

# 5 Year Environmental Implementation Plan

2019 – 2023  
Version 8.0  
23 October 2020

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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>Execution</b></p> <ul style="list-style-type: none"> <li>- PSM major hazards packages critical control's to be embedded by the end of 2020.</li> </ul>

Comments	<ul style="list-style-type: none"> <li>- Completed PSM major hazards are subject to ongoing auditing and review,             <ul style="list-style-type: none"> <li>• CCMP process (deep dive by GM on Critical Controls) ongoing on all major hazards.</li> <li>• Monthly managers review process implemented and chaired by General Manager.</li> </ul> </li> <li>- All PSM major hazard workshops have been completed.             <ul style="list-style-type: none"> <li>• A full review process is now occurring on each Major Hazard (~1/2day workshop per Major Hazard) – 17 of 23 complete</li> </ul> </li> <li>- Last quarterly business update completed in June and this quarters has commenced.</li> <li>- Functional workplace program implementation in Raw Materials, Boilerhouse, Digestion, Clarification, Residue Disposal Area, Precipitation and Calcination rollout is ongoing, with a site wide working committee established and inclusion in all operational leaders Short Term Incentive Plans.</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 (&gt;95% three years in a row).</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,</li> <li>• Implementation of high return actions will be a focus throughout 2020, with remaining action executed beyond 2020,</li> <li>• Pulse survey in April / May confirm actions are engaging the QAL workforce, and</li> <li>• Environmental improvement committee, driven by employees is up and running and is identifying environmental improvement initiatives.</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							
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



Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- Install second oxalate tank,             <ul style="list-style-type: none"> <li>• Further modelling and trials are required to improve separation of alkali in the tank.</li> </ul> </li> <li>- Digestion relief tank,             <ul style="list-style-type: none"> <li>• Undertake a study to determine the most appropriate option to reduce the risk of an uncontrolled alkali release from the digestion units.</li> <li>• The study phase has been amended to identify options to improve or modify existing front-end controls that will reduce the likelihood and/or magnitude of a relief event, and</li> <li>• Options to improve or add to the existing containment system to stop alkali releases during any event.</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <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.             <ul style="list-style-type: none"> <li>• Delays due to COVID 19 have caused the execution schedule to move into 2021.</li> </ul> </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>• Delays due to emergent work have caused the execution schedule to move into 2021.</li> </ul> </li> <li>- HP blowdown line redirection – redirect blowdown lines to reduce steam and alkali at the entrainment separators,</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 increases (conductivity increases are likely due to caustic liquor ingress)</li> </ul>
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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>
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### Implementation Schedule

Task	Alkali Release Off-Site															
	2019				2020				2021				2022			
	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											
TCV and Steam shut off valuve on holding tanks heater																
HP blowdown line redirection																
Remote stop for precip cooling tower fans					Complete											
Digestion relief system containment system																
Digestion relief system front end																


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

0 45 90 180 270  
Meters

	Revision:	1
	Date:	20/10/2020
	Created By:	Jonathan DeLore
	Approved By:	Jonathan DeLore

Project (A2)	<b>Alumina Dust Emission Reduction</b>
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>Study</b></p> <ul style="list-style-type: none"> <li>- Alumina loadout, <ul style="list-style-type: none"> <li>• Cameras are being installed at the wharf to provide an assessment of dust emissions from each area of the loadout system that emits dust.</li> <li>• Footage from the camera's will be assessed using video image processing (VIP).</li> <li>• To allow for the outcomes of VIP to be integrated into the decision making process an extension of the study period will be required.</li> </ul> </li> <li>- Island and Mainland A-frames</li> <li>- Hydrate and alumina transfer system</li> </ul> <p><b>Completed</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			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Alumina Loadout			■	■	■	■	■	■				
A-frames, alumina and hydrate transfer systems							■	■	■	■		
BSL alumina transfer upgrade	■ Complete											

Study   Engineering   Execution



**Alumina Dust Emissions**

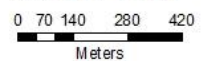
**Legend**

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

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:12,834



	Revision	A
	Date	21/10/2015
	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>- Options assessment for new technology (NTP) and existing/proven technology (RTO, direct and indirect condensing) for relief tank vapour.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- NTP Unit installation on Wash water tanks.</li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Second, larger capacity thermal oxidizer.</li> <li>- The evaporation heater vent condensate collection improvement project.</li> </ul>

Comments	
	<ul style="list-style-type: none"> <li>- QAL are progressing individual trials:               <ul style="list-style-type: none"> <li>- Source sampling program within the refinery to provide up to date results that reflect the current operating circumstances, including Amrun bauxite.                   <ul style="list-style-type: none"> <li>• The baseline sampling program is complete and results have been included in an updated model.</li> </ul> </li> <li>- Trials                   <ul style="list-style-type: none"> <li>• Undertake 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> </li> </ul>
	<ul style="list-style-type: none"> <li>• QAL will trial condensing digestion unit 3 blow off tank vapour with seawater using the wash water heater. While condensing odourous vapour streams is known technology, QAL must monitor the impact of the hot seawater entering the waste tanks.               <ul style="list-style-type: none"> <li>▪ This trial has been completed.</li> </ul> </li> <li>• Alternate technology will be progressively trialed after an initial review of suitability for use in the refinery:               <ul style="list-style-type: none"> <li>▪ Non thermal plasma technology has been trialed at QAL and options to proceed with the NTP technology on digestion relief tank emissions is being assessed.</li> <li>▪ Other technology, such as catalyst destruction has been reviewed.</li> </ul> </li> </ul>

### 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																
Alternate odour treatment technology trial - Non thermal plasma	Complete															
Evap heater vent condensate collection	Complete				Complete											
Second thermal oxidiser		Complete														
NTP Unit installation on Bad Wash Water Tank					Complete											
Relief Tank odour reduction																



Study    Engineering    Execution



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## Odour Emissions to Community

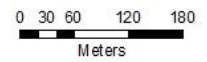
### Legend

-  Alkali and Odour Emissions Reduction
-  Thermal Oxidiser

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3: 1:5,553



N ↑	Revision	A
	Date	21/10/2016
	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	- Selected engineering option is progressed to execution.
Cost estimate A\$ million	- 1.0
Project Stage	<b>Engineering</b> - Install upgraded sprinkler system on the working coal stockpile
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

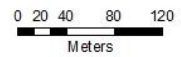
### Legend

-  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  
Reviewed By: Jonathan Dalton  
Approved By: Jonathan Dalton

Project (A5)	Bauxite Transfer Dust Emissions
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>Execution</b> - Install a belt washer station and improved scrappers
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								
Study	Engineering	Execution										



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## Bauxite Transfer Dust Emissions

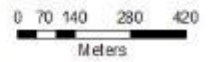
### Legend

 Bauxite conveyor and transfer points

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:12,500



N 	Revision:	1
	Date:	20/10/2020
	Created 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>Engineering</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>• Additional modelling work was required to predict the expected dust reduction from the engineering solution prior to moving into execution.</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				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Engineering for dust mitigation on ash dam	Complete												
	Study	Engineering	Execution										



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## Ash Dam Dust Emissions

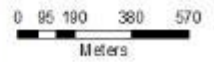
### Legend

 Ash ponds

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:16,763



	Revision:	1
	Date:	20/10/2020
	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	- Engineering options are progressed into execution.
Cost estimate A\$ million	- 0.75
Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- Third party review of operating practices relating to all unloading aspects of raw materials is being completed.</li> <li>- As other projects move into engineering they will be added to the schedule.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Gaps within the wharf bunds provide pathways for materials to be released into the water.</li> </ul>
Comments	The engineering phase for this project was extended to allow for this phase to be completed.

### Implementation Schedule

Raw Material Spill from Wharf								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Fill in opennigs on wharf								
<b>Study</b>								
<b>Engineering</b>								
<b>Execution</b>								



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## Raw Material Spill from Wharf

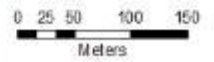
### Legend

 Wharf - Raw Material Spill

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:4,442



	Revision:	1
	Date:	20/10/2020
	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>Study</b></p> <p>Phase 2 investigate:</p> <ul style="list-style-type: none"> <li>- Improvement in neutralisation capacity in the west coal stilling pond</li> <li>- Investigate reduction of coal contaminated stormwater entering the west and east coal stilling pond</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Options to improve the functionality of the west coal stilling pond have been progressed into engineering, 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.</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																				
	Study	Engineering	Execution																	



 QUEENSLAND ALUMINA LIMITED

### Coal Stockpile Runoff

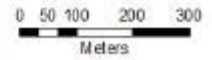
### Legend

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

QUEENSLAND ALUMINA LIMITED  
 This map is a site plan showing the location of coal stockpiles and ponds. It is intended for informational purposes only and should not be used for legal or regulatory purposes. The map is based on aerial photography and may not be 100% accurate. All rights reserved.

Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:8,884



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

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	Detailed engineering works on the overland and sections of the project will be completed to allow for construction of these sections to commence in 2020, QAL has taken receipt of all of the new pipe. Detailed engineering works for the over water sections of the project are expected to be completed by the end 2020 allowing approvals to be sort in early 2021.

**Implementation Schedule**

Waste Line 4 Capacity																	
Task	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	Complete															
<b>Study</b>	<b>Engineering</b>	<b>Execution</b>															



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**Waste Line 4**

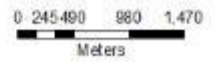
**Legend**

 Waste Line 4

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:44,421



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

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>Study</b></p> <ul style="list-style-type: none"> <li>- Identify options for east contaminants pond, i.e. relocation, upgrade at existing location.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Finalise pump sizing and pipeline requirements for west 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>

### Implementation Schedule

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

Study
Engineering
Execution



### Contaminants Ponds

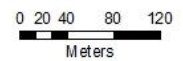
### Legend

- East Pond
- West Pond

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3 1:4,274



	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (W5)	Refinery Water Release Management
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 Curtis.
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>Engineering – Phase 2</b></p> <ul style="list-style-type: none"> <li>- An engineering service provider will commence work on the selected improvement options in Q1 2022. This is due to the commitment of a large capital program during 2021 for the 5 Year Environmental Strategy, with the projects are being executed in order of risk reduction.</li> <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:</li> <li>- Pre-treatment pond to reduce bauxite and bauxite fines from the mono bauxite stockpile entering the bauxite sweetening pond.</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

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 Westgate pond improvements																				
Bauxite sweetening pond bauxite stormwater runoff Pretreatment from mono stockpile																				




Study
Engineering
Execution





 QUEENSLAND ALUMINA LIMITED

**Refinery  
Stormwater  
Legend**

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

Details of this plan shall be subject to the conditions of the relevant licence and permit. This plan is for information only and does not constitute a contract. The plan is subject to change without notice. The plan is not to be used for any other purpose. The plan is not to be used for any other purpose. The plan is not to be used for any other purpose.

Coordinate System: GDA 1984 UTM Zone 58  
 Scale at A3: 1:11,105  
 0 62.5 125 250 375  
 Meters

	Revision:	1
	Date:	20/10/2020
	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 Black Breasted Button Quail (BBBQ) habitat do 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>Execution</b></p> <ul style="list-style-type: none"> <li>- Install a drain along the eastern side of the HRMD (historic red mud dam).</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> <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> </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			
	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										
Cell 1 cut-off wall and drain												

Study    Engineering    Execution



 **QUEENSLAND ALUMINA LIMITED**

**RDA  
Groundwater  
Impacts**

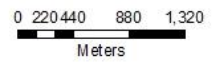
**Legend**

-  EE Stage 1
-  EE Stage 2

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:39,597



	Revision	A
	Date	21/10/2019
	Created By	Jonathan Dalton
	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 pilot treatment plant has been completed and the trial treatments being investigated have stabilised. Initial results from the first three months of continuous operation show that the facultative pond system is the most stable and provides excellent treatment of the decant. Operating scenarios are being run, including increase flow rate through the ponds, reducing artificial aeration and reducing nutrient addition.</li> <li>- Modeling of release flows is being performed, with the model updated and scenarios for alternate release points being run.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- The northern decant management and treatment area final configuration located on the historic red mud dam is in engineering phase and will look at how the next phase of ponds can be constructed in phases to provide further treatment options and to include storage of water external to the red mud dams.</li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Cell 1 of the northern management and treatment area is under construction and will provide for treatment of decant via the pond.</li> </ul>
Comments	

### Implementation Schedule

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


Study
Engineering
Execution



 QUEENSLAND ALUMINA LIMITED

**RDA Discharge**

**Legend**

-  Licenced Discharge Point

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:44,421

0 245 490 980 1,470  
Meters

Revision	1	01/10/2020
Created By	Jonathan DeLore	
Checked By	Jonathan DeLore	
Approved By	Jonathan DeLore	

Project (W8)	High Risk Pipelines
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 20year life with a reduction in likelihood of failure..
Cost estimate A\$ million	- 10.5
Project Stage	<b>Execution</b>
Comments	Leakage detection systems are being assessed.

### 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 pipelines	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Study	Engineering	Execution													






 QUEENSLAND ALUMINA LIMITED

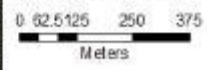
**High Risk Pipelines**

**Legend**

 High Risk Pipelines

QUEENSLAND ALUMINA LIMITED  
This map is a site plan and does not show any other features or details that may be present on the ground. It is intended for use as a reference only and should not be used for any other purpose. The map is provided as a guide only and is not intended to be used for any other purpose. The map is provided as a guide only and is not intended to be used for any other purpose.

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



N 	Revision:	1
	Date:	20/10/2020
	Created By:	Jonathan Dallas
	Approved By:	Jonathan Dallas

## Land management improvement projects

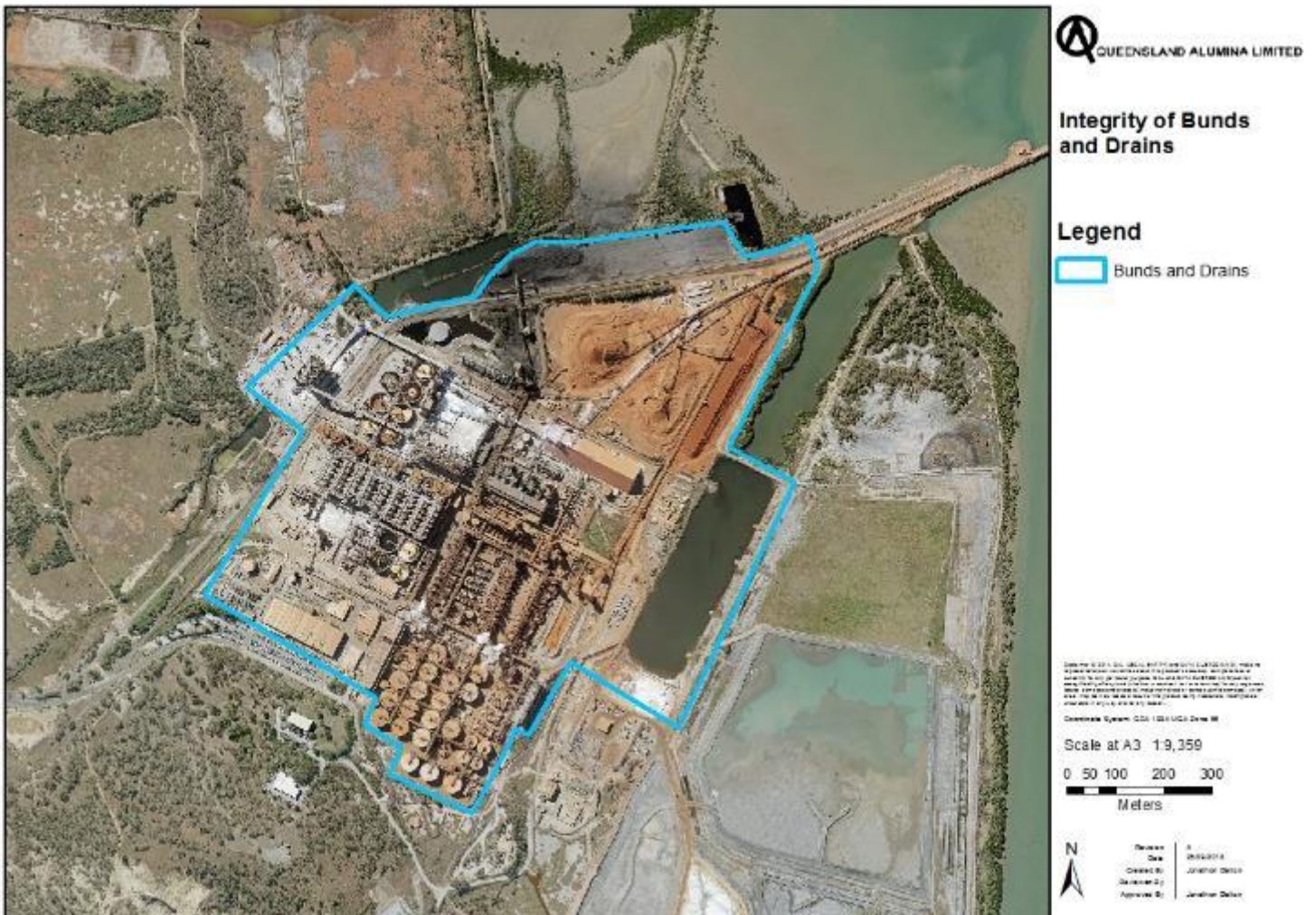
QAL's five-year land stewardship programme, supported by targets, actions and a programme of works is summarised below. Capital spend is estimated at between A\$20 million to A\$35 million.

<b>Project (L1)</b>	<b>Integrity of Bunds and Drains</b>
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>• New sulphuric acid storage and handling facility</li> <li>• HID1/5 bund repair, and</li> <li>• Tertiary tank 5 bund repairs</li> </ul> </li> <li>- Drains in execution: <ul style="list-style-type: none"> <li>• 9<sup>th</sup> Street Drain, and</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 3/4,</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> </ul>
Comments	- The Bund and drain inspection program has identified high, medium and low risk bunds and drains requiring remediation.

### Implementation Schedule

Task	Integrity of bunds and Drains																											
	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			
Complete design on remaining high risk (class IV)	█	█	█	█	█	█	█	█	█	█	█	█																
Complete design package for Class I, II and III									█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
5th Street Drain repairs					█	█	█	█	█	█	█	█																
Bravo Street Drain repair					█	█	█	█	█	█	█	█																
Sierra Street Drain repairs					█	█	█	█	█	█	█	█																
Installation of new sulphuric acid storage facility									█	█	█	█	█	█	█	█												
EF Row concrete remediation works									█	█	█	█																
Tertiary tanks 1-4 nib wall replacement									█	█	█	█																
Sulphuric acid tank interim bund remediation									█	█	█	█																
Above Ground Section of Seventh Street Drain repair	█	█	█	█	█	█	█	█																				
HID 3/4 bund repair	█	█	█	█	█	█	█	█																				
HID 1/5 bund repair													█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Tertiary tank 5 bund remediation													█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
9th Street drain repairs													█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█

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





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	- Groundwater pumping is ongoing. - Monitoring of groundwater will continue and opportunities to improve the system will continue to be investigated based on the results of the ongoing monitoring.




**QUEENSLAND ALUMINA LIMITED**

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

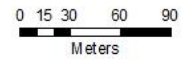
**Legend**

-  Bund 2
-  Bund 4

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3 1:2,981



N 	Revision	A
	Date	21/10/2019
	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 seepage from the mineral waste disposal facility.
Cost estimate A\$ million	- 2.6
Project Stage	<b>Execution</b> - Mineral Waste Disposal Facility stage 2 <b>Study</b> - Mineral Waste Seepage Mitigation
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																
<b>Study</b>	<b>Engineering</b>	<b>Execution</b>														



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**Mineral Waste Facility - Stage 2**

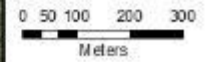
**Legend**

 Mineral Waste Facility

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:9,359



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



Project (L4)	Sewerage System Upgrade
Risk class	- III/High
Environmental risks	- Potential for land contamination from sewerage system installed during initial and subsequent plant construction phases and potential to contaminate groundwater. - Introduction of inadequately treated effluent to the RDA
Project solution / options	- Investigate the condition of the sewerage system to identify issues and assess options to rectify identified issues - Review the current operation of the sewage treatment system and look at requirement for upgrade
Objective / performance outcome	- Reduce the risk of the release of sewage to land
Performance Indicator	- Study phase identifies current state of sewerage system integrity and identifies options to improve sewage treatment plant and prevent sewage leaks in the refinery and they are progressed to engineering.
Cost estimate A\$ million	- 2.0
Project Stage	<b>Engineering</b> - Option to refurbish existing sewage treatment plant, and - Repair sewage pipes
Comments	

**Implementation Schedule**

Sewerage System								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Investigate the current state of the sewerage system at the refinery	Complete							


Study Engineering Execution



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**Sewerage System Review**

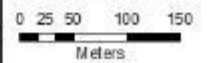
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 Sewage Treatment Plant

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	Checked By:	JONATHAN DELANEY
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	Approved By:	JONATHAN DELANEY

<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			
Investigate closure cover options for the RDA	Complete																							


Study   Engineering   Execution



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**RDA Rehabilitation - Pilot Study**

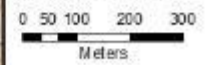
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 Rehabilitation Trial Area

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	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 is being 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



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**Proposed Oil Water Facility**

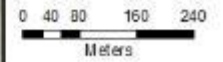
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 Oil water facility

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N ↑	Revision:	1
	Date:	20/10/2020
	Created By:	Jonathan DeLore
	Approved By:	Jonathan DeLore

Project (L8)	Strategy for Caustic Storage
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>Execution</b> - Tank T15Q006 <b>Completed</b> - Tank 1515 - Tank T15Q005
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								

Study
Engineering
Execution



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

**Legend**

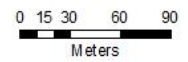
 Bund 2

 Bund 4

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Scale at A3 1:2,981



N 	Revision	A
	Date	21/10/2019
	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