

# Long Term Residue Management Strategy



**Kwinana 2013  
Partial Review**

australia's aluminium





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# executive summary

## Introduction

This Long Term Residue Management Strategy (LTRMS) partial review was conducted within the standard 5 yearly review period to introduce a new technology for residue storage (residue filtration) and keep Alcoa's key stakeholders fully informed of this change. Whilst Alcoa currently believe that we will progress with implementation of the technology, changes in global economic factors, including the global aluminium price and project implementation costs could affect this outcome.

If implementation of residue filtration progresses, most aspects of the operation and management of the residue area remain unchanged from the 2011/12 review. The 2013 LTRMS partial

major difference with the new technology is that instead of distributing mud slurry to dry in the residue beds, the mud will be dried in the filters and then transported by conveyors to the residue storage areas.

A reference group of key stakeholders including community members, local and state government and Alcoa representatives, actively participated in the development of the strategy over a month. The majority of the document's content reflects presentations to and outcomes from, the Stakeholder Reference Group process, with additional contextual information provided as required.

The LTRMS is a reflection of current knowledge, technology and regulatory

partial review in connection with the introduction of residue filtration was to:

- have stakeholders directly involved in the planning process,
- ensure that the concerns and queries of the local community, local governments and regulatory authorities are considered, and
- ensure Alcoa's responses to these issues are transparent and documented.

A summary of the working group's deliberations has been provided in the form of five Guiding Principles to Alcoa for consideration in the development of the LTRMS partial review. These were developed on environmental and social issues considered particularly significant by the working group, and include:

- noise;
- light;
- dust control and management;
- water usage;
- rehabilitation.

These Guiding Principles, together with Alcoa's response is documented in Section 5. Details of the current and future management strategies proposed to address these issues are contained within the body of the report and also the 2012 LTRMS.

## Concluding remarks

The development of this LTRMS partial review has been a constructive means of engaging stakeholders. Alcoa is very appreciative of the Kwinana LTRMS Stakeholder Reference Group members who have provided a considerable amount of personal time and commitment in working with Alcoa during November 2013 to produce this LTRMS partial review for the Kwinana Refinery.

The major difference with the new technology is that instead of distributing mud slurry to dry in the residue beds, the mud will be dried in the filters and then transported by conveyors to the residue storage areas.

review and its guiding principles are not intended to supersede the 2012 LTRMS and its guiding principles. The 2013 LTRMS partial review is to specifically address the issues associated with the adoption of residue filtration at the Kwinana refinery residue storage area (RSA)

The new technology involves installing plate and frame pressure filters and a materials handling system to distribute the dried residue material. This equipment will be installed in addition to the existing mud handling equipment already installed in the residue area. The

standards. The document does not provide detailed engineering information for future residue management; however such information is available from Alcoa upon request.

## Consultation and key issues

The contents of this document are based on issues and information discussed during consultation with a Stakeholder Reference Group formed from members of the community, local and state government departments and Alcoa. The purpose of consulting broadly with the community and government stakeholders in the development of the 2013 LTRMS

# 1 introduction

## 1.1 Background and site overview

In Western Australia, Alcoa of Australia Limited (Alcoa) owns and operates alumina refineries at Kwinana, Pinjarra and Wagerup, with a combined capacity of approximately nine million tonnes per annum, equivalent to more than 40% of Australian production and approximately 10% of world demand. The company also operates bauxite mines at Huntly and Willowdale in the Darling Range, south of Perth. A map of Alcoa's operations in Western Australia is provided in Figure 1-1. Alcoa's Kwinana Alumina Refinery is situated 40 kilometres south of Perth in the Kwinana Industrial Area – Western Australia's premier heavy industrial estate.

The Kwinana Refinery was officially opened in July 1963 with production beginning three months later. The refinery is capable of producing 2.19 million tonnes of alumina a year and produces alumina to be smelted into aluminium plus a variety of specialty aluminas, which have a wide range of industrial and manufacturing applications all around the world. These include applications as diverse as water purification, refractory materials, pharmaceuticals, artificial marble, paper sizing, ceramics, abrasives, petroleum processing, plastic and fire retardants in carpets.

Bauxite is supplied to the refinery from Alcoa's Huntly bauxite mine, located in the Darling Range east of the Pinjarra Refinery. Bauxite is supplied by overland conveyor to the Pinjarra Refinery, then railed 90 kilometres to Kwinana. The bauxite is low grade by world standards, with approximately three tonnes required to produce one tonne of alumina. The material remaining after alumina has been extracted from the bauxite ore is commonly termed "residue".

Alumina produced at the Kwinana Refinery is shipped from Alcoa's Kwinana shipping terminal to overseas markets or to Alcoa's aluminium smelters in Victoria.

## 1.2 Purpose of the Long Term Residue Management Strategy

Alcoa is committed to ensuring sustainability principles are applied to the management of bauxite residue. This Long Term Residue Management Strategy (LTRMS) document is designed to inform local and state government and the community of Alcoa's long term strategy and associated commitments. The contents of this document provide information on the issues requiring consideration in the management of bauxite residue and Alcoa's strategies in relation to future residue facilities.

A reference group of key stakeholders including community members, and local and state government representatives has been actively participating in the development of the strategy over a one month period. The majority of the document's content reflects presentations to, and outcomes from, the Stakeholder Reference Group, with additional contextual information provided as required.

The LTRMS is a reflection of current knowledge, technology and regulatory standards. The document does not provide detailed engineering information for future residue management; however such information is available from Alcoa upon request. In 2013, Alcoa reviewed the LTRMS for its Kwinana Refinery to enable the introduction of a new technology for residue storage (residue filtration). Most aspects of the operation and management of the residue area remain unchanged from the 2011/12 review. However, because the change in technology is inside the normal five yearly review period, Alcoa carried out a partial review of the LTRMS to keep its key stakeholders fully informed. This LTRMS partial review and its guiding principles are not intended to supersede the 2012 LTRMS and its guiding principles. They are specifically to address the issues associated with the adoption of residue filtration.

The filtration process produces a dry residue cake by filtering the mud slurry through a membrane. The technology Alcoa will use is called "plate and frame" pressure filtration. The introduction of filtration to residue operations will involve commissioning of a filtration building and a conveyor and stacking system. The filtration system will be designed to operate 24 hours a day, 7 days a week.

Alcoa has been regarded as the global benchmark in bauxite residue storage and will be the first major mining company in Australia to introduce residue filtration. This will open the door for other large and small operations to utilise the technology. This will have a number of broad advantages for the mining industry in Australia including: significant reduction in water usage, minimisation of residue area size, improvement of residue dam stability, reduction in dust potential from residue storage areas and reduction of residue storage costs.

The introduction of residue filtration to Alcoa's residue management will significantly reduce the area required for residue storage per ton of alumina produced. Alcoa's surrounding communities strongly support minimising the expansion of residue areas.

Appropriate community engagement via the LTRMS is a key step in evaluating the potential to implement the proposed technology at the Kwinana refinery. Final implementation of the new technology will involve successful outcomes from a detailed engineering and economic feasibility study. Whilst Alcoa currently believe that it will progress with implementation of the technology, changes in global economic factors, including the global aluminium price and project implementation costs could affect this outcome.



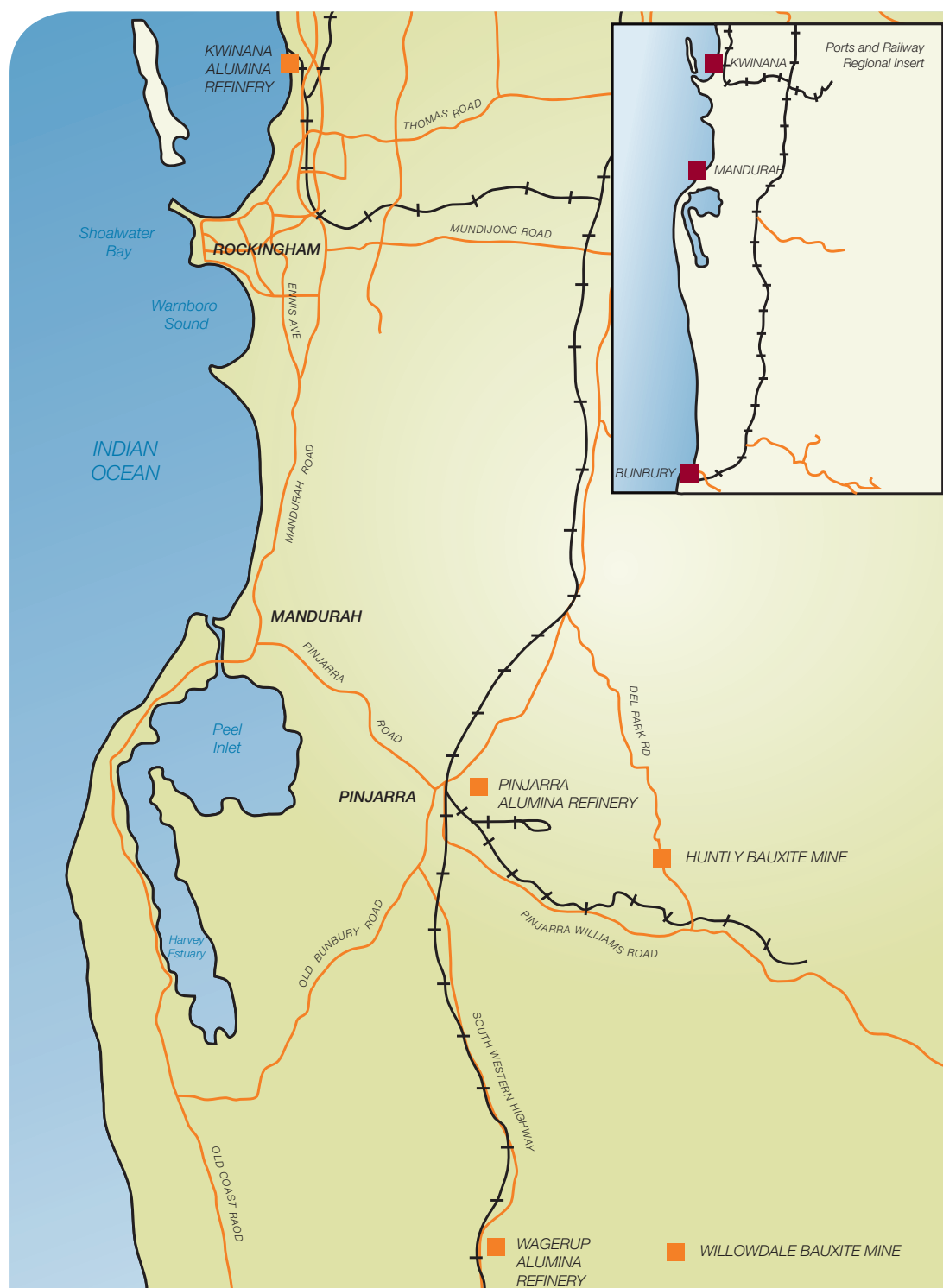


Figure 1-1: Location map.

### 1.3 Structure of report

The contents of the key sections of this report are outlined below:

**Section 2:** Presents the background and history to the development of the LTRMS and the evolution of the stakeholder engagement process used to support its development.

**Section 3:** Discusses the environmental considerations in adopting residue filtration and how they will be managed.

**Section 4:** Details Alcoa's short, medium and life-of-mine residue development strategies, focusing on the changes due to adopting residue filtration.

**Section 5:** Summarises the guiding principles for residue management associated with residue filtration as developed through the Kwinana LTRMS Stakeholder Reference Group process.

**Section 6:** Glossary of terms

**Section 7:** References.

# 2 background and history of the LTRMS

The Kwinana Refinery LTRMS was first produced in 1998 to enable Alcoa to demonstrate sound environmental management of the refinery's bauxite residue to the government and the community.

Alcoa has had an active residue management program for the past 46 years that has focused on emissions control, improvement in engineering management practices and alternative uses for residue.

## 2.1 Initial LTRMS development

As part of the 1989 Consultative Environmental Review (CER) for the Wagerup Unit Two Expansion, Alcoa agreed to develop long term and closure management plans for residue deposits in consultation with relevant State agencies, as well as to submit design reports and monitoring results from the RSAs to the then Water Authority of Western Australia (WAWA). In March 1990 the Minister for the Environment authorised the proposed expansion, subject to certain conditions including the development of a satisfactory "walk away solution" for the residue deposits.

In response to these conditions the Residue Planning Liaison Group (RPLG) was formed in 1992. The role of the RPLG was to facilitate the planning activity and to review and endorse the plans developed by Alcoa for submission to the Minister for State Development and the Minister for the Environment. The RPLG initially had membership from the Department of Resources Development (chair), Department of Environmental Protection, Water and Rivers Commission, Department of Minerals and Energy, Ministry of Planning, Agriculture Western Australia,

The Peel Development Commission, Department of Conservation and Land Management, and Alcoa.

The RPLG agreed to the following main elements of the Long Term Residue Management Strategy:

- identification of the major stakeholders in the planning process and a listing of the key issues of concern to them;
- discussion of the key issues, the environmental concerns stemming from them, and the current and recommended future management strategies to address them;
- conceptual plans for the expansion of drying facilities over the 50 year planning period;
- recommendation of a closure strategy for the deposits which satisfies, as far as possible, the concerns of the major stakeholders; and
- analysis of the gaps between the current situation and the desirable end condition and thereby identify improvement opportunities and research and development needs.

In addition, the RPLG agreed on a process and schedule (five yearly) for review of the LTRMS. Alcoa voluntarily agreed to extend this process to its Pinjarra and Kwinana refineries.

In August 1995 an expansion of the Wagerup Refinery was authorised by the Minister for the Environment. The Minister's statement (Number 390) replaced the earlier 1989 Ministerial conditions with expanded and clarified





conditions related to long term residue management. These required Alcoa to:

- develop a closure strategy and long term management plan for the residue storage areas at Wagerup in consultation with the RPLG, to the satisfaction of the Minister for Environment;
- report annually on progress towards developing the closure strategy;
- implement the closure strategy to the satisfaction of the Minister for Environment (the timing of implementation shall be determined on advice from the Minister responsible for administering the Alumina Agreement Act); and
- periodically review the long term management plans for the residue deposit in consultation with the RPLG.

Although no such conditions have been set for the Kwinana Refinery, Alcoa has voluntarily committed to meeting these conditions for the Kwinana operations.

The Kwinana Refinery LTRMS was first produced in 1998 to enable Alcoa to demonstrate sound environmental management of the refinery's bauxite residue to the government and the community. The LTRMS accounted for the views of a wide group of stakeholders and interested parties and focused on demonstrating compliance with legal and corporate requirements and detailing the engineering elements of residue planning.

## 2.2 2005 LTRMS review

Alcoa initiated a review of the 1998 Kwinana Refinery LTRMS in April 2004. During this review the approach to residue management was expanded to engage the local community and stakeholders directly in the planning process for the first time. This aimed to ensure that the concerns and queries of the local community, local government and regulatory authorities, and Alcoa's response to these issues, were transparent and clearly documented.

This was achieved by utilising a Stakeholder Reference Group (SRG). The role of the SRG was "To assist Alcoa in developing a long term strategy for bauxite residue management at the Kwinana Refinery by providing opinions and feedback on issues raised and, where applicable, provide Guiding Principles for the company to consider in the development of the Long Term Residue Management Strategy (LTRMS)."

## 2.3 2011 LTRMS review

The Kwinana LTRMS was again reviewed in 2011 and repeated the previous successful use of a Stakeholder Reference Group to obtain advice and feedback on strategy options from local community, local government and regulatory authorities.

The 2011 LTRMS review addressed residue infrastructure requirements for the life of the mine (2045) as well as the 25 year footprint requirements and the 5-7 year development plan.

Key changes in environmental management and performance since the 2005 review were also presented; however, the focus on routine operational environmental issues was reduced in recognition of the development of the Environmental Improvement Plan (EIP) process. The EIP process, implemented in 2006, is designed to address environmental improvement opportunities for the refinery and residue area. The EIPs for Alcoa's WA locations are now reviewed triennially with local and government stakeholders.

#### 2.4 2013 LTRMS partial review

In 2013, Alcoa reviewed the LTRMS for its Kwinana Refinery to introduce a new technology for residue storage (residue filtration). Most aspects of the operation and management of the residue area remain unchanged from the 2011/12

review. However, because the change in technology is inside the normal five yearly review period, Alcoa carried out a partial review of the LTRMS to keep its key stakeholders fully informed. The 2013 LTRMS partial review and its guiding principles are not intended to supersede the 2012 LTRMS and its guiding principles. They are specifically to address the issues associated with the adoption of pressure filtration.

#### 2.5 Sustainability

In recent years Alcoa has focused on achieving a greater understanding of what sustainability means to the way it manages its business, and has developed an overarching framework for sustainable development. Alcoa's drive to apply the framework and principles of sustainability is reflected in the emphasis of this document.

The approach to residue management has expanded to embrace stakeholder engagement, with local community and stakeholders directly involved in the planning process. This has ensured that the concerns and queries of the local community, local government and regulatory authorities, and Alcoa's response to these issues, are transparent and documented.

Alcoa defines sustainability as:

"using our values to build financial success, environmental excellence, and social responsibility, in partnership with all stakeholders, to deliver net long term benefits to our shareholders, employees, customers, suppliers and the communities in which we operate" (Alcoa 2009a).



#### Environmental

Life Cycle Assessment, Product Design



#### Social

Consumer Awareness, Supply Chain Management



#### Economic

Economic Value of Products



#### Environmental

Land Management, Biodiversity, Water Conservation



#### Social

Purchasing Standards, Conservation Investments



#### Economic

Security of Supply, Competitive Pricing



#### Environmental

Climate Change, Energy, Water  
Material Use, Recycling, Emissions & Waste



#### Social

Health, Safety, Our People, Wealth Generation,  
Community, Stakeholder Engagement



#### Economic

Financial Performance, Shareholder Value, Capturing Growth

Figure 2-1: Alcoa's global sustainability model.



This model views sustainability through three different, but interdependent lenses:

1. Sustainability of our products;
2. Sustainability of our resources; and
3. Sustainability of our operations.

This global sustainability model is represented in Figure 2-1. When making a business decision or developing a strategy, Alcoa aims to achieve simultaneous benefits across economic, social and environmental factors in order to achieve a net long term benefit.

## 2.6 Alcoa's stakeholder engagement process

Alcoa recognises that talking to communities, seeking input into plans, sharing environmental performance and understanding community needs is critical to maintaining its 'social license to operate'. Consequently a range of informal and formal consultation methods have been employed by Alcoa to involve and inform the community of the company's activities. The following section provides an overview of the current consultative groups in place at Kwinana and details of the process used to establish the Kwinana LTRMS Stakeholder Reference Group.

### 2.6.1 Community Consultative Networks

The Kwinana Refinery established a Community Consultative Network (CCN) in December 1994 as a way to engage with the community and better understand areas of concern and interest. The CCN was a group of community representatives who met informally with Alcoa each month.

For 10 years the CCN provided Alcoa's Kwinana Refinery with vital community feedback and input on a range of issues and activities of mutual interest in a number of areas.

Membership of the CCN was open to the local community in a voluntary capacity with most areas of interest for the community focusing on Kwinana's environment performances.

In 2004 the then Department of Environment (DoE) introduced a new initiative for WA industry: voluntarily adopt public Environmental Improvement Plans (EIPs).

After Alcoa chose to produce an EIP for its Kwinana Refinery in 2005, a decision was made to transform the CCN into an EIP advisory group to provide guidance in the development of Kwinana Refinery's EIP. The Kwinana CCN nominated and agreed on the community membership of the EIP advisory group.

During 2013, Kwinana Refinery's EIP advisory group provided input and guidance during the development of the 2014 – 2016 EIP.

### 2.6.2 Environmental Improvement Plan (EIP) consultation process

EIPs represent Alcoa's public commitment to continuously improve environmental performance, reduce environmental impacts and develop more sustainable operating practices. EIPs in WA are a voluntary initiative by Alcoa which, in many cases, go beyond the environmental management requirements specified in Alcoa's formal license conditions.

Kwinana Refinery released its first EIP in 2006. These plans are periodically updated in order to monitor progress against commitments and continuously improve our performance. The plans are currently updated triennially.

Kwinana Refinery's EIPs are developed by an Environmental Improvement Plan Advisory Group, a consultative group made up of representatives from the local community, Local and State Government, environmental regulators and Alcoa. The aim of the group is to establish targets for environmental improvement and subsequently devise actions to achieve those targets.

The EIPs cover areas such as:

- Air quality, including dust, noise and odour;
- Waste management, including energy efficiency;
- Water conservation, including groundwater management;
- Land management, including visual amenity, rehabilitation and fauna/flora management; and
- Community involvement and environmental regulation.

In 2009, Alcoa reviewed the timeframes of its EIPs across its WA operations and decided to move to three year EIPs. The 2011-13 EIP was developed in early 2011. The 2014-2016 EIP was under development at the time of publication of this document.

### 2.6.3 Community and Industries Forum (CIF)

As a member of the Kwinana Industries Council (KIC), Alcoa participates in the Community and Industries Forum (CIF). CIF operates a public, advertised community forum directed by an executive committee. The committee membership is drawn from interested community members, State regulators, and the KIC members. Meetings are held every second month and provide an open forum to exchange information between community, industry, and regulators.

## 2.7 Kwinana LTRMS stakeholder consultation process

In the past, Alcoa's residue planning has largely been an internal process incorporating feedback from government agencies.

Alcoa has further developed its consultation process for major developments and strategic planning process to include a Stakeholder Reference Group (SRG). This process involves formation of an advisory group, with affected stakeholder groups represented, to work with the company in its development of the LTRMS.

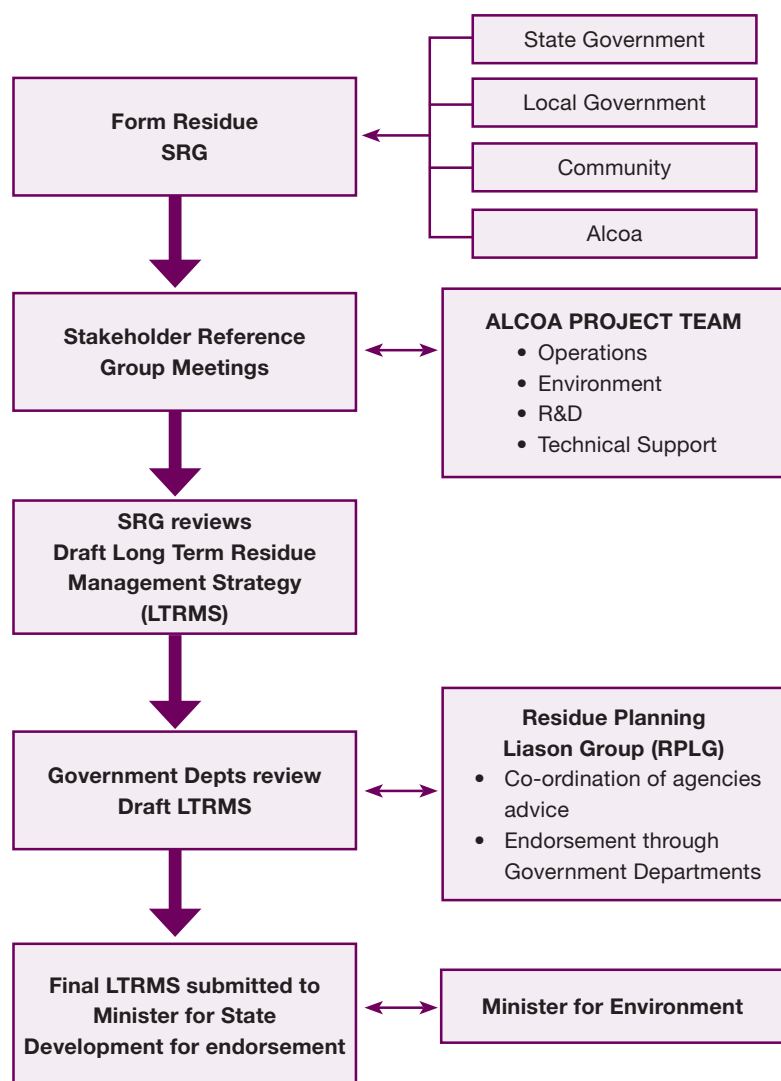


Figure 2-2: Framework for SRG Participation in LTRMS Development.

This transparent process ensures the local and state government departments and community members have access to the same information from the company, and better understand each other's issues and perspectives. The independently facilitated group works together to provide the company with a series of 'guiding principles,' or recommendations, for the company to consider in the development of the LTRMS.

The Kwinana LTRMS SRG is given an opportunity to review the draft LTRMS before it is presented to the Residue Planning Liaison Group (RPLG) for comment. Once the RPLG endorses the LTRMS the Chair of the RPLG submits the final document to the Minister for

State Development. Input is then sought from the Minister for Environment before the Minister for State Development endorses the strategy.

The framework for stakeholder consultation in the LTRMS review for Kwinana Refinery is presented schematically in Figure 2-2.

#### 2.7.1 Formation of the Kwinana LTRMS Stakeholder Reference Group

The Kwinana LTRMS Stakeholder Reference Group was formed in October 2013 and met weekly in November 2013. The process used to establish the SRG is outlined below.

##### 2.7.1.1 Landholder representation

To ensure representation by land holders on the SRG, letters and emails were sent to local residents in October 2013, inviting them to participate in the review of the LTRMS as a member of the SRG. All previous landholder LTRMS participants and current Environmental Improvement Plan landholder participants were invited to participate in the LTRMS partial review.

##### 2.7.1.2 Local business representation

Two nominations were received and accepted from local businesses, Sumich and Perth Motorplex. However, Perth Motorplex was unrepresented at the LTRMS Stakeholder Reference Group meetings.

A number of businesses in the Latitude 32 Light Industrial Area were also directly approached to participate in the LTRMS partial review although no nominations were received.

##### 2.7.1.3 Government representation

Local and state government representation was sought and received from the City of Kwinana, City of Cockburn, the Department of Environmental Regulation and the Department of State Development.

##### 2.7.1.4 Alcoa representation

Alcoa was represented on the LTRMS by its WA Operations Residue Manager, David Honey, the WA Residue Operations and Maintenance Manager, Matthew Cox, and WA Residue Operations Senior Environmental Scientist, Kathryn Forrest.

Meeting reports were produced by Alcoa's WA Operations Residue Senior Environmental Scientist, Kathryn Forrest.

#### 2.7.2 Stakeholder Reference Group terms of reference and operating procedures

An independent facilitator, Andrew Huffer, was appointed to the Stakeholder Reference Group. The initial two meetings of the SRG involved the clarification of the group's role and operation in the LTRMS planning process. It was agreed that the responsibilities of the SRG are to:

- consider the long term planning and strategic issues in residue management in connection with



Affiliation	Name
<b>Land Holders</b>	
Local Resident	Graham Bolton Garry Taylor
Sumich	Lisa Tana
QUBE Property Group	Philip Anderson
<b>Local Government</b>	
City of Cockburn	Cr Carol Reeve-Fowkes Andrew Trosic
City of Kwinana	Cr Ruth Alexander
<b>State Government</b>	
Department of Environmental Regulation	Chris Malley Lindy Twycross
Department of State Development	Phil Knight Tanya McKenna
<b>Alcoa</b>	
WA Operations Residue Manger	David Honey
WA Operations Residue Environmental Scientist	Kathryn Forrest
WA Operations Residue Operations and Maintenance Manager	Matthew Cox

Table 2-1: Kwinana LTRMS Stakeholder Reference Group membership.

Meeting No.	Date	Topics Covered
1	5 Nov 2013	Introduction to LTRMS Process and Purpose, Introduction of Residue Filtration, Overview of Residue Operations and Site Tour
2	12 Nov 2013	Environmental Management – Part 1, Residue Area Development, Terms of Reference
3	19 Nov 2013	Environmental Management – Part 2 and Development of Guiding Principles
4	26 Nov 2013	Alcoa's Response to SRG's Guiding Principles

Table 2-2: LTRMS Stakeholder Reference Group meeting schedule.

residue filtration in areas such as noise, light, dust management, water and rehabilitation,

- provide advice to Alcoa on factors that influence long-term residue management;
- provide a summary of their deliberations to be included in the development of the LTRMS; and
- conform to the Terms of Reference (TOR) agreed to by the SRG.

It was agreed to hold meetings approximately every week until all issues were resolved.

A list of agenda items and a proposed meeting schedule was developed for the SRG. Issues dealt with at SRG meetings were tabled in meeting reports. Over November 2013 four meetings were held in the Kwinana area to address the issues raised by the SRG.

Table 2-2 contains the actual meeting schedule and issues addressed by the group.

### 2.7.3 Key outcomes of the Stakeholder Reference Group process

As a result of the process undertaken five guiding principles were developed by the Stakeholder Reference Group over five topics. These guiding principles have been considered by Alcoa and addressed in the Kwinana LTRMS partial review. The complete table of guiding principles, together with Alcoa's response to them, is included in Section 5. Guiding principles on individual topics are also referenced throughout the body of the report, as appropriate.



# Existing Environmental Issues and Management Strategies

## 3.1 Environmental management systems

Environmental issues at the residue facilities are managed through a comprehensive environmental management system (EMS). The EMS was initially developed for the residue area in recognition of the importance of a rigorous, documented process of environment management and certified to ISO 14001 in December 1995. Subsequently, the EMS was extended to the remainder of the Kwinana Refinery, which gained ISO 14001 certification in December 1997. The key elements of the system are:

- an environmental policy;
- processes to identify environmental legislation;
- a risk based process for identifying key environmental aspects and potential impacts;
- detailed procedures for managing key system elements including, but not limited to, environmental training, incident reporting and internal auditing;

- detailed procedures for the control of operations to minimise potential impacts;
- extensive process emission and environmental impact monitoring; and
- an annual process of reviewing key environmental issues and developing environmental management plans for each operating area.

The remainder of this section describes the key environmental aspects for the residue area that may be influenced by the introduction of residue filtration. These have been identified through risk assessment processes and also reflect issues of concern to stakeholders, as identified by the Kwinana LTRMS SRG. The proposed areas where residue filtration related activity and infrastructure will be located are indicated in Figure 3-1. Current forecasts indicate deposition of filtered residue mud cake can continue in area N and area L up until approximately 2022 – (at current production rates). Plans past this date will be discussed at future LTRMS reviews.



Figure 3-1 Filtration infrastructure and activity areas



## 3.2 Noise

### 3.2.1 Background

Alcoa conducted a comprehensive noise assessment of its Kwinana residue area in 2010. This noise assessment showed compliance with West Australia's Environmental Protection (Noise) Regulations 1997. Historically, and more recently the 2012 stakeholder perception survey indicate noise emissions originating from the Kwinana residue area have not been a significant issue of concern for stakeholders.

Alcoa's noise assessments involve: noise monitoring; noise modelling and identification of noise control measures. Compliance assessments are based on worst case weather conditions (ie, conditions that result in maximum propagation of noise emissions as specified in the Environmental Protection (Noise) Regulations 1997). The acoustic model calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area. The necessary inputs for Alcoa's acoustic model are noise source data, ground topographical data, and receiver locations. Alcoa's noise model has been calibrated on night-time spot measurements and is intended to simulate actual operations. The acoustic model also takes into account both fixed plant and mobile equipment.

### 3.2.2 Changes with filtration

The residue filtration project will involve the installation and operation of noise generating equipment. Alcoa's goal for the residue filtration project is to maintain compliance with the assigned levels (noise limits) specified in the Environmental Protection (Noise) Regulations 1997. At the time of publication of this document Alcoa was undertaking a noise assessment to evaluate the anticipated affect of the residue filtration project on residue area noise emissions; and identify noise control measures that can be reasonably incorporated into the project to maintain compliance with the assigned levels specified in the Environmental Protection (Noise) Regulations 1997.

Effective management of noise generated from filtration activities will be an iterative

process that is conducted throughout the project design, construction and commissioning phases.

### 3.2.3 Guiding Principles and Alcoa's commitments

In response to the information provided, the Kwinana LTRMS SRG developed one guiding principle relating to noise. It is presented below, together with Alcoa's response.

#### Guiding Principle:

Alcoa will ensure all noise, light and dust complaints are formally responded to in a timely manner. This process will include informing the DER of the complaint.

#### Alcoa's Response:

Alcoa will promptly and formally follow up all noise, light and dust complaints and feed back to the complainant.

## 3.3 Light

### 3.3.1 Background

Kwinana's residue area has historically only had limited operational activity occurring at night. During the EIP and LTRMS processes Alcoa's stakeholders have not raised light spill originating from the Kwinana residue area as a key area of concern. For any night time operational activity the necessary lighting is faced inward and downward as per Alcoa's light guidelines.

### 3.3.2 Changes with filtration

The residue filtration project will involve the installation and operation of light generating equipment to facilitate night time operation. Lighting will be utilised to allow safe night time operation of equipment including a stacker and conveyor systems. Alcoa expects to achieve a good level of control over night operational activity light spill through appropriate shielding and light direction. Effective light spill management will be an iterative process that is addressed throughout project design, construction and commissioning phases.

The comparative distance from receptors and the barrier effect created from the height of other residue areas are anticipated mitigating factors.

### 3.3.3 Guiding Principles and Alcoa's commitments

In response to the information provided, the Kwinana LTRMS SRG developed two guiding principle relating to light. They are presented below, together with Alcoa's response.

#### Guiding Principle:

Alcoa will ensure all noise, light and dust complaints are formally responded to in a timely manner. This process will include informing the DER of the complaint.

#### Alcoa's Response:

Alcoa will promptly and formally follow up all noise, light and dust complaints and feed back to the complainant.

#### Guiding Principle:

Alcoa will minimise light spillage, wherever possible, by directing light inwards on the residue storage site, consistent with safe operation of the equipment and OH&S requirements.

#### Alcoa's Response:

Alcoa accepts and agrees with this principle.

## 3.4 Dust

### 3.4.1 Background

Historically, one of the key community concerns discussed at the Kwinana LTRMS SRG has related to dust from the residue area and management strategies to control dust.

Dust generated from the RSA mostly consists of fine clay particles and some sodium carbonate crystals precipitated on the surface of residue as entrained moisture evaporates. Residue dust is slightly alkaline and could be an irritant if high enough concentrations occurred – however extensive monitoring data shows this is very unlikely as the level of dust emitted from the residue area is well below the level likely to cause any health impacts. For more information on residue emissions and health, see Section 7.5 of the 2012 LTRMS.

In addition to the drying beds, the surrounding infrastructure such as roads, embankments, and drains can also be a source of airborne dust and are managed accordingly.

Dust from the residue areas is predominately due to wind erosion, rather than mechanical sources (GHD, 2008). Wind speeds in excess of 6.5 m/s (23 km/h) can pick up and transport fine residue and carbonate particles from dry residue surfaces. The distance over which these particles are transported depends on a variety of factors including atmospheric conditions and the size, shape and mass of the particles. It is also known that other neighbourhood dust that has not originated from the residue areas is weather dependent, which indicates that these neighbourhood sources also have a significant wind erosion dust component (GHD, 2009).

The months from October to April are considered to be the time of the year when the risk of airborne dust generation is potentially greatest. In summer, the predominant winds are moderate to strong east-south-easterly winds and moderate south-westerly winds. Strong and gusty south-westerly winds develop around midday with the onset of the sea breeze which eases in the late evening.

The speed of these winds together with the higher ambient temperatures over summer, and therefore faster mud drying rates, require careful control mechanisms to be in place to prevent dust being released.

Despite the potential for the residue area to generate dust, the 2009 GHD Dust Study demonstrated that there are many significant neighbourhood dust sources near the residue areas and monitoring has shown the residue area has similar significance to other neighbourhood dust sources, such as quarries and market gardens (GHD, 2009). Although no health complaints have been registered with the refinery since 2008, complaints and feedback indicate that the potential for dust to emanate from the residue area still concerns some community members.

#### 3.4.2 Current management strategies

The nature of the residue and the deposition and drying process results in a range of differing materials and surface textures that have the potential

to generate dust under windy conditions. As such the dust management systems in place are complex and consist of a range of both proactive and reactive strategies. A significant effort in planning, implementation and monitoring of the measures is undertaken to ensure best possible control of dust generated from the embankments, stockpiles, roads, verges and drains.

Long term, mid term and day to day controls are currently in place to manage residue dust at Kwinana, and an overview of each can be found in Section 7.2.2 of the 2012 LTRMS. Figure 3-2 shows the current residue dust monitoring network.

#### 3.4.3 Changes with filtration

Residue filtration requires ceasing residue carbonation. The filtered mud cake produced from residue filtration will reduce the need for keeping the large surface areas of exposed residue uncovered which the traditional evaporative drying process requires. Existing dust control measures will be maintained until the factors contributing to dust generation through the filtration, conveying and stacking process are well understood and able to be controlled. Effective dust management with the introduction of residue filtration will be an iterative process that is addressed throughout project design, construction and commissioning phases.

Residue filtration requires that we cease residue carbonation. In conjunction with residue filtration, carbonation of the mud causes large production losses in the refinery. Therefore, in order to maintain an economically viable operation, we cannot continue to run carbonation when filtration is introduced. However, filtration enables a number of other very desirable environmental outcomes – reducing the amount of land required for residue storage, reducing ground water usage and reducing the potential for dust from residue drying beds.

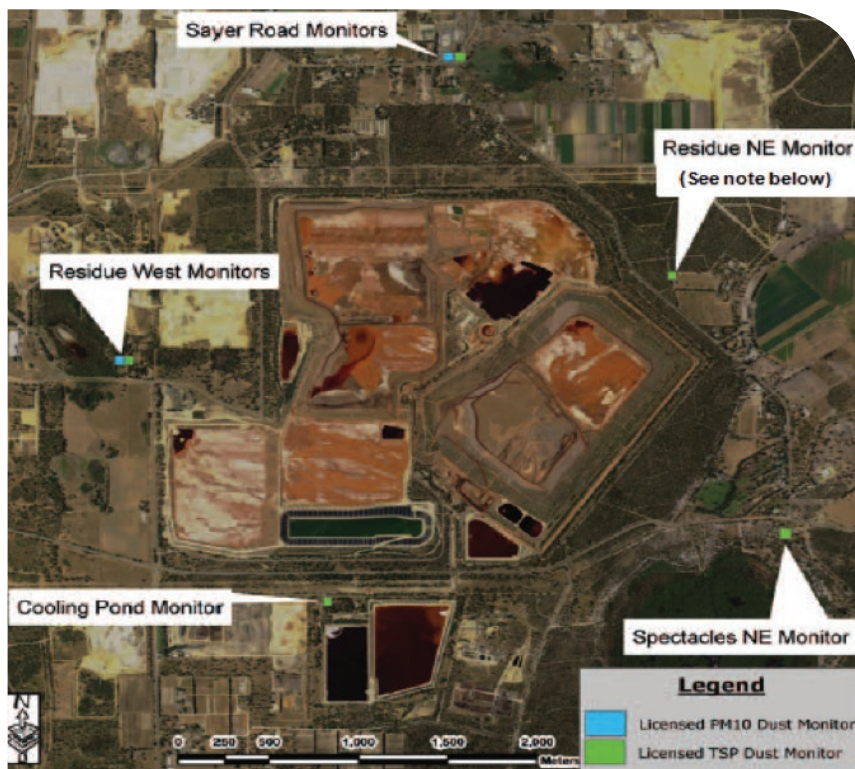


Figure 3-2 Alcoa's Licenced Residue Dust Monitors

N.B At the time of publishing this document the Residue NE dust monitor was being relocated in consultation with the Department of Environmental Regulation and local landholders.



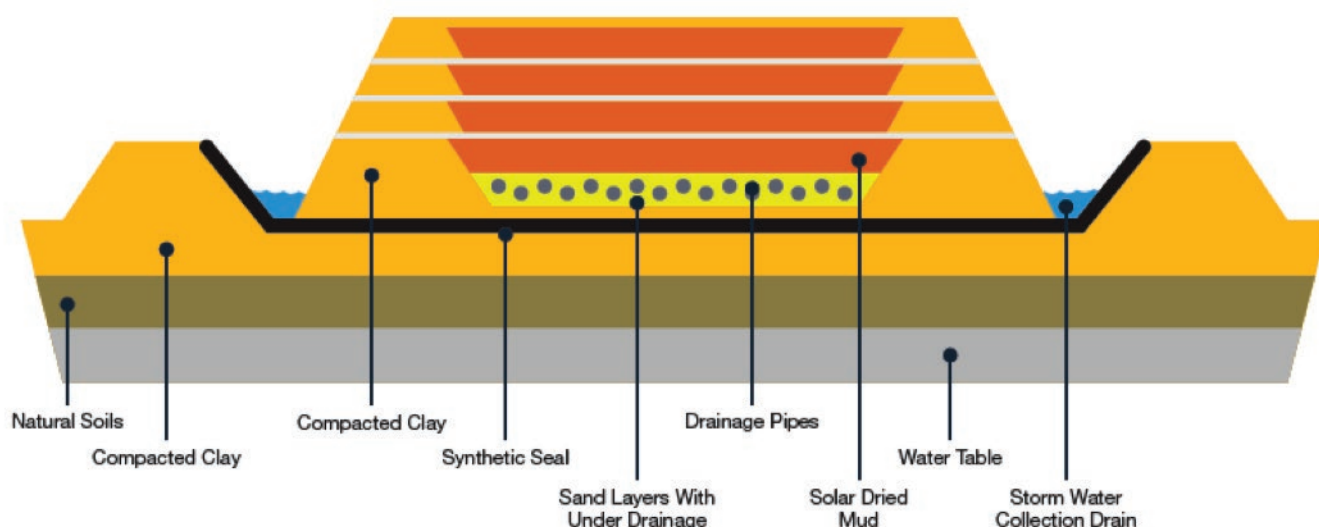


Figure 3-3 Schematic showing construction method of residue storage areas

### 3.4.4 Guiding Principles and Alcoa's commitments

In response to the information provided, the Kwinana LTRMS SRG developed two guiding principles relating to dust. They are presented below, together with Alcoa's response.

#### Guiding Principle:

Alcoa will ensure all noise, light and dust complaints are formally responded to in a timely manner. This process will include informing the DER of the complaint.

#### Alcoa's Response:

Alcoa will promptly and formally follow up all noise, light and dust complaints and feed back to the complainant.

#### Guiding Principle:

Alcoa shall ensure that the adoption of pressure filtration does not result in increased external dust impacts.

#### Alcoa's Response:

Alcoa believes that residue filtration will not increase dust impacts. Alcoa is committed to its dust management program and continues to seek improvement of dust control measures. Alcoa's dust monitoring program is reviewed and updated annually. Alcoa will continue to monitor dust, particularly with respect to the introduction of pressure filtration, in accordance with DER licence conditions and in consultation with the EIP working group.

### 3.5.1 Background

The Kwinana Refinery operates an efficient closed water circuit, which is supplemented for water losses. Water sources for the refinery include rainwater that falls on the refinery and residue areas; groundwater recovery and production bores on site; potable water; and water brought in with bauxite (% moisture). Aside from evaporation there is no discharge of process water to the environment. The RSAs have base drainage systems that collect and recycle leachate and rainfall infiltration. The majority of the rainfall runoff from the RSA 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.

From the commencement of Alcoa's operations in Western Australia, residue impoundment areas have been designed and constructed in accordance with contemporary accepted engineering standards. The need to contain the residue leachate has meant that the embankments were designed as water retaining structures that added further conservatism to their design. As such, their construction included base and embankment clay sealing layers.

The introduction of dry stacking of residue in 1987 reduced the potential for release of residue leachate to the surrounding environment as the lack of any significant water level within the deposit decreases the pressure on the base liners.

Drying areas constructed post-1980 include base drainage systems. These drainage systems provide a major defence against seepage to the groundwater by substantially lowering the hydraulic head at the base of the deposit. All RSAs constructed since 1983 have also included PVC or HDPE liners to further mitigate seepage. A schematic representation of RSA construction is provided in Figure 3-3.

Changes in standards and technology mean that containment has improved significantly over the last 50 years. Most of Alcoa's Kwinana residue area is constructed on relatively high permeability soils and the older single clay only lined retired residue area ABC and oldest operating area F have legacy issues associated with older residue area designs. Active recovery programs target the identified areas of concern and they are managed and monitored on an ongoing basis. Kwinana has a comprehensive and extensive groundwater monitoring network with a well established database of water quality data and trends (approximately 550 monitor bores). The program encompasses the refinery, operational and non-operational residue areas and regional groundwater quality monitoring. Groundwater contamination from the residue areas is typically characterised by elevated total dissolved salts and elevated pH.

## 3.5 Water

### 3.5.2 Current management strategies

The current management strategies for water are described in detail in Section 7.7.2, Section 7.8.2 and Section 7.9.2 of the 2012 LTRMS.

### 3.5.3 Changes with filtration

It is expected that residue filtration will substantially reduce the amount of water used in residue management: firstly, through less water being lost through evaporation from residue drying areas and associated free liquor; and, secondly, through less water being required for dust control due to a lower dusting potential and a smaller operational footprint. With the reduction in evaporative losses from the closed water circuit it is estimated that the water which is predominantly sourced from abstraction bores can be reduced by approximately 20%. The final saving may be greater because of reduced sprinkler water requirements.

Filtration of the residue mud will maximise the amount of process liquor recovered from the residue prior to filtered mud storage. As a result the amount of process liquor contained in the deposited residue material will be substantially reduced. There will be less downward flow of liquor to the residue storage area liners reducing the likelihood of leaks and also less liquor contained in the residue storage material reducing the potential environmental impact should a leak occur.

### 3.5.4 Guiding Principles and Alcoa's commitments

In response to the information provided, the Kwinana LTRMS SRG developed one guiding principle relating to water. It is presented below, together with Alcoa's response.

#### Guiding Principle:

Alcoa shall report reductions in water consumption as a result of implementing residue filtration via the Environmental Improvement Plan (EIP) process.

#### Alcoa's Response:

Alcoa accepts and agrees with this principle.

## 3.6 Residue Rehabilitation

### 3.6.1 Background

There are two categories for the rehabilitation of the residue areas; these are progressive rehabilitation and final rehabilitation. Progressive rehabilitation is rehabilitation of an area concurrent with the operation of the area, which is carried out on the external batters of the upstream sand embankments. Final rehabilitation is the final sand spreading, contour shaping, revegetation and dewatering of the residue after closure of a drying area.

This section outlines the strategy for progressive rehabilitation of the residue area. Final rehabilitation is addressed as part of the closure strategy discussion in Section 9.4 of the 2012 LTRMS.

The objectives of the residue rehabilitation program are to improve visual amenity of the external embankments, prevent the generation of dust, and enhance the conservation value of the area in order to achieve the progressive rehabilitation of the residue deposits.

### 3.6.2 Current management strategies

The current management strategies for residue area rehabilitation are described in detail in Section 7.11.2 of the 2012 LTRMS.

### 3.6.3 Changes with filtration

The change to pressure filtration will mean residue sand will only be placed on outer embankments as a veneer to support rehabilitation growth. This will be to a depth of approximately two metres. Sand will generally be placed mechanically, as opposed to hydraulically, allowing gypsum and any other necessary soil amendments to be incorporated at the same time.

Due to the reduced liquor content in the filtered residue material it is expected that less leaching will be required prior to commencing rehabilitation planting than is currently required. In-situ remediation is already occurring due to rehabilitation of outer residue sand embankments, as evidenced by: improved chemical characteristics; evidence of nutrient cycling; improved microbial status; and presence of above and below ground fauna (e.g. ants and worms). Filtration

will reduce the volume of entrained liquor in residue thereby encouraging in-situ remediation via leaching and natural carbonation.

Cover systems on rehabilitation areas need to fulfil various requirements from an environmental perspective including: dust control, visual amenity, conservation values, support a sustainable ecosystem and have a sustainable water balance. Constructing and shaping residue storage areas using filtered mud allows an engineered cap that can be more easily modified. Adopting residue filtration will mean less residue sand will be utilised in embankment construction. This will affect the water balance total storage volume. Residue rehabilitation processes will be adjusted over time to take into account changes to the water balance due to the introduction of filtration.

### 3.6.4 Further research

Alcoa has a vision to be recognised as a world leader in residue rehabilitation and has a full time residue research scientist who leads the residue rehabilitation research program. The broad aims of the residue rehabilitation research program involve:

- 1) developing a fundamental understanding of the various physical, chemical and microbial characteristics that affect sustainable plant ecosystems on residue sand embankments;
- 2) applying this understanding to optimize the operational rehabilitation prescription to achieve acceptable vegetation cover; and
- 3) to extend the operational prescription to recommending suitable cover systems for closed RSAs.

The change to residue filtration will present Alcoa with additional residue rehabilitation research opportunities to those described in Section 7.11.3 of the 2012 LTRMS. This would include areas relating to water dynamics, residue rehabilitation prescriptions, nutrient availability and cycling, recruitment and seed bank development and changes in rehabilitation with reduced liquor in residue material.



Alcoa will remain committed to understanding the factors influencing successful rehabilitation with the introduction of filtration. The focus will remain on better understanding the chemical, physical and microbial characteristics of rehabilitated residue sand embankments. Alcoa frequently publishes the outcomes of residue research work. Details of the publications are available on Alcoa's website at: [http://www.alcoa.com/australia/en/info\\_page/mining\\_research.asp](http://www.alcoa.com/australia/en/info_page/mining_research.asp)

### **3.6.5 Rehabilitation Guiding Principles and Alcoa's commitments**

In response to the information provided, the Kwinana LTRMS SRG developed one guiding principle relating to residue rehabilitation. It is presented below, together with Alcoa's response.

#### **Guiding Principle:**

Alcoa will evaluate and report back on the success of rehabilitation at the residue site via the Environmental Improvement Plan process.

#### **Alcoa's Response:**

Alcoa accepts and agrees with this principle.



# 4 residue Development

## 4.1 Background

Alcoa has recently updated the comprehensive management plan for the medium term (25 years) and life of current mining lease (2045) and finalised the short term (5-7 year) Residue Management Plan for 2011-2018. These plans are developed giving consideration to the guidance provided through the LTRMS SRG process. Mud drying, dyke construction, planned maintenance and other sustaining activities are carried out in accordance with a detailed annual program of work, which is developed within the context of the 5-7 year Residue Management Plan.

Planning and design of all new residue facilities is completed in accordance with Alcoa's Bauxite Residue Management Standard as well as relevant regulatory standards and guidelines. In addition to outlining the process to be followed when selecting and confirming the social,

environmental and engineering suitability of areas for new residue facilities, these documents prescribe minimum design standards for all new facilities. For instance, detailed analysis is completed to confirm that the short and long term stability of earthen embankments exceeds minimum requirements, and investigations are completed to ensure that all storm water generated from the residue area in a 1:100 wet year is able to be contained within the area without release to the environment.

## 4.2 Changes with filtration

The residue area footprint requirements are currently dominated by drying area requirements. As the mud elevation in drying areas increases over time, perimeter embankments progressively move inwards and the net available drying area reduces. The change to residue filtration will produce a dry mud and the operation will move from residue

drying to residue storing. Utilising the existing residue drying methodology, Alcoa would need to build a new 30 hectare drying area for the Kwinana Refinery every 5 years. With residue filtration, in the current operating context it is anticipated that Kwinana should be able to defer the need for a new residue storage area for 15-20 years at current production rates. Construction of new drying areas Area O and Area P can be delayed until this time. Depending on the economic life of the refinery, mud filtration enables a reduction in the residue area footprint and/or an extension of the life of the refinery. The four stages in figure 4.1 show the progressive filling of the residue area with the filtered mud. The first two stages show the existing residue dams being filled. For the third stage, Alcoa will relocate infrastructure from the centre of the residue area and then convert this area to residue storage.





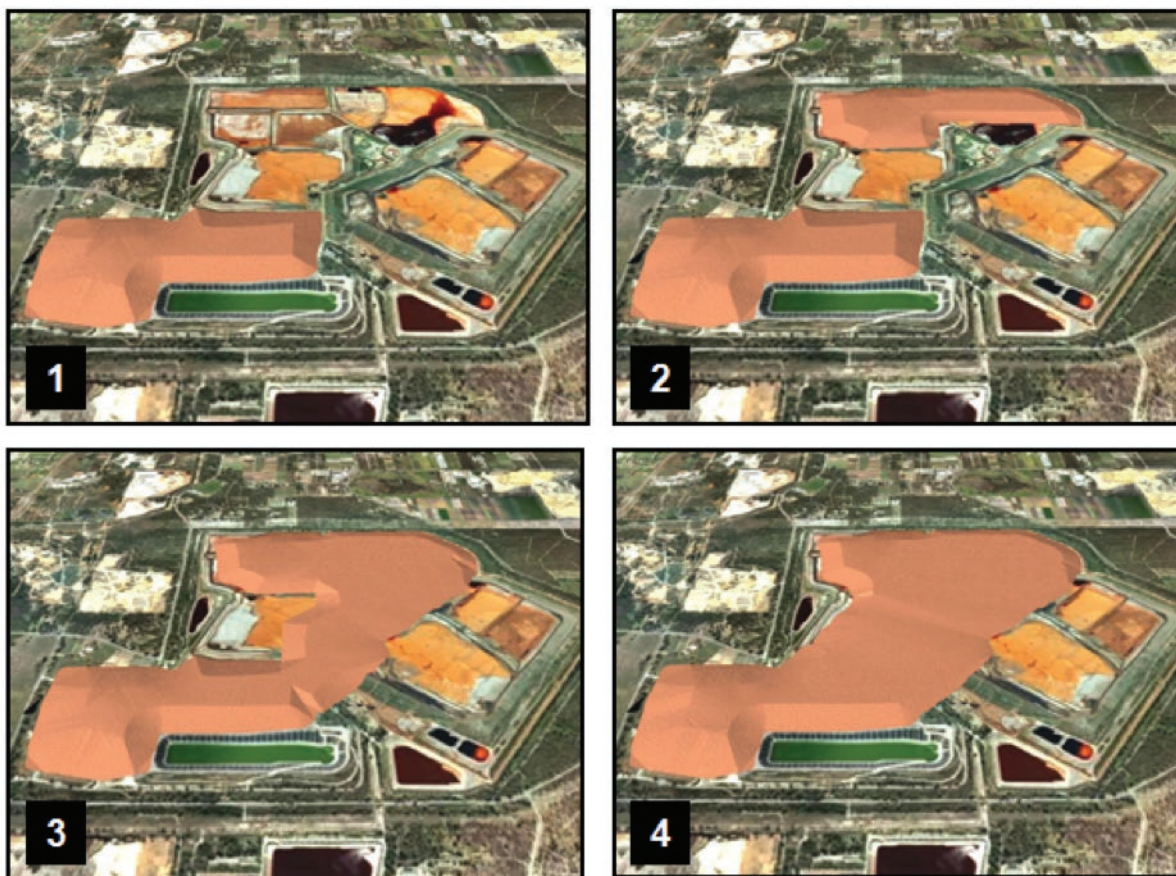


Figure 4-1 Model of the proposed next four phases of Kwinana residue area development with Residue Pressure Filtration

This enables the most efficient use of the existing residue footprint before Alcoa need to build any new residue dams.

Residue sand will be stored on the northern section of the residue storage area. The sand will be placed hydraulically (as a slurry) in the same way it is deposited today. Alcoa is actively working with government and another company to develop a market for residue sand. Alcoa's goal is to export the great majority of the residue sand for other useful purposes, thereby freeing up additional space for the storage of residue mud and further delaying the requirement to construct new residue storage dams.

The plan discussed above represents our best knowledge at this time. Once residue filtration is introduced, the plans for the area will be continually reviewed and presented at subsequent LTRMS reviews.

#### 4.3 Constraints on forward planning of residue operations

Despite the level of effort which goes into forward planning, significant shifts in direction are occasionally required as a result of a range of factors, including:

- changes in technology;
- changes at the refinery affecting the rate of production;
- changes in quality of bauxite and/or characteristics of residue material streams (the drying area required can be affected by small changes in the percentage of mud in the residue, with higher percentages of mud requiring a greater drying area);
- weather conditions, in so far as they can affect mud drying rates and the construction schedules of new residue areas;
- input from the community and regulatory agencies in the process of obtaining the necessary statutory

approvals for new residue areas;

- internal funding availability, which is influenced by a number of factors including the global aluminium market; and
- availability of key equipment and contractors.

The plans presented in the LTRMS are therefore subject to change, particularly in timing and sequencing. The five yearly review process for the LTRMS is designed to allow these changes and their impact on long term planning for the residue area to be reviewed with community and government stakeholders. In the event that a significant change will impact the 5-7 year plan presented in this document, additional consultation may be required. This LTRMS partial review triggered by Alcoa's intention to use new technology in residue management is such a change.

# 5 stakeholder reference group guiding principles

## 5.1 Summary of Guiding Principles and Alcoa's response

The Kwinana LTRMS partial review has been significantly influenced by input from the community, via the SRG process. As reflected throughout this document, the SRG participated in extensive discussion on residue management and planning issues, enabling participants to develop informed guiding principles for consideration by Alcoa.

Table 5-1 summarises the guiding principles developed by the SRG and Alcoa's response to each principle.

These guiding principles are discussed further in the body of this document, together with the information discussed on each of the issues to which they relate. The guiding principles will be reviewed and updated during the next review of the LTRMS by the future SRG.

Table 5-1 Stakeholder Reference Group Guiding Principles and Alcoa Response

SRG's Guiding Principle	Alcoa's Response
<b>NOISE, LIGHT AND DUST</b>	
Alcoa will ensure all noise, light and dust complaints are formally responded to in a timely manner. This process will include informing the DER of the complaint.	Alcoa will promptly and formally follow up all noise, dust and odour complaints and feed back to the complainant.
<b>LIGHT</b>	
Alcoa will minimise light spillage, wherever possible, by directing light inwards on the residue storage site, consistent with safe operation of the equipment and OH&S requirements.	Alcoa accepts and agrees with this principle.
<b>DUST</b>	
Alcoa shall ensure that the adoption of pressure filtration does not result in increased external dust impacts.	Alcoa believes that residue filtration will not increase dust impacts. Alcoa is committed to its dust management program and continues to seek improvement of dust control measures. Alcoa's dust monitoring programme is reviewed and updated annually. Alcoa will continue to monitor dust, particularly with respect to the introduction of pressure filtration, in accordance with DER licence conditions and in consultation with the EIP working group.
<b>WATER</b>	
Alcoa shall report reductions in water consumption as a result of implementing residue filtration via the EIP process.	Alcoa accepts and agrees with this principle.
<b>REHABILITATION</b>	
Alcoa will evaluate and report back on the success of rehabilitation at the residue site via the EIP process.	Alcoa accepts and agrees with this principle.



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## 6

# Glossary

CCN	Community Consultative Network
CER	Consultative Environmental Review
CIF	Communities and Industries Forum
DEC	Department of Environment and Conservation
DER	Department of Environmental Regulation
DoE	Department of Environment (now the Department of Environment and Conservation)
EIP	Environmental Improvement Plan
GHD	An engineering, architecture and environmental consulting company.
HDPE	High Density Polyethylene
KIC	Kwinana Industries Council
LTRMS	Long Term Residue Management Strategy
PVC	Polyvinyl Chloride
ROWS	Run Off Water Storage
RPLG	Residue Planning Liaison Group
RSA	Residue Storage Area
SRG	Stakeholder Reference Group
TOR	Terms of Reference
WAWA	Water Authority of Western Australia



## 7

# References

Alcoa 2009, 'Sustainability 09 – Unlocking the Solutions to Sustainability', Alcoa World Alumina, Australia.

GHD Pty Ltd 2008, 'Report for Kwinana Residue Dust Emissions Study 2008', Prepared for Alcoa World Alumina, Australia.

GHD Pty Ltd 2009, 'Report for Kwinana Residue Dust Emissions Study 2009', Prepared for Alcoa World Alumina, Australia.



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