PINJARRA
Environmental Improvement Plan
2018-2022
Contents

Overview and acknowledgements ............................................. 3
Overview of Alcoa of Australia’s operations ................................ 4
Air quality management .......................................................... 6
Water conservation and management ......................................... 9
Land stewardship .................................................................... 11
Waste management ................................................................... 13
Community involvement ............................................................ 15
Environmental regulation and management ............................... 16
National Pollutant Inventory ....................................................... 16
How aluminium is made ........................................................... 17
From dirt to aluminium ............................................................. 18

To access Alcoa of Australia’s Environmental Improvement Plans please visit www.alcoa.com.au.
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 Pinjarra Alumina 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 2018 - 2022.

Alcoa recognises that input from stakeholders was vital to the development of this EIP. The environmental targets, aims and actions have been established thanks largely to key stakeholders which include community members, local government representatives, regulators and Alcoa employees.

Alcoa is committed to working with the communities surrounding Pinjarra 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 can be useful to measure progress in achieving set targets.

Sincere thanks are extended to everyone involved in producing this EIP, particularly members of the Pinjarra Community Consultative Network (CCN) who have given their personal time to help Alcoa progress environmentally. The EIP consultation process is a working example of community, government and industry coming together for a common purpose.

Mark Hodgson
Refinery Manager
Pinjarra 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
- Pinjarra Alumina Refinery
- Wagerup Alumina Refinery
- Bunbury Port

PRINCIPAL OPERATIONS IN VIC
- Portland Aluminium Smelter
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.

Australian operations

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 per cent) (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).

Pinjarra refinery

Pinjarra Alumina Refinery is located 90 kilometres south of Perth, a 30-minute drive from the coastal city of Mandurah and six kilometres, or a 10 minute drive, east of the regional town of Pinjarra. It is situated in the Peel region of Western Australia, within the Shire of Murray and is a major regional employer with approximately 1,000 employees.

Bauxite mined from Huntly mine supplies the refinery which officially opened in 1972. The refinery is one of the world’s largest refineries with approval to produce up to 5 million tonnes per annum.

Combined with its co-generation partnership with Alinta, the refinery achieves reductions in greenhouse gas emissions and improvements in the use of natural resources.
The management of air quality from Pinjarra Alumina Refinery receives scrutiny from the community, government and regulators.

For many years, Alcoa has conducted extensive investigations into emissions produced from alumina refining. It has a good understanding of the range and concentration of chemical compounds present in processes and how to effectively manage them.

In 2008, Alcoa commissioned an independent Health Risk Assessment (HRA) for the refinery and residue area as part of the Pinjarra efficiency upgrade to 4.2 million tonnes per annum. In 2014, the refinery's HRA (Environ, 2014) was updated to reflect Alcoa's intent to incrementally increase the refinery's alumina production capacity to 5 million tonnes per annum. The results of the 2014 Health Risk Screening Assessment (2014 HRA) indicated that, based on a 5 million tonne per annum production scenario, the potential for emissions to cause acute or chronic non-carcinogenic health effects as well as the potential for emissions to contribute to the incidence of cancer in the exposed population remains low. The results of the 2014 HRA were subjected to peer review (Professor Philip Weinstein, 2015), with the outcomes of the 2014 HRA and the peer review submitted to the Western Australian Environmental Protection Authority. Both are available at www.alcoa.com.au.

The primary air emissions from the refinery include nitrogen oxide (NOx), carbon monoxide (CO), particulates in the form of alumina dust, volatile organic compounds (VOCs), residue dust and trace levels of metals.

**Nitrogen oxide (NOx), carbon monoxide (CO) and particulates**

Emissions of NOx and CO come from the use of fossil fuels such as natural gas and are released from the refinery’s powerhouse, calciners, oxalate kiln and digestion regenerative thermal oxidiser. Emissions of particulates are released from the calciners (in the form of alumina dust) and to a much lesser extent, the oxalate kiln.

**Volatile organic compounds (VOCs)**

VOC emissions are caused by the breakdown of organic material contained in the bauxite, additives to the refining process (liquor stream) and by-products of fuel combustion processes.

During alumina refining, the organics produce a range of substances, some of which are emitted to air. The VOC emissions cause the odour associated with alumina refineries.

**Greenhouse gases**

Alcoa Corporation has a target to reduce carbon dioxide equivalent intensity by 30 per cent by 2020 and 35 per cent by 2030 from a 2005 baseline. In 2016, a 36.9 per cent reduction was achieved globally, years ahead of schedule.

Through productivity improvements and technological innovation, Alcoa will continue to target a reduction in greenhouse intensity of its operations, while striving to increase production.
Dust

The main source of dust from the refinery is from the Residue Storage Area (RSA). If dry residue surfaces are not well managed, high wind speeds can pick up and transport fine dust particles.

Dust generated from the RSA mainly consists of fine clay particles and sodium carbonate crystals. Sufficient concentrations of this material could be an irritant to the eyes and respiratory tract. Monitoring and modelling data illustrate it is extremely unlikely to reach levels sufficient to affect neighbouring communities in this way. Dust is also generated at the bauxite stockpiles area. This dust has not been treated with caustic and has similar properties to background dust from the Darling Range. Alcoa has several ambient dust monitoring stations located around the refinery. Dust emissions from the refinery and residue drying areas are monitored daily. This data is used to assess the effectiveness of dust control measures and facilitate improvements in management practices where required.

Noise

The closest noise sensitive premises to Pinjarra refinery's boundary are approximately four kilometres to the south and north-east of the refinery. Noise monitoring conducted at the refinery indicates the closest noise sensitive premises north and south of the refinery may experience noise levels above the regulatory levels on some occasions. Premises to the west of the refinery recorded noise data well below the regulatory levels.

Air quality improvement targets

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimise risk of dust generation from Pinjarra Alumina Refinery and RSA and aim to maintain dust level below 90µg/m³ at the Pinjarra racecourse monitor.</td>
<td>Actively manage dust and investigate opportunities to further improve management practices.</td>
</tr>
<tr>
<td></td>
<td>Investigate opportunities to further improve particulate control on calciners and implement where practical.</td>
</tr>
<tr>
<td></td>
<td>Continue using weather forecasting to actively manage dust.</td>
</tr>
<tr>
<td></td>
<td>Implement Phase One of the Pinjarra Residue Filtration Facility.</td>
</tr>
<tr>
<td></td>
<td>Continue use of temporary dust monitors to manage construction / project dust where required.</td>
</tr>
<tr>
<td></td>
<td>Review dust monitoring radio network communication system.</td>
</tr>
<tr>
<td></td>
<td>Progress transition of internal dust monitors from tapered element oscillating microbalances to beta attenuation monitors.</td>
</tr>
</tbody>
</table>
Air quality

**Objective**

Continue to investigate options to reduce air emissions.

**Action**

- Investigate options for reducing greenhouse gas emission intensity.
- Update the CCN on air emission management, trends and improvements.
- Identify major sources of air emissions, investigate opportunities for reductions and prioritise according to practicality and environmental benefit.

Noise

**Objective**

Compliance with the Environmental Protection (Noise) Regulations 1997.

**Action**

- Continue implementing the refinery's noise management plan.
- Update CCN on noise plan implementation.
- Implement noise amelioration controls as part of Phase One of the Pinjarra Residue Filtration Facility.
Water conservation and management

Water use

Pinjarra refinery operates a closed water circuit which is supplemented for water losses. Water losses primarily occur as steam and moisture from the process, evaporation from water storage areas and residue surfaces, and water bound within the residue mud and sand.

Water used to supplement losses is abstracted from licensed groundwater and surface water sources. In addition, water is added to the circuit from:

- Secondary treated effluent from the Water Corporation’s Pinjarra sewage treatment plant.
- Water contained in the caustic soda and bauxite.
- Rainfall runoff from the refinery and residue areas.

The refinery’s water supply relies heavily on abstraction from surface water and groundwater sources. In low rainfall years, extra water is drawn from the groundwater source in accordance with the conditions of water licences issued by the state government.

Alcoa continues to investigate opportunities to increase the refinery’s water efficiency and to identify alternative water sources.

Groundwater management

Alcoa regularly monitors bores located across its refinery, residue storage area and farmlands. The bores are of varying depths and allow for water quality and depth monitoring in each of the aquifers beneath the landholdings. Water monitoring results are reported annually to the State Government.

Pinjarra refinery has a two-phased approach to groundwater management, encompassing spill prevention and remediation:

- A spill prevention program targets areas with the highest potential for spills to occur.
- The remediation strategy requires plans be developed to remediate existing contamination and engineering solutions devised to treat root causes and prevent future contamination.
Water use improvement targets

Water use

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage the Cattamara Aquifer within its sustainable yield.</td>
<td>Report on Pinjarra refinery’s water management and conservation programs. Continue implementing a stepwise approach to monitoring the potential impact of Cattamara abstraction on the Conjurunup Creek and South Dandalup River.</td>
</tr>
</tbody>
</table>

| | |
| Increase efficiency of water use at Pinjarra refinery. | Investigate further dust control measures for bauxite stockpiles and residue storage area which are not solely reliant on water. Continue to improve water efficiency and implement projects where feasible. |

Groundwater

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero major incident loss of containment events.</td>
<td>Continue to implement the Pinjarra Dangerous Goods Improvement Plan and update the CCN.</td>
</tr>
</tbody>
</table>

| | |
| | Continue to review and implement the remediation strategy for the refinery and residue storage area. |

| | |
| Actively manage contaminated sites investigation and reporting requirements for Pinjarra refinery landholdings. | Implement requirements of the Contaminated Sites Act 2003 in line with Department of Water and Environment Regulation (DWER) Contaminated Sites guidelines as agreed between Alcoa and DWER. |
Pinjarra refinery and the RSA are surrounded by Alcoa owned farmlands. Within the refinery and RSA, the main area of significant vegetation or habitat is located within the rail loop. However, the Alcoa farmlands contain most of the native vegetation and habitat within Alcoa’s Pinjarra landholdings.

There are several areas of regional significance within the landholdings including declared rare and priority flora (DRF), threatened ecological communities, conservation category wetlands and heritage sites.

Alcoa aims to protect the biodiversity located on its landholdings. Focus is placed on the areas of greatest significance, such as the conservation category wetlands and priority flora and fauna.

Management of the land in and immediately surrounding the Pinjarra RSA is detailed in the refinery’s Long Term Residue Management Strategy (LTRMS). The LTRMS is updated every five years by a Stakeholder Reference Group (SRG) that includes community, government and Alcoa representatives. The LTRMS contains guiding principles developed by the SRG to provide Alcoa with guidance on how the stakeholders would like the RSA to be managed.

Land stewardship improvement targets

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actively manage Alcoa landholdings to conserve natural ecological attributes.</td>
<td>Implement initiatives from the refinery’s Land Management Plan and provide updates to the CCN. Continue feral animal and weed control programs. Adopt, where practicable, research findings and advice relevant to pest and weed control. Continue the kangaroo management program. Continue the program to improve visual amenity including the use of fire retardant vegetation within the Pinjarra landholdings.</td>
</tr>
</tbody>
</table>
## Land stewardship improvement targets

### Land stewardship continued

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actively manage Alcoa landholdings to conserve natural ecological attributes.</td>
<td>Maintain species protection for the DRF Synaphea stenoloba which is represented in several populations on Alcoa property.</td>
</tr>
<tr>
<td></td>
<td>Communicate land management activities to the community via the CCN.</td>
</tr>
<tr>
<td></td>
<td>Consider completion of a Dieback assessment in the unmapped area within Alcoa’s Pinjarra landholdings.</td>
</tr>
<tr>
<td></td>
<td>Consider the requirement for heritage surveys for new projects.</td>
</tr>
<tr>
<td></td>
<td>Continue implementation of the cockatoo monitoring program.</td>
</tr>
</tbody>
</table>

### Visual amenity

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve visual amenity of Pinjarra refinery and RSA.</td>
<td>Residue rehabilitation to be self-sustaining and focused on visual amenity.</td>
</tr>
<tr>
<td></td>
<td>Progress development of a long term visual amenity plan, considering the life of mine footprint, refinery expansion and future surrounding land uses.</td>
</tr>
<tr>
<td></td>
<td>Consider options for limiting light spill as part of Phase One of the Pinjarra Residue Filtration Facility.</td>
</tr>
<tr>
<td></td>
<td>Focus visual amenity activities on Fairbridge Village.</td>
</tr>
</tbody>
</table>
Pinjarra refinery produces both process waste and non-process waste. Process waste is produced directly from the Bayer process (primarily waste alumina, hydrate, sand, mud and scale). Non-process waste is generated by activities associated with refinery operations and domestic waste.

Innovation improves bauxite residue processes

Alcoa commenced phase one construction of a residue filtration facility at Pinjarra refinery in 2017. With this innovative technology, bauxite residue generated from the alumina refining process will be forced through very large filters that squeeze out the waste water, which will be recycled in the refining process. The filtered material allows for more efficient utilisation of existing residue areas, deferring the need to build new residue storage areas. The water recovered from filtration should also reduce the refinery’s freshwater needs. The project follows the successful commissioning of a similar plant at Alcoa’s Kwinana Alumina Refinery in Western Australia in 2016. Pinjarra Residue Filtration Facility will be commissioned in 2019.

Recycling and Pinjarra worm farm

Alcoa is focused on minimising the amount of landfill waste generated by its operations. Several recycling initiatives are in place at Pinjarra refinery including e-waste recycling and a three-bin system to collect recyclable, landfill and organic waste.

Organic waste, or worm food waste, is sent to Alcoa’s own worm farm based at Pinjarra refinery where it is used for composting and refinery landscaping.

Worm food consists of organic material such as food wastes, shredded paper and paper towels; in fact, it includes ‘anything that lived’.

The worm farm has been operational since 1995 and processes almost 80 tonnes of waste from Alcoa’s Western Australian operations every year.
Bauxite residue - beneficial by-product

For more than 30 years, Alcoa has been investigating opportunities to produce economically viable products from bauxite residue.

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-graded material that has good structural properties required for fill and exhibits beneficial phosphate retention properties. Red Sand™ has been successfully trialled in various applications, including turf top dressing, road base construction and fill for industrial land development.

Oxalate

Oxalate is a waste stream of the Bayer process that builds up in the caustic stream. The refinery recycles caustic through the process and as the oxalate content increases, the process becomes less efficient. To maintain efficiency, the oxalate must be removed. The waste oxalate is destroyed using two different processes; via the oxalate kiln and the oxalate bio-removal facility.

Commissioned in 2013, the oxalate bio-removal facility uses naturally occurring bacteria to breakdown the oxalate. The bio-removal process consumes significantly less energy to operate than the oxalate kiln and produces bicarbonate and carbonate which is reintroduced into the caustic stream.

Waste management improvement targets

<table>
<thead>
<tr>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibly manage waste in accordance with requirements.</td>
<td>Report to the CCN on waste management and recycling performance.</td>
</tr>
<tr>
<td></td>
<td>Promote recycling programs to refinery employees.</td>
</tr>
<tr>
<td></td>
<td>Investigate options for alternative use / reuse of waste streams.</td>
</tr>
<tr>
<td>Progress towards a long term solution to oxalate management.</td>
<td>Implement initiatives for improving the performance of the Pinjarra oxalate management systems and investigate options for increasing oxalate destruction capability.</td>
</tr>
</tbody>
</table>
Pinjarra refinery has the benefit of a dedicated Community Consultative Network (CCN) which provides community feedback and input on issues of interest to both the community and Alcoa.

For Alcoa, this engagement is a fundamental component of managing its operations and growth projects. It makes the company more responsive to community views and creates new opportunities to work in partnership with communities on local issues.

The CCN was formed in 1994 and provides input on a range of issues relating to the refinery and mining operations, local community matters and issues relevant to the Peel region.

With members of the CCN including people active in their community, the process provides a means for Alcoa to reach its stakeholders and for Alcoa to have a greater understanding of the needs of the community. The CCN enables representation from neighbours, townspeople, local business owners and local and state government. Smaller working groups are formed as needed from the CCN such as the Environmental Improvement Plan Working Group and the Pinjarra Bauxite Residue Stakeholder Reference Group.
Alcoa’s Western Australian operations are subject to environmental regulation under the Environmental Protection Act 1986 and are licensed by the Department of Water and Environment Regulation (DWER). Alcoa is committed to meeting the terms and conditions of its environmental licence and environmental approval conditions.

Alcoa’s commitment to this Environmental Improvement Plan (EIP) is voluntary. It both complements and exceeds the requirements of the refinery’s environmental protection licence.

Environmental protection licence

Pinjarra refinery’s environmental licence is administered by the DWER and includes emission limits and other conditions to ensure environmental impacts are managed.

Specific areas covered by the licence include:
- Reporting
- Ambient dust monitoring and control
- Air emission limits, targets, monitoring and reporting
- Management of residue storage areas
- Water quality monitoring and criteria
- Liquid chemical storage
- Waste acceptance at landfill
- Storage of oxalate

National Pollutant Inventory

The National Environment Protection Council launched the National Pollutant Inventory (NPI) in 2000. It provides communities with environmental emission data and aims to satisfy community demands for this information, as well as assist governments and industry with environmental planning and management. Emissions to air, land and water are reported.

The NPI is published on the Australian Government’s National Pollutant Inventory website www.npi.gov.au. This database contains information about emissions from large operations and the estimates of emissions from smaller business activities such as petrol stations, dry cleaners and fast food outlets. Pinjarra refinery reports to the NPI annually.
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.

![Diagram showing the process from bauxite ore to versatile metal](image-url)
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.

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.

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.

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.

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

Rolling Process

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.

Hot rolling
Aluminium ingot is reheated to around 800°C, then passed through a hot finishing mill where it is reduced in thickness to 3-6mm.

Rolling Process

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

Recycling Process

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.