

# 5 Year Environmental Implementation Plan

2019 – 2023  
Version 12.0  
30 September 2021

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<b>Approver:</b>	General Manager	Pine Pienaar

## Environment Improvement Projects

The environmental improvement project outlined in this implementation plan have been grouped into key focus areas shown in Table 1.

Table 1: Summary of improvement projects

Focus Area	Key Objective
Organisation cultural change	Risk reduction through empowering the entire workforce
Air Quality Management	Emission/particulate and risk reduction
Water Management	Impact mitigation
Land Management	Mitigate contamination: safe, stable and sustainable
Other	Amenity impact reduction

## Explanation of the Implementation Schedule

The implementation schedule shown after each project table shows the study, engineering or execution phase, which are described below:

### Study Phase

Projects shown in study phase are at the earliest part of the implementation process and require work to identify and assess options that will deliver the required environmental outcome. The outcome of the study phase is to determine the option that best meets the defined performance criteria. In selecting the preferred option during the study phase to take to the engineering phase, options are assessed against a number of criteria, including,

- How effectively each option mitigates the risk,
- Can the project be delivered in the required timeframe?
- What is the cost of each option compared to the expected environmental outcome?
- Can the option be practically constructed?
- Can the option be implemented within an operating refinery?
- What approvals will be required to deliver the option?
- Can the option be delivered safely?

Some projects are quite complex requiring more time and resources in determining the right option. Consequently the outcome of the study phase for a project will deliver the option to take forward to the engineering phase.

### Engineering Phase

The engineering phase is where the detailed work is carried out and a set of documents is developed to allow the project to move into the final execution phase. The engineering phase covers traditional mechanical, civil, structural, process and electrical engineering input, which will provide a detailed design that can be constructed to meet applicable Australian, Queensland and QAL standards. Other aspects covered in the engineering phase include any required Commonwealth, Queensland and Local government approvals pertaining to environmental, planning and cultural heritage legislation. These approvals can only commence once the project design is nearing completion.

The output from the engineering phase will be a detailed design and issued for construction drawings (where required) that are based on risk reviews (process, safety, health, environmental and cultural), constructability reviews as well as hazard and operability assessments.

As stated, some projects will require a number of approvals from the Commonwealth, State and Local governments with approval time frames that may extend up to a year during the engineering phase for some of the more complex projects.

Towards the completion of the engineering phase QAL will be able to determine a more detailed performance indicator to demonstrate the environmental improvement at the completion of execution.

### Execution Phase

The output of the engineering phase will be a package of work that will generally include a number of deliverables that will be tracked during the execution phase. The type and complexity of the project will determine the number of deliverables required and how the deliverables are phased, as some may need to be finished before another can begin.

### How to Interpret the Tables

The study (gold) and engineering (blue) phase schedules are based on delivering milestones at the end of a specified quarter, i.e 2019 Q1 means Quarter 1 2019 January to March. The execution phase (green) schedules are based on delivering milestones within a calendar month.

This example shows the study phase milestone for a project is due in quarter 4 in 2018. This means that during quarter 4 the project will transition into the engineering phase and the implementation plan will be updated accordingly.

Task	Project Name					
	2018		2019			
	Q3	Q4	Q1	Q2	Q3	Q4
Description						

This example shows the engineering phase milestone due in 2019 quarter 2 and the implementation plan will be updated in quarter 2 to show the execution phase.

Task	Project Name					
	2018		2019			
	Q3	Q4	Q1	Q2	Q3	Q4
Description						

This example shows the execution phase will take 1 and a half years with the completion date of the project in April 2020.

Task	Project Name											
	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Description												

## Organisational Cultural Change

QAL recognises that the culture of an organisation is a significant factor impacting the environmental performance of a business. While leadership commitment and governance structures are important to ensure that environmental improvement projects are effectively executed; our environmental improvement program will only succeed if we empower all of our employees to have due and proper consideration of environmental obligations and risks in their everyday tasks.

Redefining our site culture begins with our workforce having a greater understanding of the process safety aspects of our operation, and the significant potential environmental and community impact our operations can have. We then need to empower our workforce to reduce risk around process and environmental concerns to avoid them and respond when potential process safety and environmental concerns arise. The introduction of a disciplined system for organizing workplaces and the broader QAL operating environment is underway.

Improved housekeeping and understanding of process safety critical controls will lead to early detection of leaks, spillage and situations that could lead to potential environmental impacts.

<b>Project (C1)</b>	<b>Site Cultural Change</b>
Risk class	- IV/Critical
Environmental risks	- Failure of systems causing environmental incidents that impact on the receiving environment and community
Project solution / options	<ul style="list-style-type: none"> <li>- Improve process safety and environmental risk detection for all QAL employees through a Process Safety Management System (PSMS) that ensures critical controls are identified and verified.</li> <li>- All QAL employees involved with ensuring critical controls are in place are aware of the importance of these controls and that they will be verified.</li> <li>- Cultural change will be incorporated into the operations systems including: <ul style="list-style-type: none"> <li>• Functional workplace program</li> <li>• Annual environmental training for all employees</li> <li>• Daily HSE meetings (environment in work preparation)</li> <li>• Quarterly business updates, led by site senior executives</li> <li>• Bi-annual engagement survey</li> <li>• Purple banner reporting which includes the introduction of reporting category focused exclusively on environmental incidents</li> </ul> </li> </ul>
Objective / performance outcome	<ul style="list-style-type: none"> <li>- Greater awareness of environmental risk and employee's role in controlling these risks.</li> <li>- Improved culture relating to process safety and environmental risk management throughout the entire organisation through the implementation of a PSMS.</li> </ul>
Performance Indicator	<ul style="list-style-type: none"> <li>- 90% of major hazard critical control health checks completed within the first 12 months after the PSMS is implemented across site (end of 2020).</li> <li>- Greater than 95% of employees completing annual environmental awareness training.</li> </ul>
Cost estimate A\$ million	- \$1 annually
Project Stage	<p><b>Executed</b></p> <ul style="list-style-type: none"> <li>- PSM Major Hazards defined, reviewed and results of the activities that determine if critical controls will work when called upon reviewed monthly by the Management Team.</li> </ul>

Comments	<ul style="list-style-type: none"> <li>- At least one example of functional workplace implemented in every section onsite, with several in many sections. Continued deployment required until full site coverage is achieved.</li> <li>- All PSM major hazard workshops complete with monthly results reported to the board.             <ul style="list-style-type: none"> <li>• CCMP process (deep dive by GM on Critical Controls) ongoing on completed major hazards.</li> <li>• Monthly managers review process implemented and chaired by General Manager.</li> <li>• A full review process has been completed on every Major Hazard (~1/2day workshop per Major Hazard).</li> <li>• A Pathway-to-Compliance has been developed for every Major Hazard and is tracked monthly.</li> </ul> </li> <li>- Annual environmental training updated and implemented in January;             <ul style="list-style-type: none"> <li>• &gt;95% of employees have completed Environmental Web Based Training in 2021 (&gt;95% in 2018-20).</li> </ul> </li> <li>- ERM organisation psychologist team supporting the organisational cultural change process, including:             <ul style="list-style-type: none"> <li>• Development of &gt;75 actions focusing on environmental stewardship,</li> <li>• Actions are fully integrated into the QAL Business Strategy,                 <ul style="list-style-type: none"> <li>▪ Waste Management and actions arising out of the QAL Environment Committee will be the primary focus areas in 2021.</li> </ul> </li> <li>• Pulse survey planned for May, to confirm actions are engaging the QAL workforce was moved to September, due to mid-improvement program celebrations, has now commenced.</li> <li>•</li> </ul> </li> </ul>
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### Implementation Schedule

Site Culture Change											
Task	2018		2019				2020				
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Site Cultural Change	Complete		Complete				Complete				
	Study	Engineering	Execution								

## Air Quality Improvement Projects

QAL's 5-year air quality improvement plan, supported by targets, actions and programme of works is summarised below. Capital spend is estimated at between A\$19 million to A\$38 million.

Project (A1)	Alkali Release Off-Site
Risk class	- IV/Critical
Environmental risks	- Alkali release to atmosphere with potential to impact air quality and property in the surrounding communities
Project solution / options	Identify sources at the refinery that can release alkali and put in place measures to reduce the risk of the release occurring. An initial suite of alkali emissions reduction projects are in execution. Stage 2 of the alkali emissions reduction project will include further study to identify further alkali sources where the risk of release can be reduced
Objective / performance outcome	- Sources will be identified where actions can be taken to reduce likelihood and consequence of alkali release - Reduce identified Class III and IV alkali release risks to Class I and II to mitigate impact to the community
Performance Indicator	- Study phase identifies options to reduce emissions from alkali sources in the refinery and they are progressed to engineering. - No alkali release events from completed projects due to QAL operations or maintenance activities - All emission sources assess as Class III and IV risk are identified and an engineering solution is developed or investigations exhausted to reduce risk to Class I and II.
Cost estimate A\$ million	- 26.0



<p>Project Stage</p>	<p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Digestion relief tank,             <ul style="list-style-type: none"> <li>• Detailed design for the digestion relief tank includes:                 <ul style="list-style-type: none"> <li>▪ Digestion relief system - containment system                     <ul style="list-style-type: none"> <li>• The design will look at improving separation of steam and slurry through:                             <ul style="list-style-type: none"> <li>○ More efficient design of the entrainment separators,</li> <li>○ Improving separation efficiency in the relief tanks. It is expected that the Unit 2 relief tank will be replaced as part of this project. Improvements in Unit 1 and 3 relief tanks have already been delivered through removal of redundant equipment inside the relief tanks.</li> </ul> </li> </ul> </li> <li>▪ Digestion relief system – front end.                     <ul style="list-style-type: none"> <li>• Installation of slurry shut off valves between the digester and the first flash tank to stop the flow of energy from the digester during a relief event.</li> <li>• Improving reliability of level detection in the flash tanks as a lead indicator of a blocked flash tank outlet,                             <ul style="list-style-type: none"> <li>▪ Adding an additional level indicator to the three highest risk flash tanks,</li> <li>▪ Based on feedback from level and other online indication (pressure) the valves will be closed by the control room.</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Install second new oxalate tank.</li> <li>- Bottom fill precipitators – reduce turbulence in the top of the tanks during filling to stop alkali misting.             <ul style="list-style-type: none"> <li>• The emergent work, which includes the removal of redundant pipework has been fully scoped and is scheduled to be completed by quarter 2 2022, hence the schedule for completion of this project has been moved to 2023.</li> </ul> </li> <li>-</li> </ul> <p><b>Projects completed</b></p> <ul style="list-style-type: none"> <li>- Existing equipment (identified as Class III and IV Risk) including piping, valving and fixtures on the Digester Pilot Steam Lines and the Flash Tank pilot steam lines have been replaced.</li> <li>- New oxalate vent tank has been installed and commissioned.</li> <li>- Upgrade and install shrouds on expansion joints;</li> <li>- Flash tank relief header shroud installation;</li> <li>- Digestion heater vent diversion;</li> <li>- Flash tank relief header shroud installation;</li> <li>- Upgrade and install shrouds on expansion joints,</li> <li>- Remote stop for precip cooling towers – precip cooling tower fans to be stopped by the control room if conductivity of cooling water</li> </ul>
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	<p>increases (conductivity increases are likely due to caustic liquor ingress)</p> <ul style="list-style-type: none"> <li>- HP blowdown line redirection – redirect blowdown lines to reduce steam and alkali at the entrainment separators.</li> <li>- Install an upgraded temperature control valve on the holding tanks contact heater steam supply line to manage steam supply to the contact heater, including stopping steam flow during upset conditions that may cause alkali emissions.</li> </ul>
Comments	<ul style="list-style-type: none"> <li>- New projects from PSM workshops and stage 2 alkali workshops have been included in the alkali reduction projects schedule, further projects are being reviewed and may include: <ul style="list-style-type: none"> <li>• Precip elevated pipelines in whiteside,</li> <li>• Press floor mist reduction,</li> <li>• Export steam systems in digestion,</li> <li>• Digestion spent liquor injection pumps and pipes, and</li> <li>• Digestion slurry pipework.</li> </ul> </li> </ul>

### Implementation Schedule

Task	Alkali Release Off-Site																			
	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Stage 2 Alkali Emissions Study	Complete																			
Bottom Fill Precipitators project																				
Upgrade and install shrouds on expansion joints	Complete																			
Install 2nd oxalate tank					Complete				Complete											
TCV and Steam shut off valve on holding tanks heater					Complete															
HP blowdown line redirection					Complete															
Remote stop for precip cooling tower fans					Complete															
Digestion relief system containment system					Complete															
Digestion relief system front end					Complete															


Study
Engineering
Execution



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## Alkali Release Off-Site

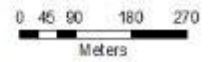
### Legend

 Alkali and Odour Emissions Reduction

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:8,119



N 	Review By:	J. J. J.
	Created By:	Jonathan Deane
	Checked By:	Jonathan Deane
	Approved By:	Jonathan Deane

Project (A2)	Alumina Dust Emission Reduction
Risk class	- III/High
Environmental risks	- Alumina dust emissions from Boyne Smelters Limited (BSL) conveyor transfer points, product load-out and island and mainland alumina storage A-frames have a potential to impact on the air quality of surrounding communities.
Project solution / options	- Identify options to reduce alumina dust emissions from high risk release points.
Objective / performance outcome	- Mitigation of alumina dust emissions
Performance Indicator	- Study phase identifies options to reduce emissions from alumina dust sources in the refinery and South Trees Island and they are progressed to engineering. - No visible dust emissions from release points from completed projects.
Cost estimate A\$ million	- 23.0
Project Stage	<p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Projects focusing on the Island and Mainland A-frames have been moved into engineering and detailed design will focus on: <ul style="list-style-type: none"> <li>• Automation of the reclaim system,</li> <li>• Improvements in the air slides in each A frame, and</li> <li>• New and upgraded dust collection systems,</li> </ul> </li> <li>- Alumina loadout, <ul style="list-style-type: none"> <li>• Engineering will be conducted for the design of a new ship loader and improvements to the wharf gallery and transfer tower.</li> </ul> </li> </ul> <p><b>Complete</b></p> <ul style="list-style-type: none"> <li>- BSL belt conveyor upgrade works</li> </ul>
Comments	- The alumina loadout dust reduction project has been identified as a priority and data on quantifying dust emissions has been collected. - The A frame storage's and conveyor systems study has commenced.

## Implementation Schedule



Alumina Dust Emissions Reduction																				
Task	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Alumina Loadout			Complete																	
A-frames, alumina and hydrate transfer systems							Complete													
BSL alumina transfer upgrade	Complete																			
Island Shed Alumina Handling Upgrade																				
Mainland Shed Alumina Handling Upgrade																				

**Study**   **Engineering**   **Execution**



## Alumina Dust Emissions

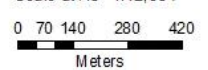
### Legend

- Ship Loadout
- Island A Frame
- BSL Conveyor and Transfer Points
- Conveyors and Transfer Points
- Mainland A Frame

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:12,834



	Revision	A
	Date	21/02/2016
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

<b>Project (A3)</b>	<b>Odour Emission to Community</b>
Risk class	- III/High
Environmental risks	- Odour releases with potential for impact on air quality of surrounding communities.
Project solution / options	<ul style="list-style-type: none"> <li>- Conduct an odour study including comparative analysis with previous 2006 study to determine an odour baseline</li> <li>- Capture current uncaptured organic emission sources, and</li> <li>- Address redundancy concerns with current treatment system</li> </ul>
Objective / performance outcome	- Minimise QAL odour profile within the community
Performance Indicator	<ul style="list-style-type: none"> <li>- Odour baseline is established when refinery is operating on Amrun bauxite.</li> <li>- Study phase identifies options to reduce emissions from odour sources in the refinery and they are progressed to engineering.</li> <li>- Selected engineering option is progressed to execution</li> </ul>
Cost estimate A\$ million	- 39.5

Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- The investigation into sources of untreated organic emissions at the refinery has been completed and the relief tank odour has been identified as the source with the highest likelihood of impacting on the community. Two sources contribute to the odour emissions from the relief tanks:             <ul style="list-style-type: none"> <li>• Condensate reflash, and</li> <li>• Organics recycled in condensate from digestion.                 <ul style="list-style-type: none"> <li>▪ Air stripping VOC's from the digestion condensate is being studied. A pilot air stripping unit is being constructed and is expected to be onsite in August to provide information for the engineering phase on sizing of a full scale unit.</li> <li>▪ Volatile organics stripped from the condensate into the air stream will be treated in an odour destruction unit.</li> </ul> </li> </ul> </li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Condensate reflash – Barometric condensing             <ul style="list-style-type: none"> <li>• This option has been chosen to move into engineering as it removes all condensate reflash steam from the relief tank using the seawater supply to the waste tanks.</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- NTP Unit installation on Wash water tanks.</li> </ul> <p><b>Completed</b></p> <ul style="list-style-type: none"> <li>- Baseline odour sampling,</li> <li>- Non-thermal plasma trial,</li> <li>- Odour modelling based on baseline sampling,</li> <li>- Wash water heater trial,             <ul style="list-style-type: none"> <li>• The wash water heater trial demonstrated that odourous vapour can be condensed into the seawater flow sent to the waste tanks.</li> </ul> </li> <li>- The new thermal oxidizer (TO) has been commissioned and its operation will reduce down time where spent liquor heaters are venting directly to atmosphere.</li> <li>- Evaporation heater vent condensate collection improvement project.</li> </ul>
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Comments	<ul style="list-style-type: none"> <li>- QAL are progressing individual trials:             <ul style="list-style-type: none"> <li>• Complete - trials on barometric condensing of relief tank vapour utilizing the wash water heater, and</li> <li>• Trials utilizing non-thermal plasma have been run on the bad wash water tank, the blow off tank and a holding tank.                 <ul style="list-style-type: none"> <li>▪ Odour destruction has been greater than 90% and up to 95% on the bad wash water tank, with results on the blow off tank and holding tank emissions at 70% to 75%.</li> </ul> </li> </ul> </li> </ul>
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### Implementation schedule

Task	Odour Emission to Community															
	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Odour source sampling and modelling	Complete															
Blow off Tank vapour wash water heater condensing trial			Complete													
Alternate odour treatment technology trial - Non thermal plasma		Complete														
Evap heater vent condensate collection	Complete		Complete		Complete											
Second thermal oxidiser	Complete		Complete													
NTP Unit installation on Bad Wash Water Tank					Complete		Complete									
Relief Tank Odour Reduction - Barometric Seawater Condensing									Complete							
Relief Tank Odour Reduction - Air Stripping																

Study
Engineering
Execution







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**Odour Emissions to Community**

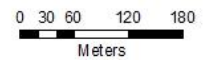
**Legend**

-  Alkali and Odour Emissions Reduction
-  Thermal Oxidiser

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3: 1:5,553



N ↑	Revision	A
	Date	21/09/2016
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (A4)	Coal Stockpile Dust Emissions
Risk class	- III/High
Environmental risks	- Fugitive dust emissions from working and strategic coal stockpiles have the potential to impact on the air quality of surrounding communities.
Project solution / options	- Investigate options for dust mitigation, including dust suppression and prevention measures on working and strategic coal stockpiles.
Objective / performance outcome	- Improved monitoring capability and reduction of potential for dust emissions
Performance Indicator	- Reduced dust emissions from the coal stockpile.
Cost estimate A\$ million	- 1.0
Project Stage	<b>Execution</b> - Install upgraded sprinkler system on the working coal stockpile and dry fogging on the loadout hopper.
Comments	- The strategic coal stockpile has been treated with a chemical sealant. - Upgraded water sprays have been chosen for dust mitigation at the working coal stockpile and dry fogging on the loadout hopper.

### Implementation Schedule

Coal Stockpile Dust Mitigation																	
Task	2019				2020				2021				2022				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Install upgraded spinkler system	Complete				Complete												

Study
Engineering
Execution







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**Coal Stockpile  
Dust Emissions**

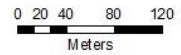
**Legend**

-  Strategic Coal Stockpile
-  Working Coal Stockpile

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:3,946



	Revision	A
	Date	21/10/2016
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

<b>Project (A5)</b>	<b>Bauxite Transfer Dust Emissions</b>
Risk class	- III/High
Environmental risks	- Fugitive dust emissions from bauxite transfer system have the potential to impact on air quality in the surrounding community.
Project solution / options	- Investigate options for reduction of dust emissions from the bauxite transfer system.
Objective / performance outcome	- Reduced dust emissions from bauxite transfer systems
Performance Indicator	- Bauxite dust emissions from return side of the wharf conveyor are mitigated.
Cost estimate A\$ million	- 0.8
Project Stage	<b>Complete</b> - Install a belt washer station and improved scrapers
Comments	- Results from a measuring system installed on the bauxite conveyor has identified carry back as a significant dust source.

#### Implementation Schedule

Bauxite Transfer Dust Reduction Study												
Task	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Install belt wash station and upgrade scrapers	Complete	Complete	Complete	Complete								
<b>Study</b>	<b>Engineering</b>	<b>Execution</b>										



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## Bauxite Transfer Dust Emissions

### Legend

Bauxite conveyor and transfer points

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:12,500

0 70 140 280 420  
Meters

N  

Revision	1	2019/07/19
Created By	Jonathan DeLore	
Checked By	Jonathan DeLore	
Approved By	Jonathan DeLore	



Project (A6)	Ash Dam Dust Emissions
Risk class	- III/High
Environmental risks	- Fugitive dust (ash) emission emissions have the potential to impact on air quality of surrounding communities.
Project solution / options	- Investigate options for reduction of dusting events from the ash through dust suppression and mitigation options
Objective / performance outcome	- Minimise dust generation from #4 Ash Dam
Performance Indicator	- Engineering option is progressed to execution.
Cost estimate A\$ million	- 4.5
Project Stage	<b>Execution</b> <ul style="list-style-type: none"> <li>- Install new ring main and saltwater pump to provide seawater to be applied to Cell's 3 and 4 during a rain event. <ul style="list-style-type: none"> <li>• Work will begin in 2022 as there are external approvals requirements for this project.</li> </ul> </li> <li>- Boilerhouse ash slurry pumps will be utilized to apply saltwater and ash to Cell 2 in the event of a rain event.</li> </ul>
Comments	Dust occurs after rainfall, due to the fresh water breaking the salt crust formed on the surface of the cells.

### Implementation Schedule


	Ash Dam Dust Emissions																			
Task	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Engineering for dust mitigation on ash dam	Complete				Complete															



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## Ash Dam Dust Emissions

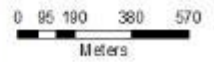
### Legend

 Ash ponds

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:16,763



	Revision:	1
	Date:	20/04/2019
	Created by:	Jonathan DeLore
	Approved by:	Jonathan DeLore

## Water Management Improvement Projects

QAL's plan to improve water quality management over the next five years is supported by targets, actions and a program of works summarised below. Capital spend is estimated at between A\$90 million to A\$175 million.

Project (W1)	Raw Material Spill from Wharf
Risk class	- IV/Critical
Environmental risks	- Release of raw materials including caustic and bauxite to Gladstone harbour during unloading operations has the potential to impact on the water quality of Port Curtis.
Project solution / options	- Investigate options for reduction of spillage of raw materials (bauxite) from the wharf during unloading activities and mitigate the potential for release of caustic during unloading
Objective / performance outcome	- Reduce risk of release of raw material spills during unloading operations
Performance Indicator	- Gaps in the wharf are filled in.
Cost estimate A\$ million	- 0.75
Project Stage	<b>Execution</b> - Gaps within the wharf bunds provide pathways for materials to be released into the water.
Comments	

### Implementation Schedule

Raw Material Spill from Wharf																
Task	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Fill in opennigs on wharf																
	Study	Engineering	Execution													





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## Raw Material Spill from Wharf

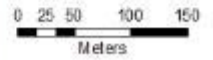
### Legend

 Wharf - Raw Material Spill

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:4,442



	Revision:	1
	Date:	20/09/2021
	Created by:	Jonathan DeLor
	Approved by:	Jonathan DeLor

<b>Project W2</b>	<b>Coal Stockpile Stormwater Runoff</b>
Risk class	- III/High
Environmental risks	- Release of coal contaminated stormwater to receiving environment has the potential to impact on the water quality in Port Cutis.
Project solution / options	- Investigate options for reduction in total suspended solids load from the coal stockpiles into the east and west coal stilling ponds, which allows ponds to meet release limits - Investigate options to improve west coal stilling pond neutralisation capability
Objective / performance outcome	- Mitigate risk of coal contaminated stormwater leaving the coal stockpile catchment area
Performance Indicator	- Study phase identifies options to reduce coal fines runoff from coal stockpiles in the refinery and improve neutralisation capacity of the west coal stilling pond and they are progressed to engineering.
Cost estimate A\$ million	- 2.2
Project Stage	<p><b>Engineering</b></p> <p>Phase 2:</p> <ul style="list-style-type: none"> <li>- Improvement in neutralisation capability in the west coal stilling pond, including <ul style="list-style-type: none"> <li>• Automation of the seawater inlet valve,</li> <li>• Improved seawater distribution to maximise mixing.</li> </ul> </li> </ul> <p><b>Complete</b></p> <ul style="list-style-type: none"> <li>- TSS functionality improvements for the west coal stilling pond have been completed, including: <ul style="list-style-type: none"> <li>• Works to stop seepage around the weir,</li> <li>• Re-establish the functionality of the dividing wall for sediment control and contaminated water segregation. <ul style="list-style-type: none"> <li>▪ Install additional fingers to lengthen the flow path and allow for easier desilting.</li> </ul> </li> </ul> </li> </ul>
Comments	

**Implementation Schedule**

Task	Coal Stockpile Stormwater Runoff																			
	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 2 Study	Complete																			
Improve west coal stilling pond functionality - Neutralisation																				
Improve west coal stilling pond functionality - TSS					Complete				Complete											

Study
Engineering
Execution



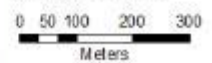
### Coal Stockpile Runoff

#### Legend

- East Coal Stilling Pond
- West Coal Stilling Pond
- Strategic Coal Stockpile
- Working Coal Stockpile

DATE: 08/09/2021  
 DRAWN BY: J. DALLON  
 CHECKED BY: J. DALLON  
 APPROVED BY: J. DALLON

Scale at A3 1:9,884



N  
 Review: J. DALLON  
 Date: 08/09/2021  
 Checked By: J. DALLON  
 Approved By: J. DALLON

Project (W3)	<b>Waste line 4 Integrity</b>
Risk class	- IV/Critical
Environmental risks	- Failure of Waste Line 4 into marine or terrestrial environments will result in release of partially neutralised red mud with a potential to contaminate land or water and impact on the water quality in South Trees Inlet and Port Curtis.
Project solution / options	- Investigate options for replacement of waste line 4 capacity that includes options that further reduces the risk of a pipeline failure. - Ensure integrity of pipeline supports
Objective / performance outcome	- No loss of containment incidents
Performance Indicator	- 20 years life of waste line 4 with minimal risk of loss of containment incidents
Cost estimate A\$ million	- 50.95
Project Stage	<b>Execution</b>
Comments	- All approvals have been granted and replacement of the pipeline along the entire route is underway.

**Implementation Schedule**

Task	Waste Line 4 Capacity																
	2018	2019				2020				2021				2022			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Waste line 4 capacity replacement	Complete																
<b>Study</b>																	
<b>Engineering</b>																	
<b>Execution</b>																	





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## Waste Line 4

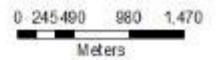
## Legend

 Waste Line 4

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Coordinate System: GDA 1984 UTM Zone 56

Scale at A3 1:44,421



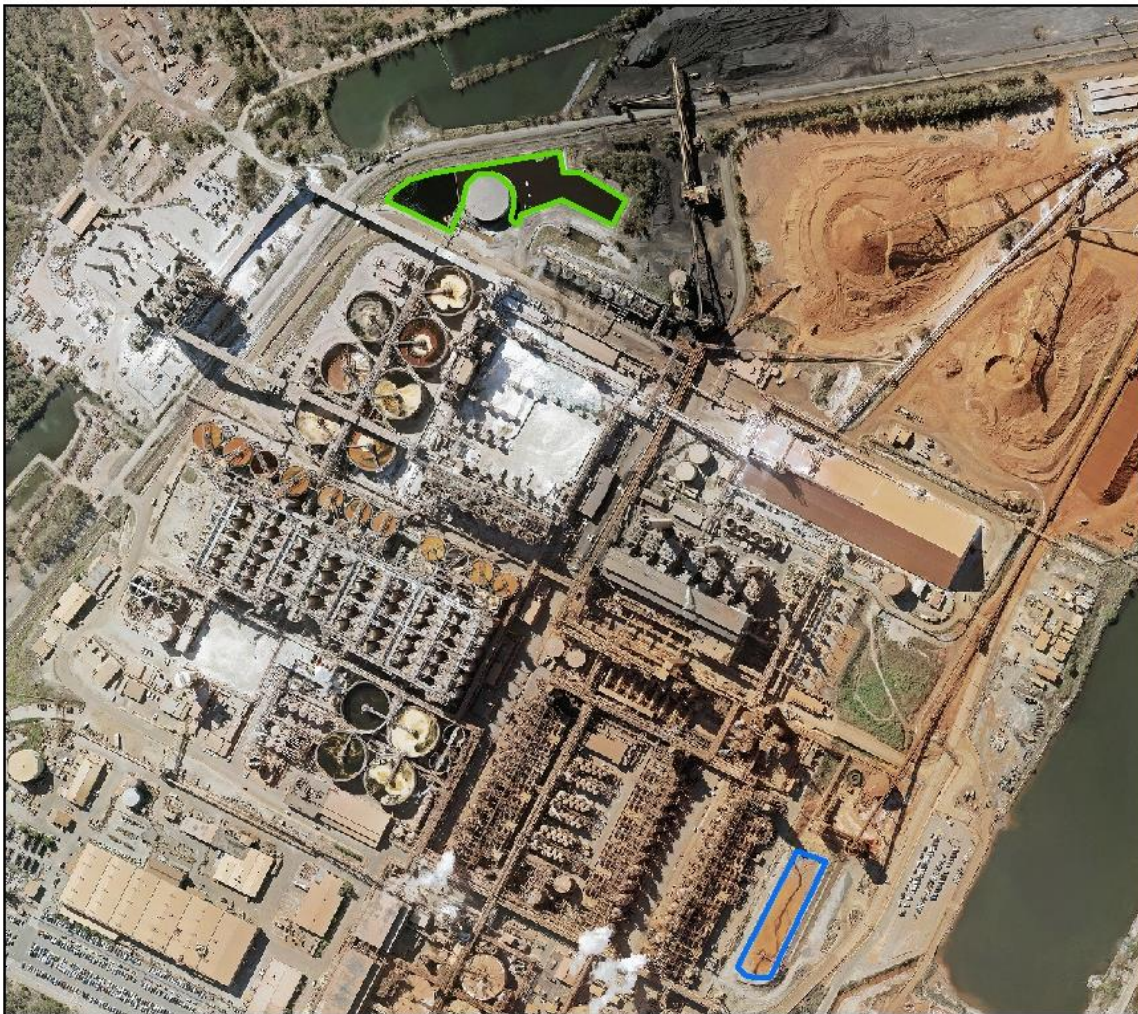
	Revised By:	J. J. J.
	Created By:	Jonathan Deller
	Checked By:	Jonathan Deller
	Approved By:	Jonathan Deller

Project (W4)	East & West Contaminants Ponds
Risk class	- III/High
Environmental risks	- The East and West contaminants ponds capture contaminated stormwater runoff for recycling into the process. Insufficient capacity has the potential to impact the capability of the contaminated stormwater treatment system prior to release and has a potential to impact on the water quality in Port Curtis. A further potential impact exists for groundwater from the unlined east contaminants pond.
Project solution / options	- Investigate options to ensure that all core refinery process areas are directed to a contaminants pond, - Options for lining and expanding the east contaminants pond, and - Investigate options to increase the pump and pipe capacity from the ponds to the process.
Objective / performance outcome	- Ensure containment ponds prevent land and groundwater contamination and mitigates the risk of stormwater contamination
Performance Indicator	- Study phase identifies options to prevent land and groundwater contamination from contaminants ponds and they are progressed to engineering.
Cost estimate A\$ million	- 11.2
Project Stage	<p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Detailed design of the east contaminates pond (ECP) will look at: <ul style="list-style-type: none"> <li>• Lining of the existing ECP,</li> <li>• Installation of a new additional lined ECP pond at the location of the waste transfer facility (to be relocated)</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Install new pump in west contaminates pond and pipeline to east contaminates pond.</li> </ul>
Comments	<p>The contaminates pond project has been spilt into two specific focus projects;</p> <ul style="list-style-type: none"> <li>• West contaminates pond pump upgrade and piping.</li> <li>• East contaminates pond location and lining options.</li> <li>• This has been done in respect of the different levels of effort that need to be applied to each of the ponds.</li> </ul>



		East and West Contaminants Ponds																		
Task	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
West contaminates pond				Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete
East contaminates pond				Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete

Study
Engineering
Execution



### Contaminants Ponds

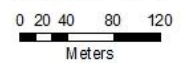
### Legend

- East Pond
- West Pond

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3: 1:4,274



	Revision	A
	Date	21/09/2021
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (W5)	<b>Refinery Water Release Management</b>
Risk class	- III/High
Environmental risks	- Releases from the sweetening bauxite pond and the west gate wetland have the potential to impact on water quality in Port Cutis.
Project solution / options	- Investigate options to improve monitoring at the sweetening bauxite pond and the wetland release - Identify options to upgrade mill sump water system to minimise release to the stormwater system
Objective / performance outcome	- Ensure pH, suspended solids and other release water quality parameters are maintained within limits and no uncontrolled release to receiving environment
Performance Indicator	- Study phase identifies options to improve water quality at the west gate wetland, mill 10 area and sweetening bauxite pond and they are progressed to engineering. - 85% availability of online instruments at the sweetening bauxite pond and wetland release point
Cost estimate A\$ million	- 5.2
Project Stage	<p><b>Execution – Phase 2</b></p> <ul style="list-style-type: none"> <li>- Westgate pond - Improve capacity and functionality: <ul style="list-style-type: none"> <li>• Increase capacity of the pond</li> <li>• Install mid pond continuous pH monitoring,</li> <li>• Relocate the seawater discharge location to allow for better access and mixing in the pond.</li> </ul> </li> <li>- Mill 10 sump; <ul style="list-style-type: none"> <li>• Improve management of bauxite in the bund,</li> <li>• Ensure grades within the bund are correct,</li> <li>• Install an additional drive-in sump to allow for collection of bauxite and fast reclaim.</li> </ul> </li> <li>- Bauxite Sweetening Pond: <ul style="list-style-type: none"> <li>• Pre-treatment pond to reduce bauxite and bauxite fines from the mono bauxite stockpile entering the bauxite sweetening pond.</li> </ul> </li> </ul> <p><b>Complete – Phase 1</b></p> <ul style="list-style-type: none"> <li>- Wetland Release: <ul style="list-style-type: none"> <li>• V-notch weir and flow meter installed,</li> <li>• Continuous water quality monitoring installed.</li> </ul> </li> <li>- Sweetening Bauxite Pond <ul style="list-style-type: none"> <li>• Continuous water quality monitoring installed,</li> <li>• A level sensor installed.</li> </ul> </li> </ul>
Comments	

**Implementation Schedule**






**Study**   **Engineering**   **Execution**

Task	Refinery water release improvement																			
	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 2 Study				Complete																
Install V notch weir and continuous monitoring at Westgate Release Point	Complete																			
Install continuous monitoring at sweetening bauxite pond Release Point	Complete																			
Mill 10 bauxite stormwater pre-treatment upgrade							Complete													
Westgate pond improvements							Complete													
Bauxite sweetening pond bauxite stormwater runoff Pretreatment from mono stockpile							Complete													



### Refinery Stormwater Legend

-  Mill 10 Area
-  Sweetening Bauxite Pond
-  West Gate Release

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:11,105

0 62.5 125 250 375

Meters


 Revision: 0  
 Date: 28/09/2021  
 Created by: Jonathan Dallas  
 Approved by: Jonathan Dallas

Project (W6)	RDA Surface/Ground water Impacts
Risk class	- IV/Critical
Environmental risks	- Impacts to surface and groundwater from the RDA that have the potential to impact on the water quality in South Trees Inlet and Port Curtis and terrestrial ecosystems surrounding the RDA.
Project solution / options	- Identify the sources, pathways and receptors of potential RDA surface and groundwater impacts and options for any required mitigation.
Objective / performance outcome	- Prevent impact of contaminants from RDA on groundwater - Mitigate the impact of the RDA on adjacent surface water systems and ensure relevant environmental values are protected
Performance Indicator	- Vegetation in the Black Breasted Button Quail (BBBQ) habitat does not show any signs of degradation and rehabilitated areas (to be completed) show no sign of impact after cut off wall is installed and soil in impacted areas is flushed. - A robust monitoring program is in place for the early detection of impact to vegetation, groundwater and marine communities. - Study phase (Environmental Evaluation) identifies options to address any areas of concern and these options are progressed to engineering. - Engineering options are progressed to execution
Cost estimate A\$ million	- 54

Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- The outcome of stage 2 (EE report) will identify priority areas for engineering for ground/surface water around the red mud dams.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- HRMD (historic red mud dam) north and west seepage mitigation. Designs for cut off walls and drains are being finalised.</li> </ul> <p><b>Completed</b></p> <ul style="list-style-type: none"> <li>- EE Stage 1 – install cut-off wall to mitigate impact on BBBQ bird habitat;</li> <li>- EE Stage 2 – Install a cut off wall along the eastern side of the HRMD.</li> <li>- Install a drain along the eastern side of the HRMD.</li> <li>- Install a cut off wall and drain along the western side of the northern decant pond – cell 1 to intercept potential seepage from the pond.</li> </ul>
Comments	<ul style="list-style-type: none"> <li>- Groundwater removal on the dam side of the cut-off wall has resulted in sustained lower water levels and there has been no matching decrease in groundwater level within the BBBQ habitat, strongly indicating that the cut-off wall is functioning as designed.</li> <li>- The study period for the environmental evaluation has been extended to address a request for further information.</li> </ul>

### Implementation Schedule

RDA Surface/Groundwater Impacts																	
Task	2019				2020				2021				2022				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Complete environmental evaluation	Study	Study	Study	Study	Study	Study	Study	Study									
EE Stage 1 - Install cut-off wall to mitigate impact on BBBQ habitat and recovery pumps	Complete																
EE Stage 2 - Install cut-off wall/trench along eastern side of historical RDA		Complete	Complete														
Cell 1 cut-off wall and drain									Complete								
HRMD North and West Seepage Mitigation											Execution	Execution	Execution	Execution			





 **QUEENSLAND ALUMINA LIMITED**

**RDA  
Groundwater  
Impacts**

**Legend**

-  EE Stage 1
-  EE Stage 2

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:39,597

0 220,440 880 1,320

Meters



Revision	A
Date	21/09/2016
Created By	Jonathan Dalton
Reviewed By	
Approved By	Jonathan Dalton

Project (W7)	RDA Release to Receiving Environment
Risk class	- IV/Critical
Environmental risks	- The chemistry of the red mud dam discharge into South trees Inlet has been changing over the past 5 to 10 years. This, together with the siltation of South Trees Inlet and decrease in water flow, has resulted in low dissolved oxygen between the discharge site and confluence of the Boyne River and has the potential to impact on the water quality in South Trees Inlet and the Boyne River.
Project solution / options	- Identify the cause of the change in water quality and investigate mitigation options, including improvements to release water quality, alternative release point locations or improving flow in South Trees Inlet.
Objective / performance outcome	- Ensure the environmental values of South Trees Inlet are protected in the long term
Performance Indicators	- Study phase identifies options to reduce the impact of the RDA discharge and options are progressed to engineering. - Engineering options are progressed to execution. - Cell 1 operation reduces BOD
Cost estimate A\$ million	- 70.0
Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- The study phase for the selection of a new discharge location has been delayed to allow for additional modelling to be conducted and to allow time for Cell 1 to operational data to be collected. <ul style="list-style-type: none"> <li>• A decision on a preferred location will be finalised by the end of Q2 2022.</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Cell 2 of the northern management and treatment area has entered the construction phase and will be linked with cell 1 when completed. <ul style="list-style-type: none"> <li>• Operation of cell 1 will provide information that will assist with determining the ultimate size of cell 2.</li> </ul> </li> </ul> <p><b>Complete</b></p> <ul style="list-style-type: none"> <li>- Construction of Cell 1 of the northern decant management and treatment area has been completed.</li> <li>-</li> </ul>



Comments	<ul style="list-style-type: none"> <li>- Two facultative treatment cells have been chosen to treat the seawater before it is returned South Trees Inlet.</li> <li>- A better location in Port Curtis is being investigated as an alternate release point.</li> </ul>
----------	--

**Implementation Schedule**

Task	RDA Alternative Discharge Location																			
	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Northern Decant Pond - Cell 1				Complete	Complete	Complete	Complete	Complete												
Northern Decant Pond - final configuration							Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete	Complete
Alternate Discharge Location																				

**Study** **Engineering** **Execution**



**RDA Discharge**

**Legend**

- Licenced Discharge Point

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Coordinate System: GDA 1984 UTM Zone 56

Scale at A3 1:44,421

0 245 490 980 1,470

Meters


 Review Date: 15/09/2021  
 Created By: Jonathan Delleo  
 Drawn By: Jonathan Delleo  
 Approved By: Jonathan Delleo

<b>Project (W8)</b>	<b>High Risk Pipelines</b>
Risk class	- IV/Critical
Environmental risks	- Caustic release to the environment as a result of failure of pipeline from the storage area (island) to refinery (mainland) across causeway with potential to impact on the water quality in Port Curtis.
Project solution / options	- Investigate options to upgrade high risk pipelines (caustic and contaminated water) to reduce the risk of a pipeline failure
Objective / performance outcome	- Reduce the risk of off-site contamination
Performance Indicator	- High risk pipelines are installed to provide a 20 year life with a reduction in likelihood of failure.
Cost estimate A\$ million	- 10.5
Project Stage	<b>Execution</b>
Comments	Construction of the new pipelines is well underway.

### Implementation Schedule


High Risk Pipelines																
Task	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Investigate options for replacement of high risk pipelin	Comple	Complete														
	Study	Engineering	Execution													



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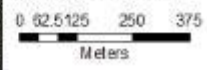
**High Risk Pipelines**

**Legend**

 High Risk Pipelines

QUEENSLAND ALUMINA LIMITED  
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Coordinate System: GDA 1984 UTM Zone 58  
Scale at A3: 1:11,096



N 	Revision:	1
	Date:	20/04/2019
	Created By:	Jonathan Dallas
	Approved By:	Jonathan Dallas



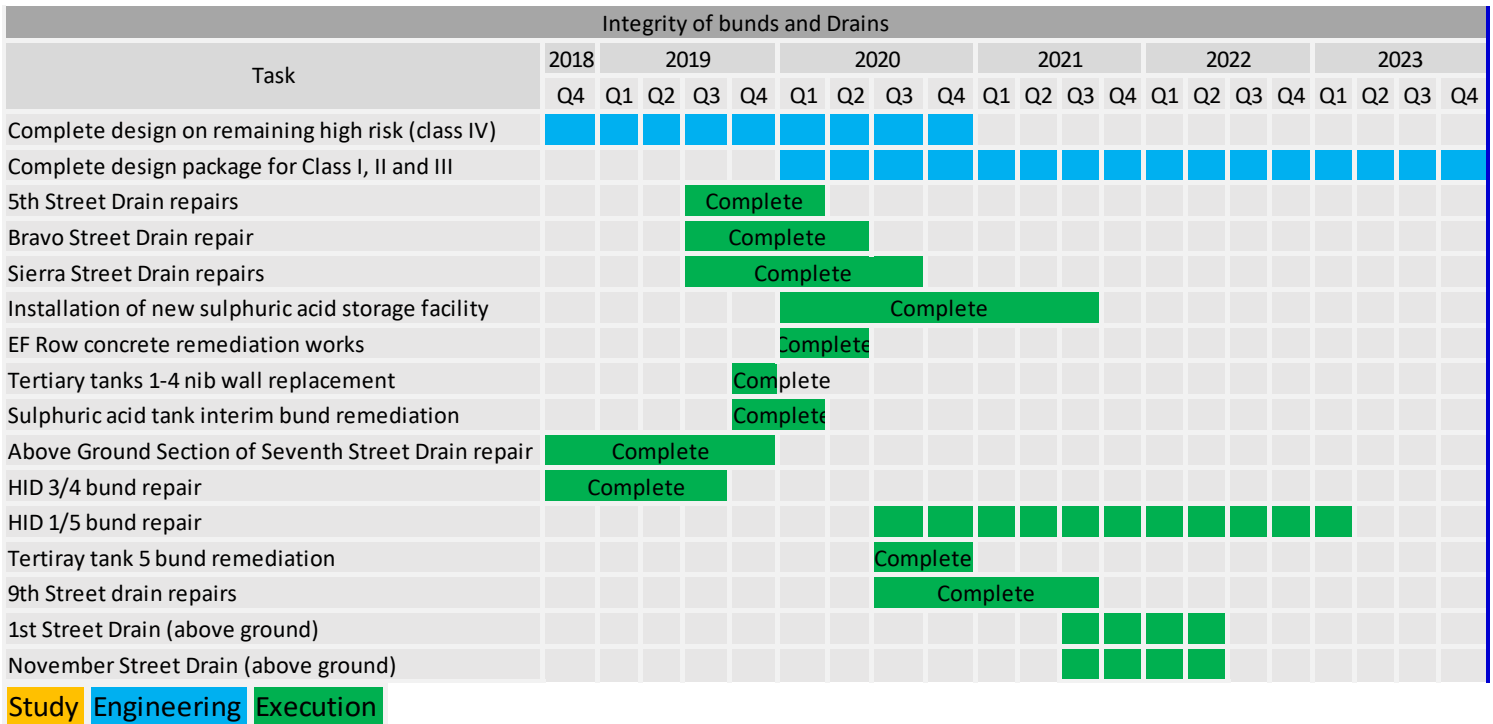
## Land management improvement projects

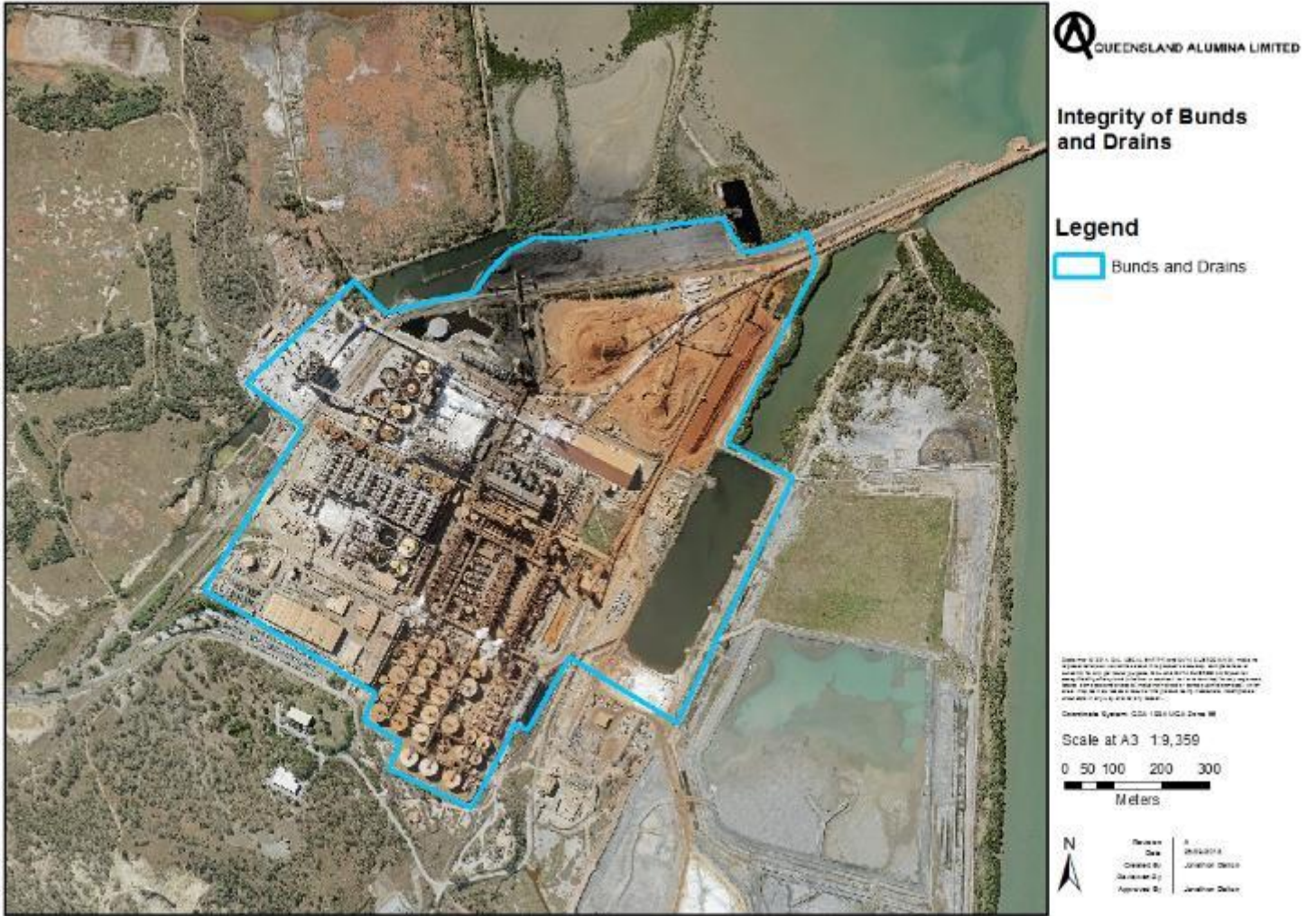
QAL's five-year land stewardship programme, supported by targets, actions and a programme of works is summarised below. Capital spend is estimated at between A\$20 million to A\$35 million.

Project (L1)	Integrity of Bunds and Drains
Risk class	- IV/Critical
Environmental risks	- Seepage from bunded refinery areas has the potential to contaminate groundwater.
Project solution / options	- Bunded refinery area and drainage integrity rectification.
Objective / performance outcome	- Restore the integrity of refinery area bunds and drains
Performance Indicator	- All areas identified for remediation are repaired
Cost estimate A\$ million	- 39.3
Project Stage	<p>Engineering</p> <ul style="list-style-type: none"> <li>- Complete engineering design for bunds and drains that were identified during the study phase requiring repairs. <ul style="list-style-type: none"> <li>• Complete engineering design on high risk (Class IV) bunds and drains</li> <li>• Complete engineering design on lower risk (Class III) bunds and drains.</li> </ul> </li> </ul> <p>Execution</p> <ul style="list-style-type: none"> <li>- High risk bunds and drains will be prioritised for repair works and will move from engineering into execution once a construction package has been prepared.</li> <li>- Bunds in execution: <ul style="list-style-type: none"> <li>• HID1/5 bund repair, and</li> </ul> </li> <li>- Drains in execution: <ul style="list-style-type: none"> <li>• 1<sup>st</sup> Street Drain (above ground), and</li> <li>• November Street Drain (above ground)</li> </ul> </li> </ul> <p>Completed</p> <ul style="list-style-type: none"> <li>• Above ground section of 7<sup>th</sup> street drain,</li> <li>• HID ¾,</li> <li>• A precipitation row concrete remediation works,</li> <li>• Tertiary tanks 1-4 nib wall replacement, and</li> <li>• Sulphuric acid tank bund interim remediation.</li> <li>• 5<sup>th</sup> Street drain,</li> <li>• EF row concrete remediation works, and</li> <li>• Bravo Street Drain.</li> <li>• Sierra Street Drain.</li> <li>• Tertiary tank 5 bund repairs, and</li> <li>• 9<sup>th</sup> Street Drain</li> <li>• New sulphuric acid storage and handling facility</li> </ul>

Comments	- The Bund and drain inspection program has identified high, medium and low risk bunds and drains requiring remediation.
----------	--

### Implementation Schedule





Project (L2)	Ground Water Impact to South Trees Island Tank Farm
Risk class	- III/High
Environmental risks	- Caustic impact to ground water and potential to migrate to receiving environment (DES EPO STAT 1249 related) and has the potential to impact on groundwater quality.
Project solution / options	- Maintain and monitor current extraction program beneath bund 4, South Trees Island - Review integrity of existing groundwater monitoring wells reinstate/upgrade as necessary and recommence monitoring program
Objective / performance outcome	- Historic ground water impact to South Trees Island does not migrate and is reduced over time
Performance Indicator	- No increase in pH in groundwater bores outside of bund with extraction system operational





Cost estimate A\$ million	- 1.0
Project Stage	<b>Completed</b>
Comments	<ul style="list-style-type: none"> <li>- Groundwater pumping is ongoing.</li> <li>- Monitoring of groundwater will continue and opportunities to improve the system will continue to be investigated based on the results of the ongoing monitoring.</li> </ul>



**Groundwater Impacts at South Trees Island Tank Farm**

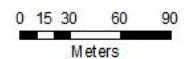
**Legend**

-  Bund 2
-  Bund 4

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3 1:2,981



	Revision	A
	Date	21/10/2016
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (L3)	Mineral Waste Disposal Facility – Stage 2
Risk class	- III/High
Environmental risks	- Potential for land contamination from landfilled mineral wastes and potential for impact on water quality in South Trees Inlet; secondary potential impact to effectiveness of current recycling program
Project solution / options	- Investigate the options for location of another mineral waste disposal facility - Investigate options to ensure design improves land contamination controls
Objective / performance outcome	- Execute the design for the mineral waste disposal facility.
Performance Indicator	- Minimise and contain leachate from the mineral waste disposal facility.
Cost estimate A\$ million	- 2.6
Project Stage	<b>Execution</b> - Mineral Waste Disposal Facility stage 2 - An interception drain located south of the mineral waste disposal facility has been identified as the best option to minimise the risk of seepage migration.
Comments	- Execution schedule has been significantly delayed and estimated completion is now expected in 2022, <ul style="list-style-type: none"> <li>Additional detailed design has been identified in additional scope items, including the western diversion drain and upgrades to the leachate sump pumping.</li> <li>Seepage mitigation has been included as a separate co-committed project.</li> </ul>

**Implementation Schedule**

Mineral Waste Disposal Facility																
Task	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Implement design for stage 2 of the MWDF	Complete															
Mineral waste seepage mitigation							Complete		Complete							

Study   Engineering   Execution







<b>Project (L4)</b>	<b>Sewerage System Upgrade</b>
Risk class	- III/High
Environmental risks	<ul style="list-style-type: none"> <li>- Potential for land contamination from sewerage system installed during initial and subsequent plant construction phases and potential to contaminate groundwater.</li> <li>- Introduction of inadequately treated effluent to the RDA</li> </ul>
Project solution / options	<ul style="list-style-type: none"> <li>- Investigate the condition of the sewerage system to identify issues and assess options to rectify identified issues</li> <li>- Review the current operation of the sewage treatment system and look at requirement for upgrade</li> </ul>
Objective / performance outcome	- Reduce the risk of the release of sewage to land
Performance Indicator	- Engineering solution progressed to execution
Cost estimate A\$ million	- 2.0
Project Stage	<p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Option to refurbish existing sewage treatment plant, and</li> <li>- Repair sewage pipes</li> <li>- Engineering for this project has been extended to finalise the detailed engineering and cost estimate.</li> </ul>
Comments	<ul style="list-style-type: none"> <li>- Phase change back to engineering, <ul style="list-style-type: none"> <li>• This project will be undertaken in 2 steps: <ul style="list-style-type: none"> <li>▪ Repair the sewage lines, and</li> <li>▪ Refurbish the STP.</li> </ul> </li> <li>• The first step must be completed before the STP can be taken off line and inspected.</li> <li>• As a part of the engineering phase a cost estimate is developed to inform the decision to proceed into the execution phase where costs from contractors are not available.</li> <li>• Approval for both steps of this project was based on the engineering cost estimate.</li> <li>• Tendered costs were significantly higher than the engineering cost estimate.</li> <li>• Given this the project team must now reevaluate the scope and costs and move back through the approval gates before execution phase can be approved.</li> <li>• Because of this delay, QAL has completed a temporary repair to the sewage pipelines.</li> </ul> </li> </ul>

**Implementation Schedule**


Task	Sewerage System															
	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Complete engineering for the sewerage system at the refinery	Complete															

Study Engineering Execution



**Sewerage System Review**

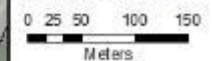
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 Sewerage Treatment Plant

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Geographic System: GDA 1984 UTM Zone 58

Scale at A3 1:4,680




 Review Date: 28/04/2021  
 Created By: Jonathan Deane  
 Approved By: Jonathan Deane

<b>Project (L6)</b>	<b>Closure Pilot - RDA rehabilitation</b>
Risk class	- II/medium
Environmental risks	- Implementation of a long term effective cover system for closure at the RDA
Project solution / options	- Undertake research of cover systems for closure of the RDA.
Objective / performance outcome	- Determine if a long term cover system can be sustained at the RDA.
Performance Indicator	- Study phase identifies options for long term remediation of the red mud dams. - Trial plot at RDA sustains vegetation to show proof of concept for the project.
Cost estimate A\$ million	- 1.75
Project Stage	<b>Engineering</b> - The remaining four years of the strategy will determine the long term viability of making technosoils from red mud.
Comments	- A Pilot rehabilitation trial is established at the Residue Disposal Area. - QAL and the University of Queensland were recognised with the 2019 Partners in Research Excellence Awards for work on the development of technosoils at the RDA.

### Implementation Schedule

RDA Closure Rehabilitation																										
Task	2018					2019					2020				2021				2022				2023			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Investigate closure cover options for the RDA	Complete					█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█		


Study Engineering Execution





**RDA Rehabilitation - Pilot Study**

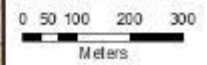
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 Rehabilitation Trial Area

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:9,359



N 	Revised By:	J. DELANEY
	Created By:	JONATHAN DELANEY
	Checked By:	JONATHAN DELANEY
	Approved By:	JONATHAN DELANEY



Project (L7)	Oil/water facility resizing
Risk class	- II/Medium
Environmental risks	- Land contamination from oily wastes with the potential to impact groundwaters and the water quality in South Trees Inlet.
Project solution / options	- Install an oil/water separator at the waste transfer facility
Objective / performance outcome	- To improve management of oily wastes.
Performance Indicator	- Management of oily/water on site is improved. - Oil spills at the refinery are reduced.
Cost estimate A\$ million	- 0.835
Project Stage	<b>Complete</b> - All oil/water separator and storage facility has been completed and has been commissioned.
Comments	- This facility provides a permanent location for the storage of oil waste prior to transport off-site to a recycling facility.

#### Implementation Schedule

Oil/water Separation Facility										
Task	2018	2019				2020				
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Complete design for upgrade to oil/water separator at waste transfer station	Complete	Complete								


Study Engineering Execution



 QUEENSLAND ALUMINA LIMITED

**Proposed Oil Water Facility**

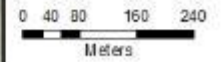
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 Oil water facility

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:7,019



N ↑	Revision:	1
	Date:	20/04/2019
	Created By:	Jonathan Dallas
	Approved By:	Jonathan Dallas

<b>Project (L8)</b>	<b>Strategy for Caustic Storage</b>
Risk class	- III/High
Environmental risks	- Current South Trees Island storage location has risks (substrate) for location of a tank farm and a risk of groundwater contamination.
Project solution / options	- Investigate options for a long term caustic storage tank farm.
Objective / performance outcome	- Confirm current locations suitability for the tank farm or; - Identify suitable alternate locations for the caustic storage tank farm
Performance Indicator	- Execution phase – all operational caustic storage tanks are inspected, all faults repaired and returned to service with RPEQ signoff.
Cost estimate A\$ million	- 18.1
Project Stage	<b>Completed</b> - Tank 1515 - Tank T15Q005 - Tank T15Q006
Comments	- QAL has decided to continue to store caustic soda in bunds 2 and 4 at South Trees Island. - All operational caustic storage tanks in bunds 2 and 4 at South Trees Island have been brought off-line, cleaned, inspected and any faults rectified prior to the tanks being returned to service. - Tank T15Q006 has been brought offline and an access hole has been cut into the side of the tank and the clean out process has commenced.

### Implementation Schedule

#### Caustic Storage Strategy

Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Inspect and repair tank T1515	Complete							
Inspect and repair tank T15Q005			Complete					
Inspect and repair tank T15Q006				Complete				

Study Engineering Execution






**QUEENSLAND ALUMINA LIMITED**

**Groundwater Impacts at South Trees Island Tank Farm**

**Legend**

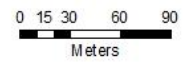
 Bund 2

 Bund 4

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N ↑	Revision	A
	Date	21/09/2016
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton



## Other Environmental Improvement Projects

In addition to projects that address the specific environmental parameters of air, water and land, projects that address other aspects of the operation have also been identified below.

<b>Project (O1)</b>	<b>Noise Emissions</b>
Risk class	- III/High
Environmental risks	- Community noise impact from operational and maintenance works
Project solution / options	- Review current noise impact management including: <ul style="list-style-type: none"> <li>• Efficacy of implemented controls on hydro-blasting</li> <li>• Adequacy of noise monitoring program;</li> <li>• Noise source assessment;</li> <li>• Plant and equipment noise mitigation options; and</li> <li>• Operational improvements (e.g. timing of noisy work practices)</li> </ul>
Objective / performance outcome	- Reduce QAL noise footprint
Performance Indicator	- Study phase – <ul style="list-style-type: none"> <li>• Verifies high risk noise sources are adequately managed.</li> </ul>
Cost estimate A\$ million	- 0.4
Project Stage	<b>Study</b> <ul style="list-style-type: none"> <li>• Complete</li> </ul> <b>Completed Projects</b> <ul style="list-style-type: none"> <li>• Emergency diesel generator building noise reduction paneling has been installed.</li> </ul>
Comments	- Noise surveys show that QAL meets the EA conditions, - High noise generating activities, such as hydroblasting are regulated through on-site procedures that limit the time these activities can be undertaken. Specific high noise exposure areas will be targeted in conjunction with occupational hygiene projects. These projects will target plant and equipment that exceed occupational exposure limits and will have an improvement on environmental noise.

### Implementation Schedule

Noise Emissions									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Review current noise impact management						Complete			

Study Engineering Execution