12 individuals;
- During the months of June and July there were a total of 20 health complaints by 9 and 8 individuals respectively;
- Some individuals were able to clearly state the time of detecting odour preceding their symptoms, others did not notice an odour prior to feeling unwell;
- When there were a number of people gathered, some detected the odour whilst others did not;
- Similarly some reported the immediate onset of symptoms, others reported symptoms were experienced many hours following detection of odour.

The symptoms recorded in this study are generally “non-specific” and occur commonly in any community. The report did not indicate a cause for the symptoms or relate the symptoms to refinery emissions, however it does provide useful information on the nature of symptoms reported in the area during the time of the study.

Healthwise, 2004

In June 2004 the second report of the Healthwise cancer incidence and mortality study was released (Healthwise, 2004). Healthwise is a long-term study designed to assess whether there is any relationship between health outcomes and working at Alcoa in Australia. It is undertaken by researchers from Monash University and the University of Western Australia. The cancer incidence and mortality study includes current and former employees who started work for Alcoa in Australia at any time from 1983.

The 2004 analysis was an update using the latest available data from the cancer and death registers up to the end of 2002. The study now includes more than 11,000 past and present employees throughout Australia. The second report found:

- a lower overall risk of death in Alcoa employees compared with the general population;
- mortality rates for all four major categories of death (circulatory disease, respiratory disease, cancer and injury/trauma) were lower amongst Alcoa employees than in the general population;

- the total incidence of cancer in past and present Alcoa employees was lower than the general population.

The research demonstrated that on the whole, Alcoa employees live longer and are healthier than the general population, but the study also raised a number of findings that are being investigated further.

The cancer incidence rates for melanoma continued to be higher in Alcoa's Western Australian operations than the general population. This is most likely due to UV exposure from the sun and more work is required to understand where and when this exposure has occurred – either in childhood, outdoor leisure activity or outdoor work. The research shows that the increase in melanoma incidence is similar across production, maintenance and office workers which would suggest it is not work related.

Medical literature suggests that occupational exposure to UV may not increase the risk of melanoma and it may well be that the increased number of cases is due to a greater awareness of skin cancer and that employees are seeing their doctors more regularly to screen for melanoma.

The cancer incidence rate for thyroid/endocrine glands in office workers in Western Australia was also higher than the general population. This finding was unexpected and this will be monitored in future searches.

While this ongoing study has continued to find in Alcoa's Western Australian operations the mortality rates and incidence of pleural cancer (mesothelioma) were higher than the general population, these cases were matched with the WA Mesothelioma Registry (WAMR) where an independent expert panel found the exposure to asbestos which causes mesothelioma, did not occur at Alcoa, except for one case which may be related to exposure at the Kwinana refinery power station (Healthwise, 2004).

The next steps in this study are to examine those cancers found to occur in excess in the current findings and in particular to investigate duration of employment, workplace exposures and the role of smoking data for participants with a smoking history. A third round of death and cancer national registry matching will take place in 3 to 5 years time when further data are available.

Department of Health - Study of Cancer Incidence and Mortality by Statistical Local Area, 2004

In 2004 the Department of Health published a report on cancer incidence and mortality in each statistical local area (SLA) of Western Australia (Threlfall *et al.*, 2004).

The report covered the period 1998 to 2002. The following quotes from the report indicate that cancer incidence and mortality rates in Waroona Shire and Harvey Shire are no greater than for Western Australia as a whole.

Waroona Shire

"Cancer incidence: Cancer incidence rates for males and females, for individual cancers and all cancers combined, were not significantly different from the all-W.A. rates."

"Cancer mortality: There was a lower mortality rate for lung cancer in males than expected (Standardised Rate Ratio 0.21, 95% confidence interval 0.00-0.77). All other cancer mortality rates for males and females, for individual cancers and all cancers combined, were not significantly different from the all-W.A. rates."

Harvey Shire - Part B

"Cancer incidence: Cancer incidence rates for males and females, for individual cancers and all cancers combined, were not significantly different from the all-W.A. rates."

"Cancer mortality: There was a significantly lower lung cancer mortality rate in females than expected (SRR 0.23, 95% cancer incidence 0.00-0.85). Otherwise cancer mortality rates for males and females, for individual cancers and all cancers combined, were not significantly different from the all-W.A. rates."

7.11 COMMUNITY COMPLAINTS

7.11.1 Community Complaint Analysis

Alcoa maintains a 24 hour, 7-day per week complaint response service linked to a free 1800 number for refinery neighbours which was introduced in 2004. The response process in place at the Wagerup refinery provides for:

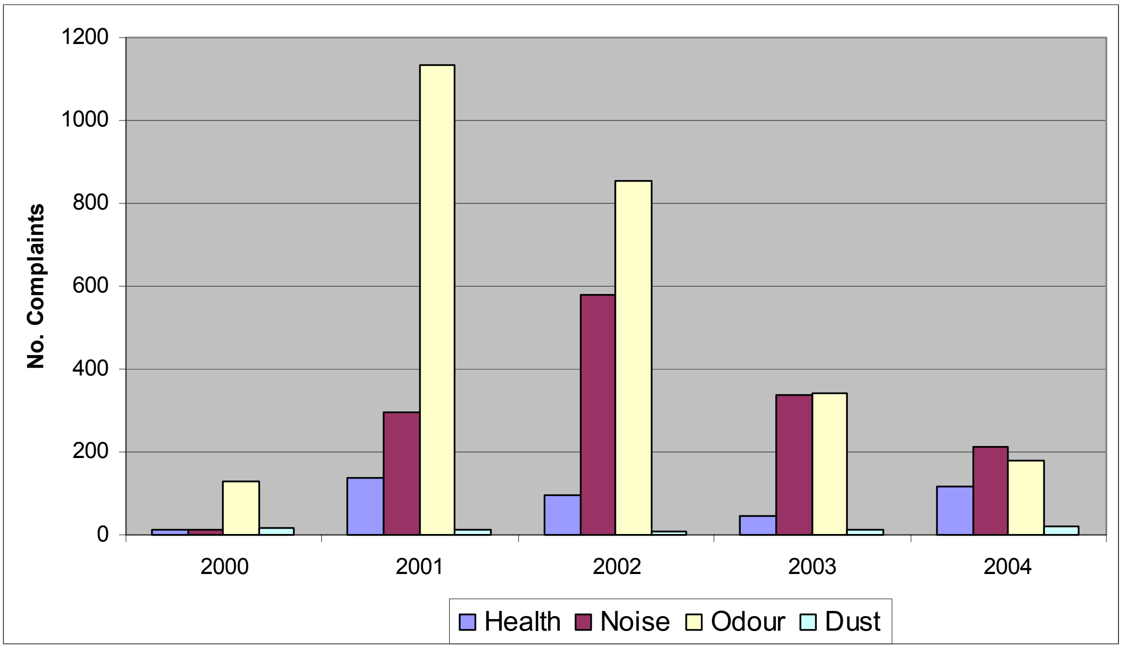
- Immediate complaint response including the offer for Alcoa staff to attend the complainant's residence and record relevant information including, nature of complaint, symptoms and environmental observations;

- Immediate consideration of potential causes including weather conditions and plant operating conditions; and
- The collection of refinery operating data, which enables subsequent assessment if relationships exist between refinery operating conditions and characteristics of the complaint database.

The complaint data base records complaints lodged from 1990 to the current day and includes complaints lodged directly with Alcoa and those lodged through the community-based Wagerup Community Health Awareness Group (WCHAG).

Figure 25 shows that the number of environment-related (odour, noise, health and dust) complaints have declined steadily since their peak in 2001. This is particularly evident with odour and noise complaints. Substantially fewer health complaints have been recorded in each year from 2001 to 2003, however, there has been an increase in health complaints from 2003 to 2004. Dust complaints remain very low in comparison to other categories.

Figure 25: Environment-related complaints by category for the period 2000 to 2004

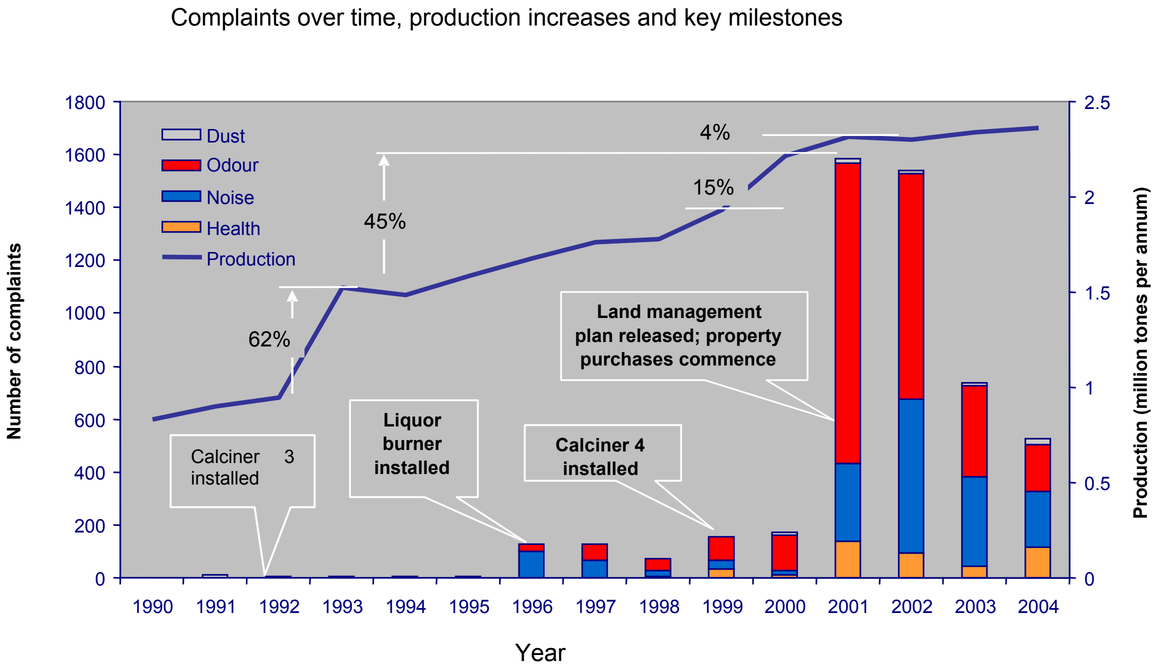


Many factors may influence environment-related complaints and a comparison of complaint numbers over a longer period (1990 – 2004) offers various observations regarding factors that may influence complaints.

Figure 26 shows the number of environmental complaints lodged between 1990 and December 2004 together with annual refinery alumina production and major changes to refinery equipment. Key characteristics of the figure include:

- Complaints increased noticeably during 1996 (from 7 to 127) when the refinery's liquor burner was commissioned. The majority of these complaints related to noise, with a smaller amount related to odour. A similar number of complaints were lodged during 1997, however, noise complaints decreased and odour complaints rose. This is consistent with community and employee feedback that malodorous emissions became a significant issue when the liquor burner was operated during 1996 and 1997;
- Liquor burner emissions were then reduced during 1998 with the installation of emission control equipment (a catalytic thermal oxidiser). This coincided with a reduction in complaints during 1998 (71);
- Complaints rose again during 1999 (157 complaints) and 2000 (173 complaints) which coincided with the installation and commissioning of an additional calciner (1999) and cooling tower (2000);
- There was a very large increase in complaints during 2001, rising from a total of 173 in 2000 to over 1,500 in 2001. This rise did not coincide with a significant increase in production or other changes in refinery operation. Alcoa believes the most notable change that occurred during 2001 was the commencement of discussions between Alcoa and community members regarding nearby property purchases;
- Odour and health complaints declined from 2001 to 2002, however the total number of complaints increased due to a significant increase in the number of noise complaints, rising from 315 to 1104. Alcoa is not aware of any changes to refinery equipment or operating practices resulting in increased noise emissions from 2001 to 2002. However, this period corresponds to Alcoa's community consultation over the use of noise emission contours as the basis for defining the extent of the Area A property purchase offer. Alcoa also submitted an application for a variation to the Environmental Protection (Noise) Regulations during this period; and
- The total number of complaints decreased significantly during 2003 and again in 2004. During this period Alcoa continued to implement various emission control works (following the works implemented during 2000 and 2001) and purchased a number of properties in the area surrounding the refinery, many of these property purchases were for residences from which complaints had originated.

Figure 26: Annual complaints, refinery alumina production and major influencing factors for the period 1990 to 2004



7.11.2 The Nature of Health Complaints to Alcoa

Wagerup refinery's complaints database indicated that 74 people made 376 health complaints to Alcoa over the period 01 January 2000 to 20 September 2004. A description of complaints numbers over time and the number of households lodging complaints is described in Section 7.11.2 while a brief summary of health complaint characteristics is given below.

- the number of complaints made per complainant ranged from 1 to 46.
- 55 of 74 complainants (74%) complained of symptoms of the upper respiratory tract (nose, sinuses, mouth, throat);
- 32 of 74 complainants (43%) complained of symptoms of the eyes;
- 25 of 74 complainants (34%) complained of symptoms of the lower respiratory tract (mostly coughing); and
- 41 of 74 complainants (55%) complained of symptoms affecting other parts of the body. These included headache, nausea, vomiting, skin problems, poor sleep, musculoskeletal pain, abdominal pain, lethargy,

The most common symptoms are consistent with irritation of the upper respiratory tract. However these relatively non-specific symptoms are commonly reported in many communities and may relate to a variety of personal, environmental or lifestyle factors. The proposed health survey (intended to be conducted prior to commissioning of the Proposal, if approved) would be able to determine whether the occurrence of these common and non-specific symptoms is different to other communities, and if so what factors are associated with their occurrence.

At various times a concern has been raised that an increase in complaints or community impacts has corresponded with significant production increases at the Wagerup refinery. Figure 26 shows that the most significant increase in complaints, in 2001, corresponded with only a 4% increase in production, whereas previous production increases of 62% in 1993 and 15% in 2000 did not correspond with significant increases in complaints. Over recent years, the belief that complaints or community impacts are linked with production levels has been partly reinforced by the maintenance of a production limit in the refinery environmental licence. Figure 27 and 28 shows a comparison between alumina production and complaints at the monthly and daily scales respectively.

Figure 27: Comparison of monthly production and odour complaints for the period January 2001 to March 2003

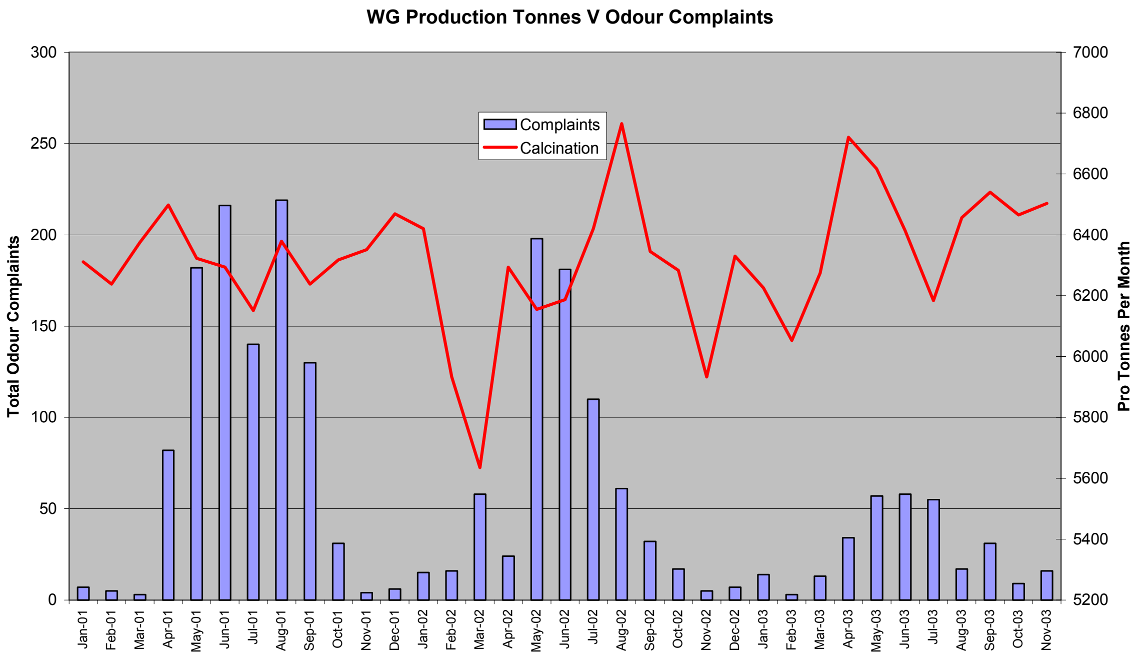
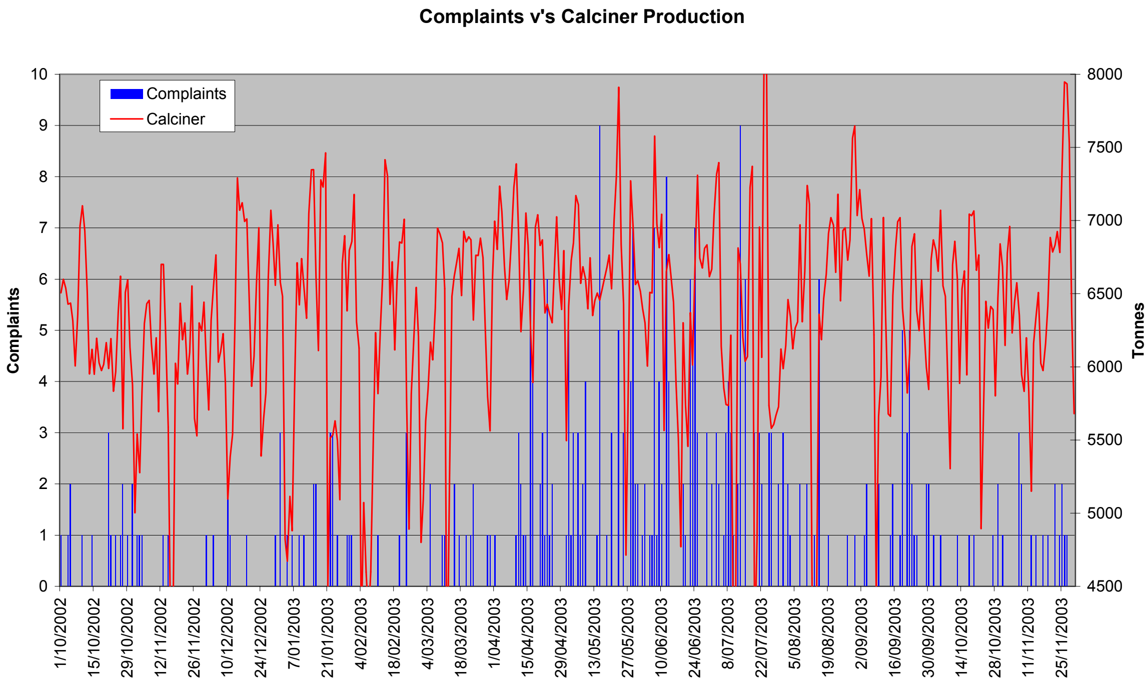


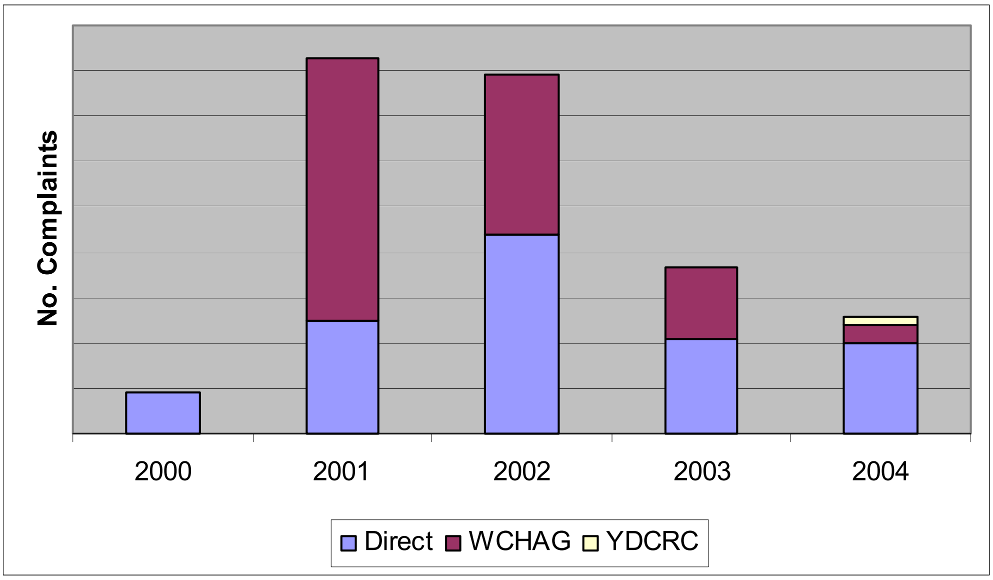
Figure 28: Comparison of daily production and total complaints for the period October 2002 to November 2003



Neither figure indicates a correlation between alumina production and community complaints. Statistical analysis of the complaint and production data sets confirms this observation. The only factors that show a correlation with complaints are aspects of meteorological conditions (e.g. wind direction and wind speed).

Figure 29 shows the total number of environment-related complaints by the method of lodgement during the 2000 to 2004 period. Three sources are identified: “direct” where the complaint is lodged directly with Alcoa; WCHAG, where the complaint is reported to Alcoa through the Wagerup Community Health Awareness Group process; and “YDCRC”, where the complaint has been forwarded by a member of the Yarloop and District Concerned Residents Committee.

Figure 29: Number of complaints lodged via different reporting mechanisms



Figures 30, 31 and 32 show the distribution of complaints throughout the calendar year for the 2000 to 2004 period for each of odour, noise and health complaints respectively.

Figure 30 shows that there has been a significant decline in odour complaints from 2001 to 2004 and that the majority of odour complaints arise in the period March/April through until September. This "odour season" corresponds to the autumn and winter periods when meteorological conditions are believed to be most conducive to odours being noticed in the neighbouring residential areas. This is consistent with air dispersion modelling undertaken for this proposal (Section 7.9 and 8.3) which identifies cold still mornings and air inversions as the conditions most likely to carry noticeable odours from the refinery operations to neighbouring residences.

Figure 30: Monthly odour complaints 2000 – 2004

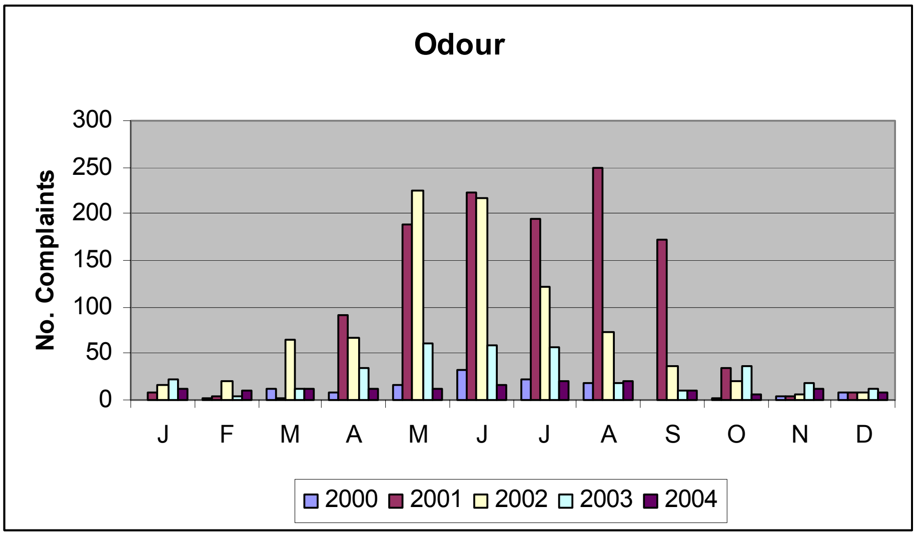


Figure 31 shows a similar pattern with health complaints declining from 2001 to 2003 and the majority of complaints occurring during the autumn – winter period. There is an increase in health complaints from 2003 to 2004.

Figure 31: Monthly health complaints 2000-2004

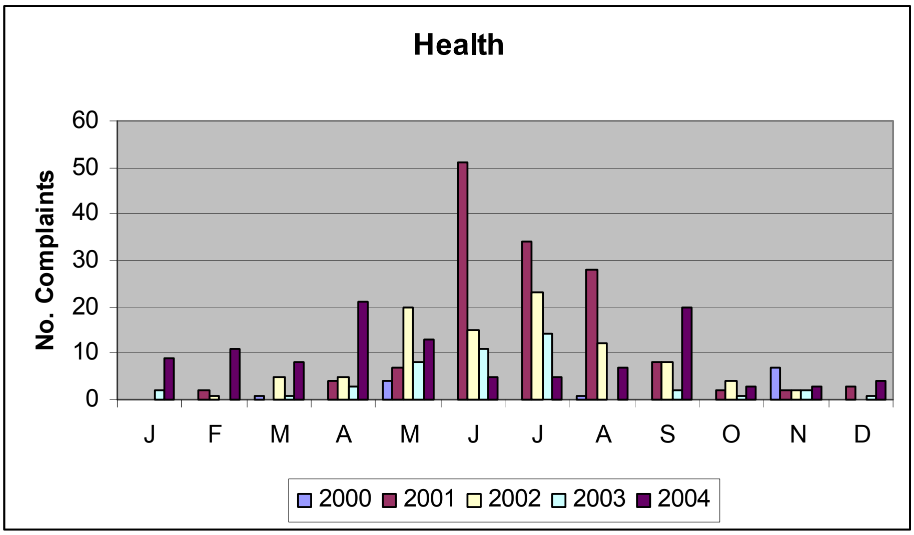


Figure 32 shows the increase in noise complaints during 2002 and the subsequent decline in noise complaints during 2003 and 2004. With the exception of the early months in 2002 the monthly pattern of noise complaints is similar to odour with the majority of complaints being received during the autumn – winter period. Meteorological conditions during this period may increase the likelihood of noise propagation to surrounding residences, particularly cold still nights and temperature inversions.

Figure 32: Monthly noise complaints 2000 – 2004

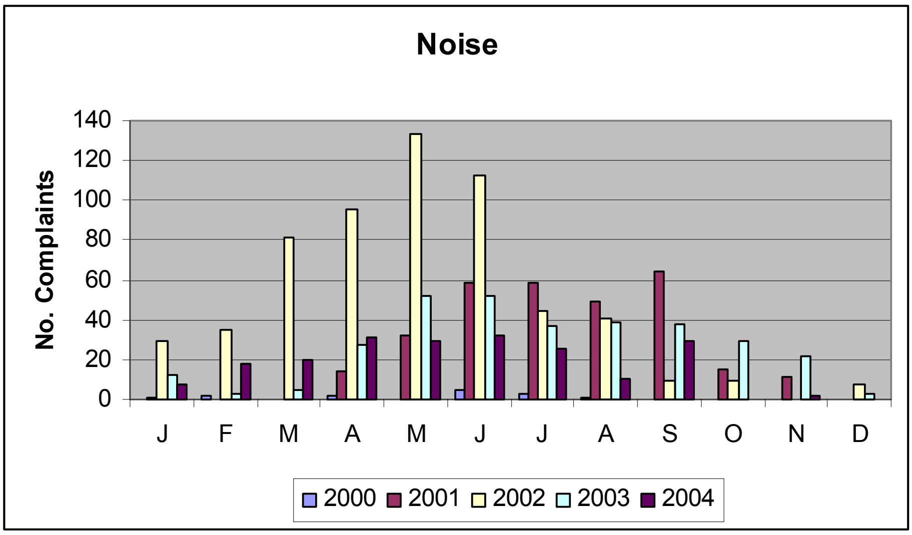


Figure 33 shows the percentage distribution of complainants against total complaints for the 2004 period, with figures 34, 35 and 36 (on the following pages) providing a corresponding description for each of odour, noise and health complaints respectively. Each figure shows the contribution of households most frequently lodging complaints (e.g. household A, household B etc) to the complaint total and the total of all other households lodging complaints (shown as "other").

In 2004 a total of 59 households made a total of 518 complaints with 71% of complaints coming from nine households. The distribution of complainants (people lodging complaints) in each of the main environment related complaint categories can be summarised as follows:

- During the same period 46 households lodged 178 odour complaints, with 49% coming from five households;
- During 2004, 19 households registered 205 noise complaints, with 87% of the complaints coming from five households; and
- A total of 109 health complaints were lodged from 19 households during 2004, again with a high dependency on point of origin with 64% of health complaints coming from two households.

Alcoa recognises that the sources of complaints is not uniformly distributed and that some individuals lodge complaints far more frequently than others, consistent with the varying levels of concern that may be felt in any given community. As a result Alcoa maintains efforts to deal broadly with the possible causes of complaints.

Figure 33: Percentage distribution of total complaints received during 2004

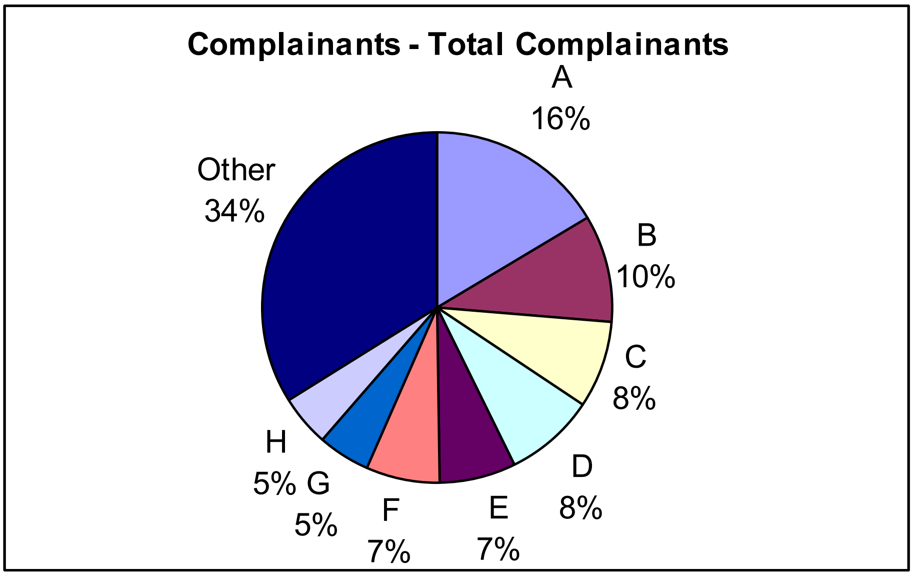


Figure 34: Percentage distribution of odour complaints received during 2004

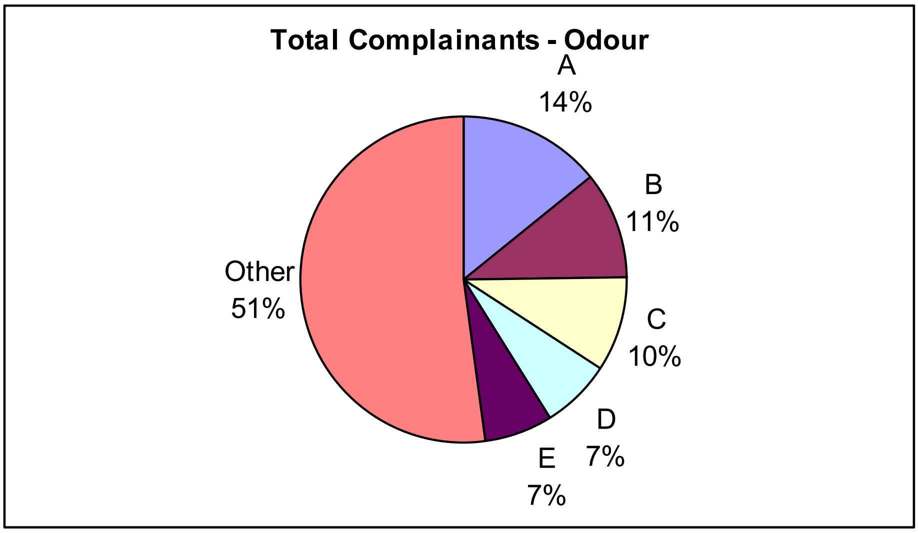


Figure 35: Percentage distribution of noise complaints received during 2004

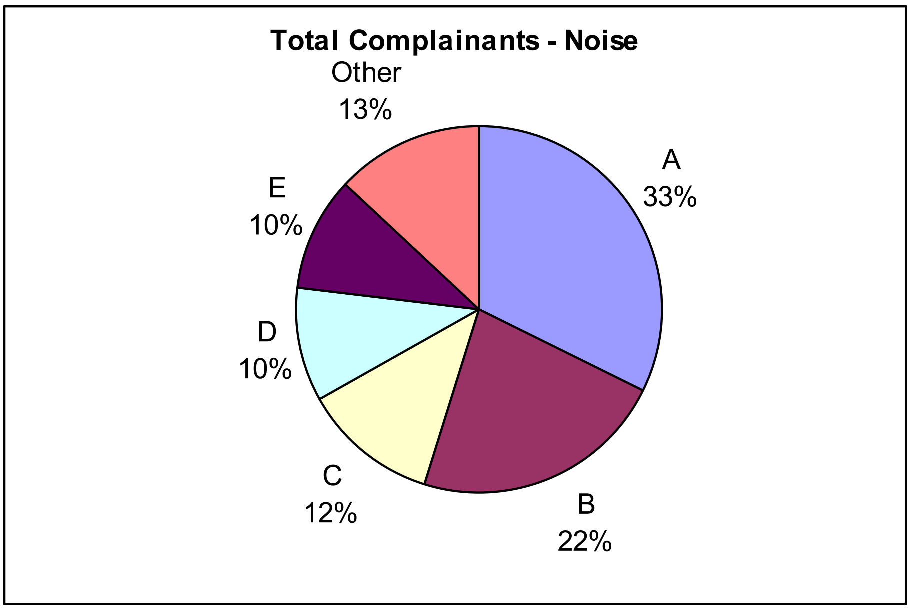
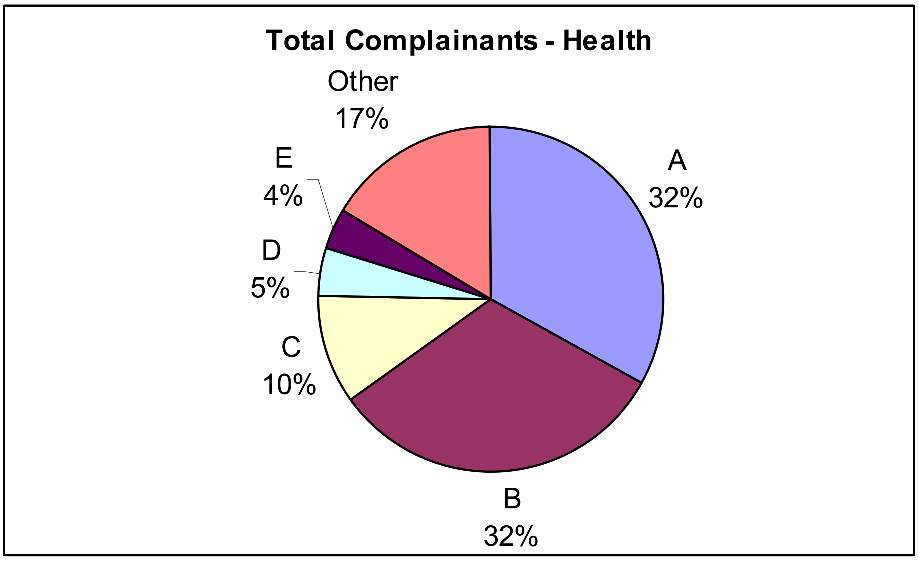


Figure 36: Percentage distribution of health complaints received during 2004



It is clear that complaints have declined significantly since the high levels recorded during 2001 and 2002. This reduction in complaints may be due to several factors, however it is likely that both emission reduction works and Alcoa's purchase of properties in the vicinity of the refinery have played a significant role in the decline in complaints during recent years.

7.11.3 Refinery Operations and Health Complaints

Specialist consultants, Emphron Pty Ltd, were commissioned to undertake statistical analysis of the complaints data base, meteorological conditions and the ambient measurements of oxides of nitrogen and particulates. The report prepared by Emphron is provided in Appendix N which describes the methodology, the study results and conclusions drawn from the analyses. The following represents a summary of the results and conclusions reached in this study.

This study examined whether ambient NOx and particulate concentrations were likely to be of refinery origin by evaluating data from the Boundary Road (Yarloop) monitoring station in conjunction with meteorological data. This study also examined whether there was any relationship between wind direction, particulate concentration, oxides of nitrogen concentration and the incidence of complaints. The report also considers whether the concentrations and alkalinity of particulates measured at Boundary Road are at levels considered likely to cause irritant respiratory impacts in the surrounding community.

7.11.4 NOx and particulate concentrations

Initial analysis of monthly ambient concentrations of nitrogen oxides (NO, NO_2, NOx) and particulates (PM_{10}, $PM_{2.5}$) against wind direction showed that the concentrations of these substances appear to be lower when wind direction is from the refinery. However, wind transport is a complex process influenced by several factors including temperature, humidity, wind speed and wind direction. To allow for this multi-factor consideration, the consultants refined the analysis to investigate the simultaneous effects of several meteorological variables. This analysis also concentrated on determining whether "peak values" were related to wind direction. A peak value is defined as being in the top 5% of all the 6-minute averaged values and allows analysis of possible short-term peak exposures.

This analysis found that for both NO_2 and NOx there is a clearly defined "wind direction effect" whereby both parameters show a correlation with wind direction from the refinery plant, the residue drying area and the township of Yarloop. The work drew the following conclusion in relation to this issue. "The highest probability of a peak concentration of oxides of nitrogen is found when the wind is blowing from the direction of the refinery stacks" and "at each [ambient monitoring] site there also seems to be some elevation in nitrogen oxide concentrations associated with winds from the residential properties at Yarloop". In this regard peaks in ambient NOx concentrations, under defined meteorological conditions provide an indicator of the presence of refinery emissions. A similar effect, of roughly the same magnitude, is produced by winds from the residential area of Yarloop.

A similar analysis was undertaken for particulate concentrations (PM_{10} and $PM_{2.5}$). The study found that peak values of both particulate parameters are associated with winds in the direction 275^o to 360^o, which includes winds coming from the refinery processing area and the residue area. For $PM_{2.5}$ a similar effect, of roughly the same magnitude, is produced by winds from the residential area of Yarloop.

7.11.5 Meteorological conditions, air quality and complaints

The Emphron study also investigated whether or not the relationships described above have a statistical correlation to complaints. “In particular the study seeks to establish whether or not there is any relationship between wind direction, particle concentration, Oxides of Nitrogen and incidence of complaints. Such a relationship would provide objective evidence of a link between refinery outputs and community complaints. The nature of the relationship might also suggest mitigation strategies” (Emphron 2005).

Complaints records (from the Alcoa complaints data base) were analysed for the period April 2000 to September 2004 with two categories of air quality complaint considered to be available in sufficient quantity for separate analysis: odour and health complaints. For the period 24 April 2000 to 18 September 2004 a total of 3,124 verified complaints, lodged by 250 complainants were available for analysis.

The study found increases in total complaints and odour complaints during the winter months, with a possible increase in health complaints during winter. This led to the study finding “there is a fairly close agreement between the monthly incidence of complaints, and the monthly proportion of each day with a northerly wind” (Emphron 2005).

Further analysis of the data supported this finding providing “some evidence that the incidence of complaints is related to wind direction, NOx and particulate concentrations”, however, “it is not possible to rule out complaints being affected by other variables”. There is also evidence that complaints are increased when much of the day shows elevated NOx and $PM_{2.5}$ (NOx and $PM_{2.5}$ are unlikely to be the cause of complaints but may act as “markers” for the presence of refinery or township emissions, depending on wind direction).

During the April 2000 to September 2004 period more than 50% of the recorded complaints were lodged by 16 individuals who registered complaints on 50 or more occasions. To facilitate analysis of this unusual distribution the consultants categorised the data into two categories, “high frequency complainants”, lodging 50 complaints or more and “low frequency complainants” lodging less than 50 complaints. Analyses were repeated on these categories separately. The results of this analysis are shown in Appendix N.

Table 15: Results of Complainant Distribution Analysis

Complainant Type	Environmental Variable	Confidence Interval by Issue Type:								
		Total			Odour			Health		
		Low	Est	High	Low	Est	High	Low	Est	High
high	Temp	−0.10	−0.04	0.01	−0.09	−0.04	0.02	−0.23	−0.08	0.05
	Wind.N	1.74	3.00	3.94	1.51	2.74	3.73	2.94	5.02	6.91
	Wind.NW	0.37	1.65	3.05	0.57	1.77	2.97	−4.66	0.86	3.90
	PM10	−5.65	−1.27	1.65	−4.83	−1.03	1.71	−23.18	−4.70	6.51
	PM25	−0.31	1.58	5.73	−0.21	1.43	5.61	−6.56	3.60	14.49
	NOx	−1.13	0.50	2.56	−1.11	0.55	2.33	−5.79	−0.02	3.79
low	Temp	−0.11	−0.06	−0.01	−0.12	−0.06	0.00	−0.13	−0.06	−0.01
	Wind.N	1.66	2.51	3.36	1.50	2.51	3.48	0.90	2.56	3.70
	Wind.NW	−1.17	0.22	1.55	−1.07	0.48	1.95	−3.30	−0.48	1.79
	PM10	−2.53	−0.02	2.45	−4.31	−0.88	2.32	−2.17	1.06	4.26
	PM25	0.43	1.97	3.49	−0.53	1.73	4.01	−0.57	2.40	4.36
	NOx	0.71	1.82	3.73	0.01	1.49	3.46	0.51	2.42	5.27

Table 15 indicates the relative importance of each environmental variable in contributing to the relationship with complaints. Results are given for each complaint type (Total, Odour and Health) and for each group of complainants (High Frequency and Low Frequency Complainants). The results are given as best estimates (Est) bounded by lower and upper confidence intervals (Low and High). Only the results which have an upper and lower confidence interval of the same sign (positive or negative) are statistically significant. For those results that are statistically significant, the magnitude of the best estimate value can be used to assess how important that variable is in comparison to others.

If the best estimate of a statistically significant result is positive, complaints increase when that environmental variable increases. If the best estimate of a statistically significant result is negative, complaints decrease when that environmental variable increases. Results which have one positive confidence interval and one negative confidence interval are not statistically significant and can be interpreted as having no importance in the relationship with complaints.

When considering total complaints; low frequency complainants showed a statistically significant relationship with $PM_{2.5}$, NOx and wind direction. High frequency complainants however, have a statistically significant relationship only for wind direction. For odour complaints, low frequency complainants are statistically significantly related to wind direction and NOx, but high frequency complainants show a statistically significant relationship only to wind direction. For health related complaints, low frequency complainants are statistically significantly related to wind direction and NOx, but high frequency complainants show a statistically significant relationship only to wind direction.

In other words, when examining total complaints, both the low frequency and high frequency complaints tend to coincide with times when the wind is coming from the direction of the refinery. Low frequency complaints also tend to coincide with higher ground level concentrations of NOx and $PM_{2.5}$, which may indicate the presence of refinery emissions reaching ground level. When examining odour and health complaints as separate categories, both types of complaint tend to be associated with wind direction, while only lower frequency complaints also tend to be associated with the presence of NOx at ground level.

The statistical analyses concluded that NOx and particulate concentrations at the Boundary Road monitoring location are strongly influenced by wind direction and that wind direction from the refinery increases the concentration of both parameters at Boundary Road, although these increases are "not markedly greater" than those associated with wind directions from the Yarloop residential area.

7.11.6 Alkalinity of airborne particles

The Emphron study also considered whether or not the alkalinity of refinery particulate emissions might cause irritation of respiratory passages, and therefore be a cause of health complaints. Using an estimate of the sodium-hydroxide (NaOH) equivalent concentration of particles measured at Boundary Road, the authors estimated a peak NaOH concentration that could be expected in particulate emissions reaching the Yarloop township. This investigation reached the following conclusion. "On the basis of conservative estimates of peak alkalinity (i.e., estimates which are likely to over estimate alkalinity), there is no evidence of particles with alkalinity sufficient to cause an irritant response. It is considered unlikely that complaints are generated by an irritant response to airborne alkaline particles" (Emphron 2005).

The alkalinity analysis in the Emphron report utilised data from a study undertaken by the Queensland University of Technology in 2002. Air quality was monitored in the QUT study over a two-week period between 18 August and 2 September 2002 at Boundary Rd, with the objective of investigating possible links between airborne particulate emissions from the refinery and air quality complaints (Morawska *et al.*, 2002).

The Proposal examined the concentrations in terms of number, mass and alkalinity of airborne particulate matter at Boundary Road.

Monitoring included real-time measurements of suspended particulate matter size distributions in the size ranges 0.015-0.723 μm and 0.5-20 μm using, respectively, a Scanning Mobility Particle Sizer (SMPS) and an Aerodynamic Particle Sizer (APS).

Particulate matter of diameter less than 10 μm, accumulated over one week, was collected using high volume samplers. One sampler was located in the Harvey townsite to provide background measurements. Two samplers were located at the Yarloop site, and were programmed to activate alternately depending on whether the wind was from within a 90° wide sector centred on the plant (referred to as the "plant quadrant" in the report) or from some other direction (referred to as the "non-plant quadrants" in the report). These samples were then analysed for average mass concentrations and alkalinity.

The results led to the following conclusions:

"The correlation analysis did not support the hypothesis that during periods when the wind direction is from the plant sector, the concentrations of fine and ultra-fine particles (or a size fraction within their respective size distributions) were significantly correlated with records in the complaints register for the Yarloop area.

Correlation between particle size and air quality complaints data was significant for particles smaller than 0.022 μm when all wind directions were considered, however these particles did not arrive at the Yarloop site from the direction of the plant quadrant, which suggests a source other than the refinery. Examination of the much longer term PM_{10} and $PM_{2.5}$ TEOM data for correlation with complaint data is strongly recommended.

The alkalinity of one-week cumulative fine particulate matter samples was higher when the wind direction was from the plant sector than for samples taken from other wind directions".

The average level of alkalinity detected when the wind blew from the direction of the refinery was 0.255 ± 0.007 μgm^{-3} (equivalent of NaOH). By way of comparison, the occupational exposure standard is 2000 μgm^{-3} (Morawska *et al.*, 2002).

The Emphron (2005) study concluded that: "in summary, it is possible that complaints are increased by airborne material from the refinery. The source within the refinery cannot be localised. There is no evidence that complaints are due to an irritant response to alkaline particles" (Emphron 2005).

7.12 ALCOA INFORMAL LAND MANAGEMENT

In October 2001, residents in Yarloop and Hamel received a "Wagerup Land Management Draft Proposal" from Alcoa for community comment. The stated aims of the proposal were to:

- Give people choice about whether they continue to live where they do;
- Protect property values; and
- Invest in the future of Yarloop and Hamel.

The Draft Proposal identified an area around the Wagerup refinery – Area A – where Alcoa proposed to establish a Special Control Area to restrict further residential development. It also identified an Area B where, in order to protect property values, Alcoa would, for 12 months, buy properties if residents wished to sell (refer to Figure 38 in section 7.14 for Area A and B). In light of community feedback, the proposal was revised and adopted in January 2002. The policy was strengthened again in November 2004.

Revised Proposal – January 2002

The Wagerup Land Management Revised Proposal, dated January 2002, contained the following key changes:

1. Identification of only a single area – Area A – where Alcoa would seek changes to the local Town Planning Scheme to ensure land use is compatible with refinery operations;
2. In the townships of Yarloop and Hamel, a commitment to purchase any property at unaffected value for the next five (5) years (assuming no unforeseen events, unrelated to Alcoa, that may lower property values);
3. A commitment to talk to people who live outside the townships of Yarloop and Hamel on a case-by-case basis; and
4. A commitment to liaise directly with business owners who may wish to sell, and to support a process for developing strategies to enhance business opportunities in the local community.

The revised proposal provided that Alcoa would purchase properties in Area A for the operating life of the Wagerup refinery. This Area A included some 118 properties in northern Yarloop.

The commitment to purchase properties in the townships of Yarloop and Hamel (Area B) was extended for a period of five years (i.e. until December 2006) with a five year extension if a study of valuations found house prices had fallen in the town due to Alcoa or publicity about Alcoa.

The boundary of 'Area A' was chosen for three reasons:

- People in this area may experience noise levels above the night time limit allowed under noise regulations (based on the modelled 35dbA noise contour plots surrounding the refinery);
- It corresponds with areas where people may be most annoyed by refinery emissions (at the time this was also the area where over 95 % of community odour complaints were being reported); and
- It allows for future expansion of Alcoa's bauxite residue area to the west of its current site and was chosen to fit the life of the refinery.

The Revised Proposal highlighted Alcoa's commitments to the following:

- Reducing odour and other emissions;
- Reducing noise;
- Investigating health concerns;
- Protecting property values;

- Supporting the integral nature and quality of the community and encouraging people to stay in the area; and
- Making it easy for those who wish to leave to sell their properties.

Alcoa proposed to those living in Area A the following:

- Offer to buy their home at the unaffected market value;
- Plus 35% to cover replacement costs; and
- Plus $7,000.00 to cover relocation costs.

The policy allows individual properties to be purchased only once (i.e. from original residents at the time of the policy announcement). The policy set out three methods of valuation and a valuation management process. It required that two valuations be prepared at Alcoa's expense; one by the owner's valuer and one by a licensed valuer chosen by Alcoa.

November 2004

In November 2004, Alcoa wrote to residents of Area B. The letter addressed recommendations of a community group (Land Management Working Group) that were drafted following an open forum in Waroona in September 2004. With the objective of providing security for those homeowners, the community group recommendations were adopted as:

For people who were, and remain, property owners in Yarloop and Hamel (Area B) on or before 1 January 2002:

1. Alcoa will extend its offer to purchase the property (at any time) from 31st December 2006 to 31st December 2011 (in accordance with the Wagerup Land Management Revised Proposal, January 2002); and
2. Alcoa will offer to purchase a property after 2011, if the owner has first marketed the property for six (6) months but has been unable to find a buyer at fair market value.

In accordance with the group's proposal, this undertaking applies for the life of the property owner or the life of the Wagerup refinery, whichever comes first. In the case of a deceased estate, the same option is available to the executor of that estate or to the person or person(s) to which land title is transferred in accordance with a Last Will and Testament, for a period of up to twelve (12) months after the property owner's death.

The Land Management Working Group continues to examine issues associated with Alcoa's land purchase policy, including valuation methods used to determine market value.

7.13 BASELINE RADIATION LEVELS

The bauxite ore from the Darling Range naturally contains low levels of radioactive elements and these radionuclides pass through the refinery process to the residue area. A baseline radiological assessment at Wagerup was undertaken by Radiation Wise and the report is presented in full in Appendix O. Since the current Wagerup refinery and residue area have been operational for more than 20 years, this study represents the assessment of the current (Year 2004) radiological levels for the Wagerup refinery and residue area.

Over the last 12 months thorium levels and uranium levels in the bauxite feed stock have been measured as 0.8 Bq g-1 and 0.1 Bq g-1 respectively. In the bauxite residue, thorium levels have been measured as 0.8 Bq g-1 in the sand fraction and 1.8 Bq g-1 in the mud fraction. Uranium levels in the residue have been recorded as <0.1 Bq g-1 in the coarse fraction and 0.2 Bq g-1 in the fine fraction (Radiation Wise, 2005).

Based on these measured levels of radioactivity, none of these materials is classified as 'radioactive' under the current Western Australian Radiation Safety (General) Regulations 1983.

It is not possible to establish a true baseline of gamma radiation at the Wagerup site due to its use for mineral processing over the last 20 years. However, the mean value of 0.16 µGy h-1 which was measured at the site boundary is considered the 'baseline' value that should be used for future rehabilitation of the site (Radiation Wise, 2005).

The gross alpha activity concentrations of dust in the vicinity of the refinery operations was determined through the analysis of dust samples collected through routine daily sampling. Five 24-hour samples from the months of January, April, July and October 2004 were selected and dust concentrations varied relative to the seasons. The potential mean annual internal radiation dose to a member of the public from inhaling dust would be a total of 0.02mSv. This is one fiftieth of the public limit of 1mSv and is considered conservative as an occupational rather than a passive breathing rate was assumed and no background subtracted (Radiation Wise, 2005).

Limited radon concentrations in air data are available for the Wagerup area. A measured mean value of 18 Bq m-3 is higher than the mean value of 16 Bq m-3 reported for Western Australian homes and the world-wide mean value of 10 Bq m-3, which is as a result of higher levels of uranium and thorium naturally occurring in the local soils (Radiation Wise, 2005).

Samples of groundwater from a number of bores at the Wagerup refinery were analysed for radium 226 and radium 228. Based on the analysis results a mean activity concentration of 65 mBq L-1 and 280 mBq L-1 for 226Ra and 228Ra, respectively, should be regarded as the 'baseline' value for the refinery (Radiation Wise, 2005).

7.14 NOISE

7.14.1 Refinery Noise Emissions

The refinery contribution to noise levels in its vicinity is caused by the combined emissions of numerous pieces of equipment across the refinery. Equipment that significantly contributes to noise emissions includes:

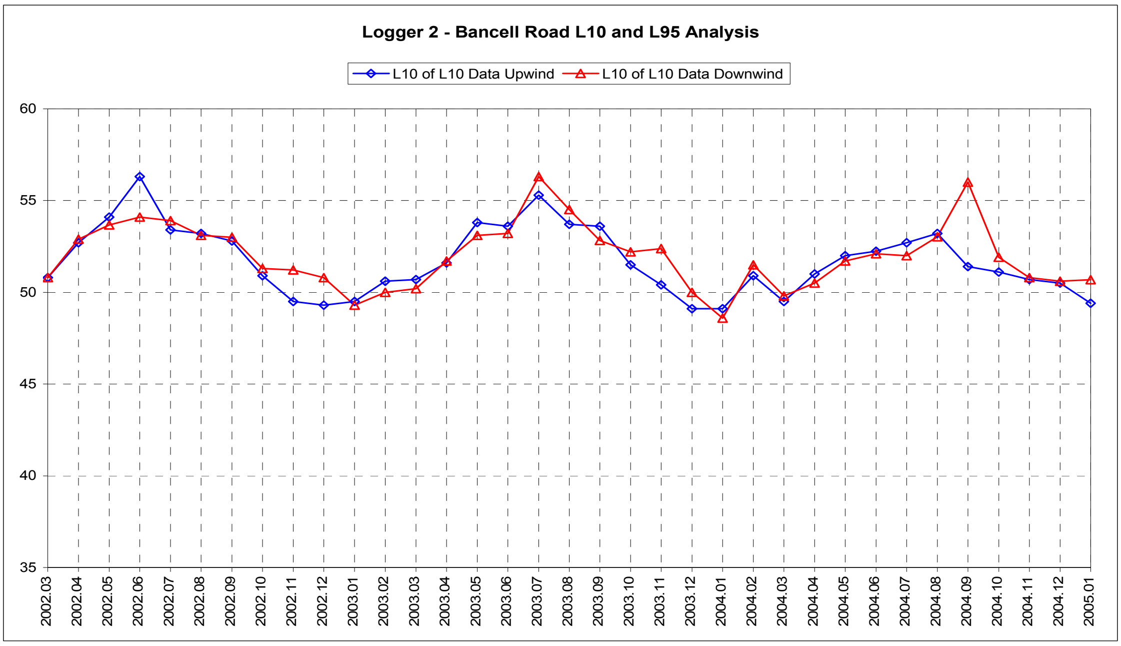
- ore and alumina conveyors;
- ore stacking and reclaiming machines;
- semi-autogenous grinding (SAG) mills;
- pumps, fans and blowers involved in liquid, steam, air and solids movement;
- liquid steam and air flow control valves and associated equipment;
- calcining kilns;
- steam generation and electric power generation plant;
- fans and pumps associated with pollution control equipment; and
- pipework used for liquid, slurry and steam movement around the refinery.

The refinery's overall contribution to noise levels in its vicinity, are well understood, having been characterised through numerous sound level monitoring campaigns. Monitoring data has been collected by acoustic consultants and from a network of fixed sound level monitoring stations. Three fixed sound level monitoring stations are located to the North and South of the refinery and have been in place since 2000. Monitoring of weather conditions at a meteorological station located to the south of Wagerup refinery is also performed, since meteorology is the major influence on the propagation of noise in any given direction.

Analysis of the monitoring data from the fixed monitoring stations and data collected by acoustic consultants, suggests that there has been no increase in the refinery contribution to ambient noise levels over the past three years. The data indicate that the actual refinery sound power level (noise emission) is relatively constant. Despite this, the recorded sound level at any measurement location varies from time to time. This variation is primarily caused by meteorological conditions. In particular, wind direction, wind speed and the presence or absence of temperature inversions play a significant role in causing this variation. It has been shown that refinery noise propagation towards the Yarloop townsite is favoured in the autumn and winter months due to the prevailing meteorological conditions.

Sound level data measured to the south of the refinery at the Bancell Rd fixed monitoring station from March 2002 to December 2004 is presented in Figure 37 as an example of the typical measured sound levels in the vicinity of the refinery.

Figure 37: Noise Levels Measured at the Bancell Rd Fixed Monitoring Station



NOTES

1. The fixed noise monitoring stations incorporate a precision sound level meter that records overall A weighted sound pressure levels to a data logger including the Regulatory requirements of L_{A0}, L_{A1} and L_{A10}. Sound levels measured at the fixed monitoring stations provide information on ambient noise levels including contributions from the refinery, traffic, wildlife, livestock etc.
2. Each data point in this chart represents the upper 10th percentile value of all 6-minute data points recorded each month at the Bancell Rd monitoring station under specific wind speed conditions (light winds, 0.5 to 3m/sec, since background noise is lowest at these speeds).
3. The upwind and downwind categories in this chart distinguish the location of the monitor relative to the refinery eg. down wind represents winds blowing from the refinery to the monitoring station.
4. Monitoring data collected prior to 2002 is provided in HSA report 9578-4-00029-4.2 (HSA, 2002a).

Figure 37 shows that there is little difference in the up-wind and down wind L_{A10} values measured at the Bancell Rd fixed monitoring station. This indicates that background noise is a significant influence on the L_{A10} values recorded at the monitoring location and that the refinery is not a significant contributor to the measured L_{A10} levels. Noise measurements recorded at this station vary seasonally, with higher levels recorded in the autumn and winter months (April to August) when the prevailing winds are often of higher average velocity. Another significant factor is the dominance of frog call noise during the winter period.

Since the sound level measurements conducted in the vicinity of the refinery are heavily influenced by other ambient noise sources, it is difficult to quantify the actual refinery contribution at any measurement location. For this reason, computer modelling has been used to estimate the refinery noise contribution at premises surrounding the refinery. A noise model has been developed for Wagerup refinery using the SoundPlan noise modelling software (version 6.2) and the associated CONCAWE algorithms (SVT, 2005a and HSA, 2002b).

The current model has been progressively developed by Herring Storer Acoustics (HSA) over a number of years. The model has been calibrated using comprehensive sound power measurements involving 193 survey points located near to the main refinery noise sources. The model predictions have been verified on many occasions under a range of meteorological conditions by field surveys conducted by qualified noise technicians (hand-held meter readings and observations) and by the fixed monitoring station data (SVT, 2005a). It is believed that the model predicts the refinery's noise contribution at noise sensitive premises to within +/- 3 dB(A) which is considered to reflect noise modelling capability (SVT, 2005a and Burgess, 2005b).

The noise model has been used to predict refinery noise contribution under maximum (worst case) sound propagation conditions, i.e., 3m/sec wind blowing from the source to the receiver combined with thermal inversion. In reality worst case propagation conditions occur very infrequently. The predicted noise levels are for the refinery only and will be less than the overall measured level at any location due to the significant influence of background noise.

The current refinery maximum noise levels predicted by noise modelling for the worst case weather conditions are shown in Figure 38. The contours shown in Figure 38 are considered "worst case" because the maximum noise levels will only occur occasionally (when meteorological conditions are suitable for maximum propagation). The figure also shows maximum refinery noise propagation in all directions simultaneously. In reality this situation can't exist as downwind conditions can only occur in one direction at any one time.

The possible variation in refinery noise contribution at receptors caused by meteorological conditions is shown in Figures 39 and 40. Figure 39 shows the predicted noise levels when the wind is blowing from the north whilst Figure 40 shows the predicted noise levels when the wind is blowing from the south. These two meteorological scenarios cause significant variations in noise levels at receptor locations even though the refinery noise output has remained constant. For example, at Boundary Rd to the south of the refinery, the two meteorological scenarios shown in Figures 39 and 40 cause a noise level variation of greater than 5 dB(A).

Figure 38: Existing Refinery Worst Case Modelled Noise Predictions in all Directions

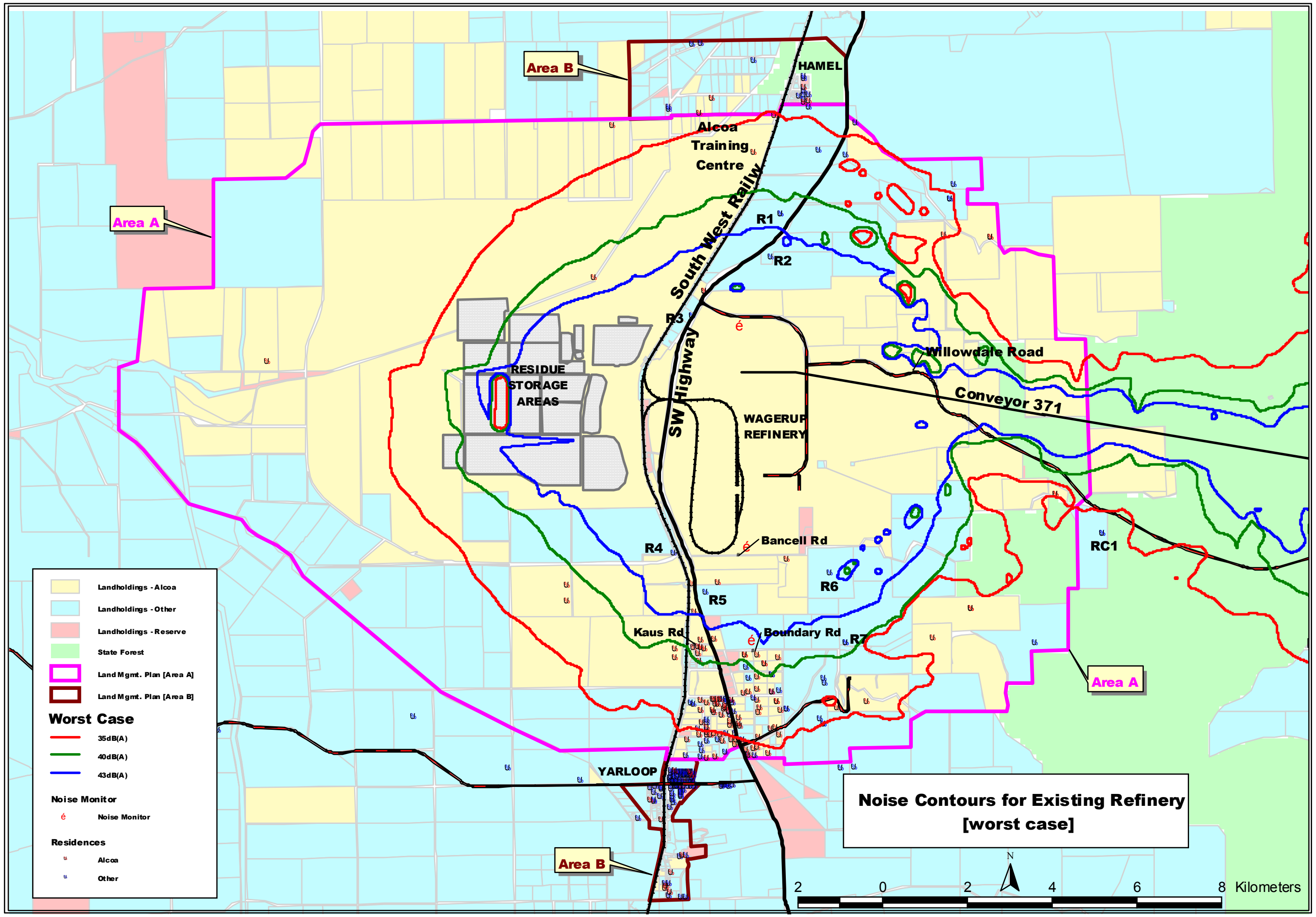


Figure 39: Existing Refinery Worst Case Modelled Noise Predictions with Northerly Winds

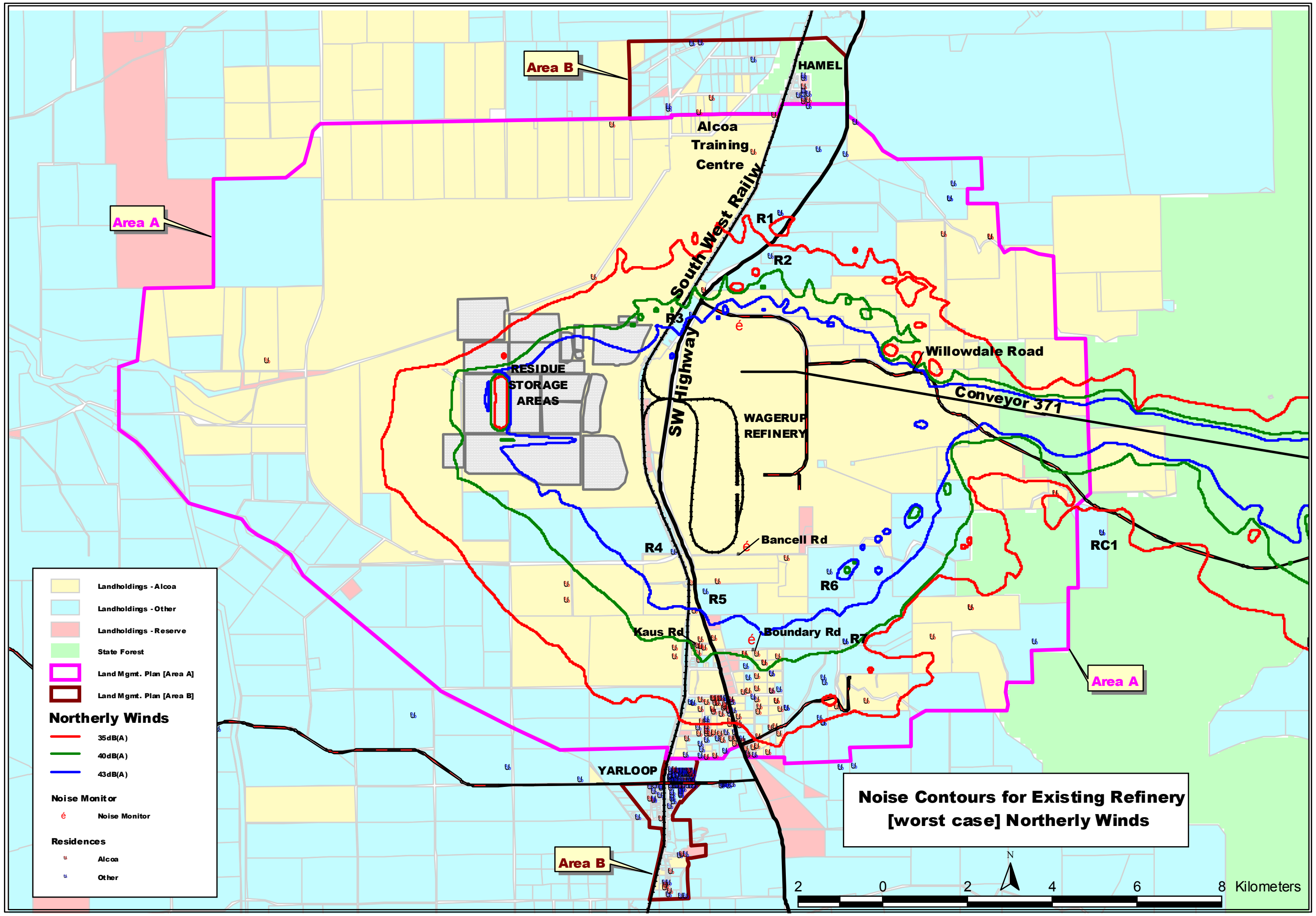
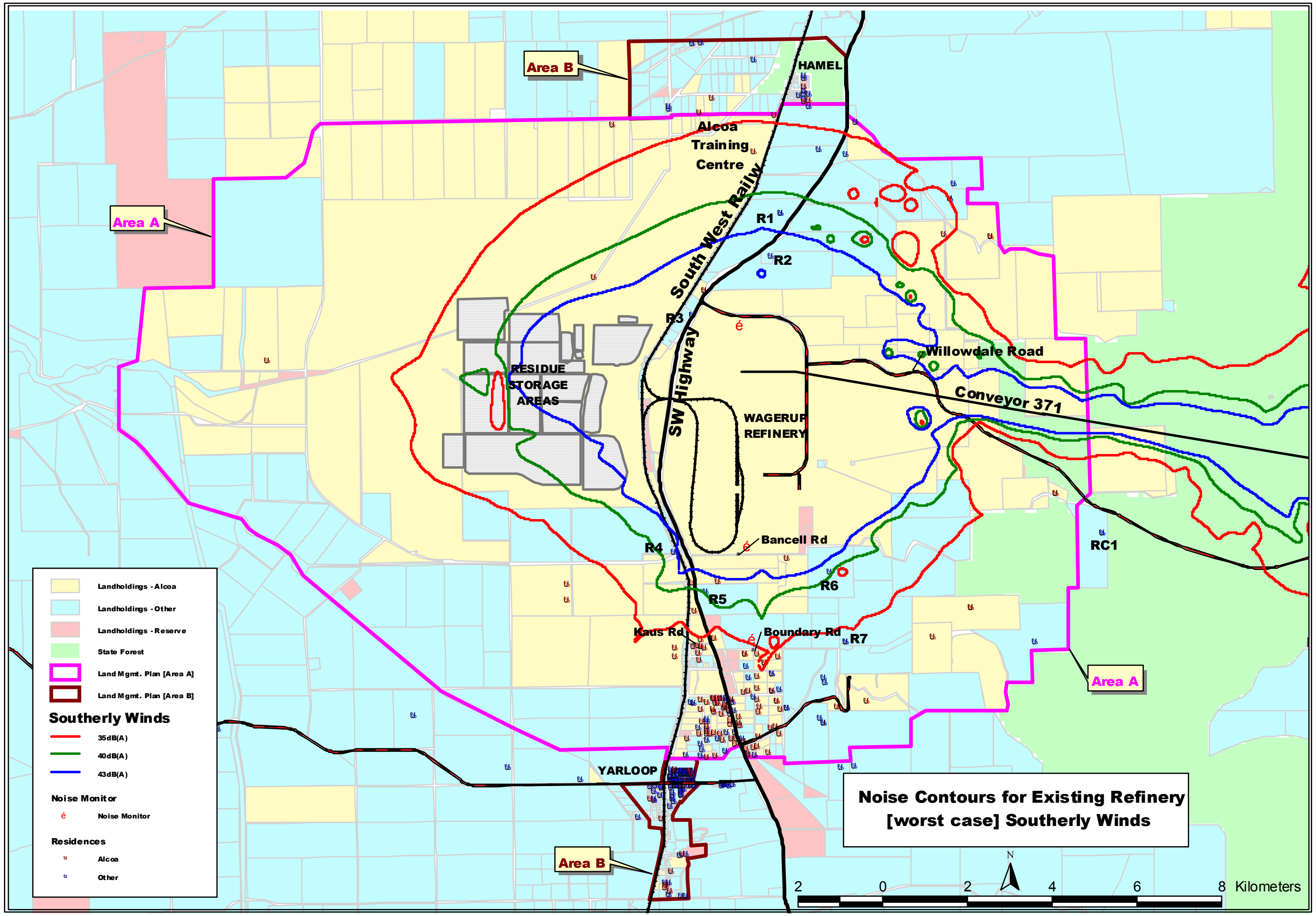


Figure 40: Existing Refinery Worst Case Modelled Noise Predictions with Southerly Winds



7.14.2 Compliance with Noise Regulations

The Environmental Protection (Noise) Regulations (The Regulations) were promulgated in 1997 and came into effect in 1999. Thus, neither Unit 1 nor Unit 2 of the Wagerup refinery (completed in 1984 and 1992 respectively) were designed or constructed to comply with the more stringent requirements of the *Environmental Protection (Noise) Regulations* 1997 which now apply (Table 16).

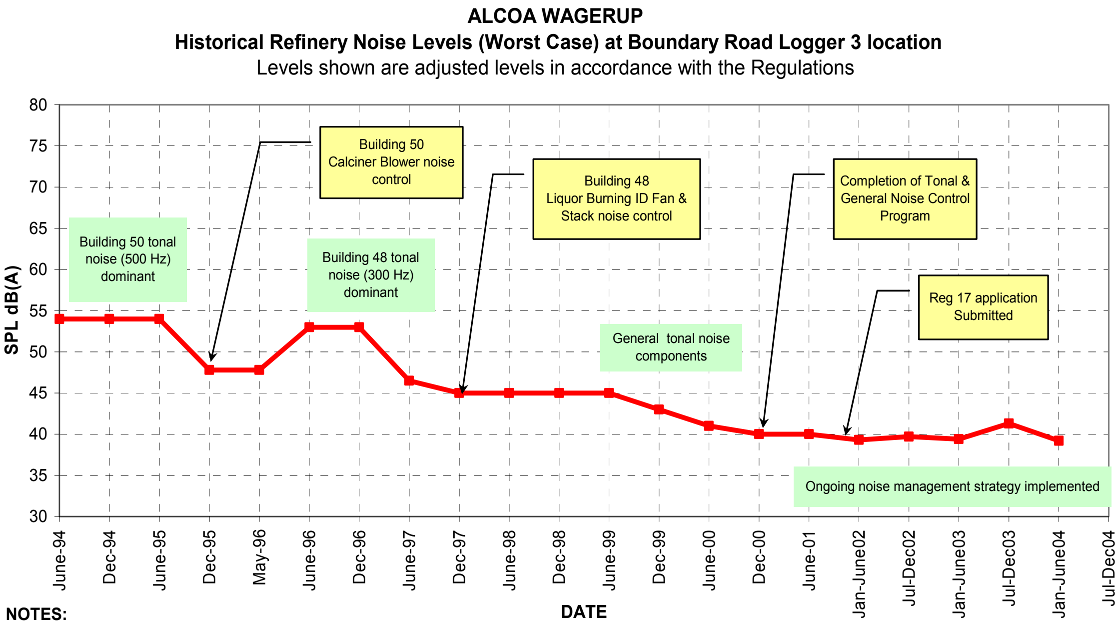
Table 16: Assigned Noise Levels for Sensitive Premises under the *Environmental Protection (Noise) Regulations 1997*

	Assigned Noise Level dB(A)		
Time of Day	L_{A10}	L_{A1}	L_{AMax}
0700 – 1900 (Mon to Sat)	45	55	65
0900 – 1900 (Sun & Public Hols)	40	50	65
1900 – 2200 (All days)	40	50	55
2200 – 0700 (Mon – Sat)	35	45	55
2200 – 0900 (Sun & Public Hols)	35	45	55

Prior to the introduction of the Noise Regulations Alcoa initiated a noise monitoring program and implemented a noise control program in consultation with the DoE. Several refinery noise sources were acoustically treated in the mid 1990's, including the calciner blower system and the liquor burner stack. Although some refinery noise sources had been acoustically treated, monitoring conducted in 1999 indicated that refinery noise levels exceeded the new night-time regulatory limits and that tonal characteristics were present.

An upgrade of the Wagerup refinery was completed in 1999 to achieve the current production capacity. This involved the installation of several new pieces of plant and coincided with the commencement of a noise reduction program, which was completed in 2001. This program successfully reduced night-time noise levels at Boundary Road (south of the refinery) by around 5 dB(A) and reduced the tonal components to meet regulatory requirements. Specific details of the noise reduction program are detailed in HSA report 9572-7-00029-4.2 (HSA, 2002c) which has been provided to the DoE previously. Figure 41 shows the effect of the noise reduction program on overall noise levels to the South of the refinery.

Figure 41: Noise Level Reduction Achieved at Boundary Road



NOTES:

1. The levels shown are equivalent L_{A10} Refinery values.
2. Jun 94 - Jun 01 data obtained by hand held spot checks to South of refinery and pro-rated to Boundary Rd.
3. Jun 01 to present data is taken from continuous monitor at Boundary Rd. Only night time data (10:00pm to 4:00am) has been used due to significant ambient influences from background noise during the day.
4. In order to capture the refinery only content, data recorded under conditions suitable for refinery maximum propagation to the South has been included (ie. wind from Northerly quadrant & wind speed between 2.5 - 3m/sec)
5. Single data points for inclusion in the chart have been obtained by averaging all data points satisfying the above criteria. The averaging used the 10th percentile values to provide a conservative indication of the worst case refinery scenario.

Despite this significant noise reduction, under worst-case propagation conditions monitoring and modelling has confirmed that the refinery noise emissions do exceed the night-time assigned levels at some private residences.

Worst case propagation occurs under light (up to 4m/s) down wind conditions or a combination of down wind and temperature inversion conditions (3m/s and 2ºC/100m) (refer Figure 38). Computer modelling and on-site measurement have shown that refinery noise emissions comply with the assigned levels for more than 85% of the time during the night at all residences beyond about 1.7 kilometres south of the refinery (HSA, 2002c). During day time and evening periods, when the assigned levels are higher, compliance with the noise regulations is achieved at all times at all residences located further than 1.7 km from the refinery (HSA, 2002c).

For privately owned residences closer than about 1.7 kilometres from the refinery, compliance will be achieved for lesser periods. For example, at the closest non Alcoa owned residence it is estimated that compliance is never achieved over night, and is not achieved for a considerable proportion of the rest of the time.

Further details of the extent of compliance have been presented in HSA reports 9578-4-00029-4.2 and 9572-7-00029-4.2 (HSA, 2002a and HSA, 2002c) submitted to the DoE in 2002 as part of Alcoa's variation application.

7.14.3 Regulation 17 Application to Vary Assigned Levels

In February 2002 Alcoa submitted an application to the Minister for Environment for a variation to the assigned noise levels, as shown in Table 16 under the provisions of Regulation 17 of the *Environmental Protection (Noise) Regulations 1997*. This provision was included in the Regulations in recognition that some existing facilities might not be able to comply with the newly introduced and more stringent assigned noise levels. Regulation 17 requires noise generators to demonstrate that "all reasonable and practicable" measures have been taken to reduce noise emissions from the facility before a Regulation 17 variation will be approved.

Alcoa's application for a variation to the assigned noise levels for the Wagerup refinery was made after the implementation of a noise reduction program that significantly reduced noise levels measured at Boundary Road to the south of the refinery (refer to section 7.14.1). The application sought to increase the assigned noise levels applicable to the refinery to the levels that had been achieved and monitored as a result of the noise reduction program. The refinery would achieve full compliance with the revised regulations if the Regulation 17 application was accepted.

The Regulation 17 submission proposed an allowable night-time noise level of 47 dB(A) + IF (influencing factor[3]) at the location of the nearest noise sensitive premises (compared to 35 dB(A) +IF as prescribed by the Regulations). The submission outlined a noise management strategy for ensuring that the noise levels at other potentially noise sensitive premises would not increase and included a commitment that noise emissions from the Wagerup refinery would not increase with any future modification, upgrade or expansion of the facility.

In the application Alcoa committed to:

- ensure ongoing noise emissions were managed by a noise management strategy involving further noise reductions, where reasonable and practicable;
- offer noise attenuation measures for the homes of people who were adversely affected by refinery noise (above the prescribed levels);
- implement a land management strategy (refer section 7.12) to facilitate relocation of adversely affected people;
- implement a complaints management program; and

[3] Refer to *Environmental Protection (Noise) Regulations*, 1997 Schedule 3 for information on how influencing factors for specific noise sensitive premises are determined.

- apply an engineering and procurement policy to adopt a 'lowest practicable' noise emission approach for new or replacement plant and equipment.

The Regulation 17 application has undergone intensive review by the DoE's technical staff since its submission in 2002. The DoE also commissioned an independent third party review by a specialist consultant of the application and the technical data that formed the basis of the application (SVT, 2003). Extensive consultation with community stakeholders and representative groups has been conducted by DoE and Alcoa.

On referral of the proposal to expand the Wagerup refinery, the EPA determined that the Regulation 17 assessment should be incorporated into the EPA's assessment of the proposed expansion of the Wagerup refinery.

7.14.4 Refinery Noise Emission Management

Over the last two years, Alcoa has successfully managed noise impacts related to the Wagerup operations through implementation of the noise management strategy and the land management strategy.

The noise reductions achieved in 2000 and 2001 have been maintained through ongoing programs of monitoring, assessment, maintenance and noise reduction works. This has been demonstrated by monitoring data which shows that noise levels have been sustained at the levels achieved in the 2000 and 2001 reduction program (refer to section 7.14.2).

A key part of Alcoa's noise management strategy was the implementation of the land management strategy. The land management strategy aims to provide community members who experience refinery noise emissions out of compliance with the Regulations, with a choice about remaining within the area.

Noise compliance was a major factor in developing the land management strategy, in that the modelled 35 dB(A) noise contour was adopted to largely define Area A. Area A is the area in which Alcoa has offered to purchase any property at a premium of 35% above market value. As a result of the implementation of the land management strategy a number of properties have been voluntarily sold to Alcoa. This has allowed those people wanting to leave the area to do so, others have remained and some neighbours have opted to stay as tenants after selling their property to Alcoa. Alcoa has also continued to deal directly with relevant residents requesting acoustic control treatment of their residences. The acoustic architect assesses the residence and provides recommendations on treatment that could reduce noise intrusion based on the resident's concerns and noise level measurements taken within the house.

By 2005, Alcoa had organised for its consultants to acoustically assess 10 homes within Area A, at the owner's request. Seven of the owners decided to proceed with the noise treatments following the assessment, which have achieved reductions of between 3 and 5dB(A). Four of the assessed properties have subsequently been purchased by Alcoa, through the land management strategy.

There are presently 41 privately owned dwellings remaining in Area A (refer to Table 17).

Table 17: Number of Privately Owned Dwellings within Area A

Inside 43 dB(A) predicted contour	Inside 40-43 dB(A) predicted contour	Inside 35-40 dB(A) predicted contour	Area A remainder	Total
8	2	17	14	41

Notes:

1. Data current as at March 2005.
2. Information on private dwelling locations has been obtained from aerial photograph's. Exact numbers may vary slightly.

Alcoa will continue to focus noise control efforts, including the land management strategy, on the premises located within 1.7 kilometres of the refinery as those residents who live beyond 1.7 km are considered to be subject to minimal noise impact from the refinery. Noise emissions from the refinery will continue to be monitored and managed and where reasonable and practical, noise emissions reduced.

7.14.5 Refinery Noise Emission Impact

In early 2004 Alcoa consulted residents of private dwellings located within Area A to help define the most suitable approach for managing noise impacts from the refinery and to remind neighbours of Alcoa's offer to acoustically treat homes.

The results of this consultation suggested that the impact of refinery noise within Area A is limited to a small number of residents. A total of 41 residents were consulted, 34 of whom indicated refinery noise was not an issue as other noise sources were more dominant. Seven residents expressed concern about noise impacts although four of these residents indicated that they only heard refinery noise occasionally.

As a result of the consultation, acoustic treatment was undertaken on two properties and this has successfully managed refinery noise in one instance.

The results of this consultation are supported by the 2004 noise complaint data, where from a total of 209 noise complaints, 76% (159) were received from four residents, located within the 35dB(A) contour (and therefore Area A). These four residents were part of a total of seven that had expressed concern over refinery noise during the consultation conducted by Alcoa in 2004. Additionally, 45 of the 209 complaints were lodged by 11 residents residing outside the 35dB(A) contour, where the refinery noise emissions although occasionally audible, comply with the noise regulations. The remaining five complaints were lodged by other residents residing inside the 35dB(A) contour.

Based on the 2004 consultation and complaint data it is understood that there are five neighbours within Area A that consider refinery noise emissions to be a continuing concern. Alcoa is undertaking discussions with two of these residents under the land management strategy which may result in these properties being purchased by Alcoa. If purchased, this would leave three residents within the 35dB(A) contour who currently indicate they are impacted by refinery noise emissions.

7.14.6 Costs to meet Noise Regulations

Extensive acoustic reduction work was undertaken at the refinery from 1995 to 2001 to achieve the current refinery noise emission levels. A detailed assessment by acoustic consultants, for the Regulation 17 submission in 2002, indicated that further overall noise reductions could only be achieved at what is believed to be excessive cost and with uncertain results. Nevertheless, in 2004 the cost estimates were reviewed for further 3, 4, 5 and 6 (5.9) dB(A) overall noise reductions for the current refinery scenario (i.e., without the Proposal).

Due to the large number of sources in the refinery that would require noise treatment, the cost was significant, with conservative estimates ranging from $9.8 to $20.7 million dollars. This analysis did not account for indirect costs, such as loss of production and shutdown costs, or include possible compromises with safety and operational controls. The cost estimate was based on achieving a noise reduction to the south of the refinery and would be significantly higher to achieve noise reductions in all directions.

On analysis of the number of residents impacted (refer to section 7.14.5) by refinery noise emissions and the cost of further noise reductions (without certainty of reductions) it was not considered reasonable or practical for further noise reductions to be implemented.

In submitting the Regulation 17 variation application, Alcoa made the commitment that noise impacts from the Wagerup refinery would not increase with any future modification, upgrade or expansion of the facility. This commitment was made because analysis suggested that while it was not reasonable or practicable to achieve further noise reductions, it was considered practicable that the costs of additional noise control works be part of the capital cost of any major expansion works, given the level of investment required for such works. An expansion can only occur through adopting tight noise standards on any new equipment and associated processing facilities. A major expansion also provides the opportunity to optimise the overall facility in ways that reduce noise output to at least offset any contribution from new equipment.

In 2002 it was estimated that the commitment to not increase noise emissions through an expansion would add approximately $14 million to the overall project capital cost. This estimate was based on an extrapolation of noise control technology that was deployed as part of the noise reduction program conducted in 2000 and 2001. Based on additional work undertaken in 2005, it is evident that the cost of this commitment was significantly underestimated in 2002. Engineering consultants were commissioned in 2005 to re-estimate the costs to maintain the existing noise emissions from the Proposal based on the preliminary design details available at the time of ERMP preparation. The capital expenditure required to maintain the existing refinery noise emissions and still implement the Proposal is estimated to be greater than $50 million.

In addition, between $0.5 to $1 million is spent annually on monitoring and maintaining noise emissions at the current refinery levels. This sum is expected to increase through the expansion of the refinery.

7.14.7 Implications of Further Noise Reductions at the Refinery

In recognition that additional acoustic reduction opportunities may exist as a result of an expansion, the sound power allocation budget (the amount of sound allocated to a particular refinery area as a limit) was reviewed to assess what would be required to achieve a 4 dB(A) reduction in overall noise emissions levels from an expanded refinery. To achieve this overall noise reduction it would be necessary to reduce noise emissions from numerous sources within the refinery. Specialist acoustic consultants concluded that a 4 dB(A) overall reduction in noise levels is not technically feasible (SVT, 2004c).

The consultant identified that at any location there are many noise sources that contribute to the overall noise level. Their analysis indicated that there are so many contributing sources that the highest contribution from any single source is approximately 10 dB(A) below the cumulative noise level from all sources at the refinery (SVT, 2005c). This demonstrates that the noise reduction and management program implemented to date has been rigorous and further reductions will be difficult to obtain. The consultant did not consider that a 4 dB(A) reduction to the south of the refinery was actually possible as in many cases the sound power allocation limits required to achieve a 4 dB(A) reduction may not be technically feasible (SVT, 2005c).

Nevertheless engineering consultants were commissioned to derive preliminary cost estimates of achieving a 4 dB(A) reduction. This costing does not include specific treatments required for the digestion, precipitation or calcination areas as practical acoustic solutions for these areas are unknown. These sources are significant contributors to noise levels received at residences, therefore acoustic treatment will be required in order to achieve an overall noise reduction. It has been estimated that the cost of the reduction would be in excess of $50 million and is in addition to the $50 million (minimum) required to meet the current noise commitment. In addition the cost analysis does not account for indirect costs (i.e. loss of production, shutdown costs, investigation costs) or include possible compromises with safety and operational controls. A significant amount of engineering followed by noise modelling will be necessary before this cost can be confirmed.

7.14.8 Requirement for Approval of Regulation 17 Application

Given that there are only a small number of residents impacted by refinery noise; the limited time that the refinery is out of compliance with the Regulations at most noise sensitive premises; the technical uncertainty around the ability to actually reduce overall noise levels; and the excessive cost related to further noise reduction Alcoa considers that further noise reduction at the refinery is not reasonable or practicable.

Alcoa has committed to ensure that the environmental noise impacts from the refinery do not increase as a result of the Proposal. This follows on from noise emission reductions achieved by the works programs implemented in 2000 and 2001. These reductions were achieved at a considerable cost and require ongoing expenditure to monitor and maintain. Further off-site noise reduction cannot be achieved at reasonable cost due to the very large number of contributing sources within the refinery, and acoustic consultants are not confident that a measurable reduction in noise levels is technically feasible.

Alcoa remains committed to implementing source reduction opportunities where reasonable and practicable at the refinery. Alcoa believes that continuing negotiations with neighbours within Area A will result in most of those remaining parties aggrieved by noise being satisfied. Alcoa believes that it has demonstrated a realistic degree of flexibility in dealing with the range of difficult issues associated with land acquisition, and continues to explore mutually acceptable ways of achieving adequate separation between the refinery and neighbours.

For its noise management strategy to be effective, Alcoa must ensure it is operating the refinery in full compliance with the *Environmental Protection Act 1986* and its Regulations. At the nearest noise sensitive premises, Alcoa requests that the night time regulatory LA10 criteria be increased from 35 dB(A) + IF to 47 dB(A) + IF, consistent with the predicted contours shown in Figure 38, in accordance with the Regulation 17 application submitted to the Minister for the Environment.

7.14.9 Bunbury Port

The current Alcoa port facility (Bunbury Port) noise emissions are considered to comply with the *Environmental Protection (Noise) Regulations 1997*.

The main existing sources of noise at the Bunbury Port are fans and blowers associated with alumina conveying and dust collection systems. Although the Port complies with the Regulations, noise emissions may be audible at neighbouring residences under certain weather conditions.

Noise emissions from the port are measured periodically to determine compliance with the Regulations. However, the measurement of port noise emissions is complicated due to relatively high ambient noise levels.

The ambient noise environment in the area surrounding the Port facility is very complex. In addition to the Alcoa facility, there is a variety of non-Alcoa owned port facilities that are significant contributors to the noise received at nearby residences. Noise from road, rail and ship traffic is also significant. The major natural ambient noise sources include wind induced tree and vegetation noise and noise from fauna e.g. birds and frogs.

Due to the high level of ambient noise it is difficult to determine the noise contribution of the Alcoa port facilities at a particular location by measurement alone. A noise model has been developed for the Port facility so that its contribution to noise levels at various locations can be calculated in accordance with the Regulations. The noise model has been developed using the SoundPlan 5.0 noise modelling software and the associated CONCAWE algorithms. This model has been developed and refined during ongoing monitoring programs and has been used to predict the Port's noise contribution under maximum (worst case) sound propagation conditions.

The noise model was updated following a noise reduction program conducted in 2000. Worst-case noise levels of 35 dB(A) and 31 dB(A) have been predicted for nearby residences to the south-west and north-east of the Port facilities respectively.

Since this review was undertaken the only change to the equipment operated at the port is an upgrade of the ship loader dust collector fan. Site measurements undertaken recently by SVT show that the new equipment is approximately 3 dB quieter than the old equipment. Based on this information SVT concluded that the current worst-case noise levels will be 32 dB(A) and 31 dB(A) at nearby residences to the south-west and north-east of the port facilities respectively (SVT, 2005b). This confirms compliance of the Alcoa Port facility with the Regulations.

7.15 SOCIAL SETTING

7.15.1 Regional Setting

A detailed review of the social setting within which the Wagerup refinery is located was undertaken by ERM (2005) and is presented in Appendix P.

The Wagerup refinery is located in the Shire of Waroona in the Peel Region near the border with the Shire of Harvey, which is in the South West Region. Peel has the second largest population of all regions in Western Australia (approximately 79,000; 4% of the State's population) and is experiencing a population growth rate almost double that of the rest of the State, the second highest behind the Perth metropolitan region. Population growth has averaged above 3% per annum since the mid 1990's, with lifestyle and housing options being the main drivers of these inflows. This rapid growth comes with some challenges: for example, public services are often regarded to be lagging behind the growing demand.

Mandurah is the major population and business centre for Peel and is one of the largest urban centres outside the Perth metropolitan area. It is also where most of the infrastructure and services for the region are located. A major asset and driver of the region's growth is the coast and estuary. The main inland centres of Peel are Byford, Pinjarra, Waroona and Boddington. Smaller communities exist at Mundijong, Jarrahdale, Serpentine, North Dandalup and Dwellingup.

The South West region has the largest population of any region outside of Perth with a population of 132,000 (6.9% of Western Australia's population). The average population growth of 2% per annum for the South West is higher than the growth rate for the State (1.4%). The majority of the population lives around the regional centres of Busselton and Bunbury on the coast, and Collie inland. The Shire of Harvey contains 14% of the population in the South West region. The community of Yarloop is located within the South West Region.

The indigenous people in the Peel and upper South West areas tend to be younger than the non-indigenous community. The majority of indigenous people are younger than 25, with nearly half of the indigenous population under 14 years of age, compared with about 23% of the non-indigenous population under 14 years. Approximately 1.4% of the Peel Region and 1.8% of the South West Region identified themselves as Aboriginal in the 2001 Census (ABS, 2001).

The economy of the Peel Region is based predominantly on mining and mineral processing, mainly sourced from Alcoa's Pinjarra and Wagerup alumina refineries, and Huntly and Willowdale bauxite mines, and Worsley bauxite mining operations near Boddington. In 2003 the Peel Region produced $3.1 billion worth of alumina of which $650.7 million worth was produced from bauxite mined in the Shire of Waroona (DoIR, 2004). The 2001 Census reported the major areas of employment for people living in the Shire of Waroona also reflected the minerals processing profile, as follows:

- manufacturing (18%);
- agriculture/forestry/fishing (11%);
- retail trade (11%);
- construction (10%); and
- mining (8%).

Alcoa's refinery operations are included in the manufacturing sector figures, whilst its mining operations are reflected in the mining sector figures.

Although mining and mineral processing is a key industry in the South West, the region has a diverse economy with power generation, agriculture, agricultural processing, viticulture and tourism. Mineral extraction, processing and manufacturing form the most valuable industries in the South West with a total of approximately $2.2 billion in 2001/2002.

The 2001 Census data reported the major areas of employment for people living in the Shire of Harvey were:

- manufacturing (including alumina refining) (20%);
- retail (11%);
- agriculture/forestry/fishing (11%);
- education (8%); and
- construction (7%).

The unemployment rate for the Peel Region as of June 2003 was 8.1%. Whilst this is significantly lower than in 1996/97 when it was 13.5%, this rate is still high compared with regional Western Australia (5.6%) and the State as a whole (5.9%) in June 2003. The latest unemployment estimates available from the ABS at the shire level are 2001 (updated April 2004) and show the Shires of Waroona (5.4%) and Harvey (4.7%) to have relatively low rates of unemployment.

The South West has an unemployment rate of 6% that is similar to that of regional Western Australia and also to that of Western Australia. This is most likely as a result of the diverse economy and the relatively high amount of manufacturing in the region. The importance of manufacturing (including alumina refining) is highlighted in the figures above for the Shire of Harvey.

With the resource sector of the economy currently very strong in Western Australia there a number of proposed large new projects. In the southern part of the State there are at least six proposed large projects in the iron ore, alumina, power and infrastructure industries. Tracking of the skilled labour market by Insite Logistics indicates that there are currently about 13,400 active construction workers in Western Australia (ERM, 2005).

7.15.2 Shire of Waroona

7.15.2.1 Population

The Shire of Waroona has a population of approximately 3,500 people (3,278 people in the 2001 Census), which accounts for under 5% of the population of the Peel Region. Between 1996 and 2016 the population of the Shire is predicted to increase by only 22%. The 2001

Census results showed that between 1996-2001 the number of households in the Shire increased, however the occupancy rate (average number of people inhabiting each household) actually declined by 10%. The decline in occupancy rates is likely to continue at a rate above the State average, but at a slower rate than that observed over 1996-2001, which will result in 'development' rates significantly exceeding rates of population growth.

In the Shire of Waroona, 2.4% of the population identified themselves as of indigenous descent.

The high proportion of people under the age of 14 and in the 25 to 44 age group reflects the employment opportunities and lifestyle in the region for families. The lack of people in the 15 to 24 age group suggests young people tend to move out of the Region to seek employment and further education and training opportunities (ERM, 2005).

7.15.2.2 Industry Profile

Mining and minerals processing is a major economic contributor in the Shire of Waroona although agriculture remains an important industry. Agriculture traditionally focussed around dairy and beef cattle production however, deregulation of the dairy industry and the development of the Waroona Irrigation Scheme have enabled new industries, such as horticulture, citrus and nut orchards to become established.

Mining and minerals processing in the Shire is dominated by Alcoa's bauxite mining operations at Willowdale and alumina processing at Wagerup, although a new mineral sands mine has recently been established in the Shire. The mining industry has resulted in the establishment of several new businesses providing services to mining in the Shire. Tourism and recreation are also important to the Shire with the attraction of the State forests, reserves and dams in the Shire, and the coastal strip (ERM, 2005).

7.15.2.3 Businesses and Services

The majority of businesses in the Shire of Waroona are located in the Waroona townsite. Businesses include:

- several supermarkets;
- food outlets;
- fashion and other retail stores;
- commercial laundry;
- bank;
- agricultural services;
- vehicle and machining services;
- real estate agencies;
- veterinary clinic.

The Shire of Waroona Community Strategic Plan (1999-2004) Status Report (Shire of Waroona, 2004) indicated that there is a lack of low-cost serviced light industrial land in the Peel Region and the Waroona Shire. There is a small industrial area in Waroona which has several larger businesses including machinery hire, steel fabrication, aluminium window and door manufacturing and concrete products manufacture. There is no domestic or commercial gas supply to Waroona, which limits energy options for industry (ERM, 2005).

The Shire of Waroona has two primary schools and one secondary school to year 10 located in Waroona. Students who wish to complete years 11 and 12 must commute to senior high schools located in Pinjarra, Mandurah or Harvey.

There is no public hospital in the Shire of Waroona, with the nearest hospitals located in Yarloop, Harvey and Pinjarra. However a Health and Community Resource Centre has recently been built in Waroona to provide health services, private medical and specialist practitioners and family and youth support services. Waroona also has a dentist and aged care facilities.

The Shire of Waroona has one police station, a district-wide State Emergency Service group and a St John Ambulance located in the town of Waroona. Concern has been expressed by some residents about the ability of currently emergency services to meet demand.

Available recreational facilities include a new recreation and aquatic centre in the town of Waroona which includes a child care facility. Outdoor sports facilities, a golf course and several recreational parks are also located in the town and there is a number of sporting and recreation groups in the Shire. There is a number of attractions in the Shire that cater for outdoor activities such as bushwalking, swimming, water skiing, sailing and fishing including the Darling Range, Waroona Dam, Drakesbrook Weir and the coastal strip (ERM, 2005).

7.15.2.4 Housing

There is a growing demand for new houses in the Shire of Waroona, which is principally driven by development along the coastal strip. The town of Waroona has also experienced steady growth in new housing development, however there is a shortage of serviced residential land in Waroona that could limit future housing and population growth. Demand for housing in Hamel is strong and the quality of existing housing is reasonably good.

Housing developments are located at Preston Beach, Tuart Grove, Armstrong Hills, Harvey River Sanctuary and Drakesbrook Meadows Estate (ERM, 2005).

7.15.2.5 Regional Planning

The Shire of Waroona has undertaken a review of existing planning and has released a discussion paper entitled "Shire of Waroona Local Planning Strategy; Discussion Paper 2", October 2002. The preliminary strategy contains the following objectives:

- consolidation and expansion of the existing Waroona, Hamel, Preston Beach and Lake Clifton settlements;
- support for a coordinated approach to land-use and development around the Wagerup refinery;
- management of land use change in rural areas to achieve positive economic, social and environmental outcomes;
- support for industrial and commercial development;
- provision of residential lifestyle opportunities;
- provision of an integrated approach to land use and infrastructure planning;
- reflection of State and regional planning;
- provision of a land use planning regime responsive to economic and social opportunities;
- protection of environmentally sensitive areas from development; and
- support for the enhancement of the Waroona Town centre.

The Strategy has identified land surrounding the Waroona Town Centre for future/potential expansion of the town centre, however there is not expected to be any need to accommodate expansion of the town centre over the short to medium term. It is anticipated that physical expansion of the town may occur over the medium to long term.

There is currently sufficient zoned land to accommodate a doubling of the Shire population growth rate over the next ten years, with shortfalls not arising for 10 to 15 years. However, there may be a shortage of 'desirable' land in the near future, as some land in Waroona and Preston Beach may be considered somewhat less desirable or development is constrained by significant up-front costs. The Shire of Waroona has recognised that this shortage of 'desirable' land may constrain population growth in the interim and it may be beneficial to identify additional opportunities for residential development and a strategy for protection of these areas from excessive fragmentation and/or incompatible development (Shire of Waroona, 2002).

The Shire has also identified that a number of areas would benefit from more detailed and integrated planning. These areas include: the Hamel Townsite and surrounds (Hamel Eco-Historic Precinct), Preston Beach Townsite and surrounds, Lake Clifton, Wagerup and Waroona Townsite and Centre. For the Wagerup area, more detailed planning would include the identification of a buffer area around the Wagerup refinery (Shire of Waroona, 2002).

Wagerup Refinery

In the Waroona Shire Town Planning Scheme (No. 7) the Wagerup refinery is zoned ‘Special Industry Zone’ for both the residue area and the refinery itself. This zone enables or permits the operations of the Wagerup refinery and also enables agricultural uses to occur where refinery uses may not be in operation. The refinery and residue area are surrounded by predominantly Rural zones classified as ‘General Farming’, ‘Irrigated Agriculture’ and ‘Hills Face’ (conservation area with large Rural holdings).

The Shire of Waroona Draft Local Planning Strategy reflects the zones in the Town Planning Scheme and reserves the Alcoa Wagerup Refinery as an area for a potential structure plan, for ‘Strategic Industry’ (areas to accommodate large-scale, capital intensive industries that have the potential to generate significant off-site impacts).

7.15.2.6 Landuse

The Shire of Waroona is an area of approximately 8,355 km2 divided into a number of different land uses. Prior to the commencement of Alcoa’s bauxite-alumina operations, agriculture was the main economic activity in the Shire of Waroona. Dairy farming generated most of the revenue but was already in a state of decline as a result of small farm sizes and high land costs contributing to the relocation of a significant number of milk quotas to areas further south. Current landuse is outlined in Table 18:

Table 18: Landuse in the Waroona Shire.

Land use	Area (ha)
Recreation and/or camping reserve	488.5
Water Reserve	94.5
Townsite Reserve	713.1
Other Reserve	234.4
Public Works Department	435.3
Water Corporation	3.9
State Forest	35,735.2
Timber Reserve – Land Act	13.8
Conservator of Forest Land	195
Vacant Crown Land	640
Private Property	39,100.5
National Park	5414
Flora and/or Fauna Reserve	443.2
Total	**835,512.6**

The Wagerup refinery comprises the majority of industrial activity in the Shire of Waroona, with mineral sands mining also occurring in the Shire along the base of the Darling Scarp. Earthmoving contractors and previously an abattoir have also been major employers in the Shire. Waroona has a light industrial area which accommodates a range of enterprises including panel beating, spray painting, aluminium door and window manufacturing, concrete products manufacturing, toy manufacturing, cabinet making, steel fabrication and machinery hire (Alcoa, 1994).

Land Management Programme

In response to community concerns about the refinery's impacts on residents in close proximity to Wagerup, Alcoa developed a draft 'Wagerup Land Management Draft Proposal' in 2001 which was distributed to the residents of Hamel (Shire of Waroona) and Yarloop (Shire of Harvey) for community comment. Based on community input, the proposal was revised and adopted in 2002 and again revised in 2004.

The aims of the proposal were to:

- Invest in the future of Yarloop and Hamel;
- Protect property values; and
- Give residents a choice about whether they continued to live where they do.

Refer to Section 7.12 for further detail.

7.15.3 Shire of Harvey

7.15.3.1 Population

The Shire of Harvey is located south of the Shire of Waroona and covers an area of 1,766 km2. The town of Yarloop in the Shire of Harvey is located approximately 2.5 km south of the Wagerup refinery. The Shire has a population of 18,397, which is 14% of the population of the South West Region. Approximately 1.7% of the Shire's population are indigenous (ERM, 2005).

7.15.3.2 Industry Profile

The dairy and beef cattle industries continue to be the mainstay of the economy of the Shire of Harvey. However, recent development of the Harvey Irrigation Scheme has enabled more horticulture and viticulture industries to become established. Significant agricultural processing operations in the Shire include the Harvey Fresh milk and juice processing plant, the Peters and Brownes factory at Brunswick Junction, EG Green and Sons abattoir, and winemaking (ACIL Tasman, 2004). In the past the timber industry has also been an important contributor to the Shire, but now employs relatively few people.

There is no current mining activity within the Shire, although the Alcoa and Worsley mining leases extend into the Shire of Harvey. Mineral processing is undertaken at the Kemerton Industrial Park approximately 17 km north east of Bunbury. The industrial park is principally tenanted by Millennium Inorganic Chemicals and Simcoa.

Tourism and recreation is an important contributor to the economy of the Shire of Harvey and mostly centred on the coastal town of Australind. However, there are also facilities that take advantage of the Darling Range (ERM, 2005).

7.15.3.3 Businesses and Services

The Shire of Harvey has a strong commercial sector supported by the populations in the towns of Australind, Brunswick and Harvey. The commercial centre of Harvey itself includes:

- supermarkets and major retail outlets;
- restaurants;
- cafes;
- food services;
- fashion and other general retail;
- banks;
- real estate agencies; and
- small businesses that service the agricultural industry.

The light industrial area on the outskirts of the town of Harvey supports a number of industries including some that service the mining industry. The E.G. Greens abattoir and Harvey Fresh are located close to town.

Yarloop has the Gunns timber mill, drying kilns and veneer plant located in Yarloop, although limited commercial services.

The Kemerton Industrial Estate provides for a number of larger industries including an abattoir, piggery, the Millennium Inorganic Chemicals' titanium dioxide pigment plant and Simcoa's silicon plant.

The Shire of Harvey has 13 pre-primary and primary schools, two secondary schools, the Harvey Agricultural College and two TAFE campuses. The towns of Cookernup and Yarloop provide for primary education only.

There are two public hospitals within the Shire. The hospital at Harvey provides 24 hour accident and emergency service. The Yarloop hospital mainly provides care for the ill elderly, and the town of Harvey also has aged care facilities. The Yarloop hospital will require temporary closure for proposed upgrades, which has caused some concern about the ability of remaining services to cope with the demand.

There are three police stations, located in Harvey, Yarloop and Australind. Harvey also has a St John Ambulance, State Emergency Services and a local bush fire brigade. Other local bush fire brigades are in Yarloop and Cookernup. However, there is concern about the ability of current emergency services to cope with demand.

The larger towns in the Shire have good built recreational facilities with a number of sporting and recreation groups. The town of Harvey has a swimming pool, outdoor sports facilities, public parks, and a recreation centre. Recreation activities in the Shire are mostly on the coastal strip at Australind and in the Darling Ranges. Nearby attractions include Stirling Dam, Harvey Dam and the Darling Ranges which cater for water skiing, fishing, swimming and bushwalking activities (ERM, 2005).

7.15.3.4 Housing

There is strong demand for housing in the Shire of Harvey, although this is focused on development of the coastal strip near Australind. Harvey Shire has indicated that there is a need for more affordable housing in the Shire, which has been partially met by the Korijekup Heights housing development near Harvey. Demand for housing in Yarloop is relatively low and there are currently no new housing developments proposed for the town.

7.15.3.5 Landuse

Informal Land Management

In October 2001, residents in Yarloop and Hamel received a “Wagerup Land Management Draft Proposal” from Alcoa for community comment. The stated aims of the proposal were to:

1. Give people choice about whether they continue to live where they do;
2. Protect property values; and
3. Invest in the future of Yarloop and Hamel.

The Draft Proposal identified an area around the Wagerup refinery – Area A – where Alcoa proposed to establish a Special Control Area to restrict further residential development. It also identified an Area B where, in order to protect property values, Alcoa would, for 12 months, buy properties if residents wished to sell. In light of community feedback, the proposal was revised and adopted in January 2002. The policy was strengthened again in November 2004.

Revised Proposal – January 2002

The Wagerup Land Management Revised Proposal, dated January 2002, contained the following key changes:

1. Identification of only a single area – Area A – where Alcoa would seek changes to the local Town Planning Scheme to ensure land use is compatible with refinery operations;
2. In the townships of Yarloop and Hamel, a commitment to purchase any property at unaffected value for the next five (5) years (assuming no unforeseen events, unrelated to Alcoa, that may lower property values);
3. A commitment to talk to people who live outside the townships of Yarloop and Hamel on a case-by-case basis; and
4. A commitment to liaise directly with business owners who may wish to sell, and to support a process for developing strategies to enhance business opportunities in the local community.

The revised proposal provided that Alcoa would purchase properties in Area A for the operating life of the Wagerup refinery. This Area A included some 118 properties in northern Yarloop.

The commitment to purchase properties in the townships of Yarloop and Hamel (Area B) was extended for a period of five years (i.e., until December 2006), with a five year extension if a study of valuations found house prices had fallen in the town due to Alcoa or publicity about Alcoa.

The boundary of 'Area A' was chosen for three reasons:

- People in this area may experience noise levels above the night time limit allowed under noise regulations (based on the modeled 35dbA noise contour plots surrounding the refinery);
- It corresponds with areas where people may be most annoyed by refinery emissions (at the time this was also the area where over 95 % of community odour complaints were being reported); and
- It allows for future expansion of Alcoa's bauxite residue area to the west of its current site and was chosen to fit the life of the refinery.

The Revised Proposal highlighted Alcoa's commitments to the following:

- Reducing odour and other emissions;
- Reducing noise;
- Investigating health concerns;
- Protecting property values;

- Supporting the integral nature and quality of the community and encouraging people to stay in the area; and
- Making it easy for those who wish to leave to sell their properties.

Alcoa proposed to those living in Area A the following:

- Offer to buy their home at the unaffected market value;
- Plus 35% to cover replacement costs; and
- Plus $7,000.00 to cover relocation costs.

The policy allows individual properties to be purchased only once (i.e. from original residents at the time of the policy announcement). The policy set out three methods of valuation and a valuation management process. It required that two valuations be prepared at Alcoa's expense; one by the owner's valuer and one by a licensed valuer chosen by Alcoa.

<u>November 2004</u>

In November 2004, Alcoa wrote to residents of Area B. The letter addressed recommendations of a community group (Land Management Working Group) that were drafted following an open forum in Waroona in September 2004. With the objective of providing security for those homeowners, the community group recommendations were adopted as:

For people who were, and remain, property owners in Yarloop and Hamel (Area B) on or before 1 January 2002:

1. Alcoa will extend its offer to purchase the property (at any time) from 31st December 2006 to 31st December 2011 (in accordance with the Wagerup Land Management Revised Proposal, January 2002); and

2. Alcoa will offer to purchase a property after 2011, if the owner has first marketed the property for six (6) months but has been unable to find a buyer at fair market value.

In accordance with the group's proposal, this undertaking applies for the life of the property owner or the life of the Wagerup refinery, whichever comes first. In the case of a deceased estate, the same option is available to the executor of that estate or to the person or person(s) to which land title is transferred in accordance with a Last Will and Testament, for a period of up to twelve (12) months after the property owner's death.

The Land Management Working Group continues to examine issues associated with Alcoa's land purchase policy, including valuation methods used to determine market value.

Further detail of the proposal is available from Alcoa and is summarised in the Socio-economic study by ERM (2005).

7.15.4 Bunbury Port

A major contributor to Alcoa's alumina operations is the Bunbury Port, through which Alcoa imports caustic and exports alumina. Currently, Bunbury Port is the world's largest alumina exporting port with trade through the port valued at more than A$3 billion per annum. Alcoa's alumina is shipped to aluminium smelters throughout the world with the majority destined for China, Canada, Africa, United Arab Emirates and Indonesia. The alumina industry accounts for some 80% of throughput, or more than three ships a week through Bunbury Port. An economic impact study commissioned by the Bunbury Port Authority in 1999/2000 has shown that for each vessel that uses Bunbury Port, two full time equivalent positions are created. Alcoa's Bunbury Port operation's today has 22 Alcoa employees, 21 of whom live in or around Bunbury.

The City of Bunbury has grown and continues to grow around the Port. The city has an estimated resident population of 30,786 with an average annual growth rate of 1.7%. It is estimated that there is a labour force of 16,165 (June 2004) and an unemployment rate of about 7.2%. Most people tend to work in the retail industry, property and business services, construction and health and community services. Approximately 125 people work in manufacturing/mining and 168 in construction (South West Development Commission website www.swdc.wa.gov.au).

Bunbury has a well serviced education sector with several government and private primary and secondary schools, and the campuses of the Edith Cowan University and the South West Regional College of TAFE. The City provides specialist medical services, including major private and public hospitals.

Bunbury has a wide range of businesses and services and acts as a regional centre for commerce, business, entertainment, health, arts and government agencies. The main shopping areas focus around the Shopping Centre in the Central Business District and the Bunbury Forum Shopping Centre in East Bunbury. The City also has extensive heavy and light industry areas including the port area itself.

7.15.5 Alcoa's Community Contribution

Alcoa directly employs nearly 3,800 people in Western Australia and contributes around A$1.1 billion each year to the State's economy. Approximately 900 full time employees work at the Wagerup refinery and Willowdale mine. Of these, 230 people are residents of the Shire of Waroona and over 100 people live in the Shire of Harvey. Total payroll contributions over the past four years averaged approximately $13 million to employees living in the Shire of Waroona and approximately $6 million to employees living in the Shire of Harvey (ERM, 2005).

Alcoa assists local suppliers in the Shire of Waroona and the Shire of Harvey to conduct business with Alcoa and the Wagerup refinery. The company invites local business to bid on locally supplied or manufactured goods or services and gives preference to local businesses. Alcoa works with local business groups to identify and utilise local suppliers and where possible, structures bids to enable local supplier participation (ERM, 2005).

Alcoa has a range of initiatives that support economic, social and environmental development within the local community. Over the 30 years in the region, Alcoa has supported and sponsored an extensive range of community, social and environmental projects including:

- High School scholarships for 'Future Women of Industry';
- around 25 vocational, apprenticeship and other training positions per year;
- funding of TAFE training places in horticulture;
- contract arrangements that include the use of local employees and local suppliers where practicable;
- workshops on the Alcoa procurement process and tendering systems;
- over $1 million for community-based Landcare activities in the Peel-Harvey catchment;
- research into advanced farming and forestry; and
- various partnerships with community programmes and organisations such as the Waroona Community Centre, Family Youth Support Service, and the Yarloop ECU Alcoa Project (YEAP).

The Alcoa Landcare Project was launched in the wheatbelt of Western Australia in 1989. Its aim is to fostering community interest and involvement in landcare, and the project has since become one of Australia's largest and most successful demonstrations of cooperative community action. By the end of Australia's National Decade of Landcare, Alcoa World Alumina Australia had committed over $16 million to community environmental and landcare projects. In 2000, the company contributed a further $1.4 million.

The success of the Alcoa Landcare Project can be attributed to cooperative partnerships that have been developed with farmers, community groups, government agencies, authorities, non-profit organisations and other corporate sponsors.

Alcoa employees also provide a wide array of voluntary effort to the local communities and this is corporately recognised by Alcoa. Three key schemes provide opportunities for Alcoa employees to contribute to the local community:

- PEACH (Personnel Employed by Alcoa Charity Help) is an employee based volunteer charitable trust dedicated to maximising the collection of funds for charity from Alcoa's employees and distributing these funds to a wide range of human care agencies in Western Australia. PEACH donates to a diverse range of organisations from large public hospitals and research institutions, through to small support groups all of which play and important role in the community. Funds have been provided for clinical research; hospital services and medical equipment; health support services and facilities for the sick, the frail and disabled; welfare support services for family and single parent support groups; young people at risk; and safety and emergency services. PEACH has been in operation since 1979 and over 1,400 Alcoa employees have donated in excess of $1.5 million to over 200 community organisations.

- ACTION (Alcoans Coming Together in Our Neighbourhoods) is a company sponsored employee engagement programme, managed by the Alcoa Foundation which is independent of the company. The grants recognise group volunteer initiatives involving at least 10 active full-time employees volunteering for at least 4 hours at qualified non-profit organisations.

- When Alcoa employees volunteer at least 50 hours of community service during a calendar year to a charitable organisation, Alcoa provides financial support to that organisation under the Bravo! programme. Eligible employees may apply through the Alcoa Foundation for one US$250 grant per year for one organisation. Qualifying organisations include non-profit, health, social, welfare, educational, cultural or community organisations.

7.16 CULTURAL HERITAGE

7.16.1 Aboriginal Heritage

There are 27 previously recorded Aboriginal archaeological sites within an 8 km radius of the Wagerup refinery operations (Table 19). Twenty-five of the archaeological sites are artefact scatters and the remaining two are camping grounds. Of the twenty-seven archaeological sites, one site (3232) is located outside the southern edge of the existing residue area. The Proposal will not impact on any known aboriginal archaeological sites.

Table 19: Aboriginal archaeological sites located within an 8 km radius of the Proposal Area

AAD Site ID	AAD Site No.	Name	Type	Size (m²)	No of Artefacts	Reported in
3212	S00332	Lake Preston: Sand Pit S32	Artefact Scatter	NR	8	Novak 1975
3213	S00333	Harvey Estuary 34: Lost	Artefact Scatter	NR	5	Novak 1975
3214	S00334	Harvey Estuary 35: Corner	Artefact Scatter	NR	3	Novak 1975
3215	S00335	Harvey River 36: Bushfire	Artefact Scatter	NR	3	Novak 1975
3216	S00336	Harvey River 37: Harvey BR	Artefact Scatter	NR	46	Novak 1975
3217	S00337	Harvey River 38: Plantation	Artefact Scatter	NR	1	Novak 1975
3218	S00338	Harvey River 39: Blackboy	Artefact Scatter	NR	2	Novak 1975
3219	S00339	Pine Plantation Swamp 40	Artefact Scatter	NR	194	Novak 1975
3220	S00340	Harvey River 41: Drain	Artefact Scatter	NR	9	Novak 1975
3221	S00341	Harvey River Flats 42 A + B	Artefact Scatter	NR	NR	Novak 1975
3222	S00342	Harvey River Flats 43	Artefact Scatter	NR	2	Novak 1975
3223	S00343	Harvey River Flats 44	Artefact Scatter	NR	9	Novak 1975
3232	S00495	Wagerup 1	Artefact Scatter	NR	40	DAS 1977
3233	S00496	Wagerup 2	Artefact Scatter	NR	2	DAS 1977
3234	S00497	Wagerup 3	Artefact Scatter	NR	7	DAS 1977
3234	S00498	Wagerup 4	Artefact Scatter	NR	40	DAS 1977
3236	S00499	Wagerup 5	Artefact Scatter	NR	12	DAS 1977
3259	S00328	Lake Clifton 4: Preston	Artefact Scatter	NR	1	Novak 1975
3260	S00329	Yalgorup Nat. Park 1 30	Artefact Scatter	NR	1	Novak 1975
3309	S00205	Waroona	Artefact Scatter	NR	NR	
3547	S02425	Buller Road Camp	Camping Ground	400	NR	O'Connor 1987
3559	S02442	Johnston Road	Artefact Scatter	100	7	Quartermaine 1987
4144	S01262	NatGas 123	Artefact Scatter	1000	10	Pickering 1982
4282	S00827	Gas Pipeline 94	Artefact Scatter	NR	NR	Pickering 1982
4334	S00825	Gas Pipeline 93	Artefact Scatter	40000	NR	Pickering 1982
5614	S00561	Lake Preston	Artefact Scatter	NR	NR	
15324	S03052	Twin Creeks	Camp and Spiritual Site	NR	NR	Carto-Cult 1997

The majority of the 25 archaeological sites listed in Table 19 were recorded during Aboriginal Heritage Surveys conducted by the Department of Aboriginal Sites (1977), Carto-Cult (1997), Novak (1975), Pickering (1982) and O'Connor (1987) and Quartermaine (1987). The archaeological sites recorded comprise mostly small scatters with numbers of artefacts ranging from 1 artefact to 129 artefacts. Only four sites have had their extent recorded and they range from 100 m² to 40,000 m².

The dominant lithic (stone) raw material, in archaeological sites on the Swan Coastal Plain and the Darling Scarp, is vein quartz (eg. Anderson, 1984; Quartermaine, 1987, 1988; Veitch, Martin & de Gand, 1997). Other lithology components recorded in archaeological sites include dolerite, granite, mylonite, crystal quartz, silcrete, glass, and fossiliferous chert. The Swan Coastal Plain does not possess any sources of natural stone. All of the raw materials, except fossiliferous chert, originate in the Darling Scarp or to the east of the scarp (Anderson, 1984). The sources of fossiliferous chert are postulated as having occurred on the continental shelf, to the west of the current coastline.

The Wagerup operations were surveyed most recently in June 2000 by archaeological consultant, Archae–aus'. This survey was carried out within the refinery boundary, and in the pastoral area surrounding the residue area. During this survey, two archaeological sites and a total of five isolated artefacts were located. All of the archaeological material located in the south-western corner of the Proposal Area appeared to be associated with the low swamp area (Archae-aus, 2000).

The archaeological site comprised a small artefact scatter located in the base of a shallow sandy deflation. The artefacts occurred in the western end of the deflation in an area measuring 5 m (north/south) by 10 m (east/west). The artefact assemblage comprised 12 quartz flakes, flake fragments and pieces of debris. The quartz was fine-grained and crystalline in nature and the quartz artefacts were small, ranging in length from 5 to 20 mm. The nature of the artefact assemblage at this site was consistent with the other sites recorded in the Wagerup area during past surveys (Archae-aus, 2000).

A previously recorded archaeological site 3232 (S00495) was originally recorded as containing a few surface artefacts in a series of closely spaced clusters (Department of Aboriginal Sites 1977; AAD Site File 3232). Subsequent to this site being mined for sand, the artefact assemblage was estimated to be in the order of 10,000 artefacts. In addition, five isolated artefacts were located in the southern part of the Proposal Area, one of which was located amongst sand excavated from a rabbit burrow. Consequently, the pattern of distribution of archaeological material appeared to be spatially associated with a known water source and resource zone. The survey also highlighted that there is considerable potential for sub-surface archaeological material in the southern portion of the survey area (Archae-aus, 2000).

The isolated artefacts were located in two areas; a small sandy rise and a flat sandy paddock with deflation areas located adjacent to a seasonal swamp. Rabbit burrowing activity appeared to have excavated some of the artefacts and indicated that sub-surface artefacts may be present in this area (Archae-aus, 2000).

7.16.2 European Heritage

No place or object within the Proposal area is included on the Register or the Interim List of the Register of the National Estate. There are no known sites or items of non-Aboriginal heritage significance in the Proposal area.

7.17 TRANSPORTATION

7.17.1 General traffic movements

The South Western Highway is the major route for traffic from the Perth metropolitan area to the south-west region including the townsites of Waroona and Yarloop.

A traffic survey was conducted in October 2003, to study traffic movements along the South Western Highway. This study was undertaken by Main Roads on South Western Highway, north of Coolup East Road, and focussed on traffic passing through Waroona and Yarloop.

The survey indicated that there are about 36,000 vehicles per week using the South Western Highway, with an average daily traffic volume during the survey of approximately 5,100 vehicles. Of the 36,000 vehicles, approximately 87% were standard passenger vehicles and cars (light vehicles). Small to medium trucks comprised approximately 6% and the remaining 7% were classed as heavy vehicles.

7.17.2 Existing Wagerup refinery freight movements

Each year there are thousands of freight movements to and from the Wagerup refinery and mining operations by road and rail. These freight movements must comply with strict government regulations which ensure that high safety levels for the public are maintained and that there is minimal inconvenience to the general community.

Rail

The South West Main Line is used by a number of train services each day, including freight trains, passenger trains and those for alumina, coal and caustic.

The rail movements associated with transportation of alumina and caustic on the South West main line is summarised in Table 20 below.

Table 20: Average Train Movements per day

Type	Wagerup Trains	Pinjarra Trains	Total
Alumina	3	4	7
Caustic	1	Same train services Pinjarra	1
Total	**4**	**4**	**8**

Note:
- On occasion there may be four Wagerup and five Pinjarra alumina trains.
- Sometimes two caustic trains are required

Alumina tonnage currently hauled for Alcoa is around 6 Mtpa, from Pinjarra to Kwinana and Bunbury and from Wagerup to Bunbury. Caustic tonnage hauled is approximately 750,000 tpa to Pinjarra and Wagerup.

Road

The refinery has a total of approximately 650 permanent staff, with many working on a shift basis. On average the total number of passenger vehicles per day is approximately 450, representing approximately 9% of all vehicles on South West Highway.

The total vehicle movements associated with deliveries to Wagerup refinery and mining operations is estimated at an average of 334 two-way freight movements per week. This represents approximately 7% of all truck movements on the South West highway.

On a daily basis, Wagerup refinery presently receives approximately seven lime trucks and one general freight semi-trailer. These are classed as heavy vehicles and represent approximately 4% of all heavy vehicles on the South West highway.

The refinery also receives approximately eight general freight vehicles per day, including, five tray-trucks and three 1-tonne courier vehicles. This represents around 5% of all small to medium trucks using the South Western Highway.

The refinery has approximately nine freight movements that occur on a weekly or fortnightly basis. These movements are associated with fuel delivery, laboratory supplies, domestic rubbish collection and recycling.

Vehicle movements for the mining operations are associated with the delivery of fuel and oil, explosives, general goods, logging and mulch contractors. The total average two-way vehicle movements per week associated with the mining operations is approximately 92.

Alcoa has its own transport department and works with relevant State Government agencies, such as the Main Roads Department, to carefully monitor road freight movements and ensure that high safety standards are maintained when transporting freight.

There are strict guidelines relating to the routing of heavy freight vehicles in populated areas and they are designed to reduce the risk of personal injury to members of the public.

The following time restrictions for the delivery of goods to the Wagerup refinery have been implemented:

- Oversize loads are restricted to daylight hours by Main Roads;
- Oversize loads from the Kwinana area are permitted to travel at any time between sunrise to sunset and would likely be in Wagerup at the earliest around 7.30am (in summer months; later in winter);
- Oversize loads from Fremantle, Henderson or Perth areas are only permitted to travel after sunrise but not between 7.30am and 9am or 4.30pm and 6pm on weekdays only. These loads must be off the road at sunset.

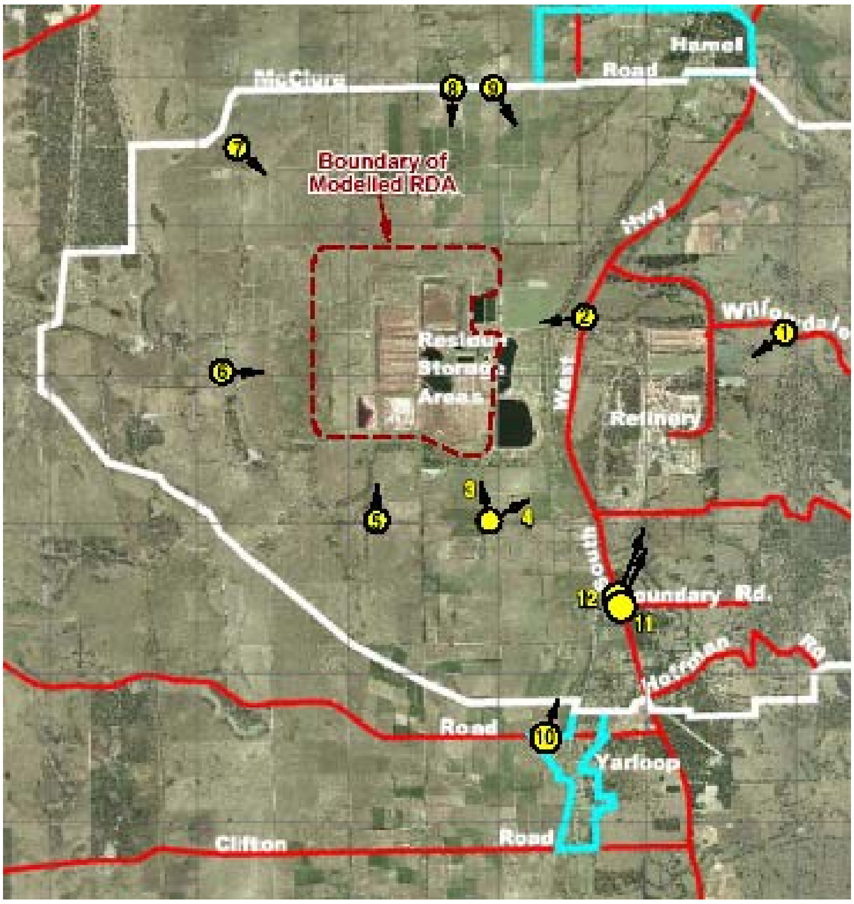
7.18 VISUAL AMENITY

7.18.1 Refinery

A visual impact assessment of the existing refinery and the Proposal was undertaken by Alcoa. Photographs taken of the existing refinery and residue area are shown in Plates 1a to 12 (refer to section 8.15) and proposed visual impact of the Proposal discussed in Section 8.15. Locations of photographic points are shown on Figure 42 on the following page.

The tallest structures on the existing refinery site that are visible from the main public viewing points are the Calciner multiflue (for calciner units 1, 2, and 3) which is 100 m tall, and the Powerhouse multiflue which is 65 m tall. The refinery as a whole is most visible from the Willowdale Mine Access Road, which is a public road, and the stacks are clearly visible from parts of the South West Highway, near Boundary Road. The larger equipment in the refinery, such as the stacks, covered conveyor, alumina storage lime silo and precipitation are visible above the tree line from a number of points surrounding the refinery (refer to Plate 4, 6a, 7a, 9-12).

Figure 42: Visual Amenity Study Photograph Locations



Plumes of steam are visible from various parts of the refinery (e.g. the multiflue) particularly under cool calm conditions, such as just prior to sunrise. Lighting of refinery equipment for safety reasons also makes the facility and its associated light spill visible at night.

7.18.2 Residue Area

The relatively flat landscape surrounding the Wagerup refinery, and the large volume of residue to be stored, means the residue storage area is a prominent feature on the local landscape. The area occupied by residue is visible from viewpoints along the Darling Range and from surrounding farmland. The red colour of the residue contrasts with the surrounding farmland, presenting an obvious change in the landscape. Extensive rehabilitation including mulching and vegetating of existing and new sections of the final external perimeter will reduce intrusive visibility of the residue area.

From the flat plain adjacent to the residue area, the view is dominated by the embankment slopes which are visible from a number of vantage points around the perimeter of Alcoa's property. These are elevated approximately 20 m above the surrounding plain. The existing residue stockpile is visible from Bancell Road (Plate 3a and 5a), South West Highway (Plate

2a) and Somers Roads (Plate 6a and 7a). Residue is barely visible from McClure Road (Plate 8a).

Vegetation planting has been conducted around the residue area over many years with the aim of enhancing visual amenity, providing native vegetation corridors for wildlife and improving species conservation. A Visual Amenity Strategy was prepared as part of planning approval for RDA7 with the aim of:

- enhancing the vegetation screening on Alcoa's property adjacent to the surrounding public roads and neighbouring properties;
- rehabilitate external-facing embankments of the residue area as soon as practicable after construction; and
- blending the residue areas with the surrounding landscape.

Alcoa's current strategy is to blend the residue area into the surrounding landscape by adopting drainage designs that are natural in appearance and creating appropriate contouring and revegetation of the embankments. Significant modification of the views from the Darling Range is not possible. However the proportion of rehabilitated residue area will gradually increase, providing visual improvement of part of the area.

Based on the feedback received via the consultation process for this ERMP, increased emphasis will be placed on vegetation of the embankments to reduce the visible impact of the residue areas from the property boundary.

<u>Closure and Rehabilitation</u>

The rehabilitation of the residue area will be ongoing during the operating life of the refinery. The perimeter embankments will be progressively rehabilitated as the height of the stack rises, and sand capping and revegetation of the surface of the drying beds will occur as each reaches its nominated final elevation. At the time of refinery closure, much of the rehabilitation will be complete with only the minimum drying area remaining to be closed.

8. ENVIRONMENTAL IMPACTS AND MANAGEMENT

8.1 OVERARCHING ENVIRONMENTAL MANAGEMENT

8.1.1 Global Sustainability

The definition for sustainability that has been widely adopted is outlined in the World Commission on Environment and Development's Brundtland Report (World Commission on Environment and Development, 1987) as:

"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs."

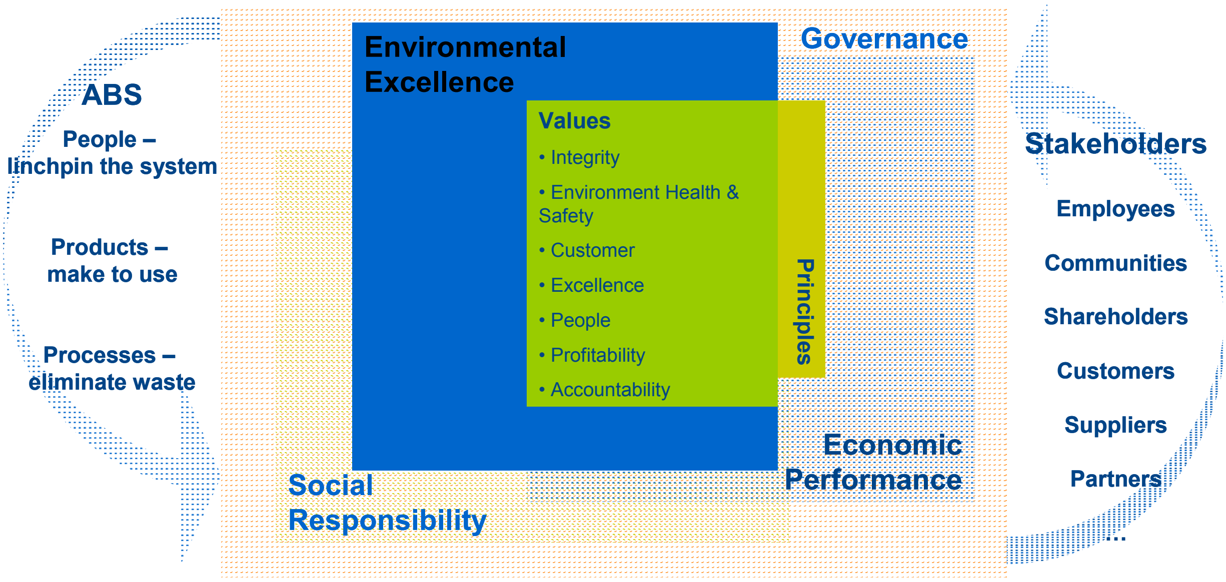
Alcoa's Vision, Values, Principles, and control systems provide the foundation for integrating sustainability into its operations. Alcoa's global sustainability strategy is designed to reflect society's values in Alcoa World Alumina Australia's values to ensure long-term success for the company and all its stakeholders.

Building on its values, Alcoa's sustainability objective is to:

"S*imultaneously achieve financial success, environmental excellence, and social responsibility through partnerships in order to deliver net long-term benefits to our shareholders, employees, customers, suppliers, and the communities in which we operate"*

To achieve this objective Alcoa has developed a sustainability model for the organisation (refer Figure 43).

Figure 43: Alcoa's Sustainability Model



8.1.2 Key global sustainability issues

At the global level Alcoa has identified four broad areas of priority for implementing sustainable practices; these are:

- Climate change
- Engagement with stakeholders, both internal and external
- Integration of sustainability into the company's strategic framework, and
- Energy strategy.

<u>Climate Change</u>

In 1998, globally Alcoa set itself a challenging target on climate change to reduce greenhouse gas (GHG) emissions by 25% below 1990 levels by 2010. That goal was achieved in 2003, and Alcoa is now considering additional targets as it strives to maintain GHG reductions as the company grows significantly.

Alcoa's Western Australian operations continue to improve greenhouse gas intensity, by reducing the amount of greenhouse gas emissions per tonne of alumina produced. The Proposal would see further improvements in greenhouse gas intensity.

Globally, Alcoa actively partners stakeholders to help develop GHG accounting standards in conjunction with the International Aluminium Institute, International Standards Organization, and the International Panel on Climate Change.

Alcoa's aluminium smelters continue to reduce perfluorocarbon (PFC) emissions. In 2004 alone, Alcoa achieved a worldwide reduction of 3.5 to 4.0 million metric tons of CO_2 equivalents per million metric tons of aluminium produced. The company continues to pursue further reductions through the development of a GHG-free (process emissions) inert anode aluminium smelting. In addition, a program to use CO_2 to neutralise bauxite residue in Australia will help improve residue impacts and reduce this emission.

Alcoa has a worldwide commitment to increase the use of recycled metal, which has lower GHG intensity, to 50% of fabricated products by year 2020. The company's beverage can recycling activities save an estimated two million tons of CO_2 each year compared to producing this same metal from primary sources.

Engagement with Stakeholders

Stakeholders are any group or individual affected by the company's operations or that has the capacity to influence operations or future prospects. Alcoa continues to focus on working more closely with stakeholders at an early stage during project development, thereby tapping into their expertise, increasing understanding of their expectations, and defining a stronger relationship.

The community involvement framework developed and implemented as part of this ERMP preparation is shown in Chapter 6.

Integrating Sustainability into Alcoa's Strategic Framework

To take advantage of opportunities for embracing sustainability, Alcoa seeks to further integrate this thinking into internal processes — governance practices, manufacturing and design processes, employee and business systems and business opportunities. Alcoa believes it can achieve this through its strategic framework for sustainability. This is based on:

- Supporting the growth of customer businesses
- Standing among the industrial companies in the first quintile of return on capital (ROC) of the Standard & Poor's Industrials Index
- Elimination of all injuries and work-related illnesses, and the elimination of waste
- Integration of environment, health and safety with manufacturing
- Products designed for the environment
- Environment, Health and Safety as a core Value
- An incident-free workplace (an incident is any unpredicted event with capacity to harm human health, the environment, or physical property), and
- Increased transparency and closer collaboration in community-based environmental, health and safety initiatives.

The integration of sustainability into Alcoa's strategic framework is presented visually in Figure 44 following.

Figure 44: Integration of Sustainability into Alcoa's Strategic Framework

Alcoa also has a strong history of using metrics as a means to drive change within the company. In 2000, it established a 2020 Strategic Framework for Sustainability that is supported by clear targets for measuring progress toward its vision for 2020. These targets are supplemented by environment, health, and safety (EHS) goals and complemented by existing financial goals.

As part of a systematic approach to integrating economic, social, and environmental aspects throughout its businesses, Alcoa has initiated a review of the existing 2020 Framework to make it more comprehensive in terms of sustainability principles. This will also help the company focus future reporting and will be a major project for the Sustainability Team during 2005. The goal is to complete this work for consideration in the 2006 planning processes.

Further, Alcoa together with stakeholders is developing a wide range of performance measures in the economic, environmental and social dimensions of its business. These measures will help gauge performance and enable the setting of targets for the future, including for an expanded Wagerup refinery, should the Proposal proceed.

8.1.3 Energy Strategy

Over the next 30 years, the world demand for energy is expected to double. Most of this growth will come from developing countries like China and India, where demand for electricity will typically outstrip supply and limit the amount of industrial growth that can occur. In addition to finding low-cost sources of energy, Alcoa is also exploring ways to reduce the amount of energy it consumes, to increase use of renewable energy and to reduce the energy used in the life cycle of its products.

8.1.4 Sustainability and the Proposal

This Environmental Review Management Program (ERMP) assesses the environmental elements of the Proposal, including a health risk assessment. The ERMP also includes analysis of certain socio-economic components, for example impacts of a construction workforce on local and regional communities.

In addition to the above, Alcoa recently published a booklet describing socio-economic ideas that could contribute to a sustainable future for the region. Two of these initiatives are a regional sustainability fund, and a learning and enterprise centre. These ideas were developed from research undertaken by Alcoa and others, and following on from dialogue with regional stakeholders, particularly the Socio-Economic Working Group convened for the ERMP preparation phase.

In the following months, during the Government's formal assessment phase, the community is invited to examine the ideas proposed in the socio-economic booklet. It is intended that this dialogue with people from community groups, industry and Government departments will improve upon the projects, with the hope that local people adopt the ideas as their own. They will be better projects with community involvement.

The ERMP and this socio-economic 'Possibilities' document (see www.alcoa.com.au/wagerup3 to download a copy) together help describe Alcoa's approach to sustainability, incorporating environmental and health components, with social and economic considerations.

8.1.5 Sustainability Principles Related to the Proposal

Alcoa's sustainability framework, which complements national and WA sustainability principles, is based on eight principles. These are outlined below and include a description of how these principles are being applied in the Proposal.

Respect for People

We listen to, and respect the views of our workforce and the communities wherever we operate, and we formulate partnerships that strengthen our interdependence and improve well-being.

Alcoa is committed to ensuring that the Proposal makes a positive and sustainable contribution to the local and regional communities in which the refinery operates.

While there are some challenges, Alcoa continues to strive to meet community concerns over health and environmental issues. There has been significant investment in the area of emissions reduction and monitoring of results, and Alcoa understands it is essential to work with the local community to address their concerns.

The community involvement framework implemented for this Proposal was designed to respect and acknowledge the different information and involvement needs of stakeholders. This framework allowed people to determine whether they wanted to be directly involved through working groups or rely on periodic information distribution through newsletters, advertising, letterbox drops, informal meetings or other channels.

Ongoing community consultation regarding many aspects of Wagerup refinery operations (environmental and otherwise) remain important to Alcoa and members of the local community and will continue well beyond the Proposal discussions.

The needs and expectations of Wagerup refinery employees have been recognised through the workforce briefings offered when the project was first discussed publicly, periodic project updates and through a program specifically structured to ensure employees have a voice in project design. Additional employee involvement programs will consider issues such as workplace ergonomics, occupational health, noise, chemical exposure and the various aspects of workplace safety.

Building Community Experience and Well-being

Our operations contribute to improved quality of life and build skills, knowledge and experience in the communities with which we interact, while respecting the significance and diversity of their culture and heritage.

A significant emphasis has been placed on positively addressing sustainable community needs. This has resulted in the formation of the Alcoa Research Centre for Stronger Communities, as part of our partnership with Curtin University of Technology launched in 2003. Alcoa hopes to use this development to assist with building skills, knowledge and experience in the communities in which it operates along with other Australian communities.

Through this and other community programs underway, Alcoa intends to contribute a positive future for the communities in which it operates, including communities around the Wagerup refinery.

Several community programs are already underway and several initiatives proposed for further discussion over the next few months have been put forward by community members and by Alcoa employees as a key component of building community experience and well-being.

As part of the Proposal, one of the key projects identified is a regional sustainability fund. It is anticipated that the community is represented on a committee including local and state government, and Alcoa. In this way our host communities will be better able to have a voice about the future of the region. It is also recognised that this responsibility will require assistance and for any representatives of local communities to have the support of the broader community. Dialogue over the next few months will enable local communities to engage in this exciting opportunity and help design how this community experience can be maximised.

Long-term Economic Benefit

Our operations deliver economic benefits to the regions and States in which they operate, to the nation, and to society in general. Our operations foster economic growth, generate wealth for the community, provide commercial returns to our shareholders and contribute to long-term economic health.

Demand for alumina, particularly from China; provides an increasing demand for aluminium which in turn has stimulated an opportunity for growth in Alcoa's Western Australian operations, through the Wagerup Unit Three proposal.

The Proposal would provide substantial economic benefits to the region, the state of Western Australia and Australia as a whole. Implementation of the Proposal would involve further investment of over $1.5 billion by Alcoa in its Wagerup refinery. It would increase production to around 4.7 million tonnes per annum and increase the value of WA exports by more than $550 million per year.

Construction of the Proposal would result in more than 1500 construction jobs. Research has shown that the Proposal would result in an additional 150 new permanent jobs at the refinery, minesite and port, and over 3000 direct and indirect jobs in Western Australia. Alcoa has policies and programs in place to maximise local and regional employment, and is working with local suppliers, in particular local fabricators, to maximise local content.

Efficient Resource Use & Cleaner Production

We use natural resources wisely and manage our environmental impacts to the benefit of the full range of our stakeholders by employing leading technology and best practice management, and by encouraging responsible design, use, recycling and disposal of our products.

Alcoa continues to develop cleaner production solutions and has continued to strive for this and efficient resource use as part of the Proposal. Considerable research, monitoring and consultation has been undertaken in the areas of air quality, noise emissions, residue management, water supply and land management issues. The Proposal includes both production improvements and emission control works, the outcomes of which are assessed and described in sections of this ERMP dealing with environmental impact management.

In the past, Alcoa has invested more than $25 million to reduce odorous emissions in the calcination, digestion, evaporation and clarification areas of the Wagerup refinery and to reduce oxides of nitrogen emissions from the powerhouse.

Noise from the refinery has been an ongoing challenge, leading to a major noise reduction program implemented in 1995 and another in 2000. As part of this Proposal, specialist noise consultants were engaged to ensure the Proposal does not result in increased noise impacts.

Ecological Integrity & Biodiversity

Our operations maintain or enhance biological diversity and the fabric of ecological integrity in the environments in which we operate.

Alcoa will maintain a specific focus on ecosystem biodiversity through its continued support of Landcare biodiversity activities. Alcoa will build on its achievement of 100 per cent species richness in post-mining jarrah forest rehabilitation in the Darling Range.

Restoration work in the forest areas will continue, with a continued effort towards research, development and implementation of innovative practices and technologies in the areas of seed treatment, seed application, topsoil handling, mine planning and native plant propagation. Alcoa will continue to work with scientists from local universities, the WA Department of Conservation and Land Management and Land Management and the Botanic Gardens and Parks Authority.

Meeting the Needs of Current and Future Generations

We take a long-term approach to our activities, and work in partnership with communities and governments to meet the needs and desires of today without compromising the ability of future generations to satisfy their own needs.

Alcoa recognises the collective effort of employees at the Wagerup refinery in the local communities where they live and rewards initiatives in several areas, including where employees volunteer their time working on community projects. Creating lasting community capacity in the region surrounding the Wagerup refinery will continue to be a focus of the Proposal.

An idea outlined in the socio-economic ‘possibilities’ document recently released describes a regional sustainability fund, which will greatly contribute to the long-term future both for current communities and their children. The specifics of this fund will be discussed with stakeholders in the region during its formation, and it is anticipated that the Principles under which it operates would refer to long-term sustainability objectives, particularly in the area of community capacity building for future generations.

Stakeholder Involvement

We work with our communities, employees, customers, shareholders and suppliers to achieve outcomes and make decisions of mutual benefit. We report regularly to all our stakeholders on the sustainability performance of our operations.

Alcoa wishes to ensure it understands and addresses the needs of all key stakeholders of its Wagerup operations especially employees, neighbours, and local and regional residents, through an effective and ongoing engagement process. The community involvement framework implemented for this project, was developed in consultation with the local Community Consultative Network, and was comprehensive and intensive community engagement. Best practice consultation has been a strength of the Proposal through early definition and resolution of issues.

Accountability & Governance

We practice ethical business governance, are accountable for our actions, continually improve our performance and integrate environmental, social and economic considerations in our decision-making.

Accountability of Alcoa in the Proposal depends on being open, honest and transparent with individuals and in the teams of all people involved in all behaviours and actions. This will determine the success of the project which has major impacts on our customers, employees, shareholders and communities. The remainder of Section 8 of this ERMP outlines the potential impacts of the proposal, and the ways in which these impacts will be avoided, minimised or managed in accordance with the above principles.

8.1.6 Environmental Management System

Alcoa has developed and implemented a comprehensive Environmental Management System (EMS) for the Wagerup refinery, which was certified to the International Standards Organisation 14001 EMS Standard in February 2001.

Key elements of the EMS currently include:

- an Environmental Management Team with specific environmental roles and responsibilities;
- environmental aspects (issues) register;
- environmental improvement plans;
- operational control procedures;
- environmental monitoring;
- regular auditing and feedback, and
- incident reporting and corrective action follow-up.

The EMS is based on the 'Continual Improvement' model outlined in ISO 14001 where organisations:

- develop an Environmental Policy;
- plan how to manage and reduce environmental impacts by setting goals and actions required to meet these goals;
- implement these plans;
- monitor and audit implementation of these plans against the system and raise corrective actions where activities are not achieving the desired outcomes; and
- review the EMS as a whole to see if it is meeting its objectives of improving environmental performance.

The Wagerup EMS is audited by both internal and external parties on a regular basis, to ensure that the system is operating effectively and resulting in continual improvement in environmental management.

The Wagerup EMS is integrated into other management systems within the organisation. The Environmental Management Manual (Alcoa, 2003) unites all the various procedures, work instructions and guidelines applicable to all parts of the operation into a simple, easily accessible cross-referencing system that can be applied by all Alcoa personnel. This helps facilitate good environmental management becoming part of day-to-day operations and is extended, via the employees, to areas outside Alcoa's immediate operations, into the home and community.

The EMS and its associated documentation will be amended as necessary to incorporate changes associated with the Proposal, including specific measures to cover the construction period of the Proposal.

Commitment 1.

Alcoa will be guided by its Sustainability Principles and will operate within the guidelines of its Environmental Management System (EMS) in implementing the Proposal.

8.2 IDENTIFICATION OF ENVIRONMENTAL FACTORS

The EPA has prepared a list of generic environmental factors and associated environmental objectives to be considered for the assessment of new proposals. These factors are broad in their coverage and are designed as a starting point from which proponents may develop site specific factors and objectives.

Alcoa commenced the identification of key environmental factors very early in the Proposal planning stages. The Proposal will be developed at the site of the existing Wagerup refinery which has been operational since 1984. There is therefore a good understanding of the natural and cultural environment within which the Proposal is located.

Of particular significance in understanding issues of community interest has been the community involvement framework established for the Proposal, which is described in detail in section 6. This framework has provided many opportunities for community input during the development of this ERMP. This has occurred through an initial stakeholder forum that identified issues and opportunities of significance and also through the five working groups established for ERMP consultation.

This community involvement framework has allowed ongoing identification and refinement of environmental issues during development of the ERMP.

Key environmental factors were initially identified in the Environmental Referral document (which assists the EPA in setting the level of assessment). These factors and objectives were then finalised in consultation with relevant government agencies and agreed with the EPA. These were presented in the Environmental Scoping document, along with the studies that would be undertaken as part of the ERMP. The Environmental Scoping document was released for a two-week public comment period in September 2004 and finalised in March 2005.

The key environmental factors and issues that are considered to be significant in the assessment of the environmental impacts of the Proposal are presented in Table E1 in the Executive Summary of this document. The key factors and issues identified are:

- Sustainability
- Air Quality – Refinery Gaseous and Dust Emissions
- Air quality – RDAs and Cooling Ponds, Gaseous and Dust emissions
- Air Quality – Bunbury Port
- Air quality – Construction Dust
- Noise – Wagerup Refinery
- Noise – Bunbury Port
- Greenhouse Gas Emissions

- Water Supply
- Surface Water Quality
- Groundwater Quality
- Liquid and Solid Wastes (other than bauxite residue)
- Biodiversity
- Flora and Vegetation
- Fauna - Specially Protected (Threatened) Fauna
- Archaeological Heritage and Ethnographic Issues
- Public Safety Risk
- Visual Impact
- Transport.

Specific management plans have been developed (refer to section 10) for the Proposal for management of the following key factors:

- Air quality;
- Noise;
- Water supply; and
- Spill management.

Management of the remaining environmental factors will be addressed within existing management plans and procedures for the Wagerup refinery.

8.3 AIR QUALITY

The EPA's objective for the Proposal with regards to management of air quality at the refinery is:

- *to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards.*

8.3.1 Introduction

Air emissions are usually grouped into two categories, point source emissions and diffuse source emissions. The emissions associated with the refinery processing area are considered point source emissions and arise where the refinery gases or particulates are emitted to the atmosphere through identified points such as stacks and vents.

Diffuse source emissions originate over a broader area where there is little or no redirection of the vapours or particulates. Emissions from the various parts of the Residue Drying Areas (RDA) and the bauxite stockpiles are considered diffuse source emissions. Emission estimates have been calculated for these diffuse sources including the stockpiles, drying beds, cooling ponds and superthickener. The specific point (refinery) and diffuse (RDA) source emission locations, their estimated emission rates as a result of the proposal and the reasons for the selection of these emission estimates are described in the Air Quality Summary report accompanying this ERMP (Appendix G)

The emissions from the various point and diffuse sources for Wagerup refinery can be broadly categorised as follows:

- Particulate matter (e.g. total suspended particulates and various sizes of dust);
- Volatile organic compounds (e.g. aldehydes, ketones, PAH's and aromatic compounds (BTEX));
- Combustion gases (e.g. nitrogen oxides (NO_x) and carbon monoxide (CO));
- Trace metals (e.g. nickel, cadmium and mercury)
- Odour

Not all sources have the range of emissions listed above, for example bauxite stockpiles can emit metals in dust, but are unlikely to emit measurable amounts of volatile organic compounds or combustion gases.

8.3.2 Main Emissions Sources

Emissions of particulate matter (or dust) are released from the RDAs, bauxite stockpiles, the calciners (as alumina dust) and to a lesser extent from the oxalate kilns. Dust emissions also arise intermittently from bulk materials handling and transport activities. These latter two sources are considered relatively minor and have not been included as emission sources for the purpose of air dispersion modelling to derive ground level concentrations in neighbouring areas.

Volatile Organic Compound (VOC) emissions from alumina refineries are caused by the breakdown of organic material contained in the bauxite, additives to the liquor stream and by-products of fuel combustion. During the refining process organics are broken down, which can create a wide range of substances, some of which are volatile enough to be emitted by air. These VOCs are considered to be the cause of the characteristic odour of alumina refineries. They are emitted from areas such as vents, stacks and cooling towers within the processing area and mainly from the surfaces of the drying beds, cooling pond, lower dam and superthickener at the residue area.

Combustion gases are released as a result of the burning of natural gas within parts of the refinery processing area, including the powerhouse, calciners and oxalate kiln. The main combustion gases released from the Wagerup refinery are oxides of nitrogen (NO_x), carbon monoxide (CO) and sulphur dioxide (SO_2).

Metals such as mercury, arsenic, cadmium and nickel are introduced into the refining process, mainly through the trace amounts present in bauxite and the current knowledge indicates the majority of metals are recirculated within the caustic liquor stream or deposited with the residue. However, trace concentrations of metals have been found in gaseous emissions from the refinery processing area and the dust leaving sources such as bauxite stockpiles and the RDA.

8.3.3 Emissions Estimates for the Proposal

The sources of emissions used in the air dispersion modelling and prediction of ground level concentrations are listed in the accompanying Air Quality Summary Report (Appendix G).

The significant point sources of emissions included in the ERMP air dispersion modelling account for approximately 96% of the total mass of refinery emissions. Minor sources not included in the modelling together account for the remaining 4% of processing area emissions, with no individual source amongst these accounting for 1% or more of point source emissions.

Wherever possible point source emissions have been estimated for the Proposal using monitored data, which, where relevant, have been adjusted to account for additional throughput or emission reduction works. Where particular parts of the processing equipment will be duplicated (as part of the proposal) emission estimates have been based on known data considering capacity, technology, anticipated operating conditions and, where relevant, other equipment specifications.

The monitored data used in these estimates have come from a variety of sampling programs including ongoing monitoring required under the environmental licence or specific monitoring campaigns such as the 1999 emissions inventory program. These monitoring programs have been described more fully in the CSIRO Air Quality Review (CSIRO, 2004) and were the subject of an independent audit undertaken for the Department of Environment in 2002/03 (AWN, 2003).

Diffuse source emissions have had limited data collection prior to consideration of this proposal, consequently a specific monitoring exercise at the residue area was undertaken as part of this ERMP.

A full description of the methodology used to estimate emissions from the RDA is provided in Appendix G. Calculations were made for both the existing, based on an active drying area of 168 ha and an expanded residue area with an active drying area of 274 ha. Although refinery throughput significantly increases as a result of the Proposal, a proportional increase in active drying area will not eventuate. This is due to a significant change in the sand to mud ratio of the total residue volume sent to the residue area as outlined in Appendix G.

Dust emission rates from the RDA were calculated considering the impacts of wind erosion, operating circumstances such as bulldozing of the residue surface and the dust control effects of the residue sprinkler system. Wind erosion from the active drying areas is considered the primary source of dust emission from the RDA and an important component of dust control associated with the proposal is the planned upgrade of the residue sprinkler system. This upgrade to increase sprinkler density and reliability contributes to a reduction in total dust emissions.

RDA gaseous emissions were estimated based on a specific monitoring program undertaken during October 2004 to February 2005. This program used a USEPA isolation flux chamber as recommended by CSIRO and AWN, to capture gaseous releases from the surfaces of drying areas, ponds and the superthickener. The measured gaseous emission rates were then multiplied by the surface area of the various sources to generate a combined mass emission rate.

The measured emission rates for the existing RDA were then used to calculate RDA gaseous emissions for the expanded RDA associated with the Proposal. This process included provision for the increased active drying area and the effects various process changes are expected to have on individual area emission rates. For example, while the surface area of the superthickener, cooling pond and ROWS pond will not increase with the Proposal, their VOC loads are estimated to increase by 20%, 50% and 100% respectively.

A detailed description of the methodology used, the assumptions made and the measured emission rates for the RDA and monitored compounds is contained in the Air Quality Summary report accompanying this ERMP (Appendix G).

8.3.4 Modelled Scenarios

The air dispersion modelling undertaken as part of the ERMP considered three refinery and two RDA scenarios. The cases for the refinery were the base case, which was taken to represent the refinery conditions during 2004, when the project was referred to the EPA. This case is based on an average daily production of 6600 tonnes per day (tpd) of alumina and a peak daily production of 7100 tpd. Two refinery expansion scenarios were also modelled; one assuming additional power and steam supply will be provided by cogeneration units (gas turbines) and the second assuming gas fired boilers will be used. Both expansion scenarios assumed an average daily production of 12,877 tpd of alumina and a peak production rate of 13,699 tpd, which were based on the respective nominal and maximum design production rates for the Proposal.

Over the life of the refinery the RDA will expand regardless of whether or not the Proposal is implemented, however, the active drying area remains relatively constant, driven primarily by the rate of residue generation. Once cells within the RDA are fully used they are stabilised and rehabilitated, while new cells are used for residue drying.

The refinery point source modelling was undertaken by the CSIRO using The Air Pollution Model (TAPM). This work was undertaken in three phases which are described in detail in the reports prepared by the CSIRO (CSIRO 2004a CSIRO 2004b and CSIRO 2005). The methodology and outcomes of this work are also summarised in Appendix G.

Phase 1 of the CSIRO modelling study involved an evaluation of the suitability of TAPM for this application by comparing the hourly-averaged meteorological predictions from TAPM to field meteorological measurements in close proximity to the Wagerup refinery. TAPM was found to adequately predict local meteorological conditions.

Phase 2 of the study involved an evaluation of TAPM as a tool to predict the impact of refinery air emissions on surrounding air quality. This was done by modelling hourly-averaged oxides of nitrogen (NO_x) concentrations at ground level and comparing this to measured NO_x data for the same period. NO_x are emitted from the refinery and dispersed in easily detectable amounts so it is a useful “marker” of refinery emissions (when other sources such as wood fires are accounted for). NO_x data are also available from several locations in the vicinity of the refinery allowing the comparison to be made with modelled predictions. Comparison of the modelled NO_x concentrations against relevant measured data showed

TAPM was able to adequately predict the ground level NO_x concentrations resulting from refinery emissions. It was therefore considered suitable for modelling the concentrations of other refinery air-emitted substances.

Phase 3 of the CSIRO study was to use TAPM to model ground level concentrations of 27 refinery-emitted substances for both the base case and two expanded refinery scenarios. The process used to select the 27 substances is described in the Air Quality Summary report (Appendix G) and was selection based on a combination of the quantity emitted and their potential to cause health effects.

The base case and expansion modelling predicted ground level concentrations of the 27 compounds for every hour in the modelled year. This then allowed identification of predicted concentrations against a variety of health or environmental guidelines, such as maximum 1-hourly concentrations, 95th percentile 24-hour average concentrations and annual average concentrations.

TAPM was not considered to be the best model to use in the case of diffuse sources emissions (from the RDA) mainly due to its limitations in modeling windblown dust. Consequently these were modelled by specialist consultants using the California Puff Model (Calpuff). Calpuff was chosen for diffuse modelling because of its ability to handle releases from large areas, its predictive capability under light winds and its incorporation of variable winds and the effects of terrain. Details of the Calpuff modelling are provided in Appendix G.

Calpuff modelling (using meteorology predicted by TAPM) was used to compare model predicted ground level particulate and odour concentrations against measured concentrations. This comparison confirmed that Calpuff was adequately predicting the dispersion of airborne contaminants from the RDA.

To establish the environmental implications of the emissions and undertake the Health Risk Assessment, it is important to consider the combined effects of emissions from point and diffuse sources. To allow this assessment the ground level concentration contributions from both TAPM and Calpuff modelling were added. This occurred for each of the 27 modelled contaminants and was undertaken hour by hour to generate a combined ground level concentration for each hour of the modelled year.

A description of the model set up parameters and the addition of the TAPM and Calpuff components is provided in Appendix G.

The evaluation of predicted contaminant concentrations against health guidelines and hazard indices is described in full in the Health Risk Assessment study accompanying this ERMP (Appendix F).

Potential Impacts

Emission control measures are included in the Proposal to ensure the changes do not cause a significant detrimental impact on surrounding air quality. Areas for consideration include: dust emissions due to the increased residue drying area; VOC emissions from the new calciners or from various vents; and metal emissions carried in dust and from some refinery point sources.

Alcoa gave public undertakings that the Proposal would not cause increased odour, dust or noise impacts on surrounding residents and that it would meet world class health risk criteria.

8.3.5 Emission Controls

To achieve these undertakings and ensure acceptable air quality outcomes, the Proposal includes some important emission control initiatives, particularly for refinery point sources. These control measures are listed in the accompanying Air Quality Management Plan (refer to section 10) and include initiatives (or equivalent emission control works) such as:

- A Regenerative Thermal Oxidiser (RTO) on the liquor burner;
- An RTO on oxalate process emissions;
- Improved calciner performance;
- Low NO_x burners in new boilers;
- Redirection of calciner low volume vent emissions for destruction;
- Reduction in cooling tower VOC emissions;
- Reduced emissions from causticisation;
- Sealing of some additional tank vents;
- Green liquor filter upgrades, and
- Upgraded sprinkler system for the RDA.

For some sources, the Proposal will result in increased emissions including:

- New pieces of equipment (e.g. additional calciners);
- Areas with emission volume increases (e.g. power house CO_2); and
- Areas where emission concentrations increase (e.g. RDA cooling pond).

Appendix G lists the emission estimates for each modelled point and diffuse source, incorporating the changes included in the Proposal. It is the net outcome of these changes that is represented by the modelled ground level concentrations for the two expanded refinery scenarios.

The modelling studies were undertaken to allow the potential air quality effects of the Proposal to be judged against the public undertakings and accepted ambient air quality standards. The modelling results were then used in a Health Risk Assessment that assesses the predicted ground level concentrations of emissions against relevant health standards and guidelines (Appendix F).

8.3.6 Results of Modelling

The predicted air quality implications of the proposal have been assessed in three ways:

- Comparison to the National Environmental Protection Council (NEPC) ambient air quality guidelines
- Assessment of changes in ground level concentrations, and
- Completion of a Health Risk Assessment.

The outcomes of these assessments are considered in relation to nearby receptors, in this case nearby residences.

<u>National Environmental Protection Measures (NEPM)</u>

The National Environment Protection Council (NEPC) has produced the following national ambient air quality guidelines for the protection of human health:

- National Environment Protection (Ambient Air Quality) Measure (NEPC, 1998a) which sets national air quality Standards for the criteria pollutants SO_2, NO_x, ozone, CO, particulate (as PM_{10}) and lead

- Draft National Environment Protection (Air Toxics) Measure (NEPC, 2003) which proposes Investigation Levels for the air pollutants benzene, benzo(a)pyrene (as a marker for Polycyclic Aromatic Hydrocarbons [PAHs]), formaldehyde, toluene and xylenes. This measure is in draft and the Investigation Levels are currently being considered by the NEPC, and therefore are subject to change.

A summary of these guideline values is presented in Table 21.

Table 21: National Environment Protection Measures - Ambient Air Guidelines

Pollutant	Averaging Period	Ambient Guideline		Goal
		(ppm)	($\mu g/m^3$) [1]	
Ambient Air NEPM		*Standard*		*See Note 2*
Carbon Monoxide	8 hours	9.0	11,250	1 day a year
Nitrogen Dioxide	1 hour	0.12	246	1 day a year
	1 year	0.03	62	none
Photochemical oxidants (as ozone)	1 hour	0.10	214	1 day a year
	4 hours	0.08	171	1 day a year
Sulphur Dioxide	1 hour	0.20	571	1 day a year
	1 day	0.08	229	1 day a year
	1 year	0.02	57	none
Particles as PM_{10}	1 day	-	50	5 days a year
	1 year	-	8	
Draft Air Toxics NEPM		*Draft Investigation Level* [4]		
benzene	Annual	0.003	8.8	*See Note 5*
formaldehyde	24 hour	0.015	16.9	
toluene	24 hour	2	6,907	
xylenes	24 hour	0.2	795	

Note:

1. Referenced to a temperature of 0 °C and absolute pressure of 101.3 kPa.
2. Maximum allowable exceedence of the Standard, to be achieved by the year 2008.
3. Goal is to gather sufficient data nationally to facilitate a review of the standard as part of the review of this Measure scheduled to commence in 2005.
4. Noted that the Impact Statement for the Draft Air Toxics NEPM (NEPC, 1998b) reports the Investigation Levels referenced to a temperature of 25 °C, however for consistency within this table the Investigation Levels have been referenced to 0 °C.
5. Eight-year goal is to gather sufficient data nationally to facilitate development of a standard.

Table 22 shows the maximum and annual average concentrations predicted at the receptor location(s) exhibiting the highest predicted impact for the expanded refinery, along with a comparison to the relevant NEPM guideline values.

Table 22: Maximum and Annual Average Ground Level Concentrations Predicted at the Receptor Location Associated with the Highest Predicted Concentration

		Maximum Predicted Concentration (μg/m³)		**Expanded refinery scenario - Case 6 (Cogeneration)**	
Pollutant	**Averaging Period**	**Base case**	**Expansion (cogen)**	**Receptor Exhibiting Highest Predicted Concentration**	**Percentage of Guideline (%)**
Nitrogen dioxide	1-hour	51	52	34	21.2%
	Annual	0.57	0.63	34	1.0%
Carbon monoxide	8-hour	31	39	16	0.3%
Sulphur dioxide	1-hour	11.2	14.1	34	2.5%
	24-hour	2.1	2.7	16	1.2%
	annual	0.04	0.07	16,34	0.1%
Particulates (as PM_{10})	24-hour	35.0	32.7	22	65.4%
Benzene	annual	0.0029	0.0034	16	0.01%
Formaldehyde	24-hour	0.476	0.144	25	1.3%
Toluene	24-hour	0.311	0.040	34	0.01%
Xylenes	24-hour	0.051	0.006	25	0.001%

From the data presented in Table 22 it can be seen that:

- The maximum and annual average ground level concentrations predicted for both the base case and expanded scenario at the receptor exhibiting the highest predicted impacts are well below the Standards (for NO_2, CO, SO_2 and PM_{10}), and the draft Investigation Levels (for benzene, formaldehyde, toluene and xylenes) specified in the relevant NEPM;

- The 24-hour average concentration of PM_{10} at receptor 22 is predicted to most closely approach the relevant NEPM Standard, but is still less than two thirds of the relevant Standard.

Table 23 below presents the relative change in air quality characteristics in the Yarloop town site as a result of the proposal and in comparison to relevant ambient guidelines. Receptor location 4 (Refer Figure 45) has been chosen as representative of Yarloop. Table 24 shows a similar set of data for Hamel, represented by receptor location 10. Yarloop and Hamel are the nearest town sites to the Wagerup refinery and are located 2 kilometres to the south and 4 kilometres to the north respectively.

Table 23: Ground Level Concentrations Predicted at the Yarloop Town site*

Pollutant	Averaging Period	Maximum Predicted Concentration (µg/m³)			Ambient Guideline (µg/m³)	% of Ambient Guideline
		Base case	Expansion (cogen)	Expansion (boilers)		
Nitrogen dioxide	1-hour	42	40	44	246	17.9%
	Annual	0.25	0.28	0.26	62	0.4%
Carbon monoxide	8-hour	15	20	20	11,250	0.2%
Sulphur dioxide	1-hour	6.3	6.5	7.7	571	1.4%
	24-hour	1.1	1.3	1.4	228	0.6%
	annual	0.02	0.03	0.03	57	0.1%
Particulates (as PM_{10})	24-hour	4.4	4.3	4.3	50	8.6%
Benzene	annual	0.0009	0.0010	0.0011	60	0.0%
Formaldehyde	24-hour	0.114	0.065	0.065	11	0.6%
Toluene	24-hour	0.105	0.011	0.011	411	<0.1%
Xylenes	24-hour	0.014	0.001	0.001	946	<0.1%

* Note: Receptor 4 was used to be representative of Yarloop Town site

Table 24: Ground Level Concentrations Predicted at the Hamel Town site

Pollutant	Averaging Period	Maximum Predicted Concentration (µg/m³) Base case	Expansion (cogen)	Expansion (boilers)	Ambient Guideline (µg/m³)	% of Ambient Guideline
Nitrogen dioxide	1-hour	35	29	30	246	12.0%
	Annual	0.24	0.33	0.27	62	0.5%
Carbon monoxide	8-hour	16	20	20	11,250	0.2%
Sulphur dioxide	1-hour	4.1	4.2	4.8	571	0.8%
	24-hour	1.1	1.2	1.3	228	0.6%
	annual	0.02	0.03	0.03	57	0.1%
Particulates (as PM_{10})	24-hour	5.3	5.8	5.8	50	11.6%
Benzene	annual	0.0010	0.0009	0.0010	60	0.0%
Formaldehyde	24-hour	0.119	0.072	0.072	11	0.7%
Toluene	24-hour	0.062	0.011	0.011	411	<0.1%
Xylenes	24-hour	0.011	0.002	0.002	946	<0.1%

* Note: Receptor 10 was used to be representative of Hamel Town site

From Table 23 and 24 it can be seen that based on accepted health guidelines, the Proposal will not cause a reduction in key air quality indicators within either adjoining town site. When considered in conjunction with ambient concentrations (section 7.9) the overall concentration of these compounds in nearby town sites may be affected more by other sources, such as vehicle emissions and wood fires during winter.

8.3.7 Changes in Ground Level Concentration Contours

For each of the modelled compounds where a GLC guideline exists, contour plotting has shown that the guidelines are met at all receptor locations. In other words, the compound concentrations from refinery and RDA sources at all nearby residences are within accepted guideline levels, including those closest to the refinery.

An understanding of the predicted air quality changes as a result of the Proposal can also be gained by comparing the modelled ground level concentrations (GLC) of key compounds under the existing and expanded scenarios. This can be seen in GLC contour plots prepared for key compounds in each scenario. This allows a visual assessment of the changes at nearby receptor locations (residences).

Figures 45 to 52 are examples of the changes in compound GLC from the existing to the expanded refinery scenario. Examples have been chosen in the four main categories of airborne emissions: VOCs, dust, metals and odour.

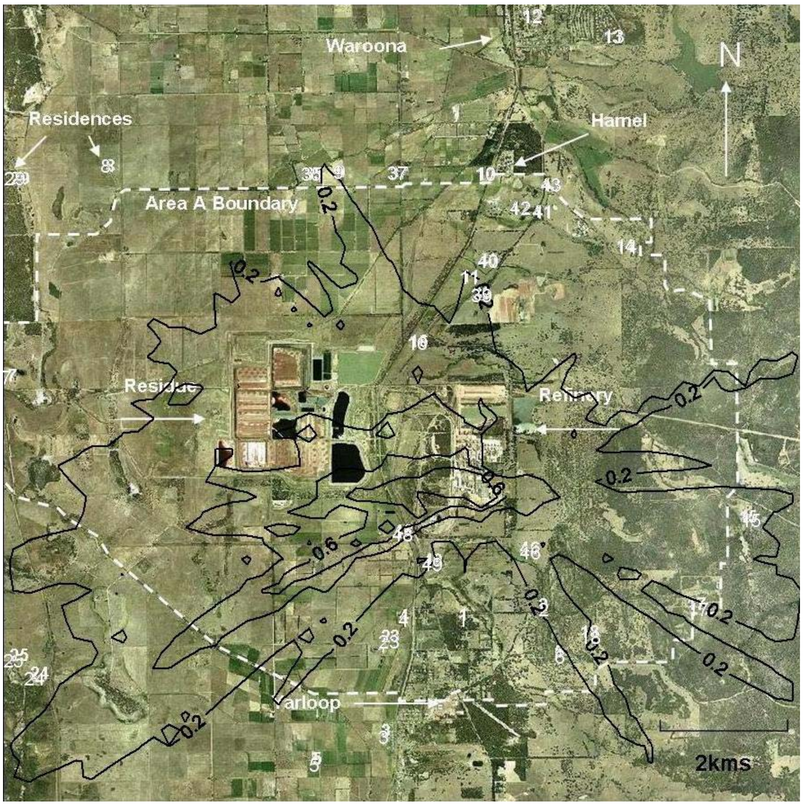
In each case:

- Refinery point sources and RDA diffuse sources have been combined;
- The expanded refinery scenario includes the cogeneration power supply;
- Nearby residences are indicated by numbers; and
- The dashed white line shows the current "Area A" land management boundary.

For contours other than odour, the averaging time and peak percentile location have been selected based on the comparison to guidelines undertaken in the accompanying Health Risk Assessment.

Figures 45 and 46 show that the predicted peak 24-hour formaldehyde and acetaldehyde ground level concentrations contours contract as a result of the Proposal. This is primarily due to emission control works in refinery areas included as part of the Proposal, particularly the capture and destruction of vent gases and reduction in VOC emissions from cooling towers.

Figure 45: Peak (99.5th percentile) 24-hour average formaldehyde concentrations for the existing (top) and expanded refinery (bottom) scenarios



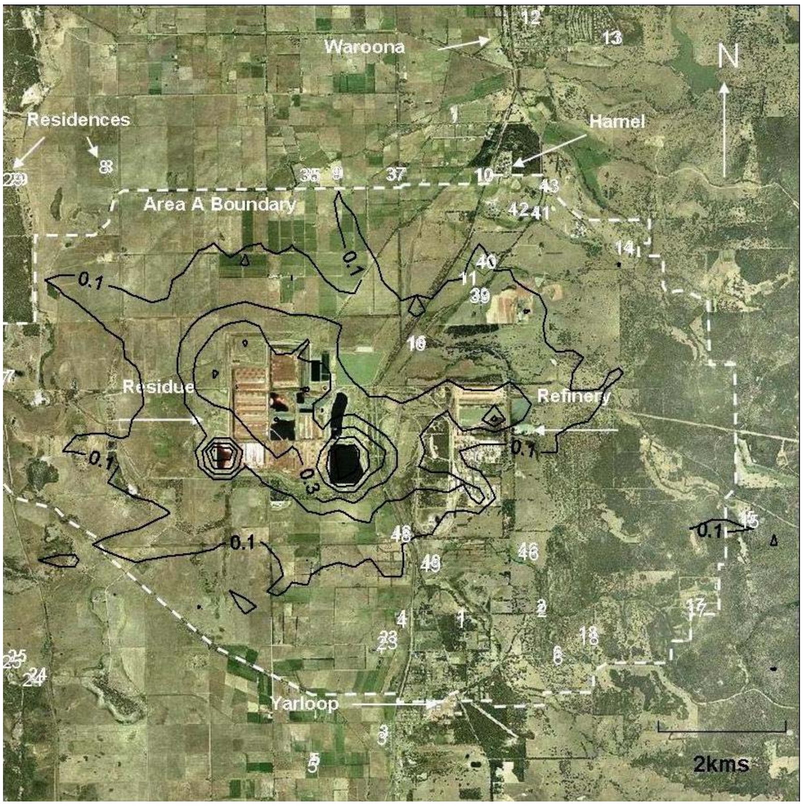
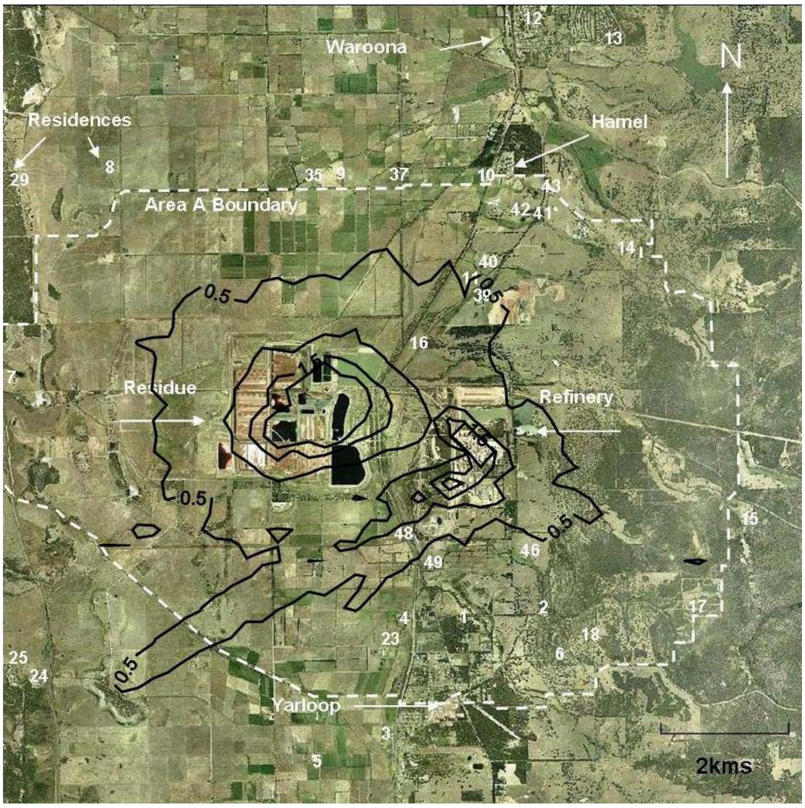


Figure 46: Peak (99.5th percentile) 24-hour average acetaldehyde concentrations for the existing (top) and expanded refinery (bottom) scenarios



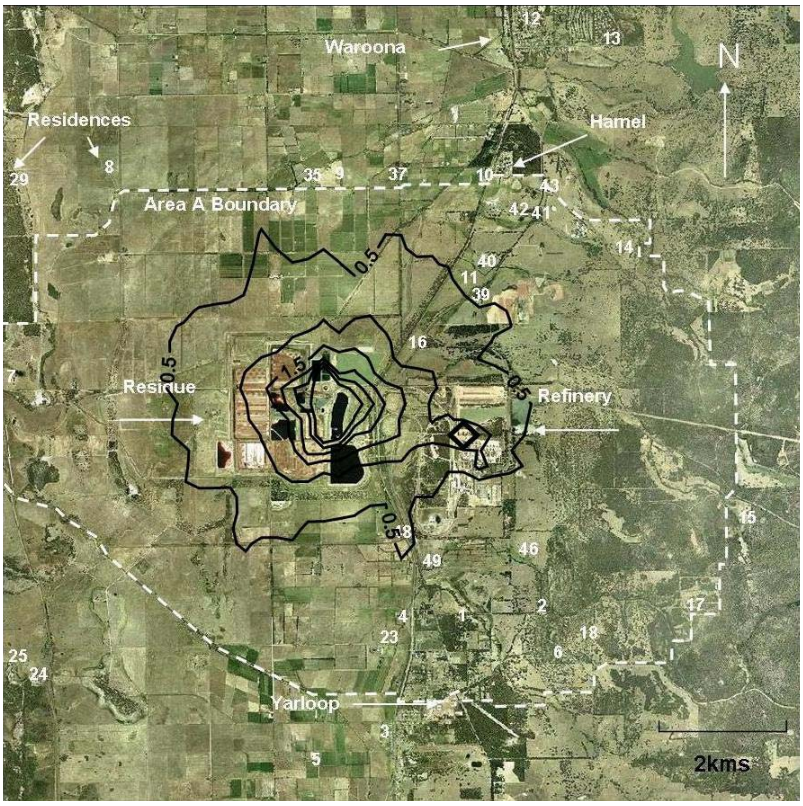
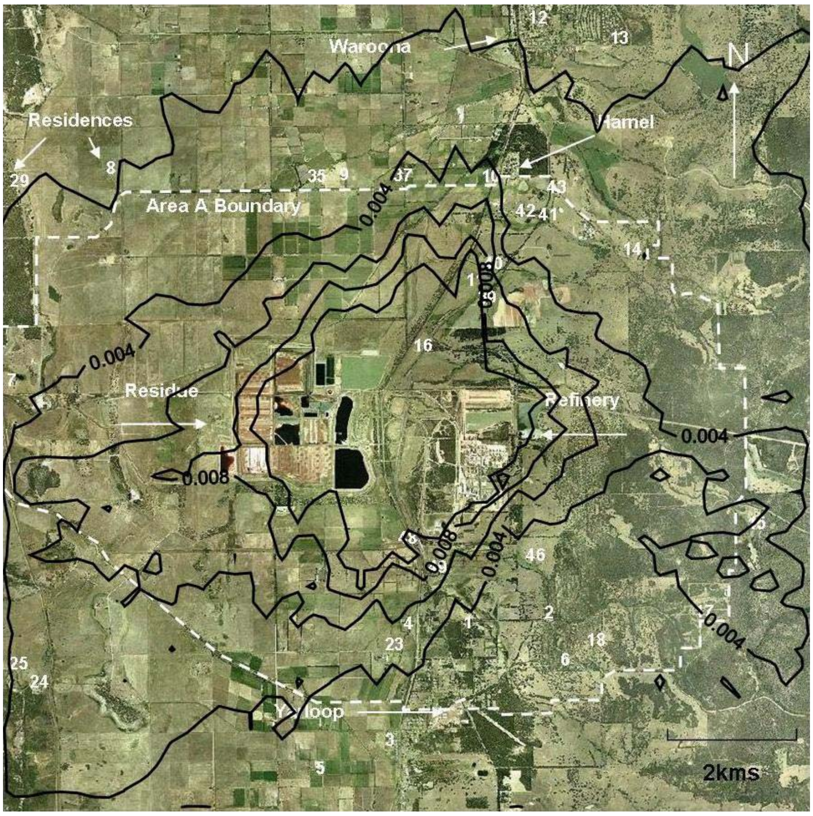


Figure 47 shows that predicted peak (99.9th percentile) 1-hour ground level concentrations for mercury increases very slightly at some receptor locations. However these changes are extremely small; less than 0.0015 micrograms per cubic metre (ug/m^3). Ground level concentrations are still some 2 % (or less) of the 1-hour guideline value of 1.8 ug/m^3 (*California Office of Environmental Health hazard Assessments Toxicity Criteria database*)

Figure 48 shows that annual average ground level concentrations of arsenic are predicted to spread slightly further from the refinery and RDA areas as a result of the Proposal. However, these concentrations are at extremely low levels. The maximum predicted concentration experienced at receptor locations, after implementation of the Proposal, is between 0.00013 and 0.000018 ug/m^3, which are 8,000 to 55,000 times less than the relevant guideline value of 1.0 ug/m^3 (*Dutch National Institute of Public Health and Environment human-toxicological Maximum Permissible Risk Levels, 2001*)

Figures 49 and 50 show that for all receptor locations the peak 24 hour dust concentrations (PM_{10} and TSP) reduce as a result of the Proposal. This is due to the combination of dust control initiatives at both refinery point sources and the RDA.

Figure 47: Peak (99.9th percentile) 1-hour mercury concentrations for the existing (top) and expanded refinery (bottom) scenarios



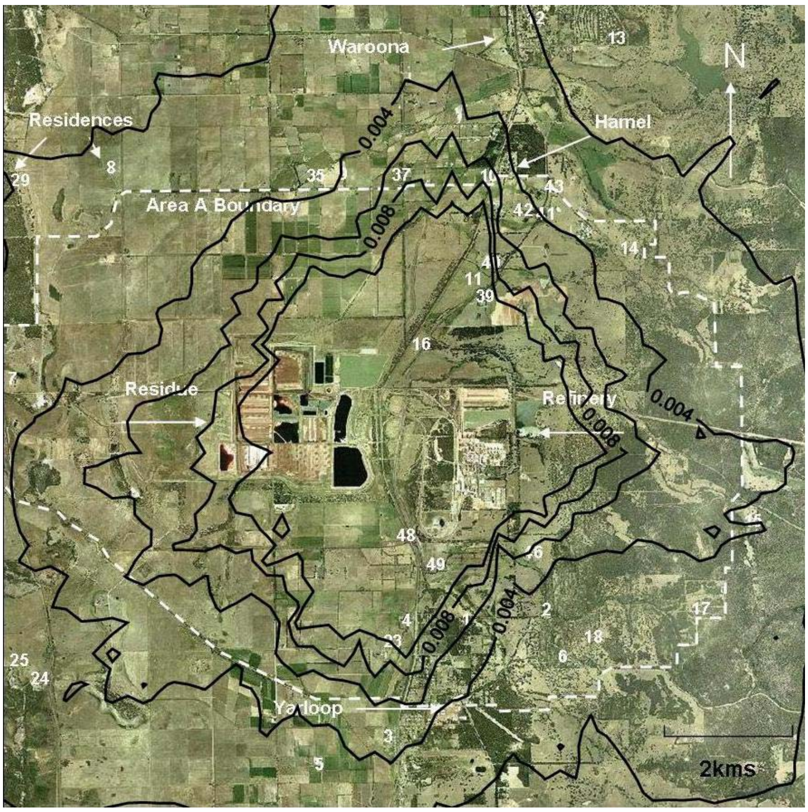
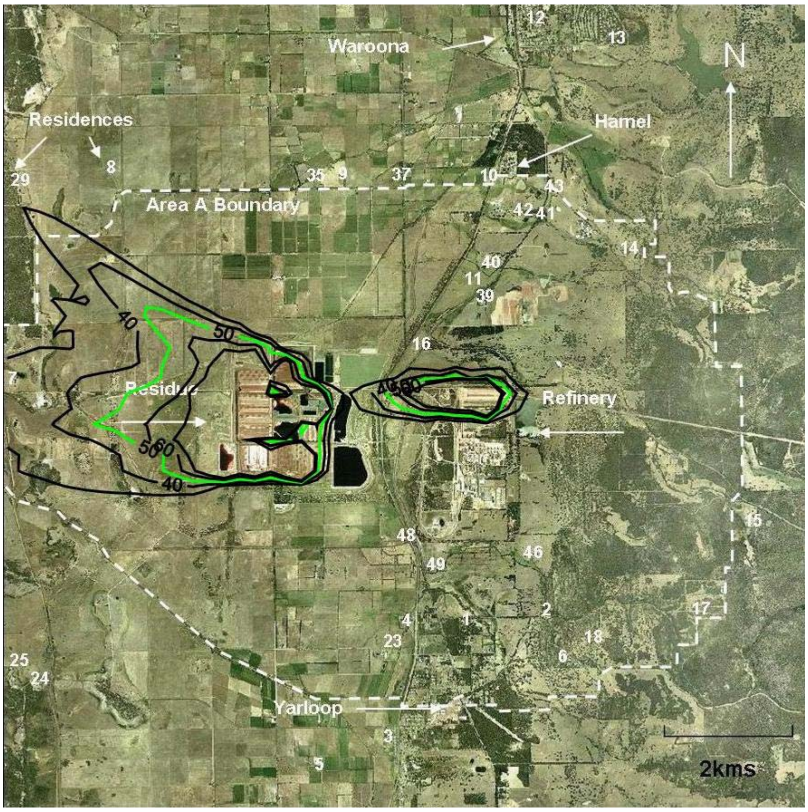


Figure 48: Annual average arsenic concentrations for the existing (top) and expanded refinery (bottom) scenarios

Figure 49: Peak (99.5th percentile) 24-hour average dust (PM_{10}) concentrations for the existing (top) and expanded refinery (bottom) scenarios



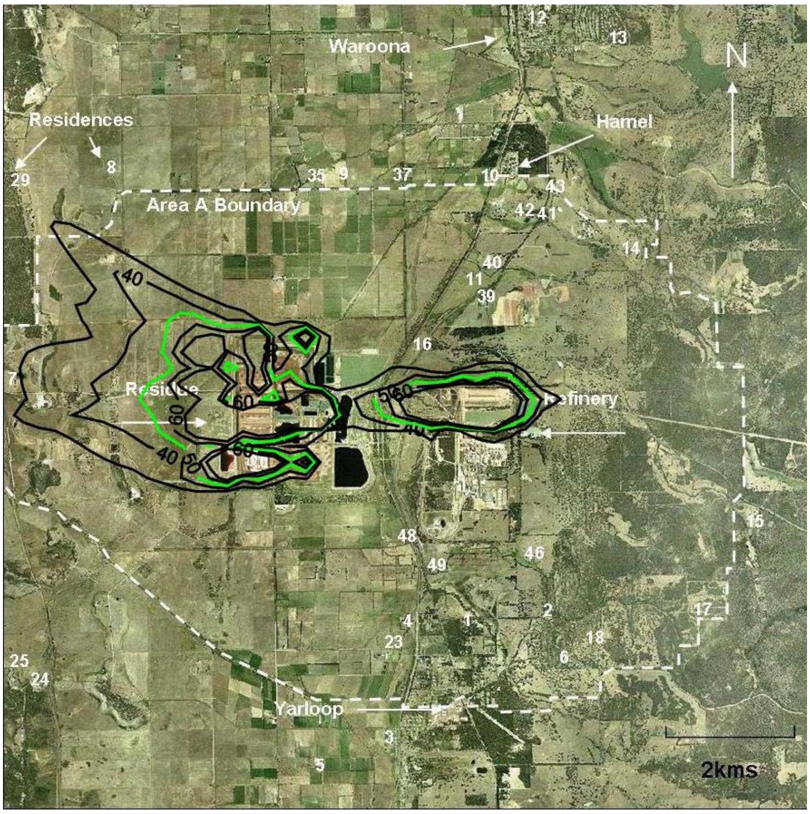
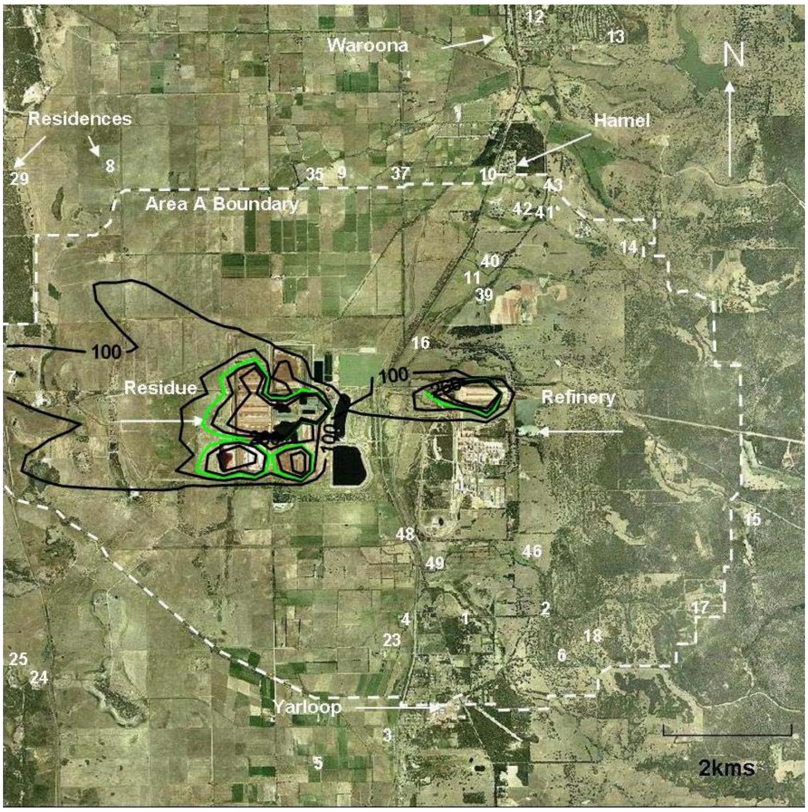
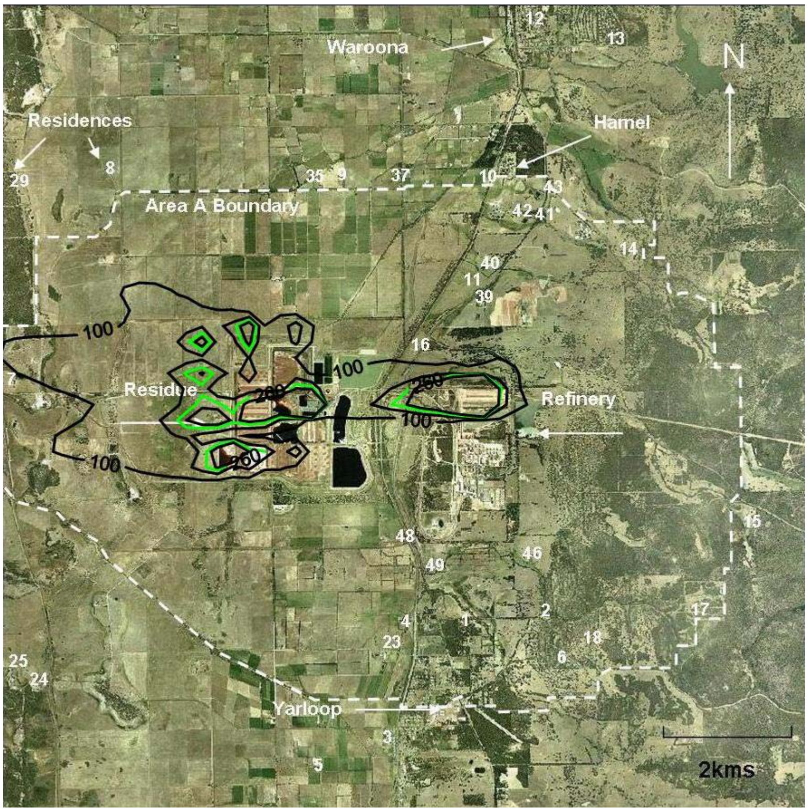


Figure 50: Maximum 24-hour average dust (TSP) concentrations for the existing (top) and expanded refinery (bottom) scenarios





8.3.8 Odour Assessment

Odour emissions from the refinery point sources were determined based on odour emission monitoring of key points and the development of an odour:VOC relationship. Odour emission rates from the residue area diffuse sources were determined from campaign sampling using a flux hood at the source to air interface and nearby ambient odour monitoring. The combination of measured emission rates and back trajectory analysis allowed emission rates to be modelled using TAPM (point sources) and Calpuff (diffuse sources) with the results combined to model the total ground level concentration (GLC) of odour from all Alcoa sources. The sampling and modelling approaches taken for odour estimates and a description of key odour sources are provided in Appendix G.

In 2002, the Western Australia EPA released its guidance document on the assessment of odour impacts from new proposals. (EPA, 2002) This document is a general guide to odour assessment and contains specific guidelines for new proposals. However the document also provides guidance for assessment of expanding existing facilities:

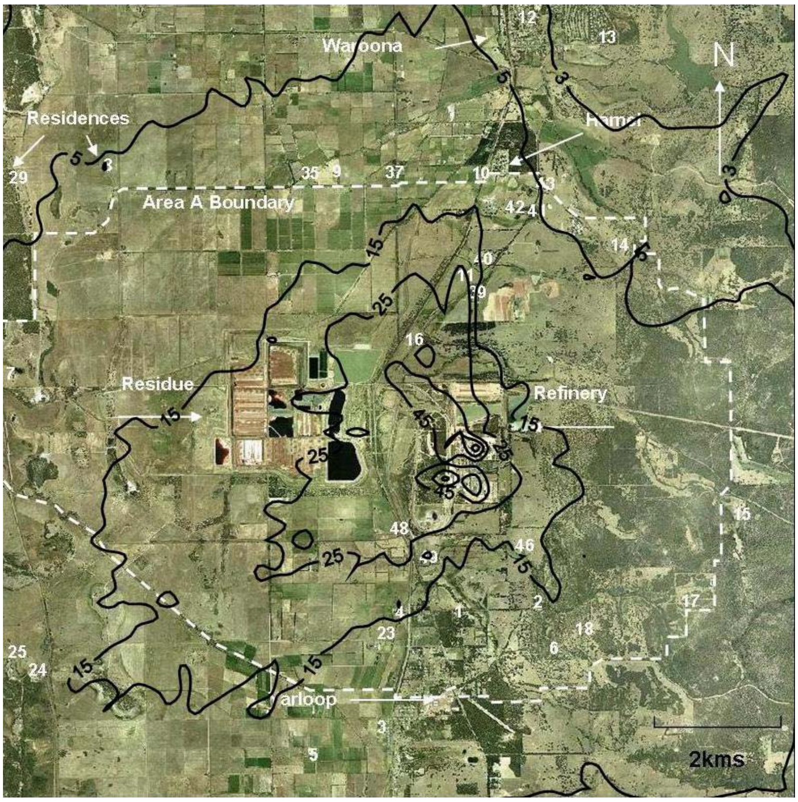
> "If an existing facility wishes to expand but does not itself comply with the odour criteria for new sources then the EPA would expect, as a minimum requirement, that predicted odour concentrations at sensitive land uses would not increase (i.e. there would be no deterioration of current amenity values)."

The following two figures (Figure 51 and Figure 52) show the predicted 3 minute odour concentrations at the peak 99.9th and average 99.5th percentiles respectively for the existing and expanded refinery. Both figures show the predicted ground level concentrations of odour from the combination of refinery (TAPM) and residue area (Calpuff) modelled sources.

The two figures show that, although refinery odours will still be detected on occasion in nearby townships, there is a significant decrease in the predicted odour concentrations for the expansion scenario for both the average 99.5th and peak 99.9th percentiles three minute ground level odour. It is therefore considered that the Proposal satisfies both the EPA's guidance statement requiring no deterioration of amenity values and Alcoa's undertaking that there is no increase in odour impacts on residents from the expansion.

It was earlier noted (section 7.9.3) that TAPM may over predict ground level concentrations of odour, therefore the concentrations shown in Figures 51and 52 may be higher than would actually occur. The emission control works associated with the proposal will still result in a significant reduction in the predicted odour concentrations from the existing refinery case, however, the reduction between the current and expanded cases may be slightly smaller than shown here.

Figure 51: Peak (99.9th percentile) 3-minute odour concentrations for the existing (top) and expanded refinery (bottom).



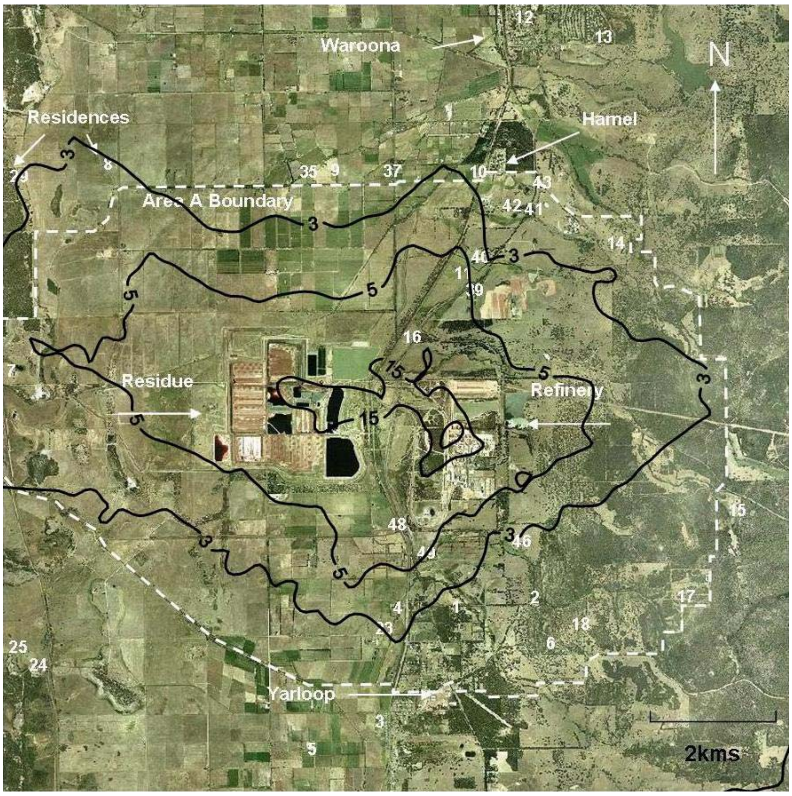
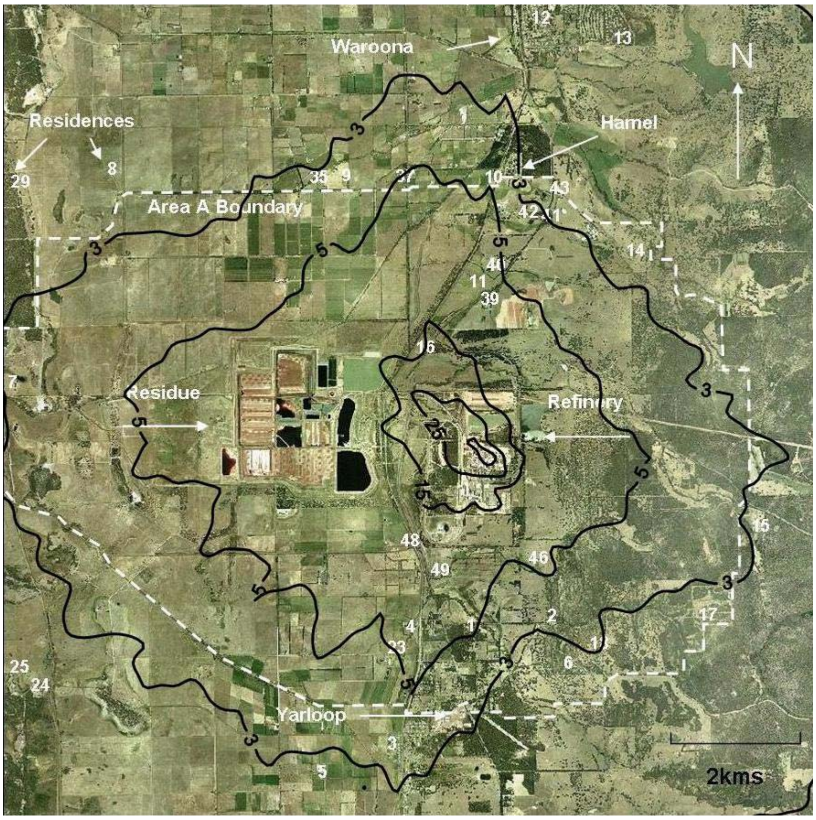
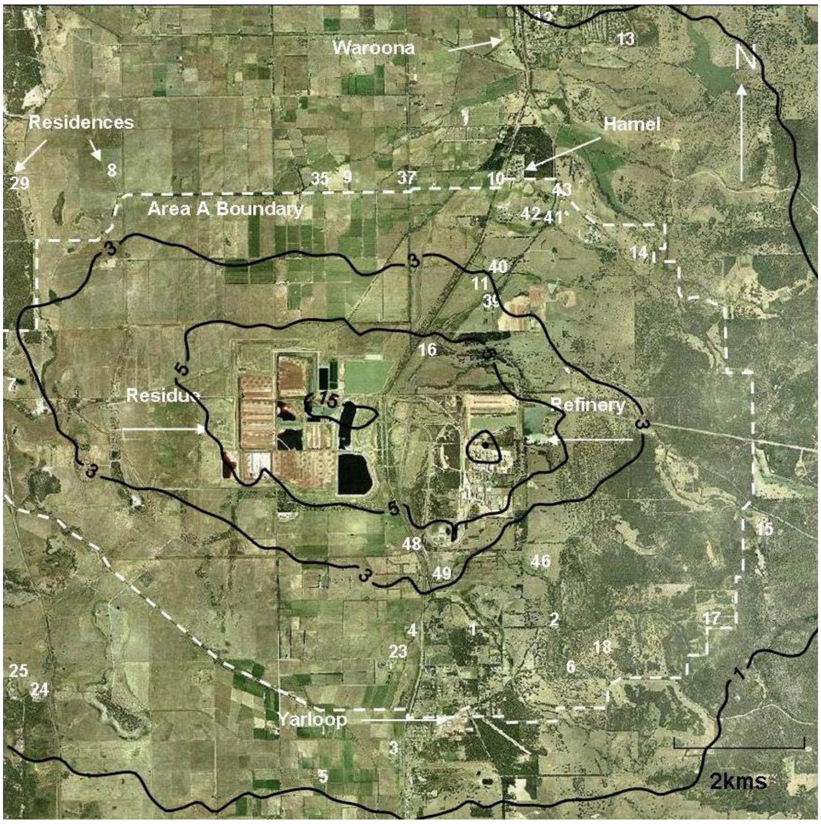


Figure 52: Average (99.5th percentile) 3-minute odour concentrations for the existing (top) and expanded refinery (bottom)





The reduction in ground level odour concentrations is due to various point source emission control works associated with the Proposal, such as redirection of calciner low volume vent emissions for destruction; reduction in cooling tower VOC emissions; reduced emissions from causticisation and the sealing of some additional tank vents.

Commitment 2.

Alcoa will implement the Air Quality Management Plan to monitor and manage aspects of proposal implementation with a potential for impacts on surrounding air quality.

Commitment 3.

Alcoa will manage the bauxite residue generated from the Proposal in accordance with the Wagerup refinery endorsed Long-term Residue Management Strategy (LTRMS).

Commitment 4.

Alcoa will improve the management of dust from the residue drying areas through an upgrade of the existing sprinkler control network

8.3.9 Expert Review of Air Dispersion Modelling

A consultant with Katestone Environmental was selected by the Emissions and Health Working Group to undertake an independent desk-top review of the Air Quality assessments for the existing and proposed Wagerup refinery.

The objectives of the review were to comment on the:

- completeness of the information presented;
- suitability of the measurements performed for assessing the project impacts;
- correctness of the analysis performed on the data presented;
- suitability of the methodology used to make predictions; and
- conclusions reached in the report(s) being reviewed.

As a desktop review; the air quality (modelling) reports were assessed to determine if the information contained in them was adequate, whether methodologies used were adequate in determining the impacts on air quality, and whether the conclusions drawn from the work were appropriate.

It was not intended to be an audit of input data, an evaluation of the process or technology associated with the Proposal, or an evaluation of the air quality impacts. The results of the expert review are provided in Appendix L.

Some of the points raised in the reviews have already been addressed, and Alcoa will continue to work with the Department of Environment to determine appropriate actions to address any remaining issues raised in the expert reviews.

Summary of Expert Review (TAPM Modelling)

The expert reviewer concluded that generally the use of TAPM for modelling the Wagerup refinery plumes should be suitable, and is probably the best available model. Generally, the modelling undertaken for the Proposal adequately assesses the potential impacts on the local atmospheric environment so long as a degree of conservatism is taken into account when applying the uncertainty factors from the modelling results presented by CSIRO in the HRA.

Katestone Environmental noted that any model or measurement process has associated errors for which it is important to estimate the likely influence on the conclusion of a given study, however, keeping this in mind the errors of a particular model will be the same for the current scenario as for the expansion and therefore the relative difference in impacts can be as important as the magnitude of impacts.

For the refinery expansion scenarios the changes depend on the pollutant and location. Due to the changes in emission rates and stack characteristics for the proposed expanded refinery it is difficult to check the validity of the predicted impacts for the refinery expansion. However, based on the reduced emissions for some sources and better dispersion for others with the inclusion of a new multiflue source, the changes in impacts seem reasonable.

The reviews found the question "is the model predicting the right answer for the right reason" remains unanswered. It would give more confidence in the results if this question was answered but due to the limited monitoring information available for the region it may not be possible.

Katestone Environmental gave key recommendations to provide more confidence of the TAPM modelling for the Proposal undertaken by CSIRO. These were:

- The TAPM modelling use data assimilation as the more appropriate meteorological scenario for the region;
- Daily average emission rates be used for configuration of the model (TAPM); and
- Modelling results be presented for the maximum exposed location as well as at the discrete receptors. This will reduce the uncertainty due to year to year variability in wind patterns.

The full review was provided to the CSIRO to enable any issues raised to be addressed before finalisation of the final report.

Summary of Expert Review Diffuse Source Modelling

Katestone Environmental acknowledges the complex nature of assessing emissions from the diffuse sources at Wagerup refinery operations. This detailed modelling of these types of diffuse sources is groundbreaking and forms the basis for further understanding and modelling of the diffuse sources.

Katesone Environmental found:

- Overall the assessment of dust impacts is very detailed and has used appropriate methodologies. A sensitivity analysis into the methodology used to estimate the emissions for the proposed expansion is recommended and would provide a further level of confidence in the final outcomes of the HRA.
- The conclusions drawn from the odour assessment seem reasonable. Katestone Environmental provided some comments on small technical issues with respect to the modelling and emission estimation techniques that should be addressed over time. These are unlikely to change to outcomes of the assessment (refer to Appendix L).
- A detailed list of uncertainties is included in the Air Assessments report (refer to Air Quality Summery report Appendix G). This list should be referred to and if possible activities undertaken in the future to reduce the uncertainty. A list of detailed recommendations for further work is also resented in Section 10, and Katestone concur with all items listed and recommend that all actions are undertaken to complete these recommendations and those presented in other reports such as the CFD modelling, outlined in the Air Quality Summary report (Appendix G).

8.3.10 Health Risk Assessment

A quantitative health risk assessment (HRA) has been conducted by specialist consultants; Benchmark Toxicology Services Pty Ltd and ENVIRON. The HRA process examines the potential health impact of refinery and RDA atmospheric emissions on the nearby population using a comparison of the predicted ground level concentrations (GLC) of selected compounds to their accepted health guideline levels. This occurs for the individual compounds and the results are totalled for all of the selected compounds. This includes evaluation of acute (i.e. short term) hazard and chronic (i.e. long term) hazard risks as well as the incremental carcinogenic risk.

The HRA concluded:

- the potential for emissions from the existing or expanded Wagerup refinery to cause acute health effects is low and is primarily driven by the particulate emissions from the RDA and oxides of nitrogen emissions from the refinery

- the potential for emissions from the existing or expanded Wagerup refinery to cause chronic non-carcinogenic health effects is very low, and

- the potential for emissions from the existing or expanded Wagerup refinery to contribute to the incidence of cancer based on inhalation exposure is below USEPA *de minimis* threshold of one in a million (i.e. 1×10^{-6}) at all of the residential receptors considered.

Furthermore, to ensure that potential risks are not underestimated, uniformly conservative assumptions have been used to characterize exposure and toxicity in the HRA. Due to the resultant compounding of conservatism, the quantitative risk indicators should be considered as over-estimates of potential health risks associated with emissions from the Wagerup refinery.

The full HRA report is contained in Appendix F and includes details of the methodology, results and findings of the investigation. The following represents a summary of the HRA undertaken for the Proposal.

In order to assess the air quality impacts associated with potential acute (i.e. short-term) and chronic (i.e. long-term) exposures, emissions associated with daily peak and annual average plant activity were modelled for the base case and two expansion scenarios. Assuming the daily peak activity occurred for the full 24 hour period the modelling predicted the average ground level concentration for each hour during the day and the average for the year. In the risk assessment the 9th highest (99.9th percentile) one hour concentration that occurs at any time during the year has been used for assessing potential acute health impacts. The predicted 99.5th percentile 1-hour modelled concentration has also been evaluated to provide insight to the frequency with which such high concentrations are predicted to occur. The HRA also considered the 99.5th percentile (i.e. 2nd highest) and 95th percentile 24-hour average concentrations when assessing the acute effects. The annual average concentration was used to assess the impact of potential chronic and carcinogenic exposures.

The potential health impact of emissions at receptor locations has been assessed firstly by comparing the predicted ground level concentrations with health based air guideline values for the individual emission components. These guidelines have been sourced from reputable regulatory agencies and incorporate large safety factors to ensure they are protective of public health. The methodology used for assessing the health risks is consistent with that recommended by the US EPA, the National Health and Medical Research Council of Australia and the enHealth Council of Australia.

When predicted ground level concentrations are less than the health guideline values there is very little likelihood of an adverse health effect occurring. The ratio of the ground level concentration to the health guideline value is called the hazard quotient. The impact of exposure to all of the individual emission is then assessed by assuming the effects of the individual components are directly additive. The sum of the individual hazard quotients is referred to as a hazard index. It should be noted that the assumption that the impacts of all pollutants is directly additive is considered to be very conservative; in reality relatively few of the emission components will have a directly additive affect on health risk.

A general rule of thumb for interpreting a hazard quotient or hazard index is that values less than one, present no cause for concern. Values between 1 and 10 generally also do not represent cause for concern because of the inherent conservatism embedded in the exposure and toxicity portions of a preliminary risk assessment. Hazard quotients or indices that are around ten present some concern regarding possible health risks, although in these circumstances it is usual to evaluate the extent to which the conservative assumptions have given rise to an overestimate of risk.

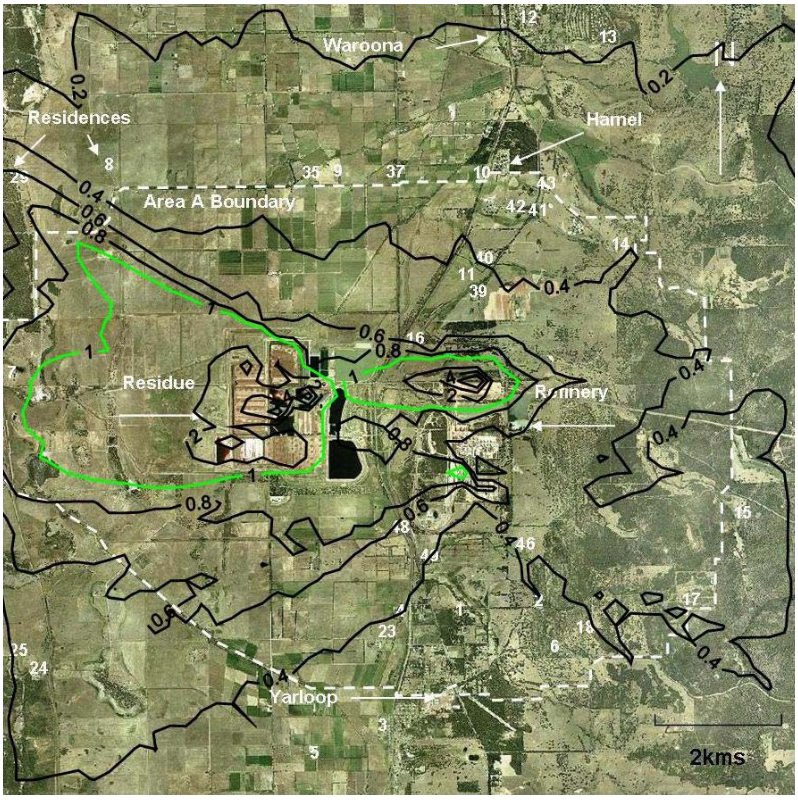
The HRA concluded there is little likelihood of an acute adverse effect occurring because all hazard quotients and hazard indices for all receptor locations are less than one (unity) and for less than the target range of one to ten (Figure 53). Furthermore, the highest concentrations are modelled from worst case emission assumptions and they will be rarely achieved which adds a further degree of conservatism to the results.

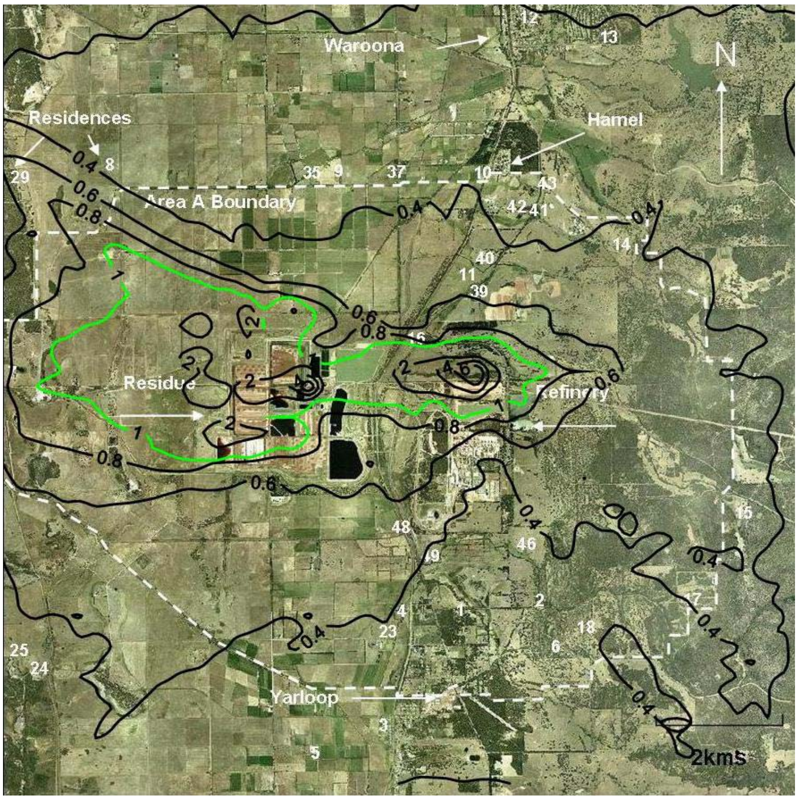
Figure 53 shows the calculated acute hazard index for both the current and expanded refinery (cogeneration option) scenarios. Representative nearby (occupied) residences have been chosen as “receptor locations” and are shown in Figure 53 as white numbers. The white dashed line represents Alcoa’s land management area A boundary.

The receptor locations (residences) closest to the refinery represent the potential worst case exposure locations. However, the HRA results indicate the acute hazard indices are low at all of the residential receptors.

The HRA is applicable to environmental (community) exposures; different exposure circumstances and health guidelines apply for occupational circumstances. However, based on the outcomes of this HRA and the systems and procedures in place at its workplaces, Alcoa is also confident that atmospheric emissions associated with the Proposal represent no appreciable health risk for workers at the Wagerup refinery.

Figure 53: Acute hazard index for existing (above) and expanded cogeneration scenario (below). The 1.0 risk contour is shown in green.





The chronic hazard indices for the existing and expanded refinery scenarios are much less than unity (Figure 54) indicating the likelihood of adverse health effects from chronic exposure to the refinery emissions is extremely unlikely. For dioxin-like compounds conservative estimates of background intakes have been assumed, even so the overall intakes are much less than the intake level that Australian authorities have deemed to be tolerable and without adverse health effects.

For emission components that are carcinogens, the carcinogenic risk from an assumed life time exposure has been calculated and compared with the USEPA's *de minimis* threshold of one in a million (i.e. 1×10^{-6}) (Figure 55). The lifetime risk is based on continuous exposure for 70 years.

The incremental carcinogenic risk that is considered acceptable varies amongst jurisdictions, typically ranging from one in a million ($1\text{x}10^{-6}$) to one in ten thousand ($1\text{x}10^{-4}$). The most stringent criterion of one in a million represents the USEPA's de minimis, or essentially negligible incremental risk level, and has been adopted for this screening assessment as a conservative (i.e. health protective) indicator of acceptable carcinogenic risk.

In conclusion, the health risk assessment indicates that there is little likelihood of health effects being caused by either acute or chronic exposure of the general public to the atmospheric emissions from the existing refinery, and the Proposal will result in no significant change from this case.

Figure 54: Chronic hazard index contours for existing (above) and expanded cogeneration scenario (below).

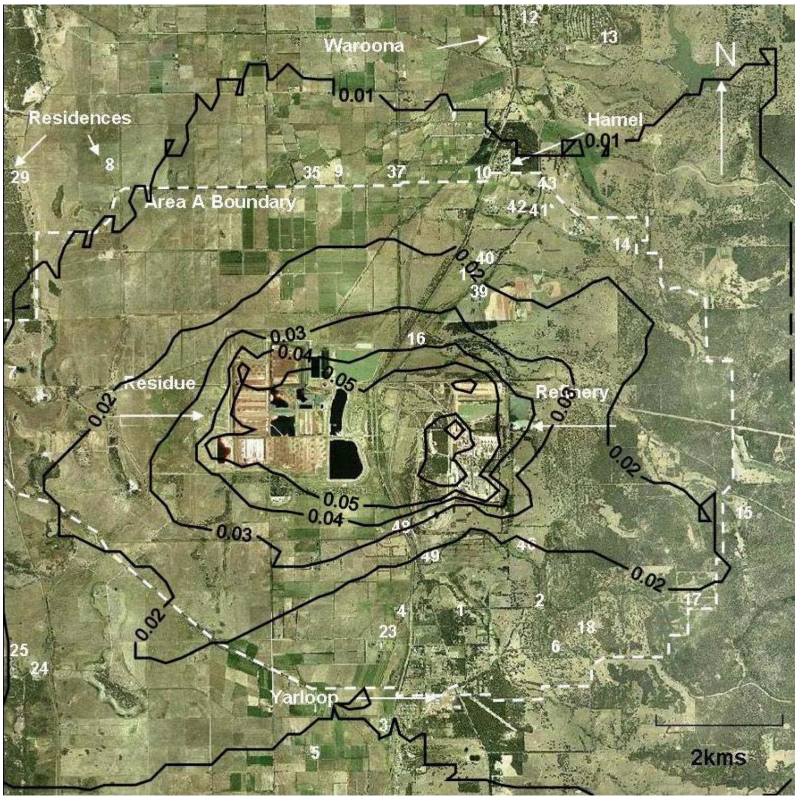
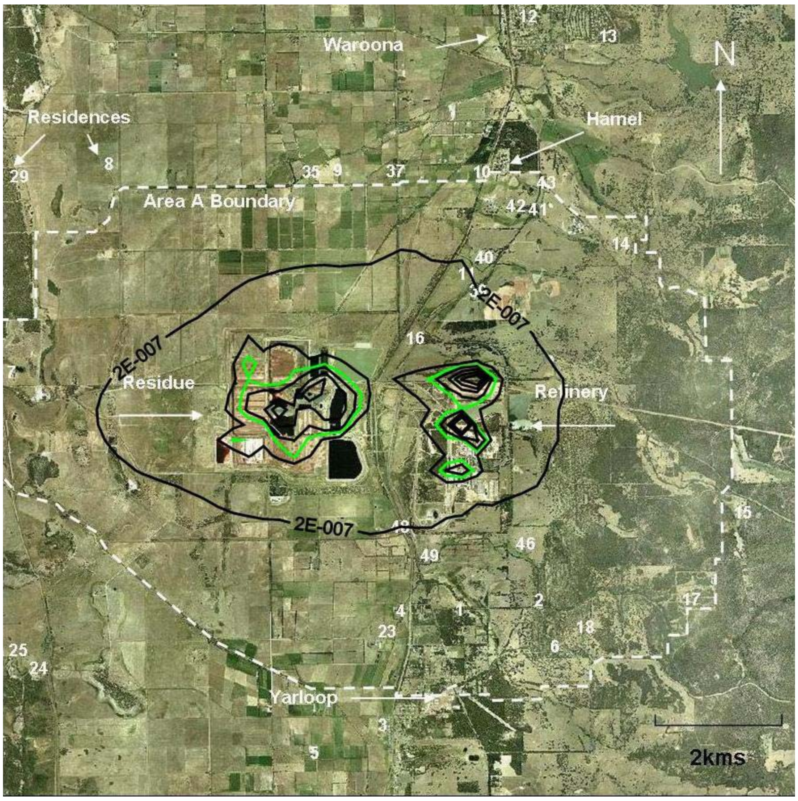
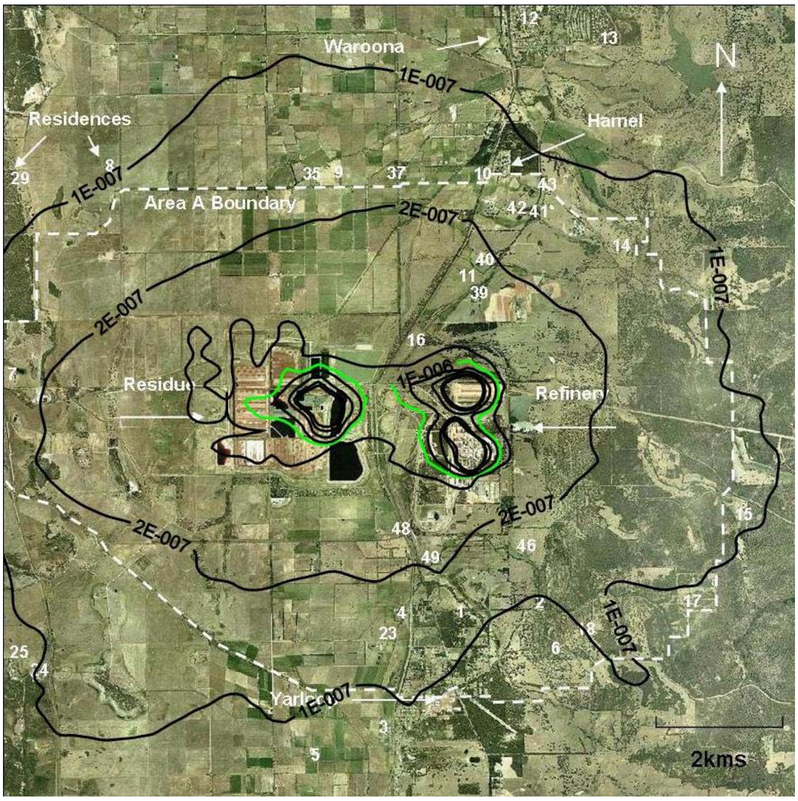


Figure 55: Incremental carcinogenic risk contours for existing (above) and expanded cogeneration scenario (below). The "one in a million" risk contour is shown in green.





Expansion including additional boilers

The health risk assessment, including contours of acute, chronic and incremental carcinogenic risk was also conducted on the expansion scenario which includes two additional boilers, rather than cogeneration units. These HRA risk contours for the boiler option are shown in Figures 56, 57 and 58.

In each case the conclusions drawn for the cogeneration expansion scenario apply equally to the scenario including additional boilers:

- the potential for emissions from the existing or expanded Wagerup refinery to cause acute health effects is low;
- the potential for emissions from the existing or expanded Wagerup refinery to cause chronic non-carcinogenic health effects is very low; and
- the potential for emissions from the existing or expanded Wagerup refinery to contribute to the incidence of cancer based on inhalation exposure is below USEPA de minimis threshold of one in a million (i.e. 1×10^{-6}) at all of the residential receptors considered;

Figure 56: Acute hazard index for the expanded scenario (boilers). The 1.0 risk contour is shown in green.

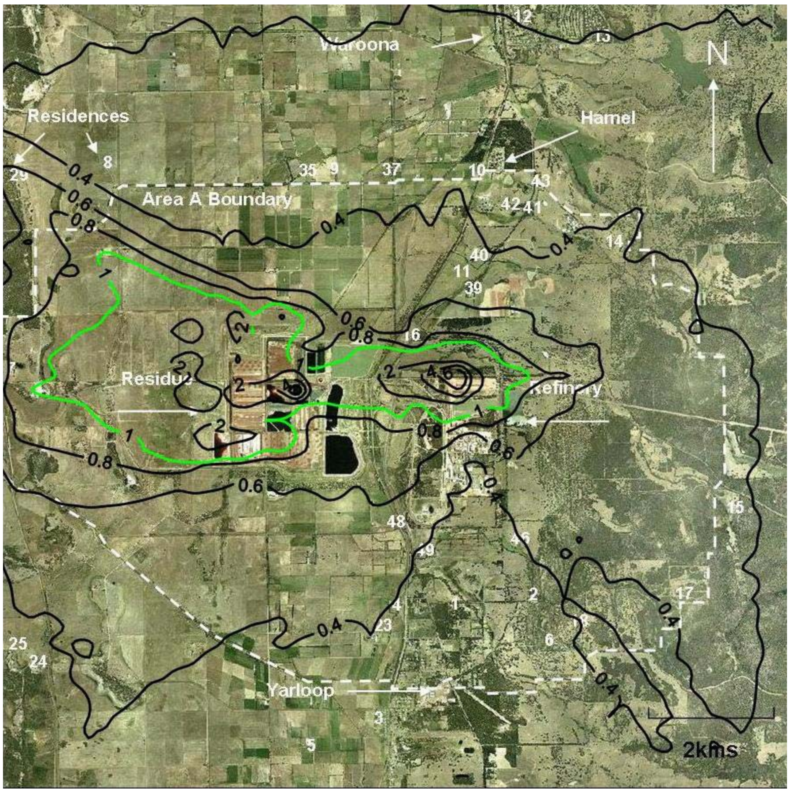


Figure 57: Chronic hazard index contours for expansion scenario (boilers).

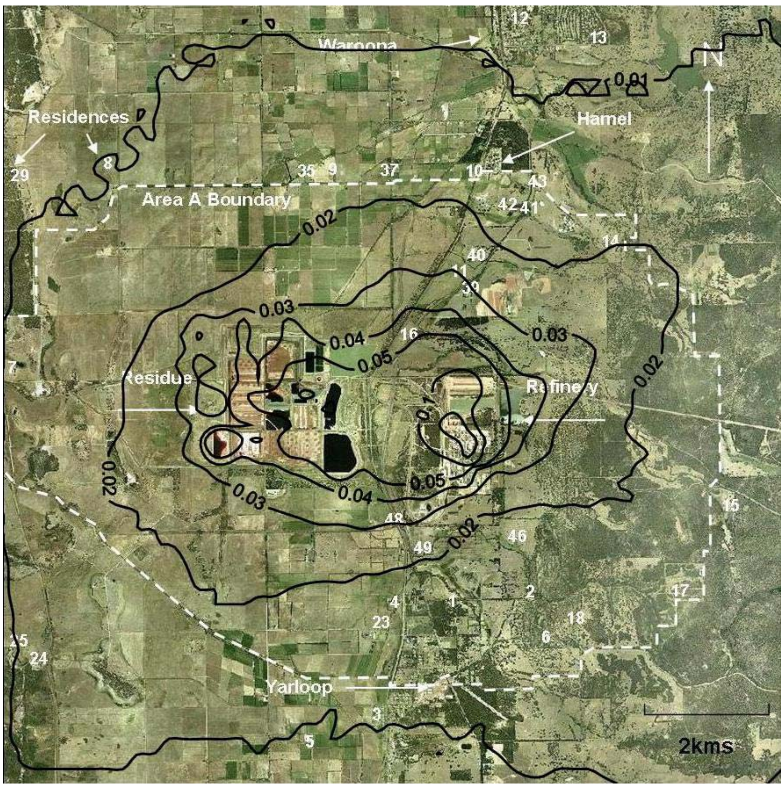
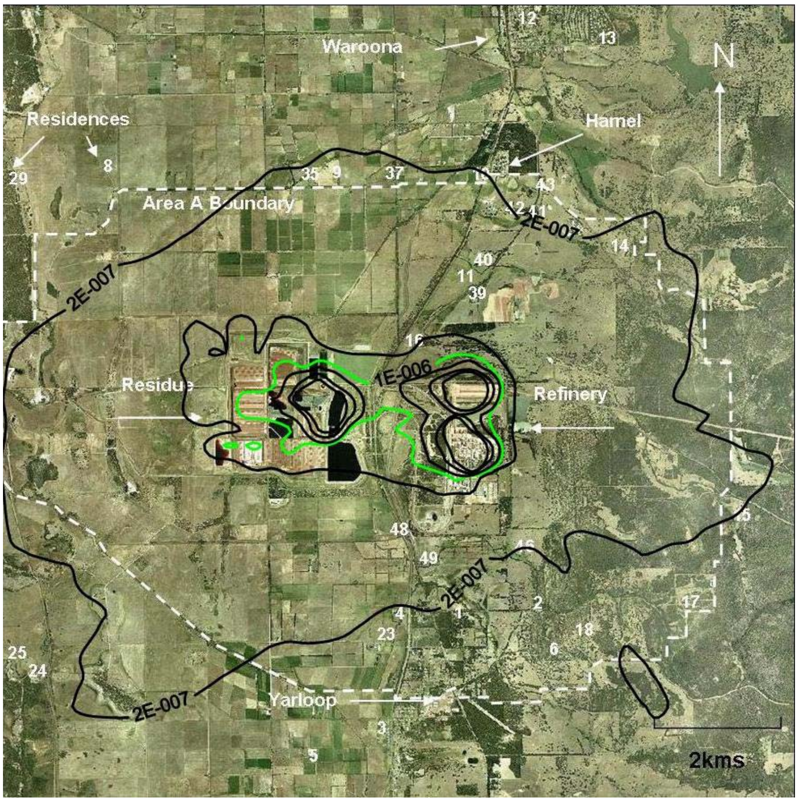


Figure 58: Incremental carcinogenic risk contours for expanded scenario (boilers). The "one in a million" risk contour is shown in green.



Substance selection for the HRA

In selecting the 27 compounds to be included within the HRA, Alcoa initially considered the 141 compounds or groups of compounds that were quantified as part of the Pinjarra Refinery Efficiency Upgrade health risk assessment. A screening assessment of these compounds found that the 27 individual compounds or groups of compounds considered in this assessment contributed over 93% of the acute HI, over 86% of the chronic HI, and 100% of the incremental carcinogenic risk calculated for the Pinjarra Refinery Efficiency Upgrade health risk evaluation at the maximally affected receptor (receptor 1) (Toxikos, 2003). Based on the findings of the Pinjarra Refinery Efficiency Upgrade health risk evaluation (Toxikos, 2003), the compounds considered in the Wagerup refinery screening assessment are expected to contribute the vast majority of the potential health risks. ENVIRON considered the process used to identify and select the compounds included within the HRA was comprehensive and appropriate given the current state of knowledge of the refinery and RDA emissions.

The 27 individual compounds or groups of compounds comprise the following compound classes and are presented in Table 25:

- particulates
- products of combustion
- metals
- organic compounds (e.g. aldehydes, ketones and aromatics [including polycyclic aromatic hydrocarbons (PAHs)], and
- ammonia.

Table 25: List of 27 Compounds modelled

No.	Compound Name	No.	Compound Name
1	Oxides of Nitrogen[1]	15	Acetaldehyde
2	Carbon monoxide	16	Formaldehyde
3	Sulphur dioxide	17	2-Butanone
4	Particulate matter	18	Benzene
5	Arsenic	19	Toluene
6	Selenium	20	Xylenes
7	Manganese	21	Acrolein
8	Cadmium	22	Ethylbenzene
9	Chromium (VI)	23	Methylene Chloride
10	Nickel	24	Styrene
11	Mercury	25	1,2,4 Trimethylbenzene
12	Ammonia	26	1,3,5 Trimethylbenzene
13	Polycyclic Aromatic Hydrocarbons	27	Vinyl chloride
14	Acetone		

Notes: 1. Oxides of Nitrogen expressed as Nitrogen Dioxide.

8.3.11 Expert Review of Health Risk Assessment

A consultant with International Health Consultants was selected by the Emissions and Health Working Group to undertake an independent desk-top review of the Health Risk Assessment for the existing and proposed Wagerup Refinery.

As a desktop review; the HRA was assessed to determine if the information contained in it was adequate, whether methodologies used were adequate in determining the impacts on health, and whether the conclusions drawn from the work are appropriate.

The full expert review report is provided in Appendix M.

Summary of HRA Expert Review (Environ / Benchmark Toxicology Services report)

The expert reviewer found the HRA was an initial screening assessment of potential for risks arising from direct toxic actions of air pollutants in predicted Wagerup emissions.

The HRA had been carried out correctly, within its limited scope and the methodology is consistent with initial assessments as defined by Australian authorities.

- The measurement of predicted risk levels was based on calculation of measures described as Hazard Index (HI) and Incremental Carcinogenic Risk (ICR). The final conclusions of the HRA are given in qualitative terms. However, being based on quantitative methods, the conclusions are regarded as semi-quantitative.
- A prudent, conservative, and highly health-protective approach was taken in the HRA.
- Review of Air Quality information and the Criteria selected shows that inputs used to calculate the measures of risk were conservative and appropriate.
- Air Quality data and information for the areas surrounding Wagerup is valid and extensive, and its quality has been independently reviewed.
- Choice of methods was appropriate, although other approaches and the limitations of the methods have been discussed in the review. Comparison of predicted GLCs with published health guidelines was carried out on a comprehensive selection of pollutants.

The expert reviewer raised the following issues with respect to the HRA:

- Some lack of clarity and readability in the HRA which may lead to confusion or unnecessary concern;
- The choice of some overseas criteria and methods, because applying overseas criteria developed for overseas contexts is not always appropriate. In this case there were no technical difficulties apparent; and

- The lack of information about context e.g. the relative importance of Wagerup emissions compared to general background levels, and overall intake of chemicals which may be important for health.

The expert reviewer found:

- The HRA presents useful and almost certainly correct assessments, on the levels of risk contributed by the predicted Wagerup emissions;
- The HRA conclusions are that low, very low, or de minimis risk of health effects on any residents can be foreseen. Given the low levels of GLCs predicted (in comparison with published standards, goals and guidelines) and review of the information presented, these conclusions are considered to have been supported by the evidence put forward in the HRA;
- On the basis of the evidence and results in the HRA the review concludes that all levels of foreseeable risk are essentially the same, and the term de minimis is preferred. Conclusions are therefore reassuring on the matter of future air quality and the de minimis nature of any health risks, taking into account the limitations of the HRA; and
- Further investigation of health complaints or health effects may be necessary or desirable, because there are as yet unresolved questions regarding “health effects” and health complaints in the community. Careful preparation will be needed to determine what types of health study or Health Impact Assessment are feasible or appropriate, if resolution of these questions for the community of Wagerup is to be achieved.

It was recommended that effort is made to enable readers and particularly the residents and community groups to understand what the HRA concluded, so that the value of it is accepted as part of the engagement process between Alcoa and the local communities.

8.3.12 Short-term emission exposures

Discussions with some members of the local community have identified a need to consider the potential for very short-term transient air quality impacts. For example, at times some local residents report the presence of refinery odour which has been noticeable for only a few minutes at a time before disappearing. This could be due to either unusual weather conditions or unusual plume behaviour.

As part of the scope of this ERMP Alcoa undertook to investigate several potential aspects of this phenomenon including:

- Ground-level concentrations at the timescale of a few minutes;
- Ambient monitoring data;
- Statistical analysis of the historical data set;

- Analysis of complaints data.

A comparison of the maximum modelled short-term (3-10 minute) ground level concentration of key refinery-emitted substances is shown in Table 26. A list of the predicted 3minute and 10 minute concentrations for all modelled substances is contained in the air dispersion modelling reports prepared by the CSIRO (CSIRO 2005, Appendix G of Appendix G)

Table 26: Comparison of maximum modelled short-term GLCs for existing and expanded refinery

	Maximum predicted concentration (3 minutes)				
Pollutant	**Averaging period**	**Ambient guideline (ug/m3)**	**Base case (ug/m3)**	**Expansion (cogeneration)**	**Expansion (boilers)**
Nitrogen dioxide	1 hour	246	54	54	54
Carbon monoxide	8 hours	11,250	210	220	220
Sulphur dioxide	1 hour	571	220	230	300
Particulates (PM_{10})	1 day	50	16	8.9	8.9
Benzene	Annual[1]	8.81	0.94	0.19	0.18
Formaldehyde	24 hour[1]	16.91	2.4	1.3	1.3
Toluene	24 hour[1]	6,9071	2.4	0.18	0.19
Xylenes	24 hour[1]	7951	0.56	0.01	0.01

[1] Draft investigation levels from Draft Air Toxics NEPM

These data for all modelled substances were considered during the health risk assessment process with the following conclusion. A comparison of modelled maximum 3-min and 10-min GLC indicates that the short term averaging GLC are lower than the reference values for 1-hr averages or annual averages (where no 1-hr average was available). In most cases, the short term estimated GLC were lower than the reference values for annual averages. These observations indicate that short term peaks in the concentration of irritant substances in air are unlikely to be sufficiently high to cause adverse health effects. (ENVIRON 2005-HRA)

A description of the refinery emissions contribution to ambient compound concentrations is given in section 7.9 and more fully in Appendix G. Among other findings this work found that all chemical compounds detected in the ambient monitoring investigations were found to be at levels well below applicable limits set for the protection of human health and were generally within the ranges expected for rural environments.

The chemical compounds detected and their levels in the atmosphere showed little spatial variation and for the most part appeared to be randomly distributed, limiting the ability to attribute specific sources. Elevated levels of both carbonyls and VOCs were found at the Waroona and Yarloop township sites, consistent with the effects of human activities associated with the use of fossil fuels. (van Ember and power 2005)

Portable Gas Chromatograph Mass Spectrometer (GCMS) monitoring for a wide range of ambient VOCs was also undertaken during the August – September period in 2004, including attempts to measure ground level concentrations downwind of the refinery and in nearby townships. In the vast majority of cases this monitoring failed to detect measurable concentrations of VOCs and in the instances where VOCs were detected they were present at concentrations well below accepted health guidelines or amounts that would normally be expected to result in health impacts (Chemistry Centre of WA 2004).

Statistical analysis of the historical data set including evaluation of short-term (six minute) NOx and particulate data, meteorological conditions, air quality and complaints, and the alkalinity of airborne particles is described in sections 7.11.3 to 7.11.6. Findings of this work included that NOx and particulate concentrations at the Boundary Road monitoring location are strongly influenced by wind direction and that wind direction from the refinery increases the concentration of both parameters at Boundary Road, although these increases are "not markedly greater" than those associated with wind direction from the Yarloop residential area.

The study also considered whether or not the alkalinity of refinery particulate emissions might cause irritation of the respiratory tract and therefore might be the cause of health complaints. The 6-minute ambient monitoring data includes occasional short-term peaks in particulate concentrations. It was considered important to determine if the alkalinity of these peaks could cause short-term irritation.

Evaluation of this potential found that the alkalinity of fine particulate samples was such that the maximum six minute average value recorded for PM_{10} at Boundary Rd corresponded to the equivalent alkalinity of 93ug/m^3 of sodium hydroxide. This suggests that short term peaks in ambient particulate concentrations are not high enough to cause irritant effects on the basis of alkalinity.

The Emphron (2005) study concluded that "in summary, it is possible that complaints are increased by airborne material from the refinery. The source within the refinery cannot be localised [identified]. There is no evidence that complaints are due to an irritant response to alkaline particles." "Complaints do seem to be more common when the wind is blowing from the North, and they may be increased when there are elevated Oxides of Nitrogen concentrations. These elevated Oxides of Nitrogen concentrations are far too small to be of physiological significance, but they may serve as a marker for the stack plumes. In other words, days experiencing a higher proportion of time with peak NOx levels are likely to be days in which the stack plumes are detected at Boundary Rd (near Yarloop). Plume odour is the most probable cause of complaints (and indeed odour is the most common issue for complaints)" (Emphron 2005). The air dispersion modelling undertaken for the ERMP has identified that the expansion is predicted to reduce peak odour concentrations in nearby townships.

In summary; statistical analyses of short term ambient concentrations of particulates and oxides of nitrogen indicate that neither of these substances reach concentrations likely to be irritant to the respiratory tract. The same conclusion holds when the alkalinity of the particulate matter is considered.

The maximum three minute average concentrations predicted by modelling are all substantially less than the ambient guidelines established for longer averaging periods. This strongly suggests that short-term exposures for these compounds are unlikely to result in health effects. This conclusion holds for the base case and the two expansion scenarios.

Alcoa will continue air quality monitoring at appropriate locations in the vicinity of the Wagerup refinery as well as maintain the existing complaints response procedures to ensure concerns about potential short-term emission impacts are properly investigated and responded to.

8.3.13 Survey of Health Status within the Local Community

A health survey of local community members will be undertaken prior to commissioning the Proposal, if approved. The survey will aim to measure the current health status of local community members to enable a comparison to Western Australia wide health results. This could allow for a follow-up survey after full implementation of the Proposal.

The proposed methodology for the health status survey is outlined following:

- A cross-sectional survey method will be undertaken. This involves surveying the community at a point in time, rather than over a period of time;
- Selection of a random sample of the populations of Yarloop, Hamel and nearby townships;
- The sample sizes will be large enough to be statistically valid (with adequate statistical power). A biostatistician will advise on appropriate sample size;
- The Computer Assisted Telephone Interview (CATI) technique will be used;
- The WA Health and Wellbeing Questionnaire developed by the Department of Health will be used for the survey. The questionnaire covers topics such as, demographics, health enhancing behaviours, health risk factors, socioeconomic status, psychological distress and chronic health conditions;
- Demographic and socioeconomic data will be obtained from the Australian Bureau of Statistics for input into the survey analysis;
- Age standardised prevalence rates for males and females will be calculated;
- A statistical comparison of the survey results with the most recent health results obtained for Western Australia;
- Logistic regression techniques will be applied to detect associations between the likelihood of chronic health conditions and several factors, including; geographic

location, health enhancing behaviours, health risk factors, socioeconomic status, psychological distress and demographic variables; and

- Logistic regression techniques will be applied to detect associations between the likelihood of individual symptom types and several factors, including; geographic location, health enhancing behaviours, health risk factors, socioeconomic status, psychological distress and demographic variables.

The final report would be made publicly available.

Commitment 5

Alcoa commits to implementing the proposal in a manner which ensures no significant change to the air quality predictions for surrounding areas (from refinery and RDA contributions) or Health Risk Assessment findings detailed in this ERMP. This will be confirmed following commissioning of the proposal.

Commitment 6

Should the Proposal proceed, Alcoa commits to commissioning a local community health survey. The results of this study would be available prior to commissioning of the Proposal.

8.3.14 Bunbury Port Air Emissions

Potential Impacts

Presently around 8.3Mtpa of alumina is exported through Alcoa's ship-loading facility at the Bunbury Port including approximately 3.2 Mtpa of alumina from Worsley and approximately 5.1Mtpa of alumina from Alcoa.

Worsley Alumina is in the process of constructing a ship-loader to handle its alumina export at the Bunbury Port. This should be operational in early 2006 and as a result Alcoa's ship-loader will manage approximately 5.7 Mtpa, including the additional 600,000 tpa expected from the Pinjarra refinery efficiency upgrade. Operations would continue at this level until the Proposal, if approved, is commissioned, resulting in the tonnage handled by the Alcoa ship-loader increasing to approximately 8.0 Mtpa.

Therefore, after inclusion of alumina from the Proposal, Alcoa's Bunbury Port facility will be operating within its current capacity. Consequently, no increase in dust impacts are expected at the Alcoa port operations. The main potential sources of dust are ship loading activities, conveyor operations and filling of the alumina bins, all of which are sized and operated to cope with the current 8.3Mtpa export load.

The Bunbury Port has an internal reporting standard for particulates of 260 ug/m3. Operations at the Port in recent years have shown continual improvement in dust control with fewer exceedences of this internal standard in 2004 (Section 7.9.5).

Proposed Management

Existing procedures are in place at Alcoa's Bunbury Port operations for controlling dust emissions (Document No. 44146 Minimising Dust During Shiploading). These include:

- ensuring that the loading chute discharge is as close as possible to the floor of the hold and that the rubber skirt is in contact with the hold to maintain a seal
- keeping loader movements to a minimum
- keeping the alumina loading chute as close to the alumina pile as possible
- lowering the chute as soon as the loader moves off the pile
- informing the relevant officer immediately if dusting appears to be excessive, so that appropriate action can be taken, and
- ceasing ship loading under bad weather conditions.

If dust generation is evident and the wind direction is blowing the dust cloud toward residential areas in Bunbury, an assessment is made about whether the dust is being carried more than 500 metres from the terminal. If this is the case, then loading is ceased until there is an acceptable wind condition change. If a dust cloud continues to hover above the loading facility because of stagnant wind conditions, then loading is also ceased until there is an acceptable wind condition change. The normal checks on dust collection performance are carried out prior to the decision to shut down.

Special procedures are followed when 'topping off' vessels to maximum hold capacity. If the wind speed exceeds 25 knots (47 km/h) regardless of wind direction, topping off is ceased. Under these conditions normal centre loading may continue, providing the seal with the rubber skirt is not broken and excessive dust is not observed.

Alcoa's Bunbury Management team reviews the dust monitoring data at the end of each month. The data are extrapolated to determine if there is a correlation between any exceedences of Alcoa's internal reporting standard and shiploading operations. This information is then used to influence future decision-making.

Sample analysis is carried out by a contracted consultant and analysed in accordance with the Wagerup procedure Determination of Total Suspended Particulate Concentration in Air (Document No. 4962).

These measures would continue to operate during the proposed Wagerup refinery expansion with the objective of continually improving dust control at the Bunbury Shipping Terminal.

Commitment 7.

Alcoa will manage ship-loading of alumina at the Bunbury Port to minimise the potential for dust impacts on the surrounding community.

8.4 NOISE

8.4.1 Refinery Noise Emissions

The EPA's objective for the Proposal regarding management of refinery noise is:

- *To comply with statutory requirements on a stand-alone basis.*

Concerns about refinery noise levels were expressed by some neighbours in the mid 1990's and in response Alcoa initiated a noise monitoring program and examined options for noise control. This program continues to the present day (refer section 7.14.1).

The Environmental Protection (Noise) Regulations were promulgated in 1997 and came into effect in 1999. Although some major refinery noise sources had already been acoustically treated, monitoring conducted in 1999 indicated that refinery noise levels exceeded regulatory limits under worst-case propagation conditions and tonal characteristics were present. A noise reduction program carried out in 2000 and 2001 successfully reduced noise levels as measured at Boundary Road to the south of the refinery by around 5 dB(A) and removed tonality (as defined by the regulations).

Despite this significant reduction, monitoring and modelling confirm that under certain weather conditions refinery noise exceeds the regulatory criteria at a number of neighbouring private residences (refer to section 7.14.2). Stakeholder consultation indicates that approximately five neighbours continue to be adversely affected by refinery noise under some conditions.

Monitoring and modelling conducted over a number of years has shown that the refinery contribution to noise levels in its vicinity is caused by the combined emissions of many pieces of equipment. This means that further noise reduction would require a large number of sources to be acoustically treated. Alcoa and its consultants have reviewed options for further noise reduction in the vicinity of the refinery. On the basis of these reviews Alcoa has concluded that all reasonable and practicable measures to reduce noise have already been implemented (refer to section 7.14.3).

In 2002, Alcoa applied to the Minister for Environment for a variation to the assigned noise levels, as allowed under Regulation 17, such that the refinery would be fully compliant with the Regulations. This application has undergone intensive review over the last two years and is now being considered by the EPA in parallel with the assessment of the proposed Wagerup expansion.

In developing the Proposal, Alcoa has set an objective that the expansion will not increase noise impacts on surrounding residences. An acoustic assessment of the proposed expansion has been undertaken to verify that the noise objective is technically feasible, and to detail the noise control and management methods required from design through to operational phases.

8.4.2 Acoustic Assessment of Refinery and Overland Conveyor Expansion Proposals

The acoustic assessment of the Proposal was undertaken by SVT Engineering Consultants (SVT) and independently reviewed by a representative of the Acoustics and Vibration Unit, School of Aerospace, Civil & Mechanical engineering, University of New South Wales at the Australian Defence Force Academy in Canberra (refer to Appendix J).

The acoustic assessment involved liaison with the engineering design team to identify key noise generating equipment related to the expansion, noise modelling and site visits to identify reduction opportunities for existing equipment. SVT have prepared three reports as part of the development of this ERMP.

- Noise Model Development Report for Wagerup 3 Expansion project (Report No. A/04/12/005) (refer to Appendix H)
- Environmental Noise Management Strategy for the Wagerup 3 Expansion Project (Report No. A/05/01/010) (refer to Appendix I)
- Noise Control Review for 4 dB(A) Noise Reduction Scenario for Wagerup 3 Expansion Project (Report No. A/05/02/002) (refer to K)

The information contained in these reports has been used by Alcoa for decision making during preliminary engineering design and the preparation of a noise management plan for the Proposal.

Noise modelling of the Proposal (including the overland conveyor system) was conducted by SVT using the SoundPlan noise modelling software (version 6.2) and the associated CONCAWE algorithms.

The most recent version of the existing refinery acoustic model (December 2004) and the overland conveyor acoustic model (September 2004) developed by Herring Storer Acoustics (HSA) were provided to SVT. SVT adopted these models in full as the base for the expansion modelling. SVT developed new noise sources to represent emissions from new equipment related to the proposed expansion and modified existing sources where these will be affected by the expansion.

The expansion models were used to predict the refinery noise contribution at neighbouring noise sensitive premises under maximum (worst-case) sound propagation conditions (i.e., 3 metre per second wind blowing from the source to the receiver combined with a thermal inversion). The methodology and assumptions used in developing the expansion models are detailed in the Noise Model Development Report provided as Appendix H (SVT, 2005a).

The important receptor locations for the Wagerup refinery and the ore conveying system are neighbouring privately owned residences. Modelling has been used to determine the worst-case noise levels at privately owned residences for the existing refinery and conveyor operations (Refer to Figures 59 and 60).

Figure 59: Existing Refinery Worst Case Modelled Noise Predictions

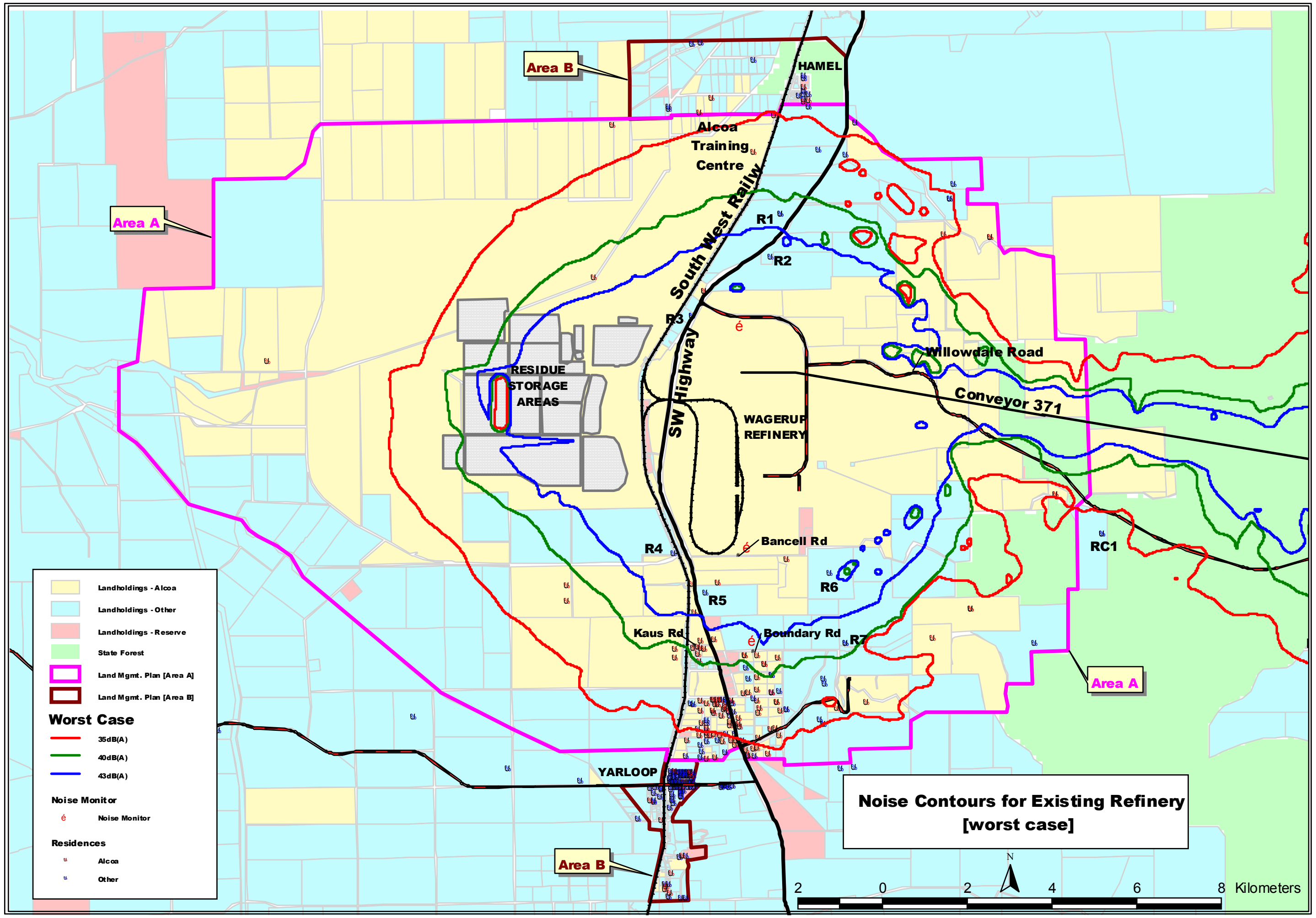
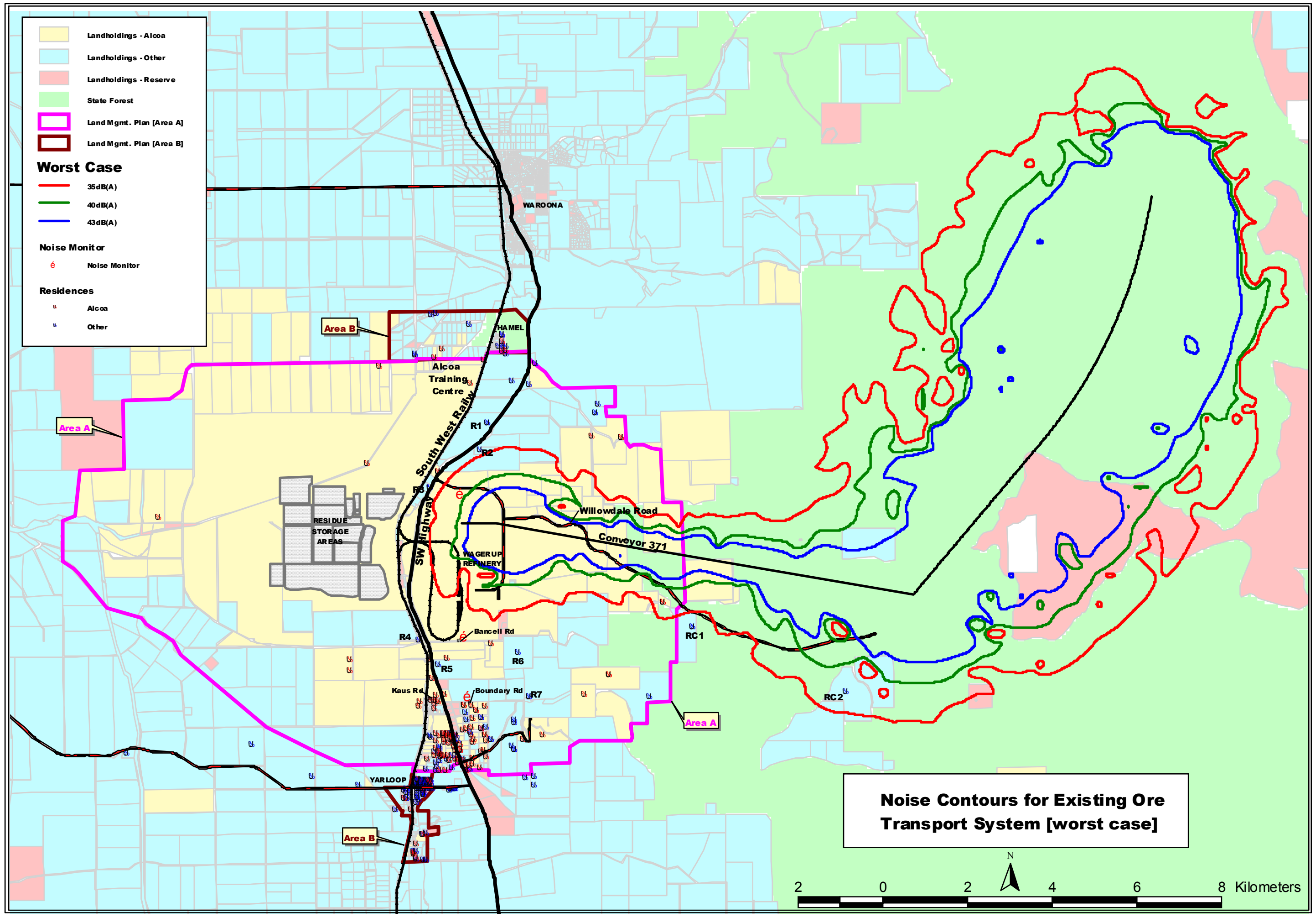


Figure 60: Existing Overland Conveyor Worst Case Modelled Noise Predictions



The effect of the proposed refinery expansion has been specifically reviewed at seven of the closest privately owned residential locations, designated R1 to R7 in SVT report A/04/12/005 (SVT, 2005a). These locations were chosen because of their proximity to the refinery and because the predicted noise levels at these locations will be indicative of the effects of the expansion in the directions where the majority of private residences are located. The overland conveyor expansion model has been used to predict noise levels from the conveyor expansion at two noise sensitive locations to the south of the overland conveyor designated RC1 & RC2 in SVT report A/04/12/005 (SVT, 2005a).

Modelling was initially used by SVT to predict worst-case noise emissions from the expansion scenarios assuming no acoustic controls were implemented. The effect of expanding the refinery and overland conveyor with no acoustic control is shown in Table 27 and Figures 61 and 62.

Table 27: Predicted noise levels at residential locations for expanded refinery and ore transport system assuming no noise mitigation

Location	Existing Noise Level dB(A)	Noise Level after Expansion dB(A)	Noise Impact dB
R1	42.0	45.7	3.7
R2	45.6	49.5	3.9
R3	48.8	53.1	4.3
R4	47.8	51.4	3.6
R5	45.9	49.9	4.0
R6	47.2	50.9	3.7
R7	40.9	45.1	4.2
RC1	32.8	34.2	1.4
RC2	37.3	38.7	1.4

Notes:

1. R1 – R7 represent private residences surrounding the refinery (SVT, 2005a).
2. RC1 - RC2 represent private residences surrounding the overland conveyor (SVT, 2005a).

It can be seen that if the expansion were to be implemented with no acoustic controls, offsite noise levels could increase by over 4 dB(A) (i.e., the noise levels will revert to levels similar to those present before the implementation of the 2000 and 2001 noise reduction program).

Figure 61: Expanded Refinery Worst Case Modelled Predictions without Acoustic Control

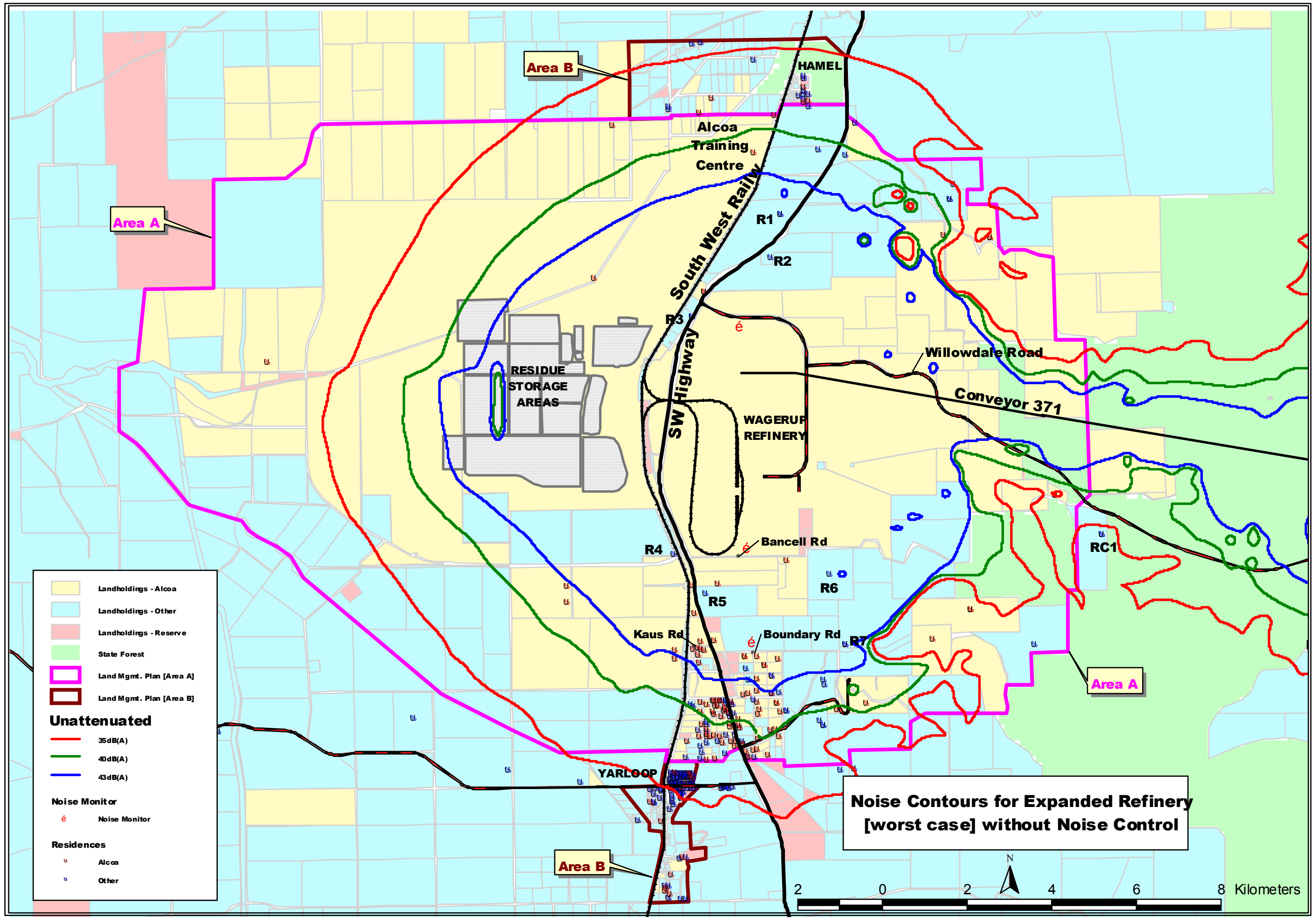
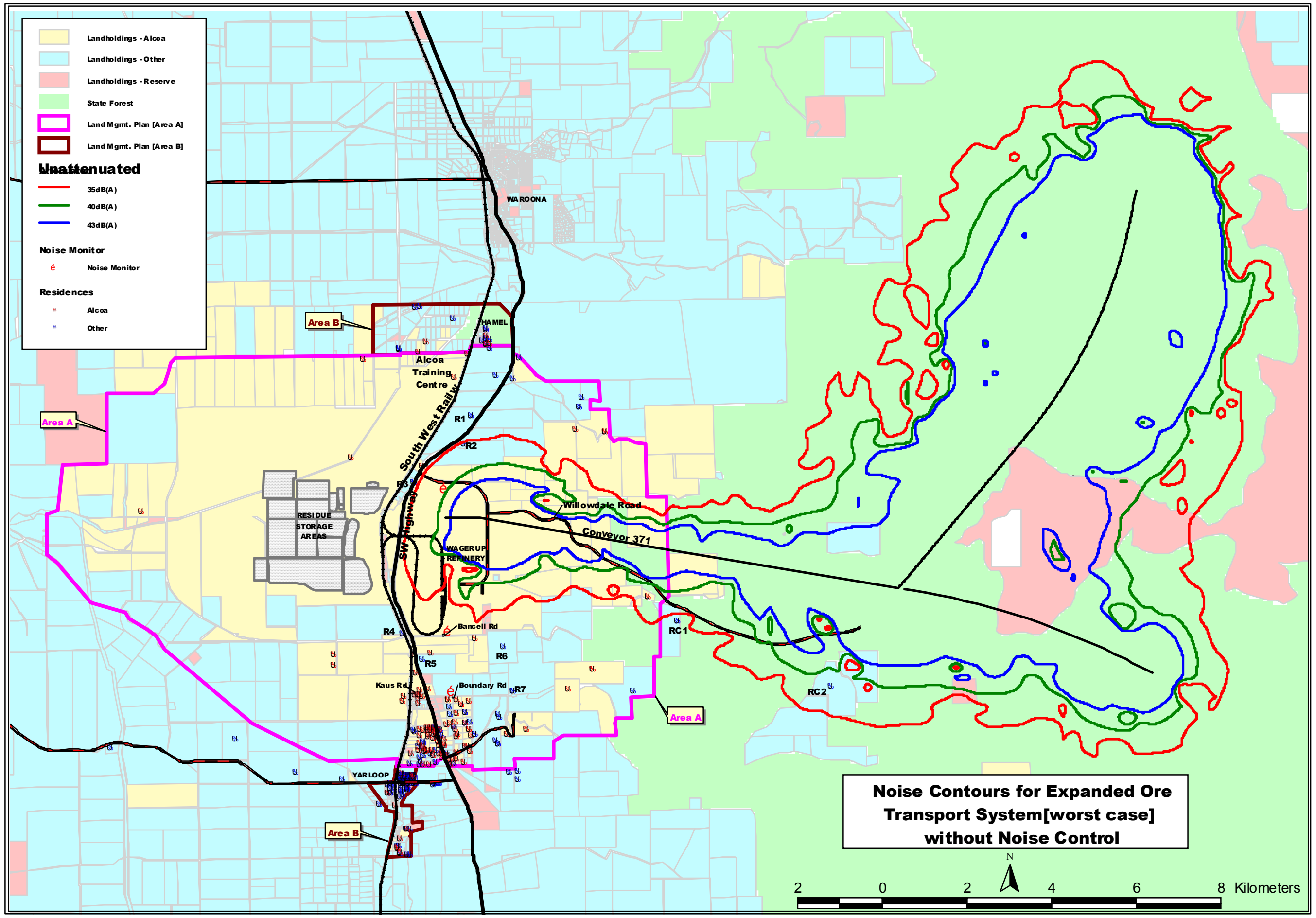


Figure 62: Expanded Overland Conveyor Worst Case Modelled Predictions without Acoustic Control



If Alcoa's noise undertaking is to be met, acoustic controls need to be incorporated into the expansion design to ensure noise levels are adequately controlled.

Modelling the proposed expansion without any acoustic controls provided SVT with a base from which to set the noise emission criteria for significant areas of the refinery and conveying system, and it enabled identification of the project items that significantly contribute to offsite noise levels. Reduced sound power level allocations were then developed for these significant plant areas (SVT, 2005a).

The sound power levels proposed for new equipment were based on SVT's knowledge of available technology and represent a significant reduction when compared to existing equipment.

In order to meet the sound power level allocation it was recognised that it will be necessary to reduce noise from existing sources. It was also evident that the expansion project provides an opportunity to implement noise reductions for some existing plant that would otherwise not be practicable. Reduced sound power level allocations were therefore applied to new and existing equipment within the refinery, where feasible and relevant.

Acoustic controls have been proposed for three major categories of equipment:

Existing Plant: As part of the expansion project, acoustic controls will be applied to some existing plant that would otherwise be unaffected by the expansion. For example installation of silencers on existing powerhouse fans.

Upgraded Plant: Some plant will be upgraded as part of the expansion process. This may provide an opportunity to upgrade acoustic controls at the same time. For example, upgrading of the stockyard conveyors may allow additional acoustic controls to be incorporated.

New Plant: Any new equipment exclusively associated with the proposed expansion will be sourced to meet low noise requirements. Due to technology advances it is possible to source new equipment that is quieter than similar equipment installed previously. For example, installation of lower noise pumps and calcination equipment.

Since the existing and expanded refinery components can't be operated independently, noise emissions from existing, upgraded and new plant will combine to determine the overall noise emission from the expanded refinery at specific receiver locations. The combined effect of acoustic controls applied to existing plant, upgraded plant and new plant is dependent on the relative contribution of each to overall noise emissions from the refinery. The overall effect of the acoustic control opportunities provided by the Proposal at specific receiver locations are detailed in Table 28 and Figures 63 and 64.

Suggestions on the generic and specific controls that could be applied to achieve the reduced sound power allocations are detailed in the Noise Management Strategy document provided as Appendix I (SVT, 2005b). This document was commissioned as an additional tool to aid the detailed design process. It is envisaged that this document will be updated to represent the latest available information throughout the design process. Therefore, the noise control measures to be implemented as part of the Proposal may change during engineering design, however the sound power level approach will ensure the same environmental outcome is achieved.

Table 28: Predicted noise levels for expanded refinery assuming implementation of noise control measures

Location	Existing Noise Level dB(A)	Noise Level after Expansion dB(A)	Noise Impact dB
R1	42.0	41.5	-0.5
R2	45.6	45.6	0
R3	48.8	48.7	-0.1
R4	47.8	48.3	0.5
R5	45.9	46.8	0.9
R6	47.2	46.8	-0.4
R7	40.9	41.5	0.6
RC1	32.8	32.1	-0.7
RC2	37.3	34.8	-2.5

Notes:

1. R1 – R7 represent private residences surrounding the refinery (SVT, 2005a).
2. RC1 and RC2 represent private residences surrounding the overland conveyor (SVT, 2005a).

Table 28 demonstrates that even with noise controls to existing, upgraded and new plant it translates to relatively small overall change at receiving locations as there is no single dominant noise source at the refinery, rather a large number of sources contributing to the noise received at nearby residences (SVT, 2005a).

This modelling confirmed that if the proposed sound power allocation is implemented there would be minimal change to noise levels experienced by neighbours from the Proposal.

Figure 63: Expanded Refinery Worst Case Modelled Predictions with Acoustic Control

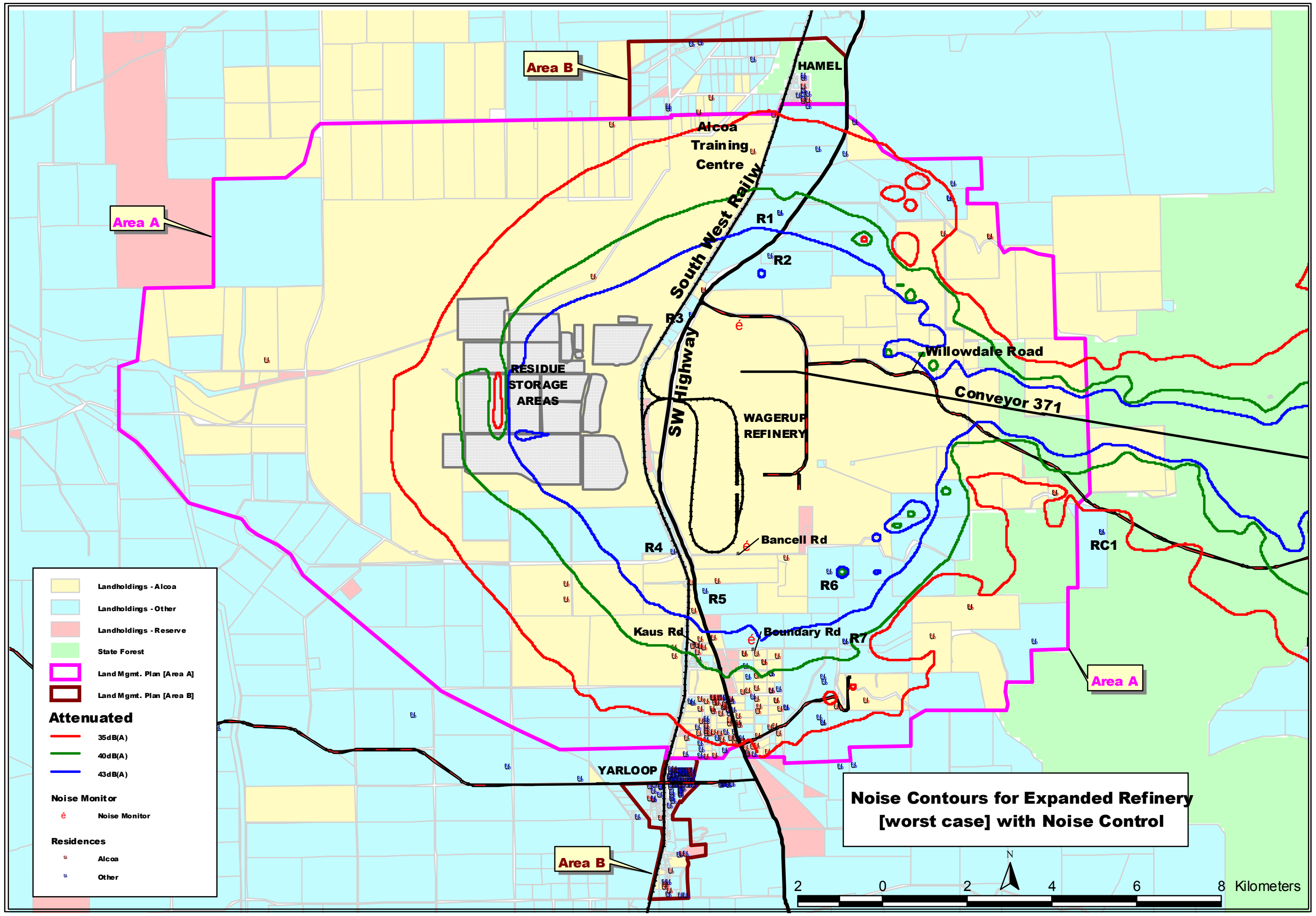
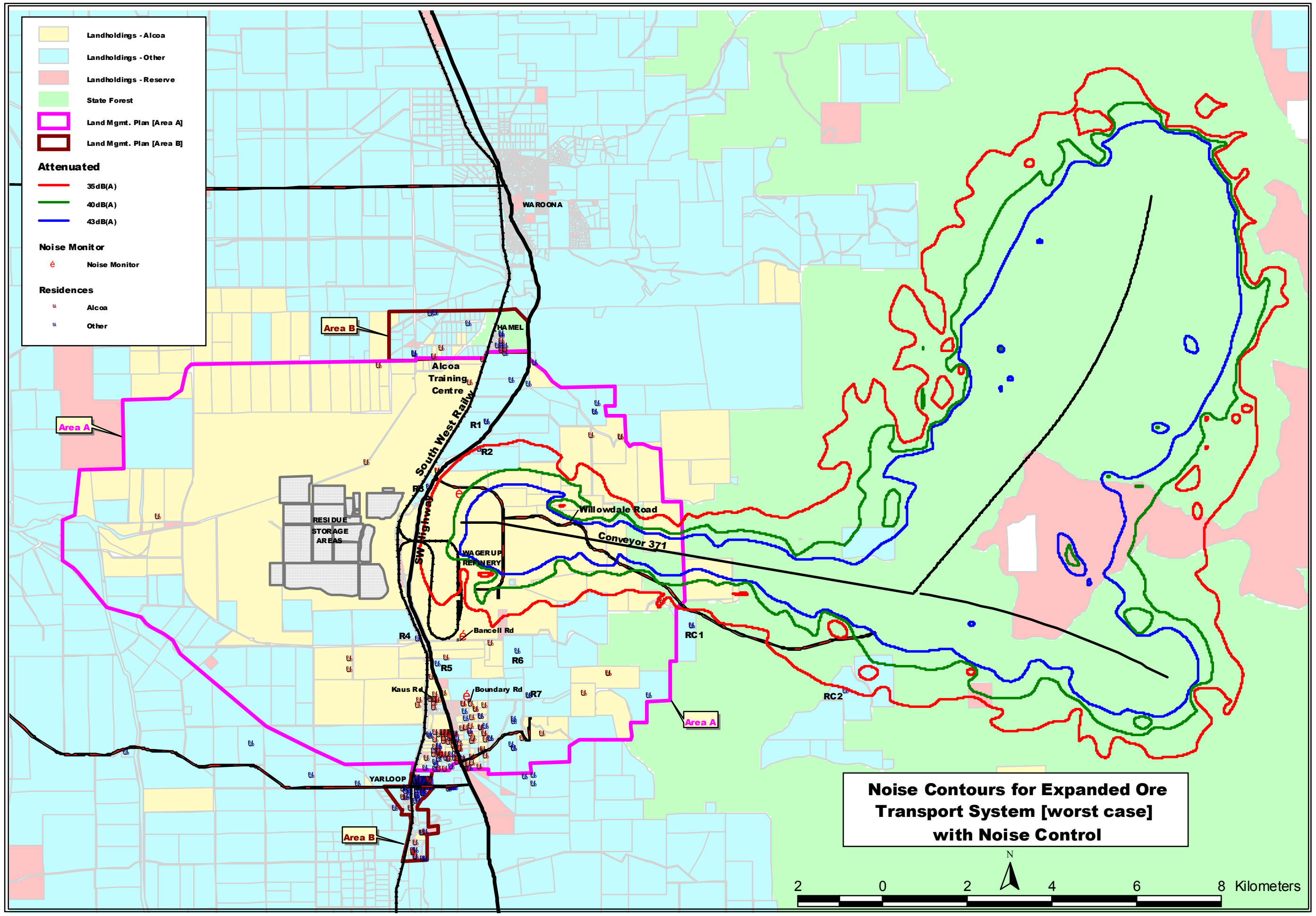


Figure 64: Expanded Overland Conveyor Worst Case Modelled Predictions with Acoustic Control



8.4.3 Compliance of New Plant with Noise Regulations

The expansion proposal involves the installation and operation of new equipment, upgrade of some existing equipment, and the integration of both with existing equipment.

SVT has assessed the compliance of new equipment with the night-time regulatory criteria of 35 dB(A). This was undertaken even though new equipment associated with the Proposal cannot be operated in isolation of existing equipment. This analysis indicated that even with significant noise attenuation, the new equipment would be unable to meet the regulatory criteria in its own right.

The contribution of new plant to overall noise levels at the nearest noise sensitive premises ranges from 34.6 to 42.6 dB(A) (SVT, 2005a). Based on their knowledge of the latest available technology, SVT concluded that it was not practical for new equipment to be installed to meet sound power allocations that would satisfy the 35 dB(A) night time criterion at all affected locations.

SVT highlighted the fact that the benefit of the new plant complying with the 35 dB(A) criteria, were it achievable, would not be realised unless the contribution from existing plant was similarly reduced (SVT 2005a). Investigations into further noise reduction conducted by SVT in 2005 and HSA in 2002 indicate that further overall noise reductions at the Wagerup Refinery are not reasonable or practicable (SVT 2005c, HSA 2002c).

8.4.4 Additional Considerations

SVT and the expert reviewer believe that the proposed sound power level allocations are technically achievable. Preliminary advice from Alcoa's engineering design team indicates that meeting the sound power allocation will require in excess of $50 million to be spent on acoustic control of new, upgraded and existing equipment. These costs do not include ongoing operational and maintenance costs associated with acoustic treatment of existing plant. The proposed acoustic treatment imposes a significant additional cost of over $50 million to the Proposal.

It has been recognised by Alcoa, SVT and the expert reviewer that the acoustic assessment and modelling has been undertaken early in the design phase when specific equipment details have not been finalised. While this is advantageous as it provides a framework for detailed design, it means that the current design information and models do not represent the final 'as-built' situation. The model will need to be reviewed as detailed design progresses to ensure it represents the latest possible information. This requirement has been reflected in the Noise Management Plan (NMP) presented in Section 10.

Alcoa recognises that ongoing model review and update will be required to provide input to the design team, allow the sound power level allocations to be refined, enable equipment sound power level specifications to be incorporated into supply contracts and to help form the basis of future operational noise management strategies at the refinery.

Providing the NMP and associated sound power allocations are implemented, the Proposal should meet the outcome of no increase in noise impacts over the existing refinery.

Commitment 8.

Alcoa will implement the noise management plan provided to ensure that the noise objectives for the Proposal will be met.

Commitment 9.

Alcoa will implement the Proposal such that there is no increase in noise impacts on nearby residents.

8.4.5 Bunbury Port Noise Emissions

The EPA's objective for the Proposal with regards to management of noise from Alcoa's Port facilities is:

- *to comply with statutory requirements.*

The noise emissions from Alcoa's Bunbury Port facility currently comply with the assigned levels in the *Environmental Protection (Noise) Regulations 1997*. Only a small number of noise complaints are lodged with Alcoa and feedback from port neighbours does not indicate that noise emissions from Alcoa's operations are a major concern for them.

Noise emissions from the port facility are measured periodically and modelling has been conducted to determine Alcoa's current contribution to noise levels at neighbouring residences.

The acoustic assessment of the Proposal was undertaken by SVT Engineering Consultants (SVT) and independently reviewed by the Acoustics and Vibration Unit of the University of New South Wales, Australian Defence Force Academy in Canberra. The reviewer provided some suggestions related to information presentation and inclusion of additional information, but generally agreed that the acoustic assessment conducted by SVT had been undertaken in an appropriate manner (refer to Appendix J).

The acoustic assessment involved close liaison with the engineering design team to identify key noise generating features of the Proposal, a review of the most recent noise model (2001 version) and site visits to measure sources that had been modified since the last model update.

Noise modelling was not conducted for the Alcoa port operations because design information identified that the modifications associated with the Proposal would not significantly affect noise emissions. Instead calculations were performed to determine the contribution to noise levels received at neighbouring residences by the modifications. The methodology and assumptions used for the Bunbury Port facility acoustic assessment are detailed in the Noise Management Strategy Report provided as Appendix I (SVT, 2005b).

The critical receiver locations for Alcoa's Port facility are two neighbouring privately owned residences located to the south-west and north-east of the facility. The current noise model predicts worst case noise levels from Alcoa's Bunbury port facility of 35 and 31 dB(A) respectively for these residences.

Since 2001 the only change to equipment operated at Alcoa's Port facility is an upgrade of the ship loader dust collector fan. SVT conducted measurements of this source as part of the proposed expansion acoustic assessment. These measurements indicated that the new fan is approximately 3 dB quieter than the old equipment.

In the 2001 model, the ship loader dust collector fan was identified as the most significant contributor to noise received at the residence to the south-west of the port operation. Therefore SVT concluded that worst-case noise levels have also reduced by approximately 3dB to the south-west of the port.

SVT predicted that following the modification to the dust collector fan, current worst-case noise levels will be 32 dB(A) at the south-western residence and 31 dB (A) at the north-eastern residence.

After reviewing the existing model and the design changes associated with the proposed expansion, SVT concluded that provided low-noise new equipment is selected and the duplicate conveyor is enclosed, the proposed changes to the Alcoa facility should have no noticeable noise impacts at nearby residences (SVT, 2005b).

Commitment 10

Alcoa will ensure that noise from the Bunbury Port Facility continues to comply with the requirements of the <u>Environmental Protection (Noise) Regulations 1997</u> following the implementation of the Proposal.

8.4.6 Expert Review of Noise Assessment studies

A representative of the Acoustics and Vibration Unit, School of Aerospace, Civil & Mechanical Engineering, University of New South Wales at the Australian Defence Force Academy in Canberra, was commissioned to undertake an independent desk-top review of the acoustic assessment conducted by SVT on the Proposal. The objectives of the review were to:

- Comment on the completeness of the information presented;
- Comment on the suitability of the measurements performed for assessing the project impacts;
- Comment on the correctness of the analysis performed on the data presented;
- Comment on the suitability of the methodology used to make predictions;
- Comment on the conclusions reached in the report(s) being reviewed

The results of the expert review are provided in Appendix J (Burgess, 2005 a & b)

Since this was a desk top review, it did not involve an investigation into the accuracy of the model, the detail of the modelling program or a review of measurement data.

A review of the noise monitoring program (both fixed and hand held) and the 2000 version of the noise model developed by HSA, was conducted in 2002 as part of the audit of Alcoa's Regulation 17 application commissioned by DoE. DoE awarded the 2002 audit contract to SVT (SVT, 2002).

As a result of the 2002 audit, SVT concluded that Alcoa's noise monitoring network is a comprehensive system, employs up to date technology, is well conceived and is capable of accurately measuring sound levels (SVT, 2002).

SVT made several recommendations relating to the 2000 version of the Refinery acoustic model. SVT concluded that the accuracy of this version of the model for predicting overall A-weighted sound pressure levels is likely to be of the order of +/- 5 dB(A) over the entire area covered by the model and they concurred with HSA's estimated accuracy of +/- 3 dB(A) for worst-case propagation conditions at locations selected for calibration (SVT, 2002).

The acoustic model has been updated since this audit to take into account the recommendations made by SVT. The December 2004 version of the model, which was used to develop the expansion model, includes the most recent sound power level information for refinery sources. The model has been re-calibrated and the contours have been extended to the north and east of the refinery.

Given the focus and outcomes of the 2002 audit commissioned by the DoE, the expert review of restricted to the acoustic assessment conducted for the Proposal.

Summary of Expert Review

The expert reviewer acknowledged that there are difficulties conducting and reviewing an acoustic assessment performed during the preliminary design phase. Ongoing modelling and acoustic review will be required throughout the detailed design phase.

The reviewer concluded that that:

- The refinery noise model appears to be appropriate and the summary of the validation of the model appears to support this
- Noise contours indicate that compliance with the sound power allocation table should lead to noise levels in the area surrounding the refinery and overland conveyor after the expansion being similar to those existing before the expansion, and
- The Bunbury Port facility components of the Proposal should not have an adverse impact on the surrounding area.

The reviewer concluded that the approach taken by SVT during the preliminary design phase appears to be correct and that "overall it would appear that the noise assessment, the determination of sound power allocations and the nature of the mitigation measures has been undertaken in a careful and appropriate manner".

8.4.7 Rail Noise

Noise from train pass-bys was raised as an issue through the Noise and Transport working group and also in discussions with the Department of Environment. Although the issue is outside the scope of this ERMP and all rail noise is exempt from the *Environmental Protection (Noise) Regulations 1997*, Alcoa recognised the issue is of importance to some community members.

Alcoa undertook to monitor typical train pass-bys to provide information on current noise impact of trains travelling along the South West Main line between the Bunbury Port and the Wagerup Refinery. Table 29 provides a summary of hand held measurement data recorded during train pass-by's during a 24 hour study conducted in November 2004.

Table 29: Sound Pressure Level Data for Trains on Line between Wagerup and Bunbury

Data collected by Herring Storer Acoustics on 22 & 23 November 2004								
All Sound Pressure Levels are 15 m from train line								
Locomotive	**Wagon Type**	**Load Status**	**Direction**	**Wagons**	**Notch Setting**	**L_{aeq} (2 min)**	**Train L_{Amax}**	**Horn L_{Amax}**
S-Class	Alumina	Unloaded	North	38	0	**69.8**	**79.6**	**79.4**
S-Class	Alumina	Unloaded	North	38	3	**82**	**88**	**100.6**
S-Class	Alumina	Unloaded	North	38	0	**86.9**	**89**	**89.5**
S-Class	Alumina	Unloaded	North	34	0	**72.1**	**76.2**	**76.1**
S-Class	Alumina	Loaded	South	38	8	**68.7**	**74.7**	**79.3**
S-Class	Alumina	Loaded	South	38	0	**68.5**	**72.5**	**89.2**
S-Class	Alumina	Loaded	South	38	8	**77.9**	**86.1**	**86.4**
S-Class	Alumina	Loaded	South	34	6	**73.3**	**82.2**	**82.7**
DB-Class	Caustic	Unloaded	South	20	4	**73.3**	**77.2**	**88**
DB-Class	Caustic	Loaded	North	20	8	**75.4**	**85.3**	**87**
Australind	-	-	North	-	-	**83.7**	**89.7**	**88.9**
S-Class & DB-Class	Coal/Lime	Loaded	South	41	0	**78.8**	**86.7**	**88.1**
S-Class	Coal	Loaded	North	29	8	**73.8**	**76**	**-**
2300 Series	Goods	Loaded	North	10	1	**70.3**	**74.7**	**79.9**
Crossing Measurements								
Locomotive	**Wagon Type**	**Load Status**	**Direction**	**Wagons**	**Notch Setting**	**L_{aeq} (2 min)**	**Train L_{Amax}**	**Horn L_{Amax}**
S-Class	Alumina	Unloaded	North	38	0	**83**	**-**	**3**
S-Class	Alumina	Unloaded	North	38	-	**81.1**	**86.9**	**3**
S-Class	Alumina	Loaded	South	34	6	**80.4**	**82.7**	**2**
S-Class	Coal	Loaded	North	29	8	**76.7**	**86.3**	1
Locomotives @Idle (15 m)								
Locomotive	Laeq (2 min)							
S-Class	68.2							
DB-Class	72.3							
Prepared for noise and transport working group meeting 24 Nov 2004								
L_{Amax} – maximum noise level of event L_{Aeq} – continuous equivalent level over the full time event								

The summary data shows that L_{Amax} values of trains measured during the study ranged from 72.5 dB(A) for a loaded 38 wagon alumina train to 89.7 dB(A) for the 'Australind' passenger train. The L_{Aeq} values ranged from 68.5 dB(A) for a loaded 38 wagon alumina train to 86.9 dB(A) for an unloaded 38 wagon alumina train. The summary data suggests that unloaded alumina wagons have a slightly higher L_{Amax} than loaded alumina wagons and that the noise level of trains related to the Alcoa operations are relatively similar to the noise levels of Non-Alcoa trains using the rail line.

8.5 WATER SUPPLY

The EPA's objective regarding water supply for the Proposal is to:

- *maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*

Alcoa commissioned two studies to investigate the potential impacts of the Proposal on surface water supplies. Options for water supply were investigated and the ecological water requirements (EWRs) and water availability in the lower Harvey River catchment considered (Appendix A).

As a result of the investigations and Water and Residue Working Group input, the preferred future water supply options identified were:

- to increase abstraction from the Harvey River Main Drain;
- to transfer part of Alcoa Farmlands Irrigation Water Entitlement to the water requirements for the refinery.
- to invest in upgrades of the existing irrigation systems and use the water savings from this upgrade; and
- to harvest winter surface flow from other agricultural drains to supplement the Harvey Drain source.

These options are discussed in detail in Appendix A. For the Proposal, Alcoa will continue to evaluate both the option to increase abstraction from the Harvey River Main Drain and the possibility of realising additional water through efficiency increases within the irrigation district. The potential issues and management measures associated with increased abstraction from Harvey Main Drain are discussed below.

A surface water supply management plan has been developed which provides more detail on the management of surface waters associated with the Proposal (refer to section 10).

8.5.1 Additional Surface Water Abstraction from the Harvey River Main Drain

Potential Issues

Based on historical stream flow data CENRM (2005) estimated about 75.2 GLpa flow passed the Logue Brook confluence, suggesting there is approximately 28 GLpa available in winter at the proposed Harvey Main Drain abstraction point after allowing for environmental flows (CENRM, 2005).

The water requirement for the Proposal is expected to be an additional 1.1 GLpa under average rainfall and runoff conditions (see Table 5; Section 5.3.3) and potentially up to 4.8 GLpa under drought conditions (see Table 6; Section 5.3.3). These requirements are well within the additional 28 GL identified as available from the Harvey River Main Drain pumpback station (CENRM 2005).

The estimates of available water provided by CENRM are based on the assumption that for multiple-use non-pristine rivers and streams at least one-third of natural flows are required to maintain ecological water requirements (EWRs). However, this needs to be calculated on a seasonal basis to ensure that over-allocation of surface water does not occur during seasonal low-flows. The one third estimate is the general 'rule of thumb' used when no formal EWR assessment has been conducted, and has been applied to the lower Harvey catchment.

It is recognised that the constructed nature of the Harvey River Main Drain means that in-site ecological value is low. Therefore, calculation of EWRs are based mainly on the need to maintain upstream connection for migratory fish and downstream flows of detritus (from the forested upper reaches) to subsidise downstream food webs (CENRM, 2005).

Proposed Management

A gauging station has been installed on the Harvey River Main Drain immediately downstream of the abstraction point in preparation for monitoring winter flows in 2005. This will allow accurate assessment of the potential yield from this source. The data obtained from such monitoring prior to, and during the construction of the Proposal (a period of several years) would allow the yield of the current pumping system to be confirmed, including consideration of EWRs. The amount of water available for use by the Proposal will therefore depend on this flow data and an ecological assessment of the Harvey Main Drain below the abstraction point, however preliminary estimates indicate sufficient water is available for the Proposal.

Alcoa will undertake an assessment of the ecological value of the Harvey River Main Drain downstream of the abstraction point prior to commissioning of the Proposal, if approved. The requirements of the ecological study for the drain will be determined through discussion with the Department of Environment.

Water supplies for the Proposal will be managed in accordance with the Water Supply Management Plan presented in section 10. The Water Supply Management Plan is based on current licence requirements and will be updated to reflect any changes to the surface water abstraction licence.

Commitment 11

Alcoa will implement the Water Supply Management Plan to manage additional water requirements for the Proposal.

8.5.2 Surface Water Supply from Irrigation Water Efficiency Upgrades

Potential Issues

Access to irrigation water through improving irrigation efficiencies of the Harvey Water Irrigation System is a potential water supply source. Much of the Harvey Water Irrigation System was constructed more than 60 years ago, and is considered inefficient by modern standards resulting in high losses from evaporation and seepage. Overall irrigation efficiency has been estimated at around 50% (ENVIRON, 2005).

Harvey Water Cooperative has commenced a programme of irrigation infrastructure improvements and is promoting more efficient on-farm irrigation practices in conjunction with the Western Australian Department of Agriculture. As a result of distribution system improvements already completed in the Harvey and Waroona irrigation districts, Harvey Water believes that more than 6 GL has been saved at a cost of around $2 million to $3 million per GL (Harvey Water *pers. comm.*). It is believed that water gained through infrastructure efficiency improvements should be available to trade for non-agricultural use with the income used to fund further improvements to the irrigation system. (ENVIRON 2005).

An option Alcoa is therefore considering is investing in water distribution improvements with the view to securing the water savings for industrial use, and benefiting the local farming community through improved irrigation practices.

8.5.3 Water Conservation Initiatives

The Wagerup refinery was designed to recycle process and runoff water in recognition of the climate, fresh water availability and environmental factors associated with effluent discharge. This means that opportunities to reduce water consumption without major process and equipment modifications are limited.

Alcoa developed a Water Conservation strategy in 2001 in recognition of the growing concerns about water in the community (Alcoa, 2001). This strategy was shared with external stakeholders including key Government personnel and community consultative networks. While recognising that opportunities to reduce total water consumption are limited for the existing refinery without major process and equipment modification (due to current water recycling and runoff capture practices), the strategy calls for a reduction in the use of high quality (potable) water supplies in competition with other users. Initiatives such as the Harvey River Main Drain Pumpback at Wagerup are considered to be consistent with this strategy.

Water conservation options considered as part of the Proposal are presented in Appendix A (ENVIRON, 2005).

Commitment 12

Alcoa will continue to implement water saving measures into plant modifications and expansions where practicable and feasible, in line with sustainability principles and cleaner production goals.

8.6 SURFACE WATER QUALITY

The EPA's objectives with regards to surface water quality for the Proposal are to:

- *retain the integrity, functions and environmental values of protected wetlands, and to ensure that the EPP lakes are protected and their key ecological functions are maintained; and*
- *maintain the integrity, functions and environmental values of rivers and ephemeral streams, and to ensure that alterations to surface drainage do not adversely impact native vegetation.*

8.6.1 Refinery Surface Water Management

Potential Issues

Alcoa uses risk assessment methodology to determine the main potential surface water pollution sources. These are reviewed during the annual review of the Operating Centres Impacts and Aspects Register as part of the EMS. The main potential sources of pollution have been identified as:

- process spills (sand, silt, high alkalinity water, hot condensate and acid);
- caustic contamination of condensate stored in the Lower Yalup Dam;
- caustic, alumina and hydrocarbon spills from railway loading and unloading facilities;
- silt runoff from bauxite stockpiles;
- paint, rust and sand particles from sandblasting in old laydown area; and
- hydrocarbons from oil, petrol and diesel from vehicles parked in car parks.

For the existing refinery, management systems are in place to capture all stormwater runoff and process spill water that is not contained within bunds. This water is contained and drained by the stormwater drainage system to the stormwater surge pond and into the cooling water pond or run off water storage (ROWS) pond in the residue area. Water from the ROWS pond and cooling pond is used in the refinery and residue area.

Stormwater runoff from the bauxite stockpile area drains to the Lower Yalup Dam, which also contains condensate from the refinery process. The electrical conductivity (EC) of water in this dam is controlled to less than 200 µS/cm and re-used around the refinery for cooling tower make-up water, washing the catalyst from the liquor burning plant, and mill flushing.

The storm sewer and surge pond for the refinery have been designed for a 1:100 year storm. The design surge capacity of the Storm Pond is 53 ML, with pipelines taking water to the ROWS and cooling pond. Should this system not cope with a rainfall event an additional 10 ML is available within the unsealed overflow pond. Existing surface drainage down gradient of the refinery area is intercepted by the Diversion Drain and a recovery system is in place. Therefore the risk of contaminated water leaving the property is considered low and manageable. The stormwater surge pond is surveyed occasionally to check capacity and remove silt build up, if required.

No wetlands identified in the Draft Wetlands EPP 2004 will be directly impacted by the Proposal (Section 7.5.1).

The nearest streams are North Yalup Brook to the north of the refinery and Lower Yalup Brook to the west, which both flow into the Diversion Drain (Figure 13) and Bancell Brook to the south of the refinery. Downstream of the refinery these streams become agricultural drains which have little native riparian vegetation and low environmental values due to their disturbed nature. Areas downstream of the refinery are mostly cleared for agricultural purposes. The risk of adversely affecting the environmental values of protected wetlands and rivers, streams or vegetation downstream of the refinery is considered low, since all surface water runoff and discharges are retained on-site for use in the refinery or residue area. The risk of seepage to groundwater coming to the surface is addressed in Section 8.7.

Implementation of the Proposal will mean an increase in the volumes of process chemicals, materials and liquors in the refinery system, and an increase in the requirement for containment vessels and pipework, thereby increasing the potential risk of surface water contamination off-site. The Proposal will occur within the existing boundary of the refinery stormwater collection systems and therefore the potential impact on surface waters is considered minimal.

Proposed Management

Any new capital project proposed by Alcoa is required to be internally assessed via a comprehensive set of management tools and designed in accordance with appropriate design principles. The design and capacity of the existing stormwater management system at the Wagerup refinery will be reviewed as part of detailed engineering design to ensure the Proposal can be accommodated. The Proposal has been designed in accordance with the following principles for the prevention of pollution of surface waters:

- Release of contaminated liquor outside the controlled refinery environment is not acceptable;
- Stormwater drainage systems are for collection of stormwater runoff, not process water;
- Primary and secondary containment systems are to be designed to eliminate the potential for uncontrolled spillage to the environment (e.g., through process controls, bunds, sumps, and pumps sized appropriately in accordance with the risk assessment results);
- Installation of any process fluid pipelines are to be above ground for quick detection of leaks and to facilitate inspection and maintenance during service life;
- Drain down pipes, valves and future maintenance are to be contained within the confines of the steel containment system;
- Steel lined drains, pipes or sumps are to be used to carry aggressive fluids (the release of hot caustic, acid or other aggressive fluids directly onto concrete surface is not acceptable); and
- Drain down fluids are to be directed to collection sumps within steel lined drains or pipes, not across unprotected concrete aprons or floor slab.

Monitoring of surface water around the refinery is undertaken to meet the requirements of the Department of Environment licence, the Surface Water licences, and is also used as a tool to detect leakage of process materials. The water monitoring programme is designed to provide the necessary information to make the most appropriate decisions regarding water quality management.

A Spill Management Plan (SMP) has been developed for the Proposal to manage the impacts from potential spills associate with the refinery Proposal. The SMP forms part of this ERMP and is presented in section 10.

8.6.2 Residue Area Surface Water Management

Potential Issues

The residue area has a 100% surface water containment policy. Surface water runoff and underdrainage is collected in either of the two Runoff Collection Ponds (ROCPs) and pumped from these to the ROWS or Cooling Pond.

The ROCPs have a typical total design capacity of around 150 ML to 200 ML. The ROWS pond is used to accommodate the surges in total water storage capacity (i.e., cooling lake, mud lake, sand lake, RDA2 and all dry disposal runoff ponds) as the evaporation and rainfall vary throughout the year. In winter, water from the detention pond is pumped to the ROWS pond for storage to be recovered in summer.

Under normal rainfall conditions water collected on the surface of the residue area is allowed to drain freely to the stormwater drainage via the decant. Under severe storm conditions water may need to be retained in the residue drying areas by closing the decant weirs. This prevents an unmanageable amount of water reporting to the ROCPs. Operational guidelines stipulate that storm surge capacity must be maintained on the residue area to capture 100% of any storm event, based on a 1:100 year 72 hour storm and a 12 to 13 day recovery period.

The main potential sources of pollution at the existing residue area are alkaline leachate (with some high levels of metals) from the residue deposited and liquor sent to the Cooling Pond; oxalate, scale and inert waste from the landfill facility at the residue area; and hydrocarbons from areas where waste oils have been used for dust suppression.

The Proposal will result in an increase in the bauxite residue deposition rate and an expansion of the active drying area. There will therefore be greater volumes of residue and liquor reporting to the residue area and cooling pond respectively and a greater area of surface water runoff from the drying areas that will need to be contained within the stormwater drainage system.

Proposed Management

The existing stormwater management system at Wagerup was designed to accommodate the additional run-off from the Proposal. The new equipment for the Proposal is all within the existing footprint of the refinery and therefore no new large areas of hardstand require containment. The stormwater management system is reviewed on annual basis as part of the Operating Centres Impacts and Aspects Register in accordance with the EMS.

Surface water and stormwater management during the operation of the Proposal will continue to be undertaken in accordance with the relevant procedures as outlined in the EMS.

8.7 GROUNDWATER QUALITY

The EPA's objective with regards to groundwater quality for the Proposal is to:

- *maintain the quality of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.*

Potential Issues

Alcoa maintains an extensive groundwater monitoring network of some 420 monitoring bores. A groundwater plume has been detected below the northern part of the refinery and in the vicinity of Building 45 (Precipitation), west of the caustic unloading facility and the former hydrate stockpile pads. This plume is largely within the superficial aquifer and influenced by the seasonal variation in the groundwater table, although it is having a very low level impact on the underlying Cattamarra Coal measures formation. Plumes extend up to 500 metres west of the refinery buildings and have impacted surface waters northwest of the former hydrate stockpile, which was removed in 2000.

In the past, minor cracks in building slabs have enabled alkaline process liquors to seep into the underlying ground. Chemical reactions have resulted in expansion of the ground and heaving has exacerbated minor cracks, creating a contaminant pathway. Alcoa is investigating appropriate remediation of this groundwater contamination. The decision to install an alkali recovery system, or to continue monitoring as plumes dissipate will depend on ability to recover the plume and will be made in consultation with the DoE. (Section 7.6.1).

Minor seepage of residue leachate has been recorded in bores around the residue area, indicated by elevated alkalinity in the groundwater. Recent monitoring showed some low or moderate levels of contamination in parts of the upper superficial formations (Parsons Brinckerhoff/Neild Consulting, 2004). Groundwater contamination is most significant beneath RDAs 1 and 2 and there is low level impact on surface waters in farm drains a few metres west of ROCP1 and RDA4 (Figure 16).

The cooling pond, runoff water storage pond (ROWS pond) and runoff collection pond 2 (ROCP2) adjacent to the residue area incorporate basal clay-geomembrane liners. The elevations of the liners are lower than normal maximum groundwater levels. Alcoa therefore operates groundwater depressurising systems around these ponds to maintain safe groundwater levels and prevent upward pressure on the liners. Without the depressurising systems, mounding and rupture of the liners may occur when groundwater levels exceed pond water levels.

Groundwater abstraction by Wagerup's groundwater depressurising systems is carried out under Groundwater Well Licence 102669, issued by the Water and Rivers Commission on 28 May 2001. There are plans to assess the need for any remediation of groundwater at the Wagerup residue area.

Implementation of Proposal will result in an increase in the volumes of process chemicals, materials and liquors in the refinery system, and residue deposited in the residue area. It will also require additional containment vessels and pipework, thereby increasing the risk of leaks and spills. Any spilt material, leaks or releases from the refinery and residue area that are not contained have the potential to percolate into the ground and contaminate the underlying groundwater.

Proposed Management

Alcoa is in the process of implementing a Groundwater Remediation Plan to address existing groundwater contamination issues. At the Wagerup refinery the remediation plan will initially focus on recovery of contaminated groundwater from beneath process buildings in 2005 and planning remediation at ROCP1 in conjunction with construction of new RDA's. Investigations to assess the need for remediation of the plume emanating from beneath the now decommissioned hydrate stockpile, will continue in 2005 and remediation of these areas undertaken, if required. Further investigation into possible groundwater contamination present beneath old landfills at the RDA and the middle process buildings will be undertaken in the coming 5 years.

Planned management of contaminant plumes beneath the refinery involve:

- recovery of contaminated groundwater from beneath process buildings where significant amounts of alkaline contamination are present
- installation of monitor bores near buildings and facilities where contaminant recovery is being carried out to measure contaminant loading;
- determining the extent of plumes west of the refinery, and
- identifying surface and groundwater being (or likely to be) impacted by plumes.

Measures implemented for the protection of surface waters (refer Section 8.6) will also minimise the risk of groundwater contamination. Measures to be incorporated into the design of the Proposal include:

- primary and secondary containment systems of process materials
- above ground installation of any process fluid pipelines for quick detection of leaks and to facilitate inspection and maintenance during service life, and
- providing steel containment systems for drain down pipes and valves, and steel lined drains, pipes or sumps used to carry hot, caustic or acidic fluids.

A Spill Management Plan has been developed for the Proposal incorporating measures that are in place (refer to section 10), to minimise the risk of future groundwater contamination as a result of spills (see Section 8.6.1).

Whilst the older RDAs at Wagerup are lined with 0.5 metre of re-compacted clay and overlain by a basal drainage layer, these are not 100% impermeable and some seepage is possible. The newest areas constructed (RDA 6 onwards) incorporate a geomembrane as part of a composite liner. 'Dry stacking' of residue commenced in 1991 (see Section 4.2) and significantly reduces the moisture content in the residue. In combination with the latest composite liner design, the risk of leachate seepage into the underlying groundwater is significantly reduced.

During construction and operation of the Proposal, groundwater monitoring will continue in accordance with the WA Operations Groundwater Monitoring Manual (Doc. Number 53409) and the network of monitoring bores expanded as required. The current groundwater monitoring strategy at Wagerup is summarised as follows:

Type of release	**Monitoring**
1. Seepage and continuous slow release	• Aquifers are monitored for long-term effects of seepage contamination. Monitoring occurs for parameters that can be used to quantify alkaline contamination and gauge any trends. Monitoring occurs at a frequency dictated by the groundwater movement rates and the risk posed to sensitive receptors. • General Chemical analysis[1] is typically measured at longer frequencies, such as 6 monthly as groundwater movements are typically very slow. • Comprehensive chemical analysis[2] is typically carried out to support the main data set collected. Data are collected upstream and downstream from anticipated sources.
2. Groundwater movement	• Horizontal movement and vertical movement are critical operational measurements. Tracking of horizontal movement allows plumes and impacts on prospective receptors to be measured. Vertical movement allows groundwater head pressure measurements to be assessed and also allows analysis of drawdown effects on aquifers. • Static Water Level measurements are used to estimate groundwater movements. The measurements are typically taken at high frequencies (e.g. up to twice a week) depending on the level of risk of an event.
3. Hydrocarbons	• Free phase hydrocarbons are tested semi-quantitatively around oil storage facilities and the residue area once a year

Notes:

1. General analysis (e.g. EC, pH, alkalinity, sodium and chloride concentration)
2. Comprehensive chemical analysis (e.g. major cations, anions, trace elements, EC, pH, alkalinity, TDS, dissolved organic carbon, ammonia, total Kjeldahl nitrogen)

The groundwater monitoring programme has been based on the following guidelines and standards:

Monitoring and Sampling

- AS/NZS 5667 Series: Water Quality 1998, in particular Part 11: Guidance on Sampling of Groundwaters;
- ANZECC - Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Part 4 (2001);
- ANZECC - Australian Guidelines for Water Quality Monitoring and Reporting - Part 7 (2001)
- Water Resource Council Guidelines (AWRC) – 1991;
- National Environmental Protection Measure (NEPC) - Groundwater Sampling Guidelines 1999;
- Western Australian Department of Environmental Protection Water Quality Guidelines 2001;
- ARMC of Australia and New Zealand Minimum Construction Requirements for Water Bores in Australia (1997);
- Victorian EPA Guidelines on Groundwater Sampling (2000);
- Murray-Darling Basin Commission (MDBC) Groundwater Quality Sampling Guidelines; and
- US EPA Standard Operating Procedures for groundwater sampling.

Analysis

- APHA-AWWA-WEF - Standard Methods for the Examination of Water and Wastewater, 20th Edition, (1998);
- NATA - General Requirements for Registration (1992);
- NATA - Supplementary Requirements for Registration (1993);
- NATA - Assessment of Uncertainties of Measurement for Calibration and Testing Laboratories (1999);
- NH&MRC - Australian Drinking Water Guidelines (1996);
- ISO 9696 Water Quality - measurement of gross alpha activity in non-saline water, thick source method (1992); and
- ISO 9697 Water Quality - measurement of gross beta activity in non-saline water (1992).

8.8 TRAFFIC AND TRANSPORT

The EPA's objectives for the Proposal regarding traffic and transport are to:

- *ensure that roads are maintained and road traffic managed to meet an adequate standard of level of service and safety;*
- *ensure that transportation and storage of fuels/chemicals complies with the Australian Dangerous Goods Code; and*
- *ensure the requirements of Main Roads Western Australia are met.*

Changes to Road Freight Movements

Implementation of the Proposal will result in an increase of road freight vehicles to a total of around 280 vehicles per week (one-way) as outlined below in Table 30.

Table 30: Estimated Change to Road Freight Movements to Wagerup refinery

	Current transport requirements	Proposal Transport requirements
Lime trucks	7 daily	11 daily
Tray trucks	5 daily	9 daily
Semi-trailers	1 daily	2 daily
Couriers	3 daily	5 daily
Weekly deliveries	9	13
Mining	46 weekly	78 weekly
Total weekly (one-way)	167	280
Total weekly (two-way)	334	560

The road freight movements associated with the Proposal represents approximately 12% of all freight movements, or 1.5% of all vehicle movements on South Western Highway in this locality. This is based on Main Roads daily class data giving an average of 36,000 vehicle movements and 4680 freight movements (class 3 to 12) per week on South West Highway.

Construction Vehicles and Workforce

During the construction phase of the Proposal it is anticipated that the workforce at Wagerup refinery will temporarily increase to over 1500 employees, during the peak construction period. There is therefore on average the potential for an estimated 400 additional passenger vehicles travelling to and from the refinery on a daily basis during construction. During the peak construction period this number could increase to a maximum of approximately 1000 additional vehicles travelling to and from the refinery.

The construction of the Proposal is likely to result in an additional 12 to 15 small to medium trucks per day during the busy periods of the construction phase. The construction phase will also require the transport of large loads into the refinery that will cause occasional periods of heavy traffic.

Alcoa's Transport coordinator will maintain liaison with the relevant local authorities on the management of potentially significant road transport issues (see below).

Changes to Rail Freight Movements

The increase in rail movements associated with transportation of alumina and caustic on the South West main line between Pinjarra/ Wagerup and Bunbury is summarised in Table 31. The following movements are based on the latest information available from the rail operator with respect to rail capacity and scheduling and should be taken as indicative only.

Table 31: Average increase in Train Movements per day – one-way

	Wagerup Trains	**Pinjarra Trains**	**Total**
Alumina[1]	3 to 5	4	7 to 9
Caustic[2]	1 to 2	Separate fleet from Kwinana	1 to 2
Total[3]	**4 to 7**	**4**	**8 to 11**

Note:

1 - On occasion there may be four Wagerup and five Pinjarra alumina trains.

2 - Sometimes two caustic trains are required

3 – The total number of trains may vary depending on the number of wagons per train.

Potential Issues

Increases in the number of vehicles on the road as a result of the Proposal has the potential to increase traffic congestion, risk of accidents along the main transport routes, and road wear. This is likely to be most noticeable on the South West Highway. Increases in traffic are likely to be most noticeable during the construction phase, with a notable increase in the number of workers travelling to and from site each day, and construction vehicles. Alcoa is aware of the potential risks this poses and will develop a specific road transport strategy for the Proposal.

The main potential for impact from increased rail movements is more frequent noise impact on residents and communities located close to the railway and near the port facility. Level crossing times will increase slightly due to the longer train configuration, and road crossings will be interrupted more frequently due to the increased number of trains.

Proposed Management

Alcoa has its own transport department and works with relevant State Government agencies, such as the Main Roads Department, to carefully monitor road freight movements and ensure that high safety standards are maintained when transporting freight.

A transport coordinator will be nominated for the Proposal, whose role will be to evaluate transport routes both on and off the Wagerup refinery site and to ensure that equipment is delivered to Wagerup in a manner that meets all legislative and Alcoa standards. The transport coordinator will prepare the traffic management plan for the Proposal, which will include monitoring traffic entering the refinery via the main access road before, during and after construction. The transport coordinator will also ensure delivery time restrictions are implemented for the delivery of goods to the Wagerup refinery during construction. This will ensure that peak times on the road are avoided and notification is given to the local Police and local Shires before heavy loads pass through the townsites.

Current delivery time restrictions imposed by Main Roads are:

- oversize loads are restricted to daylight hours
- oversize loads from the Kwinana area can travel at any time between sunrise to sun down, and
- oversize loads from Fremantle, Henderson or Perth areas can only travel after sunrise, but not between 7:30am to 9:00am or 4:30pm to 6:00pm on weekdays only.

Alcoa will consult with the Shire authorities and the local community about traffic movement management and the traffic management plan which will be implemented to minimise disruption to the local community.

Large vehicle movement routes to and from the Wagerup refinery are determined by the Main Roads Department and follow designated (>24 tonne) heavy load routes. For the Proposal it is anticipated that some heavy loads will come through the Waroona townsite during the construction phase given the South Western Highway is the approved route. However, it is expected that the frequency of these large trucks will be low. Where practical and appropriate, Alcoa will divert freight movements to avoid the Waroona and Yarloop townsites.

There will be times during construction where larger volumes of materials will be required, such as concrete. Traffic, truck availability, time of day, weather, concrete pump capacity and availability will be considered when making decisions on when these concrete pours will commence and complete.

Potentially significant aspects of traffic management for the Proposal will involve consultation through the Community Consultative Network or similar existing community consultation forums, the local Shires and the local police. Alcoa will also communicate these large traffic movements through communicated advice to the communities in the Shires of Harvey, Waroona, Murray and City of Mandurah.

Whilst detailed traffic planning for the Proposal is yet to commence, Alcoa will consider the following measures to address the impacts on road safety due to the increase in number of passenger vehicles during the construction period:

- investigation into the viability of buses to pick up construction personnel from key points locally and in Mandurah and Bunbury ;
- encouraging car-pooling;
- staggering the construction shifts from operations shifts; and
- safety briefings which will include traffic issues and enforcement of rigorous drug and alcohol policies.

Discussions with the Australian Rail Group (ARG) have commenced to establish how the rail service between Wagerup and Bunbury Port could accommodate the Proposal. The South West Main Line track is a single narrow gauge track with a number of crossing loops and therefore has capacity constraints. ARG is currently reviewing its rail operations and has indicated it intends to operate four sets of alumina trains (one loco and approximately 28 to 32 wagons each) and two sets of caustic trains (one loco and approximately 10 wagons each) from around mid 2005. This will result in an average increase of three alumina trains and one caustic train per day on the South West Main from Pinjarra and Wagerup to and from Bunbury.

The, number of train services associated with the Proposal and Pinjarra upgrade combined would result in an increase from 8 to 11 trains, one-way per day. The rail operator (ARG) is proposing to move to this new schedule (11 trains per day) in mid 2005. Assuming this level of service is maintained, no increase in train services would be expected on commissioning of the Proposal, however, train lengths would be extended from 28-32 wagons to up to 46 wagons for alumina, and from 10 wagons up to 14 wagons for caustic.

Alcoa has no management control over, or proponent responsibility, for the South West main line as it is owned and operated by ARG.

Commitment 13

Alcoa will prepare and implement a Traffic Management Plan to manage road traffic associated with construction of the Proposal.

8.9 PUBLIC SAFETY RISK

The EPA's objective for the Proposal regarding risk to public safety is:

- to ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria including Guidelines and Criteria for EIA No 2, *Guidance for Risk Assessment and Management: Off-site Individual Risk from Hazardous Industrial Plant.*

Potential Issues

A Public Safety risk assessment has been undertaken for the existing Wagerup refinery and the Proposal, by Qest Consulting (Appendix Q). This risk assessment focussed on accidental events which may have an acute impact on members of the public. The risk assessment was undertaken in accordance with the EPA *Guidance for Risk Assessment and Management: Off-site Individual Risk from Hazardous Industrial Plant, July 2000*. This study did not include incidents with only occupational impacts, health impacts and issues associated with continuous releases (Qest Consulting, 2005).

A range of hazards were identified that had potential consequences outside of the immediate workplace, followed by analysis to determine if these risks offered potential to affect areas outside Alcoa's boundary where the public risk criteria apply. The types of hazards identified were:

- Chlorine gas leak or vessel failure of two chlorine drums (920 kg max.) which are used for the chlorination of the potable water supply
- Rupture of natural gas pipeline (which reaches the surface near the site boundary and is used for onsite power requirements) and resultant fire
- Catastrophic process incidents such as explosion of high pressure/high temperature digesters and resultant caustic release. There are currently three banks of five digesters and the expansion will require another bank of digesters, and
- Chemical release from dangerous goods storage (e.g., caustic, acid, LPG storage) in 36 different locations at the refinery.

The analysis indicated that none of the events associated with these hazards has the potential to result in serious acute harm to persons outside of Alcoa's boundary. The level of public risk associated with the existing refinery and the Proposal therefore comply with the EPA criteria for 'Off-site Individual Risk from Hazardous Industrial Plants' (Qest Consulting, 2005).

Whilst this type of risk analysis does not normally address road safety issues, the increase in number of vehicle movements as a result of the construction workforce has the potential to impact on the public. Appropriate recommendations to ensure management reduces the road safety risk to 'As Low As Reasonably Practicable' are made by the Qest Consulting (2005) report and are addressed in Section 8.8.

Proposed Management

The maintenance and performance monitoring of the controls associated with the identified hazards for the existing plant, expansion and on-going operations are addressed within the Wagerup Safety Management System (which meets the requirements of AS 4801 "Occupational Health and Safety Management Systems) and the Alcoa Major Hazard Management System.

The management of public safety will be an ongoing process throughout construction and operation of the Proposal. Alcoa will implement the following recommendations made in the risk assessment undertaken for the Proposal (Qest Consulting, 2005):

- Alcoa is in the process of implementing a comprehensive Major Hazards Management System at the Wagerup refinery that focuses on equipment whose failure could result in major hazards impacts. This process will provide a systematic approach to identifying the critical equipment controls for managing major hazards and ensuring these are in place and their performance effectively monitored. The implementation of this process (planned for 2005) will include a review of all major hazards identified within the public safety risk assessment undertaken by Qest Consulting. The routines for monitoring the performance of the relevant critical equipment controls will be established and in place prior to the commissioning of the Proposal;

- The auditing and monitoring requirements of the Wagerup Safety Management System will continue to be utilised to ensure that the relevant control systems (including Dangerous Goods reviews, effectiveness of management systems, etc.) remain effective, beyond the commissioning of the Proposal;

- A road transport strategy will be implemented for the Wagerup refinery to accommodate the increase in traffic during construction (Section 8.8);

- The on-going design process for the Proposal will include all the normal hazard review processes such as HAZID, Risk Reviews and HAZOP for example; and

- Existing procedures for the management of hazardous material will be reviewed and amended if necessary to ensure that potential off-site impact is considered in addition to the normal Dangerous Goods licensing requirements.

8.10 GREENHOUSE GAS EMISSIONS

The EPA's objectives for the Proposal regarding greenhouse gas emissions are:

- *to minimise emissions to levels as low as practicable on an on-going basis; and*
- *to ensure that potential greenhouse gas emissions from the proposed project are adequately addressed and best practicable measures and technologies are used.*

Background

Greenhouse gases (GHG) is a term used to refer to a group of gaseous compounds that absorb infrared radiation and trap heat in the Earth's atmosphere. These occur naturally in the atmosphere but since the Industrial Revolution, the combustion of fossil fuels has dramatically increased the quantities of greenhouse gases emitted to the atmosphere, which is resulting in an increase in the Earth's temperature. The principle greenhouse gas (by volume) is carbon dioxide (CO2), although methane (CH4), nitrous oxide (N2O), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) are also significant contributors. The Intergovernmental Panel on Climate Change (IPCC) estimates the global average surface temperature increased by about 0.6 °C over the 20th Century. In its third assessment report, the IPCC concluded that most of the observed warming over the past 50 years is likely to be attributable to human activities (IPCC, 2001).

The most recent National Greenhouse Gas Inventory indicates that GHG emissions from stationary energy sources were 261.9 Mt CO2-e in 2002, which is equal to 47.6% of net national emissions (AGO, 2004). Alumina refining is an energy intensive activity which has the potential to release large volumes of anthropogenic GHG in power generation. The largest source of GHG emissions from alumina refining at Wagerup is from the combustion of natural gas to generate steam and electricity to meet process energy demands. The other major source is combustion of natural gas to provide direct heat for calcination and ancillary kiln-based processes.

There are significant emissions associated with the production of some of the raw materials used in alumina refining such as lime and caustic soda. Alcoa purchases these materials from other companies and has no means of reducing emissions associated with their production, other than to improve the efficiency of use of these materials in its own production processes.

Bauxite mining operations account for a relatively minor proportion of GHG emissions associated with alumina production. The main source of mining-related emissions is in the consumption of diesel fuel in heavy mobile equipment and in the clearing of vegetation for mining. Carbon stores on mined land are restored by mine rehabilitation, albeit over a considerable period of time as the post-mining ecosystem develops. The EPA has advised that mining is not part of this assessment and therefore will not be included in determining greenhouse gas emissions for the Proposal.

Wagerup Refinery 2004 Greenhouse Gas Emissions

Alcoa has used the World Business Council for Sustainable Development (WBCSD) methods for calculating GHG emissions from 2003 onwards. The calculation methods are similar to the Australian Greenhouse Office (AGO) methods more commonly used in Australia. The main difference between the two methods is that indirect emissions are not included in the final reporting figure (for WBCSD) and multiplication factors can vary.

The GHG emission calculation relies upon multiplying the amount of energy generated by various fuels by appropriate factors. For natural gas, the main fuel source for energy production at the Wagerup refinery, the WBCSD calculation method uses 1 GJ of energy corresponds to 56.06 kg CO2 equivalents. This compares with AGO calculations, whereby 1 GJ of energy corresponds to 61.6 kg CO2 equivalents.

The GHG emissions for the Wagerup refinery under the current situation and with the Proposal are presented in Table 32. GHG emissions are predominantly from combustion sources and therefore are released as CO2, with the emitted quantities of other GHG considered sufficiently small to be negligible.

Table 32: Greenhouse Gas Emissions for the existing Wagerup refinery and the Proposal (two energy supply options).

Scenario	Fuel	Projected Energy Use (GJ)	Emission Factor[1]	Total GHG Emissions (Gg CO_2 equiv.)
	Natural gas	-	-	1,327,000
Existing	Other fuels	-	-	15,000
			TOTAL	**1,342,000**
	Natural gas	4.5×10^{7}	5.6×10^{-5}	2,529,000
Boilers	Other fuels	-	-	15,000
			TOTAL	**2,544,000**
	Natural gas	4.0×10^{7}	5.6×10^{-5}	2,240,000
Cogeneration	Other fuels			15,000
			TOTAL	**2,255,000**

Notes: 1. Emission factor based in WBCSD calculation methods (WBCSD, 2004) to generate Gg CO_2 equivalents.

From Table 32 it can be seen that the Proposal would result in GHG emissions rising from 1,342,000 to 2,544,000 tonnes Gg CO2 equivalents if boilers are installed. The cogeneration option would cause emissions to increase to 2,255,000 Gg CO2 equivalents, which is significantly higher than the existing refinery, but a reduction over the boiler option. The most significant GHG contribution from the refinery arises from the combustion of natural gas.

Alcoa's Greenhouse Emissions Targets

Alcoa's goal is to reduce GHG emissions under its direct control by at least 25% (from the base year of 1990) by the year 2010, irrespective of the increase in alumina and/or aluminium production capacity that may be achieved over this period. This reduction includes emissions from Alcoa-owned power generation facilities, but does not include emissions associated with the production of raw materials and electricity purchased from other sources. This target was not intended to be applied equally to all operations and Alcoa's Western Australian operations targeted a 17% reduction (from the base year of 1990). Globally Alcoa achieved the 25% reduction target by 2003 and is now working to maintain that reduction as the company expands.

Aluminium Life Cycle Assessment

Life Cycle Assessment (LCA) is a scientific tool for the evaluation of environmental effects of products and services through the complete known life cycle, from extraction of raw material, processing (i.e., refining and smelting), fabrication, transportation, use, recycling and ultimately disposal. LCA is undertaken on both the product, the energy and the ancillary materials supplied.

Aluminium is lightweight, resistant to atmospheric corrosion, conductive, ductile and unlike some other metals, is readily able to be repeatedly recycled. It is these properties that have seen aluminium used extensively in air, land and sea transport, packaging, electricity transmissions and domestic and industrial construction. In the context of LCA for aluminium, there is a significant potential to reduce GHG emissions through the increased use of recycled aluminium and from the increased use of aluminium in transport applications. Alcoa works closely with a number of vehicle manufacturers to assist in the design of components and alloys to improve vehicle weight and other properties such as crash worthiness.

Aluminium recycling generates 95% less GHG emissions than the primary production of aluminium from bauxite ore. At present, close to 40% of the global demand for aluminium is fulfilled from recycled products, primarily from the packaging, transport and construction industries, which results in significant greenhouse benefits. Alcoa's goal is to increase the global recycling rate through the sponsorship of voluntary national aluminium recycling programmes and purchasing competitively priced scrap metal as feedstock for its secondary smelters.

The average aluminium content of motor vehicles has increased over the past ten years and this trend is forecast to continue as motor vehicle manufacturers strive to meet stringent exhaust emissions standards and continue to improve fuel efficiency. A LCA published by the International Aluminium Institute found that each tonne of alumina that replaces traditionally high density materials in a vehicle can save the equivalent of 13.9 t of CO2-e over the life of the vehicle, rising by a further 9.0 t of CO2-e with the use of recycled aluminium in the manufacture of the motor vehicle. The aluminium industry is working closely with motor vehicle manufacturers to enable the easier dismantling of aluminium components from cars in order to improve the recovery of aluminium in this industry.

Alumina Industry Energy Efficiency Benchmarks

The International Aluminium Institute estimated that the world-wide weighted average for energy used per tonne of alumina produced was 11,818 MJ/t. Table 33 provides a summary of the energy efficiency statistics for the alumina industry globally.

Table 33: Energy Efficiency Statistics for the Alumina Industry

Region	**Energy Used per Alumina Produced [1] (MJ/tonne of alumina)**
Africa and South Asia	12,938
North America	11,957
Latin America	11,436
East Asia [2] and Australia	**11,375**
Europe	13,490
World-wide Weighted Average	11,818
Alcoa Wagerup Refinery Base Case [3]	9,195
Alcoa Wagerup Refinery Boiler Option [4]	8,758
Alcoa Wagerup Refinery Cogeneration Option [4]	7,770

Notes:
Source: International Aluminium Institute Statistics Report (IAI, 2004)
1. Statistics published by the IAI are for 2002.
2. Includes China, Japan and South Korea; however data for China and South Korea were not reported to the IAI by these counties.
3. Derived from the Wagerup refinery 2004 greenhouse gas emission inventory data.
4. Projected data supplied to ENVIRON by Alcoa on 1 April 2005.

During the 2004 calendar year the Wagerup refinery operated at an average energy efficiency of 9,195 MJ/t of alumina produced, which is a significant improvement on the World-wide weighted average. Implementation of the Proposal is projected to further improve energy efficiency to 8,758 MJ/t with the boiler option and to 7,770 MJ/t with the cogeneration option.

The Wagerup refinery is very energy efficient and is supplied by natural gas-fired generators, which have a lower GHG emission intensity than coal or diesel fired generators.

Greenhouse Emissions for the Proposal

The key components of the Proposal that will increase energy consumption at the refinery are as follows:

- additional steam requirements in the digestion and evaporation areas of the process due to the increased rate of bauxite processing and increased flow rate of liquor around the process circuit
- additional electricity consumption for the two additional ball mills for bauxite grinding and additional digestion unit, and increased flows in the precipitation and clarification areas, and
- additional natural gas combustion as a result of the increased capacity in calcination, oxalate kilns and emission controls.

These increases in energy consumption will, however, be offset by energy saving initiatives that are to be incorporated into the design of the Proposal in order to achieve an overall improvement in the GHG intensity of the Wagerup refinery.

Alcoa is currently considering two energy supply options. Either the existing gas-fired power plant will be expanded with the addition of two boilers, or a gas-fired co-generation plant will be constructed (Section 5.3.2).

Table 34 presents the overall GHG emissions impact of the Proposal with the two energy options compared to existing GHG emissions.

Table 34: Greenhouse Gas Emission Estimates for current operations and the Proposal.

Greenhouse Gas Emission Parameter	**Units**	**Existing Operations**	**Addition of two boilers**	**Cogeneration facility**
Net CO_2 emissions	t CO_2	1,342,000	2,544,000	2,255,000
Net CO_2 Emissions Intensity	Kg CO_2/t alumina	557	541	480

Note: Calculations based on the WBCSD methodology.

It can be seen from Table 34 that, depending on the power supply option selected, the Proposal is estimated to improve the greenhouse gas emissions intensity by approximately 5% to 541 kg CO2-e with the boiler option, or by approximately 15% to 480 kg CO2-e per tonne of alumina produced with cogeneration.

Greenhouse Gas Emissions Minimisation

Alcoa's actions to facilitate the preservation of native vegetation and the rehabilitation of degraded areas help to counter the effects of GHG accumulation.

Alcoa relinquished large parts of ML1SA for inclusion in the conservation estate under the System 6, Regional Forests Agreement (RFA) and Forestry Management Plan (FMP) processes. In particular, the RFA and FMP Comprehensive Adequate Representative (CAR) and CAR-informal reserve systems have been enhanced by the voluntarily actions of Alcoa to enhance the reserves system. This action has restricted Alcoa's access to areas of high mineral prospectivity and emphasises Alcoa's commitment to biodiversity conservation.

Alcoa's commitment to land rehabilitation and biodiversity conservation is clearly reflected by its support of the landcare movement and other initiatives, with over $20million provided since 1989. Alcoa is supporting and will continue to support community environmental and landcare projects, through:

- National partnerships
- State-wide programs in Western Australia and Victoria
- Regional and local projects and events
- Alcoa Foundation, and
- Alcoa's environmental partnership program.

Proposed Management

Alcoa has developed a Climate Change Policy across its global operations. The principle components of this policy are:

1. to continue to improve energy efficiency at all operations; and
2. to improve operations by implementing best practice technologies to reduce GHG emissions.

In implementing the Climate Change Plan Alcoa will:

- reduce its direct GHG emissions to 25% below the 1990 baseline on a worldwide basis by 2010 (achieved in 2003), with the potential for significant additional reductions through major technology improvements
- measure its significant GHG emissions and have its baseline data and annual inventories certified by independent third parties

- monitor and separately report on the emissions associated with electricity purchased for Alcoa's smelting operations in recognition of the importance of these emissions in the overall life cycle of aluminium
- rapidly deploy appropriate best practice technologies to reduce GHG emissions
- evaluate the effectiveness of GHG sequestration approaches and seek credit for their implementation as appropriate
- support an emissions trading regime that is efficient, global, comprehensive and utilises initial allocation procedures based on a 1990 baseline
- evaluate internal trading mechanisms to determine if such procedures will enhance GHG reduction strategies
- actively participate in discussions at national and international levels on climate change policy and provide leadership, data and recommendations
- evaluate and utilise cooperative mechanisms to reduce greenhouse gases using agreed international protocols; and in partnership with its customers, and
- identify and promote beneficial uses and recycling of its products to reduce GHG emissions in transportation, construction, packaging and other applications.

Alcoa has been directly involved with the following programmes that assist in reducing the impact of greenhouse gas emissions in Western Australia, nationally and internationally. Alcoa will continue its involvement in these programs, where appropriate, as below:

Commonwealth Government Initiatives:

- Participation in the Greenhouse Challenge, Generator Efficiency Standards and Energy Efficiency Best Practice Programmes.

Alcoa International Initiatives:

- Use of energy audits and benchmarking across Alcoa's global alumina operations.

Community Initiatives:

- support for medium-scale landscape restoration projects under the Alcoa Landcare Project and related community partnerships (e.g. Catchment Groups, Landcare Groups, Land Conservation District Committees);
- support for ecological restoration and conservation projects such as the current sponsorship of the Alcoa Jarrah-Tuart Restoration Project at Kings Park Botanic Garden; and
- support for renewable energy demonstration projects such as the wind turbine installation at Fairbridge Village.

Research and Development:

- research and development into refinery process efficiency and technology improvements that have significant energy and resource use efficiency benefits;
- evaluation of carbon sequestration opportunities both within Alcoa's own operations (e.g. carbonation of bauxite residue) and in broad-acre land management; and
- support for greenhouse-related research such as sponsorship of the Cooperative Research Centres on Greenhouse Accounting and Sustainable Resource Processing.

Alcoa supporting Biodiversity conservation

<u>Greening Australia - National</u>

The Alcoa Greening Australia partnership began in 1982, the International Year of the Tree and the first year of operation for Greening Australia. Alcoa and Greening Australia have worked together to build community capacity and knowledge about environmental issues, backed by on-ground environmental restoration projects, which have generated a range of long-term, positive community outcomes.

The partnership has contributed in a practical way to repair the Australian landscape by planting over 10 million trees in 12 years in Victoria through the Alcoa Revegetation Assistance Scheme, extensive and ongoing environmental education in the Perth metropolitan and Peel regions, improving seed supply via the Alcoa Portland Seedbank, and practical knowledge transfer through a range of publications and resources.

<u>Landcare Australia Limited - National</u>

Alcoa partners with Landcare Australia through its sponsorship of the Community Landcare Award in the bi-annual prestigious National Landcare Awards. Presented by the Prime Minister of Australia, the Alcoa Community Landcare Award recognises community efforts in environmental care.

Alcoa has been a long time supporter of landcare and other environmental programs in Western Australia. Some of the programs that Alcoa supports are outlined below.

<u>Swan Alcoa Landcare Project (SALP)</u>

In Western Australia, Alcoa's partnership with the Swan Catchment Council and the Swan River Trust has enabled the continuation of the Swan Alcoa Landcare Program (SALP). In

2004, through SALP, over $550,000 in funding was provided to 44 community environmental groups. This is an excellent example of grass roots urban landcare.

Tammin Alcoa Landcare Education Centre (TALEC)

Alcoa has continued its support of the Tammin Alcoa Landcare Education Centre (TALEC). Since its inception the centre has provided a unique opportunity for teachers and students to study various aspects of environmental management in an authentic hands-on environment. The centre is dedicated to the study of the problems of soil and water degradation and increasing awareness of these problems through education. The centre also studies the possible solutions to these problems through sustainable land management practices. In 2005 TALEC will celebrate its 15 year anniversary.

Dieback Working Group

The Dieback Working Group works with 25 local government authorities in the southwest of WA to manage Phytophthora Dieback (dieback) in their bushlands. The group liaises with over 50 community-based conservation groups to increase understanding of how to manage dieback and provides the equipment to treat bushland to minimise the spread and impact of dieback. The Dieback Working Group works with World Wildlife Fund, the Dieback Consultative Council, the Dieback Response Group and CALM to develop and implement a communication plan for dieback and also to develop educational material for schools, landholders, community groups and the general public. In addition to financial support, Alcoa's Senior Environmental Research Consultant, Dr Ian Colquhoun heads up the group.

Peel Harvey Catchment Management Authority

Alcoa's long partnership with the Peel Harvey Catchment Management Authority has included funding for community groups in the Peel-Harvey catchment for landcare activities associated with rivers, wetlands and associated habitats. Many initiatives from this collaboration have been catalysts for landholders to work together in tackling local environmental problems and in developing sustainable agricultural practices.

Western Australian Museum – Alcoa FrogWatch

Frogs are often seen as the barometer of the environment and Alcoa's partnership with the WA Museum helps build community capacity in general environmental care through frog conservation. As well as support for the popular community education program, Alcoa Frog Watch, Alcoa has also funded a scientific research project on the impact of frogs in the Kimberley region of Western Australia.

Alcoa Employees

In both Victoria and Western Australia, Alcoa employees give up their personal time to provide hands-on support to conservation activities. Tree planting events are held at site level working with local Friends and other community groups. In Western Australia an annual tree planting weekend is held involving over 100 employees and their families. In addition to providing practical support, it connects our employees to issues of environmental degradation and conservation and the ways in which they can positively contribute.

Alcoa has achieved its 25% GHG reduction target (on 1990 levels) and is working to maintain these emission reductions as the company expands. The expansion of Wagerup refinery will improve the net CO2 emission intensity from 557 to 480 kg CO2/t alumina (if cogeneration selected) and help to maintain this goal. Alcoa is a strong supporter of the community initiatives and environmental programs that assist in restoring and maintaining degraded lands throughout Western Australia.

Commitment 14

Alcoa will achieve a reduction in the greenhouse gas emissions intensity of the Wagerup refinery as a result of the Proposal by approximately 15% (based on cogeneration).

Commitment 15

Alcoa will review opportunities to improve the energy efficiency of equipment to be installed as part of the Proposal during the detailed design phase of the Proposal using a Cleaner Production review process.

Commitment 16

Alcoa will maintain its existing greenhouse gas minimisation programmes.

8.11 VEGETATION CLEARING

The EPA's objectives for the Proposal regarding flora and vegetation are to:

- *maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities; and*
- *avoid adverse impacts on biological diversity, comprising of different plants and animals and the ecosystems they form at the levels of genetic, species and ecosystem diversity.*

Potential Issues

The Wagerup operations are in the majority surrounded by paddocks, used mainly for grazing of livestock. In the vicinity of the residue area the paddocks have generally been levelled to allow even water flow and are irrigated by an extensive system of drains. Vegetation in this area consists of pasture grasses and a mixture of *Eucalyptus* spp. trees and shrubs. Some stands of native vegetation in good condition are located near the refinery but the majority of the trees located near the residue area have been planted as wind breaks and generally occur along fence lines and roads.

The installation of equipment and plant associated with refinery for the Proposal will be undertaken in and around the existing refinery. Some minor clearing of vegetation may be required for certain components within the boundary of the refinery. However, no remnant native vegetation will require clearing.

The residue area will be expanded within the current LTRMS (see Section 3.1.1) which has been endorsed by the Minster for Environment. The endorsed residue expansion is over predominantly agricultural land, with very little remnant vegetation. None of the Threatened Ecological Communities (TECs) or locally significant vegetation communities identified in the vicinity of the refinery (Section 7.7.1) will be affected (either directly or indirectly) by the expansion of the refinery or RDA.

Vegetation clearing in the mining areas is not considered within this document as clearing approvals are addressed in Alcoa's five-year Mining and Management Program (Section 4.3.1). The EPA has advised clearing for mining is outside the scope of this ERMP assessment.

Proposed Management

Alcoa will keep vegetation clearing for the Proposal to a minimum and will rehabilitate the residue area with native flora indigenous to the area, where appropriate. One of the objectives of the LTRMS (Section 3.1) is to establish a native vegetation corridor on rehabilitated residue areas and land along existing and planned drainage lines to promote re-colonisation of these areas by native species, establish native fauna habitats, and improve the productivity of these rehabilitated communities.

8.12 FAUNA

The EPA objectives for the Proposal regarding fauna are as follows:

- *protect Specially Protected (Threatened) Fauna species and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950; and*
- *avoid adverse impacts on biological diversity, comprising different plants and animals and the ecosystems they form at the levels of genetic, species and ecosystem diversity.*

Potential Issues

Section 7.8 lists fauna species recorded in the vicinity of the Wagerup refinery. Baudin's Cockatoo which is listed as Vulnerable under the Commonwealth *EPBC Act 1999* and 'Rare, or likely to become extinct' under the *WA Wildlife Conservation Act 1950* has previously been recorded in the vicinity of the refinery. The species is still relatively widespread in the jarrah forest but has declined elsewhere due to clearing.

It is not expected that changes to the refinery as a result of the Proposal will result in any additional impacts to the native fauna in the area. Fauna occurring near the residue areas may be disturbed during construction of the new RDAs during the life of the Proposal, and to a lesser extent during operation. However, this disturbance is not expected to adversely impact any fauna species as no areas of remnant vegetation will be cleared. 'Dry stacking' of residue (Section 4.2) will also minimise any pools of water occurring on the surface of the residue area that may attract native fauna.

Proposed Management

Alcoa will minimise clearing of vegetation to minimise the impact on native fauna habitats. Alcoa will establish a wildlife corridor on rehabilitated residue areas and land along existing and planned drainage lines to promote re-colonisation of these areas by native fauna, establish native fauna habitats, and increase the biodiversity of these communities.

Alcoa is a major sponsor of Operation Foxglove, which is a feral animal control program to remove the threat of foxes to small and medium sized native animals. Operation Foxglove is part of a wider feral animal control program throughout WA called Western Shield. The Western Shield program covers an area of 3 million hectares and has led to the recovery and reintroduction of a number of endangered species such as the noisy scrub bird and tammar wallaby.

8.13 WASTE MANAGEMENT

The EPA's objective for the Proposal regarding waste management is to:

- *ensure that liquid and solid wastes do not affect groundwater or surface water quality, nor lead to soil contamination; and*
- *ensure that the generation of all wastes follows consideration of waste reduction in accordance with the waste hierarchy of reduction, reuse, recycle, treatment and disposal.*

Existing Waste Management

The Wagerup refinery has an existing waste management programme within the EMS. The waste streams are grouped into the following categories, which adhere to Government regulations and internal Alcoa guidelines:

- Hazardous waste (as classified under the Australian Dangerous Goods Code 2000)
- Low hazard waste (may be contained with, or contain traces of hazardous waste)
- Putrescible waste
- Inert waste (excluding putrescible wastes)
- Special wastes (e.g. asbestos, clinical and related wastes, leaded paints, fluorescent tubes), and
- Scrap/salvage (recyclable).

The hierarchy for waste management at the Wagerup refinery is:

1. Reduce: Reduce the amount of waste generated at the site through waste minimisation and cleaner production[1] practices
2. Reuse: Re-use waste products where practicable
3. Recycle: Treat waste that is no longer useable in present form and use it to produce new products
4. Treat and/or Dispose: Appropriately treat and/or dispose of waste in a way which minimises the risk of environmental harm.

The Wagerup waste minimisation program was initiated in 1993 with the objective of characterising and quantifying waste streams and identifying waste minimisation and recycling opportunities.

[1] Cleaner production is the continuous application of an integrated preventative environmental strategy over the life cycle of processes and products so as to reduce risk to humans and the environment and promote the concept of sustainability.

Significant advances have since been made in the area of waste recycling and minimisation. The programme includes: food waste, office recyclables such as plastics and paper, waste oil, scrap metal, gloves, automobile batteries, liquid waste, laboratory wastes, ozone depleting substances, cardboard, tree clippings and timber pallets, and process material such as off-specification alumina.

Waste management at Wagerup is undertaken in accordance with the Waste Management Procedure and specific procedures written for disposal of hazardous wastes.

Non-process Wastes

Non-process waste streams at the Wagerup refinery are managed and monitored in partnership with the licensed contractor, who has responsibility for day-to-day management of these wastes.

Non-Process wastes are targets of the Operational Centres', waste minimisation teams and cleaner production practises. These wastes are targeted in the cross-site waste goal of zero non-process waste to landfill by 2008. The DoE licence stipulates that only waste meeting the acceptance criteria for Class II landfills (i.e. inert waste, putrescible waste, and certain types of special waste) and waste generated from alumina production are to be deposited at the Wagerup landfill area located in the residue area.

Clearly marked recycling bins and landfill waste bins are distributed all over the refinery and a 3-Bin recycling/disposal system has been implemented in crib rooms and office areas.

Hazardous wastes are kept segregated at all times from non-hazardous wastes and disposed of according to specific procedures and regulatory requirements. Specialist contractors are used to remove asbestos. They are required to follow procedures which comply with Australian Standards and Worksafe procedures.

Lead paint on structures is removed in accordance with *Australian Standard 4361.1: Guide to Lead Paint Management Part 1: Industrial Applications, and Worksafe procedures*. Disposal of lead paint wastes is carried out by a specialist contractor and material is sent to an appropriate landfill depending on lead content.

When a vessel or pipe is removed and contains caustic scale, it can present a hazard downstream in the recycling path. Steel items which are removed from site must have scale removed. Where an item is particularly large or has a complex structure it may not be practical to clean it sufficiently for recycling. In these cases the item will be buried on site in the landfill.

The majority of the refinery area is serviced by a sewer collection system. The sewerage is delivered to a facultative lagoon system that treats the sewerage with natural biological activity. The Operate and Maintain Sewage Treatment Facility Procedure (Doc. Number 37512) describes the facility, its operation and maintenance.

Process Wastes

Process wastes from the refinery include any waste that is derived from the refinery's Bayer process (refer to Section 4.1 for a description of the Bayer process). Process wastes at the Wagerup refinery are targets of cleaner production projects by process engineers and specialists on site.

Process wastes include (but are not limited to) the following list. These include any spill or cleanup material of the following substances:

- red scale (any material from milling, digestion, and clarification circuits that contains caustic);
- white scale (from precipitation, post-precipitation and calcination circuits);
- bauxite residue (material that is piped to the residue area); and
- spilled process chemicals.

Bauxite residue is managed in accordance with Alcoa corporate mandated bauxite residue management standards and guidelines and within the framework of the LTRMS (Section 3.1.1). Approximately 10,000 tonnes of process waste is pumped to the residue drying areas daily for dry stacking. The sand and mud fractions are separated prior to transfer. The mud is pumped to a superthickener, which removes approximately half the liquor and in doing so produces very thick mud, which is deposited on beds in thin layers for solar drying. The sand is washed to recover alkaline liquor. It is then used in the construction of dyke walls within the impoundment area and as a surface cover on the RDAs.

There are a number of projects currently being carried out into alternative uses for residue waste. Alcoa will maintain a focus on research and development programs aimed at identifying alternative safe uses for bauxite residue.

Mercury is introduced to the refinery primarily through the bauxite ore in trace amounts and is mobilised from the bauxite by the elevated temperatures in the Bayer process. Secure mercury traps, installed in the Vacuum Condensor Systems of the digestion process, allow capture and collection of the mercury. Dedicated secure storage for mercury is maintained prior to mercury being removed offsite for recycling.

Other wastes generated from alumina production and associated activities that are removed and disposed off-site by a licensed waste contractor are:

- Spent liquor burner CTO catalyst
- Asbestos materials
- Packaged laboratory chemical waste, and
- Clinical waste.

Potential Issues

Whilst an almost doubling of refinery capacity associated with the Proposal would be expected to produce an incremental increase in process waste production, waste minimisation, cleaner production mechanisms and improved spill prevention and clean up (refer to section 10 for Spill Management Plan), will be incorporated into the Proposal to reduce the incremental change in waste creation. Process wastes generated during construction and operation of the Proposal will continue to be managed in accordance with Alcoa's existing waste management programme.

During construction, waste will be generated where parts of the existing refinery require modification. The main issues which may arise are associated with the potential disturbance of asbestos containing substances , structures containing lead based paint and any redundant pipes or vessels which may contain caustic scale, making them unsafe for recycling.

Proposed Management

During construction, contractors will be expected to integrate their waste management arrangements with the on-site waste management programme. This includes using the same waste segregation and collection systems, procedures and training materials.

Waste management during construction and operation of the Proposal will continue to be in accordance with Alcoa's Waste Management Procedure (Doc. Number 5102). Management of non-process and process wastes for the Proposal will be as outlined in Table 35 following.

Table 35: Management of non-process and process waste for the Proposal.

Non-process waste	
Recyclable waste (steel, aluminium, paper, plastics [types 1, 2, 3], cardboard, glass, tyres)	• Sent off-site to recycling facility;
Putrescible waste	• Food scraps, shredded paper sent to Pinjarra Worm Farm for composting • Green waste mulched and used on-site
Paints/Solvents	• Collected by licensed contractor for disposal
Waste oil	• Collected and reused for dust suppression on the residue area (with DoE approval)
Hazardous waste	• Removed off-site by a licensed waste contractor to an approved waste disposal facility • Contaminated soil or oil - disposal determined by Environmental Department;
Non-recyclable inert non-hazardous waste or low-hazardous waste	• Disposed to a secure licensed landfill within the Wagerup refinery residue ara.
Process waste	
Bauxite	• Used for clean fill
Caustic contaminated soil	• to residue area
Heavily scaled hardware (e.g. pumps, pipes)	• to landfill
General caustic contaminated waste	• to landfill
Hydrate	• to residue area
Mercury (from bauxite)	• Collected and removed off-site for recycling
Off spec chemicals (including lime, flocculant, caustic)	• Caustic – to residue area • Lime – to landfill • Catalyst – disposed of to licensed off-site facility
Bauxite residue	• to residue area
Red scale	• to residue area
Sodium aluminate	• to residue area.

Any asbestos-containing waste materials removed from the refinery during the construction of the Proposal will be managed and disposed in the residue area in accordance with DoE licence requirements.

With the operation of the Proposal and ongoing measures to improve waste reduction, there is expected to be little increase in the volume of non-process waste from refinery operations. Non-process wastes generated during construction and operation of the Proposal will continue to be managed in accordance with Alcoa's existing waste management programme and waste reduction principles.

8.14 ABORIGINAL HERITAGE

The EPA's objective for the Proposal regarding Aboriginal heritage is to:

- *ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.*

Twenty seven Aboriginal archaeological sites were recorded within an 8 km radius of the Wagerup refinery (Table 19, Section 7.16). Of the 27 archaeological sites, one site is located immediately outside the Proposal area on the southern edge of the existing RDA.

Potential Issues

The Proposal will be constructed within the boundary of the existing refinery and will therefore not disturb any known Aboriginal heritage sites. Residue produced from the Proposal will be stored in the existing residue area, which will be expanded within the area outlined in the LTRMS (Section 3.1.1). The Proposal will be implemented in accordance with the LTRMS and will not disturb any known Aboriginal heritage sites.

Refer to Section 8.17 for a discussion of the issues associated with the wider community, including indigenous peoples.

Proposed Management

During construction and operation of the Proposal, employees and contractors will be advised of the existence and location of the Aboriginal heritage sites and advised to avoid these as they may be subject to the *Aboriginal Heritage Act 1972*.

If in the future Alcoa proposes to disturb the area to the south of the residue area where the artefact scatters are located, Alcoa will undertake detailed archaeological recording of the site, and consult with appropriate indigenous representatives and organisations, prior to any disturbance of the area.

8.15 VISUAL AMENITY

The EPA's objective for the Proposal regarding visual amenity is:

- *visual amenity of the area adjacent to the Proposal should not be significantly impacted by the proposal.*

Potential Issues

The footprint of equipment associated with the Proposal will be within the confines of the existing Wagerup Refinery. The Proposal will require expansion of the existing residue area within the proposed 30 year residue footprint, which will be to the west and north of the existing residue area in accordance with the LTRMS (refer to Section 3.1).

The most obvious difference at the residue area will be the increase in height from the existing elevation of around 20metres to 40metres above ground level, in accordance with the endorsed LTRMS. This increase in height is proposed with or without the Proposal, although the Proposal will bring forward the accumulation of residue. The banks of the stockpiles will be contoured and rehabilitated on an ongoing basis to blend in with the surrounding landscape.

To assess the potential visual impacts of the Proposal, digital photographs were taken from selected locations around the refinery to show the existing views of the refinery and residue facilities. Based on the engineering design available at this early stage of the Proposal, the additional structures required for the expansion were superimposed on these photographs to allow comparison of the visual aspects of the Proposal, and identification of practical measures to reduce visual impacts.

The potential visual impacts of the Proposal, prior to and following amelioration are outlined as follows and shown in Plates 1 to 12. A map of locations showing where these photographs were taken is shown in Figure 42 (refer to section 7.18):

> **View 1 (Plate 1a):** This photograph was taken from Willowdale Road Lookout. From this vantage point the existing Wagerup refinery and Upper Dam holding rainwater runoff, can be seen. The existing stack for Calciner units 1, 2 and 3 is clearly visible, being 100metres in height as is the Powerhouse stack (65 high) and the lime silo. For the expansion, the old Calciner 4 stack will be removed and a new 100 metres stack for Calciner units 4, 5 and 6 erected. If the Cogeneration option is pursued, two cooling towers will be visible from this view point. Otherwise if the Boiler option is selected a 75 metre stack will be required and be visible from this view point. The refinery is most visible from View Point 1 and it is predicted that the overall visual impact after the Proposal will not be significantly greater than the existing visual impact.

View 2 (Plates 2a & 2b): The residue area is just visible through the trees looking west from the South West Highway, with the Detention Pond in the foreground. The increase in height of the residue stockpile will make it more visible through trees and it is likely to be visible above the tree line.

View 3 (Plates 3a & 3b): This photograph is taken from Bancell Road south of the residue area looking north-northwest. The existing residue stockpile is visible through a gap in the trees. Expansion of the residue area will make the facility visible through the gap in the trees and above the line of trees to the left of the photograph.

View 4 (Plate 4): This view is also taken from Bancell Road, looking northeast, on the opposite side of the refinery from view 1. The existing view shows the Calciner (1, 2, 3 unit) multiflue and the Calciner 4, with other parts of the refinery visible just above the tree line. With the Proposal, the Calciner 4 stack will be removed and the proposed 100 metre Calciner multiflue will be visible from this point.

View 5 (Plates 5a & 5b): Taken from Bancell Road south of the residue area looking north. The existing residue area is barely visible through the trees in the distance. With the Proposal, the residue area will be visible above the tree line.

View 6 (Plates 6a & 6b): From this vantage point on Somers Road, looking east, the residue stockpile is currently visible above the shrub line, with the refinery visible in the distance. The expanded residue area will be clearly visible from this view point, but apart from a second tall stack, no other changes to the refinery will be visible.

View 7 (Plates 7a & 7b): The residue area is currently visible through the paddocks from Somers Road looking southeast. The larger expanded facility will also be clearly visible when viewed from this point across the paddocks. Changes at the refinery are likely to be imperceptible from this vantage point.

View 8 (Plates 8a & 8b): The residue area is currently barely noticeable through the line of trees on the other side of the paddock when viewed from McClure Road looking south. The expanded residue drying areas will become visible just above the line of trees when viewed across the paddock (Plate 8).

View 9 (Plate 9): The existing 100 metre Calciner multliflue is visible above the tree line from this point on McClure Road looking southeast. From this distance the only noticeable change is likely to be the additional 100 metre multiflue for Calciner units 4, 5 and 6 adjacent to the existing stack.

View 10 (Plate 10): This view taken 700 metre west of Yarloop on Johnstone Road looking north-northeast shows the Calciner stack, and part of the feedstock conveyor in the distance beyond the tree line. The only noticeable change from this vantage point is likely to be the additional multiflue for Calciner units 4, 5 and 6.

View 11 (Plate 11): The existing Calciner stack is visible above the trees when viewed from the corner of Boundary Road and South West Highway, looking north-northeast. The only noticeable change with the expansion from this view point will be the extra Calciner multiflue stack for Calciners 4, 5 and 6.

View 12 (Plate 12): This view is taken from the intersection of Kaus Road and South West Highway looking north-northeast towards the refinery. The existing Calciner stack is visible above the trees, and the additional Calciners multiflue stack will also be visible above the tree line.

In summary the Proposal may impact on the view sheds of residents living in the immediate vicinity of the operations, people travelling along surrounding roads and visitors to the area. There are no significant tourist locations adjacent to the RDA and therefore the potential impact on tourism visual amenity is reduced. The RDA and refinery may even be of interest to some tourists interested in the alumina operations.

Proposed Management

In general, changes to the Refinery when viewed from key vantage points will not significantly alter the existing viewscape of the refinery other than an additional taller multiflue for Calciner units 4, 5 and 6 and two cooling towers (if the Cogeneration Plant option is selected) or a 75 metre stack for the Boilers (if the existing Powerhouse is upgraded).

However, the expanded residue area will be clearly visible from View points 3, 6 and 7 without amelioration (see Plates 3, 6 and 7). Alcoa currently has a Visual Amenity Strategy for the Wagerup residue area which was required for planning approval for RDA 7 (June 2003) by the Waroona Shire Council. This strategy will be expanded to consider the future residue areas required for the Proposal.

The primary aspects of the Visual Amenity Strategy are to:

- enhance the vegetation screening on Alcoa's property adjacent to the surrounding public roads
- initiate trials on new outer embankments of the residue area to blend the visual appearance of the residue area into the surrounding landscape, and
- aim to rehabilitate externally facing embankments as soon as practical after construction.

The strategy applies to an area bounded by the South Western Highway to the east, Bancell Road to the South, Somers Road to the West and McLure Road to the north (Figure 42). A review of the strategy was conducted in November 2004 with local community members providing input and advice on the 2005 planting program. A similar review process will be used for expansion of the residue area for the Proposal.

The 2004 and 2005 planting programs in the Visual Amenity Strategy are focused on creating ecologically self sustaining ecosystems and improved visual amenity for the Bauxite residue area. The species types selected for each area are dependant upon the soil type, level of inundation likely during winter and reflect those species found in similar natural environments. The Bassendean and Spearwood Dune Systems for example, typically support jarrah-marri woodland (*Eucalyptus marginata, E. calophylla, Allocasuarina fraseriana*) and banksia low woodland (*Banksia attenuata, B. menziesii*). Freshwater swamps also occupy a large area and are usually bordered by paperbarks (*Melaleuca rhaphiophylla* and *M preissiana*) *Banksia littoralis, Eucalyptus rudis* and sedges. Use of these species in their natural environment will assist in promoting self sustainable ecosystems.

Trials to modify the embankments of the residue area have commenced with the aim of creating a more natural shape. To do this slopes and contours in the natural environment are measured and similar shapes incorporated into the planning phase of new residue drying areas. This proposed change in shape combined with variation in residue rehabilitation species is aimed at being more representative of the natural environment.

The Visual Amenity Strategy is an ongoing long term programme that will take into account proposed and future project development. Plantings take time to establish and it is expected that plantings undertaken in 2005 will begin to enhance the appearance of the area in 2008 onwards. With continued infill planting and regular reviews, this strategy will result in a significant enhancement to the visual amenity of the residue area.

EXISTING VIEW

CO-GENERATION

PINPOINT CARTOGRAPHICS (08) 9277 7763   Plate View 01a.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

Plate 1a

VIEW OF THE REFINERY LOOKING SOUTH WEST FROM THE WILLOWDALE ROAD LOOKOUT

ENVIRON

Drawn: I. Yull   Date: 01/05

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EXISTING VIEW

MODELLED VIEW

Plate View 02a.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING WEST FROM SOUTH WEST HWY, 750m SOUTH OF WILLOWDALE ROAD TURNOFF

Plate 2a

ENVIRON

Drawn: I. Yull

Date: 01/05

REHABILITATION

PINPOINT CARTOGRAPHICS (08) 9277 7763 Plate View 02b.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING WEST FROM SOUTH WEST HWY, 750m SOUTH OF WILLOWDALE ROAD TURNOFF

Plate 2b

ENVIRON

Drawn: I. Yull Date: 01/05

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING NORTH FROM BANCELL RD, 1400m WEST OF SOUTH WEST HWY TURNOFF

Plate 3a

ENVIRON

Drawn: I. Yull Date: 01/05

ALCOA

PINPOINT CARTOGRAPHICS (08) 9277 7763

Plate View 03a.dgn

REHABILITATION

PINPOINT CARTOGRAPHICS (08) 9277 7763 Plate View 03b.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING NORTH FROM BANCELL RD, 1400m WEST OF SOUTH WEST HWY TURNOFF

Plate 3b

ENVIRON

Drawn: I. Yull Date: 01/05

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY LOOKING NORTH EAST FROM BANCELL RD, 1.4km WEST OF SOUTH WEST HWY TURNOFF

Plate 4

ENVIRON

Drawn: I. Yull Date: 01/05

ALCOA

Plate View 4.dgn

PINPOINT CARTOGRAPHICS (08) 9277 7763

EXISTING VIEW

MODELLED VIEW

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING NORTH FROM BANCELL RD, 2.9km WEST OF SOUTH WEST HWY TURNOFF

Plate 5a

ENVIRON

Drawn: I. Yull   Date: 01/05

PINPOINT CARTOGRAPHICS (08) 9277 7763   Plate View 05a.dgn

REHABILITATION

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING NORTH FROM BANCELL RD, 2.9km WEST OF SOUTH WEST HWY TURNOFF

Plate 5b

ENVIRON

Drawn: I. Yull Date: 01/05

PINPOINT CARTOGRAPHICS (08) 9277 7763 Plate View 05b.dgn

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY & RDA LOOKING EAST FROM SOMERS RD, 400m SOUTH OF BRISTOL RD

Plate 6a

ENVIRON

Drawn: I. Yull | Date: 01/05

REHABILITATION

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

Plate 6b

VIEW OF THE REFINERY & RDA LOOKING EAST FROM SOMERS RD, 400m SOUTH OF BRISTOL RD

ALCOA

ENVIRON

Drawn: I. Yull
Date: 01/05

PINPOINT CARTOGRAPHICS (08) 9277 7763
Plate View 06b.dgn

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY & RDA LOOKING SOUTH EAST FROM SOMERS RD, 750m SOUTH OF McCLURE RD

Plate 7a

ENVIRON

Drawn: I. Yull

Date: 01/05

REHABILITATION

PINPOINT CARTOGRAPHICS (08) 9277 7763 Plate View 07b.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY & RDA LOOKING SOUTH EAST FROM SOMERS RD, 750m SOUTH OF McCLURE RD

Plate 7b

ENVIRON

Drawn: I. Yull Date: 01/05

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING SOUTH FROM McCLURE RD, 1.7km WEST OF FAWCETT RD

Plate 8a

ENVIRON

Drawn: I. Yull

Date: 01/05

ALCOA

PINPOINT CARTOGRAPHICS (08) 9277 7763

Plate View 08a.dgn

REHABILITATION

PINPOINT CARTOGRAPHICS (08) 9277 7763 Plate View 08b.dgn

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE RDA LOOKING SOUTH FROM McCLURE RD, 1.7km WEST OF FAWCETT RD

Plate 8b

ENVIRON

Drawn: I. Yull Date: 01/05

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY LOOKING SOUTH EAST FROM SOMERS RD, 1.2km WEST OF FAWCETT RD

Plate 9

ENVIRON

Drawn: I. Yull

Date: 01/05

ALCOA

PINPOINT CARTOGRAPHICS (08) 9277 7763

Plate View 9.dgn

EXISTING VIEW

MODELLED VIEW

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY LOOKING NORTH-NORTH EAST FROM JOHNSTON RD, 700m WEST OF YARLOOP

Plate 10

ENVIRON

Drawn: I. Yull

Date: 01/05

ALCOA

EXISTING VIEW

MODELLED VIEW

Plate View 11.dgn

PINPOINT CARTOGRAPHICS (08) 9277 7763

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY LOOKING NORTH-NORTH EAST FROM CORNER BOUNDARY RD & SOUTH WESTERN HIGHWAY

Plate 11

ENVIRON

Drawn: I. Yull

Date: 01/05

EXISTING VIEW

MODELLED VIEW

ALCOA

Alcoa World Alumina Australia
WAGERUP REFINERY EXPANSION

VIEW OF THE REFINERY LOOKING NORTH-NORTH EAST 35m NORTH FROM KAUS RD & SOUTH WESTERN HIGHWAY INTERSECTION

Plate 12

ENVIRON

Drawn: I. Yull

Date: 01/05

PINPOINT CARTOGRAPHICS (08) 9277 7763

Plate View 12.dgn

8.16 LIGHT SPILL

Potential Impacts

The Wagerup alumina refinery operates 24 hours per day and therefore requires significant outdoor lighting. Development of the Proposal will require additional lighting for the additional components of the plant and therefore has the potential to increase the obtrusive effect of lighting at the Wagerup refinery.

Obtrusive effects of outdoor lighting can be categorised as:

- glare
- spill light, and
- sky glow.

In design of the Proposal, Alcoa has focussed on the potential impacts of sky glow, as this represents the greatest potential light impact from the refinery. Sky glow is as a result of light emitted from luminaries entering the sky and reflecting off particles in the atmosphere. Light may be emitted to the sky:

- directly from a luminare which is directed above the plane of horizon, or
- indirectly by being emitted from a luminare which is directed below the plane of horizon, but is reflected from the surrounding surface towards the sky.

The impact of sky glow from lighting is therefore dependent not only on the amount of light emitted to the sky, but also the reflectance characteristics of the surrounding surface and the nature and concentration of atmospheric constituents. For example, sky glow may appear greater on a foggy night (and similarly if there is smoke or dust present in the atmosphere), or if the area being illuminated is reflective.

Proposed Management

A number of Australian and international standards and guidelines exist for control of outdoor lighting. However, with the exception of regulations regarding permissible light emissions around airports and astronomical observatories, there are no statutory requirements with regards to light pollution in Australia.

Examples of some of the measures that can be implemented to reduce sky glow are as follows:

- Direct light downwards
- Select luminaries that minimise spread of light near to, or above, the horizontal

- Keep lighting levels (illuminance) to the minimum acceptable for the intended purposes
- Keep glare to a minimum; keep main beam angle to below 70º
- Use floodlights with asymmetric beams to allow front glazing to be kept at or near parallel to surface being lit, and
- Use energy efficient low-pressure sodium (LPS) lamps (especially where perception of colour is not necessary for the lighting to be effective).

The following items will be investigated by Alcoa for inclusion in the electrical design criteria, preferred equipment list and lighting installation details for the Proposal:

- Outdoor lighting will be designed so that general, non-critical lighting may be switched off during hours of inactivity, however, safety lighting such as for stairways and walkways will be maintained
- Switching will be automatic via plant control system with manual override at the affected area
- Wherever practical outdoor lighting will be directed downward to illuminate the target area. The selected luminaries will be of the cut-off type emitting little or no light above the horizontal plane
- Minimise the upward waste light ratio (UWLR)
- Where asymmetric light distribution is required floodlights will be of the asymmetric beam type to permit the front glazing to be kept at or near parallel to the surface being lit
- Outdoor lighting will be designed so that the average maintained illuminance does not greatly exceed the minimum values recommended by the applicable Australian standards and/or IES for the intended purposes
- Outdoor lighting will be designed so that glare is kept to a minimum by ensuring that the main beam angle of all lights directed towards a potential observer is kept below 70º. This may be achieved by selecting the most suitable combination of mounting height and number of fittings
- Low-pressure sodium (LPS) lamps will be used for outdoor lighting where good colour rendering or short start-up time is not critical such as road lighting, car park lighting, stockpile lighting (LPS lamps are also much more energy efficient than incandescent lamps), and
- Illuminated surface materials will be of lowest reflectance types that are compatible with the function of the area, e.g. grass or asphaltic surfaces.

Appropriate measures for management of light spill for the Proposal will be selected in consultation with plant operations and maintenance personnel to ensure adequate lighting requirements for safe working are maintained.

8.17 SOCIO-ECONOMIC IMPACTS

Potential Issues

A socio-economic impacts study for the Proposal was undertaken by Environmental Resource Management Australia (ERM, 2005; Appendix P). The following section discusses the potential consequences of impacts of the Proposal on the local communities and possible management responses to minimise these impacts.

The key positive impacts relate to economic development in shires of Waroona and Harvey, the Peel region, the State and Australia and include:

- "Economic development of the Peel Region through local procurement and 'multiplier' effects
- Increased employment security for existing Alcoa workforce and employees of suppliers
- Increased employment opportunities in the local and wider region
- Targeted investment by Alcoa on training and development in the region
- Potential for local businesses to capitalise on the opportunity by supplying goods and services during the construction phase
- Potential for population growth in adjacent shire,; and
- Revenues from taxes and royalties to State and Commonwealth governments." (ERM, 2005)

Potential adverse impacts which may occur as a result of the Proposal are:

- "Local companies might miss opportunities due to lack of investment in their capacity to supply Alcoa's needs or under-investment by governments (eg lack of light industrial land)
- Local companies may be over-optimistic about demand for their products and services as a result of the expansion and make investment decisions that harm the ongoing sustainability of their businesses
- Second tier suppliers and local businesses may be ill-prepared in transitioning their businesses out of the expansion "boom" period, resulting in a subsequent "bust" or economically depressed period post-construction
- Additional demands on government services and infrastructure due to temporary workforce
- Labour shortages could lead to wage inflation during construction and result in increased local business costs
- Short-term accommodation may be in heavy demand during the construction phase and 'squeeze out' tourists and tourism attraction spending

- Potential for anti-social behaviour associated with the presence of temporary construction workforce, and
- Slower growth of export value from South-West region due to an appreciating Australian dollar." (ERM, 2005)

Potential impacts on amenity are discussed in other sections of this ERMP (e.g. Dust, Section 8.3.7; Odour, Section 8.3.8; Noise, Section 8.4; Traffic and Transport, Section 8.8; Public Safety, Section 8.9; Visual Amenity, Section 8.15; Light Spill, Section 8.16).

Socio-Economic impacts are discussed in Appendix P in more detail and are summarised below.

Alcoa will invest over $1.5 billion in developing the Proposal and direct expenditure in the Peel and South West region could be as high as $50 million and is likely to reach twice this amount if sub-contracts and other indirect supplies are considered. This will boost the wider economy through direct and indirect employment, supporting local services and industries and providing subcontracting opportunities. Whilst the economic benefits are expected to be strongest in the Peel Region, it is also expected to stimulate economic growth in the South-West Region, Perth, Western Australia and Australia-wide.

Economic growth in regional economies is one of the aims of the State Government's Regional Development Policy (2003): *"Regional Western Australia – a Better Place to Live*" and the WA State Sustainability Policy (2003) (see Section 8.1.1). In line with these policies the Proposal will help enhance regional investment, assist in providing skilled regional communities and improve the quality of life in these regional areas.

Direct employment during the construction phase is expected to peak at over 1500, the equivalent of 500 full time jobs per year during the construction period. The expanded Wagerup refinery operations will require an additional 150 permanent employees. The multiplier effect (e.g., increased employee and business spending as a result of the Proposal stimulating local and regional economic growth) in the Peel and South West Regions is expected to result in approximately 2000 new indirect jobs during operations and another 1000 statewide. However, with strong economic growth and several other major construction projects underway or planned in the South West, there may also be labour shortages particularly in the area of skilled and semi-skilled construction labour. This may result in some wage inflation in the sector, which potentially adds to costs for local businesses which use the same workforce pool.

The Proposal will enhance training opportunities for young people in the region. In the past Alcoa has trained more than 1100 West Australian apprentices encouraging young people to seek jobs in their local communities. The Wagerup Proposal will provide an opportunity to further Alcoa's support for local communities. In 2004 Alcoa invested over $8 million in community partnerships in WA. These included partnerships on health, safety, diversity, the environment, community development, leadership and education, science and technology.

An increase in workforce will require an increase in available temporary accommodation during construction and permanent accommodation during operation of the Proposal. Based on previous construction projects in the Peel and South West, Reyco consultants (2005) have estimated that approximately 70% of the construction workforce (approx. 1000-1100 at peak) will be living within a 100km radius to the construction site. These workers will commute to and from their homes to the site by car. The remaining 30% (approx. 400-500 at peak) will be distance workers. These people will require local accommodation at reasonable cost, and based on Reyco's accommodation availability study, of these:

- it is anticipated 70% will choose to reside in Mandurah, and
- it is anticipated other 30% will choose seek accommodation in the towns of, Bunbury, Waroona, Harvey, Yarloop or coastal areas.

The Reyco research indicates accommodation is readily available for a peak construction workforce and therefore it will not be necessary for Alcoa to provide dedicated construction accommodation.

Increased demand for affordable accommodation and services in Mandurah and Bunbury is not expected to present a problem in these larger cities, but may result in a shortage of select accommodation (caravan parks, cabin/chalets and units) in the Shires of Murray, Waroona and Harvey, and may impact the availability of existing infrastructure and services.

The services most likely to be affected are medical and recreational services. During operations there are unlikely to be more than 150 new households and perhaps 450 residents in the local shires, which are not expected to result in significant adverse impacts on local services, such as family accommodation, education, essential council services and State social services.

For those workers temporarily relocated away from their families there is the risk of depression, social isolation, alcohol and drug abuse and effects on the family left behind including pressures on parenting roles and marital relationships.

The State will benefit from royalties paid by Alcoa from increased alumina production and payroll tax both as a result of direct employment by Alcoa and employment generated in the wider economy from subsequent spending. As a consequence this increased revenue flow from regional areas may strengthen the shires' positions in requesting provision of infrastructure and services from the State and Federal governments.

There is a risk that local businesses may over-invest during the period of strong demand during construction of the Proposal which may lead to a 'boom-bust' cycle once demand returns to more normal levels post-construction. However, during operations the increase in permanent population is likely to make more marginal enterprises viable.

At Bunbury, the continued growth of Alcoa through the proposed expansion at the Wagerup refinery will allow the Port Authority to continue to grow and develop the Bunbury Port and job opportunities will be created as a result of the increased activity. Based on Port Authority research into multiplier effects from additional ships, the proposal will create approximately 66 new full-time jobs in and around the Port.

Alcoa is committed to ensuring that the port facility does not adversely impact its neighbours. A new $4 million ship-loader has been installed to significantly reduce dust and other methods to further reduce dust from conveyor systems are being investigated (Section 8.3.6).

Proposed Management

Alcoa already has a number of programmes in place to support the local and regional communities (Section 7.15). Alcoa will ensure that management of socio-economic impacts will be undertaken with the community, government, local industry, and non-government organisations. Alcoa will seek to ensure that partnerships developed for the benefit of the community are aimed at developing the short and long-term capacity of the adjacent areas to further improve the community's own environment and quality of life.

To this end, members of the Socio-Economic Working Group are continuing to meet to discuss opportunities for community development and Alcoa will continue to support this group, for example, by providing facilitators and strategic advice.

Alcoa will continue to implement its local procurement policy for the Proposal. Key elements of this local content policy are to invite capable local businesses to bid on every locally supplied or manufactured good or service, give preference to local business in a competitive situation and work with local interest groups to identify and utilise local suppliers. Alcoa has provided briefings to individuals, groups and organisations (i.e. Mandurah Peel Region Chamber of Commerce) to give local businesses a better understanding of Alcoa's purchasing procedures and requirements. To increase the proportion of local procurement, Alcoa, the Shires and the development commissions have worked to compile databases of local suppliers.

Alcoa will continue to provide training placements in line with predicted workforce requirements and target skilled local residents for these placements. Alcoa already has an apprenticeship programme in place and initiatives such as 'Future Women of Industry' programme.

Based on available information the construction workforce for the Proposal can be housed in existing accommodation and no construction camp is required (Reyco, 2005). The following management measures are proposed for the construction workforce:

- Accommodation - review workforce participation and accommodation availability/demand when the Proposal is further defined. This will be achieved through undertaking an additional accommodation study
- Local employment - maximise employment of local workforce first
- Social interaction - identify opportunities for distant workers to be involved in community activities through welcome events and social/sport inclusion programs. Alcoa will liaise closely with Police and community groups to help ensure anti-social behaviour is minimised, and
- Services – Alcoa will liaise with government to quantify likely demands for health, emergency and education services.

In addition to the described socio-economic components of this ERMP, Alcoa has released a document that outlines some ideas that may assist the community with Alcoa and Government, in effecting positive sustainable change for the region.

Alcoa has conducted research, listened to the ideas from the Socio-Economic Working Group members, and to others, and has developed a set of project ideas. These 'ideas' will be used to stimulate conversation and is intended as a working paper for community, Government and Alcoa to discuss how we can work together to support social and economic growth in the region. Alcoa does not have all the answers, however Alcoa has resources to assist in the progress of a positive combined future.

This document is available on Alcoa's website www.alcoa.com.au/wagerup3.

Commitment 17

Alcoa will continue to consult with the local community on environmental aspects of the Proposal through the construction and commissioning phases of the proposal

9. ENVIRONMENTAL MANAGEMENT COMMITMENTS

Environmental management commitments outlined in Section 8 of this ERMP are summarised in the Table 36 following:

Table 36: Environmental Management Commitments for the Proposal

Category	Topic	Potential Impact (Section of ERMP)	Proposed Management Commitment	Timing	Advice From
Sustainability	Sustainability Principles	8.1	Commitment 1. Alcoa will be guided by its Sustainability Principles and will operate within the guidelines of its Environmental Management System (EMS) in implementing the Proposal.	During construction and operations	
Air Quality	Air Quality Management Plan	8.3	Commitment 2 Alcoa will implement the Air Quality Management Plan to monitor and manage aspects of the Proposal implementation with a potential for impacts on surrounding air quality.	Ongoing throughout Project implementation and operation	DoE
Air Quality	Particulates – Residue Storage area	8.3.1	Commitment 3 Alcoa will manage the bauxite residue generated from the Proposal in accordance with the Wagerup refinery endorsed Long-Term Residue Management Strategy.	During construction and operations.	DoE
Air Quality	Dust - RDAs	8.3	Commitment 4 Alcoa will improve the management of dust from the residue drying areas through an upgrade of the existing sprinkler control network.	During operations	DoE
Air Quality	Air emissions and modelling	8.3.4	Commitment 5 Alcoa commits to implementing the Proposal in a manner which ensures no significant change to the air quality predictions for	During construction and operation.	DoE DoH

Category	**Topic**	**Potential Impact (Section of ERMP)**	**Proposed Management Commitment**	**Timing**	**Advice From**
			surrounding areas (from refinery and RDA contributions) or Health Risk Assessment findings, detailed in this ERMP. This will be confirmed following commissioning of the Proposal.		
Air Quality	Community Health	8.3.4	Commitment 6 Should the Proposal proceed, Alcoa commits to commissioning a local community health survey. The results of this study would be available prior to commissioning of the proposal.	Prior to commissioning.	DoE DoH
Air Quality	Dust – Port operations	8.3.6	Commitment 7 Alcoa will manage ship-loading of alumina at the Bunbury Port to minimise the potential for dust impacts on the surrounding community.	During operation.	DoE Bunbury Port Authority
Noise	Noise Management Plan	8.4	Commitment 8 Alcoa will implement the noise management plan provided to ensure that the noise objectives for the Proposal will be met.	During construction and operations.	DoE
Noise	Noise emission impacts	7.13.3	Commitment 9 Alcoa will implement the Proposal such that there is no increase in noise impacts on nearby residents.	During operations	DoE
Noise	Noise – Port operations	8.4.2	Commitment 10 Alcoa will ensure that noise from the Bunbury Port Facility continues to comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* following the implementation of the Proposal.	During operations.	DoE Bunbury Port Authority

Category	**Topic**	**Potential Impact (Section of ERMP)**	**Proposed Management Commitment**	**Timing**	**Advice From**
Water Supply	Water Supply Management Plan	8.5	Commitment 11. Alcoa will implement the Water Supply Management Plan to manage additional water requirements for the Proposal.	During operations	DoE
Water Supply	Water Conservation	8.5.3	Commitment 12. Alcoa will continue to implement water saving measures into plant modifications and expansions where practicable and feasible, in line with sustainability principles and cleaner production goals.	Ongoing throughout Proposal implementation and operation.	
Transport	Traffic Management Plan	8.8	Commitment 13. Alcoa will prepare and implement a Traffic Management Plan to manage road traffic associated with construction of the Proposal.	During construction.	Main Roads Local Shires
Greenhouse gases	Emissions Intensity	8.10	Commitment 14 Alcoa will achieve a reduction in the greenhouse gas emissions intensity of the Wagerup refinery as a result of the Proposal by approximately 15% (based on cogeneration).	Operations.	
Greenhouse gases	Energy Efficiency	8.10	Commitment 15 Alcoa will review opportunities to improve the energy efficiency of equipment to be installed as part of the Proposal during the detailed design phase of the Proposal using a Cleaner Production review process.	Detailed design phase.	
Greenhouse gases	Greenhouse gas minimisation	8.10	Commitment 16 Alcoa will maintain its existing greenhouse gas minimisation programmes.	Ongoing throughout Proposal implementation and operation.	

Category	Topic	Potential Impact (Section of ERMP)	Proposed Management Commitment	Timing	Advice From
Social management	Community involvement	8.17	Commitment 17 Alcoa will continue to consult with the local community on environmental aspects of the Proposal through the construction and commissioning phases of the proposal.	During construction and commissioning.	

10. MANAGEMENT PLANS

The following section contains specific management plans for the Proposal to manage the following key environmental factors:

- Air Quality – refer to Section 10.1 for the Air Quality Management Plan;
- Noise – refer to Section 10.2 for the Noise Management Plan;
- Water Supply – refer to Section 10.3 for the Water Supply Management Plan; and
- Spill Management – refer to Section 10.4 for the Spill Management Plan..

10.1 AIR QUALITY MANAGEMENT PLAN

AIR QUALITY MANAGEMENT PLAN

Wagerup Refinery Unit 3

for

Alcoa World Alumina Australia

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Ref: Air Quality Management Plan- Wagerup ERMP May 05
9 May 2005

FOREWARD

This document has been prepared as part of the Wagerup Unit 3 Expansion Project, and is intended to reflect Alcoa's public commitment to transparency in its environmental management program. Public comments and submissions on its contents may be forwarded by mail to:

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This document is based on drafts prepared for Alcoa by consultants Environ. It will be reviewed and amended from time to time, and a current version maintained by Wagerup Refinery operations.

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Appendix A: Summary of Monitoring Programs

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EXECUTIVE SUMMARY

The purpose of this Air Quality Management Plan (AQMP) is to document Wagerup's existing and proposed monitoring regimes and outline management and mitigation measures proposed to reduce air emission from various key areas of the facility as a result of the Wagerup3 Project (The Project). In addition, this plan also outlines the management and monitoring commitments for point and diffuses sources on the premises, as well as subsequent ambient monitoring programs.

The main identified point sources for the Wagerup refinery are associated with the major pieces of process equipment such as calciner stacks, liquor burner flue, oxalate plant stack, boiler flues and cooling towers. The main identified diffuse sources for the Wagerup refinery include areas such as the residue drying beds, cooling ponds, Superthickner and liquor storage areas.

The emissions from the various point and diffuse sources for Wagerup refinery can be broadly categorised as follows:

1. Particulate matter (e.g. total suspended particulates and various sizes of dust);
2. Volatile organic compounds (e.g. aldehydes, ketones, polyaromatic hydrocarbons (PAH's) and Benzene, Toluene, Ethyl Benzene and Xylene (BTEX));
3. Combustion gases (e.g. nitrogen oxides, sulphur dioxide and carbon monoxide);
4. Trace metals (e.g. nickel, cadmium and mercury)
5. Odour

These groups of substances are emitted from different stages of the alumina refining process and are not present at all source locations. Having a defined monitoring program as outlined within this AQMP creates a framework for collating data and interpreting the results. It will also assist in identifying continual improvement within Wagerup's refinery operations.

The monitoring program outlines the substances to be sampled, the frequency of the sampling program and the methodology used. The monitoring program outlined in this document has three distinct phases: commissioning monitoring; performance verification monitoring; and compliance monitoring with the intention to verify the commitments made within the Environmental Review and Management Program (ERMP).

The management and mitigation measures outline the reductions estimated based on the installation of emission control equipment and other process efficiencies. This also includes ongoing management measures that will be undertaken to ensure that these reductions are sustained.

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AIR QUALTIY MANAGEMENT PLAN
Wagerup Refinery Unit 3
for
Alcoa World Alumina Australia

1 INTRODUCTION

1.1 BACKGROUND

Alcoa's Wagerup alumina refinery and its associated bauxite residue drying areas (RDAs) are located 120 kilometres south of Perth, two kilometres north of Yarloop and approximately seven kilometres south of Waroona. The refinery is located close to the foot of the Darling Scarp and is separated from the RDAs by the South West Highway and the Perth-Bunbury railway line (refer to Figure 1). The refinery produces alumina using the Bayer process from bauxite mined at the Willowdale mine site.

Alcoa proposes to expand its existing Wagerup alumina refinery through completing the construction of a third production unit. Construction of the third production unit will increase production from 2.41 million tones per annum (Mtpa) to a total of 4.7 Mtpa. An ERMP has been prepared and submitted to the Environmental Protection Authority (EPA) for assessment under Part IV of the *Environmental Protection Act 1986.* This AQMP forms part of the ERMP and is included as an Appendage to the document.

A simplified flow diagram for the refining process is presented in Figure 2. Components of the process that are significant sources of air emissions are explained in the following sections. For a full description of the production process and the nature of the expansion Project works, refer to the document *Environmental Review and Management Programme - Wagerup Refinery Unit 3, March 2005.*

1.2 PURPOSE AND SCOPE OF PLAN

The purpose of this AQMP is to document the air quality monitoring and management initiatives that will be used to assess any significant air quality predictions or assumptions made as part of the ERMP. This will also provide a platform for identifying areas for continual improvement at the Wagerup refinery in relation to air quality.

This plan will form part of the overall Wagerup refinery environmental management system and addresses the following aspects:

1. A description of air emission sources and compounds of interest;
2. A summary of existing and proposed major sources with proposed changes and control measures;
3. A summary of the proposed monitoring programs during plant commissioning and operation;
4. A summary of the management and mitigation measures; and

5. Ongoing air emission monitoring programs.

The scope of this AQMP does not include greenhouse gas emissions as this will be addressed in a separate greenhouse gas management plan.

1.3 TYPES OF AIR EMISSIONS

Air emissions are usually grouped into two categories: point source emissions; and diffuse source emissions. Point source emissions arise where the vapors or particulates have been channeled or directed to a defined point prior to emission to atmosphere, such as stacks and vents. Diffuse source emissions originate over a broader area where there is little or no redirection of the vapors or particulates. Examples of diffuse source emissions include large drying beds and lake surfaces.

The main identified point sources for the Wagerup refinery are associated with the major pieces of process equipment such as calciner stacks, liquor burner flue, oxalate plant stack, boiler flues, calcination vacuum pumps and cooling towers. The main identified diffuse sources for the Wagerup refinery include areas such as the residue drying beds, cooling ponds, Superthickner and liquor storage areas.

The emissions from the various point and diffuse sources for Wagerup refinery can be broadly categorised as follows:

1. Particulate matter (e.g. total suspended particulates and various sizes of dust);
2. Volatile organic compounds (e.g. aldehydes, ketones, PAH's and BTEX);
3. Combustion gases (e.g. nitrogen oxides (NO_x) and carbon monoxide (CO));
4. Trace metals (e.g. nickel, cadmium and mercury) and
5. Odour

Not all sources have the range of emissions listed above. For example bauxite stockpiles can emit metals in dust, but are unlikely to emit measurable amounts of volatile organic compounds.

2 OBJECTIVES AND TARGETS

2.1 BACKGROUND

Alcoa has adopted sustainability principles and it is a requirement that these principles be considered during all new projects. The principles are as follows:

1. Respect and protect people
2. Build community experience and well being
3. Long-term economic benefit
4. Efficient resource use and cleaner production
5. Ecological integrity and biodiversity
6. Meeting the needs of current and future generations
7. Stakeholder involvement
8. Accountability and governance

The following general air quality objectives and targets build upon Alcoa's sustainability principles.

1. The nature and impacts of air emissions are well understood by Alcoa.
2. The nature and impacts of air emissions are well understood by external stakeholders, and particularly the local community.
3. Air emissions do not adversely affect the health of Alcoa.
4. Air emissions do not adversely affect the health of the local community or any other external stakeholder.
5. Air emissions do not adversely impact on the physical environment.
6. Air emissions do not unreasonably impact on public amenity.
7. Air emissions are minimised as far as reasonably practicable.
8. Plant emissions controls are operated effectively.
9. Air dispersion modeling undertaken during the environmental impact assessment process is validated.
10. Compliance with all relevant legislation is achieved.

The above general air quality objectives and targets have been used as a basis for developing the monitoring programmes within the AQMP along with existing air quality licence limits, commitments to reduce emissions as outlined within the ERMP (ENVIRON 2005). The results obtained from within this management and monitoring program will need to comply with the various regulatory limits and demonstrate reduction commitments as outlined in the following sections.

2.2 ENVIRONMENTAL LICENCE LIMITS

The 2004 operating licence for the Wagerup Refinery (DoE 2004) states the following emission limits (Table 1) for emissions from the RDAs, Calciners, Boilers, the Liquid Burning Facility and Gas Turbine/Heat Recovery Steam Generator stacks (GT/HRSG).

Table 1.0: Summary of Environmental Licence Limits – Alcoa Wagerup[1]

Emission Sources	Parameter	Licence Limit
RDA	TSP	200 µg/ m^3 (for 95% of the time and never exceeding 260 µg/ m^3 (24 hour average)
Calciners 1, 2, 3 and 4 as individual emission points	Particulates	0.08 g/ m^3
	NO_x	0.35 g/ m^3
Liquid Burner Facility	Particulates	0.08 g/m^3
	CO	1.0 g/m^3
Boilers when fired on gas (average over boilers 1, 2 and 3)	CO	1.0 g/ m^3
	NO_x	0.35 g/ m^3
GT/HRSG stacks	CO	1.0 g/ m^3

2.3 ERMP COMMITMENTS AND PUBLIC UNDERTAKINGS

Alcoa has given some important public undertakings that set broad-scale air quality objectives for the Wagerup Unit Three project. The expansion of the refinery will:

1. Cause no increase in odour, dust or noise impacts on residents from mining and refining operations;
2. Cause no increase in short or long-term emission impacts on residents;
3. Meet world class health risk criteria.

The measurement of air quality parameters as a result of this AQMP will provide much of the information to assess operational performance of the project against these public undertakings.

To achieve the undertakings made for the Unit 3 expansion, Alcoa has developed a decision making framework. The framework is to be used to guide the assessment of compliance with these undertakings. The framework identified that if investigations indicate a likelihood of increased impacts on neighboring communities from particulates, odour, or short/long-term emission impacts,

[1] Western Australia, Department of Environment, Licence number: 6217/8, Alcoa World Alumina Australia ,Wagerup Alumina Refinery

project modifications will be necessary for the project to proceed. In the case of emissions three general options may be available to offset potential impacts, using the decision making framework:

1. Additional works to reduce emissions;
2. Increased dispersion; or
3. Increased separation between source and receptors.

Emission measurement and air dispersion modelling have been used to assess the potential for air quality impacts from implementation of the project, the results of which are detailed in the ERMP. Engineering design and operational changes, coupled with modelling have been used to manage potential increases in emissions and, where appropriate, increased emission dispersion. Furthermore, Alcoa's land management strategy provides an ongoing offer to purchase properties in the immediate vicinity of the refinery (known as Area A) at 135% of market value. This will remain in place following commissioning of the Unit Three, if approved. This combination provides the overall framework to ensure the public undertakings in relation to the expansion can be met.

To assess if Alcoa is meeting its public undertakings, specific objectives have been set for noise, dust, odour and other emissions. The objectives for each of these areas are described by the following:

2.3.1 Odour

Alcoa has given an undertaking that the expansion of the refinery will:

> *Cause no increase in odour, dust or noise impacts on residents from mining and refining operations;*

These undertakings are supported by specific objectives. In respect of odour, Alcoa's specific objective is that the odour impacts predicted for the expansion satisfy the EPA Odour Guidance Statement Number 47 objective 'that for expansion of existing odour sources there would be no deterioration of current amenity values'. Or in other words, that predicted odour concentrations at sensitive land uses will not increase. This will be measured as follows;

1) There will be no increase in 'peak odour impacts', defined as 99.9% 3 minute average odour concentrations at neighbouring residences for refinery peak emissions; and
2) There will be no increase in 'average odour impacts', defined as 99.5% 3 minute average odour concentrations at neighbouring residences for refinery average emissions.

2.3.2 Dust

The predicted ground-level dust concentrations, from refinery operations, meet the National Environmental Protection Measure (NEPM) 24-hour PM10 goal of 50 µg/m3 and the Kwinana EPP Area B limit for TSP of 260 µg/m3 at neighbouring residences.

2.3.3 Short-term air emission impacts

The acute hazard indices, based on 1 and 24 hour values, as predicted in the health risk assessment will meet world class guidelines (that is remain < 1 at all neighbouring residences following the expansion). Also predicted short-term refinery emission concentrations (3-10 minute peak values) do not increase at neighbouring residences or if any target compound (VOCs and metals) does show an increase it remains at insignificant concentrations. There are generally not health guidelines for these time periods, however an assessment will be made relative to health guidelines that do exist.

2.3.4 Long-term emission impacts & health risk

Both the chronic health index and incremental cancer risk predictions (parts of the Health Risk Assessment) meet world class guidelines:

The air dispersion modelling and Health Risk Assessment undertaken as part of this ERMP have established that the predicted air quality outcomes following commissioning of the Unit Three project will satisfy each of the measures described above. This AQMP proposes additional investigations and monitoring to verify that the assumptions inherent in the model predictions are correct and that air quality measurement post-commissioning of the project confirms the above targets have been met. Through the ERMP, Alcoa has committed to minimising point and diffuse source emissions where practicable.

3 WAGERUP EMISSION SOURCES

3.1 BACKGROUND

There are a large number of point and diffuse sources at the Wagerup Refinery with approximately 37 sources identified in the expansion scenario to be the main sources contributing to atmospheric emission from the refinery. The above 37 sources includes the two powerhouse options under consideration which are the implementation of additional boilers or cogeneration. These sources are further divided into major and minor sources based on their individual contribution to overall refinery emissions and their potential to contribute to health risk i.e, major sources are those sources that are large contributors to overall refinery emissions and hazard indices.

An assessment on the type of emission sources and their significance in terms of their contribution to total refinery emissions can be found within the Air Quality Summary Report – Wagerup Expansion, (ENVIRON 2005). The sources identified in the table below were also included in the Air quality impact study and the subsequent health risk assessment. These sources are identified and presented in Table 2.

Table 2.0: Summary of Major and Minor Sources

Sources	Existing/New	Major / Minor
Oxalate Kiln Stack	New	**Major**
Liquor Burning	Existing	**Major**
Calciner 1	Existing	**Major**
Calciner 2	Existing	**Major**
Calciner 3	Existing	**Major**
Calciner 4	Existing	**Major**
Calciner 5	New	**Major**
Calciner 6	New	**Major**
Boiler 1	Existing	**Major**
Boiler 2	Existing	**Major**
Boiler 3	Existing	**Major**
Boiler 2/3 (Non-condensables)	Existing	**Major**
Boiler 4	New	**Major**
Boiler 5	New	**Major**
Gas Turbine 1	Existing	**Major**
Gas Turbine 2	New	**Major**
Gas Turbine 3	New	**Major**
Non-Combustion Equipment Point Sources:		
OBF Vac Pump Stack	Existing	Minor
Calciner 1,2,3 Vac Pump, 50B and Dorrco	Existing	Minor
Calciner 4 Vac Pump and Dorrco (combined emission)	Existing	Minor
45K Cooling Tower 2 and 3	Existing	**Major**
45K Cooling Tower 1	Existing	**Major**
50 Cooling Tower 1 and 2	Existing	**Major**
Grouped Sources:		
Milling Vents	Existing	Minor
25A Tank Vents	Existing	**Major**
B26 Stacks	Existing	Minor
35F & D Vents	Existing	Minor
35A Vents (Non cons)	Existing	Minor
35C Washer Area Vents - Banks 1-3	Existing	Minor
35C Washer Area Vents - Banks 4-6	Existing	Minor
35J Tank Vents (Non cons)	Existing	Minor
Grouped Sources to Water (ultimately to air):		
Cooling Lake	Existing	**Major**
Bldg 30 Condensate to Lower Dam	Existing	Minor
Lower Dam	Existing	Minor
ROWS	Existing	Minor
RDA	Existing	**Major**
Super thickner	Existing	**Major**

Notes
1) Existing – refers to existing sources at the facility
2) New – refers to sources proposed as part of the Expansion

The main focus of the emissions monitoring and mitigation program are on those sources identified in this report as major sources (based on their contribution to overall refinery emission and health risk). In order to increase production without increasing atmospheric emissions, the project focus was to implement emission control equipment to key components of the refinery process and to continuously improve management practices to achieve further improvements in emissions management.

The significant sources included in the modeling of refinery emissions account for approximately 96% of the total mass of refinery air emissions. Sources not included in modelling together account for the remaining 4%, with no individual source among these accounting for 1% or more of air emissions. Some of these sources not included in modelling of specific substances for the HRA are included in odour modeling. This section therefore outlines the monitoring, management and mitigation measures proposed to ensure no further increase in atmospheric emissions for the major sources.

3.2 MONITORING PHASES – DEFINITION OF

The monitoring program specifically outlines what substances are being sampled, the frequency of sampling and the methodology used. The program has three distinct phases where emissions are expected to differ due to the increasing production rates during the expansion and normal operation. Reference is made throughout this document to 'commissioning', 'performance verification monitoring', and 'on-going monitoring'. For the purposes of this management plan, these terms have the following meanings:

- **Commissioning monitoring** – refers to the functional testing of continuous monitoring equipment such as temperature gauges as well as source emission monitoring. It is anticipated that direct measurements will be undertaken during the dry commissioning phase before the equipment is linked back to the process stream as well as during commissioning after the equipment is linked to the process. Commissioning monitoring is predominantly undertaken to ensure that new plant and equipment meet manufacturer specifications.

- **Performance Verification Monitoring** - is an intensive investigation of emissions immediately following the commissioning of new plant and equipment associated with the Project. The objective of monitoring during this phase is to determine the nature and extent of emissions generated during the range of normal operation in the weeks and months immediately following commissioning of equipment.

- **On-going Monitoring** – refer to monitoring of emissions as part of Alcoa Licence arrangements to ensure that licence limits are not exceeded and to assist with identifying further areas for improvement within the refinery. For the purposes of this AQMP, on-going monitoring for proposed new plant such as calciners and powerhouse boilers are assumed to be analogous to existing calciners and boilers. Additional on-going programs proposed are also detailed under this section.

Due to their nature, 'performance verification monitoring' are proposed to be more extensive than compliance monitoring, both in terms of the number of parameters monitored and the frequency of monitoring. In designing the monitoring program, consideration was also given to the point source's contribution to the total emission for each type of substance. For example, the monitoring program for the boilers does not include particulates as their overall contribution to particulate emissions is low. A summary of the point source monitoring program during the different phases of operation can be found in Appendix A.

Data gathered during the 'performance verification monitoring' will be used to compare emissions generated after the expansion for comparison against baseline data collected before the works commenced. The intention is that this will verify whether the commitments made by Alcoa are being met. A summary of the proposed monitoring programs that are likely to be undertaken are outlined in this AQMP with a view to formalise a comprehensive program prior to the commissioning stage.

3.3 POINT SOURCE MANAGEMENT PLAN

The following sections outline the monitoring programs and management measures to be undertaken to meet the above stipulated performance requirements in addition to meeting licence requirements.

3.3.1 Oxalate Kiln

Sodium oxalate is present as an impurity in the Bayer liquor, which reduces the efficiency and effectiveness of the alumina refining processes. Currently the oxalate is removed from the process and is deposited in dedicated lined areas independent of other the residue drying areas. As part of the expansion, the oxalate that is removed from the production stream will be combusted in the rotary kiln with the combusted gases directed via a wet scrubber to a RTO (regenerative thermal oxidizer) to reduce VOC and CO emissions from the discharge stack. These works are scheduled to be commissioned in 2006. Since the efficiency of the RTO is intrinsically linked to the temperature at which they operate, continuous temperature monitors will be installed. Continuous CO monitors will also be installed at the inlet and outlet of the RTO to demonstrate destruction efficiency.

It is envisaged that operational and maintenance requirements of the proposed oxalate kiln and associated control equipment will follow both manufacturer's specification and experience gained at Pinjarra. This will include targeted maintenance periods for the RTO and scrubber with control equipment linked to the process to ensure there are not uncontrolled releases of air emissions from the oxalate stack.

The oxalate kiln stack is a relatively low contributor to total emissions of CO, VOC and particulates when treated, however reduction of these substances from the oxalate kiln stack will assist in meeting performance requirements.

Emissions data for the Oxalate stack for Wagerup is based on the output from the Pinjarra Refinery oxalate stack, factored for production rate with an assumed 95% odour and VOC removal efficiency. This is based on operating experience gained by Worsley Alumina with a RTO unit fitted to their liquor burner demonstrating removal efficiency greater than 99%.

Experience from other installations of similar RTO technology indicates that if CO is being destroyed, then VOCs will be destroyed to a similar or greater degree. Alcoa therefore intends to use continuous CO monitoring to provide a surrogate indication of ongoing VOC destruction. Presented in Table 3 are the proposed monitoring and management plans for the oxalate kiln.

Table 3.0: Summary of Monitoring and Management Measures – Oxalate kiln

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
Commissioning monitoring will include functional testing of the temperature control and calibration of temperature meters prior to operation of the RTO. This will include verification that the continuous CO monitors are reading correctly. In addition monitoring will be undertaken to ensure that the oxalate kiln and the associated emission control equipment meets manufacturer and performance specifications during the commissioning phase.	Monitoring during performance verification of the oxalate kiln will aim to verify the performance targets and will comprise the following elements: A planned monitoring program for particulate and trace metals will be undertaken in the weeks and months subsequent to kiln commissioning. In addition VOC monitoring will be undertaken to establish RTO destruction efficiencies. The VOCs will be sampled primarily for aldehydes and ketones as they contribute the largest proportion of total VOCs present. Interim monitoring in the first year of commissioning will be undertaken to assess the performance of the new Oxalate kiln stack and the RTO in destroying VOCs and reducing particulates. This will include regular VOC monitoring at the inlet and outlet of the RTO to verify destruction efficiencies established during commissioning and performance verification monitoring.	It is envisaged that on-going monitoring will include quarterly monitoring for particulates, with biannual monitoring for VOCs and annual monitoring for trace metals The limits for ongoing compliance monitoring will be outlined in the new licence.	The key measure to reduce emissions in the proposed oxalate kiln is the installation of an RTO to the oxalate kiln stack. Additional measures to ensure emissions management include: 1. The CO concentration will be continuously monitored at points before and after the RTO. 2. The RTO will be shut down for planned inspection, maintenance and overhaul to ensure effective operation. 3. Oxalate kiln stack exit gases will be monitored in accordance with the performance verification and ongoing monitoring programs 4. Alcoa will prepare and publish an interim commissioning report to verify performance of the oxalate kiln emission control equipment against regulatory design criteria. 5. Alcoa will report particulate emission monitoring results against the regulatory limit in its monitoring reports to the Department of Environment 6. Alcoa will provide statistical information regarding CO destruction efficiency in its monitoring reports to the Department of Environment. 7. Procedures will be developed to ensure that excursions in operating temperature are flagged and acted upon as quickly as possible. 8. A service contract will be maintained to ensure that repairs to the RTO unit will be undertaken as quickly as possible without compromising the quality of repairs

3.3.2 Liquor Burner

The liquor burner controls the build-up of organic compounds in the recirculating process liquor. These compounds originate from organic material in bauxite. They inhibit and eventually significantly reduce the extraction of alumina from the liquor. The liquor burner thus represents a means of ensuring the continued responsible use of the bauxite resource and minimisation of energy wastage and greenhouse gas emissions. The drying and combustion of organic components in the liquor creates a range of organic compounds, which are controlled by a range of emission control technologies including replacement of the catalytic thermal oxidiser (CTO) with an RTO and incorporating with the existing electrostatic precipitator (ESP) and dehumidifier. The RTO will be installed downstream of the ESP and the dehumidifier to ensure particulates are removed from the gas stream prior to entering the dehumidifier.

There are no additional improvements planned.

Table 4.0: Summary of Monitoring and Management Measures – Liquor Burner

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
Commissioning monitoring will be similar to that of the oxalate kiln and will include functional testing of the temperature control and calibration of temperature meters prior to operation of the RTO. This will include verification that the continuous CO monitors are reading correctly. In addition, monitoring will be undertaken to ensure that the Liquor Burner and the associated emission control equipment meets manufacturer and performance specifications during the commissioning phase.	Monitoring during performance verification of the upgraded Liquor Burner will aim to verify the performance targets and will comprise the following elements: A comprehensive monitoring program will be undertaken to establish the destruction efficiencies of the proposed RTO. The VOCs will be sampled primarily for aldehydes and ketones as they contribute the largest proportion of total VOCs present.	Ongoing monitoring will be undertaken in accordance with program stipulated in the Wagerup Licence and will include quarterly monitoring for particulate matter and CO, NO_x, SO_x, acetaldehyde, acetone, 2-butanone, formaldehyde, benzene, odour concentration, temperature, stack velocity, stack flowrate and will include daily monitoring of dryer feed rate, kiln pressure and RTO pressure drop and temperatures.	The major management measure to further reduce air emission is the replacement of the CTO with an RTO to further control VOC emissions. Additional management measures will also include: 1) The CO concentration will be continuously monitored at points before and after the RTO. 2) The RTO will be shut down for planned inspection, maintenance and overhaul to ensure effective operation. 3) The stack exit gases will be monitored in accordance with the performance verification and ongoing monitoring programs 4) Alcoa will prepare and publish an interim commissioning report to verify performance of the Liquor Burner emissoin control equipment against regulatory design criteria. 5) Alcoa will report particulate emission monitoring results against the regulatory limit in its monitoring reports to the Department of Environment 6) Alcoa will provide statistical information regarding CO destruction efficiency in its monitoring reports to the Department of Environment. Procedures will be developed to ensure that excursions in operating temperature are flagged and acted upon as quickly as possible.

3.3.3 Calciners

Calcination is the processing step of converting hydrated alumina to alumina. This is done by heating in a fluidised bed furnace at approximately 1000°C to drive off the water of crystallisation. There are currently four calciners (1-4) at the refinery, with two more calciners proposed to be installed during the expansion works. Calciner emissions include alumina dust, combustion products, VOCs and some trace metals. The dust emissions are controlled by electrostatic precipitators (ESP) with approximately 80% of dust emissions from the refinery process likely to be generated from the calciners (this statistic excludes dust generated from the residue area and the bauxite storage area).

Calciners 5 & 6 are to be fitted with three zone ESP's with the expected dust output limited to 10 mg/m^3. The existing ESP's on the current calciners are 2 zone, thus peak emissions when rapping will be significantly reduced on the new calciners. Calciners 3 and 4 will have an increase in their operating rate of between 20% and 40% during the expansion with Calciners 1 & 2 increasing by between 1% and 6%. Calciner 3 will be improved to match Mark VI standard to achieve similar emission levels as Calciner 4.

A summary of the monitoring programs and management measures are presented in Table 5.0.

Table 5.0: Summary of Monitoring and Management Measures – Calciners

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
During commissioning, functional testing and calibration of the dust control monitors (DCMs) will be undertaken for Calciners 5 & 6 with comparison against isokinetic particulate matter results. The monitoring work is undertaken to confirm that the equipment is working to design specifications and to determine if particulate emissions during operation will achieve their nominated design criterion.	Performance verification monitoring will only be undertaken for Calciners 3, 5 & 6 and will aim to verify their performance targets. Sampling will be undertaken to obtain a statistically sound data set by which to verify the performance. Based on the outcomes of the performance verification monitoring, interim monitoring may be conducted for the first year. This will be dependent on the results of the commissioning and performance monitoring of Calciners 5 and 6.	On-going monitoring will be undertaken in accordance with the monitoring program stipulated in the Wagerup Licence. It is envisaged that this program will extend to the additional two calciners. The monitoring program involves 2-monthly monitoring of exit gases from all calciners for particulates, combustion products, odour, acetaldehyde, acetone, 2-butanone formaldehyde and benzene with measurements of daily gas flowrates and calciner furnace temperatures.	The measures include the management and maintenance of the emissoin control equipment installed on the calciners. The key mitigation measure is the installation of 3 zone ESP's on the new calciners. Additional measures include: 1) The maintenance of continuous DCM's on all calciners. 2) Calciner 3 will be upgraded to be equivalent to Mark VI standard to match emission characteristics of Calciner 4. 3) Calciners 5 and 6 will be installed with three zone ESP's with the expected output limited to 10 mg/m^3. 4) The modification of Calciners (1-3) such that the low volume vent emissions from each calciner are directed into the feed air into the back end of the calciner. 5) The operation of continuous dust monitors will be maintained for each calciner. 6) The calciners will be operated assuming a compliance limit of 80 mg/m^3 for each calciner with an internal operating target of 60 mg/m^3. 7) Planned regular maintenance will be undertaken on the ESPs for each calciner. 8) Calciner stack exit gases will be monitored in accordance with performance verification and compliance specifications. 9) A commissioning report will be prepared to verify performance of the calciner emission control systems against regulatory and internal targets. Sustained dust emissions above the target levels will be acted upon immediately in accordance with current procedures.

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
			10) In the event of emission control equipment failure or trips, existing control procedures will be followed to mitigate the problem.

3.3.4 Power House Boilers

The boilers at Wagerup generate process steam and electricity for the refining process by means of natural gas fired boilers (Boilers 1-3) and turbo-alternators. In addition, a Gas Turbine / Heat Recovery Steam Generator is also installed for the same purpose. There are currently three boilers *(three large ICAL boilers*) on site with an additional two boilers proposed as one of the options for the Wagerup 3 Expansion (Boilers 4 & 5) with the other option being an additional two cogeneration units (Gas turbines and Heat Recovery Steam Generators). The existing boilers are fitted with low NO_x burners with proposed boilers/GT's also including low NO_x burners. The most significant emission is NO_x, with other combustion products making up the remainder of the emission from the Boilers.

Table 6.0: Summary of Monitoring and Management measures – Boilers & Gas Turbines

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
During commissioning of Boilers 4 and 5, monitoring will be undertaken to confirm that the equipment is working to design specifications and to determine if NO_x emissions during operation will be within design specifications. Monitoring will be conducted for NO_x, CO and SO_2 during the initial commissioning period.	Performance verification monitoring will be undertaken to confirm that NO_x emissions meet design specifications Monitoring will also be undertaken for other combustion products immediately after the boilers or the gas turbines are commissioned.	The on-going monitoring program for the existing and proposed boilers and gas turbines will closely the current licence monitoring regime. This monitoring program includes three monthly sampling for NO, NO_2, NO_x, CO, fuel feed rates and steam outputs over the duration of the tests. In the event that boilers 2 and 3 are fired using diesel, then the number of tests undertaken should be adequate to define the relationship between mass rates for NO and NO_2 and steam output over the range of ambient temperatures that may be reasonably be expected to occur over the course of one year.	The management and mitigation measures for the boilers and gas turbines are summarised below. 1. The burners will be shut down on a regular basis for inspection, planned maintenance and overhaul to ensure effective operation. 2. Boiler and gas turbine exit gases will be monitored in accordance with the performance verification and ongoing monitoring programs (Appendix A). 3. Sustained emissions above the target levels will be acted upon immediately in accordance with current procedures.

3.3.5 Cooling Towers

Various parts of the Bayer process require the progressive cooling of hot liquor. Separate cooling water circuits are used to generate cool water. Water that has been used to cool the hot liquor is directed to the cooling towers where it is cooled so it can be recycled. There are a number of cooling towers present at the refinery, the most significant of which are the 45K1, 45K2, 45K3 50C1 and 50C2 cooling towers. These cooling towers have been identified as a source of VOC emissions from the refinery, largely due to the volume of air discharged from it. The water used in the tower is sourced from the Lower Dam and contains some VOCs in solution. Due to its size and shape, and the moisture content of the gas stream, it is difficult to accurately measure the amount of emissions discharged from the Cooling Towers.

All new cooling requirements in precipitation are to be met with fin fan coolers or technology that results in similar reductions in emissions to air. Enough excess capacity is to be installed to allow for the shutdown of the 45K1 cooling tower. In addition the operation of cooling towers will be modified to achieve a 50% reduction in odorous emissions.

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Table 7.0: Summary of Monitoring and Management Measures – Cooling Towers

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
There is no commissioning monitoring proposed at this stage.	There is no performance monitoring proposed at this stage.	The existing cooling towers are not licenced sources and therefore do not require compliance monitoring. There is no on-going monitoring proposed at this stage	The management measures proposed for the cooling towers include: 1. All new cooling requirements in precipitation to be met with fin fan coolers or technology that can meet similar emission reduction. 2. A 50% reduction in odorous emissions will be achieved by modifying the operation of cooling towers.

3.3.6 25A Tank Vents

Slurry storage represents the next processing step after milling and receives milled slurry to remove dissolved silica from the milled ore. It is performed at a lower temperature but has longer residence time than the subsequent digestion process. It utilises excess flash vapour from the digestion process for heating of the slurry. As a consequence there has been intermittent release of vapour from vents associated with each slurry storage tank. The slurry storage tank includes four tanks in series. The first tank is the hottest, and the only tank receiving digestion vapour directly. This is therefore considered to be the most significant source of VOCs. Additional 25A tanks are to be installed with the upgrade. Also existing contact heaters to be replaced by sealed units. This expected to reduce vapour flows from this source by 75%. No decrease in the concentration of emission from the source is expected.

Table 8.0: Summary of Monitoring and Management Measures – 25A TANK VENTS

Commissioning Monitoring	Performance Verification Monitoring	On-going Monitoring	Management Measures
Monitoring of the two additional tank vents will be undertaken to quantify the emissions from this source during the commissioning stage. Monitoring will focus on VOC emissions.	Performance verification monitoring will be undertaken to confirm the commissioning monitoring results.	The tank vents are not licenced sources and therefore do not require compliance monitoring. There is no on-going monitoring proposed at this stage	The major management measure for the 25A tank vents is the use of sealed units. This is expected to reduce vapour flows from this source by 75% which will have a direct reduction in mass emission rates.

3.3.7 Other Minor Sources

Minor point sources such as small vents and vacuum pumps were identified within the baseline emissions study as primarily emitting VOCs. Individually the majority of these sources contribute between less than 1% and 5% of the total refinery VOC emissions. However, when considered collectively the following emissions sources can contribute to a more significant proportion of emissions. These minor sources are:

1. Milling vents;
2. 35 F&D vents;
3. 35 A vents;
4. Liquor tank vents (35L & 35 H);
5. 35C Washer vents;
6. OBF vacuum pump stack;
7. 44 seed filtration;

Due to their number, size and nature, there are practical difficulties in obtaining samples from all of these minor emission sources, and VOC emission information is estimated. For those minor sources where there are multiple pieces of equipment of the same configuration, monitoring of a subset of sources will be used to estimate emissions from that group. For example, Alcoa may monitor emissions from a single milling vent, and assume similar emissions data for all milling vents. In order to ensure that comparisons can be made between each inventory, all sampling locations and methods utilised will be based on that documented within the Air Quality Summary Report, 2005. Any variations to this will be recorded, and where possible, reproduced in subsequent inventories.

3.3.8 Summary of Changes – Point Sources

A number of sources within the expansion scenario have emission reductions (either volumetric flow rates or concentrations, or both). The mass emission rates for point sources for the base and expansion scenarios are presented in the Air Quality Summary Report (AQSR) (ENVIRON 2005). The basis of these changes reflects specific design measures and improvements in operational performance that are expected to be achieved following the refinery expansion. The basis for these design and operational improvements in reducing emissions, or in limiting their increase with the expansion is given in Table 9 for each source where a reduction or reduced increase in emissions is claimed.

Table 9.0: Summary of Changes to Point Sources

Source	Management Measure
Calciner 3	1. Improvements to equivalent of Mark VI Standard
Calcination	1. Peak Wagerup 3 calcination dropped to 14,400 tpd to 14,016 tpd
Boilers 4 & 5	1. New boilers 4 and 5 to have low NO_x burners.
Calciners (1-3) Low volume vent emissions	1. The existing calciners will be modified such that the low volume emissions form each calciner are directed into the calciner combustion air.
Calciners 4-6 low volume vent emissions	1. Calciner 4 to be modified to feed existing stack emissions into calciner combustion air feed system. 2. Calciner 5 and 6 to incorporate low volume emission into combustion air feed system
Cooling Towers	1. Operation of cooling towers to be modified to achieve a 50% reduction in odorous emissions, which will also include filtration of cooling water to reduce suspended particulate matter, reduced water treatment chemical usage and alternative water source.
Milling Vents	1. The installation additional milling capacity is expected to increase vapour emissions to 133% of current flow
25A Tank Vents	1. Additional tanks to be installed with the upgrade 2. Existing tank contact heaters ot be replaced by sealed units.. 3. A reduction in vapor flows by 75% with no decrease in concentration expected.
Digestion Blow-off Containment Tank Vents	1. Unit 3 to be constructed with a spare flash tank for use during flash tank outages. 2. Improved heat recovery through better management and maintenance activities 3. Vapour emissions to be reduced to approximately 0.75tph per unit, improving the collection of vapour emissions and routing to boilers for thermal destruction. 4. 73% reduction in flowrates expected
Sand Removal	1. Emissions from proposed new cyclone separation system estimated to be approximately 50% of current emission levels
Causticisation (35J)	2. 35J causticisation will be either replaced with high efficiency causticisation units or technology installed to achieve similar emission to air output .
Clarification Filtrate (35A)	1. New filters to be modern day equivalent. No press air used to dump these filters which should avoid increasing flows from 35A vent. 2. Existing tank vents to be modified to control flow rate from the tanks.

Data gathered during the commissioning and performance verification monitoring phase will be used to compare emissions generated after Wagerup 3 against baseline data (2.41 Mtpa production scenario). The intention is that this will verify whether the commitments made within the ERMP are met.

The predicted expansion emissions were estimated from the baseline data that was collated. It was also adjusted to consider peak and average flows resulting from production. It was from this data that Alcoa was able to determine its emission reduction commitments summarised within the ERMP. The calculated mass emission rates for the existing and expanded scenarios are presented in the Air Quality Summary report (ENVIRON, 2005).

3.3.9 Source Monitoring Program

Alcoa conducts air emission source monitoring at the Wagerup Refinery on a routine basis. Some of this monitoring is required to be conducted as specified in the environmental licence for the Wagerup refinery, whilst other monitoring programs have been developed to assist Alcoa with air quality management and continuous improvement. Alcoa currently has a comprehensive source emission monitoring program for the refinery which will extend to the expanded refinery scenario. A summary of the monitoring programs proposed are presented in Appendix A. In addition, where applicable campaign monitoring will be conducted for total VOCs, aldehydes and ketones to improve understanding of key emission sources.

3.4 RDA SOURCE MANAGEMENT PLAN

3.4.1 Residue Drying Areas (RDA)

After digestion of alumina from the bauxite, the remaining residue slurry is washed and separated into mud and sand fractions. These are then pumped to the residue drying areas where the mud is thickened before being disposed onto drying bays. Due to the relatively low grade of Darling Range bauxite, residue is produced at a rate of approximately two dry tonnes per tonne of alumina produced. The RDA facilities at Wagerup are located on the western side of the South Western Highway.

The existing RDA covers approximately 546 hectares (ha) of which approximately 170 ha are used for active drying of the residue (RDA1-7), 12 ha for the thickener bypass, 69 ha for alkaline water storage and 32 ha for fresh water storage.

The RDAs are presently managed through the approved 30 year Long Term Management Residue Strategy (LTRMS). The LTRMS is prepared through consultation with the local community, local government and the Residue Planning Liaison Group (RPLG). The RPLG comprises representatives of government agencies and is chaired by the Department of Industry and Resources (DoIR). A major review of the LTRMS is planned to commence in 2005 in preparation for submission to the Minister for the Environment in 2006.

The expansion of the Wagerup refinery will result in increased production of residue and will therefore require the construction of cells currently approved in the LTRMS to be brought forward. Expansion of the RDA within the 30 year plan is an ongoing process with construction work on RDA7 completed during the 2004/5 summer period and construction of RDA8 and a new fresh water detention pond planned for the 2005/6 summer period. The existing approved RDA is shown in Figure 1.

A summary of the changes to the RDAs during the expansion include.

1. An increase in the Bauxite Residue Storage rate;
2. An expansion of the existing drying area by 80 to 100 Ha; and
3. The construction of residue drying cells approved in the LTRMS will need to be brought forward. RDA cells 9, 10 and 11 are planned to be constructed by the year 2012 should the expansion be approved.

3.4.1.1 Management and Mitigation Measures

Dust emission from the RDA's has been recognised as a potentially significant issue and is controlled by wetting the surface of the RDA's using sprinklers. A network of sprinklers has been installed across the drying beds and is used to dampen dry surfaces prior to and during windy periods. Other areas within the residue operations have more permanent dust suppressants applied to them, including bitumen spray, rock aggregate spread as a mulch, waste oil used as a binder on internally draining limestone roads, and grasses grown on residue sand areas which are not going to be disturbed for several years. Evaluation of the existing sprinkler patterns by Alcoa have indicated that a triangular grid pattern will improve coverage efficiency and therefore as part of the expansion, Alcoa are replacing the majority of sprinklers with a 60m x 60m triangular grid pattern. Please refer to RDA Sprinkler Deposition Modeling Report (ENVIRON 2005) for further information.

In addition, other management measures adopted to further reduce dust emissions include;

1. Electrical maintenance of the sprinkler system
2. Blue metal on long term stockpiles
3. Daily dust risk rating procedure
4. Improved response to mechanical maintenance issues
5. 24hr operational coverage

The Wagerup residue operations are now accredited to ISO 14001. This has led to an increased emphasis being placed on the management of a number of activities related to dust control including timing of residue sand construction activities.

3.4.2 Other Major Diffuse Sources

3.4.2.1 Cooling lake

The Cooling Lake receives a combination of high conductivity storm water run-off from the refinery site together with hot process liquor reporting to the stormwater system. Additionally excess leachate collected from the under drainage systems of the RDA's is also directed to the Cooling Lake. Although the refinery stormwater run-off can report to both the cooling lake and the ROWS (run-off water storage) pond, it more commonly reports to the Cooling Lake. This lake generally contains the highest level of process liquor present at the Residue Area. The predominant air emissions from the cooling lake are VOCs carbonyl compounds and odour.

The proposed monitoring program and management measures for the Cooling Lake will include:

1. Additional campaign flux chamber monitoring to confirm VOC, carbonyl and odour emission rates measured in 2004/2005;
2. Verification monitoring using upwind and downwind ambient monitoring data to confirm flux results.

3.4.2.2 Super Thickener.

The fine tailing are pumped to the thickener vessel where they are settled using flocculent, producing high density underflow slurry or around 50% weight for weight solids. The slurry is then pumped to one of a number of beds where it is placed in layers up to 0.5m deep. The predominant emissions from the super thickener are VOCs, carbonyl compounds and odour.

The proposed monitoring program and management measures for the Super Thickener will include:

1. Additional flux chamber monitoring of VOCs, carbonyls and odour to confirm the 2004/2005 measured emission rates.

3.4.3 Minor Sources

Minor diffuse sources such as smaller water bodies and those containing lower alkalinity waters were identified within the baseline emissions study as primarily emitting VOCs. Individually the majority of these sources are minor contributors to overall emissions, and although included in the modelling are considered minor sources. These sources include:

1. Lower Dam
2. ROWS (Run Off Water Storage)
3. Oxalate Pond
4. ROCP2
5. Sand Lake

Implicit in the calculation of emission rates for the expansion is a reduction in the rate of emissions from some diffuse sources. These reductions and their basis are detailed here.

3.4.4 Summary of Changes – Diffuse Sources

A summary of the mass emissions changes for the diffusive sources as part of the expansion are outlined below.

1. Super thickener VOCs will increase by 20% of the equivalent VOC load of the Lower Dam;
2. Cooling Pond VOCs will increase by 50% of the current VOC load;
3. ROWS Pond VOCs will increase by 100% of the current VOC load;
4. ROCP no change;
5. Oxalate Pond no change;
6. RDA areas will accept 80% of the load diverted from Lower Dam, distributed across all active surfaces;
7. Lower Dam no change;
8. Sand Lake - increase wet sand area 50% for expected 3 times increase in sand.

3.5 AMBIENT MONITORING PROGRAM

Wagerup has an extensive ambient air monitoring programme in place. The programme has a number of dimensions, which are managed and developed in a variety of ways to satisfy the various needs and stakeholders. The core of the programme is covered in the requirements of the environmental licence, which specifies targets and limits for key parameters. It is envisaged that the ongoing ambient monitoring progam will be an extension of the existing progam with a range of voluntary and joint projects also proposed to continually improve and verify the ambient air data set.

The current summary does not attempt to cover in detail all of the various historical and current programs related to ambient monitoring. Rather it is a summary of the future direction with the view to demonstrate primary adherence to commitments made in the ERMP.

3.5.1 Dust

3.5.1.1 On-going Monitoring

Ambient dust monitoring at the Residue Drying Area (RDA) was the first ambient monitoring to be incorporated in Wagerup's environmental licence. The program includes both continuous monitors such as tapered element oscillating microbalance TEOMs (*Tapered Element Oscillating Microbalance)* and high volume samples deployed at specific locations around the Wagerup facility. The locations of the dust monitors are shown in Figure 3, extracted from the Wagerup Annual Report 2003. The locations have been chosen to provide information for all the main wind directions, and the sites are in conformance with AS 2922-1987. Results of the monitoring are given in the Annual and Triennial Reviews. It is envisaged that the current program will be maintained through during the Wagerup 3 expansion. The program includes chemical analysis of a proportion of the samples for source identification. There is the possibility to rationalise the overall deployment of sampling stations based on information obtained.

The locations for any additional monitors for the expansion will be chosen to provide information for all the main wind directions to ensure that the chosen sites are in conformance with AS 2922-1987. Any proposed monitoring program will include the use of TEOMS or High Volume Samplers that meet AS 3580.9.3 2003 standards.

3.5.1.2 Other Programs

RDA Dust Emission Intensive Study: To better understand the composition and variability of dust generated at the RDAs, Alcoa is conducting a WA-wide study of dust characteristics, with the Pinjarra refinery as the main study site. The 15 month study commenced in Q4 2004 and has been scoped in consultation with independent consultants. Details of this program were provided to the Wagerup Tripartite Group in November 2004. The results of this program will be reviewed as it progresses to determine the need for any further site specific testing at Wagerup. In addition a PM_{10} monitoring program has been implemented at the Wagerup RDA to collect further information about the PM_{10} component of Wagerup's residue dust.

Yarloop Rainfall and Dustfall Study: A draft program has been developed to collect and characterise dust and rainfall in Yarloop. The program requires further development and should take into account new information recently made available in an independent report of existing data on the quality of rainwater in the Yarloop area and surrounds. The project will be presented to the Wagerup Tripartite Group for review, and milestones for its implementation developed

3.5.2 Odour

One of the objectives of the project in the ERMP was to cause no increase in odour impacts at nearbv residences. Alcoa intends to demonstrate this by undertaking diffuse source odour monitoring upon completion of the expansion which can then be compared against current baseline emissions. In addition, future odour monitoring programs will aim to corroborate and verify the odour emissions rate measurements and modelling predictions.

3.5.3 Other Gaseous Pollutants

A long path Opsis instrument has been installed to the north of Boundary Road to provide continuous monitoring of formaldehyde, benzene and sulphur dioxide on an experimental basis. The established monitoring of nitrogen oxides at the Boundary Road monitoring station will continue. The information will be examined to establish the potential to detect refinery influences on ambient air quality, in particular transient influences.

4 QUALITY CONTROL AND REPORTING

Quality control is an essential component of both source and ambient monitoring programs to ensure that the results produced are representative of actual contaminant concentrations. Alcoa will undertake the following actions to ensure quality control in all of its air monitoring programs at the Wagerup refinery.

Table 10.0: General Quality Control Commitments

Implementation Phase	Action
Sampling	All sampling for regulatory compliance will be conducted by parties holding NATA accreditation for that activity, where available. This may not be applicable to Alcoa personnel performing dust sampling.
	Sampling will be performed in accordance with the relevant USEPA, Australian/NZ or ISO Standard, Vic EPA, ASTM, NIOSH, ACGIH, CEN, VDI or other reputable testing authority methods. When variations to these methods are employed, the variation will be recorded and explained.
	Each time a stack test is performed; standard methods will be used to determine the temperature, moisture and volumetric flow rate, where possible, to enable reasonable interpretation of monitoring results.
	Sufficient volumes of gas will be collected to achieve suitable limits of detection for each key parameter.
	Where possible, stack samples will be collected under steady state operating conditions to ensure they are representative.
	Field blanks and duplicates will be included in sampling runs.
	Samples will be preserved in accordance with relevant standards and analysed as soon as possible after collection.
	Records of the chain of custody will be maintained for all samples.
Analysis	All analysis for regulatory compliance will be conducted by parties holding NATA accreditation for that activity, where available. Where a NATA accredited laboratory is not available, analysis will be performed at a laboratory with sound quality control procedures.
	Analysis will be performed in accordance with the relevant USEPA, AS or other reputable authority methods where possible. When variations to these methods are employed, the variation will be recorded and justified.
Reporting	All reports will include the date and time of sample collection, and any unusual operating conditions at the time of collection.
	All results will be presented with limits of detection for each parameter recorded.
	All results will be presented with error bands to reflect potential errors in sampling, preservation and analysis.

5 REVIEW AND UPDATE OF MANAGEMENT PLAN

This management plan may be altered from time to time to reflect changes to production requirements, or to stakeholder expectations. However, any alterations to the document must be consistent with the objectives stated in Section 2.

Alcoa will review the management plan at the following times:

- Upon completion of plant commissioning for the Wagerup3 project; and
- When there are reasons to review specific sections of the plan.

Alcoa will undertake an appropriate level of stakeholder consultation whenever alterations are made to the management plan. The level of consultation will be dependent upon the nature and significance of the alteration. Alcoa will maintain a current version of the management plan on its website. The plan will contain a version number, a date of creation, and a date of last amendment.

6 REPORTING OF RESULTS

Air quality monitoring results and investigations from the performance verification monitoring phase will be made available to the DoE, and will include:

1. Annual monitoring report detailing the summary of results from the monitoring program outlined in this management plan. This report will also fulfill specific licence reporting conditions and will be amalgamated with the existing Annual Environmental Review

2. Commissioning and performance verification reports detailing the summary of results during the commissioning and performance verification phase

3. A Report demonstrating that the air quality objectives and targets listed in Section 2 have been met.

7 REFERENCES

Environmental Scoping Document, Wagerup Refinery Unit 3, EPA Assessment No 1527, ENVIRON 2005.

ENVIRON Australia (2005). Air Quality Summary Report, Wagerup 3 ERMP. Report for Alcoa World Alumina, May 2005.

Western Australia Department of Environment, Environmental Protection Act 1986, Licence Number 6217/8, Alcoa World Alumina Australia, Wagerup Alumina Refinery.

Memorandum, Alcoa World Alumina Australia, Assumptions Made in calculation of HRA flow data for Case 4.

CSIRO, Wagerup Air Quality Review, Report C/0936, May 2004

Alcoa World Alumina Australia, Wagerup Refinery Air Emissions Inventory, September 2002.

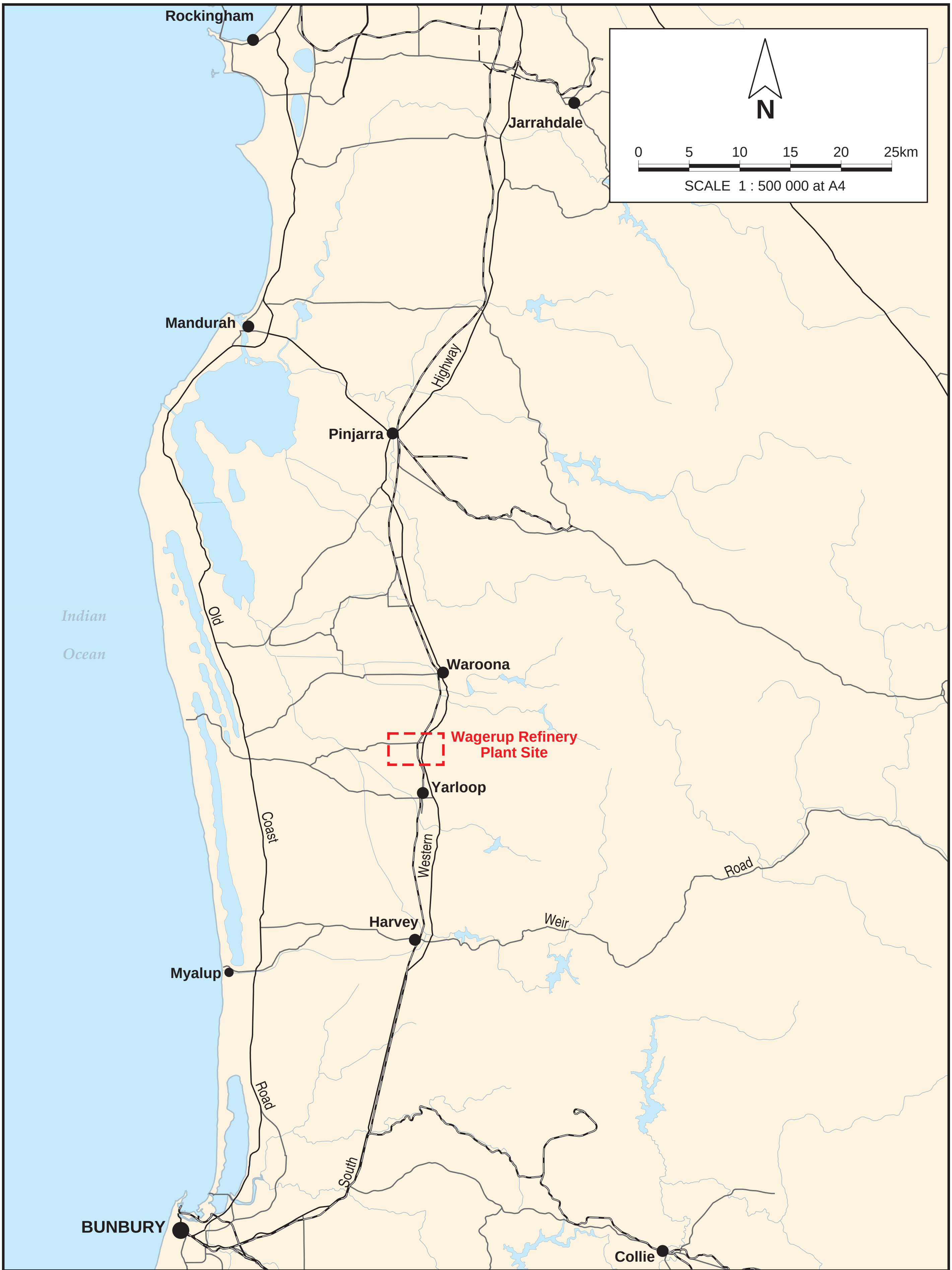
8 GLOSSARY

Alcoa	Alcoa World Alumina Australia
AGO	Australian Greenhouse Office
CALM	Conservation and Land Management
DoE	Department of Environment (Western Australia)
DCM	Dust Control Monitor
DoH	Department of Health (Western Australia)
DoIR	Department of Industry and Resources
DMA	Decision making authority
DoPI	Department of Planning and Infrastructure
EPA	Environmental Protection Authority (Western Australia)
EMS	Environmental management system
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
ROWS	Run Off Water Storage
RDA	Residue drying Areas
SRG	Stakeholder Reference Group
Wagerup 3	Wagerup3 refers to the expansion to 4.7 Mpta
A$	Australian dollars
dB	decibels
dB (A)	decibels (A-weighted)
^{o}C	degrees Celsius
ha	hectares
km	kilometres
kL	kilolitres
mm	millimetres
m	metres (length)
m^2	square metres (area)
m^3	cubic metres (volume)
m/s	metres per second
MJ	mega joules
MW	mega watts
ML	megalitres
ML/yr	megalitres per year
MLpa	megalitres per annum
Mt	megatonnes
Mtpa	megatonnes per annum
ppm	parts per million
ppb	parts per billion
μg	micrograms (one-millionth of a gram)
$\mu g/m^3$	micrograms per cubic metre
t	tonnes
tph	tonnes per hour
tpa	tonnes per annum

w/w	weight for weight
%	percent
% w/w	percent by weight

FIGURES

Wed 01 Sep 04



Alcoa World Alumina Australia
ALCOA WAGERUP REFINERY EXPANSION
ENVIRONMENTAL SCOPING DOCUMENT

REGIONAL LOCATION

Figure 1

ENVIRON

Drawn: IY

Date: 08/04

env-wag-f01v8.dgn

PINPOINT CARTOGRAPHICS (08) 9277 7763

WAGERUP REFINERY FLOW PROCESS
Alumina
Residue
Bauxite
Green Liquor
Spent Liquor
50 0 50 100 Meters
Date : August 10, 2004
DLI Geo Spatial information reproduced with permission of the Department of Land Information, P339.
STACKER
STOCKPILES (15)
RECLAIMER
LOWER DAM (Condensate)
POTABLE WATER FACILITIES (963Y)
MUD AND SAND DISPOSAL TO RESIDUE
MILLING (25)
DESILICATION (25A)
MUD THICKENING (35F)
SAND REMOVAL (26)
MUD DISPOSAL (964Y)
MUD WASHING (35C)
STORM LAKE
DIGESTION (30)
CAUSTICISATION (36J)
LIME FACILITIES (6)
OXALATE REMOVAL (47)
POWERHOUSE (110)
MUD FILTRATION (35X)
EVAPORATION (42)
HEAT INTERCHANGE (40)
LIQUOR BURNING (48)
ALUMINA STORAGE (51A)
CALCINERS (50)
ALUMINA STORAGE (51B)
HYDRATE FILTRATION (44-1) & (44-2)
RAW CAUSTIC STORAGE (8)
PRECIPITATION (45)

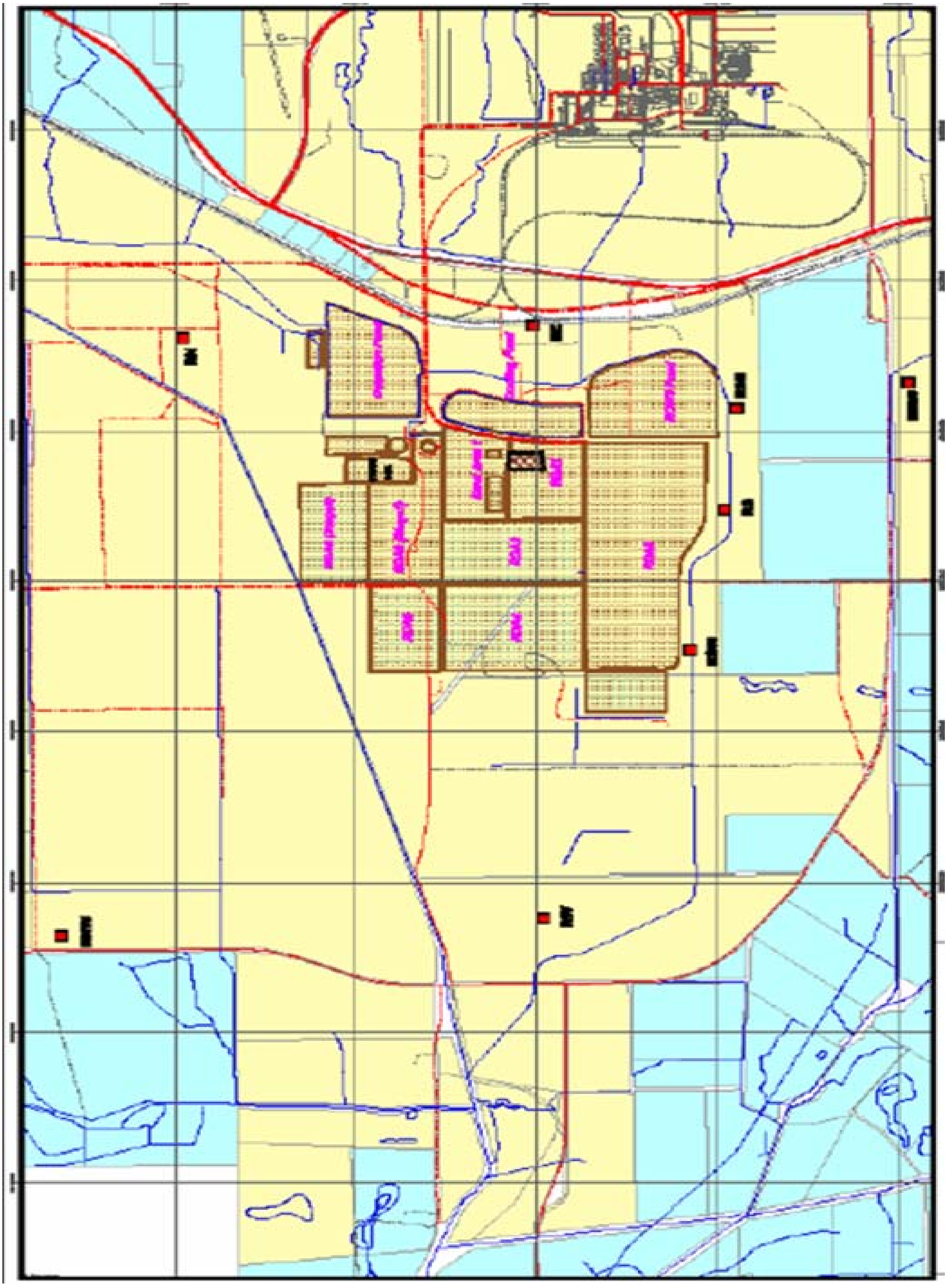


Figure 3

Ambient Monitoring Sites - Wagerup

Client: Alcoa - Wagerup	ENVIRON	
Project: AQMP – Wagerup3	Drawer:: NS	Date: March 05

Appendix A

Summary of Monitoring Programs

MONITORING PROGRAM – COMMISSIONING

Emission Source	Parameter	Base method	Monitoring schedule	Notes
Oxalate kiln stack	Temperature	Physical measurement and comparison with in-stack meter	Immediately after commissioning	Calibration of temperature meters. Calibration curve with a minimum of 5 points over the normal operating temperature range to be documented, and with a minimum of two physical measurements for each temperature plotted on the curve.
	CO	USEPA method 10	Immediately after commissioning	To be sampled at points before and after RTO to verify calibration of both CO CEMS
	Particulates	USEPA method 5	Immediately after commissioning	
	VOC	USEPA method 18	Immediately after commissioning	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
	Heavy metals	USEPA method 29	Immediately after commissioning	The analysis suite to include, at a minimum, mercury, arsenic, selenium, cadmium and nickel.
	Aldehydes and Ketones	USEPA Modified Method TO-5	Immediately after commissioning	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
Liquor Burner – RTO commissioning	Temperature	Physical measurement and comparison with in-stack meter	Immediately after commissioning	Calibration of temperature meters. Calibration curve with a minimum of 5 points over the normal operating temperature range to be documented, and with a minimum of two physical measurements for each temperature plotted on the curve.
	CO	USEPA method 10	Immediately after commissioning	To be sampled at points before and after RTO to verify calibration of both CO CEMS
	Particulates	USEPA method 5	Immediately after commissioning	
	VOC	USEPA method 18 or 30	Immediately after commissioning	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
	Heavy metals	USEPA method 29	Immediately after commissioning	The analysis suite to include, at a minimum, mercury, arsenic, selenium, cadmium and nickel.
	Aldehydes and Ketones	USEPA Modified Method TO-5	Immediately after commissioning	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
Calciners (5 & 6)	Particulates	USEPA method 5	Immediately after commissioning	This will include functionality testing and calibration of the DCM's for calciners 5 & 6.

Emission Source	Parameter	Base method	Monitoring schedule	Notes
Boilers and Gas Turbines	NO_x	Method 7E	Immediately after commissioning	
	CO	Method 10	Immediately after commissioning	
	SO_2	Method 6	Immediately after commissioning	
25A Tank Vents	VOC	USEPA method 18 or 30	Immediately after commissioning	The monitoring will be on the two new tank vents
	Aldehydes and Ketones	USEPA Modified Method TO-5	Immediately after commissioning	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.

MONITORING P ROGRAM – PERFORMANCE VERIFICATION

Emission Source	Parameter	Base method	Monitoring schedule	Notes
Oxalate kiln stack	Temperature	Physical measurement and comparison with in-stack meter	Quarterly for 12 months	
	CO	USEPA method 10	Quarterly for 12 months	
	Particulates	USEPA method 5	Quarterly for 12 months	
	VOC	USEPA method 18	Quarterly for 12 months	
	Heavy metals	USEPA method 29	Quarterly for 12 months	
	Aldehydes and Ketones	USEPA Modified Method TO-5	Quarterly for 12 months	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
Liquor Burner – RTO commissioning	Temperature	Physical measurement and comparison with in-stack meter	Quarterly for 12 months	
	CO	USEPA method 10	Quarterly for 12 months	
	Particulates	USEPA method 5	Quarterly for 12 months	
	VOC	USEPA method 18 or 30	Quarterly for 12 months	
	Heavy metals	USEPA method 29	Quarterly for 12 months	
	Aldehydes and Ketones	USEPA Modified Method TO-5	Quarterly for 12 months	To be sampled at a point after the RTO. Destruction efficiency will be assumed to be equivalent to destruction of CO.
Calciners	Particulates	USEPA method 5	Quarterly for 12 months	
Boilers and Gas Turbines	NO_x	Method 7E	Quarterly for 12 months	
	CO	Method 10	Quarterly for 12 months	
25A Tank Vents	VOC	USEPA method 18 or 30	Quarterly for 12 months	
	Aldehydes and Ketones	USEPA Modified Method TO-5	Quarterly for 12 months	

MONITORING PROGRAM – ON-GOING

Emission Source	Parameter	Base method	Monitoring schedule	Notes
Oxalate kiln stack	Temperature	Physical measurement and comparison with in-stack meter	Annual	
	CO	USEPA method 10		
	Particulates	USEPA method 5		
	VOCs	USEPA method 18		
	Heavy metals	USEPA method 29		
Liquid Burner	Particulates	USEPA method 5 or 7	3-monthly	
	CO	USEPA modified method 10		
	NOx	USEPA method 7E		
	SOx	USEPA method 6C		
	Acetaldehyde	USEPA MMTO5		
	Acetone	USEPA MMTO5		
	2-butanone	USEPA MMTO5		
	Formaldehyde	USEPA MMTO5		
	Benzene	USEPA method 18		
	Odour	AS 4323.3		
	Temperature	USEPA method 2		
	Stack Velocity	USEPA method 2		
	Stack Flowrate	USEPA method 2		
Calciners	Particulates	USEPA method 5 or 7	2-monthly	
	CO	USEPA modified method 10		
	NOx	USEPA method 7E		
	SOx	USEPA method 6C		
	Acetaldehyde	USEPA MMTO5		
	Acetone	USEPA MMTO5		
	2-butanone	USEPA MMTO5		
	Formaldehyde	USEPA MMTO5		
	Benzene	USEPA method 18		
	Odour	AS 4323.3		
	Temperature	USEPA method 2		
	Stack Velocity	USEPA method 2		
	Stack Flowrate	USEPA method 2		
Boilers and Gas Turbines	NO	USEPA method 7E	3-monthly	
	NO_2	USEPA method 7E		
	NO_x	USEPA method 7E		
	CO	USEPA method 10		
	Stack velocity	USEPA method 2		
	Stack temperature	USEPA method 2		
25A Tank Vents	VOC	USEPA method 18 or 30		

10.2 NOISE MANAGEMENT PLAN

NOISE MANAGEMENT PLAN

Wagerup Refinery

Date: 18 April 2005

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5. Long Term Noise Management 66

1. Introduction

This plan contains details of the noise control and management methods that will be employed to achieve the noise emission criteria for the Wagerup Unit Three expansion project (the Proposal).

Alcoa commissioned SVT Engineering Consultants (SVT) to conduct an acoustic assessment of The Proposal. This was independently reviewed by Mrs Marian Burgess from Australian Defence Force Academy.

2. Purpose of this Plan

a) Ensure that noise emission criteria for the Wagerup Unit Three expansion (the Proposal) are met

b) Ensure incorporation of practical noise control measures in project design.

3. Scope of this Management Plan

This Noise Management Plan applies to the implementation of the Proposal from design through to commissioning and 12 months of operation.

The Noise Management Plan extends to a post project completion upgrade of the refinery acoustic model and a one-off comprehensive environmental noise monitoring program

4. Project Control

4.1. Preliminary Design Phase

- Development and use of acoustic model (SoundPlan) to review impact of proposed project; use model as a tool to achieve design objectives

- Development of sound power level budget to achieve project noise emission criteria, and

- Specification of generic noise controls to apply to all Proposal areas.

4.2. Detailed Design Phase

- Regular review of noise-significant project elements and incorporation of measures to control noise emissions; Regular design team noise emission reviews
- Specification of noise controls for most important sources
- Regular revision of sound power level budget as design progresses to include specific equipment items
- Preparation of noise data requisition sheets based on the updated sound power budget for use in the design and tendering process
- Incorporation of noise specifications in contracts, for example, noise test data for specific equipment will be requested
- Revision of sound power level budget and acoustic model prior to construction with equipment specifications provided by suppliers and
- Revision of specific noise controls for key project noise sources.

4.3. Construction Phase

- Environmental noise requirements will be included in the contractor manual for the Project
- The Project construction manager and the site representative will have access to an acoustic consultant during the construction period, as they require
- The major portion of noisy upgrade works will be planned to occur between the hours of 7am - 7pm, weekdays and 8am – 5pm Saturday
- Noise Management procedures will be developed for specific noisy construction processes if they are planned to occur during the night period; potentially affected residents will be notified. An acoustic consultant will conduct monitoring if noisy construction processes are planned for the night period.
- Community complaints procedure will be used to ensure any complaints regarding environmental noise emissions during the construction period be recorded and investigated
- Noise monitoring at fixed locations will be undertaken during the construction period.

4.4. Commissioning Phase

- Measurement of 'noise significant' elements during commissioning will be conducted at the source and at appropriate locations by a qualified acoustic consultant

- Follow-up assessment, design review and remedial works for items of plant that are non-compliant with noise specifications.

- Develop action plan for any identified non-compliant refinery plant

- Development of maintenance and inspection procedures during operation to ensure acoustic controls are maintained.

4.5. Operational Phase

- Conduct one-off post construction monitoring program representative of refinery noise emissions under 'worst case' weather conditions to verify / calibrate acoustic model (Monitoring to include representative locations which relate to the nearest residential receiver locations)

- Development of a one-off noise verification report that presents the results of noise testing, noise monitoring and noise modelling

- One off update of noise model based on commissioning noise measurements, this will represent the as-built plant

Controls adopted from the preliminary design phase to the commissioning phase will require the implementation of the general design principles that are outlined in the document titled “Environmental Noise Management Strategy for the Wagerup 3 Expansion Project” (SVT, 2005). Where deviations are required, acoustic consultants will be involved to identify if strategies to reduce impact are required.

5. Long Term Noise Management

Alcoa will continue to monitor noise in the vicinity of the Wagerup refinery. Fixed noise monitoring and associated data reporting is currently managed through the Part V Wagerup Refinery Licence. Alcoa conducts additional monitoring to further characterise the Refinery contribution to measured noise levels and for specific investigations, for example, to review alternative monitoring technology. Alcoa will monitor noise at locations in accordance with the licence requirements. It is anticipated that noise monitoring programs will evolve over time. Changes to monitoring programs will be discussed with the DoE.

The Wagerup refinery has a long term noise management strategy that involves:

- Application for a variation to the assigned noise levels as defined in the Environmental Protection (Noise) Regulations 1997;
- Further noise reduction where reasonable and practicable;
- Continued noise monitoring and modelling;
- Noise attenuation measures for homes of people who are adversely affected by refinery noise, if requested;
- Implementation of a land management strategy to facilitate the relocation of adversely affected people
- A complaints management program, and
- An engineering and procurement policy to adopt a 'lowest practicable' noise emission approach for new or replacement plant and equipment.

This long term noise management strategy has been communicated to the DoE and progress is reported in annual reports submitted to the DoE under the Part V Wagerup Licence.

10.3 WATER SUPPLY MANAGEMENT PLAN

WATER SUPPLY MANAGEMENT PLAN

Wagerup Refinery Unit 3

for

Alcoa World Alumina Australia

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Ref: WG3 Water Supply Management Plan 19 April 05.doc

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APPENDICES

Appendix A: Wagerup Surface Water Licence - Operational Strategy

GLOSSARY OF TERMS

APSS	Alcoa Performance Support System
CCN	Community Consultation Network
DoE	Department of Environment
DoIR	Department of Industry and Resources
ERMP	Environmental Review and Management Programme
EWR	Ecological Water Requirements
RDA	Residue Drying Areas
TDS	Total Dissolved Solids measured in water as mg/L
WRC	Water and Rivers Commission (now part of DoE)

WATER SUPPLY MANAGEMENT PLAN
Wagerup Refinery Unit 3

1. INTRODUCTION

Alcoa's Wagerup alumina refinery and its associated bauxite residue drying areas (RDAs) are located 120 kilometres (km) south of Perth, 2 km north of Yarloop and approximately 7 km south of Waroona. The refinery is located close to the foot of the Darling Scarp and is separated from the RDAs by the South West Highway and the Perth-Bunbury railway line. The refinery produces alumina from bauxite mined at the Willowdale mine site, using the Bayer process.

Alcoa proposes to expand its existing Wagerup alumina refinery through completing the construction of a third production unit. Construction of the third production unit will increase production from to approximately 4.7 Mtpa. An Environmental Review and Management Program (ERMP) has been prepared and submitted to the Environmental Protection Authority (EPA) for assessment under Part IV of the *Environmental Protection Act 1986.* This Water Supply Management Plan (WSMP) forms part of the ERMP and is included in the Appendices to the document.

2. PURPOSE AND SCOPE OF PLAN

The purpose of the Water Supply Management Plan (WSMP) is to ensure that there are no adverse environmental or social impacts resulting from the refinery's harvesting, storage and use of surface waters, and to outline water conservation initiatives for Wagerup refinery.

The WSMP will document the refinery's existing water supply system and associated operating strategy and to consider proposed modifications to the strategy that will account for changes that result from the commissioning of Wagerup Refinery Unit 3 (the Proposal). The WSMP will aim to identify any impacts that may result from these changes and propose management strategies and desired outcomes. It will also assist in identifying opportunities for continual improvement in water supply management at the Wagerup refinery.

2.1 RELATED DOCUMENTS

Alcoa's existing Surface Water Licences are supported by an Operating Strategy (Document No. 44402; see Appendix A) which was developed by Alcoa and approved by the Department of Environment. This strategy was developed in 2003 and has provisions for review prior to renewal of any of the licences and under other circumstances including changes in the refinery such as the proposed expansion.

The existing Surface Water Licence Operating Strategy includes a description of sources, environmental requirements, operating rules, monitoring and reporting requirements and water efficiency measures.

This WSMP for the Proposal should be applied in the context of the existing Environmental Management Manual for Wagerup (Document No. 32600)[1]. This manual is a key document of the Wagerup Environmental Management System and the main reference document on environmental policy and principles, team structures, standards and statutory requirements, identification of environmental aspects and associated planning, management systems, procedures and environmental monitoring.

This WSMP makes reference to the following documents within the APSS[2] (Alcoa Performance Support System, Alcoa's formal document management system):

- 44402 *Surface Water Licence – Operational Strategy* (Document No. 44402);
- 53902 *Surface and Storm Water Monitoring Manual* (WA Operations); and
- 33740 *Internal Environmental Communication* (Refineries).

3. BACKGROUND

The Wagerup refinery is designed to recycle all water including rainfall runoff from the refinery and residue areas. This avoids the need to discharge effluent and minimises demands on fresh water sources beyond the refinery boundary. Nevertheless, the refinery is a net user of water which it obtains from a number of licensed sources.

The Proposal is expected to result in an additional demand of between 1.1 GLpa (gigalitre per annum) and 4.8 GLpa of water depending upon rainfall and the resulting runoff that occurs from existing harnessed catchments.

It is proposed that the additional water for the Wagerup expansion be provided by increased harvesting of winter runoff from the Harvey River Main Drain (ENVIRON, 2005). This will be achieved by upgrading the existing pump station and delivery pipeline so that the required water can be transferred to the refinery's water storage facilities during the winter pumping period for use during the following summer. The actual amount of water harvested in any winter period will depend upon the runoff gained from the internal refinery and residue area catchments.

To accommodate the additional water Alcoa will apply to Department of Environment (DoE) to increase the withdrawal limit on the existing Harvey River Main Drain Surface Water Licence

[1] As a key document related to the Wagerup Refinery Environmental Management System this document is regularly reviewed and updated and will be subject to ongoing change.

[2] All procedures within APSS are subject to change as a result of revision processes.

(SWL151027(2) from the current 4.4 GLpa to approximately 9.2 GLpa. An investigation of potential surface water sources and ecological water requirements by CENRM (2005) suggests that up to 28 GL of winter flow should be available from the Harvey River Main Drain during an average winter after ecological water requirements are deducted.

The main water supply management activities are to monitor flow, water quality and ecological parameters in the Harvey River Main Drain downstream of the current pumping station to ensure that the winter water harvesting does not adversely impact the downstream environment. This monitoring will be undertaken prior to and after commissioning of the Wagerup expansion.

Other management activities include periodic reviews of water conservation opportunities in order to minimise refinery water consumption, and maintenance of a high level of awareness within the workforce of the need to conserve water at work and at home.

The Wagerup Water Balance Model has been used to predict the refinery water supply for the existing refinery and for the expanded refinery for a range of weather conditions.

Table 1. Refinery Water Supply - CASE A – Average Rainfall/Runoff Conditions

	Current Refinery (Million Litre)	**Future Refinery 4.7 Mtpa (ML?)**
Moisture with Bauxite & Reagents	1,000	1,890
Rainfall collected in Fresh Water Reservoirs	700	1,000
Rainfall Runoff from Plant Area	270	270
Rainfall Runoff & Drainage from Residue & Liquor Pond Areas	2,390	3,330
Surface Water Sources (Licence)		
- Nth & Sth Yalup Br (1,600 MLpa)	1,200	1,200
- Black Tom Br (2,500 MLpa)	1,500	1,500
- Harvey R Main Drain (4,400 MLpa)	2,100	4,300
Groundwater (Licence = 550 MLpa)	300	300
Additional Sources		**1,110**
Total Supplied	**9,460**	**14,900**

Table 2. Refinery Water Supply - CASE B – Dry Rainfall/Runoff Conditions (Based on driest year on 25 years of record - 2001)

	Current Refinery (2.4 Mtpa)	**Future Refinery (4.5 Mtpa)**
Moisture with Bauxite & Reagents	1,000	1,890
Rainfall collected in Fresh Water Reservoirs	500	680
Rainfall Runoff from Plant Area	180	180
Rainfall Runoff & Drainage from Residue & Liquor Pond Areas	1,420	1,980
Surface Water Sources (Licence)		
- Nth & Sth Yalup Br (1,600 MLpa)	200	200
- Black Tom Br (2,500 MLpa)	800	800
- Harvey R Main Drain (4,400 MLpa)	4,400	4,400
Groundwater (550 MLpa)	300	300

Additional Sources	**660**	**4,770**
Total Supplied	**9,460**	**14,900**

4. OBJECTIVES & TARGETS

4.1 SUSTAINABILITY PRINCIPLES AND OBJECTIVES

Alcoa has adopted sustainability principles and it is a requirement that these principles be considered during all new projects. The principles are as follows:

- Respect and protect people;
- Build community experience and well being;
- Long-term economic benefit;
- Efficient resource use and cleaner production;
- Ecological integrity and biodiversity;
- Meeting the needs of current and future generations;
- Stakeholder involvement; and
- Accountability and governance.

Based upon these principles the following water supply objectives have been developed:

- Preference is given to water supply sources that are of lower quality and therefore not in competition with public water supplies.
- Refinery water supply does not adversely affect other beneficial uses of water resources in the Wagerup area including Ecological Water Requirements (EWR).
- Refinery water supply doesn't disadvantage other water users.
- Water use and supply is measured and reported in a way that is understood by all Alcoa staff.
- Refinery water conservation opportunities are identified in the water conservation plan and regularly reviewed (Water Audit).
- Water supply is achieved in ways that are consistent with the Proposed Harvey Basin Water Allocation Plan (Water and Rivers Commission, 1998) and the State Government's water resource management objectives.
- Alcoa staff are encouraged to practice water conservation at work and at home.
- The community is involved in, understands, and supports the refinery water supply strategy.

4.2 PUBLIC UNDERTAKINGS

Alcoa's global operations adopted an environmental challenge in 2000 which was publicised at a shareholder's meeting in that year. There were a number of goals including one that addressed water consumption directly: *Reduce process water use and discharge by 60% by 2008.*

In response to this challenge Alcoa's Western Australian Operations developed a water conservation strategy in 2001 which was shared with key Government and community stakeholders. The strategy addresses the flowing objective:

> *In Alcoa's Western Australian Operations, alumina refining process requirements combined with high net evaporation losses limits the options for reducing overall water consumption, however zero process water discharge is achieved. By 2005 we will have reduced the total volume of "Fresh Water" used, by 20% against a 2002 baseline.*

4.3 LICENCE LIMITS

Wagerup refinery's current surface water licences provide access to the surface water sources as outlined in Table 3:

Table 3. Wagerup Refinery Water Supply Licences

SOURCE	Licence Number	Licensed Amount (MLpa)
North & South Yalup Brooks	SWL 97472(4)	1,600 *
South Samson Diversion Drain (includes Black Tom Brook	SWL 99246(3)	2,500 *
Harvey River Main Drain	SWL151027(2)	4,400#

* Licensed amount refers to water extracted from the storage facilities on these sources

Licensed amount refers to water extracted directly from the source between May and October.

5. WATER SUPPLY MANAGEMENT PLAN

Table 4 summarises the water supply management measures that are to be implemented as part of the Proposal to achieve the water supply management objectives. These measures are based on existing procedures within the Wagerup EMS, and additional measures developed specifically for the Proposal.

Table 4. Water Supply Management Measures

What	How	Procedure Reference	Who	When	Performance Indicator
Objective 1. Use lower quality water.	Action 1.1 In addition to catchments already harnessed, give preference to using agricultural catchment winter runoff which is lower in quality than hills runoff.	-	WG3 Design team	During construction and operation	Minimise the use of potable water for process water requirements.
Objective 2. No adverse effects on downstream environment.	Action 2.1 Monitor flows, water quality and ecological parameters prior to and following the commissioning of the expanded Harvey River pumping station.	44402 *Surface Water Licence – Operational Strategy* 53902 *Surface and Storm Water Monitoring Manual*	Wagerup Environment Department	Prior to and following commissioning of the expanded Harvey River pumping Station.	Monitoring data shows no adverse effects on downstream environment from increased abstraction. Where data indicates possible adverse impacts, further investigations have been undertaken and corrective actions implemented as appropriate.
Objective 3. No adverse effects on other water users.	Action 3.1 Survey the use of the water in the lower Harvey Main Drain prior to and following commissioning. If other users are present implement communications process about any changes on flow or water quality.	-	WG3 Design team Wagerup Environment Department	Prior to and following commissioning of the expanded Harvey River pumping station.	Detailed survey of water use from the lower Harvey Main Drain, complete. Records indicate other users of the Lower Harvey Main Drain have been consulted.

What	How	Procedure Reference	Who	When	Performance Indicator
Objective 4. Water use and supply is measured.	Action 4.1 Measure major use and supply of fresh water to facilitate analysis for efficiency improvements and reporting.	44402 *Surface Water Licence – Operational Strategy*	All operational areas.	Ongoing, with data reported annually to DoIR/DoE	Water use and supply data reported annually.
Objective 5. Conduct regular reviews or audits of water supply and consumption.	Action 5.1 Review the status of major water conservation opportunities and update the Operating Strategy to reflect these.	44402 *Surface Water Licence – Operational Strategy*	Wagerup Environment Department	Five-yearly or: • 3 months prior to expiry of surface water licences; • If monitoring indicated adverse trends/unexpected performance; or • If a substantial change occurs to the refinery's assets, water requirements, releases and/or other purpose of surface water diversion or use.	Schedule of Amendments indicates Operating Strategy reviewed as required.
Objective 6.	Action 6.1	44402 *Surface Water*	Wagerup	Prior to	Operating Strategy has been reviewed

What	How	Procedure Reference	Who	When	Performance Indicator
Water allocation meets Government water resource objectives.	Negotiate increased Harvey River Main Drain Surface Water Licence including a review of the Operating Strategy which supports the licence.	*Licence – Operational Strategy*	Environment Department	commissioning of the expanded Harvey River pumping station.	as required (see Schedule of Amendments).
Objective 7. The community understand and support Alcoa's Water Conservation strategy and Wagerup refinery's water supply management strategy.	Action 7.1 Through consultation forums and interaction with the community, publicise the water conservation strategies and invite comment.	N/A	Wagerup Refinery (Community Relations Department to manage).	Prior to and following commissioning of the expanded Harvey River pumping Station.	-
Objective 8. Staff are encouraged to practice water conservation.	Action 8.1 Use internal communication mechanisms to increase staff awareness of Alcoa's Water Conservation strategy and the Wagerup refinery's surface water operating strategy.	33740 *Internal Environmental Communication*	Wagerup Environment Department	Prior to and following commissioning of the expanded Harvey River pumping Station.	-

NOTE:

Procedures are subject to review and change as part of ongoing operations.

6. WATER MONITORING PROGRAM

Table 5. Summary of Monitoring Program

Location	Parameter	Method/Frequency
SP1 - North Yalup Brook	Flow volume	Weir with level probes reading continuously and recorded on a logger. Data downloaded monthly.
Upper Yalup Dam Offtake	Volume extracted	In-line magnetic flow meters.
Detention Pond Pump Station	Volume extracted	In-line magnetic flow meters.
Harvey River Main Drain Pump Station	Volume extracted Water Chemistry (pH, TDS, Total N & P)	In-line magnetic flow meters. Grab sample Monthly when pumping
SP5 Detention Pond #1 Overflow	Release/Overflow volume	Weir with level probes reading continuously and recorded on a logger. Data downloaded monthly.
SP12 Samson South Diversion Drain	Chemical parameters (as per the DoE licence in effect at time) Metals (as per the DoE licence in effect at time) Release/Overflow volume	Monthly – when flowing Grab Sample Six-monthly Weir with level probes reading continuously and recorded on a logger. Data downloaded monthly.
SP14 Samson North Drain *	Water Chemistry (pH, TDS, Total N&P) Flow volume	Grab Sample Monthly when flowing Level probes reading continuously and recorded on a logger. Data downloaded monthly. Flow rating for control section used to estimate flow. Flow monitoring station being upgraded by DoE. Alcoa to cooperate with DoE to gain data
SP20 Harvey River Main Drain	Flow volume Water Chemistry	Level probes reading continuously and recorded on a logger. Data downloaded monthly. Flow rating for control section used to estimate flow.

6.1 ECOLOGICAL MONITORING

In line with the principle of Adaptive Environmental Assessment and Management (AEAM) ecological water requirements (EWR) evaluations have been conducted on all streams and drains that provide water sources for the Wagerup Refinery by CENRM

The EWR study was updated for the Harvey River Main Drain as part of the ERMP preparation (CENRM, 2005). The study includes recommendations for more detailed ecological monitoring prior to the Wagerup Expansion.

7. QUALITY CONTROL AND REPORTING

This WSMP will be incorporated into Wagerup's ISO 14001 Environmental Management System which is independently reviewed.

Progress against the action plan will be reported in the Review of Impact on Waters Report which is submitted to DoE and DoIR by the 31 March each year.

8. REVIEW AND UPDATE OF MANAGEMENT PLAN

This management plan will be reviewed every five years, or:

- three months prior to expiry of surface water licences;
- if monitoring or annual reporting indicate adverse trends or unexpected performance;
- if a substantial change occurs to the refinery's assets, water requirements, releases and/or purpose of surface water diversion or use; or
- if directed by the DoE.

9. REFERENCES

ENVIRON Australia Pty Ltd (2005). Water Supply Study, Wagerup Refinery Unit 3. Report prepared for Alcoa World Alumina Australia.

CENRM (2005). Ecological Water Requirements and water availability in the lower Harvey River catchment associated with the proposed Wagerup 3 Expansion. Report prepared for Alcoa World Alumina Australia.

Water and Rivers Commission (1998). Proposed Harvey Basin Water Allocation Plan.

Appendix A

Wagerup Surface Water Licence - Operational Strategy

Surface Water Licence - Operational Strategy (WGP)

Wagerup

Alcoa World Alumina – Australia

WAGERUP REFINERY

Surface Water Licence

OPERATIONAL STRATEGY

4th Revision

January 2005

This Operational Strategy forms part of Surface Water Licences issued to Alcoa World Alumina - Australia under the Rights in Water and Irrigation Act (1914), for the Wagerup Refinery located within the Harvey River Basin.

Originally three licences were granted and they set conditions under which Alcoa could divert surface water from the Samson Brook South Channel (Lic No. 97471), Black Tom Brook (Lic No. 99246) and Yalup Brook (Lic No. 97472) catchments. The Samson Brook South Channel catchment and Black Tom Brook are located within the proclaimed Waroona Irrigation District, while Yalup Brook is located within the boundaries of the proclaimed Harvey Irrigation District. The licences included an interim allocation to be replaced by development of a long-term supply.

To replace the interim allocation of 1,700 ML/yr from the Samson Brook South Channel and Black Tom Brook Catchments, and to meet the Refinery's expected water demand during dry years, Alcoa investigated several long-term water supply options. Long-term options included:

i. A trade in water allocation with SWI, giving Alcoa entitlement to stored water from the Samson and Drake's Brook Dams.

ii. Accessing groundwater

iii. Demonstrate that additional water from the hills catchment is available beyond current allocations

iv. Pump from Harvey Main Drain

v. Pump back from the end of the Diversion Drain.

vi. Pump back from Samson North Drain

vii. Cross site agreement with WC

viii. Conversion of farmlands irrigation allocation

The Harvey River Pump Back Station (Lic No 151027) was approved and commissioned at the start of winter 2003 to be utilised as a long-term water supply option for the Wagerup Refinery. Both the Black Tom Brook and Yalup Brook Licences were retained, however water can no longer be drawn from the Samson Brook South Channel.

Water diverted by Wagerup Refinery is stored in the existing Upper and Lower Yalup Dams, Detention Pond, and the refinery's Run-off Water Storage Pond (ROWS Pond). The refinery for the purpose of providing potable water, process makeup water and for residue area dust suppression diverts surface water.

Wagerup

Surface Water Licence - Operational Strategy (WGP)

1. Administrative Requirements

1.1 Duration of strategy

This strategy shall be current for five years commencing at the time of licence approval and ceasing 31st December 2007. The strategy shall be reviewed under the following circumstances:

- Three months prior to expiry of surface water licences.
- If monitoring or annual reporting indicate adverse trends or unexpected performance.
- If a change occurs to the refinery's assets, water requirements, releases and/or purpose of surface water diversion or use.

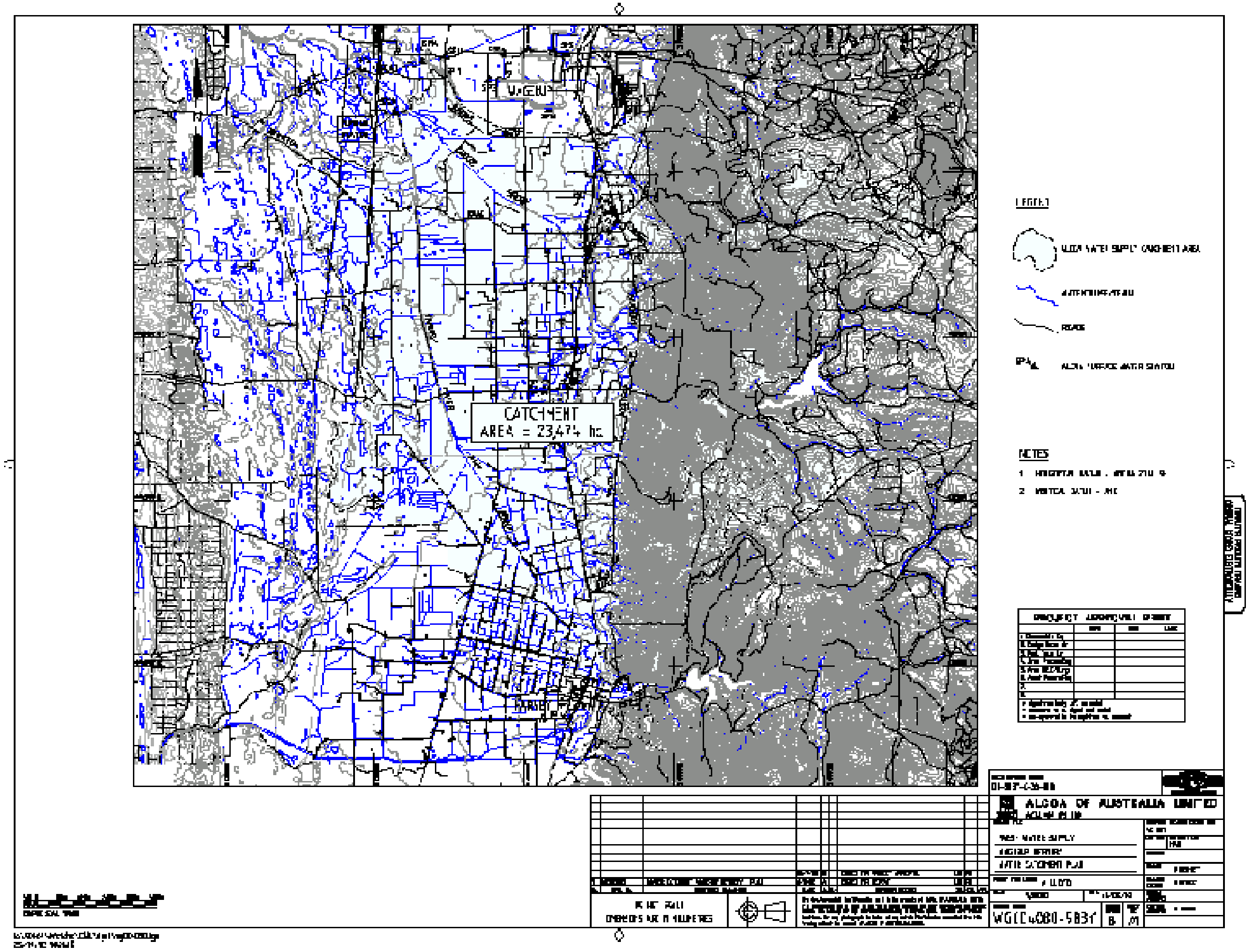
If directed by the Department of Environment (DoE) following consultation with Alcoa.

1.2 Description of source & diversion points

Figures 1 and 2 show the various water catchments and diversion points described below.

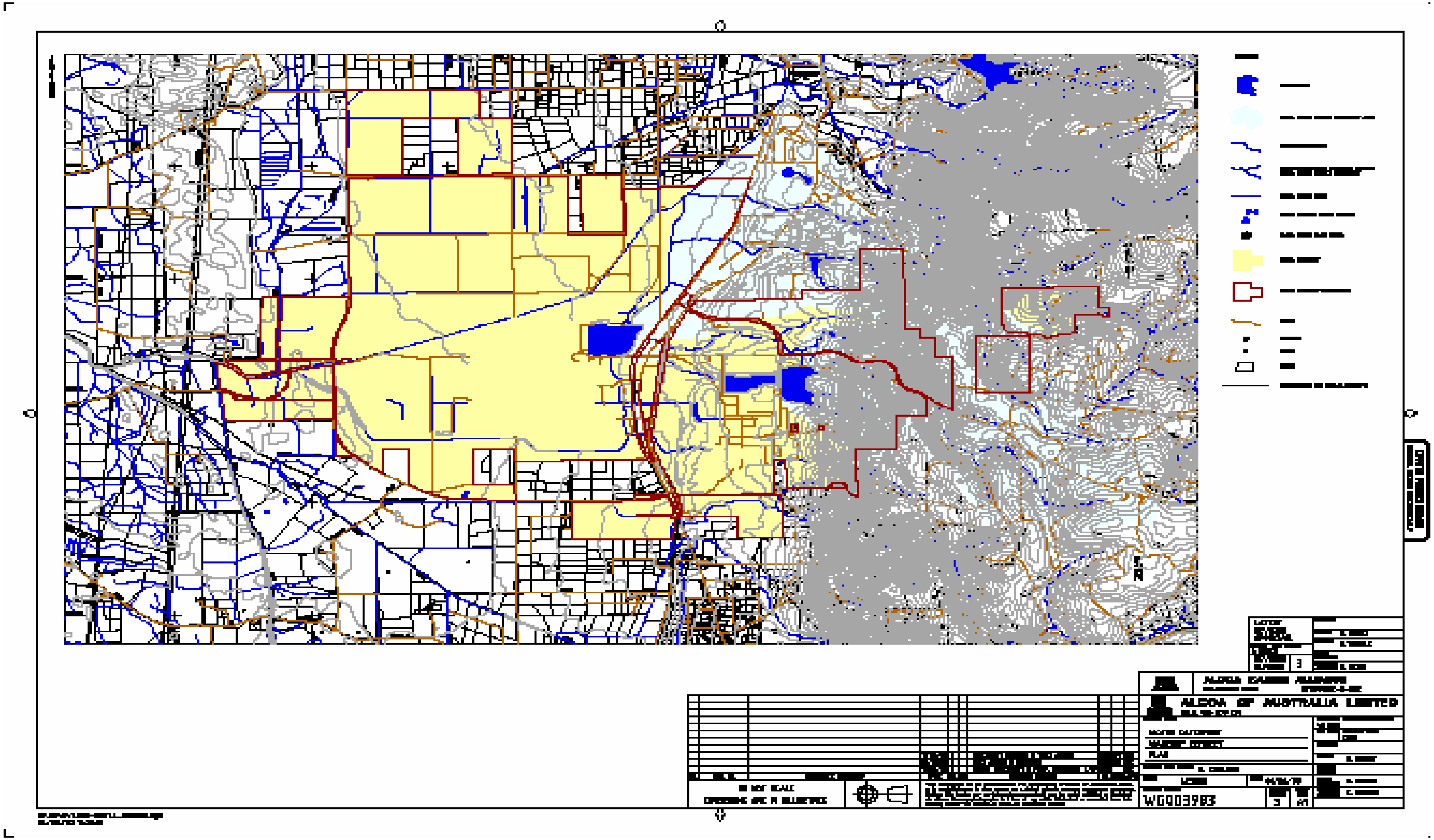
Surface Water Licence - Operational Strategy (WGP)

Figure 1 Harvey River Catchment



Surface Water Licence - Operational Strategy (WGP)

Figure 2 – Black Tom Brook and South Samson Brook Catchment



1.2.1 Yalup Brook

a) Catchment size – North & South Catchments

The Yalup Brook catchment comprises two succinct areas. The northern catchment, of 679.8 hectares, is approximately 10% vegetated and the remainder open pasture. The southern catchment, of 222.7 hectares, is approximately 60% vegetated with the remainder open pasture.

b) Yield

In average rainfall conditions, it has been estimated that the South Yalup Catchment will yield approximately 580ML, and the North Yalup Catchment will yield 1500ML (Sinclair Knight, 1991). It should be noted that the estimates of run-off quoted in this report are considerably less than estimates made prior to the construction of the refinery (Alcoa of Australia, 1978). Alcoa intend to intercept all flow from the south catchment each year, and will use flow from the northern catchment as a supplementary supply.

c) Historical flow

Streams in the South Yalup catchment are not gauged; however, their yield has been calculated using the stored volume within the Upper Yalup dam. The average over the seven year period from 1993 to 1999 has been 580 ML per annum. Of this, an average of 93% of the annual yield occurs between June and November.

A gauging station on the North Yalup just prior to the pipe head dam (SP1) has shown average yearly yields over the last twelve years (1990-2001) to be ~1150 ML per annum. Some 91% of this occurs between June and November.

d) Alcoa private property within catchment

All diversion points and dams are entirely within Alcoa private property. Of the South Yalup catchment some 95% is within Alcoa private property and in the North Yalup catchment this figure is approximately 25%. Of the remainder approximately 50% is State Forest and the rest other private owners.

e) Other users within catchment

There are no other licensed users of water within the catchments.

f) Diversion points – Upper & Lower Yalup dams & Pipe head dam

The South Yalup catchment drains into the Upper Yalup Dam and the North Yalup catchment is collected via the Pipe head Dam from where the water is piped to the Upper Yalup Dam.

The Lower Yalup Dam has only a very limited catchment within the refinery area and serves to collect excess condensate. There is provision for the transfer of water to the Lower Yalup Dam from the Upper Yalup Dam; however this has rarely been done.

1.2.2 Black Tom Brook

a) Catchment size

The catchment area of Black Tom Brook, including the contributing areas downstream of the confluence of Black Tom Brook and the ALCOA diversion drain to the detention pond, is approximately 1040 hectares. This area does not include the "closed" catchment area associated with the decommissioned Cable Sands Hamel sand mine.

Surface Water Licence - Operational Strategy (WGP)

b) Yield / Historical Flow

The Water and Rivers Commission operated a stream flow gauging station in the upper reaches of Black Tom Brook between 1981 and 1982. Flow data from this station correlates well with the observed flow at the Water and Rivers Commission stream flow gauging station on McKnoes Brook, to the north. The two data sets were used to generate monthly flows for the Black Tom Brook catchment between 1980 and 1999.

The estimated mean annual flow of the Black Tom Brook catchment is 4100 ML. The estimated 10 and 90 percentile annual flows are 3100 and 5200 ML respectively. Limited data from station SP6 (since 1997) indicates that these yields are not being achieved. The mean flow recorded is 1770 ML (1997-2001).

c) Other major users within catchment

Majority of the catchment is state forest. Several small private farming lots exist in the lower portion of the catchment as well as the decommissioned Cable Sands Hamel sand mine. There are no other licensed water users within the catchment.

d) Diversion point

The main channel of Black Tom Brook discharges into the diversion drains approximately 2.5 km upstream of the Alcoa Detention Pond. The southwest portion of the catchment has been significantly modified and is said to drain towards the Diversion Drain and Alcoa's Detention Pond.

1.2.3 Harvey River

a) Catchment size - Upstream of Logue Brook Drain

This catchment area can be described as the immediate catchment of the portion of Harvey River from the Harvey River New Dam to the abstraction point. The townsite of Harvey falls within the catchment. Other than the channel itself, the catchment area only contains one tributary, which is unnamed. The catchment area is approximately 280 km^2 measured from Bristol Road with approximately 35% of the catchment in the scarp/hills area.

b) Yield / Historical Flow

Alcoa ran a gauging station at Bristol Road between 1977 and 1986 with quality data available for the period between 1984 to 1986. Water and Rivers Commission flow data is available from Clifton Park (613052) and this has been used to back-calculate to Bristol Road – Streamtec 2002.

The estimated mean annual flow past the diversion point is around 75 GL.

c) Alcoa Private property within catchment

The diversion point is located within the Harvey River easement and within the catchment there is minor Alcoa Property.

d) Other major users within catchment

The Harvey River is used primarily as a drainage channel for removing excess irrigation water and a final pathway to drain agricultural land. There are no other major licensed users either upstream or downstream from the abstraction point.

Surface Water Licence - Operational Strategy (WGP)

e) Diversion point

A pumping station situated on the southern bank of the Harvey River immediately downstream of the confluence with Logue Brook drain. Water will be pumped via a pipeline to the Wagerup residue area. Discharge will be into either the runoff water storage pond (ROWS) or the Detention Pond.

Table 1 Surface Water Storage Details

Name	Location AMG	Storage capacity $m^3 \times 10^3$	Land ownership at storage	Source	Volume to be diverted $m^3 \times 10^3$
Upper Yalup Dam	6358150 N 399100 E	1595	Alcoa	South Yalup	580
				North Yalup	1020
Lower Yalup Dam	6358278 N 398145 E	675	Alcoa	NA	NA
Pipe head Dam	6358893 N 399480 E	14	Alcoa	North Yalup	1020
Detention Pond	6358900 N 396500 E	1745	Alcoa	Black Tom Harvey River	2500 *
ROWS	6357250 N 396250 E	5000	Alcoa	Harvey River	*

* Combined maximum 4400

1.3 Reporting

To meet the reporting requirements of the Operational Strategy, annual reporting will be incorporated into Alcoa's Annual Impacts on Waters Report for the Wagerup Refinery. The review is submitted annually to DRD in accordance with the Alumina Refinery (Wagerup) Agreement Act 1978. DRD distribute the review document to the DoE and other relevant government agencies for comment.

The review covers a calendar year (1st January to 31st December) and is submitted by 31st March each year, for the previous year's reporting.

To meet the requirements of the operational strategy, the following information will be reported within the Impacts on Waters Report:

- Volume of water drawn from storage by Alcoa from the various sources during the reporting period.
- Volume released downstream from diversion/storage points (including excess winter flow releases & environmental releases) during the reporting period.
- Surface water quality data.

Surface Water Licence - Operational Strategy (WGP)

- Reporting the refinery water circuit and surface water inventory for that year.
- Reporting of adverse trends or unexpected performance noted during reporting period.
- Breaches of operating strategy and corresponding remedial actions.
- Evaluation of water efficiency and initiatives taken during the reporting period.
- Rainfall data.
- Brief discussion of effectiveness of the monitoring program to ensure compliance with the DoE surface water licence conditions.
- Outline of any likely changes to the refinery water requirements / operational strategy for next reporting period.

1.4 Action taken in the event of a breach of Operating Strategy

As the Operational Strategy forms part of the Surface Water Licences, any breach of the strategy constitutes a breach under Section 13 of the Rights in Water and Irrigation Act 1914. Alcoa is therefore required to report any such breach to the DoE within 14 days of the monitoring results becoming available.

In the event of a breach, Alcoa will immediately undertake corrective action if required following negotiations with the DoE and other relevant government agencies. All remedial actions will be documented and reference made to any breaches in the annual report for that water year.

Department of Environment Contact

Notification to DoE should be directed to

DoE – Kwinana Peel Region

A/Program Manager- Allocation

Alan Cook

PO Box 454 Kwinana WA 6167

Phone: (08) 9411 1777 *Fax:* (08) 9419 5897

Wagerup Refinery Contact

Environmental Manager – Wagerup

Richard Bailey

PO Box 84 Waroona WA 6215

Phone (08) 9733 8119 *Fax* (08) 97338534

Surface Water Licence - Operational Strategy (WGP)

Wagerup

2. Environmental Requirements

2.1 Local Catchment EWRs

To minimise the adverse impact of surface water diversion by the Wagerup Refinery on the downstream environment and other users, Alcoa has undertaken an environmental water requirements (EWRs) study of the local catchments and a follow up assessment. The study area included:

1. Below Pipe head Dam on the north tributary of Yalup Brook
2. Downstream of the Lower Yalup Dam on the south tributary of Yalup Brook
3. Downstream of confluence of Samson Brook South Channel and the Diversion Drain to the Harvey Main Drain.

The initial study focused on the potential local impacts associated with the various diversion structures associated with the refinery water supply system. The results of this study have been documented in the following report:

Streamtec (May 2000) <u>Yalup & Samson Brook: Environmental Water Requirements</u>, Streamtec Report 07/00.

A follow up study was undertaken during 2001 to assess any impacts caused by the diversion of water. The results of this study are documented in the following report:

Streamtec (April 2002) <u>YalupBrooks & South Samson Drain: Adequacy of Environmental Water Provisions: Results from Biomonitoring</u>, Streamtec Report 04/02

Both reports reinforced that the historical and continued abstraction of water from these systems was not having an adverse effect on their ecological health.

2.2 Harvey River Basin EWRs

The above mentioned studies did not take into account the EWRs determined for the greater Harvey River Basin, which were documented in the Water and Rivers Commission Report WRAP 14 (1998) *Proposed Harvey Basin Surface Water Allocation Plan.*

The Wagerup Refinery falls within the Harvey River Basin. Allocation of surface water resources in this area need to take into consideration the management guidelines set in the 1998 Allocation Plan. The plan identifies the ecological importance of flow from the forested scarp catchments reaching the lower river system and Harvey Estuary.

The report “Assessment of proposed water abstraction from the Lower Harvey River” Streamtec 2002, submitted to support the licence application for abstraction from the Harvey River, includes a desktop analysis of EWR requirements for the Harvey River. An EWR of 3.3 GL/y has been calculated at the abstraction point.

Surface Water Licence - Operational Strategy (WGP)

3. Operating Rules

3.1 Water Allocation

Alcoa has received the following licences for the long-term allocation of surface water to sustain the Wagerup Refinery at the current alumina production capacity of 2.4 Mtpa. The projected allocation for a refinery capacity of 3.3 Mtpa is also included below.

Table 2: Summary of Water Source Allocation

	Alumina Production	
	2.4 Mtpa	**3.3 Mtpa**
Water Source	**Water Allocation (ML)**	
Yalup Brook	1,600	1,600
Black Tom Brook	2,500 *1	2,500 *1
Harvey Main Drain	4,400 *2	6,000 *3

*1 Allocation may not be available under dry conditions.

*2 Allocation can only be drawn between May and October

*3 This allocation is proposed only and will be formalised, if required, via the normal application and approval process for surface water allocation.

Historical data indicates that even under average conditions the full allocation from the Yalup or Black Tom catchments may not be available. Therefore the Harvey allocation needs to be robust enough to meet all non-potable needs.

Licences for Yalup and Black Tom Brooks are measured as draw from storage. Until expanded refinery capacity is implemented there will be no dedicated storage for water from the Harvey River. The licence to take water from the Harvey River applies to the point at which water is pumped from the River. This flow is metered from the pipeline, down stream from the pump, but prior to the control point that determines whether flow is diverted to the ROWS pond or the detention pond. It is critical that flow volumes to either the ROWS Pond or the Detention pond can be determined, to prevent double counting of water from the Detention Pond for when the water is diverted into it from the Harvey River.

Surface Water Licence - Operational Strategy (WGP)

3.2 Operating Protocol

3.2.1 Description of Water Circuit

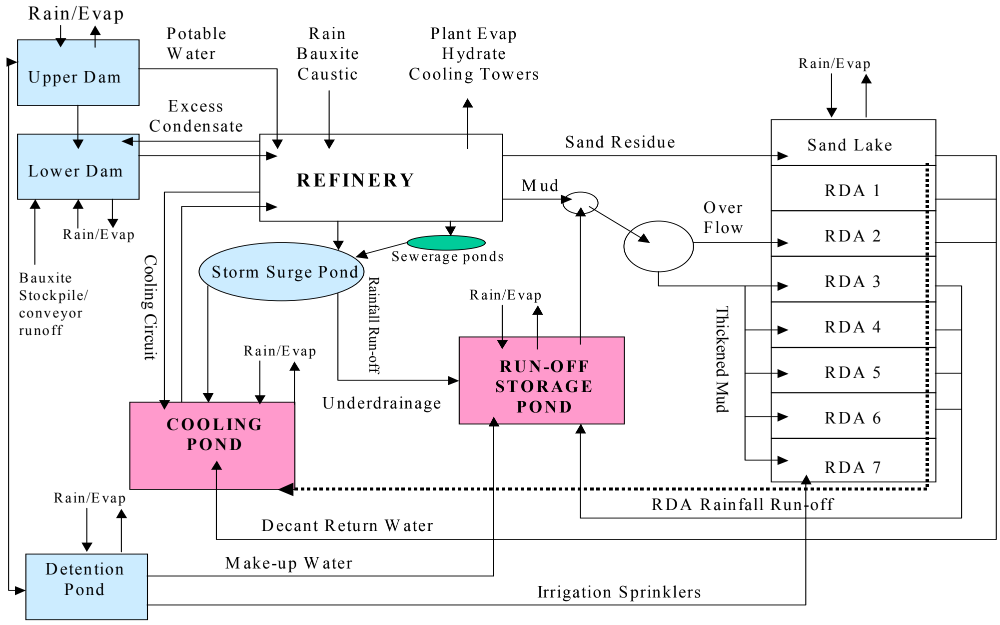


FIGURE 3 Overview of the Water Circuit

The overall water circuit is shown schematically in Figure 3. It is a “closed” water circuit, with all rainfall run-off from the refinery, residue storage areas and process water ponds transferred to the Run-off Storage Pond during winter and then used as make-up water for the refinery during summer. Losses from the process are primarily through evaporation, although there is a relatively high portion of water retained with the residue after it has been dry stacked. All of the residue storage areas have base drainage systems, and these systems collect residue leachate and rainfall infiltration, which is also returned to the refinery as make-up water.

3.2.2 Yalup Catchment

The refinery’s historical diversion of 1,600 ML/yr from the Yalup Catchment may continue for the long-term as “existing industrial use”, as implied under the management guidelines set for Management Area 5 of the Harvey Basin Allocation Plan (Northern Unregulated and Semi-regulated Darling Range Streams).

a) North Yalup – Pipe Head Dam

The Pipe head Dam collects all flow from the North Yalup Brook from where it is transferred to the Upper Yalup Dam. An amount of water is maintained in the Pipe head Dam for stock watering purposes. An overflow spillway exists to facilitate excess water accumulating in storm events. A dump mechanism can be used to drain the dam.

As all of the South Yalup catchment will be harvested, only an amount to make a total of 1600 ML will be taken from the North Yalup Catchment. Any surplus yield will be allowed to bypass the Pipe head Dam or enter and overflow the Upper Yalup Dam. Bypass or overflow will flow through Alcoa land towards the refinery area until being diverted to the Samson South Diversion Drain, which flows to the Harvey Main Drain.

Surface Water Licence - Operational Strategy (WGP)

No formal releases are required for EWRs as existing flows from the local catchment and small tributaries are considered adequate to meet the EWRs for the section of watercourse downstream of the Pipe head Dam (see Section 4 of Streamtec Report).

b) South Yalup Catchment – Upper Yalup Dam & Lower Yalup Dam

The Upper Yalup Dam receives direct runoff from the South Yalup Catchment. All runoff is collected. There is provision to transfer water to the Lower Yalup Dam; however this is not normally done.

Water in the Upper Yalup Dam is used primarily as potable water for the refinery.

No formal releases are required to meet local EWRs. The ecological value of the few river pools present can be maintained by existing local run-off (see Section 4 of Streamtec Report).

3.2.3 Black Tom Brook

Over the past 6 years the refinery has diverted, on average 2,500 ML/yr (based on those years of highest draw). In light of the management guidelines set for Management Area 5 of the Harvey Basin Allocation Plan (Northern Unregulated and Semi-regulated Darling Range Streams) the refinery may continue to divert up to 2,500 ML/yr for the long-term from the Black Tom Catchment as “existing industrial use”.

Water harvested from the Black Tom Brook catchments is stored in the Detention Pond located on the Samson South Diversion Drain, with some of the intercepted water transferred to the Run-off Water Storage Pond (ROWs Pond). This water is used primarily as make-up water to the refining process, but also provides irrigation water for dust suppression on the residue drying beds. A facility has been installed to transfer water from the Detention Pond to the Upper Yalup Dam to supplement potable water supplies.

The un-allocated portion of winter flow draining from the Samson Brook South Channel, Black Tom Brook and North Yalup Catchments overflows the Alcoa Detention Pond into the Diversion Drain. This drain discharges into the Samson Brook South Channel, just upstream of SP12 (see Figure 1).

The ecological water requirements study completed by Streamtec recommends a flow of 3,010 ML/annum to maintain the ecology at a low level of risk, for the portion of Samson Brook South Channel between SP12 and the Harvey River Main Drain. It is believed that flows from the Samson Brook North Channel are likely to meet this EWR requirement. SP14 represents Alcoa’s monitoring point on the Samson Brook North Channel (see Figure 1).

3.2.4 Harvey River

The Harvey River catchment area that feeds the diversion point is around 20,000 hectares. Of this about 35% is forest and the remainder is primarily cleared agricultural ground. River flows are comprised of winter runoff from hills catchments north of the Harvey Dam and south of the Yalup catchment and drainage from irrigated pasture during winter and summer.

The diversion of 4.4GL represents less than 5% of the total modelled flow. The pump inlet design allows for at least 200mm river depth to pass before the pumping can start. These base flows will adequately meet and exceed flows required for EWRs. Pumping rates will be variable depending on the total river flow. As the river flow rises above the base flow rate the four pumps will cut in sequentially to provide a maximum pumping rate of 465 l/sec. The pipeline discharge can be directed to either of the ROWS or Detention Ponds depending on system requirements.

Surface Water Licence - Operational Strategy (WGP)

The preferred storage is the Detention Pond as this will allow the water to be used not only as process make-up water but for summer dust suppression or even as a top-up for the Upper Yalup Dam. Until the Detention Pond can be expanded however there will need to be some transfer to the ROWS pond towards the end of winter to ensure adequate storage for all needs during the summer.

Alcoa is only permitted to draw water from the Harvey River between May and October, or otherwise directed by the Water and Rivers Commission.

3.2.5 Proposed Closure of Samson South Drain

During the initial planning for the refinery and residue storage areas, it was recognised that construction of the residue areas would block much of the normal east-west drainage across Alcoa's property. To maintain efficient drainage for the area east of the residue area, a diversion drain was constructed around the eastern and southern sides of the property. It was planned that this drain would eventually replace the function of the portion of the Samson South Drain that was located across the northern part of Alcoa's property. It was anticipated that closure of the drain would be required to facilitate future expansion of the residue storage areas.

The existing agricultural drains were designed by the PWD to prevent inundation of pasture for extended periods of time rather than prevent all flooding. To reflect this philosophy, the drains were designed to handle peak flows with a recurrence interval of two years below the natural ground surface, and a recurrence interval of ten years to be contained below the banks of the drain.

The South Samson Diversion Drain was designed on these same principles (Alcoa of Australia, 1980). Design flows for the drain were derived by dividing the catchment into three sections:

1. Upstream of Black Tom Brook (1730 Ha)
2. From Black Tom Brook to Yalup Brook which includes the Detention Pond (1750 Ha)
3. From Yalup Brook to Bancell drain (655 Ha)

Unit hydrographs for two-year and ten-year storms were applied to the catchment, and the diversion drain cross sections designed to meet the PWD flow requirements. Structures within the drain were all designed for the ten-year peak flows. These included:

- Culverts under Fawcett, Brockman and Bancell Roads
- Inlet structure to the Detention Pond including the monitoring weir
- Detention Pond overflow spillway and Bristol Road bridge
- Drop structures at buried pipeline crossings
- Drop structures along the southern diversion alignment.

Subsequent to the original design work a follow up study was completed in 2001 that assessed the capability of the Diversion Drain to accommodate floods if the Samson South Drain was closed. The report found that the Diversion drain was adequate provided that minor modifications were made to the drain profile in its upper reaches and some culverts expanded.

Surface Water Licence - Operational Strategy (WGP)

It is proposed that the existing diversion structure at the intersection of the South Samson Drain with the Diversion Drain be used to divert all the winter flow through the Diversion Drain. The existing Samson South Drain will continue to drain farmlands in the northern portion of Alcoa's property until its removal is necessitated by residue area construction. At this time it will be closed from the point where it passes under Fawcett Road; however a shallow drain will be installed to the northern and western sides of the residue areas to continue to drain Alcoa's farmlands in these areas.

Surface Water Licence - Operational Strategy (WGP)

4. Monitoring

4.1 Quantity

The volume of water drawn by Alcoa from the various sources will be measured so as to gauge compliance with the operating strategy. Similarly the volume released downstream from diversion/storage points, including excess winter flow releases and environmental releases will be monitored. Table 2 summarises the location and frequency of such monitoring.

Flow monitoring has been in place on a number of the streams within the vicinity of the refinery for many years. Figure 4 provides a summary of this monitoring data.

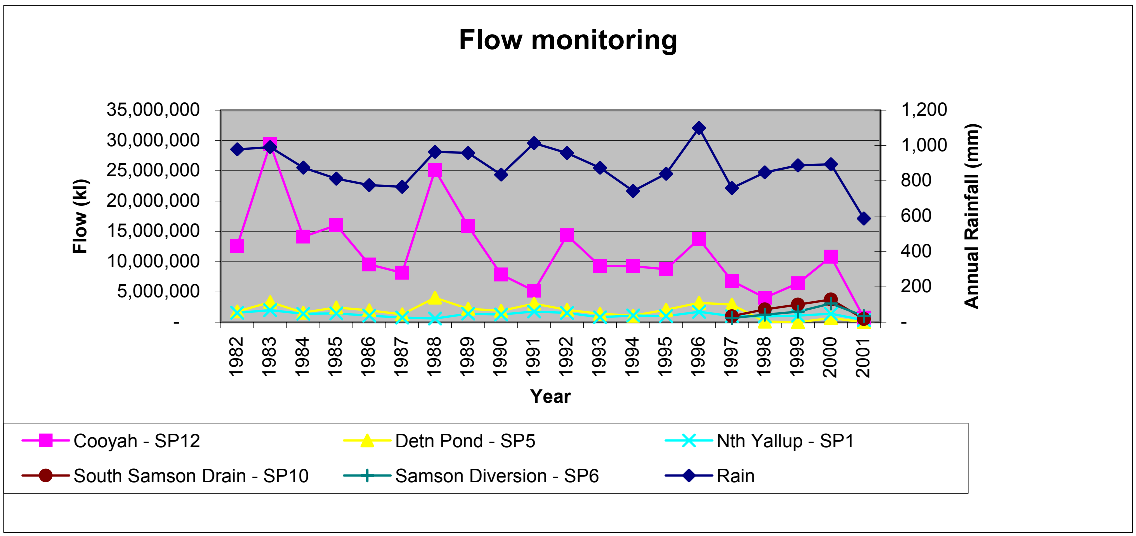


Figure 4 Summary of stream flow monitoring

4.2 Quality

Surface water quality monitoring is conducted at station SP12 (see Figure 1) in accordance with the monitoring parameters and frequency set within the Wagerup Refinery's DoE licence.

Table 3 below outlines the frequency of monitoring, and parameters measured at each site.

Surface Water Licence - Operational Strategy (WGP)

Table 3 - Summary of Monitoring Program

Type	Location	Parameter	Frequency
Quantitative	SP1	Flow volume – North Yalup	#
	Upper Yalup Dam	Draw volume	&
	Detention Pond	Draw volume	&
	Harvey River	Draw volume	&
	SP5	Release/Overflow volume	#
	SP12	Release/Overflow volume	#
	SP14	Flow volume – Samson North Drain	@
	SP15 (or alternate location as agreed with DoE)	Flow volume – Harvey	$
	SP12	Physical parameters as per the DoE licence in effect at time.	Monthly – when flowing.
		Metals as per the DoE licence in effect at time.	Six-monthly

\# weir with level probes reading continuously and recorded on a logger. Data downloaded monthly.

@ level probes reading continuously and recorded on a logger. Data downloaded monthly.

$ Estimate flows using Harvey River at Clifton Park data. Action plan to establish continuous flow monitoring as outlined in Schedule of Amendment table.

& in-line flow meters (magflow).

Monitoring parameters contained in licence # 6217/7 that expires July 2004.

Table 4 – Water Quality Parameters Measured at SP12

Physical parameters	PH, TDS or EC, Alkalinity, Nephelometric turbidity units, Sodium:Chloride ratio
Metals	Al, As, Hg, Mn, Mo, Se, U, and V

4.3 Ecological Assessment

In the context of Adaptive Environmental Assessment and Management (AEAM) the EWRs were evaluated in detail after an initial period.

The first EWR evaluation was conducted in 2001. No discernible impacts were identified over the licence period. Further repeats will be undertaken in the year prior to license renewal.

Surface Water Licence - Operational Strategy (WGP)

5. Water Efficiency

Alcoa will commit to developing a water efficiency plan outlining consumption, water auditing and target reductions in water use.

It should be noted that the quantities of water required to sustain a refining capacity of 3.3 Mtpa, are only marginally greater than the total requirement forecast in the original ERMP for a refining capacity of 2.0Mtpa. The water circuit is closed with the only losses being from evaporation and that tied up with the residue deposition. Considerable water efficiencies have already been obtained through:

(i) The introduction of dry residue storage practices.

(ii) Operating the residue system with the smallest possible alkaline water surface, reducing the potential for evaporative losses.

(iii) Water conservation initiatives and substitution within the refinery to conserve potable quality water.

Surface Water Licence - Operational Strategy (WGP)

6. Communication

The DoE and Alcoa acknowledge the benefits and need for maintaining regular communication. Both parties commit to meet at least once a year, in May, to discuss surface water use and allocation issues.

As part of water resource management in the southwest, the DoE recognise the Alcoa Wagerup Refinery as a major stakeholder, and aim to establish and maintain an effective working relationship with Alcoa.

7. Operational Strategy Agreement

Department of Environment

Approved by: ....

Date: ....22-04-04.....

Alcoa World Alumina Australia – Wagerup Refinery

Approved by: ....

Date: ....30.03.04....

Version 4

March 2004

7. Schedule Of Amendments

Date	Amendment Details	Signatories
June 2002	Licenced allocation for Black Tom Brook reduced and Samson South removed. New licence for abstraction from Harvey River.	
March 2003	Interim licences replaced by Harvey River licence.	Alan Cook and Katie Gwynne
March 2004	Introduction amended to outline current licences Amended to include licence condition stating water can only be pumped from the Harvey from May – October. Updated Water Balance diagram Annual reporting against the requirements of the operational strategy will be incorporated into Alcoa's Impacts on waters Report. Section 3.1 Water Allocation changed to reflect allocation changes under a production capacity of 2.4Mtpa and 3.3 Mtpa. Updated DEWCP and WRC to DoE	Alan Cook and Richard Bailey.
January 2005	Action Plan to cover delay in establishing continuous monitoring station on Harvey Drain at SP15 (Bristol Rd) or other more suitable location: a. For 2004 Annual report estimate flow below pump station using Harvey Drain at Clifton Park (Win Site ID# 16257) data. b. Install level probe at Bristol Road or other agreed location to measure flows in winter 2005 c. Install permanent flow monitoring station downstream of pump station at agreed location by 31 December 2005 (subject to DoE and Water Corporation approval).	Alan Cook and Anita Logiudice

10.4 SPILL MANAGEMENT PLAN

SPILL MANAGEMENT PLAN

Wagerup Refinery Unit 3

for

Alcoa World Alumina Australia

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Ref: Spill Management Plan v0 April 2005

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SPILL MANAGEMENT PLAN
Wagerup Refinery Unit 3

1. INTRODUCTION

Alcoa's Wagerup alumina refinery and its associated bauxite residue drying areas (RDAs) are located 120 kilometres south of Perth, two kilometres north of Yarloop and approximately seven kilometres south of Waroona. The refinery is located close to the foot of the Darling Scarp and is separated from the RDAs by the South West Highway and the Perth-Bunbury railway line. The refinery produces alumina from bauxite mined at the Willowdale mine site, using the Bayer process.

Alcoa proposes to expand its existing Wagerup alumina refinery through completing the construction of a third production unit (the Proposal). Construction of the third production unit will increase production to a total of approximately 4.7 Mtpa. An Environmental Review and Management Program (ERMP) has been prepared and submitted to the Environmental Protection Authority (EPA) for assessment under Part IV of the *Environmental Protection Act 1986*. This Spill Management Plan forms part of the ERMP and is included as an Appendix to the document.

Wagerup Refinery extracts alumina from bauxite through a process involving numerous tanks, vessels, pumps and interconnecting pipes. After the proposed expansion there will be an increased volume of alkaline process liquor circulated throughout the Bayer circuit. Although solutions of sodium hydroxide are by far the biggest volume of process chemical, there are also significant quantities of acid, flocculant, distillate, cooling tower treatment chemicals, and other special additives.

Key Risks: Materials such as caustic soda which if spilt can become mobile in the subsurface and may contaminate large areas of soil and groundwater if not contained. In addition hydrocarbons and other chemicals used in the process, and process liquors may also pollute soils and/or groundwater and surface water if released to the environment. Failure of containment vessels, faulty pipework, operational error, poor maintenance and housekeeping, power failures, cracks in concrete surfaces and failure of secondary containment areas (e.g. bunding) are some of the ways spills and leaks may occur.

Development of the Proposal will result in an increase in the volumes of process chemicals, materials and liquors in the refinery system, and an increase in the requirement for containment vessels and pipework, thereby increasing the potential risk of leaks and spills. It is therefore important that appropriate spill prevention and control measures are implemented.

The strategy for controlling chemicals is based on a hierarchy of control which takes account of the requirements of the Department of Environment (DoE) and Department of Industry and Resources (DoIR) containment expectations as described in the licence, and the *Dangerous Goods Safety Act 2004* and associated Regulations.

The hierarchy of control is;

Primary Controls

- Process control; level alarms, process control logic;
- Maintenance of equipment and instruments;
- Inspections of tanks (flat bottom tank inspections, non destructive testing, pipeline thickness testing).

Secondary Controls

- Bunds;
- Sumps and pumps.

Tertiary Controls

- Concrete and bitumen pavement and drains;
- Stormwater drainage system;
- Emergency Response.

These operational controls are described in more detail in section 4 (Procedures) of this report.

2. FUNCTION

This Spill Management Plan has been prepared for the Proposal. The plan is designed to reference relevant procedures in Wagerup operations' existing Environmental Management System (EMS) and outline any additional controls and procedures necessary to minimise the hazards to human health and the environment from releases of toxic and hazardous substances to the soil, surface waters and groundwater.

This Spill Management Plan will be reviewed and updated at a minimum of once every three years, or if changes to the process occur or major new projects at the refinery are implemented.

3. RELATED DOCUMENTS

This Spill Management Plan for the Proposal should be applied in the context of the existing Environmental Management Manual for Wagerup (Document No. 32600). This manual is a key document of the Wagerup Environmental Management System and the main reference document on environmental policy and principles, team structures, standards and statutory requirements, identification of environmental aspects and associated planning, management systems, procedures and environmental monitoring.

Spill prevention and control procedures for the existing Wagerup Refinery and Bunbury Port Operations are provided in the Release Prevention, Control and Countermeasure (RPCC) Plan (Document No. 38833). This Spill Management Plan for the Proposal makes reference to the RPCC

Plan and in the event of a release the Spill Response Procedures for Wagerup Refinery (Document No. 35981) and Bunbury Port Operations (Document No. 42097) should be referred to.

Documents related to this management plan and listed within the APSS[1] (Alcoa's formal document management system) are listed following:

Spill Procedures

- 65326 Spill Overview Policy (Refineries)
- 38833 Release Prevention, Control and Countermeasure (RPCC) Plan (Wagerup)
- 35981 Spill Response Procedure (Wagerup)
- 42097 Spill Response Procedure (Bunbury)
- 4696 Spill Clean-up and Soil Testing (WA Operations)
- 31765 Use Of Spill Control Kit (WA Operations)
- 40911 Managing Chemical Spills at 110C Cooling Tower (Wagerup)
- 65630 Control Chemical Spills in the Laboratory (WA Operations)
- 59083 Liquor Surge and Potential Spill Area Information (Wagerup)
- 66425 Spills Notification and Reporting (WA Operations)
- 38834 Release Prevention, Control and Countermeasure Plan, Materials Inventory (Wagerup)

General Environmental Procedures

- 32600 Environmental Management Manual for Wagerup (Wagerup)
- 41532 Environmental Design Guide (WA Operations)
- 36021 Emergency Preparedness and Response (Refineries)
- 56824 Emergency Response Procedure (Wagerup)
- 33371 Environmental Incident Investigation (WA Operations)
- 38186 Environmental Training for New and Existing Employees and Contractors (Refineries)

4. PROCEDURES

Table 1 shows indicative spill management measures that are to be implemented for the Proposal. These measures are based on existing procedures within the Wagerup EMS, and any additional measures that are required to be incorporated into the existing EMS are identified. These response

[1] As a key document related to the Wagerup Refinery Environmental Management System this document is regularly reviewed and updated and will be subject to ongoing change.

All procedures within APSS are subject to change as a result of revision processes.

actions are reviewed periodically, following significant events and as process changes are made, consequently the actions listed are to be considered indicative only.

Atmospheric releases (e.g. dust, gaseous emissions, vapours) are to be managed in accordance with the Air Quality Management Plan prepared for the Proposal.

(Refer to the RPCC Plan for facility descriptions, the refinery process, materials used on site and the stormwater system).

Table 1. Indicative Release Prevention, Control and Countermeasure Procedures for the Proposal

What	How	Procedure Reference	Who	When	Performance Indicator
RELEASE PREVENTION					
Objective 1. Identify any changes or increase in the risk of spills with the Wagerup Unit 3 expansion and put in place appropriate measures to minimise these risks.	Action 1.1 Assessment of the risk of spills for the expanded Refinery will be determined through using the "Aspects Impacts Identification and Evaluation Procedure" as follows: 1. Form a team to assess the environmental consequences of the expanded operations. 2. Define the process for the operation of the OC area (e.g. Normal Operations, Start Up and Shut Down, Emergency Stops, Upset Conditions and Maintenance Operations). 3. Become familiar with process. 4. Identify Aspect and Impacts. 5. Identify existing engineering and procedural controls. 6. Undertake the risk assessment with and without control measures, identifying 'likelihood' and 'consequence' of the potential impacts. All risks 'Medium' are considered 'significant' environmental impacts. Those risks which are not considered acceptable (i.e. risk not as low as reasonably possible (ALARP)) must have action plans to reduce the risk to ALARP. 7. Formulate an Aspects and Impacts Register and link to Action Plans. Put in place appropriate controls through Design, Operation, Maintenance and Training/Awareness measures outlined in	41716 '*Identify and Evaluate Environmental Aspects and Impacts*'	Refer to document 41716 for specific Responsibilities.	Prior to construction of the expansion, on commissioning and as required (e.g. in the event of a significant new project or process change).	Aspects Impacts Register up to date for expanded refinery. Current Action Plans are being implemented.

What	How	Procedure Reference	Who	When	Performance Indicator
	Action 2.				
Design: Objective 2. Design chemical/process material storage, handling and transfer infrastructure to minimise risk of spills.	Action 2.1 Design the expanded Refinery in accordance with: 1. Secondary Containment Design Guidelines For Dangerous Goods (Document 5076). 2. Corporate Mandated Standard for the Use of Underground Storage Tanks (Document 5541). 3. AS 1940 *Storage and handling of flammable and combustible liquids.* 4. AS 3780 *The storage and handling of corrosive substances*. Action 2.2 Conduct risk assessment to analyse operational and maintenance conditions that could result in accidental release scenarios. Action 2.3 Analysis the potential existing contamination of 'brown-field' expansion. Action 2.4 Design primary and secondary containment systems to eliminate potential of uncontrolled spillage to the environment. <u>Release of contaminated liquor outside the controlled environment is not acceptable.</u> Action 2.5	41532 '*Environmental Design Guide'* 5076 '*Secondary Containment Design Guidelines For Dangerous Goods'* 5541 '*Corporate Mandated Standard for the Use of Underground Storage Tanks'*	Engineering Department	During design and construction.	No release of process liquors/contaminated water outside the controlled Refinery environment.

What	**How**	**Procedure Reference**	**Who**	**When**	**Performance Indicator**
	Ensure stormwater drainage systems are not used for process water. Action 2.6 Install process fluid pipelines above-ground. Action 2.7 Design to ensure drain down pipes, valves and future maintenance for caustic fluids are contained within the confines of the steel containment system. Action 2.8 Ensure flat bottom tanks have membrane protection. Design tanks to minimise potential for corrosion. Action 2.9 Install appropriate leak detection and spill warning systems on expanded refinery.				
Operation: Objective 3. All practicable measures will be taken to ensure that process materials are contained within designed primary and secondary containment facilities such as tank,	Action 3.1 Maintain good housekeeping standards and use appropriate housekeeping procedures where required. Action 3.2 Ensure leak detection and spill warning systems are kept in working order. Action 3.3 Update operating procedures for expanded refinery and implement.	Refer to Housekeeping and Environmental Inspections procedures (eg. for: • Workshop (45211); • Fitting Workshop (45213) • Fabrication Workshop (45215) • Pump Factory (67530) • Machining Workshop	Area Co-coordinators	Ongoing during operations.	No release of process liquors/contaminated water outside the controlled Refinery environment.

What	How	Procedure Reference	Who	When	Performance Indicator
pipework, drains, sumps, concrete slabs and bunds.	Action 3.4 Ensure off-loading of fuel, sulphuric acid, lime, flocculant and fuel is undertaken on a bunded area where spills can be contained and treated appropriately. Action 3.5 Store and manage drums and containers whose contents have the potential to impact on the environment, in accordance with: – Drum Management Guidelines (5146); – Oils and Chemicals Containment (5100); – Corporate Environmental Policy Interpretation (36757). Action 3.6 All tanks are to be above-ground and stored in accordance with the *Dangerous Goods Regulations 1992* (unless they are exempt, e.g. process vessels). Action 3.7 Construct any new surface water containments at the Residue Drying Area with PVC liners.	(45214) • Valve Factory (67528) • Spool Factory (67529). • Drum Management Guidelines (5146); • Oils and Chemicals Containment (5100); • *Corporate Environmental Policy Interpretation* (36757).			
Maintenance: Objective 4. Ensure adequate maintenance is continued to minimise	Action 4.1 Implement inspection and maintenance procedures such as: • structural tank inspections; • concrete inspections; and • general maintenance.	All relevant inspection and maintenance procedures. *'Ultrasonic Condition*	Area co-coordinators	Ongoing during operations.	No release of process liquors/contaminated water outside the controlled Refinery environment.

What	How	Procedure Reference	Who	When	Performance Indicator
risk of leaks and spills.	Action 4.2 Update the FMMS system to include Inspection Schedules for new equipment and tanks associated with the Wagerup Unit 3 Project. Action 4.3 Periodically undertake ultrasonic monitoring of the sand to lake pipelines to check for pipe wear. Action 4.4 Check cooling water return lines from the Cooling Pond for leaks, on a monthly basis	*Monitoring Sand to Lake Lines Thickness Testing'* (5313)			
Training and Awareness: Objective 5 All Alcoa workforce and contractors are to be made aware of their legal obligations with regards to spill prevention, control and countermeasures.	Action 5.1 All new employees and contractors must undergo an induction to provide overall awareness of the safety and environmental issues on site, including Emergency Spill Response training.	'*Environmental Training for New and Existing Employees and Contractors'* (38186) *'Emergency Preparedness & Response'* (36021)	All personnel.	During construction and operation.	Training records indicate all Alcoa workforce and contractors have an understanding of the basic requirements of spill prevention, control and countermeasures.
Objective 6. Ensure all potentially hazardous materials involved in the upgraded refinery are	Action 6.1 Update RPCC Materials Inventory for Expanded Refinery.	*'RPCC Materials Inventory'* (38834)	Refer to document 38834 for specific responsibilities.	Prior to commissioning.	RPCC Materials Inventory up to date for Expanded Refinery

What	How	Procedure Reference	Who	When	Performance Indicator
documented and Emergency Response procedures updated.					
Objective 7. Minimise risk of release of process liquors in the case of emergency shutdown of expanded Refinery.	Action 7.1 In the case of emergency shutdowns (e.g. power failure) control surge volume levels in tanks as described in document 59083 to ensure liquor is contained in the process plant.	*'Liquor surge and potential spill area information'* (59083)	Process co-coordinators.	In case of emergency shutdown of Refinery.	Liquor volumes meet revised target surge volumes listed in document 59053.

What	How	Procedure Reference	Who	When	Performance Indicator
RELEASE CONTROL					
Objective 8. Contain and clean-up leaks and spills to prevent harm to persons, environment or property.	Action 8.1 Follow the procedure in document 35981: 1. Assess the situation (and risk to health and the environment). 2. Protect people (e.g. if required evacuate, warn others, request assistance, undertake initial temporary control); 3. Prevent further spillage and contain spill if safe to do so (if not safe Emergency personnel to bring situation under control). 4. Notify the appropriate people (Area Co-ordinator immediately; Area Co-ordinator to notify Supervisor/Manager by next working day. Refer to document 35981 for reporting of major and extreme spills). 5. Clean up the spill and dispose of spillage and waste appropriately if safe to do so (Refer to 31765 'Use of Spill Control Kit'). If not safe to do so, Emergency personnel to clean up and properly dispose of spill. 6. Follow-up by monitoring environmental impacts, reviewing responses to spill, completing reporting and modifying practices to prevent a re-occurrence.	*'Spill Response Overview and Policy'* (65326) *'Spill Response Procedure'* (35981)	All staff.	As soon as spill observed.	Details of all spills documented in incident reports. Corrective actions implemented within an appropriate time frame.
Objective 9. Contain and clean-up leaks and spills using appropriate Spill Kits.	Action 9.1 Use procedure 'Use of Spill Control Kit' (document 31765) to clean up spills if appropriate and safe to do so, wearing correct PPE:	*'Use of Spill Control Kit'*(31765)	Employees that have been trained in the use of Spill Kits as defined in document 31765	As soon as spill observed after necessary safety and environmental precautions taken (see	All spills cleaned up promptly and disposed of appropriately.

What	How	Procedure Reference	Who	When	Performance Indicator
	1. Barricade corridors if necessary. 2. Switch off electricity if necessary. 3. Remove portable furniture or equipment from the spill area if safe to do so. 4. Use puddle python to stop the spill spreading. 5. Place one or more pillows directly on the spill and press into the spill. 6. Place saturated pillows and python into plastic bags. 7. Label the contents. 8. Store in a metal bin prior to disposal. Method of disposal must be decided by laboratory supervisor, and/or the Environmental, Health and Safety Department. 9. Notify supervisor of spill incident. 10. Report to the service coordinator to replace used items from spill kit. Alumina spilt during train loading will be vacuumed and wagons washed before leaving site.			document 35981).	
Objective 10. Clean up spills to soils and confirm adequacy of clean up with soil tests.	Action 10.1 Follow the clean up and testing procedure in document 4696: 1. Identify chemical and criteria level. 2. Determine method of testing for compliance with criteria. 3. Identify area and depth of contamination. 4. Consider if the appropriate permits have been obtained, if problems of structures in close proximity and if occupational hazards exist (check PPE requirements).	*'Spill Clean-up and Soil Testing'* (4696)	Refer to document 4696 for responsibility for clean up of different chemicals.	As soon as spill observed.	Contamination levels in remaining soil below '*Maximum Allowable Contamination Level Guidelines*'.

What	How	Procedure Reference	Who	When	Performance Indicator
	5. Contact Environmental, Health and Safety Department for advice on removal/remediation of contaminated soil. 6. Remove identified contamination if advised by Environmental, Health and Safety Department. 7. Test remaining soil to see if within criteria outlined in '*Maximum Allowable Contamination Level Guidelines*'. 8. Environmental, Health and Safety Department to determine long term remediation if required. 9. Backfill with clay and top-dress.				
Objective 11. Clean up any spills within the 110C Cooling Tower chemical containment bunds to prevent harm to persons or the environment.	Action 11.1 Follow the procedure in document 40911: 1. On discovery of a chemical spill the person/controller should remove themselves from the immediate area, if the leak poses a serious risk and advise control room immediately. 2. LCN Controller should notify Security request the area be secured: a. Use barricade tape; b. Ensure bund drain shut; c. Limit spillage to the bund. 3. Determine nature of spillage. 4. Isolate spill/leak. 5. Notify appropriate person. 6. Chemical supplier/contractor to evaluate spill and recovery, disposal, neutralising options. 7. Ensure selected clean-up method is undertaken by the chemical supplier/contractor in a safe manner.	'Managing Chemical Spills at 110C Cooling Tower' (40911)	Refer to document 40911 for specific responsibilities.	As soon as spill observed.	Details of all spills documented in incident reports. Corrective actions implemented within an appropriate time frame.

What	How	Procedure Reference	Who	When	Performance Indicator
Objective 12. Ensure chemical spills in the laboratory are cleaned up in a safe and environmentally responsible manner.	Action 12.1 Use procedure in document 65630 using correct PPE to clean up laboratory chemical spills: 1. Vacate the area of the spillage immediately. 2. Barricade the area to avoid access from other personnel. 3. Alert all laboratory staff that a spill has occurred. 4. Ascertain nature of the spill without any risk to yourself or other personnel. 5. If you are unsure of the nature of the spill or if fumes are being generated call the Emergency Response Crew on 222 and provide full details regarding location and possible nature of the spill, and evacuate building if copious noxious fumes are being generated. 6. If the spill is minor, you know the nature of the spill and no fumes are being generated then clean up the spill using a spill kit as outlined in document 65630. 7. Consult Environmental Services regarding the disposal of the spent absorbent. Approved waste contractors are available that can arrange the final disposal offsite or advise if the wastes may be safely disposed of to the RDA.	'Control Chemical Spills in the Laboratory' (65630)	All laboratory personnel.	As soon as spill is observed.	Details of all spills documented in incident reports. Corrective actions implemented within an appropriate time frame.

What	How	Procedure Reference	Who	When	Performance Indicator
RELEASE COUNTERMEASURES					
Objective 13. Report spills to appropriate person.	Action 13.1 The Director of WA Operations must be advised of spills larger than 2 kL. The escalation of notification should be as follows: 1. Supervisor for the area. 2. Operating Centre Manager. 3. Environmental, Health and Safety Manager (who is responsible for coordinating appropriate government notifications). 4. Manufacturing Manager and/or the Refinery Manager; 5. Director WA Operations.	'Spills Notification and Reporting' (66425)	All personnel.	Spills > 2 kL which remain in a bund or overflow the bunded area onto sealed ground to be reported to Director WA Operations within 8 hours. Spills > 2 kL which contact bare soil to be reported to Director WA Operations immediately.	Incident report indicates correct personnel notified within required time.
Objective 14. Complete an Incident Investigation and Report for the spill	Action 14.1 Raise an Environmental Incident Report as soon as practicable after the spill, using the EHS Incident Management System. • Determine incident investigation level. • Determine team composition. • Gather information. • Data analysis. • Determine root causes. • Identify possible corrective actions and priorities. • Document findings. • Follow up on recommendations to ensure completed. • Sign off.	'(EHS) Environmental Incident Investigation' (33371)	Investigation co-coordinator	As soon as practicable after spill.	Incident investigations and reports available for each spill. Corrective actions implemented within an appropriate time frame.

What	How	Procedure Reference	Who	When	Performance Indicator
Objective 15. Monitor and report losses from the system as required for the National Pollution Inventory	Action 15.1 Estimate of the quantity of spilt Bayer Liquor for use in the National Pollution Inventory (NPI) annual report using the Environmental Incident (EI) System and calculation of the leakage of spilt material from the storm water system as outlined in document 46571. Specific instructions for calculations are outlined in this document.	NPI Bayer Liquor Spill Quantity Estimate (46571)	Environmental, Health and Safety Department	Annually (by September)	Monitoring records indicate compliance with DoE licensed emissions.

Note: Procedures are subject to review and change as part of ongoing operations.

11. CONCLUSION

The Unit Three Expansion of the Wagerup Alumina Refinery will be undertaken in line with Alcoa's Sustainability Framework. The proposal offers the opportunity to:

- Significantly increase employment during construction and ongoing operation of the facility;
- Increase export earnings from Western Australia by around $17 billion over the life of the project;
- Invest in a facility that Alcoa considers to be the most environmentally advanced alumina refinery in the world;
- Increase direct financial returns to Western Australia through ongoing royalty payments, and
- Facilitate significant social benefits for the locality and region.

These benefits can be realised whilst the proposal is implemented in an environmentally acceptable manner through emission controls and management practices that ensure:

- No increase in noise, dust or odour impacts on surrounding residents;
- World class health risk criteria are satisfied;
- Important land and water environmental values are protected;
- Improved greenhouse gas emission intensity; and
- Sustainable use of water resources.

These initiatives will be delivered within a framework that encourages ongoing involvement of the local community and other stakeholders.

Alcoa believes this proposal will deliver long-term sustainable outcomes for communities in the immediate vicinity of the refinery, Peel and South West regions and Western Australia.

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13. GLOSSARY

Abbreviations

Alcoa	Alcoa World Alumina Australia
AGO	Australian Greenhouse Office
CALM	Conservation and Land Management
DoE	Department of Environment (Western Australia)
DoH	Department of Health (Western Australia)
DoIR	Department of Industry and Resources
DMA	Decision making authority
DoPI	Department of Planning and Infrastructure
EPA	Environmental Protection Authority (Western Australia)
EMS	Environmental management system
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NO_x	Nitrogen oxides
PM_{10}	Particulate matter less than 10 µm in diameter
$PM_{2.5}$	Particulate matter less than 2.5 µm in diameter
SRG	Stakeholder Reference Group

Units

A$	Australian dollars
dB	decibels
dB (A)	decibels (A-weighted)
^{o}C	degrees Celsius
ha	hectares
km	kilometres
kL	kilolitres
mm	millimetres
m	metres (length)
m^2	square metres (area)
m^3	cubic metres (volume)
m/s	metres per second
MJ	mega joules
MW	mega watts
ML	megalitres
ML/yr	megalitres per year
MLpa	megalitres per annum
Mt	megatonnes
Mtpa	megatonnes per annum

ppm	parts per million
ppb	parts per billion
µg	micrograms (one-millionth of a gram)
$\mu g/m^3$	micrograms per cubic metre
t	tonnes
tph	tonnes per hour
tpa	tonnes per annum
w/w	weight for weight
%	percent
% w/w	percent by weight