Rio Tinto Alcan Yarwun and Queensland Alumina Limited
Sustainable development report 2014
Introduction

Our approach

We aspire to be a company that is admired and respected for delivering superior value and for being the industry’s most trusted partner.

As a leading global mining and metals business, our activities touch many thousands of people – including our shareholders, our employees, our host communities and governments, our suppliers and our customers – in all corners of the world. With this comes great responsibility, and also great opportunity to make a positive difference to our stakeholders’ lives.

As well as managing the financial and technical risks that our organisation faces, we are committed to managing the sustainable development risks we face at every stage of our businesses’ life cycles. By maximising the societal, environmental and economic benefits of our activities – and minimising negative impacts – we optimise business value, gain and build our stakeholders’ trust, and support our licence to operate.

Insisting on a responsible approach to mineral development helps us gain and maintain our licence to operate. It provides confidence to all our stakeholders, enabling better access to the resources, people and capital we need, and enables us to bring long-lasting benefits to the places where we work.

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

- World Commission of Environment and Development report to the UN

The nature of our business means we forge close relationships with the environment and our local communities. We are a significant employer, rate and taxpayer in Gladstone, and have invested significantly in infrastructure. We generate economic and social development through local procurement, job creation, training and skills transfer.

We support community programmes in a sustainable way by helping build local capacity, and we develop practical programmes for environmental management. But we also recognise that – if not managed properly – our operations can have a negative impact on society and the environment. This report highlights our performance in Gladstone over the last 12 months and the targets we have set to ensure we continue on our path of continuous improvement.
Message from Queensland Alumina Limited (QAL) general manager Mike Dunstan

2014 was a year of two halves for QAL as the operation finished in a solid position, despite a challenging first half of the year. I can say, with a great sense of pride, that our results in the second half of the year is a testament to the great work our people have been doing over the last few years.

The focus in 2014 was to stabilise the operation and improve the reliability of process and equipment to produce sustainable results. As a result, energy efficiency improved by 3 per cent, production improved by 5 per cent, and costs were reduced by 4.6 per cent from 2013.

QAL held its first Community Day in November 2014 and, in addition, we rolled out our Real-time Online Community System (ROCS). This was one of the first steps in improving our engagement with our neighbouring community.

Environmentally, we completed a range of dust reduction and monitoring projects within the Transitional Environmental Programmes (TEPs). We will complete additional TEP projects in 2015 and 2016, which demonstrates QAL’s ongoing commitment to environmental compliance and reducing our impact on the local community.

The QAL team is striving for improved safety and environmental performance, and our commitment to doing the fundamentals well will lead to sustained operational excellence and a reduced impact on our community.

Thank you to all our local neighbours who continue to support QAL and we look forward to hearing your feedback on this report.
Introduction

Message from Rio Tinto Alcan, Bauxite & Alumina, chief operating officer, Armando Torres

On behalf of the Rio Tinto Alcan Yarwun management team

Thanks to the gritty determination and commitment of the workforce, Rio Tinto Alcan Yarwun overcame a number of challenges in 2014 that will help to stabilise the refinery and achieve 3.4 million tonne-rates safely and sustainably in 2015.

A milestone that we should all be proud of was achieving the second best safety performance in ten years, with an All Injury Frequency Rate of 0.58. This is a testament to the countless time and effort employees have put into effectively managing manual handling and ergonomic hazards.

Strong steps forward were made to improve environmental performance in 2014, with the execution of an environmental improvement project which saw a reduction in non-compliance events by almost half of 2013 occurrences.

Outside of the operation, the year also saw continued success within the local community. In particularly, the Rio Tinto Alcan Community Fund’s flagship Here for Childcare and Here for Health initiatives continued to have a positive impact on local healthcare and childcare services. I trust that the benefits these projects have brought to the region will be felt by the workforce and the broader community for many years to come.

Within the operation, improvement to mud farming capability at the Residue Management Area (RMA) was another significant milestone in 2014. The recovery of 25 per cent of the area has significantly reduced business risk and capital expenditure by increasing the forecast lifetime of the dam to support operations.

A broader strategy has been developed to achieve the production target of 3.4 million sustainable tonne-rates in 2015. This strategy is built around recovering the residual life of the refinery, enhancing the capability of employees, and executing a number of design modifications.

Above all else, safety will remain our number one priority in 2015, and our goal is to ensure all employees go home at the end of each shift without injury or illness to themselves or the environment.

I am excited about the direction of the business in 2015, and know that we have the right people on board to work as one united team to stay safe, protect the environment, and continue to be a trusted neighbour.
Feedback

This Sustainable development report has been developed to show our neighbours and other interested stakeholders how we performed against our sustainable development commitments in 2014. We value your feedback and invite you to provide us with comments or questions about this report.

Rio Tinto Alcan Yarwun

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Queensland Alumina Limited

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People

Queensland Alumina Limited (QAL)

Recruitment and retention

Since 1964, QAL has continued to be one of the largest employers in Gladstone – and we know employing local people is good for our business. Local people are invested in the region, which usually translates into higher retention rates. QAL aims to hire local people for all roles where the candidate has the required level of skill and experience.

QAL offers a number of apprenticeships and traineeships each year and engages with local schools and the wider community to deliver these initiatives.

QAL recruited, inducted and trained 158 new employees in 2014 and, pleasingly, the annual turnover rate decreased from 14.72 per cent to 10.93 per cent.

In 2014, operator, trade, staff, professional and leadership opportunities were offered. New apprentice, trainee and graduate positions were also filled and 17 vacation students were welcomed to site during the summer break.

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* No target set
Training and development

QAL is committed to improving the skills of its people and in 2014 the Certificate III in Process Plant Operations was introduced and offered to all new non-trade plant operators. This nationally-recognised programme, completed over a two-year period, is linked to on-the-job training and competencies that are completed as part of the participant's employment with QAL. In 2014, 29 people commenced the programme with the first block of assessment completed before the end of the year.

QAL booked 17,581 training sessions throughout the year, which equated to 39,393 hours of training. Of this, 38,743 hours of training was completed in the classroom while 650 hours was web-based.

QAL was also named as a Queensland Training Awards finalist for the region.
Employee Benefits

The Yaralla Lifestyle Package is offered to make a difference to the quality of life of our people. It provides free fitness, sporting and recreational facilities for employees to enjoy across the Gladstone region.

**LIFESTYLE PACKAGE**

- free golf at the Gladstone, Boyne Island and Calliope courses;

- free gym membership at the Yaralla and Lifestyle centres in Gladstone and the Powerhouse Fitness Centre, Indoor Sports Centre and True Blue gymnasiums in Tannum Sands;

- free use of the Gladstone Aquatic Centre including the 50 metre outdoor pool, 25 metre indoor heated lap/therapeutic pool, wading pool, sun smart shade areas, expansive picnic grounds and BBQ areas;

- free movie tickets at Gladstone Cinemas; and

- free tennis and squash at the Gladstone Tennis and Squash Association (will be expanded to include these in 2015).

Other benefits to QAL employees include private health insurance (subsidised by QAL), and a nine-day fortnight roster for staff, to help improve work/life balance.
QAL up-skills its employees

This year, QAL implemented several new training initiatives to ensure its workforce had the skills to operate safely and effectively.

Read more
People

Rio Tinto Alcan Yarwun

Recruitment and retention

At Rio Tinto Alcan Yarwun, our people are our greatest asset and we are proud of our team of skilled, diverse and dedicated people. We also recognise that employing local people is good for our business.

In 2014, Yarwun hosted a careers information day that was attended by more than 200 local people. We recruited 192 new employees throughout the year, of which 56 accepted process technician roles. Recruitment and retention have been a priority for the site over the past few years and despite significant improvement in employee retention, recruitment remains a key priority and will continue to be throughout 2015 to ensure that we have the right team in place to deliver our business objectives.

2014 also saw a comprehensive review of process technician roles and remuneration packages. As part of this work, the career paths and salary progression opportunities were reviewed, redefined and communicated to all process technicians.

Graduate numbers at Rio Tinto Alcan Yarwun remain stable at 17 despite a smaller intake in 2014, and apprenticeship numbers are on target at 30. In addition, six undergraduate students undertook paid vacation work with Rio Tinto Alcan Yarwun from November 2014 through to February 2015.

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<tr>
<td>Graduate intake</td>
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<td>3</td>
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<tr>
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<td>92%</td>
<td>92%</td>
<td>94%</td>
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<td>0.1%</td>
<td>2.9%</td>
<td>3.0%</td>
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Training and development

We recognise the importance of leadership and believe that it is a key driver behind the success of our operations and the culture of our site. Leadership Essentials is a training programme that has been created to ensure that our leaders have the appropriate skills and tools available to them to lead their teams successfully. A key component of this training focuses on performance management and aims to ensure development plans are in place for all employees. The programme commenced in 2014 but will remain a key focus for the site in 2015.
<table>
<thead>
<tr>
<th>Benefit Type</th>
<th>Description</th>
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<tr>
<td>Yaralla Lifestyle Package</td>
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<tr>
<td>Rio Tinto Better Health Cover</td>
<td>this offer fully funds the cost of the Medibank Essential Hospital cover with $500 excess as well as providing a Medibank hotline for Rio Tinto employees.</td>
</tr>
<tr>
<td>Rio Tinto Medical Plus</td>
<td>assists employees and their families by reimbursing certain medical expenses such as hospital admission, travel and accommodation, and funeral expenses.</td>
</tr>
<tr>
<td>Rio Tinto Staff Death and Disability Scheme</td>
<td>provides eligible employees with a valuable insurance benefit in the event of death, total and permanent disability, or trauma.</td>
</tr>
<tr>
<td>Salary packaging</td>
<td>employees have an opportunity to allocate before tax salary towards eligible benefits.</td>
</tr>
<tr>
<td>Employee discounts</td>
<td>corporate discounts across a range of financial services, health services, retail, travel and vehicles.</td>
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Process technician salary progression and career paths

Process technicians at Yarwun now have greater visibility on how to develop and progress their career within the business.

Read more
People

Queensland Alumina Limited (QAL)

QAL up-skills its employees

This year, QAL implemented several new training initiatives to ensure its workforce had the skills to operate safely and effectively.

The Certificate III in Process Plant Operations course was launched to provide structured training – linked to key competencies – for all non-trade plant operators over a two-year period.

There are currently 29 people on site undertaking this nationally-recognised programme, with 97 per cent of new starters choosing to complete the certificate.

A new on-site training facility was also unveiled in 2014 to develop the practical skills of new starters. The Practical Skills Training Facility was established to support new recruits in their initial eight-week training programme. It offers a hands-on look into the different tools and pieces of equipment the workforce will come into contact with and allows employees to see how the equipment operates in a safe and controlled environment.

The training facility gives the incoming workforce an opportunity to understand practically how the decisions they make while using different tools and equipment can impact their safety and others, as well as the overall process.

Pumps and packing, valve operation, purge water training and the isolation system are some of the areas of focus while employees are stationed at the facility.

Rio Tinto Alcan Yarwun

Process technician salary progression and career paths

Process technicians at Yarwun now have greater visibility on how to develop and progress their career within the business.

The project, which was led by representatives from Human Resources, Training, and Operations at the superintendent and process technician level, aimed to address concerns about the way that base salaries for process technicians were determined, and the career path options that were available to employees in these roles.

Following a series of workshops and consultation, the team developed a salary banding guideline for process technicians that clearly and consistently set out progression categories based on an employee's experience, key competencies, performance and...
Process technician, Trevor Smith was a member of the project team and provided direct input into the process technician salary progression and career path project.

This project meant process technicians had a clear pathway to move through the organisation and pursue a technical or leadership career within the business.

Process technician, Trevor Smith, said the level of collaboration on this project really signified how important this project was to the business.

“IT is a great demonstration that when all the necessary parties come to the table and work together, really effective solutions can be developed and implemented to bring about change,” Trevor said.
Health & Safety

Queensland Alumina Limited (QAL)

Health and safety performance

QAL worked hard to improve its safety performance after a poor start to 2014. In total, 21 recordable injuries were recorded for 2014, of which 16 recordable injuries occurred in the first half and five injuries in the second half.

Despite the improvement in safety performance in the second half of 2014, QAL was unable to achieve the recordable injury reduction target of 14 in 2014.

QAL improved its monitoring of workplace and employee health and hygiene, introducing revised scheduled surveillance medicals and similar exposure group monitoring, which was undertaken throughout the year.

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<td>0.82</td>
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<td></td>
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<td>14</td>
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<tr>
<td>Occupational illness</td>
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<td>4</td>
<td>&lt;11</td>
<td></td>
<td>&lt;7</td>
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<tr>
<td>Significant potential incident (SPI) closure rate</td>
<td>100%</td>
<td>100%</td>
<td>95%</td>
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<td>95%</td>
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**Significant potential incident (SPI) closure rate** - We use significant potential incident reporting and remedial action closure measures to promote identification, investigation, management and sharing of lessons learned from near-miss events with potentially fatal consequences.
Hand safety

Hand safety was a major focus in 2014, with 71 per cent of recordable injuries occurring to fingers and hands. Sprains and strains accounted for 19 per cent of the remaining recordable injuries.

The occurrence of hand injuries was reduced significantly in the second half of 2014. We introduced a hand safety campaign, which focussed on injury awareness and prevention with a number of initiatives, including the Take 5 Pre-Task Hazard Assessment and the Zero Incident Process (ZIP) training programme, which were embedded throughout the year. This campaign, and commitment from our workforce, helped us reduce the number of hand injuries and the total recordable injury rate in the second half of the year.
We are committed to the continuation of that hand injury reduction throughout 2015.

Health and safety training initiatives

The Zero Incident Process (ZIP) training programme was introduced at QAL in 2014 with positive feedback gathered from the pilot sessions. This psychology-based safety training programme was presented to key employee groups throughout 2014 and will be rolled out to the rest of the workforce in 2015.

HSE Bravo! awards

In 2014, 77 Bravo! safety innovations were submitted for review by the Plant Health and Safety Committee. These initiatives were judged by the panel and the winners were presented with HSE Bravo! awards for their efforts and positive contribution to QAL. This initiative has allowed our employees to take ownership of their own health and safety and has helped engage and inspire other employees to come up with ideas to make QAL a safer place.

Health and wellbeing initiatives

The new QAL Health and Fitness standard commenced implementation in August 2014. In 2015, the objective is to achieve a system that provides the “one best way of doing things”, meaning that contractors and employees will both undertake the same pre-employment medical processes.

CASE STUDIES

Ergonomic improvements in Lubrication team

Annually, approximately 130 twenty litre drums are delivered to the top of Tertiary Tanks One to Four.

Read more
Health & Safety

Rio Tinto Alcan Yarwun

Health and safety performance

In 2014, we exceeded our all injury frequency rate target and received an 'outstanding' performance score of 0.58. We recorded seven injuries and two occupational illnesses.

This is a dramatic improvement against our 2013 results and is the second best year in Rio Tinto Alcan Yarwun's ten-year history. This result is largely attributable to a reduction in manual handling and ergonomic injuries. Each year, the five departments on site commit to improving five manual handling and ergonomic hazards. This year, we successfully completed all 25 improvements with a focus on reducing hand hazards. Sixty-eight per cent of the improvements reduced the risk of hands being crushed or caught or in the line of fire.

2014 also saw the development of the Functional Demands Register, which sets out the tasks and physical fitness required for employees to perform certain roles on site. Employees in these roles undertake a functional assessment to ensure that they are fit for the job they need to perform. In addition, the rehabilitation programme for injured employees returning to work has been revised to provide increased support in terms of occupational therapy.

In November 2014, the Hand Safety Committee was established consisting of representatives from a range of mechanical and production teams on site. The committee has been set with the task to consider ways to prevent hand and finger injuries. With injuries of this nature accounting for 57 per cent of the injuries on site, the committee aims to drive awareness and develop solutions that eliminate the root cause of these injuries, address red zones and ensure the ergonomically suitable tools are being used. Reducing hand and finger injuries will place the refinery in good stead to further reduce our AIFR and achieve our goal of zero harm.

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**Significant potential incident (SPI) closure rate** – We use significant potential incident reporting and remedial action closure measures to promote identification, investigation, management and sharing of lessons learned from near-miss events with potentially fatal consequences. *No target set*
INJURIES

INJURIES TO BODY PART

- 14% Upper limbs
- 29% Hips & Legs
- 57% Hands, Fingers, Thumbs

- 4 Restricted Work Days
- 1 Medical Treatment
- 2 Lost Days
Visible safety leadership

At Rio Tinto Alcan Yarwun, our goal is zero harm to our people and to the environment. We expect all employees and contractors to return home safe and healthy at the end of every shift. To support this goal, it is essential that we have the right processes for developing our leadership capability, and confidence in the application of systems that help builds strong safety engagement across all teams.

In 2014, we continued to focus on the HSE Leadership Roadmap that was introduced in 2013, featuring five key focus areas for leaders to drive the site’s safety culture towards interdependency. The five key focus areas include:

1. Life Saving Commitments
2. Housekeeping
3. Tool box
4. HSE interactions
5. Risk management.

In particular, our priorities for 2014 were to improve HSE interactions and to review the Golden Rules which were replaced with our new Life Saving Commitments. Considerable work was completed improving the function of the Safety Interaction Matrix so that all relevant activities on shift were observed and at least one interaction is completed by a team leader with each team member over a month. In addition, weekly coaching and formal assessment of leader safety interaction competency was implemented.

The rollout of the Life Saving Commitments was completed with the Engineering team in 2014 and now forms a focus for Operations rollout in 2015.

Leadership visibility was also a focus for 2014, with trackers now evident on Lean boards, providing a demonstrable record of how much time a senior leader spends in the plant interacting and coaching others.
Health and safety training initiatives

Throughout 2014, a number of health and safety training initiatives were implemented, which played an important role in driving better safety performance across site. These included:

- Life Saving Commitments and critical controls;
- safety interaction coaching;
- dropped object prevention improvement project; and
- ‘safety pauses’.

HSE Bravo! awards

In 2014, 175 nominations were submitted to the Rio Tinto Alcan Yarwun HSE Bravo! awards showcasing health and safety improvements our people identified and implemented across the site. Many of these projects helped us maintain a clean, tidy and safe workplace.

Health and wellbeing

382 employees participated in Rio Tinto Alcan Yarwun’s Refine Health programme in 2014. The programme encompasses an annual health assessment, assistance with personal health and wellness goals, and discounted or free registration in community events such as the Botanic to Bridge.
Dropped object prevention improvement project

Across the refinery, employees are regularly required to perform work at heights. This work presents a number of fundamental risks, including falls and dropped objects. Collectively, these risks represent 32.6 per cent of our risk of fatality onsite and are within the top three causes of fatality for all industry in Australia.

Read more
Queensland Alumina Limited (QAL)

Ergonomic improvements in Lubrication team

Annually, approximately 130 twenty litre drums are delivered to the top of Tertiary Tanks One to Four. This process has required lubrication technicians to manually distribute the drums to the gearboxes, requiring the technicians to move up and down via small platforms, collect waste oil from the top of the Tertiary Tanks and deliver it to the ground. In addition, the technicians are required to maintain housekeeping of the drums stored on the platform. As a result, there were a number of ergonomic, trips, slips and falls hazards within this work area.

The Lubrication team, with the support of the Engineering Project team, developed a new system in 2014 that involves a 650 litre bulk tank being filled with the lubricant, which is then distributed to the gearboxes using fixed steel piping and flexible fill hoses. This safety innovation has improved not only the ergonomic risks involved with the task, but also housekeeping conditions, equipment integrity and the overall efficiency of the team.

Rio Tinto Alcan Yarwun

Dropped object prevention improvement project

Across the refinery, employees are regularly required to perform work at heights. This work presents a number of fundamental risks, including falls and dropped objects. Collectively, these risks represent 32.6 per cent of our risk of fatality onsite and are within the top three causes of fatality for all industry in Australia.

Rio Tinto Alcan Yarwun recognised that managing these risks and preventing incidents had to be a priority for 2014. A project led and developed by Safety advisor Steve Boyer, with support from Training advisor Craig Munce, introduced several initiatives and tools to address these risks at Yarwun. Firstly, the DROPS calculator was incorporated in the Pre-Task Hazard Assessment process to identify the potential consequence of an object falling a distance. Secondly, work at heights competency assessments were revised to assess the theory and practical application of critical controls including control of dropped objects, control of suspended loads and use of the work at heights permit. Lastly, a range of dropped object prevention equipment including a range of lanyards and synthetic mats were introduced.
for use as temporary control methods.

Permanent control measures are being installed progressively in high risk areas across the site. These measures include meshing of handrails and elevated floor areas.

More than 500 employees and contractors have completed the dropped objects training since it was introduced in February 2014. Following the introduction of these improvements, the number of incidents due to falling equipment or tools has significantly reduced and there have been no incidents recorded for a person standing under a suspended load, handling a suspended load or leaving a protected area at height resulting in a potential to fall.

Since the introduction of the project, there has been a 46 per cent reduction in significant potential incidents in relation to dropped objects and work at heights. To ensure these results are sustainable, the programme has been fully integrated into the site work at height training programme and assessment.
Environment

Queensland Alumina Limited (QAL)

Environmental performance

In 2014, QAL operated under its new Environmental Authority (EA) for the first full year since it was introduced in 2013. We made great progress, completing a number of projects as part of the Transitional Environmental Programmes (TEPs), which ensured we achieved compliance with all our EA conditions.

Five of the 12 projects in the EA TEP have now been completed.

In 2014, projects on continuous monitoring of water, noise and air discharges were all completed. Projects in the Alumina Dust TEP are now 80 per cent finished and due for completion in 2015.

Of the nine significant environmental incidents, three were related to extreme wet weather events in early 2014. A number of the TEP projects underway will help QAL to better manage the significant variability and tropical weather of Gladstone.

As we move towards completing all TEPs in 2015 and 2016, our non-compliance position and overall environmental performance will improve significantly.

Note: The 30 reported land incidents were hydrocarbon spills; 24 of them were <15L of hydrocarbon split.
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<td></td>
<td>9,271</td>
</tr>
<tr>
<td>Freshwater use efficiency (kL/t alumina)</td>
<td>2.84</td>
<td>2.85</td>
<td>2.45</td>
<td></td>
<td>2.45</td>
</tr>
<tr>
<td>Seawater use (ML)</td>
<td>35,522</td>
<td>35,530</td>
<td>35,600</td>
<td></td>
<td>35,600</td>
</tr>
<tr>
<td>Sulphur dioxide emissions</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td></td>
</tr>
<tr>
<td>Nitrogen dioxide emissions</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td>No licence breaches</td>
<td></td>
</tr>
<tr>
<td>Waste recycled (t)</td>
<td>4,413</td>
<td>4,059</td>
<td>4,100</td>
<td></td>
<td>4,100</td>
</tr>
<tr>
<td>Land revegetation (ha)</td>
<td>5</td>
<td>6.4</td>
<td>6.4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Greenhouse gas emissions (t CO2-e/t alumina)</td>
<td>3,668,420</td>
<td>3,676,314</td>
<td>3,856,000</td>
<td></td>
<td>3,970,021</td>
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<tr>
<td>Greenhouse gas efficiency (t CO2-e/t alumina)</td>
<td>1.084</td>
<td>1.03</td>
<td>1.03</td>
<td></td>
<td>1.05</td>
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<tr>
<td>Bayer process energy use (GJ)</td>
<td>40,569,000</td>
<td>41,655,000</td>
<td>41,404,000</td>
<td></td>
<td>42,683,000</td>
</tr>
<tr>
<td>Bayer process energy efficiency (GJ/t alumina)</td>
<td>11.99</td>
<td>11.68</td>
<td>11.06</td>
<td></td>
<td>11.29</td>
</tr>
</tbody>
</table>

+Freshwater use includes all grey water and recycled water used on site.

NOTE: In 2014, QAL’s new Environmental Authority came into effect and this changed the way QAL reports environmental incidents. The increase in the ‘Technical licence breach incidents’ and ‘Significant Environmental Incident’ figures are because activities previously not required to be reported as incidents are now required to be reported.
Environmental challenges and achievements

Several achievements were celebrated by the Environment team in 2014 with huge progress made on two Transitional Environmental Programmes (TEPs) stipulated in the Environmental Authority under which QAL operates. The majority of both the Alumina Dust TEP and the Licence Compliance TEP have been completed on schedule with no milestones missed.

Seven hectares of QAL’s ash dam were also successfully revegetated. The remainder of the ash dam is used as either a working ash pond or is continually dust-suppressed. Each year, wader birds have continued to roost there and the population continues to grow.

CASE STUDIES

Transitional Environmental Programmes make progress

Five of the eight projects associated with the Alumina Dust TEP have now been completed. This includes work on the ship loader and dust collector to minimise dust emissions from the wharf.

Read more
Rio Tinto Alcan Yarwun

Environmental performance

At Rio Tinto Alcan Yarwun, we reported 46 non-compliances against our Environmental Authority during 2014. This was a significant improvement following 89 non-compliances during 2013.

A key priority for 2014 was to reduce total suspended solids (TSS) by an average of 15 per cent across all discharge points. This target was achieved through a consistent and targeted campaign to improve drainage and reduce erosion and sediment mobilisation by undertaking the following activities:

- cleaning out drains to remove sediment;
- cleaning out dams and ponds to maximise storage capacity;
- mulching to reduce surface flow and reduce sediment mobilisation;
- re-aligning drainage to improve drainage through correct channels;
- sheeting known problem areas with stones, mulch and groundcover;
- hydromulching;
- trialling various methods of revegetation and slope stabilisation;
- revegetation of open areas and traffic reduction through these areas; and
- continued trials with chemical and physical sediment suppressants.

The graph below illustrates the year on year improvement that has been made with regard to TSS. Despite the significant improvement, TSS levels remain outside of license requirements and as such reducing TSS across all discharge points will remain a key priority for 2015.
A significant number of non-compliances in 2013 were due to monitoring equipment integrity and inadequate training. All monitoring equipment has been audited and repaired or recalibrated where required and a revised training package has been rolled out to maintenance personnel to ensure equipment is operated and maintained correctly. Since this work has been completed, there have been no incidents regarding Total Suspended Particulates (TSP).

Emissions verification work continued throughout 2014 with sampling undertaken in high risk dust emission points and open path monitoring on precipitation tanks. The open path monitoring equipment enabled Rio Tinto Alcan Yarwun to provide data to the Air Emissions Verification Study as required by the Environmental Authority. The refinery is an active member of the Gladstone Air Network and will continue to support this project.

Monitoring in Port Curtis continued throughout 2014 with Rio Tinto Alcan Yarwun undertaking Receiving Environment Monitoring Programme (REMP) and contributing to the Port Curtis Integrated Monitoring Programme (PCIMP). The refinery is a member of the Gladstone Healthy Harbour Partnership and will continue to support this partnership.
<table>
<thead>
<tr>
<th>Non-Compliance Events</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spills</td>
<td>20</td>
</tr>
<tr>
<td>TSS or pH limit exceeded</td>
<td>15</td>
</tr>
<tr>
<td>Procedural</td>
<td>5</td>
</tr>
<tr>
<td>Dust release</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Environmental incidents (medium and above)</td>
<td>63</td>
</tr>
<tr>
<td>Non-compliances</td>
<td>89</td>
</tr>
<tr>
<td>Freshwater use (ML)</td>
<td>9,330</td>
</tr>
<tr>
<td>Freshwater use efficiency (kL/t alumina)</td>
<td>3.82</td>
</tr>
<tr>
<td>Seawater use (ML)</td>
<td>21,818</td>
</tr>
<tr>
<td>+Sulphur dioxide emissions (t)</td>
<td>220.00 (11 breaches)</td>
</tr>
<tr>
<td>+Nitrogen dioxide emissions (t)</td>
<td>1,100</td>
</tr>
<tr>
<td>Waste recycled (t)</td>
<td>989</td>
</tr>
<tr>
<td>Land revegetation (ha)</td>
<td>26.1</td>
</tr>
<tr>
<td>Greenhouse gas emissions (t CO2-e)</td>
<td>1,567,751</td>
</tr>
<tr>
<td>Greenhouse gas efficiency (t CO2-e/t alumina)</td>
<td>0.642</td>
</tr>
<tr>
<td>Bayer process energy efficiency (GJ)</td>
<td>24,455,700</td>
</tr>
<tr>
<td>Bayer process energy efficiency (GJ/t alumina)</td>
<td>9.17</td>
</tr>
</tbody>
</table>

**Environmental incidents (medium and above)** are near-source confined incidents with either an immediate or short-term reversible impact.

**Freshwater use** includes all process water used for washing, steam generation and cooling.

**Seawater use** includes seawater used to neutralise the caustic in bauxite residue and acts as a pumping mechanism to transport the residue to the RMA where it is separated from the residue, treated and returned to the sea.
Design storage allowance for the Residue Management Area

The 2014 RMA wall raise project was successfully delivered two weeks ahead of schedule and the 2015 RMA wall raise detailed design plan was submitted and approved prior to completion of the 2014 project. This work positions the business well to deliver the 2015 project. Work will continue in 2015 around land use approvals for the RMA2 lot.

Spill prevention and clean up

With more than 40 per cent of non-compliances due to spills, spill prevention will be a key focus in 2015.

CASE STUDIES

Non-compliance reductions achieved

An extensive improvement project was undertaken in 2014 to reduce non-compliance incidents by 30 per cent.

Read more
Environment

Queensland Alumina Limited (QAL)

Transitional Environmental Programmes make progress

Five of the eight projects associated with the Alumina Dust TEP have now been completed. This includes work on the ship loader and dust collector to minimise dust emissions from the wharf.

The number of community dust complaints fell from 30 in 2013 to eight in 2014, and the addition of the dust collector has likely contributed to this.

Another improvement made in 2014 was the commissioning of QAL’s real-time noise monitoring station at Barney Point. This instrument allows site teams to accurately track and report on noise levels from the plant and surrounds, in real-time.

Every second, the noise logger takes a reading of the noise level and a recording. The information and sound bite are then sent back to the team for analysis. It also means the team will know when the Environmental Licence noise level has been breached.

Rio Tinto Alcan Yarwun

Non-compliance reductions achieved

An extensive improvement project was undertaken in 2014 to reduce non-compliance incidents by 30 per cent.

Non-compliance incidents refer to a breach against our Environmental Authority, which sets out the regulatory requirements to minimise the risk of environmental harm.

Lead by the Business Improvement team, the project employed the Six Sigma and Lean methodologies to investigate repeat incidents and identify high risk areas.
Specialist environmental projects, Barb Tennant delivered a native vegetation area to prevent erosion and reduce dust on site.

Once identified, the project was directed to achieve zero emission exceedances in the Boilers and Calcination. A range of initiatives were carried out in these areas to cut exceedances, such as the installation of new monitoring and alarm systems, equipment modifications, and the development of new competency training modules.

The project was successful, with non-compliance incidents falling from 89 in 2013 to 46 in 2014. We recognise there is still a way to go, and so a similar methodology will be used in 2015 to continue to drive further improvements.
Our approach to communities

At Rio Tinto Alcan Yarwun and Queensland Alumina Limited, we recognise that strong management of our community relationships is as necessary to our business as the success of our operations. We set out to build enduring relationships that are characterised by mutual respect, active partnership and long-term commitment.

In all aspects of our work, we seek to understand the social, environmental and economic implications of our activities so that we can optimise benefits and reduce negative impacts, both for local communities and for regional and national economies.

Rio Tinto Alcan Community Fund

To support Rio Tinto Alcan’s Gladstone operations now and in planning for future closure, the Rio Tinto Alcan Community Fund supports community-based projects that can make a difference in a sustainable way without creating dependency.

In 2002, the Rio Tinto Alcan Community Fund was established. Governed by a board of community and company representatives, the Fund has since invested over $6 million directly in the Gladstone region and leveraged an additional $10 million across more than 50 partnerships.

In 2008, the Community Fund commissioned the Vision 2028 project, which identified childcare and health as areas of critical need in the Gladstone region. In order to address these areas, the Fund established the Here for Childcare and Here for Health initiatives. The success of these initiatives has increased service quality and accessibility within the Gladstone region.

Community Investment

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rio Tinto Alcan Community Fund</td>
<td>$649,202</td>
<td>$403,901</td>
</tr>
<tr>
<td>Sponsorships and donations</td>
<td>$379,119</td>
<td>$181,565</td>
</tr>
</tbody>
</table>
Note: Rio Tinto Alcan Yarwun and QAL joined sponsorship and donation programmes in June 2013 and now sponsor community projects and initiatives as a single entity.
Here for Health

The *Here for Health* initiative commenced in early 2013, with a coming together of community leaders and health professionals to ascertain a holistic understanding of the health needs in Gladstone, and a plan for making a positive change. Since then, the following outcomes have been achieved:

** HERE FOR HEALTH 2014

** Organising data

Release of the 'One Gladstone Health Plan', which combined the public, private and primary health care data into a single data source for the region so that all health service providers are working off a common platform;

** Health analysis

Release of a 'Health Needs Analysis' by CQ Medicare Local for the Gladstone region;

** More professionals

Launched hellogladstone.com.au, a website designed to attract health professionals to Gladstone;

** New specialists

Recruitment of seven new specialists through partnerships between the Gladstone and Mater Hospitals (co-located);

** Increasing awareness

Increased awareness through local media of the steps being taken by the committee to improve health services in the region; and

** Improving services

Working across various organisations to identify synergies and improve the relationships to drive a more effective and efficient health service in the region.

At a recent workshop, the *Here for Health* Committee agreed that it would increase its focus on integrated care between primary and tertiary health care providers in 2015.
Here for Childcare

In March 2012, the Rio Tinto Alcan Community Fund launched the *Here for Childcare* programme, committing $1.2 million over six years. The programme has since delivered the following outcomes, easing pressure on Gladstone’s childcare industry and families:

### HERE FOR CHILDCARE

<table>
<thead>
<tr>
<th>116</th>
<th>New family day care places created</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>New educator positions for long day care</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>23</th>
<th>Educators have up-skilled by obtaining their Diploma in Children Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>School based trainees have commenced a Certificate III in Children Services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>02</th>
<th>Local residents have secured tertiary scholarships and will become Early Childhood Teachers in the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Professional development workshops by international facilitators have been held for educators in Gladstone</td>
</tr>
</tbody>
</table>

### Sponsorships and donations

This year QAL and Rio Tinto Alcan Yarwun sponsored community projects and activities by actively contributing financial and in-kind assistance. These sponsorships largely focussed on the key areas of childcare, education and health in Gladstone.

### Boyne Tannum Hook Up

In 2014, we launched a three-year partnership with the Boyne Tannum Hook Up. The partnership will see an external consultant work with the Boyne Tannum Hook Up Committee to establish a robust framework for ensuring long-term sustainability of the event, and to set the foundations for growing the event into one of national significance.

QAL and Rio Tinto Alcan Yarwun also coordinated the official Boyne Tannum Hook Up merchandise sales. All profits from merchandise sales went towards supporting comprehensive mental health services from which local residents are able to seek support.

### Stakeholder engagement

Integral to our approach of building enduring relationships with our local communities, Rio Tinto Alcan Yarwun and QAL continue to find new (and maintain existing) avenues to facilitate open and transparent relationships.

QAL and Rio Tinto Alcan Yarwun worked to strengthen community engagement in 2014 by regularly interacting with key community members and groups to discuss matters of importance to community stakeholders and the refineries.
We held the first QAL Community Day in November for residents living in the nearby areas of Barney Point, South Gladstone, Toolooa, Boyne Island, Wurdong Heights, Quoin Island and O’Connell. It was a great afternoon with residents invited to tour the refinery, discuss impacts with key subject matter experts and to register with QAL’s new Real-time Online Community System (ROCS).

By listening to our community and proactively working to build open and transparent relationships through ROCS and direct engagement with the community, QAL aims to better respond to community concerns.

Rio Tinto Alcan Yarwun had to postpone its annual Yarwun Community Day due to inclement weather during December. The day took place on Sunday 1 February 2015. It was a great day with members of the local Yarwun and Targinnie communities having an opportunity to meet members of the management team, tour the refinery, and learn about the current and future position of the business.

Complaints

We understand that to achieve our vision, effective communication, consultation and engagement with our stakeholders must be part of the way we work. To ensure we engage our stakeholders effectively, we actively listen to any concerns or suggestions and consider ways in which we can drive continuous improvement in what we do.

We have implemented a Real-time Online Community System (ROCS) at QAL that helps drive better communication within our impact area. This system ensures all complaints are recorded and actioned promptly.

In 2014, QAL received 55 complaints for impacts including dust, odour, noise and alkali. The number was significantly reduced from the 78 complaints recorded in 2013. At Yarwun, two complaints were received in 2014 relating to employee driver behaviour, which was addressed through internal processes.

<table>
<thead>
<tr>
<th>COMPLAINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
<tr>
<td>5</td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

*All RTAY Complaints registered as ‘Other’
Cultural Heritage Management

We recognise and respect the cultural heritage of the Traditional Owners of our land. To ensure sites of cultural heritage significance are protected, we closely consult with local Aboriginal people. Following a traditional burn and artefact identification within Rio Tinto Alcan Yarwun’s RMA2 lot (pictured) in 2013, verification and relocation of many artefacts to the cultural heritage landscape area was undertaken in partnership with the Port Curtis Coral Coast (PCCC) Aboriginal Corporation field officers in 2014. This work was required to prepare the site for future use. The PCCC were also engaged to undertake other monitoring works at the Yarwun refinery’s existing residue management area (RMA). In 2015, Rio Tinto Alcan will again work in partnership with the Aboriginal Corporation to evaluate and manage a number of artefact scatters located on the RMA2 site.

At QAL, no work was undertaken in 2014 that required monitoring for cultural heritage artefacts.

CASE STUDIES

Here for Health

The Here for Health Committee was formed in February 2013, and over the last 22 months, has created a positive change in our local health services.

Read more

Here for Childcare

Through the Here for Childcare programme, 12 professional development workshops have been provided in Gladstone for those working in childcare.

Read more
ROCS

Over the years, the township of Gladstone has gradually expanded and residential areas are now much closer to the QAL refinery.

Read more
Health & Safety

Here for Health

The Here for Health Committee was formed in February 2013, and over the last 22 months, has created a positive change in our local health services.

Early this year, the committee released the 'One Gladstone Health Plan'. This plan was the first of its kind in Australia and was developed through intensive analysis of data from both public and private health sectors. The plan identified the key areas of need for health services in Gladstone.

Out of this plan, the committee has worked to recruit seven new specialists to Gladstone, identify synergies, and improve collaboration and resource sharing between the Mater and Gladstone hospitals. Having these specialists available locally has greatly improved quality of life for many members of the community. Not only does it instil confidence in the community, but within the medical profession by attracting other specialists to the region.

Attracting medical professionals and interns alike, is another key objective for the committee who have developed the Hello Gladstone website to support those making the move to the region.

The strength of relationships between the health service providers and community leaders has not only seen improvement across many areas of health services, but has also assisted in better informing the community regarding the challenges faced.

Here for Childcare

Through the Here for Childcare programme, 12 professional development workshops have been provided in Gladstone for those working in childcare. The workshops, which have been delivered by national experts, aim to up-skill existing educators on important topics identified by the childcare industry.

The Salvation Army Family Day Care Scheme manager Fiona Foley recently stated that the Here for Childcare workshops were an integral part of the training programme delivered to programme participants throughout the year.

The Here for Childcare programme has united the childcare community in Gladstone as all forms of childcare benefit. From family day care educators to school trainees, the childcare community has embraced the assistance this programme offers and both the quality of care and the availability of care have improved.
By listening and working hand-in-hand with key stakeholders, the Here for Childcare programme has successfully eased pressure on childcare centres, and quality, accessible and flexible care is now available to more families.

ROCS

Over the years, the township of Gladstone has gradually expanded and residential areas are now much closer to the QAL refinery. This means QAL has an ever-increasing need to engage and develop relationships with its near neighbours to ensure the operation becomes more transparent and the community develops a greater understanding of what we do. The Real-time Online Community System (ROCS) was a step towards making this transition.

ROCS was rolled out in October to stakeholders living in the suburbs of Barney Point, South Gladstone, Toolooa, Boyne Island, Wurdong Heights, Quoin Island and O’Connell.

When a resident makes a complaint via ROCS, the shift controller, and Community Relations and Environment teams are immediately notified and are required to take action, where possible, to reduce the impact. Once community users have been registered in ROCS, they are also able to rate QAL’s performance on a six-monthly basis, provide feedback and access a log of scheduled activities on site that may have an impact on the community.

While some residents have already started using ROCS as their preferred method of communication with QAL, our focus in 2015 will be to undertake direct engagement with our neighbours to present this system and understand our communities’ needs better.
Business Performance

Queensland Alumina Limited (QAL)

Production against target

QAL’s Precipitation capability provided some challenges in the first half of 2014, however, these were resolved following the introduction of the ‘Integrated Schedule’ and the development of clear operational strategies and tactics in May. With the Precipitation area back on track, the plant performed well in the second half of the year and met production forecasts.

Overall in 2014, QAL fell short of production targets, largely due to challenges in Precipitation earlier in the year.

In 2015, we will commission the 1217 conveyor to increase bauxite supply to the plant. We will also introduce Gove bauxite to the QAL process to supplement the degrading Weipa bauxite supply. It is also a 2015 priority to embed the improved Precipitation operation that was achieved in the second half of 2014.

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2014 (sticky)</th>
<th>Performance</th>
<th>2015 (sticky)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (million tonnes/annum)</td>
<td>3.383</td>
<td>3.567</td>
<td>3.744</td>
<td>3.78</td>
<td></td>
</tr>
<tr>
<td>Wages and benefits (millions)</td>
<td>$137.734</td>
<td>$145.010</td>
<td>$146.746</td>
<td>$143.850</td>
<td></td>
</tr>
<tr>
<td>+Payments to local suppliers (millions)</td>
<td>$195.111</td>
<td>$182.669</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

+ Local suppliers are suppliers within 4680 postcode * No target set

Local investment

QAL supported local suppliers who align with our values and offer a competitive option for the business. QAL has awarded contracts to locally owned and operated firms for the Residue Disposal Area, QAL site services, transport and trucking, vehicle repair as well as a multitude of service contracts including catering, the on-site food vendor and capital works.

In 2015, QAL aims to improve its engagement with local suppliers to ensure they understand QAL’s vision for the future and can tender for a number of contracts that are due to be renewed.
Digestion heaters save energy and production costs

Huge progress was made in improving Digestion heat recovery in 2014. For the first time in many years, the Digestion heaters reached their most efficient level and, as a result, QAL’s energy consumption and production costs were reduced.

Read more
Business Performance

Rio Tinto Alcan Yarwun

Production

Rio Tinto Alcan Yarwun achieved a record production of 2.7 million tonnes of alumina in 2014. This was an improvement of 300,000 tonnes against 2013. During 2014, solid performance improvements were made in Digestion and Clarification, which have put the operation in a good position to deliver 3.4 million tonne-rates safely and sustainably by December 2015. A broader strategy has been developed to further support this target, which is built around recovering the residual life of the refinery, enhancing the capability of our people, and executing a number of design modifications.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (million tonnes/annum)</td>
<td>2,446</td>
<td>2,700</td>
<td>3,215</td>
<td>2,940</td>
</tr>
<tr>
<td>Wages and benefits (millions)</td>
<td>$104</td>
<td>$109</td>
<td>$109</td>
<td>$115</td>
</tr>
<tr>
<td>*Payments to local suppliers (millions)</td>
<td>$204.673</td>
<td>$153.589</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*Local suppliers are suppliers within 4680 postcode. Rio Tinto Alcan Yarwun only sets targets for payments to all external suppliers.

Local investment

We recognise that significant socioeconomic benefits can be achieved through sourcing products and services locally. We are committed to evaluating local supply options as part of our sourcing strategy.

Rio Tinto Alcan procurement

**CASE STUDIES**

Mud farming improvements at the RMA

A team led by Mike Colledge, manager of the Gladstone Project Hub, developed a plan to increase mud farming capability at the Residue Management Area (RMA).

Read more
Energy efficiencies in Redside

Changes to the cleaning process for Jacketed Pipe Units (JPUs) in Digestion have delivered significant improvements for the refinery.

Read more
Business Performance

Queensland Alumina Limited (QAL)

Digestion heaters save energy and production costs

Huge progress was made in improving Digestion heat recovery in 2014. For the first time in many years, the Digestion heaters reached their most efficient level and, as a result, QAL’s energy consumption and production costs were reduced.

In the second half of 2013, the average T9 temperature across the three Digestion units was 200 degrees Celsius, 9 degrees below the target of 209 degrees Celsius. This inefficiency meant the site had to burn additional coal and gas to maintain energy demands.

For the full year of 2014, the average T9 temperature across the three Digestion units increased to 206 degrees and, since July 2014, the three Digestion units have consistently achieved or exceeded the average T9 target of 209 degrees.

Redside manager Greg Doyle said maintaining this trend would save significant dollars each year and significantly reduce QAL’s consumption of coal and gas.

There are a number of factors responsible for these positive results, but in particular there has been strong teamwork between the Digestion Technical and Operations teams to ensure that the spent liquor heater acid washes are performed on schedule and to the right quality, specification and standard while underperforming heaters are rapidly identified and actioned.

Rio Tinto Alcan Yarwun

Mud farming improvements at the RMA

A team led by Mike Colledge, manager of the Gladstone Project Hub, developed a plan to increase mud farming capability at the Residue Management Area (RMA). The plan consisted of a twofold strategy that aimed to:

1. immediately minimise, and eventually cease, decant storage on the mud stack; and
2. source the necessary resources required to farm the entire dam footprint.

The target density for the RMA is one tonne per cubic meter and achieving this will require use of the whole dam footprint. Over the course of 2014, we made strong improvements to our mud farming activities and by October we were farming 190 hectares.
Compare this to one year earlier which, due to a number of unforeseen circumstances, saw us farming less than five hectares.

To remove decant from the mud, a channel was dug, using specialist mud crawling excavators, through existing unfarmed mud, from the northern end of the dam to the southern end. Once the drainage path was established, decant was able to collect in the southern area of the dam where it can be pumped to the thickener, before it is returned to the ocean.

Execution of the plan required high levels of cooperation and collaboration between the project team, mud farming team, and thickeners and pigging teams.

The mud is now being dozer farmed in the south and eastern area of the RMA and the team has recovered 25 per cent of the dam. This achievement vastly reduces business risk and capital expenditure as it increases the forecast lifetime of the dam and ensures the foundations are suitable for our wall raise projects.

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### Energy efficiencies in Redside

Changes to the cleaning process for Jacketed Pipe Units (JPUs) in Digestion have delivered significant improvements for the refinery. Previously all live steam JPUs were cleaned via hydroblasting, which took four days and was completed every 14 weeks. In 2014, we began cleaning via a pigging process, which takes just 57 hours and is completed every nine weeks.

With some industry leading processes, capital improvements and teamwork, this timeframe is targeted to be reduced to just 36 hours, bringing about huge cost savings and production opportunities for the business.

The new cleaning process has improved the efficiency of heat transfer to the bauxite, increasing flow and yield rates. Further environmental benefits were delivered through reduced water usage and diesel usage. Operational costs and safety benefits were realised as the new process does not require scaffolding to be erected and dismantled. And lastly, the acid washing is now controlled by the condition of the equipment as opposed to being time based, which results in reduced acid consumption and more effective cleaning.

Although work continues to reduce cleaning turnaround times even further, the project has contributed significantly to the recovery of residual life in Digestion. Improvement projects have been undertaken across the refinery to recover residual life (a measure of completing critical work on time) and with Digestion and Clarification recovered, efforts will be ongoing in 2015 to recover residual life in Calcination.