WAGERUP REFINERY UNIT THREE

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAM

Response to Public Submissions

by

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1. EXECUTIVE SUMMARY

Wagerup Unit Three is a proposal to increase production of Alcoa's Wagerup alumina refinery from a capacity of 2.6 million tonnes per annum (mtpa) to approximately 4.7mtpa.

Past experience with issues associated with the Wagerup refinery and concerns expressed by local communities have highlighted that management of dust, noise and air emissions are key challenges for Alcoa. Accordingly, when considering expansion of the refinery, Alcoa undertook to ensure the proposed expansion would not increase odour, noise or dust impacts on residents surrounding the refinery, minesite and that the proposal would meet world-class health risk criteria. These public undertakings have guided each step of project development and will continue to guide detailed engineering design and equipment selection.

Alcoa also implemented best practice community consultation to ensure the community voice was heard throughout the process and people had the opportunity to be involved closely in the assessment of the proposal. Consequently, a wide range of opportunities for community involvement have been, and will continue to be, provided.

The environmental investigations necessary for assessment of the project and a full description of the community involvement program implemented by Alcoa were provided in the Environmental Review and Management Program (ERMP) published as part of environmental assessment of the project.

1.1 SUBMISSION SUMMARY

Alcoa's response to public submissions on the Wagerup Unit Three proposal are summarised on the following pages. The submissions resulted from a 10-week public review period in response to Alcoa's Environmental Review and Management Program (ERMP) dealing with environmental and community involvement aspects of the proposal.

The Environmental Protection Authority (EPA) received a relatively large number of submissions reflecting the high level of interest in the proposal and the intensive community involvement and communication program on Wagerup Unit Three that has been ongoing over the past twelve months.

Consistent with normal proponent practice Alcoa has responded to those submissions forwarded by the EPA. The submissions provided to Alcoa for response were from government departments and from concerned community members. At the request of the EPA Services Unit Alcoa has not responded to the submissions supporting the proposal.

The concerns raised through the submissions were grouped into similar topics. The majority of the community submissions opposing the proposal were concerned with air quality and the possible impact of an expansion on community health. The government submissions mostly requested clarification of the technical and scientific monitoring and modelling used in Alcoa's environmental assessment (the ERMP) and therefore the conclusions made in the Health Risk Assessment (HRA). For this reason the Executive Summary focuses on clarification of air quality, odour, noise and health risk evaluations, in the hope it will provide greater certainty to government that best practice assessment processes are being undertaken, and certainty to the community that the proposal to expand Wagerup refinery is safe and responsible.

1.2 AIR QUALITY EVALUATION AND HEALTH RISK ASSESSMENT

Significant progress has been made on improving Alcoa's knowledge on air emissions and the company is committed to continuous improvement and sharing this understanding with local communities and with relevant government agencies.

To evaluate the air quality issues and health risk of the expansion proposal, a number of key steps were undertaken including emissions monitoring, air quality modelling and HRA. The majority of ERMP submissions expressing concern focused on these areas.

Monitoring involved collation and evaluation of historic, ongoing and newly monitored data on substances emitted from the refinery. This emission data set was gathered from refinery emissions points, ground locations within and outside the refinery boundary, and from surrounding areas (background). This monitoring was undertaken by Alcoa, The Department of the Environment (DoE) the Chemistry Centre of WA, and other independent specialists. The levels of these emitted substances found in surrounding areas were compared with health and environmental standards and are all well below the most stringent environmental and health standards.

The next step was to undertake modelling of the air emission data to help predict the levels of emitted substances if Wagerup Unit Three was operating. Computer modelling took into account the existing

and proposed refinery emissions and atmospheric data to predict the concentrations of emitted substances at ground level – Ground Level Concentrations (GLCs) – for the current and expanded refinery.

The third step was a Health Risk Assessment (HRA), which is a recommended process used to estimate the health risks to communities arising from exposure to the refinery emissions. Results were produced for both for the current refinery operation and for the proposed expansion. The HRA process includes assessment of short-term impacts (Acute) using the modelled 1-hour concentrations (from modelling) and incremental life time risks such as Chronic illnesses and cancer, using the annual average modelled concentrations.

An extremely cautious approach was taken to calculate the health risk so Alcoa could be absolutely certain of the results and so the community and government would be confident in the calculated outcome. The current refinery and expanded refinery HRA confirms that the levels of emissions and the health risk are all well within accepted health standards.

Community and government submissions raised questions about the accuracy of the emission estimates and computer modelling undertaken by CSIRO, in particular, that the modelling under-estimated the occurrence of northerly winds. Concern was that such an under-estimation may then under-predict the potential impact on residents living south of the refinery.

To provide even greater confidence in the results, in the intervening period between submitting the ERMP and providing a response to public and government submissions Alcoa commissioned additional modelling allowing for increased occurrence of northerly winds, and then repeated the HRA using these new results. This additional work found no noticeable change to the HRA in these weather conditions, reaffirming the conclusion that the expansion presented a low to very low health risk. This work also reaffirmed similar findings for the existing refinery operations.

Submissions also raised other specific technical issues with the air dispersion modelling, including the accuracy of measured emissions, the range of compounds considered, uncertainty inherent in computer modelling and the effectiveness of emission control equipment. Each of these technical issues has been assessed by specialist consultants and is presented in detail in the body of this report. In each case the health risk posed by the expansion remains low to very low.

1.2.1 Very short-term air quality impacts

Some submissions expressed concern that estimating short-term impacts using the one-hour, or 24 hour health guidelines may be inappropriate if emission impacts occur on a shorter time scale. Alcoa is aware through discussions and consultation with the local community that some people feel they experience impacts for a shorter duration than one hour.

Alcoa requested the CSIRO, as part of their computer modelling, to estimate the maximum ground level concentration (GLC) of emissions that might occur over the timescale of three to ten minutes. Environmental or health guidelines are not available for a direct comparison at this shorter timescale, so the comparison of predicted concentrations has been made against longer time exposure periods. Longer exposure periods typically have more stringent standards, so when a very short-term exposure concentration is less than a long exposure period guideline, such as an annual value, health impacts are very unlikely as a result of the exposure.

For each modelled chemical the three-minute and ten-minute concentration is well below the standards available for longer time periods, such as the 24-hour or annual exposure standards. This remained the case when more frequent northerly winds were factored into the modelling.

The HRA also considered the potential for emitted substances to cause irritancy impacts on people, such as irritation of mucous membranes and respiratory passages. Of the 27 substances modelled, irritancy guidelines were identified for 16 of them, that is, those 16 chemicals are known to cause irritancy at certain concentrations. The predicted maximum 3 minute and 10 minute GLCs were also compared to the identified irritancy guideline values. Results showed the predicted short-term peaks are all lower than guidelines and therefore very unlikely to cause irritancy related health effects at any of the receptor locations examined, inside or outside the refinery boundary.

Alcoa is confident of the process and positive results of the air quality and HRA undertaken for both the current refinery and for the proposed expansion. As well as this reassurance Alcoa will continue to refine and upgrade the monitoring and modelling techniques to ensure Alcoa remains at the forefront of understanding emissions issues.

1.2.2 Assessment of odour impacts

There are various sources of odour within the Wagerup refinery, including from calcination, slurry vents, cooling towers, digestion, evaporation, and liquor burning. Vigorous emission reduction programs in the past have substantially reduced odours and it is a management priority that emissions and odour continually reduce, it is however, inevitable that people in nearby areas will sometimes notice odour from the refinery.

Since 1999 Alcoa has been measuring and modelling odour from the refinery, and combined with the most recent modelling undertaken by CSIRO for the Wagerup expansion proposal, Alcoa is confident it has sound understanding in the identification and management of odorous compounds.

A key concern identified in community submissions is that Alcoa might be unable to achieve its undertaking that there will be no increase in odour impacts as a result of the expansion because of the increase in alumina production. Alcoa is confident it will be able to achieve this undertaking by significantly reducing emissions from those sources which have the greatest impact on odour

Based on computer modelling the sources with the greatest odour impact are in slurry storage, green liquor tanks and the cooling towers, the major reason being that the emissions are not well dispersed. When the emissions from these sources are modelled they impact greatly on the ground level concentrations of odourous compounds – volatile organic compounds (VOCs). These process areas are receiving the most attention to incorporate reduction technologies. The liquor burner will also receive additional VOC reduction technology. Other process areas such as calcination are increasing in emissions, with expansion, but the effect of these emissions on odour is partly reduced because of better emission dispersion.

Modelling by CSIRO of these emission reductions and increases predicts that the benefits of reducing emissions from areas such as slurry storage outweighs the predicted increases in odourous emissions from increased rates of calcination, resulting in a net reduction in refinery odour.

The Department of Environment (DoE) submission included a technical review which questioned the correlation made between odour and volatile organic compounds (VOCs) and suggested the correlation made between total VOC compounds and odour may not predict the real odour impact if the expansion goes ahead.

The DoE requested that the odour to VOC correlation be reviewed by independent odour specialists, Pacific Air and Environment Pty Ltd. They undertook this review in the period between public review of the ERMP and Alcoa's response to community and government submissions. Their review found the correlation to be technically appropriate and robust.

The DoE were also concerned that, in a worst-case scenario, the reduction of odour from slurry storage may be overestimated, and therefore might not be sufficient to offset the increased impacts due to greater calciner emissions.

This concern was based partly on assessment that the correlation of odour to total VOCs does not allow for the influence of individual VOCs on odour to be predicted. To provide additional certainty, acetaldehyde was modelled to assess potential odour impacts. Acetaldehyde is a very significant component of odour from calciners and a much smaller component of odour from areas such as slurry storage. Examining only acetaldehyde in this way is a form of worst-case analysis of potential odour impacts.

The results of this analysis, using only acetaldehyde, indicates that there is very little difference in net refinery odour from the current refinery to the expanded refinery. This gives increased confidence that, even if the modelling has overpredicted the role of some odour sources, odour impacts would not increase with expansion. Wagerup refinery is already the world benchmark for alumina refineries in terms of emission and odour control and is including measures to ensure odour impact does not increase as a result of the expansion.

1.2.3 Management of the land surrounding Wagerup refinery

Over the past decade there have been high numbers of environment related complaints lodged in relation to the Wagerup refinery. Complaints of unacceptable odour, noise and to a lesser extent health concerns, increased during 1996 after Alcoa installed a liquor burner at the refinery. Alcoa has acknowledged operation of the liquor burner gave rise to offensive odours that impacted unacceptably on members of the Wagerup workforce and local community. Alcoa has also recognised and apologised that it was slow to respond to these concerns.

There is a belief that these concerns sensitised some in the community to the presence of the refinery and its emissions, who complained of health impacts. Annual complaints during the late 1990s varied around 150 to 200 per annum. Alcoa installed additional emission controls and commenced the purchase of nearby properties, culminating in the release of a land management program in 2001.

Unfortunately this approach created significant unintended consequences as landholder concern grew over apparent inequities and potential impacts on property values. This led to a dramatic increase in complaints which reached a peak of over 1500 in 2001.

Alcoa understands that improved emissions performance and resolution of most land management concerns have been the main reasons for the steady decline in complaints. Accordingly the expansion proposal includes significant additional emission controls and Alcoa continues to work with individual landowners to resolve remaining concerns.

Submissions from members of the public, health professionals, the Department of Health (DoH) and Department of Environment (DoE) emphasised that a buffer around the refinery should be provided to separate residences from refinery emission sources. In some submissions this importance was seen to be increased because of the absence of an identified causal agent to explain reported health impacts.

The Pinjarra to Brunswick Sustainability Study found that "clearly defining a development control area around the Wagerup refinery" was important "taking into account environmental and health standards, amenity issues and planning policy".

The draft State Industrial Buffer Statement of Planning Policy provides for land planning controls around industrial areas to separate industrial areas from sensitive land-uses, such as residential developments. The draft Policy notes this should be based on technical analyses and does not necessarily exclude residences within such a management area.

Alcoa considers the area identified in Alcoa's land management plan as 'Area A' around the refinery and residue drying areas is an appropriate boundary for a development control area around the refinery. Alcoa, through its land management plan offers to purchase properties in Area A provide at unaffected market value plus 35 percent plus an allowance for relocation costs, for the life of the refinery.

Based on the monitoring and modelling of air quality, noise and odour, and the HRA undertaken for the proposed expansion, it is clear the technical analyses support the Area A boundary as an appropriate land planning control area. This should ensure residential development in this area does not expand and allow the continued use of properties in this area encouraging existing residents who wish to stay in this area to do so with confidence.

Based on direct experience with land management changes, and considerable input, feedback and dialogue on Alcoa's land management policy with the Yarloop and Hamel communities, it is very clear that to change the Area A boundary, or to put in place a new boundary, would be disruptive to the social and economic fabric of those towns. The majority of local landowners have indicated it would be particularly disruptive as they view their houses as important for their future and changes to Area A might significantly impact on the value of their properties.

Alcoa does recognise that some individuals in the towns surrounding the refinery feel they are being adversely impacted due to the proximity of the refinery. Alcoa supports and understands the importance of dealing sensitively with these individuals.

Alcoa supports the future of the towns of Yarloop and Hamel, is committed to helping to build a positive future for the towns and believes existing and future residents should be able to look to the future with confidence and enthusiasm.

1.3 NOISE

Noise management at Wagerup has been a contentious issue for some residents. Addressing this issue is considered high priority and Alcoa has undertaken that with Wagerup Unit Three there will be no increase in noise impacts on residents.

Submissions from some local community members have indicated existing noise impacts are unacceptable and they are concerned refinery noise will increase with the proposed expansion.

The *Environmental Protection (Noise) Regulations* require Alcoa to achieve night-time noise levels of 35dB(A) at the nearest residence, however, this stringent hurdle is reviewed if all 'reasonable and practical measures' have been taken.

Since the Regulation was placed on Alcoa in 2001, Alcoa has invested significantly in noise control works and believes it has done all that is reasonable and practicable to reduce refinery noise.

The Area A boundary that delineates the zone in which Alcoa offers a premium to buy properties was defined in part, by noise contours. The 35dB(A) assigned level cannot be achieved at all times for residences within Area A, however, for the majority of residences within Area A the refinery is only out of compliance occasionally. Given this situation Alcoa applied to the DoE for a variation to the assigned level in 2003. This application is now being assessed as part of the Wagerup Unit Three ERMP.

Alcoa will continue to undertake all reasonable and practicable measures to manage noise emissions, including in the engineering design of the proposed expansion. This will be a key part of Alcoa's efforts to meet its public undertaking of no increase in noise impacts as a result of the proposed expansion.

1.4 COMMUNITY INVOLVEMENT

Alcoa's approach to consultation has evolved over recent years to become more inclusive and engaging, providing community members with increasing opportunities to be in involved Alcoa's business.

Some submissions expressed concerns about the community involvement program initiated by Alcoa as part of the ERMP preparation, including that the Wagerup Unit Three working group process was not independent, open or fair; and that the selection of the working group members was not fair or representative of the community. Concern was also raised that insufficient time was available for consultation on the proposal and the selection of expert reviewers was unfair.

The Wagerup Unit Three proposal included an unprecedented and best practice opportunity for community involvement starting with a community driven open forum at which 3000 local people and other stakeholders were invited, resulting in more than 60 working group meetings supported by an extensive and broad public communication program running over many months. The number of submissions received on the ERMP reflects the extent of the communication and involvement processes put in place.

Community members self-selected to the working group which was to investigate those subject areas that were of most interest to them. No community members were excluded from joining a working group and to accommodate those unable to attend, meeting reports and outcomes of all meetings were advertised and mailed locally. Each working group was independently facilitated, comprised predominantly community representatives, and included Alcoa and government representation.

Working groups chose independent expert reviewers from a panel of specialists to provide independent review and interpretation of the key technical reports produced as part of the ERMP investigations. Where there was selection of the expert reviewers, Alcoa supplied the names of three to four potential independent experts for each of the relevant working groups and selection of the independent expert was the decision of the working group members.

The working group process ran from mid-October 2004 until May 2005, with each working group meeting at least 10 times – this was an enormous contribution from the community volunteers involved. The process of community involvement was also started earlier in the planning process than is usual for project proponents. This meant at the same time technical reports were being produced for the ERMP, those same reports were reviewed and investigated by working groups (and expert reviewers). The working group's final comments in the form of 'outcomes' were included verbatim in the ERMP.

Information about the Wagerup Unit Three proposal is regularly updated and available to the community through a website, mail-outs, ongoing forums and meetings. Community involvement will remain a key aspect of Alcoa's Wagerup operations in the future and Alcoa will continue to work with

community members on matters of concern or interest to them. This includes matters related to Wagerup Unit Three, should it proceed to construction and operation.

1.5 RESIDUE

Residue management was raised as a concern in a small number of submissions. Issues raised were on disposal options, long-term use of residue and closure and rehabilitation plans.

Alcoa will continue efforts to find alternative uses and management options for residue as part of the Long-term Residue Management Strategy (LTRMS) which includes a comprehensive community engagement process and independent expert review.

Alcoa is currently investing more than $2 million per annum in researching alternatives for residue by-product use. The primary focus of this work is to convert residue into useful materials that are environmentally acceptable, commercially viable and acceptable to the public. Development of alternative uses for bauxite residue has been one of the major objectives of Alcoa's residue development program for many years. Alcoa recognises that if significant re-use is achieved, the rate of expansion of the residue storage areas can be slowed and more value can be derived from the resource.

Closure and rehabilitation plans for residue are being prepared as part of the LTRMS. Wagerup is about to start comprehensive community consultation on residue management, including closure and rehabilitation issues. These plans include the treatment and re-use of water from leachate collection post-refinery, surface rehabilitation to achieve a final land-use consistent with community expectations, ongoing dust management during active residue storage and investigating alternative uses of residue as value-added product.

1.6 WATER SUPPLY AND YARLOOP WATER QUALITY

Three submissions raised concerns that the proposal might result in over-allocation of regional water resources. Some submissions also questioned whether the additional water requirement for the mine site was included in the expansion needs. Two other submissions expressed a view that the proposed expansion of the refinery might result in a deterioration of the water quality in Yarloop.

The Wagerup refinery obtains its water from a different catchment to the Yarloop townsite so it is unlikely water supply for the expansion would impact on water availability or water quality in Yarloop. There would need to be very wide-spread contamination of surface or groundwater from refinery activities for any risk of contaminating township water resources. Ongoing and historic monitoring clearly demonstrates this is not the case based on extensive groundwater and surface water monitoring which is reported to the DoE and community on a regular basis.

The proposed expansion will require additional water supply and the ERMP included an assessment of water supply options and available resources. The existing refinery has a water supply allocation of approximately 8.5 GL per annum. Water is harvested from rain falling within the plant and residue drying areas so the amount drawn from water resources each year is dependent on the volume of rainfall and run-off collected in the refinery's storage dams. During 2004 approximately 4.3 GL of water was drawn from external water sources.

The proposed expansion will increase the water requirements at the refinery and the mine site. Additional mine site water required for the expansion is 0.55 GL per annum; 100 ML per annum harvested from site sources and 450 ML per annum obtained from existing licensed sources. For the refinery, the proposed expansion requires an additional 1.1 GL per annum under average rainfall and run-off conditions and up to 4.8 GL per annum under drought conditions. To address this issue Alcoa commissioned reviews of different refinery water supply options which considered ecological water requirements and water availability in the lower Harvey River catchment.

For the Harvey River (Drain), historical stream data has shown that approximately 75.2 GL of water passes the Logue Brook confluence. This suggests there is approximately 28 GL per annum available in winter after allowing one-third of the total flows for ecological water requirements, and the remainder for other uses in the area. The project requirement of 1.1 to 4.8 GL per annum is well within the additional 28 GL identified as available from the Harvey River drain.

Alcoa is also evaluating using water currently lost from open irrigation channels. This evaluation will continue as part of the DoE water supply licensing system.

1.7 THE FUTURE – SUSTAINABILITY

The issue of sustainability was raised in several submissions with claims that the increased production rate is unsustainable and that Alcoa does not abide by its own sustainability principles. Other concerns raised were that expansion was not in the best long term interest of the region and State and that existing aluminium stocks should be better used by recycling and re-use.

Alcoa also understands most of the supportive submissions were endorsement of the socio-economic benefits coming from the proposal.

Alcoa's sustainability objective is to: "Simultaneously 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."

Alcoa believes the increased production rate is sustainable for the foreseen life of the refinery and Alcoa's bauxite reserves. To justify Alcoa's investment of more than $1.5 billion to expand the Wagerup refinery, a minimum expected life of operations in excess of 30 years is required. The current mining lease agreement is due to expire in 2045, so it is reasonable to forecast that it will operate up to, and potentially beyond, that date. If Alcoa is unable to maintain a viable economic business case for either the refinery or the expansion proposal it will not spend the funds necessary to expand. This would potentially reduce those benefits that come to the community and government from the refinery operations.

In terms of benefits to the region, during the life of the Wagerup refinery, Alcoa has helped establish a long-term future for Waroona, Yarloop, Hamel, Harvey and the region. Since 1997, Alcoa has contributed more than $25 million to the local region to support social infrastructure and services. In addition, more than $2.3 million in community funding and payments was provided by Alcoa to the Waroona and Harvey Shires in 2004.

Alcoa supports the future development of the Peel and South West regions, and is developing a set of additional social and economic initiatives with local stakeholders to help the region in achieving long-term sustainability. Such initiatives and projects associated with expansion of the Wagerup refinery

have been described in the booklet *Your Future Our Future* and clearly indicate the intent for ongoing and additional future support for the towns and regions surrounding the Wagerup refinery. These ideas focus on a range of areas including local businesses, entrepreneurs and training/education programs and are the result of extensive consultation between Alcoa and local shire and community representatives.

In addition to local benefits, there are real and direct advantages to the state and Australia including:

- Alcoa directly employs more than 4000 people in WA;
- Alcoa accounts for seven percent of WA's total exports;
- For every export dollar earned, 80 cents stays in Australia; and
- Alcoa's investment in Australia totals more than $12 billion;

Increasing aluminium recycling is a high priorty for Alcoa and is reflected in its global target of 50 percent of manufactured products to be made from recycled aluminium by 2020. In Australia, Alcoa Australia Rolled Products operates the country's largest smelting facility at its Yennora site and recycles approximately 55,000 tonnes of scrap aluminium per year.

Aluminium can recycling re-uses a valuable resource and conserves energy. Of the three billion aluminium cans sold annually in Australia, 68.5 percent, or approximately 1.9 billion, are recycled. Alcoa Australia Rolled Products processes 1.2 billion of these cans through its remelt furnace annually, playing a significant role by reducing industry requirements for natural resources and diverting waste from landfill.

It is important to note the current increase in global demand for aluminium requires not only a commitment to recycling of aluminium, but an increase in the primary production of aluminium as well. The expansion of the Wagerup refinery aims to complement Alcoa's recycling initiatives and to help meet increasing global demand.

2. INTRODUCTION

Wagerup Unit Three is a proposal to increase production of the Wagerup alumina refinery from a capacity of 2.6 million tonnes per annum (mtpa) to approximately 4.7 mtpa. An Environmental Review and Management Program (ERMP) was prepared and submitted to the Environmental Protection Authority in May 2005 and released for a 10 week public comment period. The comment period closed on the 25th July 2005 and this report responds to the key issues raised in those submissions.

Alcoa has made the undertaking that the proposed expansion would not increase odour, noise or dust impacts on residents surrounding the refinery, minesite or Bunbury Port operations and that the proposal would meet world class health risk criteria. Alcoa believes it has shown that the proposed expansion would meet these undertakings through the studies completed for the ERMP and the subsequent information provided in this report. These public undertakings have guided the proposal to date and will continue to guide future detailed engineering design and equipment selection processes.

3. RESPONSE TO SUBMISSIONS

This section of the report details the key issues raised in the submissions received on the Wagerup Unit Three Environmental Review and Management Program (ERMP) on completion of the 10 week public comment period, which closed on 25 July 2005.

The Environmental Protection Authority (EPA) received a relatively large number of submissions reflecting the high level of interest in the proposal and the intensive community involvement and communication program on Wagerup Unit Three that has been ongoing over the past twelve months.

Consistent with normal proponent practice Alcoa has responded to those submissions forwarded by the EPA. The submissions provided to Alcoa for response were from government departments and from concerned community members. At the request of the EPA Services Unit, Alcoa has not responded to the submissions supporting the proposal.

Many of the submissions received raised very similar issues and these have been consolidated into a single issue and a response provided. The issues raised have been separated into the key environmental areas, which are consistent, where possible, with the environmental factors detailed in the ERMP. A complete list of issues raised in the public comment period and responded to in this document, is outlined in the Public Submission Matrix and presented in Appendix M.

3.1 AIR QUALITY AND EMISSIONS

Air Quality Summary

Alcoa has used the best available technology and methodology to measure and model the emissions from the Wagerup refinery. In 2001/02, Alcoa conducted a comprehensive emissions inventory to identify the substances likely to be found in the refinery emissions and their concentrations. Alcoa continues to monitor and improve knowledge of refinery emissions and used this data as input into various studies and investigations contributing to the ERMP.

The ERMP modelling was undertaken by the CSIRO for the refinery emissions using the computer model TAPM, which was specifically refined for application at Wagerup and considered appropriate

and technically robust. TAPM is not suitable for modelling emissions from wide area sources, such as the residue drying area, where the model CALPUFF was used.

Alcoa has demonstrated that it can achieve the environmental efficiencies included in the project and that the air dispersion modelling undertaken can adequately deal with the meteorology of the escarpment environment.

3.1.1 Provide evidence to confirm or refute the conclusion made by CSIRO: "there is indirect chemical evidence that there may be compounds present in the refinery emissions in significant concentrations that have been either not identified or poorly quantified …"

Alcoa has an extensive understanding of the compounds that may be present in the refinery emissions. This knowledge has been developed through:

- A comprehensive air emissions inventory program conducted at Wagerup Alumina Refinery in 2001/02 (refer to Appendix A), involving sampling 15 emission sources for up to 17 classes of compounds. This was the first such inventory to be conducted in the international alumina industry;
- Kwinana Alumina Refinery conducted an emissions inventory on its liquor burner unit and some digestion units in 2002;
- In 2003 Alcoa Pinjarra Alumina Refinery used the Wagerup Refinery emission inventory as the starting point in developing its inventory, partly by extrapolation from Wagerup sources, supplemented by additional measurements to check on and corroborate the Wagerup extrapolations;
- Pinjarra Alumina Refinery then used the inventory it had developed based upon the Wagerup Inventory, to conduct a Quantitative Health Risk Assessment (HRA) of air emissions. This 2003 undertaking was the first QHRA conducted for an alumina refinery worldwide;
- Kwinana Alumina Refinery conducted a QHRA of its liquor burner unit in support of an application for environmental approval of a new emission control project for the liquor burner in 2003/04; and
- In 2005 Wagerup Alumina Refinery undertook the present QHRA as part of the Wagerup Unit Three Expansion Proposal ERMP.

It can be seen that there has been a continuum in the development of air emissions inventories, built on through monitoring and specific studies, which Alcoa believes has identified the compounds that are present in significant concentrations from the refinery emissions.

The 2002 Wagerup Refinery Emission Inventory was independently reviewed by Air, Water, Noise Ltd (AWN) in 2002/3 (refer to Appendix B) and also CSIRO, Division of Atmospheric Research in 2003/4 (refer to Appendix C).

Both these expert reviews/audits found that in an overall sense the Wagerup Refinery Emissions Inventory represented a comprehensive and extensive identification of emissions to atmosphere from the refinery.

In summary the AWN review in 2002/03 concluded that:

- *Both the approach of selecting representative sources, and the selection method used, were considered appropriate.*
- *In general terms, the emissions inventory scope is considered comprehensive and appropriate.*

The specific recommendations of the AWN review were categorised into major and minor recommendations, and opportunities for improvement. All of the major and minor recommendations were included in Alcoa's response plan to the review, and accepted by the DoE as meeting the intent of the recommendations. All of the opportunities for improvement were considered and many have since been implemented or have influenced subsequent monitoring program design.

The CSIRO's Air Quality Review succeeded the AWN Review and considered Alcoa's response to its findings and recommendations. The CSIRO review also found the Air Emissions Inventory to be a comprehensive and extensive listing of refinery emissions. CSIRO noted the following in respect of the Air Emissions Inventory:

> *The emissions measurement program that has been carried out by Alcoa at the Wagerup Refinery has identified a large number of chemical compounds (mainly organic compounds) that probably have not previously been measured in emissions monitoring of alumina refineries. It has also established, within the detection limits of measurements undertaken, that a number of other compounds are not emitted in amounts greater than or equal to these detectable limits. This work represents a substantial advance in knowledge about emissions to the atmosphere from alumina refineries.*

As in the AWN Review, the CSIRO review recommended a number of specific improvements and actions aimed at improving certainty and filling information gaps in the inventory. Each of these recommendations has been acted upon, or is currently in the process of being implemented. The response to the CSIRO Air Quality Review has been discussed with the DoE and incorporated into the Wagerup Refinery Air Emissions Management Plan.

When preparing the HRA for inclusion in the 2005 Wagerup Unit Three ERMP, Alcoa used the reviewed emissions inventory built up through monitoring over the last four and more years to identify and then select the substances that should be assessed in the HRA. The criteria for the selection of the substances were as follows:

- Criteria Pollutant from the National Environmental Protection (Ambient Air Quality) Measure (NEPC, 1998);
- Covered by the National Environmental Protection (Air Toxics) Measure (NEPC 2004).
- Detected at Wagerup Refinery and reported to the National Pollutant Inventory (NPI);
- The detected polycyclic aromatic hydrocarbons (PAH) through emission monitoring at Wagerup refinery. These were included and represented as Benzo[a]pyrene (BAP) equivalents; and
- Assessed in the Pinjarra Efficiency Upgrade HRA and detected in Wagerup Emissions Inventory 2002.

A total of 27 individual or groups of compounds were identified for inclusion in the HRA. The compounds included in the HRA and reasons for their inclusion are provided in Table 1 below. The

full list of compounds detected at Wagerup refinery but not included in the HRA and reason for non-inclusion is presented in Appendix D. In addition a list of substances that have only been tentatively identified [1] is presented in this appendix but these are not included in the HRA as they are not confirmed to be present in the emissions.

Table 1: Substances included in Wagerup Unit Three Health Risk Assessment

Substance	Total Mass Emissions Jan-Jun 2002 kg day^{-1}	Total Mass Emissions Jan-Jun 2002 kg per year	% Total mass emissions	Reason for inclusion
Sulphur Dioxide	160	58400	3.0%	Criteria Pollutant (Air NEPM)
Nitrogen Oxides as NO_2	3300	1204500	62.1%	Criteria Pollutant (Air NEPM)
Carbon Monoxide	1100	401500	20.7%	Criteria Pollutant (Air NEPM)
PM 10	95	34675	1.8%	Criteria Pollutant (Air NEPM)
Formaldehyde (methanal*)	15	5475	0.3%	Covered by draft Air Toxics NEPM
Benzene	2.1	766.5	<0.1%	Covered by draft Air Toxics NEPM
Toluene	4.2	1533	0.1%	Covered by draft Air Toxics NEPM
Xylenes	0.19	69.35	<0.1%	Covered by draft Air Toxics NEPM

[1] The CSIRO Air Quality Review included *tentatively identified* VOCs and SVOCs in its summary of Wagerup air emissions, giving a higher total number of substances than presented in section 5 of the Wagerup refinery Emissions Inventory report (2002). Alcoa requested that the laboratories try and identify any additional compounds that in the opinion of the laboratory analyst, *appeared* to be present in the chromatograms of VOCs and SVOCs resulting from monitoring by US EPA Methods 30 and modified Method 5. These substances are not included in the emissions inventory as they were not conclusively identified or quantified. However even if present, the mass emissions of tentatively identified substances are not considered significant as the substances occurred at tentative/trace concentrations close to their detection limits, and are not regarded as compounds of interest from a toxicity perspective. Indeed if they were so, it is highly likely that standard methods would have been developed to monitor and verify their levels in emissions.

Substance	Total Mass Emissions Jan-Jun 2002 kg day^{-1}	Total Mass Emissions Jan-Jun 2002 kg per year	% Total mass emissions	Reason for inclusion
Acetaldehyde (Ethanal*)	48	17520	0.9%	Reported to National Pollutant Inventory
Acetone (propanone*)	92	33580	1.7%	Reported to National Pollutant Inventory
2-Butanone (MEK*)	11	4015	0.2%	Reported to National Pollutant Inventory
Ammonia	51	18615	1.0%	Reported to National Pollutant Inventory
Chromium	0.25	91.25	<0.1%	Reported to National Pollutant Inventory
Manganese	0.8	292	<0.1%	Reported to National Pollutant Inventory
Nickel	<0.1	-	-	Reported to National Pollutant Inventory
Arsenic	<0.1	-	-	Reported to National Pollutant Inventory
Selenium	<0.1	-	-	Reported to National Pollutant Inventory
Cadmium	<0.1	-	-	Reported to National Pollutant Inventory
Mercury	<0.1	-	-	Reported to National Pollutant Inventory
Naphthalene	<0.10	-	-	Included as PAH - Reported to National Pollutant Inventory (BAP equivalents)
2-Methyl Naphthalene (also Methyl naphthalene-2^{+})	<0.5	-	-	Included as PAH - Reported to National Pollutant Inventory (BAP equivalents)
Acenaphthylene	<0.1	-	-	Included as PAH - Reported to National Pollutant Inventory (BAP equivalents)
Phenanthrene	<0.1	-	-	Included as PAH - Reported to National Pollutant Inventory (BAP equivalents)
Fluoranthene	<0.1	-	-	Included as PAH - Reported to National Pollutant Inventory (BAP equivalents)

Substance	Total Mass Emissions Jan-Jun 2002 kg day^{-1}	Total Mass Emissions Jan-Jun 2002 kg per year	% Total mass emissions	Reason for inclusion
Vinyl Chloride	<0.10	-	-	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
1,2,4-Trimethylbenzene	0.14	51.1	<0.1%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
1,3,5-Trimethylbenzene (Benzene, 1,3,5-trimethyl)	0.12	43.8	<0.1%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
Methylene chloride (dichloromethane*)	8.4	3066	0.2%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
Acrolein (2-Propenal*)	2.8	1022	0.1%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
Styrene	0.12	43.8	<0.1%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA
Ethylbenzene (also Ethyl benzene+)	0.16	58.4	<0.1%	In the Pinjarra Efficiency Upgrade HRA – detected in Wagerup Emissions Inventory 2002 - included for Wagerup HRA

Note: Mass emission calculation not including cooling towers due to their very high volume. Cooling tower emissions included for HRA screening process

3.1.2 The ERMP should identify the sources of VOCs found at Boundary Road using robust source apportionment methods.

As detailed in section 3.1.1, Alcoa has an excellent knowledge of the refinery emissions and has included all identified and quantified compounds into the HRA based on the substance selection criteria outlined above.

Alcoa has and will continue to improve its knowledge of the refineries emissions. As part of this process, Alcoa is working with CSIRO to trial new monitoring technology at Boundary Road, Wagerup in late 2005. The instrument is called Proton Transfer Reaction Mass Spectrometry (PTRMS) and it may assist in detecting chemical compounds (Volatile Organic Compounds) at very low concentrations (ultra-trace levels). However it is not considered appropriate or practical that Alcoa accept responsibility to identify sources of all VOC's in the ambient environment.

3.1.3 Provide a detailed explanation of how the increased efficiency will be achieved

The increased production efficiency and environmental performance of the plant will be achieved through the installation of new equipment, upgrading of some existing infrastructure and implementation of emission controls.

As part of Alcoa's continual improvement program at the refinery, there have been a number of environmental upgrades since 2001 that have led to significant emission reductions. The environmental controls that have been put in place to achieve these reductions are designed to cope with the higher production levels associated with the addition of a third production unit. This means production can be increased without significantly increasing emissions. Some examples of these upgrades are:

- The liquor circuit yield will increase by approximately 15%, hence it is not necessary to increase process flows in proportion to production. This will lead to:
    - Improved energy efficiency and reduction in intensity of greenhouse gas emissions;
    - Improved intensity of any volatile organic compounds produced during energy raising processes; and
    - Less than proportional increase in process vessels and equipment required to achieve the increase in production.

- Calciner Three was upgraded in 2005 to match the calciner (Calciner 4) which has the lowest emissions per tonne of alumina processed.

As part of the Wagerup Unit Three upgrade the following measures will facilitate increased production and environmental performance:

- Improved efficiency for calciners will be achieved through:
    - The addition of two new calciners with three-zone electrostatic precipitators (ESPs) to reduce peak emissions during the "rapping" of the ESPs;
    - All calciners to further allow low-volume vent emissions (VOC's) to be redirected to a combustion process for destruction; and
    - Improving the quality of the washwater in calcination will result in a reduction in the intensity of calciner VOC emissions.

- Emission reductions from causticisation will be achieved by either replacing the existing process with a newer HEC (High Efficiency Causticisation) process where an enclosed system is deployed, or by adding condensers to the conventional causticisation process and then conveying non-condensables to a combustion process for destruction.

- In addition, the following key measures will reduce emissions and increase efficiency through:
    - The replacement of the existing contact heaters in the 25A tank area with sealed units. This is expected to reduce vapour flows from this source by 75 percent which will cause a reduction in VOC emission rates;
    - Operation of cooling towers to be modified to achieve a 50 percent reduction in odorous emissions. This will be achieved by feeding the cooling towers with improved quality water leading to a reduction in the requirement for water treatment chemicals.
    - Alcoa is also examining the possibility of performing water cooling via the use of fin-fan coolers, to reduce the dependence on cooling towers. Should fin-fan coolers be selected this will also lead to some reduction in water usage at the refinery;
    - Cooling lake emissions will not increase in proportion to production as:
        - New cooling towers will be installed;
        - Some cooling capacity will be handled by fin-fan coolers.

- The existing Catalytic Thermal Oxidiser (CTO) on the liquor burner will be replaced by a Regenerative Thermal Oxidiser (RTO). The RTO has a higher efficiency of combustion of organic compounds than the CTO and will reduce liquor burner emissions (such as VOC's) despite a higher organic load;
- Installation of an Regenerative Thermal Oxidiser (RTO) to process the exhaust gases emissions from the oxalate kiln;
- Low NOx burners on the Gas Turbines (for cogeneration) or Boilers (without cogeneration); and
- Upgraded sprinkler system for the RDAs.

3.1.4 The uncertainty analysis included the findings of remodelling NOx using data assimilation which shows under-prediction at receptors 1 to 6 to the south. CSIRO concluded that all generated statistics should be considered to have a factor of 2 uncertainty (+100% to -50%). This must be carried forward to the HRA

The peer review by Katestone Environmental undertaken on the CSIRO air dispersion studies for the ERMP indicated that the TAPM (without data assimilation) under-predicts the frequency of light to moderate wind speeds and the frequency of winds from a northerly direction. Therefore, the CSIRO modelling may have underestimated the maximum impacts particularly to the south of the refinery near Yarloop.

To investigate this issue further Alcoa, commissioned ENVIRON to re-do the TAPM refinery air dispersion modelling with data assimilation, to assess the influence of assimilated winds on the predicted ground level concentrations and the HRA, in particular to the south of the refinery.

Data assimilation is the technique where one or more locations within the meteorological model are adjusted for wind speed and wind direction to more closely match those observed in the atmosphere (site observations). The model subsequently adjusts airflows to closely follow the meteorology observed at the refinery.

A sensitivity analysis was undertaken identifying that TAPM with assimilation better predicts the frequency of light winds and the frequency of winds from the northerly direction than TAPM without assimilation.

Overall the predicted concentrations from the refinery sources with data assimilation are higher than those without and the predicted peak concentrations with assimilation are in better agreement with observations at Boundary Rd.

The cumulative modelling (point and diffuse sources) with data assimilation (and corrected emission rates, refer to section 3.1.5) indicates that although assimilated meteorology better predicts the frequency of light winds and the frequency of winds from the northern sector, there is negligible influence on the predicted ground level concentrations and hazard indices to the south of the Wagerup refinery (represented by receptor 4) and over the modelled domain.

The impact that data assimilation has on the HRA for receptors to the south of the refinery is represented by receptor 4, at Yarloop. The Acute and Chronic Hazard Indices with and without data assimilation are shown in Table 2 and 3 below.

Table 2: Receptor 4 - Comparison of Acute Hazard Indices with and without data assimilation

	Without Assimilation		With Assimilation	
	Existing Refinery	Upgrade Case 6	Existing Refinery	Upgrade Case 6
Acute Hazard Index	4.08E-01	3.98E-01	4.98E-01	4.72E-01

Table 3: Receptor 4 - Comparison of Chronic Hazard Indices with and without data assimilation

	Without Assimilation		With Assimilation	
	Existing Refinery	Upgrade Case 6	Existing Refinery	Upgrade Case 6
Chronic Hazard Index	1.39E-02	1.61E-02	2.31E-02	2.05E-02

The total ICR with and without data assimilation for receptor 4 and receptor 16 (receptor that experiences the highest ICR level in the HRA) is provided in Table 4.

Table 4: Comparison of total ICR with and without data assimilation

	Without Assimilation		With Assimilation	
	Existing Refinery	Upgrade Case 6	Existing Refinery	Upgrade Case 6
Total ICR – Receptor 4	1.02E-07	1.42E-07	1.97E-07	1.34E-07
Total ICR – Receptor 16	3.62E-07	5.18E-07	4.77E-07	3.49E-07

Contours representing Acute and Chronic HI and ICR (with data assimilation) are presented in Appendix L.

It is clearly shown in the tables above for Receptor 4 (and at all other receptors) that:

1. The maximum Acute HI for the baseline and the expansion emission scenario remains less than one (1) with data assimilation. This indicates no cause for concern based on the predicted ground level concentrations, the health protective guidelines used and the compounds considered.
2. The maximum Chronic HI predicted to occur with data assimilation is well below the acceptable threshold of one, indicating no cause for concern.
3. The results indicate for the expanded refinery (cogeneration) there is a reduction in the total ICR using data assimilation and all of the receptors remain well below the USEPA's de minimis threshold of one in a million (i.e. 1 x 10^{-6}).

Complete tables showing the Acute, Chronic and Incremental Carcinogenic Risk (ICR) for the existing and expanded refinery (case 6-cogeneration), with and without assimilation have been calculated and are shown in Appendix E. The results indicate that there is little likelihood of the existing or expanded refinery emissions (with and without assimilation) causing adverse Acute or Chronic health effects.

3.1.5 Clearly indicate emission rates for each hazard from fugitive, stack and other sources along with an indication of degree of certainty in each statistic, and references for each estimate

The emission rates for the key point and diffuse sources are provided in Appendix F. In addition, the source selection, sample methodology, limits of detection etc are tabulated and presented in Appendix G.

Corrected Emission rates

During the public comment period for the ERMP, an error was identified in the existing refinery average emission rates for some VOCs as presented in Appendix J of the Air Quality Summary report (Appendix G of the ERMP). The effect of this was to underestimate the average VOC emission rates for the existing refinery and the changes to the emissions rates are presented in Table 5 below. The corrected emission rate spreadsheet is presented in Appendix F.

Table 5 on the following page, only presents the values for sources and substances where there has been a change to an emission rate as used in the ERMP modelling. Emission rates for all other sources and substances (apart from those indicated in the table) remain as per the ERMP modelling.

Table 5: Changes to Emission Rates used in Updated Modelling for HRA and Odour

Source	Version/Run	Cadmium	Acetone	Acetaldeyhde	Formaldehyde	2-Butanone	Benzene	Toluene	Xylenes	Odour
		g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	g/sec	OU/sec
Oxalate Stack	App J									5
	Updated		8.4E-04	2.1E-04	3.6E-05	8.0E-05	4.6E-04	3.7E-05	9.0E-06	352
Calciner 1 (baseline average)	App J		3.5E-02	5.7E-02	5.0E-02	4.9E-03	5.0E-03	1.9E-03		57937
	Updated		4.7E-02	6.4E-02	5.9E-02	5.8E-03	5.1E-03	2.0E-03		57937
Calciner 1 (expansion average)	App J		6.8E-02							75088
	Updated		4.8E-02							58323
Calciner 2 (baseline average)	App J		3.8E-02	5.2E-02	4.5E-02	5.4E-03	4.9E-03	1.8E-03		54469
	Updated		4.7E-02	6.1E-02	5.5E-02	6.1E-03	5.0E-03	1.9E-03		54469
Calciner 2 (expansion average)	App J		8.0E-02							77657
	Updated		5.0E-02							57583
Calciner 3 (baseline average)	App J		3.4E-02	7.3E-02	3.3E-01	1.7E-02		2.1E-03		110285
	Updated		3.9E-02	7.8E-02	3.4E-01	1.5E-02		2.3E-03		110285
Calciner 3 (expansion average)	App J		4.5E-02							72947
	Updated		2.2E-02							65932
Calciner 4 (baseline average)	App J		6.5E-02	9.3E-02	8.9E-02	1.0E-02	7.5E-03	2.7E-03		79842
	Updated		6.8E-02	9.5E-02	9.0E-02	1.1E-02	6.4E-03	2.9E-03		79842
Calciner 4 (expansion average)	App J		1.2E-01							109874
	Updated		8.3E-02							96902
Calciner 5 (expansion average)	App J		1.2E-01							109874
	Updated		8.3E-02							96902
Calciner 6 (expansion average)	App J		1.2E-01							109874
	Updated		8.3E-02							96902
Boiler2/3	App J									
	Updated	4.45E-07								
Calciner 1,2,3 Vac Pump, 50B and Dorrco (baseline average)	App J		7.5E-02	1.4E-02	1.0E-03		4.7E-04	4.0E-02		
	Updated		8.9E-02	1.8E-02	1.3E-03		4.4E-04	2.0E-02		
Calciner 4 Vac Pump and Dorrco (combined emission) (baseline average)	App J		7.5E-02	1.4E-02	1.0E-03		4.7E-04	4.0E-02		
	Updated		8.9E-02	1.8E-02	1.3E-03		4.4E-04	2.0E-02		
45K Cooling Tower 2 and 3 (baseline average)	App J		2.9E-01							
	Updated		5.0E-01							
45K Cooling Tower 2 and 3 (expansion average)	App J		3.6E-01							
	Updated		1.7E-01							
45K Cooling Tower 1 (baseline average)	App J		1.0E-01							
	Updated		1.7E-01							
50 Cooling Tower 1 and 2 (baseline average)	App J		1.3E-02							
	Updated		2.2E-02							
50 Cooling Tower 1 and 2 (expansion average)	App J		4.9E-02							
	Updated		2.4E-02							
25A Tank Vents (expansion average)	App J		5.1E-03	1.3E-03	3.0E-05	3.3E-04	2.1E-05	1.5E-04	2.2E-05	
	Updated		1.8E-02	5.0E-03	1.2E-04	1.3E-03	8.3E-05	6.1E-04	8.9E-05	
35A Vents (Non cons) (baseline average)	App J									6568
	Updated									7422

The result of the revised emission rates is that instead of an increase in the total VOCs[2] emissions in the expansion, there is in fact a decrease, due to the existing refinery having higher average VOC emission rates (existing total VOC 9.08×10^4 to expanded total VOC 8.03×10^4). The corrected emission rates are presented in Appendix F and the impact of this change together with data assimilation of the ground level concentrations and the HRA is discussed in section 3.1.4.

[2] Total VOCs includes all VOCs shown on the emission rate spreadsheet in Appendix C.

During the 10 week public comment period, additional monitoring at the residue area was undertaken which identified that odour emission rates from the cooling pond, lower dam and wet residue (refer to Table 6), are different between summer and winter. In winter the odour emission rate is lower than during the summer period. This is believed to be due to the increased volatilisation of VOC from these sources under warm conditions. These changes for diffuse sources only relate to odour and the other diffuse source emission rates are as contained in Appendix J of Appendix G of the ERMP.

Table 6: Derived Indicative Emissions for Modelling the Lower Dam and Cooling Pond

Location	Season	Sub Area	Odour Emission ($ou/m^2/min$)	Overall Average ($ou/m^2/min$)	Overall Average Modelled in ERMP ($ou/m^2/min$)	Rationale for Estimates
Lower Dam						
Case 1	Summer	Inlet Rest	64.6 56.2	56.33	3.92	Case 1 includes all samples with October taken as representative of summer and June as winter
	Winter	Inlet Outlet Rest	49.6 3 6	6.69	3.29	
Cooling Pond						
Case 1	Summer	Inlet Rest	106.2 47	66.73	42.6	Summer based on February measurements and Winter June measurements
	Winter	Inlet Rest	14.0 13.75	13.83	42.6	
Wet Residue						Estimated as temperature dependent*

Note calculations based on:

- Lower dam total area of 17.7 ha and an inlet area of 63 by 45m;
- The cooling pond average emissions were based on assuming that 1/3 of the cooling pond is representative of the inlet and 2/3 for the rest of the cooling pond; and
- Summer was taken from 16 October through to 15 April and winter 16 April to 15 October.

* The wet residue emissions were based on the relationship with ambient temperature and due to the additional monitoring the equation to determine this relationship was modified, as follows:

- ERMP modelled equation – Wet Residue (ou/m2/min = max (0, 1.1724 x AT -12.53)
- Modified equation - Wet Residue (ou/m2/min) = max (0, 0.9994 x AT -9.8451)

AT is the 2m ambient air temperature at Bancell Rd., with this relationship based on the best fit of all data from the three campaigns excluding one outlier sample in October 2004, as described in Air Assessments email report dated 9th August 2005.

The modified temperature dependency equation for wet residue results in slightly higher emissions at lower ambient temperatures and less emissions at higher temperatures, but overall results in only a small change to the drying bed emissions.

Modelling Uncertainty

To provide an understanding of the bounds of uncertainty associated with the emission estimates, "statistically significant results" is taken to imply that mean emission levels estimated from samples taken can be considered sufficiently reliable. Key issues to be considered in this are:

- refinery process variation;
- the effect of various factors on the emissions;
- the effect of sample and analytical variability;
- the application to which the estimates are to be applied; and
- the (relative) significance of a particular emission.

The uncertainty of samples was estimated using specific examples. These examples were used as a basis to estimate typical uncertainty of all samples. The two examples were:

- Acetone, acetaldehyde and formaldehyde (VOC's) from two calciners; and
- Benzene from two boilers.

The uncertainty estimates determined for refinery point sources are provided below.

Substance Group	**Typical Uncertainty**
Products of Combustion	<15%
VOCs (including aldehydes and ketones)	<20% (some sources <40%)
SVOCs (including PAHs)	<100%
Metals and trace elements	<100%
Inorganic substances (ammonia, hydrogen sulphide etc)	<40%

Note: the estimated uncertainty comprises both measurement uncertainty (that inherent in the monitoring and analytical process) and process variability (that inherent in the natural variability of emissions due to random process variations).

The diffuse sources (RDAs, cooling pond and lower dam) were monitored using a US EPA flux chamber technique backed up by upwind/downwind sampling and back trajectory modelling. For some sources, spatially distributed samples were taken at two or three different locations, while for other sources only one sample location was tested on a number of repeat runs.

The degree of certainty for the main diffuse sources is outlined below:

- For the main diffuse sources (RDAs, Cooling Pond, Lower Dam and Superthickener), uncertainty is likely to be higher than that for refinery point sources, typically 50 percent for VOCs and odour;
- For the other diffuse sources (e.g. ROWS pond) that are relatively small in comparison to the main sources, lower sample numbers mean that VOC and odour uncertainty would likely be greater, estimated here to be as high as a factor of three;
- For minor constituents measured less frequently, such as ammonia, SVOCs, PAHs etc, uncertainty would be expected to be greater again, possibly as high as a factor of three to five.

Based on the above information, and noting that the majority of substance emissions are dominated by the refinery contribution with diffuse sources making only a small additional impact[3], the degree of uncertainty considered applicable to the combined refinery point and diffuse source ground level concentrations is outlined in Table 7 below.

Table 7: Uncertainty Factors for the cumulative refinery emissions

Uncertainty Factors	Multiplier
Products of Combustion and dust	1.15
VOCs	1.2
SVOCs	2
Metals	2
Other	1.4

To assess the impact of the calculated emission uncertainties a sensitivity analysis was undertaken at Receptor 4 (representing Yarloop), Receptor 7 (the receptor with the highest Acute HI) and Receptor 16 (receptor with the highest ICR level). The sensitivity analysis involved taking the typical uncertainties outlined above and applying these to the calculated hazard quotients (HQ) for the corresponding compounds. In addition, this sensitivity analysis was undertaken on the data assimilated HQ, providing further conservatism in the results. The effect at receptor 4 and 7 is as follows (details are given in the Sensitivity Analysis Tables in Appendix H):

[3] The exception is dust from the RDAs, for which there is a high level of confidence in monitored ambient concentrations, since there is a comprehensive all year monitoring program. Dust estimate uncertainties are considered to be at least as low for the RDAs as for refinery stacks, estimated above at +/- 15%..

Impact of uncertainty on Hazard Index for Case 6 (Cogeneration) – Assimilated Data

	Acute HI	Acute HI with Added Uncertainty
Receptor 4	0.47	0.56
Receptor 7	0.84	0.97

This analysis showed that even with data assimilation (which has reduced uncertainty) added to the emission uncertainties[4], (which are highly improbable) the Acute HI for the expansion would still meet the Alcoa target of 1.0.

The Chronic Hazard Index, although more significantly contributed to by specific metals and VOCs, was well below the target level. So even if the Chronic HI was increased by 100 percent due to uncertainty in emissions levels it would still remain very comfortably within the target range.

In the unlikely event that the Incremental Carcinogenic Risk (ICR) was increased 100 percent due to uncertainty in emissions levels, the ICR levels at neighbouring residences would still remain well below the de-minimis risk level of 1×10^{-6}. This is shown by applying a 100 percent emission uncertainty on the calculated ICR value at Receptor 16, the receptor was experiencing the highest ICR level in the HRA. The ICR at Receptor 16 increases from 3.5×10^{-7} to 5.9×10^{-7}, still well below the target level of 1×10^{-6}.

The analysis has shown that even with data assimilation (which has reduced uncertainty) and if the emission uncertainties were additive - causing all ground level concentrations to increase at the same time, which is extremely unlikely, the HRA would still be within the target levels for the proposed Wagerup expansion, which are stringent by accepted world standards.

[4] It should be noted that in aggregating hazard quotients of a range of substances to estimate a hazard index, it is very unlikely that the individual substance uncertainties would be additive and of the same sign (+/-). A more probable outcome would be that positive uncertainties would tend to be cancelled by negative ones, or in other words under-estimation of some substances would tend to be cancelled by over-estimation of others.

3.1.6 Data assimilation of TAPM not undertaken

On receiving the independent expert reviewer's (Katestone) comments on the air dispersion modelling Alcoa had the modelling re-run to include data assimilation.

The change to the existing refinery average emission rates (Section 3.1.5) does not impact on the HRA results for the expanded refinery and the Acute, Chronic and ICR for the existing refinery all remain within the target levels. The results of re-modelling with the revised rates and data assimilation are further detailed in section 3.1.4 and HI tables presented in Appendix F.

The impact on the HRA is only minor for the following reasons:

1. Acute Hazard Index is derived from peak emission rates for refinery process units, and these remain unchanged. Acute HI is thus not affected;

2. Average refinery VOC emission rates increase by about 17 percent for the existing refinery and decrease by approximately 14 percent for the cogeneration expansion case (from ERMP emission rates compared to revised emission rates post submission). Average emission rates are used to determine Chronic health impacts and incremental cancer risks and therefore:

    - there will be a slight increase in the predicted Chronic Hazard Index (HI) and Incremental Carcinogenic Risk (ICR) for the existing refinery; and

    - a slight decrease in the predicted Chronic HI and ICR for the expanded refinery.

The changes to the HRA resulting from both corrected average emission rates and data assimilation are insignificant.

3.1.7 The analysis presented in the ERMP, including the HRA is focused on incremental (i.e. refinery only) impacts.

The HRA for the proposed Wagerup Unit Three is based on the cumulative impacts of the refinery and residue drying area emissions.

As far as cumulative ambient concentrations are concerned (those due to the refinery and other sources in the region), Alcoa has made very real and significant attempts to describe and capture these

in the ERMP. Many recent and older studies have focused on ambient air concentrations of substances at Wagerup and environs, including:

- the Chemistry Centre of WA reports from 2001 to 2004;
- campaign studies of NOx and ozone in the Waroona, Hamel, Yarloop region;
- the Queensland University of Technology (QUT) fine particles study;
- ambient air campaigns (Power and Wills, 2005 & van Emden and Power, 2005); and
- the Department of Environment and community ambient air studies in 2003.

Alcoa commissioned CSIRO to undertake a comprehensive review of studies up to date as at mid-2003, and the CSIRO report was delivered in early 2004. The CSIRO Air Quality Review was extensively referenced within the ERMP and attached in Appendix C.

The Air Quality Summary Report, the Ambient Monitoring Reports, and CSIRO Air Quality Review all consider and present analysis of current ambient air concentrations of many different substances detected at one time or another over the past five years in some detail, wherever the data was available to do so. While these studies, investigations and reviews have been undertaken in good faith by Alcoa and others, they have been aimed at establishing the impact of Alcoa's emissions on ambient air in the region. They provide a valuable and extensive database on the ambient air concentrations of a range of substances commonly present in rural environments.

These studies have consistently demonstrated that despite best efforts, it is very difficult to unambiguously detect a refinery influence on concentrations of many commonly encountered substances in ambient air.

Based on the extensive monitoring undertaken and understanding of refinery and ambient emissions, it is not reasonable or practical to attempt to undertake a HRA of cumulative concentrations of ambient air pollutants in the Wagerup region.

3.1.8 Recommend that the odour/VOC relationship developed by Alcoa be independently reviewed

Alcoa consulted with Department of Environment (DoE) on suitable independent experts able to conduct the review, and agreed on the selection of Dr R Ormerod of Pacific Air and Environment, Brisbane. Dr Ormerod is the immediate past chair of the Odour Special Interest Group of the Clean Air Society of Australia and New Zealand, and an acknowledged expert in odour measurement and modelling. He has had no prior involvement for or with Alcoa on this or any other project.
The review by the independent odour specialist found that the odour/VOC relationship used in the Wagerup Unit Three ERMP was technically appropriate and robust. The independent review is presented in Appendix J.

3.1.9 Validity of odour emission estimates

The DoE Air Quality Division (AQD) raised two key areas of concern regarding the certainty of odour emission estimates for the baseline and expanded refinery (point sources) contained in the Wagerup Refinery Unit Three ERMP.

The first arises from the use of a regression relationship between total VOCs and odour to predict odour emission rates used in dispersion modelling of the current refinery and in the WG3 expansion proposal. At the request of the AQD the relationship has been reviewed by an independent third party odour specialist and found to be technically appropriate and robust. Refer to section 3.1.8 for additional information on the review.

A concern of the AQD was that the relationship may not adequately represent the odour emissions of sources that are quite different in odour strength, nature and moisture content. This is because the relationship does not allow the individual components of total measured VOCs to differentially influence odour from any individual source. Hence, in the ERMP for some sources the ratio of individual VOCs to odour can differ between sources, this is related to the different gaseous composition of the emissions.

The second point relates to the first, and arises since the odour modelling presented in the ERMP predicted a large reduction in offsite odour impact, largely driven by reduction in odour emissions from building 25A. This reduction in impact was sufficient to outweigh any tendency towards an increased odour impact due to greater calciner odour emissions (there are two new calciners proposed

for the expansion). The net effect as a result of the expansion was an overall reduction predicted in odour impact as a whole, despite some individual sources increasing in VOC emissions while others decrease.

The AQD has questioned that if the initial estimation of 25A odour emissions is over-predicted, and the existing and expanded refinery odour emissions are substantially below those predicted in the ERMP, then the margin of reduction achieved by odour control actions on 25A may also be over-predicted. The potential consequences of this could include that the predicted lower odour impacts from reducing 25A odour emissions may not be sufficient to offset the increased odour impacts due to higher calciner emissions.

To resolve this issue it was proposed that acetaldehyde be used as a surrogate to independently examine the changes that may occur in odour impacts post-expansion. The use of acetaldehyde as a surrogate for odour was adopted for the Pinjarra Refinery Efficiency Upgrade environmental assessment. This methodology was first considered for the Wagerup Unit Three ERMP but the odour/VOC relationship was used as it was considered it would better predict the odour impacts from the refinery.

Acetaldehyde was selected as the surrogate as it is known to be one of the most conspicuous odorants present in Bayer Refinery Process emissions. This is particularly true for high level sources such as calciners and it has previously been identified as contributing up to 95 percent of refinery 'chemical odour unit' (COU) emissions. These COU emissions have in turn demonstrated to have a good relationship with odour emissions as measured by dynamic olfactometry (odour panel) techniques.[5]

The use of acetaldehyde as a surrogate for odour is still only an indicator and is not completely accurate. This is because other substances do affect the odour properties of emission sources, although to a lesser degree. Acetaldehyde is considered a reasonable indicator because it:

- Is measured by a well accepted technique that does not suffer from difficulties of moisture effect on collected samples
- Does not rely on a statistical relationship between a variety of odourant gases and directly measured odour concentration of the same sources;
- Can be measured with greater precision and accuracy than odour;

[5] Refer for example to Coffey & Ioppolo-Armanios, IWA Water Science and Technology, 2003.

- Is a well known Bayer process marker and odourant (refer above); and
- Has odour properties that are quite specific.

To assess odour concentration impacts of the expansion to Acetaldehyde the following statistics were extracted for both:

- 99.9^{th} percentile 3 minute average; and
- 99.5^{th} percentile 3 minute peak.

The acetaldehyde contours predicted for the 99.9^{th} percentile 3 minute peak emissions and 99.5^{th} percentile 3 minute average emissions cases are presented in Figures 1 and 2 and show no material differences between the existing refinery and the cogeneration expansion case.

Figure 1: Average (99.5th percentile) acetaldehyde 3 minute concentrations (µg/m3) (data assimilated) for the existing (top) and expanded refinery (bottom)

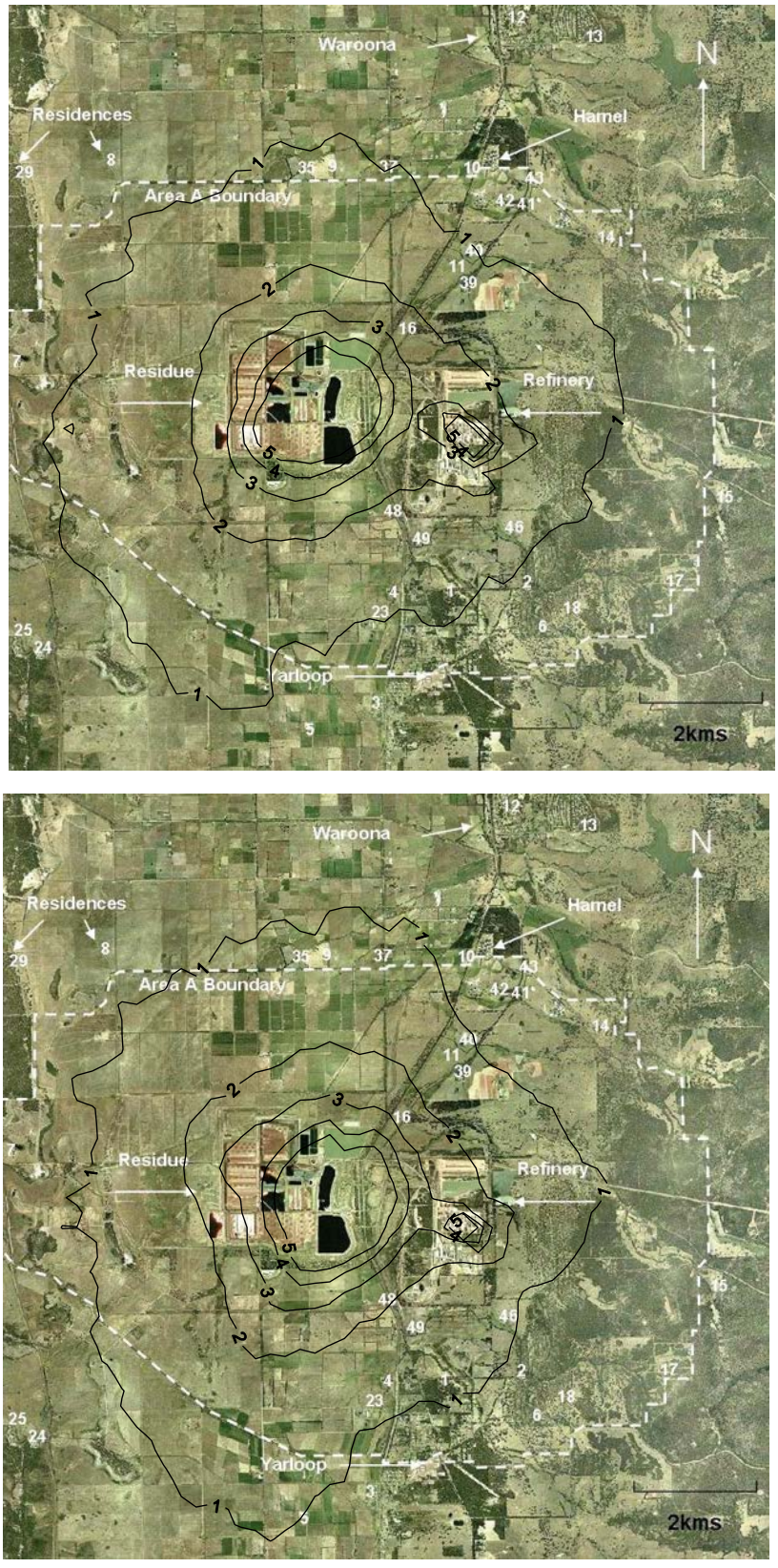


Figure 2: Peak (99.9th percentile) acetaldehyde 3 minute concentrations (µg/m3) (data assimilated) for the existing (top) and expanded refinery (bottom)

In addition to the assessing the acetaldehyde as a surrogate, remodelling of odour was undertaken after submission of the ERMP (in May 2005) to assess the impact of data assimilation and the corrected and revised emission rates (as detailed in section 3.1.5). The results of the remodelling are presented in Figures 3 and 4 below. This shows a decrease in predicted odour ground level concentrations following the proposed expansion.

The combination of remodelling and the acetalhdye surrogate give confidence that the odour impacts will not increase through the proposed expansion.

Figure 3: Average (99.5th percentile) odour 3 minute concentrations (OU) (data assimilated) for the existing (top) and expanded refinery (bottom)

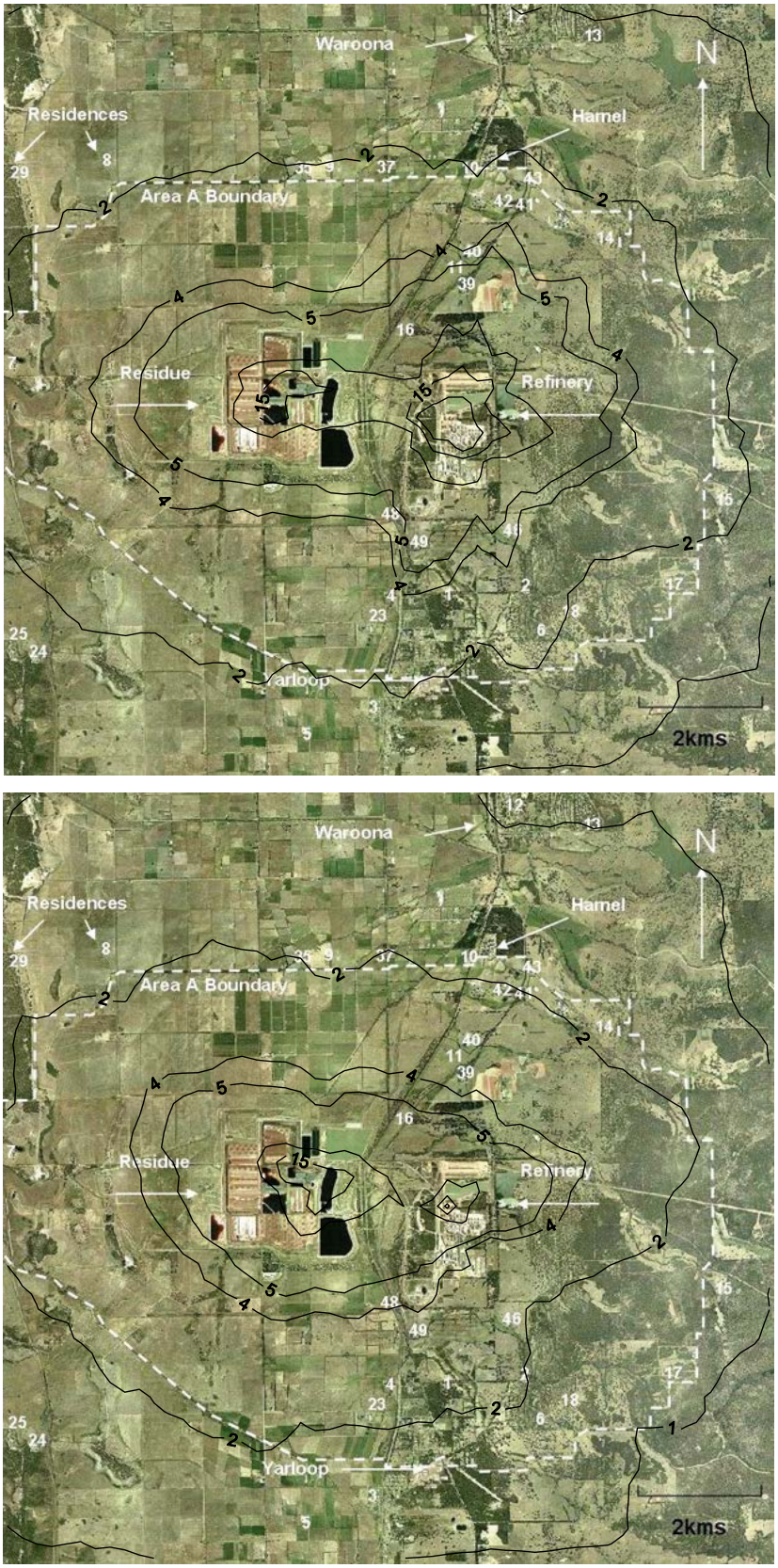


Figure 4: Peak (99.9th percentile) odour 3 minute concentrations (OU) (data assimilated) for the existing (top) and expanded refinery (bottom)

To provide further confidence in the odour predictions the following is proposed:

Additional Investigations and Analysis Proposed

To add further confidence in the findings of the odour modelling for the existing refinery and the proposed expansion the following is proposed:

1. The basis of the odour/VOC relationship will be further established and tested by use of an 'odour weighted' contributing substance approach. Instead of simply adding the total of all measured VOCs (including aldehydes and ketones), the substance contribution to odour (as COU) will be derived by dividing the measured substance concentration by its known odour threshold. The individual substance COU contributions will then be added together;

2. The concept above (point 1) will be extended to substances other than VOCs, for example also incorporating ammonia and reduced sulphur compound concentrations where measured and/or known;

3. The relationship will be changed to enable wet substance concentrations to be compared to wet odour concentrations, and dry with dry. This will overcome an inherent difficulty in that the relationship has so far been between dry substance concentrations and wet odour concentrations;

4. The amended odour/substance (COU) relationship will be used to derive new odour emission rates for the baseline and expanded refinery.

5. Additional monitoring of selected emission sources where required, for example 25A emissions.

6. Should the resulting refinery odour emission rates be substantially different to those presented in the ERMP then odour impacts will be remodelled using air dispersion modelling.

7. The results of all additional investigations and analysis will be presented to the AQD staff for their review.

Following the implementation of the refinery expansion, if approved and constructed, it is intended to conduct comprehensive monitoring upwind/downwind of the RDA sources to confirm the

effectiveness of control measures associated with the expansion on VOC and odour concentration impacts in the local area. This will also include monitoring of key specific VOCs (such as Acetaldehyde) and odour under a range of meteorological conditions and in different seasons to confirm the results of the air dispersion modelling.

3.1.10 Modelled odour impacts not representative of complaints

Using the results of the data assimilated air dispersion modelling (refer to section 3.1.4 and 3.1.6) that was undertaken during the 10 week public comment period, shows that the existing Wagerup refinery can be detected in Yarloop. If the refinery is expanded, odours may continue to be detected from the refinery, but the odour impacts are not predicted to increase, and actually to decrease. Using Acetaldehyde as a surrogate for odour also indicates that there will not be an increase in odour impacts from the expanded refinery (refer to section 3.1.9).

The resultant odour ground level concentrations[6], with data assimilation for the 99.9th percentile peak 3 minute value and 99.5th percentile average 3 minute value at Receptor 4 (representing Yarloop) are presented below and shown in section 3.1.9, Figures 3 and 4 (contour plots).

	Existing Refinery	**Expanded Refinery**
99.9th percentile Peak	9.6 OU	3.4 OU
99.5th percentile Ave	3.2 OU	2.6 OU

3.1.11 Contribution of the refinery to the ambient environment is said to be small, but this does not take into account short-term "events" where the refinery may make a bigger contribution.

Alcoa has an extensive knowledge of the refinery emissions built up of over more than five years of intensive monitoring and agrees with comments that the contribution of the refinery to the ambient environment are small and well below the standards used in the HRA. This is further detailed below and was outlined in section 8.3.12 of the ERMP.

A number of submissions raised the issue that during short-term exposures the refinery may make a bigger contribution to the ambient environment and may cause adverse health effects. Short-term exposures (normally 1 hour) associated with the proposal have been assessed through Acute health effects, represented by systemic health effects and sensory irritation. Through the air dispersion

[6] Note that some of the source emission rates were updated after the ERMP had been submitted. Refer to section 3.1.5.

modelling, shorter term exposures (3 and 10 minute) were predicted to represent times when residents have reported an odour that has lasted for minutes prior to disappearing.

The CSIRO modelling undertaken for the ERMP predicted the 3 and 10 minute GLC at each receptor based on the refinery emissions. These data were assessed in the HRA and presented and discussed section 8.3.12 of the ERMP. In summary, it was concluded that as the short-term (3 minute) GLC are less than the air guideline values used in the HRA then these peaks in concentrations (3 minute) are unlikely to be sufficiently high to cause adverse health effects. The air guideline values used were for one hour averages or annual averages, if no one hour average guideline was available.

To further quantify the short-term emissions the air dispersion modelling undertaken for the ERMP was re-run to include data assimilation. It was thought that the TAPM modelling may be under-predict the frequency of light to moderate wind speeds and the frequency of winds from a northerly direction. Therefore this may have underestimated the maximum impacts particularly to the south of the refinery near Yarloop. Data assimilation was raised by the independent peer review (Katestone Environmental) and is discussed in more detail in section 3.1.4 and 3.1.6.

The predicted maximum 1hr, 10 minute and 3 minute ground level concentrations for the existing and expanded refinery (cogeneration) with data assimilation at Receptor 4 (representing Yarloop) are presented in Table 8 on the following page. Only those modelled compounds that have irritancy thresholds are reported.

Table 8: Receptor 4 Existing and Expanded Refinery Short-term exposures, with assimilation

Receptor 4 Existing Refinery Emissions - Assimilated Data

	Irritation Index ($\mu g/m^3$)		Maximum 1-hr	Maximum 10-min	Maximum 3-min	% of Irritation Index [9]
SO_2	5.70E+02	[6]	9.59E+00	1.40E+01	1.92E+01	3.37%
Acetone	2.38E+07	[1]	8.07E+00	1.14E+01	1.48E+01	< 0.1%
Acetaldeyhde	9.00E+04	[5]	1.88E+00	2.91E+00	3.59E+00	< 0.1%
Formaldehyde	1.20E+02	[7]	9.93E-01	1.46E+00	1.88E+00	1.57%
2-Butanone	5.90E+05	[2]	7.21E-01	1.01E+00	1.34E+00	< 0.1%
Benzene	9.00E+06	[2]	2.14E-01	3.19E-01	4.18E-01	< 0.1%
Toluene	7.50E+05	[3]	5.57E-01	8.36E-01	1.09E+00	< 0.1%
Xylenes	4.35E+05	[2]	1.06E-01	1.59E-01	2.12E-01	< 0.1%
Acrolein	3.40E+02	[8]	4.15E-02	6.43E-02	8.60E-02	0.03%
Ethylbenzene	4.30E+06	[4]	8.41E-03	1.17E-02	1.52E-02	< 0.1%
Methylene Chloride	8.28E+06	[2]	7.97E-01	1.16E+00	1.61E+00	< 0.1%
Styrene	4.30E+05	[2]	1.03E-02	1.59E-02	2.06E-02	< 0.1%
Chromium (vi)	5.00E+02	[9]	1.60E-05	2.50E-05	3.30E-05	< 0.1%
Nickel	1.00E+02	[9]	1.30E-02	1.90E-02	2.40E-02	0.02%
1,2,4 Trimethylbenzene	1.34E+05	[9]	3.00E-02	4.20E-02	5.40E-02	< 0.1%
1,3,5 Trimethylbenzene	1.34E+05	[9]	9.20E-03	1.30E-02	1.70E-02	< 0.1%

Expanded Refinery Case 6 (Cogeneration) Emissions - Assimilated Data

	Irritation Index ($\mu g/m^3$)		Maximum 1-hr	Maximum 10-min	Maxium 3-min	% of Irritation Index [10]
SO_2	5.70E+02	[6]	9.41E+00	1.45E+01	1.97E+01	3.45%
Acetone	2.38E+07	[1]	3.33E+00	4.65E+00	5.96E+00	< 0.1%
Acetaldeyhde	9.00E+04	[5]	2.49E+00	3.55E+00	4.44E+00	< 0.1%
Formaldehyde	1.20E+02	[7]	7.44E-01	1.13E+00	1.51E+00	1.26%
2-Butanone	5.90E+05	[2]	4.44E-01	6.54E-01	8.53E-01	< 0.1%
Benzene	9.00E+06	[2]	7.01E-02	1.04E-01	1.42E-01	< 0.1%
Toluene	7.50E+05	[3]	8.51E-02	1.34E-01	1.72E-01	< 0.1%
Xylenes	4.35E+05	[2]	1.71E-02	2.51E-02	3.27E-02	< 0.1%
Acrolein	3.40E+02	[8]	5.41E-02	7.96E-02	1.05E-01	0.03%

Ethylbenzene	4.30E+06	[4]	2.01E-03	3.18E-03	4.53E-03	< 0.1%
Methylene Chloride	8.28E+06	[2]	9.62E-02	1.42E-01	1.83E-01	< 0.1%
Styrene	4.30E+05	[2]	7.81E-03	1.15E-02	1.42E-02	< 0.1%
Chromium (vi)	5.00E+02	[9]	2.00E-05	3.05E-05	4.00E-05	< 0.1%
Nickel	1.00E+02	[9]	1.56E-02	2.18E-02	2.80E-02	0.03%
1,2,4 Trimethylbenzene	1.34E+05	[9]	3.47E-02	4.97E-02	6.39E-02	< 0.1%
1,3,5 Trimethylbenzene	1.34E+05	[9]	1.08E-02	1.66E-02	2.07E-02	< 0.1%

References

[1] Arts JHE et al (2002). An analysis of Human Response to the Irritancy of Acetone Vapours, Crit Rev Toxicol. 32(1), 43-66

[2] Ruth JH (1986). Odor Thresholds and Irritation Levels of Several Chemical Substances, A review, Am Ind Hyg Assoc J., 47: A142-A151.

[3] World Health Organisation (1986) Environmental Health Criteria 52: Toluene, World Health Organization, Geneva.

[4] World Health Organization (1996) Environmental Health Criteria 186: Ethylbenzene International Program for Chemical Safety World Health Organization Geneva.

[5] World Health Organization (1995) Environmental Health Criteria 167: Acetylaldehyde, World Health Organization Geneva.

[6] NEPC (1998). Ambient Air Quality, National Environmental Protection Measure for Ambient Air Quality. National Environment Protection Council, 26 June 1998

[7] World Health Organization (1989). Environmental Health Criteria No 89 Formaldehyde, World Health Organization, Geneva

[8] World Health Organization (2002) Concise information Chemical Assesment Document (CICAD) Acrolein, CICD 48 www.inchem.org date assesed 220803

[9] Toxikos (2005) Health Risk & Toxicological Assessement - Worsley Expansion Emissions

Notes

[10] % of Irritation Index = (Irritation Index)/(Maximum 3-minute concentration)

Substances that have been modelled but do not have Irritation Threshold guidelines have not been included

Maximum 10-minute and 3-minute concentrations have been calculated from the maximum 1-hour concentration based on pollutant specific ratios derived from the CSIRO Stage 3a and 3B reports.

As reflected in Table 8, the maximum 3 and 10 minute concentrations predicted by the modelling are significantly lower than the irritancy thresholds for these compounds and therefore not at sufficiently high concentrations to cause irritant impacts.

Odour

Odour is another effect that occurs with short-term exposures and when associated with an industrial complex, such as the Wagerup refinery, can result in the perception that the emissions are resulting in adverse health effects.

Alcoa has assessed the potential odour impacts through using the odour/VOC relationship and Acetaldehyde as a surrogate for odour. The following conclusions are made:

- the odour/VOC relationship showed that as a result of the expansion there is an overall reduction in predicted in odour impact as a whole, despite some individual sources increasing in VOC emissions while others decrease; and
- there was no material differences between the existing refinery and expansion cases acetaldehyde contours predicted for the 99.9th percentile 3 minute peak emissions and 99.5th percentile 3 minute average emissions cases (assimilated data).

Refer to section 3.1.9 for additional information.

3.1.12 Provide justification of the estimate of a non-proportional increase in SO2 emissions with production including the reason why the emissions from the liquor burner will not increase with the doubling of throughput.

The level of sulphur dioxide emissions are related primarily to fuel combustion and secondarily to liquor throughput. The Wagerup refinery uses natural gas as its primary fuel, which only has a small sulphur content and therefore will not increase proportionally to production levels.

The refinery production capacity will increase through the introduction of a third production unit, but there will be no change to Liquor Burning throughput. The proposed expansion will include an upgrade of Liquor Burning, but this will be through the use of membrane technology, which will increase the concentration of the liquor solids feeding the Liquor Burner dryer, but it will not increase the dryer flowrate and therefore emissions (including sulphur dioxides) will increase in proportion to production levels.

In addition, practically all sulphur in liquor entering the kiln will be in the sulphate form (refer to section 3.1.13 for further detail). The environment in the kiln is strongly oxidising; and for any substantial conversion of sulphate to sulphur dioxide to occur it would need to be strongly reducing, as sulphate is the most oxidised form that sulphur can attain.

Based on this, it is considered that the potential for formation of sulphur dioxide from sulphur inputs with material via process liquor is quite low. It should be noted that sulphur dioxide makes only a very small contribution to the Wagerup HRA indices for the existing and expanded refinery.

3.1.13 Include an assurance that the sulphur stream is not diverted to sulphur containing organic compounds such as mercaptans and other odorous compounds.

Mineral sulphides (e.g. Pyrite, FeS2) are present in bauxite at very low concentrations and are the main source of sulphur in the Bayer process. These mineral sulphides are very stable under Bayer process conditions and exit the process with the residue. A small amount of mineral sulphide will dissolve under digestion conditions to form sulphide in the liquor. Bayer solids are very oxidising with respect to sulphide, and therefore the majority of sulphide that is produced will convert to sulphate in digestion. Liquor exiting digestion contains approximately 1-2ppm sulphide, but most of this remaining sulphide is oxidised to sulphate in the precipitation building. Sulphate is thermodynamically stable in Bayer liquor and will not revert back to sulphide

An emissions inventory was commissioned at Wagerup refinery to comprehensively survey the chemical composition of emissions from various parts of the refinery. Table 9 lists the number of sulphur-containing compounds detected in each of the six emission sources sampled for this class of compound, and Table 10 lists the concentration of each detected compound. Only four sulphur-containing compounds (apart from sulphur dioxide) were detected in two different emission sources, slurry storage and digestion vacuum pump. Three of these compounds (methyl mercaptan, ethyl mercaptan, hydrogen sulphide) were detected in digestion vacuum pump emissions in the range of 0.2 – 5.6 mg/m^3, and two of these compounds (methyl mercaptan, dimethyl sulphide) were detected at trace levels in slurry storage emissions in the range of 0.024 – 0.072mg/m^3. Sulphur-containing compounds excepting sulphur dioxide were not detected in any other Bayer refinery emissions. The digestion vacuum pump has since been eliminated as an emission source by re-routing to the powerhouse for thermal destruction in the boilers.

Table 9: Number of sulphur-containing compounds identified in various Wagerup emission sources.

Emission Sources	Sulphur-Containing Compounds
Mill Vent	0
Slurry Storage	2
Digestion Vacuum Pump	3
Digestion Containment Tank Blow Off	0
Calciner 4	0
Liquor Burning	0

Table 10: Concentration of sulphur-containing compounds detected in slurry storage and digestion vacuum pump emissions.

	Concentration (mg/m^3)*	
Compound	**Slurry Storage**	**Digestion Vacuum Pump**
Methyl mercaptan	0.072	5.6
Ethyl mercaptan	nd	2.6
Hydrogen sulphide	nd	0.2
Dimethyl sulphide	0.024	nd

* Reported on a wet basis

nd = not detected

These data provides further evidence that there is a very low potential for sulphur inputs into the Wagerup refinery to divert to sulphur containing organics such as mercaptans and other odorous compounds.

3.1.14 A number of problems discovered with the reports, which should be revised and tables amended.

Alcoa has met with the relevant government agencies to obtain a more detailed list of the specific aspects considered in this issue, and have revised the affected report tables to rectify the information concerned. Tables 21 – 24 and 26 of the ERMP have been revised and updated to correct these matters. The corresponding tables found in the Air Quality Summary Report have also been amended as they contained the same information as those tables corrected in the ERMP. The revised tables are presented below.

Table 21: National Environmental Protection Measures

Pollutant	Averaging Period	Ambient Guideline		Goal
		(ppm)	(µg/m^3) [1]	
Ambient Air NEPM		*Standard*		*See Note [2]*
Carbon Monoxide	8 hours	9	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	0.1	214	1 day a year
	4 hours	0.08	171	1 day a year
Sulphur Dioxide	1 hour	0.2	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	
Air Toxics		*Draft Investigation Level [3]*		
benzene	Annual	0.003	10.4	See Note 4
formaldehyde	24 hour	0.04	54	
toluene	24 hour	1	4,113	
xylenes	24 hour	0.25	1,183	

Note:

1. Referenced to a temperature of 0 ^oC and absolute pressure of 101.3 kPa.

2. Maximum allowable exceedence of the Standard, to be achieved by the year 2008. 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.

3. Noted that the Impact Statement for the Air Toxics NEPM (NEPC, 1998b) reports the Investigation Levels referenced to a temperature of 25 ^oC, however for consistency within this table the Investigation Levels have been referenced to 0 ^oC.

4. Eight-year goal is to gather sufficient data nationally to facilitate development of a standard.

Table 22a: Maximum Ground Level Concentration Predicted Across all Receptors

Pollutant	Averaging Period	Reference	Maximum Predicted Concentration at a receptor (µg/m3)				Percentage of Guideline (%)
			Base case	Expansion (cogen)	Expansion (boilers)	Receptor Exhibiting Highest Predicted Impacts	
Nitrogen dioxide	1-hour	NEPC	53.8	64.1	64.6	14	26.0%
	Annual	NEPC	0.6	0.6	0.6	16	1.0%
Carbon monoxide	8-hour	NEPC	34.0	46.4	46.9	15	0.4%
Sulphur dioxide	1-hour	NEPC	17.0	20.1	21.5	24	3.5%
	24-hour	NEPC	3.3	4.0	4.5	24	1.8%
	annual	NEPC	0.04	0.07	0.07	16,48	0.1%
Benzene	annual	OEHHA	0.0029	0.0034	0.0035	16	<0.1%
Formaldehyde	24-hour	NEPC (AT)	0.56	0.17	0.17	39	0.3%
Toluene	24-hour	NEPC (AT)	0.35	0.05	0.05	16	<0.1%
Xylenes	24-hour	NEPC (AT)	0.058	0.009	0.009	16	<0.1%

Table 22b: Six Highest 24-hour PM10 Concentration Predicted Across all Receptors

Concentration Rank	Predicted Concentration (µg/m^3)			Receptor exhibiting Highest predicted impacts	Ambient Guideline (µg/m^3)
	Base case	Expansion (cogen)	Expansion (boilers)		
1	57.2	44.6	44.6	7	NEPM Goal is to have no more than 5 exceedences of the 24-hr standard of 50 µg/m3 by June 2008
2	33.1	29.1	29.1	7	
3	31.8	27.6	27.6	7	
4	28.2	27.1	27.1	7	
5	27.3	25.7	25.7	7	
6	26.2	24.7	24.7	7	

Note: Guidelines used are those selected by the Health Risk Assessment consultant and used in the HRA

Table 23a: Maximum Ground Level Concentration Predicted at the Yarloop Town site, represented by Receptor 4

Pollutant	Averaging Period	Reference	Maximum Predicted Concentration (µg/m^3)			Ambient Guideline (µg/m^3)	Percentage of Guideline - Highest concentration (%)
			Base case	Expansion (cogen)	Expansion (boilers)		
Nitrogen dioxide	1-hour	NEPC	53	58	61	246	24.8%
	Annual	NEPC	0.25	0.28	0.26	62	0.4%
Carbon monoxide	8-hour	NEPC	16	22	22	11,250	0.2%
Sulphur dioxide	1-hour	NEPC	10.8	11.4	13.0	571	2.3%
	24-hour	NEPC	1.4	1.6	1.7	228	0.8%
	annual	NEPC	0.02	0.03	0.03	57	0.1%
Benzene	annual	OEHHA	0.0009	0.0010	0.0011	60	<0.1%
Formaldehyde	24-hour	NEPC (AT)	0.213	0.080	0.080	54	0.1%
Toluene	24-hour	NEPC (AT)	0.115	0.021	0.021	4,113	<0.1%
Xylenes	24-hour	NEPC (AT)	0.019	0.002	0.002	1,183	<0.1%

Table 23b: Six Highest 24-hour PM10 Concentration Predicted at the Yarloop Town site, represented by Receptor 4

Concentration Rank	Predicted Concentration (µg/m^3)			Ambient Guideline (µg/m^3)
	Base case	Expansion (cogen)	Expansion (boilers)	
1	4.4	6.4	6.4	NEPM Goal is to have no more than 5 exceedences of the 24-hr standard of 50 µg/m3 by June 2008
2	4.4	4.3	4.3	
3	3.1	2.9	2.9	
4	2.7	2.3	2.3	
5	1.8	2.3	2.3	
6	1.6	2.0	2.0	

Note: Guidelines used are those selected by the Health Risk Assessment consultant and used in the HRA

Table 24a: Maximum Ground Level Concentration Predicted at the Hamel Town site, represented by Receptor 10

Pollutant	Averaging Period	Reference	Maximum Predicted Concentration (µg/m3)			Ambient Guideline (µg/m^3)	Percentage of Guideline - Highest concentration (%)
			Base case	Expansion (cogen)	Expansion (boilers)		
Nitrogen dioxide	1-hour	NEPC	44	38	42	246	17.2%
	Annual	NEPC	0.24	0.33	0.27	62	0.5%
Carbon monoxide	8-hour	NEPC	18	22	22	11250	0.2%
Sulphur dioxide	1-hour	NEPC	5.3	6.2	7.3	571	1.3%
	24-hour	NEPC	1.2	1.4	1.6	228	0.7%
	annual	NEPC	0.02	0.03	0.03	57	0.1%
Benzene	annual	OEHHA	0.0010	0.0009	0.0010	60	<0.1%
Formaldehyde	24-hour	NEPC (AT)	0.165	0.088	0.088	54	0.2%
Toluene	24-hour	NEPC (AT)	0.094	0.013	0.013	4113	<0.1%
Xylenes	24-hour	NEPC (AT)	0.017	0.002	0.002	1183	<0.1%

Table 24b: Six Highest 24-hour PM10 Concentration Predicted at the Hamel Town site, represented by Receptor 10

Concentration Rank	Predicted Concentration (µg/m^3)			Ambient Guideline (µg/m^3)
	Base case	Expansion (cogen)	Expansion (boilers)	
1	3.7	4.9	4.9	NEPM Goal is to have no more than 5 exceedences of the 24-hr standard of 50 µg/m3 by June 2008
2	3.5	3.9	3.9	
3	2.8	3.8	3.8	
4	2.6	3.7	3.7	
5	2.5	3.5	3.5	
6	2.1	3.4	3.4	

Note: Guidelines used are those selected by the Health Risk Assessment consultant and used in the HRA

Table 26: Comparison of refinery only maximum modelled short-term GLCs for existing and expanded refinery [1]

Pollutant	Averaging Period	Reference	Maximum predicted concentration (3 minutes)			Percentage of Guideline - Highest concentration (%)
			Base case (ug/m3) [1]	Expansion (cogeneration) [1]	Expansion (boilers) [1]	
Nitrogen dioxide [3]	1-hour	NEPC	54	54	54	22.0%
Carbon monoxide	8-hour	NEPC	210	220	220	2.0%
Sulphur dioxide	1-hour	NEPC	22	23	30	5.3%
Particulates (PM_{10})	24-hour	NEPC [2]	16	8.9	8.9	17.8%
Benzene	annual	OEHHA	0.94	0.19	0.18	<0.1%
Formaldehyde	24-hour	NEPC (AT)	2.4	1.3	1.3	2.4%
Toluene	24-hour	NEPC (AT)	2.4	0.18	0.19	<0.1%
Xylenes	24-hour	NEPC (AT)	0.56	0.01	0.01	<0.1%

[1] Refinery only – does not include RDA emissions

[2] The NEPM Goal is to have no more than 5 exceedences of the 24-hr standard of 50 µg/m3 by June 2008

[3] Nitrogen dioxide is ozone limited

Note:

National Environment (Air Toxics) Protection Measure (NEPC 2004)

National Enviromental Protection Measure (NEPC 1986)

Office of Environmental Health Hazard Assessment, Californian EPA

Additional contours for PM_{10} and NO_2 as requested, are presented in Appendix L.

3.1.15 Further investigate some technical issues including, TAPM's building wake scheme, further testing of wind field data in fugitive source modelling and sensitivity modelling for fugitive sources

The air dispersion modelling for the Wagerup refinery ERMP and the re-modelling undertaken during the public comment period (to assess the impact of data assimilation) are considered to provide valid and accurate predictions of the GLCs from the refinery. The re-modelling indicated there is little likelihood that the existing or expanded refinery emissions would cause adverse Acute or Chronic health effects. A summary of the re-modelling is reported in section 3.1.4 and the summary report presented in Appendix I

The approach taken by Alcoa in the modelling and the HRA was extremely conservative and even with this conservatism the existing and proposed expansion meets the relevant health criteria. The technical modelling issues raised during the public comment period are further minor refinements to the model, not fundamental changes and therefore will not result in any significant change outcomes of the HRA.

3.1.16 Inadequate meteorological monitoring and maintenance of equipment

Alcoa Wagerup operates a Class 1 meteorological station "Bancell Road Meteorological Station". This station was installed in June 2003 and is designed to be used for any monitoring and modelling requirements. This station is maintained in line with the maintenance requirements stipulated in AS2923.

An independent audit of this station has been completed in 2003, 2004 and 2005. Each audit confirmed that the maintenance activities completed on this station met the requirements of AS2923. These audits also identified that the 10m instrument was shielded by the 30m mast and therefore did not meet the siting requirements of the standard. Data that may have been thus affected was not used in the Wagerup ERMP modelling.

A second mast due will be installed to hold the instrument and enable it to meet the siting requirements. The installation of the second mast is due for completion by end 2005.

Alcoa Wagerup also operates an anemometer within the residue area (RDA). This anemometer is in place for operational control purposes and hence is not maintained to Class 1 requirements.

CSIRO and Air Assessments selected to use the data from the residue anemometer in the Wagerup ERMP modelling, as they believed there was still value to be extracted from these data in the context of the modelling studies. Alcoa had made it very clear the air dispersion modellers that the residue anemometer was not maintained to a Class I level.

3.1.17 Recommendations of van Emden & Power (AQ Appendix B, section 6) should be carried out.

The van Emden & Power report contained five recommendations and these are listed below with explanation of how Alcoa is addressing them:

1. **A comparative study of Radiello and USEPA sampling techniques over the same time periods should be carried out to investigate the apparent bias between the techniques and indicate possible reasons** - The bias between the Radiello and USEPA techniques has been discussed with the Chemistry Centre and DoE Air Quality Division. The problem has been observed by others and appears to be inherent in the technique. The issue will be referred to the Wagerup Air Quality Technical Advisory Panel for consideration and prioritisation.

2. **An investigation of the cause of the apparent elevated levels of carbonyls at Boundary Rd could be informative.** - Investigation of carbonyl levels at Boundary Rd will become a part of more comprehensive study of VOC levels in line with CSIRO Recommendation 14 (refer to section 3.1.2)
3. **Investigation of techniques for monitoring short-term concentrations of compounds of interest should be progressed, preferably by continuous monitoring techniques such as the Opsis that is currently being trialed for formaldehyde and benzene. This should attempt to correlate variations in concentrations with short-term influences of refinery emissions on the ambient atmosphere indicated by marker compounds, in particular NOx.** - Continuous Opsis measurement has been established at Boundary Rd for formaldehyde, benzene and SOx, in addition to the NOx and particulates monitoring already in place.
4. **Information from recommendation 3 above, should be used in combination with dispersion modelling and emission source measurements to improve knowledge of the influences of the refinery on ambient air quality. This provides a practical alternative to the approach of event monitoring with ultra-trace analysis, which is not recommended due to the difficulties involved in identifying and capturing events, the high dilution from dispersion, and the background levels of chemicals existing in the atmosphere from other natural and anthropogenic sources.** - Action on this will be considered in combination with the information obtained from recommendation 3, and the Proton Transfer Reaction Mass Spectrometry (PTRMS) trial (refer to section 3.1.2)
5. **An investigation of the hexanes, pentanes and PAHs detected at the Yarloop site could be carried out to confirm their concentrations and identify likely sources.** - This will be referred to the Wagerup Air Quality Technical Advisory Panel for consideration and prioritisation.

3.1.18 Cooling towers should be better characterised

Alcoa has a comprehensive understanding of the cooling tower emissions. This has been achieved through extensive monitoring (refer to section 3.1.1) of the cooling towers in accordance with the USEPA sampling methodologies. The sampling was undertaken using specialist monitoring consultants and samples analysed at NATA registered laboratories.

Due to the high flow rate of this source and high moisture content it is a more difficult source to sample and analyses trace levels (very small concentrations) of compounds. To continually improve its knowledge of the Wagerup refinery emissions Alcoa engaged specialist monitoring consultants and laboratories to develop methods for improved measurement of trace level carbonyls and VOCs in cooling towers. The independent audit of Wagerup air emissions measurements in 2003 (Air Water Noise Ltd) concurred with the planned approaches.

3.1.19 What will happen to Calciner 5 & 6 low-volume vent emissions? Will there be any low-volume vents with these calciners?

The two new calciners 5 and 6 will have the low-volume vents. The emissions from these vents will be directed to a combustion process for destruction.

Refer to section 3.1.3 for additional information on improved efficiency at Wagerup refinery through the proposed expansion.

3.1.20 The use of best practice emission control for all the refinery (not just the expansion) has not been identified in the ERMP

Alcoa has adopted what it considers best practice emission controls for the proposed expansion at Wagerup refinery in accordance with the EPA Guidance statement No.55 "Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process" December 2003.

The Proposal will increase refinery production capacity without exceeding any recognised environmental protection standards (i.e. National Environmental Protection Measures) through the adoption of best practice emission controls.

A HRA was undertaken for the proposal which concluded that the Incremental Carcinogenic Risk was less than one-in-a-million and there is little likelihood of the emissions from the existing or expanded refinery having adverse Acute or Chronic health effects. Alcoa has achieved this outcome through

production efficiencies and the use of best practice emission controls applicable to the Wagerup refinery. Improved efficiency will be achieved through production efficiencies and emission control measures as outlined in section 3.1.3 and the Air Quality Management Plan (section 10.1 of the ERMP).

To ensure Wagerup refinery continually improves its environmental performance, 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.

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.

Alcoa has continually strived for the implementation of best practice at its Wagerup refinery and this is reflected in the ongoing improvements to the refinery, such as the non-condensable gas destruction project while having regard to factors such as local conditions, costs, available technology, technical knowledge and reliability. The expansion of the refinery does enable additional opportunities for best practice to be implemented that may otherwise have not been possible due the factors outlined above (i.e. technology, practicability and cost).

3.1.21 Is NOx a good tracer for all primary emissions? Not all emission sources emit uniform NOx. and the modelling may not accurately reflect emission dispersion behaviour from other (non NOx) sources.

NOx is one of a number of tracers that have been used to verify and ground truth dispersion modelling results. NOx is primarily released from combustion stacks, most of which are relatively tall, so is a good indicator for these types of sources and stacks. For sources that emit Bayer process emissions but no combustion products, specific characteristic substances and/or odour are better tracers. In the CSIRO TAPM Phase 2 report, both the four specific PFC tracer compounds used in the ANSTO tracer study and the odour emission impacts measured in field odour surveys, were used to provide model ground truthing and performance checking for non-combustion type refinery sources.

For the diffuse source Calpuff modelling validation, ground-truthing odour surveys, supplemented by GC/MS Hapsite measurements of specific VOCs (by CCWA) and some additional TO17 tube sampling of VOCs (by GHD) were used to verify modelling predictions. Independent back trajectory modelling was carried out by Queensland Department of Agriculture and Environmental Alliances using the field odour, GC/MS and TO17 VOCs data. All of these studies and verification exercises are reported fully in the various ERMP appendices. In summary, NOx was just one of a number of tracers used in the dispersion model verification steps undertaken on both refinery TAPM and diffuse source Calpuff models - and was useful for particular source validation, while for non-combustion sources and diffuse sources a range of other tracers as referenced above were used.

3.1.22 Calciner 3 improvements should be included in the modelled basecase

The baseline for Wagerup was set at April 2004 and this was the point from which the existing emission estimates were taken. The Wagerup Unit Three Referral Document was prepared and submitted to the EPA in June 2004. This baseline was set for air dispersion modelling of the base case to commence and process and emission control improvements which are a continual focus at Wagerup still continued. The improvements to Calciner 3 were planned for some period of time and carried out in December 2004. Alcoa has an ongoing program to improve emissions controls and is committed to this program and this will continue whether the expansion proceeds or not.

3.1.23 Why was source emission baseline compared to ambient baseline – is this a valid approach?

The existing refinery baseline was compared to the ambient monitoring results as detailed in section 7.9.2 of the ERMP. It was important to provide an indication of the overall contribution of Wagerup

refinery to the ambient environment, clearly showing the relatively small contribution of Wagerup emissions to the ambient air. There is an ongoing ambient monitoring program at Wagerup which is providing consistent results to that shown in the ERMP.

3.1.24 Refinery is located in an unsuitable position due to the influence of the escarpment

Air dispersion modelling has been has been developed to take into account the specific characteristics and meteorological conditions in the Wagerup area. A GIS database for the Wagerup area was used which included information about land-use zones, water streams and topographic contours (and included the Darling escarpment). Details of the CSIRO TAPM modelling is located in Appendix G of Appendix G in the ERMP.

In further developing the TAPM model, CSIRO evaluated 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 be capable of adequately predicting local meteorological conditions. As TAPM is not suitable for area sources; the Calpuff model was used and this used the meteorological files that were developed by CSIRO for the Wagerup area. Findings of re-modelling with data assimilation (after submission of the ERMP) is detailed in section 3.1.4 and Data assimilation report located in Appendix I.

3.1.25 Emissions should not be averaged as it disguises short-term concentrations.

24 hour dust and some specific VOC standards and guidelines are established in the Air NEPM and Air Toxics NEPM. Alcoa has not selected these averaging periods; they have been established by fully referenced, independent and public review processes as appropriate periods for the protection of health and environmental effects; and for the investigation of ambient concentrations, for the substances they apply to.

It was necessary in the ERMP to compute 24 hour average concentrations predicted for the expansion and experienced for the current operating refinery; to enable comparison to the appropriate standards or guidelines; to express as a hazard quotient for inclusion in the HRA of these substances.
Dust monitoring using the NEPM mandated approach requires monitoring over 24 hour periods. It is possible to use other methods to monitor over shorter time periods. Alcoa does so with a number of TEOM (Tapered Element Oscillating Microbalance) monitors for dust, and for specific VOCs an OPSIS long path monitoring system recently installed. Short-term concentrations predicted for the

existing refinery and proposed expansion are further discussed in section 3.1.11 and are detailed in section 8.3.12 of the ERMP.

3.1.26 Increase in production must lead to increase in emissions

There will be emissions that will increase as a result of the proposal, for example CO_2, NOx , which are primarily products of combustion, however Alcoa has made an undertaking that there will not be an increase in odour, noise and dust impacts from the refinery, minesite and port operations as a result of the Proposal. There has been significant work to focus on key contributors to these impacts and the ERMP has demonstrated these undertakings can be achieved. Further detail regarding efficiency is provided in section 3.1.3 and additional information will be provided as part of the Works Approval process.

3.1.27 Tall stacks have made emissions worse further from the refinery

This assertion has been made by some community members. The installation of the tall stack has reduced emission impacts from the refinery and this is supported from two main areas, modelling and tracer studies; and the intensive ambient monitoring programs.

Modelling and Tracer Studies

Prior to the recommendation to build the tall stack as a means of promoting improved dispersion of emissions and achieving lower ground level concentrations, there was extensive modelling studies and validation carried out. Sinclair Knight Merz (SKM) conducted an intensive modelling study, using three different dispersion models (Ausplume, Calpuff and TAPM); and Alcoa's in-house specialists carried out computational fluid dynamics (CFD) modelling. All these modelling studies indicated a benefit to proceeding with the project, while none indicated that ground level concentrations would worsen by doing so. The predicted benefits varied according to the models used, but there was no indication of increased risk of concentrations worsening at any location relative to the refinery.

Prior to the commencement of the tall stacks project, a tracer study was carried out to obtain more direct measures of the degree of dispersion being achieved from the existing stacks planned for inclusion in the multi-flue stack. This was followed up after the commissioning of the tall stack by another tracer release campaign. The results of the tracer releases were compared and modelled to reach conclusions regarding the effectiveness of the tall stacks. The conclusions reached by SKM after modelling and thorough analysis of the tracer results were as follows:

- 'Concentrations decreased rapidly with distance with the maximum concentrations decreasing by around a factor of 2 with increasing distance from one km to three km from the refinery.'

- 'An indication of the relative benefit of the replacement of Calciner 3 with the 100m stack can be gauged by comparing the ratio of Calciner 3 to Calciner 4 concentrations in June and the ratio of the 100m multiflue to Calciner 4 concentrations in August. Using the RHC as the best estimate of the maximum concentrations, the concentrations are estimated to have decreased by between 1.1 to 3.6 times. This large variation is probably indicative of there being insufficient data to make a proper comparison, but does indicate that a reduction in the concentrations has occurred.'

- Furthermore the study found 'that there is a good degree of confidence in the modelled concentrations for the various reduction scenarios modelled in 2002.'

In their 2003 Air Quality Review CSIRO recommended that *'consideration be given to the possibility that under certain meteorological circumstance (e.g. convective mixing) a higher stack may cause higher ground-level concentrations at a given receptor than those due to a smaller stack depending on the downwind location of the receptor.'* Alcoa commissioned CSIRO to conduct Wagerup III TAPM modelling as part of the ERMP for expansion of the Wagerup Refinery in 2005, using a more sophisticated/updated version of TAPM to that used in the SKM study. (It was primarily the TAPM modelling in the SKM study that had been relied upon for the predicted improvement in dispersion for the tall stacks, supported by Calpuff and CFD modelling.)

CSIRO's modelling found good model agreement as measured by the robust highest concentration measure of peak impacts, particularly focusing on the taller stacks that emit NOx. The 100 m multiflue stack is one such source. They examined likely short-term (3 and 10 minute) peak impacts from refinery sources using state-of-the-art methods, and predicted the peak values for both the existing refinery and the expansion. Short-term exposures under convective mixing conditions were noted by CSIRO as instances were the possibility of higher ground level concentrations should be considered. Using formaldehyde as a marker for the calciner stacks (since it is primarily emitted from calciners), it is clear that in the expansion, which includes a second tall stack, there are consistent reductions in short-term exposures (3 and 10 minutes) at all receptors.

TAPM was found to perform at least as well at Wagerup as at other locations where it has been extensively verified by CSIRO and others. On this basis CSIRO considered TAPM to be a capable

and reliable indicator of peak and average emissions impacts due to the refinery. As a result we can now have greater confidence in the accuracy of TAPM predictions.

The findings of all modelling and tracer studies conducted to date, from prior to the decision to build the tall stack, to post commissioning and to the current Wagerup Unit Three expansion modelling using TAPM, is support for the prediction of reduced emissions impact from the building of a 100 m multiflue stack.

Ambient Monitoring Programs

Over 2004/05 there was a rejuvenated and intense ambient monitoring effort. The scope and conduct of the ambient monitoring programs was presented to the Wagerup Tripartite Group before proceeding, and the selection of independent monitoring specialists and laboratories was reviewed by the group.

The findings of these ambient programs have been published in the ERMP. Two aspects of the findings are important in regard to the tall stacks assertion: -

- Firstly, the concentration of carbonyl and VOC compounds emitted from the refinery including the tall stacks was found to be at similar levels everywhere monitored, regardless of distance from the refinery. In fact the highest levels were monitored in the towns of Waroona and Yarloop; levels near the refinery and at other locations away from the refinery and towns were found to be lower. On this basis the study concluded that the levels of carbonyl and VOC compounds found were generally typical of rural levels measured elsewhere, and did not show a discernable refinery influence.

- Secondly, the one exception to the above pattern was found to be for formaldehyde measured at Boundary Rd, which showed some elevation, and to a lesser extent also at Hoffman Rd. The words ‘lesser extent’ are noted, since if the formaldehyde elevation is due to a refinery influence, it is clear that this influence declines with distance from the refinery, since Hoffman Rd is further from the refinery than Boundary Rd. The main sources of formaldehyde emissions in the refinery are the calciner stacks, of which three out of four are part of the 100 m multiflue stack.

As in the modelling and tracer studies, there are no ambient data here to support a finding of an increasing refinery influence with greater distance from the refinery. The data that does exist suggest

refinery influence declines with distance. Indeed, beyond a few kilometres (about the distance of Hoffman Rd) it is not possible to discern a clear refinery influence on VOC and carbonyl levels in background air.

3.1.28 Monitoring should be independently conducted and audited.

Alcoa contracts out all monitoring to NATA certified independent sampling contractors and laboratories. Where standards exist, Alcoa uses the most relevant USEPA, Australian or equivalent sampling and analytical standards. Alcoa believe that this provides sufficient independence in monitoring performance.

Equipment is sampled under normal operating conditions on occasions where equipment is not available for monitoring at a planned time, e.g. it is offline, and then the follow-up monitoring is carried out to ensure appropriate information is gained.

The significant point sources included in the ERMP air dispersion modelling account for approximately 96 percent of the total mass of refinery emissions. Minor sources not included together account for the remaining 4 percent of point source emissions, with no individual source amongst these accounting for 1 percent or more of point source emissions.

There was a submission requesting continuous emissions monitoring. Such technology is available for a very limited number of compounds. Continuous monitoring is being researched and applied where appropriate by Alcoa.

The use of the continuous emissions monitoring technology known as FTIR was investigated in 2002 and reported on previously. It was found that FTIR was not capable for in-stack measurements at Wagerup.

Subsequent to this investigation, an alternative technology called OPSIS was investigated at Wagerup in 2003. This investigation was conducted as a requirement of licence 6217/7 and the investigation report submitted to DoE was independently reviewed by CSIRO. Some limited success was achieved with OPSIS, however further developmental work is required by the manufacturer before it can be proved a reliable continuous emissions measurement tool for Wagerup stacks.

Since 2004 Alcoa has been working with the Chemistry Centre of W.A. to investigate the options for using online Gas Chromatograph Mass Spectrometry (GCMS) technology for continuous monitoring of VOC's. This work is in its infancy and requires further assessment.

In the meantime, the program of regular manual stack monitoring continues. This program ensures that our knowledge of emissions variability continues to improve.

Continuous emissions monitoring cannot be conducted (or licenced) where proven technologies are not available.

A submission commented that the stack diameters and exit velocities were inaccurate. The stack diameters and exit velocities used for the air dispersion modelling are correct. This issue was also raised in the Emissions and Health Working Group and a response provided. This response was reviewed and accepted by CSIRO beforehand.

3.1.29 Slurry tanks should be monitored and licensed.

Slurry tanks comprise four percent of average and two percent of peak VOC emission rates for the existing refinery. They are not the most significant source of VOC emissions from the refinery, however they are a significant source of odour emissions in the current operating refinery. In the expansion, their contribution to odour emissions from the refinery will be reduced by 75 percent, through process changes that will result in a large reduction in the amount of digestion flash vapour routed to the slurry tanks and then released to atmosphere. This change will mean they will not remain significant contributors to odour, nor to VOC emissions. Alcoa does not believe it is appropriate or value adding to require their licensing.

3.1.30 Cooling towers are the source of Legionnaire's disease outbreak on several occasions

There have never been any cases of Legionnaires disease amongst the workforce at Wagerup.

There is a weekly monitoring program undertaken by the Cooling Tower Chemical Supplier and where required, the towers are slug dosed with Sodium Hypochlorite to maintain appropriate levels.

3.1.31 Emission control measures on Building 50 and Calciner 3 have not been effective

It is not correct to say that Calincer 3 emission control measures have not been effective. A report has been submitted to the DoE on the Calciner 3 results of the improvements. This report contains a detailed statistical analysis of Calciner 3 formaldehyde emissions and compares the pre-upgrade concentrations to those following the upgrade. A copy of the report is provided in Appendix K

Figure 5 below shows the formaldehyde levels prior to the upgrade. The pink series represents the formaldehyde concentration and it is evident that there was significant instability and surges in formaldehyde levels as a result of the "surging" issue.

Figure 5: Calciner 3 OPSIS Measured Formaldehyde emissions July to October 2003

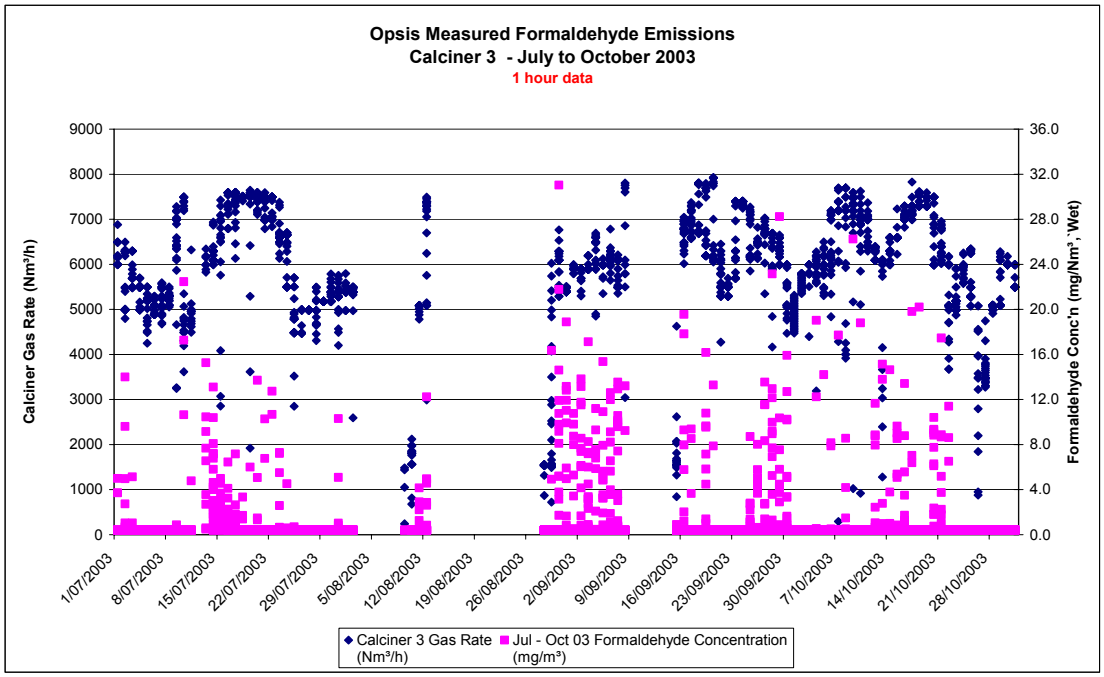
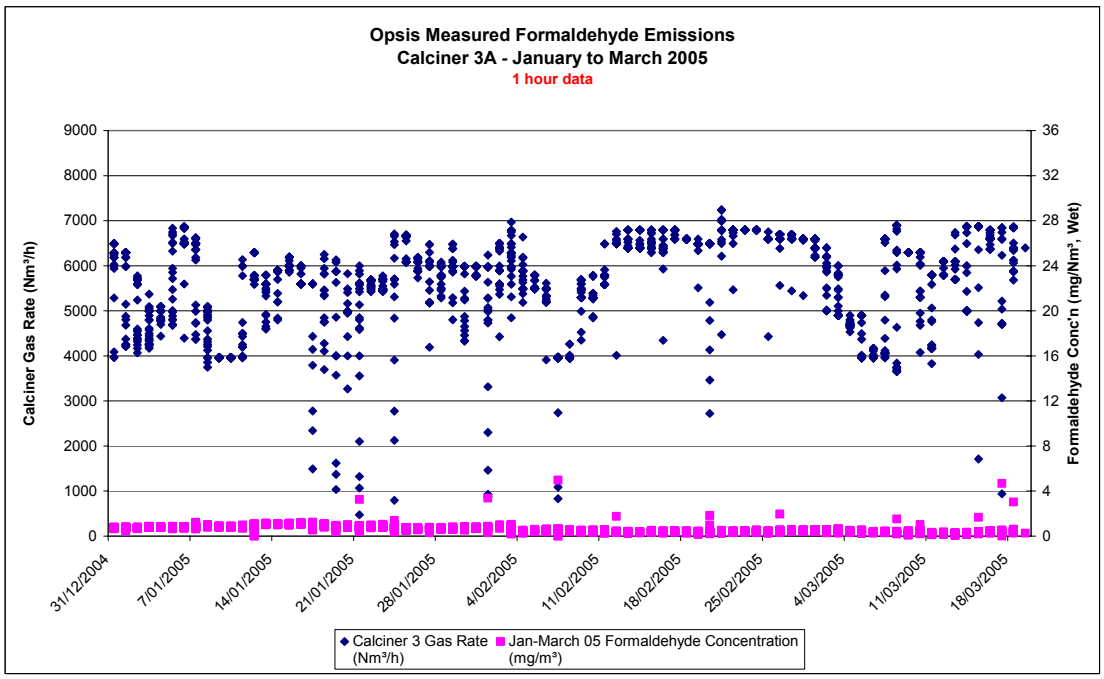


Figure 6 below shows the formaldehyde levels monitored during the period January – March 2005. This figure clearly illustrates that the instability that was present prior to the upgrade has been rectified, with formaldehyde emissions substantially reduced.

Figure 6: Calciner 3 OPSIS Measured Formaldehyde emissions Jan to March 05



As part of the Calciner 3 upgrade dust is removed from the calciner exhaust gas stream through the use of an electrostatic precipitator. These emission control devices operate continuously and are effective in reducing the dust concentration in the Calciner exhaust gas stream to levels lower than 80 mg/m³. This is below the limit allowed by the Wagerup Environmental licence.

3.1.32 Residue samples are washed prior to analysis to remove leachable compounds. This may affect fluoride results.

Data on fluoride content of bauxite, residue mud and residue sand was provided to Professor Frank Murray based on samples collected during 1999 and 2000. This data was used by Professor Murray to conduct a desk-top review of fluoride emissions from the Wagerup Refinery.

Based on the data presented to him, Professor Murray concluded that emissions of fluoride, at the level and form present in bauxite, residue mud and residue sand are unlikely to present high levels of risk of fluoride damage in the environment.

The analytical results provided to Professor Murray were based on 36 samples collected by Alcoa and analysed by AGAL.

The residue mud samples provided to AGAL for analysis, were a sub-set of samples that had been previously prepared by Alcoa for internal process purposes. The preparation of the samples was conducted in accordance with the standard Alcoa sample preparation procedures. The sample preparation involves filtering the mud slurry, washing the mud slurry with de-ionised water and drying the sample. This dried material is then re-slurried in hot de-ionised water before filtering and drying again. The purpose of the preparation is to remove entrained liquor so internal analysis of elemental composition can be performed for engineering materials balances. Since fluoride in residue mud is present as insoluble calcium fluoride, washing is unlikely to affect the fluoride results.

AGAL digested the residue mud, residue sand and bauxite samples using aggressive techniques (aqua regia and four acid digests). Thus the results were considered representative of total fluoride concentrations.

The results of the fluoride analysis are presented in Table 11 below.

Table 11: AGAL Fluoride Analysis Results Performed on Alcoa Residue Mud, Residue Sand and Bauxite Samples

	Average Fluoride Concentration (ppm)
Residue Mud	403
Residue Sand	93
Bauxite	188

Fluoride analysis of liquor is conducted routinely at Wagerup. The concentration of leachable fluoride in residue liquor is very low, 0.2 g/L. Approximately 95 percent of residue liquor reports back to the refinery, whilst five percent remains with the mud in the residue area. The liquor that remains with mud does contain fluoride, and represents around 4 ppm of the leachable fluoride concentration in residue mud.

Given the low fluoride concentration of residue liquor it is unlikely that the standard Alcoa sample preparation procedure, which involves sample washing, would have changed the concentration of fluoride in the residue mud samples or the conclusions drawn by Professor Murray.

3.1.33 Some emission estimates differ to reported NPI data

Overall, there is good correlation between the current refinery emissions from the refinery as modelled in the WG3 ERMP and the 03/04 NPI reported data. However, it is recognised that there are differences between the two data sets because:

- Additional monitoring at the refinery and residue areas was undertaken specifically for emissions modelling for the Wagerup refinery expansion proposal. The monitoring data used in the WG3 ERMP modelling was not available when the 03/04 NPI data was reported;
- A program to monitor gaseous emissions from the RDA was undertaken and included in the WG3 modelling, this was previously not available for NPI reporting
- Dust emissions from the RDA are higher than those reported in the NPI data as RDA7 was included in the modelling of the existing refinery for the WG3 ERMP, resulting in an overall larger active residue drying area.

The 04/05 NPI data for Wagerup refinery will be updated with the best information available at the time of reporting and will draw on the data included in the WG3 ERMP.

3.1.34 The original CSIRO study proposal should be implemented

Alcoa has and will continue to implement the CSIRO 'Wagerup Air Quality Program' and this is recognised by the Government in its response to the Legislative Council inquiry, as outlined below.

"Technical elements of the proposed CSIRO 'Wagerup Air Quality Program' have been superseded by CSIRO's report entitled 'Review of Air Quality at Wagerup'. This more recent CSIRO investigation reviewed over 1000 documents relating to the Wagerup issue and resulted in 18 recommendations.

Alcoa has already been required to implement all 18 recommendations of this report as a condition of its 2004 licence under the Environmental Protection Act 1986 in August of this [last] year.

Key social elements of the proposed CSIRO 'Wagerup Air Quality Program' are being appropriately progressed via other initiatives such as the Pinjarra-Brunswick Sustainability Strategy."

The air emissions sampling program at the Wagerup refinery is performed by independent specialist consultants and samples analysed by independent laboratories. These companies are contracted by Alcoa to undertake the sampling, with exception of the daily residue dust, with sampling and analysis performed by Alcoa technicians.

The companies contracted by Alcoa are to perform the sampling and analysis are in the majority NATA registered and methods conducted in accordance with appropriate standards, such as US EPA methods.

3.1.35 There should be continuous ambient air monitoring at a number of locations

The ambient air monitoring program conducted in August to October 2004 was in five locations around Wagerup. Boundary Road was selected as an indicative site. The comparison was made with other rural environments and all of the compounds detected were well below applicable environmental and health standards. The most commonly detected compounds were formaldehyde, acetaldehyde and acetone, which were found at levels similar to those measured in a 2003 Department of Environment study.
Refer to section 3.1.11 for additional information.

3.1.36 Comparison of ambient air with rural not rural environment with industry

By choosing a cleaner air environment (rural as opposed to rural/industrial) Alcoa chose a higher standard and therefore a more conservative approach by which to measure its emissions against.

Had Alcoa chosen an industrial/rural environment, the levels of non-Alcoa chemical compounds in the ambient air would have been higher than in a rural environment (as Alcoa used to compare refinery emissions).

Thus Alcoa's contribution to total airborne chemicals would have been proportionally lower than if compared to a rural ambient air environment.

3.1.37 Some calciners and liquor burner were off during ambient sampling

It is not correct that some calciners and the liquor burner were off during the entire ambient air sampling program, although it is true that due to production problems these pieces of equipment were offline for certain periods during the sampling.

Ambient air sampling was conducted from August 23 to October 1, 2004. During that time there were a number of production issues which caused three calciners and the liquor burner to be shut down for longer than normal maintenance periods. The availability of these sources during the monitoring period are outlined below

	C1	C2	C3	C4	LB
%Availability over Monitoring Period	67	67	55	93	46
# Days in Monitoring Period	92	92	92	92	92
# Days online	62	62	51	86	42

C – calciner LB – Liqour burner

The average VOC emission from calciners during this period was 69.7 kg/day, compared to an average of 80.2 kg/day for the period 14 August to 19 November (the period before the Calciner 3 upgrade and subsequent reduction in VOC emissions).
This is approximately 13 percent lower than "normal". It is important to note that the overall contribution of the refinery to the ambient environment is small and this would not have had a significant effect on the results.

Occasional production problems leading to shutdowns of these items of equipment are not uncommon. The production problems that caused these shutdowns at this time were not foreseen and was in no-way related to the fact that ambient air sampling was being conducted during this period.

3.1.38 Emissions from tall stacks is said to be only steam

This is not correct. About 98 percent of emissions from the tall stacks comprise of water vapour (steam) and carbon dioxide (CO2). The remaining 2 percent of total emissions comprise of a number of chemical compounds.

The nature and total volume of these chemical compounds mean that they are not insignificant contributors to both emissions and odour. For example, the tall stacks are estimated to contribute about 20 percent of total refinery odour.

3.1.39 It should have been possible for Environ to directly or indirectly use the peak to mean ratios from TAPM output.

The peak to mean ratios generated via TAPM is undertaken by computing the variance in the Eluerian frame of reference in each grid square over the modeled domain. The variance contribution for each source is subsequently summed to determine a total variance which is used to determine the fluctuation intensity (computed from total variance and mean concentration). The exponent (p) is calculated from this fluctuation intensity.

At that time of post processing for the ERMP, the ASCII source files supplied by CSIRO were used to produce emission files and combined with CALPUFF outputs to produce cumulative ground level concentrations of nominated compounds from point and diffuse sources.

Therefore, the concentration variation statistics were not readily available and so a conservative estimate of the exponent (p) based on CSIRO's determination was used to generate short-term (3-minute) average concentrations.

3.1.40 Emissions from the refinery have an adverse impact on organic and traditional farms

Refinery emissions are not believed to have an impact on farm health as the levels found in the surrounding area were well below relevant health and environmental standards. Ambient monitoring found key refinery emitted substances to be below background levels (refer to section 3.1.4 and 3.1.11).

3.2 AIR QUALITY – RESIDUE DRYING AREA

Summary

Questions raised regarding residue air quality issues (dust) related principally to the adequacy of monitoring and modelling, the period between Long Term Residue Management Strategy reviews and the effects of residue dust on neighbours.

Alcoa's responses demonstrate that there are some misconceptions about residue air quality monitoring and modelling. The monitoring and modelling programs are significantly more robust than perceived by some respondents. For example, residue monitoring is conducted year-round, not just during winter as some respondents asserted.

3.2.1 A robust monitoring program must be instigated along with continuous particulate monitoring and collection of meteorological data in accordance with recognised standard methods in an attempt to verify modelled fugitive particulate emissions, especially in regard to gustiness of wind.

Ambient particulate monitoring has been conducted in the vicinity of the refinery and residue area as part of long term (year-round continuous) monitoring programs and short-term emission investigations. Total Suspended Particulates (TSP), PM_{10}, $PM_{2.5}$ and ultra fine (<0.1 um) particulate data has been collected under various meteorological conditions. Monitoring programs have utilised both high-volume samplers which generally have produced 24-hour average concentration data and TEOM (Tapered Element Oscillating Microbalance) monitors which produce short-term concentration data (typically 6 minute and 1-hour averages).

The current ambient dust monitoring program involves measurement of Total Suspended Particulate (TSP) and PM_{10} particle fractions in the vicinity of the refinery and residue areas using high-volume samplers and TEOM's. The main purpose of the current dust monitoring network is to provide information to direct operational dust control processes and data for compliance monitoring. Data produced from this program can be considered robust as all monitors are sited to meet the intent of AS 2922-1987 and sample collection and analysis is conducted in accordance with the requirements of AS 3580.9.3-2003. This program has been in place for a number of years, with data reported annually to the DoE and DoIR in the Annual Environmental Review.

Meteorological data produced by the Bancell Road Meteorological station is generally used for emissions modelling and to assist with data analysis. Again, data produced by this meteorological station can be considered robust as it is operated to meet AS 2923-1987.

The effect of the gustiness of the wind was included in the modelling to account for increased gustiness during the day. Here the analysis described in Section 5.9 of the Fugitive Emissions Modelling report (Appendix D of Appendix G of the ERMP) found that the gustiness (taken as 6 minute winds/1hour winds) could be 20 percent stronger during the day. This is consistent with approaches used in some of the more research grade dust emission models (The Texas Erosion Analysis Model (TEAM) (Singh et. al., 1997) and the Columbia Plateau PM_{10} Project model (Claiborn et. al, 1998) as referenced in Countess et al, 2002)

The 6-minute and 1-hour dust data generated by the existing monitoring programs are useful for comparison to dust events and for investigating the relationship between dust and winds. However, as emphasised in the Air Quality Summary report (Appendix G of the ERMP) any method is indicative.

Although measurements of specific dust events can be undertaken, the variability in the dust emissions for a given wind speed can be very large as this is dependent on a number of factors. Without controlled experiments, it is considered very difficult, even with good quality measurements, to infer accurately the dust emission, wind speed and wind gust relationships. The ERMP studies used relationships that were based on field experiments at Pinjarra and Kwinana and that were supported by the ambient measurement data. To our knowledge, this approach to dust modelling for air quality assessment is at the forefront of the field.

'In addition to the meteorological station at Bancell Rd, Alcoa has a meteorological station at the residue drying area that is used for operational dust control purposes. This RDA meteorological station is not maintained as a Class 1 station. As part of the air quality assessment conducted for the Wagerup Unit Three project, a review of data generated by the RDA meteorological station and the Bancell Rd meteorological station indicated that additional data would be advantageous for the review of dust generation and wind gustiness. Hence the modelling consultant decided that this data would be used for the modelling investigations even though the data was not generated by a Class 1 meteorological station.

3.2.2 Assessment of dust is based solely on dust monitoring during the winter months, with no summer data

Alcoa's Wagerup ambient dust monitoring program is a year round program. The current ambient dust monitoring program involves measurement of Total suspended particulate (TSP) and PM10 particle fractions in the vicinity of the refinery and residue areas using Highvolume samplers and TEOM. Monitoring locations were chosen to be indicative of dust levels received by the community. The main purpose of the current dust monitoring network is to provide information to direct operational dust control processes and data for compliance monitoring.

Data collected over a number of years shows that dust generation is an issue during the summer months not winter months (refer to Annual Environmental Review's submitted to DoE and DoIR from 2000 to 2004). For this reason, dust management programs are based on data generated over the summer months since this provides the best indication of the effectiveness of dust control efforts and any improvements required.

The Air Quality assessment conducted as part of the ERMP included predictive modelling of worst-case 24 hour average particulate emissions for the current residue and refinery operations using TAPM for PM10 from the refinery and Calpuff for fugitive PM10 and TSP. The data generated by the models compared well to the west and east of the RDA, though over-predicting to the north west and tending to under-predict to the south against the historical monitoring data. Predictive modelling was also conducted for the expansion scenarios. This modelling suggested that there would be minimal change to existing dust emission impacts as a result of the proposal.

3.2.3 RDA dust emissions have a significant impact on neighbours

The Emphron report (refer to Appendix N of the ERMP) found that the alkalinity of particulate at Boundary Rd coming from both the refinery and the RDA was very unlikely in the current state to reach irritant concentrations over short-term (6 minute) averaging periods. The GLC modelling shows that particulate concentrations from both the refinery and RDA will not increase in the community with expansion.

Additional information is provided in section 3.4.3 of this report.

3.2.4 The review period for the RDA by the LTRMS and RPLG should be reduced from 5 to 3 years

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 has been discussed with members of the neighbouring community. The LTRMS covers the proposed 25-year plan for residue management at Wagerup.

Consistent with our approach across WA, we plan to commence a comprehensive review of our Wagerup Long-Term Residue Management Strategy with the relevant government agencies, local Shire members, close neighbours and local community representatives. This will represent a review of the existing strategy after just three years.

This shortened review period is considered appropriate for Wagerup at this time for the following reasons:

- It reflects the timing of the proposed changes to the Wagerup refinery and enables Alcoa to incorporate the community's expectations into our planning for the proposed expansion; and
- It is consistent with our capital planning process and the changes that are likely to occur in residue management in response to the proposed refinery changes.

The review period can be altered to occur more frequently to reflect significant changes in the community, operations or government expectations, but a five year review period is considered optimal to review and undertake community consultation on residue management at Wagerup refinery.

3.2.5 Odour Modelling of Cooling Pond with Plume Rise should be Considered Exploratory

In a technical submission DoE noted that while there can be little doubt that plume rise effects are operative at the Cooling Pond – as demonstrated in CFD modelling, the incorporation of these effects into the diffuse source odour modelling for the ERMP using empirical relationships should be regarded as exploratory. Furthermore, that the verification offered in the diffuse source modelling report may fall short of the degree required under the DoE's modelling guidelines.

In response it should be noted that in the ERMP modelling of specific substances for the HRA, which was conducted before the CFD modelling of the Cooling Pond was undertaken, no plume rise was assumed. Plume rise was incorporated only for odour modelling for the Cooling Pond. Thus the

HRA modelling is conservative and depicts a worst-case scenario as far as predicted GLCs due to Cooling Pond emissions are concerned.

Initial odour modelling of the Cooling Pond with Calpuff also assumed no plume rise, as it was undertaken before the results of the CFD modelling were known. The initial modelling indicated the following (extract from report by Air Assessments to Alcoa, dated 7th Feb 2005): -

> *'This modelling indicates for three days with moderate winds that there is an indication that the model is starting to over-predict for the last hour. Note these measurements were undertaken from around 1800 to 1830 WST in December and so are still before night time, when it is considered that the odour emission rates may be over-predicted.*
>
> *In conclusion, the results indicate the modelling system (emissions and model) tend to over-predict odour levels by up to 50%. There is also some indication that emissions may be over-predicted towards night with lower wind speeds, but more data from lower wind speeds, more stable conditions are needed. As an indication of the odour levels that could result on a typical night for these emissions, the maximum 1-hour odour levels for a 0.8 m/s westerly wind at night show a level of 35ou on the South West Highway. The annual 3 min 99.5 percentile odour levels showing that the 7 ou level would be exceeded past Yarloop. As this is considered unrealistic, based on the complaints, it indicates that there are still issues to be resolved with the emission estimates for the conditions leading to high concentrations, low wind speed, stable conditions.'*

Further field odour surveys conducted at night in December 2004 and February 2005 indicated that under light to moderate night-time winds across the Cooling Pond, Calpuff modelling without the plume rise formulation tended to over-predict the observed downwind odour concentrations by between 2 ½ and 5 times. Indeed under some conditions where odour was predicted by modelling to be well above the odour detection threshold level (for example 35 OU referenced above), no field odour could be detected in a direct downwind position relative to the Cooling Pond. By contrast incorporation of the plume rise formulation from the CFD modelling enabled a good fit to the observed field odour (or lack of observed odour) to be achieved. Greater details on the comparisons and sensitivity analyses are available in the referenced report and supporting field odour surveys conducted at night in December 2004 and February 2005.

3.3 AIR QUALITY – BUNBURY PORT

3.3.1 Dust and noise will increase from Bunbury Port loading bays through the expansion

Noise emissions from the Port facilities are measured periodically and modelling has been conducted to predict worst-case noise levels at nearby residences. Modelling and monitoring has confirmed that the existing Alcoa operations at Bunbury Port currently comply with the assigned noise levels as specified in the Environmental Protection (Noise) Regulations 1997.

The proposed Wagerup refinery expansion will require some changes to the existing facilities. Modelling conducted by SVT has confirmed that the proposed upgrades to the Alcoa Port operations should result in continued compliance with the Environmental Protection (Noise) Regulations. There should be no noticeable change in noise impacts at nearby residences.

Additionally, no increase in dust impacts are expected as there will be no increase in the quantity of alumina exported through Alcoa's ship-loading facility at Bunbury Port. The existing ship-loader handles around 8.3 million tones per annum (Mtpa) of which approximately 3.2 Mtpa is 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 and no increase in dust or noise impacts is expected.

Refer to section 8.3.14 and 8.4 of the ERMP for additional information.

3.4 HEALTH RISK ASSESSMENT

HRA Summary

An important major theme in some submissions relates to claims that the refinery "makes people sick", that these health issues are not adequately addressed and a refinery expansion will increase health impacts.

The available scientific evidence continues to show no causal link between refinery emissions and health complaints. For example, the Health Risk Assessment shows that Acute and Chronic health effects are very unlikely to result from refinery emissions. Similarly no refinery emitted compound is at a level which could be expected to cause health impacts in the workforce or community. However, Alcoa also acknowledges that a small number of people continue to report health impacts they believe are caused by the refinery. This remains a significant issue for both Alcoa and the local community.

Alcoa has also demonstrated a link between complaints and social issues such as the land management program. The Company continues to study refinery emissions and has committed to undertake a health impact study of the local communities.

Some responses called for more information, which has been provided. For example, summary tables have been provided to show for each receptor and each chemical compound, the ground level concentration (fugitive and point source), its human guideline value, toxicological endpoint, averaging time, the calculated hazard quotient and an error estimate (refer to section 3.1.4 and Appendix E).

Others asked Alcoa to demonstrate why certain compounds, such as metals in residue or fine airborne particulates, where not considered a health risk or why the residue drying area is not considered a health risk, and these queries have been explained.

In other cases additional work requested is currently being undertaken (e.g. updated mercury balance for the refinery) and will be provided to relevant stakeholders as soon as it is complete.

A number of questions about the proposed health survey have also been addressed.

3.4.1 ERMP to include a summary table in the main document which gives, for each receptor and each chemical compound, the ground level concentration (fugitive and point source), its human guideline value, toxicological endpoint, averaging time, the calculated hazard quotient and bounds of uncertainty, i.e. an error estimate.

In response to this issue a series of tables have been prepared for the existing refinery and expanded refinery with cogeneration and using data assimilated results. For each receptor a separate table for Acute, Chronic and Incremental Carcinogenic Risk has been prepared.

The tables for the Acute and Chronic risk at each receptor show:

- the relevant modelled chemical compound;
- air guideline value;
- guideline reference;
- averaging period;
- ground level concentration;
- calculated hazard quotient; and
- hazard index.

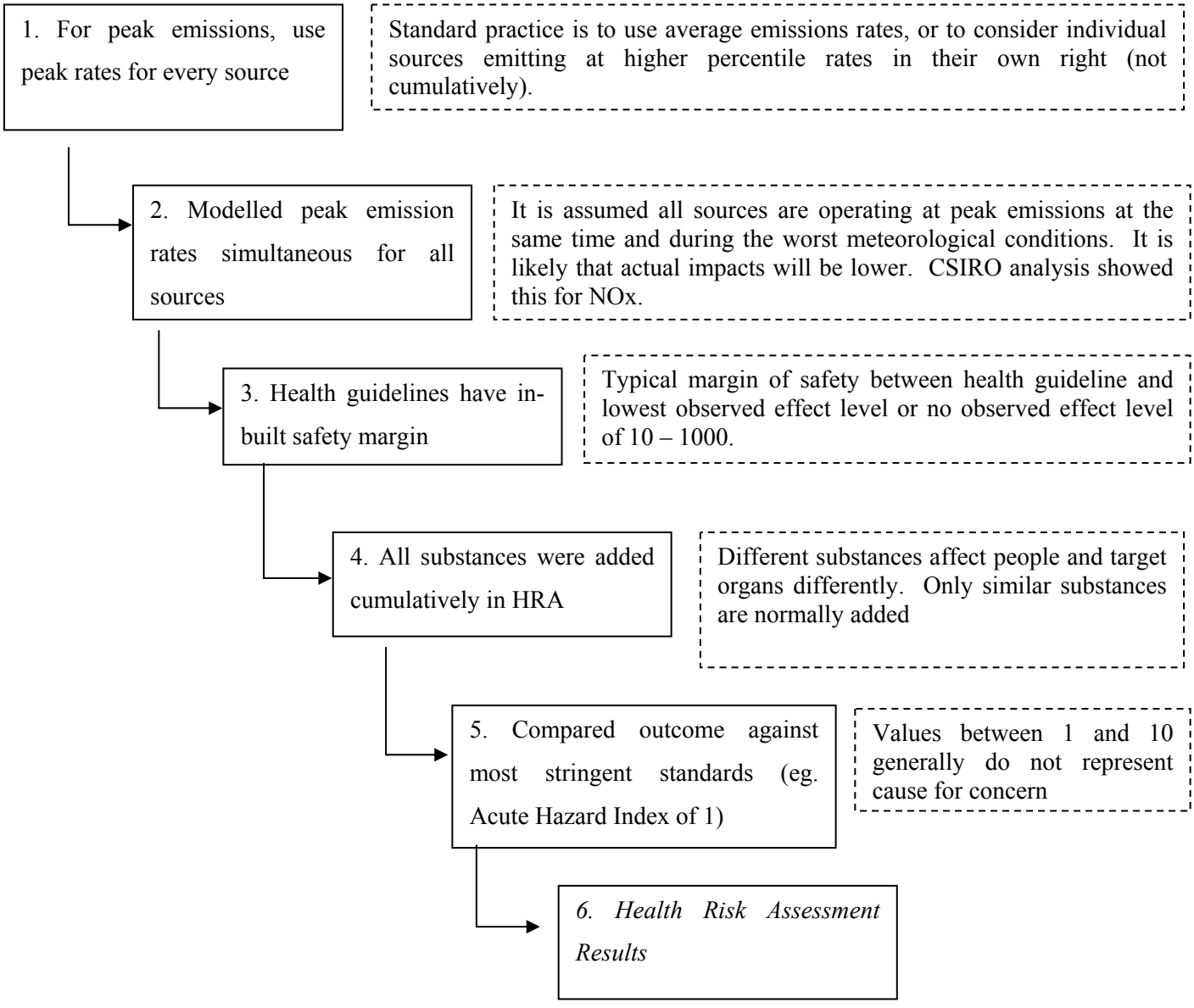
The Incremental Carcinogenic Risk factor tables show:

- the relevant modelled chemical compound;
- the unit risk factor;
- reference source;
- ground level concentration;
- individual Incremental Carcinogenic Risk; and
- total Incremental Carcinogenic Risk.

The full set of tables is presented in Appendix E.

The tables also provide an opportunity to assess the impact of data assimilation on the HRA. As can be seen and further discussed in section 3.1.4 data assimilation does not result in any significant change to the HRA.

Alcoa has adopted a conservative approach when undertaking the modelling and HRA. The level of conservatism in the HRA is reflected in the following flow diagram



In assessing the effect of uncertainty on the outcomes of the HRA, it is important to note that for the Acute Hazard Index the dominant contributors are PM_{10} and NO_2, with only minor contributions from additional substances such as VOCs. These two substances (PM_{10} and $NO_{2)}$ have among the lowest uncertainty levels of any emissions from the refinery.

A sensitivity analysis of the effect of these emissions uncertainties was undertaken at Receptors 4 (representative of Yarloop) and 7 (representative of the highest Acute HI exposed receptor). Using the typical uncertainties in the as in Table 7 of Section 3.1.5 and adding each uncertainty together and applying these to the calculated hazard quotients for corresponding compounds the effect at each receptor was as follows (full details are given in the Sensitivity Analysis Tables in Appendix H):

Impact of uncertainty on Hazard Index for Case 6 (Cogeneration) – Assimilated Data

	Acute HI	**Acute HI with Added Cumulative Uncertainty**
Receptor 4	0.47	0.56
Receptor 7	0.84	0.97

This indicates the sensitivity of Acute HI estimates to the uncertainty in emission values, in the extremely unlikely event that the uncertainties were all of the same sign and additive. The target HI for the expansion of 1 would be met even in this highly improbable situation. An important point to also note is that the data assimilation reduced uncertainty and this step above is another layer of conservatism.

Chronic Hazard Index, although more significantly contributed to by specific metals and VOCs, was substantially (more than an order of magnitude) below the target level. So even if the Chronic HI was in error by 100 percent due to uncertainty in emissions levels[7], it would still remain very comfortably within the target range.

Incremental cancer risk (ICR) was more significantly contributed to by specific metals and VOCs, with the 'de-minimis' risk level of 1 x 10-6 confined well within Alcoa's property boundary. So even if the ICR was in error by 100 percent due to uncertainty in emissions levels1, it would mean that the present 0.5 x 10-6 contour could 'relate to' 1 x 10-6. In the event this unlikely scenario occurred, the ICR levels at neighbouring residences would still remain well below the de-minimis risk level.

A sensitivity analysis was undertaken for the effect of emission uncertainty on the calculated ICR value at Receptor 16, which the receptor was experiencing the highest ICR level in the HRA. The effect of the emissions uncertainties all being of the same sign and additive, would be to increase the

[7] It should be noted that in aggregating hazard quotients of a range of substances to estimate a hazard index, it is very unlikely that the individual substance uncertainties would be additive and of the same sign (+/-). A more probable outcome would be that positive uncertainties would tend to be cancelled by negative ones, or in other words under-estimation of some substances would tend to be cancelled by over-estimation of others.

ICR at Receptor 16 from 3.5 x 10-7 to 5.9 x 10-7, remaining comfortably below the target level of 1 x 10-6 .

3.4.2 Demonstrate why the principal metal components of the feed-stock are not a health risk to susceptible individuals, including vanadium, zirconium, thorium, rubidium, niobium and strontium, irrespective of their radionuclide status

Bauxite contains the above elements in the following approximate concentrations:

Vanadium:	280 ppm
Zirconium:	590 ppm
Rubidium:	20 ppm
Niobium:	30 ppm
Thorium:	190 ppm
Strontium:	2 ppm

These levels are well within the range of typical concentrations for soils and rocks of the Darling Range.

The Wagerup licence limit for ambient dust is 260 μg/m^3. Typical levels at the site boundary are well below this, usually in the 20 – 30 μg/m3 range. With the assumption the trace metal concentrations in airborne dust mirror those in the parent material, then airborne concentrations for individual metals can be calculated.

There are not relevant international ambient air goals for some of the metals mentioned above (rubidium, niobium, thorium, strontium). However, calculated levels of these materials in a typical airborne dust would have them at minute concentrations (less than 1 nanogram(ng)/ m3).

- Vanadium has a WHO ambient air goal of 1000 ng/ m3 (annual average), which puts expected concentrations more than 1000 times below this.
- Zirconium and its compounds have been assigned an Occupational Exposure Limit by the American Conference of Governmental Industrial Hygienists. The Threshold Limit Value is 5 mg/ m3 or 5000 μg/ m3 (8 hour time-weighted average). On the basis of the above calculations, this would put personal exposure at 0.018 μg/ m3. Again, this suggests exposures would be trivial and of no consequence from a health point of view.

- Radiological aspects of bauxite and its residue have been communicated extensively to stakeholder groups. It has been demonstrated that there are no health impacts to either the workforce or the community from the radionuclide content of these materials. Fact sheets are available if needed.

3.4.3 Demonstrate $PM_{2.5}$ is not a health risk with this project

Analysis of hourly average PM2.5 data collected by TEOM from March 2002 to March 2003 at Boundary Rd to the South of the refinery indicated that

- There is a seasonal pattern of higher PM2.5 concentrations during the spring and summer months.
- PM2.5 concentrations are not influenced by wind direction or wind speed.
- Dust concentrations when wind was from the refinery direction were below the NEPM PM2.5 advisory standard of 25 $\mu g/m^3$. (In winter the average 24 hour level was 6 $\mu g/m^3$ and in summer 9 $\mu g/m^3$).
- The PM2.5 concentration in the vicinity of the Wagerup Refinery was low and appeared to be independent of refinery activities.

From this monitoring it was considered that the PM2.5 risk from the refinery is not significant currently, and based on its noted independence of refinery activities, would remain so after expansion.

Refer to section 3.4.6 for additional information on size fractions of dust particles.

3.4.4 Table 1.0, AQ Appendix F should be expanded to include all chemicals detected or are reasonably certain to be present in Wagerup refinery emissions and indicate reasons for inclusion or rejection of each substance in the HRA. If a hazard index is used as a screen, indicate the toxicological criteria value, its reference and calculated value. If selection was based on "professional opinion" provide justification statements. Final selection should be benchmarked against comparable alumina refinery inventories.

In responding to this issue it is important to provide a summary of the development of emission inventories and their use in air dispersion modelling, with the modelling results used in quantitative HRA at Alcoa alumina refineries in Western Australia.

- Wagerup Alumina Refinery conducted a comprehensive air emissions inventory program in 2001/02; the first to be conducted in the international alumina industry;
- Kwinana Alumina Refinery conducted an emissions inventory on its liquor burner unit and some digestion units in 2002;
- In 2003 Alcoa Pinjarra Alumina Refinery used the Wagerup Refinery emission inventory as the starting point in developing its inventory, partly by extrapolation from Wagerup sources, supplemented by additional measurements to check on and corroborate the Wagerup extrapolations;
- Pinjarra Alumina Refinery then used the inventory it had developed based upon the Wagerup Inventory, to conduct a quantitative health risk assessment (QHRA) of air emissions. This 2003 undertaking was the first QHRA conducted for an alumina refinery worldwide;
- Kwinana Alumina Refinery conducted a QHRA of its liquor burner unit in support of an application for environmental approval of a new emission control project for the liquor burner in 2003/04; and
- In 2005 Wagerup Alumina Refinery undertook the present QHRA as part of the Wagerup Unit Three Expansion Proposal ERMP;

It can be seen that there has been a continuum in the development of air emissions inventories and their application to QHRA; from the original Wagerup Air Emissions Inventory commenced in 2001, to the present Wagerup Unit Three QHRA in 2005.

The substances selected for the Wagerup refinery HRA has been based on the following process:

- Substances positively identified in the Wagerup Air Emissions Inventory (presented in Appendix A) were considered for inclusion in the HRA;
- Substances tentatively identified in the Wagerup Air Emissions Inventory are not included as they are not conclusively identified or quantified (refer to section 3.1.1).
- The substance selection process for the Pinjarra Refinery QHRA was used as input into the substance selection for Wagerup HRA. The substance selection procedure detailed in that HRA (reported fully by Drew et al in Toxikos, 2003) thus implicitly included consideration of all Wagerup Emissions Inventory substances.
- The substances selected for inclusion accounted for 96 percent of the refinery total mass emissions to air
- The remaining four percent of substances not included, no single substance comprised one percent or more of total emissions to air. One exceptions to this rule was methane, which was not included as it is not considered a toxic substance;
- A number of substances which had emissions less than one percent were included based on they are recognized air toxics and to ensure the HRA was conservative.

Tables outlining the positively identified and tentatively identified substances, along with their mass emission rates (where relevant), proportion of refinery air emissions, and reasons for inclusion/exclusion from the Wagerup HRA are presented in Appendix D of this report.

The 27 substances chosen for inclusion in the Wagerup HRA were selected by a combination of these screening procedures, and is greater than the 22 substances included in detailed modelling for the Pinjarra Refinery QHRA.

3.4.5 The actual value used in each HI calculation needs to be shown, given the differences in the reference values shown in the ERMP and appendices. NEPM values which are presented but NOT used in the HRA need to be clearly identified to prevent confusion.

Tables have been prepared and presented in Appendix E that show the air guideline values, guideline reference, ground level concentration, Hazard Quotient and Indices or Incremental Carcinogenic Risk for each receptor. Tables are presented for both the existing data and assimilated data.

The DoE also raised a number of queries with certain tables in the ERMP. Alcoa has met with DOE to obtain a more detailed list of the specific aspects considered in this issue, and is currently revising the affected report tables to rectify the information concerned. Tables 21 – 24 and 26 of the ERMP

have been revised and updated to correct these matters. The corresponding tables found in the Air Quality Summary Report have also been amended as they contained the same information as those tables corrected in the ERMP. The revised tables are presented in section 3.1.14.

The changes to the tables do not impact on the findings of the HRA. The guideline value shown for the averaging period was incorrect in some cases on these tables. The corrected tables have resulted in the refinery contributing even less to the ambient environment in the vicinity of Hamel and Yarloop.

3.4.6 Justification for the expected size fraction of TSP and expected compositions of those fractions

It is assumed this recommendation refers to the different size fractions included in airborne dust (total suspended particulate), their levels and variability, and their individual chemical composition. The response below addresses the recommendation from two perspectives, (i) an examination of the existing historical dataset on all particulate size intervals and (ii) discussion of the present and ongoing monitoring programs aimed at addressing the recommendations made in the CSIRO Air Quality Review and incorporated into the Wagerup Refinery environmental licence.

Ambient particulate monitoring has been conducted in the vicinity of the refinery and residue area as part of long-term monitoring (continuous) programs and short-term emission investigations. Total Suspended Particulates (TSP), PM_{10}, $PM_{2.5}$ and ultra fine (<0.1 μm) particulate data have been collected under various meteorological conditions. Monitoring programs have utilised both high volume samplers which generally have produced 24-hour average concentration data and TEOM (Tapered Electronic Oscillating Microbalance) monitors which produce short-term concentration data (typically 6 minute and 1-hour averages). The results from these programs are summarised below

Ultra-Fine Particulate Investigation

Analysis of ultra fine particle data using a Scanning Mobility Particle Sizer, Aerodynamic Particle Sizer and Highvolume samplers over a two week period at Boundary Rd to the South of the Refinery between August 18 and 2 September 2002 indicated that:

- Fine particles (<0.1μm) are not influenced by wind direction and appeared to be independent of refinery or residue activities.
- Sub micrometre particle number concentrations were on average lower when wind came from the plant quadrant than from other sectors.

- The highest individual particle number concentration event occurred in the plant sector.
- The average sub-micrometre particle number concentration in Yarloop was comparable to a relatively pristine area and the maximum individual event was comparable to concentrations found in urban locations.

PM2.5 Investigation

Analysis of hourly average PM2.5 data collected by TEOM from March 2002 to March 2003 at Boundary Rd to the South of the refinery indicated that

- There is a seasonal pattern of higher PM2.5 concentrations during the spring and summer months.
- PM2.5 concentrations are not influenced by wind direction or wind speed.
- Dust concentrations when wind was from the refinery direction were below the NEPM PM2.5 advisory standard of 25 $\mu g/m^3$.
- The PM2.5 concentration in the vicinity of the Wagerup Refinery was low and appeared to be independent of refinery or residue activities.

PM10 Investigation

Analysis of PM10 data collected by TEOM from March 2002 to January 2004 at Boundary Rd to the south of the refinery and data collected by High-volume sampler from January 2004 to December 2004 to the North and South of the residue area indicated that:

- There is a seasonal pattern of higher PM10 concentrations during the spring and summer months.
- PM10 fraction accounts for a higher proportion of TSP in the winter months.
- Dust concentrations when wind was from the refinery or residue direction were below the NEPM PM10 standard or within guideline criteria.
- There is a slight influence on PM10 concentrations when wind is from the refinery or residue direction (although concentrations are not significantly elevated when compared to concentrations recorded under other wind conditions)
- At the two southern locations dust concentrations when wind was from the refinery or residue direction were generally below the NEPM PM10 standard or within guideline

criteria. At the northern site which is located closer to the residue area, the NEPM PM10 guideline of five days above 50 μg/m^3 was not met. However, the source of a number of the dust events at this location was earthworks on a non-Alcoa owned site located to the East of the monitoring station.

TSP Composition

Data on chemical composition of TSP are available for some summer samples collected in the vicinity of the Wagerup residue area. Analysis of 10 High-volume sampler filter papers from the residue area ambient monitoring program has been conducted since December 2002. The filter papers have been analysed for aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, gallium, lead, lithium, mercury, molybdenum, nickel, selenium, thallium, vanadium and zinc. Filter papers are analysed using either Inductively Coupled Plasma Mass Spectroscopy (ICPMS) or Inductively Coupled Plasma Atomic Emissions Spectroscopy (ICPAES), Vapour Generation Atomic Absorption Spectroscopy (CVAAS) analytical methods. With the exception of aluminium and one Boron result, all compounds are either not detected or are detected at concentration below 0.1 μg/m^3. Aluminium (as alumina) is consistently detected at concentrations above 0.1 μg/m^3 and not at a level that would be expected to cause any health impacts.

Future Particulate Studies

Alcoa is working with CSIRO to respond to recommendations from the Air Quality Review conducted in 2003. A technical advisory panel has been convened to provide specific advice on the approach to the technical investigations recommended by CSIRO in their 2003 Wagerup Air Quality Review. To close-out recommendation 5 of this review, further studies of aerosols, including fine particle concentrations, dust deposition and rainfall, and the chemical composition of these components will be undertaken. This monitoring program is currently in design phase. Program implementation will occur once feedback on the program design is provided by the TAP.

The detailed dust investigation to be undertaken at Alcoa's Pinjarra operations will build on this body of knowledge. This program will measure TSP, PM_{10} and $PM_{2.5}$ concentrations in the vicinity of the refinery. Filter papers will be analysed to determine the chemical composition of each fraction under conditions when the sample is predominantly sourced from the residue area. In addition, deposition gauges will also be deployed to provide information on dust fallout rate and chemical composition.

3.4.7 Clarify total mercury emissions under the current and proposed scenarios, its sources and control measures

An updated Wagerup mercury balance is currently being finalised and will be communicated to Government and community stakeholders shortly. This will describe mercury sources and their break-up. A summary balance is indicated in the table below.

Table 12: Summary Mercury Balance - 2001, 2004 and Proposed Expansion

	2000	**2001**	**2004**	**WG3 with controls**
Production mtpy	2.3	2.3	2.4	4.6
Production tpd	6320	6400	6650	12600
Bauxite Hg ppb		50	62	50
Residue Hg ppb		48	29	48
Air Emissions kg/y		216 (291)	234 (312)	260
Calcination (ppb in hydrate)		9 (5ppb)	19 (10ppb)	19 (5ppb)
42 B + C non cons		84	87	50
Oxalate kiln stack		(75)	(78)	74
Digestion non cons		45	47	50
25A Tank vents		9	9	17
Process water		54	56	20
Others		15	16	30

Note – oxalate stack and total figures in brackets assume notional emission from oxalate stack, which was not operated between 2001 and the present.

The ERMP modelled baseline was derived for 2003 production based on factoring production from 2001, equivalent to a refinery air emissions total of 218 kg/y, which was estimated prior to completion of the above balances. The calendar 2004 figure above is somewhat higher than 2003/04, due to an increase in input bauxite mercury levels in recent times and updating of the mercury balance. The ERMP modelled expansion figure assumed successful implementation of new mercury reduction technology being trialed at Alcoa Point Comfort Refinery (USA).

In the above table, a lesser reduction is shown than predicted in the ERMP on the basis of conventional (proven) mercury removal technology including, indirect cooling and chilling of digestion and evaporation building vapour flows, and sulphide addition to oxalate flows. It is shown to illustrate the minimum reduction (and hence maximum mercury emission) that could be achieved. However Alcoa is continuing with the developmental work in the Point Comfort trials, and will endeavor to achieve a higher level of mercury reduction at Wagerup than the minimum shown above.

To examine the affect of a smaller than modelled mercury emission reduction for the expanded refinery, a sensitivity analysis of the mercury emission values was undertaken. Taking the figure of 260 kg/y for Wagerup Unit Three with conventional controls as shown in the table above, the contribution of mercury to Acute hazard quotient at two receptors, 4 and 16 (representing Yarloop and the maximum exposed location for mercury respectively), the sensitivity analysis showed the following:

Mercury Sensitivity Comparison

			Receptor 4	Receptor 16
HQ Now Proposed			1.11E-02	2.52E-02
HQ ERMP			4.40E-03	1.00E-02
Difference			6.71E-03	1.52E-02
Acute HI ERMP			0.47	0.91
Acute HI revised			0.48	0.92

Mercury Emission Rate ERMP	103	kg/y
Mercury Emission Rate Proposed	260	kg/y
Ratio Proposed Now/ERMP	2.52	

Note: Hazard Quotient for mercury determined by air guideline value/ground level concentration.

It can be seen from this sensitivity analysis that the effect of the potential smaller mercury emissions reduction is to increase the Acute Hazard Index (HI) at each receptor by approx. 0.01. This is regarded as insignificant within the context of the Acute HI remaining within the target level of 1.

3.4.8 Give assurance that the growth of the RDA will not increase the risk to human health given the dynamic nature of the RDA

The introduction of a third production unit at the Wagerup refinery would require an increase in the active drying area from approximately 180ha to around 270ha. The increase is required to dry the additional residue associated with increased production. The maximum additional drying area associated with the expansion is around 100ha required in winter, when the residue takes longer to dry and a greater surface area is required. Therefore the actual active drying area will vary between and additional 80 to 100ha based on seasonal variations in residue drying times.

The fugitive emissions from the existing and the expanded residue area (as shown in the LTRMS) have been predicted using a Gaussian puff model (CALPUFF) and the results are contained in the report titled "Air Dispersion Modelling of Fugitive Emissions Wagerup Refinery" prepared by Air Assessments, 2005. The modelling of the RDA has taken into account the changing conditions of the residue area. The model predicted particulate emissions were compared against monitored emissions

(minus background concentrations) and were found to be well quantified (refer to section 7.1 pg 95 to 98 of the Air Assessment report found in Appendix D of Appendix G of the ERMP) giving confidence in the accuracy of model predictions.

The results of the fugitive emission modelling were combined with the predicted refinery emissions to assess the potential risk to human health in the HRA. The HRA concluded that for the expansion of the Wagerup refinery:

- 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 the USEPA *de minimis* threshold of one in a million (i.e. 1 x 10^{-6}) at all residential receptors.

The HRA findings indicate that the particulate emissions from the expanded residue area are within the health guidelines (PM_{10} Air NEPM) and therefore the risk to human health is low.

To manage the existing and expanded residue drying area, Alcoa proposes an upgrade of the sprinkler system, and will continue to implement existing operational practices including:

- Use of computer controlled sprinkler systems, which are activated in response to wind alarms and visual monitoring by area operators, at the residue and bauxite stockpile areas;
- Use of predictive weather forecasts to determine dust management strategies;
- Operation of Amphi-roller and bulldozers to turn over the dried surface layer and expose wet residue;
- Mulching or revegetation of open areas where dust could be generated; and
- Use of water carts and dust suppressants on unsealed roads

Wagerup operates an existing ambient dust monitoring program with High Volume Samplers (24 hour averaged dust concentrations) and TEOM monitors (averaged 6 minute dust concentrations) which are located around the residue area. The monitors are used to monitor dust levels from the residue area

and are present at the following locations; Residue North West (RNW), Residue West (RW), Residue North (RN) and Residue East (RE) as shown on Figure 22 of the ERMP. The monitors are used to improve management of particulate emissions and to ensure the operations comply with licence conditions.

Subsequent to the initial increase in drying area required, incremental increases to the footprint of the residue area are required to compensate for the loss of active drying area to internal dyke lifts as the drying areas are filled and raised. However it is important to note that although the footprint of the residue area will grow, the open area will remain fairly constant.

3.4.9 Compare substances modelled with those in the Worsley ERMP

The Worsley alumina refinery and Alcoa's Wagerup refinery both use the Bayer process to refine alumina from bauxite and therefore can be compared in general terms, but the refineries do have some significant differences. For example, at Worsley the bauxite mined has different organic content and trace metals and coal is used to fire the boilers. While at Wagerup refinery, natural gas is used to generate power and steam.

The Worsley's HRA included 64 substances while 27 were assessed in the Wagerup HRA. The main difference is that the Worsley HRA included 33 compounds which do not have an air guideline value but were above the concentration of no toxicological concern (CoNTC). The CoNTC is an internal system developed by Toxikos Pty Ltd to screen minor components of emissions that do not have an air guideline value, it is not required as part of a formal HRA.

Substance selection for HRA

Worsley	Wagerup
64 substances	27 substances
Substances selected if: ▪ contributed more than 41000kg/annum; ▪ was a criteria substance; ▪ dioxins like substances; ▪ metal compounds; ▪ or a substance was above the concentration of no toxicological concern (CoNTC)	Substances selected if: ▪ constituted greater than 1% (by mass) individually to refinery emissions; ▪ was a criteria substance; ▪ were detected and had known health effects (such as mercury, PAHs, xylene, styrene) ▪ this process covered 96% (by mass) of known refinery emissions
Substances 1) 21 Metals included 2) 5 Criteria pollutants - SO_2, NO_2, CO, particulates, Pb 3) 1 dioxins/furans/PCBs 4) Benzo(a)pyrene equivalent 5) Acetaldehyde and formaldehyde 6) 2 inorganic compounds; Br & P 7) 32 Acute and 1 Chronic GLC above CoNTC - such as volatiles, amines, sulphur containing substances	Substances 1) 7 metals (17 sampled 7 detected) 2) 4* Criteria pollutants - SO_2, NO_2, CO, particulates. 3) No dioxins/furans detected 4) B(a)P equivalent included 5) Acetaldehyde and formaldehyde 6) Bromine and phosphorus detected but <1% of emissions 7) 12 other substances included based on Wagerup substance selection process

* Lead was not detected in the emissions inventory program or follow up testing and therefore not included.

The Worsley HRA does not include gaseous emissions from diffuse sources such as residue areas while the Wagerup HRA includes gaseous emissions from both the refinery and residue drying areas.

The main contributors to the Worsley HRA are NO2, SO2 and particulate matter, which have known health impacts and air guideline values. The main contributor's to the Wagerup HRA are very similar being, particulate matter and oxides of nitrogen (NO2). SO2 is not a significant contributor in the Wagerup HRA because the Wagerup refinery does not use coal in the generation of steam or power.

3.4.10 The existing refinery emissions has adverse health impacts and are making people sick

Alcoa acknowledges that some local residents continue to report health impacts which they believe are related to refinery emissions. However, despite intensive scientific investigations over several years, a refinery-emitted cause for these complaints has not been established.

Alcoa recognises that past emissions, particularly during commissioning of the liquor burner led to a situation where the refinery intruded unacceptably into the lives of people living near the refinery. This caused increased complaints for noise, odour and health, with complaints increasing from seven to 127 in 1996. This situation was greatly exacerbated when Alcoa began implementing a land purchase policy which many in the local community saw as potentially impacting on property values and dividing the Yarloop township. On implementation of the land purchase policy, complaints rose from 173 in 2000 to over 1,500 in 2001.

While the number of environmental complaints has declined significantly from previous years Alcoa recognises that the issue still requires careful management. The offer to purchase properties in Area A at 135 percent of unaffected market value and to purchase properties within Area B at 100 percent of market value for the life of the refinery, reflects Alcoa's desire for people to have confidence to stay in the area, or for those people who believe they are significantly impacted, a practical opportunity to leave.

The Health Risk Assessment (HRA) undertaken for the Wagerup Unit Three proposal shows that neither Acute nor Chronic health impacts should be experienced by local residents because of refinery emissions. However, it is acknowledged that detectable odour will occasionally be experienced at nearby residences and townships, which in itself may lead to both odour and health complaints.

In a study of health impact reporting in an area surrounding a petroleum refinery in Canada, Luginaah et al (2002) examined the change in odour and health complaints reporting following a significant odour reduction program. They found the balance of evidence from their analysis supported a relationship between odour perception and ill-health reporting; "that residents perceiving odours are sensitised to possible health effects and are more likely to report ill-health and attribute it to refinery emissions."

There is no clear toxicological or exposure evidence to link current refinery emissions to the reported health complaints. However, Alcoa recognizes that for some people refinery emissions are believed to impact on their health and that while this situation persists it remains an important issue for both the

local community and Alcoa. There is evidence to suggest the presence of odorous refinery emissions and Alcoa's position on land purchase give rise to both odour and health complaints.

Alcoa believes the work in improving community confidence, ongoing management of refinery emissions and providing an equitable opportunity for people to stay with confidence or for those closest to the refinery to relocate (should they wish to) have led to a situation of significantly decreasing environmental complaints.

Nevertheless, concern from past activities and the occasional detection of odour continues to result in complaints. In this regard the emission reduction works associated with the Unit Three proposal and stability in land management are important parts of addressing community concerns.

3.4.11 The ERMP does not address current health and amenity impacts.

The occurrence of complaints of odour and health effects from community members have declined substantially in the last few years. Complaints appear to have become much more frequent at the time of land management policy changes, after effective emission control implementation, reflecting some of the complex non-toxicological determinants of these complaints.

The symptoms recorded by the community nurse were generally non-specific and occur commonly in any community. The report did not indicate a cause for the symptoms or relate them to the refinery emissions.

3.4.12 The ERMP has not identified a causative agent for complaints

To date no causal agent has been found at levels that could explain the reports of health impacts from refinery emissions. In considering this issue the Medical Practitioners Forum concluded that while emission reductions should be pursued, there was little value in continuing to try to identify a compound in emissions that might be the causal agent. Many environmental factors potentially contribute to the health and wellbeing of nearby residents and a focus on trying to find a specific chemical, or combination of chemicals, that could be responsible is unlikely to assist in recovery or expedite improved health for persons suffering from ill-health.

3.4.13 The HRA is based on a dose-response relationship and is not predictive or correlates to illness.

The general methodology of the HRA is that which has been adopted in recent years by authoritative environmental agencies including the US EPA and enHealth.

The HRA is necessarily based on the principles of exposure-response relationships as these are central to the science of toxicology and environmental health policy.

Conditions which do not have any demonstrated exposure-response relationship are generally regarded as lacking sufficient evidence to satisfy the criteria for causation. In other words, they are generally not regarded as conditions having an established occupational or environmental cause.

"Failure of environmental monitoring to correlate with health problems" does not necessarily imply inadequacy of environmental markers. It is quite plausible that health problems occur independently of the refinery. Correlations between probable markers of the refinery plume and both odour and health complaints have been reported in the ERMP. However the plume components were present at such small concentrations that they could not plausibly be irritant. The most likely explanation is that on these occasions odour was detected and indeed odour complaints substantially outnumbered health complaints.

The HRA has assumed additive effects for the compounds selected, despite their diverse characteristics. This is a conservative approach to the issue of compound interaction. An added conservatism in the Acute Hazard Index assessment is that essentially worst-case exposures were assumed and assumed to occur simultaneously for each compound.

The mass emission rates of compounds not included in the HRA are so small that the resultant hazard quotients are very small where health guidelines are available. It is not plausible that such low exposures could cause illness. It is also not plausible that compounds lacking a health guideline would present significant health risks - given that they are present in such small mass emissions (and therefore GLCs) and that they would need to be extremely toxic, a highly unlikely situation given that they have not already been the subject of regulatory attention.

Environmental health agencies acknowledge the existence of susceptible sub-groups within populations including the very young, the elderly, those with pre-existing disease, and those with greater sensitivities. This is recognised by applying safety factors of typically 10 - 1000 to NOAELs or LOAELs when setting the types of health guidelines that have been used in the HRA. In other words the health guidelines, which have been clearly satisfied by the HRA already incorporate large safety factors designed to protect susceptible sub-groups.

3.4.14 An increase in refinery production will result in increased health impacts (short-term emissions).

Short-term GLC modelling (3 – 10 minute averaging periods) has shown that for the base case and expansion scenarios the concentrations of nitrogen dioxide, carbon monoxide, sulphur dioxide, particulates, benzene, formaldehyde, toluene and xylene will all remain substantially below the NEPM values for longer averaging periods. Most of them will actually decrease with expansion, including all of the VOCs listed above. This means that the potential for Acute health effects due to short-term peak exposures is likely to remain very small. The Emphron report found that the 6 minute average concentrations of nitrogen dioxide and alkali particulate at Boundary Rd recorded over 2 years were not high enough to be plausibly irritant. The short-term GLC modelling also shows that nitrogen dioxide and particulate concentrations will not increase with expansion.

3.4.15 A full health impact assessment for residue dust and radiation.

The dust emissions from the residue drying area have been included in the HRA (HRA) completed for the proposed refinery expansion and is presented in Appendix F of the ERMP. The HRA showed that the proposed expansion is well with the guidelines for the protection of health.

Information on radiation associated with the refinery and residue area are contained in the baseline radiation monitoring report that is presented in Appendix O of the ERMP.

3.4.16 Only 27 compounds have been included in the HRA

Alcoa has undertaken an extensive monitoring program of the Wagerup refinery emissions including resulting in the development of the Wagerup Emissions Inventory that sampled 15 emissions sources for up to 17 classes of compounds. This Inventory has been independently reviewed by AWN and CSIRO. More detail on the substance selection process is in Section 3.1.1.

3.4.17 Mine workers should not have been included in the health survey (HealthWise)

The 2004 Healthwise report did in fact make it quite clear that the Western Australian sub-group of the Healthwise cohort includes current and former employees from the three mine sites Jarrahdale (now closed), Huntly and Willowdale, as well as the three refineries and the Bunbury shipping terminal. This enables the study to examine occupational factors at all of these locations.

3.4.18 Alcoa does not recognise the correlation between refinery pollution and complaints as found in AWN/CSIRO study 2003

Alcoa recognises that there is a correlation between complaints and wind direction from the refinery/RDAs, and that there is an indication of a weaker correlation with NOx from the refinery direction. The same analysis that found this (Emphron, 2005) concluded that there was also correlation of complaints with NOx and PM2.5 levels associated with wind from the direction of the Yarloop township. There was no correlation found between complaints and fine particle (<PM2.5) levels from the direction of the refinery and the RDA in the QUT fine particle study (QUT, 2003).

3.4.19 The refinery poses a radiation risk and the increased rates of thyroid cancer in Healthwise study (2004) is not unexpected

Extensive monitoring programs in the WA refineries over many years have demonstrated that occupational exposures to radiation are below the public limit of 1mSv/year, and substantially below the occupational limit of 20mSv/year.

The statistically significant excess of thyroid cancer reported in the Healthwise report of 2004 was restricted to the WA office workers (four observed versus one expected). No significant excess was observed in the WA production or maintenance workers. This is clearly inconsistent with any occupational cause (including radiation) within the process areas. The researchers' comment on this unexpected finding was: "While this finding will need to be monitored in future searches, it may be an artefact of the large number of analyses performed in this study."

3.4.20 EPA to be provided a full copy of the Community Health Nurse report 2002/03

Alcoa understands that the Community Health Nurse report was provided to the EPA and made public via the tripartite consultation group. A summary of the report was presented in the ERMP.

3.4.21 The health survey results should be available for inclusion in ERMP or prior to the expansion.

Prior to commissioning, if Wagerup Unit Three is approved, the results of a health survey will be available. The health survey will enable a baseline to be established and allow comparison with Western Australian data previously obtained by the Department of Health.

The proposed methodology for the health status survey was detailed in section 8.3.13 (page 298) of the ERMP.

3.4.22 Ensure a mechanism is in place for adequate follow-up surveys of participants and any trends acted upon.

If the baseline survey, undertaken prior to commissioning, indicated the need for a follow up survey this would be conducted after full implementation of the proposal. The detailed methodology and follow up procedures for the proposed health status survey would be determined in consultation with the body undertaking the health survey.

3.4.23 An independent body should undertake the health survey

Alcoa also considers it important that the survey is undertaken by an independent body and that the survey should be coordinated by the Department of Health, with data collection and analysis undertaken by an organization with specialised skills in conducting surveys.

3.4.24 The health survey should include people who lived in area and have now moved.

It is not considered appropriate to include people who have moved from the area in the proposed health status survey. To effectively assess the health status of the community prior to commissioning or subsequently, the respondent's must reside in the area. The inclusion of people from distance areas will make it difficult to determine the health status prior and post commissioning.

3.4.25 Health survey should not include people from outside local area as this will influence the results.

The survey should include people from nearby communities as this would allow for some comparison. However there is no value in including more distant communities as data already obtained by the Department of Health from other locations in the State can be utilized for comparison purposes.

3.4.26 Chemical illness in workers or community members adjacent to Wagerup since 1996 is not addressed in the ERMP.

The occurrence of complaints of odour and upper-respiratory tract symptoms in Wagerup employees has declined substantially since the implementation of emission controls on the liquor burner.

The HRA and related components of the ERMP seek to assess the potential for both the existing and the proposed expansion to cause health impacts.

Refer to section 8.3 and Appendix F of the ERMP for additional information on the HRA undertaken for the proposed Wagerup expansion.

3.4.27 Alcoa Medical Services is unresponsiveness in meeting the health needs of employees and other affected by chemical illness.

Alcoa's medical services are currently of the highest quality, employing specialist occupational health physicians, occupational health nurses, physiotherapists, and rehabilitation co-ordinators. Global Alcoa standards for health surveillance are employed and these exceed regulatory requirements. There is a well established Employee Assistance Program (EAP) which provides access to a range of services including those of clinical psychologists. The occupational hygiene programs are comprehensive and are run by highly qualified occupational hygienists.

3.5 WAGERUP LAND MANAGEMENT

3.5.1 An adequate buffer zone should be established around the refinery

Several submissions, including those from some government agencies, Shire of Harvey, some members of the Medical Practitioners Forum (MPF), community groups and some individuals emphasised that an appropriate "buffer" distance should be provided to separate residences from refinery emission sources. In some submissions this importance was seen to be increased because of the absence of an identified causal agent to explain reported health impacts.

For example, members of the MPF submitted: "We do not support the proposal to expand in the existing circumstance of an inadequate buffer." In the general observations component of the Department of Environment (DoE) submission, it was suggested: "A formal buffer at Wagerup may need to be established with similar separation distances that exist in Pinjarra."

The Department of Health (DoH) submission considered the issue of a land-use buffer and provided more specific comment, including the following:

- "That the cases (health effects) have occurred despite the absence of any breach of emissions guidelines has been attributed to a combination of an inadequate buffer zone between the refinery and resident population…compared to other WA refineries, local meteorological conditions and short-term plume strikes";
- "It would be inappropriate to declare a large no residents zone of influence around the refinery. While some people have been severely impacted, the overwhelming majority of residents are not affected and over-stating the problem will have significant impacts on the sustainability of the local region and have further social effects";
- The DoH is supportive of the project if appropriate safe-guards are introduced including: "the establishment of an adequate buffer zone around the refinery" and "that a set of principles are adopted to enable individuals who experience health concerns within the buffer to have adequate compensation to enable them to relocate from the area".

The DoH provided further detail on the last point as follows:

i. "The current zone A and zone B immediately around the refinery are based on noise levels. These zones should be disregarded in terms of determining the new buffer zone";

ii. "When the site is compared with other similar refineries in WA and other tertiary industrial areas the current 'buffer zone' is seriously inadequate. For example the buffer zone around the Worsley alumina refinery is approximately 10km. The buffer zone around the Pinjarra alumina refinery is approximately 5km";

iii. "The DoH recognises that the installation of a buffer zone has the potential to impact on the sustainability of the community and services to the immediate locality of Yarloop, Hamel and Waroona";

iv. "The DoH stresses that the justification for the buffer zone in this instance is to allow the very small proportion of individuals who may be impacted to be sensitively managed. It is not proposing that all residents be removed from the zone as this would be unnecessary";

v. "The DoH has not prescribed a buffer zone but recommends that a minimum zone of 5km should be adopted."

The DoH also proposes a principle in relation to the buffer issue.

"If refinery emissions adversely impact on the health or amenity of any resident there should be genuine choices, freely and equitably available, for them and their families to either leave the area or stay, without economic loss, hardship or unreasonable time constraint. Residents with demonstrated adverse health impacts associated with emissions should be encouraged to relocate."

Alcoa agrees that the provision of an appropriate land-use planning area around heavy industry, including refineries, is an important mechanism for both environmental management and community confidence.

The draft State Industrial Buffer Statement of Planning Policy 4.1 states that if industrial emissions cannot be contained on-site, then there is a need for a buffer to separate industrial areas from sensitive land-uses. Sensitive land-uses include: residential developments, hotels, motels, caravan parks, hospitals, nursing homes, schools, shopping centres and some public buildings.

The buffer policy indicates buffer distances should be determined based on technical evaluations: "a technical analysis, which will determine the nature and level of emissions from the industry and the site context, should ideally be undertaken to evaluate proposals and determine appropriate buffer areas" (WAPC 2004). The policy also states that such a buffer is not necessarily a "no resident" zone but an area in which specific planning controls might be applied.

The Pinjarra to Brunswick Sustainability study also found that "clearly defining a development control area around the Wagerup refinery" was important "taking into account environmental and health standards, amenity issues and planning policy". This was presented in the study as being consistent with the state buffer policy described above.

The DoH submits that the proposed buffer area should not be based solely on noise emissions and therefore, not the existing Areas A and B, already identified in the vicinity of the refinery.

The Area A boundary was determined based on noise contours and the potential for dust impacts from residue drying areas. The Area B boundary was put in place following community feedback that property values may be adversely impacted because of the establishment of Area A. It provided a mechanism for those who wished to sell their property to do so. The term of the Area B land management policy arrangement has now been extended to apply to properties for the life of the refinery, which was agreed following a series of meetings in 2005.

Alcoa agrees with the DoH point that a land planning control area should not just be based on noise contours. Alcoa believes the scientific investigations undertaken for the ERMP now allow for consideration of a relevant planning control area to also consider ambient air quality; odour; ground level concentrations of air emissions (chemical compounds and dust); and a quantitative health risk assessment (HRA). Consistent with the land-use planning policy, the combination of these environmental factors should be used to determine the extent of any land planning control area.

The results of these investigations show that from all scientific results, for the current refinery and expanded refinery, Area A would represent an appropriate land planning control area. The 35dB(A) noise contour, under worst-case propagation conditions (in any direction) extends to the northern and southern limits of the Area A zone. This was expected as noise was a key factor in identifying the Area A boundary (Figure 7). Examination of key predicted odour contours (99.9 percent, 4 ODU and 99.5 percent, 2 ODU) shows that they are predicted to occur is effectively contained within the Area A boundary (see Figure 8 and 9). However, it is acknowledged that odours will still be noticeable from time to time to some people outside Area A. The HRA results indicate the risk within Area A for short-term, Chronic and cancer risk is low to very low. (e.g. Figure 10).

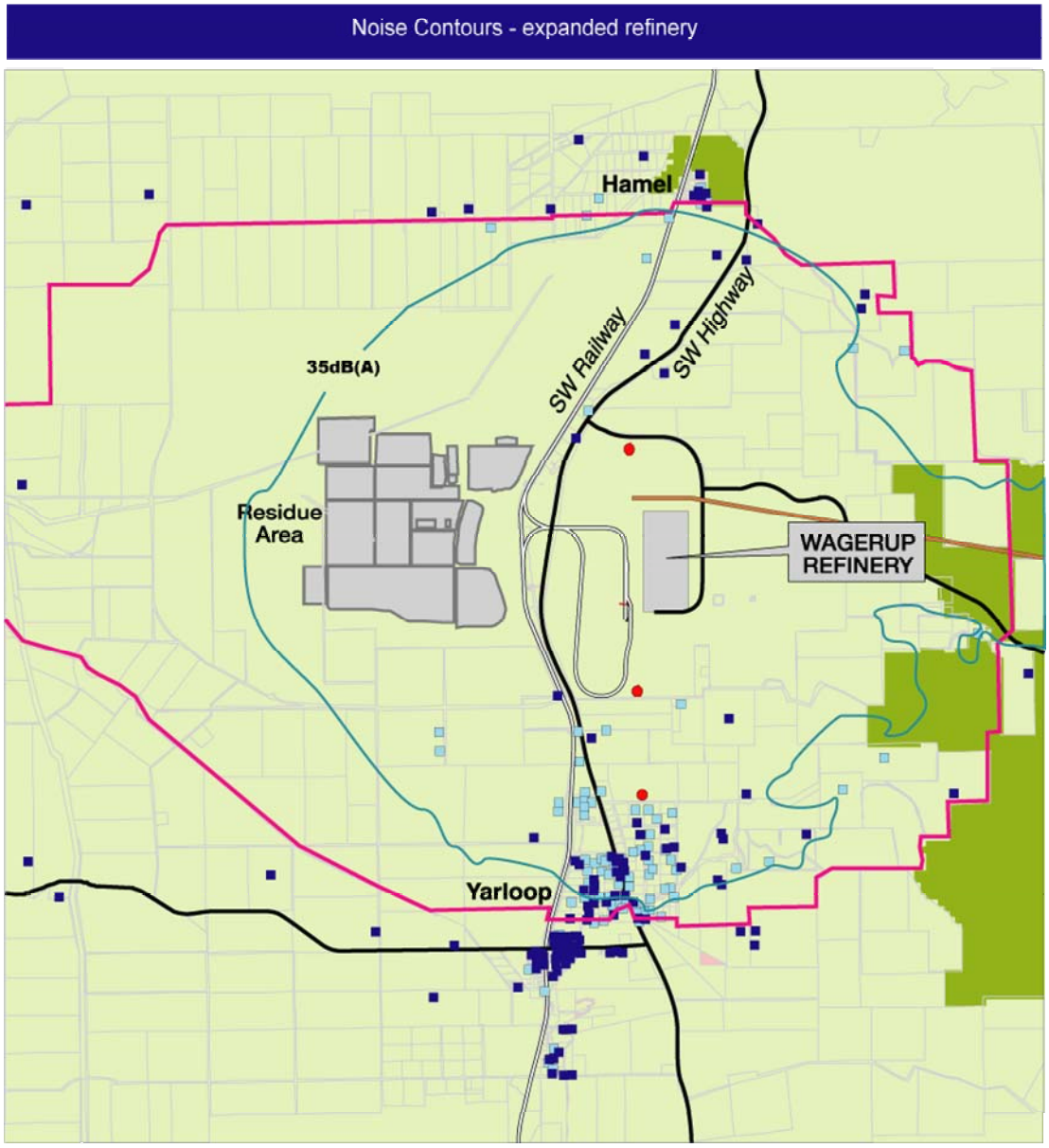


Figure 7: Modelled extent of 35dB(A) noise contour under worst-case propagation conditions (simultaneously in all directions) relative to the Area A boundary. Expanded refinery case (current refinery also shows contour is within the Area boundary)

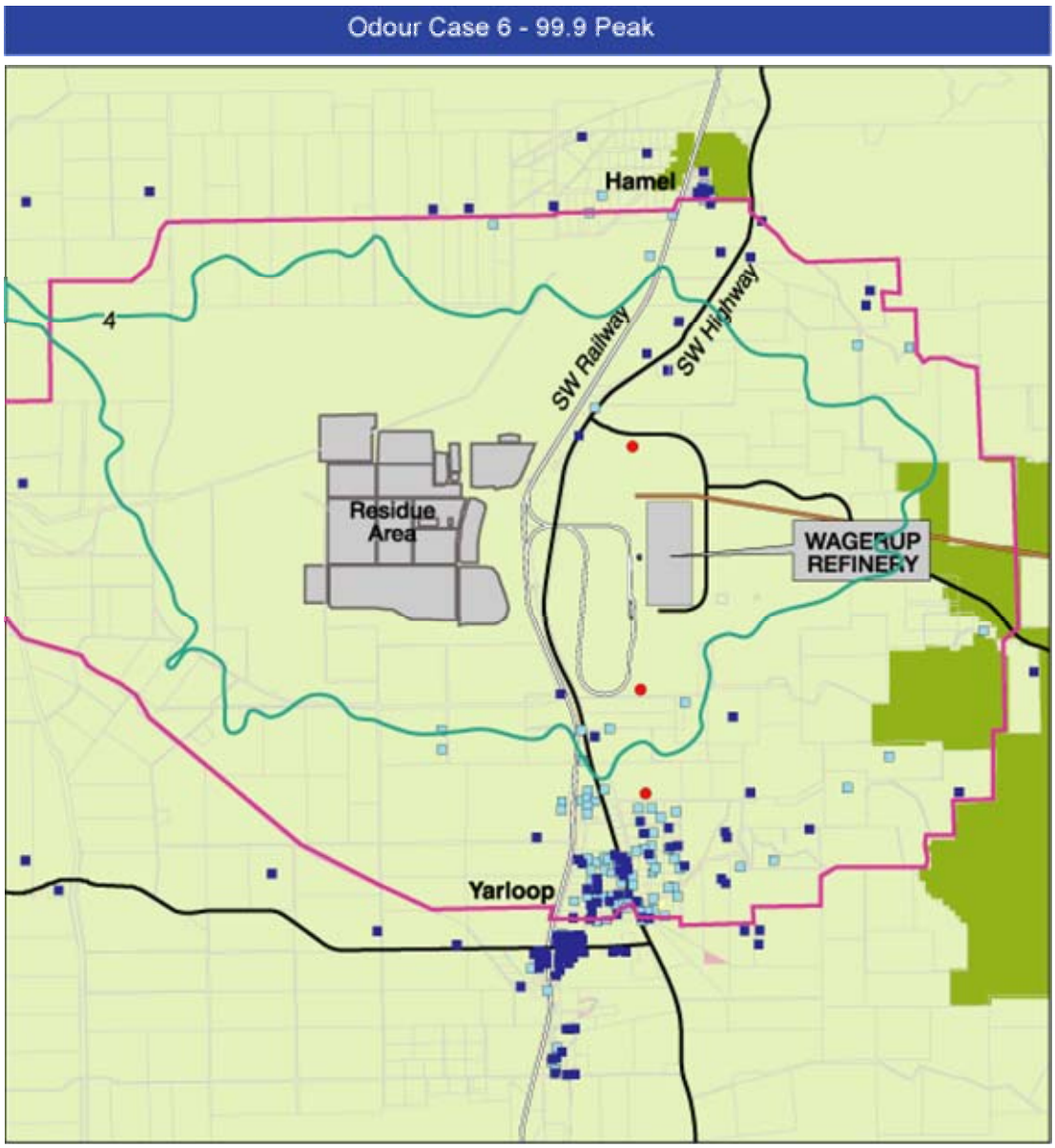


Figure 8. Modelled extent peak 99.9% 4 odour unit contour relative to the Area A boundary. Expanded refinery case

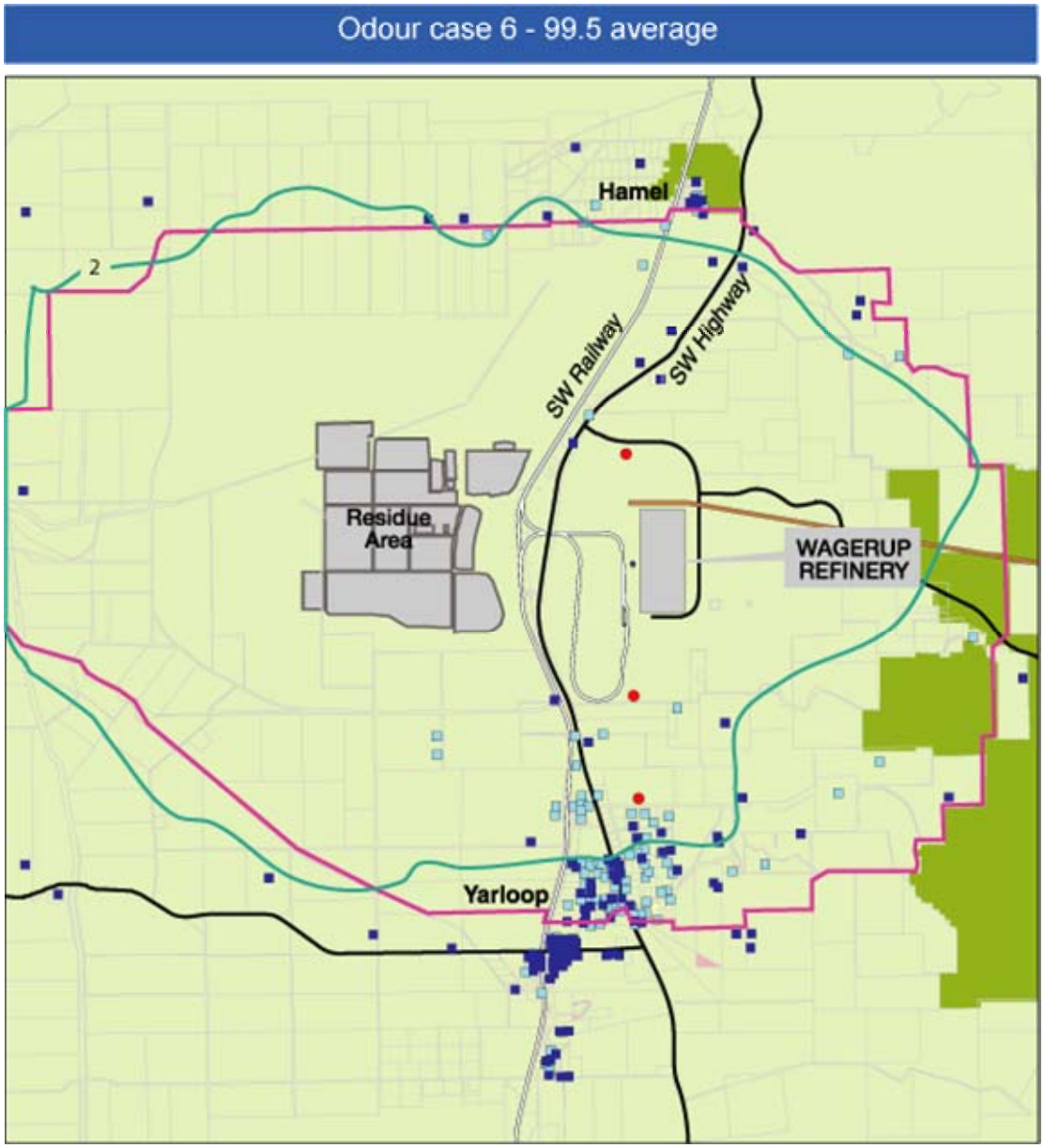


Figure 9: Modelled extent of average 99.5% 2 odour unit contour relative to the Area A boundary. Expanded refinery case

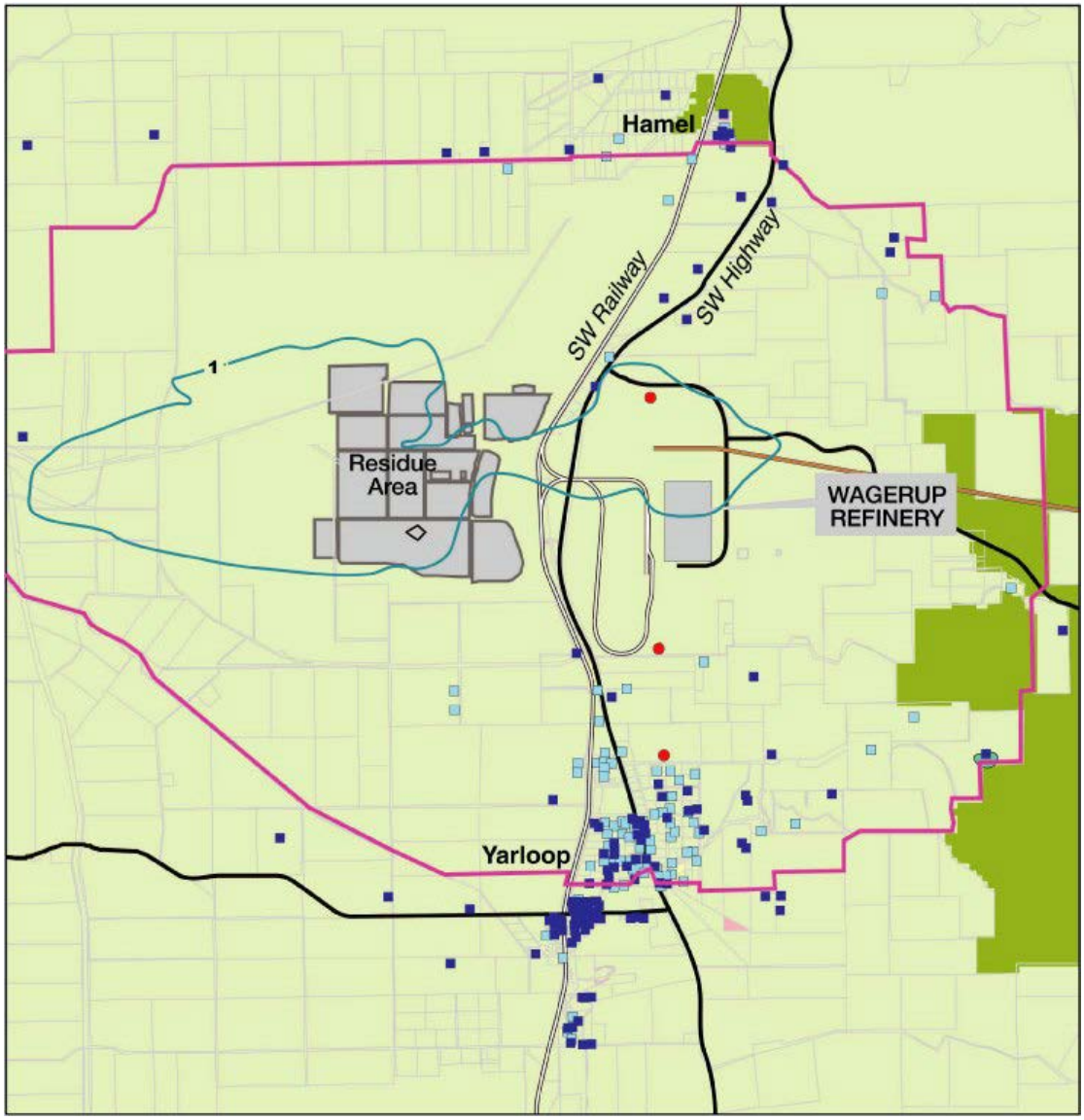


Figure 10: Modelled extent of 1.0 Acute hazard index contour relative to the Area A boundary. Expanded refinery case

3.5.1.1 Comparison with Pinjarra Refinery land management area

Several submissions suggest that a Wagerup refinery buffer of similar size to the Pinjarra refinery land holding is required, on the basis that few health complaints are received for the Pinjarra operations, however, other important differences exist between the Pinjarra and Wagerup refinery. The Pinjarra refinery operations have not included a liquor burner or a property purchase strategy. Both of these elements have been triggers for increased complaints at Wagerup.

It is correct that the Wagerup refinery has less separation distance to the nearest residence(approximately one kilometre compared with 2.75 kilometres for the Pinjarra refinery), however, if Area A was adopted as a land planning control area the separation distances for the two refineries are similar. The Area A boundary provides a separation distance to the nearest residence of 3.5 kilometres compared with the Pinjarra case of 2.75km. With Area A being considered a land-use planning area, the zone around the Wagerup refinery (8442ha) would exceed Alcoa's land holdings around the Pinjarra operations (6071ha).

The Area A boundary around Wagerup is also supported by other comparisons with Pinjarra refinery. The Fairbridge Village youth training facility, which is occupied year-round, had 38,000 people accommodated overnight during 2004, and has over 150,000 people accessing the village each year. It is located approximately 3.5km north of the Pinjarra refinery, and is approximately 2.25 km from the Pinjarra refinery residue drying area. As a comparison the Area A boundary in northern Yarloop is 3.2km south of the Wagerup refinery premises and 3.3km from the residue drying area; and, the Area A boundary at Hamel is just under 3.5km from the refinery premises.

It should also be noted that the towns of Pinjarra and North Pinjarra are closer to the Pinjarra residue drying areas (2.5 kms) than either the towns of Hamel or Yarloop are to the Wagerup residue drying area. Wagerup refinery's Area A boundary provides at least a 3 km separation to the west of Wagerup's bauxite residue areas, and more than 3 km separation from the towns of Hamel and Yarloop.

3.5.1.2 Relevance to health complaints

The Department of Health submission advises: "The DoH has not prescribed a buffer zone but recommends that a minimum zone of 5km should be adopted." This is suggested in response to the reported health impacts. However, Alcoa is convinced that imposing a new buffer area of five

kilometres is unwarranted; it would not recognise the current complaint situation and most significantly it would lead to greatly increased community concerns.

During 2004 Alcoa received a total of 116 health complaints from 19 households. Seven households made more than one complaint and these seven accounted for 90 percent of the total health complaints. The nearest of these seven households is 4.7km from the refinery. The other six are all between 5km and 8km from the refinery, clearly indicating a buffer of 5kms would hold little relevance to the 2004 reports of health impacts.

A similar situation exists for 2005 health complaint data. Up until the end of July 2005 six households lodged health complaints with Alcoa's Wagerup refinery. Five of these are south of the refinery, between 4.7 and 9km. The sixth household made a single health complaint, and is in Area A, north of the refinery. Two households, one 4.7kms and the other about 5.5km from the refinery, accounted for 75 percent of health complaints. The other residences in this grouping range from 5.5kms to about 9 kms from the refinery (Figure 11). The distance of 9km is further from the refinery than the Waroona township.

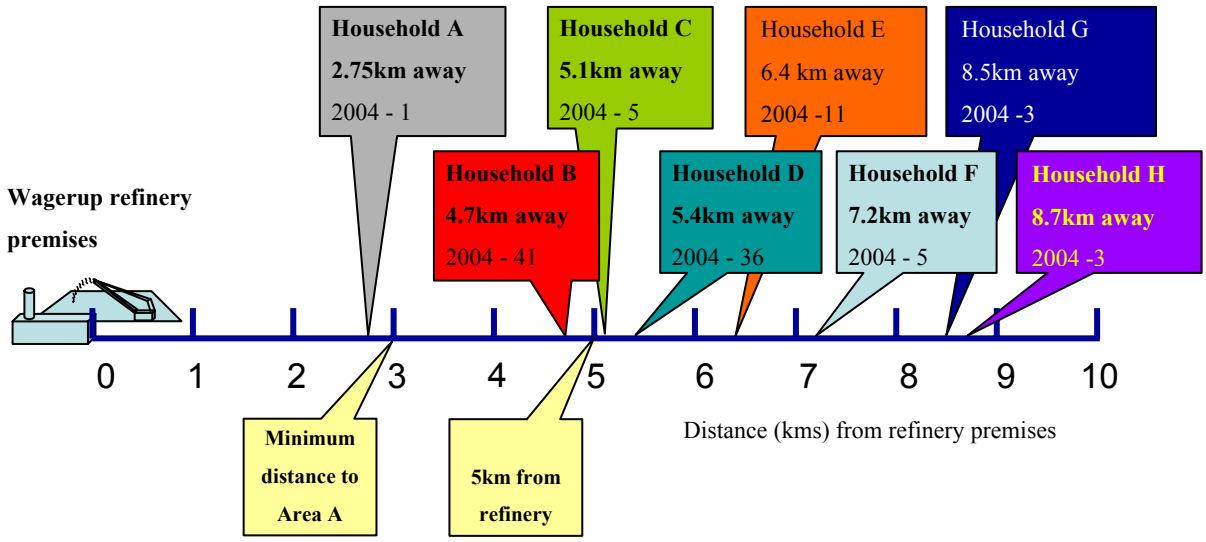


Figure 11: Relative distance from refinery premises of households most frequently lodging health complaints during 2004 and 2005.

The distribution of health complaints does not support a buffer zone of 5kms. To accommodate the current households lodging health complaints, a zone of almost twice this distance would be required,

which would potentially impact on several hundred households. Even as a "zone of choice" the consequences of such a large area being prescribed would be intolerable for a great many landholders.

3.5.1.3 Reported Health Impacts and Multiple Chemical Sensitivity

The Department of Health (DoH) submission states that the overwhelming majority of residents in the vicinity of the Wagerup refinery are not affected by emissions from the refinery. This statement is consistent with air quality data showing the measured compounds are well within appropriate guidelines set for the protection of human health. Furthermore, ambient air quality investigations in the area show key compounds are at typical levels and the refinery's contribution to measured concentrations is very small. Alcoa acknowledges the great importance of community health and wellbeing but based on the best available medical advice Alcoa believes the reports of Multiple Chemical Sensitivity (MCS) around Wagerup are within the 2 – 6 percent of any population that might be expected to experience such symptoms. Furthermore this medical advice indicates that reducing emissions from the refinery is unlikely to improve symptoms among those in the community who are generally sensitive to odours and irritants.

3.5.1.4 Impacts of any boundary changes

Analysis of complaints data, direct discussions with concerned landholders and community feedback provides strong evidence that the initial imposition of Alcoa's land management proposal, although well intentioned, caused significant and ongoing community concern. This included issues of inequity, fear over loss of property values, and a belief for some that complaints were necessary to trigger property purchases by Alcoa.

The Area A boundary was initiated to allow people closest to the refinery to leave the area if they wished to do so, with the boundary determined on the basis of environmental factors (principally noise contours and residue planning) and community complaints regarding noise and odour. The property purchase assurance provided for Area B residents was implemented following community feedback and concern that property values in this area may be affected because of Alcoa's offer to purchase properties in Area A. There was no environmental factor that led to the definition of the Area B boundary.

Alcoa continues to receive complaints regarding land management issues from landholders in the vicinity of Yarloop but outside Areas A and B. In several cases these landholders have requested Alcoa purchase their properties or extend the Area B security offer to include their landholding.

However, based on experience, Alcoa is convinced changing the current arrangement would re-create significant unintended consequences for the majority of property owners in the area.

Consequently, Alcoa continues to decline to purchase properties outside Areas A and B and believes this approach is very important in maintaining community confidence in the land management process. Were Alcoa to extend the boundary for property purchases there would inevitably be a damaging repeat of the unintended consequences arising from the establishment of Area A:

- defining a new boundary without apparent scientific justification would imply a hidden environmental or health consequence of emissions;
- landholders would face an uncertain future, not knowing whether their property values would be impacted in the longer term and whether the boundary may arbitrarily change again;
- it would re-ignite inequities, with people outside the new area feeling disadvantaged; complaints from bordering areas would inevitably increase placing pressure on a further extension of a land planning area; and
- any psychosocial factors that influence community fears would be exacerbated, with health concerns increasing.

This assessment is based on direct experience, over several years, of this issue and the lessons learnt from previous changes to Alcoa's land management processes.

Alcoa recognises the importance of land planning issues to the local community and will continue to work with community representatives on implementation issues through the current community involvement processes, such as the land management working group. These processes, combined with statutory planning processes are the appropriate vehicles for ongoing consultation about land management and land planning issues, and it would be inappropriate to impose changes through any other mechanism.

3.5.1.5 The role of a land planning control area

Alcoa agrees the entire Area A zone should not become a "no-residents" zone, but acknowledges that the zone could be reflected in formal land-use planning, perhaps as a special control area, which would encourage compatible land-uses but restrict intensification of sensitive land-uses.

Currently Alcoa does not rent out properties it purchased that are closest to the refinery. However, properties purchased in the Yarloop township part of Area A are sub-let. This is done to help ensure ongoing sustainability of the township population. In each case the tenant is made aware of the proximity of the refinery.

The DoH submission refers to a principle that is considered appropriate to guide land management within the vicinity of the refinery. “If refinery emissions adversely impact on the health or amenity of any residents there should be genuine choices, freely and equitably available, for them and their families to either leave the area or stay, without economic loss, hardship or unreasonable time constraint. Residents with demonstrated adverse health impacts associated with emissions should be encouraged to relocate.”

Alcoa supports the intent of this principle and believes it currently applies within the relevant area surrounding the refinery. Alcoa has made a commitment to purchase properties within the Area A boundary, should the owners wish to sell, at any time for the operating life of the Wagerup refinery. Properties are purchased at unaffected market value, plus 35 percent to cover replacement costs, plus $7,000 to cover relocation costs. Owners also have the option of obtaining a building replacement cost for their home, rather than receiving the 35 percent. Where a business is involved, such as a farming enterprise, other options are available for relocating the business. Alcoa does not intend to resell properties within this area, but in some instances is leasing them back to the former owners or to new tenants.

Area B (in Yarloop and Hamel) was defined following community feedback concerned that property values in this area may be affected by Alcoa buying properties in Area A. Alcoa made a commitment to purchase properties in Area B from those people who were owners at the time the revised Wagerup Land Management Proposal was published (January 2002) in order to protect property values in these areas. In February 2005 this offer was extended to eligible property owners for the life of the refinery. Consistent with the intent of the Area B approach, to encourage economic viability of the townships, any properties Alcoa purchases in Area B are advertised for re-sale. Alcoa has sold 100 properties in Area B since July 2002 and has only a small number still on the market.

Consistency and maintenance of the Area A boundary and the provision of security for landholders in Area B has led to a significant decline in community concern over the land management arrangement.

3.5.1.6 Dealing Sensitively with People

Alcoa agrees people outside Area A who feel their health is affected by the refinery need to be treated sensitively. The individual circumstances and factors contributing to people feeling affected are complex, and this is not a matter in which Alcoa can or should take a lead. Any actions by Alcoa to extend its direct role beyond an objectively identified buffer area would unnecessarily increase community concern and erode confidence and trust. It would also artificially lead to increased and more wide-spread concerns amongst other land owners in the community. Alcoa's role in these areas should be to act as a good neighbour - helping to ensure people who feel affected are able to access appropriate professional support or referral services.

It is important that services are available in the area to respond genuinely to individual needs as part of broader community development and town growth initiatives. In this regard opportunities exist for a partnership approach between Alcoa and government, which should be further developed through consultation. The strategies of the Pinjarra to Brunswick Sustainability Study support this approach. When considering how the future of the Yarloop and Hamel townships should be secured, the study drew attention to the need to create "an environment in which issues can de discussed and resolved between the community, state government, local government and Alcoa".

3.5.1.7 Summary

- Alcoa supports formal land-use planning controls around the Wagerup refinery;
- Any land-use planning control area must be based on objective scientific data, and draw upon the lessons learnt in past land-use planning initiatives
- Existing environmental and health data supports formalisation of Area A into a land-use planning control area, which does not restrict the current uses of properties within this area;
- Without scientific justification the imposition of a different zone would have substantial negative impacts on the majority of the local community; and

- It is important that services are available in the area to respond genuinely to individual issues as part of broader community development and support initiatives. In this regard opportunities exist for a partnership approach between Alcoa and government, which should be further developed through consultation.

3.5.2 Social and economic impact of the Land Management strategy is not adequately addressed in the ERMP.

Many of the socio-economic challenges facing the communities of Hamel and Yarloop are challenges facing many small regional communities across Australia. However, community reaction to the implementation of Alcoa's land management proposal did cause rapid changes in Yarloop and Hamel. Yarloop in particular underwent a significant change in population, with some long-term residents moving away and new residents moving in. This rapid change-over in population created unintended social challenges for the local community that were not anticipated at the time, and which provided a sense of dislocation in some people's lives.

Dealing with these impacts has required an ongoing complex mix of support programs, government measures and outside expertise. Alcoa entered into a partnership with Edith Cowan University (ECU) in 2002 in which ECU provided professional support by:

- Identifying and problem-solving issues;
- Providing advice and support to Alcoa and community members;
- Implementing a shopfront in Yarloop to inform and include people;
- Facilitating meetings between Alcoa and community members; and
- Developing ways for local people to "have their say".

ECU's activities in the local community continued until the end of March 2005, at which time Alcoa supported the opening of the Yarloop Community and Learning Drop-In Centre and direct employment of a community development officer.

Alcoa also supported the Pinjarra-Brunswick Sustainability Strategy, initiated by government to provide an integrated response to shared issues experienced by communities between Pinjarra and Brunswick. The resulting document, "Shaping the Future", released for public comment, contains specific strategies to enhance the social and economic futures of Hamel and Yarloop.

Alcoa has also funded a range of projects and activities, through direct sponsorship and its Community Development Fund, designed to support and improve social and economic activity in Yarloop and Hamel. These include:

- Establishment and ongoing support for the Yarloop Progress Group;
- Establishment and ongoing support for the Yarloop Community and Learning Drop-in Centre;
- Redevelopment and refurbishment of the historic Yarloop Workshops;
- Implementation of a "Breakfast Club" at the Yarloop Primary School, as well as funding for a new transportable classroom, computers, video equipment, and play equipment;
- Enhancement of community facilities, such as the Yarloop Bowling Club; and
- Development of the Hamel Eco-Tourism project.

Recent survey results indicate there is increased optimism in the area. This is stronger in Waroona, but there is also a feeling that the 'hump' has been passed in Yarloop. Alcoa believes that activities to strengthen social and economic activity in the region should be supported, and that any proposals that re-ignited fears over buffer boundaries, land values, and social structures should be firmly avoided.

3.5.3 The town sites close to Wagerup refinery should be relocated 20 kilometres to the west.

Alcoa supports the future of the towns of Yarloop and Hamel. There is no intention at all by Alcoa to relocate the town-sites which are currently close to Wagerup refinery. This is a proposal that has been raised by some community members and Alcoa's understanding is that this proposal is not supported by the broader community of Yarloop or Hamel.

3.5.4 The throughput limit should be decreased if complaints from a wider area are received.

The extensive studies undertaken predict that the expansion will not result in increases in odour, dust or noise impacts and the Health Risk Assessment (HRA) showed that world class health criteria will be achieved. A verification and monitoring program (including a community health survey and environmental monitoring) will be implemented to assess performance, should the project be approved and proceed to implementation.

3.5.5 Alcoa prevents its tenants from complaining about refinery emissions and operations.

This is untrue. Alcoa has a standard lease agreement with tenants, which does not prevent them from making complaints to Alcoa if they experience any refinery related impact. The same issue has been raised in the media and in the Parliamentary Inquiry into Wagerup refinery and was clarified by Alcoa.

The issue relates to a simple misinterpretation of Alcoa's standard lease agreement.

The lease agreement contains a section entitled ‘quiet enjoyment’ which is defined as a right to undisturbed occupation and possession of an estate in land. Such a right is one of the covenants for title commonly given on a conveyance of old system title land. It is also given expressly or by implication in a lease. Any physical interference with the premises will amount to a breach of the covenant for ‘quiet enjoyment’.

The relevant section of the lease contains a ‘waiver’ of certain of the tenant's rights under the doctrine of ‘quiet enjoyment’ and relates only to formal complaints against Alcoa for breach of the tenant's rights under this doctrine. It does not prevent a tenant from complaining to Alcoa about noise, dust, health or odour.

Alcoa sent a letter to all of its tenants in October 2003 making it clear that the section in the lease agreement under the heading ‘quiet enjoyment’ does not prevent them from making complaints to Alcoa, or the Department of Environment, about noise, dust or odour from the refinery.

3.5.6 Alcoa will not purchase properties outside the buffer area, even though those residents suffer the same impacts

While many Yarloop and Hamel residents have voluntarily taken the opportunity to sell their property to Alcoa under the company's Land Management Proposal, Alcoa believes the introduction of the proposal itself was a major driver in increasing the number of community complaints during 2001 and 2002. This may be because what was an emissions and amenity issue for a few people before 2001 became a land and personal assets issue for the broader community when the buffer proposal was introduced.

The data show that complaints increased significantly in 2001 (from less than 200 per year to more than 1600 per year). This was when Alcoa began consulting community members about purchasing properties around the Wagerup refinery. During the same period, refinery production increased only four percent. Previous production increase of 62 percent (between 1992 and 1993) and 15 percent (between 1999 and 2000) did not result in a significant increase in complaints.

In 2000, Alcoa received 173 complaints at Wagerup, with three quarters of these related to odour and less than ten percent to noise. The vast majority of these complaints were from households within about three kilometres of the refinery operational area (and within the proposed land management area boundary known as Area A).

In March 2001, the Wagerup refinery had received three complaints from two households. At the March meeting of Alcoa's Community Consultative Network (CCN) Alcoa discussed extending its land buffer, based on modelled noise contours. Alcoa received more than 100 complaints in April, all from one household. At the April CCN meeting, community members recommended Alcoa talk to the major complainants about purchasing their property. Complaints in May totalled more than 200, with 94 percent from four households. Also in May, Alcoa offered to purchase two homes. In June, complaints exceeded 300, with seven households making up 97 percent of complaints. Alcoa commenced an extensive community consultation program in July, speaking with individual households about extending the land buffer based on modelled noise contours. Noise complaints increased from seven in April to almost 80 in September. Total complaints in July, August and September remained high (280, 334 and 257).

In early October, because of the level of concern about Alcoa's intentions, Alcoa published a media statement saying it had bought two properties but would not purchase any more until the consultation process was finished. Alcoa said its aim was to make sure any buffer took account of community

concerns and expectations, met the needs of the refinery both now and into the future, and was recognised in regional and town planning schemes. Complaints in October fell to 52.

Throughout 2001, 21 households accounted for over three quarters of the complaints made to Alcoa: 19 of these households were in Area A, and 15 of these properties have since been sold to Alcoa. The property from which the most complaints were lodged in 2001, 2002, and 2003 has not been sold to Alcoa (and has the same residents).

Property purchases under the Revised Land Management Proposal began in January 2002, with Alcoa purchasing some 138 properties during that year. Purchases fell by more than half during 2003 and have continued to decline. Demand for houses in Hamel and Yarloop is now high, with Alcoa having sold almost all the properties it purchased in Area B.

In 2004, some 532 complaints were received at the Wagerup refinery from 59 households. More than 83 percent of these came from 15 households:

- six in Area A (45 percent of total complaints);
- three in Area B (10 percent of total complaints); and
- six outside both areas A and B (28 percent of total complaints). All of these six households are between five and ten kilometres from the refinery centre. Five of the six (all south of the refinery) have asked Alcoa to include them in its land purchase scheme.

The largest number of 2004 complaints (40 percent) related to noise, with 78 percent of those coming from four Area A residences and 12 percent from one Area B residence.

3.5.7 The ERMP and Alcoa has not addressed the issue of community dislocation

The communities of Yarloop and Hamel appear to have stabilised since Alcoa implemented its Revised Land Management Proposal in January 2002. Alcoa's property purchases peaked in 2002, with some 138 properties being sold to Alcoa during that year. The number of property owners electing to sell to Alcoa fell by more than half during 2003 and has declined significantly in 2004 and 2005.

Alcoa purchased just 23 properties in 2004 (10 in Area A and 13 in Area B) and has purchased 10 properties in 2005 (seven in Area A). Demand for houses in Hamel and Yarloop is now high, with Alcoa having sold almost all the properties it had purchased in Area B.

A change in Alcoa's purchase policy in Area B, implemented in February 2005 after consultation with community members, is designed to give residents in Yarloop and Hamel security and to encourage them to remain living in these communities, thereby preventing further community dislocation. This is in addition to the implementation of Alcoa's $2 million Community Development Fund. Through that fund, $500,000 has been allocated to Hamel and $1.5 million to Yarloop to make these communities even more attractive places to live.

In Yarloop, the Yarloop Precinct Advisory Group, comprising community, Shire and Alcoa representatives, was established to advise Alcoa on which projects should be funded. Through this process, $500,000 has been allocated to the historic steam workshops, and $500,000 to other projects in the town precinct. These include installation of a state-of-the-art artificial bowling green at the Yarloop Bowling Club, new playground facilities next to the Yarloop Town Hall, and funding for the Yarloop Community and Learning Drop-in Centre. Alcoa also provided around $100,000 to the Yarloop Primary School in 2002 for a new transportable classroom, computers, video equipment, play equipment and other resources. Alcoa has also helped establish, and continues to support, the Yarloop Progress Group, and supports events such as the very popular "In the Loop" series, designed to bring visitors and economic activity to the area.

Yarloop in particular did suffer the social impact of a rapid change in residents throughout 2002 and 2003, however the population now appears to have stabilised and many of the community and social structures are being strengthened. Alcoa believes it essential that fears over property values and changing social structures within local communities are not re-ignited by further changes to land management areas. This would result in further community dislocation.

3.5.8 The refinery and the expansion make it difficult to sell property in the area

It is difficult to determine if the refinery expansion or the proximity of the refinery itself, will negatively affect land values outside the proposed buffer for Wagerup refinery (Area A).

Market evidence indicates that in recent years property values in Yarloop, Hamel and Waroona have been increasing, and property is sought after in the area. The ready re-sale of properties to new buyers in Area B supports this.

Anecdotal evidence suggests that the properties not sought after are dairy farms or those in the higher value, higher acreage bracket (more than $800,000) with existing residences. Alcoa is aware of medium sized vacant blocks (less than 10 hectare) selling south of Yarloop (less than eight kilometres from the refinery).

3.5.9 Property purchasers new to the area are not aware of the existing problems

Alcoa ensures that the potential purchasers of any of its properties have read and understood the Land Management Proposal. Purchasers sign a sale contract annexure to this effect.

Alcoa is not aware of what real estate agents tell potential purchasers of property in the local area, however, those purchasers doing their due diligence on a property do contact Alcoa for information. Alcoa informs these people of the Land Management Proposal and responds to specific questions.

3.6 COMMUNITY CONSULTATION PROCESS

3.6.1 Alcoa does not have community support for the expansion and therefore should not proceed

Alcoa has sought general community and government support for the Wagerup expansion. While Alcoa never expected 100 percent support, it is evident the proposal has broad community support.

Alcoa began the public consultation process by inviting more than 3000 stakeholders, principally from the communities surrounding the refinery, to discuss expansion of the Wagerup refinery at an open forum held in Waroona in September 2004. About 120 people attended the open forum and many expressed concerns about health and land management while some were supportive of Alcoa's operations and the future expansion. The open forum marked the start of a long and detailed consultation process in which five community working groups were formed to discuss aspects of the proposal in detail.

At the end of that process, Alcoa again invited more than 3000 local community members to return to Waroona for two information days held in June 2005. Only one of the people who attended those information sessions expressed an opposition to the expansion. The vast majority expressed support.

When Alcoa held information displays in shopping centres in Bunbury and Mandurah, again there was almost no opposition to the project and where views were expressed they were overwhelmingly supportive of the proposal.

Since announcing the proposal in May 2004 there has been very little negative comment expressed to Alcoa or in public forums about the proposal. For instance, Alcoa's Wagerup Unit Three email address, widely advertised on all Wagerup Unit Three literature, has not received a single email opposing the project. Nor has there been a single letter objecting to the proposal sent to the refinery address, also widely advertised on all Wagerup Unit Three literature.

Public meetings called to discuss opposition to the proposal have attracted small audiences. The three or four meetings called in Yarloop are the only such meetings Alcoa is aware of and these attracted about 40 people at each meeting. A more recent organized public protest at Parliament House attracted less than 40 people.

The level of public submissions is in itself an indication of support. Although Alcoa acknowledges that the public response phase is not meant to be a 'vote', it also notes that more than 80 percent of submissions received in response to the ERMP were supportive of the expansion proposal.

On the basis of this combined evidence it can be concluded that the project does have broad community support.

3.6.2 The working group process was not independent, open or fair

Alcoa values its place in the community. It recognises that in the past it has not always responded to community concerns in a timely and effective manner and in recent years has devoted significant effort and resources to improving on this.

The working group process is a clear demonstration of Alcoa's attempts to be more open with the community. Throughout the process, community members were provided with full reports pertaining to the ERMP studies. Community members were invited to view the operations, and given access to a range of Alcoa personnel to have questions and concerns answered.

As outlined in Section 6 of the ERMP, the Wagerup Unit Three community involvement program aimed to meet the varying needs of a broad range of stakeholders. To this end, a variety of tools were applied including the working group process. Group methods of consultation and stakeholder

engagement, such as working groups, are recognised by the Department of Environment (DoE) as being appropriate and are referenced in the DoE's Community Involvement Framework.

Alcoa also recognises the value of one-on-one discussions with members of the community. A range of Alcoa employees and representatives are made available to work with members of the community on a range of issues on an ongoing basis.

Independence of facilitators

As the sponsor of the working group process, Alcoa was responsible for recruiting and paying the facilitators of the process. As outlined on page 89 of the ERMP, the facilitators were charged with the responsibility of ensuring that the consultation was fair, transparent and inclusive, while managing the information flow within the identified project timeline.

The facilitators guided a process that provided all members of the community with an opportunity to participate in the process and express their views, whether they were a member of a working group or an observer at a meeting.

Community members were free to raise any issue and have it recorded in the meeting report which was widely published or in the final outcomes of each working group which have been published in the ERMP. The nature of the some of the outcomes recorded during the process and in the ERMP that do not support the project or Alcoa's operations generally, is testament to the fact that the process was not controlled by the facilitators or Alcoa.

Topics of Discussion

Members of the working groups were informed at the beginning of the process that the consultation would be focused on the proposal. This was clearly outlined in the working group terms of reference (see Appendix C of the ERMP) presented and agreed at the first meeting of each working group.

The five working groups addressed a range of issues pertaining to the proposal that could be described as either potential issues or opportunities for the community, as highlighted in the Final Outcomes detailed on pages 97 – 143 of the ERMP. Further evidence of the breadth of topics discussed is provided in the meeting reports found in Appendix D of the ERMP.

Topics not pertaining to the proposal were also discussed at length. For example, the Social & Economic Working Group devoted much time to discussing crisis care services in the local area.

Members of the group invited guest speakers to address the group and as a result of this, additional services were brought into the area. The Social & Economic Working Group also held extensive discussions about other government services in the area, not related to Alcoa's operations.

Alcoa acknowledges that many of the issues discussed during the working group consultation and addressed in the ERMP are highly complex. Despite this, every attempt has been made to provide the information in a simple format and in plain English. Similar advice was provided to consultants preparing reports on behalf of Alcoa for the ERMP.

Furthermore, Alcoa representatives are always available to discuss items that may be of concern or require further explanation with community members. This has been widely advertised in the local newspaper, through newsletters and via direct mail. Additionally two information days were held on 23 and 24 June 2005 in Waroona. Once again, the days were widely advertised and aimed specifically at clarifying points of concern or confusion for community members.

Meeting reporting and communication

As described on page 91 of the ERMP, an independent meeting reporter was present for all meetings and meeting reports were generated on the basis of outcomes issues or actions from the group. This reporting process was agreed by the members of the Working Groups at the first meeting of each group.

During the process it was noted by a member of one group that the meeting reports did not necessarily reflect all the topics discussed. In response the process was modified to include the details of presentations and major discussion topics.

Alcoa regrets confusion caused due to the language used on page 91 of the ERMP in reference to the process of signing off the meeting reports. Signing the meeting report indicated that the working group member was present to the meeting and agreed ('endorsed') that the content of the report was accurate. The facilitators told members that they were signing off to the meeting report being a true and accurate record of the meeting. It did not mean that the members supported the content. It should be noted that it was the responsibility of members to raise matters for inclusion in the meeting report and to bring to the attention of the group items they believed were incorrectly recorded. This was regularly reinforced by the independent facilitators.

Meeting dates and topics of discussions were advertised in the advertisement published regularly in the Harvey Reporter newspaper, along with the outcomes of each meeting.

Due to the number and frequency of meetings, it was sometimes difficult to provide the full details of discussion topics in advance. As is the case in any process, meeting details sometimes changed at short notice due to the availability of information, speakers or indeed participants in the process.

However, this should never have impeded interested community members from accessing information about the meetings. The contact details of a range of people involved in the process including a well known Alcoa representative, independent facilitator and community members, were also regularly published in the Harvey Reporter. Interested community members were encouraged to contact these people for information about the process or specific meetings.

3.6.3 The selection of the working group members was not fair or representative of the community

As outlined on page 87 of the ERMP, an open and inclusive process was used to involve community members in the working group process. The mail out invited community members to nominate to be involved in the consultation and went to more than 3000 households in the local area. An advertisement was also placed in the local newspaper the Harvey Reporter.

Those who nominated to be involved 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. Neither Alcoa nor the independent facilitators selected the membership of the groups.

In most groups, including the Emissions & Health Working Group, the community members decided that it was appropriate to try to ensure that a community member from each of the local communities – Waroona, Hamel, Yarloop, Cookernup, Harvey – was on the group. The Emissions & Health Working Groups membership included residents from each of these towns excluding Hamel as there was no nomination from a Hamel resident.

From Alcoa's perspective it would have been desirable to have as many different sectors of the community represented, including the indigenous population, but as Alcoa did not control the process, it could not influence this aside from inviting broad participation. Once the working groups were formed, the members of the groups determined what day and time they would meet.

Community Consultative Network (CCN) and Tripartite not representative of the community

Alcoa's consultation is based on the principle of inclusiveness and promotes the opportunity for any interested member of the community to participate. Following is an overview of the CCN and Tripartite Groups.

Wagerup CCN

Alcoa formed the CCN in 2000, however at no time has Alcoa claimed that the CCN is representative of the community. The group is based on inclusion and participation – any member of the community is welcome to participate. The CCN is chaired by a member of the community, elected by the community members who participate. Members of the community are encouraged to raise issues for discussion at CCN meetings. Minutes of CCN meetings are published in the Harvey Reporter newspaper to ensure broad community access to topics discussed.

Wagerup Tripartite Group

The Wagerup Tripartite Group is a Ministerial initiative coordinated by the DoE that represents a more constructive approach to community consultation. The group contains a broad range of stakeholders from the local community, including local government officers, community members from Hamel, Waroona and Yarloop, as well as Department of Environment, Health and Alcoa.

An open invitation is extended by the Tripartite Group for any interested party to attend the meetings. Meeting protocols were established in February 2004 to facilitate the involvement of observers in the meeting. The DoE publicly stated in its media statement dated February 27 2004 that "observers are welcome to attend meetings and time will be set aside for their questions towards the end of each meeting". Additionally the DoE has posted all meeting minutes on its website to allow people that couldn't attend the meeting to be informed of discussion items and future meeting topics and dates.

3.6.4 The ECU study cut short and there was no final report or outcomes

The partnership with Edith Cowan University (ECU) was not cut short as the original agreement with ECU was for a 12-month partnership with potential for extension.

It is Alcoa's belief that the ECU project did produce several positive outcomes and it is its understanding that many community members involved in the project are of the same view.

While the contract with ECU no longer exists, two of the ECU practitioners who were involved in the project are still working in Yarloop and Hamel. One is employed by the Yarloop and Learning Drop-In Centre as a community development officer for Yarloop and Hamel. Funding for this arrangement is provided by Alcoa. The second is working with the Yarloop Steam Workshops, which Alcoa has also supported with a $500,000 allocation from the Community Development Fund.

The shift in management of these community resources from Alcoa to the community reflects a successful outcome from the project. No final report from the partnership was requested by Alcoa and therefore no report is available to be released.

3.6.5 Concern over the Alcoa complaint response system and fear of intimidation

As outlined on page 192 of the ERMP, Alcoa maintains a 24-hour, 7-day a week contact response service to a free 1800 number. Designated personnel with extensive refinery process knowledge and experience have been trained to respond to complaints.

In most instances, complaints response is immediate, however under certain circumstances, delays may be experienced, for example refinery process issues. Alcoa is mindful of the need to deal with complaints in a sensitive manner and that respect for neighbours' views is paramount. Training of contact response personnel is designed to address this important issue.

Alcoa is very concerned that claims of intimidation have been made against its personnel and believes these are unfounded. All Alcoa personnel are expected to operate in accordance with Alcoa's values which do no support this behaviour. Similarly we expect our personnel to be treated with respect when dealing with members of the public. Neighbours who believe their complaints have not been responded to in an appropriate manner can contact the Wagerup Community Relations Officer on 9733 8768 so the matter can be investigated.

It should also be noted however that complaints personnel cannot agree with a neighbour for the sake of agreeing. That is, if the person attending a complaint about odour cannot smell the odour, they should not indicate that they do.

Alcoa is constantly looking at ways to improve its processes and a review of the contact response and follow-up procedures was recently undertaken and changes will be rolled out with relevant personnel in the next few months. This will include updated training for contact response.

Complaints are recorded and reported as a requirement of the Wagerup environmental licence. When Alcoa personnel attend a complaint the neighbour is requested to read the detail of the complaint recorded and sign-off on its accuracy.

The Department of Environment also has a process for receiving complaints.

3.6.6 Limited time for consultation on the expansion

The working group meetings for the ERMP were conducted over six months. Alcoa acknowledges however that the detailed nature of the consultation meant that some participants felt that additional time should have been allowed.

It is acknowledged also that in some instances reports being considered by the working groups were delivered only a short time before the meetings. Once again, this relates to the detailed nature of the consultation and it should be noted that this is also a demonstration of Alcoa's commitment to open and transparent consultation. In most instances, full reports were provided to the working groups, along with summary presentations.

<u>Health Risk Assessment (HRA)</u>

Delays in some of the scientific investigations meant that the full HRA was not able to be provided to the Emissions & Health Working Group before the preparation of the group's final outcomes. This and other Working Groups did however receive a summary presentation on the HRA process, delivered by the HRA consultant. In addition, the full HRA report and independent expert review of the report were supplied to the group when they were made available and a meeting called to discuss these in detail.

Social & Economic Working Group

At the conclusion of the ERMP process, the Social & Economic Working Group undertook steps to form a community led group to address issues and opportunities that the group had identified during the ERMP process. Alcoa supported this process through involvement and the provision of a facilitator, but the group is yet to be established.

Alcoa is committed to discussing ongoing issues of concern for the community and forums exist for this to take place. The Wagerup CCN has been examining its roles and processes since the completion of the ERMP process and most recently decided it should be the entry point for community members wishing to raise issued of concern with Alcoa. The group identified that it would place greater emphasis on matters of a social and economic nature, and direct environmental issues to the Wagerup Tripartite Group.

Communication about these outcomes will be circulated to the community in the near future.

3.6.7 Selection of expert reviews was not fair

As the sponsor of the process, Alcoa was responsible for providing the supporting elements of the working group process, including potential independent experts. Alcoa supplied the names of three to four potential independent experts for each of the relevant working groups and selection of the independent expert was the decision of the working group.

A Scope of Work and Selection Criteria for expert reviewers was agreed with the working groups. To this end the expert reviewers were to have no conflict of interest with Alcoa or any other party related to the Wagerup Unit Three process. The exact wording read as follows: 'As well as have appropriate skills to be able to conduct the reviews; expert reviewers were required to be independent ie. not to be; contracted to any stakeholder group [Alcoa (any site), community group, specific government agencies] and not be a member or employee of any stakeholder group; participating in the consultation'.

The expert reviewers were advised of the independence and openness of the process. Expert review reports were immediately provided to the relevant working group. Group members were also entitled to seek further expert advice during the process and provide this as input to the working group discussions

3.6.8 Open forum issues not published

The outcomes of the open forum were compiled in a report that was distributed to participants of the forum at the conclusion of the event. Those people who were unable to be present for both days of the forum were sent a copy of the report.

In addition, the outcomes of the open forum were referred to in a letter sent to over 3000 residents following the open forum. The letter served to provide those who had been invited to the forum with information about the event and the opportunity to participate in the working group consultation. Recipients of the letter were encouraged to contact the independent facilitator should they require additional information about the forum or the working group consultation. Through this process they were able to obtain a copy of the report.

Finally the participants in the working group process were offered a copy of the report from the open forum at the first meeting of each working group. The full report was also made available as an appendix to the ERMP.

A review of the items described in the open forum report has confirmed that these topics were discussed during the working group process, though Alcoa acknowledges that they may not have been resolved to the satisfaction of all community members. Some matters such as 'eliminate emissions completely' are not practicable and therefore such an issue unlikely to be resolved.

Land management

Several issues raised during the open forum pertain to Alcoa's Land Management Plan and in particular the purchase of properties outside Areas A & B. The Land Management Working Group, which formed at the open forum, continues to meet and most recently addressed the issue of Alcoa's purchasing policy for properties outside Areas A & B. At the meeting the group identified actions to bring this outstanding issue to the attention of Alcoa's senior management.

Land management is discussed in more detail in section 3.5 of this report.

3.6.9 A full social impact assessment should be undertaken

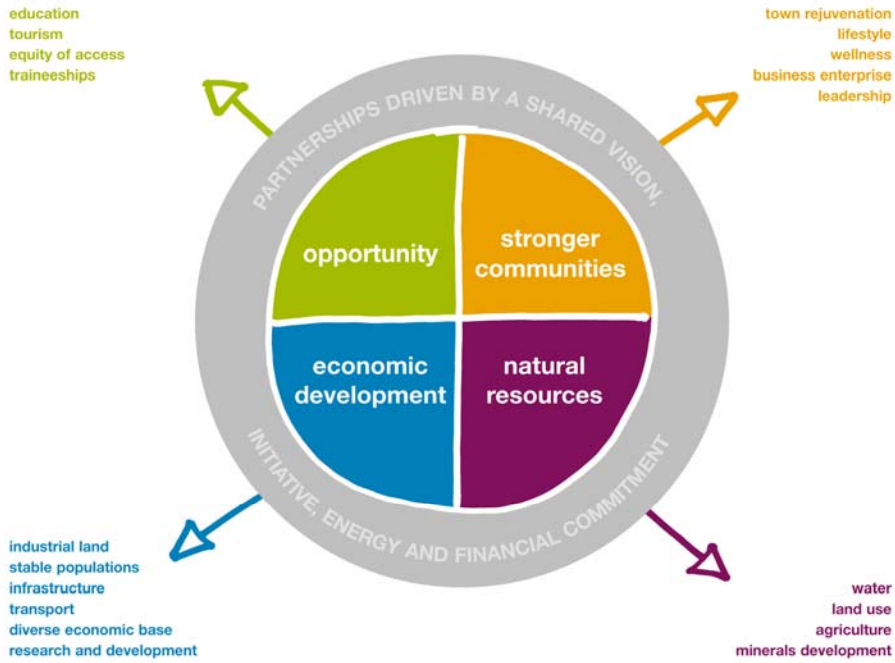
The ERMP included the assessment of social factors to the extent agreed with the EPA through the approval of the environmental scoping document for the Wagerup expansion. Through the ERMP

process, Alcoa has worked closely with the community to consider the social and economic implications of the proposed Wagerup expansion. The working groups provided the community with an active participation role in the ERMP process and a total of 58 meetings were held with each group meeting at least 10 times. The social and economic working group was specifically formed to collaboratively examine and develop opportunities, initiatives and strategies that relate to the socio-economic outcomes of the ERMP. The final outcomes and Alcoa response to these outcomes are contained in section 6.4.4 in the ERMP.

The issue of a more extensive social impact assessment was also previously raised in the original CSIRO Air Quality Study proposal and recommended to be undertaken by the Wagerup Inquiry Committee.

The Government in its response recognises that "Key social elements of the proposed CSIRO 'Wagerup Air Quality Program' are being appropriately progressed via other initiatives such as the Pinjarra-Brunswick Sustainability Strategy." Alcoa actively supported the Pinjarra-Brunswick Sustainability Strategy, initiated by government to provide an integrated response to shared issues experienced by communities between Pinjarra and Brunswick. The resulting document, "Shaping the Future", released for public comment, contains specific recommendations to enhance the social and economic futures of Hamel and Yarloop.

Through the social and economic working group and discussions both formally and informally with other local community groups, local shires, business groups, state government and Alcoa employees, a booklet of ideas has been developed called "*Your future Our future*". The ideas in this booklet will build on existing programs and implement new strategies to form a framework for sustainable regional development as shown below.



3.7 NOISE EMISSIONS

3.7.1 Adverse comments of the SVT "Audit" in 2003 have not been dealt with in the ERMP.

In October 2004 the EPA decided that Alcoa's Regulation 17 application to vary the assigned noise levels in the vicinity of the refinery, would be included in the assessment of the Wagerup Unit Three expansion proposal. As a result, a section outlining the basis of Alcoa's Regulation 17 application and the DoE assessment process conducted to date was included in the ERMP. It was not the intent of this section to reproduce documents that have been submitted or produced as part of the Regulation 17 assessment process that has occurred since 2002 (refer section 7.14.3 of the ERMP document). Specific comments made in the SVT audit report, both adverse and positive, have not been repeated in the ERMP since the SVT document is publicly available.

SVT was commissioned by the DoE to audit Alcoa's noise variation application, noise monitoring, modelling and management processes as part of the Regulation 17 assessment process. The audit was conducted by SVT in 2002 and the report was released by DoE on 12 May 2003. Two years have passed since the audit was conducted and noise management at the Wagerup refinery has continued with significant progress being made, including;

- The acoustic model has been updated with sound power level data collected subsequent to the audit.

- Additional near field and far-field model validation has occurred (using both hand held measurement techniques and directional monitoring technology). The validation confirms that the Wagerup acoustic model has an accuracy of +/- 3 dB(A), which is consistent with the limitations of current modelling technology.

- Far field measurements confirm that tonality (as defined in the Regulations) is no longer present in the refinery emissions.

- Digital audio tapes (DAT's) continue to be used as part of the noise complaint investigation process. These tapes are analysed by Alcoa's acoustic consultant using narrow band analytical technology.

During 2005 a noise feasibility study was conducted by Alcoa as a condition of licence 6217/8. The feasibility study scope of work was prepared by Alcoa in conjunction with the Wagerup Tripartite Group Noise Sub-committee (The Noise Sub-committee). The Noise Sub-committee includes two community representatives, three DoE representatives and Alcoa representatives. The feasibility study investigated opportunities related to noise model validation, noise monitoring at sensitive receptors, monitoring for operational variability, noise complaint response and community access to noise data. Regular updates were provided to the Noise sub-committee and input into the study was sought. A proposed works program was produced by Alcoa as part of the feasibility study report. The feasibility study report and the works program were endorsed by all members of the Noise sub-committee. As a result the works program has been incorporated into Wagerup's interim Environmental Improvement Plan (EIP). The EIP process will be used as a key input for the ongoing development of the Wagerup Noise Management Strategy into the future.

3.7.2 It is unclear if the Alcoa-owned residences which they permit to be occupied are included in the discussion.

The discussion about noise impacts from the proposed upgrade primarily addresses the area bounded by the Land Management Plan Area A boundary. The Area A boundary is partly based on the location of the 35 dB(A) refinery noise contour. While the land management plan applies to privately owned properties only, the acoustic assessment conducted for the proposed expansion applies equally to privately owned and Alcoa owned properties.

3.7.3 Like to see a study along the entire length of old and new sections of the conveyor and various transfer stations .

Along the majority of the conveyor there are no noise sensitive premises. Since the Environmental Protection (Noise) Regulations apply at noise sensitive premises, the SVT review focused on the two noise sensitive premises that could be potentially affected by the upgrade proposal (Refer SVT report No A/04/12/005 provided as Appendix H of the ERMP).

3.7.4 There should be a sign-off process for the detailed construction noise management plans for the various construction phases.

Alcoa agrees with this statement. Commitment 8 recorded in the ERMP states that Alcoa will implement the noise management plan to ensure that the noise objectives for the proposal will be met. Section 4.3 of the noise management plan (refer to section 10.2 of the ERMP) identifies the need for noise emissions to be managed during the construction phase in line with the requirements of the Environmental Protection (Noise) Regulations 1997.

3.7.5 The use of best practice noise control for the entire refinery (not just the expansion) has not been identified in the ERMP.

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. For this reason, the acoustic assessment conducted by SVT did not only focus on new plant. The SVT review identified the need for acoustic controls to be applied to some existing sources if the proposed sound power level allocation is to be met (refer to SVT Report No. A/04/12/005 provided as Appendix H of the ERMP).

The contribution of individual plant items to refinery noise emissions at a given receiver differs. This means that the effectiveness, or need, for acoustic control is dependent on the relative contribution of each individual source to overall noise emissions from the refinery. For this reason, best practice acoustic controls will be applied where feasible and relevant, and will not include the entire refinery, but will incorporate some existing and new equipment.

Modelling conducted by SVT confirmed that if the proposed sound power allocation is implemented, there will be minimal change to noise levels (or no increase in noise impacts) experienced by neighbours.

3.7.6 Is no increase in noise impacts the best practicable outcome for noise. Unclear if this mitigation of impacts only involves mitigation of activities within the refinery or whether the realisation of the above would involve acoustic treatment or other remedies applicable at receiving premises.

Alcoa believes that the commitment of no increased noise impacts is the best practicable outcome for noise management at the Wagerup refinery. Significant reductions in noise emissions have been achieved in recent years, does restrict the opportunities for further reductions at the refinery.

In recognition that additional acoustic reduction opportunities may exist, Alcoa commissioned a review by SVT to assess acoustic control requirements to achieve a 4 dB(A) reduction in overall noise emission levels from an expanded refinery.

The review confirmed that the highest contribution from any single refinery source is approximately 10 dB(A) below the cumulative noise level from all sources at the refinery. This demonstrated that the acoustic reduction program implemented by Alcoa to date has been rigorous and confirmed that further reductions in overall noise levels would be difficult to achieve. SVT did not consider that a further 4 dB(A) reduction in noise was actually possible, as in many cases the sound power allocation limits may not be technically feasible (refer to SVT report No.A/05/02/002 provided as Appendix K of the ERMP). Costings conducted by Alcoa's engineering consultants also confirmed that, even if technically feasible, the cost of achieving a 4 dB(A) reduction would be excessive (in the order of $90 million). Achieving the undertaking of no increase in noise impacts may ultimately involve a variety of measures, such as:

- 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;
- Implementation of a complaints management program;
- Engineering and procurement policy to adopt a 'lowest practicable' noise emission approach for new or replacement plant and equipment;
- Noise attenuation measures for homes of people who are adversely affected by refinery noise, if requested; and
- Implementation of a land management strategy to facilitate the relocation of adversely affected people.

3.7.7 Existing noise levels are in excess of the prescribed levels and this matter is still yet to be resolved.

The Environmental Protection (Noise) Regulations were first promulgated in 1997 and came into effect in 1999. They introduced noise limits that necessitated significant reductions in noise emissions for many pre-existing industries including the Wagerup Refinery.

The program to reduce noise emissions from the refinery began in 1995 when the Regulations were in draft form. A noise source reduction program was developed in consultation with the DoE. Since this time, substantial noise reduction measures have been applied to the refinery. These projects were shown to have successfully removed the tonal components from the refinery noise emission and consolidated the reduction in overall noise level as measured approximately 1.5 km south of the refinery.

Despite the noise reductions achieved to date, the Wagerup Refinery periodically exceeds the allowable noise levels within the area known as Area A in the Alcoa Land Management Plan. It is not feasible or practicable to bring the refinery into compliance with the noise limits assigned by Regulation 8 at the closest noise sensitive premises. Alcoa believes that the only way full compliance can be achieved is either through a variation under Regulation 17 or acquisition of relevant property. The need for such variations was allowed for in the regulations for cases such as the Wagerup refinery, where the new noise regulations could not reasonably or practicably be met.

The variation application submitted by Alcoa in 2002, requested that noise limits in the vicinity of the refinery be increased to match existing noise levels. The application also made a commitment that a Land Management Plan would be implemented to provide neighbours within the noise impacted area, the opportunity to relocate if noise emissions are an unacceptable issue for them or to have their house acoustically treated. This noise variation application is still being assessed and has been incorporated into the ERMP assessment process. It is Alcoa's understanding that a decision on the application will be made as part of the assessment of the proposed Wagerup Unit Three project.

At all locations outside of the Area A Boundary, modelling and monitoring have shown that the Wagerup Refinery is in full compliance with the Regulations.

3.7.8 Noise levels will increase through the expansion.

Modelling of the proposed Wagerup expansion scenario has indicated that the absolute changes in noise levels at seven of the closest residences will be minimal, ranging from an increase of 0.9 dB(A) to a reduction of 0.5 dB(A). Generally a change of 3 dB(A) is required for the human ear to detect changes in sound levels. For this reason it was concluded that noise impacts were unlikely to change as a result of the expansion.

3.7.9 Conveyor affected residences currently still regularly record levels in excess of 40 dB.

Recent monitoring indicates that the conveyor is in full compliance with the Regulations. During 2005, monitoring was conducted with a directional monitoring system known as BarnOwl to the south of the conveyor. This instrument recorded overall noise levels (ie sound levels from Alcoa sources and other ambient sources) in the order of 30 to 42 dB(A). The contribution from Alcoa equipment, ranged from 23 to 32 dB(A).

Predictive modelling confirms that the conveyor operations comply with the regulations under worst-case weather conditions. Since the conveyor and mining operations are fully compliant with the regulations a variation application has not been submitted for these components.

3.8 WATER SUPPLY

3.8.1 The proposed expansion of the refinery will result in a deterioration of the water quality in Yarloop

The Wagerup refinery gets its water from a different catchment to the Yarloop town so there should be no impact on the Yarloop town water supply (either water quality or water quantity).

The Wagerup refinery operates a closed water circuit which means it does not discharge any process water from the site. Surface water monitoring results from 2000 to 2004 indicate that the Wagerup refinery operations have not affected the quality of surface water sources.

Rainfall records throughout the South West show that 2001 and 2002 were extremely dry years with minimal recharge or run-off causing water supply issues during the summer months. These may be factors in the observed changes referred to in the submissions.

3.8.2 The expansion would result in an over commitment of scarce water resources in the region, reducing levels and quantity available

The Wagerup refinery operates a closed water circuit, with water continuously re-used in the process. Losses from the water circuit are replaced with make-up water which is sourced from refinery storage facilities which collect rainfall and surface run-off. In addition, the existing refinery is licensed by the Department of Environment (DoE) to divert surface water to meet the refinery's water needs.

Surface water is taken from the following three sources:

- Yalup catchment via the upper Yalup dam. This water is used primarily as a source of potable water and for cooling tower make-up;
- Black Tom Brook Catchment, via the detention pond. This water is primarily used for dust control on the residue area; and
- Harvey River (Drain) via the Harvey pumpback system. This water is primarily diverted to the run-off water storage (ROWS) pond for use as process water make-up.

An operating strategy, which is a requirement of the water licences, has been submitted to the DoE and approved. This strategy outlines how water will be managed to ensure minimal impact on the environment and other users. Significant improvements in water efficiencies have been made at the refinery over time, such as conversion of wet residue storage to dry stacking and thickening of residue.

The Willowdale mine site uses water for dust control on haul roads, wash down of equipment (dieback hygiene), and various small volume uses, including drinking water. Alcoa currently holds a surface water licence for up to 0.45 GL per annum from Drakes Brook and Sampson Brook catchments. This allocation is obtained through a Bulk Water Agreement with the Water Corporation for the purchase of this quantity from Sampson Reservoir.

Water resources within the region are used for irrigated agriculture, public water supply and industrial use. The major water use in the area is irrigated agriculture which has an 80GL per annum allocation. Licensed allocation for industry is less, at approximately 10GL per annum.

The existing Wagerup refinery currently has an allocation of approximately 8.5 GL per annum. The proportion taken each year is dependent on the volume of rainfall and run-off collected in the

refinery's storage dams. During 2004, about 4.3 GL of water was abstracted under the Wagerup refinery surface water licences.

The proposed expansion will increase water requirements at the refinery and the mine site. The mine site water requirement related to the proposed expansion is 0.55 GL per annum. It is anticipated around 100 ML per annum will be collected from site sources and 450 ML per annum is obtained through existing licensed sources. For the refinery the proposed expansion requires an additional 1.1 GL under average rainfall/run-off conditions and up to 4.8 GL per annum under drought conditions. To accommodate this, Alcoa has commissioned reviews of different refinery water supply options and undertaken an investigation of the ecological water requirements and water availability in the lower Harvey River catchment.

For the Harvey River (Drain), historical stream data has shown that approximately 75.2 GL of water passes the Logue Brook confluence. This suggests that there are approximately 28 GL per annum available in winter after allowing one-third of the total flows for ecological water requirements. The project requirement of 1.1 to 4.8 GL per annum is well within the additional 28 GL identified as available from this source.

On the basis of these reviews, Alcoa is evaluating further the following two refinery water supply options:

- Increasing water abstraction from the Harvey River; and
- Obtaining additional water by using water previously lost from open irrigation channels.

Further assessment of the ecological value of the Harvey River will be conducted, with the requirements of the reviews determined through discussion with the DoE as part of the water supply licensing process.

3.9 GROUNDWATER QUALITY

3.9.1 Lack of groundwater (site) investigation in vicinity of the proposal area

Alcoa undertook an investigation of groundwater potential in 1979 and 1980 following advice from the Western Australian Government Geological Survey that sizeable high quality groundwater supplies were unlikely to exist in the Wagerup area based on information collected at 20 – 30 m. The Alcoa investigation involved the drilling of two exploratory wells to a depth of 300 to 400m in case a supply similar to that established at Pinjarra could be proven at Wagerup. Low permeability strata and brackish water were encountered. It was concluded that a suitable groundwater resource was not likely to be available in the area (Layton Consultants, 1980).

Limited quantities of shallow groundwater of variable quality are available but is not considered suitable as the sole supply for the Wagerup refinery.

3.9.2 Is acid sulphate soil an issue for the proposal

The Western Australian Planning Association Bulletin No 64 provides generic mapping of acid sulfate soil risk. The Wagerup refinery is located in an area that has a moderate to low risk of acid sulfate soils.

The Wagerup refinery has been in operation for over 20 years and there has been no observed problem with acid generation from existing activities, confirming the low risk in this area.

The RDAs associated with the proposed expansion would be constructed with a composite lined (clay and geo-membrane) perimeter drain. The drain would capture any run-off or contain any potential spillage and reports to the ROCP (Run off collection pond). Collected water is then transferred back to the Cooling Pond or ROWS pond.

3.9.3 Have not demonstrated the reasoning of utilising surface water verses the use of groundwater from the Harvey River Main Drain and how this would be managed.

During the establishment of the Wagerup refinery the availability of groundwater was examined and the advice of the Western Australian Government's Geological Survey at the time was that sizable high quality groundwater supplies (such as had been developed for the Pinjarra refinery) were unlikely in the Wagerup area. This was confirmed by some preliminary investigations commissioned by Alcoa (Layton Groundwater Consultants, 1980).

A small quantity of surficial groundwater is extracted to manage hydrostatic pressures beneath some of the residue facilities but the quality of groundwater in the area limits its use in the alumina refining process at Wagerup.

Surface water sources are used to provide make-up water for the refinery and this is expected to continue for the proposed refinery expansion. Surface water abstraction is minimised through the refinery which has been designed to maximise the recycling of process and other water collected within the refinery and residue areas. No process or cooling effluent is discharged due to the level of recycling within the refinery.

As part of the ERMP, a Water Supply study (ENVIRON 2005) was undertaken to identify and assess water supply options for the refinery expansion. The study identified that, based on historical stream flow data, approximately 28GL per annum is available in winter for abstraction after accounting for environmental flows. It was recommended that additional stream flow data was obtained to confirm water availability and quality of the Harvey Main drain. Based on these recommendations, Alcoa has installed a continuous flow monitor on Harvey River Main drain and is taking additional water quality data in the vicinity of the Harvey pumpback station. This is in addition to investigating the possibility of securing additional water through improved efficiency measures within the Harvey irrigation district.

A surface water supply management plan was prepared and included in the Wagerup ERMP (refer to section 10.3 of the ERMP), which outlines the proposed management measures associated with the abstraction of surface waters for the Wagerup refinery. The management plan will be revised in response to environmental, organisational and licence changes.

3.9.4 There will be further contamination of groundwater from the RDA's and refinery

Wagerup has a comprehensive groundwater monitoring program in place to identify and manage groundwater quality impacts from the refinery and residue drying areas. The program involves monitoring approximately 420 bores that are located around the refinery, residue drying areas and in the area surrounding the Wagerup lease.

Monitor bores installed near refinery process buildings and the residue drying areas have shown some low level alkaline groundwater contamination. There has been no data showing elevated radioactivity levels. There has been no data indicating caustic contamination from the refinery or residue area activities has affected non-Alcoa owned property. Groundwater monitoring data is reported annually to the Department of Environment.

Investigations have indicated that the contamination in the refinery area is due largely to past operational practices. The contamination in the residue areas has occurred beneath the older residue areas and is thought to be due to past operational practices and the construction of bores used for groundwater monitoring. Design and construction of the RDA's and monitor bores has improved significantly over time. All new residue areas have a clay seal, a geomembrane layer and an underdrainage system.

Management or remediation of previously contaminated areas is necessary to ensure the groundwater quality is maintained. A long-term strategy has been developed and this historical contamination poses no risk to downstream environmental values due to the current remediation and management practices. Some components will be progressed during 2005 and 2006 as part of the Wagerup Refinery Environmental Improvement Plan. Alcoa will continue to work with the DoE to develop and implement the remediation strategy.

3.9.5 Alcoa has a significant number of spills indicating poor environmental management

Alcoa's Western Australia operations, including the Wagerup refinery has a strong focus on spills prevention. The refinery has three levels of control to prevent and manage spills, these are:

- Primary controls - includes the installation of tank level gauges, alarms and a master flow controller.
- Secondary controls - Concrete bunding to contain spillage from operating areas (known as secondary containment); and

- Tertiary controls - a network of stormwater drains that report to a lined stormwater lake (known as tertiary containment). Water from this stormwater lake is re-used in the refinery. Any spills that escape the secondary containment system enter this drainage network.

If an incident does occur, clear operational procedures are in place and response personnel trained to minimise the potential for contamination of soil and groundwater by effectively remediating any affected. Any material that escapes the bunded area is reported in Alcoa's incident management system. The severity of the incident determines the investigation and reporting level. Investigations are conducted to identify root causes and corrective actions to prevent recurrence.

Alcoa's Western Australian operations have implemented a proactive spills reduction program over the last few years to improve its performance with respect to spill management. The program includes such activities as:

- Improvements to primary controls such as high level tank alarms;
- Improvements to secondary controls such as bunding;
- Improvements to tertiary controls such as storm water drainage;
- Spills response procedures;
- Incident reporting and investigation;
- Education and awareness programs; and
- Engineering design guidelines.

Alcoa recognises the need for continuous improvement to reduce spills and hence implemented the above actions. However, it is important to note that no environmental harm has resulted from the spills referred to and cleanup measures are implemented immediately.

3.10 SURFACE WATER QUALITY

3.10.1 The Wagerup stormwater containment system is badly damaged and is causing contamination

The Wagerup stormwater system is not badly damaged. Inspections of the stormwater system by Alcoa between 2001 and 2003 using camera technology did reveal some minor damage. In response to the inspections, Alcoa has initiated a number of projects to repair and improve damaged sections of the stormwater system. The projects include:

- Removal of scale and debris from the pipes through water milling;

- Repair of pipes damaged by scouring; and
- Removal of some direct process connections.

The stormwater system is suitable for its intended use for the transport of stormwater.

3.11 TRANSPORT

3.11.1 Increased impacts (noise, vibration, dust, traffic delays) in towns from increased road and rail traffic.

Road traffic movements to and from the Wagerup refinery use the South West Highway, which is the major transport route from the Perth metropolitan area to the south-west region passing through the townsites of Waroona and Yarloop.

Traffic surveys undertaken by Main Roads indicated that the total number vehicles using the South West highway is estimated at approximately 36,000 per week. Of this total, 87 percent are passenger vehicles, small to medium trucks comprised 6 percent and heavy vehicles 7 percent.

The existing truck traffic (small to medium and heavy vehicles) relating to Wagerup represents approximately 7 percent of all weekly truck movements on the south west highway. The Proposal will see this increase to approximately 12 percent of all weekly truck movements or only 1.5 percent of all weekly vehicle movements on South West highway.

Alcoa does not believe that the increase in truck movements related to the proposal will result in a noticeable increase in noise or vibration impacts in Waroona or Yarloop because they make up a relatively small proportion of the overall traffic movements through the towns. Truck movements are not anticipated to contribute to dust impacts as loads with dust potential are covered or transported in sealed tankers.

Truck movements during the construction phase of the Proposal will see additional movements and Alcoa has committed to prepare and implement a Traffic Management Plan to manage road traffic associated with the construction. The Traffic Management Plan will be agreed with input from community stakeholders and will consider such restrictions as limiting construction related heavy vehicle movements either side of school opening and closing times.

The washing down of alumina wagons remains the main mechanism to avoid dust impacts from rail transport.

Further information on transportation associated with the proposal is contained in section 5.3, section 7.17 and section 8.8 of the ERMP.

3.11.2 Increased heavy rail traffic will result in greater noise levels and vibration having further negative impacts on residents

Train numbers will be dependant to a large degree on the operating parameters implemented by the rail owner and operator, Australian Railroad Group ("ARG"). At the present time ARG is operating 4 x alumina fleets and 2 x caustic fleets, with the alumina trains between 28 and 34 wagons in length and the caustic trains comprising 10 wagons. If the proposal is approved, it is unlikely that the number of trains will increase above current numbers, however, the length of trains will increase as more wagons are added. It is anticipated that the length of the alumina trains will increase to 46 wagons and the caustic trains up to 14 wagons.

In comparison, until recently, ARG was operating 3 x alumina fleets and 1 x caustic fleet, with the alumina trains being 38 wagons in length and the caustic train 20 wagons in length.

Alcoa does not believe that the change in the length of the trains will result in significant noise and vibration increases over the existing scenario. Alcoa has no management control over or proponent responsibility for the South West main rail line as it owned and operated by ARG.

It is Alcoa's understanding, that an independent study of the cumulative impacts of increased rail traffic on the South West main line has been commissioned by the Western Australian Government to assess noise and vibration impacts.

Further information on transportation associated with the proposal is contained in section 5.3, section 7.17, section 8.4.7 and section 8.8 of the ERMP.

3.11.3 A study of all sectors of track between Pinjarra and the Port and include cumulative noise impacts from all three upgrade proposals (Pinjarra, Wagerup and Worsley).

As outlined in section 3.11.2, Alcoa understands that an independent study of the cumulative impacts due increased rail traffic due to the Wagerup, Pinjarra and Worsley proposals has been commissioned by the state government. Information has been requested and provided by Alcoa to the EPA to assist in this study.

3.12 GREENHOUSE GAS EMISSIONS

3.12.1 The refinery expansion will increase greenhouse gas emissions

In absolute terms the project will increase greenhouse emissions from the Wagerup refinery due to the production rate increase. However, the expansion will result in improvement to the greenhouse intensity (CO2-e per tonne of product produced) through more efficient processing technology. The greenhouse intensity of the existing operations will improve from 557 kg CO2-e per tonne to 480 kg CO2-e per tonne with the implementation of cogeneration.

Alcoa is committed to reducing its greenhouse emissions on a global basis and committed to a reduction of GHG emissions under its direct control by at least 25 percent by the year 2010 (from the base year of 1990), irrespective of the increase in alumina and/or aluminium production capacity that may be achieved over this period. Globally, Alcoa achieved the 25 percent reduction target by 2003 and is now working to maintain that reduction as the company expands to meet increasing global demand for its products.

Alcoa is committed to increasing the rate of aluminium recycling on a global scale and achieves this through supporting voluntary national aluminium recycling programs and purchasing competitively priced scrap metal as feedstock for its secondary smelters. Secondary smelters are those that remelt scrap aluminium for re-use.

Remelting aluminium scrap saves up to 95 percent of the greenhouse gas emissions associated with primary aluminium smelting. The recycle rate for automotive scrap is close to 90 percent. Recycled aluminium now makes up more than 60 percent of aluminium used in new vehicles, and this is expected to increase further.

In Australia, Alcoa Australia Rolled Products operates the country's largest remelting facility at its Yennora site and recycles approximately 55,000 tpa of scrap aluminium.

Aluminium can recycling re-uses a valuable resource and conserves energy. Of the 3 billion aluminium cans sold annually in Australia, 68.5 percent, or approximately 1.9 billion, are recycled. Alcoa Australia Rolled Products processes 1.2 billion of these cans through its remelt furnace annually, playing a significant role by reducing industry requirements for natural resources and diverting waste from landfill.

The improved greenhouse intensity, levels of aluminium recycling (approximately 40 percent global demand filled by recycled product) and increased use of aluminium in transportation and other energy intensive applications will enable Alcoa to continue to reduce its global greenhouse gas emissions.

3.13 WASTE MANAGEMENT

3.13.1 An alternative method of disposal needs to be found for oxalate other than restarting the oxalate kiln

Up until 2002, oxalate was provided to the Windamarra Vanadium plant, which required the oxalate as part of their process. In 2002 the vanadium plant was shut down and an alternative oxalate disposal method was required. No additional industrial processes were identified that required oxalate and approval was sought from the Department of Environment (DoE) to dispose of the oxalate in the licenced landfill site at the residue drying area. As part of the Wagerup refinery expansion, the disposal of oxalate was assessed and the best long term destruction method identified for oxalate disposal was the destruction via an oxalate kiln. Alcoa will continue to look for alternative disposal or treatment options for its waste products as part of its continuous improvement programs.

One of the main concerns with restarting the oxalate kiln is the potential for increased emissions. The increase in emissions will be addressed by emission controls proposed as part of the refinery expansion. Oxalate that is removed from the production stream will be combusted via a rotary kiln (known as the oxalate kiln) with the combustion gases directed to a new Regenerative Thermal Oxidiser (RTO). The oxalate kiln stack is a relatively low contributor of carbon monoxide, volatile organic compounds and particulates, but the RTO will remove 95 percent of these emissions from this source.

The effectiveness of the RTO proposed in the expansion is based on the operating experience gained by Worsley Alumina, who have had an RTO unit fitted to their liquor burner demonstrating a removal efficiency of greater than 99 percent. This has resulted in a major emission reduction for the oxalate destruction process at Worsley.

The disposal of the oxalate via and oxalate kiln for the proposed expansion has been communicated to the DoE through the oxalate management strategy submitted to the DoE in August 2004, as a condition of Wagerup licence 6217/8.

3.14 VISUAL AMENITY

3.14.1 Further planting on the northern end of Somers Rd is required to screen the RDAs.

In 2004, tree lines comprising indigenous species to enhance biodiversity (refer to Figure 12) were planted to break up views from McLure and Somers Roads. The survival rate of this planting was at 60 – 70 percent in August 2005.

To enhance residue screening and amenity value of the immediate area, the 2005 planting program included further planting along McLure Road and infill planting along Somers Road. Advice from community members involved in the planting program review conducted in 2004 saw the McLure Road planting area extended west to a point where the irrigation channel crosses under McLure Road (refer to Figure 13). Community members and Alcoa identified significant drainage problems along Somers Rd that affect tree survival due to inundation during winter. Species that can survive wet, clayey conditions have been targeted for the infill planting along Somers Rd, but success of these plantings is not guaranteed. These areas were planted during 2005 and survival rates will be assessed in 2006.

Figure 12: 2004 Visual Amenity Plantings Farmlands Residue Amenity Plantings provide further screening from the North of the Residue Area.

Figure 13: 2005 Visual Amenity Plantings, McLure Road Plantings provide further screening from the North of the Residue Area.

3.14.2 Increased visual amenity impacts of RDA

Alcoa has planted vegetation around the bauxite residue storage areas over many years with the aim of enhancing visual amenity and improving species conservation.

A review of plantings was conducted by Alcoa in 2003 as part of the northern residue area expansion projects (i.e. RDA7 and RDA 8). This review identified areas that required infill planting and new areas that could be planted to improve amenity.

A further review was conducted in November 2004. The review focused on visual amenity from surrounding public roads. Local community members living to the North of the residue area volunteered to be involved in this review and provided valuable input and advice on the 2005 planting program. This plan was presented to the Waroona Council and is being implemented during 2005.

It must be recognised that the implementation of planting programs to enhance visual amenity is an ongoing and long-term program. Plantings continued during 2004 and 2005 with the aim of reducing the visual impact of the residue area, while helping to create habitat corridors for wildlife.

Trees and areas of ecological significance take time to establish. Assuming they suffer no set-backs, the plantings that have occurred in 2004 and 2005 will not begin to enhance the appearance of the area until 2008 and 2009. With continued emphasis, infill planting and regular reviews, it is believed that the planting strategy will significantly enhance the visual amenity of the area.

3.14.3 Increased visual amenity impact's from a second tall stack.

The potential visual impact of the proposed expansion was assessed and is detailed in section 8.15 of the ERMP. The existing refinery and tall stack is visible from a number of locations, particularly from the escarpment. The addition of another tall stack within the refinery complex will be visible but this is not expected to be significantly greater than the existing visual impact. Refer to section 8.15 of the ERMP for additional information on visual amenity.

3.15 SUSTAINABILITY

3.15.1 Alcoa to benchmark its efforts to find alternative disposal options for residue

Alcoa will benchmark its efforts to find alternative disposal options for residue as part of the Long Term Residue Management Strategy (LTRMS) which includes a comprehensive community engagement process and independent expert review.

Alcoa is currently investing more than $2 million per annum in researching alternatives for residue by-product use. The primary focus of this work is to convert residue into potentially useful materials that are environmentally acceptable and commercially viable. By identifying and demonstrating a range of technically and economically feasible alternative uses, bauxite residue may become a resource rather than a waste product. Some successful by-products have already been developed or are nearing completion such as acidic soil conditioner (Alkaloam) and residue sand.

Development of alternative uses for bauxite residue has been one of the major objectives of Alcoa's residue development program since 1978. Alcoa recognises that if significant re-use is achieved, the rate of expansion of the residue storage areas can be slowed and more value can be derived from the resource.

Carbonation is a process that naturally occurs in the environment and has a positive effect on bauxite residue. Carbon dioxide in the air reacts with sodium hydroxide in the residue and slowly neutralizes it. Alcoa researchers have developed an innovative technology to speed up this process to deliver three real benefits:

- Alkalinity of residue is reduced 300-fold from pH13 to pH10.5. This creates new opportunities for residue re-use such as a material for road construction.
- Carbon dioxide is diverted from the atmosphere into the carbonation process, reducing greenhouse gas emissions.
- Less dust, as the process makes residue that is less dusty to traditional residue storage techniques.

Other opportunities for residue re-use include:

- Use of the fine residue fraction (red mud) as a soil amendment;
- Separation of lime residue for a range of potential uses such as agricultural lime and as a raw material in other industries; and

- Washing and mineral separation of the course residue fraction (residue sand) to potentially use high silica fraction as a concrete aggregate and high iron fraction as a low grade feed for iron production.

Much of the research work in this area is being coordinated through the Centre for Sustainable Resource Processing (CSRP). Alcoa is a major sponsor of the CSRP, providing $5.6 million over seven years (cash and in-kind support). The CSRP is also supported by a range of research groups, universities and government agencies.

Agriculture Western Australia continues to work with Alcoa to support long-term research into the environmental effects of soil amendments with ongoing monitoring of a number of sites.

Unfortunately, a key barrier to reusing residue has been the community's reluctance to accept residue by-products as viable alternatives, even though the products meet all the environmental and health requirements.

3.15.2 Long-term use of residue as RDAs are not sustainable

The RDAs footprint will increase as a result of the Wagerup expansion, however the Long Term Residue Management Strategy will define the final land-use, closure and rehabilitation requirements in line with community expectations.

Alcoa is progressively rehabilitating residue drying areas as the tiered banks are completed and the final result will be a self-sustaining eco-system of native vegetation. Meanwhile, Alcoa continues to seek alternative uses for residue such as acidic soil conditioner (Alkaloam) or as red construction bricks.

3.15.3 Increased production rate is not sustainable

Alcoa believes the increased production rate is sustainable for the foreseen life of the refinery and Alcoa's bauxite reserves. Alcoa is confident the remaining bauxite resource it has retained the right to access is more than adequate to sustain operations for many more years at the rates at which the three existing refineries are proposed to operate in future.

To justify Alcoa's investment of more than $1.5 billion to expand the Wagerup refinery, a minimum expected life of operations in excess of 30 years is required. The current mining lease agreement is

due to expire in 2045, so it is reasonable to forecast that it will operate up to, and potentially beyond, that date.

The life of the refinery is difficult to predict as it is dependent on a range of factors, including the extent of demand for alumina, the economics of metal markets, competition from more efficient operations, maintenance expenditure, capital re-investment required to refurbish and upgrade equipment, and technology improvements to meet government and community expectations.

However, if further economic bauxite resources are available in the Darling Range in the future and, provided that Alcoa and the State government are able to reach satisfactory agreement, there is every possibility that both mining and refining operations will continue beyond 2045.

3.15.4 Expansion is not in the best long term interests of the South West and WA's Long term economic and social benefits

South West

During the life of the Wagerup refinery Alcoa has helped establish a long-term future for Waroona, Yarloop, Hamel, Harvey and the region through its contribution to:

- local infrastructure and services;
- local community organisations;
- regional and state infrastructure; and
- community-based training and education.

Since 1997, Alcoa has contributed more than $25 million to the local region to support social infrastructure and services, including:

- $3.2 million on new community infrastructure and services;
- $1 million for local community organisations;
- $21 million in community-based training and education, including apprentices and trainees; and
- $800,000 in rates and ex gratia payments to Waroona and Harvey Shires.

In addition, more than $2.3 million in community funding and payments was provided by Alcoa to the Waroona and Harvey Shires in 2004.

Alcoa supports the future development of the Peel and South West regions, and is developing a set of additional social and economic initiatives with local stakeholders to help the region in achieving real sustainability.

Such initiatives and projects associated with expansion of the Wagerup refinery have been described in the booklet '*Your Future Our Future*' and clearly indicate the intent for ongoing and additional future support for the towns and regions surrounding the Wagerup refinery. These ideas focus on a range of areas including local businesses, entrepreneurs and training/education programs and are the result of extensive consultation between Alcoa and local shire and community representatives.
Two exciting new ideas in the booklet are the Sustainable Development Fund and the Learning and Enterprise Centre. With Wagerup Unit Three there is additional opportunity for greater funding into the proposed Sustainable Development Fund, which is a new long-term initiative. Every year the fund will receive an injection of money and future payments will be linked with production of alumina from the Wagerup refinery. It is intended that this funding is used for sustainable long-term projects, and a fund committee consisting of community, shire and Alcoa representatives will jointly make decisions about how those funds will be spent.

A local purpose built Learning and Enterprise Centre could improve long-term employability and business enterprise skills of local people. By offering quality training and education locally it is hoped more young people will remain in the area and work within the local economy, building the skills base of the region. This project will be made possible if Wagerup Unit Three proceeds.

<u>Western Australia</u>

The following are real and direct advantages to the state and Australia:

- Alcoa directly employs more than 4000 people in WA;
- Alcoa accounts for seven percent of WA's total exports. This adds economic wealth to the State and helps maintain a trade balance against imports;
- For every export dollar earned, 80 cents stays in Australia. Alcoa distributed more than $2.3 billion in Australia last year;
- Alcoa's investment in Australia totals more than $12 billion;
- Alcoa's presence in WA has enabled the development of essential regional infrastructure;
- Alcoa's operations and need for energy underwrote construction of the Dampier to Bunbury Natural Gas Pipeline in the 1980s which has delivered stable long-term and low cost energy supplies to the South West for local communities and businesses;

- In 2004, Alcoa jointly purchased the pipeline with Alinta Limited and Macquarie Bank, with the group committing at least $450 million to expand the pipeline.
- Alcoa and Alinta Limited are partnering to develop cogeneration power units at Alcoa's refineries. The plants produce both electricity and heat from the same fuel source.
- Alcoa is the biggest rail customer in WA. Australian Western Railroad hauls almost 15 million tonnes for Alcoa between Pinjarra, Kwinana and Bunbury.
- The alumina industry accounts for around 80 percent of throughput at the Bunbury Port – more than three ships a week. The world class port is one of Australia's most efficient and a strategic asset for the South West.

Life of Operation

Since Alcoa's mining operations began, bauxite from Alcoa's mineral lease in the [Darling] Ranges has been supplied to the Kwinana refinery for more than 40 years, the Pinjarra refinery for more than 30 years and the Wagerup refinery for more than 20 years. Alcoa's longevity in the State and local region over the past 40 years is evidence of its commitment to creating wealth and opportunities, as well as providing a solid basis for its future endeavors.

Under the terms of the WA Act of Parliament governing establishment and operation of the alumina refineries in WA, Alcoa has the right to mine bauxite within Mineral Lease 1SA until 2045 provided that specified conditions are met. There is an implied right to apply for renegotiation and extension of the lease agreement after that date.

As outlined in the response to 'Increased production rate is not sustainable' refer to section 3.15.3, to justify Alcoa's investment of more than $1.5 billion to expand the Wagerup refinery, a minimum expected life of operations in excess of 30 years is required.

However it is important to note that estimates of the total mineable bauxite resource within the mineral lease, and therefore the duration of alumina refining, can only be preliminary in nature for the following reasons:

- The lease area is very extensive and the majority of this area has not yet been thoroughly explored for bauxite, although it is believed to contain a substantial resource based on similarity to better known areas. A substantial proportion of the remaining lease area (approximately one third) was covered by a program of broad spaced exploration drilling

during the 1960s and early 1970s. However, much of the lease area has yet to be explored and estimates of the bauxite resource in these areas are based on aerial mapping and limited geological inspections in the field. Generally mine planning and understanding of bauxite ore reserve status is known from three to five years before mining.

- Bauxite, like any other mineral ore, is defined as material of a quality that can be mined, processed and delivered to a customer at a profit. Consequently, the criteria determining the portion of the laterite deposits in the Darling Range deemed to represent a mineable bauxite resource, will vary as technology and economic factors vary, such as world demand and price for alumina and aluminium. The criteria used for ore definition keep evolving and currently includes consideration of, for example, the proportion of organic matter. Predicting the quantity of bauxite remaining within the lease which will be considered to be mineable in the future is therefore inherently uncertain.

- Over the period of Alcoa's operations in WA there has been a series of renegotiations affecting the boundaries of the mining lease. The area of the lease within which Alcoa retains the right to mine has been reduced to approximately one third of the original area as Alcoa has foregone the right to mine and assisted the establishment of a number of new national parks and other conservation reserves. Some other potential ore deposits in areas outside of such parks and reserves have also been bypassed since they were located in areas assessed as environmentally or socially sensitive, for example those in close proximity to stream zones or private residences. Additionally, with government consent, Alcoa has sub-leased a portion of the lease area to Worsley Alumina, in recognition that Worsley's operations are better located to mine this resource.

These factors were considered when preparing the ERMP for Wagerup Unit Three expansion.

Alcoa remains confident that the remaining bauxite resource which Alcoa has retained the right to access is more than adequate to sustain operations for many more years at the rates at which the three existing refineries are proposed to operate in the future.

3.15.5 Alcoa does not comply with its own sustainability principles

The definition of sustainability that has been widely adopted is outlined in the World Commission on Environment and Development's Brundtland Report as: *"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs."*

Alcoa's Visions, Values, Principles and control systems provide the foundation for integrating sustainability into its operations. Alcoa's global sustainability strategy is designed to align Alcoa's values with societal values to ensure long-term success for the company and all its stakeholders.

Building on its values, Alcoa's sustainability objective is to: *"Simultaneously 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."*

Details of how Alcoa meets these objectives can be found in section 8.1 of the ERMP (pp.247-256)

Alcoa refutes the following specific claims raised in one submission:

- Alcoa has shown respect for local residents and employees who claim their health and well-being have been affected by the refinery. A complaints system allows people to lodge complaints which have been subsequently investigated. Alcoa continues to investigate refinery emissions to ascertain whether there is any link between refinery operations and these claims.
- Alcoa acknowledges the possibility that its operations have adversely affected community well-being for those living near the refinery. The Land Management Plan was instigated to provide an opportunity for those affected to leave the area immediately surrounding the refinery (Area A) with fair compensation and to assist those wishing to sell in to the nearby towns of Hamel and Yarloop (Area B).
- It is incorrect to say WA receives no long-term benefit from Alcoa's operations (refer to section 3.15.4).
- The public is able to assess the efficiency of Alcoa's use of resources. Alcoa publishes an annual Sustainability Report which addresses this issue. In terms of the Wagerup refinery Alcoa liaises with a Community Consultative Network which is briefed on the efficient use of water, gas and relevant issues, which were further discussed with the working groups as part of the ERMP consultation process.
- Alcoa rehabilitates the jarrah forests in which it mines and its rehabilitation work has been widely recognised with a number of environmental awards. Rehabilitated forest areas are less prone to dieback and arguably more sustainable in the long-term.
- Alcoa has openly encouraged all stakeholders to participate in consultation processes in a fair and open way, including those people who oppose Alcoa operations. More than 3000 local residents were invited repeatedly to participate in the ERMP consultation and independent

facilitation ensured the process for selecting and consulting with working group members remained fair to all participants.

- Alcoa, like any other company operating in WA, is accountable to various government departments for its operations and is governed by laws, regulations and licence conditions

3.15.6 Waste of natural gas resources and restricts long term energy options for WA

Alcoa is a major contributor to regional and state energy infrastructure and has enabled the growth and sustainability of the south west region and local communities.

Alcoa's operations underwrote the original construction of the Dampier to Bunbury Gas Pipeline in the 1980s via its take or pay gas contract with SECWA. The pipeline has delivered stable, low-cost energy supplies to businesses and communities in the south west.

Alcoa underwrote 50 percent of the pipeline's debt servicing and capital repayments and contributed more than $1.4 billion over almost 20 years. Alcoa derived no benefit when the State sold the pipeline for $2.4 billion in 1998.

Alcoa is a member of the consortium which bought the pipeline in 2004 to secure its expansion. The consortium has committed $450 million to expand the pipeline capacity by 25 percent over the next 18 months. Continuing expansion of the pipeline will enable further development in the state by meeting existing and future demand for energy.

Alcoa and Alinta Limited are partnering to develop cogeneration power units at Alcoa's refineries. The plants produce both electricity and heat from the same fuel source, delivering greenhouse benefits. A year's electricity from the cogeneration unit will produce 430,000 tonnes less greenhouse gas emissions than a similar sized coal fired plant.
Each cogeneration unit will supply 140 megawatts of power, enough to provide the power needs of 90,000 households. Energy will be supplied to WA households and businesses directly through the south-west grid.

The first power plant at the Pinjarra refinery is scheduled for operation in 2005 and a second unit will be commissioned in the fourth quarter of 2006. Expansion of the Wagerup refinery could support an additional two cogeneration plants. Alcoa is already the largest co-generator of energy in Australia.

3.15.7 Alcoa to prepare closure and rehabilitation plans

Closure and rehabilitation plans for residue (the remaining footprint post refining activity) are being prepared as part of the Long Term Residue Management Strategy for each refinery. Wagerup is about to start comprehensive community consultation on residue management, including closure and rehabilitation. These plans include the treatment and re-use of water from leachate collection post-refinery, surface rehabilitation to achieve a final land-use consistent with community expectations, ongoing dust management during active residue storage and investigating alternative uses of residue as value-added product.

Upon closure of the operation, infrastructure from the refinery will be removed in accordance with licence conditions.

3.15.8 Use existing aluminium stocks through better re-use and recycling

Alcoa is committed globally to increasing the recycling of aluminium in the global market through its target of 50 percent of manufactured products to be made from recycled aluminium by 2020.

The recycle rate for automotive scrap is presently close to 90 percent and recycled aluminum now makes up more than 60 percent of aluminium used in new vehicles, and this is expected to increase further.

In Australia, Alcoa Australia Rolled Products operates the country's largest re-melting facility at its Yennora site and recycles approximately 55,000 tonnes of scrap aluminium per year.

Aluminium can recycling re-uses a valuable resource and conserves energy. Of the three billion aluminium cans sold annually in Australia, 68.5 percent, or approximately 1.9 billion, are recycled. Alcoa Australia Rolled Products processes 1.2 billion of these cans through its re-melt furnace annually, playing a significant role by reducing industry requirements for natural resources and diverting waste from landfill.

The current increase in global demand for aluminum requires not only a commitment to recycling of aluminium, but an increase in the primary production of aluminium as well. The expansion of the Wagerup refinery aims to complement our recycling initiatives and to help meet increasing global demand.

3.15.9 The refinery should use new green technology

Alcoa World Alumina has invested significant effort in developing new technology in alumina refining. Wagerup refinery has installed leading-edge technology in the control of emissions and management of resources (e.g. CTO on liquor burner, low NOx burners in power station) and is considered one of the most modern refineries in the world.

We are constantly investigating ways to improve our technology including investing more than $5.6 million in cash and kind in research as the major industry partner in the Centre for Sustainable Resource Processing.

Refer to section 3.1.3 for additional information on efficiency improvements through the Wagerup Unit Three expansion.

3.16 BIODIVERSITY

3.16.1 Require that some formal assessment of the increased mining activity (including transportation issues) is undertaken.

The project description and environmental factors that were to be covered and assessed in the Wagerup Unit 3 Environmental Review and Management Program (ERMP) were outlined in the environmental scoping document. On review of the scoping document, the EPA advised that: 'All reference to mining operations should be removed. The project being assessed is the refinery upgrade, changes to the Residue Disposal Area, changes to transport arrangements and any upgrade of the overland conveyor.' The EPA advised that 'anything that is managed by the Mining and Management Program Liaison Group (MMPLG) in the mining area defined by a previous approval should not be included'.

On this advice, Alcoa prepared and submitted the ERMP without an assessment of mining activities.

Mining operations are undertaken within the existing Mineral Lease 1SA. The MMPLG provides advice to the Minister for State Development on the environmental acceptability of proposed long term mining areas within the existing approved Mineral Lease 1SA.

The role of the MMPLG is to:

- Ensure that Alcoa's mine plans are developed and implemented, with due regard to the potential impacts of mining on the local community;
- Co-ordinate environmental auditing of the Mining and Management Programs (MMPs) submitted with Alcoa's draft mine plans;
- Continue to oversee the development of rehabilitation completion criteria;
- Employ best practice environmental management principles; and
- Regularly review and, if necessary, revise the above criteria.

The MMPLG process considers potential impacts from mining operations including vehicle movements and proposes appropriate management measures to minimise potential impacts. The truck vehicle movements associated with the transportation of fuel and oil, explosives, general goods, logging and mulch for mining have been included, for information purposes in the transportation section of the ERMP in response to queries from the working group. The expansion will result in an increase in weekly truck movements on the South West Highway, but these truck movements will comprise only 12 percent of all truck movements or 1.5 percent of all local vehicle movements on the South West Highway.

Alcoa has committed to prepare and implement a traffic management plan to manage road traffic associated with the Wagerup Unit Three expansion. Relevant community stakeholders will be consulted about the plan, which will consider such restrictions as limiting construction related heavy vehicle movements around school opening and closing times.

Further detail of the MMPLG process is provided in Section 4.3 or in Section 8.8 for traffic and transportation of the ERMP.

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Appendix A

Wagerup Emissions Inventory 2002

(refer to cd)

Appendix B

AWN Final auditors report(2003)

(refer to cd)

Appendix C

CSIRO Wagerup Air Quality Review 2004

(refer to cd)

Appendix D

Substance Selection Tables

Appendix E

Hazard Quotient and Indicies Tables

(refer to cd)

Appendix F

Revised Emission Rates

Appendix G

Sampling Methodology Tables

Appendix H

Uncertainty Sensitivity Analysis Tables

Appendix I

Data Assimilation Summary Report

Appendix J

Odour/VOC Review report

Appendix K

Calciner Three Improvement report

(refer to cd)

Appendix L

Substance and Health Risk Assessment contour plots
(with data assimilation and revised emission rates)

Appendix M

Public Submission Matrix