Pinjarra Refinery Efficiency Upgrade Environmental Protection Statement

December 2003

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ENVIRONMENTAL PROTECTION STATEMENT

PINJARRA REFINERY EFFICIENCY UPGRADE

for

ALCOA WORLD ALUMINA AUSTRALIA

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EXECUTIVE SUMMARY

The Project

The Alcoa World Alumina Australia (Alcoa) Pinjarra Alumina Refinery is located approximately 90 km south of Perth and 5.5 km east of the rural town of Pinjarra. Bauxite ore is mined at Huntly Mine on the Darling Scarp approximately 16 km northeast of the Pinjarra refinery. Alcoa's mining lease (ML1sa) is within multiple-use Jarrah forest and the surrounding forest is managed by the State for water catchment protection, timber production, recreation and conservation.

Alcoa proposes to improve the efficiency of the Pinjarra Alumina Refinery to increase alumina production capacity of the facility by approximately 600,000 tonnes per annum to 4.2 million tonnes per annum. The production from the Efficiency Upgrade (the project) equates to an 17% increase in annual alumina production from the refinery.

The project does not require major alterations to existing plant and infrastructure, but centres around provision of a new seed filtration process, which increases the alumina precipitation rate that can be achieved. This in turn, enables an increased refinery throughput. The increased throughput will require additional facilities including a ball mill, slurry storage tank and calciner. A reduction in atmospheric emissions will result from the addition of Regenerative Thermal Oxidisers (RTO) on the digestion circuit and oxalate kiln.

Table E1: Key Characteristics of the Pinjarra Refinery Efficiency Upgrade [1]

Characteristic	Units	Current Refinery	Upgraded Refinery
Alumina Production	Mtpa	3.5 (+ 0.1 Mtpa continuous improvement in alumina production)	4.2
Refinery Operations		Continuous operation	Continuous operation
Bauxite Mine		Continuous operation	Continuous operation
Bauxite Mining Rate [2]	Mtpa	20.6	22.6
Project Life	yrs	>50	>45
Capital Investment	A$	-	440 million
Refinery Footprint	Ha	250	250
Construction Period	yrs	-	2
Workforce (peak construction)	persons	-	1000
Workforce (operation) (Refinery + mine)	persons	1,570	1,570
REFINERY INPUTS			
Bauxite	Mtpa	13	15
Caustic Soda	tpa	210,000	245,000
Lime	tpa	176,000	195,000
Water	MLpa	6,130	7,400
REFINERY OUTPUTS			
Atmospheric Emissions			

Characteristic	Units	Current Refinery	Upgraded Refinery
Particulates (from stacks)	tpa	190	140
Oxides of Nitrogen (NO_x)	tpa	1,120	640
Carbon Monoxide (CO)	tpa	815	815
Volatile Organic Compounds (VOCs)	tpa	180	162
Greenhouse Gases (Net CO_2 –Refinery with Alinta Cogeneration Project)	tpa	2,045,000 (3)	2,347,000 (3)
Greenhouse gas emission intensity	$kgCO_2$/t alumina	583 (3)	564 (3)
Noise		Compliance with *Environmental Protection (Noise) Regulations 1997*	Compliance with the *Environmental Protection (Noise) Regulations 1997*
Bauxite Residue	Mtpa	6.41	7.73

Notes:

(1) Data presented for Current and Upgraded refinery does not include inputs or outputs from the Alinta Cogeneration Project, although they have been considered in the context of cumulative air quality impacts upon nearby residences.

(2) Huntly mine also supplies ore to Alcoa's Kwinana Refinery.

(3) Includes impact of Pinjarra refinery energy savings associated with the Alinta Cogeneration Project Stages I and II.

It is anticipated that the engineering design phase of the project will take approximately six months and preliminary design and feasibility work is already underway. Construction will commence following the receipt of government approvals, and it is proposed to commence operation of the upgraded project components towards the end of 2005.

Environmental Approvals

State government approval for the Pinjarra refinery was granted in 1969 under the *Alumina Refinery (Pinjarra) Agreement Act 1969*, and the Pinjarra refinery is not subject to Ministerial Conditions pursuant to the Part IV provisions of the *Environmental Protection Act 1986*. However the refinery and associated mining activities operate subject to various environmental approvals and consents. Two examples of such approvals are the rolling Five-Year Mine Plan prepared in consultation with the Mining and Management Program Liaison Group (MMPLG) and the Long-term Residue Management Plan prepared in consultation with the Residue Planning Liaison Group (RPLG). These liaison groups include representatives of the key decision making bodies, and these plans require endorsement by the Minister for Environment.

The Environmental Protection Authority (EPA) has advertised its intention to set the level of environmental assessment at an Environmental Protection Statement (EPS). Management of environmental issues will be dealt with by the Ministerial Conditions and Proponent's Commitments arising from the EPS process, together with the Works Approval and Licence issued under the *Environmental Protection Act 1986.*

As part of the EPS process, Alcoa has implemented an extensive consultation program, which ensures both the local community and other interested stakeholders are involved in the development of environmental management components for the upgrade. Alcoa is developing this project within a sustainability framework, taking a triple bottom line approach to decision-making. During development of this EPS, Alcoa has consulted with a number of key Decision-Making Authorities (DMAs).

Sustainability Principles and Stakeholder Engagement

This is the first project to which Alcoa will apply its newly-adopted sustainability principles. Community engagement will guide Alcoa in shaping the project to ensure it will deliver net benefits for the community and guide the development of action plans that will implement the company's sustainability principles. Stakeholder participation has been implemented in the context of Alcoa's Sustainability Principles, which are driven by the inclusion of environmental, social and economic factors.

The Principles are as follows:

- *Respect & Protect People*
- *Building Community Experience and Well-being*
- *Long-term Economic Benefit*
- *Efficient Resource Use & Cleaner Production*
- *Ecological Integrity & Biodiversity*
- *Meeting the Needs of Current and Future Generations*
- *Stakeholder Involvement*
- *Accountability & Governance*

Alcoa has developed a comprehensive consultation and engagement process that builds on the existing Community Consultation Network (CCN). This process included the establishment of the Stakeholder Reference Group (SRG). The SRG was established during an independently facilitated stakeholder workshop where the composition and role of the SRG was determined by the key stakeholders. The SRG currently comprises:

- members of the local community and refinery neighbours;
- representatives of Alcoa Pinjarra refinery workforce;
- Local Government;
- Pinjarra businesses;
- Non-government Organizations (NGOs);
- Department of Environment (DoE);
- Department of Industry and Resources (DoIR); and
- Alcoa Efficiency Upgrade representatives.

Following the selection of representatives, the SRG agreed on the Terms of Reference, scope of facilitation, and appropriate communication modes. The SRG is being supported by Working Groups established to address specific issues of importance to the SRG. An Expert Review Panel also assists the SRG by providing technical review and advice on specific issues and comprises various independent environmental and public health specialists.

Existing Environment

Biophysical

The Pinjarra refinery is located in the Peel region which has a temperate Mediterranean climate, characterised by warm, dry summers and mild, wet winters. The refinery is located near the foothills of the Darling Scarp where the Pinjarra Plain meets the Ridge Hill Shelf. The Huntly Mine is located in the Darling Ranges in the Jarrah forest. Alcoa's mineral lease ML1sa also covers parts of the water catchments that supply Perth and some rural areas. The current (White Road) Alcoa mining areas are bounded by the Dandalup River to the north, and the South Dandalup River to the south. These rivers both flow into dams that ultimately flow westwards into the Murray River, discharging to the Peel Inlet on the coast near Mandurah. Future mining areas (McCoy area) also occur within the Serpentine River catchment, which flows into the Serpentine Dam.

Three major aquifer systems are recognised in the Pinjarra area. These are the upper superficial aquifer, the underlying Leederville aquifer and the deeper Cattamarra aquifer (from which Alcoa abstracts water).

Social

The Peel region has the second largest population of all regions in Western Australia (approx 76,000) and is experiencing a population growth rate almost double that of the rest of the state, the second highest behind the Perth metropolitan region. This rapid growth comes with some challenges. Public services are often regarded to be lagging behind the growing demand.

Mandurah is the major population, business, infrastructure, and services centre for Peel and is one of the largest urban centres outside the Perth metropolitan area. The economy of the Peel Region is based predominantly on mining and mineral processing, mainly sourced from Alcoa's Pinjarra and Wagerup refineries, and Huntly and Willowdale mines and the Worsley bauxite mining operations near Boddington. The main inland centres of Peel are Byford, Pinjarra, Waroona and Boddington. The Pinjarra refinery is located approximately 5.5 km east of Pinjarra, which is the largest population centre in the Murray Shire and acts as a service centre for the surrounding farming communities. A total of 603 people live in Pinjarra and approximately 31% of these are employed by Alcoa.

Potential Impacts of the Project and Proposed Management

Stakeholder consultation and technical review has highlighted that the key environmental issues associated with the Pinjarra refinery Efficiency Upgrade are:

- air quality including odours and dust;

- greenhouse gas emissions;
- noise; and
- water supply.

Each of these issues, and others raised during consultation, have been addressed as part of stakeholder involvement, development of the proposal and preparation of this Environmental Protection Statement.

Owing to the pre-existence of the mine and plant, and the use of existing refinery equipment wherever practical, the project is not expected to have a significant impact upon the following issues which will be proactively managed by Alcoa in line with its existing practices and requirements:

- forest clearing;
- flora, vegetation or fauna;
- rivers, creeks, wetlands and estuaries;
- areas of significant conservation value;
- groundwater contamination
- solid waste management;
- cultural heritage; or
- regional social values.

Whilst mining activities will essentially not change, the Efficiency Upgrade will require the timing of the approved mine plans to be brought forward.

Alcoa believes that the Efficiency Upgrade will result in positive impacts on the community including further development of the alumina industry within Western Australia, a capital investment of about A$440 million, employment generated by a construction workforce of up to 1,000 people and regional and State benefits to the economy.

Consultation with the local community has highlighted the need for continued support of local businesses and community development initiatives, and the provision of training and skills development. The potential environmental and socio-economic impacts, and proposed management measures are presented in Table E2. A summary of Alcoa's commitments to management of environmental and social aspects is presented in Table E3.

Table E2: ENVIRONMENTAL FACTORS

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Air quality	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards.	The Pinjarra refinery is the largest industrial source of atmospheric emissions in the area, although other sources such as motor vehicles, agricultural activities, wildfires or hazard reduction burning, and the use of domestic wood heaters are also significant contributors to atmospheric emissions on occasion. The nearest residence is located 3.5 km to the north-northeast of the refinery, and the town of Pinjarra is located 5.5 km west of the refinery.	Increased production could result in increased air emissions.	Installation of new air pollution control equipment, or upgrading of existing control equipment to minimise emissions of VOCs, particulates and NO_x from key sources within digestion, the Oxalate kiln, powerhouse and calcination. Sprinkler coverage will be improved on residue drying areas on the western edge of the RDA (closest to the Pinjarra town site).	Reduction in total Refinery emissions of key pollutants (i.e. VOCs, particulates and NO_x). Compliance with nationally recognised ambient air quality criteria. Little likelihood of health effects being caused by either acute or chronic exposure of the general public to refinery emissions. Overall improvement in air quality, including a reduction in odour impacts, and potential public health impacts.
Greenhouse Gas Emissions	To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.	The existing refinery emits 2,299,000 tpa (CO_2 equivalent) greenhouse gases which equates to 656 kg CO_2/t alumina, making the existing refinery already one of the most energy efficient within Australia and throughout the world.	Increased production could result in increased greenhouse gas emissions.	Incorporation of a number of key energy saving initiatives to further improve the overall energy efficiency of the Pinjarra refinery.	Greenhouse gas emissions intensity of the refinery Efficiency Upgrade alone (excluding the Alinta Cogeneration Project) is estimated to improve by approximately 5% compared to the existing refinery, to 625 kg CO_2/t alumina. With the energy savings that will be made at the refinery as a result of the Alinta Cogeneration Project, the greenhouse gas intensity of the refinery will further improved, reducing to 564 kg CO_2/t alumina.
Noise - Refinery	To comply with statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from refinery operations.	Closest residents under critical meteorological conditions are approximately 4 km south of the refinery. The refinery has implemented noise controls to ensure compliance of the existing refinery with the *Environmental Protection (Noise) Regulations 1997* and removed an existing 5 dB(A) penalty for tonal noise. A follow-up noise compliance survey confirms noise emissions are within the regulations requirements.	Modelling of the Upgrade has shown potential exceedence of the noise regulations without noise attenuation measures.	Implementation of noise controls in upgraded parts of the refinery such as: -acoustic shroud over new mill shell; -full enclosure of the additional calcinations blowers; -provision of adequate intake and discharge silencers for blowers; -high efficiency fans; -best practice design for new seed filtration building; - attenuation of steam valves and pipe-work breakout noise; and -upgrade of oxalate kiln to attenuate fan noise from stack.	No increase in noise emissions from existing refinery. Maintain compliance with noise regulations.
Noise – Rail	To comply with statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from refinery operations.	From the refinery, rail operations head north to Kwinana and south to the port of Bunbury. Residents are located in proximity to the spur lines into Pinjarra refinery, and noise from the northern spur has resulted in a number of complaints from Pinjarra residents.	No change in operations will occur along the northern line (and northern spur). Increased number of alumina wagons and possibly caustic trains may increase existing noise impacts.	Speed controls on curved sections of the rail and improved maintenance of train lubrication systems in conjunction with Westnet Rail. Investigate realigning the problem curve for the northern spur, in conjunction with Westnet Rail, to reduce existing noise impacts.	No increase in rail noise as a result of the Efficiency Upgrade. Reduction in noise from existing operations if feasible.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Noise - Mine	To comply with statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from mine operations.	Nearest residence to current mining areas is 3 km and future mining areas, 7 km. Noise impacts from blasting currently assessed using the Blast Acoustic Model and managed to minimise disturbance to neighbours.	No change from existing operations. Mining noise impacts will be reduced in the McCoy mining area due to greater distance to nearest residents.	Continue existing noise management practices.	No increase in mining noise. Maintain compliance with noise regulations.
Water Supply	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	Water supply for the Huntly Mine is from: -Banksiadale Dam; -Boronia Waterhole; -Pig Swamp Waterhole; -South Dandalup Dam (drought contingency). Water supply for the Pinjarra refinery is from: -Oakley Brook Detention Dam; -Lower Oakley Pumpback; -Barritt Brook Detention Dam; -Pinjarra sewage treatment plant; -Cattamarra aquifer; -Murray groundwater area (drought contingency). Sustainable yield of the Cattamarra aquifer is 2,500 MLpa. Recent drought years have required abstraction from the Murray groundwater area.	An additional 1,100 MLpa is required for the Efficiency Upgrade. Potential increased draw on surface water supply and potential impact on groundwater resources	Continual improvement in water use efficiency. Alcoa is currently investigating options for a secure water supply for the Efficiency Upgrade. Preference will be to use recycled water from the Mandurah Sewage Treatment Plant. If this option is not available other options may include: -water from South Dandalup Dam; -increased abstraction of groundwater (subject to further study on sustainable yield); -desalination of water from Murray River. The selected water supply option will be subject to further consultation and environmental approvals.	No adverse impacts on surface water or groundwater resources. Avoid inappropriate use of high-grade water.
Increased mining rate (Biodiversity) (Land) (Conservation Areas) (Soil Quality) (Decommissioning)	To maintain the abundance, diversity, geographic distribution and productivity of flora and fauna species, and ecosystems through the avoidance or management of adverse impacts and improvement in knowledge. To maintain the integrity, ecological functions and environmental values of the soil and landform. To protect the environmental values of areas identified as having significant environmental attributes. To ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate criteria. To ensure as far as practicable that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and environmental values	Mining is currently undertaken in the Jarrah forest in the Darling Plateau at Huntly (16 km northeast of the refinery), with future mining in the McCoy area (24 km northeast of the refinery).	Rate of mining to be increased by approx. 30 ha per year within areas already approved for mining.	Continue mining in accordance with the Government approved procedures and practices set out in the Five-year Mine Plan. Development and review of the Mine Plan is the subject of separate consultation and environmental approvals process. Continue best practice rehabilitation practices and increase rate of rehabilitation by approx. 30 ha per year to compensate for increased rate of clearing.	Bring forward the timing of the approved Mine Plan. Shorten mine life by approximately 10%. Return mining areas to ecologically sustainable Jarrah forest.
Bauxite Residue Disposal	To ensure that there are no adverse impacts on the amenity of people, or land uses as a result of operation of the RDAs.	The existing RDAs are located within Alcoa farmlands which act as a buffer to the town of Pinjarra approximately 2.5 km to the east of the RDAs.	Rate of residue deposition will increase by approximately 20% as a result of increased efficiency.	Continue residue disposal in accordance with the approved procedures and practices in the Long-term Residue Management Plan (LTRMP).	Bring forward the timing of the approved LTRMP, including development of future RDA areas.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
				Development and review of the LTRMP is the subject of separate consultation and environmental approvals process.	
Groundwater Contamination	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	Contamination of groundwater from caustic is restricted to an area beneath the plant and beneath the RDAs.	No predicted groundwater contamination impacts as a result of the Upgrade.	A risk assessment will be undertaken to determine the need for foundations for the Upgrade to have a liner below any new concrete slabs to prevent groundwater contamination in the event of slab failure. Existing groundwater contamination remediation will continue.	No groundwater contamination as a result of the upgrade. Remediation of existing groundwater contamination.
Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	No areas of heritage significance are located within or near areas proposed for the Efficiency Upgrade. Aboriginal and European heritage areas are avoided during mining.	No additional impacts.	Continue pre-mining surveys to avoid significant areas. Continue liaison with key stakeholders with regards to Aboriginal and European heritage.	No additional impacts
Risk	To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.	Existing risks associated with the refinery and mining operations meet acceptable standards.	Potential risks associated with construction within an existing refinery. No increase in operational risks.	Construction risks to be managed within the existing Alcoa Health and Safety requirements. HAZOP analysis conducted during the design phase of the Efficiency Upgrade will ensure no increase, or a decrease in operational risk.	No increased risks.
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.	The Pinjarra refinery is visible from vantage points near Pinjarra, however, the Huntly mining areas are not visible from vantage points generally open to the public.	No additional impacts	The Efficiency Upgrade is within the context of an existing refinery, and new equipment installed will not be highly visible from main vantage points.	No additional impacts
Recreation	To ensure that existing and planned recreational uses are not compromised.	The refinery is located away from popular recreational sites, with the exception of the Pinjarra racecourse, approximately 1.4 km to the west of the RDAs. Access is restricted in areas of the forest where mining is being carried out to minimize the spread of dieback disease and ensure public safety.	No additional impacts	Continue existing air quality and noise monitoring and management practices	No additional impact
Solid Waste (other than bauxite residue)	To reduce as far as practicable the generation of solid and liquid wastes resulting from the Pinjarra operations. To dispose of wastes in an environmentally acceptable manner.	Alcoa has a comprehensive waste reduction, re-use and recycling program in place. Non-recyclable wastes are disposed of to a landfill adjacent to the RDAs.	Some construction wastes will be generated. There will be little change in the generation of operational waste.	Continue to implement waste reduction, re-use and recycling practices to achieve Alcoa's internal target of zero non-process waste to landfill by 2008.	No additional impact.
Decommissioning	To ensure as far as practicable that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and environmental values.	Mining areas are progressively rehabilitated to Jarrah forest throughout the life of the mine. Rehabilitation of the RDAs will be undertaken as operational cells are completed. Decommissioning of the refinery is not expected for	No change in the overall requirements for decommissioning as a result of the Upgrade.	Continue to undertake progressive rehabilitation in mining areas. Continue to rehabilitate completed RDA cells and provide for the eventual decommissioning of the refinery.	No additional impact.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
		more than 45 years.			
Community Consultation	Ensure that the local community is adequately consulted in relation to this proposal and any subsequent changes to the proposal	A Community Consultative Network (CCN) has been in operation since 1994 to address community concerns with Alcoa's operations.	Improved community relations through formation of the Stakeholder Reference Group (SRG).	Consult with the SRG and wider community to provide input into the management of the Efficiency Upgrade.	Improved community relations.
Socio-economic impacts	Ensure that the activities of the proposal are undertaken with minimal practicable disruption, and provide net benefits to the local community.	Alcoa is currently involved in numerous community initiatives to enhance community well being (e.g. training, education and employment programs, support of local business, research and financial and in-kind contributions).	No negative impacts. The Efficiency Upgrade will provide up to 1,000 new jobs during construction.	Continue existing community initiatives. Investigate further opportunities/partnerships to aid the community. Increased use/support of local business.	Local community will continue to benefit from being located near the Pinjarra refinery.
Road and Rail Traffic	To reduce, as much as practicable, the impacts on affected communities of the road and rail traffic resulting from the Project	All roads and railways related to this project are already in existence. Bauxite to supply the Kwinana Refinery is railed north, and alumina is railed South to Bunbury and north to Kwinana. Caustic is supplied by rail from Bunbury and Kwinana.	Increase in road activity during the construction period. Slight increase in road traffic during operations. Impacts on the South Western Highway and Pinjarra expected to be minimal. There will be an increase in rail transport by 6-8 alumina wagons per train and possibly increase in caustic train movements south.	Encourage traffic movements away from residential areas.	No significant impacts.

Table E3: List of Commitments for the Pinjarra Refinery Efficiency Upgrade

No.	Issue	Commitment
1	General environmental management	Alcoa will be guided by its sustainability principles and will operate within the guidelines of its Environmental Management System (EMS) at all stages of the Pinjarra refinery Efficiency Upgrade.
2	Air Quality	a) Alcoa will install air pollution control equipment at the Pinjarra refinery to achieve: • a reduction of about 10% in VOC emissions; • a reduction of about 25% in particulate emissions from the calciners; • a reduction of over 90% in CO emissions from the Oxalate kiln; and • an offset of the increase in general refinery NO_x emissions by installing low-NO_x burners in the power station. b) Alcoa will improve the management of dust from residue areas through an upgrade of the existing sprinkler network and other operational controls consistent with the Long Term Residue Management Plan which will be revised in consultation with the community. c) Alcoa will undertake a study of its residue dust to better understand its particle size distribution and composition. d) An air dispersion model validation study will be completed to assess the performance of available models with respect to predicting air quality impacts from the upgraded Pinjarra refinery. The temporary ambient gaseous air pollutant monitoring network will continue to be operated for a period of time as part of the air dispersion model validation study. e) An ongoing targeted source monitoring program will be carried out at the Pinjarra refinery to further characterise and improve the understanding of atmospheric emissions from the refinery.

No.	Issue	Commitment
3	Greenhouse Gases	a) Alcoa will achieve a reduction in the greenhouse gas emissions intensity of the Pinjarra refinery as a result of the Efficiency Upgrade of approximately 5%. b) Alcoa will review opportunities to improve the energy efficiency of equipment to be installed as part of the Efficiency Upgrade during the detailed design phase of the project using a Cleaner Production review process. c) Alcoa will maintain ongoing involvement in programs such as the Greenhouse Challenge and Generator Efficiency Standards programs, community initiatives, and research and development, that contribute to the management of the global climate change issue.
4	Noise	a) Alcoa will ensure that noise from mining operations continues to comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* as a result of the Efficiency Upgrade. b) Alcoa will ensure that noise from the refinery continues to comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* as a result of the Efficiency Upgrade. c) Alcoa will prepare a noise management plan for this project, which will outline how compliance with the *Environmental Protection (Noise) Regulations 1997* will be maintained. The noise management plan will include a monitoring program at the nearest receptor locations to the north and south to demonstrate compliance with Commitment 4b.
5	Vegetation Clearing	Alcoa will operate within the guidelines of its current approved Five-year Mining and Management Program to supply ore for the Efficiency Upgrade, although the timing of the Plan will be brought forward by about one year. The annual rehabilitation program will be adjusted in subsequent years to include rehabilitation of the additional area which will be mined each year.
6	Water Use	a) Alcoa commits to ongoing protection of the Oakley and Barritt Brooks by ensuring that downstream Environmental Water Requirements (EWR) continue to be met. b) Alcoa will continue to implement water conservation initiatives to achieve its water use reduction goal. c) The refinery will continue to use best practicable technology to conserve water, and ensure no adverse environmental impacts will result from the supply of water for the upgrade.

No.	Issue	Commitment
7	Residue Management	Alcoa will manage the bauxite residue generated from the Efficiency Upgrade in accordance with Pinjarra refinery revised Long-term Residue Management Plan (LTRMP).
8	Surface Water	Alcoa commits to continue its mining operations under current approved guidelines as set out in its Five-year Mine Plan, including water monitoring and response procedures as defined in that plan.
9	Community Consultation	Alcoa will continue to support stakeholder participation through the Stakeholder Reference Group and supporting framework, and will incorporate advice into the Efficiency Upgrade, until the project is commissioned.
10	Socio-economics	Alcoa commits to apply its procurement policy to ensure that opportunities for local spending are explored and taken where commercially appropriate.

ENVIRONMENTAL PROTECTION STATEMENT
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE

for
Alcoa World Alumina Australia

1. INTRODUCTION

1.1 THE PROPOSAL

Alcoa World Alumina Australia (Alcoa) proposes to improve the efficiency of the Pinjarra Alumina Refinery (the refinery – Figures 1 and 2) to increase alumina production capacity of the facility by approximately 600,000 tonnes per annum (tpa), to 4.2 million tonnes per annum (Mtpa). The production from the Efficiency Upgrade (the project) equates to a 17% increase in annual alumina production capacity from the refinery. The Efficiency Upgrade project uses the latest technology in the precipitation area of the refinery process to improve the overall operating efficiency of the Pinjarra plant. Pinjarra will install a new "seed filtration" facility to increase the productivity of the precipitation area thereby enabling an increase in the bauxite processing rate. Increased production of alumina will require increasing the rate of bauxite mining at the Huntly bauxite mine, improving processing technology, increasing the capacity of existing components in the refinery and installation of some new equipment.

In addition to improving production capacity, further atmospheric emissions controls will be installed as part of the project. These new emission control measures are expected to result in:

- an overall reduction of about 10% in volatile organic compounds (VOCs) emissions over existing emissions;
- a 25% overall reduction in particulate emissions from the calciners;
- a reduction in dust from the residue area;
- greenhouse gas emission intensity being reduced by approximately 5%;
- a reduction of over 90% in carbon monoxide (CO) emissions from the Oxalate kiln; and
- offsetting the increase in general refinery oxides of nitrogen (NO_x) emissions by installing low NO_x burners in the power station (i.e. no net increase in NO_x emissions).

Alcoa has developed and implemented a comprehensive community consultation process which includes a Stakeholder Reference Group (SRG) that will ensure the local community is directly involved in the development of environmental management components for the project. Alcoa's existing Community Consultative Network (CCN), established in 1994, is represented on the SRG and will continue to be consulted. A broader range of stakeholders have been involved through regular communications, periodic meetings with project team members and a public open day during the preparation of this EPS.

Alcoa is developing this project within a sustainability framework, taking a triple bottom line approach to decision-making. Community information and involvement will include a process

whereby Alcoa will work with stakeholders to identify local initiatives, with socio-economic benefits, which can be jointly supported. Alcoa sees this as a partnering approach which will be the way forward for future community involvement. The consultation process also includes broadening the stakeholder base at a regional and Western Australian level.

1.2 THE PROPONENT

Alcoa World Alumina Australia, the Proponent for the Pinjarra Refinery Efficiency Upgrade, is one of 25 Alcoa Inc. business units, and is a trading name of the unlisted public company, Alcoa of Australia Ltd. The principal shareholders of Alcoa of Australia Ltd are:

- Alcoa International Holdings Company (60%); and
- Alumina Limited (39.25%) (previously WMC Ltd).

The remaining 0.75% is held by QBE Investments Pty Ltd and QBE Nominees Pty Ltd. Both Alcoa Inc. and Alumina Limited are listed on the Australian Stock Exchange.

Alcoa is the world's leading producer of alumina. Alcoa's alumina refineries at Kwinana, Pinjarra and Wagerup have a combined annual production capacity of 7.3 million tonnes (Mt), equivalent to some 15% of world demand. The Pinjarra refinery current annual operating capacity is 3.5 million tonnes and has been operating since 1972.

Environmental management is a high priority for Alcoa in all aspects of its operations, as reflected in Alcoa's Sustainability Principles (Section 1.9). Accordingly Alcoa has developed and implemented a comprehensive Environmental Management System (EMS) for the Pinjarra refinery (Section 6.1.1), which was certified to the International Standards Organisation 14001 EMS Standard in February 2001.

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1.3 PROJECT BACKGROUND

The Pinjarra Alumina Refinery (the refinery), the second largest in the world, is located 5.5 km east of the town of Pinjarra, which is 90 km south of Perth and some 18 km southeast of the coastal city of Mandurah. Pinjarra was the second of Alcoa's Australian refineries to be constructed and began operations in 1972 at an initial annual production rate of 210,000 t. This grew over the years to the 3.5 Mt now produced each year. Continuous improvement is expected to see a further increase in alumina production of 0.1 Mtpa before the Efficiency Upgrade is commissioned.

Since commissioning of the Pinjarra refinery, Alcoa has been involved in a program of continual improvement. This has included research into issues such as cleaner production, improved efficiency (e.g. water, energy and raw material efficiency), improved refinery performance, and improved rehabilitation practices. As a result, the current refinery is a much more cost-effective and environmentally sound operation than the original refinery, and Alcoa's achievements in continually improving environmental performance have been internationally recognised.

The Efficiency Upgrade presents an ideal opportunity to increase production primarily using existing infrastructure. The proposed upgrade will also improve management of environmental issues such as air emissions, by introducing improved pollution control equipment.

1.4 PROJECT SCHEDULE

It is anticipated that the engineering design phase of the project will take approximately six months and preliminary design and feasibility work is already underway. Construction would commence following the receipt of government approvals, and it is proposed to commence operation of the upgraded project components towards the end of 2005.

1.5 PROJECT LOCATION

The Pinjarra refinery is in the Shire of Murray in the Peel region south of Perth, Western Australia and located approximately 5.5 km east of the Pinjarra town site. The refinery is located on industrial-zoned land owned by Alcoa, which incorporates the residue disposal areas (RDAs) and a buffer zone

encompassing an area of over 6,000 ha of freehold property. The surrounding land-use is predominantly rural, with most of the region between the South Western Highway and the Darling Scarp cleared of natural vegetation. The major agricultural activities in the region are beef cattle and sheep grazing. The nearest residential property is off North Spur Road and is located approximately 3.5 km north-northeast of the refinery. There are other residences on Napier Road 4 km to the south of the refinery (Figure 2) and at Fairbridge Village 5 km to the north (Figure 3).

Bauxite ore is mined at Huntly Mine in the Darling Range (Figures 1 and 3). The Huntly Mine is located 16 km northeast of the Pinjarra refinery. The mine is within multiple-use Jarrah forest and the surrounding forest is managed by the State for water catchment protection, timber production, recreation and conservation. The multiple-use forest acts as a buffer to conservation reserves to the east. The nearest residences to the current mining activities at Huntly are located 3 km from the White Road mining area. Nearest residences to the future McCoy mining area will be 7 km to 10 km away.

1.6 LAND TENURE

Alcoa's mineral lease ML1sa (Figure 4), which encompasses an area in the Darling Range from east of Perth to east of Bunbury, was granted in 1961 under the *Alumina Refinery Agreement Act 1961*. Alcoa's Huntly bauxite mining operations and the Pinjarra refinery are located in the central and western parts of the mining lease. The eastern boundary of mining lease ML1sa adjoins the Worsley mining lease ML258sa.

Since 1961 a series of reviews of conservation reserves have been undertaken to improve biodiversity protection in this region. As a result, Alcoa has agreed not to mine in the conservation areas and that agreement was incorporated in the *Alumina Refinery Agreement 1961* through a 1986 amendment, which will be modified to account for the additional reserves established under the Regional Forest Agreement between the State and Commonwealth, and the current Forest Management Plan review process (refer to Section 6.8).

1.7 LEGISLATIVE FRAMEWORK

1.7.1 Existing Environmental Approvals

State government approval for the Pinjarra refinery was granted in 1969 under the *Alumina Refinery (Pinjarra) Agreement Act 1969*. As the Pinjarra refinery was established before the introduction of environmental protection legislation in Western Australia, it is not subject to Ministerial Conditions pursuant to the Part IV provisions of the *Environmental Protection Act 1986.* However, the refinery and associated mining activities operate subject to various environmental approvals and consents including:

- Environmental Licence and project Works Approval pursuant to Part V of the *Environmental Protection Act 1986*;
- Surface and groundwater licences pursuant to *Rights in Water and Irrigation Act 1914*; and

- Dangerous Goods Licence pursuant to the *Explosives and Dangerous Goods Act 1961*;
- Annual approval of mine plans and associated management programs by the Minister for State Development on recommendation from the Mining and Management Program Liaison Group (MMPLG – refer to Section 3.1); and
- Development of a long-term residue management plan (LTRMP) in consultation with the Residue Planning Liaison Group (RPLG) and endorsement of these plans by the Minister for Environment.

Recently, Alinta Cogeneration (Alcoa Pinjarra) Pty Ltd, a wholly owned subsidiary of Alinta Limited, secured environmental approval for the Pinjarra Cogeneration Project to be located at the Pinjarra refinery. The Alinta Cogeneration Project will supply high-pressure steam to the refinery, and Alinta will sell electrical energy to customers connected to the South-West Interconnected System (SWIS).

1.7.2 Environmental Approval Process

Alcoa has submitted an Environmental Referral for the Pinjarra Refinery Efficiency Upgrade to the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (as amended).

The EPA has advertised its intention to set the level of environmental assessment at an Environmental Protection Statement (EPS). Alcoa considers that an EPS level of assessment is appropriate for the project as the planned upgrade will help to reduce the environmental impacts of the refinery, as well as improve value-adding to Western Australia's bauxite resources and creating opportunities for employment through suppliers to the project. Management of environmental issues will be dealt with by the Ministerial Conditions and Proponents Commitments arising from the EPS process, together with the Works Approval and Licence issued under the *Environmental Protection Act 1986.*

During development of this EPS, Alcoa has consulted with the community (refer to Section 7.1) and a number of key Decision-Making Authorities (DMAs) including:

- Department of Environment (DoE) - formerly Department of Environment, Water and Catchment Protection and prior to that, Department of Environmental Protection and Water and Rivers Commission;
- Department of Conservation and Land Management (CALM);
- Water Corporation;
- Department of Industry and Resources (DoIR) - formerly Department of Minerals and Petroleum Resources and prior to that, Department of Minerals and Energy and Department of Industry and Resources;
- Department of Health; and
- Local Government.

The Proponent is also required to comply with local and State planning requirements as set out by the Department of Planning and Infrastructure (DoPI). However, the proposal lies wholly within the

existing facility boundary of the Pinjarra refinery and the intended land use for the project site is consistent with the land's current zoning. Therefore planning approval is not considered part of the environmental approvals process.

In developing the project, Alcoa would comply with all relevant legislation, and regulations associated with that legislation, such as:

- *Aboriginal Heritage Act 1972;*
- *Agriculture and Related Resources Protection Act 1976;*
- *Bush Fires Act 1954;*
- *Conservation and Land Management Act 1984;*
- *Environmental Protection Act 1986 (as amended);*
- *Environmental Protection Regulations 1987;*
- *Environmental Protection (Noise) Regulations 1997;*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act;* Cmwlth*);*
- *Explosives and Dangerous Goods Act 1961;*
- *Dangerous Goods Regulations 1992;*
- *Mining Act 1978 (as amended);*
- *Occupational Safety and Health Act 1984;*
- *Rights in Water and Irrigation Act 1915 (as amended);*
- *Water Supply Sewage and Drainage Act 1912;*
- *Waterways Conservation Act 1976;* and
- *Wildlife Conservation Act 1950 (as amended).*

In addition, the *Dangerous Goods Safety Act 2002*, which will replace the current legislation on dangerous goods, and the *Contaminated Sites Bill 2000* will be considered, as these will probably be promulgated by the time the project is commissioned.

Agreements and treaties that may affect the project are:

- Montreal Protocol on Substances that Deplete Ozone;
- United Nations Framework Convention on Climate Change;
- National Greenhouse Response Strategy;
- National Strategy for Ecologically Sustainable Development;
- "Hope for the Future" - The Western Australian State Sustainability Strategy; and
- Greenhouse Strategy for Western Australia (in development).

The National Environment Protection Measure (NEPM) for ambient air quality which provides standards and goals for criteria pollutants (carbon monoxide, nitrogen dioxide, photochemical oxidants (as ozone), sulphur dioxide, lead and particulates (less than 10 μm [i.e. PM_{10}]) has been used in considering the air quality impacts of these pollutant emissions from the refinery.

The project will increase the rate of forest clearing for mining by about 30 ha per year (9 %) and the Five-year Plan for mining takes into account legislation and policies such as the *Western Australian Wildlife Conservation Act 1950, Conservation and Land Management Act 1984, Soil and Land Conservation Act 1945*. The Mine Management Planning and Liaison Group (MMPLG) was established under the *Alumina Refinery (Wagerup) Agreement* and *Acts Amendment 1978*, and its role in managing environmental aspects of the mining operations was recognised in the Ministerial Statement 390 of 11 August 1995 on Alcoa's proposed expansion of the Wagerup Alumina Refinery. The refinery upgrade itself will not have any direct impact on remnant vegetation or native fauna as the site is already cleared and has been used for many years for industrial purposes. Therefore the above Acts and Perth's *Bush Forever Policy* are not directly considered in this EPS.

1.8 STRUCTURE OF THIS EPS

Section 1 sets out the background and legislative requirements and Section 2 discusses the justification, benefits and alternatives considered for the project. Section 3 describes the existing mine and refinery operations, followed by Section 4 which provides details of the upgrade. Section 5 describes the biophysical and social environment so that project information can be assessed in context. Sections 6 and 7, respectively, provide a detailed discussion of the potential environmental and social impacts and proposed management measures. Section 8 summarises the environmental and social commitments associated with the project.

1.9 ALCOA SUSTAINABILITY PRINCIPLES

This is the first project to which Alcoa will apply its newly-adopted sustainability framework. Community engagement is being used to guide Alcoa in shaping the project to ensure it will deliver net benefits for the community and guide the development of action plans that will implement the company's sustainability principles.

Stakeholder participation has been implemented in the context of Alcoa's Sustainability Principles, which are driven by the inclusion of environmental, social and economic factors. The Principles, as stated by Alcoa's Australian operations, are as follows:

> ***Respect & Protect People***
> *We listen to, and respect the views of our workforce and the communities wherever we operate, and we formulate partnerships that strengthen our interdependence and improve well-being.*
>
> ***Building Community Experience and Well-being***
> *Our operations contribute to improved quality of life and build skills, knowledge and experience in the communities with which we interact, while respecting the significance and diversity of their culture and heritage.*

Long-term Economic Benefit

Our operations deliver economic benefits to the regions and States in which they operate, to the nation, and to society in general. Our operations foster economic growth, generate wealth for the community, provide commercial returns to our shareholders and contribute to long-term economic health.

Efficient Resource Use & Cleaner Production

We use natural resources wisely and manage our environmental impacts to the benefit of the full range of our stakeholders by employing leading technology and best practice management, and by encouraging responsible design, use, recycling and disposal of our products.

Ecological Integrity & Biodiversity

Our operations maintain or enhance biological diversity and the fabric of ecological integrity in the environments in which we operate.

Meeting the Needs of Current and Future Generations

We take a long-term approach to our activities, and work in partnership with communities and governments to meet the needs and desires of today without compromising the ability of future generations to satisfy their own needs.

Stakeholder Involvement

We work with our communities, employees, customers, shareholders and suppliers to achieve outcomes and make decisions of mutual benefit. We report regularly to all our stakeholders on the sustainability performance of our operations.

Accountability & Governance

We practice ethical business governance, are accountable for our actions, continually improve our performance and integrate environmental, social and economic considerations in our decision-making.

2. PROJECT JUSTIFICATION, BENEFITS AND ALTERNATIVES

2.1 THE ALUMINIUM INDUSTRY

The current world production of alumina is around 50 Mtpa, of which Australia produces approximately 33%. Alumina production from other areas of the world includes Latin America (22%), West Europe (12%), North America (11%), East/Central Europe (10%), and Asia (10%). Metal-grade alumina demand is driven by primary aluminium production, which is, in turn, driven by global aluminium metal consumption. Aluminium metal consumption is expected to grow steadily for the foreseeable future, given reasonable levels of world economic growth, and after taking increased aluminium recycling into account.

2.1.1 Alcoa's Participation in the Alumina Market

Alcoa Inc holds alumina interests in Australia, North America, South America, and Europe. Alcoa's Australian operations include bauxite mines, alumina refineries and shipping terminals in Western Australia, an aluminium smelter at Pt Henry (Victoria), a power station at Anglesea (Victoria) and Alcoa is the majority shareholder and manager of the Portland smelter in Victoria.

Alcoa's mining and refining operations in Western Australia supply alumina to produce approximately 15% of the world's primary aluminium. With assets with a replacement value over A$8 billion in Western Australia, the company directly employs nearly 5,000 people, and contributes around A$1.1 billion each year to the State economy. Most of the alumina produced at the refineries is exported world-wide and generates sales revenues of nearly A$2.2 billion per year.

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

2.2 PROJECT JUSTIFICATION

Continued growth in the aluminium market has resulted in high demand for quality alumina. As a low-cost producer, and with secure access to substantial bauxite reserves, Alcoa's Pinjarra refinery is well positioned to capture this expanding market opportunity, which will further improve Alcoa's global market competitiveness and enhance Western Australia's position as a leading alumina producer. In doing so, the Efficiency Upgrade will also provide direct economic benefits to the State and the Peel region through increased royalties, as well as increasing social capacity through skills and employment experience in the Peel region.

2.3 PROJECT BENEFITS

There are a number of significant benefits to be gained from the Pinjarra Efficiency Upgrade Project, both from a socio-economic and environmental perspective, including:

- further development of the alumina industry within Western Australia;
- optimising the utilisation of an existing process plant site and existing infrastructure;
- capital investment of about A$440 million;
- employment generated by a construction workforce of up to 1,000 people;
- a net improvement in Australia's balance of trade driven by the export of more alumina;
- an increase in Western Australia's Gross State Product and Australian Gross Domestic Product;
- a reduction in volatile organic compounds (VOCs) and hence odours released to the atmosphere;
- a reduction in dust emissions from the residue areas;
- a reduction in particulate emissions released to the atmosphere from the calciners;
- a reduction in greenhouse emissions intensity per tonne of alumina produced; and
- replacing old burners in the power station with low oxides of nitrogen (NO_x) burners to minimise the emissions of nitrogen oxides from the refinery.

It is expected that further opportunities for environmental improvements will be identified and incorporated in the project's designs during the detailed engineering design of the project, which is currently underway.

2.4 ANALYSIS OF ALTERNATIVES

2.4.1 No Project Option

If this project did not proceed, then it would represent a lost opportunity to enhance the utilisation of the existing refinery and to improve the greenhouse gas intensity of alumina production.

2.4.2 Project Alternative

The alternatives to the proposed Efficiency Upgrade that were considered included:

- adding additional production capacity through increasing the recirculating liquor flow around the refinery, increasing energy consumption;
- incorporating some impurity removal processes to the current proposal; and
- opportunities at other alumina refineries within the Alcoa World Alumina global system.

The option of production upgrades through increased flow did not provide the desired outcomes in terms of cost, resource use and environmental impacts. The option of adding an impurity removal process or processes to the current proposal is the subject of ongoing research. Of the options

considered the current upgrade proposal provides the most efficient use of capital (i.e. use of existing equipment) with current technology, and provides a number of environmental benefits through emissions upgrades and reduced greenhouse gas emissions intensity.

2.4.3 Proposed Efficiency Upgrade

The proposed Efficiency Upgrade has been determined from a detailed feasibility study to be the most cost-effective and environmentally acceptable alternative.

The project does not require major alterations to existing refinery and supporting infrastructure, but centres on installing a seed filtration process that increases the production rate of the refinery without having to expand or duplicate every process within the refinery. As a result the additional alumina is produced more efficiently and will increase the usage of major raw materials such as bauxite and caustic. It is anticipated that energy usage per tonne of alumina produced, and hence greenhouse gas emissions intensity, will decrease.

A reduction in atmospheric emissions from the refinery will be achieved by the addition of Regenerative Thermal Oxidisers (RTO) on the digestion circuit and oxalate kiln. These aspects are described in more detail in Section 4.1.

3. EXISTING MINE AND PINJARRA REFINERY

3.1 BAUXITE MINE

Ore for the Pinjarra refinery is supplied from the Huntly Mine (Figure 5). The current approved five-year mining plan for Huntly (for 2003-2007) projects the production of 20.6 Mtpa of bauxite, approximately 40% of which goes to the Kwinana refinery and the remainder to the Pinjarra refinery.

Mining is undertaken in accordance with a Five-year Mining and Management Program which is reviewed annually by the Mining and Management Program Liaison Group (MMPLG) and approved by the Minister for State Development. The MMPLG consists of representatives of Department of Industry and Resources (DoIR), Department of Environment (DoE), Department of Conservation and Land Management (CALM) and the Water Corporation. The mine operates under agreed Working Arrangements with CALM, Water Corporation and DoE.

The Water Working Arrangements set the framework for cooperative and efficient interaction by Alcoa operations at Huntly and Willowdale (Figure 4) with the DoE and the Water Corporation on water resource management and protection. They complement existing Working Arrangements in place between CALM and Alcoa, which define agreed standards and prescriptions for mine rehabilitation and forest management.

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

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

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

The annual process for review and approval of the five-year Mining and Management Program (MMP) is as follows (Figure 6):

a. A review of the previous five-year Mining and Management Program is undertaken each July/August;
b. A site visit and presentation is made to Local Government representatives and neighbours in August and September each year;
c. Alcoa prepares a draft five-year Mining and Management Program incorporating feedback from the various stakeholders, and presents it to the MMPLG by 1st October each year;
d. The MMPLG review the draft five-year Mining and Management Program and provide feedback to Alcoa by the end of November. The MMPLG meet with Alcoa and visit the site during this process;
e. A final five-year Mining and Management Program, incorporating the MMPLG recommendations is prepared and submitted to the Minister for State Development by late December;
f. The Minister for State Development advises the Minister for Environment and Heritage of the MMPLG recommendations;
g. Approval of the Mining and Management Program by the Minister for State Development is usually issued by the end of January. Approval may be subject to a number of conditions.

Based on the approved five-year Mining and Management Program, Clearing Plans are developed. The Plans are submitted (in April and September every year), and inspected on the ground by the Mining Operations Group (MOG). This group consists of representatives from Water Corporation, DoIR and CALM. The Clearing Plans are reviewed and, if considered to be acceptable, are approved by July and November. During approval, review and implementation of the Clearing Plans, there is ongoing consultation with government agencies to ensure that clearing, mining and rehabilitation activities do not result in unacceptable impacts.

Mining of bauxite at Huntly currently involves clearing of Jarrah forest at an average rate of 350 hectares (ha) per year. Mining occurs in isolated pods from 1 ha to 100 ha and saleable timber is salvaged by the Forest Products Commission prior to clearing. Currently clearing involves heaping and burning the remaining vegetation (tops, stumps, understorey and timber debris). Alcoa is working with the Forest Products Commission and other interested parties to find an alternative to burning forest debris and a number of opportunities are being pursued. Following clearing, about half a metre of topsoil and overburden is removed for use in rehabilitation. Ideally the topsoil which contains much of the organic matter, nutrients, micro-organisms and seeds is used immediately after stripping to rehabilitate a nearby pit, otherwise, it is stockpiled alongside the pit for future rehabilitation.

The top one to two metres of cemented cap rock is broken so that it can be excavated along with the more friable bauxite below. To prevent unacceptable noise and vibration impacts associated with blasting activities, a predictive acoustic model is used to assist in the selection of appropriate weather conditions for blasting (Section 6.5.1).

Mining removes a layer of bauxite an average of 4 m deep. Ore is loaded into haul trucks by excavators or front-end loaders and transported to crushers at the mine. Here the ore undergoes primary and secondary crushing before being transported by conveyor to the Pinjarra refinery and the railhead stockpiles (at the Pinjarra refinery) for the Kwinana refinery. The mobile crushers are periodically relocated to new mining areas when the bauxite resource around the existing crusher site is depleted. The duration of mining in any one area can vary between approximately 5 and 25 years. Mining operations are currently located in the White Road mining area, which is bounded by the North Dandalup Dam to the north, the North Dandalup River to the east and Lake Banksiadale (South Dandalup Dam) to the south[1] (Figure 5). Mining in this region will be completed in 2005. Planning and development of the next mining area called McCoy is well underway with mining planned to commence in 2004.

The average period that land remains cleared before rehabilitation is between one and two years. Rehabilitation of the disturbed areas is undertaken by battering down the pit walls, restructuring the landscape to blend in with the surrounding forest and control run-off, spreading of overburden then topsoil, returning logs and stumps for fauna habitat, deep ripping, seeding, planting of recalcitrant species (those that are difficult to germinate from seed) and fertilising. Alcoa has recorded very high levels of success with rehabilitation and has achieved plant species richness values equivalent to pre-clearing within just a few years.

3.2 ALUMINA REFINING PROCESS

The Pinjarra refinery currently produces approximately 3.5 Mtpa of alumina. As with the majority of other commercial alumina refineries throughout the world, the Bayer process is used. The Bayer process involves a number of key steps, including:

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

A simplified process flow diagram of the Bayer process used at the Pinjarra refinery is presented in Figure 7.

3.2.1 Bauxite Grinding and Slurry Storage

Bauxite is ground to less than 1.5 mm particle size at the refinery, using semi-autogenous grinding mills (SAG mills), to ensure sufficient solid-liquid contact during the digestion phase. This improves the alumina extraction efficiency. A solution of sodium hydroxide (NaOH i.e. caustic) liquor, bled

[1] Buffer zones are maintained around water bodies. Refer to Section 6.9.1.

from the recycled caustic liquor circuit, is added to the bauxite during grinding to produce a slurry. The slurry is pumped to a series of holding tanks prior to the next stage of the Bayer process. The purpose of the holding tanks is to allow for minor interruptions to the ground bauxite supply, blending of bauxite grade, and to allow the process of desilication (i.e. removal of silicate from the liquor) to commence.

3.2.2 Digestion

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

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

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

3.2.3 Clarification

The clarification stage of the process separates the undissolved ore solids from the green liquor. This is achieved using large clarification vessels (mud thickeners), which allow the undissolved bauxite solids to settle out. These bauxite solids are then passed through a counter-current washing train (mud washers) using water to recover as much of the caustic as possible to enable it to be recycled back within the recycled caustic liquor circuit. The washed solids from the counter-current washing train is called process residue or red mud, and is pumped to the Residue Disposal Area (RDA) (refer to Section 3.4).

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

3.2.4 Organic Removal

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

Other than oxalate (discussed below) the Pinjarra refinery currently does not have a specific process for the removal of organic impurities from the liquor. While other refineries utilize liquor burners to destroy organics, the Pinjarra refinery does not currently have plans to include a liquor burner at Pinjarra. Alcoa has an active research and development program underway to identify and develop alternative technologies to control organic build-up in the recycled caustic liquor.

Oxalate (an organic that primarily exists as sodium oxalate) is concentrated and removed by a sequence of seeding, precipitating, and washing to produce a wet oxalate cake. The oxalate is combusted using a rotary kiln, and the emissions are discharged via a wet scrubber to remove particulates. The oxalate combustion results in the production of sodium carbonate, which is then converted to sodium hydroxide (caustic soda) and returned to the process. The oxalate kiln emissions have historically been associated with an unpleasant odour (primarily on site) attributed to VOC emissions and the oxalate kiln is also one of the primary sources of carbon monoxide at the refinery.

3.2.5 Precipitation

Green liquor is passed to precipitation via a heat exchange process where it is cooled. The heat from the green liquor is transferred to the cold spent liquor (i.e. liquor from which the alumina has been removed) that is returned to the start of the digestion process. The cooled liquor is seeded with crystals of alumina tri-hydrate, which act as the nucleus for precipitation. The liquor is passed through a series of 120 large precipitator vessels, and the alumina tri-hydrate is sorted by size and thickened before being passed to calcination. The process of sorting the alumina tri-hydrate by size is based on gravity separation equipment. The alumina tri-hydrate that is too small or "fine" for calcination is recycled back to the beginning of precipitation as the "seed".

3.2.6 Calcination

Calcination involves heating the alumina hydrate to dry it by driving off the water held during crystallisation to produce alumina using a two-stage heating process. Alumina is a fine white powder, and particulate emissions from the calciners are currently controlled using an electrostatic precipitator on each calciner.

3.3 REFINERY WATER CIRCUIT

The Pinjarra refinery operates an efficient "closed" water circuit, which is supplemented for water losses. Losses of water primarily occur as steam and moisture from the process, evaporation from water storages and residue surfaces, and water bound within the residue mud and sand. There is a relatively high portion of water retained within the residue (~50%) after it has been "dry" stacked. Overall, the Pinjarra refinery uses approximately 1.75 kilolitres (kL) of water per tonne of alumina product (annualised figure).

Make-up water is taken from licensed ground and surface water sources. In addition, water is added to the circuit from grey water (250,000 kL per year) imported from the Water Corporation's Pinjarra

sewage treatment plant, water contained in the caustic soda and bauxite, and rainfall runoff. The RDAs have base drainage systems that collect residue leachate and rainfall infiltration. All rainfall runoff from the refinery, residue storage areas and process water ponds is transferred to the Cooling Pond or Runoff Water Storage Pond during winter and then used as make-up water for the refinery during summer. On average, total water storage in the refinery circuit is approximately 13,000 ML.

3.4 BAUXITE RESIDUE DISPOSAL

The material remaining after the alumina has been extracted from the bauxite ore is commonly termed "residue" or red mud. Due to the relatively low grade of Darling Range bauxite, residue is produced at a rate of approximately two dry tonnes per tonne of alumina produced. Bauxite residue consists of caustic-insoluble components (i.e. haematite, quartz and titanite) which have passed through the Bayer process unaltered, precipitated silica and iron compounds, and residual quantities of caustic soda not recovered in the residue washing stage.

To reduce the geographic extent of the bauxite RDA, and to minimise the amount of seepage causing groundwater contamination, 'dry' stacking techniques are used. A schematic diagram of the dry stacking process used at Alcoa's RDA is presented as Figure 8. Coarse particles are separated from fine tailings using cyclones and counter-current wash towers. This results in roughly equal portions of coarse and fine tailings. The fine tailings are pumped to a thickener vessel where they are settled using flocculent, producing high-density underflow slurry of around 50% weight for weight (w/w) solids. This slurry is pumped to one of a number of beds where it is placed in layers up to 0.5m deep, and allowed to dry in the sun. The final dry density of the tailings is around 70% solid material. This compares to the final density of 60-65% solids typically achieved using earlier wet disposal methods. The coarse tailings or residue sand is used for construction of dyke walls and roads within the residue area.

4. UPGRADE PROJECT DESCRIPTION

4.1 PROJECT OVERVIEW

4.1.1 Bauxite Mining

The proposed upgrade will enable Pinjarra refinery to process an additional 2 Mt of bauxite per year, taking the total annual throughput at the Pinjarra refinery to approximately 15 Mt.

The bauxite for the Efficiency Upgrade project will be supplied by the Huntly Mine, increasing the total rate of mining from 20.6 million tonnes to 22.6 million tonnes per year (Mtpa). These mining rates include the bauxite supplied to both Pinjarra and Kwinana refineries. On average, this will increase the rate of clearing by an additional 30 hectares of land per year taking the average area disturbed for bauxite mining from about 340 ha per year to approximately 370 ha per year. The area mined annually varies depending on the various depths of ore and the road construction program required to access the ore.

Mining at Huntly will progress within the strategy set out in the long-term mine plan, but the increased rate of mining will accelerate the mining of areas scheduled in the current Five-year Mine Plan and will ultimately reduce the expected mine life of over 50 years by approximately 5 years. Thus, although the rate of mining will increase by about 10%, the total area mined over the life of the operation will remain unchanged. Although the efficiency upgrade is expected to reduce the life of the mine by approximately one tenth based on the current estimate of the bauxite resource available, the process of exploration will continue and it is possible that the life of the mine may exceed 45 years. The rate of rehabilitation will also be increased proportionally to ensure that active mining areas are kept to a minimum.

Within the current approved mine plan, it is proposed to relocate the crushing station to the McCoy site during 2004,, approximately 8 km northeast of the existing White Road crushing station. Relocation of mining operations will also require extension of the conveyor system from White Road to McCoy (Figure 3). Mining of the McCoy region is expected to continue until about 2013.

Mining is also planned to commence in the Jayrup demonstration mining catchment in 2005. This Trial Mining Project involves the mining of the Jayrup catchment's orebodies and is a crucial component of the Joint Intermediate Rainfall Zone[2] Research Program (JIRZRP). The JIRZRP has two objectives:

a) To determine what impact bauxite mining in the intermediate rainfall zone will have on the water resources of the region, and
b) To determine the forest, mine and rehabilitation management practices which should be used in the intermediate rainfall zone.

4.1.2 Refinery Production Changes

The major components of the Efficiency Upgrade are outlined in Sections 4.1.3 and 4.1.4, and Section 1.4 outlines the anticipated design, construction and operating schedule. Table 1 presents a summary of the key characteristics of the upgraded refinery compared to the existing refinery.

Table 1: Key Characteristics of the Pinjarra Refinery Efficiency Upgrade (1)

Characteristic	Units	Current Refinery	Upgraded Refinery
Alumina Production	Mtpa	3.5 (+ 0.1 Mtpa continuous improvement in alumina production)	4.2
Refinery Operations		Continuous operation	Continuous operation
Bauxite Mine		Continuous operation	Continuous operation
Bauxite Mining Rate	Mtpa	20.6	22.6
Project Life	yrs	>50	>45
Capital Investment	A$	-	440 million
Refinery Footprint	Ha	250	250
Construction Period	yrs	-	2
Workforce (peak construction)	persons	-	1000
Workforce (operation) (Refinery + mine)	persons	1,570	1,570
REFINERY INPUTS			
Bauxite	Mtpa	13	15
Caustic Soda	tpa	210,000	245,000
Lime	tpa	176,000	195,000
Water	MLpa	6,130	7,400
REFINERY OUTPUTS			
Atmospheric Emissions Particulates (from stacks)	tpa	190	140
NO_x	tpa	1,120	640

[2] The intermediate rainfall zone is described by CALM as areas receiving between 900 mm and 1,100 mm of rainfall per year (www.calm.wa.gov.au/forest_facts/BurrowsPart1FinalReport.pdf).

Characteristic	Units	Current Refinery	Upgraded Refinery
CO	tpa	815	815
VOCs	tpa	180	162
Greenhouse Gases (Net CO_2 –Refinery with Alinta Cogeneration Project)	tpa	2,045,000 (2)	2,347,000 (2)
Greenhouse gas emission intensity	$kgCO_2/t$ alumina	583 (2)	564 (2)
Noise		Compliance with *Environmental Protection (Noise) Regulations 1997*	Compliance with the *Environmental Protection (Noise) Regulations 1997*
Bauxite Residue	Mtpa	6.41	7.73

Notes:

(1) Data presented for Current and Upgraded refinery does not include inputs or outputs from the Alinta Cogeneration Project, although they have been considered in the context of cumulative air quality impacts upon nearby residences.

(2) Includes Pinjarra refinery energy savings associated with the Alinta Cogeneration Project Stages I and II.

4.1.3 Refinery Modifications

The Efficiency Upgrade will be achieved primarily by increasing the rate of precipitation in the Bayer Liquor circuit, utilising existing equipment as much as possible. Figure 9 presents an aerial photograph of the refinery layout with some detail about the process and shows the additional equipment required.

Engineering design work for the Efficiency Upgrade is currently underway and this has identified the main equipment components; these are summarised in Table 2 and outlined in Section 4.1.4.

Table 2: Main Equipment Components of the Pinjarra Refinery Efficiency Upgrade

Process Area	Equipment	Existing Refinery	Refinery Upgrade
Bauxite grinding	SAG mill	6	+1
	Bauxite storage bin	6	+1
Slurry storage	Slurry storage tank	7	+1
Digestion	Pumps and piping		Increased capacity
	Vents		Capture vent emissions and send to an RTO (1)
	Evaporators	7	+1
Clarification	Mud thickeners	9	Evenly distribute flow across existing thickeners
	Mud washers	5 units of 5 total of 25	Convert two existing mud washer units to single washer unit with larger capacity (i.e. 2 units of 5, to 1 larger unit)
	Causticisation		Install new tanks, pumps and piping for the causticisation process
Precipitation	Seed filtration	-	Install a new seed filtration facility
	Precipitation vessels	120	No addition
Calcination	Calciners	6	Install an additional calciner, and upgrade the ESP's on 3 existing calciners.
Oxalate removal	Oxalate kiln		Upgrade capacity Install a new wet scrubber and RTO

Notes:
"RTO" Regenerative Thermal Oxidiser (thermally destroys volatile organic compounds and other combustible components).

4.1.4 Equipment/process Modifications

4.1.4.1 Bauxite Milling

A new semi-autogenous grinding (SAG) mill will be added to the existing bank of six SAG mills currently installed at the refinery. The SAG mill grinds the bauxite ore to particles of less than 1.5 mm which produces sufficient surface area for the ore to react with the process liquor. Associated with the increased bauxite grinding capacity, an additional bauxite storage feed bin will be required. The area already cleared for bauxite stockpiling will not be increased.

An additional tank will be added to the seven tanks in the slurry storage system to maintain the current holding time for slurry (Figure 9).

4.1.4.2 Digestion

The existing capacity in digestion is adequate to handle the increased flow rate of slurry through digestion resulting from the increase in bauxite to process. The resulting green liquor (liquor containing dissolved alumina) slurry flow exiting digestion will also increase slightly due to the higher bauxite tonnage (and as a consequence, volume) used. The pump and piping capacity will be increased where required.

New air pollution control equipment (Figure 9) to reduce the emissions of VOCs will be installed (refer to Section 6.3). A system to capture and condense the vapour emitted from the digestion area will also be installed which will minimise emissions of VOCs, and will also be used to drive higher thermal efficiencies within the heat exchange area of the process.

Additional evaporation equipment will be installed in the digestion area. It will not use any additional plant steam, but use the existing plant steam load more efficiently.

4.1.4.3 Clarification

To improve the operational integrity of the area, the green liquor slurry flow will be more uniformly distributed across the existing mud thickeners. The mud washers, which recover caustic before the mud is disposed to the residue area, will be upgraded in capacity by converting two of the existing mud washer banks to a single larger capacity washer bank. The existing facilities will be improved by installing new tanks, pumps and piping. This will result in a slight reduction in lime use per tonne of alumina produced.

A system to return the clear "overflow" liquor from the mud washer circuit (containing the caustic recovered from the mud residue) will be installed to feed this liquor into the mud thickeners which will provide an indirect energy benefit.

4.1.4.4 Precipitation

The upgrade of the precipitation area will be primarily achieved by the installation of a new seed filtration facility and associated equipment. The 'seed' is a crystal of alumina hydrate and acts as the nucleus on which the alumina can be deposited causing the seed to become larger, eventually becoming product. The seed filtration building makes the conditions for precipitation more favourable by increasing the seed tonnage and reducing the amount of liquor recycled within the precipitation circuit. The new seed filtration facility (Figure 9) will result in improved precipitation rates.

4.1.4.5 Calcination

There are currently six calciners installed at the Pinjarra refinery. To supply additional calcination capacity a seventh calciner will be installed and this will include a baghouse to reduce particulate emissions to very low levels. Further, the pollution control equipment (ESPs) servicing three of the existing calciners will be upgraded to match the capability of the other three existing ESPs that were previously upgraded. Dust emissions from these calciners during normal operation will be less than 30 mg/m^3 representing an overall reduction in dust emissions from the calcination area after the implementation of the efficiency upgrade of about 25% (refer to Section 6.3).

4.1.4.6 Oxalate Removal

The capacity of the Oxalate kiln will be upgraded to cater for the increased oxalate production. As part of this increase in the capacity of the Oxalate kiln, new air pollution control equipment will be installed to significantly reduce the emissions of VOCs and carbon monoxide. Particulates from the kiln stack will be reduced to less than 10 mg/m^3 by installing a new wet scrubber system replacing the existing wet scrubber. The RTO is expected to reduce VOC and CO emissions from the oxalate kiln by > 98% (refer to Section 6.3).

Wastewater from the new wet scrubber system will be used within the mud washer circuit, or it will be pumped to the RDA from which water is recovered and reused within the refinery process.

4.2 SERVICES AND UTILITIES

4.2.1 Raw Materials and Product Transportation

4.2.1.1 Overland Conveyors

The Efficiency Upgrade project will require an increased ore throughput, and therefore increased capacity to transport raw materials to site. One of the existing conveyors that transports crushed bauxite from Huntly Mine to the refinery will be upgraded to achieve this increased capacity by increasing its speed from 7.3 m/s to 8.0 m/s.

4.2.1.2 Rail Transport

All of the increased alumina production resulting from the upgrade will be transported by rail to Bunbury Port. There will be no change in rail traffic on the rail line to Kwinana to the north. The additional transport of alumina to the Bunbury Port will be achieved by increasing the length of the existing trains from about 38 wagons to between 44 and 46 wagons. There will also be one or two caustic trains from Bunbury per week. Currently caustic trains only run from Bunbury to Pinjarra if supplies from Kwinana are unavailable.

The additional alumina train length will require extension of some sidings and it is expected that the increase in the number of wagons, will only marginally increase crossing times.

The additional alumina production will be handled within the existing capacity of the Bunbury Port facilities. It is estimated that there will be an additional 12 ships per annum.

4.2.1.3 Road Transport

Alcoa road freight movements for all vehicle types into the Pinjarra refinery are approximately 4,300 per year. Of these, 2,850 are lime movements, which currently enter and exit through the Pinjarra town site. Of the other 1,450 movements, it is estimated that 95% travel to Pinjarra from the north

along the South Western Highway thereby avoiding the town centre. The Efficiency Upgrade is likely to increase road freight movements by two or three vehicles per day, but during peak construction movements may increase by 12 vehicles per day, of which the majority are expected to use the South Western Highway route. Following the upgrade, an additional lime truck per day (approximately 350 per year, or a 12% increase) is likely to be required. Local suppliers in Pinjarra, Mandurah and adjoining districts will likely require transportation routes through the Pinjarra town site. Where possible the use of heavy vehicles through the town of Pinjarra will be avoided.

Alcoa anticipates that there will be no net increase in vehicle movements to and from the mine, from 2003 levels.

4.2.2 Energy Requirements

The Pinjarra refinery uses natural gas as its main energy source as it is less expensive and has less environmental impact than do other carbon-based energy sources. The on-site powerhouse boilers make steam to heat the process and also generate electricity to run the refinery and ancillary facilities. Natural gas is also combusted in the oxalate kiln, calciners and the alumina leach drying plant. Alcoa is constantly examining ways to reduce energy consumption and improve the overall energy efficiency of the refinery including measures such as waste heat recovery. These energy efficiency programs have resulted in Alcoa's Australian alumina refineries improving energy efficiency by approximately 8% during the period 1990 to 2000.

When operational, the Alinta Cogeneration project (shown as Alinta Co-Generation on Figure 9) will supply some of the refinery's steam requirements, thereby allowing Alcoa to reduce steam production from its own less efficient boilers. This change will result in a net greenhouse gas benefit brought about through the more efficient use of the input energy (Section 6.4).

The Alinta Cogeneration Project has approval under Part IV of the *Environmental Protection Act* for two 140 MW-capacity gas turbine generators and two heat-recovery steam generators capable of generating 210 tph of high-pressure steam. Construction of the first cogeneration unit (Stage 1) is expected to commence in 2004, and commissioning is currently scheduled for the fourth quarter of 2004. The Alinta Cogeneration Project will also generate electrical power that will be sold to customers connected to the South West Interconnected System (SWIS).

The Efficiency Upgrade project will result in the installation of current best practice energy efficient processes, such as the seed filtration process, and enhanced causticisation that will improve the efficiency of the refinery liquor stream. Although the Efficiency Upgrade will be associated with a total increase in energy consumption at the Pinjarra refinery, the overall energy consumption per tonne of alumina produced will be decreased by about 14%, owing to the combined effects of the Alinta Cogeneration Project and process improvements.

Electrical power for mining activities is supplied from the Pinjarra refinery and is principally utilised to operate the mining fixed plant, with a smaller proportion used in workshops, offices and pumping

stations. Distillate is used for mobile mining equipment and an annual increased usage of approximately 1.5 ML or 10% is expected as a result of the Efficiency Upgrade.

The Upgrade project will require more electrical energy (~14 MW) than the Pinjarra refinery powerhouse can produce. Alcoa intends to source this electricity from a cogeneration source connected to the SWIS.

4.2.3 Water Supply

The refinery's current water requirement is 6,130 MLpa (1.75 kL/t AlO_3 make-up). An additional water requirement of 170 MLpa will be required to meet continuous improvements in alumina production expected up to the commissioning of the Efficiency Upgrade project. These water requirements can be met from ground and surface water resources, plus effluent from the Water Corporation's Pinjarra town sewage treatment plant. The refinery operates under three surface water licences and two groundwater licences issued by the Water and Rivers Commission (now DoE). Surface water harvesting typically supplies up to 4,000 ML from Oakley and Barritt Brooks. The groundwater licences allow abstraction of up to 2,500 MLpa from the Cattamarra Formation. Effluent from the Water Corporation sewage treatment plant adds a further 250 MLpa to the refinery's water supplies.

The Efficiency Upgrade will require an additional 1,100 MLpa of water. The options for obtaining a sustainable water resource to meet the additional water requirement for the upgraded refinery are currently being investigated and are discussed in Section 6.10.

4.2.4 Bauxite Residue Disposal Areas

Alcoa has a Long Term Residue Management Plan (LTRMP) in place for each of its Western Australian refinery sites, including the Pinjarra refinery. The purpose of the LTRMP is to identify the future RDA requirements for each refinery and ensure that the location and design of new areas is optimised to reduce environmental impacts and consider long-term land use issues. The LTRMP for the Pinjarra refinery was endorsed by the Minister for the Environment in July 1997. A review of Pinjarra refinery's future storage requirements and long-term alternatives for residue is currently underway. A range of layout options and research alternatives are being developed and these will form the basis for consultation with a wide range of stakeholders. The review will lead to an update of the LTRMP for Pinjarra during the next 12 months.

The Efficiency Upgrade project will result in an increase in the quantity of residue generated, which will require the LTRMP to be brought forward approximately 12 months, as the areas currently designed for use in 2007 are expected to be required in 2006.

5. PROJECT AREA ENVIRONMENT

5.1 REGIONAL CONTEXT

Pinjarra refinery is located at the foot of the Darling Scarp where the Pinjarra Plain meets the Ridge Hill Shelf. Huntly mine is located in the Darling Range in the Jarrah forest.

Alcoa's mineral lease ML1sa also covers parts of some water catchments that supply Perth and rural areas. The current (White Road) Alcoa mining area is bounded by the North Dandalup River to the north and east, and the South Dandalup River to the south and west (Figure 5). These rivers both flow into reservoirs and ultimately flow westwards into the Murray River, discharging to Peel Inlet on the coast near Mandurah. Conjurunup Creek, which has a Pipehead Dam, rises near Huntly mine and also flows into the Murray River. Future mining areas will lie within the Serpentine River catchment, which flows into the Serpentine reservoir.

5.2 CLIMATE

The climate of the Peel Region is Mediterranean, characterised by warm, dry summers and mild, wet winters. Meteorological data (including rainfall, temperature, humidity and wind data) measured at the Pinjarra refinery during the 12 month period from August 2002 to July 2003 are summarised in Table 3.

Table 3: Summary of Climatic Data for the Pinjarra Refinery – August 2002 to July 2003

Month	Temperature (ºC)		Relative Humidity (%)		Rainfall	
	Mean Daily Maximum	Mean Daily Minimum	9 am Mean	3 pm Mean	Mean (mm)	Mean No. of Rain Days
August 02	17.2	6.8	71.7	60.7	115.2	18
September 02	18.5	8.4	67.0	59.7	125.9	13
October 02	20.5	10.3	64.6	57.8	75.2	12
November 02	26.3	12.8	48.1	41.7	19.6	4
December 02	30.0	15.9	42.3	31.1	4.9	3
January 03	30.8	16.0	41.5	28.9	2.4	3
February 03	30.6	17.7	52.8	37.9	26.0	3
March 03	30.0	17.3	50.0	37.9	23.0	6
April 03	24.3	14.4	62.5	51.9	99.6	12
May 03	21.6	12.0	56.6	49.0	94.2	13
June 03	16.5	7.3	68.0	58.3	132.2	18
July 03	14.5	6.4	71.7	64.1	161.8	22
Annual Mean	23.4	12.1	58.1	48.3	73.3	11
Annual Total					880.0	127

5.2.1 Temperature and Humidity

Based on the data presented in Table 3 the mean annual maximum and minimum temperatures for the Pinjarra refinery were 23.4^{o}C and 12.1^{o}C during the period August 2002 to July 2003. The highest temperatures were experienced in January, when the mean daily maximum temperature was 30.8^{o}C, and the mean daily minimum temperature was 16.0^{o}C. The lowest temperatures were experienced in July, when the mean daily maximum temperature was 14.5^{o}C, and the mean daily minimum temperature was 6.4^{o}C.

The mean annual relative humidity for the Pinjarra refinery was 58.1% at 9 am, deceasing to 48.3% at 3 pm during the period August 2002 to July 2003. Relative humidity is generally higher in winter, with the July mean of 71.7% at 9 am, decreasing to 64.1% at 3 pm. During January, the mean relative humidity at 9 am was 41.5%, decreasing to 28.9% by 3 pm.

These figures are comparable to the long-term means from Wokalup Agricultural Research Station (55 km south of the refinery) where data recording commenced in 1951.

5.2.2 Rainfall and Evaporation

Rainfall in the Peel region is seasonal with the majority of rainfall being received during the winter months (June to August). Based on the data presented in Table 3, total monthly rainfall varied from 64.1 mm in July, to 2.4 mm in January during the period August 2002 to July 2003. The annual average total monthly rainfall for this period was 73.3 mm, and the total annual rainfall was 880 mm with a total of 127 rain days. The long-term average annual rainfall at the Pinjarra Post Office for the 127 years of data available between 1875 and 2002 is 944 mm (Parsons Brinckerhoff, 2003) and at Wokalup is 974.4 mm, indicating that the annual rainfall received at the Pinjarra refinery during the period August 2002 to July 2003 of 880 mm was well below the regional average.

Evaporation data are not available from the refinery, the nearest site with comparable data being Wokalup Research Station. At Wokalup the mean annual evaporation is 4.9 mm/day, with the highest evaporation being 9.1 mm/day in January and lowest in winter at 2.1 mm/day in June and July. Total annual evaporation is approximately 1,788 mm/year, which exceeds annual rainfall by approximately 844 mm.

5.2.3 Winds

Winds in the Pinjarra region result from both large-scale (synoptic) winds associated with low and high pressure systems, and local-scale winds induced by thermal influences (e.g. sea breeze) and to a lesser extent the terrain features of the Darling Scarp.

Measurements from the Pinjarra refinery meteorological station for the period August 2002 to July 2003 have been presented in an annual wind rose (Figure 10). It can be seen that winds are

predominantly from the east to east-southeast for approximately 17.8% of the time, from the south-southwest to southwest for approximately 17.2% of the time, and from the north-northeast for approximately 6.9% of the time. The meteorological data also indicate the calm conditions (i.e. winds less than 0.5 m/s) occur relatively frequently in Pinjarra, occurring for approximately 12.4% of the time.

The Pinjarra refinery meteorological data has also been presented as seasonal wind roses (Figure 10). A comparison of seasonal and annual wind roses for the Pinjarra refinery shows that wind patterns vary considerably between seasons.

During the period from November to April, in particular, the winds in Pinjarra exhibit a diurnal pattern of east and south easterly land breeze developing over-night and continuing through to mid-morning, followed in the afternoon by south westerly winds associated with the sea breeze (Dames and Moore, 1989). This sea breeze/land breeze cycle is typical of coastal environments. The effects of the sea breeze/land breeze cycle is evident in the summer wind rose (Figure 10) which indicates the predominant winds are from the east to east southeast and which are relatively strong, and from the south southwest to south west.

The wind roses for autumn, spring, and to a lesser extent winter, also exhibit relatively strong easterly oriented winds. In addition to the influence of the land breeze effect, it is likely that these easterly winds are partially attributable to the presence of katabatic flows off the Darling Scarp. Katabatic flows occur when surface air, cooled by the cold land surface at night, becomes denser, and flows down-hill, off the Darling Scarp. Such winds are normally light, but they tend to converge in valleys and cause stronger airflows along the valley floors. The influence of these katabatic winds is unlikely to extend more then 5 km to 10 km west of the scarp (Dames and Moore, 1989).

The annual trend in winds exhibited for the period August 2002 to July 2003 have been found to be relatively consistent with a longer-term historic meteorological dataset available for the Pinjarra refinery for the period June 1986 to October 1994.

5.3 TOPOGRAPHY AND GEOLOGY

5.3.1 Mine Site

The Huntly mining area occurs on the undulating Darling Range with an elevation ranging from about 240 m Above Mean Sea Level (AMSL) to 370 AMSL. Future mining areas will be within the McCoy Mining area which has a similar elevation, typically around 300 m AMSL.

The Huntly mine occurs within Cainozoic deposits dominated by laterite, formed at least in part during the Tertiary era by *in situ* weathering of underlying rocks (Geological Survey of Western Australia, 1976). The laterite surface is flat to undulating, strongly dissected by streams, and extends through a zone of variable thickness to weathered bedrock. It is within this zone that the bauxitic

laterite mined by Alcoa occurs. Overlying soils are mostly skeletal ironstone gravels with deeper pockets of soil along drainage lines and in depressions in the cap rock.

5.3.2 Refinery Site

The land surrounding the Pinjarra refinery has an elevation between 25 m and 50 m Above Mean Sea Level (AMSL). The land slopes gently to the west and rises to 75 m AMSL in the foothills of the Darling Range, and up to 200 to 300 m AMSL on top of the scarp, east of the refinery.

The refinery is located at the eastern edge of the Perth Basin, adjacent to the Darling Fault. The stratigraphic units recognised in the Pinjarra area are summarised in Table 4.

Table 4: Stratigraphic Units in the Pinjarra Area

Age	Stratigraphic Unit	Formations
Cainozoic	Superficial formations (to ~ 12 m depth)	Bassendean Sand = Dune sand; Guildford formation = alluvial clay loam sand, gravel Yoganup Formation = sand, clay, silt
Early Cretaceous	Warnbro Group (to ~ 92 m depth)	Leederville Formation = clay, silty sand and sand; South Perth Shale = interbedded siltstone and shale with some sandstone; Gage = alternating sandstone shale succession.
Early Jurassic	Cattamarra Coal Measures	Interbedded sandstone, siltstone and shale with thin coal seams.

5.4 SURFACE HYDROLOGY

5.4.1 Mine Site

Most first order streams in the vicinity of the mine sites are ephemeral, flowing only after winter rains have saturated the surrounding soils and runoff and seepage commences. Higher order streams in the high rainfall zone have base flows all year round except when droughts occur, when they may dry up over late summer and autumn. There are no natural permanent watercourses, lakes or swamps near the actual mine pits. There are several man-made dams in the area, some of which provide water to the mining operation and refinery. Alcoa has operated close to South Dandalup Dam over the last 20 years both at Del Park and Huntly mining areas, with no adverse environmental impacts.

The White Road crusher facility is supplied with water from Banksiadale Dam (Figure 3) and water for the Del Park facilities is supplied from Boronia Waterhole. Potable water is supplied to the Huntly and White Road workshops and offices from Pig Swamp Waterhole. Marrinup Nursery,

which grows the plants for Alcoa's rehabilitation, is supplied by a dam on a tributary of Marrinup Brook, south of the mining area.

5.4.2 Refinery Site

Pinjarra refinery obtains surface water from Oakley Brook and Barritt Brook (Figure 2), which are natural, seasonal creek systems, which cross the Alcoa property from east to west. The total surface water allocation from the two streams is 9,000 MLpa. Surface water harvesting is generally undertaken throughout winter, and supplements other water sources (groundwater and treated effluent) for the refinery.

Alcoa has two structures on Oakley Brook, which drains a catchment area of 49 km^2. These are:

- the Oakley Brook Detention Dam (storage capacity of 629 ML) with an operating licence of 4,000 MLpa; and
- the Lower Oakley Pumpback Dam (storage 25 ML) to hold surge volumes following rainfall events with an operating licence of 3,000 MLpa.

Barritt Brook has a catchment of approximately 8 km^2. Alcoa uses water from the Barritt Brook Detention Dam (storage capacity 251 ML) with an operating licence of 2,000 MLpa.

To understand the possible impact of the refinery's diversion of surface water on the downstream environment and other users, Alcoa commissioned an environmental water requirements study (EWR). The work was undertaken by Streamtec Ecological Consultants. The report (Streamtec, 2000) presented the following findings:

- The low EWR volumes reported by the study were a function of the lack of important water-dependent ecosystem components in the lower Oakley and Barritt Brooks. The riparian vegetation of the brooks was degraded and the channels were characterised by extensive erosion. The brooks have temporary inflow and, as such, supported generalist fauna. There were no native fish.

- As EWRs for both brooks were estimated to be low and it was concluded that "compensation" or sub-catchment flows would adequately meet the EWRs. Even in the absence of reservoir releases from the detention dam, modelled flows in Oakley Brook show tributary inputs, groundwater discharge and surface run-off, are sufficient to meet the required 57.2 ML/annum EWR for Oakley Brook.

- Barritt Brook is expected to have similar transmission gains. The high run-off coefficient of the largely farmland catchments of the brooks would result in substantial surface run-off.

The EWR for areas downstream of the Lower Oakley Pumpback Dam is met with a combination of environmental flows maintained by continuous discharge at the weir, and storm flows that exceed pumping rate.

In accordance with recommendations by Streamtec (2000), an Adaptive Environmental Assessment and Management monitoring program was established to enable review of the initial in-stream flow recommendations. The EWRs were formulated in the context of an incomplete ecological record and limited hydrological data. In light of this, the recommended EWRs will continue to be regularly evaluated and reviewed based on new information.

5.5 HYDROGEOLOGY

5.5.1 Mine Site

There are no defined hydrogeological features within the mining area that can be classed as regional aquifer systems because the geology is weathered granites or dolerites with overlying clays and bauxite. The weathered profile is typically 20 m to 30 m in depth with unconfined water table depths ranging from 0 m to 10 m in stream zones. Groundwater saturated thickness decreases on hill slopes away from the stream zones with mostly no permanent groundwater table above the bedrock on hilltops and ridgelines. Groundwater exists in rock fractures within the first few metres of unweathered bedrock and in sediments laid down along creek lines or which have accumulated in valleys. In addition, there may be small localised areas of groundwater held in seasonally perched water tables in the ferruginised zone overlying the impermeable pallid zone clays.

Due to the clayey nature of the weathered profile of the Darling Range nearly all bores drilled have very low yields. Therefore the localised Darling Range groundwater systems are not considered to represent a significant water resource for industrial use.

5.5.2 Refinery Site

Three significant aquifer systems are recognised in the Pinjarra area, in order of increasing depth (derived from Parsons Brinckerhoff, 2003):

- superficial aquifer (which contains an upper clayey unit and a lower more sandy unit);
- Leederville aquifer; and
- Cattamarra aquifer.

Alcoa is permitted to abstract 2,500 MLpa of water from the Cattamarra aquifer for use in the Pinjarra refinery, and an additional 1,500 ML in drought conditions, to supplement surface water supplies (refer to Section 6.10.2). Abstraction is carried out from a borefield adjacent to the RDA comprising five production bores. Bores are screened in the Cattamarra aquifer and are up to 200m deep. Water abstraction is metered continuously, and groundwater levels and water quality are monitored regularly as part of Alcoa's licence requirements.

The superficial aquifer has limited groundwater supply potential. Recharge is predominantly by infiltration of rainfall and groundwater discharges as base-flow to the surface drainage. Potable groundwater, with a salinity of less than 250 mg/L total dissolved solids (TDS), occurs adjacent to the Darling Scarp in the Pinjarra area, however, groundwater salinity increases towards the west where salinities in excess of 1,500 mg/L TDS are reported close to the Murray River. Near the RDAs, the top part of the superficial formation is dominated by the Guildford Clay formation. The low permeability clays of this formation form an important barrier to vertical and horizontal groundwater flow. In the vicinity of the refinery the superficial aquifer is directly underlain by the Cattamarra aquifer and there is evidence of a steep hydraulic gradient between the two aquifers at this point.

Thin, laterally extensive sand beds occur within the Leederville aquifer and groundwater salinity in these sand beds increases towards the west, and is highly variable at depth. Recharge is generally derived by leakage from the overlying superficial formations. Groundwater is abstracted from the Leederville aquifer for water supplies to the Pinjarra Racecourse and two small orchards on the east side of the Murray River near Pinjarra. Alcoa does not draw water from the Leederville aquifer. Analysis of water levels in one of the Alcoa monitoring bores in the Leederville Aquifer shows impacts from abstraction, independent of climate effects. This indicates a hydraulic connection between the Cattamarra and Leederville aquifers at least in a westerly direction from the Alcoa's borefield.

Recharge of the Cattamarra aquifer is derived by leakage from the overlying Leederville aquifer and from the superficial aquifer adjacent to the Darling Scarp where it overlies the Cattamarra aquifer. Groundwater salinity in the sandstone layers of the Cattamarra aquifer generally increases with depth. Water levels in the Cattamarra aquifer declined in the three-year period from 1999 to 2002 when abstraction was high through a period of drought. All Cattamarra hydrographs show a long term declining trend in water levels, with shorter term downward deflections due to increases in abstraction during drought years. Alternatives to using groundwater from the Cattamarra aquifer above sustainable levels during drought, are currently being investigated by Alcoa (refer to Section 6.10.4).

There is little evidence of discernible alteration of groundwater conditions beyond the boundaries of the RDAs and the refinery due to contaminant migration in the superficial aquifer. There is no evidence of vertical migration of impacts to the underlying Leederville and Cattamarra aquifers (Parsons Brinckerhoff, 2003).

5.6 VEGETATION AND FLORA

5.6.1 Mine Site

The Huntly mine is located within Jarrah (*Eucalyptus marginata*) forest classified by Beard (1990) as part of the Northern Jarrah Forest subregion. It occurs with Marri (*Corymbia calophylla*) where soils are shallow over granite, and Wandoo (*Eucalyptus wandoo*) where dolerite dikes occur, or soils are deep and rich in clay. Watercourses and swamps may have minor stands of Blackbutt (*Eucalyptus patens*), Flooded Gum (*Eucalyptus rudis*) or Bullich (*Eucalyptus megacarpa*) and the middle storey includes *Banksia, Allocasuarina* (Sheoak) and *Persoonia* species. The understorey is rich and varied containing many endemic species.

The forest has a diverse flora, with almost 300 species identified by Alcoa in pre-mining surveys. Declared Rare Flora (DRF) and Priority Flora are a particular consideration in mine planning and areas known to contain significant flora and habitat are avoided. Alcoa has a policy of avoiding clearing 'old growth' forest as defined in the Regional Forest Agreement for Western Australia (1999). Details as set out in the Five-year Mine Plan and Environmental Management Manual are strictly adhered to at all stages of mining operations.

Alcoa undertakes progressive rehabilitation of its mines, to return them to Jarrah forest. Due to Alcoa's ongoing research into improving rehabilitation techniques, rehabilitation after mining is highly successful. A feature of the Jarrah forest ecosystem is the high diversity of understorey plants, and the goal has been to restore 100% species richness to rehabilitated areas. This was achieved in 2000 at the Huntly and Willowdale Mines. Alcoa has received a number of national and international awards for achievements in its rehabilitation program, including the Golden Gecko Award for Environmental Excellence, in September 2002.

Many species, including Jarrah, are susceptible to dieback, a disease that has been present in the forest for at least 100 years. The disease is as a result of the fungus *Phytophthora cinnamomi*, which attacks the roots of plants and causes them to rot. This kills the plant by stopping the uptake of water and nutrients. The fungus is spread mainly by the movement of contaminated soil, or the flow of water.

Prior to commencement of mining activities, detailed dieback disease surveys are undertaken in the Jarrah forest. Areas of dieback disease are mapped and boundaries marked on the ground (e.g. by marking trees). It is estimated that approximately 20% of the current mining envelope is affected by the dieback disease, although in most instances it has not resulted from Alcoa's operations. Special precautions for exploration and mining in dieback affected areas, and movement across dieback boundaries are implemented to minimise the risk of spread of the disease (refer to Section 6.6.2). These procedures are described in the Alcoa/CALM Working Arrangements and mining follows these procedures.

5.6.1.1 Conservation Areas

The Regional Forest Agreement for Western Australia (1999) established a comprehensive forest reserve system in the southwest of the State that includes 16% of Alcoa's mineral lease. Alcoa has agreed not to mine in formal conservation reserves located within the lease, such as those located east of Huntly. Assessment and management of informal reserves are discussed in Section 6.8.

5.6.2 Refinery Site

The refinery and Alcoa's surrounding freehold landholdings are located on a flat coastal plain with heavy clay soils overlain by thin sandy loams. Immediately to the east of the refinery are low foothills with Ridge Hill Shelf vegetation that is backed by the Darling scarp and the Jarrah Forest.

Prior to construction of the refinery, the landholdings and surrounding areas had been cleared of the majority of native vegetation and principally used for cattle grazing. Since 1992 substantial revegetation work has been conducted within refinery and on the surrounding landholdings. The focus has been on establishing native vegetation corridors, primarily along natural watercourses. The purpose of this rehabilitation is to enhance biodiversity and provide habitat for native fauna. Wetlands have also been created at various locations along these corridors. They are studied each year by Curtin University honours students, with the intent of identifying the natural building blocks and barriers required to establish man-made self-sustaining wetland ecosystems.

A comprehensive three-yearly floristic survey has been implemented that uses consistent assessment plots and methodologies so that any impacts from the operations can be assessed. These surveys have identified one species *Synaphaea stenobola* that is listed on the CALM declared species list. Alcoa has instigated a recovery program for this species jointly with Kings Park Botanic Gardens in Perth.

The on going land management program at Pinjarra refinery has been awarded the John Tonkin Tree Award and in 2001 was a recipient of the Golden Gecko award.

5.7 FAUNA

5.7.1 Mine Site

Native fauna diversity is much higher in the Jarrah forests to the east of the refinery than on the cleared plain west of the Darling Scarp. The Jarrah forest provides habitats for about 240 species of native animals, including 29 mammals, 45 reptiles, 11 frogs, four fish and about 150 birds (www.calm.wa.gov.au/forest_facts).

Alcoa undertakes surveys of fauna in unmined as well as rehabilitated areas to measure fauna populations and estimate long-term population trends. The information from these surveys is used to identify rare fauna and minimise the impact of mining on fauna as well as to monitor the return of fauna to rehabilitated areas.

Baseline vertebrate surveys:

- provide baseline fauna survey data with an emphasis on the distribution and abundance of rare, specially protected or uncommon fauna species;
- assess likely and potential impacts on fauna and recommend mining and rehabilitation options for minimising those impacts;
- determine specific rehabilitation requirements for fauna (e.g. where fauna corridors may be required); and
- establish permanent monitoring plots that will enable long-term assessment of impacts.

Monitoring also includes a long term program, which began in 1992 to monitor mammals, birds, reptiles and ants. A frog monitoring program was commenced by Alcoa in 1993. Monitoring is conducted to assess impacts of operations on fauna of surrounding areas and to assess the rates of recolonisation following rehabilitation. Alcoa also sponsors "Operation Foxglove" to control the numbers of introduced foxes within its mineral lease. Recent survey results indicate significant recovery in the numbers of several key vertebrate species including the rare Chuditch (Western Quoll) and Quenda (Southern Brown Bandicoot) and confirm that reintroduced populations of the locally extinct species Noisy Scrub Bird and Tammar Wallaby appear to be surviving.

Alcoa's fauna monitoring programs have contributed to the development of standards and procedures for mining and rehabilitation which minimise impacts on fauna and encourage rapid recolonisation of mined areas.

5.7.2 Refinery Site

A three-yearly fauna monitoring program was established at Pinjarra refinery to measure impacts from the refinery on native fauna. The program is linked to the revegetation program and landscape management plan for the refinery surrounds. Prior to construction of the refinery and development of the land management program, the presence of native fauna was limited and species diversity and populations were consistent with those expected on agricultural grazing lands. However, by 2002 a survey of the refinery surrounds identified 13 mammal, 13 reptile, 10 frog and 110 bird species, many of which were water birds associated with the wetlands that had been created by Alcoa. Since the 1995 fauna survey, various rare species have been identified on the Pinjarra refinery landholdings such as the Chuditch, Peregrine Falcon, Baudins Cockatoo and Carpet Python. These species are listed under the WA *Wildlife Conservation Act* 1950. The presence of these species, together with other fauna monitoring results over time, is an encouraging indication of the success of the refinery's Land Management Program. Other evidence of further improvements in species diversity has been noted the stream zone vegetation corridors.

5.8 SOCIAL ENVIRONMENT

5.8.1 Peel Region

The Pinjarra refinery is located in the Shire of Murray in the Peel Region. Peel has the second largest population of all regions in Western Australia (approx 76,000) and is experiencing a population growth rate almost double that of the rest of the state, the second highest behind the Perth metropolitan region. Population growth has averaged above 3% per annum since the mid 1990's, with lifestyle and housing options being the main drivers of these inflows. This rapid growth comes with some challenges. Public services are often regarded to be lagging behind the growing demand.

Mandurah is the major population and business centre for Peel and is one of the largest urban centres outside the Perth metropolitan area. It is also where most of the infrastructure and services for the region are located. A major asset and driver of the region's growth is the coast and estuary. The main inland centres of Peel are Byford, Pinjarra, Waroona and Boddington. Smaller communities exist at Mundijong, Jarrahdale, Serpentine, North Dandalup and Dwellingup.

The economy of the Peel Region is based predominantly on mining and mineral processing, mainly sourced from Alcoa's Pinjarra and Wagerup refineries, and Huntly and Willowdale mines and Worsley bauxite mining operations near Boddington. In 2001/02 the Peel Region produced $3.6 billion worth of alumina (which is around 80% of total production in the Region) and $62 million worth of gold (DoIR, 2002). About $1.8 billion of this alumina is produced from bauxite mined in the Shire of Murray. The 2001 Census reported the major areas of employment for people living in the Shire of Murray also reflected the minerals processing profile:

- manufacturing (16.4%);
- retail trade (15%);
- agriculture (10%);
- construction (8.8%); and
- mining (5.9%).

Alcoa's refinery operations are included in the manufacturing sector figures whilst the mining operations at Huntly are reflected in the mining sector figures.

The main transport routes are the South Western Highway from Perth to Albany via Bunbury, the Pinjarra Road from Mandurah to Pinjarra, and the Old Coast Road from Mandurah to Bunbury. Passenger and freight rail services occur between Perth/Fremantle and Bunbury.

5.8.2 Shire of Murray

The Shire of Murray had a population of 10,061 people at the 2001 Census - around 12% of the Peel Region's population. The Shire as a whole is sharing in the growth of the Peel Region but the Peel Development Commission report 'Peel Away the Mask' (PCD, 2001) indicates the Murray Shire community has concerns about local employment opportunities, housing, youth employment, education, Aboriginal employment and water quality in rivers. Unemployment is skewed towards people aged over 35. The rate of unemployment is much higher than for the State.

Pinjarra is the largest population centre in the Shire of Murray and acts as a service centre for the surrounding farming communities. A total of 603 people live in Pinjarra and approximately 31% of these are employed by Alcoa, although the population of Pinjarra has declined slightly in recent years. The larger employment sectors in town are manufacturing, health and retail. Farming specializations include dairy, cattle breeding, timber and equestrian services.

The Murray Shire Council Annual Report 2002 indicates a wide range of initiatives aimed at improving social amenity and attracting tourists to local towns. Heritage is a significant asset to the towns of Pinjarra and Dwellingup and gives each town a distinctive appeal.

5.8.3 Alcoa's Contribution

5.8.3.1 Employment

Alcoa is a major employer in the Peel Region. Alcoa employs more than 2,600 people in the Peel Region. Another 650 are employed full time by Alcoa's contractors. The Pinjarra refinery employs over 1,000 people and the Huntly mine employs the equivalent of 570 full time people. The Pinjarra Refinery Efficiency Upgrade will provide up to 1,000 jobs during a two-year peak construction phase.

Alcoa is the largest employer in both the Shire of Murray and Town of Pinjarra, with a large percentage of Alcoa's employees living in Mandurah and smaller numbers of employees living in other towns in the region, including Pinjarra, Dwellingup, North Dandalup, and Yunderup. Some employees choose to travel longer distances from as far as Perth, Harvey and Rockingham to work at Pinjarra or Huntly.

5.8.3.2 Economic Contribution

Alcoa contributes to the economy directly through spending on goods and services and by paying salaries and wages to its workforce. Alcoa also contributes indirectly through flow on spending. In 2002, Alcoa directly contributed around $160 million to the Peel Region. Of that figure, $135 million was in the form of wages, over $24 million in purchase orders and contracts, and more than $1 million in corporate credit card purchases. Four million dollars of this total was spent in the town of Pinjarra.

Each year Alcoa contributes to the economy indirectly through payments of State payroll tax of $6.3 million, State royalties from the mining of bauxite of $20 million and rates and land lease fees to the Shire of Murray.

5.8.3.3 Social Investment & Sponsorship

Pinjarra has many active community organizations and Alcoa provides support to a number of these groups through sponsorship, in-kind support and employee interactions. In 2002, Alcoa donated nearly $4 million to a wide range of community projects, of which over $700,000 went to the local Pinjarra community. Further detail on Alcoa's contribution to the community is provided in Section 7.2.

As a predominantly regional employer and operator Alcoa is committed to the long-term sustainability and vibrancy of local communities. This commitment continues with the current plans for business growth, and the prosperity this growth can bring through partnerships with the community.

5.9 CULTURAL HERITAGE

The Peel Region has a rich history of Nyoongar culture. Around the town of Pinjarra, there are seven sites on the State Register of Heritage Places and a total of 50 sites of heritage importance including 18 relating to Aboriginal heritage. A significant site located near the Pinjarra refinery will not be impacted by the proposal. Alcoa has a specific Heritage Management Plan that clearly specifies its responsibilities and strategies for managing heritage sites and issues within its Lease and operating areas.

Alcoa conducts ethnographic and archaeological surveys using consultants and Aboriginal custodians. Sites that are identified during the Aboriginal Heritage Surveys are registered with the Department of Indigenous Affairs and protected from mining impacts. Alcoa and Aboriginal heritage consultants have developed a draft model to predict areas most likely to contain heritage values, based on soil types, aspect, slope and vicinity to streams. This allows intensive surveys in areas more likely to have heritage values. Surveys of the future McCoy mining areas have been undertaken using this model. Sites have been identified, recorded and will be protected from future mining impacts.

An historical consultant was engaged during 1999 to survey the extent of European heritage remaining at the location of the former Banksiadale townsite and its hinterland. Details of the remaining heritage values have been documented and mining is not planned within the former townsite.

6. ENVIRONMENTAL IMPACTS AND MANAGEMENT

Alcoa adheres to two over-arching sets of principles at its Pinjarra refinery. These are the Sustainability Principles that Alcoa has recently established, and its Environmental Management System which has developed since the 1960's and was formalised with ISO 14001 accreditation in 2001. All of Alcoa's major actions and activities are undertaken with full knowledge of, and in cooperation with, relevant regulatory agencies.

6.1 GENERAL ENVIRONMENTAL MANAGEMENT

6.1.1 Alcoa's Environmental Management System

Pinjarra's Environmental Management System (EMS) was certified to the International Standards Organisation ISO14001 EMS Standard in February 2001. The Huntly Mine Environmental Management System was certified in March 2002. Key elements of the EMS include:

- an Environmental Management Team with specific environmental roles and responsibilities;
- environmental aspects (issues) register;
- environmental improvement plans;
- operational control procedures;
- environmental monitoring;
- regular auditing and feedback; and
- incident reporting and corrective action follow-up.

The Environmental Management Manual (Alcoa, 2003) unites all the various procedures, work instructions and guidelines applicable to all parts of the operation into a simple, easily accessible cross referencing system that can be applied by all Alcoa personnel. In this way good environmental management is part of day-to-day operations and is extended, via the employees, to areas outside Alcoa's immediate operations, into the home and community.

The EMS and its associated documentation will be amended as necessary to incorporate changes associated with the Pinjarra refinery Efficiency Upgrade, including specific measures to cover the construction period of the project.

6.1.2 Application of Alcoa's Sustainability Principles

This is the first project to which Alcoa will apply its newly adopted sustainability framework, and the management of the environmental impacts of the Efficiency Upgrade will be within the context of the following principles (refer to Section 1.9):

- Respect and Protect People;
- Building Community Experience and Well-being;
- Long-term Economic Benefit;
- Efficient Resource Use and Cleaner Production;
- Ecological Integrity and Biodiversity;
- Meeting the Needs of Current and Future Generations;
- Stakeholder Involvement; and
- Accountability and Governance.

Commitment 1
Alcoa will be guided by its sustainability principles and will operate within the guidelines of its Environmental Management System (EMS) at all stages of the Pinjarra refinery Efficiency Upgrade.

6.2 IDENTIFICATION OF ENVIRONMENTAL ISSUES

Stakeholder consultation and technical review has highlighted that the key environmental issues associated with the Pinjarra refinery Efficiency Upgrade are:

- air quality including odours and dust;
- greenhouse gas emissions;
- noise; and
- water supply.

Each of these issues, and others raised during consultation, have been addressed as part of stakeholder involvement, development of the proposal and preparation of the Environmental Protection Statement.

Owing to the pre-existence of the mine and plant, and the use of existing refinery equipment wherever practical, the project is not expected to have a significant impact upon:

- forest clearing;
- flora, vegetation or fauna;
- rivers, creeks, wetlands and estuaries;
- areas of significant conservation value;
- groundwater contamination
- solid waste management;
- cultural heritage; or
- regional social values.

These issues will continue to be proactively managed by Alcoa in line with its existing practices and requirements.

The following sections provide more detail on the management of environmental issues for the Efficiency Upgrade.

6.3 AIR QUALITY

6.3.1 Regional context

6.3.1.1 Background Air Quality

The Pinjarra refinery is the largest industrial source of atmospheric emissions in the area. The contribution of emissions to atmosphere from other sources include emissions associated with motor vehicles, agricultural activities, wildfires or hazard reduction burning, and the use of domestic wood heaters. These sources are also significant contributors of particulates, oxides of nitrogen, ozone and volatile organic compounds on occasion.

6.3.1.2 Meteorological Features

The meteorology experienced in the Pinjarra area is influenced by broad scale synoptic flows (due to the movement of high and low pressure weather systems), as well as local winds induced by the topographical features of the Darling Scarp and by land and sea breezes. Section 5.2.3 discusses the prevailing winds in the area, based on historical measurements available for the Pinjarra refinery site.

Given the proximity of the Pinjarra refinery to the Darling Scarp, the influence of topographical features on local meteorology is an important consideration. The following local meteorological influences have been found to occur at the Pinjarra refinery site:

- very strong easterly "foothill" winds (up to a factor of two or more times higher than elsewhere on the coastal plain) that are typically experienced during the summer months from early evening to several hours after sunrise;

- wind direction reversal resulting from the mechanical generation of turbulent eddies in the lee of the Scarp;

- the channeling of westerly orientated winds (i.e. winds from the northwest to southwest) along the Darling Scarp into a more northerly or southerly direction; and

- katabatic drainage flows associated with the cooling of the air near the ground surface at night becoming denser and draining to areas of lower relief, typically resulting in light easterly winds.

6.3.2 Air Emissions

6.3.2.1 General

The primary emissions released from the Pinjarra refinery include NO_x, CO, SO_2, particulates, VOCs, and trace levels of metals. Emissions of NO_x, CO and SO_2 arise primarily from the combustion of natural gas and are released to atmosphere from the Powerhouse boilers, Calciners, Oxalate kiln and Alumina Leach Dryer.

Emissions of particulates (or dust) are released from the Calciners (in the form of alumina dust), and to a lesser extent the Oxalate kiln and the Alumina Leach Dryer. In addition, particulates are also released intermittently as a result of mining activities, windblown dust emissions from the bauxite stockpile area and the RDA, and bulk materials handling and transport activities.

VOC emissions from alumina refineries are caused by the breakdown of organic material contained in the bauxite, additives to the liquor stream and in by-products of fuel combustion processes. During alumina refining, these organics are degraded and produce an extensive range of substances, some of which are volatile enough to be emitted to air. These VOC emissions are the cause of the characteristic odour associated with alumina refineries.

Metals such as mercury, arsenic and nickel are introduced into the Bayer process primarily through the trace amounts present in bauxite, and the current knowledge indicates that the majority of metals are recirculated within the caustic liquor stream or deposited with the residue. Notwithstanding this, trace amounts of various metals have been found to be present in emissions from various sources at the Pinjarra refinery. Alcoa has been gaining an understanding of the mercury mass balance and emission sources for each of the Western Australian refineries with the goal of reducing emissions. In 2004 a pilot project will be commissioned at Wagerup to remove mercury from the Bayer process using a filtration and absorption process. This technology is still being developed and when proven it is likely to be transferred to other Alcoa refineries throughout the world.

Further information on emissions from the Pinjarra refinery is available on the National Pollutant Inventory (NPI) website at www.npi.gov.au. Changes in the refinery emissions associated with the Efficiency Upgrade are outlined in Section 6.3.2.3.

6.3.2.2 Air Pollution Control Installations

The Efficiency Upgrade will result in a significant capital investment in pollution control equipment to reduce air emissions from various key areas of the refinery, including:

Digestion: a Regenerative Thermal Oxidiser (RTO) will be installed to thermally destroy emissions of VOCs from key sources within the digestion area. In addition, a number of other minor sources will be captured and condensed;

Oxalate Kiln: a new wet scrubber and a RTO will be installed to reduce the emissions of particulates, CO, VOCs and metals from the Oxalate kiln;

Calciners: the particulate collection efficiency of the ESPs servicing Calciner Units 4, 5 and 6 will be upgraded (to meet the specifications of Calciner Units 1, 2 and 3). The new Calciner (Unit 7) will be installed with a baghouse;

Powerhouse Boilers: Powerhouse boiler Unit 6 will be retrofitted with low-NO_x burner technology to reduce the emissions of NO_x; and

RDA: Part of the existing sprinkler network will be upgraded to improve surface area coverage and enhance dust suppression.

Specific details on the design specifications of these proposed items of pollution control equipment are provided in Section 4.1.

The RTO technology is designed to achieve high destruction efficiencies for VOCs and other combustible air pollutants. Thermal oxidation technology is used extensively for industrial applications around the world to destroy VOCs. The operation of an RTO typically involves the use of multiple ceramic beds that are heated (via the combustion of auxiliary fuel) to temperatures required to oxidise the target pollutants. The multiple chambers of an RTO increases the residence time of pollutants and hence the destruction efficiency that can be achieved. The advantage of an RTO over conventional thermal oxidation technology is that it is more energy efficient, and can achieve superior destruction efficiencies and operational reliability.

6.3.2.3 Change in Refinery Emissions

With the installation of the proposed pollution control equipment, the Efficiency Upgrade will achieve a reduction in total atmospheric emissions from the refinery for many of the key pollutants, although minor increases in some specific compounds (in proportion to the increase in the production capacity of the refinery) are also expected. Figure 11 illustrates the percent change in total refinery emissions expected as a result of the Efficiency Upgrade compared to the Baseline (i.e. current refinery emissions and including the Alinta Cogeneration Project). The pollutants presented in Figure 11 include:

- those for which the NEPC has established (or is proposing to establish) national ambient air quality guidelines for;
- acetaldehyde as it is an indicator of odour impacts (refer to Section 6.3.5); and
- the metals identified in the health risk assessment as the most significant contributors to the potential health risks.

From Figure 11 it can be seen that emissions are expected to change as a result of the Efficiency Upgrade as follows:

- significant reductions in emissions of NO_x, particulates, benzene, arsenic, cadmium and nickel of between approximately 25% (particulates) and 75% (nickel);
- a reduction in average emissions of acetaldehyde of approximately 10%, and a reduction in peak emissions of approximately 15%;
- increases in emissions of formaldehyde, and mercury of approximately 10% and 20% respectively; and
- no change to emissions of CO, SO_2, toluene and xylenes.

The proportion of change between acetaldehyde, which is reduced by the upgrade, and formaldehyde which increases is due to the different proportions emitted throughout the refinery process. Destruction of VOCs at digestion includes mostly compounds released at ground level, of which acetaldehyde is a higher proportion.

The significant reduction in arsenic is through improved wet scrubbing on the oxalate kiln, which will remove a high proportion of arsenic compounds that are found in particulate form in this emission. On the other hand, mercury will increase proportionally with production because the emissions controls proposed do not capture mercury, which is emitted as a vapour. Alcoa's plans to develop techniques for capturing mercury are discussed further in Section 6.3.2.1.

6.3.3 Ambient Air Quality Standards

6.3.3.1 National Environment Protection Council

The National Environment Protection Council (NEPC) has produced the following national ambient air quality guidelines for the protection of human health:

- National Environment Protection (Ambient Air Quality) Measure (NEPC, 1998a) which sets national air quality Standards for the criteria pollutants SO_2, NO_x, ozone, CO, particulate (as PM_{10}) and lead;

- variation to the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2002) which sets an Advisory Reporting Standard for particulate (as $PM_{2.5}$). The purpose of the Advisory Reporting Standard is to gather sufficient data to facilitate a review of the Standard as part of the review this Measure (scheduled to commence in 2005); and

- Draft National Environment Protection (Air Toxics) Measure (NEPC, 2003) which proposes Investigation Levels for the air pollutants benzene, benzo(a)pyrene (as a marker for Polycyclic Aromatic Hydrocarbons [PAHs]), formaldehyde, toluene and xylenes. This measure is draft and the Investigation Levels are currently being considered by the NEPC, and therefore are subject to change.

The relevant NEPC guideline values have been adopted in this study for assessing potential human health impacts associated with these pollutants at nearby residences. A summary of these guideline values is presented in

Table 5.

Table 5: National Environment Protection Measures - Ambient Air Guidelines

Pollutant	Averaging Period	Ambient Guideline		Goal
		(ppm)	($\mu g/m^3$) [1]	
Ambient Air NEPM		*Standard*		*See Note 2*
Carbon Monoxide	8 hours	9.0	11,250	1 day a year
Nitrogen Dioxide	1 hour	0.12	246	1 day a year
	1 year	0.03	62	none
Photochemical oxidants (as ozone)	1 hour	0.10	214	1 day a year
	4 hours	0.08	171	1 day a year
Sulphur Dioxide	1 hour	0.20	571	1 day a year
	1 day	0.08	229	1 day a year
	1 year	0.02	57	none
Particles as PM_{10}	1 day	-	50	5 days a year
Variation to the Ambient Air NEPM		*Advisory Reporting Standard*		
Particles as $PM_{2.5}$	1 day	-	25	*See Note 3*
	1 year	-	8	
Draft Air Toxics NEPM		*Draft Investigation Level* [4]		
benzene	Annual	0.003	8.8	*See Note 5*
formaldehyde	24 hour	0.015	16.9	
toluene	24 hour	2	6,907	
xylenes	24 hour	0.2	795	

Note:

1. Referenced to a temperature of 0 ^oC and absolute pressure of 101.3 kPa.
2. Maximum allowable exceedences of the Standard, to be achieved by the year 2008.
3. Goal is to gather sufficient data nationally to facilitate a review of the standard as part of the review of this Measure scheduled to commence in 2005.
4. Noted that the Impact Statement for the Draft Air Toxics NEPM (NEPC, 1998b) reports the Investigation Levels referenced to a temperature of 25 ^oC, however for consistency within this table the Investigation Levels have been referenced to 0 ^oC.
5. Eight-year goal is to gather sufficient data nationally to facilitate development of a standard.

6.3.3.2 Other Ambient Air Quality Regulatory Standards

There are no ambient air quality standards specified in a NEPM for Total Suspended Particulate (TSP). The environmental licence for the Pinjarra refinery does however specify an ambient TSP concentration limit of 260 $\mu g/m^3$ (24-hour average) at the Pinjarra racecourse monitoring site.

In addition to the licence limits set by regulatory agencies, Alcoa has established its own "internal standards" and "target". The purpose of the internal standard is to ensure that a higher level of

performance than the minimum acceptable levels specified by the environmental regulatory authorities is achieved, and the purpose of the target is to encourage continuous improvement through the establishment of a long-term goal that Alcoa strives to achieve.

To facilitate continuous improvement in the management of dust from the RDA in particular, Alcoa has set an internal ambient TSP target of 120 $\mu g/m^3$ (24-hour average) at the Pinjarra racecourse site, which is less than half of the limit established by the DoE in the environmental licence for the Pinjarra refinery.

6.3.4 Air Quality Impacts

Air quality impacts for those pollutants covered in the relevant NEPMs have been assessed using air dispersion modelling techniques to predict the maximum ground level concentration of pollutants at nearby residences, and comparing these predictions to the relevant ambient concentration guidelines. In addition, a Quantitative Health Risk Assessment has been conducted to assess the potential health risks arising from the inhalation of emissions released to atmosphere from the Pinjarra refinery, and this is discussed in Section 6.3.6.

The nearby residential areas that were considered as part of the assessment of air quality impacts are summarised in Table 6. They include the Pinjarra town site to the west of the refinery, the Carcoola town site to the northwest of the refinery, and a number of individual residences located around the refinery. A brief description of each of the residential areas and individual receptors is presented in Table 6, and the locations are shown in Figure 12.

Table 6: Residential Areas and Individual Residences

Receptor Identification Number(s)	Location
1, 12	Residences to the northeast of the refinery on the Darling Scarp
2	Fairbridge farm accommodation to the north of the refinery within the refinery buffer area
3	Carcoola residential area to the northwest of the refinery
4	Pinjarra racecourse as an indicator of the Pinjarra town site to the west of the refinery
5	Residence to the southwest of the refinery
6 - 11	Residences to the south of the refinery
13, 14	Residences to the southwest of the refinery within the refinery buffer area

6.3.4.1 Air Dispersion Modelling

6.3.4.1.1 Emissions Scenarios Modelled

The following air pollutant emission scenarios were considered in the air dispersion modelling:

Baseline scenario: representing emissions from the existing Pinjarra refinery (including the Alinta Cogeneration Project Stage I and II); and

Upgrade scenario: representing emissions from the Upgraded Pinjarra refinery (including the Alinta Cogeneration Project Stage I and II).

Both the Baseline and Upgrade scenarios have been included to allow an assessment of the incremental change in the air quality impacts likely to be associated with the Efficiency Upgrade.

Emissions from the Alinta Cogeneration Project have been included in both the Baseline and Upgrade scenarios as this project has already been granted the necessary environmental approvals and its operation is expected to be phased in from the fourth quarter 2004 (Stage I) through to 2005 (Stage II), and is therefore expected to be fully operational before the Efficiency Upgrade. Atmospheric emissions from the Alinta Cogeneration Project comprise primarily NO_x and CO_2 generated by the combustion of natural gas in the gas turbines.

Emissions arising from upset conditions have also been considered. Of the possible upset conditions that can lead to an increase in emissions at the refinery, the most significant is process failure within Calcination or a failure of the ESPs servicing the Calciners. Section 6.3.4.2.1 discusses the predicted air quality impacts associated with such upset conditions.

Due to the high level of uncertainty associated with using air dispersion modelling techniques to assess the potential impacts from fugitive windblown dust emissions (such as particulate emissions from the RDA), the modelling of particulate emissions has been confined to stack emissions only. Air quality impacts arising from windblown dust emissions from the RDA have however been addressed as part of the air quality assessment, based on the historical results of ambient particulate monitoring conducted at the Pinjarra Racecourse (refer to Section 6.3.4.4).

6.3.4.1.2 Model Selection

Numerous air dispersion models have been developed with specific applications in mind, and as such these models exhibit different capabilities. The air dispersion models most commonly in use throughout Australia include:

Ausplume: the Victorian Environmental Protection Authority's Gaussian model;
TAPM: "The Air Pollution Model" developed by the CSIRO; and
CalPuff: the Californian Puff model.

Each of these models has the tacit endorsement of the environmental regulatory agencies of Australia, although historically Ausplume has been most widely applied for environmental regulatory purposes. The capabilities (and limitations) of each of these dispersion models is presented in detail in Appendix A, and can be summarised as follows:

Ausplume:
- wide regulatory acceptance throughout Australia
- treatment of terrain and dispersion under light winds is simplistic

CalPuff:
- can model spatially varying wind and turbulence fields that are important in complex terrain, long-range transport and near calm conditions

TAPM:
- can predict the meteorology for a region without the need for site-specific meteorological observations based on Bureau of Meteorology data
- can simulate photochemistry

To select the most appropriate model for use in this study, a comparison of the predictions from the three models has been undertaken for elevated point sources (i.e. stack emissions) based on emissions of NO_x, and for low level and fugitive sources based on emissions of VOCs from relevant sources.

The predicted ground level concentrations of each of the models were generally comparable, with Ausplume generally predicting the highest ground level concentrations. A notable exception occurs for the short-term (i.e. 1-hour average) ground level concentration predictions at the Pinjarra town site (receptor 4) where the highest concentrations are predicted by TAPM, then Ausplume, and the lowest concentrations are predicted by CalPuff.

The overall comparative assessment of each of the models indicated that Ausplume provides the most conservative (i.e. health protective) estimate of ambient concentrations at the identified receptor locations. Therefore Ausplume was selected as the most appropriate air dispersion model to apply, although CalPuff was also used for the receptors located on the Scarp. The accuracy of the modelled ground level concentrations will be verified against ambient NO_x and CO concentration measurements obtained from the ambient monitoring network established by Alcoa in the vicinity of the Pinjarra refinery (refer to Section 6.15.3), and will therefore provide an assessment of the level of conservatism inherent in the Ausplume predictions.

Further details on the comparative assessment of the three air dispersion models is available in the technical report on air dispersion modelling, presented as Appendix A.

6.3.4.2 Air Dispersion Modelling Results

Ausplume has been used to predict the ground level concentration of criteria pollutants at the identified receptor locations for the relevant averaging periods for both the Baseline and Upgrade emission scenarios. Table 7 presents the maximum and annual average concentrations predicted at the receptor location(s) exhibiting the highest predicted impact for the Upgraded refinery, along with a

comparison to the relevant NEPM guideline values. The values in the table for particle matter (PM_{10} and $PM_{2.5}$) include the point sources within the refinery. Fugitive sources from other sections of the process such as the RDA and bauxite stacking area are not included in Tables 7 and 8, as they are discussed separately in Section 6.3.4.4.

Table 7: Maximum and Annual Average Ground Level Concentrations Predicted at the Receptor Location Associated with the Highest Predicted Impact

Pollutant	Averaging Period	Predicted Concentration (µg/m^3)		Upgrade	
		Baseline	Upgrade	Receptor Exhibiting the Highest Predicted Impact	Percent of NEPM Guideline
Nitrogen dioxide	1-hour	103.3	144.1	12	58.6
	Annual	1.90	1.70	12	2.7
Carbon monoxide	8-hour	91.5	95.0	12	0.8
Sulphur dioxide	1-hour	32.9	33.4	12	5.8
	24-hour	3.91	3.98	12	1.7
	annual	0.18	0.19	1	0.3
Particulates (as PM_{10}) [1]	24-hour	4.63	3.50	12	7.0
Particulates (as $PM_{2.5}$) [1]	24-hour	2.25	1.70	12	6.8
	annual	0.20	0.14	1 and 12	1.8
Benzene	annual	0.025 – 0.038	0.003	1 and 12	0.03
Formaldehyde	24-hour	0.81	0.84	12	5.0
Toluene	24-hour	1.98	0.89	1	0.01
Xylenes	24-hour	0.48	0.40	1	0.05

Notes:

1. Air dispersion modelling confined to particulate emissions from elevated point sources (i.e. stacks).

From the data presented in Table 7 it can be seen that:

- the maximum and annual average ground level concentrations predicted for both the Baseline and Upgrade scenarios at the receptor(s) exhibiting the highest predicted impacts are well below the Standards (for NO_2, CO, SO_2 and PM_{10}), Advisory Reporting Standard (for $PM_{2.5}$), and the draft Investigation Levels (for benzene, formaldehyde, toluene and xylenes) specified in the relevant NEPMs;

- the 1-hour average concentrations of nitrogen dioxide at receptor 12 (located on the Darling Scarp) is predicted to most closely approach the relevant NEPM Standard, but is still less than 60% of the Standard;

- the highest ground level concentrations for the pollutants listed in Table 7 are predicted to occur at receptors 1 and 12 (located on the Darling Scarp) for both short-term (i.e. ≤ 8-hour) and long-term (i.e. annual) averaging periods.

Figures 13 and 14 present the predicted maximum 1-hour average concentration contours of nitrogen dioxide for the Baseline and Upgrade scenarios respectively. A comparison of these contours indicates that no material change in the maximum ground level concentrations of nitrogen dioxide are predicted to occur as a result if the Efficiency Upgrade. Figure 15 presents the predicted annual average ground level concentration contours of nitrogen dioxide for the Upgrade, and indicate that the impacts associated with the Efficiency Upgrade are predicted to remain within the relevant NEPM guideline at the residences located near the refinery.

In considering the results presented in Table 7 and Figures 13 to 15, it is important to note that Ausplume's treatment of air quality impacts upon elevated terrain is simplistic compared to other available models, and it is widely accepted that it tends to result in overly conservative predictions (i.e. predicts higher than actual concentrations) for such cases. Therefore, it is likely that the actual concentrations experienced at the receptors located on the Darling Scarp are lower than the concentrations predicted by Ausplume. In order to better understand this factor an ambient monitoring site has been installed near receptor 12 to measure the ambient concentrations of NO_x and CO. The results of this ambient monitoring will be used to validate the accuracy of the model predictions for these receptor locations (refer to Section 6.15.3).

Concentrations predicted at the Pinjarra and Carcoola town sites were less than half of the concentrations predicted on the Darling Scarp, and the concentrations predicted at the residences located to the south of the refinery were less than 75% of the concentration predicted on the Darling Scarp. Therefore, the air quality impacts at the Pinjarra and Carcoola town sites, and at residences located to the south of the refinery are also predicted to be well within the acceptable concentrations specified in the NEPMs.

Table 8 presents the relative change in the air quality impacts associated with the Efficiency Upgrade, as predicted for the Pinjarra town site.

Table 8: Ground Level Concentrations Predicted at the Pinjarra Town site

Pollutant	Averaging Period	Maximum Predicted Concentration (µg/m^3)		Ambient Guideline (µg/m^3)
		Baseline	Upgrade	
Nitrogen dioxide	1-hour	32	34.8	246
	Annual	1.09	0.77	62
Carbon monoxide	8-hour	20.9	22.7	11,250
Sulphur dioxide	1-hour	6.6	7.2	571
	24-hour	1.47	1.5	229
	annual	0.07	0.08	57
Particulates (as PM_{10})	24-hour	1.77	1.41	50
Particulates (as $PM_{2.5}$)	24-hour	0.88	0.73	25
	annual	0.08	0.06	8
Benzene	annual	0.016	0.001	8.8
Formaldehyde	24-hour	0.35	0.39	16.9
Toluene	24-hour	1.1	0.44	6,907
Xylenes	24-hour	0.25	0.2	795

From Table 8 it can be seen that the Efficiency Upgrade will result in a significant decrease in the air quality impacts arising from the emissions of particulates, benzene, toluene and xylenes, with the most significant being a 16 fold decrease in the annual average ground level concentrations of benzene resulting from the refinery emissions predicted at the Pinjarra town site. The Efficiency Upgrade will however result in a small increase in the air quality impacts arising from the emissions of NO_2 (1-hour average only), SO_2 and formaldehyde, but these increases are predicted to be less than 14% higher than the ground level concentrations predicted for the Baseline scenario at the Pinjarra town site. It is important to note however that the ground level concentrations for these pollutants are predicted to remain well within the relevant ambient air quality guidelines for the Efficiency Upgrade.

6.3.4.2.1 Upset Conditions

The most significant upset conditions that can impact on the atmospheric emissions from the Pinjarra refinery occur as a result of a process failure within Calcination or a failure of the ESPs servicing the Calciners. In addition, during certain Calciner operating conditions, such as start-up and shut-down, the ESPs can not be operated due to the generation of a potentially explosive atmosphere within the Calciners which also results in elevated particulate emissions for one to three hours in duration. Typically less than ten Calciner upset events per month occur at the Pinjarra refinery.

Previous modelling of a worst-case Calciner upset has been revised as part of this assessment to take account of the full range of meteorological conditions likely to be experienced in the Pinjarra area. These modelling results indicate that particulate emissions experienced during a worst-case Calciner upset is likely to result in a maximum 24-hour average total particulate concentration of less than 0.5 µg/m^3 at distances from the refinery of 1 km and beyond. This predicted concentration is not considered significant compared to the relevant NEPM 24-hour Standard of 50 µg/m^3 for PM_{10} and the Advisory Reporting Standard of 25 µg/m^3 for $PM_{2.5}$, or when compared to the Pinjarra refinery

ambient TSP concentration licence limit of 260 $\mu g/m^3$ (as measured at the Pinjarra Racecourse monitoring site).

Notwithstanding the very low predicted impacts of Calciner upsets, such events are stringently managed at the Pinjarra refinery so as to minimise the emissions during such events. This is achieved through the use of continuous dust concentration meters that are installed in the Calciner stacks that sound an alarm to alert the process control attendant of high emission levels. Depending on the nature of the ESP failure, the process control attendant is allowed between 10 minutes (total ESP failure) to an hour (partial ESP failure) to resolve the cause of the upset condition before feed to the Calciners is taken off.

The baghouse pollution control equipment that is proposed to be installed with the new Calciner (Unit 7) will significantly reduce the emissions of particulates during normal operation, but will also operate fully during start-up and shut-down for this unit.

6.3.4.3 Photochemical Smog

Photochemical smog is formed by the reaction of NO_x and reactive organic compounds (ROCs, a subset of total VOCs) in the presence of sunlight. The principal component of photochemical smog is ozone and therefore measurements of photochemical smog (and ambient air quality standards) are usually referenced to ozone. Elevated ozone levels near the ground (as distinct from the "ozone layer" that occurs tens of kilometres up in the atmosphere) are typically associated with large urban centres, and arise predominantly as a result of emissions from motor vehicles, although other urban, commercial and industrial activities also contribute.

There has been no ambient monitoring for ozone conducted in the Pinjarra region, however monitoring conducted by Alcoa for the Wagerup refinery during the period from August 2002 to July 2003 indicated that the maximum 1-hour average ozone concentration did not exceed 63 ppb, which equates to less than 63% of the NEPM Standard (100 ppb). This monitoring also showed that the elevated ozone levels typically coincided with smoke from bushfires or hazard reduction burning activities, rather than being a result of emissions from the Wagerup refinery or the surrounding residential area.

It is also worth noting that the Efficiency Upgrade will result in a decrease in the total NO_x and VOC emissions (necessary precursor to the formation of photochemical smog) from the refinery. These considerations indicate that photochemical production within the Pinjarra refinery plume is unlikely to have an appreciable impact upon ozone levels in the region.

6.3.4.4 Fugitive Dust

6.3.4.4.1 Mining

Blasting activities carried out at the Huntly mine have the potential to generate dust emissions. The Efficiency Upgrade may result in a minor increase in the frequency of blasting to achieve the necessary increase in the mining rate. Dust is also generated by vehicle movements and the operation of stackers, crushers and conveyors, however the dust impacts associated with these activities will continue to be managed in accordance with Alcoa's existing procedures and to maintain compliance with the requirement of the *Mines Regulation Act*.

6.3.4.4.2 Refinery

At the refinery, fugitive dust is intermittently released from the RDA and, to a lesser extent, bauxite stockpile area during adverse wind conditions (typically strong winds). The Efficiency Upgrade will result in an increase in the generation of residue, which will require the Long Term Residue Management Plan to be brought forward approximately 12 months (refer to Section 4.2.4). There is a potential for windblown dust emissions from the bauxite stockpile area to increase due to the increased rate of bauxite stacking and reclaiming rates associated with the Efficiency Upgrade, however this will be minimised through the ongoing implementation of the dust mitigation measures that are already in-place, including:

- regular clean-up of fine material;
- use of dust suppressant agents to stabilise bare gravel areas;
- mulching; and
- the use of a water cart and water cannon to wet areas down in preparation for strong wind conditions.

Alcoa has established a network of ambient particulate monitoring sites around the perimeter of the refinery and RDA, and at the Pinjarra Racecourse to provide quantitative feedback on the effectiveness of dust mitigation measures. The results available for the Pinjarra Racecourse site are also used to assess the acceptability of dust impacts upon the nearby residential areas by comparison to recognised standards such as the NEPM Standard for PM_{10} and the ambient licence limit for TSP (refer to Section 6.3.3).

Ambient concentration measurements for TSP and PM_{10} size fractions are available for the Pinjarra Racecourse site. Typically the TSP size fraction is used as an indicator of the impacts upon amenity, and PM_{10} is used as an indicator of the potential impacts upon health.

The most recent three year period (i.e. July 2000 to June 2003) of ambient particulate monitoring data obtained from high-volume samplers (Hi-Vol) located at the Pinjarra Racecourse has been analysed

and the results are summarised in Table 9 and Figure 16. Table 9 compares the Pinjarra racecourse data to the relevant ambient air quality standards. Figure 16 presents the following annual statistics derived from the Pinjarra Racecourse data:

- Maximum recorded 24-hour average;
- 2nd highest recorded 24-hour average;
- 6th highest recorded 24-hour average;
- 95th percentile 24-hour average;
- 50th percentile 24-hour average; and
- annual average.

Table 9: Summary of Ambient Particulate Monitoring Data for the Pinjarra Racecourse July 2000 to June 2003

Assessment Criteria	12 month period [1]	TSP	PM_{10}
Number of Days Above TSP licence limit (260 µg/m^3; 24-hour average)	00/01	0	-
	01/02	0	-
	02/03	0	-
Number of Days Above Alcoa's Internal TSP target (120 µg/m^3; 24-hour average)	00/01	2	-
	01/02	4	-
	02/03	2	-
Number of Days Above Air NEPM PM_{10} Standard (50 µg/m^3; 24-hour average)	00/01	-	5
	01/02	-	4
	02/03	-	2

Notes:
1. 12 month period commencing 1 July.

From Table 9 and Figure 16 it can be seen that there have been no exceedences of the ambient TSP concentration licence limit measured at the Pinjarra Racecourse over the period for which data is presented, with the maximum concentrations remaining well below the licence limit. The number of days above Alcoa's Internal TSP target has been restricted to no more than four days in any twelve month period. It can also be seen from Table 9 and Figure 16 that there has been no more than five days in any twelve month period for which a 24-hour average PM_{10} concentration of greater than 50 µg/m^3 (i.e. NEPM Standard) has been recorded at the Pinjarra Racecourse, and therefore this site complies with the NEPM Goal which allows for up to five days above the NEPM Standard per year. It should also be noted that no attempt has been made to separate out the days with elevated PM_{10} concentrations that may not have been primarily due to dust emissions associated with the Pinjarra refinery's operations, such as days when bushfire smoke or regional dust may have been significant contributors to the measured concentrations.

Notwithstanding the acceptability of the ambient particulate monitoring data compared to the licence limit and NEPM Goal, Alcoa recognises the need for ongoing improvement to minimise the release of windblown dust emissions from the RDA in particular. Therefore as part of the Efficiency Upgrade

sprinkler coverage will be improved on residue drying areas on the western edge of the RDA (closest to the Pinjarra town site) which will enable wetting down of drying areas more effectively before unfavourable winds. Concurrently, the redevelopment of RDA 3 will include sprinklers with a closer spacing.

In addition, as part of the Long Term Residue Management Plan, Alcoa will be looking at opportunities to further minimise the impacts arising from wind-blown dust emissions from the RDA, including consideration of further improvements to the sprinkler infrastructure and the location of future RDA drying areas with respect to prevailing winds and nearby residential areas.

6.3.4.4.3 Materials Transport

The materials transport activities associated with the Efficiency Upgrade are outlined in Section 4.2. Fugitive dust emissions arising from materials transport activities are expected to be negligible as a result of the continued implementation of the existing dust control measures, such as:

- regular watering and the use of alternative dust suppression measures on mine haulage roads;
- bulk material transfer points are enclosed where ever practicable;
- the use of water sprays to suppress dust emissions from the bauxite stockpiles located at the refinery site;
- transport of alumina product in fully enclosed containers, with any alumina spillage vacuumed up prior to train departure from site; and
- high level of attention to general site housekeeping to eliminate fugitive dust sources.

Whilst not part of the Efficiency Upgrade, Alcoa is also planning to commission a new alumina delivery chute used for ship loading at the Bunbury Port in early 2004 which is expected to reduce the emissions of alumina dust from this facility. This project is part of a program of continuous improvement at the Bunbury Port facility. The resulting improvement in dust control will negate any potential increase in emissions arising from the increase in alumina product export out of the Bunbury Port associated with the Efficiency Upgrade.

6.3.4.4.4 Construction

During construction dust may be generated from earthmoving activities and vehicular movement on unsealed tracks. The construction site occupies less than five hectares, or less than two percent of the refinery site area and therefore dust emissions from earthmoving activities are not expected to be significant. Much of the road infrastructure at the refinery site is sealed and therefore dust emissions from vehicular movement associated with construction activities are also not expected to be significant. Appropriate dust control measures such as watering down exposed areas will be implemented at the refinery site during construction.

6.3.5 Odour

Odorous emissions from alumina refineries are caused by the breakdown of organic material contained in the bauxite, additives to the liquor stream and in by-products of fuel combustion processes. Some of these volatile substances are odorous and even the trace levels emitted can contribute to ambient odour.

Research conducted by Alcoa indicates that one of the main compounds likely to be contributing to odour emitted from Bayer process refineries in Western Australia is acetaldehyde, which has been estimated to contribute in the order of over 90% of odours based on emissions monitoring conducted at the Wagerup refinery (Coffey and Ioppolo-Armanios, 2003). Acetaldehyde has therefore been selected as a representative indicator compound to assess the relative change in odour impacts associated with the Efficiency Upgrade.

Figures 17 and 18 presents the maximum 1-hour average ground level concentrations for acetaldehyde predicted by Ausplume (refer to Section 6.3.4.1.2) for the Baseline and Upgrade emission scenarios respectively. Comparison of the contours presented in Figures 17 and 18 shows a significant decrease in the extent of the acetaldehyde concentration contours as a result of the Efficiency Upgrade, with the results from air dispersion modelling predicting that the Efficiency Upgrade will result in a 55% reduction in the maximum 1-hour average concentration of acetaldehyde at the Pinjarra town site. Similar changes are exhibited for total VOCs, for which a 43% reduction in the maximum 1-hour average concentration is predicted at the Pinjarra town site.

The EPA has published guidance for the *Assessment of Odour Impacts from New Proposals* (EPA, 2002). This guidance indicates that for an expansion of an existing facility, the EPA would expect "that predicted odour concentrations at sensitive land uses would not increase (i.e. there would be no deterioration of current amenity values"). As VOCs, and specifically acetaldehyde, are able to be used as indicators of the odour impacts associated with the Pinjarra refinery, the reduction in the predicted concentrations for these compound(s) translates to a reduction in odour impacts from the Pinjarra refinery as a result of the Efficiency Upgrade.

6.3.6 Potential Health Impacts

A quantitative health risk assessment has been conducted by an independent specialist. After discussions with the Department of Health on the appropriate scope of work, Toxikos Pty Ltd was commissioned to examine the potential health impact of emissions from the Pinjarra refinery to the population residing near the refinery. The health risk assessment concludes there is little likelihood of health effects being caused by either acute or chronic exposure of the general public to atmospheric emissions from the Pinjarra refinery.

The report prepared by Toxikos is provided as Appendix B, and this provides details of the methodology, results and findings of the health risk assessment. The following represents a summary of the quantitative health risk assessment.

In order to assess the air quality impacts associated with potential acute (i.e. short-term) and chronic (i.e. long-term) exposure, emissions associated with daily peak and annual average plant activity were modelled for both the 'Baseline' and 'Upgrade' scenarios. Assuming the daily peak activity occurred for the full 24 hour period the modelling predicted the average ground level concentration for each hour during the day and the average for the year. In the risk assessment the highest one hour concentration that occurs at any time during the year has been used for assessing potential acute health impacts. The predicted the 95th percentile 1 hour modelled concentration has also been evaluated to provide insight to the frequency with which such high concentrations are predicted to occur. The yearly average concentration was used to assess the impact of potential chronic exposures.

Of the fourteen receptor locations for which predicted ground concentrations were provided, Toxikos chose locations 1, 3, 4, & 7 to conduct the health risk assessment, as follows:

- Location 1 is the site of the highest modelled 1 hour maximum and highest annual average VOC concentrations of all the fourteen modelled locations; hence is representative of the worst case exposure to emissions from the refinery. All other locations have lower exposures.

- Location 3 is representative of the nearest residence in Carcoola town site and will experience the highest concentrations of this population.

- Location 4 is at the edge of the Pinjarra Racecourse and therefore representative of a residence at Pinjarra town site that is potentially closest to the refinery; this location, while having lower exposures than Location 1, is representative of the highest exposure at the town of Pinjarra.

- Location 7 represents the residences to the south of the refinery (locations 6 – 11) and has been chosen because this is where the highest VOC exposure is predicted to occur for this area.

The potential health impact of emissions at receptor locations has been judged by comparing the predicted ground level concentrations with health based air guideline values for the individual emission components. These guidelines have been sourced from reputable regulatory agencies and incorporate large safety factors to ensure they are protective of public health. The methodology used for assessing the health risks is consistent with that recommended by the US EPA, the National Health and Medical Research Council of Australia and the Health Council of Australia.

When predicted ground level concentrations are less than the health guideline values there is very little likelihood of an adverse health effect occurring. The ratio of the ground level concentration to the health guideline value is called the hazard quotient. The impact of exposure to the emission mixture has been assessed by assuming the effects of the individual components are additive. It should also be noted that the assumption of additivity of effect is very conservative; in reality relatively few of the emission components will have a directly additive affect on health risk.

A general rule of thumb for interpreting a hazard quotient is that values less than one presents no cause for concern. Values greater than one generally also do not represented cause for concern because of the inherent conservatism embedded in the exposure portions of a preliminary risk assessment. Hazard quotients that are around ten present some concern regarding possible health risks, although in these circumstances it is usual to evaluate the extent to which the "safety margins" in the health guideline values used to compare estimated exposures may have been eroded in order to gauge whether concern is warranted.

The quantitative health risk assessment concluded there is little likelihood of an acute adverse effect occurring because:

- all hazard quotients and hazard indices for all receptor locations, except location 1 where ground level concentrations are most probably over predicted, are less than unity;

- the highest concentrations are modelled from worst case emission assumptions and they will be rarely achieved; and

- the 95th percentile acute hazard indices are substantially below unity and approximately an order of magnitude less than the maximum hazard indices, thereby supporting the notion that the latter will be rarely achieved.

Since the receptor locations were chosen to reflect the worst exposure situations for each locality, it is unlikely acute health effects will be induced at other locations. This will include people traveling across the Alcoa buffer zone to/from the Scarp by car or by train. Background intakes of most of the emission components do not affect the risk assessment.

The chronic hazard indices for the existing plant (Baseline scenario) and the Upgrade are all markedly less than unity indicating the likelihood of health effects from chronic exposure to the refinery emissions is unlikely. For dioxin-like compounds conservative estimates of background intakes have been assumed, even so the overall intakes are much less than the intake level that Australian authorities have deemed to be tolerable and without adverse health effects.

For emission components that are carcinogens, the carcinogenic risk from an assumed life time exposure has been calculated and compared with an acceptable target risk of one in a million of developing a cancer.

There were seven components in the emissions that are regarded as being potentially carcinogenic. Based on the predicted ground level concentrations the combined cancer risk of all these substances is below the target acceptable risk of one in a million at all locations except location 1 in the base case scenario. The combined cancer risk (1.56×10^{-6}) at this location is slightly above the target risk; however this is likely to be due to the over-prediction of ground level concentrations by the dispersion model used and the conservative emission scenarios.

Although there are many compounds in the emissions for which regulatory derived guidelines do not exist, the predicted ground level concentrations of these substances are very low, in the majority of cases less than the level of no toxicological concern. This indicates that such low levels are unlikely to be associated with health effects.

In conclusion, the health risk assessment indicates that there is little likelihood of health effects being caused by either acute or chronic exposure of the general public to the atmospheric emissions from the Alcoa Pinjarra refinery currently, and that the upgrade is predicted to reduce these levels further.

6.3.7 Expert Review of Air Quality Assessments

The SRG commissioned independent expert reviews of the key components of the air quality assessment, including:

- *Air Quality Data – Environmental Protection Statement*

  This report was prepared by ENVIRON Australia Pty Ltd and documents the approach and methods used by Alcoa to define the nature and estimate the quantity of air emissions from the Pinjarra refinery. In addition, this report addressed other key information gathered by Alcoa for the purposes of the air quality assessment, such as the meteorological data required as input to the air dispersion modelling and the ambient particulate monitoring data used to assess the impacts of fugitive dust emissions from the refinery.

- *Pinjarra Refinery Efficiency Upgrade – Air Dispersion Modelling*

  The air dispersion modelling was conducted by Sinclair Knight Merz Pty Ltd (SKM) and documents the modelling methodology, refinery air emissions used within the modelling, and results in terms of predicted ground level concentrations at the residences surrounding the refinery.

- *Health Risk and Toxicological Assessment of Emissions from the Upgraded Alcoa Pinjarra Alumina Refinery*

  The health risk and toxicological assessment was conducted by Dr Roger Drew of Toxikos Pty Ltd and documents the approach used for the health risk assessment and the conclusions with respect to the potential for adverse health impacts arising from atmospheric emissions from the Pinjarra refinery.

The assessments reported in the *Air Quality Data – Environmental Protection Statement* and the *Pinjarra Refinery Efficiency Upgrade – Air Dispersion Modelling* were independently reviewed by Jack Chiodo of CH Environmental. The health risk assessment was independently reviewed by Prof. Philip Weinstein of University of Western Australia. The SRG selected these independent expert

reviewers on the basis of their extensive experience in the fields of air quality and public health management respectively.

In general the expert review conducted by Jack Chiodo of the air quality data and air dispersion modelling concluded that the appropriate methodologies have been applied and an adequate level of conservatism (i.e. health protectiveness) has been incorporated. The reviewer made some suggestions to improve future work, and the presentation of information. These included:

- an assessment of the impact of particle and metal emissions from stockpiles and the RDA;
- alternative presentation of emission rates used by the Baseline and Upgrade refinery emissions scenarios;
- some assessment of the significance, or otherwise, of the odours from area based sources such as ponds, RDA and stockpiles, which are not modeled; and
- more explicit information on the range of model predictions for the compounds used as indicators of odour to improve the clarity.

The expert review conducted by Prof. Philip Weinstein of the health risk assessment concluded that a comprehensive toxicological assessment of emissions from the Pinjarra refinery has been conducted. The expert reviewer supports the conclusion that there is little likelihood of health effects being caused by either acute or chronic exposure of the general public to refinery emissions, provided the Efficiency Upgrade performs to expectations and a rigorous hazard surveillance system for NO_x, arsenic and mercury is maintained. The health risk assessment report has been revised by Toxikos to take into account some of the issues raised by the expert reviewer.

The outstanding issues raised by the expert reviewers will be further considered by Alcoa, the SRG, the relevant state government environmental and health regulatory agencies, and appropriately addressed.

Copies of the reports prepared by the expert reviewers are provided as part of Appendix A (independent review by J. Chiodo) and Appendix B (independent review by P, Weinstein).

6.3.8 Management

Air quality impacts associated with the Efficiency Upgrade will be managed through the installation of the proposed new items of air pollution control equipment (refer to Section 6.3.2.2) and the Pinjarra refinery's existing EMS (refer to Section 6.1.1).

The Efficiency Upgrade will achieve a reduction in total atmospheric emissions from the refinery for many of the key pollutants through the installation of various items of pollution control equipment, as summarised in Table 10.

Table 10: Summary of Atmospheric Emissions Reductions for the Efficiency Upgrade

Emissions Group	New Wet Scrubber and RTO (Oxalate kiln)	RTO (Digestion)	Low-NO_x Burner Retrofit (Boil Unit 6)	ESP Upgrade (Calciner Units 4, 5 and 6)	Baghouse (Calciner Unit 7)	Digestion Vapour Condensation	Emissions Compound	Change in Total Refinery Average Emissions Compared to Baseline (%) "+" increase "-" decrease
Products of Combustion	✓		✓				NO_x	- 40
							CO	0
							SO_2	0
Particulates	✓			✓	✓		Particulates	- 25
VOCs	✓	✓				✓	Benzene	- 75
							Formaldehyde	+ 10
							Toluene	0
							Xylenes	0
							Acetaldehyde	- 10
Metals	✓					✓	Arsenic	- 75
							Mercury	+ 20
							Cadmium	- 75
							Nickel	- 75

In addition to the existing air emissions monitoring programs currently conducted at the Pinjarra refinery on a routine basis, Alcoa will develop a targeted emissions monitoring program as part of the Efficiency Upgrade. Further details are provided in Section 6.15.3.

The air dispersion modelled that has been conducted for the Efficiency Upgrade identified the need to conduct an air dispersion model validation study to assess whether available models are reliable in predicting air quality impacts from the Pinjarra refinery's emissions, particularly in relation to higher concentrations predicted by Ausplume on the elevated terrain of the Darling Scarp. This will involve the continued operation of the ambient gaseous air pollutant monitoring network for use in an air dispersion model validation study.

6.3.9 Commitments

Commitment 2a
Alcoa will install air pollution control equipment at the Pinjarra refinery to achieve:

- ***a reduction of about 10% in VOC emissions;***
- ***a reduction of about 25% in particulate emissions from the calciners;***
- ***a reduction of over 90% in CO emissions from the Oxalate kiln; and***
- ***an offset of the increase in general refinery NO_x emissions by installing low-NO_x burners in the power station.***

Commitment 2b
Alcoa will improve the management of dust from residue areas through an upgrade of the existing sprinkler network and other operational controls consistent with the Long Term Residue Management Plan which will be revised in consultation with the community.

Commitment 2c
Alcoa will undertake a study of its residue dust to better understand its particle size distribution and composition.

Commitment 2d
An air dispersion model validation study will be completed to assess the performance of available models with respect to predicting air quality impacts from the upgraded Pinjarra refinery. The temporary ambient gaseous air pollutant monitoring network will continue to be operated for a period of time as part of the air dispersion model validation study.

Commitment 2e
An ongoing targeted source monitoring program will be carried out at the Pinjarra refinery to further characterise and improve the understanding of atmospheric emissions from the refinery.

6.4 GREENHOUSE GASES

6.4.1 Background

Human activities are known to have significantly increased the atmospheric concentrations of greenhouse gases since the pre-industrial era. Scientific observations mostly support a picture of changes in the global climate system, which are believed to be linked to the increased atmospheric concentration of greenhouse gases. The Intergovernmental Panel on Climate Change (IPCC) estimates the global average surface temperature increased by about 0.6°C over the 20th century. In its third assessment report, the IPCC concluded that most of the observed warming over the past 50 years is likely to be attributable to human activities (IPCC, 2001).

The latest National Greenhouse Gas Inventory indicates that fossil fuel combustion by the Stationary Energy sector accounted for 47.8% (260 Mt CO_2) of Australia's total net greenhouse gas emissions in 2001 (AGO, 2003). The largest source of greenhouse gas emissions from alumina refining in Western Australia is from the combustion of natural gas to generate steam and electricity to meet process energy demands. The next major source is combustion of natural gas to provide direct heat for calcination and ancillary kiln-based processes. Alcoa's primary strategy for minimising refinery greenhouse gas emissions is therefore to improve the efficiency of its steam and power generation, calcination, and heat conservation and recovery processes.

There are significant emissions associated with the production of some of the raw materials used in alumina refining, particularly lime and caustic soda. Alcoa purchases these materials from other companies and has no means of reducing emissions associated with them other than to improve the efficiency of use of these materials in its own production process.

Bauxite mining operations account for a relatively minor proportion of greenhouse gas emissions associated with alumina production. The main sources of mining-related emissions are in the consumption of diesel fuel in heavy mobile equipment and in the clearing of vegetation for mining. Carbon stores on mined land are restored by mine rehabilitation, albeit over a considerable period of time as the post-mining ecosystem develops.

6.4.1.1 Pinjarra Refinery 2002 Greenhouse Gas Emissions Inventory

Table 11 presents a summary of the Pinjarra refinery greenhouse gas emissions inventory for 2002. Greenhouse gas emissions are predominantly from combustion sources and therefore are released as CO_2, with the emitted quantities of other greenhouse gases considered sufficiently small to be negligible. Sources such as methane emissions generated from the decomposition of solid waste in the landfill and from mining have not been accounted for as they are either insignificant or are counterbalanced by the mine rehabilitation program.

Table 11: Summary of the Pinjarra Refinery 2002 Greenhouse Gas Emissions Inventory

Greenhouse Gas Emissions Sources and Sinks		Percent	Total Greenhouse Gas Emissions (tCO_2 e)
Refinery Site	Natural Gas Combustion – Stationary Sources (i.e. Powerhouse boilers, Calciners, Oxalate kiln and Alumina Leach Dryer)	99.5	2,194,000
	Diesel Combustion – Stationary Sources (i.e. Powerhouse boilers)	0.05	
	Petrol / Diesel Combustion – Mobile Sources (i.e. all on and off road vehicles) [1]	0.1	
	Organics Combustion – Stationary Sources (i.e. Oxalate kiln)	0.3	
	Process Emissions (i.e. non-combustion emissions from the Alumina Leach Dryer)	0.1	
		100 %	
Huntly Mine site [2]	Electricity Consumption [3]	18	42,000
	Fuel Consumption (i.e. diesel, petrol, LPG and propane)	80	
	Explosives	2	
		100 %	
Off-sets	Electricity Export [4]	28	- 27,000
	Causticisation	56	
	Residue Surface Carbonation	16	
		100 %	
Net			2,209,000

Notes:

1. Does not include raw materials and product transportation to and from the Pinjarra refinery, but does include motor vehicle use on the refinery site.
2. Huntly mine supplies bauxite to Pinjarra (13 Mtpa) and Kwinana (7 Mtpa), therefore total greenhouse gas emissions from the Huntly mine have been apportioned to the Pinjarra refinery according to annual bauxite mine production.
3. Supplied by the Pinjarra refinery Powerhouse boilers, therefore treated as an offset for the purposes of greenhouse emissions from the refinery site alone.
4. Surplus electricity generated by the Pinjarra refinery Powerhouse is exported to the Kwinana Refinery or Alcoa's third party contracts via the SWIS.

It should be noted that Table 11 does not include consideration of the greenhouse gas emissions from clearing and debris burning, or soil carbon loss associated with the Huntly mine, nor does it claim any greenhouse gas emission off-sets associated with mine rehabilitation or the Blue Gum Plantations operated on land leased by Alcoa. This is because there is a high level of uncertainty in the accuracy of the greenhouse gas emission estimation techniques available for such activities. However, the greenhouse implications of these activities are relatively minor compared to natural gas combustion at the Pinjarra refinery, and the emissions associated with clearing, debris burning and soil carbon loss are expected to be partially off-set by the mine rehabilitation program.

From Table 11 it can be seen that the most significant greenhouse gas contribution from the refinery arises from the combustion of natural gas. Combustion of natural gas in the Powerhouse boilers contributes approximately 68% to these greenhouse gas emissions, and natural gas combustion in the Calciners contributes approximately 29%. The most significant greenhouse gas contribution from the Huntly mine is associated with fuel consumption.

6.4.1.2 Alcoa's Greenhouse Emission Targets

Alcoa's goal is to reduce greenhouse gas emissions under its direct control by at least 25% (from the base year of 1990) by the year 2010, irrespective of the increase in alumina and/or aluminium production capacity that may be achieved over this period. This reduction includes emissions from Alcoa-owned power generation facilities, but does not include emissions associated with the production of raw materials and electricity purchased from other sources. To-date, the global operations have collectively achieved 17.6% reduction (from the base year of 1990), which equates to a reduction of approximately 12 Mt CO_2 over a 12 year period.

It is important to note that Alcoa's global greenhouse gas emission reduction target is not intended to apply equally to all operations. Because of their relative efficiency, some operations (including those in Western Australia) will expand their production capacity, while production at some other less efficient facilities worldwide will be reduced or terminated. For the more efficient operations, greenhouse gas emission targets are more usefully set in terms of emissions intensity (i.e. tCO2/t alumina produced) rather than aggregate emissions.

Alcoa's Western Australian operations are targeting a 17% reduction (from the base year of 1990) in the net greenhouse gas intensity of alumina production to be achieved by the year 2010. Figure 19 presents the trend in net greenhouse gas emissions intensity for the Pinjarra refinery from 1990 to 2002. Figure 19 shows a decreasing trend in the greenhouse gas intensity has been achieved consistently since 1997, which has been the result of incremental improvements in the refinery's energy efficiency. The deterioration in the early part of the 1990s was due partly to the installation of an alumina leach drying process to improve product quality. Also, during this period superfine alumina captured from calciners was not able to be included in the product until 2000 when the product specification was revised. This change was facilitated by improved reliability of the calciners. From 1997 to 2002 the greenhouse gas intensity has reduced by almost 12%, although a small portion of this reduction is a result of the Australian Greenhouse Office's (AGO) CO_2 emission factor for Western Australian natural gas being revised downward in 2002. The main enablers were changes to the process to improve the yield of alumina, and improvements to the heat exchange efficiency. Figure 19 illustrates that the Pinjarra refinery is making a significant contribution towards achieving the 2008 target for Alcoa's Western Australian operations.

6.4.1.3 Aluminium Life Cycle Assessment

Life Cycle Assessment (LCA) is a scientific tool for the evaluation of environmental effects of products and services through the complete life cycle, known as from "cradle to grave". This includes consideration of the extraction of raw material, processing (i.e. refining and smelting), fabrication, transportation, use, recycling and ultimately disposal; both of the product, and the energy and ancillary materials supplied.

Aluminium is lightweight, resistant to atmospheric corrosion, conductive, ductile and is able to be repeatedly recycled. It is these properties that have seen aluminium used extensively in air, land and

sea transport, packaging (aluminium foil and cans), electricity transmission and domestic and industrial construction. In the context of the LCA for aluminium, there is a significant potential to reduce greenhouse gas emissions through the increased use of recycled aluminium and from the increased use of aluminium in transportation applications. Alcoa works closely with a number of vehicle manufacturers to assist in the design of components and alloys to improve vehicle weight and other properties such as crash worthiness.

Aluminium recycling generates 95% less greenhouse gas emissions compared to the primary production of aluminium from bauxite ore. At present, close to 40% of the global demand for aluminium is fulfilled from recycled products, primarily from the packaging, transport and construction industries, which results in significant greenhouse benefits. Alcoa's goal is to increase the global recycling rate through the sponsorship of voluntary national aluminium recycling programs, and purchasing competitively priced scrap metal as feedstock for its secondary smelters.

The average aluminium content of motor vehicles has increased over the past ten years, and this trend is forecast to continue as motor vehicle manufacturers strive to meet stringent exhaust emission standards and continue to improve fuel efficiency. A LCA published by the International Aluminium Institute found that each tonne of aluminium that replaces traditional high density materials in a vehicle can save the equivalent of 13.9 t of CO_2 over the life of the vehicle, rising by a further 9.0 t of CO_2 with the use of recycled aluminium in the manufacture of the motor vehicle. The aluminium industry is working closely with motor vehicle manufacturers to enable the easier dismantling of aluminium components from cars in order to improve the recovery of aluminium within this industry.

6.4.2 Energy Efficiency Benchmarks

6.4.2.1 Alumina Industry Energy Efficiency Benchmarks

The Australian alumina industry is relatively efficient (energy used per unit of production) in comparison with other countries. According to estimates from the International Aluminium Institute (IAI) the Australian industry has one of the lowest energy consumption rates per tonne of alumina produced in the world (Table 12).

Table 12: Energy Used (MJ) per Tonne of Alumina Produced [1]

North America	11,082
East Asia [2] and Australia	11,087
Latin America	11,807
Europe	12,934
Africa and South Asia	15,421
World-wide Weighted Average	11,765

Notes:

Source: International Aluminium Institute Statistics Report (IAI, 2002)

1. Statistics published by the IAI are for 2001.
2. Includes China, Japan and South Korea; however data for China and South Korea were not reported to the IAI.

Pinjarra refinery's current energy efficiency is significantly better than both the Australian and World Wide weighted averages. Implementation of the Alinta cogeneration project and the efficiencies inherent in this project will further, and substantially, improve Pinjarra refinery's energy efficiency.

A study into Energy Efficiency Best Practice in the Australian Aluminium industry was commissioned in 2000 by the Commonwealth government as part of a raft of initiatives that formed Australia's response to climate change (DoISR, 2000). The study surveyed all of the six alumina refineries currently in operation in Australia, and found that average energy consumption was approximately 11,000 MJ/t of alumina produced, with a range between lowest and highest of 30%. After the Pinjarra refinery Efficiency Upgrade and the Alinta Cogeneration Project are fully operational the energy efficiency of the Pinjarra refinery will make the Pinjarra refinery one of the most energy efficient within Australia, and throughout the world.

6.4.3 Greenhouse Impact Of The Project

The key components of the Efficiency Upgrade that will increase energy consumption at the refinery are as follows:

- additional steam requirements in the Digestion and Evaporation areas of the process due to the increased rate of bauxite processing and the increased flow rate of liquor around the Bayer process circuit;
- additional electricity consumption with the installation of an additional SAG mill for bauxite grinding, increased flows in the Precipitation and Clarification areas, and the installation of the new Seed Filtration facility; and
- additional natural gas combustion as a result of the increased capacity in Calcination and of the Oxalate kiln.

These increases in energy consumption will, however, be offset by energy saving initiatives that are to be incorporated into the design of the Efficiency Upgrade (refer to Section 6.4.4.2) in order to achieve an overall improvement in the greenhouse intensity of the Pinjarra refinery. In addition, greenhouse gas emissions from the Pinjarra refinery will also be further reduced as a result of the Alinta Cogeneration project. This is achieved by the displacement of steam produced by the less efficient refinery boilers.

6.4.3.1 Alinta Cogeneration Project

Cogeneration has the advantage of being more thermally efficient and less greenhouse gas emissions intensive than other forms of power generation using fossil fuels. The thermal efficiency of the Alinta Cogeneration project is high compared with any of the other power generation configurations due to the more efficient utilisation of the waste heat to generate steam which is then used for heating within the refinery. The Alinta Project is expected to achieve a thermal efficiency of 79% compared to the SWIS average in 2000 of 31% (Western Power, 2001).

6.4.3.2 Overall Greenhouse Impact of the Project

Table 13 presents a summary of the overall greenhouse emissions impact of the Efficiency Upgrade, with and without the savings attributable to the use of steam generated by the Alinta Cogeneration Project.

Table 13: Overall Impact of the Efficiency Upgrade on Greenhouse Gas Emissions

Greenhouse Gas Emission Parameter	Units	Existing Pinjarra Alumina Refinery	Upgraded Pinjarra Alumina Refinery
Without Alinta Cogeneration Project Energy Savings			
Alumina Production	t	3,500,000	4,200,000
Net CO_2 Emissions	t CO_2	2,299,000	2,601,000
Net CO_2 Emissions Intensity	**kg CO_2/t alumina [1]**	**656**	**625**
With Alinta Cogeneration Project Energy Savings			
Refinery Energy Savings due to Alinta Cogeneration Project [2]	t CO_2	-254,000	-254,000
Net CO_2 Emissions of the Refinery	t CO_2	2,045,000	2,347,000
Net CO_2 Emission Intensity of the Refinery	**kg CO_2/t alumina [1]**	**583**	**564**

Notes:

1. Values round to nearest 1,000 t CO_2, hence exact Net CO_2 Emission Intensity estimates can not be calculated from the data presented within the table.
2. Includes Alinta Cogeneration Project Stages I and II (2 x 140 MW). Refer to ENVIRON (2003) for derivation of refinery energy savings due to the Alinta Cogeneration Project.

From Table 13 it can be seen that the Efficiency Upgrade alone is estimated to improve the greenhouse gas emission intensity of the Pinjarra refinery by approximately 5%, to 625 kg CO_2/t alumina. With the energy savings as a result of the Alinta Cogeneration Project, the greenhouse gas intensity will further improve, reducing to 564 kg CO_2/t alumina. Therefore, the Efficiency Upgrade and the Alinta Cogeneration project will result in an overall improvement in the greenhouse gas emission intensity of the Pinjarra refinery of approximately 14% compared to the existing refinery, which is considered significant in the context of Alcoa's reduction target of 17% for its Western Australian operations (from the base year of 1990) by the year 2010.

It should be noted that the Australian Greenhouse Office revised the CO_2 Emission Intensity factor in 2003 to 61.6 kg CO_2/GJ, from 59.3 kg CO_2/GJ in 2002, and prior to this 62.3 kg CO_2/GJ. To ensure consistency between the Existing and Upgraded cases, the most recently published CO_2 Emission

Intensity factor of 61.6 kg CO_2/GJ has been applied. Therefore minor differences in the net greenhouse gas emissions estimates presented in Table 11 compared to Table 13 are apparent.

Minor increases in greenhouse gas emissions associated with the increased bauxite mining rate are not accounted for in Table 13. The increase in greenhouse gas emissions associated with an increase in the bauxite mining rate at the Huntly mine site will be partially offset by an increase in the rehabilitation rate. The annual net increase in greenhouse gas emissions from the Huntly mine site associated with the Efficiency Upgrade is estimated to be less than 30,000 tCO_2, which is minor (< 1%) compared to the savings in greenhouse gas emissions arising from the more efficient combustion of natural gas and utilisation of heat at the refinery. Opportunities to avoid burning of timber debris at the Huntly mine are being actively pursued by Alcoa, and will eventually result in greenhouse gas savings and other environmental benefits for the Huntly mine. There has also been a significant trend for improved fuel efficiency in heavy mobile equipment used at the mine, and this is expected to continue.

6.4.4 Greenhouse Abatement Measures

6.4.4.1 Collaborative Involvement and Other Initiatives

Alcoa has maintained strong and continued involvement in various greenhouse programs through participation in various Commonwealth Government and Alcoa international initiatives, supporting volunteer and not-for-profit groups with greening and renewable energy demonstration projects, research and development, and a commitment to continually improving energy efficiency in all areas of its business. Alcoa has been directly involved with the following greenhouse programs:

Commonwealth Government initiatives:

- participation in the Greenhouse Challenge, Generator Efficiency Standards and Energy Efficiency Best Practice programs.

Alcoa international initiatives:

- use of energy audits and benchmarking across Alcoa's global alumina operations.

Community initiatives:

- support for medium-scale landscape restoration projects under the Alcoa Landcare Project and related community partnerships;
- support for ecological restoration and conservation projects such as the current sponsorship of the Alcoa Jarrah-Tuart Restoration Project at King's Park and Botanic Garden and WWF Australia's Woodland Watch and Greening Australia's Living Landscapes projects; and

- support for renewable energy demonstration projects such as the wind turbine installation at Fairbridge Village.

Research and Development:

- research and development into refinery process efficiency and technology improvements that have significant energy and resource use efficiency benefits;
- evaluation of carbon sequestration opportunities both within Alcoa's own operations (e.g. carbonation of bauxite residue) and in broad-acre land management;
- support for greenhouse-related research such as sponsorship of the Cooperative Research Centres (CRCs) on Greenhouse Accounting and Sustainable Resource Processing; and
- feasibility studies on the use of mine clearing wood residue for power generation or biofuel conversion.

6.4.4.2 Project Measures

The existing Pinjarra refinery is already one of the most energy efficient within Australia and throughout the world (refer to Section 6.4.2), and therefore it is expected that, increasingly, the most significant and cost effective energy reduction opportunities for Alcoa are unlikely to be delivered by the Pinjarra refinery, but rather from opportunities that exist elsewhere throughout its worldwide alumina refining, aluminium smelting and power generation operations.

Notwithstanding this, a number of key energy saving initiatives have been incorporated into the design of the Efficiency Upgrade to further improve the overall energy efficiency. It is estimated that the combined effect of these initiatives will reduce the greenhouse gas intensity of the Pinjarra refinery by approximately 5% (or 31 kg CO_2/t alumina), which equates to an annual saving in greenhouse gas emissions of approximately 129,000 t CO_2 (i.e. 31 kg CO_2/t alumina x 4.2 Mtpa alumina production).

The mechanisms for increasing the energy efficiency of the Upgraded refinery include:

- an increase in the rate of yield of alumina from the Bayer Process through the installation of the Seed Filtration facility;
- the re-use of steam emissions through the capture of blow-off vapour in the Digestion area of the process to optimise heat-exchange within the refinery; and
- upgrade heat exchange to reduce the direct steam addition which results in dilution of the liquor stream and thus the need for steam for the extra evaporation required to offset this.

Additional opportunities to improve the energy efficiency of equipment to be installed as part of the Efficiency Upgrade will be reviewed on an ongoing basis as the detailed design phase of the project progresses.

6.4.4.3 Ongoing Management

To ensure effective ongoing management of greenhouse gas emissions, Alcoa will develop a Greenhouse Gas Management Plan for the Pinjarra refinery. It is envisaged that elements of the Greenhouse Gas Management Plan will include:

- continued involvement in the Greenhouse Challenge and generator Efficiency Standards programs;
- continued use of energy auditing and benchmarking within the Alcoa worldwide alumina refining system;
- tracking of the consumption of fossil fuels, energy efficiency and key indicators of greenhouse gas emissions applicable to the Pinjarra refinery's operations;
- public reporting of Alcoa's medium-term greenhouse gas emission reduction targets, and progress towards achieving these targets;
- continued commitment to research and development, particularly in the areas of bauxite residue carbonation, high-efficiency causticisation and process optimisation; and
- a strategy for identifying appropriate greenhouse gas emission offsets, including sequestration opportunities.

6.4.5 Commitments

Commitment 3a
Alcoa will achieve a reduction in the greenhouse gas emissions intensity of the Pinjarra refinery as a result of the Efficiency Upgrade of approximately 5%.

Commitment 3b
Alcoa will review opportunities to improve the energy efficiency of equipment to be installed as part of the Efficiency Upgrade during the detailed design phase of the project using a Cleaner Production review process.

Commitment 3c
Alcoa will maintain ongoing involvement in programs such as the Greenhouse Challenge and Generator Efficiency Standards programs, community initiatives, and research and development, that contribute to the management of the global climate change issue.

6.5 NOISE

6.5.1 Mining

The main source of noise complaints from mining operations is blast noise. The Blast Acoustic Modelling (BAM) system continues to form the basis for predicting noise impacts from cap-rock blasting at the mine. Blast noise levels are monitored in potentially sensitive locations using portable monitors. The main blast is preceded by a pilot shot and if adverse noise levels are recorded, the blast is postponed. Real time monitoring of operational noise is undertaken at selected private properties. Training programs for security and production personnel are held on the use of real time noise monitoring data to proactively manage equipment near noise sensitive premises.

The *Environmental Protection (Noise) Regulations* 1997 state that the maximum airblast over pressure levels must not exceed 125 dB Linear Peak between Monday to Saturday between the hours of 0700 and 1800 hours, and 120 dB Linear Peak during the day on Sundays and Public Holidays. Alcoa has an internal standard of 115 dB Linear Peak Monday to Saturday and Public Holidays, with no blasting on Sundays. For the year to date all blasts at Huntly complied with this internal standard and did not exceed the regulatory levels.

Noise from mine blasting and mining operations will continue to be managed according to Alcoa's existing noise management policy, which has made noise management at Huntly a benchmark within the mining industry. The potential impacts on nearby residents is expected to be reduced when the Huntly mining operations relocate to the McCoy region, which is more remote from neighbours than the current mining area.

A study of the potential increase in noise emissions from mining operations with the Efficiency Upgrade was undertaken by Herring Storer Acoustics. Residences near the existing mining envelope are 3,000m or further from mining operations. Although mining operations noise is sometimes audible at near locations, a comprehensive Noise Management Program, which restricts mining activity in selected areas under adverse climatic conditions, ensures compliance with the Regulations and minimises disturbance to neighbours. The exhaustion of bauxite deposits in the Huntly mining area means that following rehabilitation, noise immission (noise received) to these residences should cease or diminish significantly.

Two caretaker's residences located at the South Dandalup Dam, some 800 m from Conveyor #272 will have minimal observable change in noise immission as the proposed speed change is predicted to only increase noise emission (noise emitted) by 1 – 2 dB(A). The current noise level of 37 dB LA10 would increase marginally and is well within the Regulation 'assigned level' for an industrial caretakers premises of 65 dB LA10.

It was concluded that as a consequence of a 10% increase in mining production (measured as tonnes per annum) at the Alcoa Huntly mine site resulting from the proposed Pinjarra Efficiency Upgrade project, the predicted noise immissions will comply with the requirements of the *Environmental Protection (Noise) Regulations* 1997. Furthermore, because of planned changes in mining areas, the

potential for rural residences to be exposed to mining noise will decrease significantly in the near future.

Commitment 4a
Alcoa will ensure that noise from mining operations continues to comply with the requirements of the Environmental Protection (Noise) Regulations 1997 as a result of the Efficiency Upgrade.

6.5.2 Refinery Noise Issues

At the refinery, the main existing sources of noise are from the powerhouse, calcination blowers and process pumps. Refinery noise has been audible at neighbouring residences under certain weather conditions, especially to the south during the autumn months. Noise emissions from the refinery are monitored on an ongoing basis, and during 2000/2001 Alcoa spent A$1.8 million on noise reduction for the existing Pinjarra refinery which has reduced noise levels by 2 to 3 dB(A) and removed the 5 dB(A) restriction on the noise regulations for tonal noise. This noise reduction program focused on noise sources with annoying characteristics and included upgrading of three large forced draft fans and calcination blowers, with current best practice acoustic noise controls. Alcoa has conducted an ambient noise monitoring program to determine compliance with the *Environmental Protection (Noise) Regulations 1997* since these improvements and the current dataset indicates that compliance has been achieved based on these regulations.

The proposed Alinta Cogeneration project (assessed separately and not part of the scope of the Alcoa refinery Efficiency Upgrade) will use best available technology to ensure that there is no increase in existing refinery noise levels.

There is the potential for increased noise emissions from the Pinjarra refinery Efficiency Upgrade from:

- a new 450t/hr SAG mill or improvements/changes to existing mills;
- upgrades to washers;
- additional evaporation infrastructure;
- seed filters and new vacuum pumps in the Precipitation Circuit; and
- additional calciner blowers.

The upgrade will be designed to ensure noise levels are minimized, to maintain compliance with the *Environmental Protection (Noise) Regulations 1997* and to make reductions where feasible. Further noise reductions may occur either in the existing plant or as part of the upgrade, whichever is more environmentally effective.

The *Environmental Protection (Noise) Regulations 1997* stipulate maximum allowable external noise levels. These are determined by the calculation of an influencing factor, which is added to the base levels indicated in Table 14. The influencing factor is calculated for the land-uses occurring within two circles, having radii of 100 m and 450 m from noise-sensitive premises. If the noise has annoying

characteristics, such as tonality, amplitude modulation or impulsiveness, then the measured noise level is adjusted by adding 5 dB(A) for tonality, 5 dB(A) for modulation, and 10 dB(A) for impulsiveness, up to a maximum of 15 dB(A).

Table 14: Baseline Assigned Outdoor Noise Levels for Noise Sensitive Premises (Residential)

Time of Day	**Assigned Level (dB)**		
	L_{A10}	L_{A1}	$L_{A\ max}$
0700 – 1900 hours Monday to Saturday	45	55	65
0900 – 1900 hours Sunday and Public Holidays	40	50	65
1900 – 2200 hours all days	40	50	55
2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	35	45	55
Commercial premises (all hours)	60	75	80
Industrial and utility premises (all hours)	65	80	90

Note:
The L_{A10} is the noise level exceeded for 10% of the time.
The L_{A1} is the noise level exceeded for 1% of the time.
The $L_{A\ max}$ is the maximum noise level.

Since noise from the upgraded refinery will be present for more than 10% of the time, then it is the L_{A10} criteria which must be met.

6.5.3 Noise Modelling

Noise modelling for the proposed Efficiency Upgrade was undertaken by Herring Storer Acoustics (HSA) and independently reviewed by Sound Vibration Technology (SVT), who agreed with the methodology and findings of the HSA study (Appendix C). The modelling used data from existing similar equipment at the Pinjarra Alumina refinery, and measured data of similar equipment at Alcoa's Wagerup Alumina refinery. The Pinjarra refinery noise model has been developed during ongoing studies for Alcoa.

The critical receiver locations for the Pinjarra refinery are the neighbouring rural residences with an assigned night-time noise criteria of 35 L_{A10}. The critical residences for the proposed Pinjarra Efficiency Upgrade are on Napier Road (south of the refinery). Previous monitoring and modelling has established that residences to the northeast of the refinery are exposed to refinery noise emissions that are significantly lower than the 'assigned level'.

Actual noise measured at Napier Road reasonably matches the acoustic model predictions used for previous projects, and therefore the model was considered a useful tool in the prediction of noise resulting from the proposed Pinjarra Efficiency Upgrade. Impacts on these residences were modelled under worst-case meteorological conditions, which are a combination of:

- source to receiver wind direction;
- wind speed of 1.5 m/s;
- 70% humidity;

- temperature of 7ºC; and
- temperature inversion of 2ºC/100m.

Modelling was undertaken using the SoundPlan 5.0 program and the associated CONCAWE algorithms, which are most suited to industrial type noise and allows the incorporation of various meteorological conditions. For further detail on modelling methodology refer to the HSA report in Appendix C.

6.5.4 Noise Abatement Design Features

Due to the relatively low natural background noise at rural properties near the refinery, even noise emissions from the refinery that are compliant with the Regulations are audible under certain climatic conditions. Noise control work carried out at the refinery in recent years has significantly reduced tonal noise emissions from the refinery and has been effective in reducing the audibility of the noise.

The proposed Efficiency Upgrade will comply with the objectives of the Regulations by ensuring that best practice noise control measures are incorporated into the upgrade design. These are likely to include:

- upgrading of pumps and piping to include design changes (variable speed drives) to reduce pump cavitation noise and excessive throttling of pumps (two major causes of high noise emissions from pump/piping systems). This action is expected to further reduce current noise emissions and will offset the marginal increase in noise due to new or larger pump installations;

- containment of noise from the new mill (for example by use of an acoustic shroud). ;

- full enclosure of the proposed additional blowers in the calcination area and provision of adequate intake and discharge silencers;

- provision of high efficiency fans and best practice design for the proposed new seed filtration building;

- attenuation of steam valves and pipe-work breakout noise for the additions to evaporation and for the existing evaporation steam valves; and

- upgrade of the oxalate kiln, which will attenuate fan noise currently emitted from the stack.

6.5.5 Predicted Noise Levels

The proposed Pinjarra Efficiency Upgrade has been modelled using the acoustic modelling program ‘SoundPlan 5.0’, with resultant noise level contours as shown in Appendix C. Scenarios have been generated under ‘worst case’ climatic conditions for the following:

- Base Scenario: Refinery with two co-generation units (Stage 2) (project approved and commenced) (Figure 20); and
- Upgrade: Base scenario with the addition of the proposed Efficiency Upgrade noise sources (Figure 21).

A summary of the overall received sound pressure levels at the southern residences under worst-case meteorological conditions are as follows (Table 15). It should be noted that noise levels at the Napier Road monitoring location (intersection of powerlines and Napier Road) are approximately 1.4 dB(A) higher than for the critical residence (i.e. the residence nearest to the refinery) (Figure 21).

Table 15: Predicted Noise Levels at Southern Locations

Description	Napier Road Critical Residences (dB(A))
Refinery + 2 Std Co-Gen Units (Base Scenario)	33.9
Upgrade Noise Sources Only	18.3
Refinery + 2 Std Co-Gen Units + Efficiency Upgrade	34.0

A noise source ranking for the additional Efficiency Upgrade major plant, based on noise levels at the Napier Road receiver location under 'worst case' climatic conditions is tabulated below (Table 16).

Table 16: Source Contribution to Emissions at Napier Road from the Efficiency Upgrade

Noise Source Contributor	Contributed Noise Level (dB(A))
Mill #7 (with attenuation shroud)	17.1
Seed Filtration Building	15.5
Calciner Blower #9 (in enclosure)	8.2
45T Additional Cooling Tower Cell	7.5

The proposed Pinjarra refinery Efficiency Upgrade is able to comply with the noise objectives of the *Environmental Protection (Noise) Regulations 1997*, providing noise control measures outlined above are incorporated into the upgrade design.

Under worst case propagation conditions, the overall noise level from the Pinjarra refinery, must be no greater than 35 dB(A) at any neighbouring noise sensitive premises. The predicted noise level from the proposed Pinjarra Efficiency Upgrade with noise control as detailed in Appendix C at the nearest noise sensitive premises south of Napier Road is 34 L_{A10}, which is an increase of 0.1 dB(A) to the 'base refinery' emission level of 33.9 L_{A10}. An increase in overall noise level emission of 0.1 dB(A) is considered to be undetectable by the human ear and the overall level remains below the 35 L_{A10} 'assigned level' under the *Environmental Protection (Noise) Regulations 1997*. It is worth noting that the noise levels described herein relate to 'worst case' propagation conditions and noise levels for much of the time will be significantly less at residential locations.

Following completion of the Efficiency Upgrade, noise levels will be tested against the acoustic model, and this information will form the basis of future noise reduction strategies at the refinery.

Commitment 4b
Alcoa will ensure that noise from the refinery continues to comply with the requirements of the Environmental Protection (Noise) Regulations 1997 as a result of the Efficiency Upgrade.

Commitment 4c
Alcoa will prepare a noise management plan for this project, which will outline how compliance with the Environmental Protection (Noise) Regulations 1997 will be maintained. The noise management plan will include a monitoring program at the nearest receptor locations to the north and south to demonstrate compliance with Commitment 4b.

6.5.6 Rail Noise

Alumina is currently transported by rail from the Pinjarra refinery to Bunbury and Kwinana. Kwinana's port facilities are near capacity, so the additional alumina produced from the Efficiency Upgrade will be railed to Bunbury for export. It is expected the upgrade will increase the number of alumina rail wagons on each train to Bunbury by six to eight, but will not change the number of rail movements per day. Bulk products, such as caustic, are delivered to the refinery by rail and the upgrade may increase the number of caustic rail movements south (refer to Section 4.2.1).

The addition of six to eight wagons on each alumina train to Bunbury is not expected to significantly increase noise emissions but may extend the passage of trains by a few seconds.

Alcoa is aware that laden bauxite trains traversing the small radii of curved sections of the track cause wheel 'squealing' and is the biggest cause of noise complaints from neighbours. Noise monitoring at residences near a problem section of track where the rail line from the refinery joins the northern rail line route east of Pinjarra, indicated significant variation of noise as a result of a number of factors:

- Slower trains were observed to have noise levels of the order of 60 $L_{Aeq,5min}$ compared to other trains of 70 $L_{Aeq,5min}$ which were traveling slightly faster;
- Accelerating trains may generate more noise due to increased lateral forces on the rail;
- Empty wagons were generally quieter than loaded wagons;
- Correct maintenance and operation of the rail greasing mechanism on each train reduced noise squeal. Recent tests on the lubrication system of the trains have had some positive results.

Alumina produced from the Pinjarra refinery Efficiency Upgrade will not use this problem section of the line. However, Alcoa recognizes this section of the rail as an ongoing noise management issue, and is currently investigating the options for realigning the curve in conjunction with the rail operator, Westnet Rail.

6.5.7 Expert Review of Noise Issues

Sound Vibration Technology (SVT) was commissioned to undertake an independent review of the acoustic assessment work undertaken by HSA. The objectives of the review were to:

- verify the methodology used for noise modelling of the refinery;
- assess the validity of the noise predictions from the acoustic model;
- review the noise monitoring work used to support the acoustic model; and
- review and comment on the noise mitigation recommendations provided by HSA.

The results of the expert review are provided in Appendix C.

SVT found that the methodology used for noise modelling of the refinery was appropriate. SVT checked the results of the modelling by undertaking a simplified assessment based on the overall existing and upgraded plant sound power levels provided by HSA. SVT's simplified assessment yielded results of a similar magnitude to those presented by HSA and therefore SVT believe that the model of the refinery provides a good indication of sound attenuation during propagation to the south of the refinery.

SVT were satisfied that both the equipment used and procedure adopted for noise monitoring were appropriate. The noise monitoring results adequately demonstrate compliance with environmental noise limits is currently being achieved under worst-case sound propagation conditions at noise sensitive residences to the south of the refinery. The acoustic model is effective in demonstrating that the Upgrade project is also able to achieve compliance.

In SVT's opinion the noise controls proposed by HSA are appropriate. The noise model for the Efficiency Upgrade assumes these noise controls have been implemented and HSA has recommended that acoustic specifications are developed for the major noise sources. Provided that the Upgrade is constructed in accordance with HSA's recommendations, SVT found that the overall sound power level of the Upgrade should be considerably lower than the overall sound power level of the existing facility, and any increase in overall noise emission levels should be marginal.

6.6 VEGETATION CLEARING

There will be no significant impacts on vegetation, flora or fauna at the refinery site as a result of the upgrade, as the area has long been cleared for agriculture. Vegetation impacts will result from the mining operations that will provide bauxite to the refinery on completion of the Efficiency Upgrade project.

6.6.1 Forest Clearing

The mining part of Alcoa's operation is managed by a Five-year Mining and Management Program (Figure 6) that is developed in conjunction with regulatory agencies and environmental specialists

(Section 3.1). The following environmental management commitments have been made by Alcoa, which set the guidelines for the Five-year Mining and Management Program.

1. *In addition to the mining plans submitted to the State under Clause 5 of the Wagerup Agreement, Alcoa will submit to the State, mining and management programs which will specify areas which it proposes to mine, the method of mining, and proposed methods of rehabilitation in accordance with procedures to be agreed between Alcoa and the State. Alcoa undertakes to consult closely with the State on the preparation of these programs and will not implement programs until agreement has been reached with the State or they have been determined by arbitration.*

2. *Alcoa will plan and manage its mining operations to minimise disturbance to biologically diverse areas fringing major granite outcrops and stream zones. Appropriate buffers will be maintained between these areas and mine pit boundaries. Stream crossings will be constructed in a manner which facilitates their removal and rehabilitation after use, unless required for ongoing forest management, or other purposes agreed with the State's Mining and Management Program Liaison Group (MMPLG).*

3. *The assessment and approval process agreed to by the EPA (Environmental Protection Authority) for the disturbance of CAR (Comprehensive, Adequate, Representative) Informal Reserves will be followed.*

Within this context, no new impacts to vegetation, flora or fauna are anticipated at the Huntly mine as a result of the Efficiency Upgrade, outside the areas already approved for mining as defined in the current Five-year Mining and Management Program. The mine plan for 2003-2007 indicates an average of about 340 ha per year of Jarrah forest will be cleared at Huntly, with the exception of 2003 (425 ha) when clearing for the construction of the relocated McCoy crusher site, office and workshop facilities and haul roads, is undertaken. The proposed Efficiency Upgrade will however, bring forward the timing of the mine plan by about a year, resulting in an additional 30 ha per year to be cleared (i.e. on average 370 ha per year), and mined. The rate of rehabilitation will also be increased proportionally.

Before bauxite mining begins, surveys of the existing flora, fauna and forest health are always undertaken. These surveys are used to map the site vegetation types and areas of dieback, provide information on the fauna assemblages, and to find declared rare or priority species. Mine plans are modified where appropriate, or management programs are developed to minimise the risk to environmentally sensitive areas, and to protect rare or priority species. For example, within the future McCoy crushing area, a 3 ha block of Jarrah forest that has never been logged is surrounded by a 100 m buffer zone to protect it from mining disturbance. Alcoa monitors dieback spread in this area and has funded the treatment of the Jarrah trees to protect it from dieback disease. Clearing buffers are maintained around streams, dams, and rock outcrops to ensure environmentally and socially sensitive areas are not impacted by mining activities.

Prior to clearing for mining, all salvageable timber is removed by the Forest Products Commission. Some of the remaining forest debris is stockpiled for use in future rehabilitation as habitat material but the remaining debris is heaped and burnt. Alcoa is currently investigating alternatives to burning forest waste. Options include the processing of the debris as charcoal, for silicon production and the production of wood chips.

Haul road alignments are selected with consideration to dieback distribution, CAR Informal Reserves, swamp and stream zone protection and the location of the ore. All crossings are designed to minimise ecological and hydrological impacts and to facilitate rehabilitation on completion.

6.6.2 Dieback Management

Approximately 80% of the forest within the Huntly mining region is free of the dieback disease. The Huntly mine operates under a 'dieback-free mining system' which means equipment cannot enter the mine unless it is clean and all the constructed haul roads are dieback free. Pockets of dieback infested forest are carefully managed so that do not infect dieback free areas. The procedures for dieback management are defined in the CALM/Alcoa Working Arrangements. Movement of mining equipment between different dieback categories of forest or cleared forest is strictly controlled and boundaries are marked on trees (in the forest), by pegs, continuous yellow flagging and signs on tracks for cleared areas. All mine operations are planned to minimize the number of times that vehicles or machines must cross dieback boundaries. Dieback management also includes the use of washdown equipment for mining vehicles and equipment and Huntly mine operates with 23 field washdown units. All exploration drilling ceases in winter to avoid the increased risk of spreading dieback during the wet season.

The amount of dieback spread that has been caused by Alcoa's operations has been measured. For every hectare that is mined, dieback is potentially spread to another 0.01 hectare. Alcoa also funds a rehabilitation program that is undertaken by CALM for severely dieback affected areas in the forest surrounding Alcoa's operations.

6.6.3 Rehabilitation

Progressive mine rehabilitation is undertaken in accordance with Alcoa's existing policy of mine rehabilitation which is underlain by the Principle that "…operations do not result in a loss of biological diversity or disrupt the fabric of ecological integrity in the environments in which (Alcoa) operate(s)." This includes:

- keeping areas of disturbance to a minimum;
- undertaking baseline studies and habitat impact assessments before commencing clearing;
- adopting a catchment management approach to environmental management;
- promoting biodiversity and ecological integrity beyond Alcoa's zone of impact (e.g. through Landcare); and
- ensuring endangered and threatened species existing in the region are protected.

The bauxite mine rehabilitation program involves:

- reshaping mined areas to visually blend in with the surrounding landscape;
- earthworks to control runoff from rehabilitated areas;
- returning topsoil, logs and other debris to help in flora and fauna return and maximise soil nutrients;
- contour-ripping subsoils to assist tree root penetration, maximise water infiltration and assist in erosion control;
- seeding with tree, understorey and other plant species locally indigenous to the Jarrah forest;
- hand-planting of recalcitrant (those that do not normally establish from seed) species; and
- application of nitrogen and phosphate fertiliser, usually by helicopter.

Alcoa has received formal recognition for the high standard of rehabilitation it has achieved following mining in the Darling Range. This includes being awarded the 2002 Golden Gecko Award for Environmental Excellence for its work in restoring the botanical diversity of the Jarrah forest after bauxite mining. Just recently, Alcoa was the 2003 recipient of the Society for Ecological Restoration 'International Model Project' award. The award was presented for work on returning the botanical richness of the Jarrah forest in restored bauxite mines in Western Australia. Alcoa was commended for developing a rigorous, scientifically based restoration project, representing one of the best large-scale examples of native ecosystem restoration.

Improvements in rehabilitation techniques during the last ten years now result in the average number of indigenous plant species in 15-month old rehabilitated sites being 100% of the number found in representative undisturbed Jarrah forest sites. Research into seed treatment and application, topsoil handling, mine planning, and native plant propagation has been undertaken. Alcoa's Marrinup nursery produces nearly 230,000 plants a year from cuttings and tissue culture of recalcitrant species for planting in rehabilitated areas.

Improvement in the number of species represented in rehabilitation continues to be targeted. Optimising the use of soil-stored seed is one way to increase botanical diversity. This is achieved by developing mine plans to enable soil handling under the best possible conditions. A major component is maximising the proportion of direct topsoil return which substantially improves the botanical diversity of rehabilitation. Further improvement strategies include the planting of recalcitrant species seedlings in rehabilitated pits and the sieving of topsoil recovered from proposed mining areas.

Commitment 5

Alcoa will operate within the guidelines of its current approved Five-year Mining and Management Program to supply ore for the Efficiency Upgrade, although the timing of the Plan will be brought forward by about one year. The annual rehabilitation program will be adjusted in subsequent years to include rehabilitation of the additional area which will be mined each year.

6.7 FAUNA

Fauna are directly impacted upon by mining as a result of habitat removal. Alcoa has an ongoing program to monitor fauna returning to rehabilitated areas after mining has ceased. The results indicate that as new forests begin to grow, there are suitable habitats for most fauna, although some species still remain dependent on surrounding unmined areas for specific needs.

Rehabilitated areas in the forest have less timber debris on the surface compared with unmined forest. To overcome this, rehabilitation practices include scattering debris and providing small rock structures as cover for small animals. As the rehabilitated areas regenerate and habitats develop, fauna are able to return to the area. Monitoring to date has found that return of native fauna to rehabilitated areas is generally very successful with up to 100% of mammals, 90% of birds, 78% of reptiles and 80% of ants returning to rehabilitated areas.

As indicated, no new impacts to fauna habitat are anticipated as a result of the Efficiency Upgrade, outside the areas already approved for mining through the current Five-year Mining and Management Program. The Efficiency Upgrade will bring forward the rate of clearing and this will be offset by an increased rate of rehabilitation to minimise the areas left open. Rehabilitation practices, such as returning logs and other debris, and revegetating the site with endemic plant species will encourage the re-establishment of fauna habitats.

There will be no disturbance to remnant vegetation (and therefore fauna habitats) in the vicinity of the refinery, as a result of the Efficiency Upgrade. No other impacts on fauna are anticipated from the project.

6.8 SIGNIFICANT AREAS

No environmentally significant areas occur in the immediate vicinity of the Pinjarra refinery.

Comprehensive, Adequate and Representative (CAR) Informal Reserves were established within Alcoa's mining lease ML1sa in 1999 with the development of the Regional Forest Agreement (RFA). Mining operations had already commenced in some of these areas prior to the RFA, but any future clearing was postponed until the ecological value of these areas could be verified, and only if approval was granted by the Mining and Management Program Liaison Group (MMPLG) (refer to Section 3.1).

A process has been developed to verify the values, determine the significance of, and record accurate boundaries for the CAR Informal Reserves. Specialist environmental scientists are used to verify the ecological values of the CAR Informal Reserves where mining is proposed. Alcoa then prepares a Mining and Management Program (MMP) in consultation with CALM. Mine plans are modified to avoid areas of ecological significance and/or management programs developed to ensure protection of threatened species or ecological communities. The MMP is reviewed and considered by the MMPLG and the Minister for State Development who may approve the final MMP in whole or with conditions.

6.9 RIVERS, CREEKS AND WETLANDS

6.9.1 Mining Surface Water Management

The Huntly Mining areas occur within the Perth water supply catchments. Managing the quality of runoff water from haul roads and pits is achieved by either infiltrating water through sumps or by processing it through sedimentation sumps before discharge into a stream zone. Annual sump clean out occurs before winter to ensure maximum sediment holding capacity. Monitoring of turbidity to check the performance of sumps and drainage control is undertaken upstream of storage reservoirs that supply water to the public. Additional water monitoring points are usually located below conveyor or haul road crossings, or a series of large mine pits. Drainage control structures around the mine are inspected daily during rainfall periods to ensure they are operating effectively. All employees are made aware of the importance of turbidity management through a regular training program.

A minimum buffer zone of 100 m is retained around Priority 1 water reservoirs, measured from the top water level, with each location reviewed on an individual risk basis (refer WRC, 2000). Alcoa will not mine within 100 m of the top water level of Priority 1 reservoirs.

A water resource sensitive-zone has been defined adjacent to reservoirs. These zones are approximately 500 m from the top water level and 200 m wide along the first kilometre of reservoir feeder streams. Within these areas, Alcoa commits to applying a risk assessment as part of the Clearing Plan approvals to ensure that mining or infrastructure have no impact on the water resource.

Mining within the 100 m to 200 m buffer zone of the South Dandalup Dam is determined on a case-by-case basis during the review of the Clearing Plan approvals by the Mines Operation Group. Risk management assessments are applied to protect the reservoir from potential mining impacts. Alcoa has operated close to the South Dandalup Dam over the last 20 years both at Del Park and at Huntly without any detectable impact on the dam.

Alcoa's mining procedures have been developed to prevent the release of water from mine pits, thereby minimising the risk of dieback spread into unmined forest, and to decrease turbidity and sedimentation in streams and dams. Specific plans for mining near streams and dams are submitted to the Mines Operation Group. The following strategies used to prevent water runoff outside the ore-bodies will continue to be used for the Efficiency Upgrade where mining is planned near a water body:

a) **Containment of Drainage**: Storage to contain 1:20 year 24 hour rainfall intensity will be maintained throughout clearing, mining and rehabilitation operations. This may be increased to 1:200 for areas within the 200 m buffer of reservoirs. The mine pit is an adequate containment structure for stormwater runoff and facilitated by the low permeability friable zone and the clay zone. Water collected in the mine pit is allowed to infiltrate and evaporate. Runoff from around the crushers and associated facilities is collected in lined sumps to be pumped into a pond, for reuse by the crushing plant.

b) Scheduling of Operations: Areas where there is a high potential risk for surface water impacts, are usually scheduled to be mined and rehabilitated during the summer months.

c) Management of Hydrocarbons: Priority is given to the management of hydrocarbons. Management measures include spill prevention and cleanup training, spill response equipment on standby, spill cleanup procedures covering spills to soil or water, and the Huntly Mine Emergency Response Plan. Hydrocarbons stored on site are bunded to Australian Standards.

d) Access Control: Access down-slope of mining areas is minimised to prevent disturbance to the forest below ore-bodies. The areas adjacent to the South Dandalup Dam are closed off with gates which are patrolled by security personnel.

e) Contingency Plans: The Huntly Mine has procedures for preparing for intense weather. Daily forecasts are issued for the mine and a green alert is issued if rainfall is predicted within three days. If rainfall greater than 10 mm is expected within 24 hours, then a red alert is issued. In preparing for heavy rainfall, extra storage volume may be dug from the pit, or ripping undertaken or pumps installed to control runoff and overflows.

6.9.2 Refinery Surface Water Management

Surface water runoff from the refinery site drains into a closed system, where the water is collected and used to supplement the refinery water supply. No surface runoff, drainage or effluent is released to the nearby Oakley and Barritt Brooks. The containment system has the capacity to contain a rainfall event with a return interval of one in 100 years.

Construction of the Efficiency Upgrade will not result in the disturbance of large areas, and hence the potential for sedimentation of the nearby watercourses is low. This Efficiency Upgrade will not result in any impacts on the surface water systems in the vicinity of the refinery.

Surface water quality monitoring is undertaken as part of Alcoa's licence conditions (refer to Section 6.15.3). Surface water quality downstream of the refinery is generally more variable than that upstream of the site. However, water quality data from these monitoring sites indicates that Alcoa's operations have not significantly impacted the water quality in the Murray River.

The Pinjarra refinery uses surface water from the existing Barritt Brook and Oakley Brook Detention Dams (refer to Section 6.10.2).

6.10 WATER SUPPLY

6.10.1 Water Supply at the Mine

At the Huntly mine, water is mainly used for dust suppression on unsealed roads, and for cleaning and hygiene purposes to control the spread of dieback. The White Road crusher facility is supplied from Banksiadale dam (Figure 3), which is a dedicated supply, via a 6 km pipeline. Water is supplied to the

Del Park Exploration office and workshop facilities and the Del Park conveyor belt transfer station from Boronia waterhole. Potable water is supplied to the Huntly and White Road workshops and offices from Pig Swamp waterhole.

A pump at South Dandalup Dam extracts water from the main dam and is a contingency source for when Banksiadale Dam has insufficient storage to meet ongoing demand. The Water Corporation has approved an LPG-driven generator and pump installation at this location for summer use. Alcoa and the Water Corporation have negotiated a long term Bulk Water Agreement for the purchase of water from this source.

Huntly's water use from the Banksiadale Dam and South Dandalup Dam system was 390 ML for the July 2001 to June 2002 period, compared with 540 ML for the 2000 to 2001 season when drought was severe. Alcoa is committed to reducing total mine water consumption by 20% below 2000 consumption, by 2003, which in combination with other water harvesting measures is expected to remove the need for any purchase of supplementary water supplies after the 2003/2004 summer period, other than in exceptional circumstances. This will include the predicted increase in annual mine water demand of approximately 40 ML (i.e. 10%) to support the Efficiency Upgrade. Alcoa continues to seek methods to improve water use strategies, which will enable the minimisation of water use at the mine.

6.10.1.1 Long-term Mine Water Supply

A long-term 25 year water supply strategic review investigated numerous alternate water supply options for the mining areas and compared them to the base case (continued supply from Banksiadale Dam, plus supplementary pumping from the South Dandalup Dam in low rainfall years). Alcoa will continue to discuss the best long-term water supply options for McCoy and subsequent mining regions with the appropriate Government agencies.

Water for the McCoy mining area will be supplied by a pipeline extension along the conveyor trace from White Road. The long-term water supply strategy for McCoy operations is a combination of:

- continued pumping from Banksiadale Dam with supplementation from South Dandalup Dam if required;
- water conservation strategies to reduce demand;
- harvesting and storing of winter runoff at the McCoy crusher complex (haul roads and paved areas) with the construction of large storage sumps; and
- management treatments of rehabilitation and forest have been undertaken within the Banksiadale Dam catchment to enhance water yield (in conjunction with CALM);
- possible pumping of groundwater from within the experimental mining area is under consideration.

Huntly's overall water consumption is expected to reduce during 2005 as a result of shorter truck haul distances at McCoy and continuing improvements in water use efficiency

6.10.2 Water Supply at the Refinery – Surface Water

Current annual water usage at Pinjarra refinery is 6,130 ML and is used to replace water outputs. This includes 250 MLpa from the Water Corporation Pinjarra Town Water Treatment Plant. The current water balance for the Pinjarra refinery is set out in Table 17.

Table 17: Water Balance for the Pinjarra Refinery

Water Inputs	ML	Water outputs	ML
Water in bauxite	900	Moisture in calciner feed	280
Water in caustic	190	Moisture in ALD feed	250
Rainfall	1,080	Evaporation from tanks	110
Rainfall residue	3,700	Blow off	180
Make-up water	6,130	Cooling tower blowdown and windage	2,800
		Cooling evaporation of RDA1	1,300
		Liquor loss with mud	1,980
		Liquor loss with sand	1,150
		Natural evaporation	2,900
		Loss due to irrigation	1,050
TOTAL input	12,000	TOTAL output	12,000

It is seen from this table that water inputs and outputs are balanced by the addition of 6,130 MLpa of make-up water. It is this make-up water requirement that Alcoa obtains from the surface and underground sources.

Three surface water supply impoundments are operated under surface water licences issued by the DoE (Section 5.4.2). These are:

	Maximum Allowable Diversion Volume
Oakley Brook Detention Dam (Licence No. 98940)	4,000 MLpa
Lower Oakley Pumpback (Licence No. 98937)	3,000 MLpa
Barritt Brook Detention Dam (Licence No. 98939)	2,000 MLpa
Total	9,000 MLpa

Alcoa's water management program takes account of the size of the water allocation, the environmental water requirements (EWR) and downstream users, and the need to use groundwater sustainably.

Both Oakley and Barritt Brooks generate significant flows downstream of the detention dams and the EWR Study indicated that these flows exceed downstream environmental water requirements (refer to Section 5.4.2).

The Lower Oakley Pumpback Dam is designed to harvest water during peak flow during winter, to minimise impacts downstream. Other flows are bypassed. The water requirements downstream (and

requirements of private rural property before the Murray River) are met by continuously releasing water at the weir to meet EWRs, and the weir overflows naturally during winter runoff.

Commitment 6a
Alcoa commits to ongoing protection of the Oakley and Barritt Brooks by ensuring that downstream Environmental Water Requirements (EWR) continue to be met.

6.10.3 Water Supply at the Refinery – Groundwater

The Upgrade is not expecting to have an impact on the current rate of water abstraction. Process and potable water supplies at the Pinjarra refinery are sourced primarily from the Cattamarra Aquifer via five artesian bores on the Alcoa property (Section 5.5.2). The maximum draw under licence GWL98936 is limited to 2,500 MLpa, with an additional 1,500 MLpa that may be drawn from the Murray groundwater area under drought conditions (GWL 109935). Groundwater abstraction during average rainfall years is maintained below the estimated sustainable yield for the Cattamarra aquifer of 2,500 MLpa (PPK & Thomas, 1998). A minimum of 1,600 MLpa groundwater is required to meet the existing water requirements of the refinery process, and for potable use.

During drought conditions when runoff into the dams is reduced, the Pinjarra refinery may request permission from the DoE (previously Water and Rivers Commission) to draw up to 4,000 MLpa from groundwater sources. The definition of a drought in the DoE Water Licenses Operating Strategy is a condition when the volume of water (fresh and alkaline) held in storage at the residue area at the end of winter is less than 9,500 ML. In this situation, Alcoa does not have sufficient water to sustain operations throughout the following summer, and therefore needs to obtain additional supplies from groundwater. DoE may allow an increase in abstraction, subject to information obtained through groundwater monitoring and investigation, and requiring that the abstraction be short-term and that recovery is allowed to occur.

The Pinjarra refinery currently also abstracts smaller volumes of groundwater from depressurisation bores at the Runoff Water Storage (ROWS) pond and from the horizontal bore installed below Building 40 to recover contaminated groundwater (refer to Section 6.12). The maximum draw from these sources under licence GWL 150586(3) is 80 ML per annum. Seepage recovery from the RDA also supplements water supply to the refinery.

Groundwater abstraction licence allocations for the Pinjarra refinery are summarised below:

Cattamarra Aquifer (GWL 98936)	2,500 MLpa
Contingency supply subject to licence approval under drought conditions	1,500 MLpa (under drought conditions only)
ROWS pond/Building 40 Non Artesian Bore (GWL 150586-1)	80 ML
Total	2,580 MLpa (4080 ML under drought conditions)

Alcoa is required by the conditions of licences to report on the annual abstraction rate and on the impact of abstraction on the aquifer.

Groundwater to be used as a potable supply is first filtered through calcite beds and chlorinated before reticulation throughout the operation to all points requiring potable quality water. The water treatment plant is operated and maintained by Alcoa.

Potable water quality is monitored for possible biological or chemical contamination in accordance with the 2000 Australian & New Zealand Environment and Conservation Council (ANZECC, 2001) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

6.10.3.1 Impacts of Existing Abstraction

Abstraction from the Cattamarra aquifer is generally in the order of 60% to 80% of the annual allocated amount. Water levels in the Cattamarra aquifer declined by between 1 m and 8 m since 1999 because of the demand caused by the extended period of drought. Some monitoring bores have since shown partial recoveries since pumping rates were relaxed and annual abstraction returned to less than 2,500 ML.

Water levels in superficial monitoring bores in the refinery area are generally stable, with some minor seasonal recoveries.

6.10.4 Water Conservation Initiatives

The refinery operates a closed water circuit, with no releases or discharges to the ground or streams. Losses from the water circuit occur as steam, evaporation, and as water entrained in the residue sand and mud. Water is continuously reused until lost through these paths, and the annual make-up requirement averages approximately 6,130 ML per year.

In 2001 a detailed water audit was carried out to better understand the water circuit and to identify and prioritise opportunities for improvement. As all water is recaptured, opportunities identified focus on reducing evaporation. Examples of improvements include:

- Reuse of bauxite stacking area runoff for dust suppression rather than taking potable grade water. A pump has been established at a collection sump to allow water trucks to fill up with water runoff from the bauxite stacking area.

- Improved control of condensate quality. If condensate collected from the refinery process is maintained clean, then it can be used to supply other parts of the process instead of potable grade water.

The refinery's water supply relies heavily on surface water flows and the recent drought has affirmed the need for Alcoa to secure a more robust and sustainable water supply during periods of extended

dry weather. Alcoa has set an internal goal of achieving a 20% reduction in water consumption by 2005 (against a 2002 baseline). Initiatives are to:

- eliminate all forms of waste of its water resources, in particular "fresh" (previously unused) water;
- make all of the operations less susceptible to risks from extreme weather events (droughts and floods).
- minimise inappropriate use of "fresh" water;
- substitute lower grade water (such as treated sewage effluent or drainage water) wherever practicable, with particular reference to community acceptance;
- implement "real cost accounting" for water, which recognises its true current value;
- proactively demonstrate and promote environmental outcomes associated with water conservation; and
- for Alcoa to be recognised for its water conservation initiatives.

Commitment 6b
Alcoa will continue to implement water conservation initiatives to achieve its water use reduction goal.

6.10.5 Changes Resulting from the Upgrade

The Efficiency Upgrade will require an additional 1,100 MLpa of water, which equates to a 13% increase on the existing refinery water requirement.

In preparation for the Efficiency Upgrade, opportunities to reduce evaporation from the water storage lake were investigated. Annual evaporation results in the loss of more than 1,000 ML from the surface of the water storage lake, which has an area of 44 ha. Covers have been used successfully on smaller reservoirs, which are designed to prevent evaporation whilst allowing runoff to be collected. A detailed review of this option found that it had not been attempted on this scale and had significant engineering risks. The cover would need to withstand high wind conditions, in particular the easterly winds during Spring and Summer. The estimated cost took account of these concerns and was found to be unviable.

Other options for obtaining a sustainable water resource to meet the additional water requirements for the project are currently being investigated by Alcoa's water conservation team and include:

- taking treated effluent from the Water Corporation's sewage treatment plant located in Gordon Road, Mandurah;
- capturing excess vapour currently released from blow-off tanks in the digestion area;
- investigating additional surface water harvesting structures designed to collect surface water during peak stream flows in winter. This has been successfully achieved at the Lower Oakley Pumpback Dam; and/or

- investigation of the Cattamarra aquifer to better establish its extent and yield capability.

Obtaining reuse water from Mandurah wastewater treatment plant effluent is the preferred option. Mandurah reuse water would be added only to alkaline water. No environmental or health issues are expected. Water from effluent has already been used successfully for several years at Pinjarra. Initial estimates suggest that the 2,000 ML annually can be sourced from the Mandurah wastewater treatment plant. This water supply would maintain bore water usage below 2,000 ML annually including allowance for a 1 in 10 year mild drought. More severe droughts or back–to–back drought years could be handled by using retained surge or by increased bore usage.

Commitment 6c
The refinery will continue to use best practicable technology to conserve water, and ensure no adverse environmental impacts will result from the supply of water for the upgrade.

6.11 WASTE MANAGEMENT

Alcoa has an existing waste management program within the Alcoa EMS. The waste streams are grouped into the following categories, which adhere to Government regulations and internal Alcoa Guidelines:

- Hazardous waste (as classified under the *Australian Dangerous Goods Code 2000*);
- Low hazard waste (may be contaminated with, or contain traces of hazardous waste);
- Putrescible waste;
- Inert waste (excluding putrescible waste);
- Special wastes (asbestos, clinical and related wastes, leaded paints, fluorescent tubes); and
- Scrap/salvage (recyclable).

During construction, waste will be generated by dismantling and modification of existing equipment (some of which may date back to the 1960's). The main issues which may arise are asbestos containing substances may need to be disturbed, infrastructure may contain lead based paint, and pipes or vessels which are made redundant may contain caustic scale, which makes them unsafe for recycling.

Alcoa has a policy of removing asbestos materials when they need to be disturbed, and this policy will be applied to the Efficiency Upgrade. Specialist contractors are used and follow procedures which comply with Australian Standards and Worksafe Procedures.

Lead paint on structures is removed following a program covering containment systems, worker protection, emission control and environmental monitoring. The program is aligned to *Australian Standard 4361.1: Guide to Lead Paint Management Part 1: Industrial Applications*, and Worksafe Australia procedures. Disposal of lead paint wastes is carried out by a specialist contractor and material is sent to an appropriate landfill depending on lead content.

When a vessel or pipe is removed and contains caustic scale, it can present a hazard downstream in the recycling path. Steel items which are removed from site must have scale removed. Where an item is particularly large or has a complex structure it may not be practical to make it clean for removal for recycling. In these cases the item will be buried onsite in the landfill.

6.11.1 Non-Process Wastes

6.11.1.1 Mining

Very little industrial or domestic solid waste is generated by the mining operations. Waste that is generated is either transported to the refinery for disposal through its disposal processes. When part of the Huntly site is decommissioned, the heavy vehicle wash down area, hydrocarbon storage tanks, waste water treatment plant, dieback wash-down facility and other facilities, will be relocated or demolished.

6.11.1.2 Refinery

Non-process waste streams at the Pinjarra refinery are managed and monitored in partnership with a licensed waste contractor who has responsibility for day-to-day management of these wastes. The partnership is committed to cleaner production, which includes minimising waste generation and maximizing recycling and reuse. The Pinjarra refinery Waste Minimisation Program was initiated in 1993 with the formation of a waste minimisation and recycling lead team. Since then the non-process waste sent to landfill has been reduced by 80% with the introduction of a recycling system playing the biggest part in this reduction.

Significant advances have been made in the area of waste recycling and minimisation. The recycling program has been developed to include: waste oil, scrap metals, gloves, nuts and bolts, automobile batteries, liquid waste, laboratory wastes, ozone-depleting substances, cardboard, tree clippings and timber pallets.

The management of the non-process waste streams generated on site is summarised below.

Recyclable waste (steel, aluminium, paper, plastics (types 1, 2, 3), cardboard, glass)	• Sent to the on-site recycling facility.
Putrescible waste	• Chipped or composted and used as mulch
Solvents	• Collected and consigned to Environmental Recovery Services Ltd (ERS) for treatment.
Waste oil	• Collected and reused for dust suppression on the Residue Disposal Areas (RDA) (with DoE approval).

Hazardous waste	• Removed off-site by a licensed waste contract or to an approved waste disposal facility.
Non-recyclable inert non-hazardous waste or low-hazardous waste	• Disposed to a secure licensed landfill (Class II) designated area within the Pinjarra Refinery RDA

Non-recyclable solid low-hazard waste from the operation is disposed of to a dedicated landfill in RDA2, after completion of a risk assessment. This area is part of a contained and clay lined facility. Disposal of low-hazard waste at this landfill facility has been approved by DoE, and the site is licensed to take 9,000 m^3pa.

Raw sewage effluent is pumped direct to RDA1 (Cooling Pond) via a centrifugal pump (to provide maceration), where it is injected at least 1 m below the surface of the hot, alkaline liquor. Monitoring is undertaken to ensure sewage management equipment function, and to test the lake water taken into the refinery for bacterial indicators of sewage. Biological testing is undertaken monthly to ensure that adequate sterilisation is taking place.

The Pinjarra refinery has been surveyed to identify and document the location of all asbestos products in current use. The Alcoa WA Operations Policy Statement commits to the removal, as soon as practicable, of all sources of asbestos fibre that have the potential to exceed existing standards. The Alcoa Corporate Asbestos Standards include details on hazard control, removal practices, air monitoring, labelling, exposure standards and medical surveillance. Any asbestos-containing waste materials removed from the refinery during the upgrade would be placed in an asbestos disposal area in the RDA adjacent to the Recycling Centre. The asbestos disposal area is in a surveyed, controlled-access area, dedicated to the purpose of disposal of asbestos, synthetic mineral fibres, and low-grade medical waste. The facility is recognised in the DoE licence.

During construction, contractors are expected to integrate their waste management with the onsite waste management program. This includes using the same waste segregation and collection systems and procedures and training materials.

With the Efficiency Upgrade and ongoing measures to improve waste reduction, there is expected to be little increase in the volume of non-process waste generated as a result of operations. Non-process wastes generated during construction and operation of the Efficiency Upgrade will continue to be managed in accordance with Alcoa's existing waste management program and waste reduction principles.

6.11.2 Refinery Process Wastes

Process wastes from the refinery include any waste that is derived from an ingredient of the refinery Bayer process. Process wastes at the Pinjarra refinery are targets of cleaner production projects by process engineers and specialists on site. Process wastes include (but are not limited to) the following list. These include any spill or cleanup material of the following substances:

- red scale (any material from milling, digestion and clarification circuits that contains caustic);
- white scale (from precipitation, post-precipitation and calcinations circuits);
- bauxite residue (material that is piped to the RDAs); and
- spilled process chemicals.

Waste alumina and hydrate are also recorded, as these represent lost raw materials.

A summary of the types, and management of process wastes that are currently generated are summarised below:

Bauxite	• Clean fill;
Caustic contaminated soil	• RDA;
Heavily scaled hardware (e.g. pumps, pipes)	• Landfill;
General caustic contaminated waste	• Landfill;
Hydrate	• RDA;
Mercury (from bauxite)	• Collected and removed off-site for recycling;
Off Spec Chemicals (including lime, flocculant, caustic)	• Caustic – RDA; • Flocculant – consistent with DoE guidelines; • Lime –Landfill; • Catalyst - depends on level of contamination and DoE guidelines;
Bauxite residue	• RDA;
Red scale	• RDA;
Sodium aluminate	• RDA.

6.11.2.1 Mercury

Mercury is introduced to the refinery primarily through the bauxite ore in trace amounts, although due to the high rate of throughput, this adds up to approximately 430 kg of mercury per year. Mercury is mobilised with elevated temperatures in the Bayer process. Secure mercury traps, installed in the Vacuum Condenser Systems of the digestion process, are opened monthly for removal of any collected mercury. Annual maintenance of lake water seal tanks associated with the Vacuum Condenser Systems may also yield free mercury metal.

Dedicated, secure storage for mercury is maintained prior to mercury being removed offsite for recycling. A Mercury Spill Clean Up procedure is in place in the event of spillage.

6.11.2.2 Bauxite Residue

Bauxite residue is managed in accordance with Alcoa Corporate Mandated Bauxite Residue Management Standards and Guidelines and within the framework of the Long Term Residue Management Plan (LTRMP). Approximately 18,000 t of residue mud and residue sand is pumped to the RDA daily.

The sand and mud are separated prior to disposal. The mud is pumped to a super-thickener that removes approximately half the liquor. During this process thickened mud with 50% solids is produced, and this is deposited within the drying areas in thin layers (≤ 0.5m) for solar drying. The sand is washed to remove alkaline liquor and is then used in the construction of dike walls within the impoundment area and as a surface cover on the drying areas prior to surface rehabilitation. The recovered liquor goes back to the refinery for reuse.

Whilst a 17% increase in production with the Efficiency Upgrade would be expected to produce an incremental increase in process waste production, waste minimization, cleaner production mechanisms and improved spill prevention and clean up, will be incorporated into the Efficiency Upgrade. Process wastes generated during construction and operation of the Efficiency Upgrade will continue to be managed in accordance with Alcoa's existing waste management program.

6.12 GROUND WATER CONTAMINATION

6.12.1 Refinery

At Pinjarra refinery groundwater levels and quality are monitored using a network of bores in the refinery, RDA, on Alcoa's buffer farm, and throughout the region. Every 6 months over 300 bores are monitored.

Groundwater quality below the refinery area is currently monitored at 41 locations. Changes in groundwater quality resulting from impact by Bayer liquor or residue leachate are assessed using the following parameters:

pH - consistently elevated pH (i.e. >pH 7.0) indicates significant losses of alkaline process fluids to the subsurface. This parameter is, however, of limited value when assessing minor losses owing to the acidity and buffering capacity of the native soils and groundwater in the Pinjarra area.

Electrical Conductivity - EC in native groundwater in the Pinjarra area is variable, although generally less than 4,000 µS/cm. Residue leachate has an EC greater than 30,000 µS/cm. It is a conservative parameter when compared to pH and alkalinity.

Sodium: Chloride Ratio - the mass ratio of sodium to chloride in rainfall and native groundwater at Pinjarra is approximately 0.6 which contrasts strongly with a ratio of approximately 6 in residue leachate. Interpretation of data may be complicated by ion exchange reactions with natural clays, but these data are a good indicator of potential Bayer process impacts.

Methyl (M)-alkalinity – is a reliable indicator of contamination by residue leachate and process liquor although reactions with native soils and groundwater limit its sensitivity to low levels of impact.

Additional analyses for major ions and trace elements are undertaken on samples from the five production bores and from a subset of monitoring bores every 6 months.

The chemical data collected from monitoring bores show considerable spatial variability, reflecting the number of potential sources of contamination and the variable nature of the near-surface soils, including their assimilative capacity and permeability. Under the refinery there is evidence of vertical migration of caustic liquor to the lower superficial aquifer beneath two buildings. However, no detrimental trends are evident in other bores and there is no evidence of impacts to the underlying Cattamarra aquifer.

At one of these buildings remediation is occurring using a horizontal recovery bore. Groundwater Licence 150586 was issued by the Water and Rivers Commission in July 2002 for abstraction from the horizontal bore installed in the superficial formation, about 4m below Building 40. Weekly recording of water levels in monitor bores in the vicinity of Building 40 commenced in August 2002 to assess the influence of the horizontal bore and results have been positive, with early indications that the pH in monitoring bores beside the building is falling. The bore is yielding 3 kL to 5 kL per day.

Spillage inside operating areas is mostly contained in bunded holding enclosures (secondary containment). Spills beyond these areas are contained in a tertiary containment system, which comprises a network of stormwater drains which report to a lined stormwater lake. Water from this lake is re-used in the refinery process. Any spill that escapes the bunded areas of the refinery is reported in Alcoa's Incident Management System. Procedures for spill cleanup are documented, and are rehearsed in training. Training has been undertaken with all employees on the refinery to heighten awareness of the impacts of spills on soil and potentially on groundwater. Advanced spill cleanup training has also been provided to specialist emergency response groups who are on call should a spill occur.

A focus on spill prevention during the last three years sees the refinery on track to achieve a 50% reduction in the number of larger spills (spills greater than 2kL) by December 2003. This has been achieved through improvements to; training and awareness, process controls including level indication on vessels, alarms and improvements to the interlocks between different sections of the plant to ensure that the surge capacity in one area is not sacrificed resulting in spillage.

The Efficiency Upgrade will replace some of the old equipment from the original refinery. As a result of installation of new equipment and ongoing improvements in spill management, the potential for contamination of soils and groundwater below the refinery is expected to decrease as a result of the Efficiency Upgrade. Bunding will be designed to contain more than 110% of the largest vessel in the area. Foundations of new areas will undergo a risk assessment to determine if they should be lined, to prevent contamination of the underlying ground should the slab crack during its lifetime. Steel lined

sumps and drains will be used to protect the concrete structure from damage. Management of spills and contamination sources during construction and operation of the Efficiency Upgrade, will continue to be undertaken according to Alcoa's existing procedures.

Groundwater monitoring (refer to Section 6.15.1) will continue to be used to detect contamination. Where practical, recovery and remediation will be undertaken within the existing operation Careful design and operational controls applying the learnings described above will be used to minimise the risk of impacts on groundwater as a result of the Efficiency Upgrade.

6.12.2 Residue Disposal Areas

There is little evidence of alteration of groundwater quality beyond the boundaries of the residue areas and the refinery. Further, there is no evidence of vertical migration of contaminants to the underlying Leederville and Cattamarra aquifers (Nield, in Parsons Brinckerhoff, 2003, suggested there is poor direct hydraulic connection between the aquifers).

There is evidence of contamination of groundwater in the upper superficial aquifer below the floor of the Cooling Pond. Data from bores located on the Cooling Pond dikes suggest that groundwater impacts have not spread laterally beyond the footprint of the Cooling Pond.

Impacts on the lower superficial aquifer are reflective of those observed in the upper aquifer, with some evidence of deteriorating water quality in some areas. Sodium to chloride ratio and alkalinity have shown a steady increasing trend in some bores while others have shown a steady decrease.

A slight deterioration in water quality is evident adjacent to the ROWS Pond, but, based on the available data, there is no evidence of impacts upon the Leederville aquifer below the residue area.

The bauxite residue from the refinery will continue to be disposed of to the RDA to the west of the refinery, but the increased rate of residue generation with the Efficiency Upgrade will bring forward the planned expansion of the RDA. Seepage, and the potential impact on the underlying groundwater will continue to be reduced in accordance with Alcoa's existing LTRMP which includes measures such as:

- disposal to RDAs with multiple liners and underdrainage for seepage recovery;
- dry stacking of tailings with around 50% weight for weight (w/w) solids;
- groundwater quality monitoring (refer to Section 6.15.1); and
- seepage recovery from below old and existing RDAs, which is returned to the refinery for use in the process.

Commitment 7
Alcoa will manage the bauxite residue generated from the Efficiency Upgrade in accordance with Pinjarra refinery revised Long-term Residue Management Plan (LTRMP).

6.12.3 Mining Areas

Control systems are in place to reduce the risk of, and to contain, any potential hydrocarbon spills in the mining areas. All hydrocarbons stored on site are in above-ground facilities with secondary containment, in compliance with the *Explosives and Dangerous Goods Act 1961*.

An upgraded Emergency Response Plan has been developed and deployed to all employees to ensure a rapid response to any emergency situation, including pollution prevention.

No additional impacts as a result of the Efficiency Upgrade are expected with regards to groundwater contamination in the mining areas.

Commitment 8
Alcoa commits to continue its mining operations under current approved guidelines as set out in its Five-year Mine Plan, including water monitoring and response procedures as defined in that plan.

6.13 RISK ASSESSMENT

Some process liquors containing caustic are at high temperatures and pressures. Some acids and flammable products are also stored and used at the refinery. All these materials represent a hazard to those who work at the refinery site, with the principal danger to personnel being burns. Spills of these chemicals may also present a hazard.

Alcoa operates a comprehensive safety standard that follows and expands on legislation requirements. Safety awareness is the key management tool and comprehensive inductions, on-the-job training, and training updates are given to both personnel and contractors and are a significant part of the operational effort. Further, incident reporting and analysis is intensive and ensures continual improvement of the safety program.

Finally there is a comprehensive emergency response plan for hazardous materials. The plan includes all aspects of incident management including safety, containment, cleanup and notification of authorities. Both personnel safety and environmental protection are considered in the plan.

As part of the Efficiency Upgrade, a risk assessment is undertaken during the detailed design and engineering stage (currently in progress) via the HAZOP (Hazard and Operability Study) processes. Risk is reduced to acceptable levels through engineering design and operating strategies. The Efficiency Upgrade will therefore not present an unacceptable risk to the construction and operation workforce, or the general public. Refer to Section 6.3 with regards to the Health Risk Assessment.

6.14 TRAFFIC AND TRANSPORT

Construction employees will travel to the site daily as there will be no onsite accommodation provided at the refinery. Alcoa anticipates a peak workforce of up to 1,000 people during the construction

period, and the companies providing services are likely to be based mostly in Perth or Kwinana. It is anticipated that employees will commute mostly from locations south of Perth, possibly Mandurah and Rockingham, and some may elect to stay in rented accommodation in Pinjarra or other locations. These employees are likely to use established high volume transport routes. Alcoa will work with construction contractors to minimise traffic impacts during construction.

All increased alumina production resulting from the Efficiency Upgrade will go to Bunbury. The length of the existing trains will be increased from about 38 wagons to 44 or 46 wagons, but there are not expected to be any additional trains. An additional six to eight wagons per train is not expected to result in a significant delay at crossings. Management of noise from additional wagons is discussed in Section 6.5.6.

The volume of caustic to be transported by rail to the refinery will increase by one or two caustic trains per week, although the exact configuration is yet to be determined. The final caustic schedule will be determined after analysis of existing haulage capacity and the most efficient way to cater for increased consumption at the Pinjarra refinery.

6.15 MONITORING AND REPORTING

Alcoa is required to report the environmental performance of its operations against environmental management commitments. There is already a well established monitoring program covering air and water, noise, flora and fauna, land, energy, dust, which will only require minor modification to cater for the upgrade.

6.15.1 Water Monitoring

Annual reporting is incorporated with reporting requirements for water-related issues, such as surface water and groundwater quality and total volumes of water drawn. The Annual Report includes, as a minimum:

- Volume of water diverted by Alcoa from the various sources during the reporting period;
- Volume released downstream from diversion points (including excess winter flow releases & environmental releases);
- Surface water and groundwater quality data;
- Refinery Water Inventory for that year;
- Adverse trends or unexpected performance noted;
- Breaches of operating strategy and corresponding remedial actions;
- Evaluation of water efficiency and initiatives;
- Rainfall data;
- Review of compliance with WRC Surface and Groundwater Licence conditions; and;
- an outline of any likely changes to the refinery water requirements / operational strategy for the next reporting period.

There is also a Triennial Aquifer Performance Review submitted to the DoE. Alcoa commissions a groundwater professional to produce an independent assessment of the effects of the refinery's draw on the underground resources and an assessment of the monitoring program. This assessment is prepared in accordance with the "Water and Rivers Commission guidelines for Hydrological Reports and Groundwater Monitoring Reports Associated with a Groundwater Well License", and reports on the following:

- The monitoring data compiled to the time of reporting.
- An assessment of the affects of the licensee's draw on the underground water resources of the area as determined from the monitoring data.
- An assessment of the monitoring program and recommendations for any desirable changes to the program.

A summary of Alcoa's monitoring programs are presented below, the results of which are presented as part of the company's annual reporting requirements.

6.15.1.1 Groundwater

A groundwater monitoring program provides early identification of areas of possible contamination, and information on the impacts of groundwater extraction.

There are about 700 water monitoring bores at Pinjarra refinery. About 320 are monitored six-monthly for groundwater level, pH and conductivity (EC). These bores are also monitored annually for alkalinity, Na/Cl ratios and other parameters. Twenty-four of the bores have been selected (in consultation with DoE) for annual reporting to DoE in March of each year. These bores are sampled for pH, Ec, alkalinity, sodium, magnesium, calcium, potassium, chloride, sulphate, bicarbonate, carbonate, nitrate, total cations, total anions, Ionic Difference, Na:Cl ratio, total iron, silica, cadmium, lead, copper, manganese, zinc, selenium, arsenic, chromium, mercury and fluoride.

Production bores are monitored monthly for determination of water level plus annual sampling for assessment of quality. No change to monitoring of groundwater is proposed as part of the Efficiency Upgrade.

6.15.1.2 Surface Water at the Mine

Alcoa's Environmental Management Manual describes the water monitoring programs at the mine and includes monitoring at three levels:

- Automatic turbidity measurement downstream of the mining operations but upstream of neighbours and storage reservoirs (including North Dandalup, South Dandalup and Conjurunup Creek Dams) that supply water to the public (these are known as compliance monitoring points). Reporting limits have been agreed with the Water Corporation who operate the dams in these catchments, but are not part of a licence.

- Upstream from the compliance monitoring points are a number of local monitoring points. These are selected to provide short-term information on the performance of the drainage infrastructure of the mine, and are typically located in streams below haul road crossings, or below a series of large mine pits. Monitoring at these points uses the same type of automatic turbidity measuring equipment.
- Turbidity control structures around the mine are inspected daily during rainfall periods in summer and winter to ensure they are operating effectively. In addition, all Huntly employees are aware of the importance of turbidity management and report to management any issues of concern.

Background monitoring of surface water quality has already commenced for the McCoy crusher region with one monitoring station located on Big Brook above the Serpentine Dam and a second downstream from the crusher location.

Water Monitoring at the mine will continue as managed at present and as specified and approved in the Five-year Mining and Management Program. There will be no changes required as a consequence of the Efficiency Upgrade.

6.15.1.3 Surface Water at the Refinery

Surface water monitoring programs are designed to identify any contribution by refinery and/or residue related activities to contamination of water discharged from the Alcoa property boundary. Monitoring points upstream and downstream of operating areas provide data that distinguish, to some degree, between contamination from farming and refinery/residue activities. DoE licence conditions reflect this distinction.

Twenty-three surface water stations are monitored: nine along Barritt Brook; six along Oakley Brook; two on the Murray River; one at Lake Kulinup; four in the Residue Disposal Area; and one in the Water Storage Lake. Flow data are obtained from V-notch weirs. Each weir is equipped with a data logger to record the flow, and some also record conductivity and temperature.

Surface waters are spot sampled for pH, Ec, alkalinity, sodium, magnesium, calcium, potassium, chloride, sulphate, bicarbonate, carbonate, nitrate, total cations, total anions, Ionic Difference, sodium to chloride ratio, total iron, silica, cadmium, lead, copper, manganese, zinc, selenium, arsenic, chromium, mercury and fluoride.

The existing surface water management program for the refinery will continue to be implemented throughout the construction and operation of the Efficiency Upgrade.

6.15.2 Rehabilitation Monitoring

Alcoa have an ongoing rehabilitation monitoring program that monitors the re-establishment of native species and the return of native fauna to rehabilitated mining areas.

Rehabilitated pits are monitored at 9 and 15 months to determine eucalypts and legume, and weed density, as well as species richness. Completion criteria have been developed and endorsed by stakeholders, and are used to determine when the land has been successfully rehabilitated and can be handed back to State Government control.

Fauna monitoring is conducted to assess impacts of operations on fauna of surrounding areas or to assess the rates of recolonisation following minesite rehabilitation.

Rehabilitation monitoring will continue and will include monitoring of additional areas rehabilitated as part of the Efficiency Upgrade.

6.15.3 Air Quality at the Refinery

Alcoa conduct ambient air quality and air emission source monitoring at the Pinjarra refinery. Some of this monitoring is required to be conducted as specified in the environmental licence for the Pinjarra refinery, whilst other monitoring programs have been developed on a voluntary basis to assist Alcoa with air quality management and continuous improvement.

Alcoa's existing ambient monitoring program includes a network of ambient particulate monitoring sites located at the Pinjarra racecourse and around the perimeter of the refinery process area and RDA. Alcoa conduct ambient particulate monitoring for total suspended particulates (TSP) and particulates less than 10 μm (PM_{10}).

Alcoa also has an existing comprehensive air emissions monitoring program for the Pinjarra refinery which includes:

- monthly stack testing of the Calciners, Oxalate kiln and Powerhouse boilers for emissions of products of combustion (i.e. NO_x, SO_2 and CO);
- quarterly isokinetic stack testing of Calciners, Oxalate kiln, and Alumina Leach Dryer for emissions of particulates;
- continuous dust concentration meters installed on each of the Calciners; and
- ongoing campaign monitoring of total VOCs, and aldehydes and ketones to improve understanding of key emissions sources.

These existing ambient air quality and air emissions monitoring programs will continue for the Efficiency Upgrade.

To assist with the air quality assessment for the Efficiency Upgrade, Alcoa has installed three ambient gaseous monitoring sites located to the northeast of the refinery on the elevated terrain of the Darling Scarp, at the Pinjarra racecourse, and to the northwest of the refinery in-line with the Carcoola town site, as indicated in Figure 12. Ambient concentrations of NO_x and CO are measured at each of these sites. The results of this monitoring will be used to validate the accuracy of the model predictions applied in the air quality assessment. As the concentrations of NO_x and CO are predicted to be well

within the relevant ambient air quality guidelines at these locations (refer to Section 6.3.4.2), ongoing monitoring is unlikely to be warranted, however this will be reassessed based on the monitoring results gathered.

In addition to the existing air emissions monitoring programs currently conducted at the Pinjarra refinery on a routine basis, Alcoa will develop a targeted emissions monitoring program as part of the Efficiency Upgrade that will:

- confirm the reductions in emissions achieved as a result of the installed pollution control equipment, and verify that performance guarantees provided by pollution control equipment suppliers are achieved;
- provide additional emission monitoring data to further characterise and improve the understanding of atmospheric emissions, and to refine the health risk assessment of air emissions from the Pinjarra refinery; and
- form the basis for an ongoing targeted source monitoring program for major emission sources throughout the Pinjarra refinery.

6.15.4 Noise

Noise from the refinery is monitored on an annual campaign basis to verify the effectiveness of noise control measures, and monitor the potential for noise from the refinery to cause a disturbance (Section 6.5.2). This will continue following commissioning of the upgrade.

Blast noise levels from mining operations are monitored in potentially sensitive locations using portable monitors. The main blast is preceded by a pilot shot and if adverse noise levels are recorded, the blast is postponed. Real time monitoring of mobile equipment noise is undertaken at the selected private properties (refer to Section 6.5.1), and will continue during the Efficiency Upgrade.

6.16 DECOMMISSIONING

Mine site decommissioning and rehabilitation is undertaken on a progressive basis and will be in accordance with the Five-year Mine Plan active at the time, and the scope of the 25 year mine plan. The Efficiency Upgrade will not result in any changes to minesite rehabilitation and decommissioning other than bringing forward the timing of the current Five-year Mine Plan, and increasing the rate of rehabilitation in proportion to the rate of clearing.

Pinjarra refinery decommissioning is not expected to occur for at least another 45 years. Under current conditions and requirements the key factors in decommissioning are proposed to be as shown in Table 18, which are not expected to change as a result of the proposed Upgrade.

Table 18: Main Features of Decommissioning of the Pinjarra Refinery (Current Scenario)

Part of Operation	**Proposed Decommissioning Action**
Mine sites	Progressively rehabilitated to native Jarrah forest throughout the life of the project.
Conveyor	Conveyor system superstructure will be removed and the corridor will be rehabilitated.
Major parts of plant	Salvaged where practicable. Non-salvageable material may be disposed of as scrap or taken to landfill.
Foundations and underground pipe-work, etc.	Will be removed to landfill or broken up and buried on-site (subject to approval). The land will then be returned to the agreed land use.
Power lines	Unless required for some other purpose, these will be removed and the line tracks rehabilitated.
Access tracks	Unless required for future management, tracks will be rehabilitated.
Water supply reservoirs	As these do not adversely affect the downstream environment, they will remain intact for future use, unless Alcoa is required by stakeholders to remove them.
Bores (water extraction and monitoring)	Bores will remain in place to permit long-term monitoring of groundwater.
Residue Disposal Area	Rehabilitated once dry and returned to the agreed land use. Seepage monitoring and recovery may continue for a time post-closure.
Areas of soil and groundwater contamination	Remediated and rehabilitated to the agreed land use.

For each of the above areas Alcoa is developing strategies for decommissioning, although, by necessity, these are mainly broad principles. This is because of the long operational life of the project and the inevitable changes to statutory requirements and social expectations that will occur over such a long period. The plans are being developed in consultation with relevant government agencies and the community and will be updated regularly as a response to changing expectations. Alcoa has set aside a decommissioning provision to finance those parts of the decommissioning program that must be left until later in operational life.

7. SOCIAL ISSUES AND MANAGEMENT

7.1 COMMUNITY CONSULTATION

Consulting with the local community and key stakeholders helps Alcoa to understand and respond to community expectations, and accordingly Alcoa values the input of the communities neighbouring its facilities.

Alcoa currently consults the community and provides information on environmental and other matters in relation to the refinery, through a Community Consultation Network (CCN), community meetings, local council deputations, presentations, mail outs, environmental reports, annual reviews and bi-monthly newsletters.

Meaningful and effective community consultation is a critical part of planning and implementing the Efficiency Upgrade of the Pinjarra alumina refinery. Alcoa has adopted a participation framework which provides a mechanism for Alcoa, the local community and other interest groups to consider environmental, social and economic management initiatives associated with the project.

This participation framework supports the EPS process, under the *Environmental Protection Act* 1986 (as amended), which provides for consultation with key stakeholders and the wider community during the planning and implementation stages of a project. The consultation includes community input into the assessment of environmental and social impacts and the interactive development of environmental and social initiatives for a project.

Alcoa has commenced this through the development of a comprehensive consultation and engagement framework that centres around the establishment of a Stakeholder Reference Group (SRG), formed to specifically consult on the Pinjarra Efficiency Upgrade, and which builds on the existing CCN established for the Pinjarra refinery.

Alcoa established the Pinjarra CCN in 1994 to foster a collaborative approach to managing issues of interest to stakeholders. The SRG was established in September 2003 to provide regular input into the development of the economic, environmental and social issues associated with the proposed upgrade and the development of the EPS document for this project. The CCN and the SRG form part of a broader consultation program that is outlined below.

7.1.1 Consultation Program

Alcoa has developed a consultation and communication strategy that includes identification of stakeholders and their potential interests and the activities required to meaningfully engage these interested parties in the consultation process. The consultation program is designed to:

- Brief stakeholders on the project and the associated key environmental issues, along with initiatives being developed to minimise these environmental impacts.

- Seek stakeholder input into the environmental, social and economic aspects of the proposed upgrade.

- Provide Alcoa with a forum for collaboration with stakeholders.

7.1.1.1 Stakeholder Identification

Key stakeholders for the Pinjarra refinery Efficiency Upgrade were identified through Alcoa's current community interactions within the Shire of Murray and the Peel Region along with a broader process to identify stakeholder interest in the project. The stakeholder analysis identified a wider network of stakeholders that would need to be involved in planning and development of the proposed project. Stakeholders such as Perth-based environmental groups were identified and included in consultation activities.

Groups identified and consulted during the preparation of this EPS were broad ranging and included Commonwealth, State and Local Government; Government departments; Shire of Murray committees; local residents from areas including Pinjarra, Dwellingup and North Dandalup; local business associations; environmental groups, local Members of Parliament and Pinjarra refinery employees (management, general workforce, unions) (Table 19).

Table 19: Identified Stakeholders

Group	Stakeholder	Location of Consultation
Local Government	Shire of Murray	Pinjarra and Huntly
	City of Mandurah	Mandurah
	Shire of Waroona	Waroona Mundijong
	Shire of Serpentine-Jarrahdale	Mundijong
Government Departments	Department of Environment (DoE)	Mandurah Kwinana Perth
	Premier and Cabinet	Perth
	Department of Industry and Resources (DoIR)	Perth
	Environmental Protection Authority (EPA)	Perth
	Department of Health (DoH)	Perth
Government Departments (Con't)	Peel and Rockingham/Kwinana Health Services	Pinjarra
	Department of Conservation and Land Management (CALM)	Perth Dwellingup
	Department of Planning and Infrastructure (DoPI)	Perth
Shire of Murray	Local residents (Pinjarra, Carcoola, Ravenswood, Yunderup, Coolup, Dwellingup, North Dandalup	Pinjarra Dwellingup Mundijong
	Pinjarra Refinery Community Consultative Network	Pinjarra

Group	Stakeholder	Location of Consultation
	Pinjarra Refinery Neighbours	Pinjarra
	Huntly Minesite Neighbours	Dwellingup/ Huntly
	Murray Districts Business Association	Pinjarra
	Shire of Murray ratepayers association	Pinjarra
	Pinjarra Rotary Club	Pinjarra
	Local High Schools and Primary Schools	Pinjarra
Peel Region	Peel Economic Development Unit	Mundijong
	Peel Region Chamber of Commerce	Mandurah
	Peel Area Consultative Committee	Mandurah
	Peel Development Commission (PDC)	Mandurah
	Mandurah residents	Mandurah
Members of Parliament	Greens WA	South west
	Member for Murray Wellington	South west
	Member for Dawesville	South west
	Member for Mandurah	South west
	Minister for State Development	Perth
	Minister for the Environment	Perth
	Federal Member for Canning	
Member of Legislative Council	Members for the South West	South west
Environmental Interest Groups	Conservation Council	Perth
	WA Forest Alliance	Perth
	Wildflower Society of WA	Perth
Industry Groups	Chamber of Commerce and Industry (CCI)	Perth
	Australian Aluminium Council (AAC)	Perth
	Business Council of Australia	Perth
Unions	Australian Manufacturing Workers Union (AMWU)	Perth Pinjarra
	Australian Workers Union (AWU)	Pinjarra
	Communications, Electrical and Plumbing Union of Australia (CEPU)	Pinjarra
	Construction Forestry Mining and Energy Union (CFMEU)	Perth
Alcoa employees	Pinjarra refinery	Pinjarra
	Huntly & Willowdale mines	Huntly
	Corporate office	Booragoon

7.1.1.2 Communication Phases

During each phase of the project, key community consultation milestones have also been identified. The phases conducted to-date along with the consultation undertaken during each phase is outlined below.

Phase One – Pinjarra Efficiency Upgrade proposal announcement.

In conjunction with the State Government's announcement of support for a study into an Efficiency Upgrade of the Pinjarra alumina refinery, stakeholders were provided with

information regarding the project proposal and the potential benefits to the local community, the region and the state.

Phase Two – Alcoa's Sustainability Principles and new consultation framework

During phase two, stakeholders were provided with a project overview and Alcoa sought feedback about the project and the proposed outline and development of a stakeholder consultation process including the formation of the SRG. In response, Alcoa modified its consultation program to reflect this feedback.

Phase Three –formation of the Stakeholder Reference Group

Phase three of the project signified the formation of the project's key communications and consultation mechanism, the SRG. The SRG was established from a community workshop and became part of a framework including working groups and an expert review panel.

Phase Four – Updates and On-goings of the Stakeholder Reference Group

During phase four, fortnightly 'Upgrade Updates' have been provided on the workings and discussions of the SRG, including the progress of resolving outcomes around issues raised at the community workshop and documented in an 'Issues Register'. Updates have also been created to provide profiles on the SRG members, the interest group they represent and their contact details.

Phase Five – Beyond the EPS

Phase five will continue throughout the Environmental Protection Statement submission and assessment and through to the end of commissioning. The SRG will continue to meet regularly and the output of these meetings will continue to be published through 'Upgrade Updates', media releases, newsletter articles and other communication channels.

Appendix D shows the specific stakeholder groups contacted at each of the communication phases.

7.1.1.3 Consultation Activities

The consultation activities conducted to-date include the formation of a Stakeholder Reference Group, information meetings, community workshops, stakeholder specific briefings, presentations and the creation of many communication tools. Some of these activities are listed in detail below.

Stakeholder Reference Group

Through advertisements in local papers and by personal invitation to 160 stakeholders, members of the community were invited to attend an independently facilitated workshop aimed at determining the stakeholder participation framework for this project. At this workshop, 38 stakeholders representing a broad range of interests agreed the participation framework shown in Figure 22 and determined the interests to be represented on the SRG. Individuals were nominated by workshop participants to represent these interests.

The SRG comprises of 12 members who are representatives of the:

1. Local community and Pinjarra residents;
2. Farming community and Pinjarra refinery neighbours;
3. Pinjarra refinery workforce;
4. Local Government;
5. Pinjarra businesses;
6. Local education and training departments;
7. Indigenous Community;
8. Local Landcare groups;
9. Pinjarra refinery Community Consultative Network;
10. Department of Environment;
11. Department of Industry and Resources; and
12. Pinjarra Efficiency Upgrade project team.

Following the selection of representatives, the SRG developed the Group's terms of reference, scope of facilitation, and appropriate communication modes. The appointment of an SRG agreed independent facilitator to guide the process is an important aspect of the consultation process.

The participation framework is supported by working groups and an expert review panel. To date working groups have not been required however this opportunity will remain in place throughout implementation of the project. The roles and responsibilities of the SRG and various supporting groups are summarised below:

The SRG:

- considers economic, environmental and social issues associated with the Efficiency Upgrade;
- reviews mechanisms to manage identified issues (e.g. environmental impacts and social implications) and the advice of the Expert Review Panel;
- reviews key Alcoa draft documents submitted to environmental regulatory agencies;
- requests investigations and assessments via working groups; and
- assists in communicating information on the project and progress to other stakeholders.

The Working Groups:

- undertake specific investigations; and
- develop solutions to any issues identified.

The Expert Review Panel:

- provides independent expert advice;
- reviews documentation; and
- assesses technical issues referred to it.

The Alcoa Project Team:

- manages Alcoa's internal processes associated with the project;

- provides process and engineering technical input to the SRG, and
- considers options or suggestions regarding the project from the SRG.

The Independent Facilitator:

- guides the SRG through the participation process; and
- ensures the SRG process continues constructively within the scope and time limits.

Figure 23 shows a schematic diagram of the consultation structure and within the environmental assessment process.

Stakeholder Reference Group meetings

The SRG was formed in September 2003 and has met almost weekly since. The group initially focused on gaining an understanding of the current Pinjarra refinery operations and an overview of the project proposal. This included a site tour of the Pinjarra refinery with particular reference to the changes that would occur as a result of the proposed upgrade. Each week members discuss particular issues raised at the community workshop or report back on other issues or enquiries received from community members. These are captured on an issues register (see Appendix D) and worked through by discussion, presentations from technical experts and specialists, and agreed actions for resolution. Each fortnight a SRG 'Upgrade Update' summarizes the meeting outcomes and is published for key stakeholder groups and all residents of the Shire of Murray.

Community Consultative Network meetings

The Pinjarra refinery CCN meets on a bi-monthly basis and has been provided with three presentations on the proposed upgrade. One CCN member was nominated as a SRG member and provides the CCN with updates on the progress of the SRG discussions. The CCN has been very interested in the social and economic aspects of the project.

Briefings in the Peel Region

The Pinjarra refinery Manager and project representatives met with the Shire of Murray and the City of Mandurah, Peel Development Commission, Peel Area Consultative Committee, the Murray Districts Business Association, Peel Chamber of Commerce, State and Federal politicians, the Peel Economic Development Unit, the CCN and relevant state government departments within the planning, environment, health and industry sectors. Formal presentations made to each stakeholder group included:

- an overview of Pinjarra refinery's current and potential position in the global market;
- Alcoa's economic contribution to the local community and the State;
- an overview of the Pinjarra Efficiency Upgrade;
- diagrams showing structural changes to the Pinjarra refinery as a result of the proposed Efficiency Upgrade;

- benefits of the proposed project;
- community consultation and the process of stakeholder engagement;
- environmental assessment process; and
- a stakeholder and approvals implementation schedule.

Government Agency Briefings

Meetings were held with key government agencies to provide briefings on the project with opportunity for comment and input. Where appropriate this was conducted with both local based and Perth based departments, and is identified in Table 19. In many instances these government agencies were briefed on more than one occasion and both the DoE and the DoIR are represented on the SRG.

Government agencies, SRG members and politicians were also invited on a tour of the Pinjarra refinery site. The site visit included a description of the current operations and viewing of the areas within the refinery where new equipment would be installed as part of the proposed upgrade.

Community Information Displays

An Open Day information session was held in Pinjarra on the 22 October 2003 from 2:00pm to 7:00pm, to provide further information on the Pinjarra Efficiency Upgrade proposal. A notice was placed in the local Mandurah Mail and Coastal Times newspapers with the details of the Open Day and letters were sent to key stakeholders including refinery neighbours, Shire of Murray community committees, local and metropolitan government agencies and local members of parliament.

A display was also manned at the Pinjarra Fair from 9:00am until 4:00pm on Saturday, 1 November 2003. Hundreds of people, some from Kwinana, Harvey and Bunbury, attended the fair and viewed the display.

The display provided information on the Upgrade, a site layout and the proposed changes to the refinery footprint, the environmental approval process, current environmental impacts and proposals to minimise these impacts, current environmental technical modelling and monitoring techniques used. Alcoa's project team staff and the SRG members were on hand to answer questions and receive feedback. Contact sheets recorded community comments or issues raised.

Future displays are proposed over the coming months within the towns of Pinjarra, Dwellingup, and Mandurah. Displays will also be featured at each of the Alcoa sites at Pinjarra, Kwinana, Wagerup, and Bunbury.

Stakeholder Specific Briefings

Face to face meetings were conducted with the President and Chief Executive Officer of the Shire of Murray, the Mayor and CEO of the City of Mandurah, Members of the Legislative Assembly for the

Murray-Wellington, Dawesville and Mandurah electorates, the Federal member for Canning, the WA Conservation Council, the President of the Legislative Council and the Greens party.

Broad Consultation Activities

Activities to allow wider community consultation included:

- a telephone survey and focus groups in the local Pinjarra and Dwellingup communities to identify the level of community interest in Alcoa's operations in the region. Feedback on issues and levels of concern were used to develop a more targeted consultation process for the proposal.

- Announcements and media launches of the proposed project and the possible investment into the state of Western Australia;

- Advertisements in the local newspapers and 160 letters of invitation sent to Shire of Murray residents and key stakeholders in the Peel, South-West and Perth metropolitan region to attend a community workshop to establish the composition and representation of the SRG and workshop a list of community issues;

- Development of information packs for community consultation including fortnightly Pinjarra 'Upgrade Updates' and media releases, a stakeholder briefing document, newsletter articles and presentations;

- Development and distribution of fortnightly 'Upgrade Updates' to all residents of the Shire of Murray. Currently seven Updates have been produced and sent to key stakeholders and all residents within the Shire of Murray; and

- Consultation with Pinjarra employees and Pinjarra refinery management through electronic information, displays, newsletters, 'Upgrade Updates', presentations and focus groups.

Table D1 provided in Appendix D provides a detailed summary of the community consultation program activities carried out to date, the stakeholders consulted and the method of consultation.

Project updates and communication briefings will continue with the broader community at regularly scheduled meetings, focus groups and through local media, fact sheets, publications and presentations throughout the development and implementation of this proposed project.

7.1.2 Responses to Issues Raised

During the stakeholder consultation a broad range of issues were raised as shown in Appendix D (Table D2). Alcoa's response to the following issues is addressed in more detail below.

- Residue dust emissions;
- Air emissions and potential impact on health;
- Greenhouse gas emissions;
- Noise emissions;
- Socio-economic sustainability;
- Increased rate of mining and residue deposition;
- Water usage.

7.1.2.1 Residue Dust

Fugitive dust from the residue drying areas was identified as an issue by the community. Members of the SRG indicated they would like Alcoa to maintain, or improve, dust management following implementation of the Efficiency Upgrade (particularly from the RDA) by using best practice dust management.

Alcoa provided information on the dust control measures used, and on the monitoring network in place around the refinery and in Pinjarra town site. Information on the composition and particle size of the residue dust was also presented.

Whilst the footprint of the residue area would not change during the implementation of this project, new residue drying areas would be commissioned by 2006 as part of ongoing refinery operations. The new drying areas will add drying capacity as existing residue drying areas are progressively rehabilitated. Alcoa has committed to improving residue dust control measures (refer to Section 6.3.4.4.2).

In addition, Alcoa recognises that some members of the community are concerned about the potential health impacts from residue dust, and is undertaking a study into residue dust to better understand the particle size distribution and the composition of dust. This study, which was piloted summer 2002/2003, will be undertaken during the summer of 2003/2004, and the outcomes will be included in the consultation program, being established to support the review of the Long Term Residue Management Plan.

7.1.2.2 Air Emissions

Consultation showed that some people were concerned about potential health effects from air emissions, which they believed may increase as a result of the upgrade.

Alcoa committed to conduct a comprehensive assessment of the impacts of the upgrade, and to undertake a health risk assessment covering both the existing refinery operation and the upgraded refinery. The SRG reviewed the scope of these studies by specialist consultants, and decided that they would submit them to independent experts for review.

The air quality assessment was conducted by Sinclair Knight Merz Pty Ltd (SKM), and the results indicate that the atmospheric emissions from the upgraded refinery are predicted to remain well within the relevant ambient air quality guidelines (refer to Section 6.3.4). In addition, a quantitative health risk assessment of emissions was conducted by Dr Roger Drew of Toxikos Pty Ltd (Toxikos). The health risk assessment concludes that there is little likelihood of health effects being caused by exposure of the general public to atmospheric emissions from the Pinjarra refinery (refer to Section 6.3.6).

As part of the Efficiency Upgrade, Alcoa is proposing to install various items of air pollution control equipment, and also upgrade some of the existing air pollution control equipment to reduce emissions of VOCs, particulates and NO_x (refer to Section 6.3.8). As a result, both the air quality assessment and the health risk assessment also showed that the Efficiency Upgrade would result in a further improvement in air quality compared to the existing refinery.

The SRG commissioned independent expert reviews of the assessments conducted by SKM and Toxikos. Information on the findings of the expert reviews is presented in Section 6.3.7.

Copies of the reports prepared by SKM, Toxikos, and the expert reviews are provided in Appendix A (air quality assessment) and Appendix B (health risk assessment).

7.1.2.3 Greenhouse Gas Emissions

Greenhouse gas emissions were raised in discussion with the conservation movement, and the DoE. Alcoa's global operations have collectively achieved a 17.6% reduction (from the base year of 1990) in net greenhouse gas emissions. Alcoa's Western Australian operations are targeting a 17% reduction (from the base year of 1990) in the net greenhouse gas intensity of alumina production to be achieved by the year 2010. The Efficiency Upgrade will incorporate energy saving initiatives into the design in order to achieve an overall improvement in the greenhouse intensity (i.e. CO_2 emissions per tonne of alumina produced) of the Pinjarra refinery of approximately 5%. In addition, the refinery will use steam generated by the Alinta Cogeneration Project to replace steam produced by the less energy efficient refinery boilers, thereby further reducing greenhouse gas emissions (refer to Section 6.4.3). To ensure effective ongoing management of greenhouse gas emissions, Alcoa will develop a Greenhouse Gas Management Plan for the Pinjarra refinery (refer to Section 6.4.4).

7.1.2.4 Noise

During the consultation, some people, especially near neighbours, asked if the Efficiency Upgrade would result in more noise being generated by the Pinjarra refinery and associated activities such as rail transport.

In response, Alcoa has undertaken to ensure that specific noise control measures will be implemented during the Efficiency Upgrade. New production facilities such as the new mill, calcination blowers and seed filtration building will be constructed using the most effective noise control procedures and equipment (refer to Section 6.5.4). During normal refinery operation, the main sources of noise are

the powerhouse, calcinations blowers and electric pumps. Alcoa is required to adhere to the *WA Environmental Protection (Noise) Regulations 1997*. These regulations set the maximum acceptable noise levels received at sensitive receptors (e.g. residences). Noise emissions from the refinery are monitored on an ongoing basis, to confirm compliance of the Pinjarra refinery with the regulations, and to provide information on where improvements in noise control can be made.

Whilst only two complaints about refinery noise have been received during the last five years, Alcoa is aware that the refinery is audible under some weather conditions at neighbouring residences. Alcoa recently completed a major noise reduction program at the refinery, identifying specific sources that produce noises annoying to human hearing. As part of this noise control program, three large forced draft fans and six calcination blowers were upgraded using the current best practices in acoustic noise controls. This included installing silencing equipment, placing lagging around pipes and building sound barriers. Following the Efficiency Upgrade, noise levels will be monitored to ensure predicted levels have been achieved and are in compliance with the noise regulations.

There have been a number of complaints related to rail 'screech' at the tight rail curve heading north onto the main line at the Pinjarra town site, from laden bauxite trains travelling from Pinjarra to Kwinana. Alcoa is working with Westnet Rail (Alcoa's freight contractor) to find ways of reducing this noise, including improvements to the rail track, installing a grease pot which automatically lubricates the curve on the passage of the train, the use of mobile lubrication on a weekly basis, and operating the trains at low speed as well as regular maintenance and track inspections.

The Efficiency Upgrade will not result in changes to the number or frequency of bauxite trains to Kwinana. All additional alumina produced from the Efficiency Upgrade will be railed to Bunbury. The maximum number of alumina trains per day as a result of the Upgrade is unlikely to change. To cater for the additional tonnage it is anticipated an extra six to eight wagons will be added to each existing train. The additional wagons are not expected to significantly increase noise emissions but may extend the passage of trains by a few seconds. Caustic is delivered to the refinery by rail and the upgrade may increase the number of caustic rail movements south (refer to Section 4.2.1).

7.1.2.5 Socio-economic Sustainability

The SRG has indicated that the key socio-economic issue they would like addressed is to ensure more support of local businesses by Alcoa. The Efficiency Upgrade will provide up to 1,000 jobs during the construction phase and local businesses will be used where appropriate during construction and implementation of the project. Alcoa also has a number of ongoing community projects and internal policies and goals (refer to Sections 5.8 and 7.2) to support local business development, and provide training and skills development. These projects will continue during the Upgrade.

7.1.2.6 Rate of Mining and Residue Deposition

Increased rate of mining and production of bauxite residue are issues that were also raised by the SRG. Information was provided to the group to explain the changes that will occur as a result of the upgrade.

An additional 30 hectares per year will be cleared for mining to provide ore for the upgraded refinery. This will be offset by an additional 30 hectares of rehabilitation undertaken per year to ensure that uncleared areas are kept to a minimum. Mining will continue at Huntly mine following the current approved Five-Year Mine Plan, although the timing of the plan will be brought forward by one year. However, the total area planned to be cleared over the life of the mine will not change as a result of the Efficiency Upgrade, although based on estimates, the total life of mine will be reduced by about five years. Assessment and management of the impacts from mining, and mining approvals are undertaken through the Mining and Management Program Liaison Group (MMPLG), which consists of government representatives from DoIR, DoE, CALM and the Water Corp (refer to Section 3.1).

Storage of residue to the drying areas will continue within the framework of the Long Term Residue Management Plan (LTRMP). Long-term plans are reviewed and endorsed by a committee called the Residue Planning Liaison Group (RPLG) which consists of representatives from the DoIR, DoE, Department of Planning and Infrastructure, Department of Agriculture WA, Peel Development Commission, and CALM as well as Alcoa. The RPLG and the Minister for Environment endorse the LTRMP. The Efficiency Upgrade will result in some of the steps in the plan being brought forward. For instance a reconfiguration of the drying bed areas that was planned for 2007 will now be needed in 2006. The SRG were keen to understand the process of developing the next LTRMP, and how they will be given opportunity to participate. Alcoa presented information on the proposed process to the group who were keen for this process to get underway (refer to Sections 4.2.4 and 6.11.2.2).

7.1.2.7 Water Use

The SRG expressed concerns over the potential impact of abstraction of groundwater on the water table on adjacent properties, and potentially reduced surface flows from increased use of surface water for the Efficiency Upgrade. The SRG also requested implementation of best practice water conservation measures.

The Pinjarra refinery uses over 6,000 ML of water each year. The refinery takes its water supply from groundwater and surface water sources. Groundwater allocation is abstracted from five production bores while the surface water is taken from three dams. The refinery also uses treated sewage water from the Pinjarra township waste water treatment plant. At the refinery, water is used to dilute caustic for use in the refinery process and to wash residue sand and mud to recover caustic for recycling. It was explained to the group that the newest of the surface water dams was designed to harvest water during peak flows in winter when a large pump is used. The weir bypasses significant flows to ensure that environmental water requirements are met. This strategy has enabled Alcoa to reduce its demand for groundwater to within the sustainable yield in years where surface water runoff is sufficient. In drought years such as 2001, Alcoa is required to apply for an additional groundwater allocation.

As part of its water conservation strategy in Western Australia, Alcoa is seeking to achieve a 20% reduction in the use of high-grade water by 2005. The refinery Efficiency Upgrade will result in an increased water demand of approximately 1,100 ML. The use of low-grade water from the Mandurah

sewerage treatment plant is being investigated as one option for water supply for the Efficiency Upgrade, although other options are also being investigated (refer to Section 6.10.5).

Alcoa will continue to implement water conservation measures to achieve its goal of a 20% reduction in water consumption by 2005. Alcoa will also continue its groundwater and surface water monitoring programs required as a part of Alcoa's licence conditions (refer to Section 6.15), which extend to adjacent properties.

7.1.3 Ongoing Consultation

The SRG process will continue beyond environmental approval. There are many issues which, whilst not directly relevant to the environmental assessment of the project, are important to the community. Alcoa has committed to maintain the consultation process and the supporting framework, which includes the expert review panel, working groups and broader consultation.

Commitment 9
Alcoa will continue to support stakeholder participation through the Stakeholder Reference Group and supporting framework, and will incorporate advice into the Efficiency Upgrade, until the project is commissioned.

7.2 SOCIO-ECONOMIC

Some of the socio-economic issues raised during consultation with the SRG and the wider community include:

- Employment opportunities;
- More support of local businesses;
- Improved business liaison with Alcoa; and
- Impact of the project on lifestyle and land values.

The Western Australian State Sustainability Strategy outlines a vision for sustainability in Western Australia and Alcoa has reflected this in its own sustainability principles. In undertaking the Efficiency Upgrade, Alcoa wants to ensure it is contributing to outcomes that deliver a net benefit to the local community. As the project will be designed and implemented in line with these principles the Efficiency Upgrade is not expected to have any negative impact on lifestyle, or property values.

Economically, if Alcoa is able to ensure the long-term viability of the Pinjarra refinery, it will deliver long-term local economic benefits: both directly through employment and local contracts and indirectly through multiplier effects of this employment and contracts.

Currently the company directly employs nearly 5,000 people and contributes around A$1.1 billion each year to the State's economy. The Upgrade will provide a peak of 1,000 jobs during construction,

and see a direct investment of $440 million. Alcoa will also support local businesses where possible throughout construction and operation of the project.

Sustainable outcomes achieved will be far greater if partnerships are formed with government, business and community on proposed initiatives. Alcoa wants to work with the local community to identify new opportunities for contributing to the social and economic development of the local community. Alcoa will also align additional investment (financial and in-kind) initiatives to support economic development in local communities.

Commitment 10
Alcoa commits to apply its procurement policy to ensure that opportunities for local spending are explored and taken where commercially appropriate.

7.2.1.1 Company Initiatives

Alcoa has a range of community initiatives that support economic, social and environmental development. Over the 30 years in the region, Alcoa has supported and sponsored an extensive range of community, social and environmental projects. These include the provision of: High School scholarships for 'Future Women of Industry'; around 25 vocational, apprenticeship and other training positions per year; funding of TAFE training places in horticulture and training and leadership programs at Fairbridge Village; contract arrangements that include the use of local employees and local suppliers where practicable; workshops on the Alcoa procurement process and tendering systems; over $1 million for community-based Landcare activities in the Peel-Harvey catchment, research into advanced farming and forestry; and funding for infrastructure projects such as the Alcoa Murray Library and the Bedingfield aged care facility.

Alcoa is heavily involved in technical and environmental research and development that directly benefits the region and spends more than A$20 million a year in Western Australia on these activities which include: mine and residue rehabilitation; dieback disease management; Landcare; aquaculture; advanced farming techniques and forestry in partnerships with the University of Western Australia, Curtin University of Technology and Murdoch University. Western Australia is also host to Alcoa's global bauxite and alumina research and development efforts

Alcoa employees also provide a wide array of voluntary effort to the local communities and this is recognised corporately by Alcoa. Three key schemes provide the opportunity for Alcoa employees to contribute to the local community:

1. **PEACH (Personnel Employed by Alcoa Charity Help)** is an employee based volunteer charitable trust dedicated to maximising the collection of funds for charity from Alcoa's West Australian employees and distributing these funds to a wide range of human care agencies in Western Australia. PEACH donates funds to a diverse range of organisations, from large public hospitals and research institutions, through to small support groups, all of which play an important role in the community. Funds have been provided for clinical research; hospital

services and medical equipment; health support services and facilities for the sick, the frail and the disabled, welfare support services for family and single parent support groups; young people at risk; and safety and emergency services. **PEACH** has been in operation since 1979 and over 1,400 Alcoa employees have donated in excess of $1.5 million to over 200 community organisations in that time.

2. ACTION (Alcoans Coming Together in Our Neighbourhoods) is a company sponsored employee engagement program. The program is managed by the Alcoa Foundation which is independent to the company. The grants recognise group volunteer initiatives involving at least 10 active full-time employees volunteering for at least 4 hours at qualified non-profit organisations. The community organisation receives US$3,000 for the employees' efforts.

3. Bravo! When Alcoa employees volunteer at least 50 hours of community service during a calendar year to a charitable organisation, Alcoa provides financial support to that organisation. Eligible employees may apply through the Alcoa Foundation for one US$250 grant per year for one organisation. Qualifying organisations include non-profit, health, social welfare, educational, cultural or community organisations.

Under the recently initiated sponsorship banner of 'Partnering Stronger Communities' Alcoa will continue forming partnerships and undertake a range of sponsorships designed to strengthen communities. Alcoa believes that partnerships with other business, government authorities or community groups are more sustainable over the long-term. Key elements of this strategy include:

- helping communities to find solutions through joint projects,
- undertaking additional support, such as in-kind and volunteers, rather than simply offering financial support, and
- focusing on a shared commitment to making local communities a better place to live and work.

The Alcoa Research Centre for Stronger Communities is the flagship for Alcoa's community partnership program. Based at Curtin University of Technology in Western Australia, the Centre evolved from discussions about the need to strengthen communities in line with international trends. It supports Alcoa's drive to build community capacity and to undertake joint research projects relevant to both the local neighbouring communities and the company.

An example of a strong community partnership is Alcoa's association with Fairbridge WA, which aims to provide life skills, and training and employment opportunities so young people can reach their full potential. Fairbridge is a registered training organisation and develops courses and provides on the job accredited training in all aspects Fairbridge Village's operations. Located just north of the Pinjarra refinery, Fairbridge's activities include hospitality, building and maintenance, tourism, reception and administration, Landcare and outdoor recreation. One program, the Alcoa Landcare Traineeship offers six training places for young people to take Certificate II in Horticulture through TAFE. The activities of the trainees have resulted in local landscaping, and recreational walk trails

around the areas of Fairbridge Village and the Pinjarra refinery. Alcoa has provided almost $2 million to support restoration and infrastructure development at Fairbridge, and to partner with State and Federal Government agencies in delivering programs for young people. Alcoa supports the governance and management of Fairbridge with two company representatives on the Association's Board of Governors.

7.3 VISUAL AMENITY, RECREATION, TOURISM AND AESTHETICS

There will be no changes to visual amenity at the mine site as a result of the proposed Upgrade, other than those already addressed in the Five-year Mine Plan.

The changes to plant and equipment at the Pinjarra refinery are relatively small in size compared to the existing plant. There will be one additional calciner stack similar to those existing, installed as part of the Efficiency Upgrade and therefore should be only minimal change in visual amenity.

The issue of increased light spill from the refinery was raised during consultation. A design approach including the use of lower wattage lamps will be applied to minimise the light spill from the upgraded refinery. It is expected that less than 7% extra lighting will be required and with some of the additional light being inside enclosed buildings the overall impact of the additional lighting from the Efficiency Upgrade is not expected to be noticeable.

Recreation, tourism and aesthetics in the Huntly area, and in Pinjarra and nearby regions, will not be altered by the proposed Efficiency Upgrade.

7.4 CULTURAL HERITAGE

Areas of actual or potential cultural heritage at Alcoa mine sites are strictly avoided in development of the Five-year Mine Plan.

There are no cultural heritage sites in the immediate vicinity of the existing refinery and none regionally that would be affected by the Upgrade.

8. CONCLUSIONS AND PROPONENT COMMITMENTS

8.1 CONCLUSIONS

The Pinjarra Refinery Efficiency Upgrade will be undertaken within Alcoa's Sustainability Framework and in line with the company's Sustainability Principles. The Efficiency Upgrade offers the opportunity to:

- increase alumina production primarily using existing infrastructure;
- reduce volatile organic compounds (VOC's) released to the atmosphere;
- reduce particulate emissions released to the atmosphere from the calciners;
- reduce dust from the residue area;
- reduce the energy intensity per tonne of alumina produced and therefore improve greenhouse gas emission intensity;
- offset the increase in general refinery oxides of nitrogen (NO_x) emissions by installing low NO_x burners in the power station;
- reduce carbon monoxide emissions from the oxalate kiln; and
- generate employment through a construction workforce of up to 1,000 people.

Alcoa believes that the Efficiency Upgrade of the Pinjarra refinery will result in net environmental, economic and social benefits to the local and regional community and the State as a whole.

8.2 LIST OF ENVIRONMENTAL COMMITMENTS

In undertaking the Efficiency Upgrade of the Pinjarra refinery, Alcoa makes the commitments detailed in Table 20.

Table 20: Alcoa Commitments for the Pinjarra Refinery Efficiency Upgrade

Category	Topic	Potential Impact (Section of EPS)	Proposed Management Commitment	Timing	Advice From
General Environmental Management	Sustainability Principles	6.1	Commitment 1 Alcoa will be guided by its sustainability principles and will operate within the guidelines of its Environmental Management System (EMS) at all stages of the Pinjarra refinery Efficiency Upgrade.	Ongoing throughout project implementation and operation	SRG / CCN
Air quality	Air emissions	6.3	Commitment 2a Alcoa will install air pollution control equipment at the Pinjarra refinery to achieve: • a reduction of about 10% in VOC emissions; • a reduction of about 25% in particulate emissions from the calciners; • a reduction of over 90% in CO emissions from the Oxalate kiln; and • an offset of the increase in general refinery NO_x emissions by installing low-NO_x burners in the power station.	Construction and operation	SRG / CCN Alcoa Inc - 2020 Global Environmental Strategy
Air quality	Fugitive Dust	6.3.4.4	Commitment 2b Alcoa will improve the management of dust from residue areas through an upgrade of the existing sprinkler network and other operational controls consistent with the Long Term Residue Management Plan which will be revised in consultation with the community.	Construction and operation	SRG / CCN

Category	Topic	Potential Impact (Section of EPS)	Proposed Management Commitment	Timing	Advice From
Air quality	Fugitive Dust	6.3.4.4	Commitment 2c Alcoa will undertake a study of its residue dust to better understand its particle size distribution and composition.	Commencement during the 2003/2004 summer	DoE
Air quality	Air dispersion modelling	6.3.8	Commitment 2d An air dispersion model validation study will be completed to assess the performance of available models with respect to predicting air quality impacts from the upgraded Pinjarra refinery. The temporary ambient gaseous air pollutant monitoring network will continue to be operated for a period of time as part of the air dispersion model validation study.	Prior to commissioning of Efficiency Upgrade	DoE
Air quality	Monitoring	6.3.8	Commitment 2e An ongoing targeted source monitoring program will be carried out at the Pinjarra refinery to further characterise and improve the understanding of atmospheric emissions from the refinery.	Operation	DoE and SRG / CCN
Greenhouse gases	Emissions intensity	6.4.3	Commitment 3a Alcoa will achieve a reduction in the greenhouse gas emissions intensity of the Pinjarra refinery as a result of the Efficiency Upgrade of approximately 5%.	Operations	SRG / CCN Alcoa Inc - 2020 Global Environmental Strategy
Greenhouse gases	Energy efficiency	6.4.4	Commitment 3b Alcoa will review opportunities to improve the energy efficiency of equipment to be installed as part of the Efficiency Upgrade during the detailed design phase of the project using a Cleaner Production review process.	Design phase	SRG

Category	Topic	Potential Impact (Section of EPS)	Proposed Management Commitment	Timing	Advice From
Greenhouse gases	General	6.4.4	Commitment 3c Alcoa will maintain ongoing involvement in programs such as the Greenhouse Challenge and Generator Efficiency Standards programs, community initiatives, and research and development, that contribute to the management of the global climate change issue.	Ongoing throughout project and ongoing operations.	DoE
Noise	Noise-mining operations	6.5.1	Commitment 4a Alcoa will ensure that noise from mining operations continues to comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* as a result of the Efficiency Upgrade.	Ongoing throughout life of mine	Agencies involved in development and implementation of the Five-year Mine Plan. Immediate neighbours
Noise	Noise-refinery	6.5.2	Commitment 4b Alcoa will ensure that noise from the refinery continues to comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* as a result of the Efficiency Upgrade.	Ongoing throughout project and ongoing operations.	DoE
Noise	Noise monitoring-refinery	6.5.5	Commitment 4c Alcoa will prepare a noise management plan for this project, which will outline how compliance with the *Environmental Protection (Noise) Regulations 1997* will be maintained. The noise management plan will include a monitoring program at the nearest receptor locations to the north and south to demonstrate compliance with Commitment 4b.	At commencement of operation of Upgrade, then as required.	DoE

Category	Topic	Potential Impact (Section of EPS)	Proposed Management Commitment	Timing	Advice From
Flora, Vegetation and Fauna	Mining Impacts	6.6	Commitment 5 Alcoa will operate within the guidelines of its current approved Five-year Mining and Management Program to supply ore for the Efficiency Upgrade, although the timing of the Plan will be brought forward by about one year. The annual rehabilitation program will be adjusted in subsequent years to include rehabilitation of the additional area which will be mined each year.	Throughout the life of the Mine	Agencies involved in development and implementation of the Five-year Mine Plan. Immediate neighbours
Water Use	Stream protection	6.10.2	Commitment 6a Alcoa commits to ongoing protection of the Oakley and Barritt Brooks by ensuring that downstream Environmental Water Requirements (EWR) continue to be met.	Ongoing throughout operations	SRG / CCN and DoE
Water Use	Water conservation	6.10.4	Commitment 6b Alcoa will continue to implement water conservation initiatives to achieve its water use reduction goal.	Ongoing throughout operations	SRG / CCN and Alcoa Inc - 2020 Global Environmental Strategy
Water use	Protection of water resources	6.10.5	Commitment 6c The refinery will continue to use best practicable technology to conserve water, and ensure no adverse environmental impacts will result from the supply of water for the upgrade.	Ongoing throughout operations	SRG / CCN and DoE
Waste Management	Residue management	6.11.2.2	Commitment 7 Alcoa will manage the bauxite residue generated from the Efficiency Upgrade in accordance with Pinjarra refinery revised Long-term Residue Management Plan (LTRMP).	Ongoing	SRG / CCN and Residue Planning and Liaison Group

Category	**Topic**	**Potential Impact (Section of EPS)**	**Proposed Management Commitment**	**Timing**	**Advice From**
Surface Water	Impacts from mining	6.12.3	Commitment 8 Alcoa commits to continue its mining operations under current approved guidelines as set out in its Five-year Mine Plan, including water monitoring and response procedures as defined in that plan.	Throughout the life of the Mine	Agencies involved in development and implementation of the Five-year Mine Plan. Immediate neighbours
Community consultation	Community involvement	7.1.5	Commitment 9 Alcoa will continue to support stakeholder participation through the Stakeholder Reference Group and supporting framework, and will incorporate advice into the Efficiency Upgrade, until the project is commissioned.	Throughout construction and operations	SRG / CCN
Socio-economics	Local business support	7.2	Commitment 10 Alcoa commits to apply its procurement policy to ensure that opportunities for local spending are explored and taken where commercially appropriate.	Throughout construction and operations	SRG / CCN

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10. GLOSSARY

Abbreviations

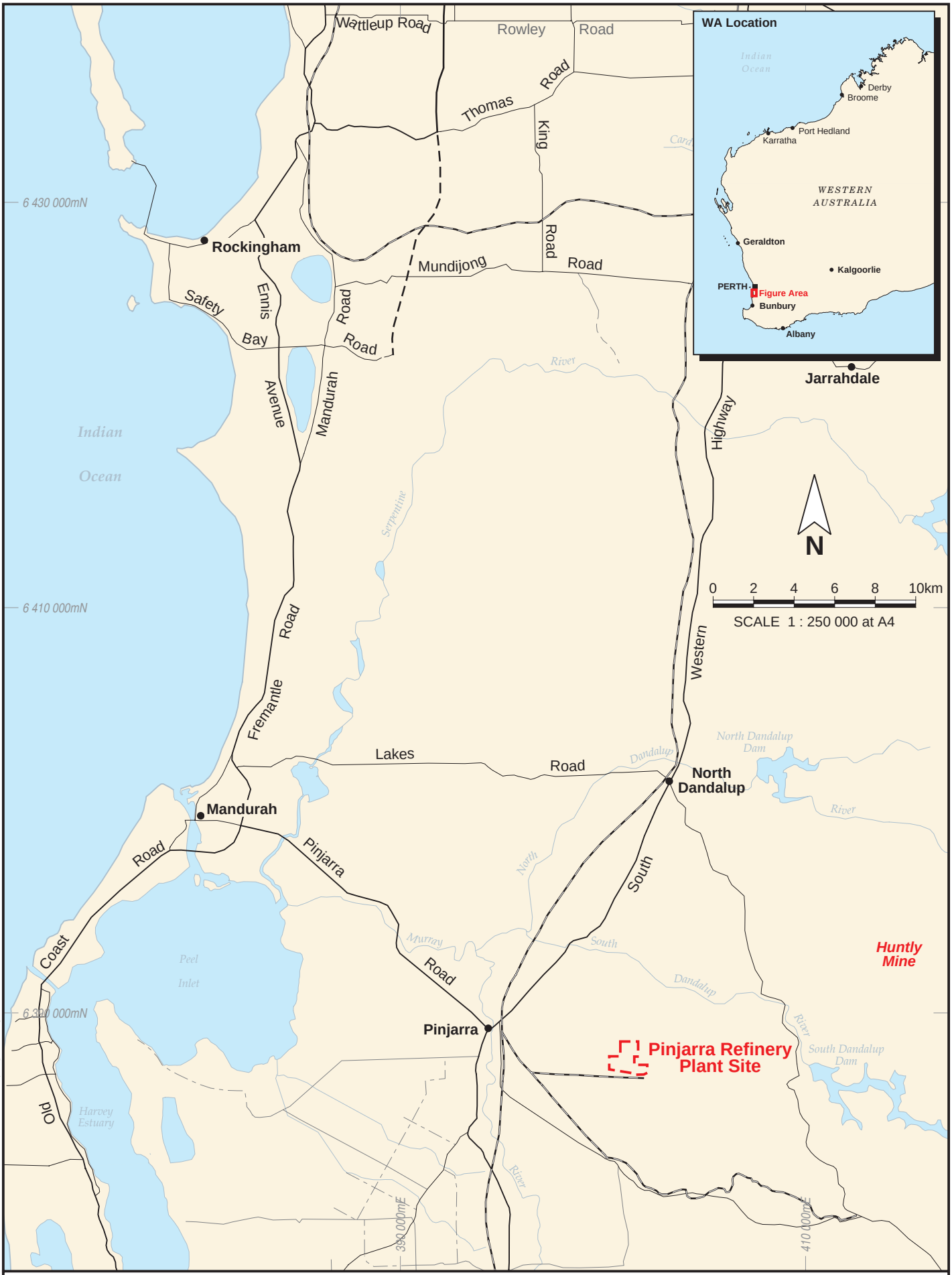
Alcoa	Alcoa World Alumina Australia
AAC	Australian Aluminium Council
AMWU	Australian Manufacturers Workers Union
AWU	Australian Workers Union
AGO	Australian Greenhouse Office
AMSL	Above Mean Seal Level
BAM	Blast Acoustic Modelling
CALM	Conservation and Land Management
CAR	Comprehensive, Adequate and Representative
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalents
CCN	Community Consultative Network
CRC	Cooperative Research Centre
CFMEU	Construction Forestry Mining and Energy Union
CCI	Chamber of Commerce and Industry
DoE	Department of Environment (Western Australia)
DoH	Department of Health (Western Australia)
DoIR	Department of Industry and Resources
DRF	Declared rare flora
DMA	Decision making authority
DoPI	Department of Planning and Infrastructure
EPS	Environmental Protection Statement
EPBC Act	Environmental Protection and Biodiversity Conservation Act
ERS	Environmental Recovery Services
EWR	Environmental water requirements
EPA	Environmental Protection Authority (Western Australia)
EMS	Environmental management system
ESP	Electro-static precipitators
H_2O	Water
HSA	Herring Storer Acoustics
Hi-Vol	High-volume
HAZOP	Hazard and Operability
IPCC	Intergovernmental Panel on Climate Change
IAI	International Aluminium Institute
JIRZRP	Joint Intermediate Rainfall Zone Research Program
LTRMP	Long Term Residue Management Plan
LCA	Life-cycle assessment
MMPLG	Mining and Management Program Liaison Group

MOG	Mining Operations Group
MMP	Mining and Management Program
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
NaOH	Sodium Hydroxide
NGO	Non-government Organisation
PM_{10}	Particulate matter with an aerodynamic particle diameter of less than 10 microns
$PM_{2.5}$	Particulate matter with an aerodynamic particle diameter of less than 2.5 microns
PAH	Polycyclic aromatic hydrocarbons
PDC	Peel Development Commission
PEACH	Personnel Employed by Alcoa Charity Help
QHRA	Quantitative Health Risk Assessment
RDA	Residue Disposal Area
RTO	Regenerative Thermal Oxidiser
RPLG	Residue Planning Liaison Group
RFA	Regional Forrest Agreement
ROC	Reactive Organic Compounds
SAG	Semi-autogenous grinding
SWIS	South West Interconnected System
SO_2	Sulphur Dioxide
SRG	Stakeholder Reference Group
SVT	Sound Vibration Technology
TDS	Total Dissolved Solids
TSP	Total Suspended Particulates
TAPM	The Air Pollution Model
VOCs	Volatile organic compounds
WMC	Western Mining Corporation Limited

Units

A$	Australian dollars
dB	decibels
dB (A)	decibels (A-weighted)
^oC	degrees Celsius
ha	hectares
km	kilometres
kL	kilolitres
mm	millimetres

m	metres (length)
m^2	square metres (area)
m^3	cubic metres (volume)
m/s	metres per second
MJ	mega joules
MW	mega watts
ML	megalitres
ML/yr	megalitres per year
MLpa	megalitres per annum
Mt	megatonnes
Mtpa	megatonnes per annum
ppm	parts per million
ppb	parts per billion
µg	micrograms (one-millionth of a gram)
$\mu g/m^3$	micrograms per cubic metre
t	tonnes
tph	tonnes per hour
tpa	tonnes per annum
w/w	weight for weight
%	percent
% w/w	percent by weight



Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

REGIONAL LOCATION

Figure 1

ENVIRON

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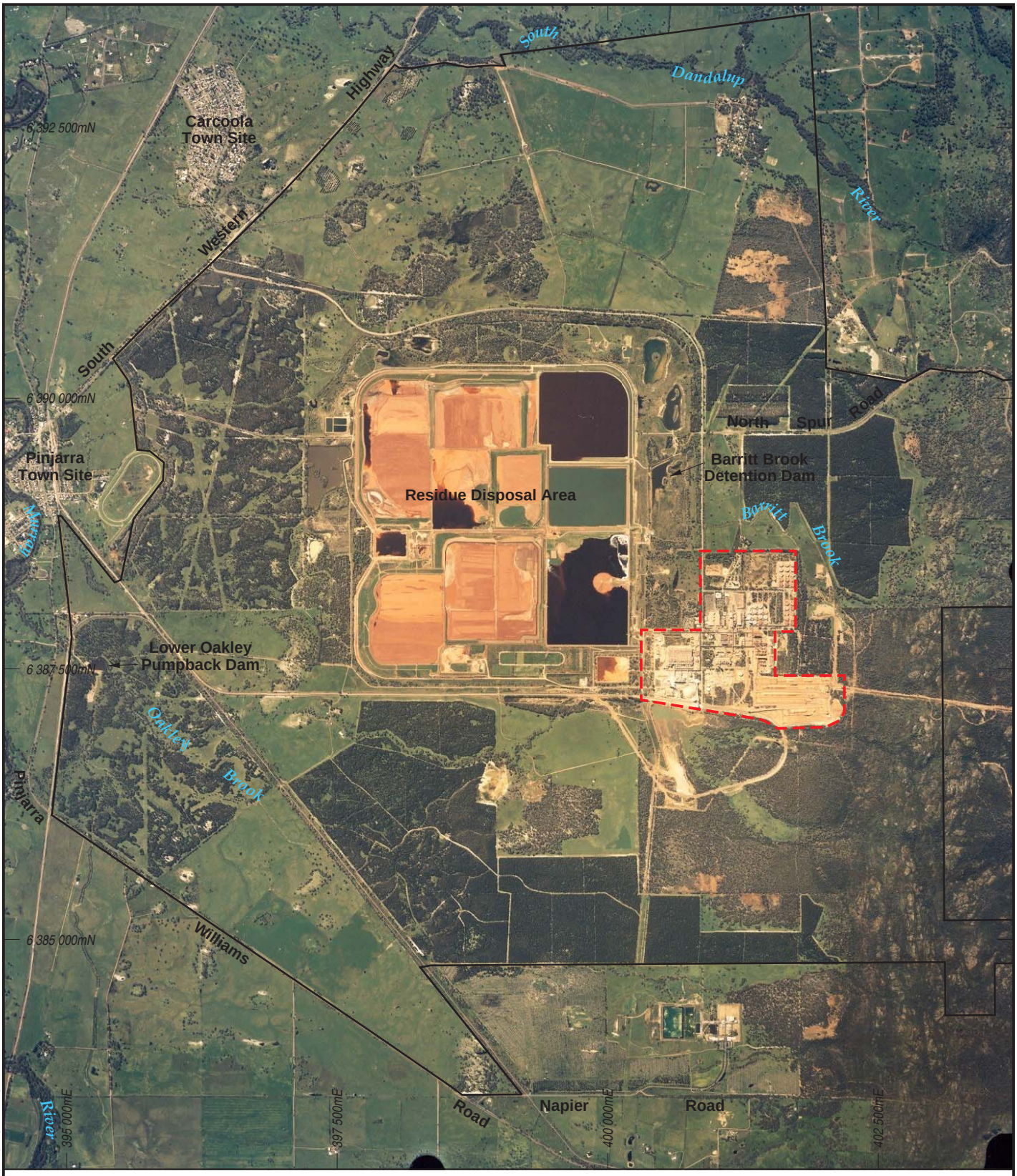


Legend

- Alcoa Property Boundary
- Pinjarra Refinery Plant Site

N

0 0.5 1.0 1.5 2.0 2.5km

SCALE 1 : 50 000 at A4

AERIAL SOURCE: Kevron Aerial Surveys, Pinjarra Regional Run SE2, 11/09/2000.

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 2

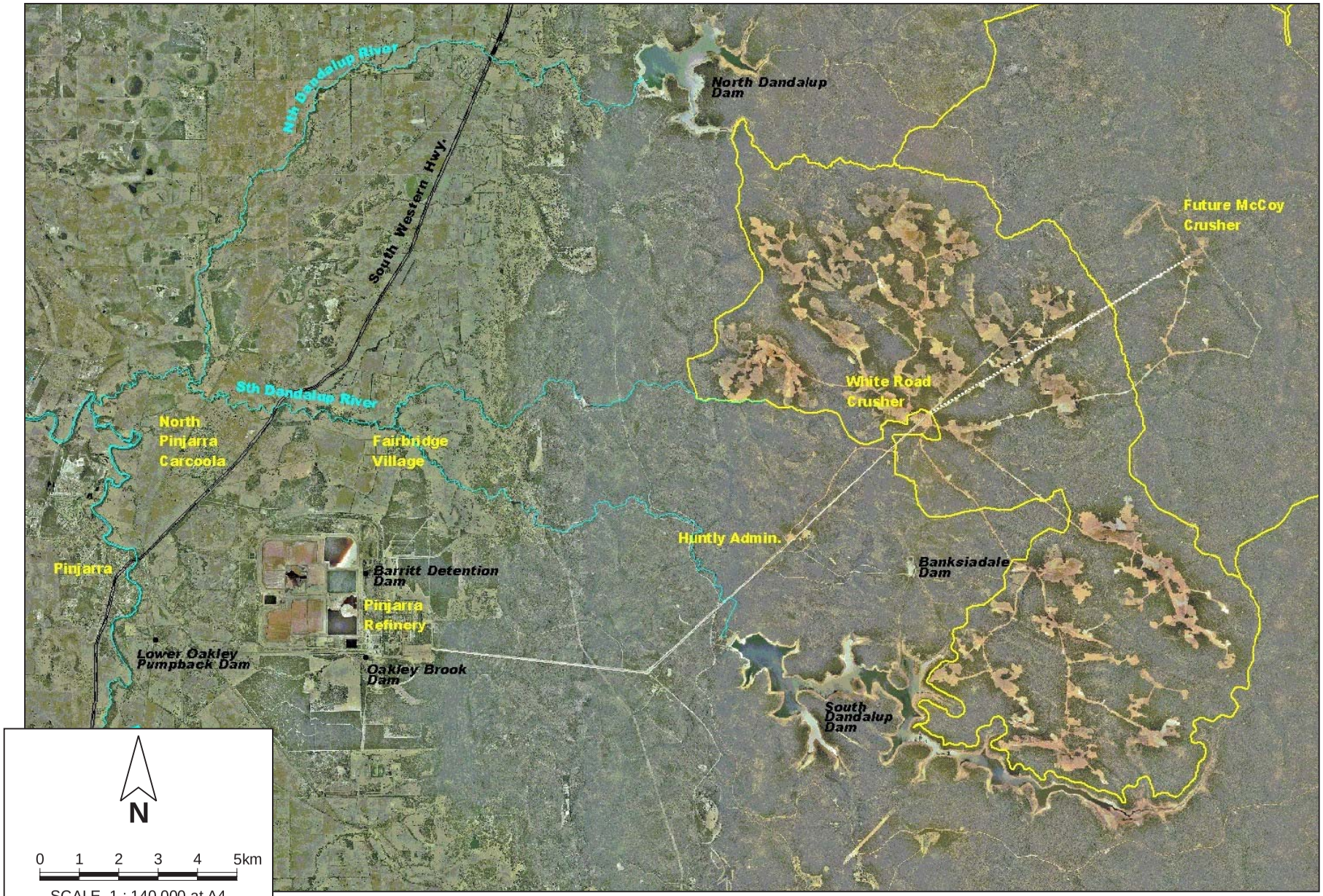
AERIAL PHOTOGRAPH OF REFINERY VICINITY

ENVIRON

Drawn: KP Date: 10/03

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

LOCATION MAP



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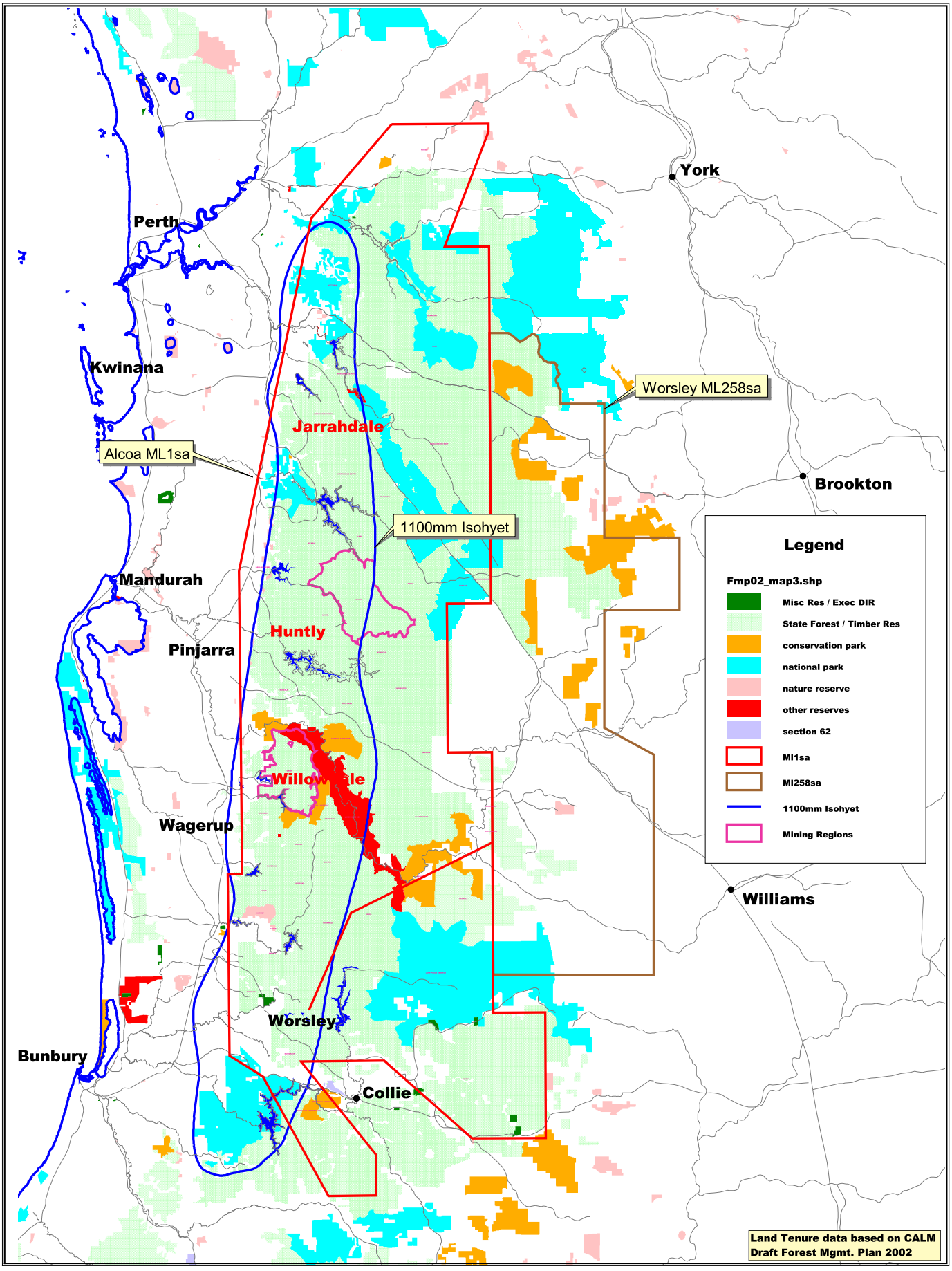
ENVIRON

Figure 3



Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

ALCOA's LEASE ML1sa

Figure 4

ENVIRON

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Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

MINING AREAS

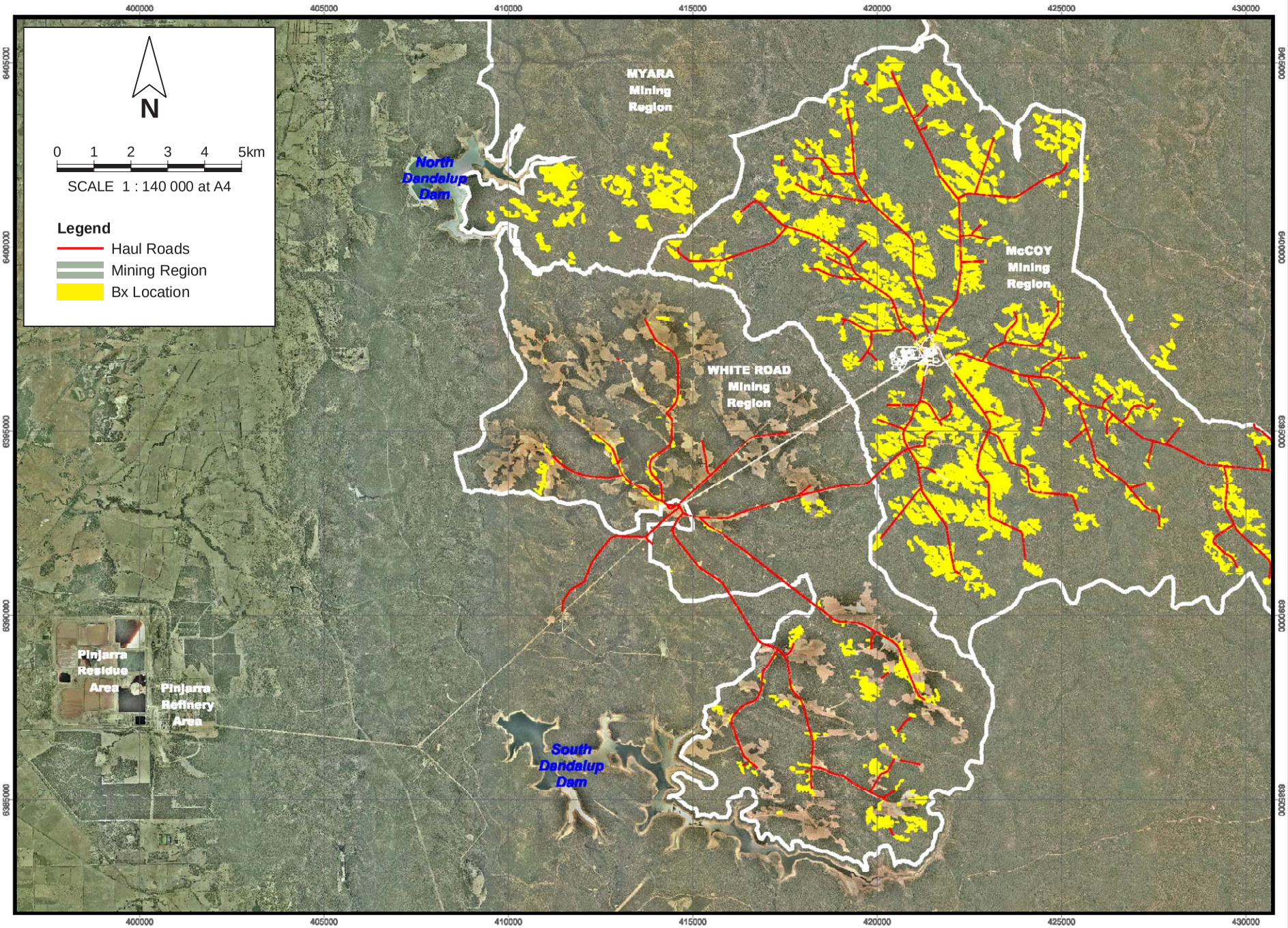

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Figure 5

ENVIRON

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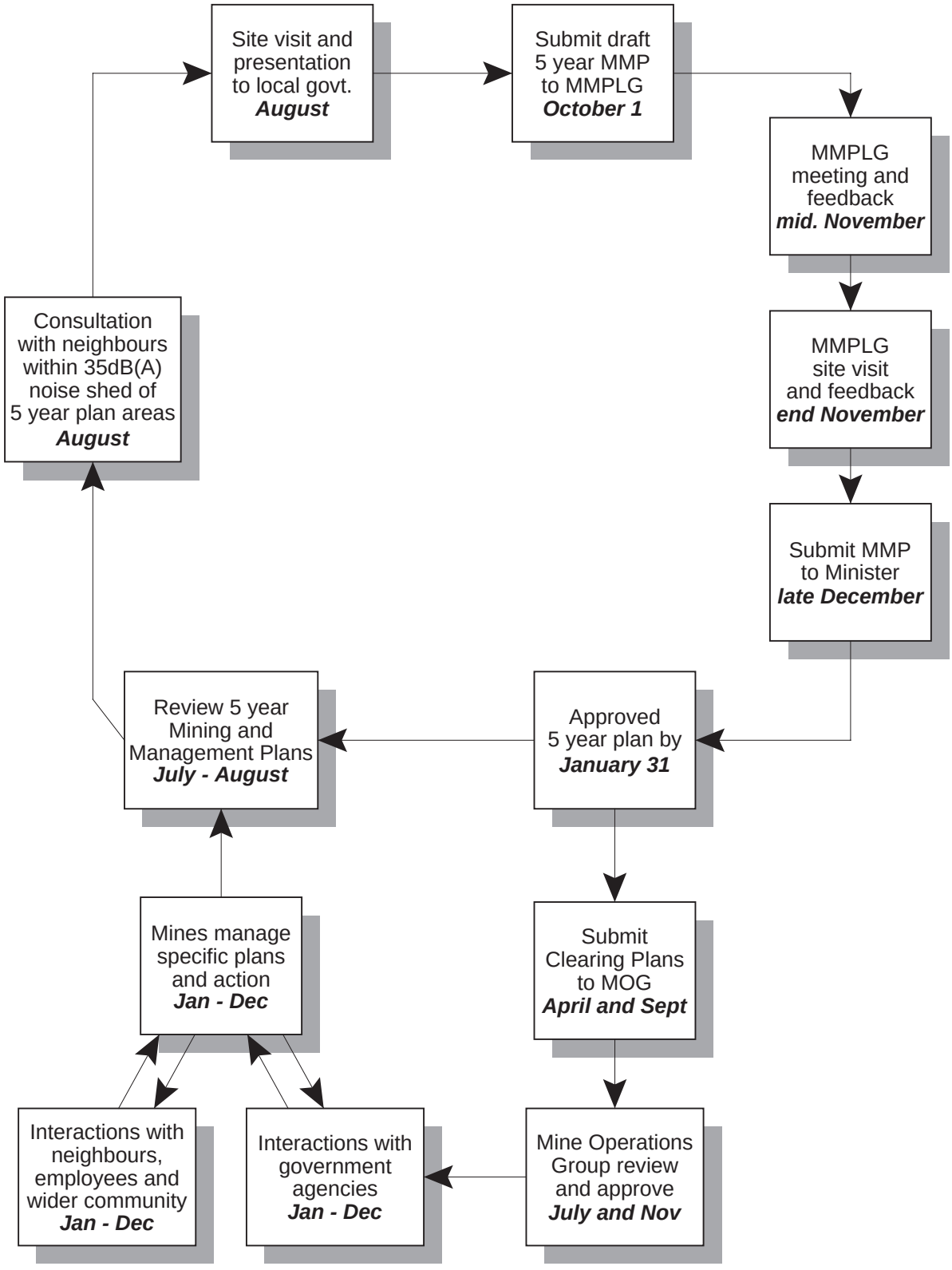


Note:

MOG - Mining Operations Group
MMPLG - Mining and Management Programme Liaison Group
MMP - Mining and Management Programme

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 6

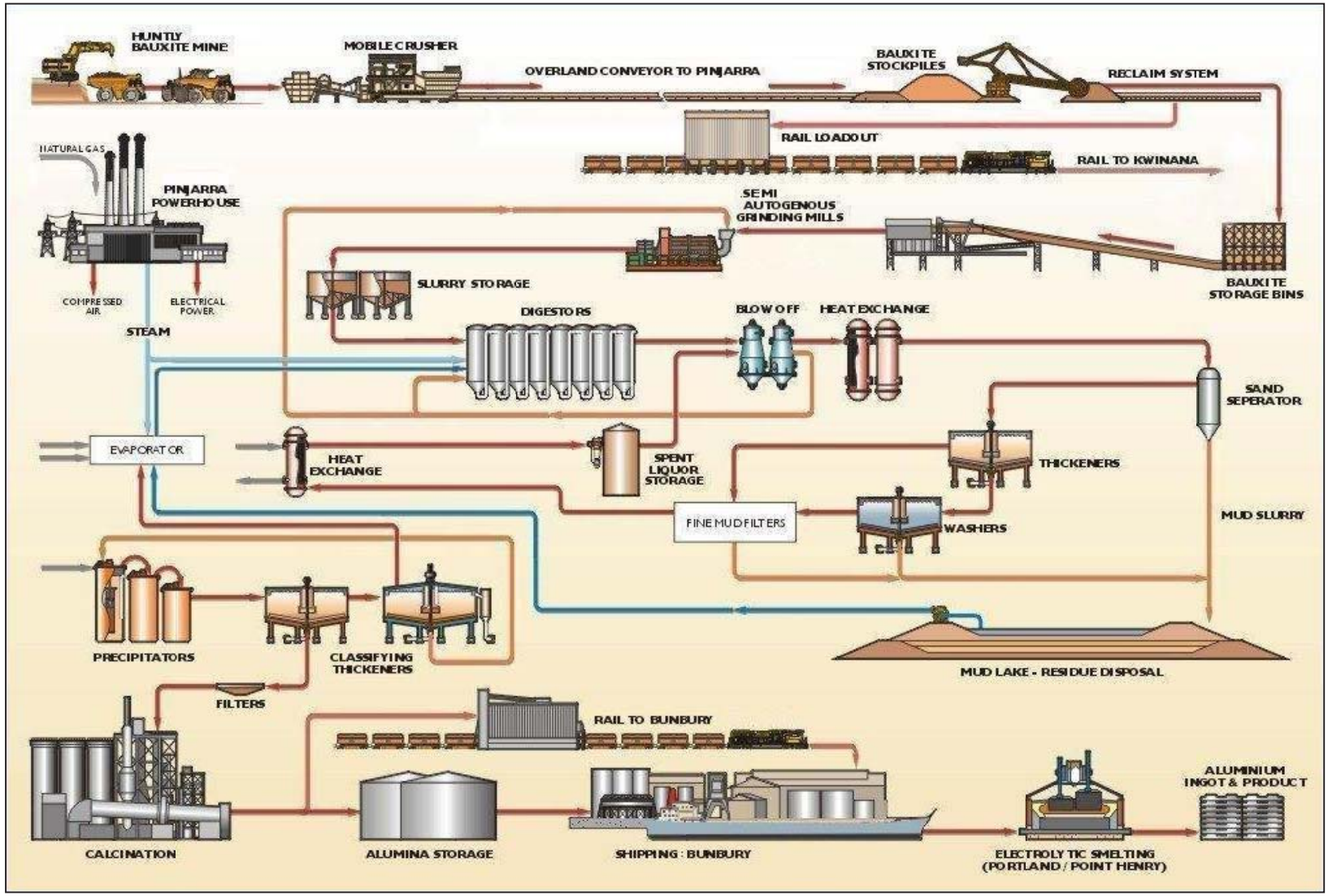
ALCOA CONSULTATION AND REPORTING PROCESS FOR THE MINING AND MANAGEMENT PLAN

ENVIRON

Drawn: KP Date: 10/03

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

BAYER PROCESS FLOW DIAGRAM



SOURCE: ALCOA, October 2003

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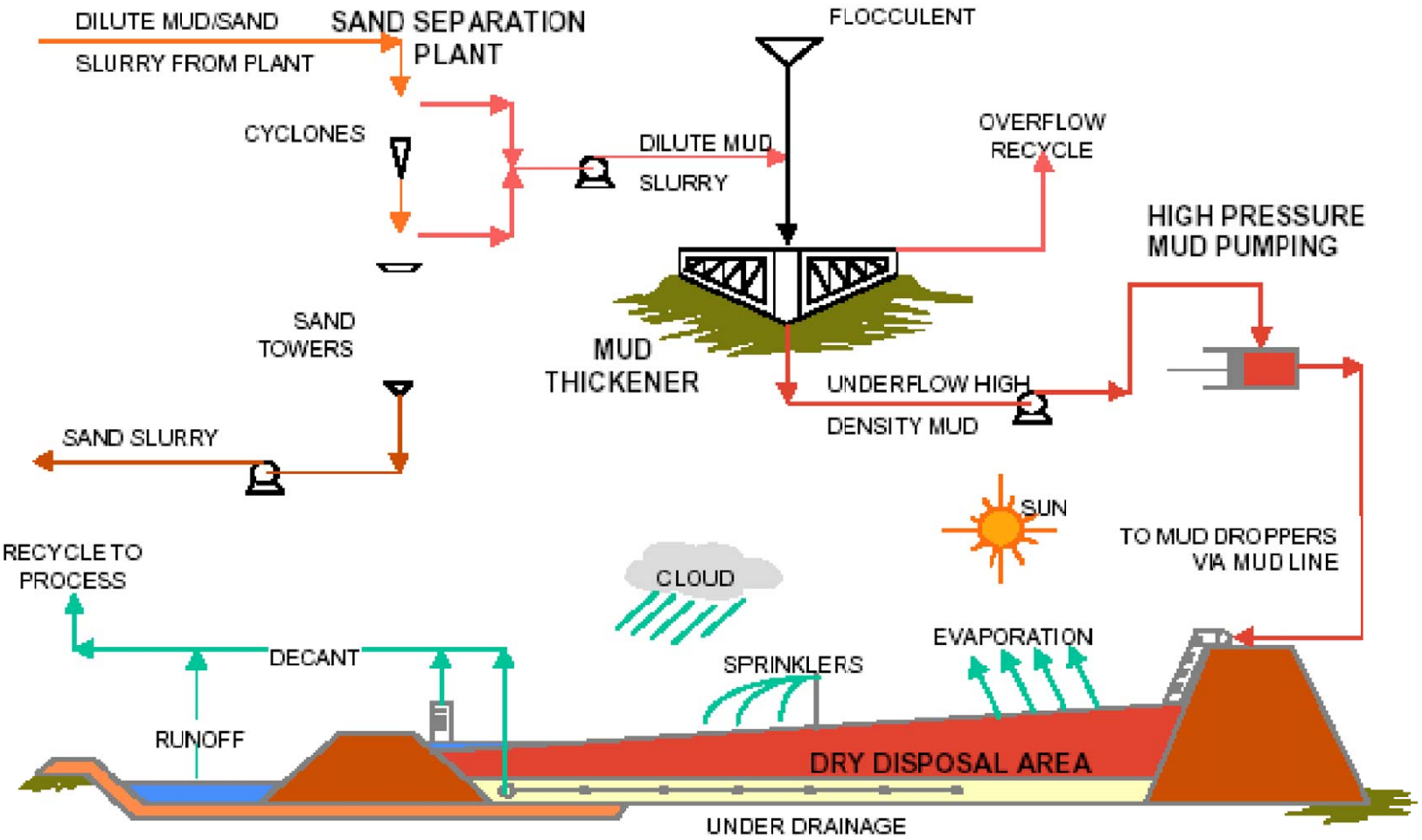
Date: 10/03

ENVIRON

Figure 7

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

SCHEMATIC OF THE RESIDUE STACKING PROCESS



SOURCE: ALCOA, August 2003

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ENVIRON

Figure 8

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PINJARRA REFINERY EFFICIENCY UPGRADE

Residue and Water Storage
Residue 'mud' is stored within the Refinery boundary. The Residue Disposal Program will be advanced by one year so that storage areas planned for 2006 will be used in 2005

Precipitation
Pumping and piping modifications

Calcination
A seventh calcination unit will be added and the ESP's on three existing units will be upgraded to reduce particulates

Seed Filtration
New Seed Filtration facility to be installed

Alinta Co-Generation
The new facility will produce electricity and steam. Pinjarra Refinery will utilise the steam. The upgrade will increase total energy use but energy consumption per tonne of alumina produced will decline by approximately 14% with Stages 1 and 2.

Oxalate Kiln
Upgrade capacity of oxalate kiln and upgrade air emission controls.

Evaporation
Additional evaporation vessels installed in series with existing evaporators

Mud Thickening/Removal
Flow will be uniformly distributed across all tanks

Mud Washing
Two existing mud washer banks will be upgraded. Capacity of Unit 5 will be modified to meet additional production throughput. Upgraded Causticiser Facilities included

Digestion
Efficiency improvements with existing units. Thermal oxidation of volatile organic compounds will reduce odours to normally undetectable levels and with no increase in noise levels

Slurry Storage
Additional storage time required. Eighth tank constructed

Grinding
Seventh mill and additional storage bin

Bauxite Storage
No additional storage area required
Increased stockpile turnover rate

Huntly Mine Bauxite ▸
Huntly Mine will increase production to supply more bauxite to Pinjarra Refinery

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

REFINERY LAYOUT SHOWING AREAS INVOLVED IN UPGRADE

Figure 9

ENVIRON

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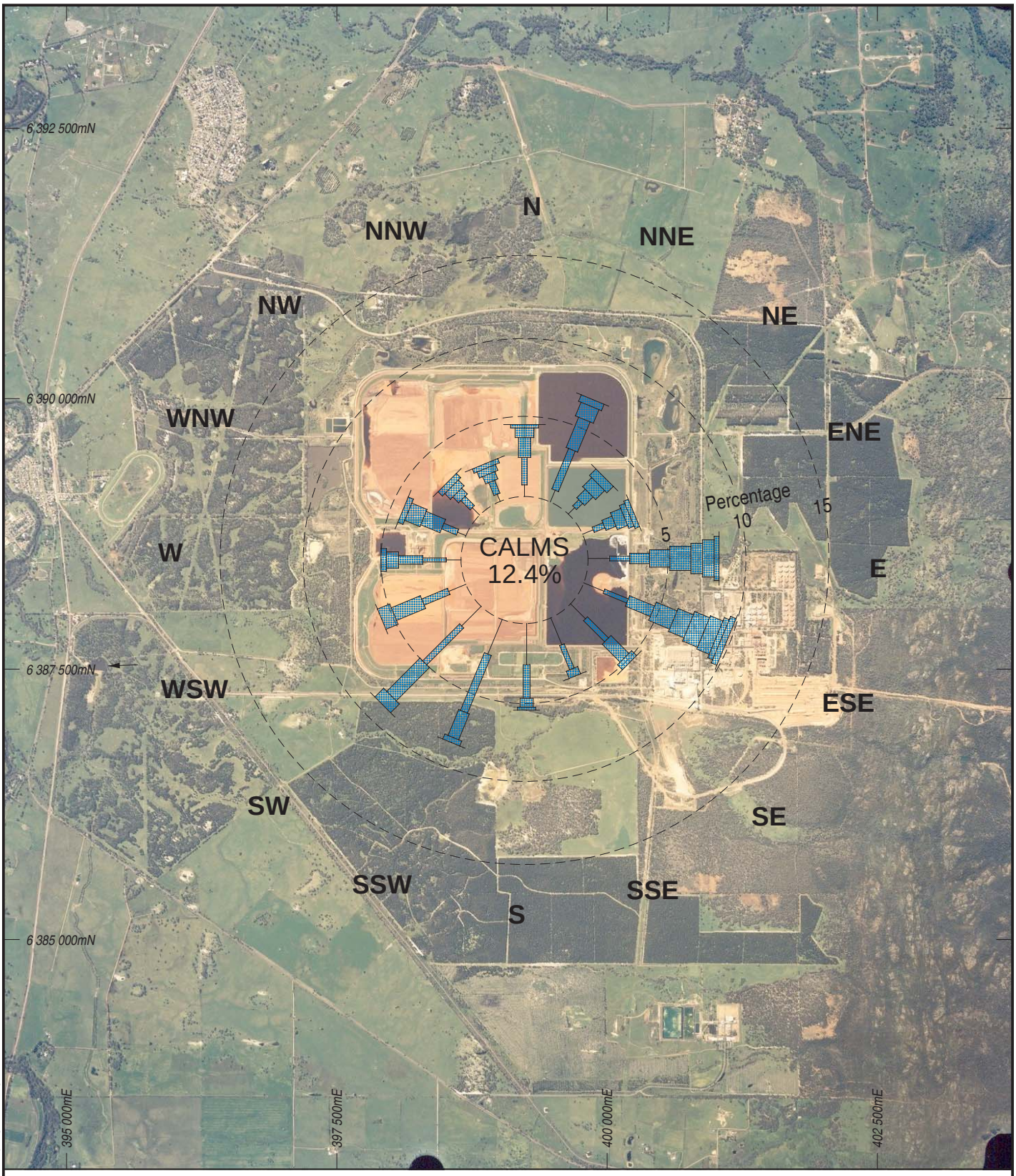


SCALE 1 : 50 000 at A4

AERIAL SOURCE: Kevron Aerial Surveys, Pinjarra Regional Run SE2, 11/09/2000.

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 10

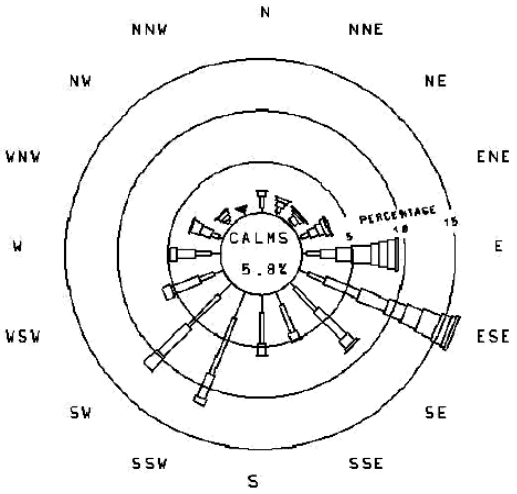
ANNUAL WINDROSE FOR THE PINJARRA REFINERY AUGUST 2002 TO JULY 2003

ENVIRON

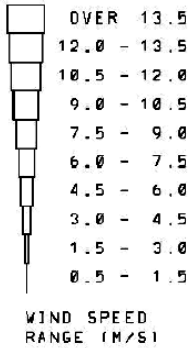
Drawn: KP Date: 10/03

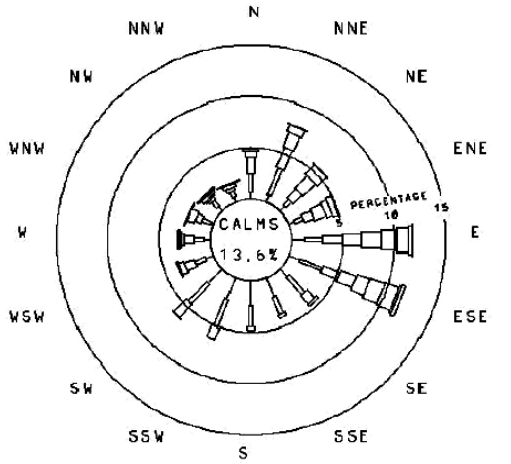
Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

SEASONAL WIND ROSES FOR PINJARRA REFINERY
AUGUST 2002 TO JULY 2003

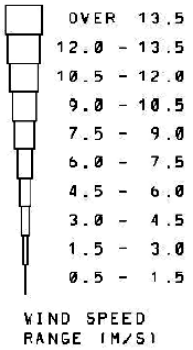


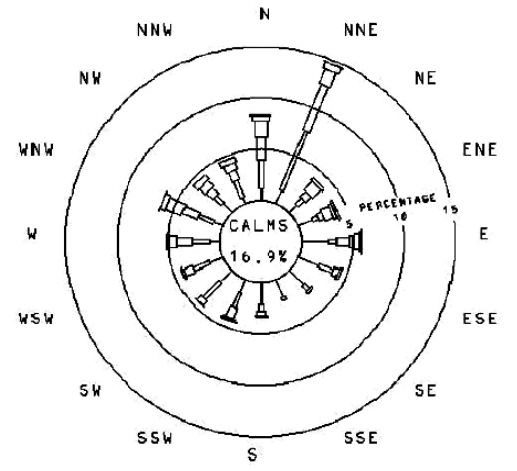
Summer



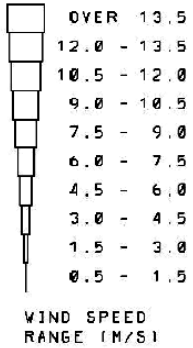


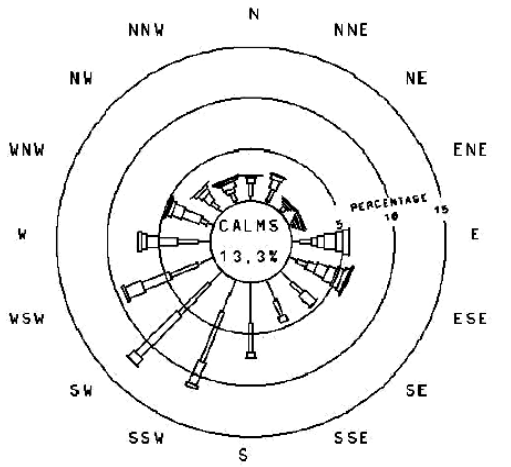
Autumn





Winter





Spring

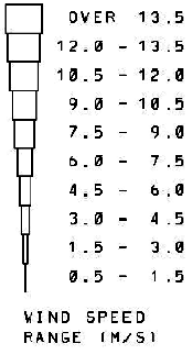
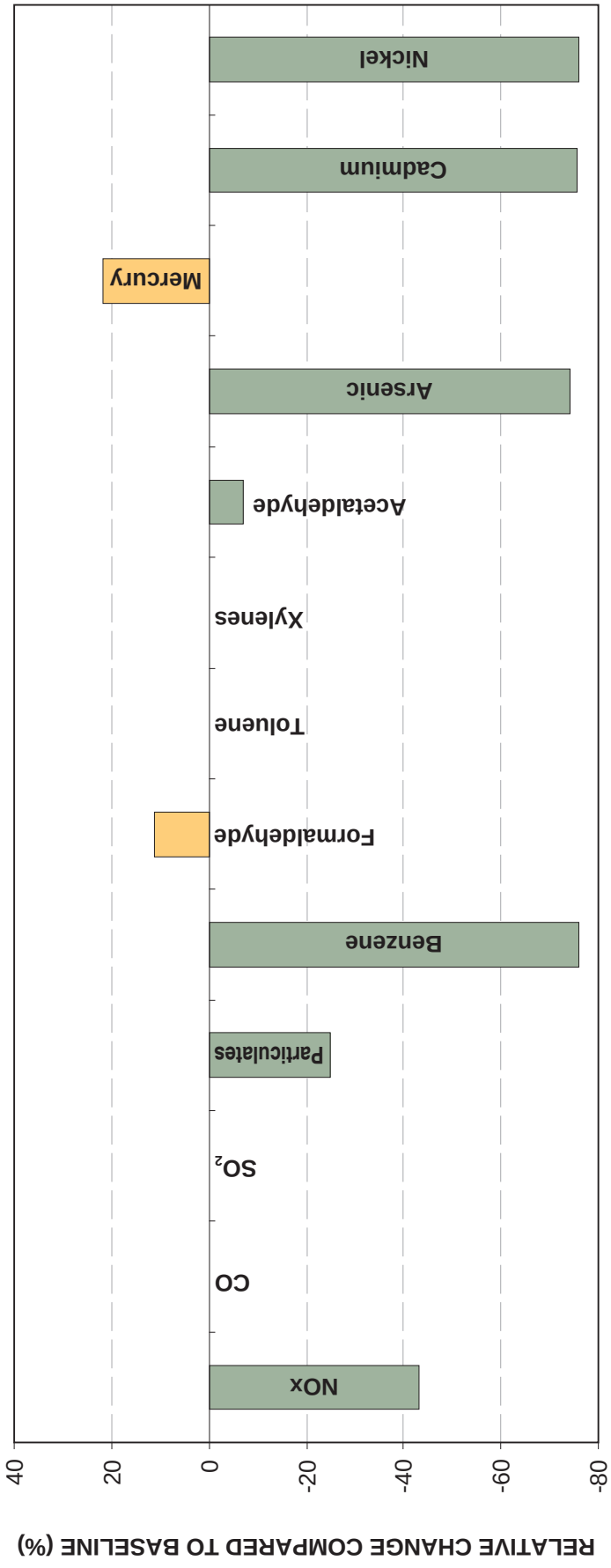


Figure 10b

ENVIRON

Drawn: KEH

Date: 11/03



Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 11

RELATIVE CHANGE IN PINJARRA REFINERY ANNUAL EMISSIONS RESULTING FROM THE EFFICIENCY UPGRADE

ENVIRON

Drawn: KEH Date: 11/03

N

0 500 1000 1500 2000 2500m

SCALE 1 : 60 000

Legend

- Residential Receptor
- Meteorological Monitoring Site
- Dust Monitoring Site
- NOx and CO Monitoring Site

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 12

LOCATIONS OF NEAREST RESIDENTIAL RECEPTORS AND AMBIENT AIR QUALITY MONITORING SITES

ENVIRON

Drawn: KH Date: 11/03

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 13

PREDICTED MAXIMUM 1-HOUR AVERAGE GROUND LEVEL CONCENTRATION OF NITROGEN DIOXIDE (µg/m³) - BASELINE

ENVIRON

Drawn: KH Date: 11/03

N

0 500 1000 1500 2000 2500m

SCALE 1 : 60 000

Legend

- 40 Nitrogen Dioxide Concentration Contour (µg/m³)
- Alcoa Property Boundary
- Residential Receptor

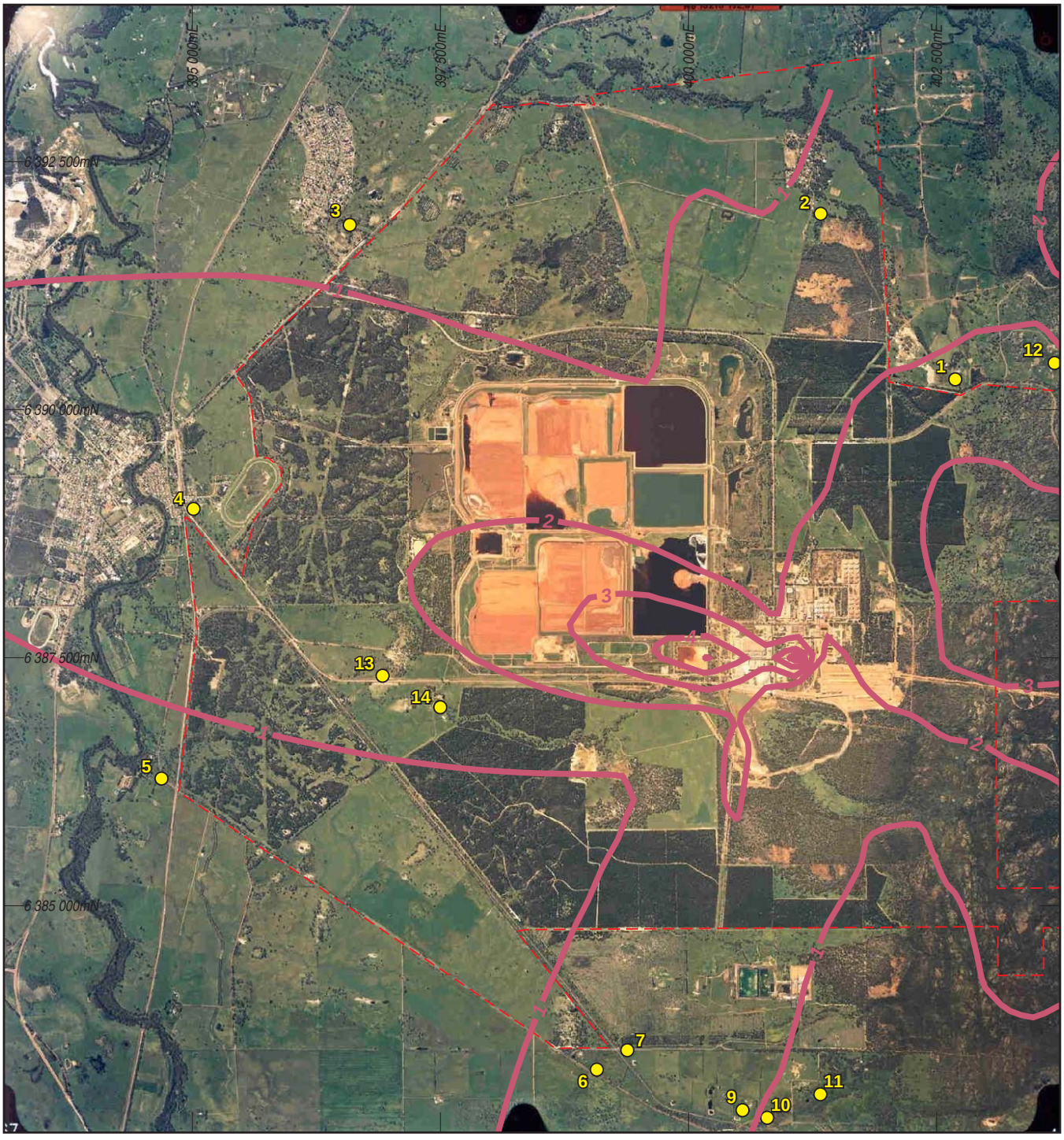
Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 14

PREDICTED MAXIMUM 1-HOUR AVERAGE GROUND LEVEL CONCENTRATION OF NITROGEN DIOXIDE (µg/m³) - UPGRADE

ENVIRON

Drawn: KH Date: 11/03



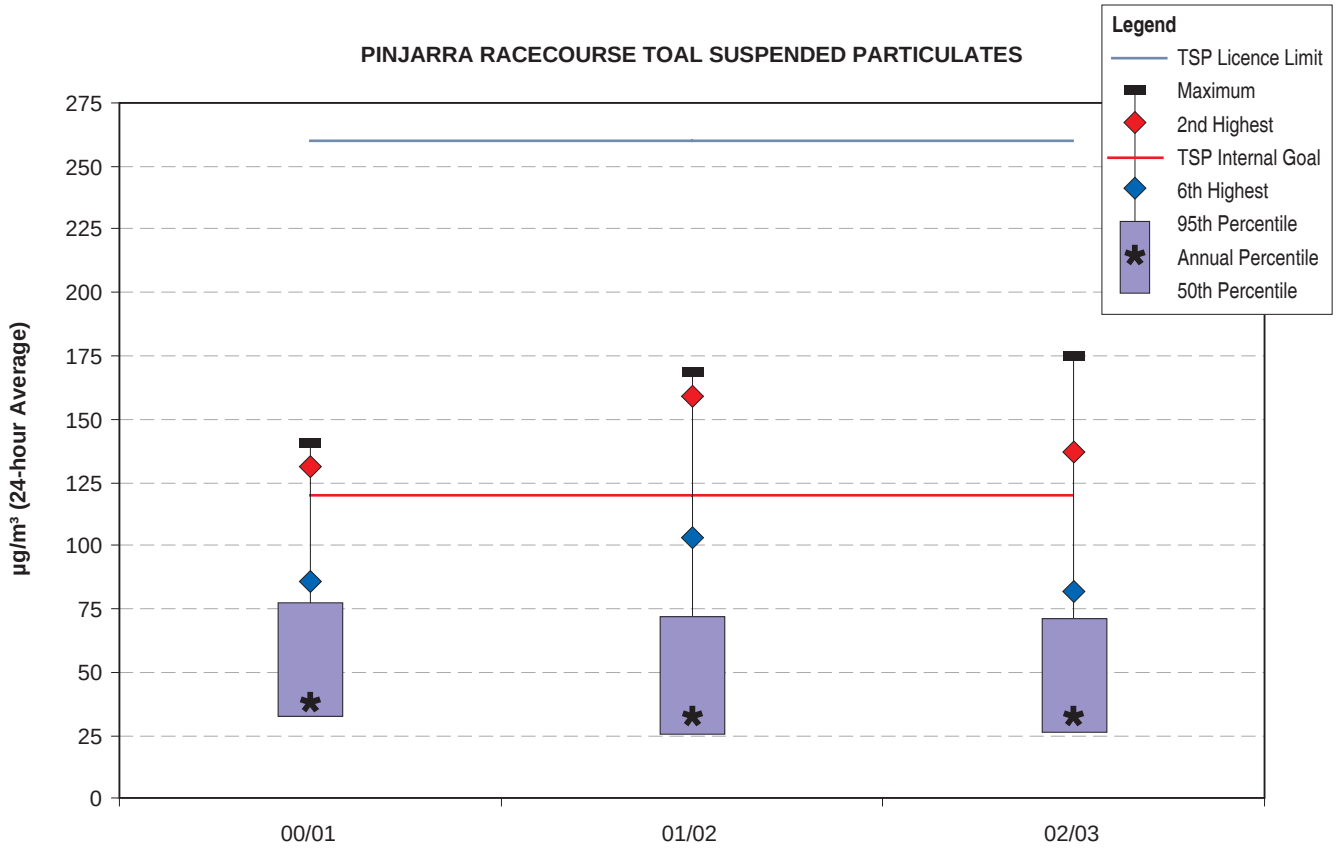
Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

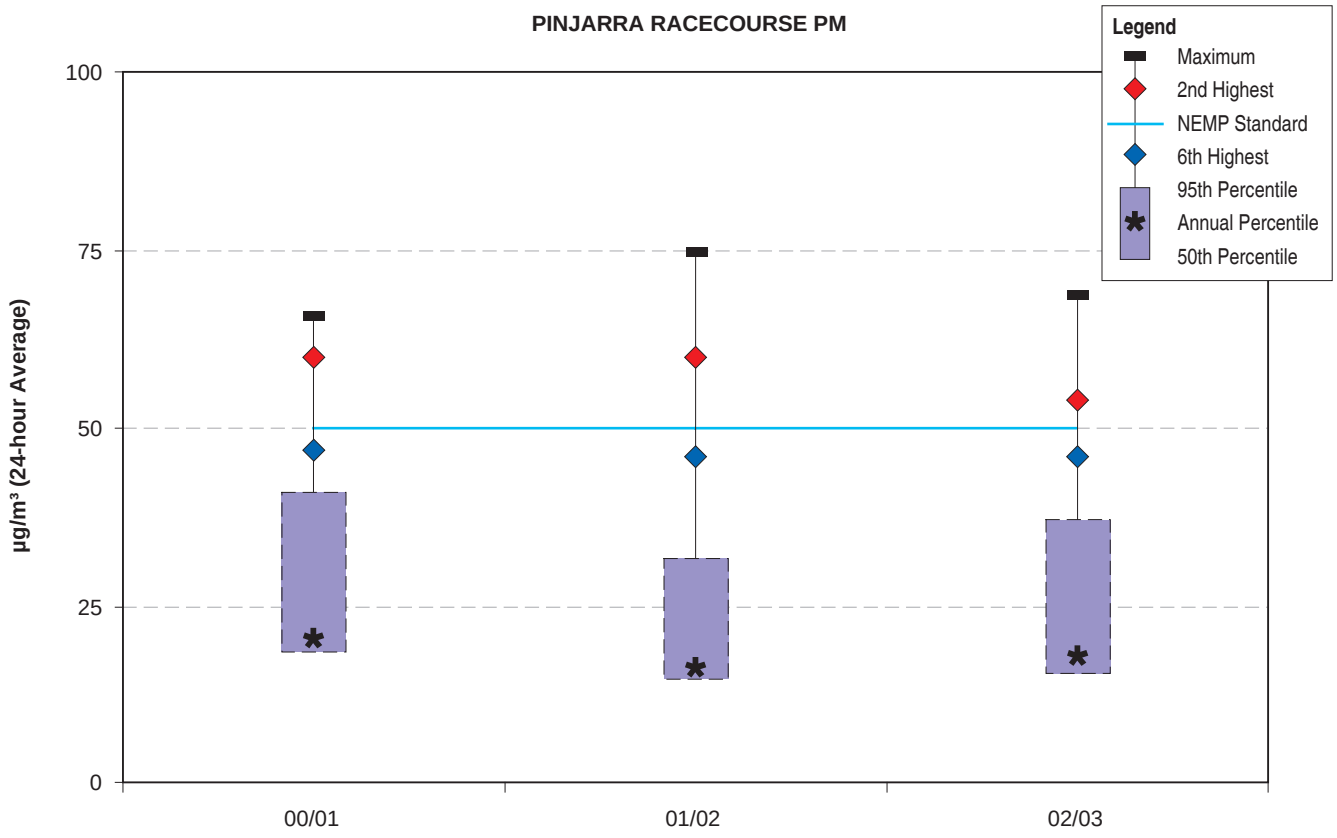
Figure 15

PREDICTED ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NITROGEN DIOXIDE (µg/m³) - UPGRADE

ENVIRON

Drawn: KH Date: 11/03





Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 16

ANNUAL STATISTICS DERIVED FROM AMBIENT PARTICULATE MONITORING AT THE PINJARRA RACECOURSE JULY 2000 TO JUNE 2003

ENVIRON

Drawn: KEH Date: 11/03

N

0 500 1000 1500 2000 2500m

SCALE 1 : 60 000

Legend

- 10 Acetaldehyde Concentration Contour (µg/m³)
- Alcoa Property Boundary
- Residential Receptor

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 17

PREDICTED MAXIMUM 1-HOUR AVERAGE GROUND LEVEL CONCENTRATION OF ACETALDEHYDE (µg/m³) - BASELINE

ENVIRON

Drawn: KH Date: 11/03

N

0 500 1000 1500 2000 2500m

SCALE 1 : 60 000

Legend

40 Acetaldehyde Concentration Contour (µg/m³)

Alcoa Property Boundary

Residential Receptor

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 18

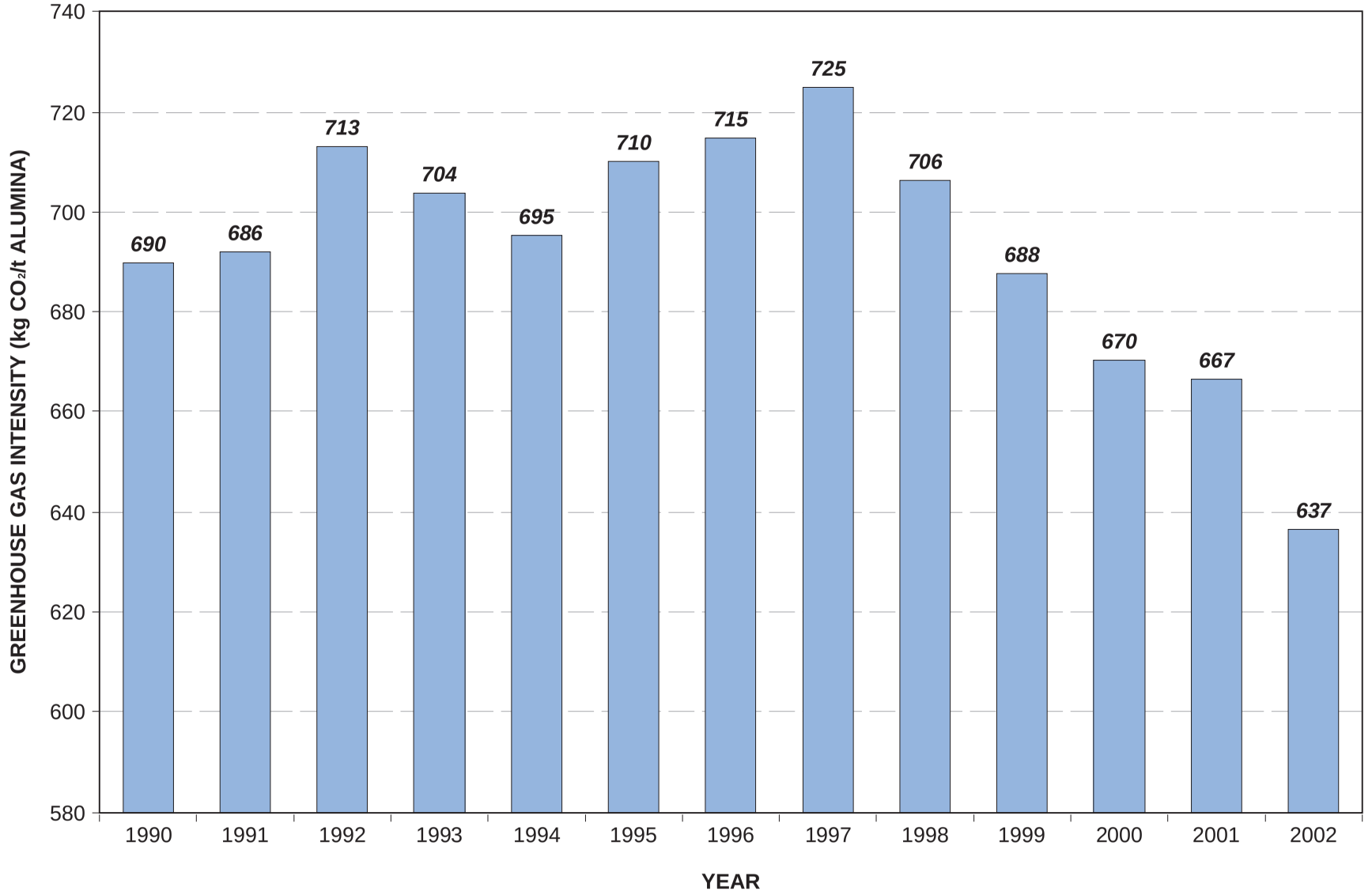
PREDICTED MAXIMUM 1-HOUR AVERAGE GROUND LEVEL CONCENTRATION OF ACETALDEHYDE (µg/m³) - UPGRADE

ENVIRON

Drawn: KH Date: 11/03

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

TREND IN GREENHOUSE GAS INTENSITY OF THE PINJARRA REFINERY - 1990 TO 2002

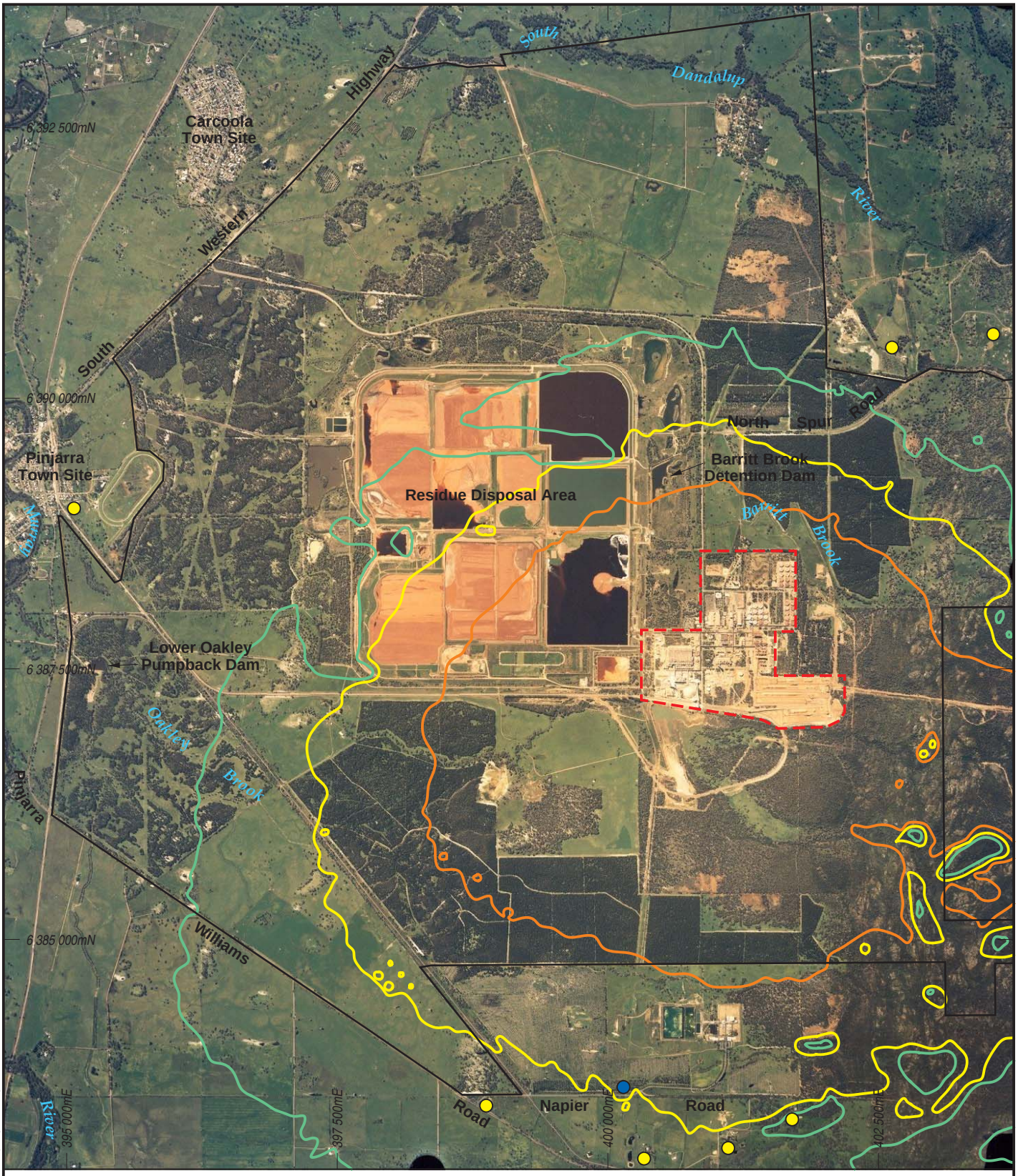


NOTE: The Australian Greenhouse Office revised the CO_2 Intensity Factor in 2002 down to 59.3 kg CO_2/GJ, from 62.3 kg CO_2/GJ which partially accounts for the relatively large reduction in the greenhouse gas intensity seen in 2002.

Drawn: KEH Date: 10/03

ENVIRON

Figure 19



Legend

- Alcoa Property Boundary
- Pinjarra Refinery Plant Site
- Nearest Residential Receptor
- Monitoring Location

Noise Level

- 30 - 35 dB(A)
- 35 - 40 dB(A)
- Greater than 40 dB(A)

N

0 0.5 1.0 1.5 2.0 2.5km

SCALE 1 : 50 000 at A4

AERIAL SOURCE: Kevron Aerial Surveys, Pinjarra Regional Run SE2, 11/09/2000.
NOISE CONTOURS SOURCE: Herring Storer Acoustics, 2003.

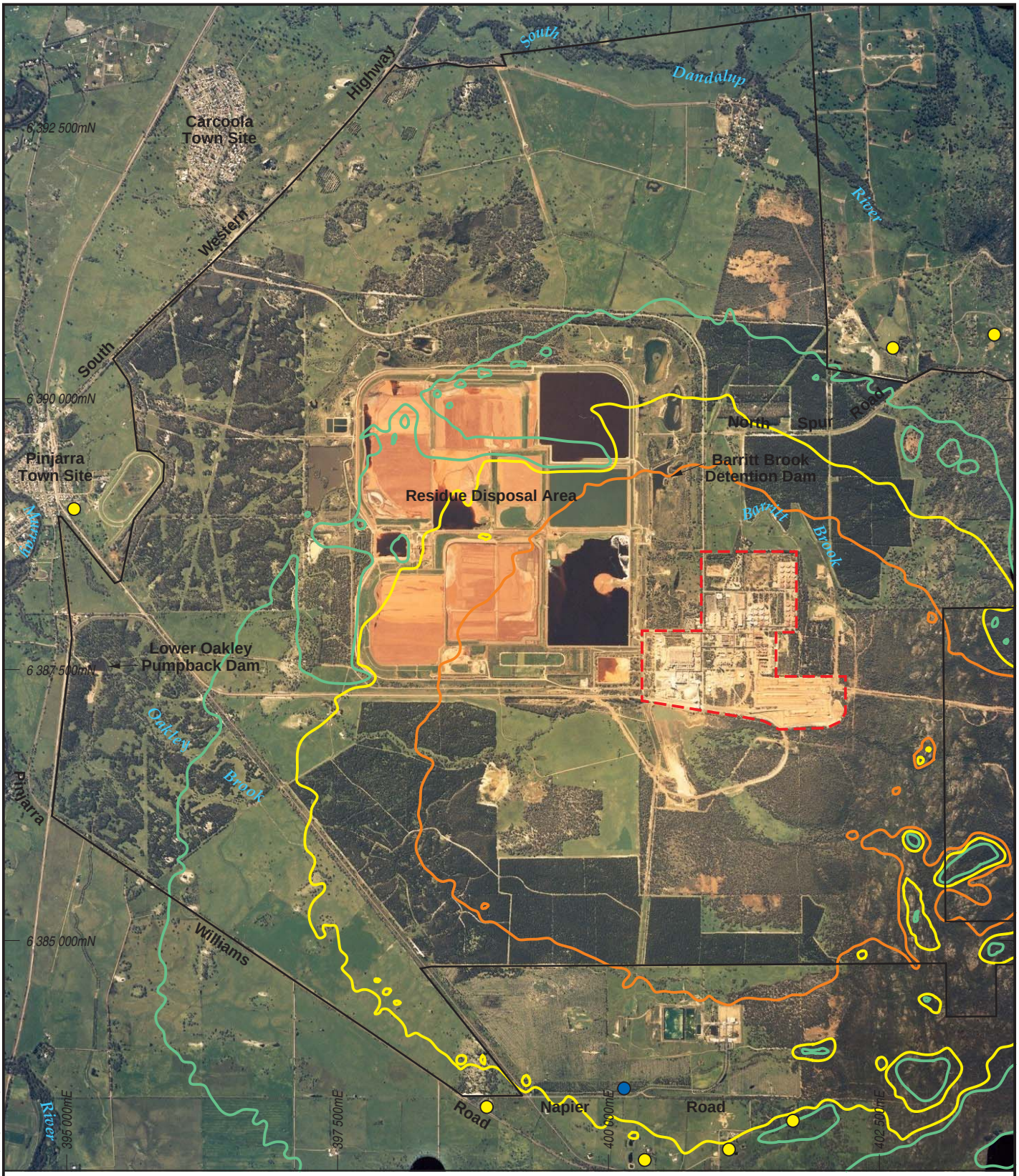
Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

NOISE CONTOURS FOR THE EXISTING REFINERY AND TWO COGENERATION UNITS (BASE SCENARIO)

Figure 20

ENVIRON

Drawn: KP Date: 10/03



Legend

- Alcoa Property Boundary
- Pinjarra Refinery Plant Site
- Nearest Residential Receptor
- Monitoring Location

Noise Level

- 30 - 35 dB(A)
- 35 - 40 dB(A)
- Greater than 40 dB(A)

N

0 0.5 1.0 1.5 2.0 2.5km

SCALE 1 : 50 000 at A4

AERIAL SOURCE: Kevron Aerial Surveys, Pinjarra Regional Run SE2, 11/09/2000.
NOISE CONTOURS SOURCE: Herring Storer Acoustics, 2003.

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

NOISE CONTOURS FOR THE EFFICIENCY UPGRADE (BASE SCENARIO PLUS EFFICIENCY UPGRADE)

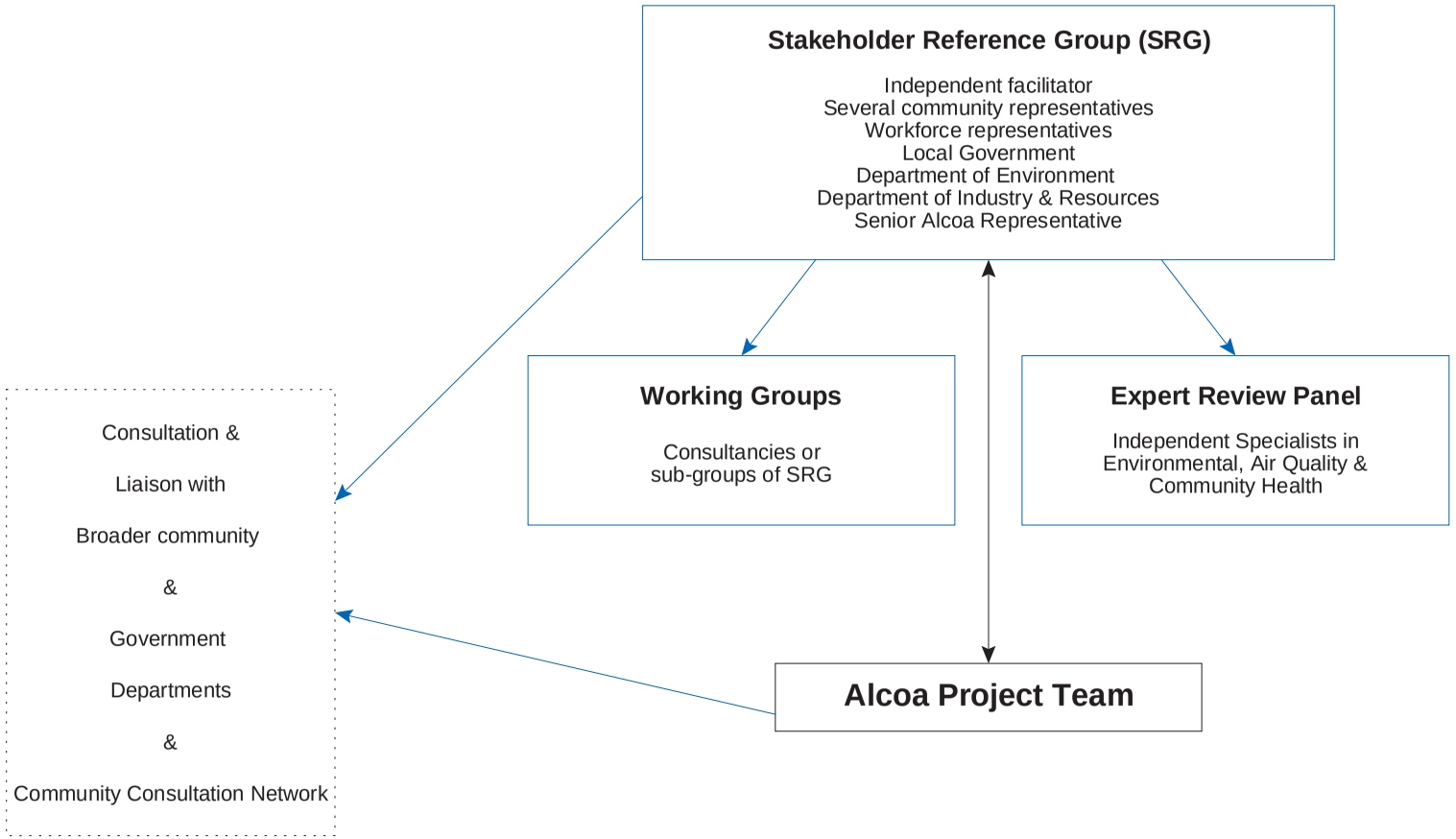
Figure 21

ENVIRON

Drawn: KP Date: 10/03

Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

CONSULTATION STRUCTURE FOR THE EFFICIENCY UPGRADE



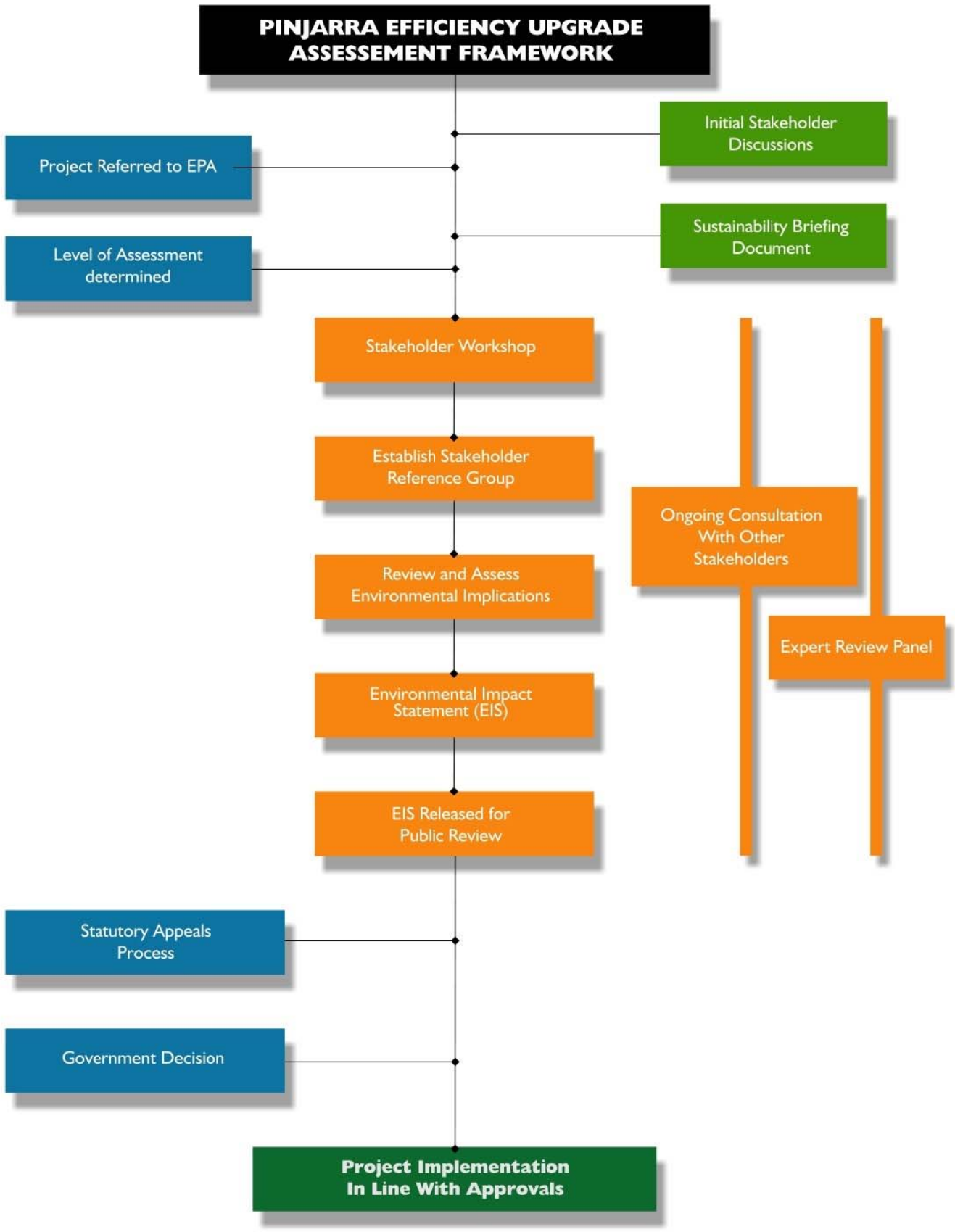
SOURCE: ALCOA, August 2003

Figure 22

ENVIRON

Drawn: KP

Date: 10/03



Alcoa World Alumina Australia
ALCOA PINJARRA REFINERY EFFICIENCY UPGRADE
ENVIRONMENTAL PROTECTION STATEMENT

Figure 23

ASSESSMENT FRAMEWORK

ENVIRON

Drawn: KH Date: 11/03

Appendix A

Air Emissions Study
by Sinclair Knight Merz
(Independent Review by J. Chiodo[A])

[A] Jack Chiodo of CH Environmental (formerly of the Victorian Environment Protection Authority)

REFER TO DIGITAL COPY OF REPORT FOR COMPLETE APPENDIX A

Appendix B

Health Risk Assessment
by Toxikos
(Independent Review by P. Weinstein[B])

[B] Philip Weinstein of the University of Western Australia (Population Health)

REFER TO DIGITAL COPY OF REPORT FOR COMPLETE APPENDIX B

Appendix C

Noise Impact Study
by Herring Storer Acoustics
(Independent Review by Sound Vibration Technology)

REFER TO DIGITAL COPY OF REPORT FOR COMPLETE APPENDIX C

Appendix D

Community Consultation

TABLE D1: Summary Of Stakeholder Consultation Conducted

PHASE ONE – Announcing an engineering study for an efficiency upgrade at Alcoa's Pinjarra Refinery

Group	Stakeholder	Date	Location of Consultation Contact	Method of Consultation
Local Government	City Of Mandurah	June 2003	Mandurah	Meeting Mail out
	Shire of Murray	1 July 2003 16 July 2003 15 August 2003	Pinjarra	Monthly meeting Council presentation Telephone
	Shire of Murray Planning Committee	19 August 2003	Pinjarra	Council Committee meetings Mail out
	Shire of Waroona	July 2003	Mundijong	Presentation
	Shire of Serpentine-Jarradale	July 2003	Mundijong	Presentation
Murray Community	Local Residents	July 2003	Pinjarra Carcoola Ravenswood Coolup Yunderup Dwellingup North Dandalup	Mail out Telephone
	Pinjarra Refinery Neighbours	July 2003	Pinjarra	Mail out Telephone

Group	Stakeholder	Date	Location of Consultation Contact	Method of Consultation
	Community Consultative Network	July 2003	Pinjarra	Presentation Mail out
	Huntly Mine site neighbours	July 2003	Dwellingup	Mail out
Peel Region				
Committees/Chambers	Murray Economic Development Unit	18 July 2003	Pinjarra	Mail out
	Peel Development Commission	16 July 2003 4 July 2003	Mandurah	Meeting & Mail out
	Peel Chamber of Commerce	17 July 2003 2 August 2003	Mandurah	Meeting Presentation Telephone
	Peel Area Consultative Committee	17 July 2003	Mandurah Pinjarra	Meeting Presentation Site Tour
Government Departments - State	Environmental Protection Authority	25 July 2003	Perth	Meeting Presentation
	Department of Industry and Resources	25 July 2003	Perth	Meeting and presentation
	Department of Environment	25 July 2003	Perth	Meeting and presentation
	Water Corporation	25 July 2003	Perth	Meeting and presentation
	Peel and Rockingham/Kwinana Health Services	July 2003	Pinjarra	Mail out
Members of Parliament	Minister for State Development	June 2003 July 2003	Perth	Meeting
	Member for Murray-Wellington	13 June 2003 22 August 2003	Pinjarra	Meeting Mail out Presentation

Group	Stakeholder	Date	Location of Consultation Contact	Method of Consultation
	Member for Mandurah	4 July 2002	Mandurah	Telephone Mail out
	Member for Dawesville	16 July 2003	Mandurah	Meeting, Presentation Telephone Mail out
	Federal Member for Canning	22 July 2003 4 July 2003	Pinjarra Perth	Meeting Presentation Site Tour Mail out
Environmental Interest Group	Local Landcare Groups (LCDC's)	July 2003	Pinjarra	Mail out
Alcoa Employees	Pinjarra Refinery WA Operations Corporate	July 2003	Pinjarra WA	Newsletter Electronic announcements – Email; Infovision and Pinjarra Points Telephone
Unions	AMU		Pinjarra	Meeting Mail out
	AMWU		Perth Pinjarra	Presentation Meeting Mail out
	CFMEU		Perth	Mail out
Media	Mandurah Mail	July 2003	Mandurah	Media statement Interview

Group	Stakeholder	Date	Location of Consultation Contact	Method of Consultation
	Coastal Times	July 2003	Mandurah	Media statement Interview
	The West Australian	July 2003	Perth	Media statement
	The Australian	July 2003	Melbourne	Media statement

PHASE TWO – Stakeholder Consultation Process

Group	Stakeholder	Date	Location	Method of Consultation
Local Government	City Of Mandurah	August 2003	Mandurah	Meeting Mail out
	Shire of Murray	August 2003	Pinjarra	Monthly meeting Council presentation Letter received
	Shire of Murray Planning Committee	August 2003	Pinjarra	Council Committee meeting
Murray Community	Residents	August 2003 September 2003	Pinjarra Carcoola Ravenswood Coolup Yunderup Dwellingup North Dandalup	Mail out Workshop invitation Advert in the Mandurah Mail
	Pinjarra Refinery Neighbours	August 2003	Pinjarra	Mail out

Group	Stakeholder	Date	Location	Method of Consultation
	Community Consultative Network	August 2003	Pinjarra	Presentation Mail out
	Huntly Mine site neighbours	August 2003	Dwellingup	Mail out
Chambers & Commissions	Peel Development Commission	August 2003	Mandurah	Meeting & Mail out
	Peel Chamber of Commerce	2 August 2003	Mandurah	Meeting Presentation Telephone Mail out
	Peel Area Consultative Committee	August 2003	Mandurah Pinjarra	Meeting Presentation Mail out
Government Departments - State	Environmental Protection Authority	August 2003	Perth	Meeting Presentation
	Department of Industry and Resources	August 2003	Perth	Meeting and presentation
	Department of Environment	August 2003	Perth	Meeting and presentation
Members of Parliament	Minister for the Environment	August 2003	Perth	Meeting & mail out
	Minister for State Development	August 2003	Perth	Mail out
	Shadow Minister for the Environment	August 2003	Perth	Mail out
	Minister for South-West	September 2003	Perth	Mail out
	Greens WA representative(s)	August 2003 September 2003	South-west Perth	Mail outs Meeting Presentation Telephone
	Member for Murray-Wellington	22 August 2003	Pinjarra	Meeting Presentation

Group	Stakeholder	Date	Location	Method of Consultation
	Member for Mandurah	August 2002	Mandurah	Telephone Mail out
	Member for Dawesville	August 2003	Mandurah	Meeting, Presentation
	Federal Member for Canning	August 2003	Perth	Meeting Mail out
Environmental Interest Groups	Local Landcare Groups (LCDC's)	August 2003 September 2003	Pinjarra	Mail out Workshop
	Representatives of Conservation Council of WA & WA Forests Alliance	September 2003	Perth	Meeting and Presentation
Alcoa Employees	Pinjarra Refinery WA Operations Corporate	August 2003 September 2003	Pinjarra WA	Newsletter Management meetings Electronic announcements
Unions	AMU	August 2003 September 2003	Pinjarra	Meeting Mail out
	AMWU	August 2003 September 2003	Perth Pinjarra	Presentation Meeting Mail out
	CFMEU	September 2003	Perth	Presentation

PHASES THREE & FOUR– SRG formation and ongoing progress

Fortnightly mail outs have been sent to the above list of stakeholders. The mail outs have included regular Updates on the progress of the SRG and also any new communication materials that have been produced to provide further information on the project. Other activities, over and above these mail outs are listed below:

Group	Stakeholder	Date	Location	Method of Consultation
Shire of Murray	Residents	October 2003	Pinjarra	Pinjarra Refinery Open Day Pinjarra Fair Function
	Pinjarra Refinery Neighbours	October 2003 November 2003	Pinjarra	Pinjarra Refinery Open Day Pinjarra Fair
	Community Consultative Network	October 2003 November 2003	Pinjarra Mandurah	Presentation Meetings
	Murray Districts Business Retention Committee	September 2003 October 2003	Pinjarra	Meetings Workshops
Commissions	Peel Development Commission	October 2003 November 2003	Mandurah	Presentation Fundraising luncheon Meeting
	Peel and Rockingham/Kwinana Health Services	November 2003	Pinjarra	Telephone
Government Departments - State	Environmental Protection Authority	September 2003	Perth	Meeting Presentation
	Department of Industry and Resources	25 July 2003	Perth	SRG Meetings
	Department of Environment	September 2003 October 2003 November 2003	Perth	SRG Meetings Open Day and Fair

Group	Stakeholder	Date	Location	Method of Consultation
	Department of Health	October 2003 November 2003	Perth	Meeting
	Department of Premier and Cabinet	September 2003	Perth	Meeting
Members of Parliament	Premier of WA		Perth	Presentation
	Minister for Community Development	October 2003	Perth Mandurah	Presentation Public expo
	Minister for the South-West	November 2002	Dwellingup Perth	Meeting
	Minister for Health	October 2003	Perth	Meeting
	Shadow Minister for Health	October 2003	Perth	Meeting
	WA Parliamentary Secretary to the Treasurer	October 2003	Perth	Meeting
	President of the Legislative Assembly	November 2003	Dwellingup Perth	Meeting
	Member for Murray-Wellington	October 2003 November 2003	Perth Dwellingup	Presentation Meeting Newsletter articles
	Member for Mandurah	October 2003	Perth	Presentation Newspaper articles
	Member for Dawesville	16 July 2003	Mandurah	Presentation Meeting Newsletter articles
Unions	AMU		Pinjarra	Telephone
	AMWU		Perth Pinjarra	Telephone

Group	Stakeholder	Date	Location	Method of Consultation
Media	Mandurah Mail	July 2003	Mandurah	Media statement
	Coastal Times	July 2003	Mandurah	Media statement
Other	Residents		Kwinana Rockingham Harvey Yarloop Waroona Bunbury Hamel	Pinjarra Festival

TABLE D2: Issues Raised During Consultation

(Issues of direct relevance to the Environmental Protection Statement are highlighted)

ENVIRONMENTAL ISSUES

Issues Raised by SRG

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
Air emissions	Will the project use best practice air emissions management	Landcare Group (Sept 3)	An air emissions inventory has been completed. Monitoring has been undertaken by expert consultants and specialist laboratories both accredited by NATA, and using recognised Australian or USEPA standards. Modelling has been undertaken by a consultant using recognised modelling programs. The project is committed to reduce VOC's, particulates and to offset NO_x emissions, and will do so using the latest technology in; wet scrubbers, regenerative thermal oxidisers, electrostatic precipitators and baghouses.	1. Implement the project requirements.	Response accepted – Independent Expert review performed (SRG chose Jack Chiodo)	Air Emission/Odour Presentation - 24/9– G Baird Section 6.3 of EPS Air Emissions Expert Review report
Health	Will there be an impact on community health	Neighbours/Farming Group (Sept 3)	Alcoa has modelled the emissions from the refinery and commissioned an expert to conduct a Health Risk assessment. Ground level	1. Review output of HRA for any potential changes	Response accepted – Independent Expert review of HRA performed (SRG chose Philip	Air emissions/odour presentation – 24/9 – G Baird Section 6.3.6 of EPS

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			concentrations were found to be well within health guidelines, A comprehensive health risk assessment will add another dimension to this assessment.		Weinstien)	
Odour	Will there be an Odour impact for the community	Neighbours/Farming Group (Sept 3)	A 10% reduction in VOC's will result in an equivalent odour reduction.	Implement project requirements	Response accepted	Air emissions/odour presentation – 24/9 – G Baird Section 6.3.5 of EPS
Dust	Will the project provide equal to or better than current performance on dust management. Will best practice dust management be employed.	Workforce Group (Sept 3). Landcare Group (Sept 3) 2 community members 22/10 open day	The project has committed to improve residue dust emission by making improvements to dust control measures. The project will have minimal impact on dust, however, as residue area increases over time this has the potential to increase the risk of dust. A variety of techniques are used to control dust, including sprinklers, stone or wood mulching, cropping, use of local wind forecasting	1. Implement project changes.	Questions on dust constituents – response provided 8/10.	Dust Presentation – 24/9 – G Baird Dust Constituents & Fine Particles and PM2.5 presentation – 8/10 – G Baird Section 6.3 of EPS
Water use	Will the project have an impact on groundwater. Precise monitoring of water table impacts on neighbouring land. Best Practice water management	Neighbours/Farming Group (Sept 3) Landcare Group (Sept 3)	In normal rainfall years the refinery can meet its needs within the sustainable yield of the groundwater aquifer. Alcoa is interested in developing a low grade source to supply the additional water required for this upgrade.	1. develop options with Water Corp. A letter of intent is being drafted.	Response accepted	Water presentation – 8/10 - G. Baird Sections 6.10 and 6.15.1 of EPS
Water use	What is the impact on surface	Neighbours/Farming	There will be no change to our	No actions	Response accepted	Water presentation 8/10 – G

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
	water runoff.	Group (Sept 3). Landcare Group (Sept 3)	surface water harvesting pattern after the upgrade. We have 3 dams on our property that supply over 30% of our needs. We have conducted environmental water requirement studies for each of the dams and the requirements are exceeded.			Baird Section 6.10.2 of EPS
Water Catchment	Oakley Brook does not flow all year.	Local Council Representative (SRG)	Oakley Brook does not normally flow all year. A downstream neighbour confirmed this to the SRG. The newest of Alcoa's three dams – the Lower Oakley Pumpback is a 3 metre structure which is designed to harvest during peak stream flows. Flow is continuously released through a drain in the wall.	No actions	Response accepted	Section 6.10.2 of EPS
Noise	Refinery noise – will the refinery increase noise levels	Neighbours/Farming Group (Sept 3), Workforce Group (Sept 3)	There will be no increase in noise emissions from the refinery. The project will implement noise control measures on new and modified equipment to ensure this is met.	1.Implement project requirements 2. Carry our noise survey as part of project implementation.	Response accepted	Noise Presentation – 15/10 – G Baird Section 6.5 of EPS
Noise	Train noise – there is rail screech noise when laden bauxite trains heading to Kwinana pass over a curve in the line entering PJ town from the south	Neighbours/Farming Group (Sept 3)	This project will not change the number of trains heading north to Kwinana, however we are continuing to work with Westnet Rail to determine the economic impacts of realigning the curve that is	1. Facilitate discussions with Westnet rail to finalise plans for realignment of rail line	Response accepted	Section 6.5.6 of EPS

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			subject of most concern.			
Design	Improve environmental controls during design phase	Workforce Group (Sept 3)	Design review process incorporates EH&S reviews and risk assessments and workforce representatives are involved. E.g. Seed Filtration building location discussion.	1. Follow design review process	Response accepted	1.Quick Find guide showing procedures 2.Environmental Risk Assessment procedure 3. EH&S Design review process 4. Statutory approval check list
Feral animals	Control of rabbits, foxes, pigs on Alcoa land and neighbouring areas	Landcare Group (Sept 3) Neighbours/Farming Group (Sept 3)	The project will not impact the control of feral animals. However Alcoa recognises its role in the local farming community and will play its part in feral animal control	Re-establish a fox control program and investigate rabbit and pig control	Response accepted	Section 6.7 of EPS
Light spill	Will there be more light spill at night?	CCN/Residents Group (Sept 3)	Alcoa recognises the amenity impact of light spill but also needs to ensure that its workforce are provided with adequate lighting during the night time. A design approach including the use of lower wattage lamps is applied to minimise the light spill. It is expected that less than 7% extra lighting will be required and with some of the additional light being inside enclosed buildings the overall impact of the additional lighting is not expected to be noticeable.	1. Apply design philosophy to minimise light spill 2. identify a means of demonstrating no noticeable change e.g. examine whether before and after photographs will work	Response accepted	Section 7.3 of EPS
Revegetation	Demonstrate revegetation of disturbed residue area	Landcare Group (Sept 3)	At the refinery the project will not disturb natural or original vegetation areas.	No action for the project.	Response accepted	Rehabilitation - Research Activity

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			In the residue area initial rehabilitation is with grasses but typically a year after construction of the batter walls the area is revegetated with native vegetation including shrubs, ground cover and small trees. The Mining rehabilitation program is considered world's best practice. e.g. UN Global 500 roll of honour.	However, as part of normal operations the Residue area are looking to establish new demonstration rehabilitated areas on RDA 4 batters over next 2 years. This is part of a program to accelerate rehabilitation over the next 3-4 years.		Sections 6.6.3 and 6.16 of EPS
Clearing of Remnant Vegetation	Flora and fauna surveys of remnant vegetation before further clearing	Landcare Group (Sept 3)	No clearing of remnant vegetation, within the Refinery or farmlands is planned as part of the project. Mining operation will continue to follow government approved baseline survey program relating to fauna and flora.	No action planned	Response accepted	Vegetation monitoring reports Sections 5.6, 5.7, 6.6,6.7 of EPS
Stream zones on Alcoa land	Streamlining and nutrient trapping on waterways flowing from Alcoa farm (some glaring flaws at present)	Landcare Group (Sept 3)	The project will not impact on this issue.	Tree planting planned for Oakley south area during winter 2004.	Response accepted	
Traffic	Extra traffic through Pinjarra town during construction	CCN/Residents Group (Sept 3)	Work with the SRG to collect more data on the baseline and supply information on the impact of the Efficiency Upgrade. Most of the heavy vehicle traffic for the	Assist the Murray Shire with baseline survey and provide estimates of traffic movements	Response accepted	MRD reports from June 2000 Section 6.14 of EPS

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			construction program will not come through the Pinjarra town. Alcoa understands that the local community is concerned about traffic volume through the town of Pinjarra and has made available land that would be used for a bypass being considered by the local community. These concerns will be eased if there is a heavy-duty bypass.			
Traffic	Access to areas like North Spur Road	CCN/Residents Group (Sept 3)	Construction traffic will be managed to ensure access to these areas are not impacted			Section 6.14 of EPS

Issues Raised by Others

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
Radiation	What is the Residue area radiation Concern about the clarity of information available and that residue land was not available for residential housing	WA Conservation Council and SRG members	The levels of radiation are below safe levels and this project will not change the level of radiation resulting from the disposal of residue. Government bodies, including the radiation council have determined that future land use options for residue should include agricultural and light industrial but not residential housing.	Clarify the information provided on residue radiation.	Accepted with the requirement to provide improved communication for local community.	Radiation fact sheet –8/10
Residue area Land Use	What are the long term residue requirements Concern raised that the residue area consumes too much valuable land and that it prevents higher value use of surrounding areas	SRG members/ WA Forest Alliance/Tony Hall	The project does not incorporate additional residue area. However, there is a parallel planning process that addresses the future impacts and plans with the land use requirements for residue.	Implement the process for engaging local community in residue long term planning in parallel with the Efficiency Upgrade project	Agreement that community involvement in residue planning was critical and that it needs to occur prior to further expansion of the residue footprint.	Residue Long Term planning strategy presentation – 8/10 V. Guthrie & A. Bermingham Section 6.11.2 of EPS
Greenhouse	What is the Greenhouse impact of this project	WA Forest Alliance	Greenhouse intensity improves by 5% for this project but 14% if you include the steam produced by the Co-generation facility provided by Alinta. The additional electricity required for the upgrade is likely to be provided by a co-generation source. Alcoa	1. implement project requirements 2. develop GHG abatement plans.	Response accepted	Section 6.4 of EPS

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			worldwide is targeting a 20% reduction in greenhouse emissions by 2005 based on a 1990 baseline.			
Forest Clearing	Mine area clearing Query on whether the increased rate of clearing at Huntly as a result of the PJ Efficiency Upgrade would increase the Area Open	WA Forest Alliance Wildflower Society	Alcoa's mine rehabilitation is a recognised benchmark. We rehabilitate all mined areas with a self sustaining Jarrah forest eco-system. The average number of indigenous plant species in a 15 month old rehabilitation area is 100% of the number found in representative Jarrah forest sites. The increased rate of clearing at the Huntly Mine as a result of the Pinjarra Efficiency Upgrade will be approximately 30 hectares/year. We also plan to increase our rate of rehabilitation by 30 hectares/year. Our objective is to rehabilitate areas progressively as soon as they become available after mining	No change to current program	Response accepted	Bauxite Mining and Conservation of the Jarrah Forest in South West Australia – paper by John Gardner and Geoff Stoneham Sections 5.6.1 and 6.6.1 of EPS
Residue Liners	Concern raised about the quality of plastic liners and clay used for lining residue areas. Also concern about the quality of workmanship	Anonymous – employee of plastic liner installer	Quality of materials is assured through use of appropriate standards and inspection through manufacture and installation. Alcoa has recently	No project specific actions, although there is a need to communicate residue storage	Response accepted.	

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			completed an investigation to check the long term performance of the PVC liner. A sample, which represented around 16 years of exposure to alkaline conditions was taken. The tests showed that the liner was still performing to all its design parameters without degradation. All residue storage areas built since 1980 include a full composite (clay and PVC) liner and underdrainage layer. There are no indications of seepage from any of these composite lined storage areas.	quality assurance programs to stakeholders		
Water Recycle	What plans are there to minimise the loss of water	DoE/EPA	A number of options have been considered to provide the 1,100ML needed for the upgrade. These include; reducing evaporation from the water storage reservoir, capture of steam from some sections of the process (blowoff vapour capture), use of lower grade sources such as saline Murray River water, or recycle water from the Water Corporation Gordon Rd sewage treatment plant.	Continue process to identify a water source for the upgrade. Detailed feasibility studies are underway to explore the recycle water option further. It is also likely that blow off vapour will be captured resulting in a water saving of approximately 350ML pa	Response accepted	Section 6.10.4 and 6.10.5 of EPS

SOCIAL ISSUES

Issues Raised by SRG

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
Contractor workforce	Short term contractors < 2 years	Workforce Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Catering	Adequate catering facilities needed	Workforce Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Commissioning	Employee training wanted	Workforce Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Consultation	Ensure two way communication, active involvement and participation (Communication has been lacking until recent years)	Neighbours/Farming Group (Sept 3)	This project will be developed with community participation. Neighbours communicated to at regular key project milestone achievements through - Letters and fact sheets, website, newspaper adverts, Pinjarra newsletter and through a bi-annual house visit.	Project consultation process to continue	Response accepted	Neighbour Day – newsletter/invitation Project Open day held on 22/10 also 1/11 at PJ Fair Section 7.1 of EPS
Consultation	Communication has been lacking until recent years	Neighbours/Farming Group (Sept 3)	Alcoa has developed an extensive list of stakeholders and will ensure the Pinjarra Refinery newsletter will be distributed to all residents of Shire of Murray Regular updates will be mailed out.	Project consultation in place.	Response accepted	Section 7.1 of EPS
Consultation	Risk of negative image for the	Neighbours/Farming	Alcoa endeavours to keep		Response accepted	

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
	area due to bad publicity	Group (Sept 3)	all stakeholders regularly informed of the project. A stakeholder matrix has been developed. We will liaise face to face with anyone who signals a problem or issue with the project. Alcoa will listen to, and respect people's views.			
Design	Employee involvement wanted	Workforce Group (Sept 3)	Asset Owner Team Leaders have been appointed to ensure adequate representation on the project team. Their role is to ensure involvement from all areas of the workforce	Ensure project procedures implemented	Response accepted	
Employment	More local employment	CCN/Residents Group (Sept 3)	*To be addressed as part of ongoing consultation*			Section 7.2 of EPS
Employment	Workforce structure in the future	CCN/Residents Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Employment	Will there be any more jobs at Alcoa?	CCN/Residents Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Employment	Size of the construction workforce	CCN/Residents Group (Sept 3)				Section 2.3 of EPS
Employment	More permanent employees compared to contractors	Workforce Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Fairbridge	Both a neighbour and tenant for Alcoa	Neighbours/Farming Group (Sept 3)	As a sponsor of Fairbridge, Alcoa will ensure that its needs are met.	Continue current neighbour and commercial relationships.	Response accepted	Section 7.2 of EPS
Fairbridge	Impact on eco-village and eco-tourism at Fairbridge	Neighbours/Farming Group (Sept 3)	As a sponsor and board member of Fairbridge, Alcoa is committed to		Response accepted	Section 7.2 of EPS

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
			maintain and improve its eco-tourism objectives			
Neighbourhood	Risk to lifestyle	Neighbours/Farming Group (Sept 3)	Alcoa will endeavour to ensure there are no significant changes to the refinery operation that will impact beyond our boundary		Response accepted	Sections 7.2, 7.3 of EPS
Property values	Property values in the area could decline	Neighbours/Farming Group (Sept 3)	This project will build confidence and deliver economic benefits to the area that should provide encouragement to people to live in the area		Response accepted	

ECONOMIC Issues Raised

Issues Raised by SRG

Issue	Details	Identified by (date)	Alcoa Responses	Actions	Status	Information Provided
Business	More spending locally	CCN/Residents Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Business	Will there be more work for local contractors?	CCN/Residents Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Business	Improve understanding of how to do local business with each other. Improve business liaison by Alcoa.	Business Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Business	Develop a local business directory	Business Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Business	Attract more business to local area	Business Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Catering	Local businesses to tender for catering service	Workforce Group (Sept 3)	*To be addressed as part of ongoing consultation*			
Property values	Property values in the area could decline	Neighbours/Farming Group (Sept 3)	*To be addressed as part of ongoing consultation*			
	Improve the communication about radiation to the community		*To be addressed as part of ongoing consultation*			
	Add Peter's list from the employees to the Register.					

Appendix E

Community Consultation
(Supporting Information)

REFER TO DIGITAL COPY OF REPORT FOR COMPLETE APPENDIX E