WAGERUP
Environmental Improvement Plan
2017-2021

Alcoa

*The Element of **Possibility**™*

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For more information on Alcoa of Australia's Environmental Improvement Plans please visit **www.alcoa.com.au.**

2017 – 2021 Environmental Improvement Plan for Wagerup

Overview and acknowledgements

In April 2006, Alcoa of Australia (Alcoa) released for the first time an Environmental Improvement Plan (EIP) for each of its sites in Western Australia. EIPs are a voluntary initiative by Alcoa and were a first for industry in this state. Subsequent plans were released for 2008 – 2009, 2011 – 2013 and 2014 - 2016.

This EIP outlines Alcoa's commitment to continuously improve Wagerup refinery's environmental performance, reduce environmental impacts and develop more sustainable operating practices. This EIP also forms part of the refinery's operational plan for 2017 – 2021.

Alcoa recognises that input from stakeholders is vital, which is why several sectors of the community assisted in the development of this EIP. New environmental targets, aims and actions have been established thanks largely to the Wagerup EIP Stakeholder Reference Group which included community members, Alcoa employees and local government representatives.

Simon Pascoe

General Manager
Western Australian Refining Operations

Alcoa is committed to the communities surrounding Wagerup refinery and acknowledges that initiatives based on ideas from key stakeholders help to maintain continuous improvement. It is also the intention that this EIP will give the local communities a much better understanding of Alcoa's activities.

External involvement and review is integral to the success of this EIP and the information on the following pages will be useful to measure progress in meeting set targets.

Sincere thanks are extended to everyone involved in producing this EIP, particularly members of the Wagerup EIP Stakeholder Reference Group who have given their personal time to help Alcoa progress environmentally. The EIP consultation process is a working example of community, government and business coming together for a common purpose.

Mark Hodgson

Manager
Wagerup Alumina Refinery

Overview of Alcoa of Australia's operations

Alcoa of Australia (Alcoa) has been sustainably mining, refining and smelting in Australia since 1963 and is active in all major aspects of the aluminium industry. The company employs approximately 4,300 people, predominantly in regional Australia.

PRINCIPAL OPERATIONS IN WA

- Huntly Bauxite Mine
- Willowdale Bauxite Mine
- Kwinana Alumina Refinery
- Pinjara Alumina Refinery
- Wagerup Alumina Refinery
- Bunbury Port

PRINCIPAL OPERATIONS IN VIC

- Portland Aluminium Smelter

Australian operations overview

The Huntly and Willowdale bauxite mines in the Darling Range south of Perth supply bauxite to Alcoa's three alumina refineries at Kwinana, Pinjarra and Wagerup. These refineries extract alumina from the bauxite. The Huntly mine is the world's second largest bauxite mine.

Alcoa's aluminium smelter is located at Portland in Victoria. Portland Aluminium Smelter is a joint venture between Alcoa of Australia Limited (45 per cent), which manages the day to day operations; Eastern Aluminium Portland Pty Ltd (10%) (a wholly owned subsidiary of Alcoa of Australia); CITIC Nominees Pty Ltd (22.5 per cent); and Marubeni Aluminium Australia Pty Ltd (22.5 per cent).

Wagerup refinery overview

Wagerup refinery has been part of the Western Australian community and economy since operations commenced in 1983.

The refinery, which is surrounded by private agricultural land, is located on the border of Western Australia's Peel and South West regions, 130km south of Perth, 4km north of Yarloop and 13km south of Waroona. It is in close proximity to the Willowdale Bauxite Mine and is 70km from the Bunbury Port. Wagerup refinery and Willowdale mine employ more than 800 people and of those, around 30 per cent live in the local shires of Waroona and Harvey. Wagerup refinery is one of the most environmentally advanced refineries in the world.

Air quality management

Committed to ongoing improvement

The management of air quality from Wagerup refinery receives close community and government scrutiny; Alcoa is committed to ongoing improvement in this area.

Extensive investigations of refinery emissions have been conducted and Alcoa's detailed knowledge of the range and concentration of chemical compounds present is the outcome of years of detailed study by experts, including the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Air emissions from the refinery are usually grouped into two categories, point source emissions and diffuse source emissions.

The primary emissions associated with the refinery processing area are considered point source emissions. They arise where refinery gases or particulates are emitted to the atmosphere through identified points such as stacks and vents.

Diffuse source emissions originate over a broader area where there is little or no redirection of the vapours or particulates. Emissions from various parts of the Residue Storage Area (RSA) and bauxite stockpiles are considered diffuse source emissions.

The primary air emissions from the refinery include:

- Particulate matter – total suspended particulates and various sizes of dust.
- Volatile organic compounds (VOCs) – such as aldehydes, ketones and aromatic compounds.
- Combustion gases – such as nitrogen oxide (NOx) and carbon monoxide (CO).
- Trace metals.
- Odour.

Understanding and reducing air emissions

In previous years Alcoa has worked with scientists from the Department of Environment Regulation (DER), Chemistry Centre of Western Australia, the CSIRO and community representatives to better understand and manage air quality at Wagerup refinery.

This work has contributed to a number of successful emission reduction projects which have resulted in significant improvements in odour, VOC and combustion gas impacts including:

- Odour emissions reduced by 60 per cent since 2000.
- VOCs emissions reduced by 30 per cent in 2002.
- Powerhouse NOx emissions reduced by 60 per cent.
- Calciner 3 formaldehyde emissions reduced by 75 per cent in 2004.
- Liquor burner odour and VOC emissions reduced by >90 per cent following the installation of the regenerative thermal oxidiser in 2006.

Outcomes of detailed monitoring and modelling work conducted in 2005 and 2006 show the air quality around Wagerup refinery is typical of a rural Australian environment in terms of the nature and quantity of chemicals found. It also found the refinery contributes only a small amount of chemical compounds to local air.

CSIRO air quality review

In 2004 Alcoa commissioned CSIRO Atmospheric Research to undertake an independent Air Quality Review at Wagerup refinery.

The review documented the air quality knowledge and information concerning Wagerup refinery and the surrounding region at the time and assessed various scientific studies undertaken to date.

In the review the CSIRO recognised the work undertaken at the refinery represented “a substantial advance in knowledge about emissions to the atmosphere from alumina refineries”.

As part of the review the CSIRO made 18 recommendations aimed at further understanding air quality around the refinery.

Each of these recommendations has been acted upon by Alcoa with reports presented to the Community Consultative Network (CCN)

Residue dust management

Residue dust management is of significant importance to both Alcoa and the local community. The potential for residue dust to have off-site impacts during dry and adverse weather conditions means Alcoa has progressively introduced new technology to improve monitoring and management of residue dust.

Wagerup refinery has five dust monitors located around the refinery for compliance monitoring. In addition to these, the refinery has four continuous dust monitors for internal residue dust management purposes. The continuous monitors are used as an early warning system and trigger a management response to prevent dust generation.

The dust management systems in place are complex and consist of a range of both proactive and reactive strategies. Alcoa uses online weather forecasting systems to predict adverse weather conditions and allow preparation time for forecast winds. Experience has shown that pre-wetting the residue areas in anticipation of forecast winds significantly reduces the potential for dust generation.

Specific dust control strategies with a focus on minimising water use include:

- Use of wood chips and blue metal instead of water to cover areas which can generate dust.
- RSA bank stabilisation with mulch, bitumen or grass.
- Revegetation of external embankments with native vegetation.
- Ripping of residue drying areas during summer to expose wet mud to lower the water usage required for dust suppression of the mud surfaces.
- Shallow pouring of mud, which allows previously poured mud to be covered with fresh mud before completely drying, thereby reducing the need for sprinklers.

Air quality improvement targets

Particulates

Objective	Action
Minimise risk of dust generation from operations.	Increase the use of green alternatives for dust control (e.g. pasture and mulch) and rehabilitate where practical and reasonable. Identify opportunities to further improve dust management systems, including sprinkler system and weather forecasting data methods, and implement where practicable. Provide annual updates to the CCN on dust management data and compliance with internal dust management standards.

Odour

Objective	Action
Continue to investigate options to reduce refinery air emissions.	Review and update the refinery emissions inventory, investigate opportunities for reductions and prioritise according to practicality and environmental benefit. Utilise the emissions inventory work to gain an understanding of the composition of typical refinery odours. Provide annual updates to the CCN on air emission management, trends and improvements. Investigate options for reducing greenhouse gas emission intensity.

Noise management

Noise from Wagerup refinery is recognised as a potential impact on residents living close to the refinery and is therefore a priority area of environmental management.

Refinery equipment significantly contributing to noise emissions includes:

- Ore and alumina conveyors.
- Ore stacking, reclaiming and milling equipment.
- Pipe work, pumps, fans and blowers involved in liquid, steam, air and solids movement.
- Liquor, steam and air flow control valves and associated equipment.
- Fans and pumps associated with pollution control equipment.
- Steam and electric power generation plant and calciners.

Noise reductions were achieved as part of a program implemented from 1999 to 2001. The program reduced night-time noise levels at Boundary Road, to the south of the refinery, by approximately 5 decibels (db(A)). Despite achieving this reduction, noise monitoring and modelling confirmed that refinery noise emissions still exceeded night-time assigned noise levels at some private residences under worst case weather conditions.

In 2002 Alcoa submitted an application as allowed by Regulation 17 of the Environmental Protection (Noise) Regulations to increase the assigned refinery noise levels to those achieved by the noise reduction program.

Alcoa has committed to ensuring ongoing noise emissions are managed by a noise management strategy.

Variation to assigned levels

In 2012 the Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Approval was granted by the Minister for Environment. This varies the assigned noise limit levels for the refinery from the standard levels prescribed in the regulations. It does not allow increased noise, but rather brings current noise levels within the regulations.

Noise improvement targets

Monitoring

Objective	Action
Maintain compliance with the *Environmental Protection (Noise) Regulations 1997.*	Provide annual updates to the CCN on compliance with the noise approval.

Water conservation and management

Water resource

Water is a valuable community resource and Alcoa has a strong commitment to water conservation and using fit for purpose water. This means where possible, Alcoa deliberately sources and uses lower quality water, which has less value to other water users.

Wagerup refinery is located adjacent to one of the largest irrigation regions in Western Australia (WA), bringing with it additional responsibility to minimise potential impact on irrigator allocations. As part of its commitment to have secure water available for irrigators during any prolonged drought period, Wagerup refinery has a contractual commitment with the farmer-owned irrigation cooperative Harvey Water. The financial certainty provided by this agreement has enabled Harvey Water to develop infrastructure to support the transfer of water from Wellington Dam (the largest fit for purpose water storage dam in south-west WA) to the Harvey-Waroona Irrigation District.

This enables a volume of fit for purpose water, equal to or greater than Alcoa's industrial water requirements, to be transferred from Wellington Dam to Harvey Dam and then on supplied to Wagerup refinery. This water is part of the licensed industrial allocation held by Harvey Water for Wellington Dam. Delivery of this water is planned for early spring and autumn to minimise disruption to the delivery of irrigation water during summer.

Wagerup refinery is focused on effective water recycling and does not discharge any water off site. Water losses occur through steam from the process, evaporation from water storage and residue surfaces and water bound within residue mud and sand.

The reduction of residue sprinkler spacing has resulted in more efficient water use and dust reduction.

Groundwater management

A business objective for Wagerup refinery is to have zero loss of containment incidents and in recent years there has been good progress towards achieving this goal. Loss of containment incidents are reported in line with Alcoa's internal reporting systems.

A comprehensive groundwater monitoring program is in place to identify and manage groundwater quality impacts with results reported annually to the DER and Department of Water.

Monitor bores installed near refinery process buildings have shown some low level groundwater contamination. This is due to past operational practices and meeting the regulations and standards of the time which are no longer acceptable due to a greater focus on environmental management. To assist with remediation, groundwater recovery bores have been installed within the refinery. Water recovered is directed into the refinery process and included in annual water use calculations reported to the CCN and authorities.

Water use improvement targets

Water use

Objective	Action
Increase efficiency of water use.	Continue to improve water efficiency and implement projects where feasible. Provide annual updates to the CCN on the refinery's water balance, water use and water strategies.

Ground water

Objective	Action
Minimise potential off site groundwater impacts.	Continue to improve secondary and tertiary containment to reduce the risk of spills to open ground.

Management

Objective	Action
Actively manage contaminated sites investigations and reporting requirements for the refinery and residue areas.	Implement requirements of *Contaminated Sites Act 2003* in line with DER contaminated sites guidelines. Provide an annual update to the CCN on contaminated sites investigations.

Land stewardship and visual amenity

Alcoa is responsible for the management of land covered by Wagerup refinery's operational areas and Alcoa owned farmlands surrounding the refinery. Each area has its own unique set of environmental and land management needs.

Wagerup refinery has a land use management plan which specifically addresses land use planning and the successful integration and interaction between heavy industry, farming and conservation. It addresses land management issues for wetlands, vegetation, fauna, heritage and visual amenity.

The refinery's land management program protects areas of remnant vegetation and progressively enhances and links these areas with ecological corridors for native fauna. Natural or realigned watercourses on Alcoa's property have been rehabilitated to create corridors for fauna movement.

Work undertaken to enhance the existing flora and fauna features of the land surrounding the refinery include:

- Extensive earth works, planting and infill planting along Somers Road, Waroona, bordering the Residue Storage Areas.
- Participation in the Harvey River Restoration Taskforce Bancell Brook Project.
- Weed control, planting and feral animal control in the South West Ecological Corridor.
- Screen planting on McClure Road.
- Planting native flora in the Bancell Road Rail Loop.
- Refinery planting and landscaping.
- Development of Dan's Block, located alongside Bremar Road, a vital connection in the Peel Biolink Project.

Future tree planting is designed to complement the extensive planting already undertaken around the residue area and along the ecological corridors being established.

Land stewardship improvement targets

Biodiversity

Objective	Action
Positively contribute to the biodiversity of the region.	Provide an annual update to the CCN on Greening Australia partnership activities.
	Implement feral animal control programs in and around the refinery and communicate strategies to neighbours.
	Conduct triennial flora and fauna surveys.
	Implement management plan for Bancell Loop paddock and wetland project.
	Continue to investigate options for more environmentally friendly weed control practices and implement where practicable.
Improve visual amenity around the residue storage areas.	Progress development of a long term visual amenity plan taking into account life of mine footprint, refinery expansion and future surrounding land uses.
	Provide an annual update to the CCN on land management activities.
Actively manage Alcoa landholdings to enhance and conserve natural ecological attributes while maintaining a commercial enterprise.	Manage bushfire risks on landholdings.
	Maintain and enhance the environmental value of Alcoa landholdings (wetlands, streams and environmental corridors) where feasible and practical.
	Provide an annual update to the CCN on mining activities within the local area.

Waste management

From waste to resource

For more than 30 years Alcoa has been investigating opportunities to produce economically viable products from bauxite residue. By identifying and demonstrating a range of alternative uses, bauxite residue may become a resource rather than a waste in the future.

Alcoa's residue sand is currently used for the construction of residue storage areas, with excess being stored within these storage areas. Alcoa has also developed a process to wash and carbonate the sand so that it can be considered for alternative value-adding applications.

The resulting product is known as Red Sand™, which has a nominal particle size of +100 micron and is physically similar to crushed bauxite.

Red Sand™ is a well-structured material and exhibits beneficial phosphate retention properties. Red Sand™ has been successfully trialled in various applications, including turf top dressing, road base construction and industrial land development. It has also been successfully trialled as an alternative material for golf course bunker sand.

Waste management improvement targets

Residue re-use

Objective	Action
Continue to investigate options to use refinery generated waste (e.g. Red Sand™).	Provide an annual update to the CCN on the status of residue re-use strategies.

Oxalate

Objective	Action
Progress with the oxalate management strategy.	Progress with the design and implementation of further oxalate treatment at the refinery. Investigate options for alternative oxalate use.

Litter

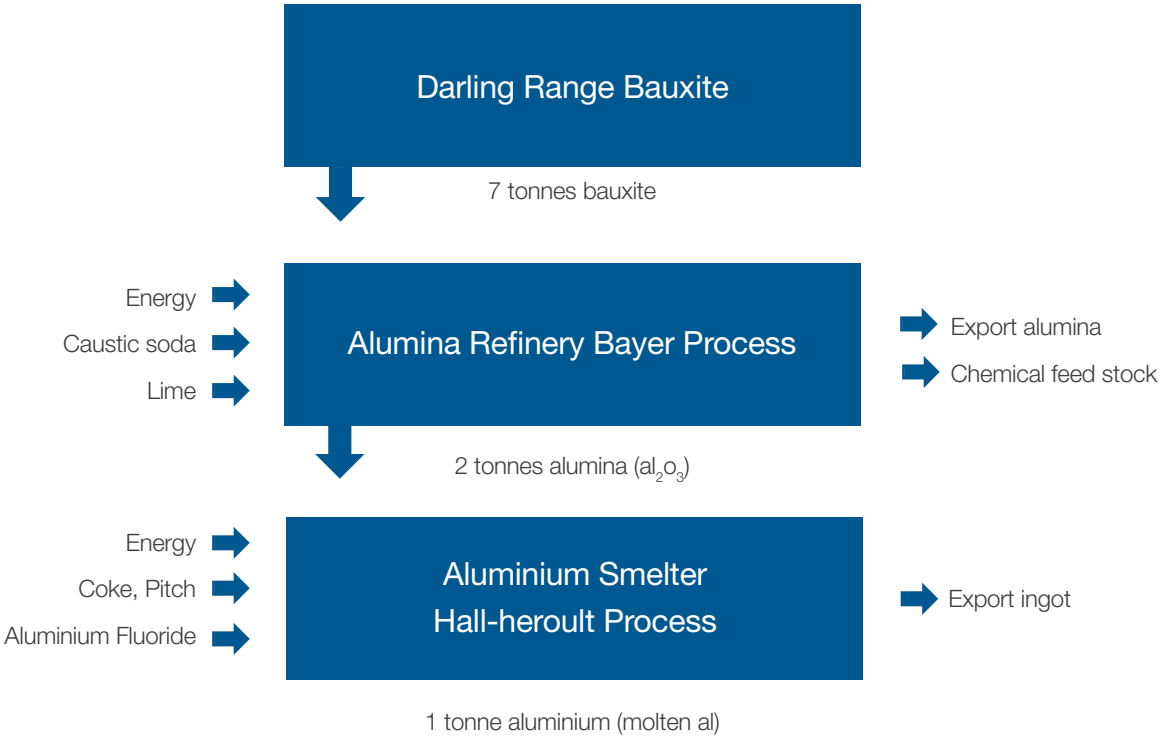
Objective	Action
Maintain a proactive approach to litter.	Periodic litter collection along refinery access road.
Reduce waste going to landfill.	Continue to improve the refinery recycling program. Promote recycling programs to the refinery workforce. Investigate options for alternative use/reuse of waste streams. Provide an annual update to the CCN on waste management and recycling performance.

How aluminium is made

From bauxite ore to versatile metal

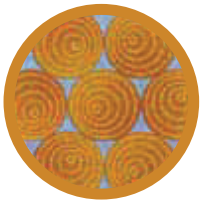
The aluminium making process starts with a chemically altered and weathered rock known as bauxite. Its colour and texture looks little more than ordinary gravel. However, its careful extraction from mines in the Darling Range of Western Australia starts a process which since the beginning of the 20th century has revolutionised the transport, building and other high technology industries.

By mixing bauxite with caustic soda, and then pressure heating, Alcoa extracts alumina in a fine white powder form. Alumina is shipped to Portland Aluminium smelter in Victoria and exported around the world. The alumina is then smelted at very high temperatures and an electric current passed through it to form aluminium – one of the world's most versatile metals.



From dirt to aluminium

Mining and Rehabilitation



Preparation of mining area

After clearing of timber and other material, topsoil and overburden are carefully removed and returned after mining when the areas are being rehabilitated.

Bauxite mining

A 4-5 m layer of caprock and bauxite is removed using large excavators or loaders and haul trucks.

Crushing plant

Ore is taken to a crusher where it is crushed into smaller pieces.

Ore conveyors

The ore is then transported by conveyor belt and rail to the refineries for processing.

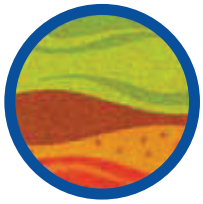
Rehabilitation

After mining, topsoil and overburden are returned to the area and the site is prepared for revegetation.

Refining Process

Digestion

Finely ground bauxite is mixed with hot caustic soda solution to dissolve the alumina from the bauxite. Every seven tonnes of bauxite makes two tonnes of alumina.



Clarification

Insolubles, such as sand and mud, are settled and filtered out, leaving a solution of dissolved alumina hydrate.

Precipitation

The liquid containing alumina hydrate is then cooled in large open tanks and seed crystals added, causing the alumina to crystalise out of solution.

Calcination

The alumina hydrate is washed, then heated to remove water, leaving a pure dry alumina in the form of a fine white powder. This is cooled and stored, then shipped to smelters for processing.

Smelting Process

Dissolving alumina

Alumina is dissolved in an electrolytic bath of molten cryolite within a large lined furnace known as a “pot”. There are hundreds of pots at a typical smelter.

Chemical process

Alumina is made up of aluminium and oxygen, which need to be separated to produce the metal. Every two tonnes of alumina makes one tonne of aluminium.

Reduction process

A high electric current is passed through pots via carbon blocks. The current flows continuously from the carbon block (positive) through the alumina/ cryolite mix to the lining of the pot (negative), and then on to the next pot.

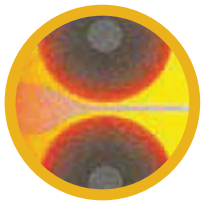
Forming aluminium

Electricity maintains the temperature of the process at about 950°C and enables the alumina to split into aluminium and oxygen, with aluminium settling to the bottom of the pot.

Casting

The molten aluminium is cast at a temperature of just over 700°C to form ingots.

Rolling Process



Hot rolling

Aluminium ingot is reheated to around 600°C, then passed through a hot finishing mill where it is reduced in thickness to 3-6mm.

Coiling

The aluminium strip from the hot rolling mill is coiled and cooled before being sent to the cold rolling mill.

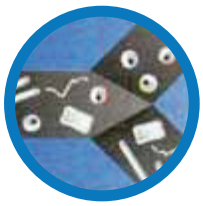
Recycling Process

Final processing and casting

Molten aluminium is transferred to a holding furnace and then cast into ingots. Recycling aluminium consumes approximately five per cent of the energy required to make new aluminium, with no loss in quality.

Initial processing

Coated aluminium (painted or lacquered) is processed through a gas fired rotary furnace before being sent to a “melter” where it is mixed with uncoated or new aluminium.



Classification

Upon receipt, the recycled aluminium is classified so the optimal end use and processing path can be determined.

Preparation

Recycling aluminium starts with preparation for transporting, which involves compaction to improve the density of the aluminium and to reduce freight, storage and handling costs.

Sheet finishing

Most sheet products require a finishing step such as cleaning, coating and slitting. All products are trimmed to customer specified widths.

Cold rolling

The aluminium coil is further reduced (to as thin as 0.24 mm) by three passes through a cold rolling mill. Exit speeds of cold rolling mills are as high as 1000 metres per minute.