ANNUAL REVIEW
1 April 2021 – 31 March 2022

Northern Dune Extension

TABLE OF CONTENTS

1 STATEMENT OF COMPLIANCE 6
2 INTRODUCTION 7
2.1 Name and Contact Details 10
2.2 Background Information and Mining History 11
3 APPROVALS 15
4 OPERATIONS SUMMARY 16
4.1 Exploration 16
4.2 Land Preparation 16
4.3 Construction Activities 16
4.4 Quarry Operations 16
4.5 Next Reporting Period 16
5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW 17
5.1 Actions from 2018/19 Annual Review 17
5.2 Management Plan Updates 17
6 ENVIRONMENTAL PERFORMANCE 18
6.1 Summary of Environmental Performance 18
6.2 Noise 21
6.2.1 Key Environmental Performance 21
6.3 Air Quality 21
6.3.1 Approved Criteria 21
6.3.2 Management Measures 22
6.3.3 Key Environmental Performance 23
6.3.3.1 Depositional Dust 23
6.3.4 Proposed Improvements 28
6.4 Traffic Management 28
6.4.1 Approved Criteria 28
6.4.2 Key Environmental Performance 28
6.5 Biodiversity 29
6.5.1 Nest Box Installation and Monitoring Program 29
6.5.2 Amphibian Monitoring 30
6.5.3 Koala Monitoring 31
6.5.4 Habitat Restoration 33
6.5.4.1 Vegetation Condition Survey 33
6.5.4.2 Weed Control Works 34
6.6 Heritage 34
6.6.1 Approved Criteria 34

6.6.2 Cultural Heritage Management Plan 34
6.6.3 Key Environmental Performance 34
6.6.4 Proposed Improvements 35
6.7 Waste Minimisation 35
6.7.1 Management Measures 35
6.7.2 Key Environmental Performance 35
6.7.3 Proposed Improvements 35
7 WATER MANAGEMENT 36
7.1 Groundwater Management Measures 36
7.1.1 Groundwater Levels 39
7.1.1.1 Groundwater Level Results Discussion and Trend Summary 42
7.1.2 Groundwater Quality 43
7.1.2.1 Groundwater Quality Results Discussion and Trend Summary 46
8 REHABILITATION AND LANDSCAPE MANAGEMENT 48
8.1 Rehabilitation Management 48
8.2 Rehabilitation Monitoring 48
8.3 Weeds 52
8.4 Plantings 53
8.5 Performance Indicators 53
8.6 Rehabilitation Actions 57
9 COMMUNITY 58
9.1 Community Engagement Activities 58
9.2 Complaints 58
10 INDEPENDENT AUDIT 59
11 INCIDENTS AND NON-COMPLIANCE 60
12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD 61
13 APPENDICES 63

TABLES

Table 1: Statement of Commitments 6
Table 2: Annual Review Requirement 9
Table 3: Summary of operations 12
Table 4: Approvals for Northern Dune Extension 15
Table 5: EPL Fee-Based Activity at Northern Dune Extension. 15
Table 6: Summary of Conditions 18
Table 7: Long term criteria for particulate matter 21
Table 8: Short term criterion for particulate matter 21
Table 9: Long term criteria for deposited dust 21
Table 10: Insoluble Matter (g/m2) Monitoring results for the D3 / TB4 Monitoring Station (April 2021 – April 2022). 25

Table 11: Insoluble Matter (g/m2) Monitoring results for the D5 / TB3 Monitoring Station (April 2021 – March 2022). 26
Table 12: Amphibian presence during targeted nocturnal monitoring 31
Table 13 Koala activity levels from the Spot Assessment Technique. 32
Table 15 Current Groundwater Quality Monitoring Locations 38
Table 16: EPL 11633 Groundwater Monitoring Requirements 39
Table 17: Groundwater Levels at Northern Dune Extension Monitoring Locations 41
Table 18: Comparison of Groundwater quality results against trigger values for the 2019/20 reporting period. 44
Table 19: Block preparation and survey details for the North Dunes Extension Rehabilitation Blocks 49
Table 28: Performance Indicators for Tanilba Northern Dune Extension rehabilitation 54
Table 30: Proposed works – 2021/22 61

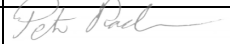
FIGURES

Figure 1: Northern Dune Extension Operations (Including Offset Areas) 8
Figure 2: Northern Dune Extension Site Plan 13
Figure 3: Northern Dune Extension Land Ownership and Extraction Area 14
Figure 4: Dust Sampling Locations 22
Figure 5: Insoluble Matter (g/m^2) Monitoring results for the D5 / TB3 Monitoring Station and D3 / TB4 Monitoring Station 27
Figure 6: Location of the Tanilba Northern Dune Projects and Associated Current Monitoring Locations 37
Figure 7: 2020/21 Monthly Rainfall at Williamtown RAAF 40
Figure 8: ACI-2 Iron Results Trend History 45
Figure 9: ACI-2 Manganese Results Trend History 45
Figure 10: ACI-13 Iron Results Trend History 46
Figure 10: Locations of Blocks Q1 to Q6 50

APPENDICES

Appendix 1 – Project Approval MP-09-0091
Appendix 2 – Nest Box Monitoring, Amphibian Monitoring and Koala Monitoring Report
Appendix 3 – Groundwater Level Trend Hydrographs
Appendix 4 – Groundwater Quality Trend Hydrographs (Quality vs. Trigger Values)
Appendix 5 – Rehabilitation Monitoring Report

SITE DETAILS

Name of operation	Northern Dune Extension
Name of operator	Holcim (Australia) Pty Ltd
Development consent / project approval #	MP 09_0091
Name of holder of development consent / project approval	Holcim (Australia) Pty Ltd
Annual Review start date	April 1, 2021
Annual Review end date	March 31, 2022
I, certify that this audit report is a true and accurate record of the compliance status of Northern Dune Extension for the period of April 1, 2020- March 31, 2021 and that I am authorised to make this statement on behalf of Holcim (Australia) Pty Ltd. *Note.* *a) The Annual Review is an 'environmental audit' for the purposes of Division 9.4) of the Environmental Planning and Assessment Act 1979. Division 9.42 provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.* *b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).*	
Name of authorised reporting officer	Peter Radzievic
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	1.07.2022

1 STATEMENT OF COMPLIANCE

See **Table 1** for statement of commitments for the 2019/20 reporting period for Northern Dune Extension Quarry.

Table 1: Statement of Commitments

Were all conditions of the relevant approval(s) complied with?	
MP 09_0091	Yes
Hunter Water (Special Areas) Regulations 2010 – Approval under Clause 10(1)	Yes
EPL No. 11633	Yes

No incidents or non-compliances were recorded during this AR period.

2 INTRODUCTION

Holcim (Australia) Pty Ltd (Holcim) operates Northern Dune Extension (NDE), a sand quarry located in Tanilba Bay, within the Port Stephens Local Government Area. The site operates under Project Approval (MP-09-0091) approved by the New South Wales (NSW) Department of Planning and Environment (DPE) on 8 March 2013.

This Annual Review (AR) has been prepared for the Tanilba Northern Dune Extension Project to report on mining activities undertaken during the past 12 month reporting period from 1st April 2021 to 31st of March 2022. This report addresses the site's present compliance obligations and status, activities undertaken at the site during the reporting period and proposed activities for the following 12 month period.

This AR encompasses the annual reporting requirements required by Project Approval MP 09_0091 issued by the Department of Planning and Environment on 8 March 2013 for the Tanilba Northern Dune Extension Project (attached as Appendix 1).

This AR will be distributed to DPE, Hunter Water Corporation (HWC) and Port Stephens Council (PSC) and will also be made publicly available on Holcim's website

The site also operates in accordance with Environment Protection License (EPL) No. 11633 issued by the Environmental Protection Authority (EPA). A location figure and aerial view of the site are outlined in Figure 1 below.

Project Application MP 09_0091 was approved under Section 75J of the *Environmental Planning and Assessment Act 1979* for Sibelco Australia to conduct mining activities on Lots 11, 12 and 13 on DP601306, Lot 408 on DP1041934, and Lots 1 and 2 on DP408240. Project Approval MP 09_0091 has been attached as Appendix 1.

The Annual Review required by approval MP 09_0091 is detailed in Schedule 5, Condition 3 of the approval whereby it is stated:

"Within 12 months of the commencement of quarrying operations, and annually thereafter, the Proponent shall review the environmental performance of the project to the satisfaction of the Director-General. This review must:

- *(a) describe the works (including rehabilitation) that were carried out in the previous year, and the works that are proposed to be carried out over current year;*
- *(b) include a comprehensive review of the monitoring results and complaints records of the project over the past year, which includes a comparison of these results against:*
  - *the relevant statutory requirements, limits or performance measures/criteria;*
  - *the monitoring results of previous years; and*
  - *the relevant predictions in the EA;*
- *(c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;*
- *(d) identify any trends in the monitoring data over the life of the project;*
- *(e) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and*
- (f) *describe what measures will be implemented over the next year to improve the environmental performance of the project."*

Mining commenced within Lots 11 – 13 of the Extension area in 2016 and ceased on 18 December 2018. As such, **no clearing or extraction occurred during the reporting period**.

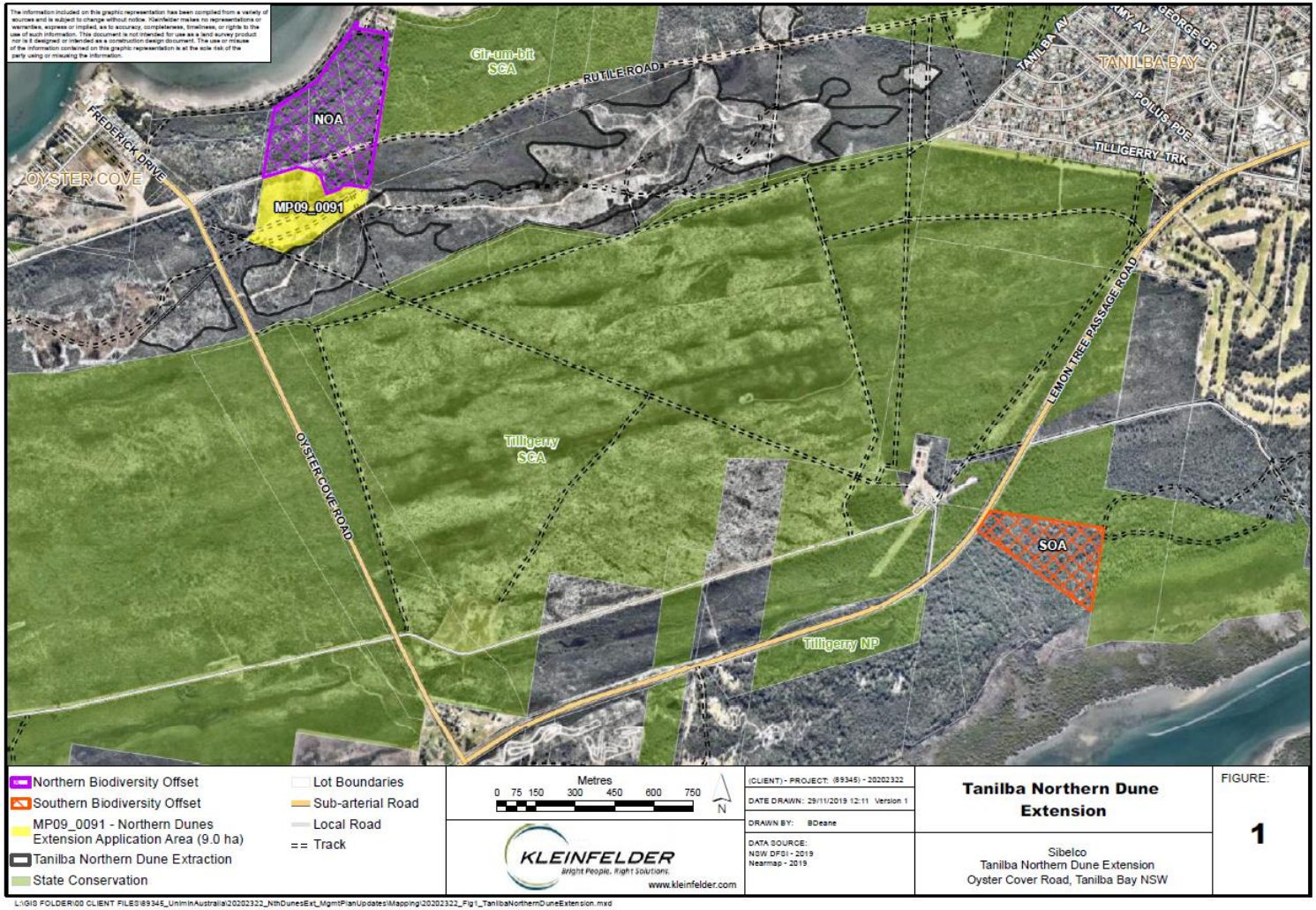


Figure 1: Northern Dune Extension Operations (Including Offset Areas)

In accordance with Schedule 5, Condition 4 of the modified Development Consent the site is required to undertake an Annual Review of the site. This Annual Review has been prepared in accordance with Schedule 5 Condition 4 (Annual Performance Monitoring) of the Development Consent and in accordance with the *Annual Review Guideline: post approvals requirements for state significant mining developments* (October 2015). The Annual Review requirements and the section where they have been addressed in this document have been provided in **Table 2**.

Table 2: Annual Review Requirement

Condition	Section in Annual Review
4. Annual Review Annual Review by the end of March each year, the Applicant shall review the environmental performance of the development to the satisfaction of the Secretary. This review must: (a) describe the development (including rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;	Section 4 and 6
(b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against: - the relevant statutory requirements, limits or performance measures/criteria;. - the monitoring results of previous years, and - the relevant predictions in the documents listed in condition 2 of Schedule 2;	Section 6 and 7
(c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;	Section 1 and 11
(d) identify any trends in the monitoring data over the life of the development;	Section 6 and 7
(e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and	Section 6
(f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development	Section 12

2.1 Name and Contact Details

Quarry Manager

Peter Radzievic
Work: +61 2 4982 6399
Mob: +61 419 440 588
peter.radzievic@holcim.com

Sydney Aggregates Manager

Chris Hamilton
Work: +61 2 6656 8620
Mob: +61 429 790 213
chris.s.hamilton@holcim.com

Planning & Environment Manager NSW/ACT
Luke Edminson
Holcim (Australia) Pty Ltd
Mob +61 429 790 756
Email: luke.edminson@holcim.com

Planning and Environment Coordinator NSW/ACT
Shilpa Shashi
Mob: +61 427 859 852
Email: shilpa.shashi@holcim.com

2.2 Background Information and Mining History

The Tanilba Northern Dune is an elevated sand dune system located on the Tilligerry Peninsula adjacent to the township of Oyster Cove in the Port Stephens Shire, New South Wales.

White silica sand has been extracted from the Tanilba Northern Dune by several companies at different locations since 1991 - the approved extraction area in relation to the regional context can be seen in Figure 1.

Prior to 2003, the western parts of the Tanilba Northern Dune were mined by ACI Operations Ltd. Sibelco commenced operations in 2004. Sand extraction works at the Tanilba Northern Dune were comprised of four approval areas separated jurisdictionally by Crown Lands, Hunter Water (x2) and Department of Planning and Environment approvals.

In 2013 approval was granted by the Minister for Planning and Infrastructure to extend the approval area for quarrying activities by 9 ha in an area to the north of the existing extraction operations. The extension project was a Major Project considered under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and is known as the Tanilba Northern Dune Extension Project (now declared a State Significant Development under an Order dated 22 November 2018). Holcim took ownership of the Project on 1 April 2020.

The project area comprises land owned by the Crown, the Hunter Water Corporation and Holcim (the site) and consists of the following:

- Lots 11, 12 ,13 DP601306 (Sibelco);
- Lot 408 DP1041934 (Crown Land); and
- Lots 1, 2 DP408240 (Hunter Water Corporation).

The above areas are depicted in Figure 3.

In terms of the mining process, clearance was undertaken progressively across the site to minimise the area exposed at any one time. Topsoil was then stripped before sand was extracted for processing at the nearby Salt Ash processing plant. Sand was extracted in a rolling south to north sequence where possible with previously mined areas no longer subject to extraction undergoing rehabilitation at the same time. Pre-clearance surveys for flora, fauna and the presence of culturally significant sites were undertaken prior to any clearing of vegetation.

Mined areas are required to be rehabilitated in accordance with an approved Landscape Management Plan and areas cleared of vegetation are required to be offset by implementation of a Biodiversity Offset Strategy including management and improvement of vegetation retained in the north of the approval area. Once rehabilitation is complete, the rehabilitated areas will be returned to their respective owners. Extraction ceased in December 2018, with the project moving to a rehabilitation only phase.

A summary of operating parameters at the Tanilba Northern Dunes Extension during the reporting period (reportable per the January 2006 Annual Environmental Management Report guidelines) is provided below.

Table 3: Summary of operations

Parameter	Site detail
Operating hours	Daylight hours from 7:00am to 6:00pm (light permitting) Monday to Friday.
Infrastructure	No permanent infrastructure has been constructed on-site at the Northern Dune Extension as per approvals.
Construction activities	No construction took place at Northern Dune Extension during the reporting period.
Equipment management	No chemicals or mobile plant are stored overnight at Northern Dune Extension
Waste management	No bins or other waste management facilities are kept on site - any waste produced is removed at the end of each working day.
Lighting	Northern Dune Extension does not operate outside of daylight hours and therefore does not have a lighting system installed.
Exploration	No exploration took place at the Northern Dune Extension during the reporting period.
Blasting	Blasting does not occur at the Northern Dune Extension Project site.
Land clearing	No land clearing occurred during the reporting period.
Extraction	Extraction ceased at the site on December 18 2019. No extraction occurred during the reporting period.

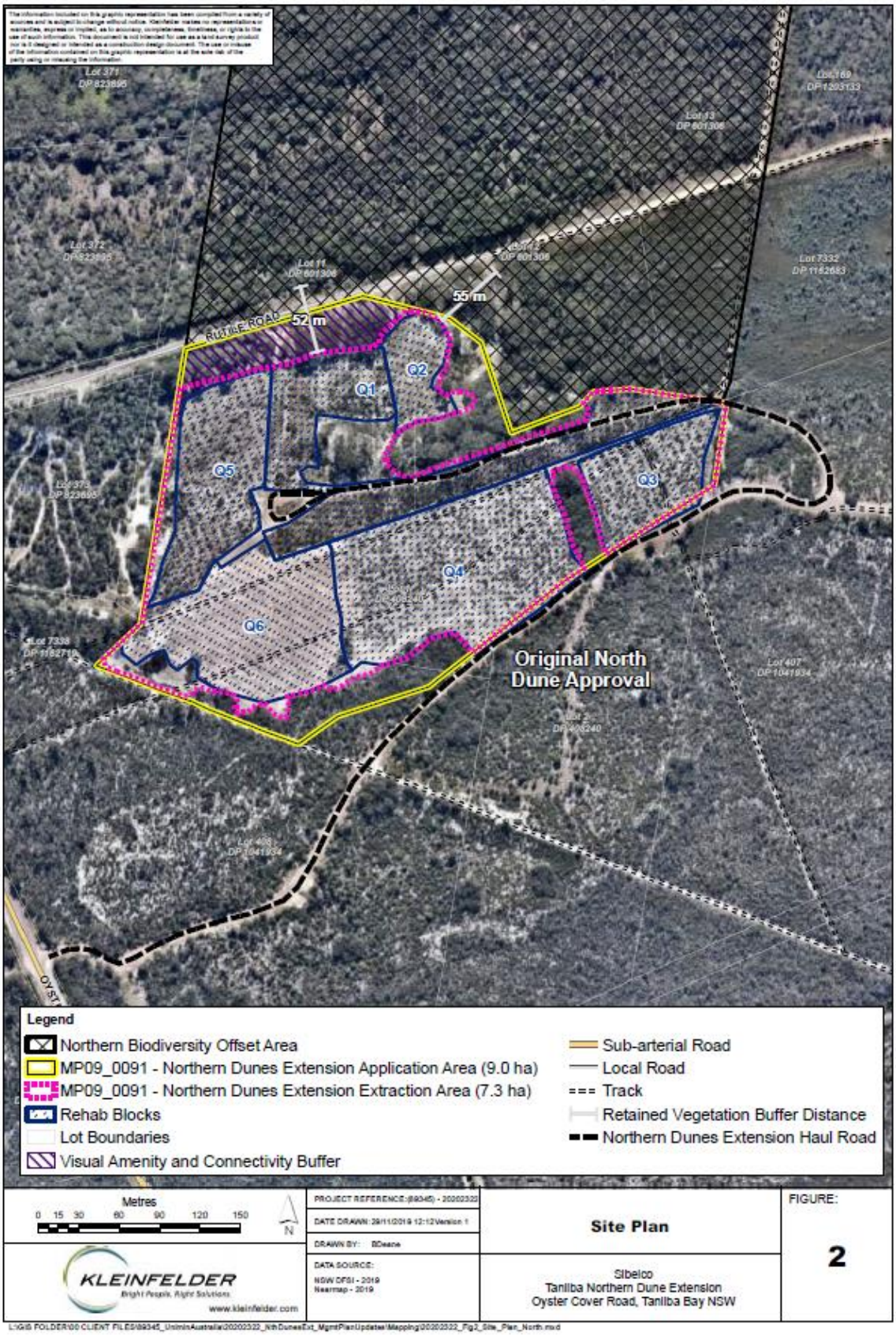


Figure 2: Northern Dune Extension Site Plan

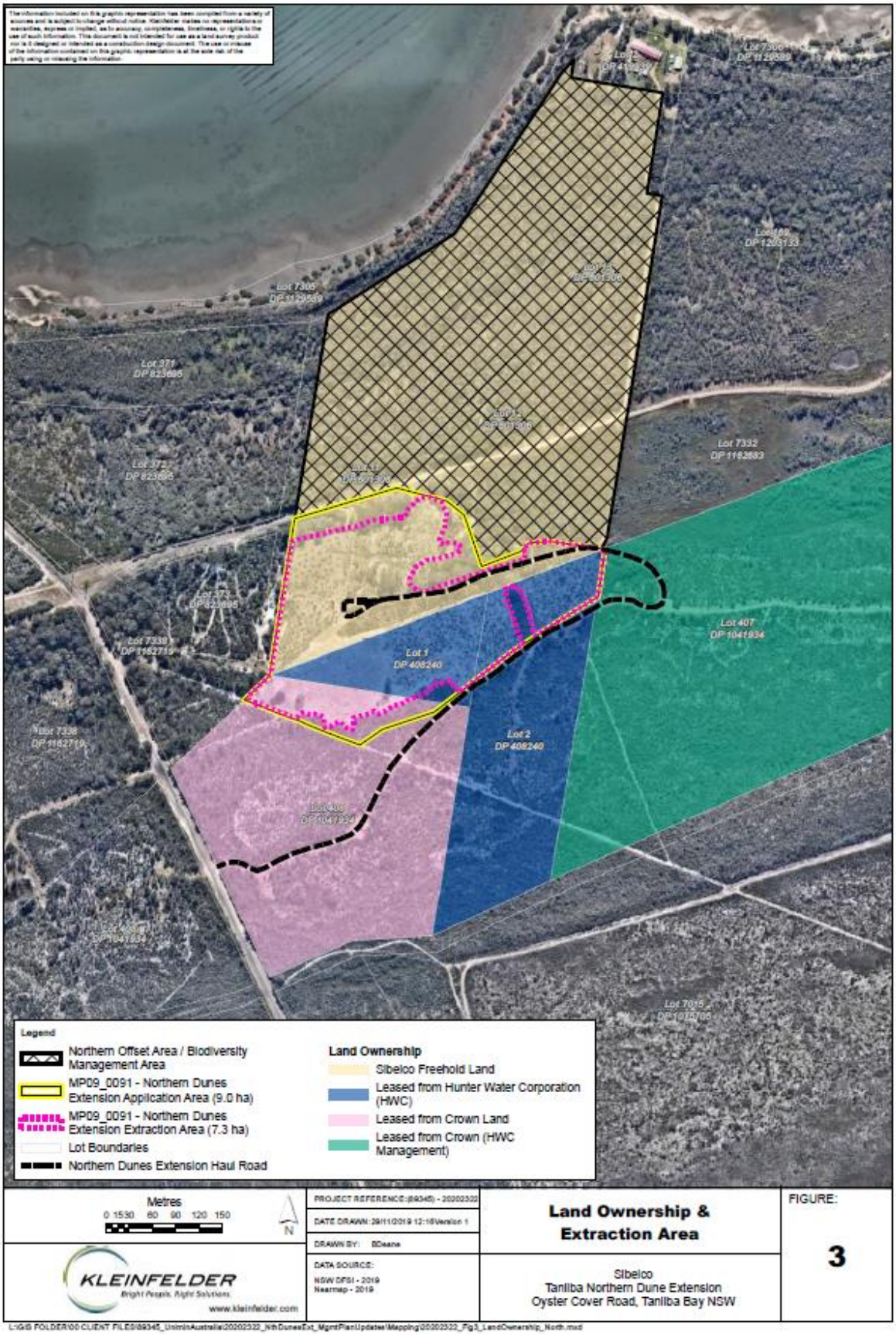


Figure 3: Northern Dune Extension Land Ownership and Extraction Area

3 APPROVALS

The site operates under the following approvals listed in **Table 4**, with the areas of land ownership displayed in **Figure 3**.

Table 4: Approvals for Northern Dune Extension

Approval	Regulatory Authority
MP 09_0091	NSW Department of Planning, Industry & Environment
EPL11633	NSW Environmental Protection Authority
Hunter Water (Special Areas) Regulations 2010 – Approval under Clause 10(1)	Hunter Water Corporation

Holcim holds EPL11633 which covers its activities at Northern Dunes Extension. **Table 5** outlines the EPL licensing limits.

Table 5: EPL Fee-Based Activity at Northern Dune Extension.

Scheduled Activity	Fee Based Activity	Scale
Extractive activities	Land-based extractive activity	>100,000 – 500,000 T extracted, processed or stored

Schedule 2 Condition 6 outlines that the proponent shall not transport more than 150, 000 tonnes of extractive materials from the site in any calendar year.

4 OPERATIONS SUMMARY

4.1 Exploration

No exploration activities were completed during the Annual Review period.

4.2 Land Preparation

No clearing took place during the Annual Review period. All areas of the site were undergoing rehabilitation and covered by vegetation

4.3 Construction Activities

There was no construction undertaken during the Annual Review period.

4.4 Quarry Operations

No extraction occurred during the reporting period. Only rehabilitation activities were performed and are discussed in Section 8. No extractive material was transported from site.

4.5 Next Reporting Period

Extraction at the Northern Dunes Extension site has ceased. Only rehabilitation activities are proposed during the next reporting period. These are discussed further in Section 8.6. Groundwater monitoring will also be performed as per the Groundwater Management Plan (GMP).

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

5.1 Actions from 2018/19 Annual Review

A site visit invitation was extended alongside submission of the previous AR but was not attended due to the onset of the COVID-19 pandemic and associated restrictions in place. DPE did attend site for an inspection on 25 March 2021. At the time of writing this AR no formal feedback has been received.

5.2 Management Plan Updates

Schedule 5 Clause 4 of the project approval requires that management plans are reviewed and, if necessary, revised within 3 months of the submission of an Annual Review. All management plans for the Northern Dune Extension were reviewed and where necessary revised following the submission of the 2020/21 AR. Revisions were made to reflect the requirements of the current operation now that it has transitioned into a rehabilitation phase. Following revision, they were submitted to DPE for review to meet the satisfaction of the Director-General.

6 ENVIRONMENTAL PERFORMANCE

6.1 Summary of Environmental Performance

A summary of the conditions of the approval MP 09_0091 and sections within this AR where each condition is addressed is provided in **Table 6** below.

Table 6: Summary of Conditions

MP 09_0091 Reference	*Summary of Condition*	*Report Reference*	*Compliance*
ADMINISTRATIVE CONDITIONS			
S2, Cl6	*The Proponent shall not transport more than 150,000 tonnes of extractive materials from the site in any calendar year*	4.4	Y
S2, Cl7	*The Proponent shall ensure that no more than three hectares of the site would be exposed (ie cleared but not re-vegetated) at any one time*	4.2	Y
ENVIRONMENTAL PERFORMANCE CONDITIONS			
Identification of Boundaries			
S3, Cl1	*Prior to the commencement of quarrying operations, the Proponent shall:* *(a) Engage a registered surveyor to mark out the boundaries of the approved limits of extraction; and* *(b) Ensure that these boundaries are clearly marked at all times in a permanent manner that allows operating staff and inspecting officers to clearly identify those limits*	4.4	Y
Noise			
S3, Cl2	*The Proponent shall ensure that the operational noise generated by the project does not exceed the noise impact assessment criteria in Table 1 at any residence on privately-owned land*	4.4	Y
S3, C3	*The Proponent shall only conduct quarrying operations on the site … during stipulated hours*	4.4	Y
Noise Monitoring Program			
S3, Cl5	*The proponent shall prepare and implement a Noise Monitoring Program for the project to the satisfaction of the DG. This program must (amongst other items):* *Include quarterly noise monitoring during at least the first two years of operations*	6.2	Y
Air quality			
S3, Cl6	*The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed the criteria listed in Tables 2 to 4 at any privately-owned land*	6.3.2	Y
S3, Cl7	*The Proponent shall regularly assess air quality monitoring data*	6.3.2	Y
S3, Cl8	*The Proponent shall prepare and implement a Dust Monitoring Program*	6.3.2	Y
Soil and Water – Management and monitoring			
S3, Cl10	*The Proponent shall not extract sand or other extractive materials or carry out any work in the extraction area below a level of 0.7 m above the predicted maximum groundwater elevation (see condition 14 of schedule 3), other than the construction of any bores approved by NOW*	4.4	Y
S3, Cl11	*The Proponent shall ensure that the final landform of the extraction area must be at least 1 metre above the predicted maximum groundwater elevation*	4.2	Y
S3, C13	*Erosion and sediment control plan*	5.2	Y
S3, Cl14	*The Ground Water Monitoring Program shall include* *(a) Detailed baseline data on groundwater levels and quality* *(b) Groundwater impact assessment criteria'* *(c) A program to monitor groundwater levels and quality* *(d) A protocol for the investigation, notification and mitigation of any notified exceedance of the impact assessment criteria;* *(e) The outcome of groundwater modelling to establish the predicted maximum groundwater elevation for the site*	7.1	 Y Y Y Y Y

MP 09_0091 Reference	*Summary of Condition*	*Report Reference*	*Compliance*
	(f) a program to monitor any impacts on GDE *(g) a contingency plan to manage any acid sulfate soils and potentially acid sulfate soils encountered during quarrying operations*		N/A Y
MP 09_0091 Reference	*Summary of Condition*	*Report Reference*	*Compliance*
Biodiversity			
S3, Cl15	*The Biodiversity Management Plan must* *(c) Address project site and offset areas* *(d) provide for retention of hollow bearing trees* *(e) on-going monitoring (at least 6 years) of at least 2 nest boxes for each hollow tree removed during clearing* *(f) a program to undertake targeted survey for* Uperoleia sp *(g) implement a program for any areas within offset areas requiring rehabilitation and/or revegetation* *(i) include monitoring procedures and performance indicators with reference to* Uperoleia *sp., Koala and Wallum Froglet*	6.5	Y
S3, Cl16	*By 31 December 2013, or otherwise agreed by the Director-General, the Proponent shall:* *(a) enter into a Biobanking agreement in respect of the proposed offset areas (see Appendix 4) with the Minister for the Environment, in accordance with Part 7A of the Threatened Species Conservation Act 1995, to implement the Biodiversity Offset Strategy; or* *(b) enter into an agreement with OEH to transfer the offset areas into the national parks estate, to the satisfaction of the Director-General*	N/A	Y
Rehabilitation and landscaping			
S3, Cl18	*The Proponent shall prepare and implement a Landscape Management Plan to the satisfaction of the DG. This shall include a Rehabilitation Management Plan and a Long Term Management Strategy.*	8	Y
Aboriginal Cultural Heritage			
S3, Cl22	*The Proponent shall prepare and implement an Aboriginal Cultural Heritage Management Plan to the satisfaction of the DG*	6.6.2	Y
Visual amenity			
S3, Cl27	*The Proponent shall 19inimize the visual impacts of the project to the satisfaction of the DG*	8	Y
Waste Management			
S3, Cl28-31	*The Proponent shall comply with conditions of waste management as outlined in the approval]*	6.7.1	Y
Dangerous Goods			
S3, Cl32	*The Proponent shall ensure that chemicals and/or petroleum products are not stored on site*	6.7.1	Y
Production Data			
S3, Cl34	*The Proponent shall* *(a) provide annual quarry production data to DRE using the standard form for that purpose and* *(b) include a copy of this data in the Annual Review*	4.4	Y
ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING			
Annual Review			
S5, Cl3	*Within 12 months of the commencement of quarrying operations, and annually thereafter, the Proponent shall review the environmental performance of the project to the satisfaction of the Director-General.*	This Report and 5.2	Y
Reporting			
S5, Cl 5	*The Proponent shall notify the DG … of any incident associated with the project*	11	Y
Auditing			
S5, Cl 7	*Within 1 month of completion of quarrying operations … the Proponent shall commission an Independent Environmental Audit to … assess the environmental performance of the project and whether it is complying with the relevant requirements in this approval and any relevant EPL.*	10	Y
Access to Information			

MP 09_0091 Reference	***Summary of Condition***	***Report Reference***	***Compliance***
S5, Cl 9	*From 1 July 2013, the Proponent shall make the following information publicly available on its website:* • *A copy of all approved strategies, plans and programs* • *A summary of all monitoring results of the project* • *A complaints register that is updated on a quarterly basis* • *Copies of any Annual Review* • *Copies of any Independent Environmental Audit and the Proponents response to the recommendation in any audit*	9.1	Y

6.2 Noise

6.2.1 Key Environmental Performance

The approved Noise Management Plan states that as quarrying operations have been performed for greater than 2 years and the project is currently in the rehabilitation and closure phase, noise monitoring will only be conducted upon the receipt of a verified noise complaint from a local resident. No noise complaints were received during the reporting period.

6.3 Air Quality

6.3.1 Approved Criteria

Air Quality monitoring is required to be undertaken in accordance with the following development consent conditions:

"The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed the criteria listed in Tables 2 to 4 at any privately-owned land."

Table 7: Long term criteria for particulate matter

Pollutant	Averaging Period	[d] Criterion
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 8: Short term criterion for particulate matter

Pollutant	Averaging Period	[d] Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3

Table 9: Long term criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables above:

- *[a] Total impact (i.e. incremental increase in concentrations due to the projects plus background concentrations due to all other sources);*
- *[b] Incremental impact (i.e. incremental increase in concentrations due to the projects on their own);*
- *[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient A–r - Determination of Particulate Matt–r - Deposited Matt–r - Gravimetric Method.*
- *[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General in consultation with DECCW.*

6.3.2 Management Measures

Air quality monitoring for the site is undertaken consistent with the Dust Management Plan, available as Appendix J of the Northern Dune Environmental Management Plan.

Depositional dust monitoring is undertaken at four locations, known as D3 / TB4, D4 / TB2, D5 / TB3 and D6 / TB1 (see **Figure 4**). Monitoring locations D3 / TB4 and D5 / TB3 are located adjacent to the closest sensitive receiver to extraction activities undertaken by Holcim within the Northern Dunes Extension area and represent compliance monitoring sites.

Monitoring locations D4 / TB2 and D6 / TB1 are located immediately adjacent to extraction activities where deposited dust is most likely to be related to Holcim's activities. These sites enable evaluation of compliance stations D3 / TB4 and D5 / TB3 with data from comparison stations D4 / TB2 and D6 / TB1 to infer whether the high dust levels are likely related to the Northern Dune Extension activities or may have been associated with external land use activities.

Depositional dust was monitored monthly over the AR reporting period and analysis conducted by ALS Laboratory Services (NATA accredited) for insoluble solids in accordance with *AS 3580.10–1 - 2003*.

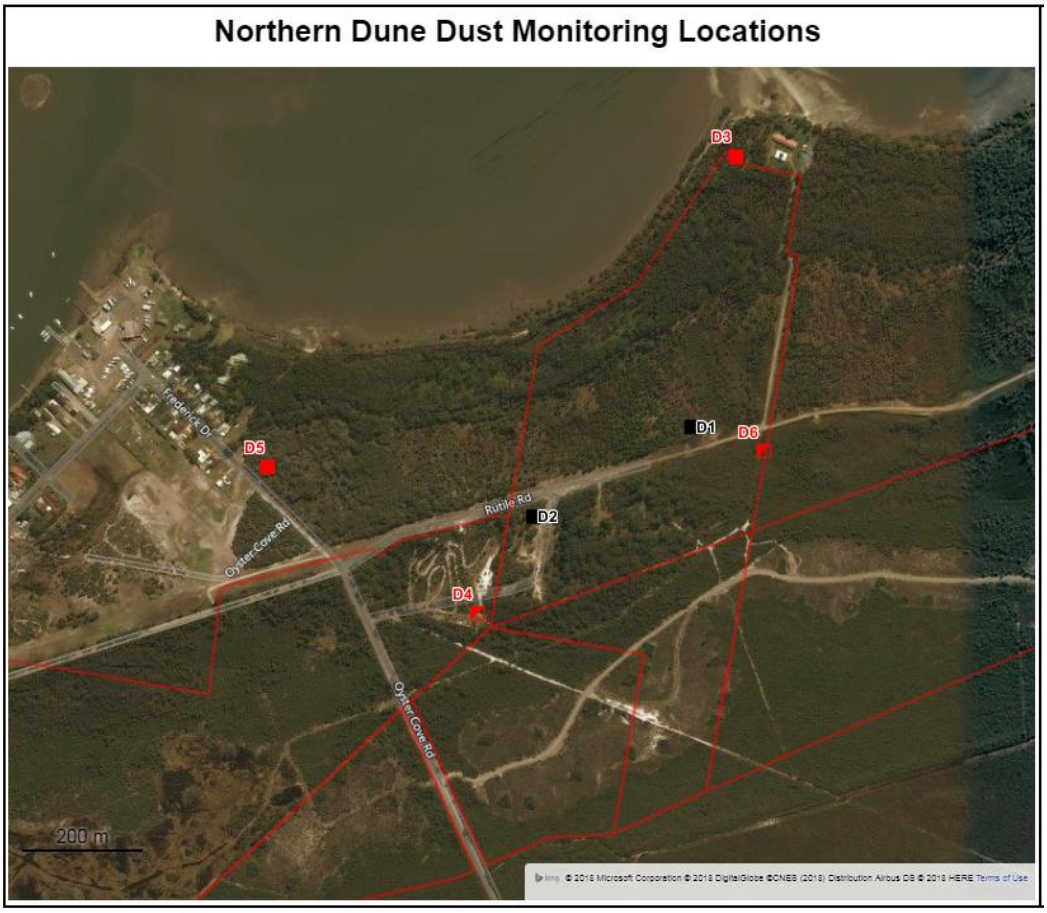


Figure 4: Dust Sampling Locations

6.3.3 Key Environmental Performance

6.3.3.1 Depositional Dust

Monitoring results for the 2021/22 reporting period are presented in Table 10 and Table 11. Results at compliance locations D3 / TB4 and D5 / TB3 have been compared against criteria in Schedule 3, Condition 6, Table 4, shown above. The criteria allows for an annual average of up to 4 g/m^2/month for insoluble solids (or Total Insoluble Matter (TIM) as reported by ALS), as a total (inclusive of the site and background dust). The criteria of 2 g/m^2/month relates to an incremental impact from the Project alone and is also assessed as a rolling annual average.

TIM is an indicator of the mineral constituent of dust as indicative of soil or rock particles and is the parameter of interest when measuring levels of deposited dust as per *Notes to Tables 2 to 4*, *Note C* referenced above. Highlighted results within the table indicate where dust trigger limits were exceeded during the reporting period.

The annual rolling average shown for D3 / TB4 and D5 / TB3 in Table 10 and Table 11 was calculated using data obtained over a rolling 12 month period in accordance with *Appendix J Dust Monitoring Program* of the approved Environmental Management Plan (EMP). The annual rolling average was then compared to the long term maximum total deposited dust level trigger level of 4 g/ m^2/month under Schedule 3, Clause 6 for analysis of ongoing compliance of Northern Dune Extension operations in relation to depositional dust levels. A standard background level of 1.5 g / m^2, drawn from the median of values from D3 / TB4, was utilised as the monthly average to generate the rolling average values for data where a 12 month back-date of data was not available.

As seen in Table 10 and Figure 5, there was one single instance where measured deposited dust exceeded 4 g/m^2/month at monitoring station D3 / TB4

- November 2021 (8.4 g/m^2). It was noted in the EPA portal at the time of receiving this result that construction work had been carried out on the private property where eD3 / TB4 is located. This construction work included ground disturbing activities. And is suspected as being the source of the elevated November 2021 result.

Review of depositional dust results at comparison sites D4 / TB2 and D6 / TB1 in the same time period found the following:

- In November 2021 comparison site D4 / TB2 had an insoluble matter level of 68.1 g/m2 while D6 / TB1 had an insoluble matter level of 0.4 g/m2.

The results at the comparison sites suggest the following:

- D4 / TB2 has most likely been tampered with. As reported on the EPA portal when the result was received, there is evidence for this through the presence of a significant amount of dirt in the bottle as opposed to finer particle dust as would be expected if it were due to Holcim activities. D4 / TB 2 is located in an area that is accessed by the public and has been susceptible to suspected tampering in the past (as reported in previous Annual Reports).
- D6 / TB 1 has recorded a level of only 10% of the allowable criteria suggesting that Holcim activities have not resulted in any significant air quality impacts.

Further evidence to support this is that given no extraction was occurring during the time of the November 2021 result, the source is highly unlikely to be related to activities on the Northern Dune Extension site. The only activities performed during the reporting period were rehabilitation activities (as discussed in Section 8.2) which generally do not have the potential to generate dust beyond the criteria.

Given that no extractive activity occurred through the reporting period it is possible that background dust levels are responsible for exceedances of the criteria. Any dust exceedances are attributed to external activities, i.e. not related to quarrying operations due to:

1. Extraction and ground disturbing activities have not occurred during the reporting period.
2. Rehabilitation monitoring shows greater ground cover in comparison to previous years (see Section 8).
3. No dust complaints have been received from nearby residents.

The annual rolling average for both D3 / TB 4 and D5 / TB3 are below the trigger threshold under Schedule 3, Clause 6 of the conditions of approval for all months within the monitoring period.

Table 10: Insoluble Matter (g/m2) Monitoring results for the D3 / TB4 Monitoring Station (April 2021 – April 2022).

Sample Period		Dust Monitor		Purpose (Comparison / Compliance)	D3 - Insol. Matter (g/m^2)	Comment	D3 - Annual Rolling Average (g/m^2)	Criteria (g/m^2)
Month	Year	TB	D					
April	2021	TB4	D3	Compliance	1.5		2.1	4.0
May	2021	TB4	D3	Compliance	1.3		2.0	4.0
June	2021	TB4	D3	Compliance	0.7		1.9	4.0
July	2021	TB4	D3	Compliance	0.2		1.7	4.0
August	2021	TB4	D3	Compliance	0.2		1.7	4.0
September	2021	TB4	D3	Compliance	1.5		1.8	4.0
October	2021	TB4	D3	Compliance	1.3		1.7	4.0
November	2021	TB4	D3	Compliance	8.4	The elevated result is not related to Holcim operations Construction work involving earthworks has been completed on the private property where the D3 monitoring point is located. D4= 68.1, D5= 3.0, D6= 0.4. D4 contains dirt as opposed to dust in bottle and exhibits signs of tampering. D4 has experienced suspected tampering throughout the monitoring program as it is accessible by the public.	2.3	4.0
December	2021	TB4	D3	Compliance	2.5		2.4	4.0
January	2022	TB4	D3	Compliance	1.8		2.4	4.0
February	2022	TB4	D3	Compliance	2.5		2.5	4.0
March	2022	TB4	D3	Compliance	0.5		2.2	4.0

Table 11: Insoluble Matter (g/m2) Monitoring results for the D5 / TB3 Monitoring Station (April 2021 – March 2022).

Sample Period		Dust Monitor		Purpose (Comparison / Compliance)	D5 - Insol. Matter (g/m^2)	Comment	D5 - Annual Rolling Average (g/m^2)	Criteria (g/m^2)
Month	Year	TB	D					
April	2021	TB 3	D5	Compliance	0.3		1.1	4.0
May	2021	TB 3	D5	Compliance	0.5		1.1	4.0
June	2021	TB 3	D5	Compliance	0.4		1.1	4.0
July	2021	TB 3	D5	Compliance	0.7		1.0	4.0
August	2021	TB 3	D5	Compliance	1		1.0	4.0
September	2021	TB 3	D5	Compliance	0.9		1.0	4.0
October	2021	TB 3	D5	Compliance	1.4		1.2	4.0
November	2021	TB 3	D5	Compliance	3		1.3	4.0
December	2021	TB 3	D5	Compliance	0.7		1.3	4.0
January	2022	TB 3	D5	Compliance	1.1		0.9	4.0
February	2022	TB 3	D5	Compliance	1.4		1.0	4.0
March	2022	TB 3	D5	Compliance	0.4		0.9	4.0

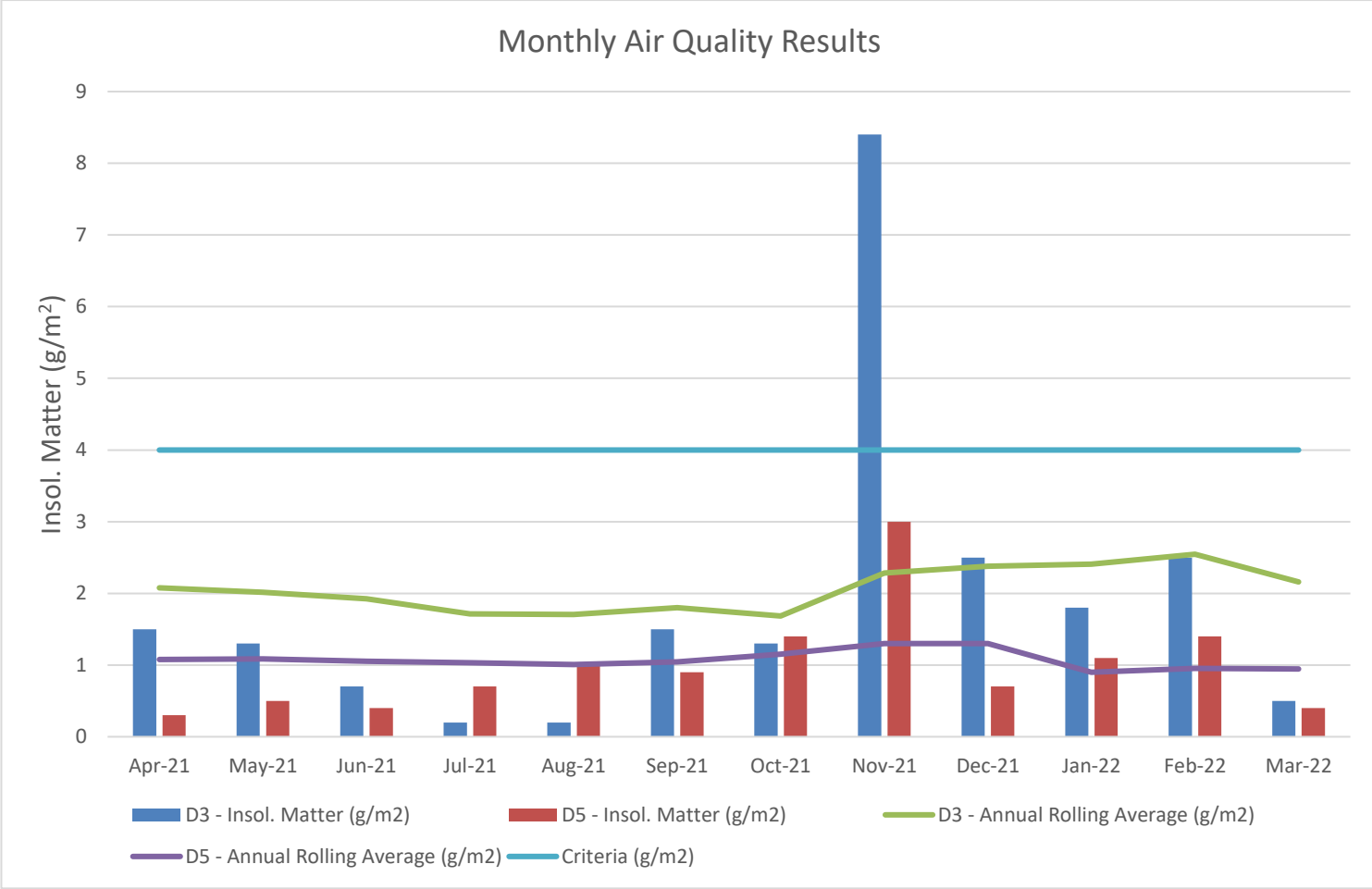


Figure 5: Insoluble Matter (g/m^2) Monitoring results for the D5 / TB3 Monitoring Station and D3 / TB4 Monitoring Station

6.3.4 Proposed Improvements

The Northern Dune Extension Dust Management Plan will be reviewed following submission of this AR and updated if necessary. Given that extractive operations are no longer occurring and the potential for air quality impacts from dust due to operations are therefore removed, the value of an ongoing dust monitoring program is limited. The results from this reporting period suggest that external sources contribute more dust to the monitoring network than the NDE site which further limits the value.

6.4 Traffic Management

6.4.1 Approved Criteria

The site is required to operate traffic and manage transport through compliance with the requirements of the conditions listed below:

TRAFFIC

Haulage Route

23. All extractive materials dispatched from the site must be delivered to Sibelco's Salt Ash Sand Processing Plant by the most direct route available.

Road Signage

24. Prior to commencing quarrying operations, the Proponent shall:
    (a) install "Trucks Crossing" and "Trucks Entering" warning signs on Nelson Bay Road on both the western and eastern approaches to the intersection of Lemon Tree Passage Road; and
    (b) pay the full cost of this installation,
    to the satisfaction of RMS.

On-Site Traffic Management

25. The Proponent shall ensure that:
    (a) all vehicles do not exceed a speed of 25 kph on the site;
    (b) all loaded vehicles entering or leaving the site have their loads covered; and
    (c) all loaded vehicles leaving the site are cleaned of sand and other materials that may fall on the road, before leaving the site.

Traffic Management Plan

26. The Proponent shall prepare and implement a Traffic Management Plan for the project, to the satisfaction of the Director-General. This plan must:
    (a) be submitted to the Director-General for approval prior to commencing quarrying operations;
    (b) include a drivers' code of conduct to minimise the impacts of project-related trucks on local residents and road users; and
    (c) describe the measures that would be put in place to ensure compliance with the drivers' code of conduct.

6.4.2 Key Environmental Performance

No extractive materials were dispatched form the site during the reporting period resulting in zero truck movements related to Northern Dune Extension. An approved Traffic Management Plan is in place, available as Appendix H of the Northern Dune EMP. No traffic related non-compliances were recorded during the reporting period.

6.5 Biodiversity

Schedule 3, Condition 15 of the Tanilba Northern Dune Extension Project Approval (MP 09_0091) required the preparation of a BMP. While the BMP requires similar management actions as the LMP, for operational and administrative simplicity, these plans apply to the site as follows:

- Management measures for the extraction area are addressed in the LMP (See Section 8).
- Management of the approved Biodiversity Offset Areas are addressed in the BMP.

Biodiversity offset areas for the project have been established in the north-east of the approved extraction area (northern biodiversity offset area) and to the south east of the extraction area off Lemon Tree Passage Road (southern biodiversity offset area).

The BMP requires the following actions to be undertaken within the offset areas:

- Implementation of a nest box installation and monitoring program within the northern offset area to replace hollow bearing tress removed from the extraction area;
- Utilisation of potential habitat features from the disturbance area (e.g. large organic debris and habitat hollows) either within the rehabilitation or northern offset area;
- Targeted fauna monitoring across all offset areas to monitor for Wallum Froglet, Koala and *Uperoleia* sp
- Establishment of a habitat restoration and rehabilitation program across all offset areas (including the visual amenity buffer along the northern boundary of the extraction area) consisting of:
    - Annual inspections to identify areas requiring weed and pest control;
    - A weed and pest management program;
    - Enhancement of the availability of habitat for the Koala through the use of *Eucalyptus robusta* (Swamp Mahogany) within the offset area;
    - Rehabilitation of the regenerating Grassland-Heath to the surrounding Swamp Mahogany – Paperbark Swamp Forest through seeding and planting of appropriate species;
- Establishment of a vegetation monitoring program (VMP) to ensure vegetation and fauna habitat qualities within the offset areas are being maintained and identify any issues requiring management.

6.5.1 Nest Box Installation and Monitoring Program

The approved BMP requires the establishment and on-going monitoring (at least 6 years) of at least two nest boxes for each tree hollow removed during clearing.

A nest box installation program was implemented on 21st December 2015 to offset the loss of 26 hollows across the whole of the approved extraction area. These were replaced at a 2:1 ratio resulting in the installation of 52 nest boxes in the Northern Offset Area within Coastal Sands Apple Blackbutt Forest and the northern section of the Swamp Mahogany – Paperbark Forest. Nest boxes were positioned in areas of vegetation that contained suitable food resources but lacked denning sites for arboreal fauna. As such, the central part of the offset area was the most appropriate site for installation. The installation of the nest boxes was supervised by suitably trained ecologists to ensure appropriate site selection.

Environmental contractor Kleinfelder was engaged by Holcim to conduct annual monitoring of the nest boxes during the reporting period on 11 August 2021, and prepared a report on the monitoring program (refer Appendix 2).

In 2021, the percentage of all nest boxes exhibiting any sign of use was 50% (26). Seventeen percent (17) of the total number of nest boxes were determined to be unavailable for use resulting from occupation by pest species such as wasps, bees or rats and missing boxes. In 2021, two boxes (4%) were observed to have animals present (A). There were three boxes showing recent evidence of use

with four boxes within the “moderately fresh” category, and the total number of boxes showing old evidence was 17 boxes, or 33%. A total of nine boxes were categorised as NA – not available due to insects as noted above, but four boxes were noted to being missing, believed stolen. This brought the total number of nest boxes available for fauna use to 43, three less than the 2021 survey.

Fauna uptake of the nest boxes was successful in the first year of installation with several species of mammals and reptiles recorded occupying boxes, and evidence of usage across many more boxes. Since that initial survey, no fauna has been recorded in the boxes in 2019 and 2020. In the recent survey in 2021 has seen an increase in usage and Fauna present within two of the nest boxes.This year’s survey was brought forward into the winter (August) to determine if the fauna were not using the nest boxes in the heat of the summer of the months. In 2021 fauna was recorded occupying two of the nest boxes, with evidence of usage increased from the last two years (scratches or nesting materials) judged to be fresh and moderately fresh, indicating some type of continuing usage.

It has previously been suggested that the relatively recent fires (late 2018) in proximity to the offsets may have acted as a deterrent to the fauna utilising the offsets, even though the offsets itself was not directly fire affected and the fauna has not yet recolonised the area. Drought conditions throughout 2019 may have also led to a reduction in food supply for fauna, with effects still being seen in the populations recorded during this survey period.

Suggestions for further action are:

• Increase the survey effort to twice per year one in the autumn/winter and one in the following spring for a single year. This would indicate whether the Offsets nest boxes are being used seasonally or whether the Offsets are no longer being used for nesting, and;

• Placing remote cameras in the offsets to determine if fauna are utilising the offsets for foraging and are simply not using the nest boxes, but utilising natural hollows in adjacent vegetation.

6.5.2 Amphibian Monitoring

Targeted fauna monitoring for the Wallum Froglet (Crinia tinnula) and Mahony’s Toadlet (Uperoleia mahonyi) was conducted as part of the requirements outlined in section 5.1.4 of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2014). The monitoring wasa conducted on October, 10 November 2021 and 19 January 2022 by two ecologists over the three nights, following periods of rainfall. A prior diurnal assessment of the offset areas was conducted to determine habitat suitability. Surveys consisted of a meandering search in the Northern Biodiversity Offsets Area (NBOA). Several areas were noted which had the potential to contain water after rainfall and later became the target of nocturnal surveys.

Nocturnal surveys for amphibian species employed visual and audible detection techniques with the aid of spotlights. Crinia tinnula was recorded within the NBOA on all survey nights at multiple locations while U. mahonyi was not identified within the NBOA during this years monitoring event. An adjacent waterbody to the east was visited to confirm the presence of U. mahonyi and C. tinnula and only C. tinnula were found to be calling.

Opportunistic sightings of non-target amphibian species were also recorded. Additional opportunistic sightings of non-amphibian species within the NBOA included the Brushtail Possum (Trichosurus vulpecula) and an unidentified species of freshwater crayfish. Results from the surveys show that one of the targeted species are utilising the NBOA for breeding and foraging habitat when the conditions are suitable. With no permanent water bodies on the NBOA, this is restricted to periods of higher rainfall. Nearby more permanent water bodies are presumed to be the core habitat for these species. Ongoing surveys after suitable rain events will determine if the species continue to utilise the NBOA.

Table 12: Amphibian presence during targeted nocturnal monitoring

Species detected	Observation type	14/10/2021	10/11/2021	19/01/2022
Crinia signifera	Heard	+	+	+
Crinia tinnula	Heard/ Observed	+	+	+
Limnodynastes peronii	Heard/ Observed	+	+	+
Litoria fallax	Heard/ Observed	+	+	-
Litoria latopalmata	Heard	-	+	-
Litoria freycineti	Heard/ Observed	-	+	+
Platyplectrum ornatum	Heard/ Observed	+	+	-
Uperoleia mahonyi	-	-	-	-

6.5.3 Koala Monitoring

Koala monitoring was undertaken using the Spot Assessment Technique (SAT) within the NBOA as described by Phillips and Callaghan (2011). The SAT test involves a radial survey of koala "activity" within the immediate area of a tree that is known or deemed to be utilised by koalas. The search beneath each tree is conducted for two person minutes or until a single pellet is found, whichever occurs first. A tree is defined as a live woody stem of any species (except for cycads, palms, tree ferns and grass trees) which has a diameter at breast height (dbh) greater than 10cm. Two ecologists conducted three SAT surveys on the 14 October 2021. A total of 15 SAT tests were to be conducted over the offset area although with the high rainfall totals the majority of the area has been inundated with water and is not possible to conduct the other 12 SAT tests. The SAT surveys that could be completed in 2021 found Koala activity in the NBOA to be the same from the 2020 data. Within the NBOA, the greater activities are found to be within the Swamp Mahogany – Paperbark Swamp Forest in the north of the offset area where there are mature trees for feeding, although evidence of use was found throughout the extent of the NBOA in previous years monitoring. The NBOA has good habitat suitability for the koala to the north of the area, although parts of this area were hard to traverse due to of thick belt of Lantana camara (Lantana) dominating the understory which has the potential to hinder Koala movement through the site. The remaining southern areas of the NBOA are still regenerating but have shown promising signs of koala use in previous years monitoring which will continue to improve as the trees mature.

Table 13 Koala activity levels from the Spot Assessment Technique.

Location	No Activity			Low Activity			Medium Activity			High Activity		
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
1				+	+	+						
2				+	+	+						
3	+	+	+									
4		+	-	+		-			-			-
5			-	+	+	-			-			-
6		+	-	+		-			-			-
7			-		+	-	+		-			-
8			-			-	+	+	-			-
9			-	+	+	-			-			-
10			-	+	+	-			-			-
11			-	+	+	-			-			-
12			-	+	+	-			-			-
13			-	+	+	-			-			-
14			-	+	+	-			-			-
15	+	+	-									

Location	No Activity			Low Activity			Medium Activity			High Activity		
				Northern Offset Area								
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
1				+	+	+						
2				+	+	+						
3	+	+	+									
4		+	-	+		-			-			-
5			-	+	+	-			-			-
6		+	-	+		-			-			-
7			-		+	-	+		-			-
8			-			-	+	+	-			-
9			-	+	+	-			-			-

10			-	+	+	-			-			-
11			-	+	+	-			-			-
12			-	+	+	-			-			-
13			-	+	+	-			-			-
14			-	+	+	-			-			-
15	+	+	-									

(- Areas not completed due to water indundation)

6.5.4 Habitat Restoration

6.5.4.1 Vegetation Condition Survey

An annual inspection of the NBOA is to be conducted as per Section 5.1.3B of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2019). This survey was conducted on 27th January 2021.As per the BMP, photo monitoring points were established, weed infestations were noted, locations of rubbish dumping were noted, survey the regeneration and health of the Eucalyptus robusta along one transect, east to west across the BOA noting the size in classes of trees 1m either side of the transect, noting the extent and requirement of any revegetation works in the BOA.

South of Rutile Rd, a small section of the NBOA abuts the extraction zone. Most of this area was affected by the 2018 fires but has recovered with increased rainfall in late 2020 and early 2021. The condition improves moving east from Coastal Sand Apple Blackbutt Forest that fringes the extraction zone and Block Q2 which is quite weed infested until good condition Swamp Mahogany – Paperbark Forest is encountered. This area has some scattered Fishpole Bamboo (Phyllostachys aurea), and Bugle Lily (Watsonia meriana). The 50m buffer zone of vegetation along Rutile Rd is quite weedy with exotic grasses, Lantana (Lantana camara) and some minor Blackberry (Rubus fruticosus spp. agg.), Glory Lilly (Gloriosa superba), W. meriana and Pinus elliottii (Slash Pine) as well as others. Regeneration of the E. robusta within this “regenerating” area was assessed by measuring the health and size of E. robusta trees within 1 m of a transect running East to West across the NBOA (Figure 6). The individual trees were divided into five height classes (<1m, 1-2m, 2-10m, 10-15m and >15m or mature trees) for determination of age. Trees <1m in height were classified as seedlings/saplings, trees 1-2m in height were classified as saplings, trees between 2 and 10m were classified as immature trees, trees 10-15m were classified as intermediate, while trees estimated to be over 15m in height were classified as mature. This year, a total of 114 trees (81 trees last survey) were assessed along the transect that was approximately 400m long. The assessment found that there were two saplings <1m, only 11 were estimated to be between 1-2m in height, with 76 trees estimated to between 2-10m, 25 trees between 10-15m tall and no trees assessed as mature. The majority of the E. robusta – 92 trees - were located in the eastern section of Swamp Mahogany – Paperbark Swamp Forest. Two areas at the western end of the NBOA are classified as regenerating grassland where the density of trees and shrubs is greatly reduced. Since the initial survey in 2013, natural regeneration has occurred, with many shrubs and some midstorey species self-seeding. The northern most section of the NBOA has been classified as mature Swamp Mahogany – Paperbark Swamp Forest. This area contains mature E. robusta and Melaleuca quinquenervia trees with an understorey of Tall Saw-sedge (Gahnia clarkei) and other swamp flora. Lantana has colonised this section of the BOA with infestation levels varying from scattered individuals to very heavy (<75% cover), with a belt of dense Lantana acting to separate this section from the southern regenerating section of the NBOA. Evidence of previous control works conducted by Kleinfelder is visible.

Where weed species have not become established the condition of the native vegetation is quite good. Native vegetation is generally in good health with no visible dieback observed amongst the canopy species on site. The regenerating grassland is slowly self-seeding with some native species such as Coastal Wattle (Acacia longifolia) and Coast Teatree, but would benefit from a modest planting program of tubestock installation of E. robusta, Red Bloodwood (Corymbia gummifera) and Smooth-barked Apple (Angophora costata). Sibelco Australia (the previous owners) had commenced

a modest weed control program, and Holcim (Australia) have continued this program. Further on-going and more intense weed control efforts will be required to improve the condition of the NBOA.

6.5.4.2 Weed Control Works

Kleinfelder was engaged by Holcim (Australia) to conduct weed control works in the NBOA during the 2021 reporting period. These works consisted of a team of two Land Management Technicians working on site for two rounds of two days each. Works were performed on the 23th and 27th November 2021 and the 14th and 17th of January 2022. The technicians were instructed to work from areas of low infestation towards higher infestation and concentrated on the southern and eastern sections of the NBOA. The November weed control effort targeted the Bugle Lily, Fishpole Bamboo and Slash Pine. The January weed control effort again applied herbicide to the lantana, slash pine, Bugle Lily and Fishpole Bamboo.

6.6 Heritage

6.6.1 Approved Criteria

"The Proponent shall prepare and implement an Aboriginal Cultural Heritage Management Plan to the satisfaction of the Director-General. This plan must:

(a) be prepared in consultation with all relevant local Aboriginal communities;

(b) be submitted to the Director-General for approval prior to commencing quarrying operations; and

(c) include:

· measures for the protection and management of site 38-4-0318 within Lot 13 DP601306;

· a program to complete prospective pre-clearance surveys of the extraction area in consultation with Aboriginal stakeholders;

· measures for ongoing consultation with local Aboriginal communities and the involvement of these communities in pre-clearance surveys and the ongoing management of any Aboriginal cultural heritage values identified within the site;

· an Aboriginal cultural education program for the induction of personnel and contractors involved in quarrying operations; and

· a description of the measures that would be implemented if any new Aboriginal objects or skeletal remains are discovered during the project."

6.6.2 Cultural Heritage Management Plan

An Aboriginal Cultural Heritage Management Plan (CHMP) has been prepared in consultation with the three Registered Aboriginal Parties (RAPs) within the local area:

- Worimi Local Aboriginal Land Council;
- Mur-Roo-Ma Incorporated, and;
- Nur-Run-Gee Pty Ltd

The CHMP contains plans of actions for pre-clearance surveys and unexpected finds such as new Aboriginal objects or skeletal remains during extraction as well as an ongoing plan to manage Aboriginal Cultural Heritage. With respect to actions under the CHMP during the reporting period:

- No clearing or extraction occurred as the project is in the rehabilitation phase;
- Site 38-4-0318 is located in the northern part of Lot 13 outside the extraction area. There was no disturbance of this area during the reporting period.

6.6.3 Key Environmental Performance

No clearing or extraction occurred during the reporting period. There were no issues relating to Aboriginal and Cultural Heritage in the reporting period.

6.6.4 Proposed Improvements

The CHMP will be reviewed and if necessary updated in the next reporting period.

6.7 Waste Minimisation

6.7.1 Management Measures

The following management measures are in place at Northern Dune Extension:

- No burning of waste;
- Any noxious plant species will be removed from the site, bagged and disposed of at a licensed landfill;
- Any waste will be removed daily and recycled or disposed of directly at a licensed landfill; and
- The site will be maintained and kept free of rubbish and cleaned up at the end of each working day.

6.7.2 Key Environmental Performance

No bins or other waste management facilities are kept on site - any waste produced is removed at the end of each working day.

6.7.3 Proposed Improvements

There are no proposed improvements to waste management during the Annual Review period.

7 WATER MANAGEMENT

This section addresses compliance with the approved GMP required by Schedule 3, Clause 14 of Project Approval MP 09_0091, and EPL 11633.

No environmental incidents or implementations of the Emergency Response Plan (ERP) in relation to groundwater occurred.

As described in the approved GMP there are no Groundwater Dependent Ecosystems (GDE) identified within the Northern Dune Extension area, therefore no impacts are able to be assessed. A study by SKM in 2012 for the NOW on NSW Coastal GDE's did not identify a GDE at the Northern Dune Extension area site, and a site is not listed in the National Atlas of GDE's.

7.1 Groundwater Management Measures

Groundwater Management issues are currently managed by the regulatory approved Groundwater Management Plan 2020 (GMP). The GMP has been developed to ensure compliance with the conditions of consent and licensing requirements stipulated by the relevant regulatory authorities, during development and operation at Northern Dune. The GMP provides a formal framework for ongoing monitoring of groundwater at the site to manage the potential impact of sand extraction on groundwater level and quality. The GMP stipulates that:

- No excavation is to be carried out to a depth greater than 0.7m above the maximum predicted elevation of the water table;
- The land surface is to be restored, following mining, to a level at least 1m above the maximum predicted elevation of the water table; and
- If concentrations of any analyte are found to exceed the provisional trigger levels given in the GMP, that monitoring point will be re-sampled within fourteen days, with investigatory monitoring implemented should re-sampling also be in exceedance of the trigger values.
- The relevant Regulatory Authorities will be contacted if any recorded water level exceeds the benchmark maximum predicted groundwater levels.

The GMP states that the GMP will be reviewed at the completion of sand extraction in a zone and/or prior to commencement of operations in each new zone (the Northern Dune Extension is effectively a single zone). If this review indicates a need to change programs or procedures, then a submission outlining the proposed changes and the need for them will be made to DPE and HWC. Extraction ceased in 2018 and no extraction occurred during the reporting period.

A revised GMP (2021) was submitted in October 2021 due to the cessation of extraction and progression of the project into a rehabilitation activity.

During the reporting period, the 2021 updated plan was not yet approved or therefore being implemented. This resulted in the groundwater quality monitoring locations and frequencies listed in Table 14 remaining for the reporting period. The locations of these bores are shown in Figure 6.

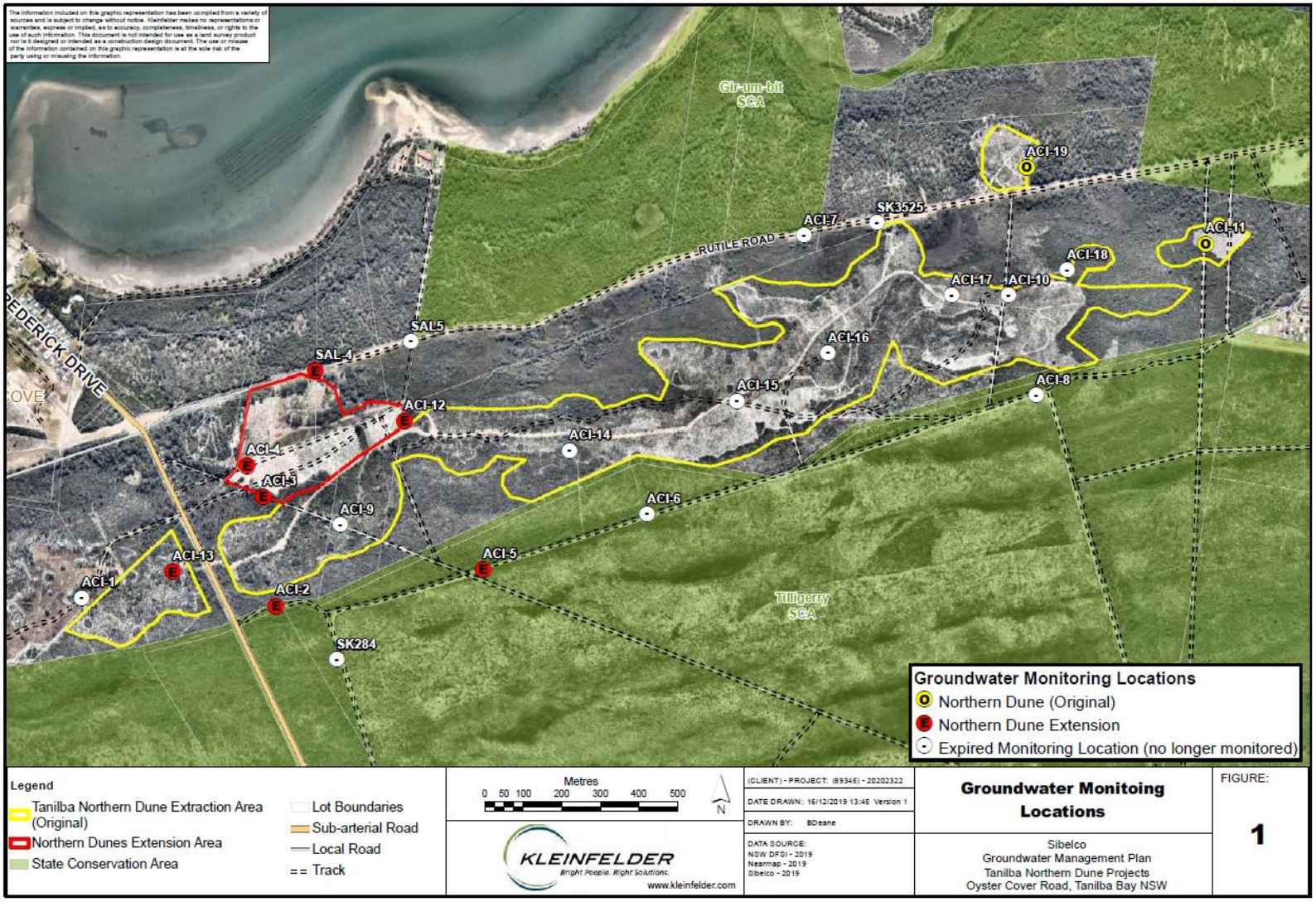


Figure 6: Location of the Tanilba Northern Dune Projects and Associated Current Monitoring Locations

Table 14 Current Groundwater Quality Monitoring Locations

Project	Agency / Approval Jurisdiction	Monitoring Location Name	Easting	Northing	End of Mining Activity	Groundwater quality Monitoring Frequency	Groundwater Level Monitoring Frequency
Northern Dune Extension	DPE / HWC / EPA	ACI-2	402538	6376802	Ceased Jan 2006 (monitoring required until EPL surrendered / varied)	6 Monthly	Monthly
	DPE / HWC / EPA	ACI-5	403076	6376897	Outside of extraction zone (monitoring required until EPL surrendered / varied)	6 Monthly	Monthly
	DPE / HWC / EPA	ACI-13	402270	6376891	Ceased Jun 2005 (monitoring required until EPL surrendered / varied)	6 Monthly	Monthly
	DPE / HWC / EPA	SAL-4	402641	6377413	Outside of extraction zone (monitoring required until EPL surrendered / varied)	6 Monthly	Monthly
	DPE / HWC	ACI-3	402505	6377085	July 2018	Annually	Monthly
	DPE / HWC	ACI-4	402463	6377166	July 2018	Annually	Monthly
	DPE / HWC	ACI-12	402872	6377282	July 2018	Annually	Monthly

The results of the requirements of the current GMP, as per Table 14 are reported in this AR, as is now required by the the current GMP (noting that separate biannual reporting is no longer required since the 2020 revision of the GMP).

Groundwater quality is tested for the parameters required by EPL 11633, as presented in Table 15.

Table 15: EPL 11633 Groundwater Monitoring Requirements

POINT 2,5,13,14

Pollutant	Units of measure	Frequency	Sampling Method
Arsenic	milligrams per litre	Every 6 months	Grab sample
Conductivity	microsiemens per centimetre	Every 6 months	Grab sample
Iron	milligrams per litre	Every 6 months	Grab sample
Manganese	milligrams per litre	Every 6 months	Grab sample
pH	pH	Every 6 months	Grab sample
Standing Water Level	metres	Monthly	In situ
Total petroleum hydrocarbons	milligrams per litre	Every 6 months	Grab sample

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
2	Groundwater quality monitoring		Groundwater monitoring bore ACI-2 located to the South of Extraction Zone 1 near DLWC in "Northern Dune Water Bore Locations" figure accompanying additional information supplied to EPA on 6 May 2002.
5	Groundwater quality monitoring		Groundwater monitoring bore ACI-5 located at the South of Extraction Zone 2 & outside lease boundary in "Northern Dune Water Bore Locations" in additional information supplied to EPA on 6 May 2002.
13	Groundwater quality monitoring		Groundwater monitoring bore ACI-13 located within Extraction Zone 1 in "Northern Dune Water Bore Locations" figure in additional information supplied to EPA on 6 May 2002.
14	Groundwater quality monitoring		Groundwater monitoring bore SAL4 as identified on Figure 6.2 of report titled 'Tanilba Northern Dune Sand Extraction Extension - Environmental Assessment' dated August 2012.

7.1.1 Groundwater Levels

Wider groundwater monitoring was initiated at Northern Dune in 2002, prior to the commencement of sand extraction in 2003. Baseline groundwater level and quality monitoring is undertaken within a planned zone prior to commencing sand extraction. Baseline groundwater level monitoring is used to create a Predicted Maximum Groundwater Elevation (PMGE) which is then used for determining depth of extraction and final landform.

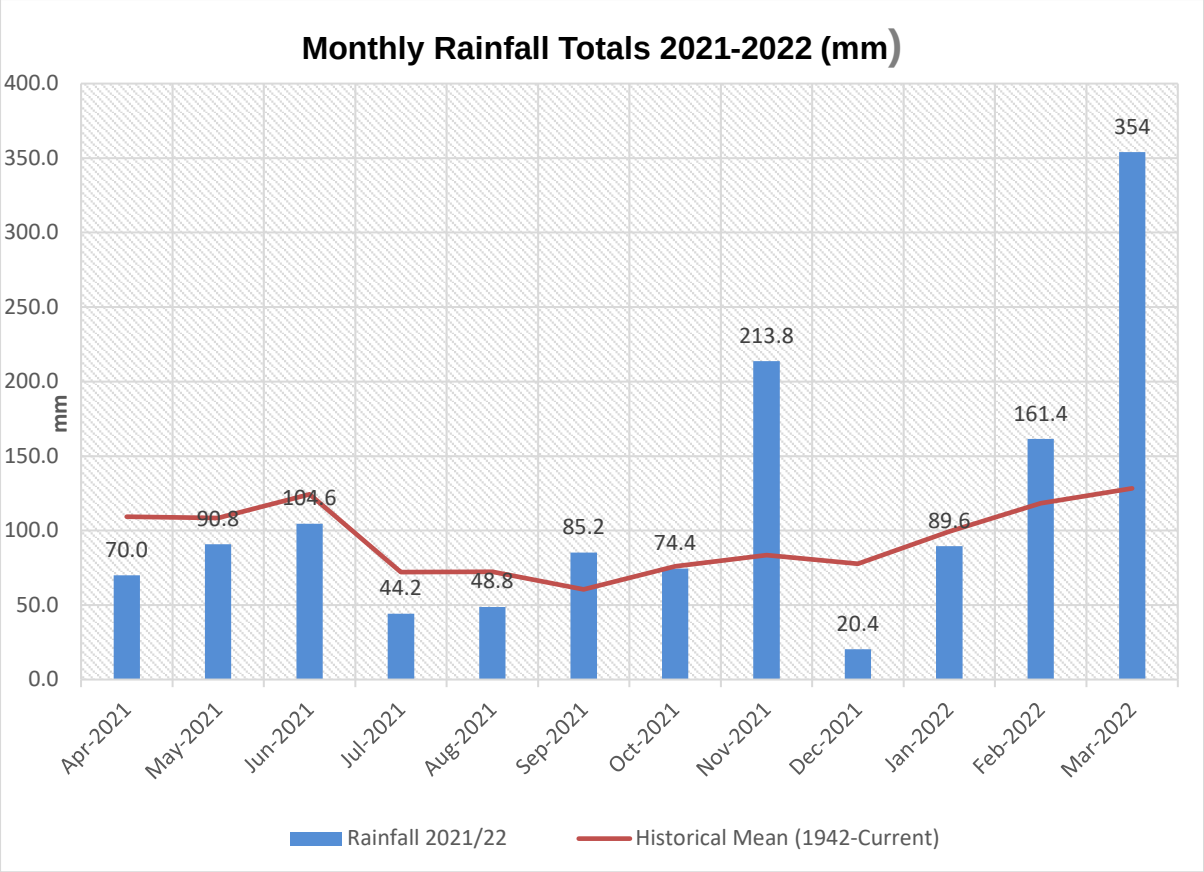


Figure 7: 2020/21 Monthly Rainfall at Williamtown RAAF

Historically, groundwater level data is collected monthly across the entire wider monitoring network with reporting against the piezometers used to analyse Predicted Maximum Groundwater Extent (PMGE) surfaces for the extraction zones.

For the Northern Dune Extension area, the required monitoring locations were reduced in March 2020 to those that are considered most relevant to groundwater level observation as detailed in Table 14. This was done via regulatory approval of a revised GMP as discussed above.

Other locations within the wider monitoring network are considered to be more applicable to the wider Northern Dune area, and of less significance to the specific Northern Dune Extension area (this report). The results for all locations are provided in tabulated form for this reporting period in

Table 16, with those relevant to the Northern Dune Extension area shaded grey.

The hydrographs in Appendix 6 demonstrate the groundwater trends throughout the life of the project, and Table 8 presents the monthly results for the current reporting period which demonstrate that all locations were monitored monthly (or weekly) during the current reporting period as per the requirements.

Annual rain monitoring data recorded at Williamtown throughout the reporting period has been included in Figure 7 for reference. During the reporting period, the highest recorded rainfall was in March 2022 with 354 mm being recorded. This was a very significant rain event that resulted in more than three times the monthly average rainfall. During this event, the majority of this rain fell heavily and consistently for 4 consecutive days. There were further significant rainfall events in September 2021 (85.2 mm),November 2021 (213.8 mm) and February 2022 (161.4 mm). December 2021 saw the lowest rainfall, with 20.4 mm falling throughout the month. The rainfall received is likely to influence the groundwater levels which respond to rainfall.

When rainfall levels exceeded more than 100 mm in a seven-day period, bores are monitored weekly for a total of four weeks. This occurred three times during the reporting period in June 2021, November 2021 and March 2022, and subsequent weekly monitoring was performed, the results of which are presented in Table 16. It should be noted that weekly monitoring carried over from the previous reporting period was performed in April 2021.

Groundwater level monitoring results (Table 16) demonstrate that there have been no exceedances of the Predicted Maximum Groundwater Extent (PMGE) during the reporting period except for during the exceptional rain events described. . Rainfall such as this was experienced to in the previously reporting period and is attributed to the La Nina weather phenomenon that has been experienced throughout the summers of 2021 and 2022 resulting in significantly increased rainfall events as demonstrated in Figure 7 which resulted in exceedances of the PMGE at ACI-4.

Table 16: Groundwater Levels at Northern Dune Extension Monitoring Locations

Date	ACI-2	ACI-3	ACI-4	ACI-5	ACI-12	ACI-13	SAL4
7/4/2021 100mm Rain	8.33	9.22	9.40	8.09	8.76	8.83	8.32
15/4/2021	8.31	9.21	9.66	7.98	8.59	8.62	8.26
17/5/2021	8.26	8.89	8.95	7.92	8.39	8.57	8.12
16/6/2021	8.23	8.66	9.71	7.78	8.21	8.43	8.01
23/6/2021 100mm Rain	8.23	8.64	9.70	7.78	8.19	8.42	8.00
2/7/2021 100mm Rain	8.39	8.78	9.17	8.13	8.61	8.84	8.25
9/7/2021 100mm Rain	8.32	8.98	9.03	8.11	8.53	8.73	8.18
16/7/2021 100mm Rain	8.40	9.15	9.21	8.13	8.68	8.90	8.28
16/8/2021	8.04	8.72	8.75	7.73	8.29	8.49	8.02
15/9/2021	8.29	8.81	8.84	8.09	8.30	8.71	8.25
18/10/2021	8.13	8.62	9.34	7.78	8.22	8.43	8.16
16/11/2021 100mm Rain	8.12	8.60	8.62	7.77	8.19	8.38	7.97
23/11/2021 100mm Rain	8.26	8.88	8.98	7.85	8.44	8.64	8.13
30/11/2021 100mm Rain	8.19	8.74	8.78	7.81	8.32	8.51	8.05
07/12/2021 100mm Rain	8.08	8.60	8.67	7.80	8.26	8.44	8.00
15/12/2021	8.00	8.52	8.57	7.74	8.18	8.37	7.95
19/1/2022	7.95	8.37	8.17	7.69	7.94	8.09	7.89
18//2022	7.66	8.15	8.22	7.42	7.88	8.00	7.76
9/3/2022	8.18	8.57	8.67	8.01	8.26	8.46	8.04
16/3/2022 100mm Rain	8.10	8.58	8.64	7.85	8.24	8.44	7.99

23/3/2022 100mm Rain	8.13	8.63	8.69	7.91	8.28	8.67	8.09
30/3/2022 100mm Rain	8.44	8.91	9.63	8.13	9.05	9.11	8.49
PMGE	**8.44**	**9.47**	**9.31**	**8.16**	**9.28**	**9.20**	**8.65**

In accordance with the GMP, the results of groundwater level monitoring are analysed to determine whether they are anomalous and whether further sampling is required. If further sampling confirms anomalous results, then notification to the regulators is required.

The groundwater elevations above the PMGE at ACI-4 correspond to the extraordinary rainfall events and as such are not considered to be anomalous. Other than the exceedances related to the extraordinary events, during the reporting period there were no groundwater level elevations recorded to be above the PMGE or any other anomalous results at any of the monitoring points, as demonstrated by Table 16.

7.1.1.1 Groundwater Level Results Discussion and Trend Summary

During previous reporting periods, it was noted that the trend observed in groundwater levels is that they fluctuate naturally in response to rainfall. During this reporting period Table 16 demonstrates the same trend is observed; groundwater levels rise as there is increased monthly rainfall and fall during periods of reduced rainfall. This trend is highlighted by the elevated levels following the significant rain events described.. The annual trends over previous reporting periods show that following rain significant rain events, groundwater levels return to the expected fluctuating trend over time and this is demonstrated following the events.

The ongoing fluctuating trend over the life of the project is shown in the hydrographs provided in Appendix 3. As the groundwater in the area is rain fed, and this reporting period has seen an overall increased trend in the rainfall received annually, groundwater levels have shown a slight trend of increasing across the monitoring network when compared to previous years.

No significant change to the trends demonstrated in groundwater levels over the life of the project have been observed within this reporting period.

7.1.2 Groundwater Quality

In addition to the requirements of EPL11633, Trigger Values were established for a number of initial monitoring bores. Baseline groundwater quality samples were collected prior to extraction to create trigger values for comparison against sample concentrations during extraction operations and post-extraction operations to assist in detecting any changes in groundwater quality at the site.

The trigger values are then tested against at predetermined increments. Groundwater quality testing is undertaken as per Table 14 and reported to the relevant regulators.

Groundwater quality is sampled and tested by an external third party with results sent to Holcim.

The groundwater quality monitoring results presented in Table 17 show that all results were within normal limits with the exception of:

- ACI-2 which displayed an exceedance of the trigger value for Iron and Manganese in the March 2022 monitoring event. This coincided with rainfall events resulting in three times the average for the month of March, likely resulting in mobilization of Iron and Manganese from the coffee rock horizon.
- ACI-13 which displayed an exceedance of the trigger value for Manganese in the March 2022 monitoring event. Again, this coincided with rainfall events resulting in three times the average for the month of March, likely resulting in mobilization of Manganese from the coffee rock horizon.

Previous reports submitted to DPE and HWC stated that Iron results are on a rising trend and have exceeded the assigned triggers (3.058mg/L dissolved Fe and 3.62mg/L Total Fe) in the September/October monitoring events at ACI-2 since September 2017 and that results have been below trigger values during the March/April monitoring events. Unfortunately no sample was collected in the September event at ACI-2 as it was inaccessible due to the prevailing weather conditions (the same case for ACI-5 at that time). The March 2022 result reverse the trend of being below the trigger value in the March event and this is likely due to the extraordinary rainfall conditions experienced throughout the summer period under a second consecutive La Nina weather system.

Figure 9 demonstrates how Manganese results are also on a rising trend and have exceeded the assigned triggers in the September / October monitoring events at ACI-2 since September 2017. Results have been below trigger values during the March/April monitoring events until the previous reporting period. The March 2022 results exhibit similar trend to the previous reporting period, which again is likely due to the extraordinary rainfall conditions experienced throughout the summer period under a second consecutive La Nina weather system, with March 2022 in particular being a significantly above average month for rainfall.

ACI-13 also returned an exceedance of the trigger value for dissolved iron in March 2022. As per the trend demonstrated by ACI-2, ACI-13 fluctuates above and below the trigger value between the winter and summer monitoring events, with exceedances traditionally returned in winter under increased rainfall and below trigger results returned in summer under drier conditions. However, once again this exceedance in March 2022 is likely due to the extraordinary rainfall conditions experienced throughout the summer period under a second consecutive La Nina weather system, with March 2022 in particular being a significantly above average month for rainfall. This would have resulted in mobilization of iron from the coffee rock horizon.

.

Table 17: Comparison of Groundwater quality results against trigger values for the 2021/22 reporting period.

	Date	Bore	pH	EC µS/cm	Iron mg/L		Arsenic mg/L		Manganese mg/L		TPH mg/L			
					Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*C6- C9*	*C10- C14*	*C15- C28*	*C29- C40*
Trigger Value		**ACI-2**	N/A	N/A	3.058	3.623	0.001	0.01	0.015	0.014	0.02 (LOR)	0.05 (LOR)	1 (LOR)	1 (LOR)
Results	23/09/2021		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Results	*18/03/2022*		5.01	86	**3.30**	3.61	x	x	**0.016**	**0.016**	<LOR	<LOR	<LOR	<LOR
Trigger Value		**ACI-3**	x	x	x	x	x	x	x	x	x	x	x	x
Results	23/09/2021		5.01	167	1.90	1.98	<0.001	<0.001	0.008	0.010	<LOR	<LOR	<LOR	<LOR
Trigger Value		**ACI-4**	x	x	x	x	x	x	x	x	x	x	x	x
Results	23/09/2021		4.76	105	0.19	0.26	<0.001	<0.001	0.001	0.001	<LOR	<LOR	<LOR	<LOR
Trigger Value		**ACI-5**	N/A	N/A	2.048	3.286	0.001	0.015	0.014	0.036	0.02	0.05	1	1
Results	23/09/2021		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Results	*18/03/2022*		4.84	129	0.43	0.043	<0.001	<0.001	0.002	0.001	<LOR	<LOR	<LOR	<LOR
Trigger Value		**ACI-12**	N/A	N/A	0.493	0.935	0.001	0.001	0.006	0.006	0.02	0.05	1	1
Results	23/09/2021		5.18	59	0.16	0.43	<0.001	<0.001	0.005	0.011	<LOR	<LOR	<LOR	<LOR
Trigger Value		**ACI-13**	N/A	N/A	1.547	6.428	0.001	0.012	0.061	0.056	0.02	0.05	1	1
Results	23/09/2021		5.94	69	1.05	1.86	<0.001	<0.001	0.017	0.018	<LOR	<LOR	<LOR	<LOR
Results	*18/03/2022*		5.87	75	**2.62**	3.59	<0.001	<0.001	0.037	0.037	<LOR	<LOR	<LOR	<LOR
Trigger Value		**SAL-4**	4.44 - 6.6	213	3.21	3.64	0.001	0.002	0.093	0.116	0.02	0.05	1	1
Results	23/09/2021		4.74	125	0.21	0.34	<0.001	<0.001	0.025	0.032	<LOR	<LOR	<LOR	<LOR
Results	*18/03/2022*		4.84	118	0.79	1.67	<0.001	<0.001	0.025	0.038	<LOR	<LOR	<LOR	<LOR

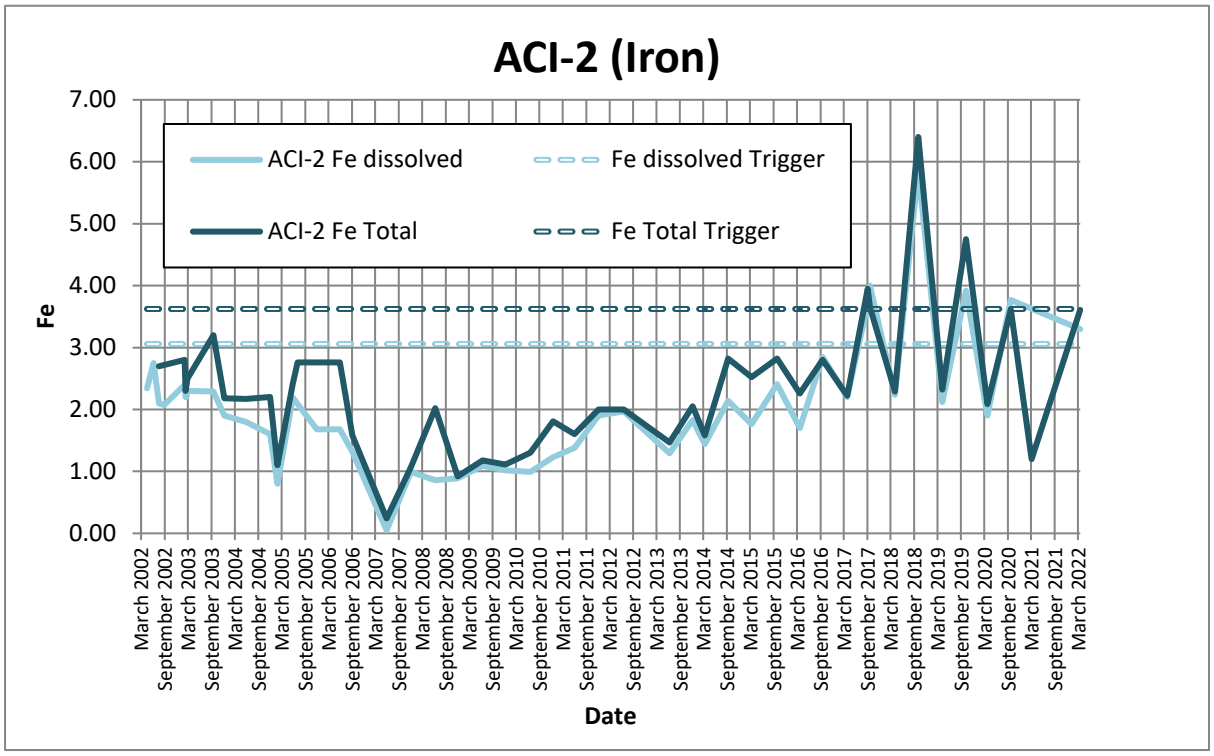


Figure 8: ACI-2 Iron Results Trend History

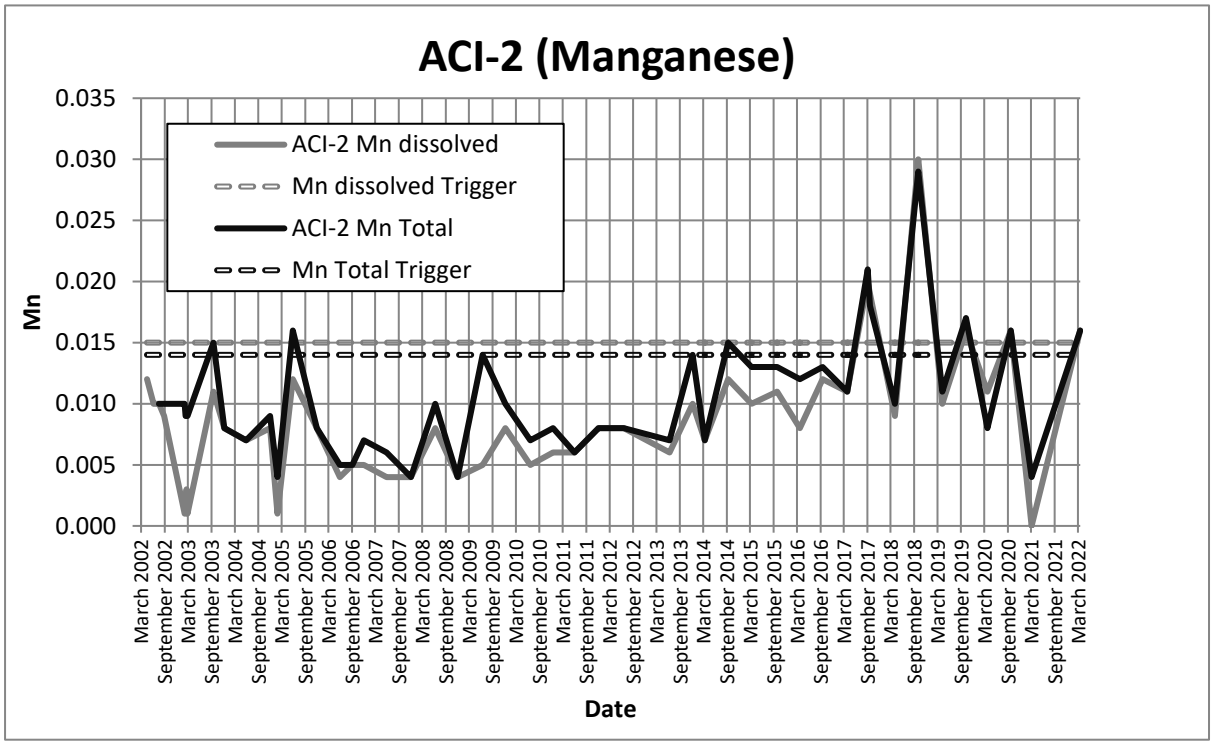


Figure 9: ACI-2 Manganese Results Trend History

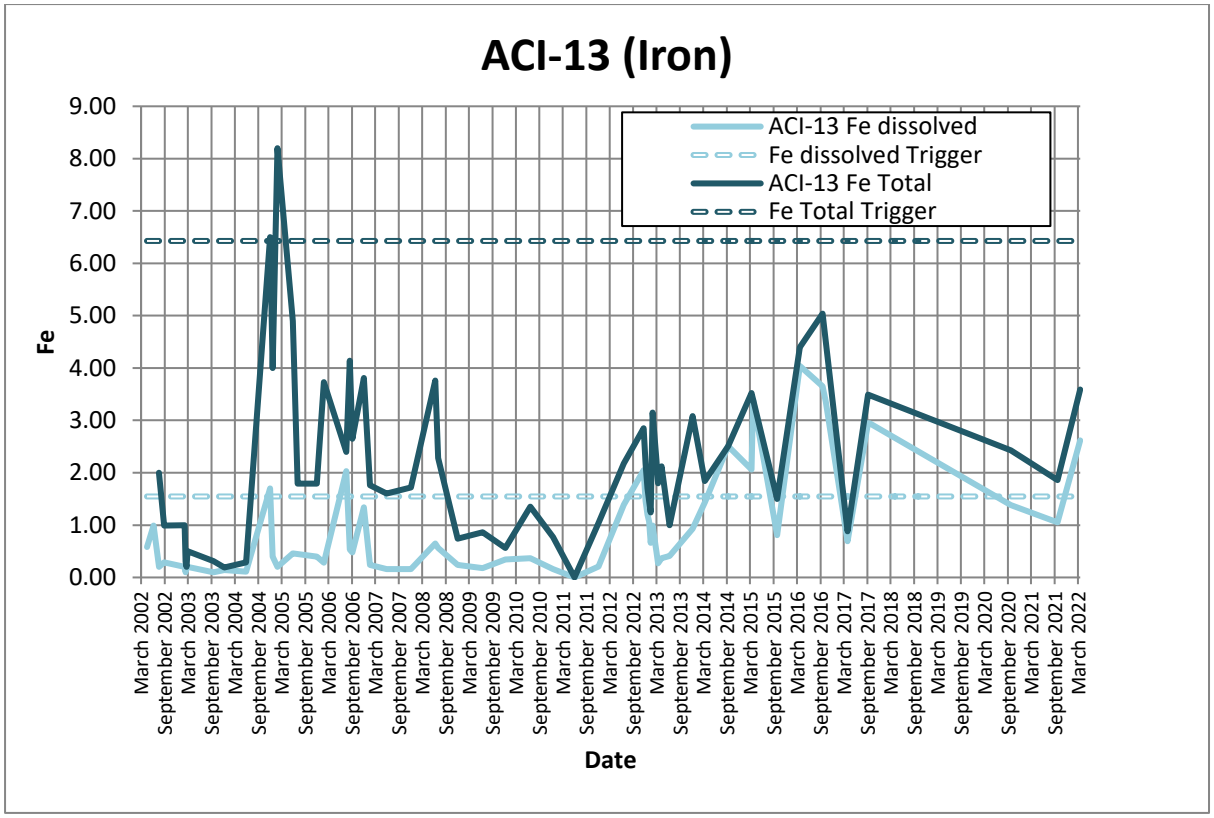


Figure 10: ACI-13 Iron Results Trend History

Groundwater quality at Northern Dune is driven by the nature of rainfall and properties of the unsaturated zone. Rainfall entering the soil zone undergoes significant changes in chemical composition and pH by processes such as root respiration and decomposition of organic matter via chemical reactions such as sorption and redox. The chemical constituency of infiltrating water in turn modifies groundwater chemistry by processes such as leaching, dilution but not concentration (which is protected against by licence conditions limiting depth to groundwater) as well as dissolution/precipitation. The effect of multiple processes on groundwater quality parameters and therefore setting Trigger Values is that water quality data is often multiple-modal (non-normal distribution) and so simple statistical analysis using mean and standard deviation may not adequately represent processes leading to water quality change. Water quality is dependent upon the nature of rainfall (ie. timing, intensity, duration...etc.) which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals. Water quality can improve or deteriorate with rainfall and therefore timing of a small, limited sample set strongly influences the calculated trigger value.

The ACI-2 and ACI-13 monitoring locations have exhibited similar seasonal exceedances for Iron in previous reporting periods as detailed in reports previously provided. ACI-2 has historically been used to monitor potential impacts from the Northern Dune project area, not the Northern Dune extension area. These exceedances are not related to the extension area and, consequently, have not been reported to the DPE under Project Approval MP09_0091.

It is noted that extraction activities within proximity to ACI-2 ceased in 2006, and ACI-13 in 2005 and therefore the elevated iron and manganese levels observed are unlikely to be the result of extraction activities within the NDE area.

7.1.2.1 Groundwater Quality Results Discussion and Trend Summary

Observations of groundwater quality trends over time show concentrations have fluctuated throughout

the life of the project. This trend has been demonstrated by the results provided in previous annual reports provided as per the approval requirements, along with previously required bi-annual groundwater monitoring reports. This observation was also made based upon analysis of data collected during operations across the wider Tanilba Northern Dune site and presented in the trend predictions of the Environmental Assessment (EA) for the Northern Dune Extension Area.

The fluctuating trend previously identified has been continued in the current reporting period as demonstrated by the data presented in the hydrographs (Quality vs. trigger values) which demonstrate this trend over the life of the project in Appendix 8, and in the tabulated results for the current reporting period provided in Table 17.

The EA for the Northern Dunes Extension project discussed possible causes and influences of the trends observed in metal concentrations (based upon observations of the wider Northern Dune area) and predicted that:

- Peak total iron concentration seems to be attributed to the re-establishment of topsoil and regeneration which occurs after mining has ceased.
- The fluctuation of the water table (in response to rainfall) may cause enhanced mobilisation of iron from the coffee rock horizon, giving rise to potentially increased concentrations of iron.
- Localised variability of metal concentrations has been seen throughout monitoring of the wider northern dune area and appears to be impacted from well construction through localised coffee rock deposits.

Groundwater quality trends have continued as expected during the reporting period. In line with earlier predictions of the EA, measured metal concentrations are consistent with data collected across the wider Tomago Sandbeds and have generally not exceeded the natural variation within metal concentrations recorded in the wider Tomago region. This is due to operations occurring above the deep grey sands and the groundwater table (by maintaining an exclusion zone from the PMGE), which are known to liberate metals in significant quantities if disturbed. The results presented in this report do not suggest any significant disturbance during the reporting period.

8 REHABILITATION AND LANDSCAPE MANAGEMENT

Rehabilitation objectives and targets for the Tanilba Northern Dune Extension Project are described in the LMP prepared to satisfy Schedule 3, Condition 17 of the Tanilba Northern Dune Extension Project Approval (MP 09_0091). The LMP describes management measures for the extraction (disturbed) area and, in accordance with the Project Approval, includes a Rehabilitation Management Plan (RMP) and Long-Term Management Strategy.

8.1 Rehabilitation Management

Rehabilitation at the Tanilba Northern Dunes Extension area is undertaken in conjunction with works in areas mined as part of the approvals for the wider Tanilba Northern Dune. For rehabilitation purposes, works across both approval areas have been subdivided into several blocks: The extraction area within Tanilba Northern Dunes Extension is known as Block Q.

Inspection of revegetated areas forms part of monthly site inspections to identify issues requiring management. The outcomes and observations of inspection are incorporated into the future works program together with any items or recommendations resulting from the annual performance monitoring program (refer Appendix 5).

Works undertaken within the Tanilba Northern Dunes Extension during the reporting period include:

- Supplementary planting of assorted native species undertaken over several planting events
- Weed management inspections to identify areas requiring control by spraying.

The revegetation (planting) program at the Extension site was completed during the current reporting period. Sibelco previously implemented a regime of weed control across the whole of the Tanilba Northern Dunes mining area which is ongoing and Holcim maintains a continued commitment to ongoing and progressive rehabilitation. Site wide weed management of the Extension will continue to be undertaken following the completion of planting.

8.2 Rehabilitation Monitoring

During the reporting period, monitoring of the progress of rehabilitation at the Tanilba Northern Dune Extension Project area was undertaken by Kleinfelder in July 2020 and January 2021.

The objective of the LMP is to progressively re-establish original vegetation community types, after extraction and landform rehabilitation has been completed, to as close as possible to that of the original vegetation. This recognises that the final landform will be lower in elevation than the original topography, and Section 4.5 of the LMP therefore describes performance measures to assess the success of the rehabilitation. This section addresses compliance to the following parts of the approved LMP:

- 4.5.1 Baseline Data – sets target figures for vegetation structure and content.
- 4.5.2 Performance Indicators – provides performance indicators for each stage of the rehabilitation program.

Section 4.5.3 of the LMP provides completion criteria to be applied to each rehabilitation block at the end of the monitoring program (8 years) to determine eligibility of operational areas for release from further rehabilitation or monitoring. Rehabilitation of the Northern Dunes Extension area commenced in 2016: Section 4.5.3 is therefore not discussed in the current report.

The Tanilba Northern Dunes Extension area has been subdivided into several blocks (known as Q1 to Q6 shown in Figure 11) for ease of data collection. Rehabilitation blocks are prepared and biannually surveyed after 6 months of growth for a period of 3 years. Details of each block surveyed for the 2021/22 Annual Report are provided below**.**

Table 18: Block preparation and survey details for the North Dunes Extension Rehabilitation Blocks

Block	Prepared	First Biannual Survey Conducted	Last Biannual Survey Conducted
Q1	December 2016 - July 2017	January 2018	July 2020
Q2	July 2018	January 2019	July 2021
Q3	July 2018	January 2019	July 2021
Q4	July 2018	January 2019	July 2021
Q5	July 2018	January 2019	July 2021
Q6	July 2019	January 2020	Jan 2022

The monitoring plan has been designed in accordance with principles of the EMP and will facilitate the stated aim of the EMP (Section 7.1) to re-establish stable and sustainable native vegetation cover in-line with the original vegetation community types pre-extraction, including similar structural components and species composition at similar elevations.

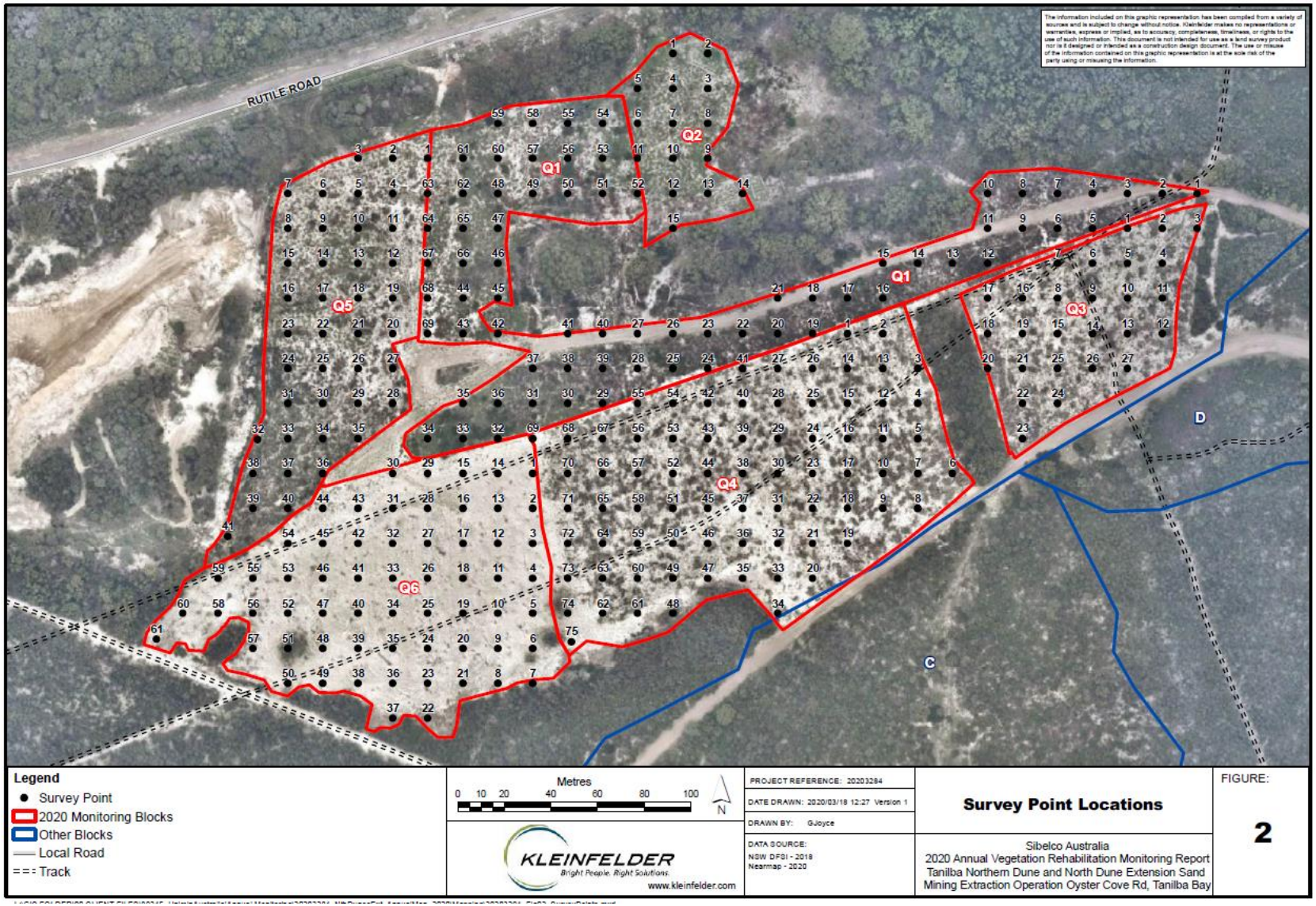


Figure 11: Locations of Blocks Q1 to Q6

A total of 227 plots were surveyed for the purpose of the current annual report consisting of:

- 69 plots on Block Q1,
- 15 plots on Block Q2,
- 27 plots of Block Q3,
- 75 plots on Block Q4,
- 41 plots of Block Q5, and,
- 62 plots of Block Q6.

Each of the blocks has been established at different time intervals as per **Table 18**. Results for each of the blocks is therefore presented in summary separately below.

The full rehabilitation monitoring report is provided in Appendix 7 and includes survey results against rehabilitation and species composition targets established in the LMP. A summary of the results follows.

The Extension has been subdivided into several smaller blocks for ease of data collection. This report provides details for the monitoring of the revegetation of Blocks Q1, Q2, Q3, Q4, Q5 and Q6 for the Northern Dunes Extension. Rehabilitation blocks are prepared and biannually surveyed after 6 months of growth, for a period of 3 years. Biannual monitoring was completed on Block Q1 in July 2020 and the first of the Post 3 Year Monitoring events was completed in October 2021 and is included in this report. As mentioned above, as per Section 4.3.4 the LMP modification increased the frequency of Post 3-year monitoring. Previously Post 3-Year monitoring occurred at two intervals, a 4-5 year event and again at 8 years. In line with the modification, Post 3-Year monitoring is now to occur annually.

The Biannual Monitoring was conducted later than usual, with Blocks Q2 – Q6 monitored from the 15th to the 20st of October 2021, Block Q1 4 Year Monitoring was conducted on the 20th and 21st of October 2021 and Block Q6 monitored again on the 7th and 8th of February 2022.

Monitoring methodology for this survey and report are as for previous surveys on the NDE and other areas of the Oysters Cove Sand Extraction Projects. That is for Blocks Q2 – Q6, 45 2mx 2m plots per hectare were surveyed. Block Q1 4 Year monitoring had two 20m x 20m quadrats established and was surveyed as per the standard Post 3 Year monitoring employed on the Tanilba North Dunes.

Results show the that the revegetation of the NDE can be divided into two sections with the old haul road the boundary. Sections or blocks north of the haul road have poorer revegetation than the blocks to the south of the haul road. **Block Q1** 4 monitoring straddles this divide. Quadrat 46 (southern section) recorded 41 flora species, 34 of which were native species. These consisted of three overstorey, two native midstorey, 23 native shrub species and six native ground stratum species. Quadrat 47 located in the northern section of Block Q1 recorded a total of 25 flora species, 14 native and 11 exotic species. The natives consisted of four overstorey, two midstorey, only four shrub and four ground strata species. The paucity of shrub species highlights the lack of natives in this area of the NDE. The area surrounding Quadrat 47 had been the subject of significant previous weed control efforts by Holcim which included burning of the dominant weeds, African Lovegrass, scalping of the topsoil to remove the seed bank and replanting.

Similarly **Block Q2** recorded few native species, with a large percentage of the flora being exotic species, to the point where several of the monitoring plots recorded only exotic species. This block is below target for all growth parameters, with low species per plot, and the stratum proportions totally unbalanced due to the preponderance of exotic species and numbers of plants. The majority of the native species in this block were the planted key species.

Block Q5 to the west of the NDE is likewise in poor rehabilitation condition. Average number of species in the plots was 4.08, with over 50% of those exotic species. Most of the native species recorded were the pioneer species A. longifolia with a lesser number of A. ulicifolia and A. suaveolens. Weed species were prevalent throughout this block as mentioned above, with African Lovegrass, Red Natal Grass and Fleabane the most common.

Blocks to the south of the haul road show excellent growth parameters and diversity as follows:

Block Q3 continues to progress with all but one of the parameters increasing. Growth parameters – height and cover – have increased further, while species richness parameters are above targets. Stratum proportions, while not at target, are trending in the right directions. Target species numbers are mixed, with L. polygalifolium not been recorded in this block for several surveys and was not observed during the monitoring in between survey plots. It can be can now be safely assumed that this species, for whatever reason is no longer present on this block and requires installation.

Block Q4 is progressing well with most of the parameters improving or remaining above target. Growth parameters – height and cover – have increased marginally, while the species richness parameters have remained about the same but are on track or above target. The stratum proportions are still heavily weighted towards shrubs which account for 84% of all species in this block. Target species in this block are all present, and with the additional planting undertaken by Holcim, overstorey species are varied and well above target. All planting of overstorey species should cease.

Block Q6 is the youngest of the rehabilitated areas – apart from the reworked area of Block Q1 - and as such growth parameters are positive, with average height and average cover increasing, and species richness parameters above target – very positive results. Stratum proportions are trending in the desired direction, with the planting effort by Holcim increasing the density of the overstorey species substantially over target.

These last three blocks have some relatively minor weed encroachment that should be treated urgently to prevent further spread.

In summary there is a dichotomous nature of the rehabilitation, noting the excellent condition of the southern three blocks – Blocks Q3, Q4 and Q6. The northern blocks (Q1, Q2, Q3) are not sufficiently advanced to satisfy relinquishment criteria, whereas the southern blocks are well on track to do so.

8.3 Weeds

As has been reported previously weeds are a major problem for the Northern Dune Extension. Weeds encroach into blocks Q3, Q4 and Q6 from the adjoining haul roads and weed infested areas adjacent to the site. The northern section of block Q1, the whole of Q2 and Q5 are heavily weed infested.

It should be noted that Holcim has undertaken several weed control measures in the period covered by this report including hand pulling, cut and paint, and herbicide application in Blocks Q1, Q2, Q3, Q5 and Q6. Weed control operations were undertaken between March and May 2021.

8.4 Plantings

No further planting occurred within the NDE area during the reporting period. Planting was performed up to December 2020 and is now establishing (see Section 8.2).

8.5 Performance Indicators

At each stage of monitoring, rehabilitation is compared to the performance indicators outlined in Table 11 of the LMP. Those relevant to the rehabilitation stages of the Tanilba Northern Dunes Extension area (years 1 to 3) are summarised below in Table 19. Performance indicators are relevant to age of each rehabilitation quadrat. As such, performance indicators not relevant to each quadrat in Table 19 are listed as 'NA – Not Applicable'. If rehabilitation areas do not meet these performance indicators, specific management measures are required to be outlined in the AR (Section 8.6).

Table 19: Performance Indicators for Tanilba Northern Dune Extension rehabilitation

Year	Aims for Each Strategic Ecosystem Development Stage	Performance Indicators	Compliance						
			Q1 (Sth Haul Rd)	Q1 Nth Haul Rd)	Q2	Q3	Q4	Q5	Q6
1	Monitoring will be on a bi-annual basis until achieving the early pioneer stage, with the following features: Topsoil stabilized by primary colonizers (eg. acacias & pea species); Key species present and densities increasing towards target numbers. No significant erosion problems; and Weed and pest control program in place as outlined in sections 4.3.4 and 4.3.7.	Early pioneer stage appearing: Small seedlings (< 5 cm) regenerating from topsoil, < 5% surface cover; At least 25 transplanted mature Grass Trees per hectare; Brush-matting evident. Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	NA	NA	NA	NA	NA	NA	NA
2		Natural regeneration of pioneer species covering 20% of ground surface, average 20 cm tall; Seedlings developing under brush-matting; Planted trees and shrubs in predetermined numbers according to revegetation strategy, 20 - 30 cm tall; No significant erosion problems; Noxious or significant environmental weeds control programme in place; and Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	NA	NA	NA	NA	NA	NA	NA
3		All structural species present in predetermined density, 30 - 90 cm tall;	NA	NA	N	Y	Y	N	P

Year	Aims for Each Strategic Ecosystem Development Stage	Performance Indicators	Compliance						
			Q1 (Sth Haul Rd)	Q1 Nth Haul Rd)	Q2	Q3	Q4	Q5	Q6
		Shrub layer and ground cover strata evident;	NA	NA	N	Y	Y	N	Y
		Natural regeneration covering 40 – 60% of surface, average 50 – 80 cm tall;	NA	NA	N	Y	Y	Y	Y
		No significant erosion problems;	NA	NA	Y	Y	Y	Y	Y
		Weed control programme in place and weeds successfully controlled;	NA	NA	N	Y	Y	N	N
		Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	NA	NA	Y	Y	Y	Y	Y
4	Single annual monitoring event to determine development of mature pioneer stage characterised by: Gradual dieback of some primary colonizers; Appearance of mature vegetation species; Key species present at target densities, or showing increase towards target numbers; Beginning of differentiation of	Structural species in predetermined density, average 1 m tall;	Y	Y	NA	NA	NA	NA	NA
		Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	Y	Y	NA	NA	NA	NA	NA
		Mature pioneer stage evident; cover 60 - 80%, average 80 cm;	Y	N	NA	NA	NA	NA	NA
		No significant erosion problems;	Y	Y	NA	NA	NA	NA	NA
		Weed control programme in place and weeds successfully controlled; an	N	N	NA	NA	NA	NA	NA

Year	Aims for Each Strategic Ecosystem Development Stage	Performance Indicators	Compliance						
			Q1 (Sth Haul Rd)	Q1 Nth Haul Rd)	Q2	Q3	Q4	Q5	Q6
5	structural layers (canopy, sub-canopy, shrub layer); No significant erosion problems; and Weed and pest control program in place as outlined in sections 4.3.4 and 4.3.7.	Decline in pioneer community, coinciding with emergence in canopy species; Canopy layer emerging above shrub layer; No significant erosion problems; Weed control programme in place and weeds successfully controlled; and Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	NA	NA	NA	NA	NA	NA	NA
8*	Single monitoring event to determine development of early stages of mature vegetation assemblage characterised by: Increase in dominant shrub and tree species; Development of structural layers; and Species composition similar to pre-mining.	Overstorey and midstorey species increasing in height and percentage cover; Overstorey and midstorey species density stable; Key overstorey and midstorey species present at densities comparable to pre-mining at similar elevations; Increase in differentiation of structural layers, including litter; and Overstorey layer evident above shrub layer. Rehabilitation area will be (as far as reasonably practicable) free from rubbish.	NA	NA	NA	NA	NA	NA	NA
*Note – in the event that rehabilitation has not yet achieved the completion criteria by year 8, 3-yearly monitoring and weed and pest control (as outlined in sections 4.3.4 and 4.3.7) will continue until rehabilitation achieves the completion criteria to the satisfaction of the Planning Secretary.			-	-	-	-	-	-	-

8.6 Rehabilitation Actions

Weed control activities are recommended to be substantially increased. Works need to be conducted regularly and frequently to break seed set cycles and to reduce overall weed densities. This may require engagement of suitably qualified and experienced outside contractors. Weed control works, in the first instance should commence with the less dense areas and weeds encroaching into Blocks Q3, Q4 and Q6 to keep these blocks in their present excellent condition.

Weed works should proceed to the visual screen along Rutile Rd and remove the Lantana, L. laevigatum, and Slash Pine starting to encroach form the NDE Offsets, and other grassy weeds.

The northern blocks then require intense weed control efforts that should include but not be limited to spot spraying and hand removal of individual plants. These blocks could be progressively weeded in such fashion with intense seeding and/or planting of natives to follow up.

To maximise the weed control efforts, seed collection of native species is required. This seed collection and brush matting should incorporate collection of as wide a range of species as is possible and not just the easier to collect Banksias, Eucalyptus and Acacias. This recommendation has been made in other monitoring reports for Holcim this year (Kleinfelder, 2022) and is part of an envisaged comprehensive seed collection program that would serve to increase diversity in all areas of the sand extraction complex that are lacking said diversity. Holcim does have the expertise to conduct this work in-house, but the staff require resourcing – time, additional labour, and adequate facilities for drying and storage of seed – to undertake this specialised and skilled work. Excess seed could be on-sold to commercial seed merchants and nurseries to offset some of the costs. Alternatively, suitably skilled contractors can be engaged.

An additional revegetation strategy for these northern blocks would be to seed with a high density of native grasses. There are 10 species of native grasses that have been identified during surveys of the various sand extraction projects and while they are usually found occurring in low densities between a dense shrub layer in the heath communities, this approach would at least introduce native species and provide a level of competition with exotic species and help suppress their spread.

Revegetation efforts within the existing blocks should include installation of key species to densities up to targets with the proviso that prior to any major additional planting effort, a survey is undertaken to determine numbers more accurately in each of the blocks. These surveys should be conducted using a combination of methods –

- “Threatened Species Survey” methodology, whereby transects at a 5m spacing are walked over the blocks and all key species are recorded.
- Drones using hi-definition digital cameras flown over the blocks – many of the key species could be identified utilising this method.

The exception being L. polygalifolium in Block Q3 where an estimated 700 or so should be installed.

In conclusion, the NDE revegetation is a dichotomy with about half of the area on track to achieve relinquishment, with the other half requiring a great deal of work to be brought up to an acceptable standard of revegetation.

9 COMMUNITY

9.1 Community Engagement Activities

Schedule 5, Clause 9 of the project approval requires specific information to be made available on the proponents website.

Holcim provides information on operations at the Tanilba Northern Dune Extension Project to the public via its website. This includes a copy of approved strategies, management plans, monitoring data, approvals and annual reviews. This AR will be made available on Holcim's website once accepted.

9.2 Complaints

Holcim maintained a community complaint register that was updated quarterly throughout the reporting period to include any new community complaints. Any complaints that are received are elevated to a Level 2 incident and investigated internally using the Incident Cause Analysis Method (ICAM) method.

There were no community complaints received during the reporting period.

10 INDEPENDENT AUDIT

Schedule 5 Clause 7 requires an Independent Environmental Audit (IEA) to be commissioned within one month of the completion of quarrying operations. An IEA was performed the IEA on 7 August 2019. No further IEA was required during the reporting period.

11 INCIDENTS AND NON-COMPLIANCE

Schedule 5 Clause 5 requires reporting of any incident associated with the project as soon as practicable after Sibelco becomes aware of the incident. This includes circumstances that cause or threaten to cause material harm to the environment and / or breaches or exceeds the limits of performance measures/criteria in approval MP 09_0091.

No incidents or non-compliances were recorded during this AR period.

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Along with the improvements discussed throughout this document, Holcim will undertake the following activities in the next reporting period (April 1 2021 – March 31 2022) to ensure compliance with the consent and to ensure that effective environmental management controls are in place and operating in accordance with the requirements of the Consent.

Table 20: Proposed works – 2021/22

Item	Requirement		2020-2021 program	Due Date
OPERATIONS/ADMINISTRATION				
1		Site condition	Inspection of site for identification of maintenance requirements including condition of roadside drainage and rehabilitated areas	Monthly
2	S5, Cl 3	Annual Review	Prepare and submit AR to DPE on activities undertaken in the 2021-2022 reporting period	30 June 2022
3	S5 Cl 2	Performance review	Monitoring requirements will be reviewed to ensure all future monitoring and reporting following closure is relevant to the activities being performed. The review will be performed in consultation with DPI-Water and HWC	Following submission of AR
GROUNDWATER				
4		Groundwater Level Monitoring	Sibelco to monitor bores as per approved GMP.	Monthly (weekly for 4 weeks if >100 mm rain per 7 days)
5		Groundwater quality Monitoring	Third Party contractor to monitor bores as per approved GMP.	As per GMP
6		GMP Review	The GMP will be reviewed to ensure the monitoring and reporting is relevant to the activities being performed. The review will be performed in consultation with DPI-Water and HWC.	Following submission of AR
7		Reporting	The results of the groundwater level and quality monitoring will be reported as per the GMP. Reporting frequency will be determined during the review of the GMP following consultation with DPI-Water and HWC.	Frequency determined following GMP review and consultation with DPI-Water and HWC
Item	**Requirement**		**2020-2021 program**	**Due Date**
S5, Cl 17 - FORMER EXTRACTION AREA (LMP)				
8			Supplementary planting as required following the inspections and biannual monitoring	As required
9	LMP 4.3.9	Weed management	Site wide weed spraying following the completion of the final stage of revegetation planting	As required
10		Maintenance	Follow up inspections to identify and manage regrowth across all rehabilitated areas	As required
11	LMP	Performance	Implement recommendations in Annual	As required

	4.3.6	monitoring	Vegetation Rehabilitation Monitoring Report (Kleinfelder 2021)	
12			Monitoring of rehabilitated areas to assess performance against the requirements of the BMP	Biannual
13			Prepare report to summarise results of rehabilitation program, identify trends and any management measures required to achieve objectives of rehabilitation program	April 2023
14	S5 Cl 2	LMP Review	The LMP will be reviewed to ensure the monitoring and reporting is relevant to the activities being performed. The review will be performed in consultation with DPI-Water and HWC	Following submission of AR
S3, Cl15 - OFFSET AREAS (BMP)				
15	BMP 5.1.2	Nest box installation and monitoring program	Annual monitoring for a minimum six year period within the northern offset area to record uptake and attend to maintenance	October 2022
16	BMP 5.1.4	Fauna survey program	Targeted monitoring across all offset areas for Wallum Froglet to detect changes in recruitment success and assess impacts	In accordance with seasonal survey requirements
17	BMP 5.1.4, 5.2		Targeted monitoring across all offset areas for *Uperoleia sp nov* to identify habitat preferences of spp	In accordance with seasonal survey requirements
18	BMP 5.2		Monitoring to determine if Koala is utilising areas determined as Preferred Koala Habitat (Swamp Mahogany – Paperbark Swamp Forest) and Supplementary Habitat (Coastal Sand Apple – Blackbutt Forest) within the offset areas	
	5.1.5 of BMP	Vegetation management and monitoring program	Habitat restoration and rehabilitation program for proposed offset area in Lots 11, 12 and 13:	
19			• Inspection to identify areas requiring weed and pest control	Annual
20			• Weed and pest management	Annual
21			• Rehabilitation of the regenerating Grassland-Heath	Annual
Item	**Requirement**		**2020-2021 program**	**Due Date**
22	BMP 5.1.7		• Supplementary planting of *E robusta* within offset area to expand availability of habitat for Koala	During rehab program
23	BMP 5.2		• Monitoring of the offset area to ensure vegetation and habitat qualities are being maintained	
24	S5 Cl 2	BMP Review	The BMP will be reviewed to ensure the monitoring and reporting is relevant to the activities being performed. The review will be performed in consultation with DPI-Water and HWC	Following submission of AR
COMMUNITY				
25	S5, Cl9	Information Access	Upload the Annual Review for 2019-2020 to the company website when approved.	N/A
26		Complaints Register	Maintain and update	Quarterly

13 APPENDICES

APPENDIX 1
Project Approval MP-09-0091

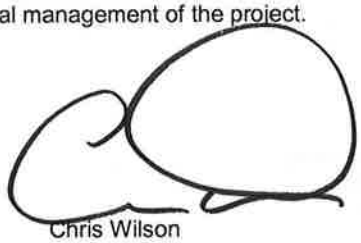
Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

As delegate for the Minister of Planning, I approve the project application referred to in schedule 1, subject to the conditions in schedules 2 to 5.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the on-going environmental management of the project.



Chris Wilson
Executive Director
Development Assessment Systems & Approvals

Sydney 8 MARCH 2013

SCHEDULE 1

Project Application:	09_0091
Proponent:	Sibelco Australia Limited
Approval Authority:	Minister for Planning and Infrastructure
Land:	Lots 11, 12, 13 DP601306; Lot 408 DP1041934; and Lots 1, 2 DP408240.
Project:	Tanilba Northern Dune Extension Project

TABLE OF CONTENTS

DEFINITIONS 3

ADMINISTRATIVE CONDITIONS 4

Obligation to Minimise Harm to the Environment 4
Terms of Approval 4
Limits on Approval 4
Staged Submission of any Strategy, Plan or Program 4
Protection of Public Infrastructure 4
Operation of Plant and Equipment 5

ENVIRONMENTAL PERFORMANCE CONDITIONS 6

Identification of Boundaries 6
Noise 6
Air Quality 7
Soil and Water 7
Biodiversity 8
Rehabilitation and Landscaping 8
Aboriginal Cultural Heritage 10
Traffic and Transportation 10
Visual 11
Waste Management 11
Emergency and Hazards Management 11
Production Data 11

ADDITIONAL PROCEDURES 12

Notification of Landowners 12
Independent Review 12

ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING 13

Environmental Management 13
Reporting 14
Auditing 14
Access to Information 15

APPENDIX 1: PROJECT SITE 16

APPENDIX 2: NOISE RECEIVER LOCATIONS 17

APPENDIX 3: STATEMENT OF COMMITMENTS 18

APPENDIX 4: BIODIVERSITY OFFSET STRATEGY 21

DEFINITIONS

Annual Review	The review required by condition 3 of schedule 5
Biodiversity Offset Strategy	The conservation and management of the Proponent's offset sites on the Tilligerry Peninsula, being Lots 11, 12, 13 DP601306 and Lot 24 DP579700
Conditions of this approval	Conditions contained in schedules 2 to 5 inclusive
Council	Port Stephens Council
Day	The period from 7.00am to 6.00pm, Monday to Saturday
Department	Department of Planning and Infrastructure
Director-General	Director-General of the Department of Planning and Infrastructure, or nominee
DRE	Division of Resources and Energy (within the Department of Trade and Investment, Regional Infrastructure and Services)
DST	Daylight Savings Time
EA	Environmental Assessment of the project titled *Tanilba Northern Dune Extraction Extension - Environmental Assessment Report* prepared by ERM Australia Pty Limited, dated June 2012 and the Proponent's response to the issues raised in submissions, dated November 2012
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPL	Environment Protection Licence under the *Protection of the Environment Operations Act 1997 (POEO Act)*
EST	Eastern Standard Time
Feasible	Feasible relates to engineering considerations and what is practical to build
HWC	Hunter Water Corporation
Incident	A set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in this approval
Land	Land means the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this approval
m AHD	metres Australian Height Datum
Material harm to the environment	Material harm to the environment as defined in the *Protection of the Environment Operations Act 1997*
Minister	Minister for Planning and Infrastructure, or nominee
NOW	NSW Office of Water (within the Department of Primary Industries)
OEH	Office of Environment and Heritage (within the Department of Premier and Cabinet)
Privately-owned land	Land that is not owned by a public agency or a quarrying company (or its subsidiary)
Project	The development as described in the EA
Proponent	Sibelco Australia Limited, or its successors in title
Quarrying operations	The extraction, processing and transportation of extractive materials on the site and the associated removal of vegetation, topsoil and overburden
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Rehabilitation	The treatment or management of land disturbed by the project for the purpose of establishing a safe, stable and non-polluting environment
RMS	NSW Roads and Maritime Services
Statement of Commitments	The Proponent's commitments in Appendix 3
Site	Land to which the Project Approval applies, as listed in schedule 1 and shown in Appendix 1

SCHEDULE 2
ADMINISTRATIVE CONDITIONS

Obligation to Minimise Harm to the Environment

1. The Proponent shall implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation or rehabilitation of the project.

Terms of Approval

2. The Proponent shall carry out the project generally in accordance with the:
   (a) EA;
   (b) Statement of Commitments; and
   (c) conditions of this approval.

   Note: The general layout of the project is shown in the figure in Appendix 1.

3. If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this approval shall prevail to the extent of any inconsistency.

4. The Proponent shall comply with any reasonable requirement/s of the Director-General arising from the Department's assessment of:
   (a) any reports, plans, programs or correspondence that are submitted in accordance with this approval; and
   (b) the implementation of any actions or measures contained in these reports, plans, programs or correspondence.

Limits on Approval

5. The Proponent may carry out quarrying operations on the site until 31 December 2020.

   Note: Under this Approval, the Proponent is required to rehabilitate and revegetate the site and provide and implement a Biodiversity Offset Strategy to the satisfaction of the Director-General. Consequently this approval will continue to apply in all other respects other than the right to conduct quarrying operations until the site has been rehabilitated and revegetated and the Biodiversity Offset Strategy implemented to a satisfactory standard.

6. The Proponent shall not transport more than 150,000 tonnes of extractive materials from the site in any calendar year.

7. The Proponent shall ensure that no more than three hectares of the site would be exposed (ie cleared but not re-vegetated) at any one time.

Staged Submission of any Strategy, Plan or Program

8. With the approval of the Director-General, the Proponent may submit any strategy, plan or program required by this approval on a progressive basis.

Protection of Public Infrastructure

9. The Proponent shall:
   (a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the project; and
   (b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the project.

Operation of Plant and Equipment

10. The Proponent shall ensure that all plant and equipment used at the site, or to transport extractive materials from the site, is:
    (a) maintained in a proper and efficient condition; and
    (b) operated in a proper and efficient manner.

Section 94 Contributions

11. For the life of quarrying operations under the project, the Proponent shall pay Council a Section 94 contribution rate in accordance with the *Port Stephens Section 94 Development Contributions Plan 2007*.

Notification of Commencement

12. The Proponent shall notify the Department of its intention to commence quarrying operations at least two weeks prior to the commencement of quarrying operations.

SCHEDULE 3
ENVIRONMENTAL PERFORMANCE CONDITIONS

IDENTIFICATION OF BOUNDARIES

1. Prior to the commencement of quarrying operations, the Proponent shall:
   (a) engage a registered surveyor to mark out the boundaries of the approved limits of extraction; and
   (b) ensure that these boundaries are clearly marked at all times in a permanent manner that allows operating staff and inspecting officers to clearly identify those limits.

NOISE

Impact Assessment Criteria

2. The Proponent shall ensure that the operational noise generated by the project does not exceed the noise impact assessment criteria in Table 1 at any residence on privately-owned land.

Table 1: Noise impact assessment criteria

Receiver	$L_{Aeq\ (15\ min)}$ ***dB(A)***
R1, R2, R3 and all residences in Oyster Cove	37
All other receivers	35

Notes:

- *Receiver locations are shown in the Figure in Appendix 2; and*
- *Noise generated by the project is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.*

Hours of Operation

3. The Proponent shall only conduct quarrying operations on the site:
   (a) between 7.00 am and 6.00 pm EST, Monday to Friday;
   (b) between 7.00 am and 7.00 pm DST, Monday to Friday; and
   (c) at no time on Saturday, Sunday or public holidays.

Operating Conditions

4. The Proponent shall:
   (a) implement best practice noise management to minimise the construction, operational and traffic noise of the project;
   (b) maintain the effectiveness of any noise suppression equipment on site at all times and ensure defective equipment is not used operationally until fully repaired; and
   (c) conduct extraction activities in a south to north direction so that the topography shields the sensitive receivers,

   to the satisfaction of the Director-General.

Noise Monitoring Program

5. The Proponent shall prepare and implement a Noise Monitoring Program for the project to the satisfaction of the Director-General. This program must:
   (a) be submitted to the Director-General for approval prior to commencing quarrying operations;
   (b) include quarterly attended noise monitoring during at least the first two years of quarrying operations, to be conducted on days when at least 30 truck dispatches occur from the site; and
   (c) include details of how the noise performance of the project would be monitored, and include a noise monitoring protocol for evaluating compliance with the noise criteria in this approval.

AIR QUALITY

Impact Assessment Criteria

6. The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed the criteria listed in Tables 2 to 4 at any privately-owned land.

Table 2: Long term criteria for particulate matter

Pollutant	Averaging Period	[d] Criterion
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 3: Short term criterion for particulate matter

Pollutant	Averaging Period	[d] Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3

Table 4: Long term criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables 2 to 4:

- [a] *Total impact (i.e. incremental increase in concentrations due to the projects plus background concentrations due to all other sources);*
- [b] *Incremental impact (i.e. incremental increase in concentrations due to the projects on their own);*
- [c] *Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.*
- [d] *Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General in consultation with DECCW.*

Dust Management

7. The Proponent shall:
   (a) implement best management practice to minimise the dust emissions of the project;
   (b) regularly assess air quality monitoring data and relocate, modify, and/or stop operations on site as may be required to ensure compliance with the relevant conditions of this approval;
   (c) minimise any visible off-site air pollution; and
   (d) minimise surface disturbance of the site, other than as permitted under this approval.

Dust Monitoring Program

8. The Proponent shall prepare and implement a Dust Monitoring Program for the project to the satisfaction of the Director-General. This program must:
   (a) be submitted to the Director-General for approval prior to commencing quarrying operations;
   (b) include a program for the use of a water tanker on unsealed roads;
   (c) include details of how the air quality performance of the project would be monitored, and a protocol for evaluating compliance with the relevant air quality criteria in this approval.

SOIL AND WATER

Pollution of Waters

9. Except as may be expressly provided for by an EPL, the Proponent shall comply with section 120 of the *Protection of the Environment Operations Act 1997* in carrying out the project.

Management and Monitoring

10. The Proponent shall not extract sand or other extractive materials or carry out any work in the extraction area below a level of 0.7 m above the predicted maximum groundwater elevation (see condition 14 of schedule 3), other than the construction of any bores approved by NOW.

11. The Proponent shall ensure that the final landform of the extraction area must be at least 1 metre above the predicted maximum groundwater elevation.

12. The Proponent shall prepare and implement a Soil and Water Management Plan for the project to the satisfaction of the Director-General. This plan must:
    (a) be prepared:
        - by suitably qualified person(s), approved by the Director-General; and
        - in consultation with HWC and NOW;
    (b) include a(n):
        - Erosion and Sediment Control Plan; and
        - Groundwater Monitoring Program; and
    (c) be submitted to the Director-General for approval prior to commencing quarrying operations.

13. The Erosion and Sediment Control Plan shall:
    (a) be consistent with the requirements of *Managing Urban Stormwater, Soils and Construction Volume 2E Mines and Quarries,* (DECC 2008), or the latest edition;
    (b) identify activities that could cause soil erosion and generate sediment;
    (c) describe measures to minimise soil erosion and the potential for the transport of sediment off site;
    (d) describe the location, function, and capacity of erosion and sediment control structures; and
    (e) describe what measures would be implemented to maintain these structures over time.

14. The Ground Water Monitoring Program shall include:
    (a) detailed baseline data on groundwater levels and quality, based on statistical analysis;
    (b) groundwater impact assessment criteria;
    (c) a program to monitor groundwater levels and quality;
    (d) a protocol for the investigation, notification and mitigation of any identified exceedances of the groundwater impact assessment criteria;
    (e) the outcome of groundwater modelling to establish the predicted maximum groundwater elevation for the site;
    (f) a program to monitor any impacts of the project on groundwater dependent ecosystems, and
    (g) a contingency plan to manage any acid sulfate soils and potentially acid sulfate soils encountered during quarrying operations.

BIODIVERSITY

Biodiversity Management Plan

15. The Proponent shall prepare and implement a Biodiversity Management Plan for the project to the satisfaction of the Director-General. This plan must:
    (a) be prepared:
        - by suitably qualified person(s), approved by the Director-General; and
        - in consultation with Council and OEH;
    (b) be submitted to the Director-General for approval prior to commencing quarrying operations;
    (c) address both the project site and the offset areas;
    (d) provide for the retention of hollow-bearing trees, wherever practicable;
    (e) ensure the establishment and on-going monitoring (at least 6 years) of a least 2 nest boxes for each tree hollow removed during clearing;
    (f) include a program to undertake targeted surveys for the novel *Uperoleia sp*.;

(g) identify any areas within the offset areas requiring rehabilitation and/or re-vegetation and implement a program for this;
(h) include a detailed description of the measures that would be implemented, including the procedures to be implemented for:
- enhancing the quality of existing vegetation, fauna habitat and wildlife corridors;
- landscaping the site to minimise any visual impacts of the project;
- maximising the salvage of resources within the approved disturbance area – including vegetative, soil and cultural heritage resources – for beneficial reuse in the offset areas and/or rehabilitation areas;
- minimising the impacts of the project on fauna, including undertaking pre-clearance surveys and minimising the use of insecticides, herbicides, pesticides and biocides;
- controlling weeds and feral pests;
- maintenance of a buffer zone at the northern edge of the extraction area;
- controlling access;
- minimising edge effects; and
- bushfire management; and

(i) include:
- management measures;
- monitoring procedures;
- performance indicators; and
- reporting frameworks,

with particular reference to the novel *Uperoleia sp.*, Koala, and Wallum Froglet.

Long-term Security for Offset

16. By 31 December 2013, or otherwise agreed by the Director-General, the Proponent shall:
(a) enter into a Biobanking agreement in respect of the proposed offset areas (see Appendix 4) with the Minister for the Environment, in accordance with Part 7A of the *Threatened Species Conservation Act 1995*, to implement the Biodiversity Offset Strategy; or
(b) enter into an agreement with OEH to transfer the offset areas into the national parks estate,
to the satisfaction of the Director-General.

REHABILITATION AND LANDSCAPING

Landscape Management Plan

17. The Proponent shall prepare and implement a Landscape Management Plan for the project to the satisfaction of the Director-General. This plan must:
(a) be prepared:
- by suitably qualified person(s), approved by the Director-General; and
- in consultation with Council and HWC;

(b) be submitted to the Director-General for approval prior to commencing quarrying operations; and
(c) include:
- a Rehabilitation Management Plan; and
- a Long Term Management Strategy.

18. The Rehabilitation Management Plan must include:
(a) rehabilitation objectives for the site;
(b) a description of the measures that would be implemented to:
- rehabilitate and stabilise the site;
- minimise the removal of mature trees; and
- manage the remnant vegetation and habitat on the site;

(c) detailed performance and completion criteria for the rehabilitation and stabilisation of the site;
(d) a detailed description of how the performance of rehabilitation would be monitored over time to measure achievement of the performance and completion criteria and the rehabilitation objectives;
(e) a detailed description of what measures would be implemented to rehabilitate and manage the landscape of the site, including the procedures to be implemented for:
- progressively rehabilitating and stabilising areas disturbed by quarrying;
- implementing revegetation and regeneration within the disturbance areas;
- protecting areas outside the disturbance areas;

- vegetation clearing protocols, including a protocol for clearing any trees containing hollows and the relocation of hollows from felled trees;
- managing impacts on fauna, particularly threatened fauna and the novel *Uperoleia* sp.;
- controlling weeds and pests;
- controlling access;
- bushfire management; and
- reducing the visual impacts of the project;

(f) a description of the potential risks to successful rehabilitation, and a description of the contingency measures that would be implemented to mitigate these risks; and

(g) details of who is responsible for monitoring, reviewing, and implementing the plan.

19. The Long Term Management Strategy must:
    (a) define the objectives and criteria for quarry closure and post-extraction management;
    (b) investigate and/or describe options for the future use of the site;
    (c) describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the project; and
    (d) describe how the performance of these measures would be monitored over time.

Rehabilitation Bond

20. Prior to commencing quarrying operations, the Proponent shall lodge a rehabilitation bond for the project with the Director-General. The Proponent may lodge the rehabilitation bond in two portions. The first portion for 4.5 hectares must be lodged with the Department prior to commencing quarrying operations, with no land disturbance to exceed 4.5 hectares until the second portion of the bond is accepted by the Department.

    The sum of the bond shall be calculated at $\$2.50/m^2$ for the area to be disturbed by quarrying operations, to the satisfaction of the Director-General.

    If rehabilitation and revegetation works have been completed in accordance with the Rehabilitation Management Plan and to the satisfaction of the Director-General, the Director-General will release the rehabilitation bond.

    If rehabilitation and revegetation works are not completed to the satisfaction of the Director-General, the Director-General will call in all or part of the rehabilitation bond, and arrange for the satisfactory completion of the relevant works.

21. Within 3 months of each Independent Environmental Audit (see condition 8 of schedule 5), the Proponent shall review, and if necessary revise, the sum of the rehabilitation bond to the satisfaction of the Director-General. This review must consider:
    (a) the effects of inflation; and
    (b) performance under the Rehabilitation Management Plan to date.

ABORIGINAL CULTURAL HERITAGE

Aboriginal Cultural Heritage Management Plan

22. The Proponent shall prepare and implement an Aboriginal Cultural Heritage Management Plan to the satisfaction of the Director-General. This plan must:
    (a) be prepared in consultation with all relevant local Aboriginal communities;
    (b) be submitted to the Director-General for approval prior to commencing quarrying operations; and
    (c) include:
        - measures for the protection and management of site 38-4-0318 within Lot 13 DP601306;
        - a program to complete prospective pre-clearance surveys of the extraction area in consultation with Aboriginal stakeholders;
        - measures for ongoing consultation with local Aboriginal communities and the involvement of these communities in pre-clearance surveys and the ongoing management of any Aboriginal cultural heritage values identified within the site;
        - an Aboriginal cultural education program for the induction of personnel and contractors involved in quarrying operations; and

- a description of the measures that would be implemented if any new Aboriginal objects or skeletal remains are discovered during the project.

TRAFFIC

Haulage Route

23. All extractive materials dispatched from the site must be delivered to Sibelco's Salt Ash Sand Processing Plant by the most direct route available.

Road Signage

24. Prior to commencing quarrying operations, the Proponent shall:
    (a) install "Trucks Crossing" and "Trucks Entering" warning signs on Nelson Bay Road on both the western and eastern approaches to the intersection of Lemon Tree Passage Road; and
    (b) pay the full cost of this installation,
    to the satisfaction of RMS.

On-Site Traffic Management

25. The Proponent shall ensure that:
    (a) all vehicles do not exceed a speed of 25 kph on the site;
    (b) all loaded vehicles entering or leaving the site have their loads covered; and
    (c) all loaded vehicles leaving the site are cleaned of sand and other materials that may fall on the road, before leaving the site.

Traffic Management Plan

26. The Proponent shall prepare and implement a Traffic Management Plan for the project, to the satisfaction of the Director-General. This plan must:
    (a) be submitted to the Director-General for approval prior to commencing quarrying operations;
    (b) include a drivers' code of conduct to minimise the impacts of project-related trucks on local residents and road users; and
    (c) describe the measures that would be put in place to ensure compliance with the drivers' code of conduct.

VISUAL

Visual Amenity

27. The Proponent shall minimise the visual impacts of the project to the satisfaction of the Director-General.

WASTE MANAGEMENT

28. The Proponent shall minimise the amount of waste generated by the project to the satisfaction of the Director-General.

29. The Proponent shall ensure that wastewater and/or sewage disposal is not undertaken on the site.

30. The Proponent shall not undertake any refuelling or maintenance of vehicles or equipment on the site, except to the extent necessary to remove vehicles or equipment from the site in the case of breakdowns.

31. The Proponent must not cause, permit or allow any waste generated outside the site to be received at the site for storage, treatment, processing, reprocessing or disposal or any waste generated at the site to be disposed of at the site, except with the approval of the Director-General and as expressly permitted by a licence under the *Protection of the Environment Operations Act 1997.*

Note: This condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the site if it requires an EPL under the Protection of the Environment Operations Act 1997.

EMERGENCY AND HAZARDS MANAGEMENT

Dangerous Goods

32. The Proponent shall ensure that chemicals and/or petroleum products are not stored on site.

Safety

33. The Proponent shall ensure public safety at the site to the satisfaction of the Director-General.

PRODUCTION DATA

34. The Proponent shall:
    (a) provide annual quarry production data to DRE using the standard form for that purpose; and
    (b) include a copy of this data in the Annual Review (see condition 3 of Schedule 5).

SCHEDULE 4
ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS

1. If the results of the monitoring required in schedule 3 identify that the impacts generated by the project on site are greater than the relevant impact assessment criteria, and there is no negotiated agreement in place to allow the impact, then within 2 weeks of obtaining the monitoring results the Proponent shall:
   (a) notify the Director-General, the affected landowners and tenants (including tenants of any quarry-owned properties) accordingly, and provide monitoring results to each of these parties until the results show that the project is complying with the relevant criteria in schedule 3; and
   (b) in the case of exceedances of the relevant air quality criteria, send the affected landowners and/or tenants a copy of the NSW Health fact sheet entitled *"Mine Dust and You"* (as may be updated from time to time).

INDEPENDENT REVIEW

2. If a landowner of privately-owned land considers the project to be exceeding the relevant criteria in schedule 3, then he/she may ask the Director-General in writing for an independent review of the impacts of the project on his/her land.

   If the Director-General is satisfied that an independent review is warranted, then within 2 months of the Director-General's decision the Proponent shall:
   (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Director-General, to:
      - consult with the landowner to determine his/her concerns;
      - conduct monitoring to determine whether the project is complying with the relevant criteria in schedule 3; and
      - if the project is not complying with these criteria then identify the measures that could be implemented to ensure compliance with the relevant criteria; and
   (b) give the Director-General and landowner a copy of the independent review.

SCHEDULE 5
ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. The Proponent shall prepare and implement an Environmental Management Strategy for the project to the satisfaction of the Director-General. The strategy must:
   (a) be submitted to the Director-General for approval prior to the commencement of quarrying activities;
   (b) provide the strategic framework for environmental management of the project;
   (c) identify the statutory approvals that apply to the project;
   (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the project;
   (e) describe the procedures that would be implemented to:
      - keep the local community and relevant agencies informed about the operation and environmental performance of the project;
      - receive, handle, respond to, and record complaints;
      - resolve any disputes that may arise during the course of the project;
      - respond to any non-compliance; and
      - respond to emergencies; and
   (f) include:
      - copies of the various strategies, plans and programs that are required under the conditions of this approval once they have been approved; and
      - a clear plan depicting all the monitoring to be carried out in relation to the project.

Management Plan Requirements

2. The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:
   (a) detailed baseline data;
   (b) a description of:
      - the relevant statutory requirements (including any relevant approval, licence or lease conditions);
      - any relevant limits or performance measures/criteria; and
      - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;
   (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
   (d) a program to monitor and report on the:
      - impacts and environmental performance of the project; and
      - effectiveness of any management measures (see (c) above);
   (e) a contingency plan to manage any unpredicted impacts and their consequences;
   (f) a program to investigate and implement ways to improve the environmental performance of the project over time;
   (g) a protocol for managing and reporting any:
      - incidents;
      - complaints;
      - non-compliances with statutory requirements; and
      - exceedances of the impact assessment criteria and/or performance criteria; and
   (h) a protocol for periodic review of the plan.

   Note: At the discretion of the Director-General, some of these requirements may be waived where they are either not relevant or necessary.

Annual Review

3. Within 12 months of the commencement of quarrying operations, and annually thereafter, the Proponent shall review the environmental performance of the project to the satisfaction of the Director-General. This review must:
   (a) describe the works (including rehabilitation) that were carried out in the previous year, and the works that are proposed to be carried out over current year;
   (b) include a comprehensive review of the monitoring results and complaints records of the project over the past year, which includes a comparison of these results against:
      - the relevant statutory requirements, limits or performance measures/criteria;
      - the monitoring results of previous years; and
      - the relevant predictions in the EA;
   (c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
   (d) identify any trends in the monitoring data over the life of the project;
   (e) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and
   (f) describe what measures will be implemented over the next year to improve the environmental performance of the project.

Revision of Strategies, Plans & Programs

4. Within 3 months of:
   (a) the submission of an annual review under condition 3 above;
   (b) the submission of an incident report under condition 5 below;
   (c) the submission of an audit report under condition 8 below; and
   (d) any modifications to this approval,

   the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Director-General.

   Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the project.

REPORTING

Incident Reporting

5. The Proponent shall notify the Director-General and any other relevant agencies of any incident associated with the project as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of the date of the incident, the Proponent shall provide the Director-General and any relevant agencies with a detailed report on the incident.

Regular Reporting

6. The Proponent shall provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval, and to the satisfaction of the Director-General.

AUDITING

Independent Environmental Audit

7. Within 1 month of the completion of quarrying operations, unless the Director-General directs otherwise, the Proponent shall commission and pay the full cost of an Independent Environmental Audit of the project. This audit must:
   (a) be conducted by suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General;
   (b) include consultation with the relevant agencies;
   (c) assess the environmental performance of the project and assess whether it is complying with the relevant requirements in this approval and any relevant EPL (including any assessment, plan or program required under these approvals);

(d) review the adequacy of strategies, plans or programs required under the abovementioned approval or licences; and
(e) be completed within 2 months of the approval of the audit team.

Note: This audit team must be led by a suitably qualified auditor and include experts in any fields specified by the Director-General.

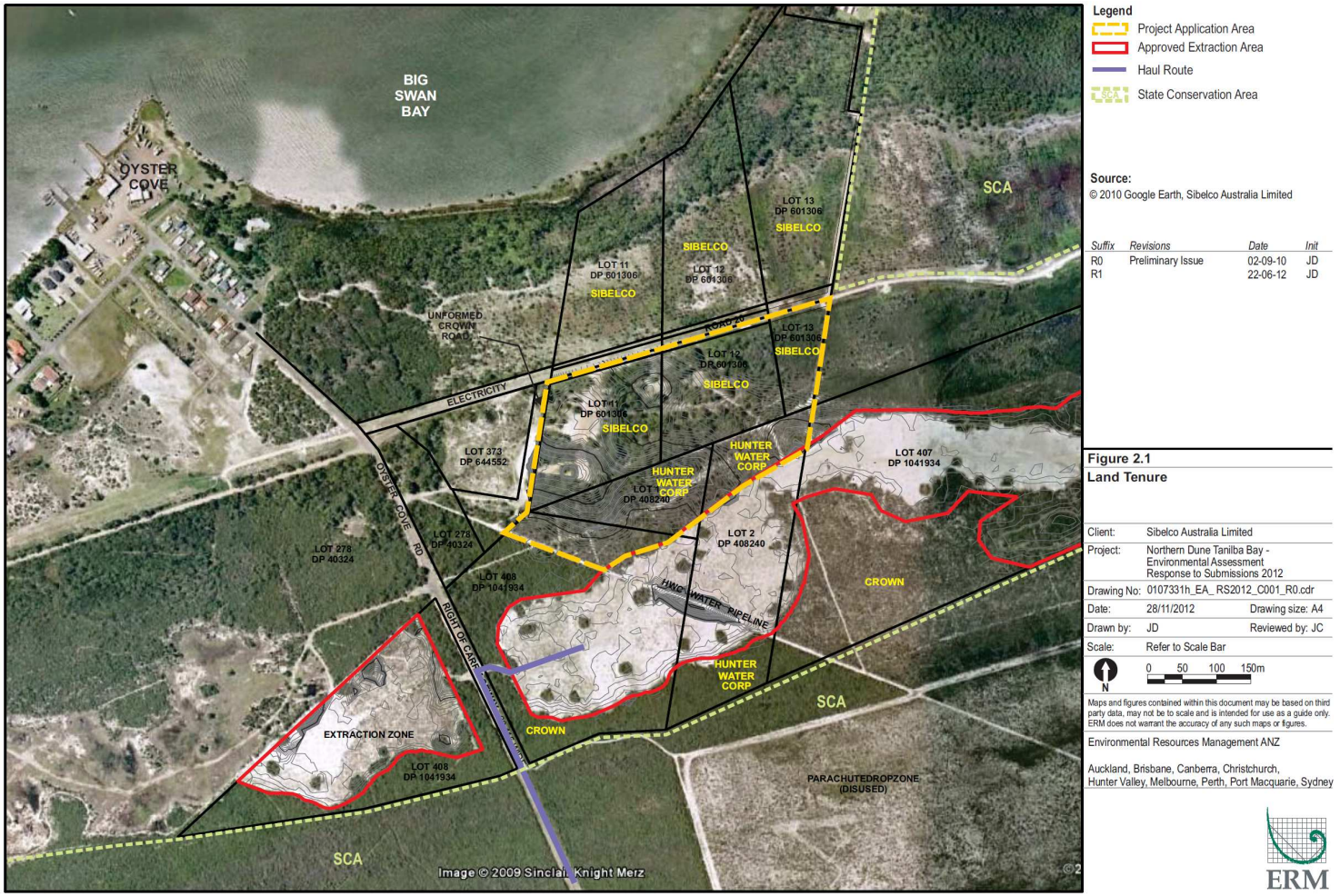
8. Within 6 weeks of the completing of this audit, or as otherwise agreed by the Director-General, the Proponent shall submit a copy of the audit report to the Director-General, together with its response to any recommendations contained in the audit report.

ACCESS TO INFORMATION

9. From 1 July 2013, the Proponent shall:
(a) make the following information publicly available on its website:
- a copy of all approved strategies, plans and programs;
- a summary of all monitoring results of the project, which have been reported in accordance with the various plans and programs approved under the conditions of this approval, updated on a quarterly basis;
- a complaints register, updated on a quarterly basis;
- copies of any Annual Reviews;
- copies of any Independent Environmental Audit, and the Proponent's response to the recommendations in any audit;
- copies of the development consent and approved management plans for existing adjacent quarrying operations; and
- any other matter required by the Director-General; and

(b) keep this information up-to-date,
to the satisfaction of the Director-General.

APPENDIX 1
PROJECT SITE



Legend
- Project Application Area
- Approved Extraction Area
- Haul Route
- State Conservation Area

Source:
© 2010 Google Earth, Sibelco Australia Limited

Suffix	Revisions	Date	Init
R0	Preliminary Issue	02-09-10	JD
R1		22-06-12	JD

Figure 2.1
Land Tenure

Client:	Sibelco Australia Limited	
Project:	Northern Dune Tanilba Bay - Environmental Assessment Response to Submissions 2012	
Drawing No:	0107331h_EA_ RS2012_C001_R0.cdr	
Date:	28/11/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: JC
Scale:	Refer to Scale Bar	

N
0 50 100 150m

Maps and figures contained within this document may be based on third party data, may not be to scale and is intended for use as a guide only. ERM does not warrant the accuracy of any such maps or figures.

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

***Figure 1**: Project site*

APPENDIX 2
NOISE RECEIVER LOCATIONS

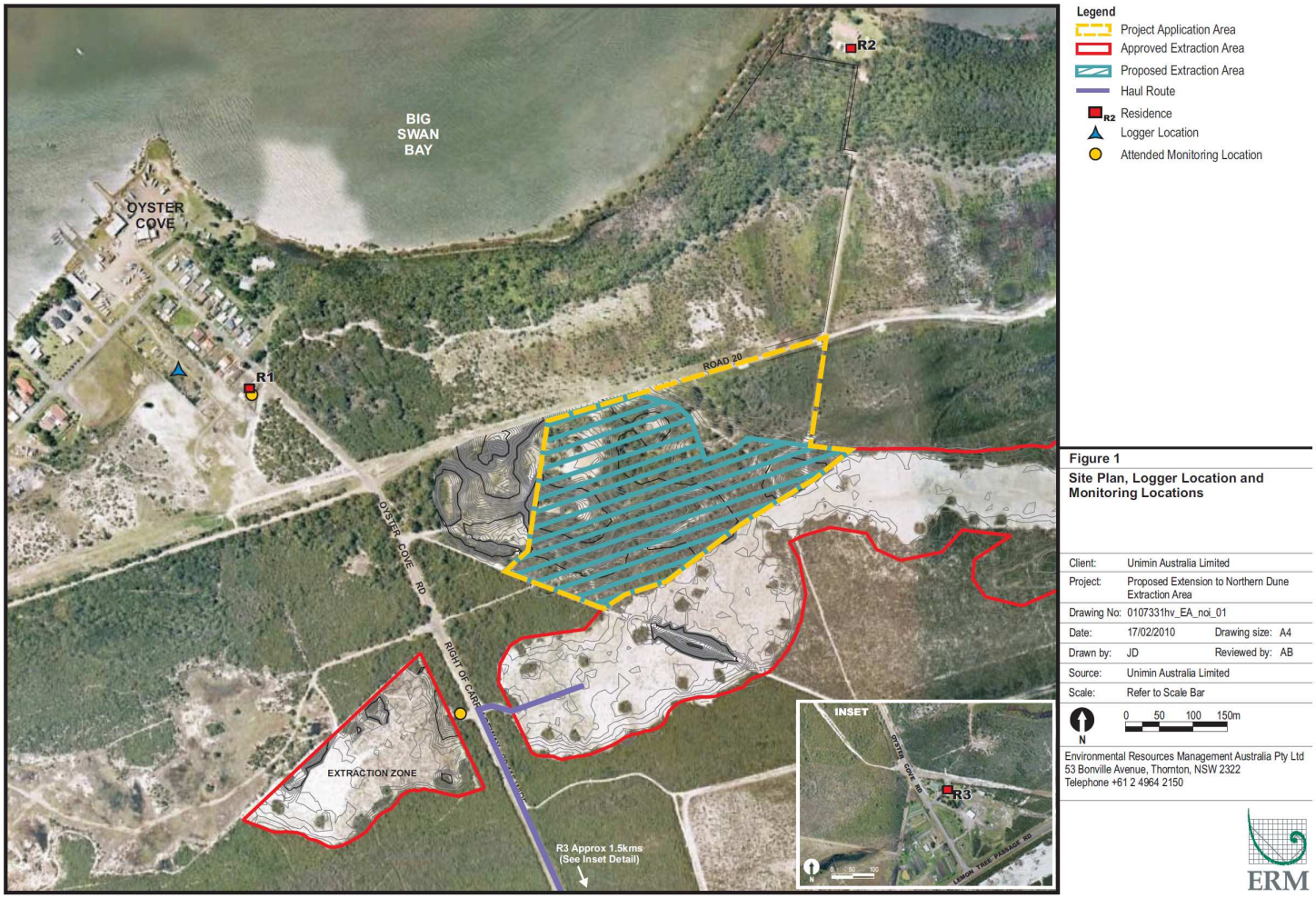


Figure 2: *Noise receivers*

APPENDIX 3
STATEMENT OF COMMITMENTS

Issue	Mitigation Measure/Commitment
Environmental Management Plan	The currently approved EMP (2003) will be applied over all 9 EMPs and updated as necessary to meet the needs of the extension area. These include; • EMP1 - Environmental Induction and Training • EMP2 - Hydrocarbon Spill Procedure • EMP3 - Operations Management Procedure • EMP4 - Extraction Depth and Area Monitoring • EMP5 - Groundwater • EMP6 - Cultural Heritage • EMP7 - Vegetation Rehabilitation • EMP8 - Landform Rehabilitation • EMP9 - Erosion and Sediment Control
Groundwater Monitoring	The Groundwater Management Plan (GMP) in place for the existing operation will be updated to incorporate ongoing monitoring at additional bores SAL4 and SAL5 in accordance with the existing approved monitoring regime.
	Current environmental management commitments will be adopted for the extraction extension, including: • groundwater quality and level monitoring, and reporting as part of the approved groundwater management plan; • regular review of environmental performance through the AEMR process; • maintenance of a minimum 1.0 m vertical buffer between the predicted maximum groundwater elevation and the final landform (extraction will occur to 0.7 m above predicted maximum groundwater elevation, with final rehabilitated landform being 1.0 m above these elevations following placement of 0.3 m topsoil); • staged rehabilitation of extraction areas; • avoiding storing machinery or hazardous materials onsite; and • avoiding servicing or refuelling equipment onsite.
Noise Emissions	The currently approved EMP (2003) would continue to be applied, and updated as necessary to meet the needs of the proposed extension area.
	All reasonable steps would be undertaken to reduce noise emissions during extraction and transport. • sequentially extracting from the south to the north, so that the topography will naturally help shield the sensitive receptors to the north against operational noise emissions; • ensuring all machines are in good working condition, with particular attention to exhaust silencers, engine covers and other noise reduction devices;

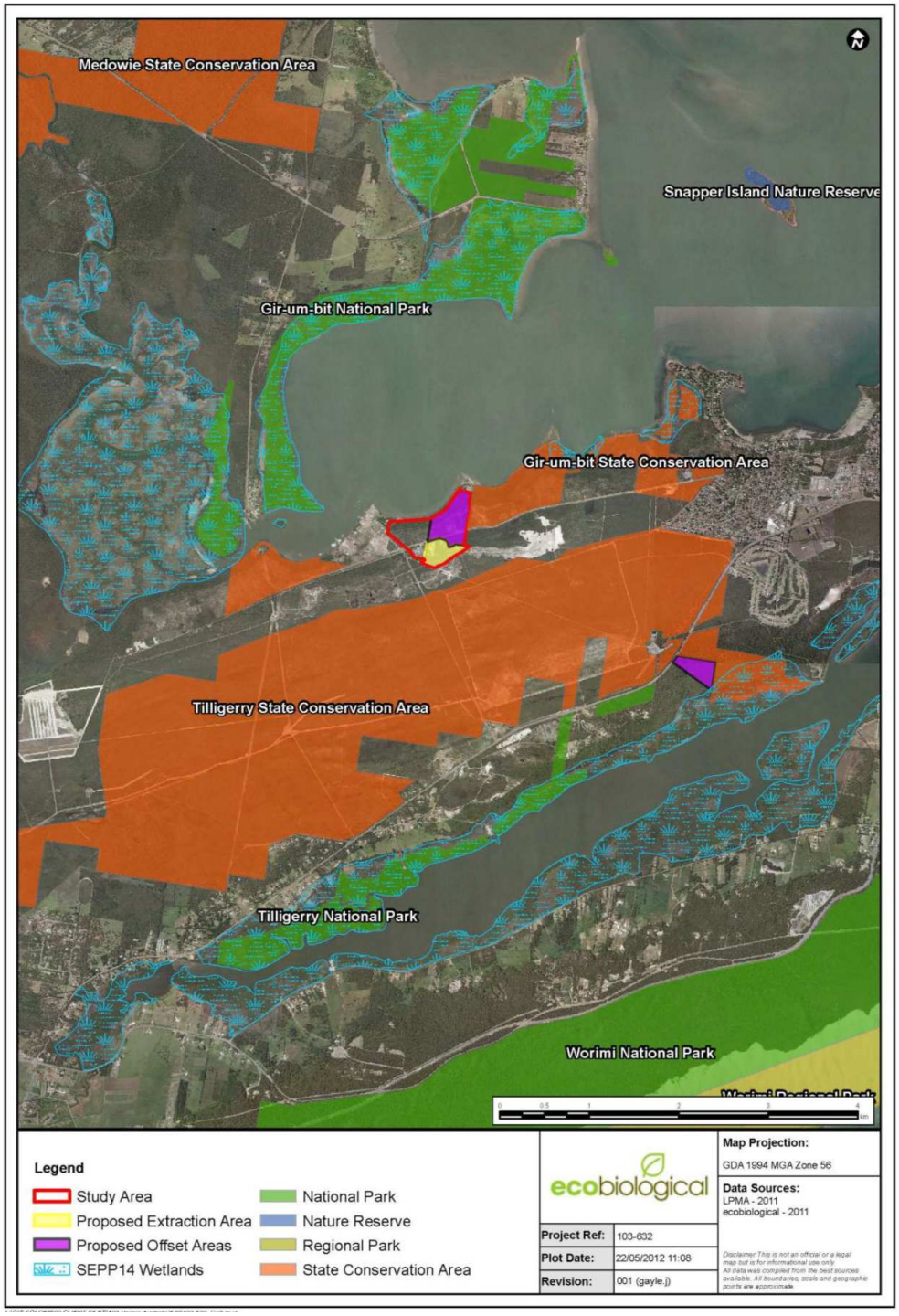
Issue	Mitigation Measure/Commitment
	• all work and transport will be restricted to daylight hours, typically from 7:00am to 6:00pm Monday to Friday, but when light permits continuing to 7:00pm; and • site imposed speed limits up to 25 km/hr to be enforced to minimise noise generation.
Air Emissions	Air emissions related management measures are already in place and proposed to continue as part of the extension of operations to reduce the generation of particulate emissions.
	A water tanker will be used on all unsealed roads on an as-needs basis, dependant on weather conditions.
	Sand extraction cells will be progressively rehabilitated throughout the life of the extraction. It is anticipated that no more than three hectares will be exposed at any one time.
Surface and Groundwater Quality	Surface water management principles will be implemented to prevent contamination of surface (and therefore groundwater) quality. Management and monitoring actions stipulated in the existing Groundwater Management Plan (2011) for current operations will be
	Additional documents will be produced for the extraction extension area to mitigate any impacts to the quality of the groundwater, the adjoining forested wetlands and, to aid in the rehabilitation of the extraction area post sandmining including: • Surface Water Management Plan to prevent runoff, pollution and sedimentation from the extraction area entering into adjoining forested wetlands; • Vegetation and Weed Management Plan for rehabilitation of the proposed sand extraction area; and • Offset Strategy and associated Habitat Management Plan which will detail management actions to be undertaken on the remaining portions of Lots 11, 12 and 13 and on Lot 24. This plan will cover vegetation, weed, fire and stormwater management, minimisation of edge effects, control of public access and management of habitat enhancement measures.
Ecology	Hollow bearing trees 16, 17, 18 and 20 (refer to Figure 2.2, Northern Dune Submission Report) to be retained.
	• avoidance of the use of biocides and implementing erosion and sediment controls; • incorporating implementation of pre-clearing surveys, a fauna displacement mitigation protocol, Koala mitigation measures, nestbox installation and monitoring, and a monitoring plan for the Wallum Froglet as detailed in Annex M of the EA; • staged rehabilitation of the extraction area (to be supported by a Vegetation Rehabilitation Management Plan), to be conducted in the same fashion as successful rehabilitation of Sibelco's existing approved extraction areas directly to the south; and • implementation of an Offset Strategy as detailed in Section 11.6.4 if the EA.
Vegetation Clearing	At least one week prior to any vegetation clearing, a survey of habitat trees will be conducted in the planned clearing area in accordance

Issue	Mitigation Measure/Commitment
	with the survey methodology outlined in Section 11.6.1 of the EA.
	Pre-clearing surveys will be conducted to check for the presence of any Koalas within the proposed extraction area.
	Hollow-bearing trees will be left standing for two nights after the surrounding vegetation has been cleared to encourage any native fauna species utilising the habitat hollows to self-relocate. The actual felling of any habitat trees will be attended by a suitably experienced fauna ecologist in order to ensure the safety of any fauna found to be in the hollows. On all occasions, trees having potential habitat hollows should be 'soft felled' by an experienced machine operator in accordance with the procedure outlined in section 11.6.1 of the EA.
Fauna Displacement Protocol	A fully qualified, experienced and licensed ecologist will supervise clearing and encourage movement of any displaced animals into adjoining vegetation.
	Captured fauna and/or displaced fauna will be relocated to adjacent habitat by an ecologist. During tree removal or any other construction activity, Fauna Displacement protocols outlined in Section 11.6.2 of the EA will be followed in the case of an injured animal.
Wallum Froglet Management Plan	A management plan for the Wallum Froglet (*Crinia tinnula*) will be developed in accordance with the management guidelines outlined under Section 6 of the National Recovery Plan for the Wallum Sedgefrog and Other Wallum- dependent Frog Species. In particular this will include specifications on: • minimising affects from soil disturbance; • ensuring sufficient retention of vegetation particularly around breeding sites; and • monitoring the habitat condition and frog numbers to ensure the threats to the species are properly managed. This should be undertaken with sufficient regularity and should preferably be carried out a year or more before development starts and continue for the duration of extraction operations, including rehabilitation works.
Nestbox Installation and Monitoring Program	A nestbox installation and monitoring program will be implemented on a ratio of 2:1 to replace 38 hollows present in the 17 hollow-bearing trees mapped within the proposed extraction area. Nestboxes should be erected prior to clearing commencing in order to provide alternative den and/or nest sites for any displaced fauna.

Issue	Mitigation Measure/Commitment
	Nestboxes are to be erected within the Proposed Offset Areas on Lots 11, 12 and 13. Nest box designs should be selected to replace the natural hollow sizes removed (ie, 20 small, 16 medium and 2 large) and will target insectivorous bats, gliders and possums. Annual monitoring for a minimum 6-year period post installation is recommended to record uptake of the nestboxes and to attend to any maintenance issues. A brief letter confirming annual inspection of the nestboxes and documentation of results should be provided to OEH.
Vegetation Management and Monitoring Plan	Weed Management and Vegetation Management and Monitoring Plans will be prepared for the rehabilitation area and proposed Offset Areas on Lots 11, 12, 13 and 24, which will include a thorough and intensive program to protect the adjoining forested wetland communities against weed invasion, and surface and underground run-off that may occur both during and after sand extraction activities. The management and monitoring plans will consider: • the nature and control of sediment run-off during the extraction phase particularly as a result of an exceptional storm event; • the volume, path and content of stormwater discharging from the site during and after extraction; • the handling of hydrocarbon spills on the site ; • existing flow regime of surface and groundwater flow from the proposed extraction area into the forested wetlands; and • weed invasion
Biodiversity Offset Strategy	A biodiversity offset strategy will be adopted as outlined in detail in Annex P of the EA. Biodiversity offsets are proposed on lands currently owned by Sibelco, comprising portions of Lots 11 to 13, DP601306 (approximately 18.35 ha) and all of Lot 24, DP579700 (approximately 9.44 ha) (the offset lands). A secure offset mechanism (through a Voluntary Conservation Agreement or other similar tool for management in perpetuity) will be placed over these offset lands, which will result in permanent protection and management of the land and result in numerous ecological benefits.
Aboriginal Heritage	As ground visibility is limited within the extraction extension area, further archaeological work is required prior to commencement of extraction operations. The further assessment will be undertaken in accordance with any conditions of consent and will consist of a prospective clearing program that will be undertaken to improve ground visibility and allow the registered Aboriginal stakeholders to inspect the ground surface within the approved extraction area, to provide greater certainty of the presence or otherwise of Aboriginal archaeological sites. Sibelco will contact the three Aboriginal stakeholder groups at least three weeks prior to the proposed clearing and invite them to attend. Details of the methodology as agreed by the registered Aboriginal stakeholders is presented in Chapter 7 of Annex N of the EA, including procedures for undertaking the required site clearance, required actions should Aboriginal sites or artefacts be found during the prospective clearing program, and the requirements for updating the Cultural Heritage Management Plan, which will be undertaken prior to commencement of any extraction.

Issue	Mitigation Measure/Commitment
Bushfire	• provision of a separation distance (minimum of 10 m) between stockpiles of combustible material and remnant vegetation;
	• managing operations and the site to minimise likelihood of ignition sources through good 'housekeeping' (for example, all waste in bins);
	• emergency planning procedures in the event of a fire occurring on the site;
	• fitting of all earth moving machinery with spark arresting mufflers and haul trucks have serviceable exhaust systems to prevent accidental ignition of vegetation; and
	• equipping the operations to assist in the management of any fires on-site, including presence of fire extinguishers, water cart (as contracted), and the site front-end loader and bulldozer for any requisite fire fighting purposes.
Waste Management	• no burning of waste;
	• any noxious plant species will be removed from the site, bagged and disposed of at a licensed landfill;
	• any waste will be removed daily and recycled or disposed of directly at a licensed landfill; and
	• the site will be maintained and kept free of rubbish and cleaned up at the end of each working day.

APPENDIX 4
BIODIVERSITY OFFSET STRATEGY


Medowie State Conservation Area
Snapper Island Nature Reserve
Gir-um-bit National Park
Gir-um-bit State Conservation Area
Tilligerry State Conservation Area
Tilligerry National Park
Worimi National Park
Legend
Study Area
Proposed Extraction Area
Proposed Offset Areas
SEPP14 Wetlands
National Park
Nature Reserve
Regional Park
State Conservation Area
ecobiological
Map Projection:
GDA 1994 MGA Zone 56
Data Sources:
LPMA - 2011
ecobiological - 2011
Project Ref: 103-632
Plot Date: 22/05/2012 11:08
Revision: 001 (gayle.j)

APPENDIX 2

NEST BOX, AMPHIBIAN AND KOALA MONITORING REPORT

North Dune Extension Biodiversity Offset Area 2021 Monitoring Report

Tanilba North Dunes Extension Northern Biodiversity Offsets Area

20221962

21 March 2022

KLEINFELDER
Bright People. Right Solutions.

Suite 3, 240-244 Pacific Highway,
Charlestown, NSW 2290

Phone: +61 2 4949 5200

North Dune Extension Biodiversity Offset Area 2021 Monitoring Report

Rutile Rd, Oyster Cove, NSW

Kleinfelder Project: 20221962

Kleinfelder Document: NCA22R137574

Prepared for:

Holcim (Australia) Pty Ltd
9 Oakvale Rd.,
Salt Ash, NSW 2319

Prepared by:

Kleinfelder Australia Pty Ltd

Suite 3, 240-244 Pacific Highway, Charlestown, NSW 2290
Phone: +61 2 4949 5200
ABN: 23 146 082 500

Document Control:

Version	Date	Description	Author	Reviewed
1.0	21 March 2022	Draft for client review	M.Dean/N.Fisher	N.Fisher

EXECUTIVE SUMMARY

Holcim (Australia) Sibelco Australia has consent to extract white silica sand from the Tanilba North Dune Extension located in the Oyster Cove area, in the Port Stephens Council Local Government Area. Schedule 3, Condition 15 of the Tanilba Northern Dune Extension Project Approval (MP 09_0091) required the preparation of a Biodiversity Management Plan (BMP) (Kleinfelder, 2019). The BMP outlines management measures for the approved Biodiversity Offsets Areas (BOA). BOAs for the project have been established in the north-east of the approved extraction area (Northern Biodiversity Offset Area, NBOA). The NBOA consists of an area of 18.3 ha of native vegetation in varying condition that is covered by Lots 11, 12 and 13 of DP 601306 and is located to the north and north-east of the Tanilba North Dunes Extension sand extraction project. The NBOA is owned as freehold by Holcim (Australia).

The BMP requires the following actions to be undertaken within the NBOA. The relevant sections of the BMP are noted:

- *Annual inspection and monitoring to be conducted by a suitably qualified person/s (Section 5.1.3B) – results detailed in this report,*
- *Implementation of a nest box installation and monitoring program within the northern offset area to replace hollow bearing tress removed from the extraction area (Section 5.1.3F),*
- *Targeted fauna monitoring across all offset areas to monitor for Wallum Froglet (Crinia tinnula), Mahony's Toadlet (Uperoleia mahonyi), and Koala (Phascolarctos cinereus) (Section 5.2),*
- *Establishment of a habitat restoration and rehabilitation program across the offset areas (including the visual amenity buffer along the northern boundary of the extraction area) consisting of (Section 5.1.3D),*
    - *Annual inspections to identify areas requiring weed and pest control (5.1.3B),*
    - *A weed and pest management program (Section 5.1.3C),*
    - *Enhancement of the availability of habitat for the Koala through the installation of Eucalyptus robusta (Swamp Mahogany) within the offset area (Section 5.1.3D),*
    - *Rehabilitation of the regenerating Grassland-Heath to the surrounding Swamp Mahogany – Paperbark Swamp Forest through seeding and planting of appropriate species (Section 5.1.3D).*

To satisfy the above requirements, Kleinfelder was engaged by Holcim to conduct targeted fauna monitoring for the amphibians and koalas as outlined above, annual monitoring of the 52 nest boxes that have been installed in the NBOA, an assessment of the vegetation of the NBOA and weed mapping to inform and conduct weed control works.

Amphibians

Targeted fauna monitoring for the Wallum Froglet (Crinia tinnula) and Mahony's Toadlet (Uperoleia mahonyi) was conducted by Kleinfelder ecologists on the 14 October, 10 November 2021 and 19 January 2022 by two ecologists over the three nights, following periods of rainfall. A prior diurnal assessment of the offset areas was conducted to determine habitat suitability. Surveys consisted of a meandering search in the NBOA. Several areas were noted which had the potential to contain water after rainfall and later became the target of nocturnal surveys. Nocturnal surveys for amphibian species employed visual and audible detection techniques with the aid of spotlights. Crinia tinnula was recorded within the NBOA on all survey nights at multiple locations while U. mahonyi was not identified within the NBOA during this years monitoring event. An adjacent waterbody to the east was visited to confirm the presence of U. mahonyi and C. tinnula and only C. tinnula were found to be calling. Opportunistic sightings of non-target amphibian species were also recorded. Additional opportunistic sightings of

non-amphibian species within the NBOA included the Brushtail Possum (Trichosurus vulpecula) and an unidentified species of freshwater crayfish. Results from the surveys show that one of the targeted species are utilising the NBOA for breeding and foraging habitat when the conditions are suitable. With no permanent water bodies on the NBOA, this is restricted to periods of higher rainfall. Nearby more permanent water bodies are presumed to be the core habitat for these species. Ongoing surveys after suitable rain events will determine if the species continue to utilise the NBOA.

Koala SAT Surveys

Koala monitoring was undertaken using the Spot Assessment Technique (SAT) within the NBOA as described by Phillips and Callaghan (2011). The SAT test involves a radial survey of koala "activity" within the immediate area of a tree that is known or deemed to be utilised by koalas. The search beneath each tree is conducted for two person minutes or until a single pellet is found, whichever occurs first. A tree is defined as a live woody stem of any species (except for cycads, palms, tree ferns and grass trees) which has a diameter at breast height (dbh) greater than 10cm. Two Kleinfelder ecologists conducted three SAT surveys on the 14 October 2021. A total of 15 SAT tests were to be conducted over the offset area although with the high rainfall totals the majority of the area has been inundated with water and is not possible to conduct the other 12 SAT tests. The SAT surveys that could be completed in 2021 found Koala activity in the NBOA to be the same from the 2020 data. Within the NBOA, the greater activities are found to be within the Swamp Mahogany – Paperbark Swamp Forest in the north of the offset area where there are mature trees for feeding, although evidence of use was found throughout the extent of the NBOA in previous years monitoring. The NBOA has good habitat suitability for the koala to the north of the area, although parts of this area were hard to traverse due to of thick belt of Lantana camara (Lantana) dominating the understory which has the potential to hinder Koala movement through the site. The remaining southern areas of the NBOA are still regenerating but have shown promising signs of koala use in previous years monitoring which will continue to improve as the trees mature.

Nest Box Monitoring

In December 2015, Kleinfelder installed 52 nest boxes within the NBOA as per the offset requirements for the Tanilba Northern Dune Extension Project. As per the Nest Box Installation and Monitoring Protocol within the Biodiversity Management Plan – Tanilba Northern Dune Extension (Kleinfelder 2019), the 52 nest boxes were required to be monitored annually for a period of six years. This was the fifth survey conducted by Kleinfelder on behalf of Holcim (Australia) and the previous owners of the site, Sibelco Australia. Nest boxes were monitored using a wireless GoPro™ camera mounted on an extension pole capable of reaching heights of over 6 m. A live video feed is transferred wirelessly from the camera to an iPhone device capable of capturing still HD images or video. Images were captured in the field and processed in the office. A handheld Global Positioning System (GPS), pre-loaded with co-ordinates, was used to locate the boxes. Once a box was located, the pole camera was used to open the lid and to observe the contents. In 2021, the percentage of all nest boxes exhibiting any sign of use was 50% (26). Seventeen percent (17) of the total number of nest boxes were determined to be unavailable for use resulting from occupation by pest species such as wasps, bees or rats and missing boxes. In 2021, two boxes (4%) were observed to have animals present (A). There were three boxes showing recent evidence of use with four boxes within the "moderately fresh" category, and the total number of boxes showing

old evidence was 17 boxes, or 33% (Chart 2). A total of nine boxes were categorised as either NA – not available due to insects as noted above, but four boxes were noted to being missing, believed stolen. This brought the total number of nest boxes available for fauna use to 43, three less than the 2021 survey.

Fauna uptake of the nest boxes was successful in the first year of installation with several species of mammals and reptiles recorded occupying boxes, and evidence of usage across many more boxes. Since that initial survey, no fauna has been recorded in the boxes in 2019 and 2020. In the recent survey in 2021 has seen an increase in usage and Fauna present within two of the nest boxes.This year's survey was brought forward into the winter (August) to determine if the fauna were not using the nest boxes in the heat of the summer of the months. In 2021 fauna was recorded occupying two of the nest boxes, with evidence of usage increased from the last two years (scratches or nesting materials) judged to be fresh and moderately fresh, indicating some type of continuing usage. Suggestions for further action are –

- *Increase the survey effort to twice per year one in the autumn/winter and one in the following spring for a single year. This would indicate whether the Offsets nest boxes are being used seasonally or whether the Offsets are no longer being used for nesting, and following on from the above,*
- *Placing remote cameras in the offsets to determine if fauna are utilising the offsets for foraging and are simply not using the nest boxes, but utilising natural hollows in adjacent vegetation.*

Vegetation Condition Survey

An annual inspection of the NBOA is to be conducted as per Section 5.1.3B of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2019). This survey was conducted on 27th January 2021.As per the BMP, photo monitoring points were established, weed infestations were noted, locations of rubbish dumping were noted, survey the regeneration and health of the Eucalyptus robusta along one transect, east to west across the BOA noting the size in classes of trees 1m either side of the transect, noting the extent and requirement of any revegetation works in the BOA.

*South of Rutile Rd, a small section of the NBOA abuts the extraction zone. Most of this area was affected by the 2018 fires but has recovered with increased rainfall in late 2020 and early 2021. The condition improves moving east from Coastal Sand Apple Blackbutt Forest that fringes the extraction zone and Block Q2 which is quite weed infested until good condition Swamp Mahogany – Paperbark Forest is encountered. This area has some scattered Fishpole Bamboo (Phyllostachys aurea), and Bugle Lily (Watsonia meriana). The 50m buffer zone of vegetation along Rutile Rd is quite weedy with exotic grasses, Lantana (Lantana camara) and some minor Blackberry (Rubus fruticosus spp. agg.), Glory Lilly (Gloriosa superba), W. meriana and Pinus elliottii (Slash Pine) as well as others. Regeneration of the E. robusta within this "regenerating" area was assessed by measuring the health and size of E. robusta trees within 1 m of a transect running East to West across the NBOA (Figure 6). The individual trees were divided into five height classes (<1m, 1-2m, 2-10m, 10-15m and >15m or mature trees) for determination of age. Trees <1m in height were classified as seedlings/saplings, trees 1-2m in height were classified as saplings, trees between 2 and 10m were classified as immature trees, trees 10-15m were classified as intermediate, while trees estimated to be over 15m in height were classified as mature (**Table 4**). This year, a total of 114 trees (81 trees last survey) were assessed along the transect that was approximately 400m long. The assessment found that there were two saplings <1m, only 11 were estimated to be between 1-2m in height, with 76 trees estimated to between 2-10m, 25 trees between 10-15m tall and no trees assessed as mature. The majority of the E. robusta – 92 trees - were located in the eastern section of Swamp Mahogany – Paperbark Swamp Forest. Two areas at*

*the western end of the NBOA are classified as regenerating grassland where the density of trees and shrubs is greatly reduced. Since the initial survey in 2013, natural regeneration has occurred, with many shrubs and some midstorey species self-seeding (**Plate 9**). The northern most section of the NBOA has been classified as mature Swamp Mahogany – Paperbark Swamp Forest. This area contains mature E. robusta and Melaleuca quinquenervia trees with an understorey of Tall Saw-sedge (Gahnia clarkei) and other swamp flora. Lantana has colonised this section of the BOA with infestation levels varying from scattered individuals to very heavy (<75% cover), with a belt of dense Lantana acting to separate this section from the southern regenerating section of the BOA (**PP7 Plate 10**). Evidence of previous control works conducted by Kleinfelder is visible.*

Where weed species have not become established the condition of the native vegetation is quite good. Native vegetation is generally in good health with no visible dieback observed amongst the canopy species on site. The regenerating grassland is slowly self-seeding with some native species such as Coastal Wattle (Acacia longifolia) and Coast Teatree, but would benefit from a modest planting program of tubestock installation of E. robusta, Red Bloodwood (Corymbia gummifera) and Smooth-barked Apple (Angophora costata). Sibelco Australia (the previous owners) had commenced a modest weed control program, and Holcim (Australia) have continued this program. Further on-going and more intense weed control efforts will be required to improve the condition of the BOA.

Weed Control Works

Kleinfelder was engaged by Holcim (Australia) to conduct weed control works in the BOA during the 2021 reporting period. These works consisted of a team of two Land Management Technicians working on site for two rounds of two days each. Works were performed on the 23th and 27th November 2021 and the 14th and 17th of January 2022. The technicians were instructed to work from areas of low infestation towards higher infestation and concentrated on the southern and eastern sections of the BOA. The November weed control effort targeted the Bugle Lily, Fishpole Bamboo and Slash Pine. The January weed control effort again applied herbicide to the lantana, slash pine, Bugle Lily and Fishpole Bamboo.

TABLE OF CONTENTS

1 INTRODUCTION 3
1.1 BACKGROUND 3
1.2 SCOPE 3
2 TAREGETED AMPHIBIAN SURVEYS 5
2.1 AMPHIBIANS 5
2.1.1 Methods and Results 5
2.1.2 Discussion 6
2.2 KOALA SPOT ASSESSMENT TECHNIQUE (SAT) TESTS 10
2.2.1 Monitoring Methodology 10
2.2.2 Results and Discussion 10
2.3 NEST BOX MONITORING 13
2.3.1 Background 13
2.3.2 Monitoring Methods 13
2.3.3 Results 13
2.3.4 Discussion 17
3 VEGETATION CONDITION SURVEY 18
3.1 BACKGROUND 18
3.2 RESULTS 18
3.2.1 General Condition 18
3.2.2 Weed Mapping 26
3.2.3 Vegetation Condition Discussion and Recommendations 28
4 WEED CONTROL WORKS 29
4.1 WORKS PERFORMED 29
4.2 DISCUSSION 29
5 REFERENCES 31

TABLES

Table 1: Weather Conditions During Surveys 5
Table 2 Amphibian presence during targeted nocturnal monitoring 5
Table 3: Koala activity levels from the Spot Assessment Technique. 11
Table 4: *Eucalyptus robusta* trees surveyed in the Northern Dunes Offsets Area 19

FIGURES

Figure 1: Locality of the Northern Biodiversity Offsets Area and its relationship to the Tanilba North Dunes Extension sand extraction project. 4
Figure 2: Targeted Amphibian Survey Transects 7
Figure 3 Location of SAT test sites within the NBOA surveyed for the 2021 Monitoring report 12
Figure 4 Location and summary of usage for 52 nest boxes surveyed in 2021. 16
Figure 5: Vegetation Condition Monitoring 22
Figure 6: Weed Mapping of the BOA 2021 27
Figure 7: Weed Control works conducted on the BOA in 2021 and 2022. 30

PLATES

Plate 1 Mahony's Toadlet (*Uperoleia mahonyi*) 8
Plate 2 Wallum Froglet (*Crinia tinnula*) 8
Plate 3 Ornate Burrowing Frog (*Platyplectrum ornatum*) 9
Plate 4: Nest box 41 with four Sugar Gliders in residence 15
Plate 5: PP1 looking east showing poor condition (foreground) and better condition vegetation (background) 23
Plate 6: PP2 looking north showing dense Lantana and previous control works 23
Plate 7: PP3 looking north showing typical understorey 24
Plate 8: PP4 looking north along access track showing Slash Pine infestation and control works (bottom left). Illegal dumping is visible in the centre of the track 24
Plate 9: PP5 looking south showing dense Bugle Lily infestation 25
Plate 10: PP6 looking west showing the regenerating grassland area (north). Note the shrubby regrowth. . 25
Plate 11: PP7 looking north at the dense Lantana "belt" that separates the regenerating and mature Swamp Mahogany – Paperbark Swamp Forest. Control efforts are visible in the foreground. 26

CHARTS

Chart 1 General usage rates of nest boxes in 2021 and comparison to previous surveys 14
Chart 2 Detailed usage by category of nest boxes for the 2020 survey and comparison to the previous surveys 14
Chart 3 Detailed usage per nest box type for the 2021 survey and comparison to the previous surveys 15

APPENDICES

Appendix A: Weed Control Works Daily Worksheets
Appendix B: Staff Contributions

1 INTRODUCTION

1.1 BACKGROUND

Holcim (Australia) Sibelco Australia has consent to extract white silica sand from the Tanilba North Dune Extension located in the Oyster Cove area, in the Port Stephens Council Local Government Area.

Schedule 3, Condition 15 of the Tanilba Northern Dune Extension Project Approval (MP 09_0091) required the preparation of a Biodiversity Management Plan (BMP) (Kleinfelder, 2019). The BMP outlines management measures for the approved Biodiversity Offsets Area (BOA).

The Northern BOA consists of an area of 18.3 ha of native vegetation in varying condition that is covered by Lots 11, 12 and 13 of DP 601306 and is located to the north and north-east of the Tanilba North Dunes Extension sand extraction project. The NBOA is owned as freehold by Holcim (Australia) (**Figure 1**).

1.2 SCOPE

The BMP requires the following actions to be undertaken within the NBOA. The relevant sections of the BMP are noted:

- Annual inspection and monitoring to be conducted by a suitably qualified person/s (Section 5.1.3B) – results detailed in this report,
- Implementation of a nest box installation and monitoring program within the northern offset area to replace hollow bearing tress removed from the extraction area (Section 5.1.3F),
- Targeted fauna monitoring across all offset areas to monitor for Wallum Froglet (Crinia tinnula), Mahony's Toadlet (Uperoleia mahonyi), and Koala (Phascolarctos cinereus) (Section 5.2),
- Establishment of a habitat restoration and rehabilitation program across the offset areas (including the visual amenity buffer along the northern boundary of the extraction area) consisting of (Section 5.1.3D),
    - Annual inspections to identify areas requiring weed and pest control (5.1.3B),
    - A weed and pest management program (Section 5.1.3C),
    - Enhancement of the availability of habitat for the Koala through the installation of Eucalyptus robusta (Swamp Mahogany) within the offset area (Section 5.1.3D),
    - Rehabilitation of the regenerating Grassland-Heath to the surrounding Swamp Mahogany – Paperbark Swamp Forest through seeding and planting of appropriate species (Section 5.1.3D).

To satisfy the above requirements, Kleinfelder was engaged by Holcim to conduct targeted fauna monitoring for the amphibians and koalas as outlined above, annual monitoring of the 52 nest boxes that have been installed in the NBOA, an assessment of the vegetation of the NBOA and weed mapping to inform and conduct weed control works.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/08 11:35 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2021
NSW OEH - 2021
Nearmap - 2022

Locality

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

1

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig1_Locality.mxd

2 TARGETED AMPHIBIAN SURVEYS

2.1 AMPHIBIANS

Targeted fauna monitoring for the Wallum Froglet (*Crinia tinnula*) and Mahony's Toadlet (*Uperoleia mahonyi*) was conducted by Kleinfelder ecologists as part of the requirements outlined in section 5.1.4 of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2014). Monitoring was conducted on the 14 October, 10 November 2021 and 19 January 2022 by two ecologists over the three nights, following periods of rainfall. Surveys were undertaken at night, after rainfall was received (**Table 1**). **Figure 1** represents the northern dune offset areas in which the nocturnal surveys were conducted.

Table 1: Weather Conditions During Surveys

Date	Temperature (°C)	Humidity (%)	Barometric pressure (hPa)	Wind (spd/direction)	Rain past 24 hours (mm)	Rain past 5 days (mm)
14/10/2021	26.8	62	1003.8	31/NE	1.2	54.8
10/11/2021	21.9	89	1004.8	17/SSE	0.4	21.4
19/01/2022	23.4	86	1019.1	19/S	32.0	37.6

2.1.1 Methods and Results

A prior diurnal assessment of the offset areas was conducted to determine habitat suitability. Surveys consisted of a meandering search in the Northern Offset Area. Survey effort was focused around ephemeral and semi-permanent water bodies using both spotlighting and call-playback techniques. Surveys revealed that no permanent water existed within the offset area. Several areas were noted which had the potential to contain water after rainfall and later became the target of nocturnal surveys. The greatest potential to detected threatened amphibian species was identified within the northern offset with habitats including areas of Melaleuca/Swamp Mahogany forest and low-lying areas dominated by herbs, rushes and/or emergent vegetation.

Nocturnal surveys for amphibian species employed visual and audible detection techniques with the aid of spotlights. The Wallum Froglet (*C. tinnula*) was detected all survey nights within and adjacent to the NBOA. *Crinia tinnula* was recorded within the NBOA on all survey nights at multiple locations while *U. mahonyi* was not identified within the NBOA (**Figure 1**). An adjacent waterbody to the East was visited to confirm the presence of *U. mahonyi* and *C. tinnula* and only *C. tinnula* was confirmed to be calling *U. mahonyi* was not calling on any of the survey nights. **Table 2** represents amphibian records for the three nights of surveys in October, November 2021 and January 2022. Opportunistic sightings of non-target amphibian species were also recorded. Photos of amphibians taken over the duration of the monitoring period are included below. Addition opportunistic sightings of non-amphibian species within the NBOA include the Brushtail Possum (*Trichosurus vulpecula*) and a species of freshwater crayfish.

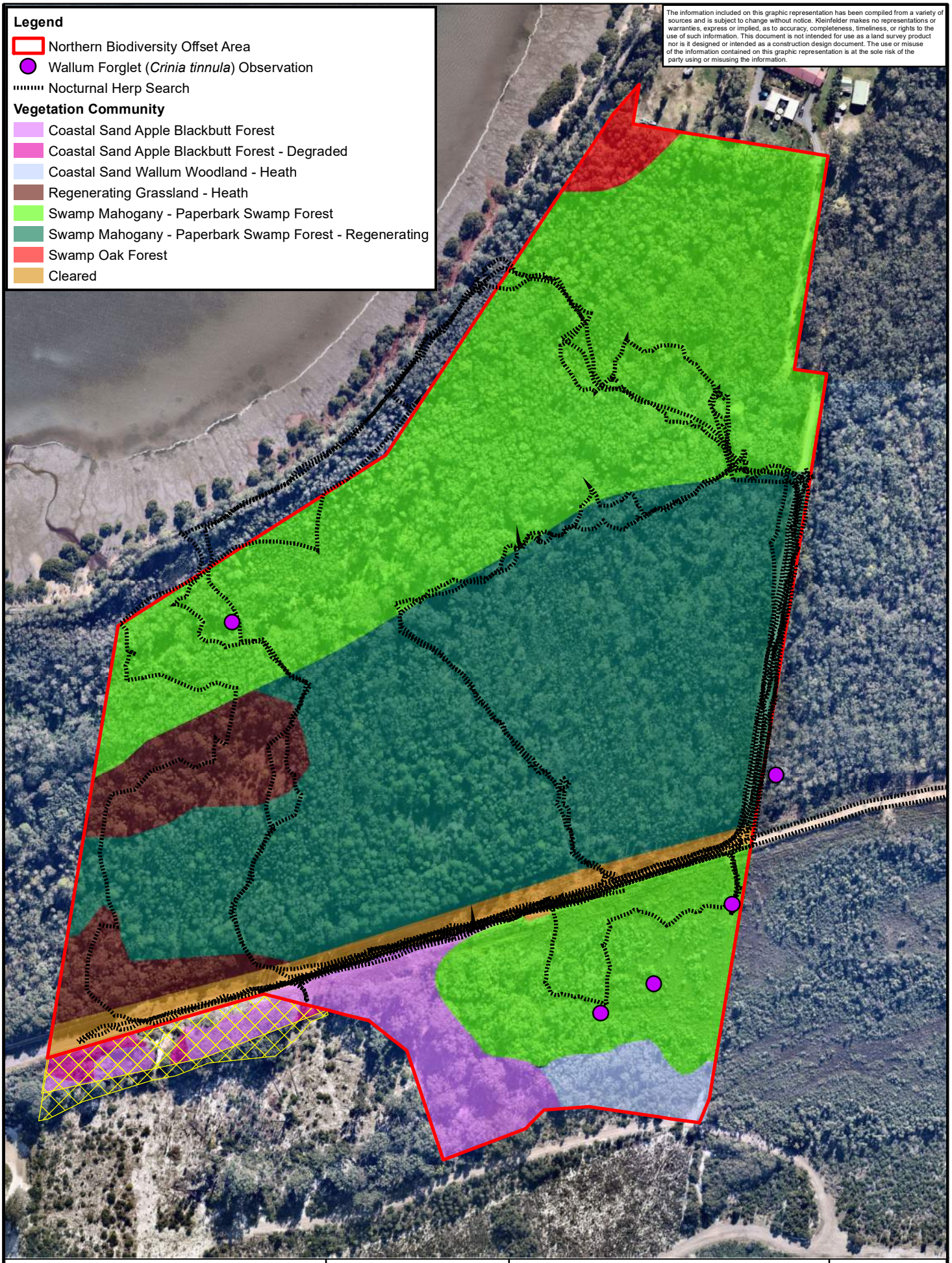
Table 2 Amphibian presence during targeted nocturnal monitoring

Species detected	Observation type	14/10/2021	10/11/2021	19/01/2022
Crinia signifera	Heard	+	+	+
Crinia tinnula	Heard/Observed	+	+	+
Limnodynastes peronii	Heard/Observed	+	+	+

Species detected	Observation type	14/10/2021	10/11/2021	19/01/2022
Litoria fallax	Heard/Observed	+	+	-
Litoria latopalmata	Heard	-	+	-
Litoria freycineti	Heard/Observed	-	+	+
Platyplectrum ornatum	Heard/Observed	+	+	-
Uperoleia mahonyi	-	-	-	-

2.1.2 Discussion

Results from the surveys show that the targeted species are utilising the NBOA for breeding and foraging habitat when the conditions are suitable. With no permanent water bodies on the NBOA, this is restricted to periods of higher rainfall. Nearby more permanent water bodies are presumed to be the core habitat for these species. Ongoing surveys after suitable rain events will determine if the species continue to utilise the NBOA.



Metres
0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/08 12:07 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2021
NSW OEH - 2021
Nearmap - 2022

Frog Survey Effort and Observations

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

2

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig2_FrogSurveys.mxd

Plate 1 Mahony's Toadlet (*Uperoleia mahonyi*)

Plate 2 Wallum Froglet (*Crinia tinnula*)

Plate 3 Ornate Burrowing Frog (*Platyplectrum ornatum*)

2.2 KOALA SPOT ASSESSMENT TECHNIQUE (SAT) TESTS

Koala monitoring for the NBOA was undertaken by Kleinfelder as part of the requirements of section 5.2 of the of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2019):

2.2.1 Monitoring Methodology

Koala monitoring was undertaken using the Spot Assessment Technique (SAT) within the NBOA as described by Phillips and Callaghan (2011). The SAT test involves a radial survey of koala "activity" within the immediate area of a tree that is known or deemed to be utilised by koalas. In the field this the test is applied as follows:

- Locate and mark a tree (the centre tree) that meets one of more of the following criteria,
  - A tree of any species beneath which are one or koala fecal pellets and/or,
  - A tree in which a koala has been overserved and/or,
  - Any other tree known or considered to be a potentially important for koalas.
- Identify and mark the nearest 29 trees to the centre tree,
- Undertake a search for koala fecal pellets beneath each of the 30 marked trees based on a cursory inspection of the undisturbed ground surface within a distance of 1m of the base of the tree. If no fecal pellets are found, a more thorough inspection of the leaf litter and ground cover is conducted.

The search beneath each tree is conducted for two person minutes or until a single pellet is found, whichever occurs first. A tree is defined as a live woody stem of any species (except for cycads, palms, tree ferns and grass trees) which has a diameter at breast height (dbh) greater than 10cm. Two Kleinfelder ecologists Mark Dean and James Baldry conducted SAT surveys on the 14 October 2021. A total of 3 SAT tests were conducted over the offset area in 2021 with the other 12 SAT locations being unable to be surveyed due to the excess amount of rainfall and flooding of the Offset area to the North of Rutile Rd (**Figure 1**).

2.2.2 Results and Discussion

The SAT surveys that were completed (total of three) in 2021 found Koala activity in the NBOA to be the same although during this year's surveys within 2021 there has been an increase in rainfall with a total of 1735mm of rain with a yearly average of 1342mm (BOM Nelson Bay 61054). The section of the NBOA north of Rutile Rd has become inundated with water for the majority of the survey period which cannot be surveyed and would not find any evidence of Koala activity with the high water levels. Please see **Table 3** and **Figure 3** for Koala activity levels for each SAT test for the NBOA. Within the NBOA, the greater activities were found to be within the Swamp Mahogany – Paperbark Swamp Forest in the north of the offset area during the 2019 and 2020 where there are mature trees for feeding, although evidence of use was found throughout the extent of the NBOA.

The NBOA has good habitat suitability for the koala with plenty of mature *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Casuarina glauca* (Swamp She-oak) to the north of the area, although parts of this area were hard to traverse due to of thick belt of *Lantana camara* (Lantana) dominating the understory which has the potential to hinder Koala movement through the site. The remaining southern areas of the NBOA are still regenerating but have shown promising signs of koala use which will continue to improve as the trees mature. This will provide koalas with more habitat and a greater food source in the future.

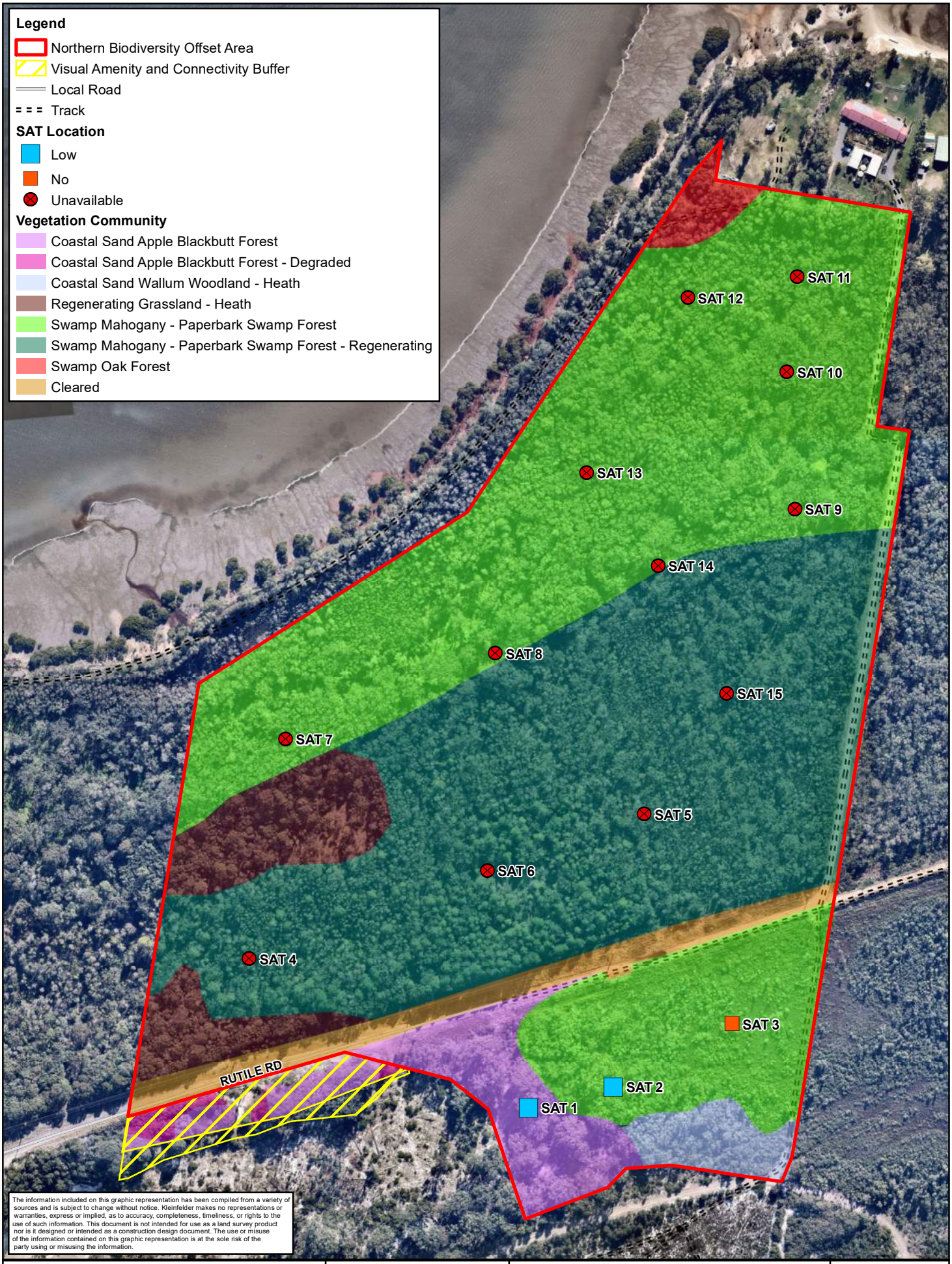
The assessed low activity levels within the NBOA suggest that koalas are not permanently resident within the site but use it to transition between other areas of higher populations. Despite the apparent suitability of the NBOA as habitat, a number of possible factors can be suggested as to why the site is not used at higher levels or even permanently. As alluded to above, there is a dense lanata understory that effectively separates the site in two (see Weed Mapping Section below). There have been historic and ongoing disturbance due to recent fires, and human activity including motorcycle riding, dog walking and rubbish dumping, although these activities within the NBOA have decreased as the vegetation has increased in density and made access to the site more difficult. As discussed above higher rainfall and site inundation would remove all scats onsite and therefore would be less evidence of usage when using the SAT survey technique. It is recommended when the site becomes drier to be

able to conduct the rest of the SAT surveys so the report can be updated in the coming months. More active management actions as instigated by Holcim will improve the suitability of the NBOA in the future.

Table 3: Koala activity levels from the Spot Assessment Technique.

Location	No Activity			Low Activity			Medium Activity			High Activity		
Northern Offset Area												
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
1				+	+	+						
2				+	+	+						
3	+	+	+									
4		+	-	+		-			-			-
5			-	+	+	-			-			-
6		+	-	+		-			-			-
7			-		+	-	+		-			-
8			-			-	+	+	-			-
9			-	+	+	-			-			-
10			-	+	+	-			-			-
11			-	+	+	-			-			-
12			-	+	+	-			-			-
13			-	+	+	-			-			-
14			-	+	+	-			-			-
15	+	+	-									

(- Areas not completed due to water indundation)



Metres
0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962
DATE DRAWN: 2022/03/08 12:17Version 1
DRAWN BY: GJoyce
DATA SOURCE:
Nearmap - 2022
NSW DFSI - 2021

Koala Survey

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:
3

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig3_KoalaSurvey.mxd

2.3 NEST BOX MONITORING

2.3.1 Background

In December 2015, Kleinfelder installed 52 nest boxes within the NBOA as per the offset requirements for the Tanilba Northern Dune Extension Project. The following types of nest boxes were installed within the Northern Offset Area:

- 16 Microchiropteran bat boxes,
- 34 Glider boxes, and
- 2 Possum boxes.

As per the Nest Box Installation and Monitoring Protocol within the Biodiversity Management Plan – Tanilba Northern Dune Extension (Kleinfelder 2019), the 52 nest boxes were required to be monitored annually for a period of six years (Figure 4). In 2018 fire destroyed six nest boxes (three Bat and three Glider boxes) which were replaced after the 2018 monitoring. This was the fifth survey conducted by Kleinfelder on behalf of Holcim (Australia) and the previous owners of the site, Sibelco Australia.

2.3.2 Monitoring Methods

Two Kleinfelder Ecologists, Mark Dean, with experience and accreditation in handling animals and working at heights attended the site on 11 August 2021. Nest boxes were monitored using a wireless GoPro™ camera mounted on an extension pole capable of reaching heights of over 6 m. A live video feed is transferred wirelessly from the camera to an iPhone device capable of capturing still HD images or video. Images were captured in the field and processed in the office. A handheld Global Positioning System (GPS), pre-loaded with co-ordinates, was used to locate the boxes. Once a box was located, the pole camera was used to open the lid and to observe the contents. Status of the boxes were recorded as either:

- A – Animal present,
- E1 – Fresh evidence of use (i.e., fresh nest or scats),
- E2 – Moderately fresh evidence of use (i.e., green leaves but beginning to age),
- E3 – Old signs of use (i.e., old leaf nest, old scats),
- N – No evidence of use,
- NA – Not available for use, and
- X – Missing.

If a box was found to be occupied, an attempt was made to capture the animal for positive identification, where required. Signs of use include the presence of hair, scats, nesting material or evidence of scratches/physical marks on the entrance of the nest box. Boxes which contained wasp nests or other pest species, had lids which were open or missing, or had fallen or were missing/destroyed were deemed to be not available for use by target animals.

2.3.3 Results

In 2021, the percentage of all nest boxes exhibiting any sign of use was 50% (26) (**Chart 1**). Seventeen percent (17) of the total number of nest boxes were determined to be unavailable for use resulting from occupation by pest species such as wasps, bees or the box was found to missing from its location on the site. Nest boxes 44 (Glider), 45 (Bat), 46 (Glider) and 47 (Glider) were missing. This reduces the number of available boxes to 43, but the remaining statistics regarding usage are based upon the original number (52) to provide a more accurate comparison. Use of nest boxes by insects is generally a temporary feature, and as the insects move on, the box becomes available for use by vertebrates.

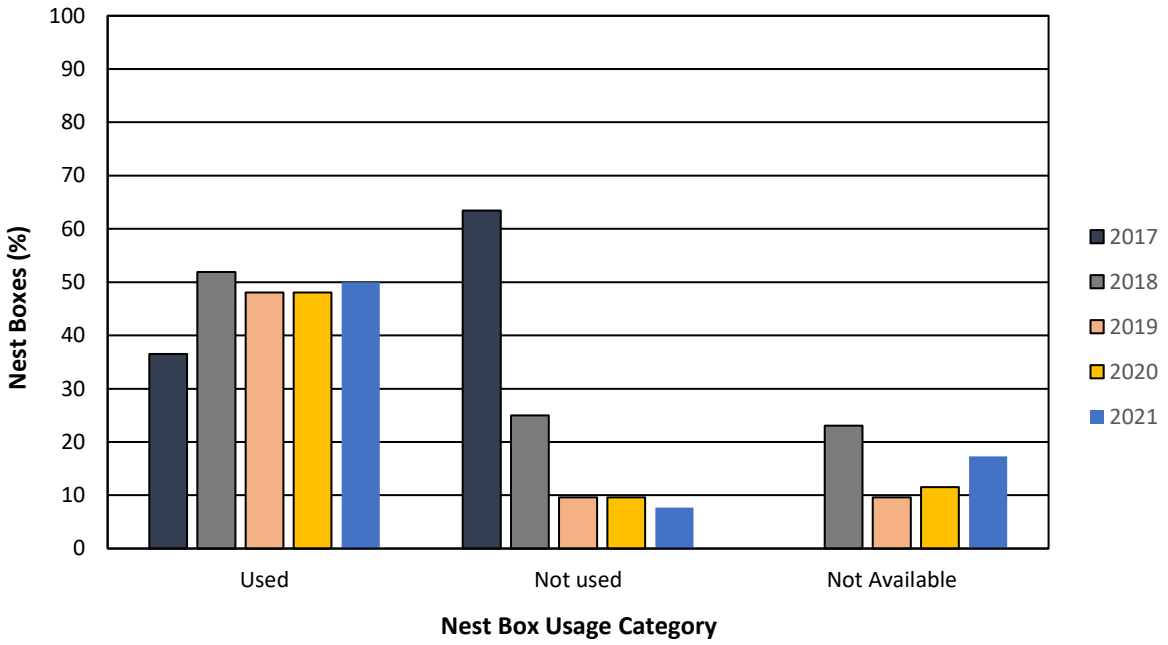


Chart 1 **General usage rates of nest boxes in 2021 and comparison to previous surveys**

In 2021, two boxes (4%) were observed to have animals present (A). There were three boxes showing recent evidence of use with four boxes within the "moderately fresh" category, and the total number of boxes showing old evidence was 17 boxes, or 33% (**Chart 2**). A total of nine boxes were categorised as either NA – not available due to insects as noted above, but four boxes were noted to being missing, believed stolen. This brought the total number of nest boxes available for fauna use to 43, three less than the 2021 survey.

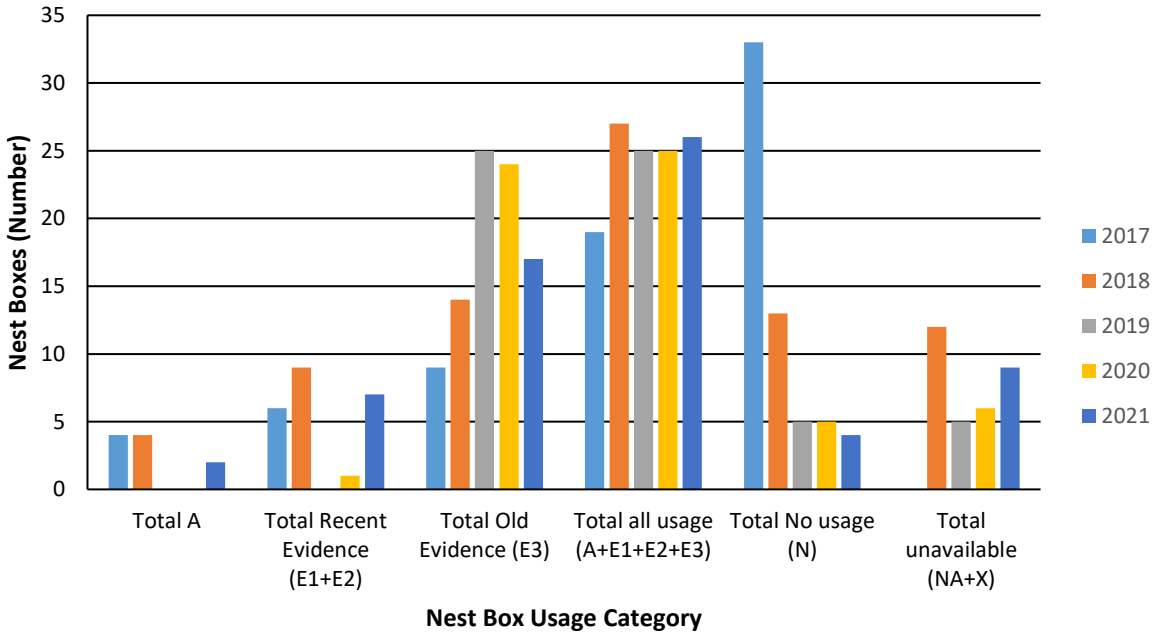


Chart 2 **Detailed usage by category of nest boxes for the 2020 survey and comparison to the previous surveys**

Usage per box type in 2021 is shown in **Chart 3**. Two of the Possum boxes showed evidence of use with one being occupied by a Common Brushtail Possum (*Trichosurus vulpecula*), Glider boxes had a utilisation rate of 71% (24 out of 34 boxes) with one of the boxes being utilised by four Sugar Gliders (*Petaurus breviceps*) (**Plate 4**) with another box be occupied by a Black Rat (*Rattus rattus*) which was captured and euthanised.

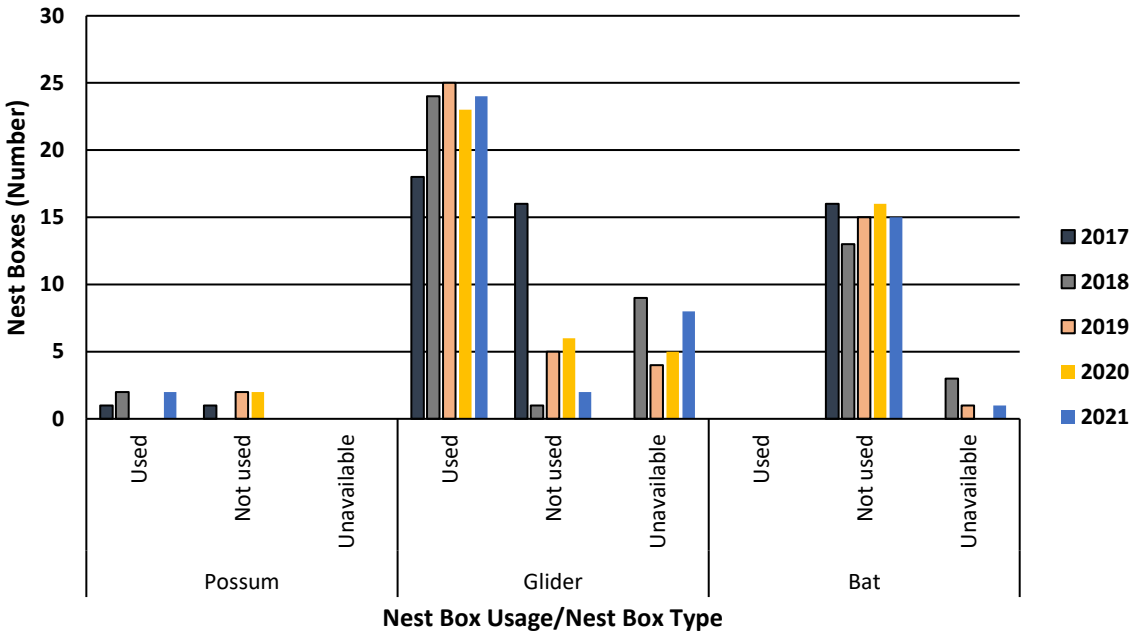
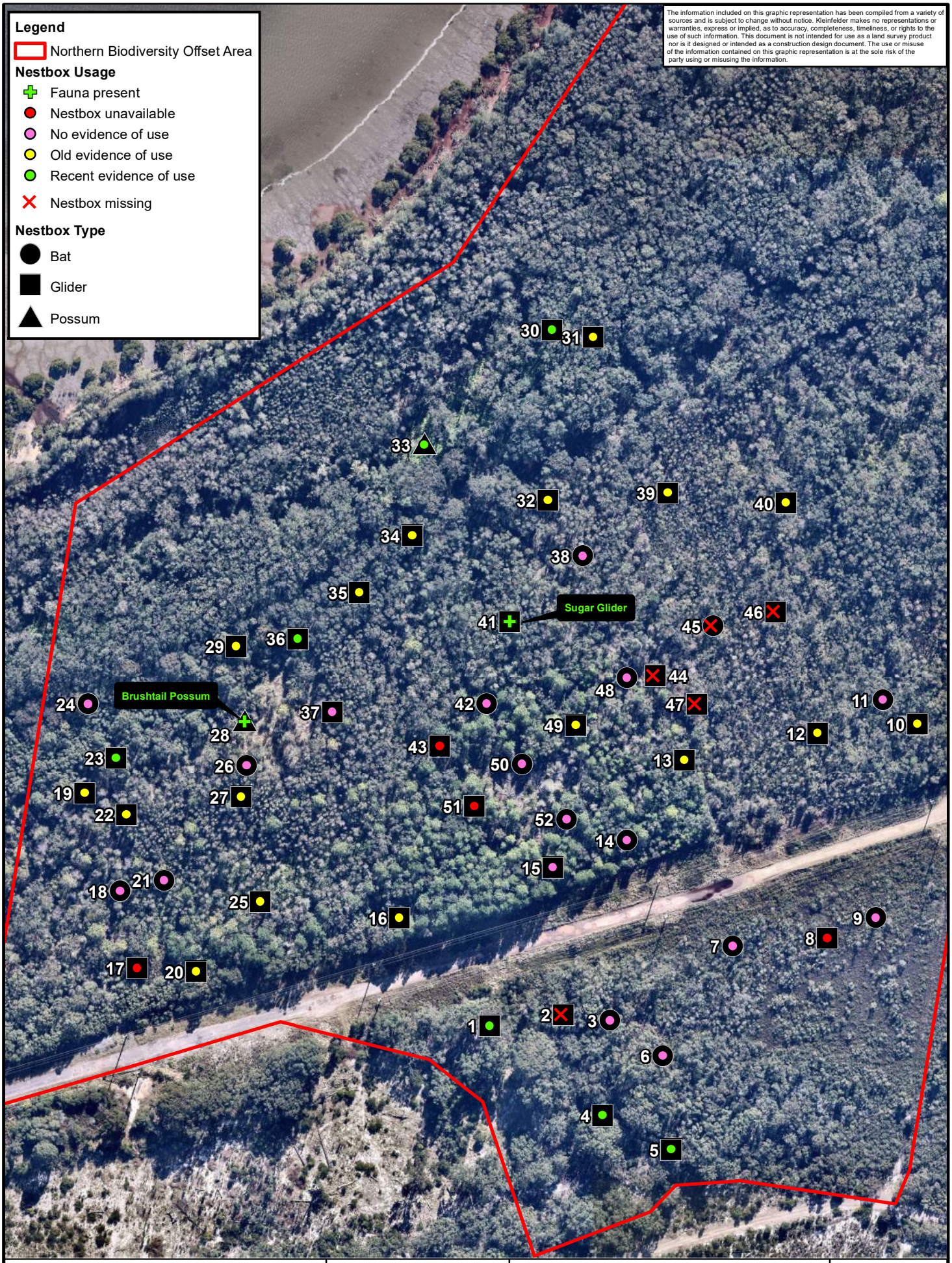


Chart 3 **Detailed usage per nest box type for the 2021 survey and comparison to the previous surveys**

Plate 4: **Nest box 41 with four Sugar Gliders in residence**



Metres
0 10 20 40 60 80 100
N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/08 12:41 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2021
NSW OEH - 2021
Nearmap - 2022

Nestbox Locations and Usage

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

4

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig4_NestboxLocationsAndUsage.mxd

2.3.4 Discussion

Fauna uptake of the nest boxes was successful in the first year of installation with several species of mammals and reptiles recorded occupying boxes, and evidence of usage across many more boxes. Since that initial survey, no fauna has been recorded in the boxes in 2019 and 2020. In the recent survey in 2021 there has been an increase in usage and fauna present within two of the nest boxes.

This year's survey was brought forward into the winter (August) to determine if the fauna were not using the nest boxes in the heat of the summer of the months. In 2021 fauna was recorded occupying two of the nest boxes, with evidence of usage increased from the last two years (scratches or nesting materials) judged to be fresh and moderately fresh, indicating some type of continuing usage.

It should be noted that for two of the box types – possum and bat – little evidence of usage will be apparent, unless an animal is actually recorded in the box as neither of the target fauna generally leave nesting materials behind, as with gliders.

It is suggested that the relatively recent fires may have acted as a deterrent to the fauna utilising the offsets, even though the offsets itself was not directly fire affected and the fauna has not yet recolonised the area. Kleinfelder ecologists have noted in nest box surveys at other sites that fauna usage of boxes can be periodic, with fauna absent for consecutive surveys.

Suggestions for further action are –

- Replace missing boxes but relocate to more hidden locations within the NBOA
- Place remote cameras in the offsets to determine if fauna are utilising the offsets for foraging and are simply not using the nest boxes, but utilising natural hollows in adjacent vegetation.

3 VEGETATION CONDITION SURVEY

3.1 BACKGROUND

An annual inspection of the NBOA is to be conducted as per Section 5.1.3B of the Biodiversity Management Plan Tanilba Northern Dunes Extension (Kleinfelder, 2019). This survey was conducted on 27th January 2021.

As per the BMP, photo monitoring points were established, weed infestations were noted, locations of rubbish dumping were noted, survey the regeneration and health of the *Eucalyptus robusta* along one transect, east to west across the BOA noting the size in classes of trees 1m either side of the transect, noting the extent and requirement of any revegetation works in the BOA.

3.2 RESULTS

3.2.1 General Condition

The vegetation condition of the NBOA is presented in **Figure 5**.

South of Rutile Rd, a small section of the NBOA abuts the extraction zone. Most of this area was affected by the 2018 fires but has recovered with increased rainfall in late 2020 and early 2021 (**Plate 5**). The condition improves moving east from Coastal Sand Apple Blackbutt Forest that fringes the extraction zone and Block Q2 which is quite weed infested until good condition Swamp Mahogany – Paperbark Forest is encountered. This area has some scattered Fishpole Bamboo (*Phyllostachys aurea*), and Bugle Lily (*Watsonia meriana*).

The 50m buffer zone of vegetation along Rutile Rd is quite weedy with exotic grasses, Lantana (*Lantana camara*) and some minor Blackberry (*Rubus fruticosus spp. agg.*), Glory Lilly (*Gloriosa superba), W. meriana* and *Pinus elliottii* (Slash Pine) as well as others.

The main section of the NBOA lies north of Rutile Rd. and as can be seen from **Figure 5,** has been assessed as Swamp Mahogany – Paperbark Swamp Forest "regenerating" in the area immediately to the north, and "mature" at the farthest north section of the BOA.

This regenerating area can be further divided into an eastern section where weed control efforts have largely brought the woody weeds under control and a western section where several weed species are present and are the subject of on-going control efforts (see **Section 4**). These include Slash Pine, Bugle Lily (PP5 **Plate 9**) and Lantana (*Lantana camara*) (PP2 **Plate 6**) that exclude Native species and shrubby regrowth are present, and evidence of some regeneration is present with seedlings and saplings apparent.

The Slash Pine is a concern to the general condition of this area. It is a fast-growing species and a prolific seeder with a multitude of seedlings visible each survey. It has formed dense thickets and the litter acts to suppress and regeneration of native species. Many of the larger trees are now of such a size as to present major issue for removal – both as a safety issue and for the damage that would be caused to native vegetation.

Regeneration of the *E. robusta* within this "regenerating" area was assessed by measuring the health and size of *E. robusta* trees within 1 m of a transect running East to West across the NBOA (**Figure 5**). The individual trees were divided into five height classes (<1m, 1-2m, 2-10m, 10-15m and >15m or mature trees) for determination of age. Trees <1m in height were classified as seedlings/saplings, trees 1-2m in height were classified as saplings, trees between 2 and 10m were classified as immature trees, trees 10-15m were classified as intermediate, while trees estimated to be over 15m in height were classified as mature (**Table 4**). This year, a total of 114 trees (81 trees last survey) were assessed along the transect that was approximately 400m long. The assessment found that there were two saplings <1m, only 11 were estimated to be between 1-2m in height, with 76 trees estimated to between 2-10m, 25 trees between 10-15m tall and no trees assessed as mature. The majority of the *E. robusta* – 92 trees - were located in the eastern section of Swamp Mahogany – Paperbark Swamp Forest.

Two areas at the western end of the NBOA are classified as regenerating grassland where the density of trees and shrubs is greatly reduced. Since the initial survey in 2013, natural regeneration has occurred, with many

shrubs and some midstorey species self-seeding (**Plate 10**). However, very few *E. robusta* have established in these areas, and the southern-most section adjacent to Rutile Rd is a dense thicket of *Leptospermum laevigatum* (Coast Teatree) that will prevent any other re-growth of native species. **Table 4** has field notes of observations of native species in and around the grassland area traversed by the transect.

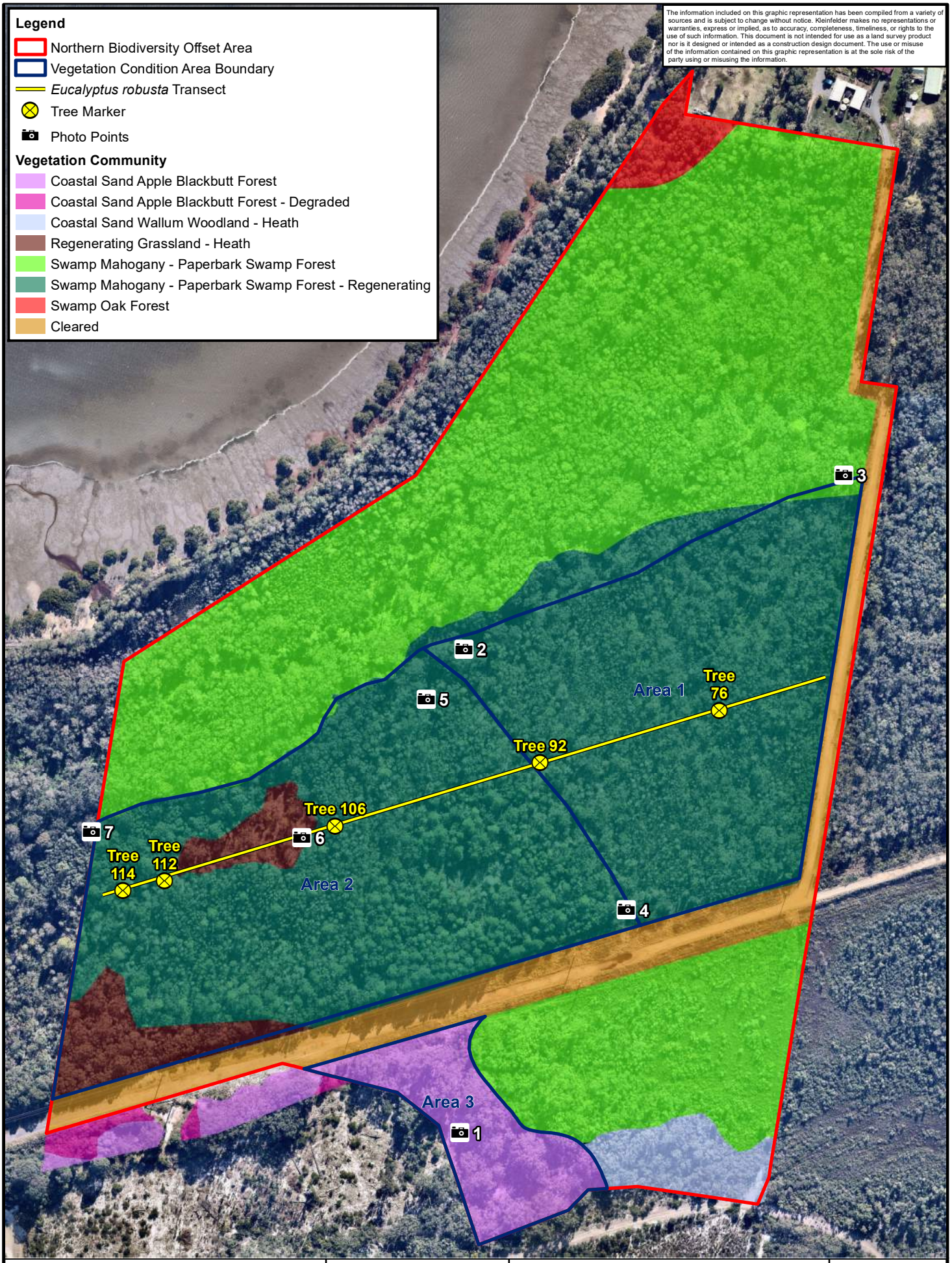
Table 4: *Eucalyptus robusta* trees surveyed in the Northern Dunes Offsets Area

Tree No. (From East)	Tree Height (m)					Comments
	<1	1-2	2-10	>10-15	Mature >15m	
1		✓	✓			Start at eastern end of transect
2			✓			
3			✓			
4		✓				
5	✓					
6		✓				
7		✓				
8			✓			
9			✓			
10			✓			
11			✓			
12				✓		
13		✓				
14			✓			
15			✓			
16			✓			
17		✓				
18			✓			
19				✓		
20	✓					
21			✓			
22		✓				
23			✓			
24			✓			
25			✓			
26			✓			
27			✓			
28			✓			
29			✓			
30			✓			
31			✓			
32			✓			
33				✓		
34				✓		
35			✓			
36				✓		
37			✓			
38			✓			
39			✓			
40				✓		
41			✓			
42			✓			
43			✓			
44			✓			
45			✓			
46		✓				
47			✓			
48			✓			
49			✓			
50			✓			
51			✓			
52			✓			
53			✓			
54			✓			
55			✓			
56			✓			

Tree No. (From East)	Tree Height (m)					Comments
	<1	1-2	2-10	>10-15	Mature >15m	
57		✓				
58			✓			
59			✓			
60			✓			
61			✓			
62			✓			
63			✓			
64			✓			
65			✓			
66			✓			
67			✓			
68			✓			
69		✓				
70			✓			
71			✓			
72			✓			
73			✓			
74			✓			
75			✓			
76			✓			
77			✓			Sparser area of *E. robusta*
78			✓			
79			✓			
80			✓			
81				✓		
82				✓		
83			✓			
84			✓			Large band of *Leptospermum laevigatum* -
85			✓			Monoculture between regrowth & lantana
86			✓			in drier, slightly higher area – stops where
87			✓			Watsonia begins.
88		✓				
89				✓		
90				✓		
91				✓		
92				✓		GPS track (Tree is 5m East from track)
93				✓		
94			✓			
95				✓		
96				✓		
97				✓		Regen area is full of African love grass &
98			✓	✓		sporadic whisky grass.
99			✓			
100				✓		*Acacia longifolia, Bossiaea rhombifolia,*
101				✓		*Acacia ulicifolia, Dodonaea triquetra,*
102			✓			*Leptospermum laevigatum,*
103			✓			*Melaleuca quinquenervia,*
104				✓		*Angophora costata, Corymbia gummifera,*
105				✓		*Eucalyptus robusta, Dianella,* (Rainforest
*106				✓		plant x8 – photos, soft furry leaf),
107			✓			Pines, Lantana, Watsonia,
108				✓		*Leptospermum polygalifolium* (FL),
109				✓		*Platysace ericoides, Melaleuca linearifolia,*
110			✓			*Exocarpos.*
111			✓			
112			✓			*GPS - Regrowth area 5m West
113				✓		in regrowth area
114			✓			Last Tree on Transect
115						Dieback

The northern most section of the NBOA has been classified as mature Swamp Mahogany – Paperbark Swamp Forest. This area contains mature *E. robusta* and *Melaleuca quinquenervia* trees with an understorey of Tall Saw-sedge (*Gahnia clarkei*) and other swamp flora. Lantana has colonised this section of the BOA with infestation levels varying from scattered individuals to very heavy (<75% cover), with a belt of dense Lantana acting to separate this section from the southern regenerating section of the BOA (PP7 **Plate 11**). Evidence of previous control works conducted by Kleinfelder is visible.

An access track is becoming overgrown at PP4 (**Plate 8**). While access by the general public is not encouraged, there is historical illegal rubbish dumping along this track that requires removal.



Metres
0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/09 13:24 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
NSW OEH - 2019
Nearmap - 2021

Vegetation Condition Monitoring

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

5

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig5_VegConditionMonitoring.mxd

Plate 5: PP1 looking east showing poor condition (foreground) and better condition vegetation (background)

Plate 6: PP2 looking north showing dense Lantana and previous control works

Plate 7: PP3 looking north showing typical understorey

Plate 8: PP4 looking north along access track showing Slash Pine infestation and control works (bottom left). Illegal dumping is visible in the centre of the track

Plate 9: PP5 looking south showing dense Bugle Lily infestation

Plate 10: PP6 looking west showing the regenerating grassland area (north). Note the shrubby regrowth.

Plate 11: PP7 looking north at the dense Lantana "belt" that separates the regenerating and mature Swamp Mahogany – Paperbark Swamp Forest. Control efforts are visible in the foreground.

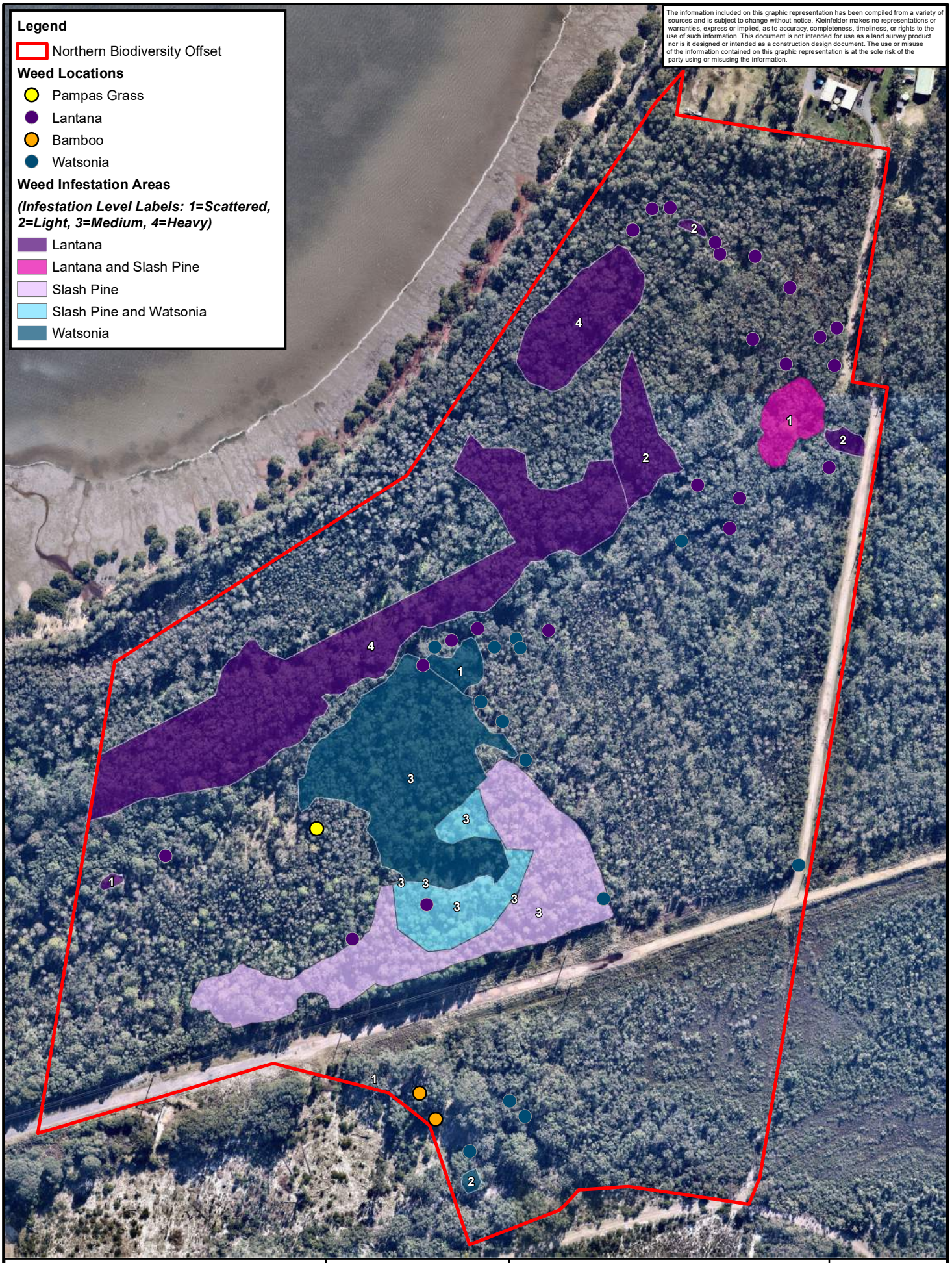
3.2.2 Weed Mapping

Weed mapping was conducted as part of the monitoring of the BOA (**Figure 6**). The key weed species recorded on site that have the potential to restrict revegetation or native fauna use are the Slash Pine, Lantana and Bugle Lily, all mentioned previously with minor occurrences of Senna and Pampas Grass (*Cortaderia selloana*).

The Slash Pine is concentrated along Rutile Rd in the regenerating Swamp Mahogany – Paperbark Swamp Forest, but seedlings and saplings have spread throughout this entire section of the BOA. The density has been mapped from medium to heavy in these areas and there are many scattered immature and mature trees in other areas. The Slash Pine is rapidly spreading through the BOA and does pose a threat to the viability of the area as an offset. Prolific seed production, rapid growth and production of pine needles that serves to suppress other vegetation acts to degrade the condition of the BOA, providing competition for the Eucalyptus species that are preferred koala feed trees. Native fauna – with the possible exception of bird species such as Glossy-Black Cockatoo and Sulphur Crested Cockatoo and other large seed eating birds - do not use the pines for foraging or habitat.

The Bugle Lily is concentrated in the central portion of the regenerating Swamp Mahogany – Paperbark Swamp Forest with a large central dense infestation that becomes less dense towards the edges. This species is out-competing native species such as the Tall Saw-sedge and was observed to be spreading into the eastern section of the regenerating Swamp Mahogany – paperbark Forest.

Lantana is the major threatening weed in the BOA, forming dense thickets at ground level and climbing into the mature tree canopies and covering a substantial portion of the BOA (Figure 6). The infestation density covers the full spectrum from isolated or scattered individuals to the dense thicket or belt referred to earlier. At its most dense, these thickets have the potential to hinder movement of koalas through the BOA and effectively divides the Swamp Mahogany – Paperbark Swamp Forest into two sections. This year's weed mapping highlights the continued spread of this weed into the mature Swamp Mahogany – Paperbark Swamp Forest where scattered individuals are maturing and spreading into infestations.



Metres
0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/09 13:26 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
NSW OEH - 2019
Nearmap - 2021

Weed Infestation Areas

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

6

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig6_WeedLocations.mxd

3.2.3 Vegetation Condition Discussion and Recommendations

Where weed species have not become established the condition of the native vegetation is quite good. Native vegetation is generally in good health with no visible dieback observed amongst the canopy species on site. Seedlings of *E. robusta* have been observed away from the transect where the lack of mature trees indicates that the regenerating Swamp Mahogany – Paperbark Swamp Forest is indeed regenerating, and not mature forest as is the case in the northern section of the BOA.

The regenerating grassland is slowly self-seeding with several native shrub species such as Coastal Wattle (*Acacia longifolia*), Coastal Teatree, *Bossiaea rhombifolia, Dodonaea triquetra* (Sticky Hopbush), *Acacia ulicifolia* (Prickly Moses) and *Platysace ericoides.* The area still has African Lovegrass as the dominant groundcover, but this species will eventually be shaded out. Spot spraying of these grasses would encourage native species regeneration. A modest planting program of tubestock installation of *E. robusta*, Red Bloodwood (*Corymbia gummifera*) and Smooth-barked Apple (*Angophora costata*) would be beneficial for the revegetation.

Sibelco Australia (the previous owners) had commenced a modest weed control program, and Holcim (Australia) have continued this program. Further on-going and more intense weed control efforts will be required to improve the condition of the BOA. In particular, the Slash Pine infestation requires specialist arborist and tree removal subcontractors. Previous weed control efforts have used a “cut and drop” approach to controlling this species, but the density of trees is so high that it is necessary to remove the cut logs. This will however result in considerable damage to the surrounding native vegetation, including to mature Swamp Mahogany as it will be necessary to employ machinery to achieve this.

The access track at PP4 requires a locked gate to limit access. While it is acknowledged that this might attract attention that may facilitate illegal access, provision of access to the site for fire-fighting and weed control is desirable.

4 WEED CONTROL WORKS

Kleinfelder was engaged by Holcim (Australia) to conduct weed control works in the BOA during the 2021 reporting period. These works consisted of a team of two Land Management Technicians working on site for two rounds of two days each. Daily worksheets are provided in **Appendix A**.

Works were performed on the 22nd and 23rd of November 2021 and then the following January 14th and 17th 2022.

Figure 6 shows the areas targeted during these four days of works, outlined as the yellow boxes. The technicians were instructed to work from areas of low infestation towards higher infestation and concentrated on the section to the south of Rutile Rd and then southern regenerating section of the BOA.

4.1 WORKS PERFORMED

On the 23rd of November the LM team worked on the Rutile Rd edge of the BOA (Figure 6). The team hand removed Slash Pine seedlings, ring barked or cut down larger saplings. Backpack spraying of Bugle Lily was also performed.

The 27th of November the LM team worked on either side Rutile Rd, spot spraying Fishpole bamboo and Bugle Lilly in the southern most section of the BOA adjacent to Block Q2. The team the continued to cut and ring bark Slash Pine saplings and seedlings and spray Bugle Lilly in the regenerating section of the Swamp Mahogany – Paperbark Forest.

On the 14th of January the team worked areas of dense Lantana infestation that have been mapped previously. The team used backpack sprayers to splatter the Lantana.

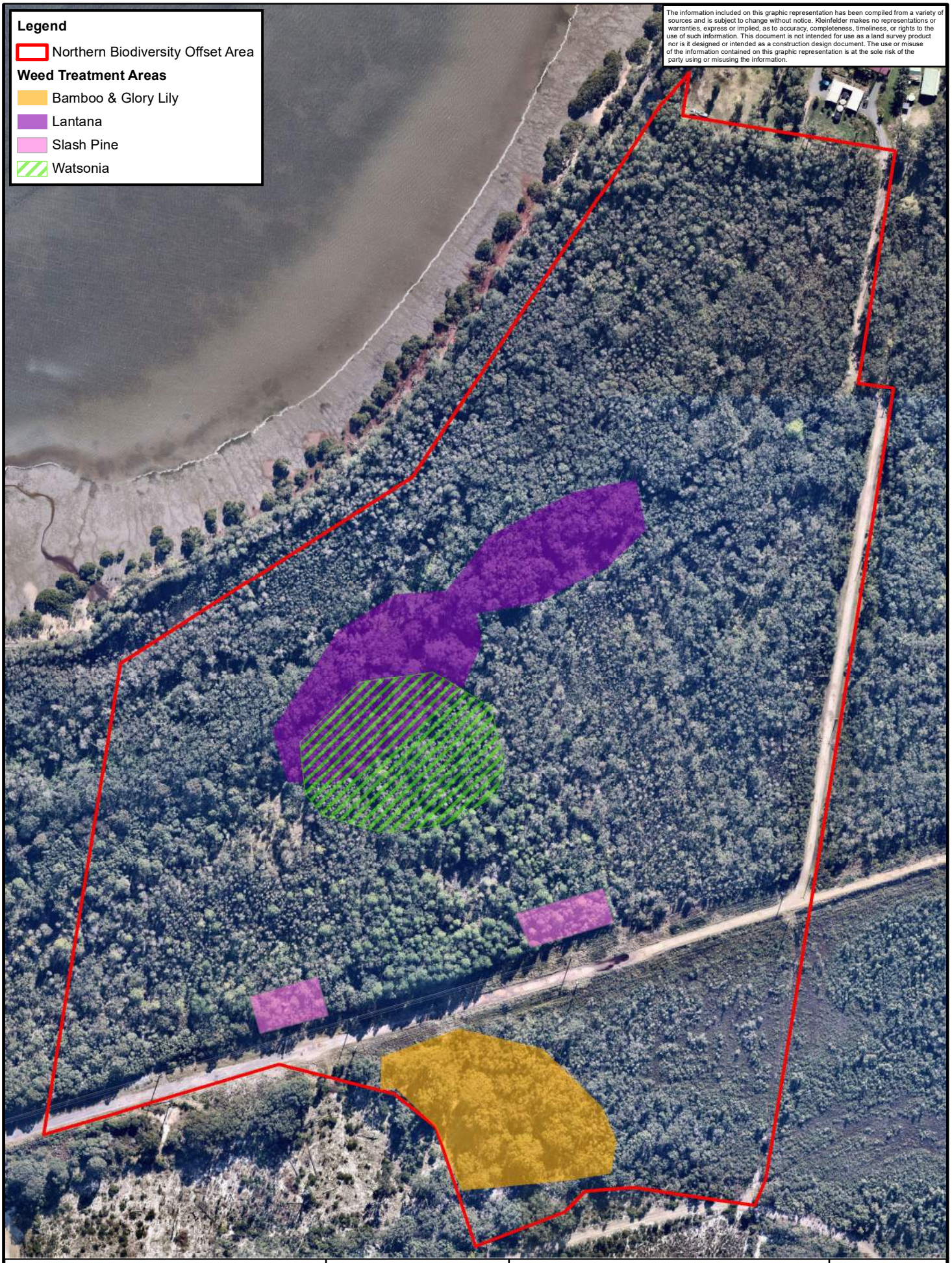
On the 17th of January the team worked in the southern section of the BOA hand weeding a Mother-of-Millions patch, bagging and disposing of these weeds off site. In addition, they re-sprayed the Fishpole Bamboo and Glory Lilly. They moved across Rutile Rd and continued to spot spray the Bugle Lilly and Lantana. Additionally, moving west from the track, isolated Lantana plants were cut and painted in the area bounded by Rutile Rd, the major Lantana “wall” and the western boundary of the BOA.

4.2 DISCUSSION

The current effort of 8 person days per year is making minimal progress in the control of the weeds on the BOA. This was the first season that control works were conducted on the Bugle Lilly infestation, and a much larger area remains to be treated. Likewise, the other two major weed species – the Slash Pine and Lantana. Slash pine is a prolific seed producer and seedlings have been removed each year. This effort is slowing the spread the of the Slash Pine, but is not removing the source of the infestation, the large trees. The Lantana is spreading into the mature Swamp Mahogany – Paperwork Forest to the north of the Lantana “wall”.

The following recommendations are made –

- The weed control effort is increased to allow for a greater area to be worked. Given the level of infestation it is suggested that effort be doubled – i.e., 16 person days per year.
- The Slash Pine saplings that have been cut and dropped in the past control efforts should be removed – most can be removed by hand to Rutile Rd and chipped there. This will facilitate native species regeneration.
- The larger Slash Pine trees require a specialist arborist to safely be removed.
    - This is not a small undertaking given the proximity of the high voltage power lines and Rutile Rd.
    - The volume of material that is required to be removed also necessitates chipping and disposal off site.
    - A decision will need to be made as to whether felled trees deeper into the BOA are cut and dropped or removed. Either option will lead to a certain amount of damage to native vegetation.



Metres
0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221962

DATE DRAWN: 2022/03/09 19:19 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
NSW OEH - 2019
Nearmap - 2021

Weed Control Works 2021/2022

Holcim Australia
North Dunes Extension Offsets
Fauna & Vegetation Monitoring 2021

FIGURE:

7

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221962_3_NDE_OffsetsMonitoring\Mapping\20221962_Fig7_WeedControlWorks.mxd

5 REFERENCES

Kleinfelder (2019a), Biodiversity Management Plan – Tanilba Northern Dune Extension. A report prepared by Kleinfelder on behalf of Sibelco Australia.

Kleinfelder (2019b), Koala Monitoring within the Northern Dune Extension Biodiversity Offsets Areas. Report prepared for Sibelco Australia by Kleinfelder.

Kleinfelder (2020a), Targeted Nocturnal Fauna Monitoring within the Northern Dune Extension Biodiversity Offsets Areas. Report prepared for Sibelco Australia by Kleinfelder.

Kleinfelder (2020b), 2019 Annual Nest Bx Monitoring at the Northern Offsets Area – Northern Dune Extension Project. Report prepared for Sibelco Australia by Kleinfelder.

Phillips S and Callaghan J (2011). The Spot Assessment Technique: A tool for determining localised levels of habitat use by Koalas (Phascolarctos cinereus). Australia Koala Foundation. Australian Zoologist 35(3) 774-780.

APPENDIX A: WEED CONTROL WORKS DAILY WORKSHEETS

Daily Activity Record

on **27-Oct-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Weather

Time Observed	Ambient Conditions	Temp	Temp Forecast	Humidity	UV Rating	Wind (Max)	Beaufort Wind Scale	Current Warnings
07:45:00	Clear Sky	15.1	26	87		20 E	1-3	

General

Site Access Requirements / Issues:

Call in and out

Security requirements:

Lock vehicle, valuables locked up

Emergency Muster Point:

Klf vehicle

Planned Meeting Point:

Klf vehicle

Public Safety Issues:

Lock vehicle

Breaks:

Break Time 1: 10:00 AM to 10:15 AM Total: 15

Break Time 2: 12:00 PM to 12:30 PM Total: 30

Break Time 3: 12:00 AM to 12:00 AM Total: 0

Toolbox Talk

Changed Task/ Conditions	Task Number	Basic Tasks	Hazards	Hazard Controls	MSDS	PPE Worn
	0	Packing and Unpacking the Vehicle	Hazardous manual handling- Physical/muscular injury due to manual handling or poor lifting technique	Utilise a two person lift where possible, Use correct procedures for lifting and bend with the knees, not the back., All equipment stored in a flat tray Ute must be secured with appropriate strapping which will ensure	Y	Boots, Gloves, Hat, Other
	1	Traversing the Site	Trips, slips and falls	Tread Carefully, Other	Y	Boots, Gloves, Hat, Other
	2	Traversing the Site	Exposure to elements, insects and fauna	Use correct PPE (broad rimmed hat, sunblock, insect repellent). Stay hydrated. , Inform other_hazard_controls team members of any dangerous insect or fauna sightings. , Record tick bites in the Tick Bite Register, located in the LM office	Y	Boots, Gloves, Hat, Other
	3	Mixing of Chemicals	Inhalation, consumption, contamination or absorption may cause harm to the mixer or fellow staff	Use appropriate manual handling techniques when lifting. Bend knees, do not lift from the back., Wear appropriate PPE (chemical gloves, long sleeves/trousers, overalls, safety glasses/face shield)., Use respirator where necessary. , Follow chemical label instruction for mixing concentrations.	Y	Boots, Gloves, Hat, Respirator, Other
	4	Backpack spraying	Drift, off target damage, heavy load, uneven and slippery ground,	Other	Y	Boots, Gloves, Hat, Respirator, Other

Daily Activity Record

on **27-Oct-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Work Completed

Description of Works	Area Worked	Plant Count	Species	Lat/Long	Photo
Spot spray bamboo, cut and paint lantana, spray Watsonia, cut down slash pine	10000			Lat: -32.78630 Long: 151.913666 Acc: 5.000 m	See Photo Log

Chemicals Used

Product Mixture	Mode of Application	Rate (%)	Weather Conditions	Comments
100 mL BRUSHWET ORGANOSILICONE SURFACTANT (1020 g/L Polyether modified polysiloxane), 100 mL EnviroDye Red (Diazo Dyestuff), 25 L Water, 250 mL Weed master duo 360	Back Pack	1		Watsonia
105 mL Weed master duo, 20 mL BRUSHWET ORGANOSILICONE SURFACTANT (1020 g/L Polyether modified polysiloxane), 20 mL EnviroDye Red (Diazo Dyestuff), 5 L Water	Back Pack			Bamboo

Equipment Used

Fauna Observations

Client Liaison Notes

Comments / Future Management / Recommendations / WHS Issues

K Griffin

Daily Activity Record

on **27-Oct-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

Photo Log

Fig. 1:

Fig. 2:

Fig. 3:

Fig. 4:

Photo Log

Fig. 5:

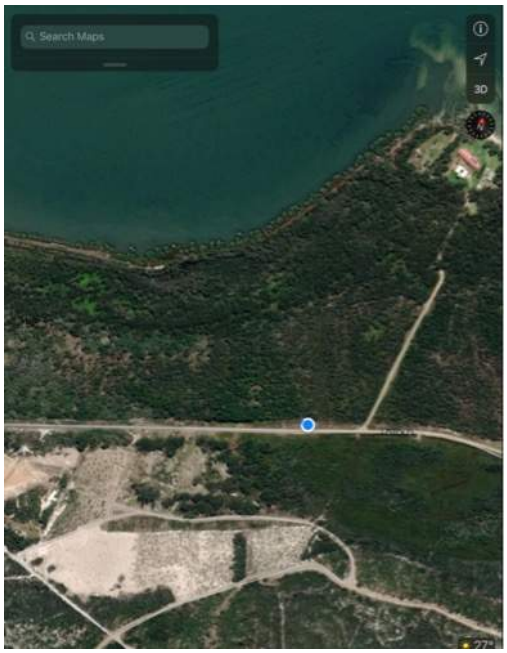


Fig. 6:

Daily Activity Record

on **23-Nov-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Weather

Time Observed	Ambient Conditions	Temp	Temp Forecast	Humidity	UV Rating	Wind (Max)	Beaufort Wind Scale	Current Warnings
07:17:00	Overcast	18.6	23	83		20 SE	1-3	

General

Site Access Requirements / Issues:

Parking on side of road, nature strip too boggy

Security requirements:

Lock vehicle

Emergency Muster Point:

KLF Vehicle

Planned Meeting Point:

Klf vehicle

Public Safety Issues:

Breaks:

Break Time 1: 10:00 AM to 10:15 AM Total: 15

Break Time 2: 12:00 PM to 12:30 PM Total: 30

Break Time 3: 12:00 AM to 12:00 AM Total: 0

Daily Activity Record

on **23-Nov-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Toolbox Talk

Changed Task/ Conditions	Task Number	Basic Tasks	Hazards	Hazard Controls	MSDS	PPE Worn
	0	Packing and Unpacking the Vehicle	Hazardous manual handling- Physical/muscular injury due to manual handling or poor lifting technique	Utilise a two person lift where possible, Use correct procedures for lifting and bend with the knees, not the back., All equipment stored in a flat tray Ute must be secured with appropriate strapping which will ensure	Y	Boots, Gloves, Hat, Other
	1	Traversing the Site	Trips, slips and falls	Tread Carefully, Other	Y	Boots, Gloves, Hat, Other
	2	Mixing of Chemicals	Inhalation, consumption, contamination or absorption may cause harm to the mixer or fellow staff	Use appropriate manual handling techniques when lifting. Bend knees, do not lift from the back., Wear appropriate PPE (chemical gloves, long sleeves/trousers, overalls, safety glasses/face shield)., Use respirator where necessary. , Follow chemical label instruction for mixing concentrations.	Y	Boots, Gloves, Hat, Other
	3	Cutting and Painting Various Sized Trees	Injury due to incorrect body positioning and awkward proximity to the targeted weed.	Keep body parts clear from the line-of-fire whilst cutting., Wear appropriate PPE (leather gloves or slash-proof gloves)	Y	Boots, Gloves, Hat, Other
	4	Cutting and Painting Various Sized Trees	Repetitive strain injury	Rotate tasks as required, Other	Y	Boots, Gloves, Hat, Other
	5	Cutting and Painting Various Sized Trees	Injury due to falling branches / trunk	Plan the cut and ensure all team members are positioned approriately	Y	Boots, Gloves, Hat, Other
	6	Back pack spraying	Drift, contamination, off target damage, heavy load,	Other	Y	Boots, Gloves, Hat, Other

Team Members

Team Member	Staff Position	Start Location	Drop Off Location	Applying Chemicals	Signature
Kat griffin	Supervisor	Office	Office	Y	
Mariah Kennedy	Field Staff	On Site	On Site	Y	

Work Hours

Team Member	Arrive Office	Leave Office	Arrive On-Site	Lunch Start	Lunch End	Leave Site	Return Office	Finish	Work Hours (minus lunch)	Total Travel Hours
Kat griffin	06:00	06:10	07:00	12:00	12:30	15:00	16:00	16:00	9.5	1.83
Mariah Kennedy	07:00		07:00	12:00	12:30	15:00	15:00	15:00	7.5	-0.17

Daily Activity Record

on **23-Nov-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Work Completed

Description of Works	Area Worked	Plant Count	Species	Lat/Long	Photo
Weed control by hand, hand removal of small slash pine, Watsonia and lantana , ring bark or cut down larger slash pine	50			Lat: -32.73671 Long: 151.960748 Acc: 5.000 m	See Photo Log

Equipment Used

Fauna Observations

Client Liaison Notes

Comments / Future Management / Recommendations / WHS Issues

K Griffin

Daily Activity Record

on **23-Nov-2021**
by K Griffin for NDE Offsets Weed Control Works 2021

Photo Log

Fig. 1: Treatment of slashpine

Fig. 2: Treatment of slashpine

Fig. 3: Treatment of slashpine

Fig. 4: Area worked

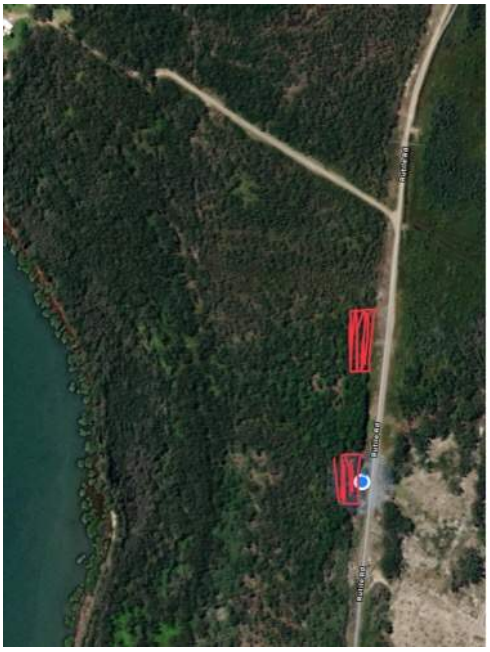


Photo Log

Fig. 5: Watsonia - treated last visit

Daily Activity Record

on **14-Jan-2022**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Weather

Time Observed	Ambient Conditions	Temp	Temp Forecast	Humidity	UV Rating	Wind (Max)	Beaufort Wind Scale	Current Warnings
07:20:00	Clear Sky	22	33	71		24 E	0	

General

Site Access Requirements / Issues:

Security requirements:

Keep vehicle locked

Emergency Muster Point:

Klf vehicle

Planned Meeting Point:

Klf vehicle

Public Safety Issues:

Breaks:

Break Time 1: 10:00 AM to 10:15 AM Total: 15

Break Time 2: 12:30 PM to 1:00 PM Total: 30

Break Time 3: 12:00 AM to 12:00 AM Total: 0

Daily Activity Record

on **14-Jan-2022**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Toolbox Talk

Changed Task/ Conditions	Task Number	Basic Tasks	Hazards	Hazard Controls	MSDS	PPE Worn
	16	Packing and Unpacking the Vehicle	Hazardous manual handling- Physical/muscular injury due to manual handling or poor lifting technique	Utilise a two person lift where possible, Use correct procedures for lifting and bend with the knees, not the back., All equipment stored in a flat tray Ute must be secured with appropriate strapping which will ensure	Y	Boots, Gloves, Hat, Other
	17	Traversing the Site	Trips, slips and falls	Tread Carefully, Other	Y	Boots, Gloves, Hat, Other
	18	Traversing the Site	Exposure to elements, insects and fauna	Use correct PPE (broad rimmed hat, sunblock, insect repellent). Stay hydrated. , Inform other_hazard_controls team members of any dangerous insect or fauna sightings. , Record tick bites in the Tick Bite Register, located in the LM office, Other	Y	Boots, Gloves, Hat, Other
	19	Mixing of Chemicals	Inhalation, consumption, contamination or absorption may cause harm to the mixer or fellow staff	Use appropriate manual handling techniques when lifting. Bend knees, do not lift from the back., Wear appropriate PPE (chemical gloves, long sleeves/trousers, overalls, safety glasses/face shield)., Use respirator where necessary. , Follow chemical label instruction for mixing concentrations.	Y	Boots, Gloves, Hat, Respirator, Goggles, Other
	20	Back pack spraying	Heavy lifting, walking long distances, drift,strain and sprain, inhalation, consumption	Other	Y	Boots, Gloves, Hat, Respirator, Goggles, Other

Team Members

Team Member	Staff Position	Start Location	Drop Off Location	Applying Chemicals	Signature
Kat Griffin	Supervisor	Office	Office	Y	
Ruby Cornish	Field Staff	Office	Office	Y	

Work Hours

Team Member	Arrive Office	Leave Office	Arrive On-Site	Lunch Start	Lunch End	Leave Site	Return Office	Finish	Work Hours (minus lunch)	Total Travel Hours
Kat Griffin	06:00	06:05	07:00	12:30	13:00	15:00	16:00	16:00	9.5	-46.09
Ruby Cornish	06:00	06:05	07:00	12:30	13:00	15:00	16:00	16:00	9.5	-47.08

Daily Activity Record

on **14-Jan-2022**
by K Griffin for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Work Completed

Description of Works	Area Worked	Plant Count	Species	Lat/Long	Photo
Splatter works of lantana as shown in map	5000			Lat: -32.73492 Long: 151.960704 Acc: 0.000 m	See Photo Log

Chemicals Used

Product Mixture	Mode of Application	Rate (%)	Weather Conditions	Comments
160 mL EnviroDye Red (Diazo Dyestuff), 2 L Weed pro bio aqua 360, 20 L Water, 80 mL BRUSHWET ORGANOSILICONE SURFACTANT (1020 g/L Polyether modified polysiloxane)	Back Pack	10	Light Cloud, 28.9 deg C, 53%, 7 kph SW	

Equipment Used

Fauna Observations

Client Liaison Notes

Comments / Future Management / Recommendations / WHS Issues

K Griffin

Daily Activity Record

on **14-Jan-2022**
by K Griffin for NDE Offsets Weed Control Works 2021

Photo Log

Fig. 1: Area treated

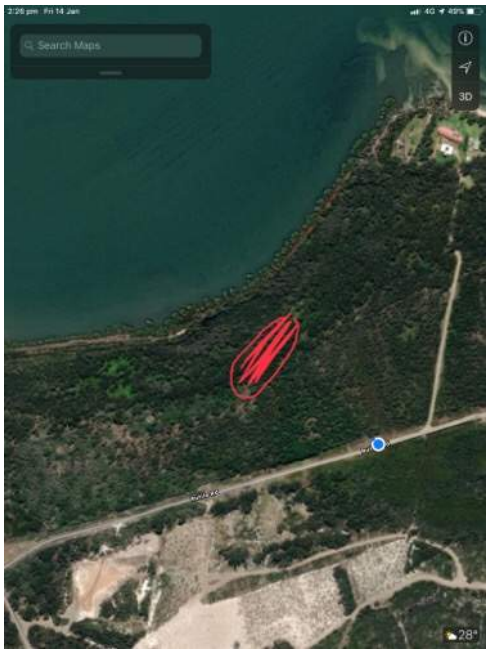


Fig. 2: Lantana treated

Fig. 3: Lantana treated

Daily Activity Record

on **17-Jan-2022**
by R Cornish for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Weather

Time Observed	Ambient Conditions	Temp	Temp Forecast	Humidity	UV Rating	Wind (Max)	Beaufort Wind Scale	Current Warnings
07:35:00	Light Cloud	23.1	30	95	13	10 SW	1-3	Hazardous surf warning

General

Site Access Requirements / Issues:

Dirt road

Security requirements:

Lock cars

Emergency Muster Point:

KLF08

Planned Meeting Point:

KLF08

Public Safety Issues:

Avoid engaging with the public

Breaks:

Break Time 1: 9:45 AM to 10:00 AM Total: 15

Break Time 2: 12:00 PM to 12:30 PM Total: 30

Break Time 3: 12:00 AM to 12:00 AM Total: 0

Daily Activity Record

on **17-Jan-2022**
by R Cornish for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Toolbox Talk

Changed Task/ Conditions	Task Number	Basic Tasks	Hazards	Hazard Controls	MSDS	PPE Worn
	0	Packing and Unpacking the Vehicle	Hazardous manual handling- Physical/muscular injury due to manual handling or poor lifting technique	Utilise a two person lift where possible, Use correct procedures for lifting and bend with the knees, not the back., All equipment stored in a flat tray Ute must be secured with appropriate strapping which will ensure	Y	Boots, Gloves, Hat, Other
	1	Traversing the Site	Trips, slips and falls	Tread Carefully	Y	Boots, Gloves, Hat, Other
	2	Traversing the Site	Exposure to elements, insects and fauna	Use correct PPE (broad rimmed hat, sunblock, insect repellent). Stay hydrated. , Inform other_hazard_controls team members of any dangerous insect or fauna sightings. , Record tick bites in the Tick Bite Register, located in the LM office	Y	Boots, Gloves, Hat, Other
	3	Mixing of Chemicals	Inhalation, consumption, contamination or absorption may cause harm to the mixer or fellow staff	Use appropriate manual handling techniques when lifting. Bend knees, do not lift from the back., Wear appropriate PPE (chemical gloves, long sleeves/trousers, overalls, safety glasses/face shield)., Use respirator where necessary. , Follow chemical label instruction for mixing concentrations.	Y	Boots, Gloves, Hat, Other
	4	Cutting and Painting Various Sized Trees	Injury due to incorrect body positioning and awkward proximity to the targeted weed.	Keep body parts clear from the line-of-fire whilst cutting., Wear appropriate PPE (leather gloves or slash-proof gloves)	Y	Boots, Gloves, Hat, Other
	5	Cutting and Painting Various Sized Trees	Repetitive strain injury	Rotate tasks as required	Y	Boots, Gloves, Hat, Other
	6	Cutting and Painting Various Sized Trees	Injury due to falling branches / trunk	Plan the cut and ensure all team members are positioned approriately	Y	Boots, Gloves, Hat, Other
	7	Backpack spraying	Inhalation, contamination or consumption, spray drift and off target damage	Other	Y	Boots, Gloves, Hat, Respirator, Other

Team Members

Team Member	Staff Position	Start Location	Drop Off Location	Applying Chemicals	Signature
Ruby Cornish	Supervisor	On Site	Office	Y	
Katrina Hailstone	Field Staff	On Site	On Site	Y	

Daily Activity Record

on **17-Jan-2022**
by R Cornish for NDE Offsets Weed Control Works 2021

20221963.001A
Fisher, Nigel B.

Work Hours

Team Member	Arrive Office	Leave Office	Arrive On-Site	Lunch Start	Lunch End	Leave Site	Return Office	Finish	Work Hours (minus lunch)	Total Travel Hours
Ruby Cornish	07:00		07:00	12:00	12:30	15:00	16:15	16:30	9	
Katrina Hailstone	07:00		07:00	12:00	12:30	15:00	15:00	15:00	7.5	-1

Work Completed

Description of Works	Area Worked	Plant Count	Species	Lat/Long	Photo
Backpack spraying of bamboo, glory lily, and follow up spraying of Watsonia. Splatter spray of lantana	Approx 10km2			Lat: -32.73630 Long: 151.962656 Acc: 5.000 m	See Photo Log
	Approx 2m2			Lat: -32.73732 Long: 151.961369 Acc: 0.000 m	See Photo Log

Chemicals Used

Product Mixture	Mode of Application	Rate (%)	Weather Conditions	Comments
100 mL BIOCHOICE 360 HERBICIDE (360 g/L GLYPHOSATE)	Back Pack	1	Light Cloud, 28 deg C, 68%, 10 kph SE	
500 mL BIOCHOICE 360 HERBICIDE (360 g/L GLYPHOSATE)	Splatter Gun	10		
300 mL BIOCHOICE 360 HERBICIDE (360 g/L GLYPHOSATE)	Back Pack	2		
60 mL EnviroDye Red (Diazo Dyestuff)	Back Pack	1		
120 mL BRUSHWET ORGANOSILICONE SURFACTANT (1020 g/L Polyether modified polysiloxane)		1		

Equipment Used

Fauna Observations

Kookaburra, quails, black cockatoos

Client Liaison Notes

N/A

Comments / Future Management / Recommendations / WHS Issues

Follow up spraying to be done for Watsonia

Daily Activity Record

on **17-Jan-2022**
by R Cornish for NDE Offsets Weed Control Works 2021

R Cornish

Photo Log

Fig. 1: Map of areas sprayed

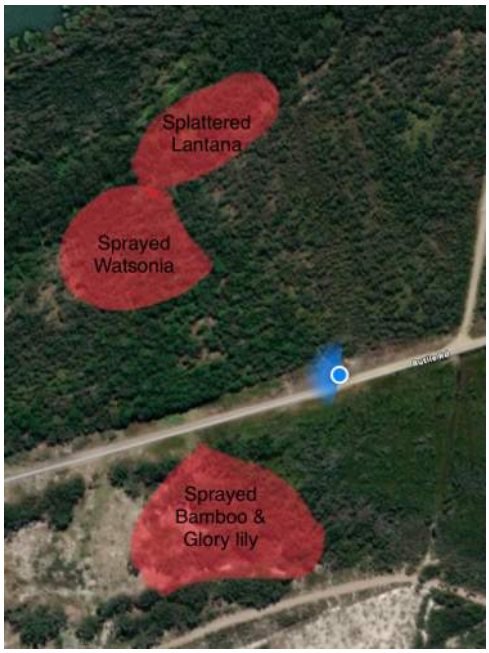


Fig. 2: Sprayed watsonia

Fig. 3: Sprayed watsonia

Fig. 4: Before 1

Photo Log

Fig. 5: After 1

Fig. 6: Before 2

Fig. 7: After 2

Fig. 8: Area worked

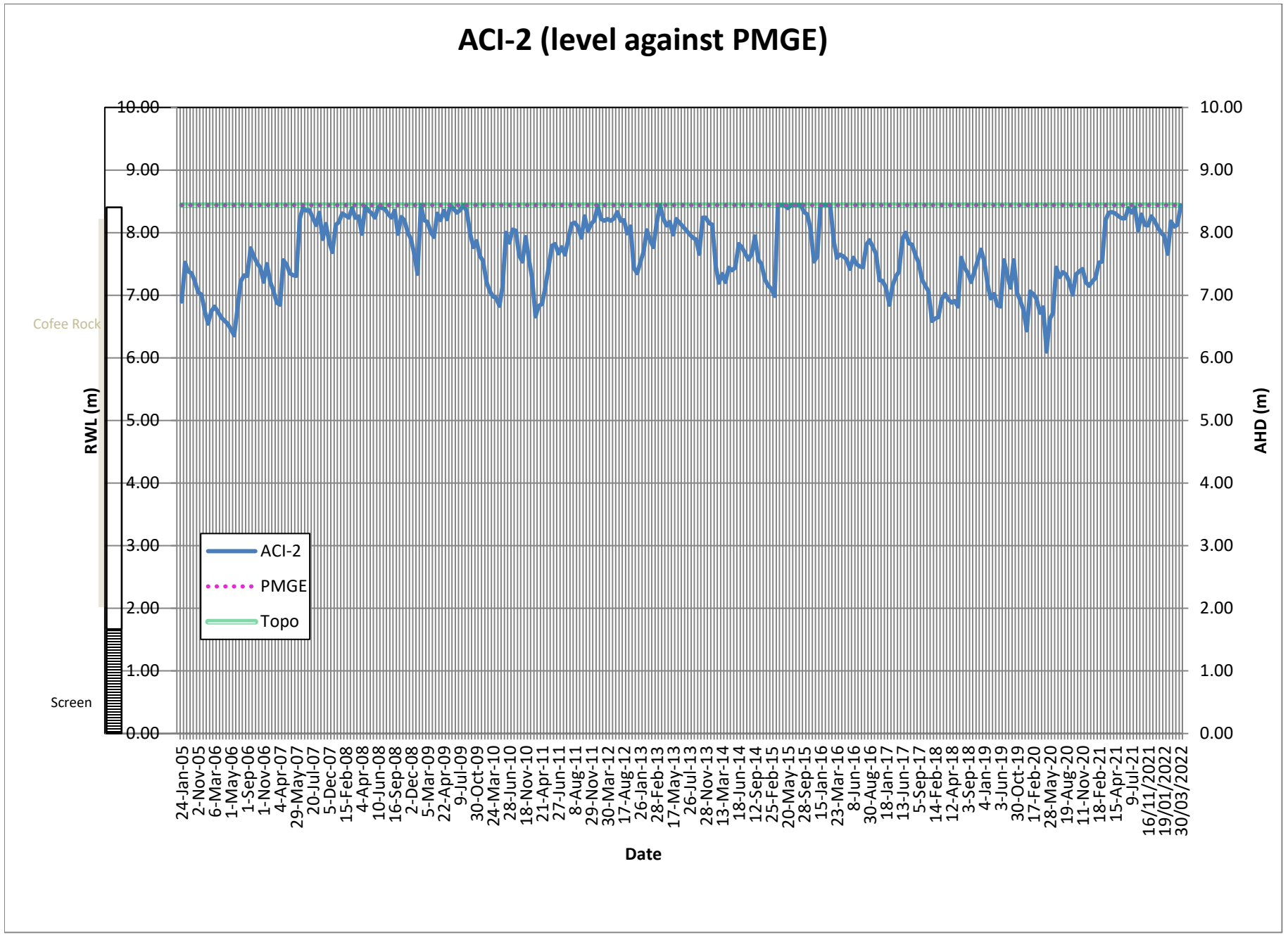
APPENDIX B: STAFF CONTRIBUTIONS

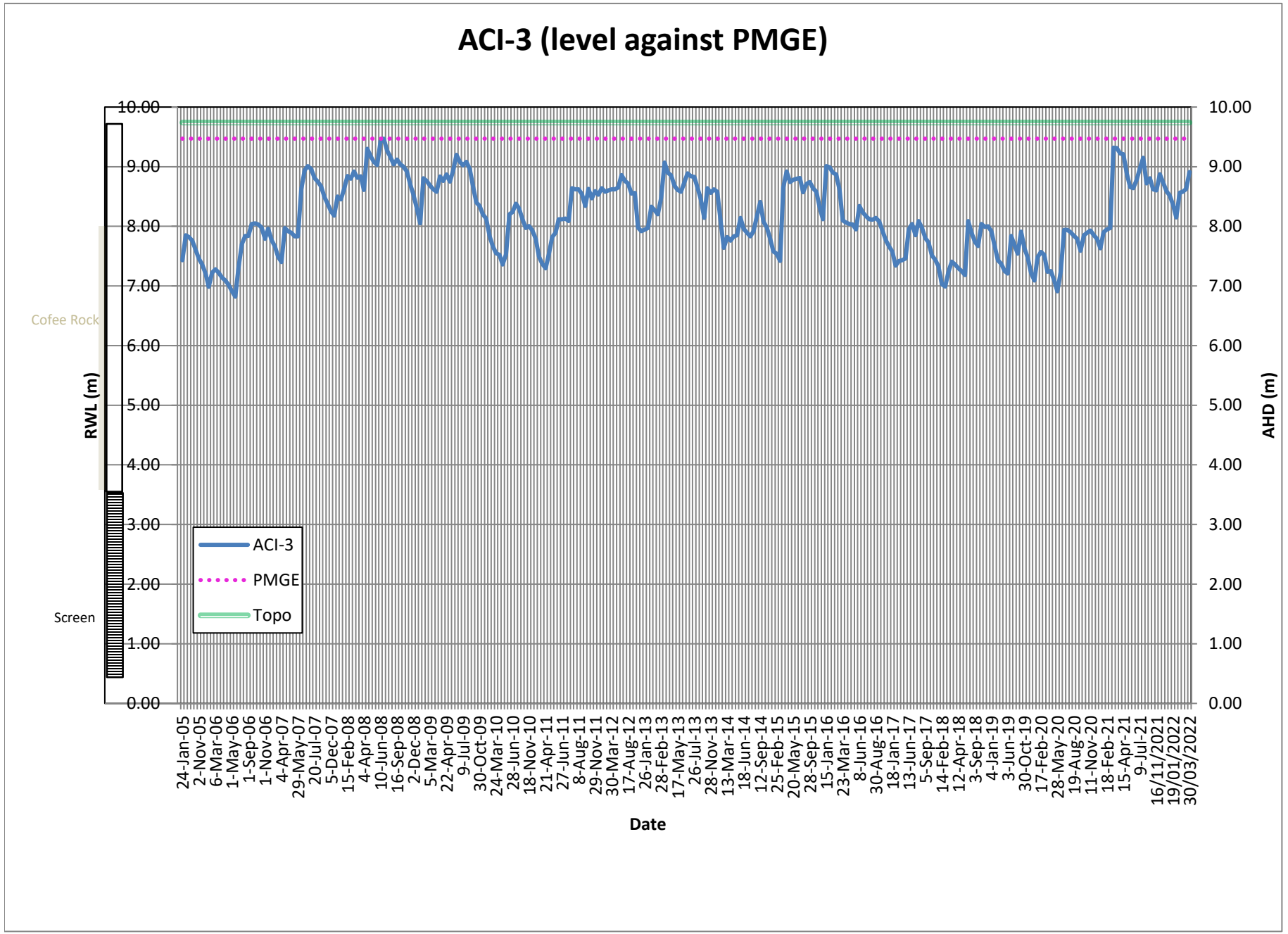
The following staff were involved in the works required for the compilation of this report.

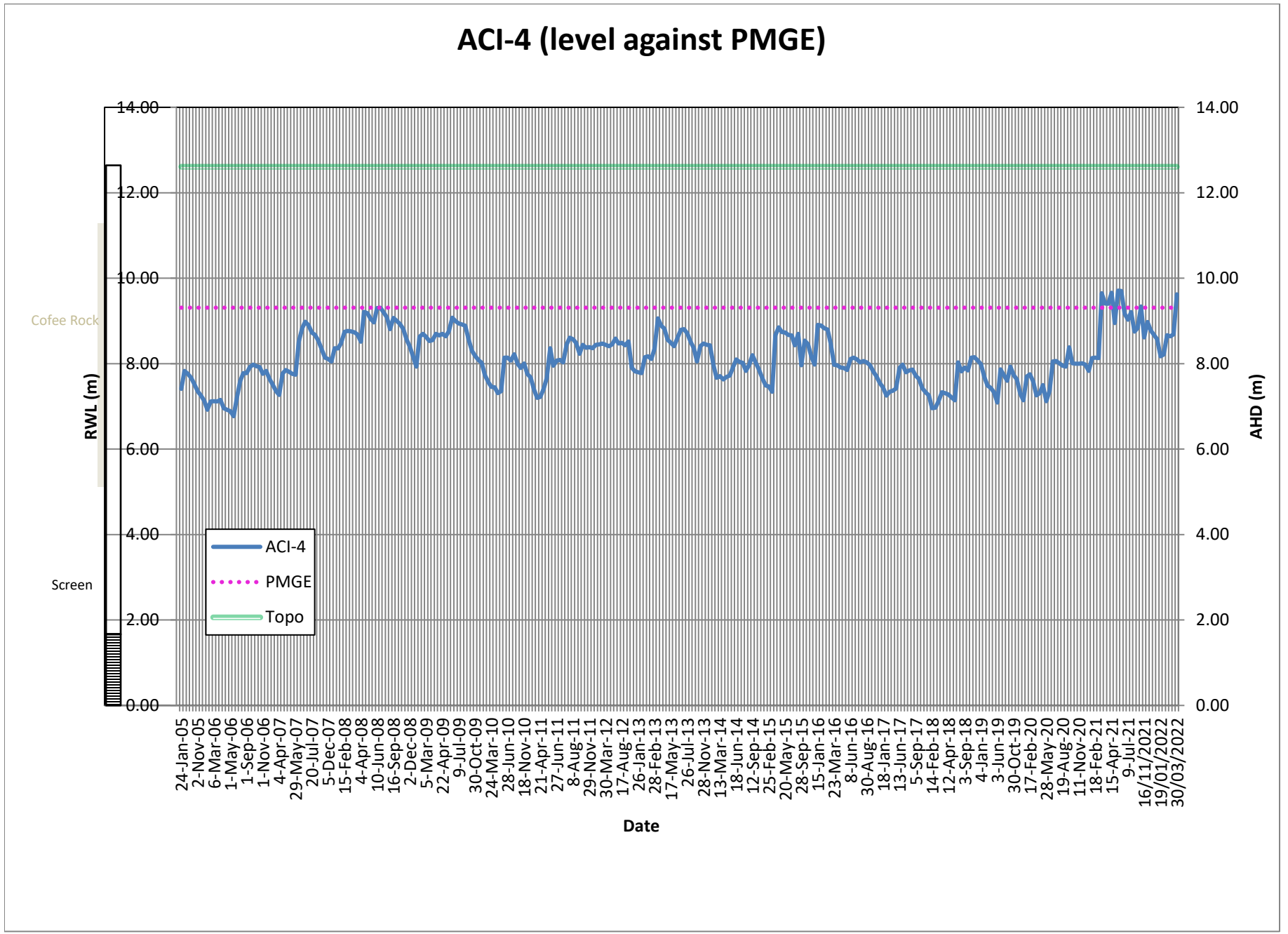
Name	Qualification	Title/Experience	Contribution
Gayle Joyce	BSc Forestry – Hons 1	GIS Specialist	Figures and mapping
Daniel O'Brien	BEnvSc & Mgt (Hons) PhD	Ecologist	Field work
Nigel Fisher	BSc (Hons) PhD	Senior Soil Microecologist	Project Management, Field work and Reporting
Mark Dean	BEnvSc & Mngt	Ecologist	Field work and Reporting

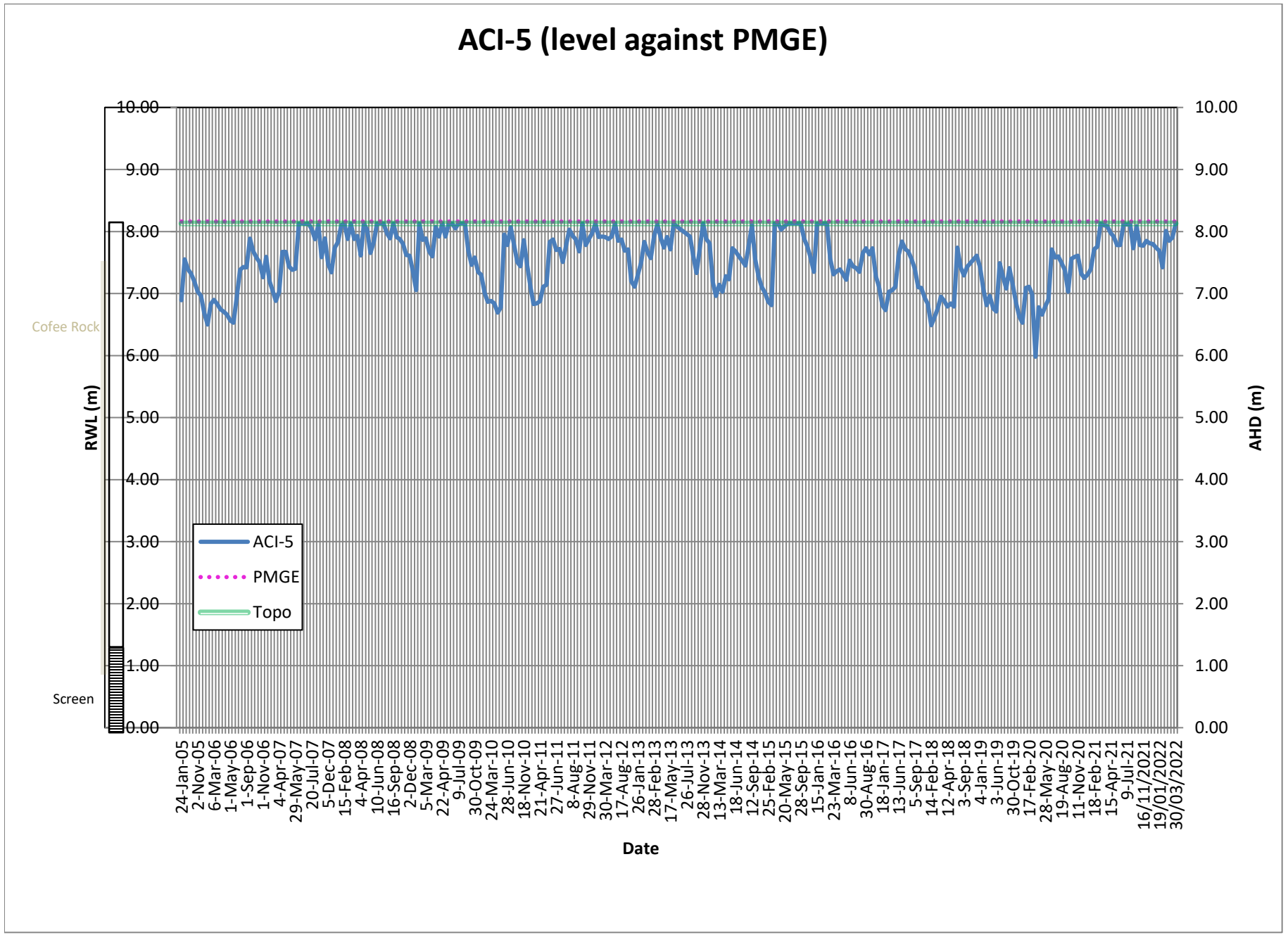
APPENDIX 3

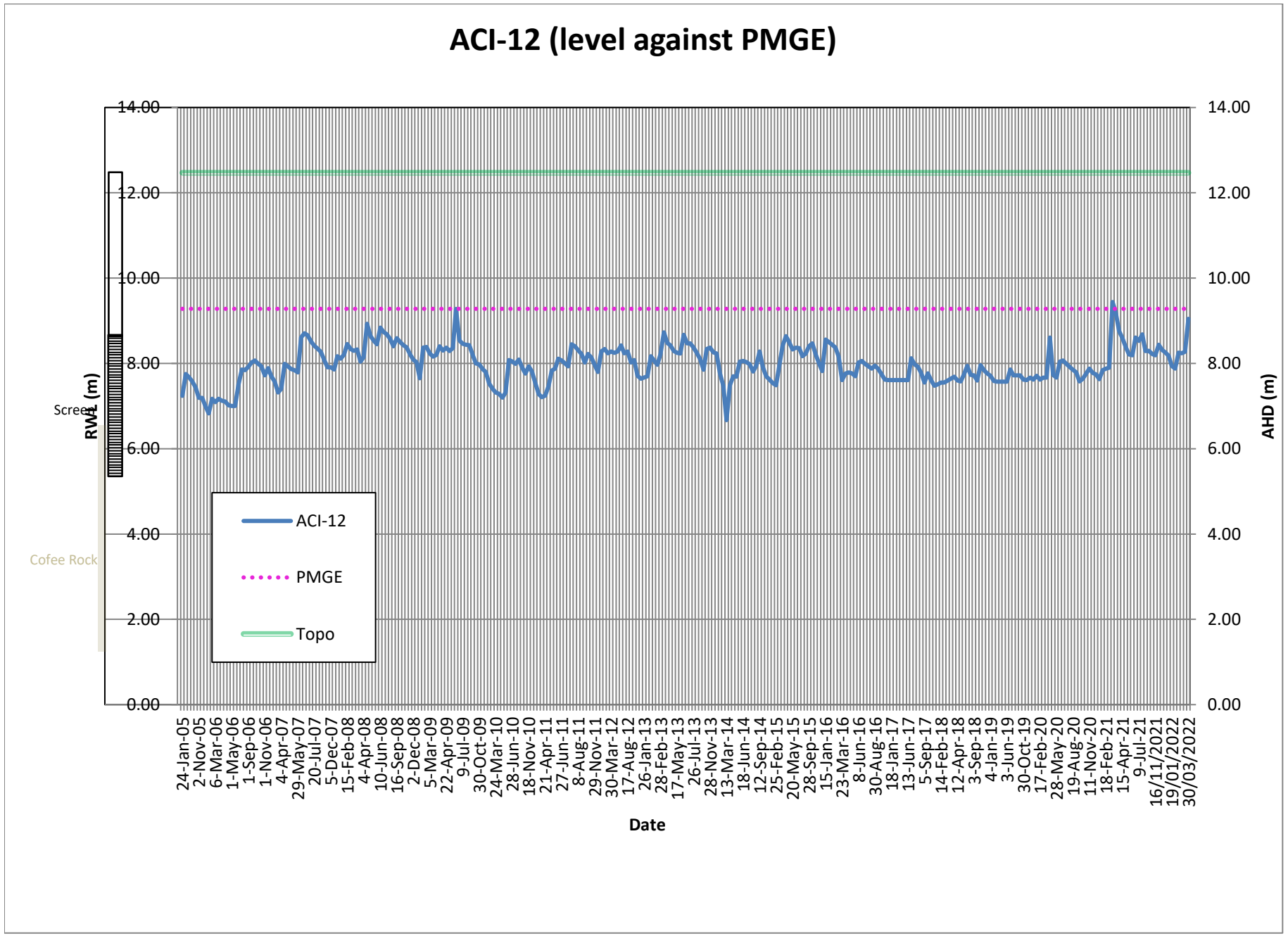
GROUNDWATER LEVEL TREND HYDROGRAPHS

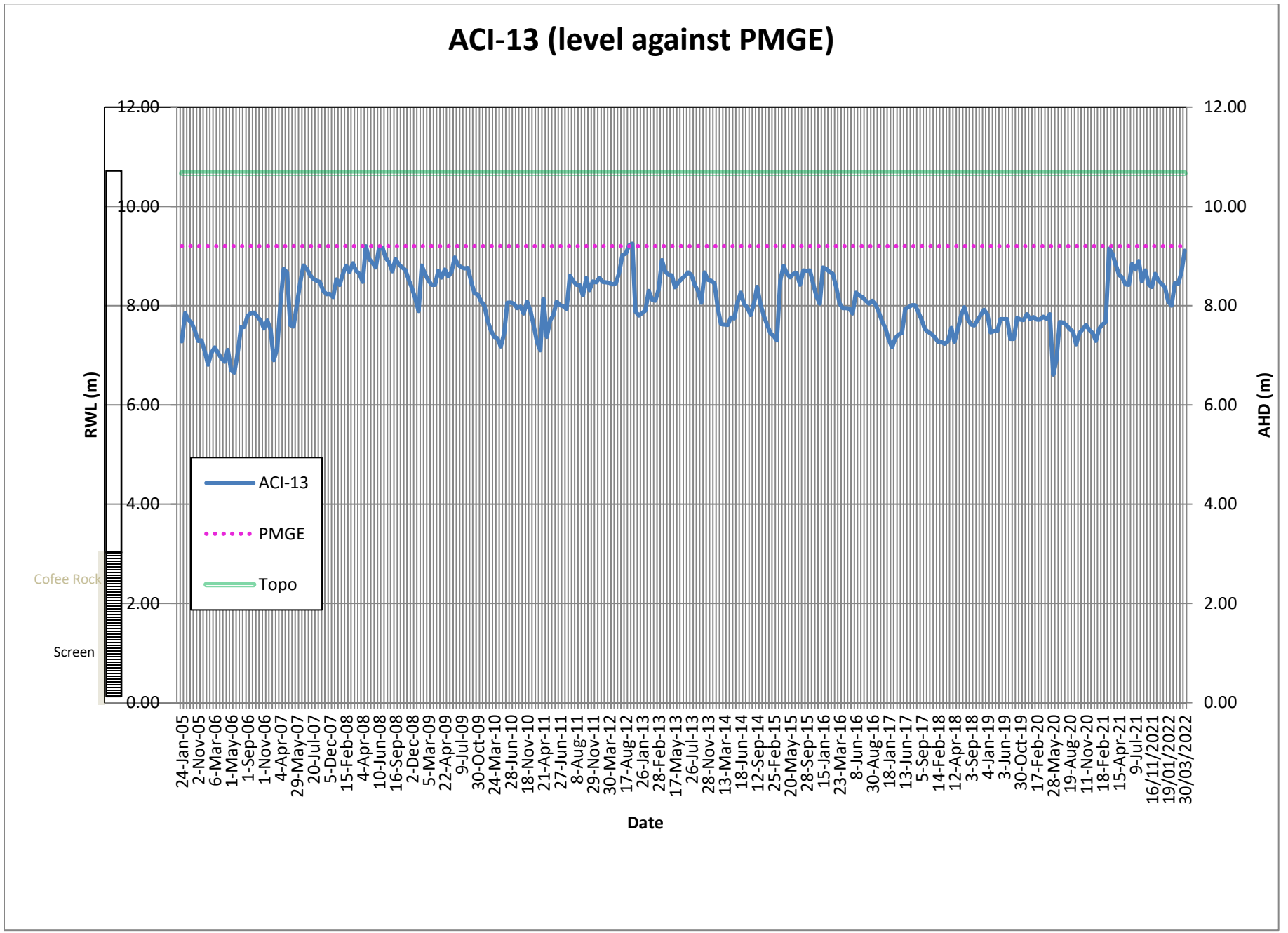

ACI-2 (level against PMGE)
RWL (m)
AHD (m)
Cofee Rock
Screen
ACI-2
PMGE
Topo
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date

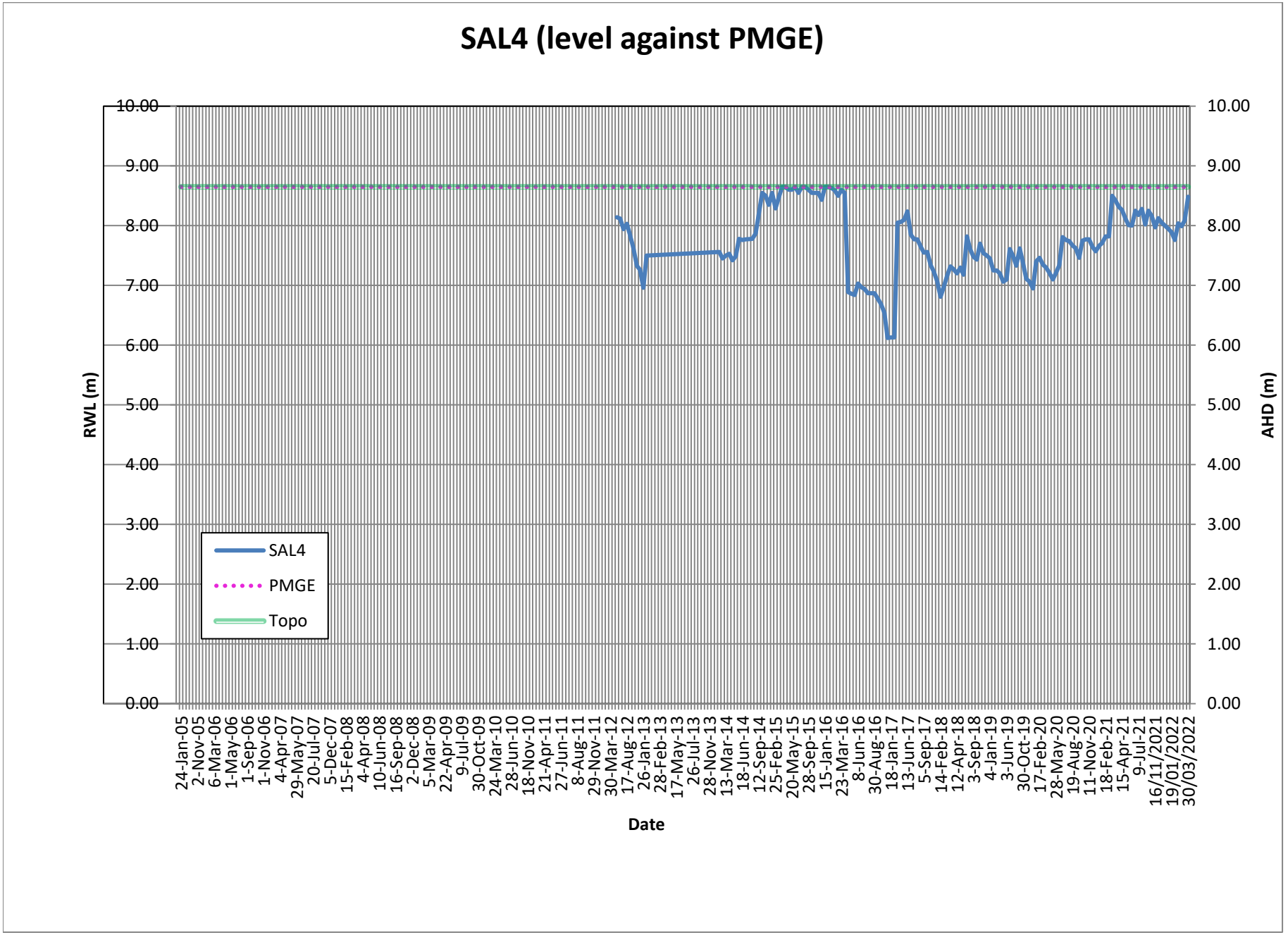

ACI-3 (level against PMGE)
RWL (m)
AHD (m)
Cofee Rock
Screen
ACI-3
PMGE
Topo
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date


ACI-4 (level against PMGE)
RWL (m)
AHD (m)
Cofee Rock
Screen
ACI-4
PMGE
Topo
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date


ACI-5 (level against PMGE)
RWL (m)
AHD (m)
Cofee Rock
Screen
ACI-5
PMGE
Topo
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date


ACI-12 (level against PMGE)
RWL (m)
AHD (m)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Screen
Cofee Rock
ACI-12
PMGE
Topo
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date

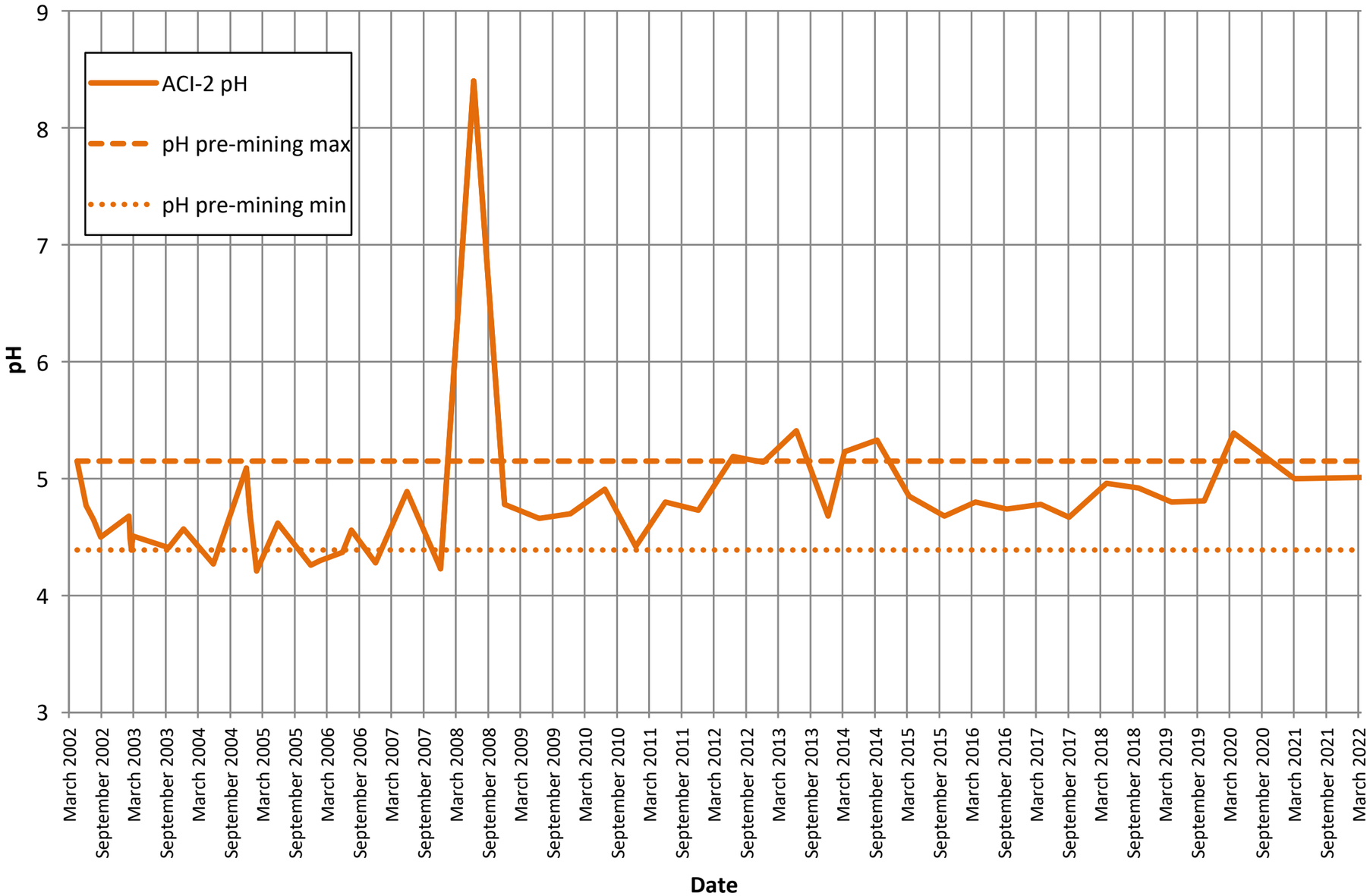

ACI-13 (level against PMGE)
RWL (m)
AHD (m)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Cofee Rock
Screen
ACI-13
PMGE
Topo
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date


SAL4 (level against PMGE)
RWL (m)
AHD (m)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
SAL4
PMGE
Topo
24-Jan-05
2-Nov-05
6-Mar-06
1-May-06
1-Sep-06
1-Nov-06
4-Apr-07
29-May-07
20-Jul-07
5-Dec-07
15-Feb-08
4-Apr-08
10-Jun-08
16-Sep-08
2-Dec-08
5-Mar-09
22-Apr-09
9-Jul-09
30-Oct-09
24-Mar-10
28-Jun-10
18-Nov-10
21-Apr-11
27-Jun-11
8-Aug-11
29-Nov-11
30-Mar-12
17-Aug-12
26-Jan-13
28-Feb-13
17-May-13
26-Jul-13
28-Nov-13
13-Mar-14
18-Jun-14
12-Sep-14
25-Feb-15
20-May-15
28-Sep-15
15-Jan-16
23-Mar-16
8-Jun-16
30-Aug-16
18-Jan-17
13-Jun-17
5-Sep-17
14-Feb-18
12-Apr-18
3-Sep-18
4-Jan-19
3-Jun-19
30-Oct-19
17-Feb-20
28-May-20
19-Aug-20
11-Nov-20
18-Feb-21
15-Apr-21
9-Jul-21
16/11/2021
19/01/2022
30/03/2022
Date

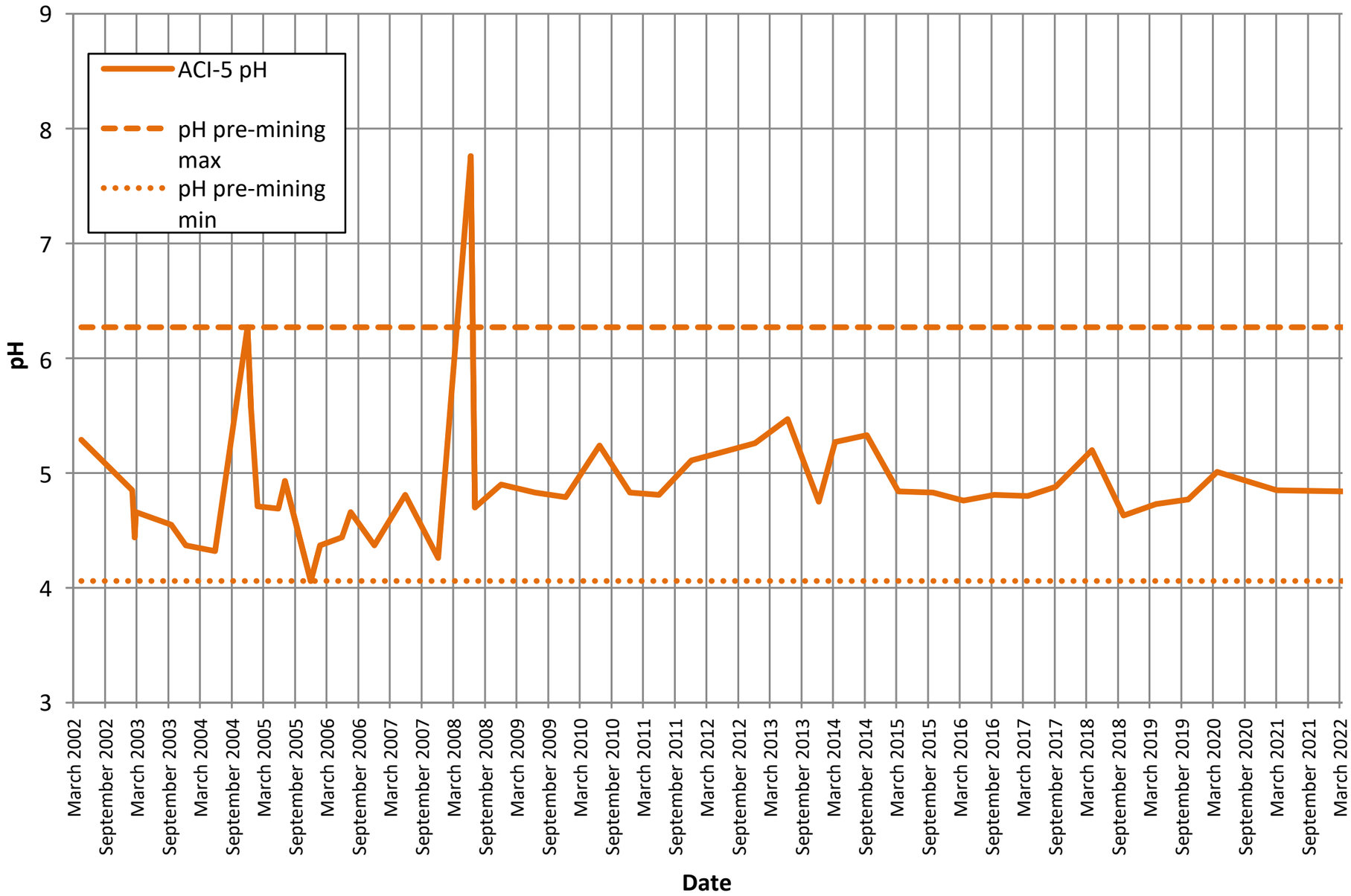
APPENDIX 4

GROUNDWATER QUALITY TREND HYDROGRAPHS (QUALITY VS. TRIGGER VALUES)

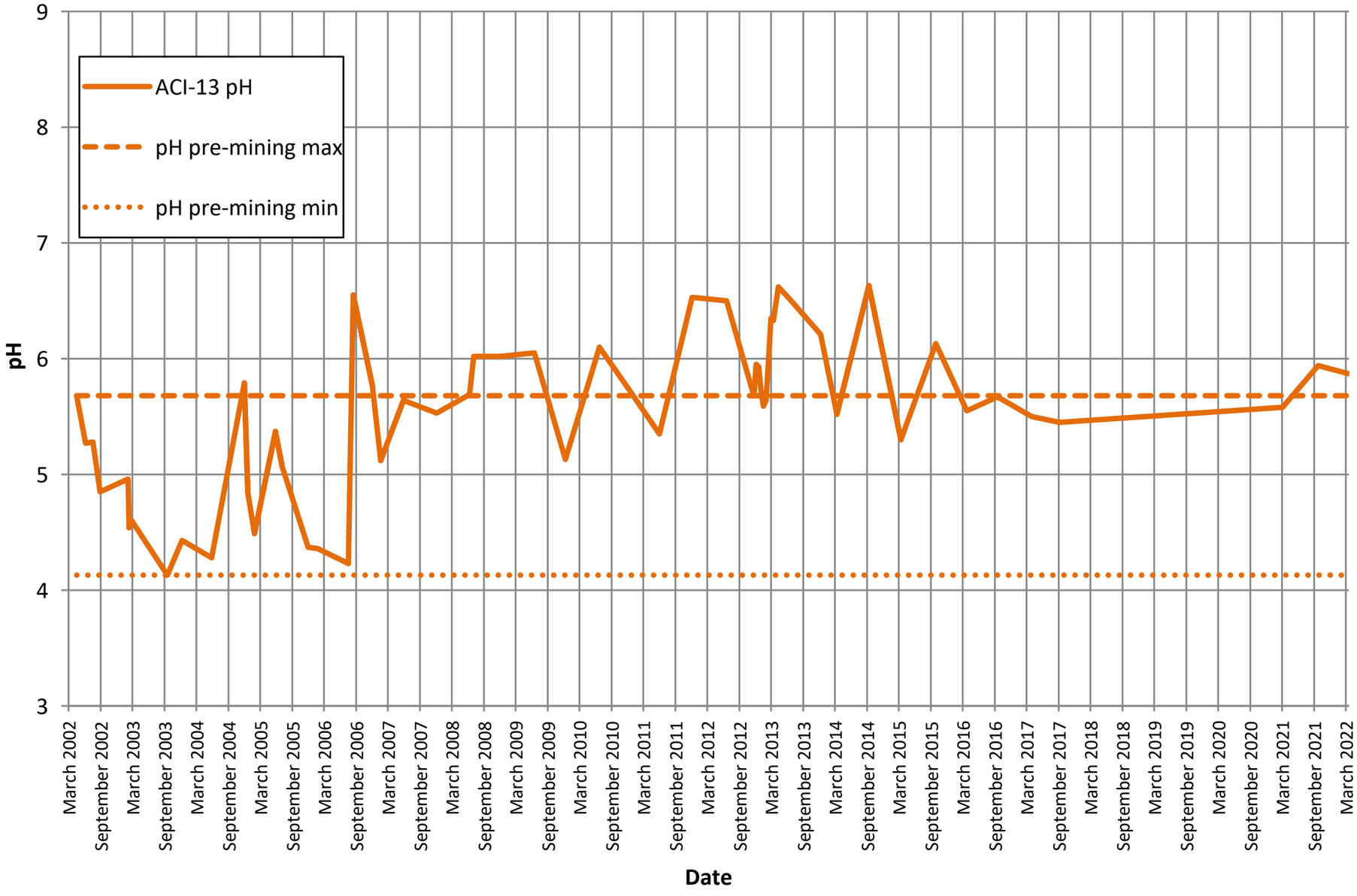
ACI-2 (pH)

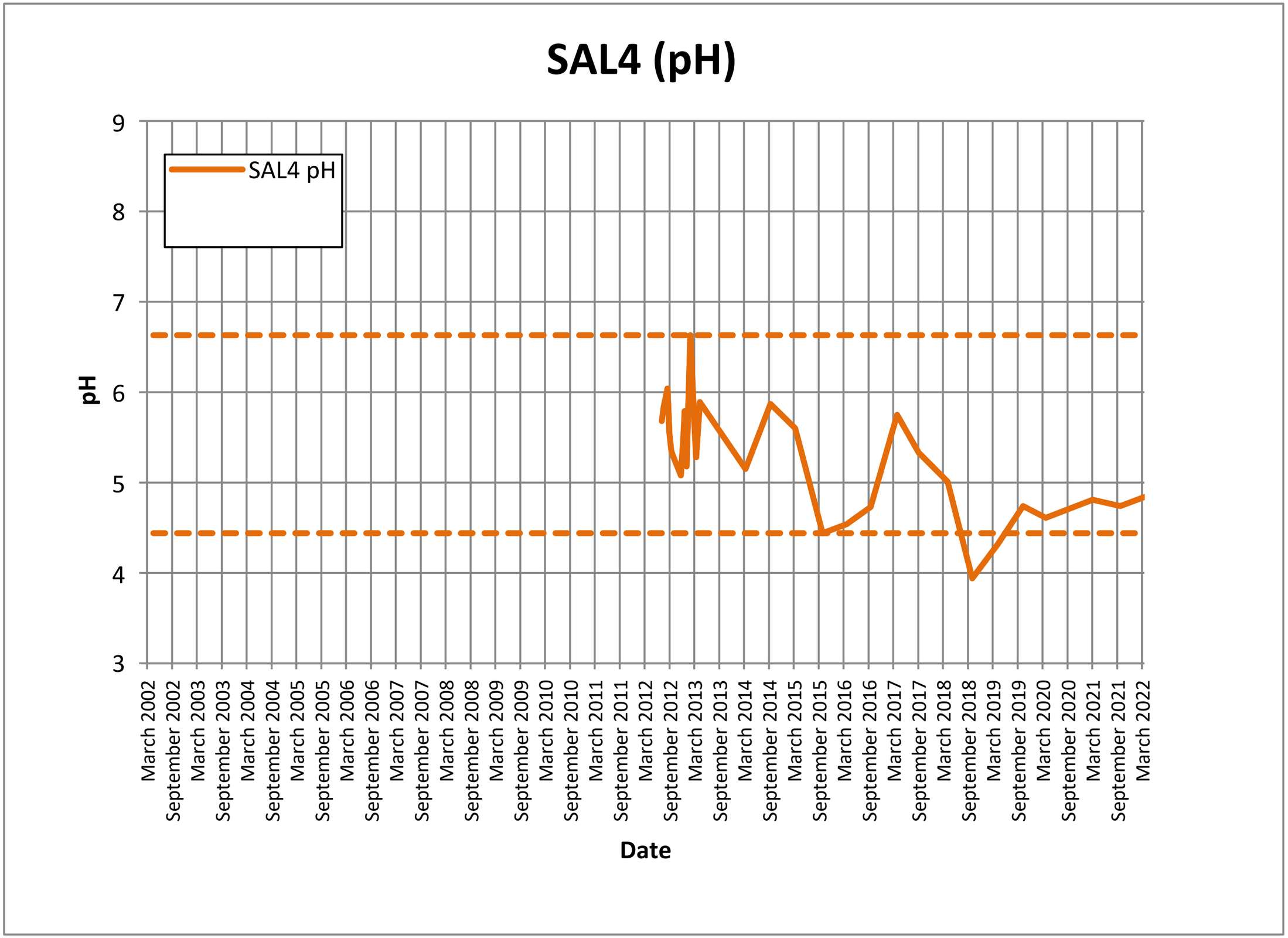

ACI-2 pH
pH pre-mining max
pH pre-mining min
pH
9
8
7
6
5
4
3
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

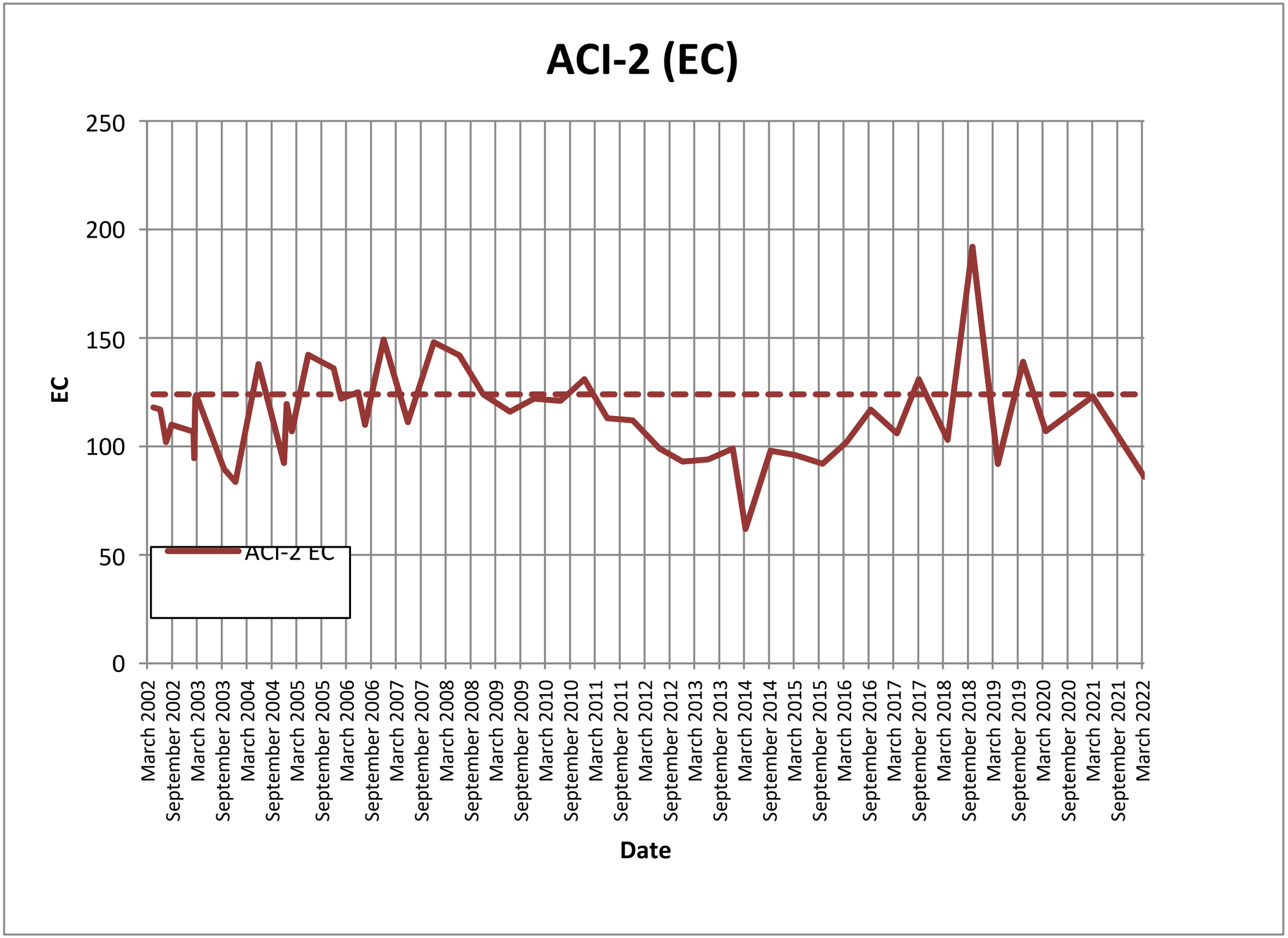
ACI-5 (pH)

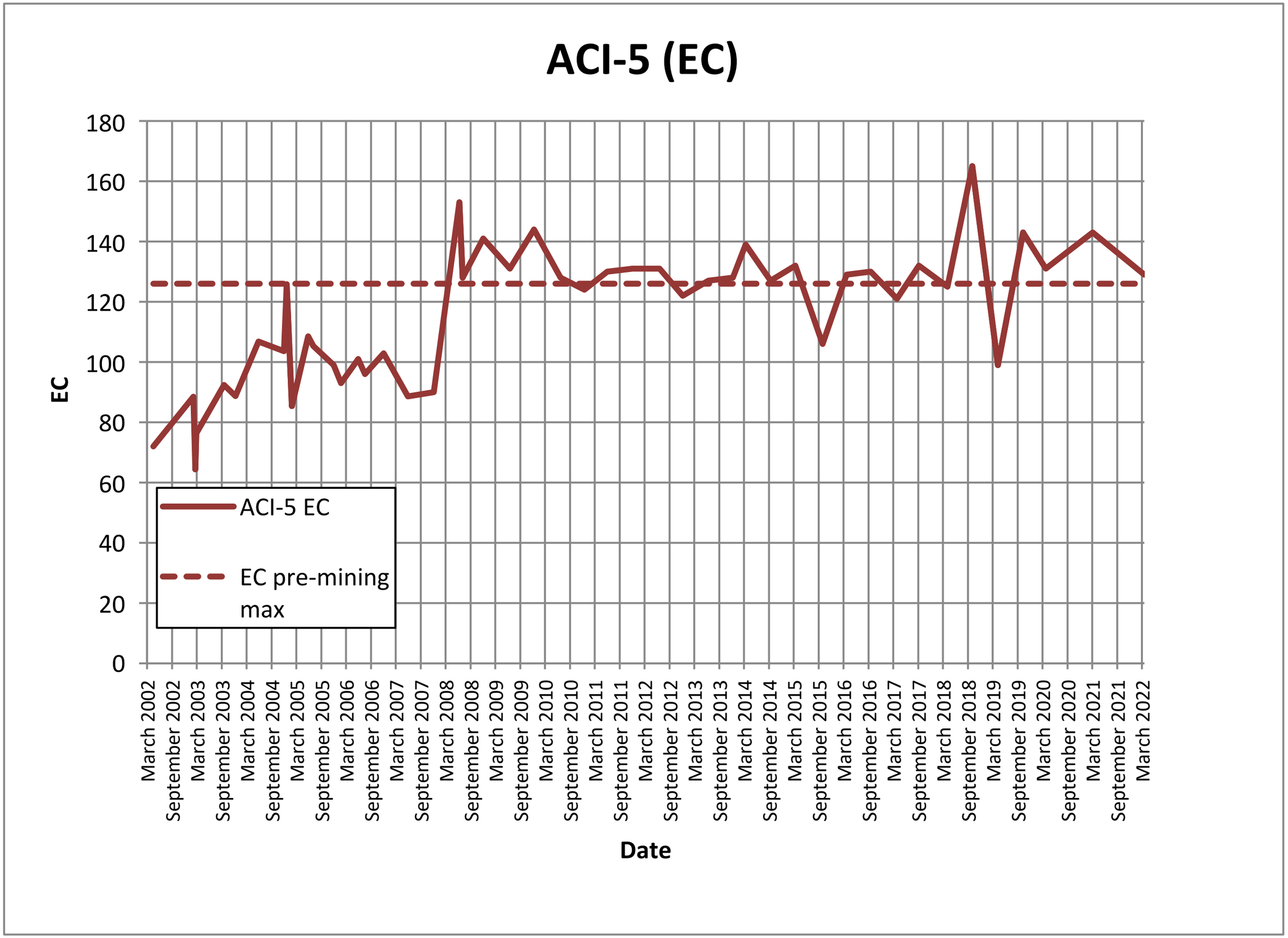

ACI-5 pH
pH pre-mining max
pH pre-mining min
pH
9
8
7
6
5
4
3
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

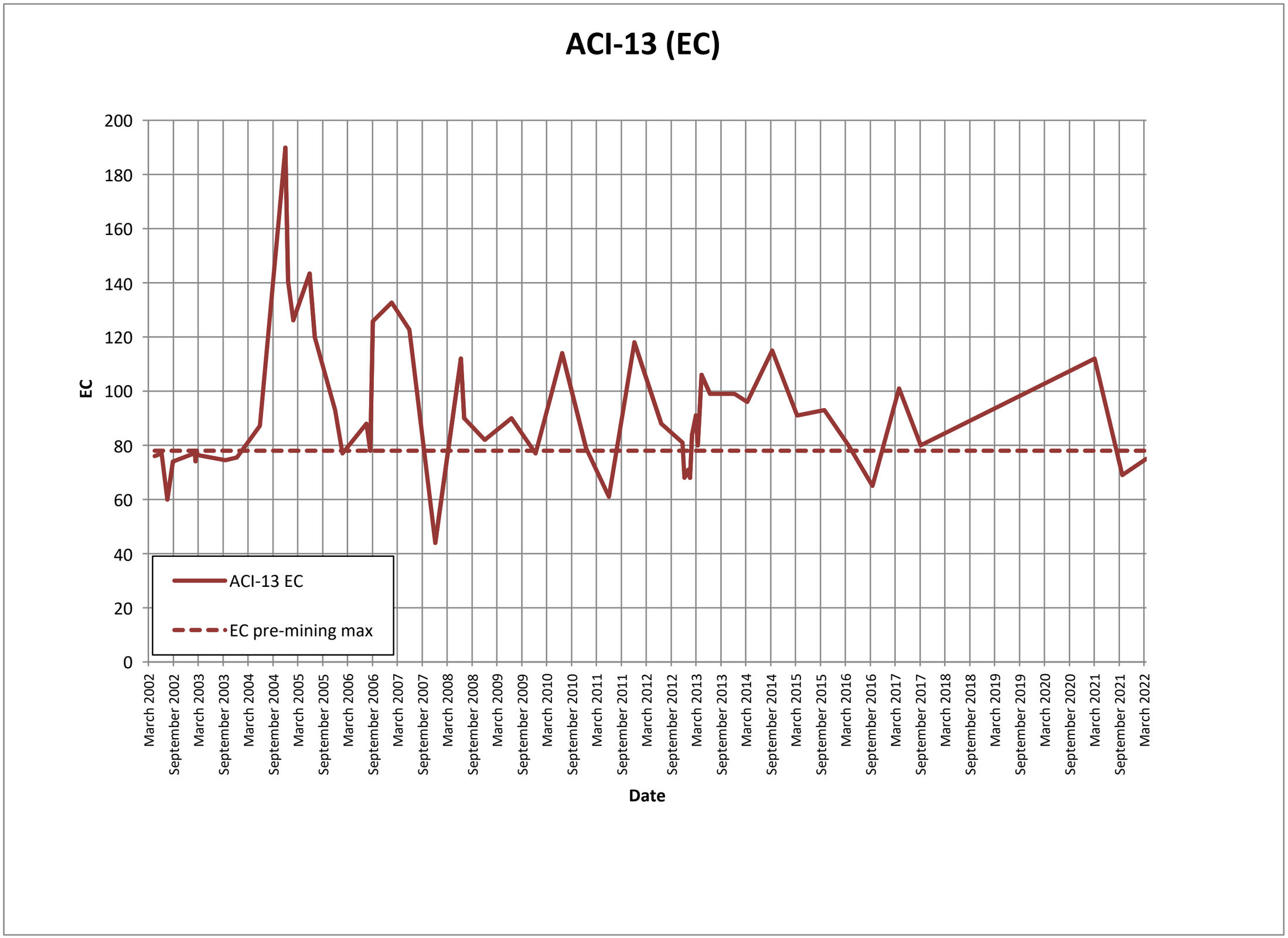
ACI-13 (pH)

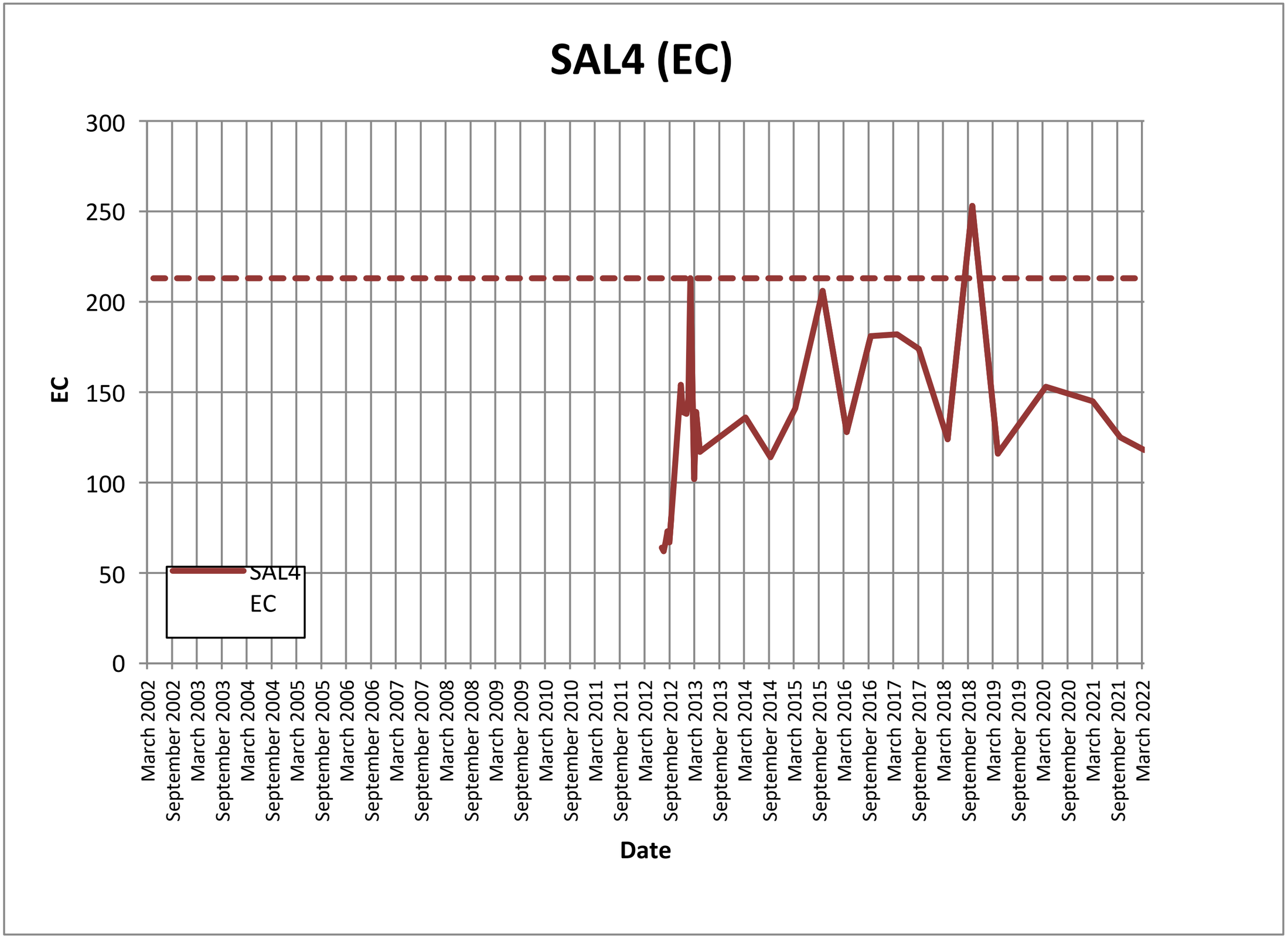

ACI-13 pH
pH pre-mining max
pH pre-mining min
pH
9
8
7
6
5
4
3
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

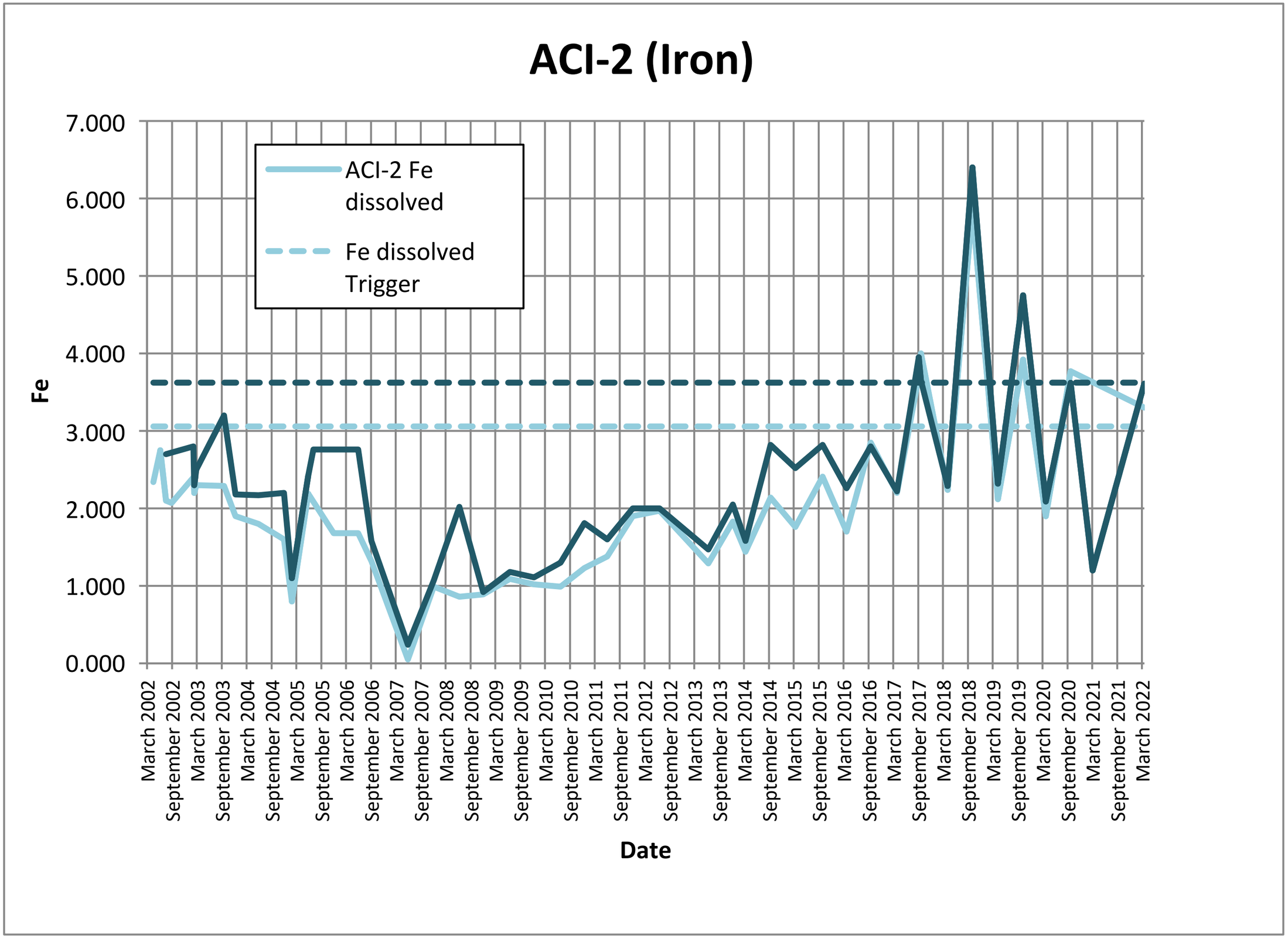

SAL4 (pH)
SAL4 pH
pH
9
8
7
6
5
4
3
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date


ACI-2 (EC)
EC
250
200
150
100
50
0
ACI-2 EC
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

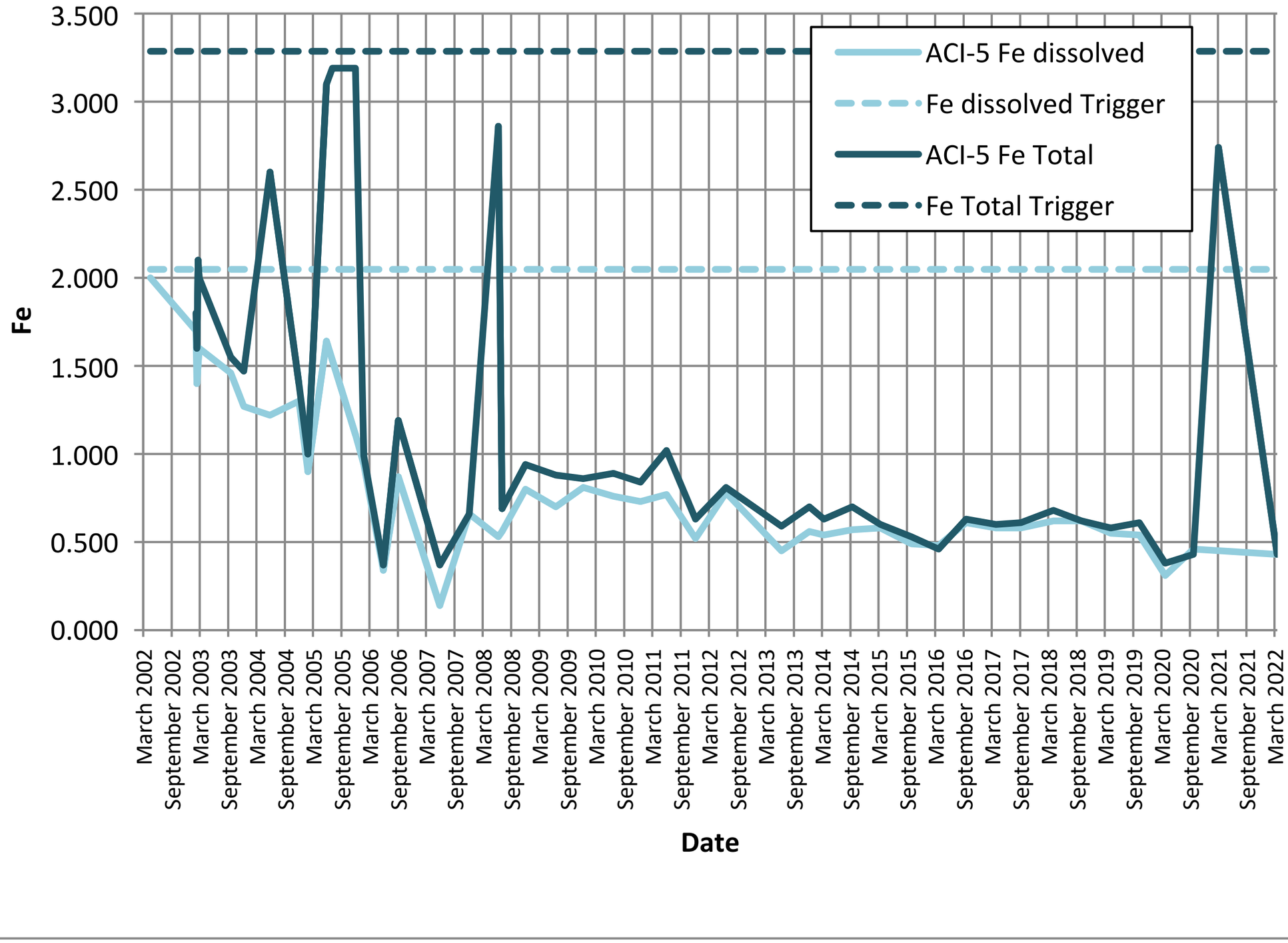

ACI-5 (EC)
EC
180
160
140
120
100
80
60
40
20
0
ACI-5 EC
EC pre-mining max
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date


ACI-13 (EC)
EC
200
180
160
140
120
100
80
60
40
20
0
ACI-13 EC
EC pre-mining max
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

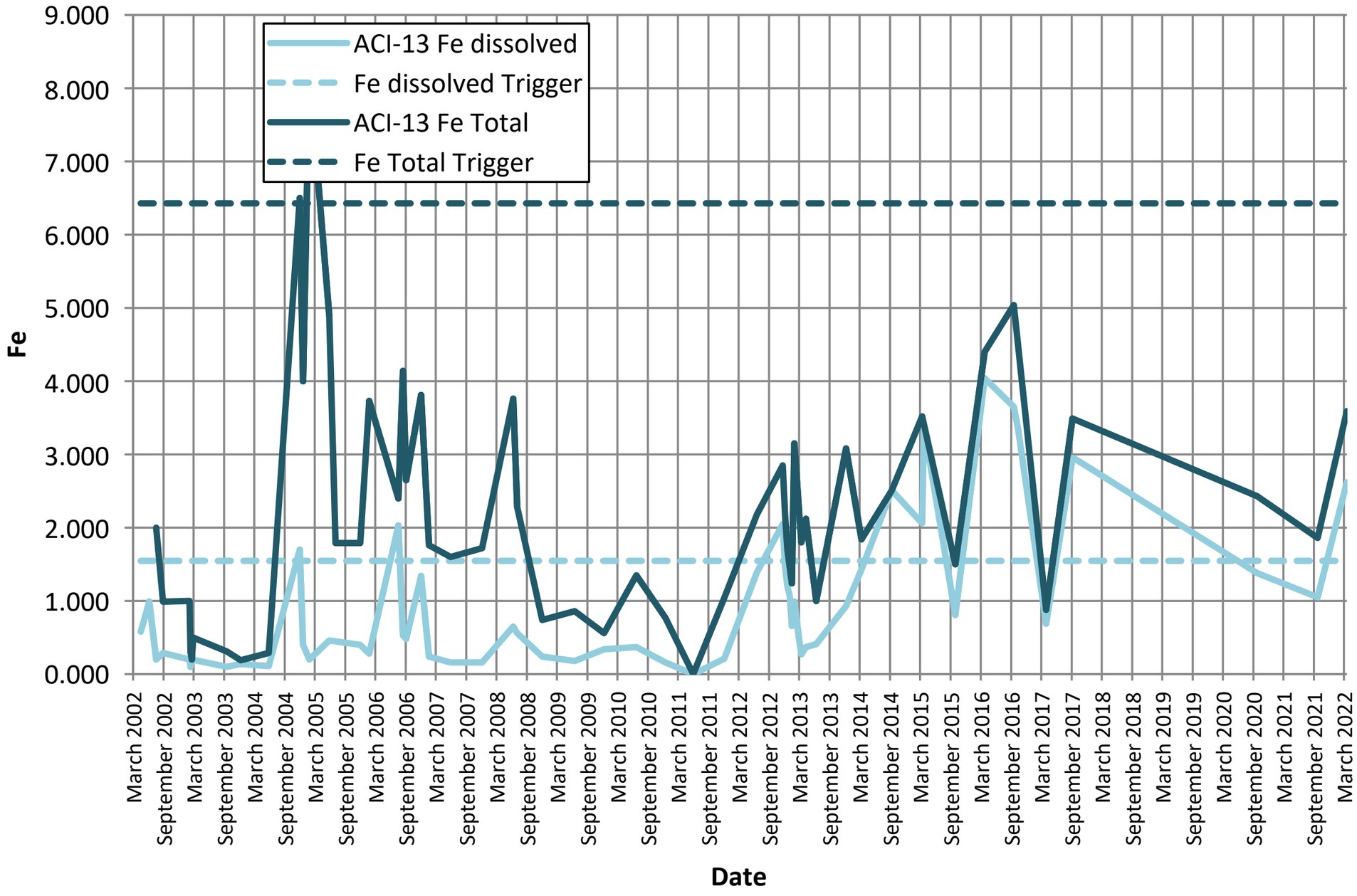

SAL4 (EC)
EC
300
250
200
150
100
50
0
SAL4 EC
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

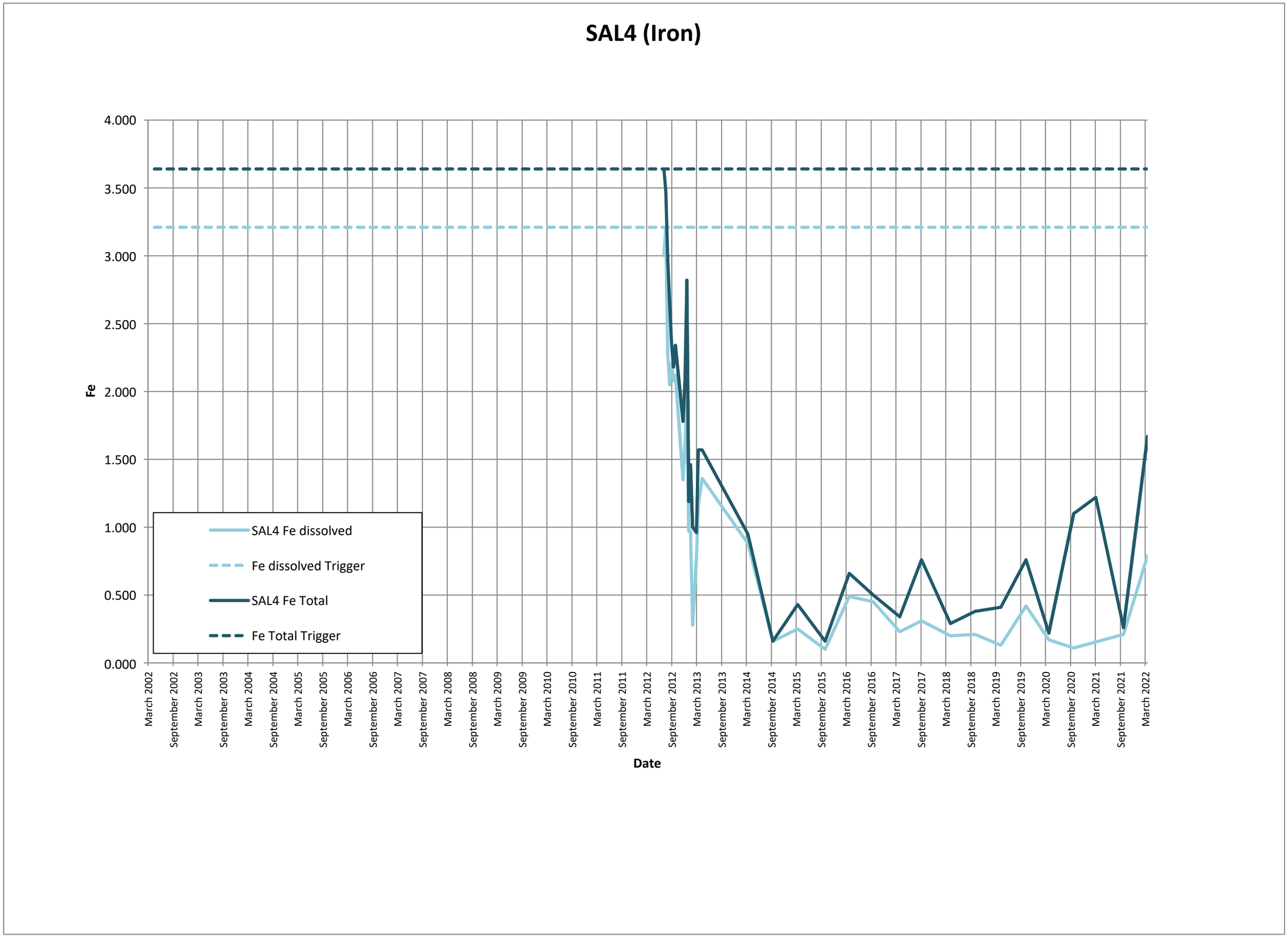

ACI-2 (Iron)
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
Fe
ACI-2 Fe dissolved
Fe dissolved Trigger
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

ACI-5 (Iron)

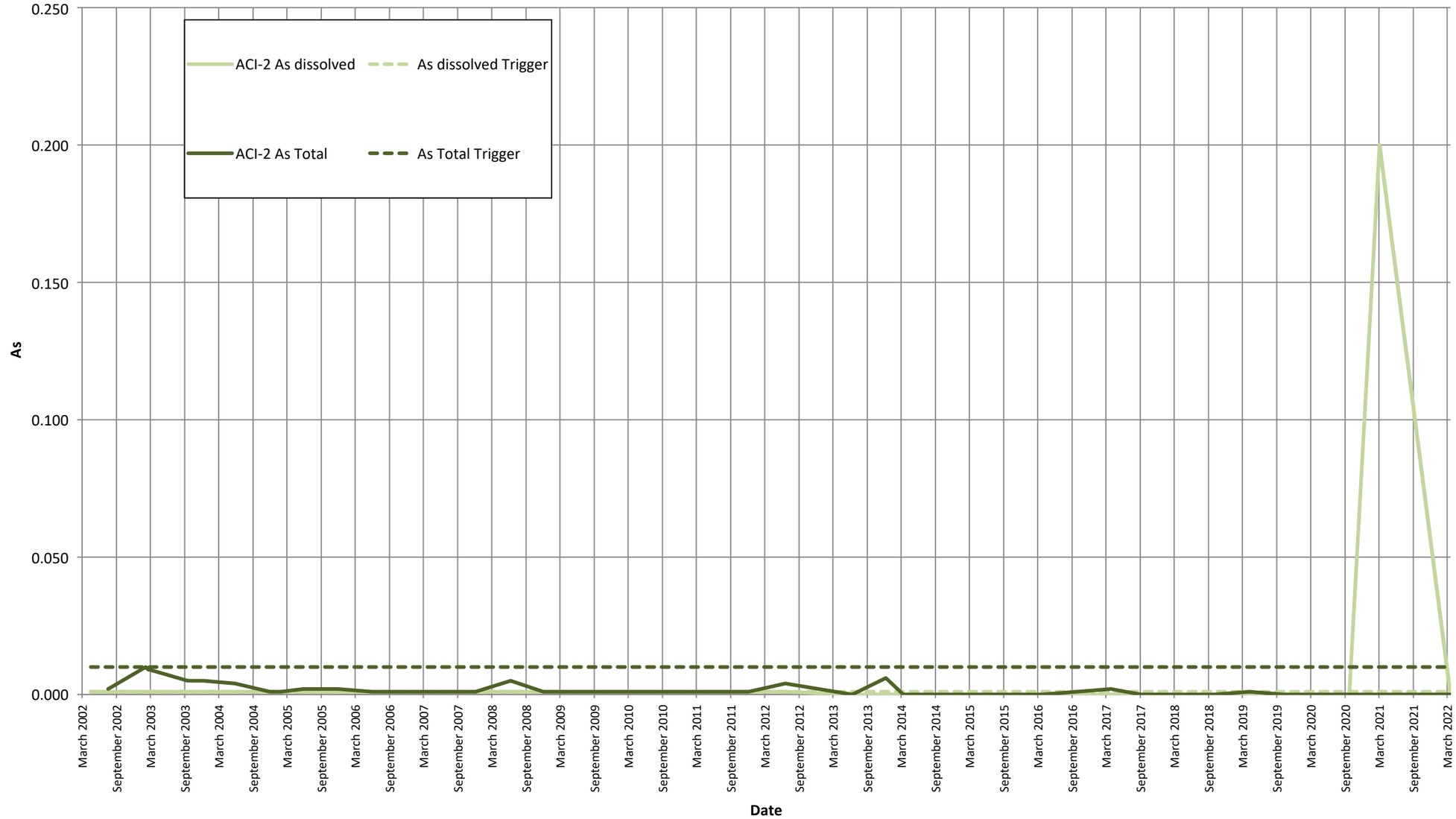

3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Fe
ACI-5 Fe dissolved
Fe dissolved Trigger
ACI-5 Fe Total
Fe Total Trigger
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

ACI-13 (Iron)

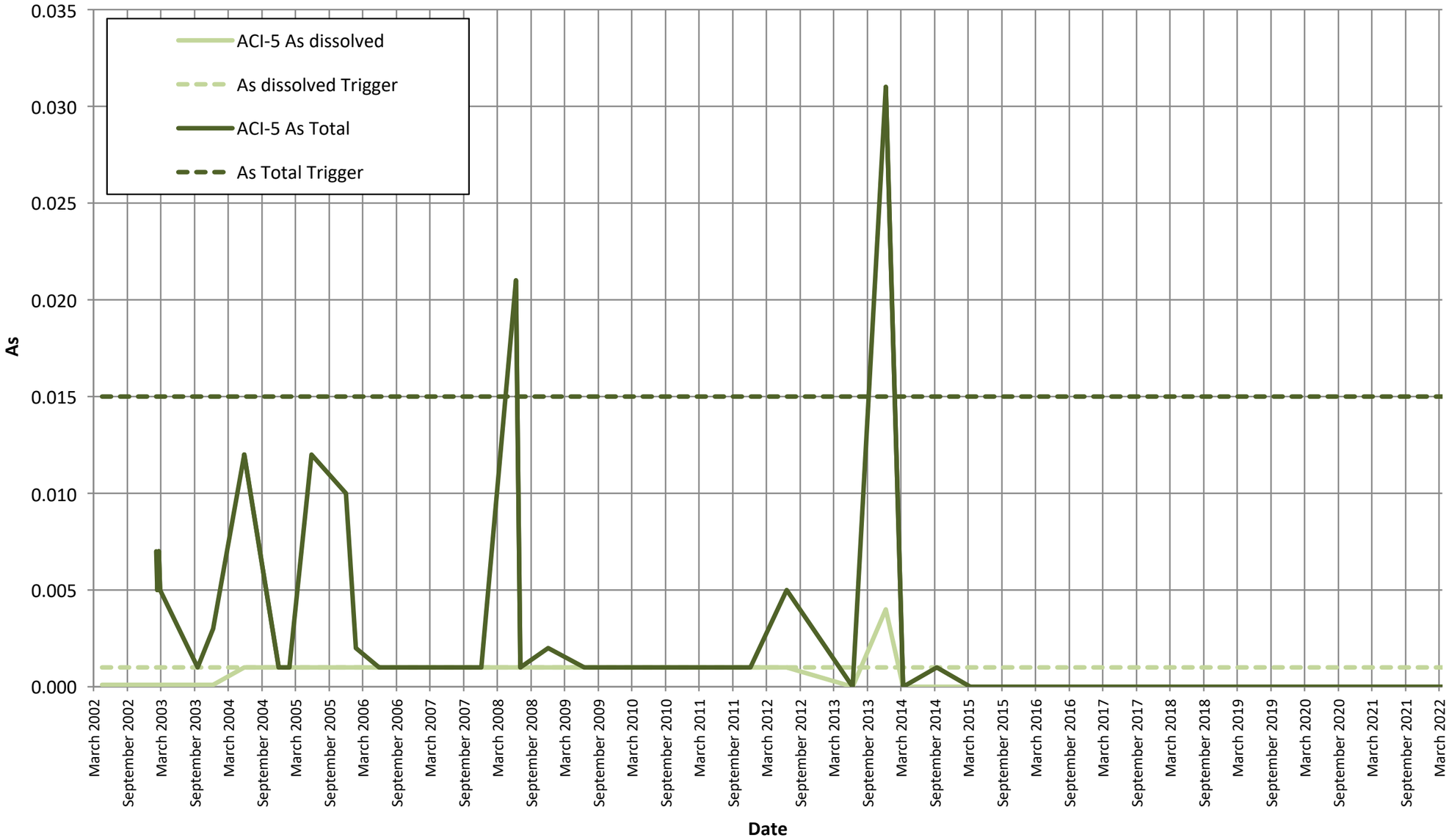

ACI-13 Fe dissolved
Fe dissolved Trigger
ACI-13 Fe Total
Fe Total Trigger
Fe
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date


SAL4 (Iron)
Fe
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
SAL4 Fe dissolved
Fe dissolved Trigger
SAL4 Fe Total
Fe Total Trigger
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

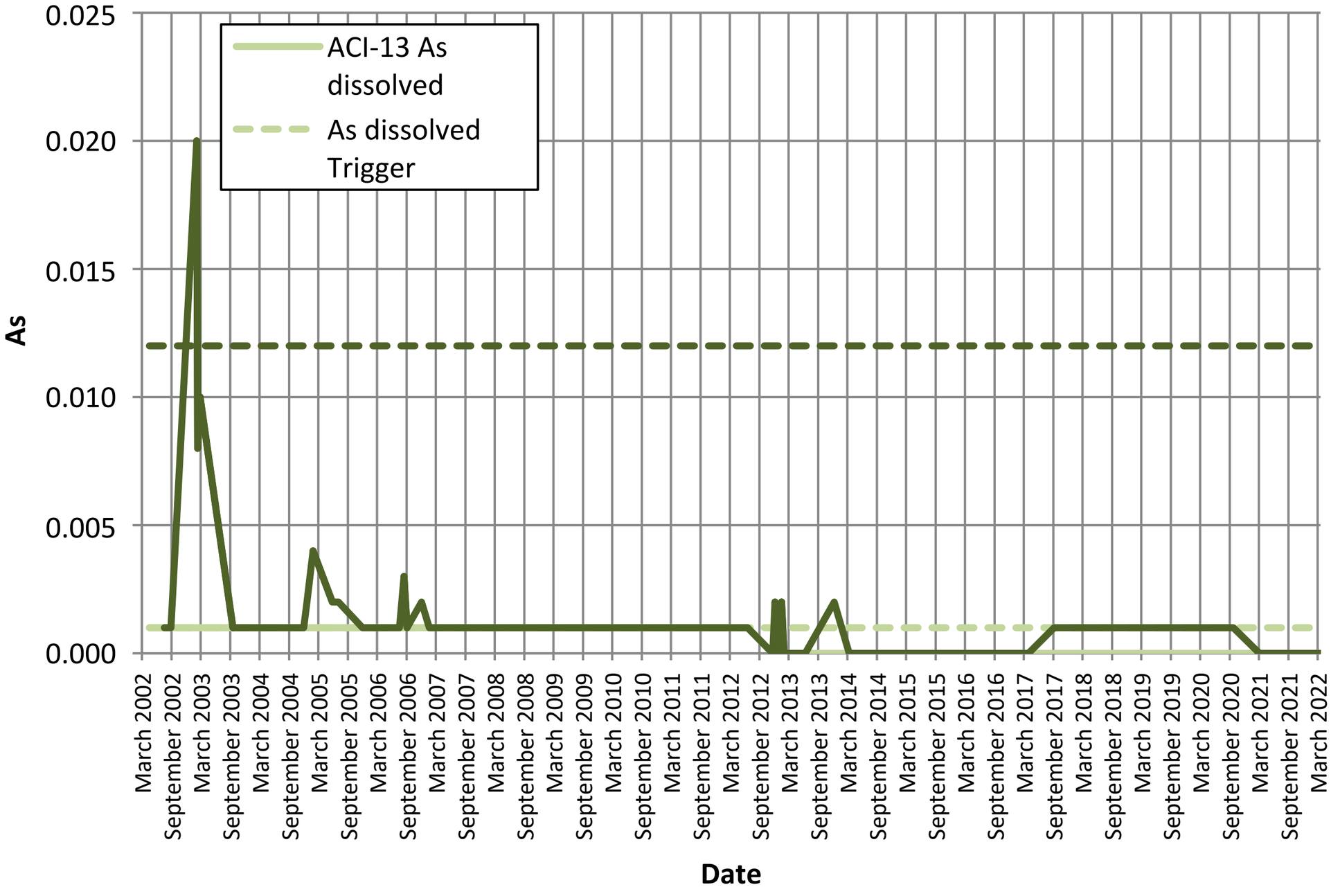
ACI-2 (Arsenic)

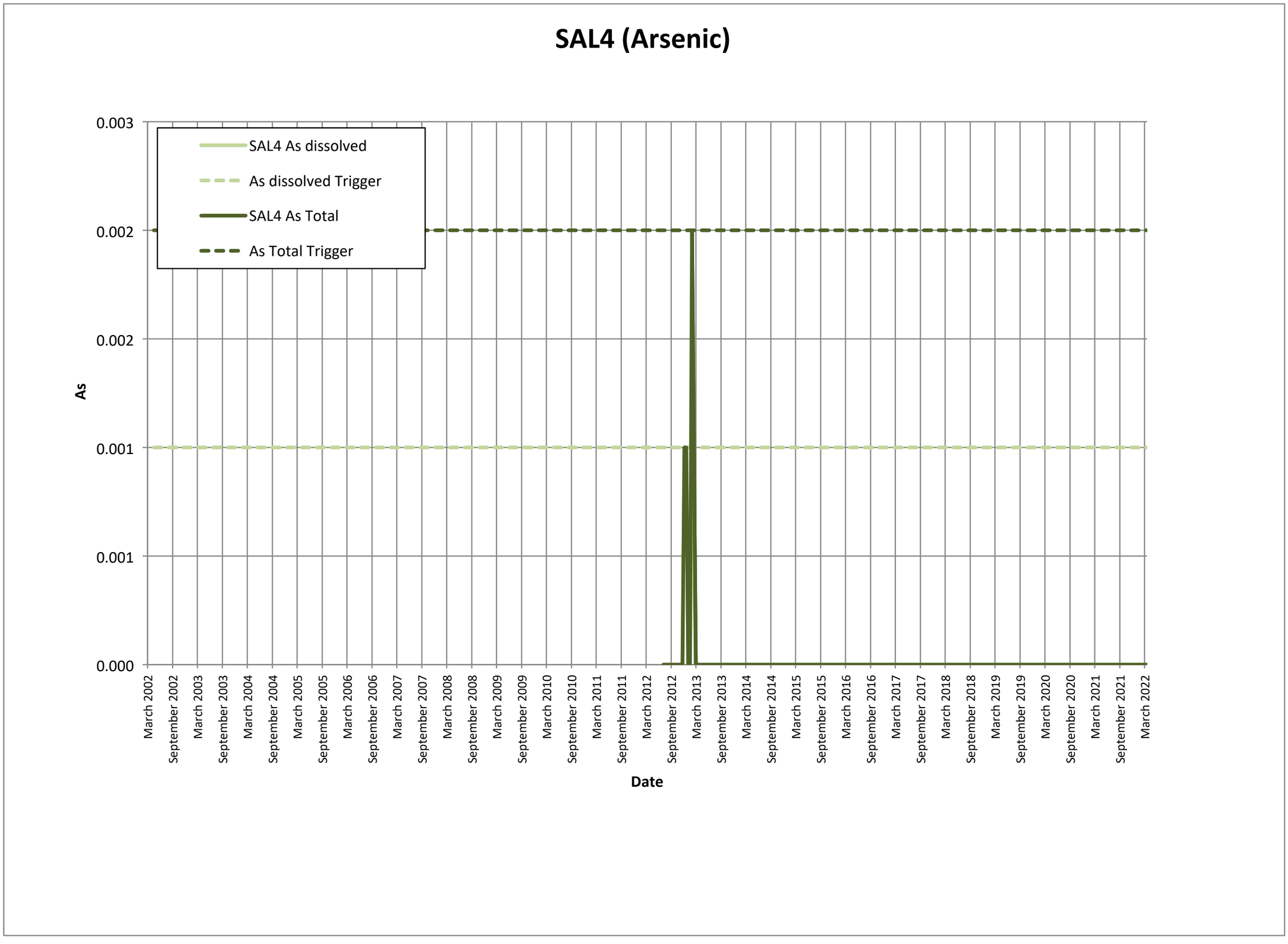


ACI-5 (Arsenic)

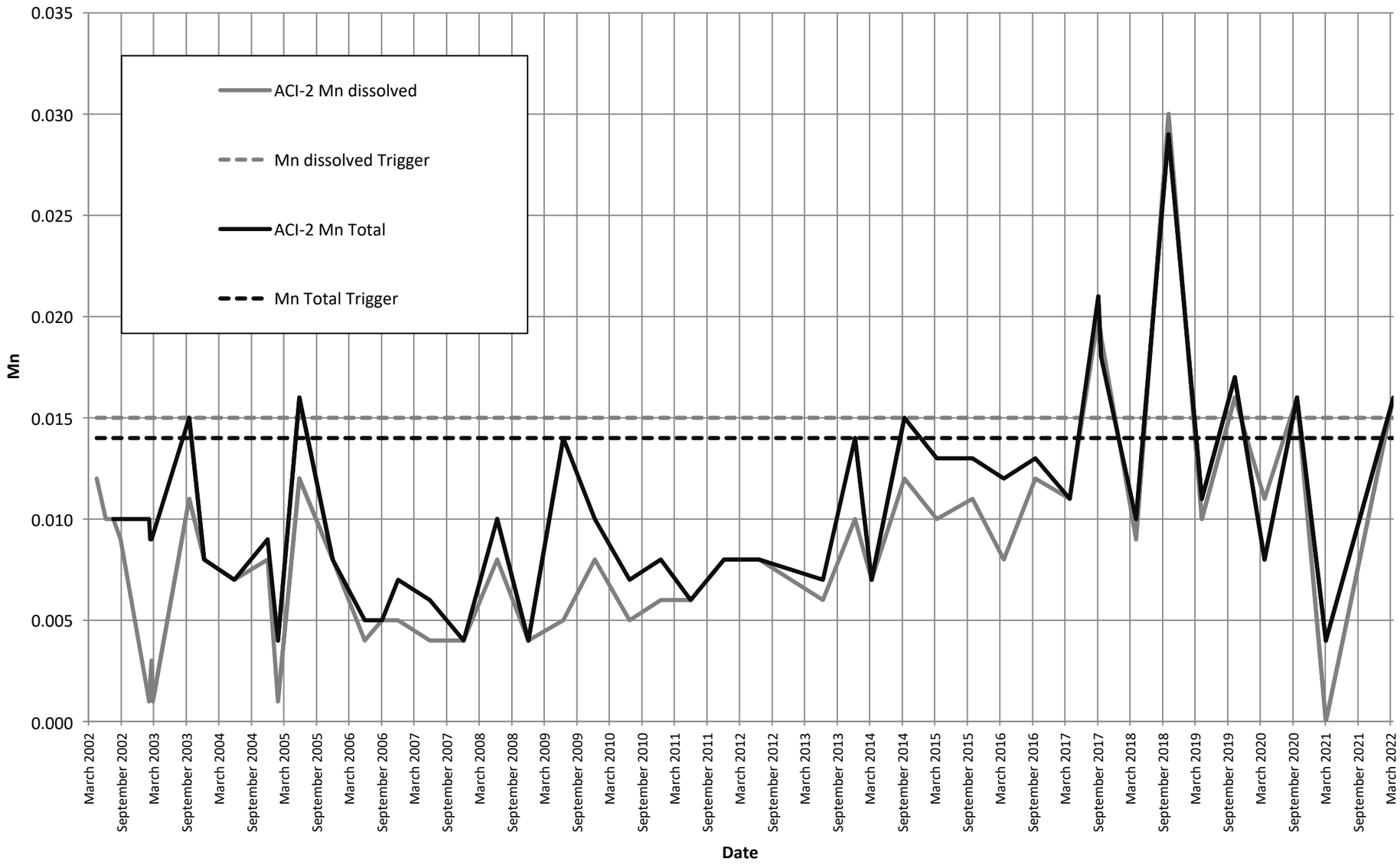


ACI-13 (Arsenic)

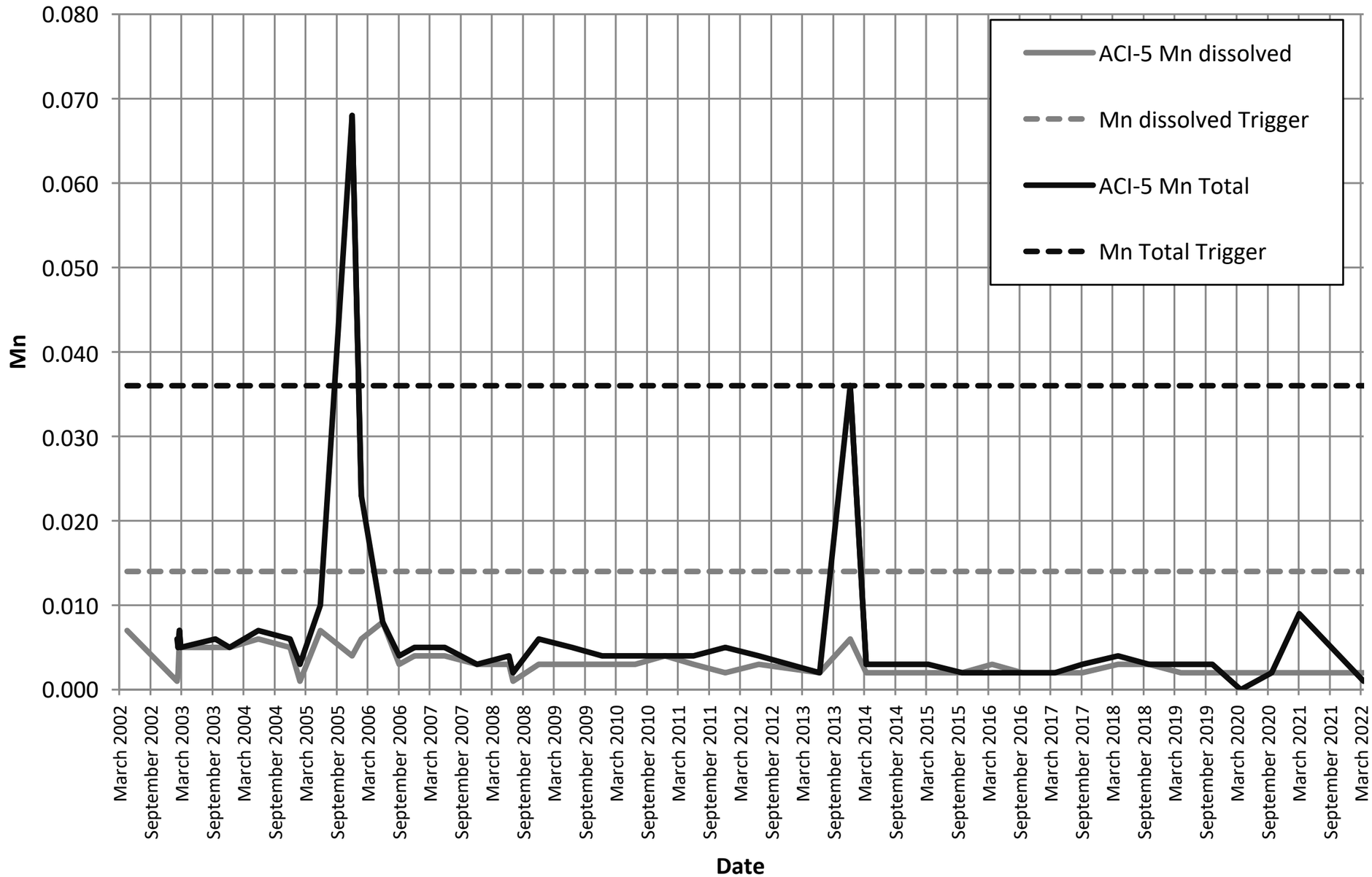



SAL4 (Arsenic)
SAL4 As dissolved
As dissolved Trigger
SAL4 As Total
As Total Trigger
0.003
0.002
0.002
0.001
0.001
0.000
As
March 2002
September 2002
March 2003
September 2003
March 2004
September 2004
March 2005
September 2005
March 2006
September 2006
March 2007
September 2007
March 2008
September 2008
March 2009
September 2009
March 2010
September 2010
March 2011
September 2011
March 2012
September 2012
March 2013
September 2013
March 2014
September 2014
March 2015
September 2015
March 2016
September 2016
March 2017
September 2017
March 2018
September 2018
March 2019
September 2019
March 2020
September 2020
March 2021
September 2021
March 2022
Date

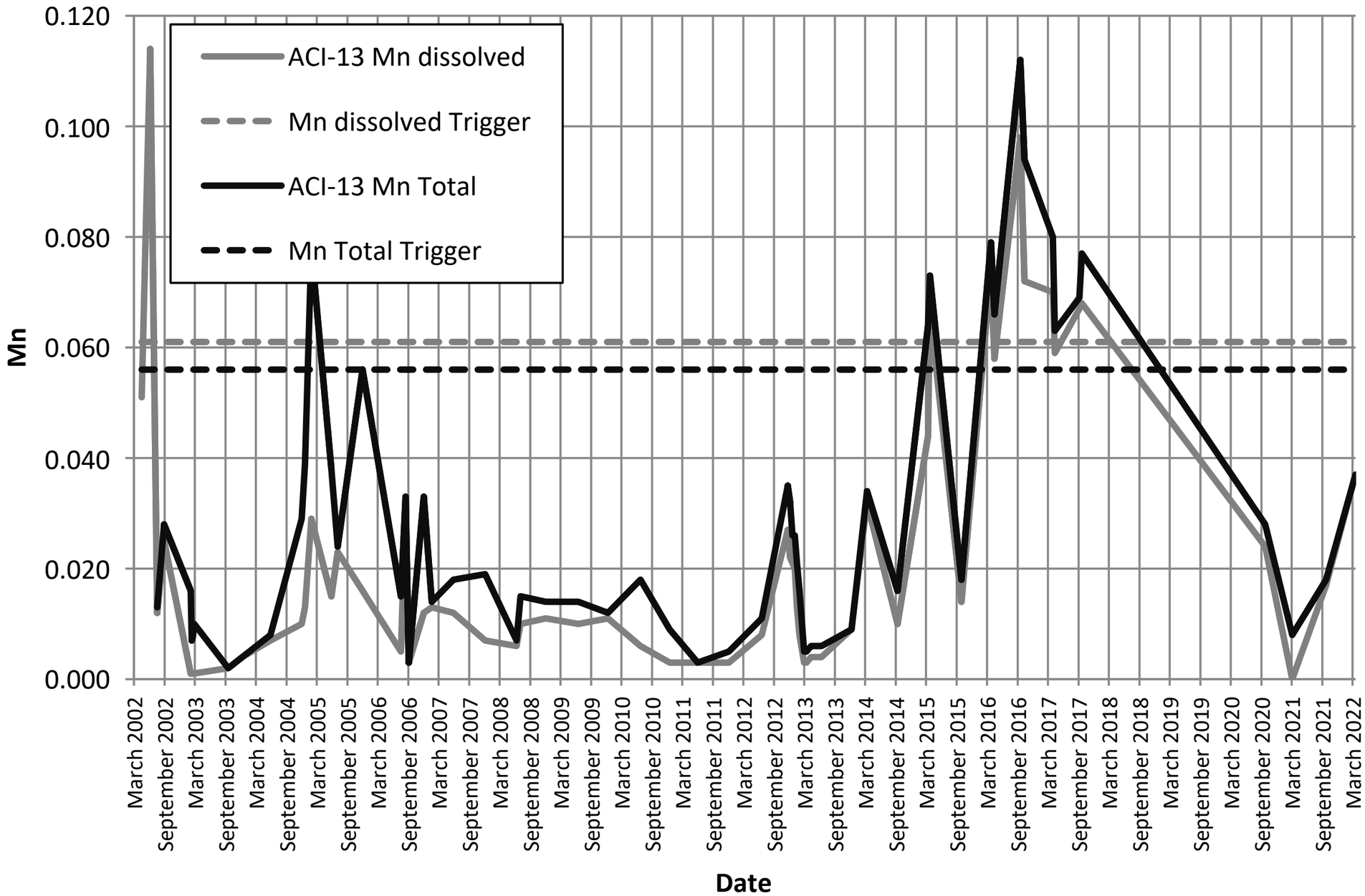
ACI-2 (Manganese)



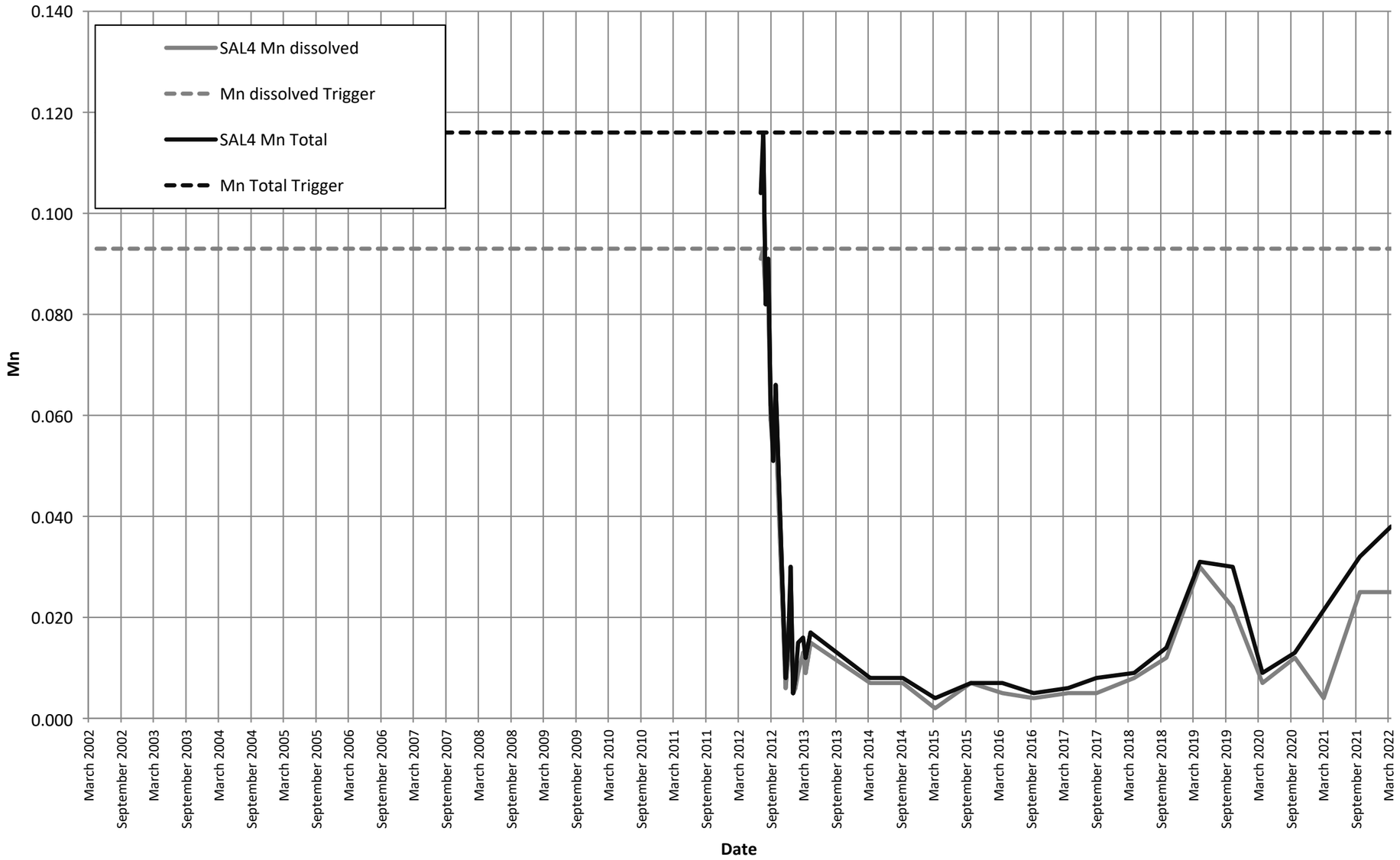
ACI-5 (Manganese)



ACI-13 (Manganese)



SAL4 (Manganese)



APPENDIX 5
REHABILITATION MONITORNG REPORT

North Dune Extension Vegetation Rehabilitation Monitoring Annual Report – Year Ending January 2022

Tanilba North Dunes Extension, Oyster Cove Rd, Tanilba Bay

20221961

27 May 2022

KLEINFELDER
Bright People. Right Solutions.

Suite 3, 240-244 Pacific Highway,
Charlestown, NSW 2290

Phone: +61 2 4949 5200

North Dune Extension Vegetation Rehabilitation Monitoring Annual Report – Year Ending January 2022

Oyster Cove Road, Tanilba Bay, Port Stephens

Kleinfelder Project: 20221961

Prepared for:

Holcim (Australia) Pty Ltd
9 Oakvale Rd.,
Salt Ash, NSW 2319

Prepared by:

Kleinfelder Australia Pty Ltd

Suite 3, 240-244 Pacific Highway, Charlestown, NSW 2290
Phone: +61 2 4949 5200
ABN: 23 146 082 500

Document Control:

Version	Date	Description	Author	Reviewed
1.0	8 March 2022	Draft for client review	N. Fisher	
2.0	27 May 2022	Final	N. Fisher	R. Townsend

EXECUTIVE SUMMARY

Holcim Australia (formerly Sibelco Australia) was granted consent to extract white silica sand from the Tanilba North Dune Extension located in the Oyster Cove area, in the Port Stephens Council Local Government Area. While sand extraction operations have now ceased, an ongoing vegetation monitoring program has been established to aid in management of the rehabilitation project.

The extraction of sand was granted by the Minister for Planning and Infrastructure (DP&I) for quarrying activities to occur over 9 ha in an area bounded by Rutile Rd to the north and previous sand extraction operations at Tanilba North Dune. This project is labelled the Tanilba North Dune Extension Project (the Extension) and is located within Lots 11, 12 and 13 DP 601306; Lot 408 DP 1041934; and Lots 1 and 2 DP 408240. The extension project was a Major Project assessment and is considered under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act). Kleinfelder was appointed by the former owners, Sibelco Australia to conduct the rehabilitation monitoring for this project in January 2017, and the new owners Holcim Australia Pty Ltd, appointed Kleinfelder to continue the monitoring program from July 2020. A modification to the Landscape Management Plan (LMP) was undertaken by Kleinfelder (Kleinfelder, 2020a) on behalf of Sibelco Australia in July 2020. The major outcome that affects this report were changes to the monitoring requirement after the initial three-year biannual monitoring.

The Extension has been subdivided into several smaller blocks for ease of data collection. This report provides details for the monitoring of the revegetation of Blocks Q1, Q2, Q3, Q4, Q5 and Q6 for the Northern Dunes Extension. Rehabilitation blocks are prepared and biannually surveyed after 6 months of growth, for a period of 3 years. Biannual monitoring was completed on Block Q1 in July 2020 and the first of the Post 3 Year Monitoring events was completed in October 2021 and is included in this report. As mentioned above, as per Section 4.3.4 the LMP modification increased the frequency of Post 3-year monitoring. Previously Post 3-Year monitoring occurred at two intervals, a 4-5 year event and again at 8 years. In line with the modification, Post 3-Year monitoring is now to occur annually.

The Biannual Monitoring was conducted later than usual, with Blocks Q2 – Q6 monitored from the 15th to the 20st of October 2021, Block Q1 4 Year Monitoring was conducted on the 20th and 21st of October 2021 and Block Q6 monitored again on the 7th and 8th of February 2022.

Monitoring methodology for this survey and report are as for previous surveys on the NDE and other areas of the Oysters Cove Sand Extraction Projects. That is for Blocks Q2 – Q6, 45 2mx 2m plots per hectare were surveyed. Block Q1 4 Year monitoring had two 20m x 20m quadrats established and was surveyed as per the standard Post 3 Year monitoring employed on the Tanilba North Dunes.

Results show the that the revegetation of the NDE c nabe divided into two sections with the old haul road the boundary. Sections or blocks north of the haul road have poorer revegetation than the blocks to the south of the haul road. Block Q1 4 monitoring straddles this divide. Quadrat 46 (southern section) recorded 41 flora species, 34 of which were native species. These consisted of three overstorey, two native midstorey, 23 native shrub species and six native ground stratum species. Quadrat 47 located in the northern section of Block Q1 recorded a total of 25 flora species, 14 native and 11 exotic species. The natives consisted of four overstorey, two midstorey, only four shrub and four ground strata species. The paucity of shrub species highlights the lack of natives in this area of the NDE. The area surrounding Q47 had been the subject of severe weed control efforts by Holcim which included burning of the dominant weeds, African Lovegrass, scalping of the topsoil remove the seed bank and replanting.

Similarly Block Q2 recorded few native species, with a large percentage of the flora being exotic species, to the point where several of the monitoring plots recorded only exotic species. This block is below target for all growth parameters, with low species per plot, and the stratum proportions totally unbalanced due to the preponderance of exotic species and numbers of plants. The majority of the native species in this block were the planted key species.

Block Q5 to the west of the NDE is likewise in poor rehabilitation condition. Average number of species in the plots was 4.08, with over 50% of those exotic species. Most of the native species recorded were the pioneer species A. longifolia with a lesser number of A. ulicifolia and A. suaveolens. Weed species were prevalent

throughout this block as mentioned above, with African Lovegrass, Red Natal Grass and Fleabane the most common, but by no means the only, weeds.

Blocks to the south of the haul road show excellent growth parameters and diversity.

Block Q3 continues to progress with all but one of the parameters increasing. Growth parameters – height and cover – have increased further, while species richness parameters are above targets. Stratum proportions, while not at target, are trending in the right directions. Target species numbers are mixed, with L. polygalifolium not been recorded in this block for several surveys and was not observed during the monitoring in between survey plots. It can be can now be safely assumed that this species, for whatever reason is no longer present on this block and requires installation.

Block Q4 is progressing well with most of the parameters improving or remaining above target. Growth parameters – height and cover – have increased marginally, while the species richness parameters have remained about the same but are on track or above target. The stratum proportions are still heavily weighted towards shrubs which account for 84% of all species in this block. Target species in this block are all present, and with the additional planting undertaken by Holcim, overstorey species are varied and well above target. All planting of overstorey species should cease.

Block Q6 is the youngest of the rehabilitated areas – apart from the reworked area of Block Q1 - and as such growth parameters are positive, with average height and average cover increasing, and species richness parameters above target – very positive results. Stratum proportions are trending in the desired direction, with the planting effort by Holcim increasing the density of the overstorey species substantially over target.

These last three blocks have some relatively minor weed encroachment that should be treated urgently to prevent further spread.

Discussion focused on the dichotomous nature of the rehabilitation, noting the excellent condition of the southern three blocks – Blocks Q3, Q4 and Q6. The northern blocks are not sufficiently advanced to satisfy relinquishment criteria, whereas the southern blocks are well on track to do so.

Management action included the following –

- *Substantially increase weed control efforts using suitably qualified and experience subcontractors to progressively treat the northern section using spot spraying and hand weeding techniques.*
- *Treat the vegetation screen along Rutile Rd to prevent it acting as a weed source.*
- *Treat the weeds encroaching into the southern blocks.*
- *As the northern blocks are progressively treated for weeds, they should be seeded and or planted with natives – possibly with a seed mix of native grasses that have been identified on site, although the option below is preferred.*
- *Seed collection activities should be increased substantially with the target species greatly expanded. These can then be seeded into any areas of the sand extraction rehabilitation (including areas beyond the NDE).*
    - *Holcim can utilise the excellent in-house resources to conduct and supervise this work if adequate resources such as time, labour, and space – are provided.*
    - *Otherwise suitably qualified and experienced subcontractors can be engaged.*
- *A survey targeting key species should be conducted prior to any further installation of plants. This survey should be a combination of drone digital photography and threatened species transect style survey.*
- *The excepting being L. polygalifolium in Block Q3 which has consistently been absent from surveys – 700 additional plants to be planted into this block.*

TABLE OF CONTENTS

1 INTRODUCTION 3
1.1 BACKGROUND 3
1.2 SCOPE 3
2 METHODS 6
2.1 PLOT MONITORING DESIGN 6
2.2 PLOT SAMPLING METHODOLOGY 7
2.3 QUADRAT MONITORING DESIGN 7
2.3.1 20m x 20m Quadrat Monitoring 7
2.3.2 2m x 2m Plot Monitoring 9
2.4 MONITORING OUTCOMES 9
2.4.1 Defining Targets 9
2.4.2 Assessment of Rehabilitation Parameters 9
3 RESULTS 10
3.1 BLOCK Q1 10
3.1.1 Quadrat 46 10
3.1.2 Quadrat 47 10
3.2 BLOCK Q2 11
3.2.1 Growth Parameters 11
3.2.2 Target Species 14
3.3 BLOCK Q3 14
3.3.1 Growth Parameters 14
3.3.2 Target Species 16
3.4 BLOCK Q4 17
3.4.1 Growth Parameters 17
3.4.2 Target Species 18
3.5 BLOCK Q5 19
3.5.1 Growth Parameters 19
3.5.2 Target Species 21
3.6 BLOCK 6 22
3.6.1 Growth Parameters 22
3.6.2 Target Species 23
4 DISCUSSION AND MANAGEMENT ACTIONS 25
4.1 DISCUSSION 25
4.2 MANAGEMENT ACTIONS 25
5 REFERENCES 27

TABLES

Table 1: Block preparation and survey schedule details for the North Dunes Extension Rehabilitation Blocks for the 2021 Annual report 4
Table 2: Details of data collected for each sample 2m x 2m plot. 6
Table 3: Modified Braun-Blanquet cover-abundance scale. 7

Table 4: A summary of which survey method addresses the performance criteria of the EMP. 9
Table 5: Results of the 4 Year Monitoring for the two quadrats established for Block Q1 11
Table 6: Progression of average monitoring parameter data and target projections for Block Q2 over the course of the rehabilitation 12
Table 7: Total estimated numbers of target species and additional species and comparison to targets for Block Q2 14
Table 8: Results of the rehabilitation monitoring for Block Q3 15
Table 9: Total estimated numbers of target species and additional species and comparison to targets for Block Q3 16
Table 10: Results of the rehabilitation monitoring for Block Q4 17
Table 11: Total estimated numbers of target species and additional species and comparison to targets for Block Q4. Note – additional species have not been calculated for previous surveys. 19
Table 12: Progression of average monitoring parameter data and target projections for Block Q5 over the course of the rehabilitation 20
Table 13: Total estimated numbers of target species and additional species and comparison to targets for Block Q5. 21
Table 14: Progression of average monitoring parameter data and target projections for Block Q6 over the course of the rehabilitation 22
Table 15: Total estimated numbers of target species and additional species and comparison to targets for Block Q6. 24

FIGURES

Figure 1: Locality of the NDE Sand Extraction Project 5
Figure 2: Location of the individual blocks showing the 2m x 2m plots and 20m x 20m quadrats used in the monitoring for this report 8

APPENDICES

Appendix A: Photographic Monitoring Record
Appendix B: North Dunes Extension Blocks Q1 to Q6 Growth Parameter Comparison Charts
Appendix C: Predictive Trends
Appendix D: Species List by Rehabilitation Block - July 2021 and February 2022
Appendix E: Staff Contributions

1 INTRODUCTION

1.1 BACKGROUND

Holcim Australia (formerly Sibelco Australia) was granted consent to extract white silica sand from the Tanilba North Dune Extension located in the Oyster Cove area, in the Port Stephens Council Local Government Area (**Figure 1**). While sand extraction operations have now ceased, consent conditions require the vegetative rehabilitation of mined areas following sand extraction. An ongoing vegetation monitoring program has been established to aid in management of the rehabilitation project.

The extraction of sand was granted by the Minister for Planning and Infrastructure (DP&I) for quarrying activities to occur over 9 ha in an area bounded by Rutile Rd to the north and previous sand extraction operations at Tanilba North Dune. This project is labelled the Tanilba North Dune Extension Project (the Extension) and is located within Lots 11, 12 and 13 DP 601306; Lot 408 DP 1041934; and Lots 1 and 2 DP 408240. The extension project was a Major Project assessment and is considered under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Kleinfelder was appointed by the former owners, Sibelco Australia to conduct the rehabilitation monitoring for this project in January 2017, and the new owners Holcim Australia Pty Ltd, appointed Kleinfelder to continue the monitoring program from July 2020. A modification to the Landscape Management Plan (LMP) was undertaken by Kleinfelder (Kleinfelder, 2020a) on behalf of Sibelco Australia in July 2020. The major outcome that affects this report were changes to the monitoring requirement after the initial three-year biannual monitoring.

An annual report is prepared in autumn to support the Annual Environmental Management Report (AEMR). Monitoring is performed biannually to determine if significant changes are occurring.

1.2 SCOPE

The Extension has been subdivided into several smaller blocks for ease of data collection. This report provides details for the monitoring of the revegetation of Blocks Q1, Q2, Q3, Q4, Q5 and Q6 for the Northern Dunes Extension (**Figure 2**). Rehabilitation blocks are prepared and biannually surveyed after 6 months of growth, for a period of 3 years. Details of each block surveyed for the 2022 annual report are shown in **Table 1**. Biannual monitoring was completed on Block Q1 in July 2020 and the first of the Post 3 Year Monitoring events was completed in October 2021 and is included in this report. As mentioned above, as per Section 4.3.4 the LMP modification increased the frequency of Post 3-year monitoring. Previously Post 3-Year monitoring occurred at two intervals, a 4-5 Year event and again at 8 years. In line with the modification, Post 3-Year monitoring is now to occur annually.

Biannual Monitoring for Blocks Q2-Q5 was completed in October 2021, with the last Biannual Monitoring completed for Block Q6 in February 2022 and that data is presented in this report.

The Biannual Monitoring was conducted later than usual, with Blocks Q2 – Q6 monitored from the 15th to the 20st of October 2021, Block Q1 4 Year Monitoring conducted the 20th and 21st of October 2021 and Block Q6 monitored again on the 7th and 8th of February 2022.

Table 1: Block preparation and survey schedule details for the North Dunes Extension Rehabilitation Blocks for the 2021 Annual report

Block	Prepared for Revegetation	First Biannual Survey Conducted	Last Biannual Survey Conducted	Comments
Q1	December 2016 - July 2017	January 2018	July 2020	Pots 3 Year Monitoring now conducted Annually – 4 Year Monitoring Completed – October 2021 (This report)
Q2	July 2018	January 2019	July 2021	Biannual Monitoring completed October 2021 – this report
Q3	July 2018	January 2019	July 2021	Biannual Monitoring completed October 2021 – this report
Q4	July 2018	January 2019	July 2021	Biannual Monitoring completed October 2021 – this report
Q5	July 2018	January 2019	July 2021	Biannual Monitoring completed October 2021 – this report
Q6	July 2019	January 2020	July 2022	Biannual Monitoring October 2021 – this report Annual Monitoring February 2022 – This report One more Biannual Monitoring event

km
0 0.1 0.2 0.4 0.6 0.8 1

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221961

DATE DRAWN: 2022/02/23 12:40 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2021

Locality

Holcim Australia
2021 Annual Vegetation Rehabilitation Monitoring Report
North Dune Extension Sand Mining Extraction Operation
Oyster Cove Rd, Tanilba Bay

FIGURE:

1

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221961_NDE_AnnualMonitoring\Mapping\20221961_Fig01_Locality.mxd

2 METHODS

2.1 PLOT MONITORING DESIGN

The sampling scheme conducted during the biannual monitoring is as established in Section 4.6 Monitoring Protocol of the Landscape Management Plan – Tanilba Northern Dune Extension (Kleinfelder, 2013).

As set out in Section 4 – Rehabilitation Management Plan, the objective of the rehabilitation is to progressively re-establish original vegetation community types after sand extraction and completion of landform rehabilitation. The plan sets out to achieve a standard of tree and shrub growth, and recovery in species richness and abundance, as close as possible to that of the original vegetation, within the limits of current best practice techniques, final landform, and a reasonable period of post-extraction monitoring.

To achieve this stated objective the RMP will aim at re-establishing:

- Stable and sustainable native vegetation cover, free of erosion,
- The original vegetation community types, although at different proportions due to lowered post-extraction landform,
- The structural components and dominant species of vegetation, comparable with pre-extraction vegetation at similar elevations, and
- Similar species composition to pre-extraction at similar elevations.

Efforts will also be made to re-establish all other structural components of the vegetation including canopy, sub-canopy, understorey, groundcover, and litter, though not necessarily in the same proportions as pre-extraction vegetation at similar elevations, and within the above limits.

The current monitoring design monitors 2% of the total area, and aims to attain accurate information from across the whole area and increase the ability to identify important site characteristics that would not be recorded and quantified when using the pre-determined survey methods in the EMP.

Each Block had points overlaid in a grid fashion at approximately 15 m intervals using a GIS program. These points represent a single sample quadrat, each 2m x 2m (4 m^2). This results in approximately 45 plots/hectare. Plot points were confirmed in the field during the first monitoring event, to ensure each point occurred within the extraction area. These confirmed points are retained and used for following monitoring events until completion after three years. **Table 2** details the data type and the value of the data collected within each sample plot.

Table 2: Details of data collected for each sample 2m x 2m plot.

Parameter	Details	Description
Species (as per EMP)	The total number of different species of plant present.	A measure of biodiversity.
Plants (as per EMP)	The total number of plants present.	A measure of plant density.
Stratum proportions – ground, shrub, midstorey and overstorey species (as per EMP)	The proportion of species which will become ground, shrub, midstorey and overstorey layers.	A measure of the stage of vegetation development and community structure.
Height (as per EMP)	The average height of all plants in the quadrat.	An indicator of overall growth.
Cover (as per EMP)	An estimate of the total quadrat area having plant cover-percentage of area.	A measure of the total green cover for the rehabilitation area.
Fire resistant species (as per ecobiological, 2005)	The proportion of fire-resistant species to total species present.	An indicator of the potential resilience of the new vegetation to a fire event.

2.2 PLOT SAMPLING METHODOLOGY

The pre-confirmed 2 m x 2 m plot locations are uploaded onto a hand-held GPS unit. A qualified ecologist then visits each of these plot locations using the GPS. Once the point is located, four 2 m poles are laid on the ground around the point to define the sample area and the data outlined in **Table 2** is collected at each point.

A total of 220 plots were surveyed for the purpose of the current annual report, consisting of:

- 15 plots on Block Q2
- 27 plots on Block Q3
- 75 plots on Block Q4
- 41 plots on Block Q5
- 62 plots on Block Q6

The total area of rehabilitation surveyed as part of the present annual monitoring period was approximately 4.98 ha, and the total area of sampling plots was 0.088 ha and Figure 2 shows the total surveyed rehabilitation area for the 2022 annual report within the former sand extraction area. The location of all plots, quadrats, rehabilitation blocks and photo monitoring points has been detailed.

At each survey event a photograph of the regrowth on the blocks is taken from a consistent location. Photographs have been provided in a separate document to reduce the size of this report.

2.3 QUADRAT MONITORING DESIGN

The 4 Year monitoring established on Block Q1 this year is the same methodology as has been employed in all Post 3 Year monitoring on the Tanilba North Dunes site and ensures continuity of methodology.

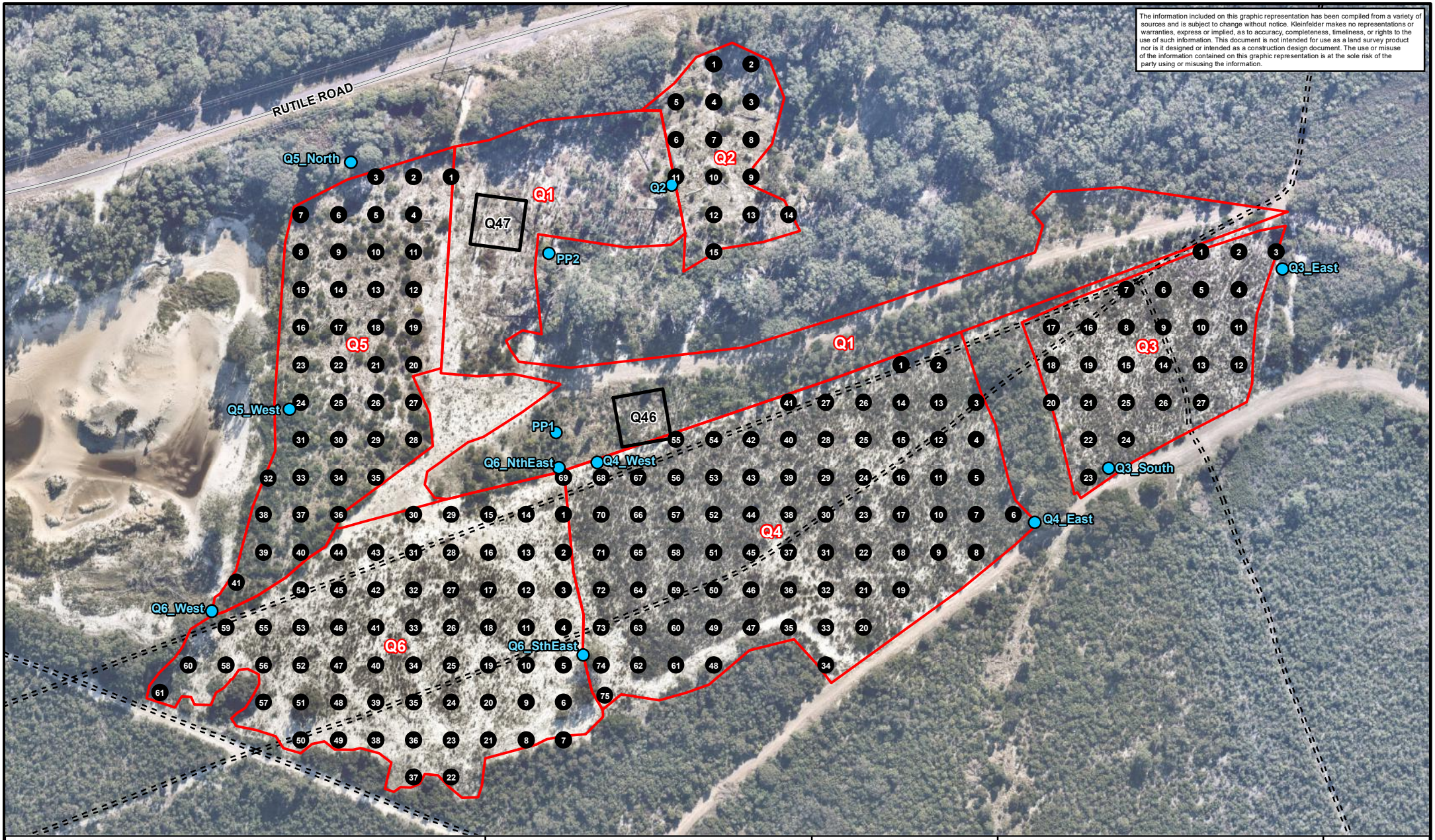
2.3.1 20m x 20m Quadrat Monitoring

One permanent 20 m x 20 m (0.04 ha) quadrat per hectare of rehabilitation has been used to give a broad scale indication of the rehabilitation structure and diversity (the standard recommended for vegetation surveys by the Flora and Fauna Survey Guidelines for the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS)). The location of these quadrats was selected and placed in areas that are most representative of the total rehabilitation block (**Figure 2**). The data collected from these quadrats included:

- Total species identification (richness) (Full species list in **Appendix D**)
- Species cover abundance (diversity) using the modified Braun-Blanquet cover-abundance scale, **Table 3**),
- Average height of each stratum
- Reproductive status of species i.e., observations are made as to whether seedlings, fruit or flowers were recorded
- General comments.

Table 3: Modified Braun-Blanquet cover-abundance scale.

Rating	Cover-abundance
1	< 5% cover, few individuals or sparse occurrence
2	< 5% cover, many individuals
3	5 - 25% cover
4	25 - 50% cover
5	50 - 75% cover
6	75 - 100% cover



Legend

- Block Boundary
- Monitoring Quadrat (20m x 20m)
- Photo Points
- Survey Plots (2m x 2m)
- Local Road
- Track

Metres

0 10 20 40 60 80 100

N

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT REFERENCE: 20221961

DATE DRAWN: 2022/02/28 12:54 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2021

Survey Plots, Monitoring Quadrats and Photo Locations

Holcim Australia
2021 Annual Vegetation Rehabilitation Monitoring Report
North Dune Extension Sand Mining Extraction Operation
Oyster Cove Rd, Tanilba Bay

FIGURE:

2

L:\GIS FOLDER\00 CLIENT FILES\131942_Holcim\AnnualMonitoring\20221961_NDE_AnnualMonitoring\Mapping\20221961_Fig02_SurveyPoints.mxd

2.3.2 2m x 2m Plot Monitoring

Within these 20 m x 20 m quadrats, six smaller 4 m^2 (2 m x 2 m) plots were surveyed to give a more detailed indication of the rehabilitation structure and diversity. The location of each of these plots within the 20 m x 20 m quadrats is selected at random each year. Within each of these plots the following data is recorded for each species:

- Average height of each species type,
- Total number of plants/species, and,
- Estimated percentage foliage cover.

The combination of the 20 m x 20 m quadrats and 2 m x 2 m plots identifies how the rehabilitation area compares against the performance criteria of the EMP. This information is summarised in **Table 4**.

Table 4: A summary of which survey method addresses the performance criteria of the EMP.

Performance criteria	Survey Type	
	20 m x 20 m Quadrat	2 m x 2 m Plot
Post 3 Year Monitoring to determine development of: Mature pioneer stage characterised by		
Gradual dieback of some primary colonisers	✓	✓
Appearance of mature vegetation species	✓	✓
Planted trees and shrubs present in predetermined numbers		✓
Beginning of differentiation of structural layers (canopy, sub-canopy, shrub layer)		✓
No significant erosion problems	✓	

A permanent photographic record was established for each permanent 20 m x 20 m quadrat. A photograph is taken from each corner looking into the quadrat at each survey to allow a visual assessment of the rehabilitation progression in future monitoring reports.

2.4 Monitoring Outcomes

2.4.1 Defining Targets

The desired outcome for the vegetation rehabilitation of the sand extraction areas is to achieve a vegetative structure and composition comparable to that of the surrounding areas which have a similarly shallow elevation above the water table. The data collected from monitoring events has been compared with targets for these parameters. The target figures for the ideal outcome for the parameters described in **Table 2** were determined from two 20 m x 20 m (400 m^2 each) sample plots located in the undisturbed vegetation either side of the extraction area near Block A of the Tanilba North Dunes Sand Extraction Project in 2005. The target figures from these two survey plots have been used for all rehabilitation blocks.

2.4.2 Assessment of Rehabilitation Parameters

The total averages for each parameter at 6-month intervals, for each block, have been shown in charts (**Appendix B**). These charts compare the similarity and divergences between blocks by analysing the recorded data for each block against the same time-line (i.e. 3 years).

Predictive trends for height and foliage cover growth out to the end of operations has been analysed by plotting the initial data from the data recorded to date and extrapolating this inclination until it meets the targeted parameter (i.e., height or foliage cover targets). The results are given in **Appendix C**.

3 RESULTS

3.1 BLOCK Q1

This block was surveyed as part of the new guidelines outlined in Section 4.3.4 of the LMP Modification (Kleinfelder, 2020a). Methodology as per Section 2.3 was undertaken to collect the requisite data. This block had two quadrats established – Q46 south of the haul road, and Q47 to north of the haul road in the reworked section (**Figure 2**).

3.1.1 Quadrat 46

This quadrat recorded a total of 41 flora species, 34 of which were natives. Three overstorey species were recorded, *Corymbia gummifera, Eucalyptus robusta* and *Melaleuca nodosa* with the tallest estimated to be 5m in height, and a calculated average height of 2.22m. There were two native midstorey species, 23 native shrub species and six native ground stratum species (**Appendix D**). Exotic species were quite prevalent. The position of this section of the rehabilitation, adjacent to the haul road facilitates the spread of these invasive species such as *Eragrostis curvula* (African Lovegrass) and *Conyza bonariensis* (Fleabane), both which were well established in this quadrat. The far western section of this sliver of revegetation is highly infested with *E. curvula* and has been the subject of weed control in the past including manual removal and controlled burning, albeit with limited success.

The plot data shows that the vegetative cover in this area varies greatly from 40% to 100% (under canopy). Despite the relatively high number of species in the quadrat, the plot data recorded less than the target of 12 species/4m^2 averaging just 9.33 species, suggesting that many species were in low numbers and not recorded in the six plots. The total number of plants per plot was greatly boosted by the exotics and averaged 45 plants.

Stratum proportions show a high percentage of ground species at 30.00%, with a corresponding low proportion of shrub species at 55.00%. Midstorey and Overstory species were 9.00% and 5.00% respectively.

3.1.2 Quadrat 47

This quadrat has been the subject of major weed control works (Kleinfelder, 2020b). As such most of this section of the block was burned, the topsoil scalped, and a major replanting effort undertaken. As a result, there was little native regeneration occurring apart for the intensive planting effort of key species. This is apparent from the species by stratum numbers in **Appendix D**. A total of 25 species was recorded in this block, consisting of 14 natives and 11 exotic species. The natives consisted of four overstorey, two midstorey, only four shrub and four ground strata species. The paucity of shrub species highlights the lack of natives in this area of the NDE. The weed control effort has been largely successful, with *E. curvula*, the main target of this effort greatly reduced in density. However, *Conyza bonariensis* has colonised the bare soil and is now estimated to cover between 50% and 75% of the block.

Plot data shows average cover to be 66.67% while average species numbers are only 5.67 species/4m^2, less than half the target of 12 species/4m^2. Given the prevalence of *C bonariensis*, average plant numbers are extremely high at 95.50 plants/4m^2.

Stratum proportions recorded a high percentage of ground species (exotic) with 37.00% and only 19% shrub species.

Table 5: Results of the 4 Year Monitoring for the two quadrats established for Block Q1

Parameter	Target	Q46	Q47	Block Ave
Ave. Cover (%)	**80**	83.33	66.67	75.00
Ave. height (cm)	**230**	114.81	75.23	95.02
Ave. No. of plants (plants/4 m^2)	**40**	45.17	95.50	70.33
Ave. No. Fire resistant species (plants/4 m^2)	**1**	1.33	1.67	1.50
Ave. Species Richness (species/4 m^2)	**12**	9.33	5.67	7.50
Ave. Exotic Species (species/4 m^2)	**0**	1.5	1.83	1.67
Ave. Ground stratum proportion (%)	**27**	0.30	0.37	0.34
Ave. Shrub stratum proportion (%)	**61**	0.55	0.19	0.37
Ave. Midstorey stratum proportion (%)	**7**	0.09	0.21	0.15
Ave. Overstorey stratum proportion (%)	**5**	0.05	0.24	0.15

3.2 BLOCK Q2

3.2.1 Growth Parameters

This block is a small block located adjacent to Bl Q1 and suffers from relatively poor species diversity, with many of the species present being exotic weeds (**Table 6**). This block is relatively older than the remaining blocks (Q3 – Q6) and this is reflected in the average height and cover parameters. This block has been the subject of ongoing weed control works during the reporting period.

The high exotic weed presence is shown in the figures in **Table 6**, with an average of 4.6 exotic species per plot. This was over 50% of average species, and indeed in some plots, only exotic species were recorded. It should be noted that “exotics” also includes Australian natives that are not endemic to this vegetation community such as *Leptospermum laevigatum.* The low native diversity is highlighted the very low proportion of shrubs – 35.69%. Shrub species are usually the dominant native growth form on the rehabilitated areas when topsoil with adequate seedbank is available. Many of the shrub/midstorey species that were recorded are the typical *Acacias*, *A. longifolia*, *A. suaveolens*, and *A. ulicifolia* that are short-lived and will die back relatively soon. The relatively high proportion of midstorey and overstorey species reflects the planting effort by Holcim. While not recorded in any of the monitoring plots, natural recruitment of *Angophora costata* (Smooth-barked Apple) with seedlings observed.

The weed control activities that have occurred on this block has resulted in much reduced infestations of African Lovegrass, which has also resulted in a reduction in average height.

Table 6: Progression of average monitoring parameter data and target projections for Block Q2 over the course of the rehabilitation

Parameter	Target	Rehab status Jan 2019	Rehab status Jul 2019	Rehab status Jan 2020	Rehab status Jul 2020	Rehab status Jan 2021	Rehab status Jul 2021	Percent Target Ach'd (Jul 21)
Ave. Cover (%)	**80**	53.30	61.33	59.00	37.00	54.33	61.33	76.67
Ave. height (cm)	**230**	41.62	37.19	54.65	41.77	65.68	29.16	12.68
Ave. No. of plants (plants/4 m^2)	**40**	32.67	27.73	18.86	13.86	23.60	97.67	244.17
Ave. No. Fire resistant species (plants/4 m^2)	**1**	1.27	0.53	1.46	1.46	1.46	1.00	1.00
Ave. Species Richness (species/4 m^2)	**12**	8.73	6.6	6.0	5.8	5.9	7.4	61.67
Ave. Exotic Species (species/4 m^2)	**0**	Not Calc	Not Calc	Not Calc	Not Calc	Not Calc	4.6	-
Ave. Ground stratum proportion (%)	**27**	50.77	41.20	46.59	49.82	48.62	66.50	246.30
Ave. Shrub stratum proportion (%)	**61**	34.36	40.09	19.25	21.80	32.79	21.77	35.69
Ave. Midstorey stratum proportion (%)	**7**	13.31	16.93	25.19	16.13	8.92	8.00	114.29
Ave. Overstorey stratum proportion (%)	**5**	1.56	1.78	8.97	5.58	9.67	3.73	74.60

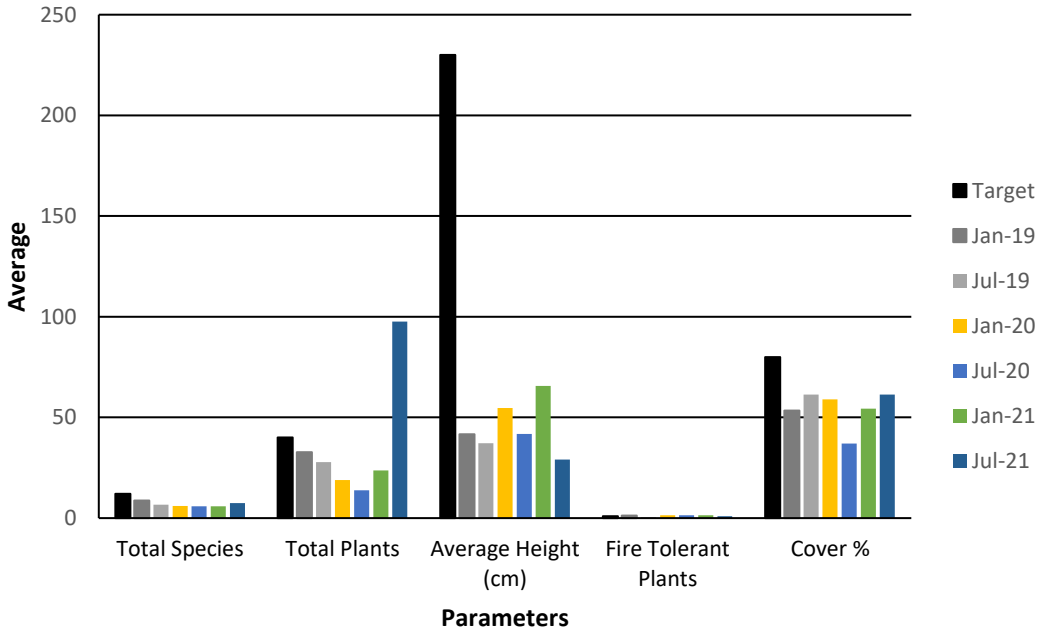


Chart 1: The average key rehabilitation parameters for Block Q2 and comparison to rehabilitation targets over the course of the monitoring surveys

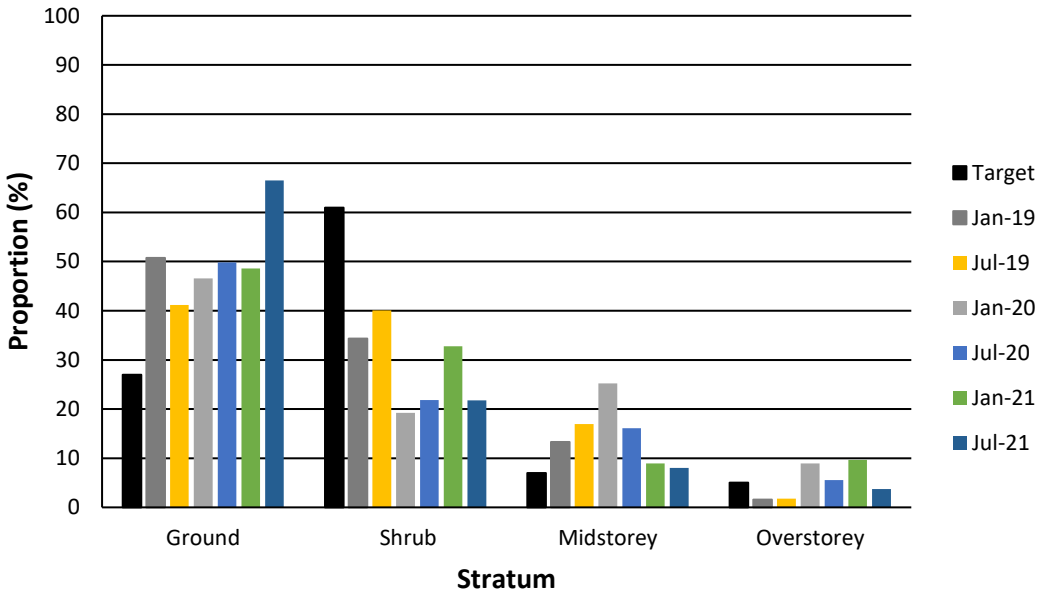


Chart 2: **The average proportion of species that will occupy each stratum for Block Q2 and comparison to rehabilitation targets over the course of the biannual surveys.**

Plate 1: **Monitoring plot 2 on Bl Q2 showing only exotic species**

3.2.2 Target Species

Target species have been planted into this block with mixed results (**Table 7**). Overstory species are well above target and have been overplanted by Holcim with the aim of eventually shading out many of the exotic species. And while not recorded in this survey, natural recruitment of *A. costata* has been recorded. Additional planting and brush matting of *B. aemula, L. polygalifolium* and *L. trinervium* is recommended.

Table 7: Total estimated numbers of target species and additional species and comparison to targets for Block Q2

Species	Target Number	Est No. Jan- 19	Est No. Jul-19	Est No. Jan-20	Est No. Jul-20	Est No. Jan-21	Est. No Jul- 21	Target Achieved this Survey (%)
Banksia aemula/serrata	832	533	267	213	267	213	267	32.05
Corymbia gummifera	26	0	0	0	0	160	160	625.00
Eucalyptus piperita	96	0	0	0	0	0	0	0
Leptospermum polygalifolium	384	320	373	53	160	213	160	41.67
Leptospermum trinervium	435	213	373	107	0	0	0	0
Melaleuca nodosa	896	0	0	0	53	107	53	5.95
Xanthorrhoea glauca	No target	160	53	107	160	160	107	-
Eucalyptus robusta	No target	-	-	53	53	107	0	-
Angophora costata	No target	-	-	-	213	107	0	-
Eucalyptus spp.	No target	-	-	-	0	0	0	-

Note – additional species have not been calculated for previous surveys.

3.3 Block Q3

3.3.1 Growth Parameters

This block continues to progress with all but one of the parameters in **Table 8, Chart 3,** and **Chart 4** increasing. The average number of plants per plot has decreased slightly reflecting the die back of some of the earlier succession species. For instance, *Dillwynia retorta,* a key pioneer species was recorded in much reduced numbers (data not shown). Growth parameters – height and cover – have increased further, while species richness parameters are above targets. Stratum proportions, while not at target, are trending in the right directions.

Weed species were not recorded in the plots themselves but some exotic grasses are encroaching along the edges, with three individual *L. laevigatum* observed during the monitoring. Weed control works are recommended.

Table 8: Results of the rehabilitation monitoring for Block Q3

Parameter	Target	Rehab status Jan 2019	Rehab status Jul 2019	Rehab status Jan 2020	Rehab status Jul 2020	Rehab status Jan 2021	Rehab status Jul 2021	Percentage Target Achieved (Jul 21)
Average Cover (%)	**80**	33.70	42.10	27.03	46.29	66.29	69.62	87.04
Average Height (cm)	**230**	21.42	28.75	27.49	40.40	47.40	55.13	23.97
Ave. No. of plants (plants/4 m^2)	**40**	56.70	52.27	29.00	35.88	32.85	27.62	69.07
Ave. No. Fire resistant species (plants/4 m^2)	**1**	2.04	2.10	1.74	1.62	2.22	1.74	174.07
Ave. Species Richness (species/4 m^2)	**12**	15.44	17.34	13.00	15.96	14.92	13.37	111.42
Ave. Ground stratum proportion (%)	**27**	5.98	5.30	8.31	8.38	8.28	9.64	35.71
Ave. Shrub stratum proportion (%)	**61**	82.75	81.39	79.04	78.78	79.85	77.71	127.40
Ave. Midstorey stratum proportion (%)	**7**	5.17	4.65	6.31	6.24	3.84	5.27	75.25
Ave. Overstorey stratum proportion (%)	**5**	6.09	5.21	6.33	6.60	8.04	7.38	147.55

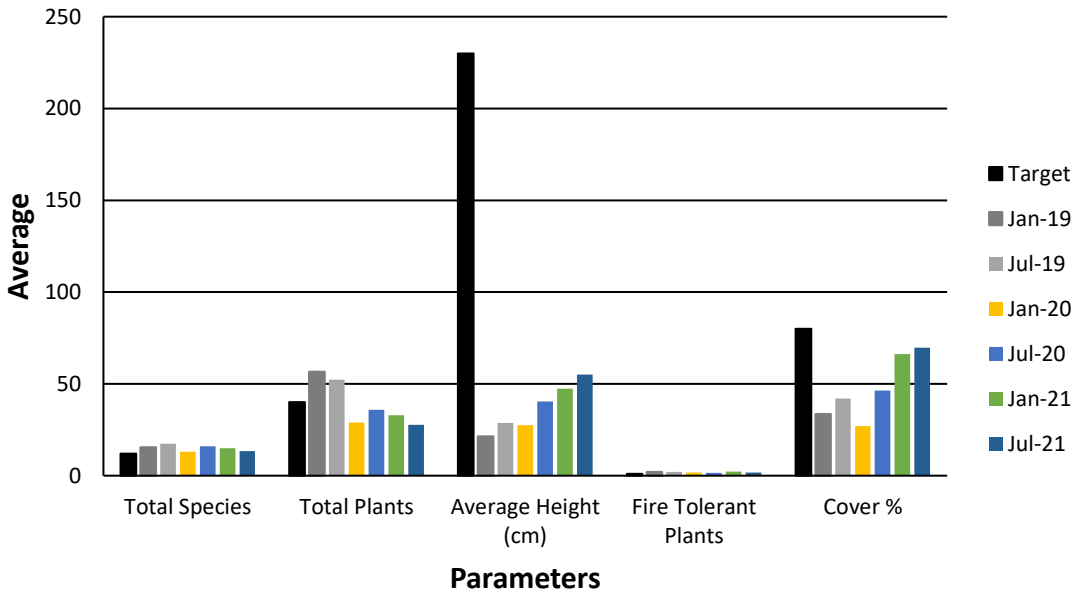


Chart 3: The average key rehabilitation parameters over the course of the surveys for Block Q3 and comparison to rehabilitation targets

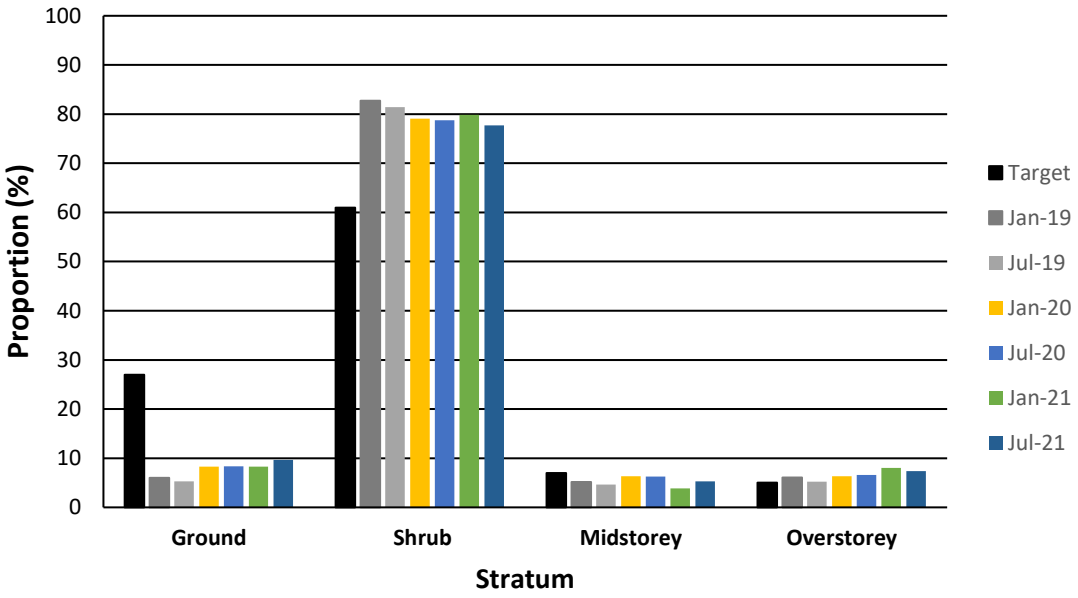


Chart 4: **The average proportion of species that will occupy each stratum for Block Q3 and comparison to rehabilitation targets over the course of the biannual surveys.**

3.3.2 Target Species

Target species numbers are mixed (**Table 9**). Overstorey species are above target with *C. gummifera* well over numbers. *L. polygalifolium* has not been recorded in this block for several surveys and was not observed during the monitoring in between survey plots. It can be can now be safely assumed that this species, for whatever reason is no longer present on this block and requires installation. The remaining species are at approximately half density, and further monitoring only is required.

Table 9: **Total estimated numbers of target species and additional species and comparison to targets for Block Q3**

Species	Target Number	Est No. Jan-19	Est No. Jul-19	Est No. Jan-20	Est No. Jul-20	Est No. Jan-21	Est No. Jul-21	Target Achieved this Survey (%)
Banksia aemula	1612	1033	748	689	631	746	689	42.74
Corymbia gummifera	50	804	374	344	804	402	402	810.19
Eucalyptus piperita	186	57	267	0	0	57	115	61.73
Leptospermum polygalifolium	744	57	53	0	0	0	0	0.00
Leptospermum trinervium	843	115	267	0	230	57	517	61.27
Melaleuca nodosa	1736	919	802	746	804	919	976	56.22
Xanthorrhoea glauca	No target	287	481	402	115	459	172	-
Eucalyptus robusta	No target	-	-	230	0	631	172	-

Species	Target Number	Est No. Jan-19	Est No. Jul-19	Est No. Jan-20	Est No. Jul-20	Est No. Jan-21	Est No. Jul-21	Target Achieved this Survey (%)
Angophora costata	No target	-	-	0	0	0	0	-
Eucalyptus spp.	No target	-	-	0	0	0	0	-

Note – additional species a have not been calculated for previous surveys

3.4 BLOCK Q4

3.4.1 Growth Parameters

This is another block that is progressing well with most of the parameters in **Table 10**, **Chart 5**, and **Chart 6** improving, or remaining above target. Growth parameters – height and cover – have increased marginally, while the species richness parameters have remained about the same but are on track or above target. The stratum proportions are still heavily weighted towards shrubs which account for 84% of all species in this block.

Table 10: Results of the rehabilitation monitoring for Block Q4

Parameter	Target	Rehab status Jan 2019	Rehab status Jul 2019	Rehab status Jan 2020	Rehab status Jul 2020	Rehab status Jan 2021	Rehab status Jul 2021	Percent Target Achieved (Jan 21)
Average Cover (%)	**80**	2.48	20.48	41.84	48.38	66.96	69.06	86.33
Average height (cm)	**230**	13.84	10.02	13.86	36.16	44.70	54.87	23.86
Ave. No. of plants (plants/4 m^2)	**40**	12.83	18.26	29.97	34.96	32.48	31.68	79.20
Ave. No. Fire tolerant species (plants/4 m^2)	**1**	1.13	1.57	1.41	1.74	1.97	1.33	133.33
Ave. Species Richness (species/4 m^2)	**12**	5.11	7.64	10.94	13.68	14.23	12.65	105.44
Ave. Ground stratum proportion (%)	**27**	2.28	2.88	7.47	6.51	8.39	4.04	14.98
Ave. Shrub stratum proportion (%)	**61**	75.97	74.67	78.02	77.58	76.55	84.93	139.22
Ave. Midstorey stratum proportion (%)	**7**	6.34	10.21	8.07	7.10	6.32	5.54	79.17
Ave. Overstorey stratum proportion (%)	**5**	11.40	12.23	6.44	8.80	8.74	5.49	109.75

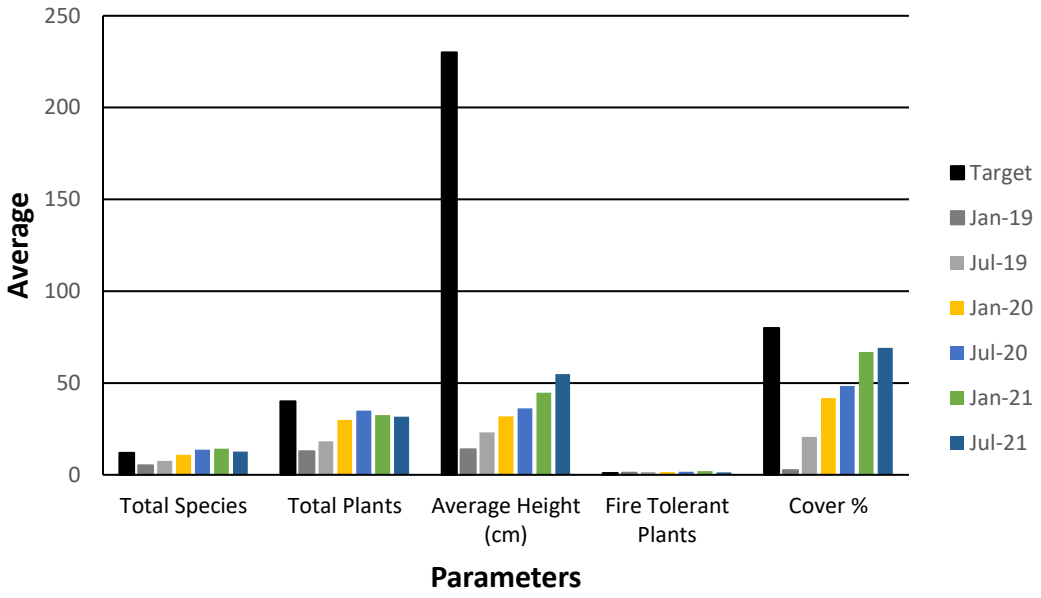


Chart 5: **The average key rehabilitation parameters over the course of the surveys for Block Q4 and comparison to rehabilitation targets**

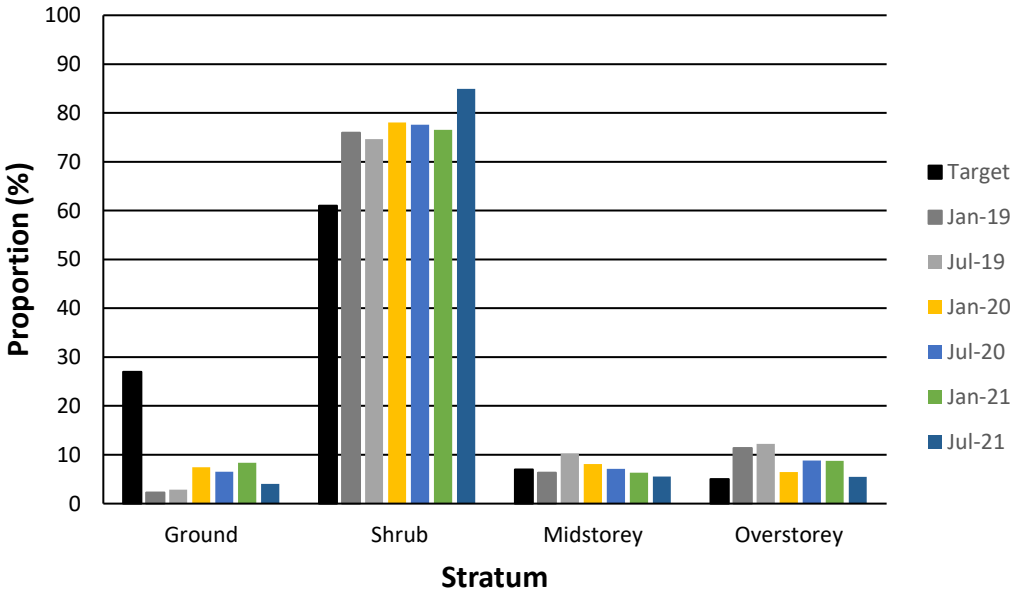


Chart 6: **The overall averages for stratum proportions for Block Q4 for the initial biannual survey and comparison to rehabilitation targets**

3.4.2 Target Species

Target species in this block are all present, and with the additional planting undertaken by Holcim, overstorey species are varied and well above target. All planting of overstorey species should cease. With *B. aemula* and *M. nodosa* numbers calculated to be low with less than 40% of target numbers, additional planting is recommended with additional brush matting of *L. trinervium.*

Table 11: Total estimated numbers of target species and additional species and comparison to targets for Block Q4. Note – additional species have not been calculated for previous surveys.

Species	Target Number	Est No. Jan-19	Est No. Jul-19	Est No. Jan-20	Est No. Jul-20	Est No. Jan-21	Est No. Jul-21	Target Achieved this Survey (%)
Banksia aemula	4576	1467	3461	2411	2557	2081	1760	38.46
Corymbia gummifera	141	1877	1291	1567	1903	832	1115	791.67
Eucalyptus piperita	528	645	939	844	238	1070	645	122.22
Leptospermum polygalifolium	2112	0	293	844	951	832	939	44.44
Leptospermum trinervium	2394	0	469	0	357	1368	587	24.51
Melaleuca nodosa	4928	469	880	1326	1724	1903	1349	27.38
Xanthorrhoea glauca	No target	528	293	362	476	416	997	-
Eucalyptus robusta	No target	-	-	904	714	2141		-
Angophora costata	No target	-	-	0	0	0		-
Eucalyptus spp.	No target	-	-	0	0	0		-

3.5 BLOCK Q5

3.5.1 Growth Parameters

This block has deceptively good growth parameters with high average cover and average height, but well below target for species richness (**Table 12**, **Chart 7** and **Chart 8**). Average number of species in the plots was 4.08, with over 50% of those exotic species. The majority of the native species recorded were, once again the pioneer species *A. longifolia* with a lesser number of *A. ulicifolia* and *A. suaveolens.* The *A. longifolia* dominated the vegetation in this block providing most of the cover and a substantial portion of the height, these plants being in excess of 1.8m tall. This gives the block a superficial excellent coverage of vegetation, which will clearly die back at some stage – this species generally living for 5-6 years.

Stratum proportions show a higher percentage of ground covers, largely exotic species, while the planting of key species (see below) explains the remainder of the strata.

Weed species were prevalent throughout this block as mentioned above, with African Lovegrass, Red Natal Grass and Fleabane the most common, but by no means the only, weeds. This block also adjoins the amenity screen that separates Rutile Rd from the NDE and acts as a source for *L. laevigatum,* the northern section of this block, recorded many stems of this species.

Table 12: Progression of average monitoring parameter data and target projections for Block Q5 over the course of the rehabilitation

Parameter	Target	Rehab status Jan 2019	Rehab status Jul 2019	Rehab status Jan 2020	Rehab status Jul 2020	Rehab status Jan 2021	Rehab status Jul 2021	Percent Target Achieved (Jan 20)
Average Cover (%)	**80**	42.20	58.98	31.60	44.51	71.09	79.51	88.87
Average height (cm)	**230**	28.64	51.56	32.93	61.81	89.88	93.75	39.08
Ave. No. of plants (plants/4 m^2)	**40**	39.10	21.48	40.56	18.26	21.97	18.26	54.94
Ave. No. Fire resistant species (plants/4 m^2)	**1**	4.85	4.36	3.56	3.78	3.87	3.07	387.50
Ave. Species Richness (species/4 m^2)	**12**	12.88	8.73	8.60	6.00	5.95	4.08	49.59
Ave No. Exotic species (species/4 m^2)	**0**	Not Calc	Not Calc	Not Calc	Not Calc	Not Calc	2.27	-
Ave. Ground stratum proportion (%)	**27**	46.13	35.72	53.93	50.01	41.66	36.77	36.77
Ave. Shrub stratum proportion (%)	**61**	38.56	44.96	22.66	22.94	26.10	31.99	31.99
Ave. Midstorey stratum proportion (%)	**7**	12.17	15.37	22.71	19.75	21.08	23.89	341.31
Ave. Overstorey stratum proportion (%)	**5**	3.14	3.95	0.70	4.87	8.72	7.35	147.08

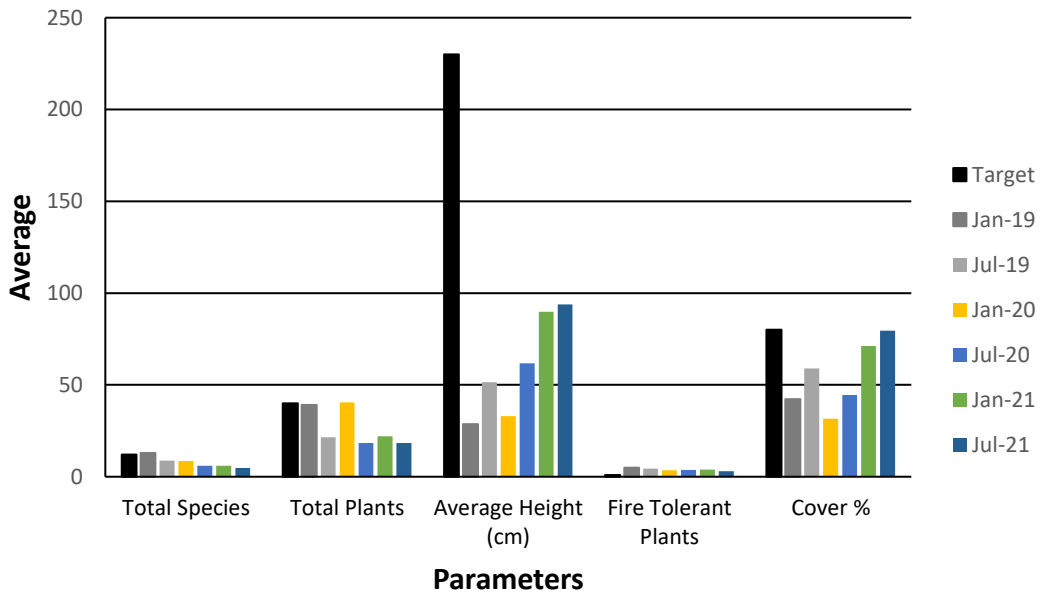


Chart 7: The average key rehabilitation parameters over the course of the surveys for Block Q5 and comparison to rehabilitation targets

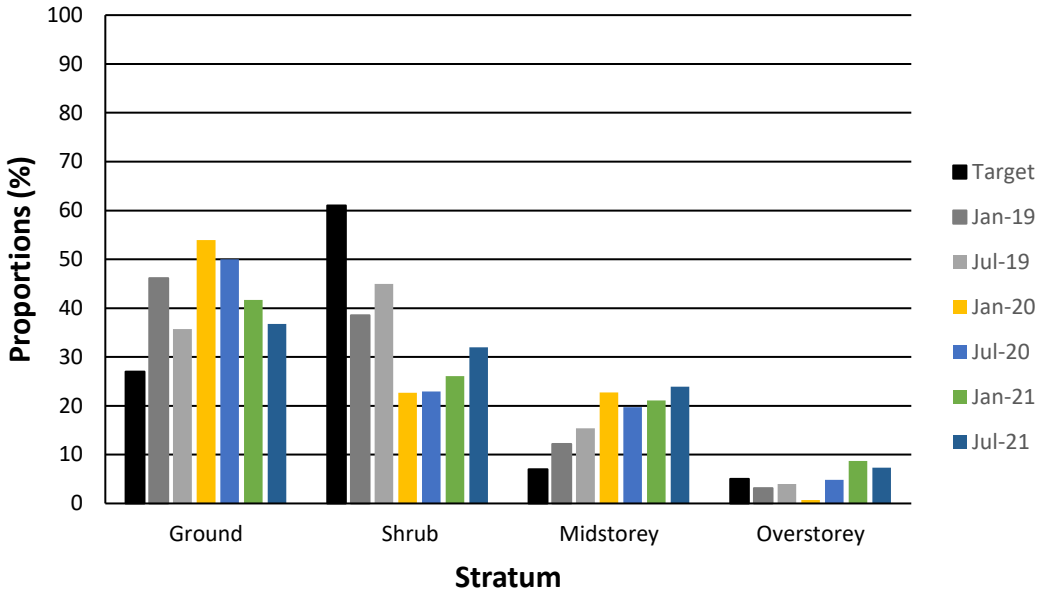


Chart 8: The average proportion of species that will occupy each stratum for Block Q5 and comparison to rehabilitation targets over the course of the biannual surveys

3.5.2 Target Species

Except for the shrub *X. glauca,* all target species are in low numbers for this block. Additional planting of overstorey species will not be required as Holcim have planted *E. robusta* and *A. costata* as well as the targeted species. The remaining targeted species require increased numbers, but additional planting and/or brush matting will have to wait for the die back of *A. longifolia,* to provide space for staff to be able to physically move through this block.

Illegal access - i.e., motorcycles - have caused some damage to the vegetation, but as always with the North Dune and NDE sites, the effort and cost of effective restriction of access is probably prohibitive.

Table 13: Total estimated numbers of target species and additional species and comparison to targets for Block Q5.

Species	Target Number	Est No. Jan-19	Est No. Jul-19	Est No. Jan-20	Est No. Jul-20	Est No. Jan-21	Est No. Jul-21	Target Achieved this Survey (%)
Banksia aemula	2366	666	610	222	333	444	610	25.80
Corymbia gummifera	73	610	333	0	222	222	55	76.22
Eucalyptus piperita	273	0	0	0	0	55	55	20.33
Leptospermum polygalifolium	1092	666	555	0	555	111	444	40.65
Leptospermum trinervium	1238	0	55	388	0	333	0	0.00
Melaleuca nodosa	2548	444	499	277	499	610	444	17.42
Xanthorrhoea glauca	No target	999	2330	388	444	999	832	-
Eucalyptus robusta	No target	-	-	0	111	388	277	-
Angophora costata	No target	-	-	0	0	-	111	-
Eucalyptus spp.	No target	-	-	0	0	-	0	-

Note – additional species a have not been calculated for previous surveys.

3.6 BLOCK 6

3.6.1 Growth Parameters

This block has one further biannual monitoring event to come in July 2022 and is at the 30-month stage of rehabilitation **Table 14**, **Chart 9**, and **Chart 10**). As such growth parameters are positive, with average height and average cover increasing, and species richness parameters above target – very positive results.

Stratum proportions are trending in the desired direction, with the planting effort by Holcim increasing the density of the overstorey species substantially over target.

Weeds are generally restricted to the northern edge along the old access road, adjoining Block Q5 and a section of the rehabilitation mentioned in previous reports surrounding plots 16 and 28. Weed control works have been undertaken in this area in the past in response to monitoring recommendations, but further efforts are required to prevent the relatively minor current infestation intensifying.

Table 14: Progression of average monitoring parameter data and target projections for Block Q6 over the course of the rehabilitation

Parameter	Target	Rehab status Jan 2020	Rehab status Jul 2020	Rehab status Jan 2021	Rehab status Jul 2021	Rehab status Jan 2022	Percent Target Achieved (Jan 22)
Average Cover (%)	**80**	6.11	18.90	40.88	49.01	64.34	80.43
Average height (cm)	**230**	14.65	19.81	30.27	34.34	39.73	17.27
Ave. No. of plants (plants/4 m^2)	**40**	19.14	21.29	28.18	36.34	41.83	104.59
Ave. No. Fire resistant species (plants/4 m^2)	**1**	2.14	1.70	2.32	1.88	2.11	211.48
Ave. Species Richness (species/4 m^2)	**12**	6.93	7.32	13.32	14.22	14.90	124.18
Ave. Ground stratum proportion (%)	**27**	7.49	4.31	3.82	4.61	6.80	25.20
Ave. Shrub stratum proportion (%)	**61**	60.22	68.07	74.31	76.56	73.15	119.91
Ave. Midstorey stratum proportion (%)	**7**	12.59	15.28	12.73	11.80	12.73	181.89
Ave. Overstorey stratum proportion (%)	**5**	19.69	12.35	9.14	7.03	7.32	146.32

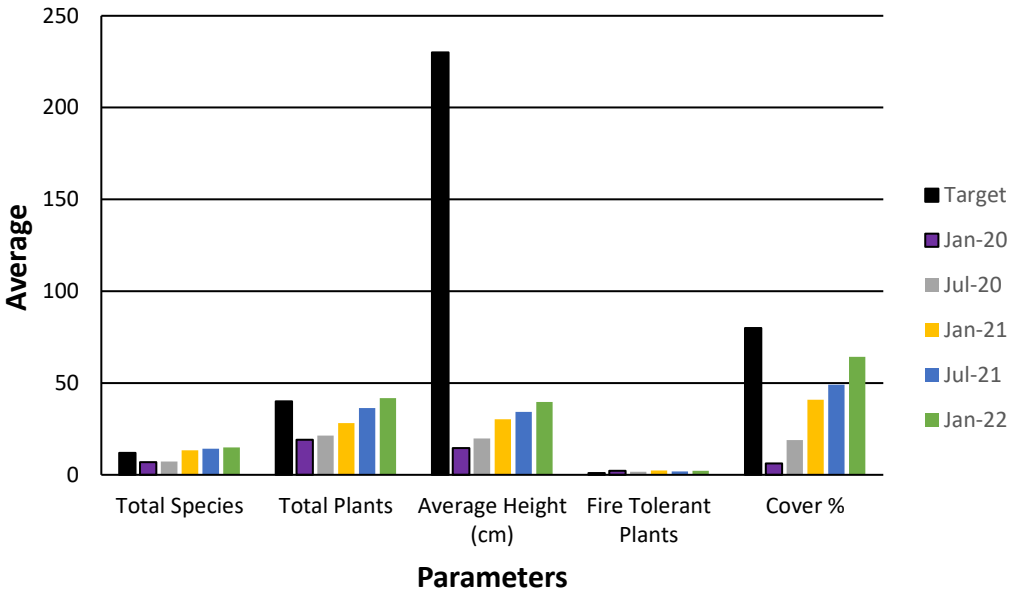


Chart 9: **The average proportion of species that will occupy each stratum for Block Q6 for the biannual surveys and comparison to rehabilitation targets**

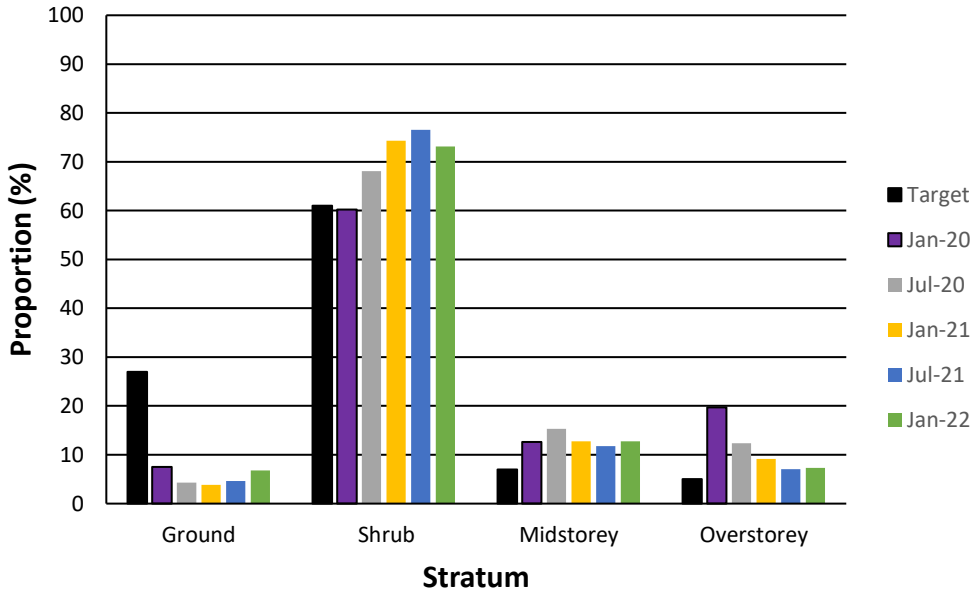


Chart 10: **The average key rehabilitation parameters for the biannual surveys for Block Q6 and comparison to rehabilitation targets**

3.6.2 Target Species

This block has some of the best target species densities in the NDE rehabilitation and does not, at this stage require any action with regards to additional planting. Overstorey species were over substantially over target ensuring a dense canopy cover at maturity (if they all survive to maturity) while the midstorey species *B, aemula* and *L. polygalifolium* are in adequate numbers to ensure seeding and spread and only require further monitoring to ensure numbers do not drop any further.

Table 15: Total estimated numbers of target species and additional species and comparison to targets for Block Q6.

Species	Target Number	Estimated No. Jan- 20	Estimated No. Jul- 20	Estimated No. Jan- 21	Estimated No. Jul- 21	Estimated No. Jan- 22	Target Achieved this Survey (%)
Banksia aemula/serrata	3562	1797	1853	2302	2134	2407	67.78
Corymbia gummifera	110	1291	1291	1797	1348	1344	1229.51
Eucalyptus piperita	411	449	730	730	505	784	191.26
Leptospermum polygalifolium	1644	2077	2190	2246	1909	1680	102.46
Leptospermum trinervium	1863	0	56	4716	8871	7390	397.78
Melaleuca nodosa	3836	2583	1460	1684	1909	1791	46.84
Xanthorrhoea glauca	No target	287	337	730	393	336	No Target
Eucalyptus robusta	No target	0	168	56	56	112	No Target
Angophora costata	No target	0	0	0	0	0	No Target
Eucalyptus spp.	No target	0	0	0	0	0	No Target

4 DISCUSSION AND MANAGEMENT ACTIONS

4.1 DISCUSSION

The revegetation on the NDE can be divided into two sections with the old haul road as the boundary. The blocks north of the haul road (including the newly revegetated sections of the haul road itself) that it is, the northern section of Block Q1, and the entirety of Blocks Q2 and Q5, are poorer quality revegetation with lower species diversity and with exotic species accounting for much of the diversity. Sibelco and Holcim have made good attempts at weed control – cool season burning, topsoil stripping – to remove the dense African Lovegrass that dominated much of these areas and increased planting of key species with additional overstorey density installed. It would appear that the original topsoil used to rehabilitate these blocks was deficient in native species and this has resulted in very low native species diversity. Block Q5 has a high density of *Acacia longifolia*, which are now quite tall and dense and the illusion of quality native revegetation. However, it is predicted that these plants will die back, and the block will appear to regress in terms of cover and diversity. This will allow exotics to exploit the spaces and become established until the next disturbance such as fire, stimulates the seed bank and the Acacias regenerate *en masse*. Weed species such as *Leptospermum laevigatum* and Lantana are colonising from the visual screen along Rutile Rd.

The higher density of key species in these areas has been done with the purpose of eventually shading out the exotics, but this is a long-term strategy – 10-20 years – and will not improve native species diversity. As these blocks now stand, they do not, and will not in the foreseeable future achieve relinquishment criteria.

South of the haul road, Blocks Q3, Q4 and Q6 represent excellent revegetation with excellent species diversity and relatively good key species densities. These areas do have some weedy grasses starting to encroach from the older Block Q1 and the section of this block that has a high African Lovegrass groundcover, and the old haul road to the south of these blocks. A small area in Block Q6 surrounding plots 16-17 and 28 require weed control and some individual *L. laevigatum* were observed in Block Q3 and Q4.

Apart form some minor weeds and some additional key species installation – see below - these blocks are well on track to achieve relinquishment.

4.2 MANAGEMENT ACTIONS

Weed control activities are recommended to be substantially increased. Works need to be conducted regularly and frequently to break seed set cycles and to reduce overall weed densities. This may require engagement of suitably qualified and experienced outside contractors. Weed control works, in the first instance should commence with the less dense areas and weeds encroaching into Blocks Q3, Q4 and Q6 to keep these blocks in their present excellent condition.

Weed works should proceed to the visual screen along Rutile Rd and remove the Lantana, *L. laevigatum,* and Slash Pine starting to encroach form the NDE Offsets, and other grassy weeds.

The northern blocks then require intense weed control efforts that should include but not be limited to spot spraying and hand removal of individual plants. These blocks could be progressively weeded in such fashion with intense seeding and/or planting of natives to follow up.

To maximise the weed control efforts, seed collection of native species is required. This seed collection and brush matting should incorporate collection of as wide a range of species as is possible and not just the easier to collect *Banksias, Eucalyptus* and *Acacias.* This recommendation has been made in other monitoring reports for Holcim this year (Kleinfelder, 2022) and is part of an envisaged comprehensive seed collection program that would serve to increase diversity in all areas of the sand extraction complex that are lacking said diversity. Holcim does have the expertise to conduct this work in-house, but the staff require resourcing – time, additional labour, and adequate facilities for drying and storage of seed – to undertake this specialised and skilled work. Excess seed could be on-sold to commercial seed merchants and nurseries to offset some of the costs. Alternatively, suitably skilled contractors can be engaged.

An additional revegetation strategy for these northern blocks would be to seed with a high density of native grasses. There are 10 species of native grasses that have been identified during surveys of the various sand extraction projects and while they are usually found occurring in low densities between a dense shrub layer in the heath communities, this approach would at least introduce native species and provide a level of competition with exotic species and help suppress their spread.

Revegetation efforts within the existing blocks should include installation of key species to densities up to targets with the proviso that prior to any major additional planting effort, a survey is undertaken to determine numbers more accurately in each of the blocks. These surveys should be conducted using a combination of methods –

- "Threatened Species Survey" methodology, whereby transects at a 5m spacing are walked over the blocks and all key species are recorded.
- Drones using hi-definition digital cameras flown over the blocks – many of the key species could be identified utilising this method.

The exception being *L. polygalifolium* in Block Q3 where an estimated 700 or so should be installed.

In conclusion, the NDE revegetation is a dichotomy with about half of the area on track to achieve relinquishment, with the other half requiring a great deal of work to be brought up to an acceptable standard of revegetation.

5 REFERENCES

ecobiological (2005), *Vegetation rehabilitation monitoring of Block A, June 2005.* A report prepared by ecobiological now Kleinfelder Australia) on behalf of Unimin Australia (now Sibelco Australia)

Kleinfelder (2013), *Landscape Management Plan – Tanilba Northern Dune Extension*. A report prepared for Sibelco Australia by Kleinfelder Australia

Kleinfelder (2019), *Annual Report for North Dunes and North Extension – 2019* A report prepared by Kleinfelder Australia for Sibelco Australia.

Kleinfelder (2020a) Landscape Management Plan - Tanilba Northern Dune Extension. A report prepared by Kleinfelder Australia for Sibelco Australia.

Kleinfelder (2020b), *Weed Control Recommendations for the Sibelco Sand Extraction Operations at Salt Ash and surrounds.* A report prepared by Kleinfelder Australia for Sibelco Australia.

Kleinfelder (2020c), *Annual Report for North Dunes and North Extension – 2020* A report prepared by Kleinfelder Australia for Sibelco Australia.

Kleinfelder (2020d), *Recommended management actions for the North Dunes Extension Area following the July 2020 biannual rehabilitation monitoring*. A short report prepared by Kleinfelder Australia for Holcim Australia.

Kleinfelder (2021), *Annual Report for North Dunes Extension – 2021* A report prepared by Kleinfelder Australia for Holcim Australia.

Kleinfelder (2022), *4-5 Year Monitoring of the Rehabilitation of Zone 4 of the Tanilba North Dune Sand Extraction Project – 2022.* A report prepared by Kleinfelder Australia for Holcim Australia.

APPENDIX A: PHOTOGRAPHIC MONITORING RECORD

Block Q1

Plate 2: View of Block Q1 from PP1 looking East (left) and West (right) January 2018

Plate 3: Block Q1 PP2 January 2018

Plate 4: Block Q1 PP2 July 2018

Plate 5: Block Q1 PP1 looking from east to west January 2019

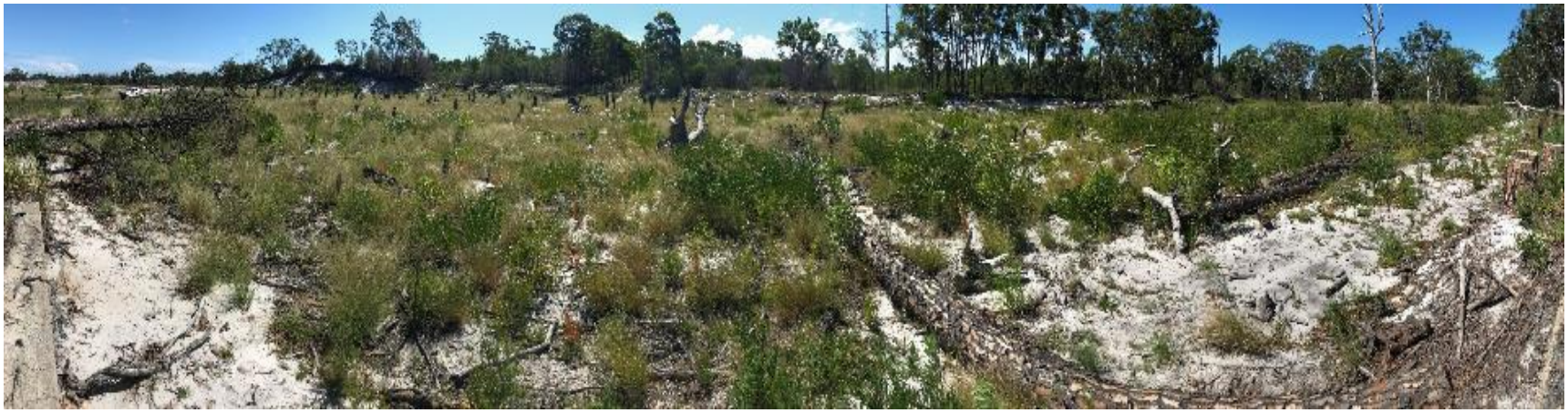


Plate 6: Block Q1 PP2 looking west January 2019


Plate 7: View of Block Q1 from PP1 looking East (left) and West (right) July 2019

Plate 8: Block Q1 PP2 looking west July 2019

Plate 9: View of Block Q1 from PP1 looking East (left) and West (right) January 2020. Notice the dieback of shrub species and the height of the Eucalypt (left) and the prevalence of *Eragrostis curvula* (right)

Plate 10: Block Q1 PP2 looking west January 2020

Plate 11: Block Q1 PP2 looking south - west – north, July 2020 just after controlled burns

Plate 12: Block Q1 PP1 looking west – north – east, October 2021

Plate 13: Block Q1 PP2 looking south - west – north, October 2021

Block Q2

Plate 14: Block Q2 looking east January 2019

Plate 15: Block Q2 looking east July 2019

Plate 16: Block Q2 looking east January 2020. Note the die back of *Acacia longifolia* around the perimeter of the block

Plate 17: Block Q2 looking east July 2020.

Plate 18: Block Q2 looking east January 2021.

Plate 19: Block Q2 looking east October 2021

Block Q3

Plate 20: Block Q3 east (looking west) January 2019

Plate 21: Block Q3 east (looking west) July 2019

Plate 22: Block Q3 east (looking west) January 2020

Plate 23: Block Q3 east (looking west) July 2020

Plate 24: Block Q3 east (looking west) January 2021

Plate 25: Block Q3 east (looking west) July 2021

Plate 26: Block Q3 south (looking east along haul road) January 2019

Plate 27 Block Q3 south (looking east along haul road) July 2019

Plate 28: Block Q3 south (looking east along the haul road) January 2020

Plate 29: Block Q3 south (looking east along haul road) July 2020

Plate 30: Block Q3 south (looking east along haul road) January 2021

Plate 31: Block Q3 south (looking east along haul road) October 2021

Block Q4

Plate 32: Block Q4 east (looking west) January 2019

Plate 33: Block Q4 east (looking west) July 2019

Plate 34: Block Q4 east (looking west) January 2020

Plate 35: Block Q4 east (looking west) July 2020

Plate 36: Block Q4 east (looking west) January 2021

Plate 37: Block Q4 west (looking east) January 2019

Plate 38: Block Q4 west (looking east) July 2019

Plate 39: Block Q4 west (looking east) January 2020. Note the grassy weeds adjacent to this block (far left and right of photo)

Plate 40: Block Q4 west (looking east) January 2020.

Plate 41: Block Q4 west (looking east) January 2021. Note the dense weedy grass infestation in Block Q1 (left of photo) and the encroachment into this block.

Plate 42: Block Q4 west (looking east) October 2021

Block Q5

Plate 43: Block Q5 looking east January 2019

Plate 44: Block Q5 looking east July 2019

Plate 45: Block Q5 looking east January 2020

Plate 46: Block Q5 North - looking south July 2020

Plate 47: **Block Q5 north (looking south) January 2021. Growth of vegetation necessitated the relocation of the photo point for this block. Note the dominance of grasses (brown) and *Acacia longifolia* (large green shrubs)**

Block Q6

Plate 48: Block Q6 south-east (looking south-west to north-east) July 2020.

Plate 49: Block Q6 south-east (looking south-west to north-east) January 2021.

Plate 50: Block Q6 south-east (looking south-west to north-east) October 2021

Plate 51: Block Q6 south-east (looking south-west to north-east) February 2022

Plate 52: Block Q6 North-east (looking south and west) July 2020.

Plate 53: Block Q6 North-east (looking south and west) January 2021. Note the grassy weeds encroaching from Block Q1 at right of photo

Plate 54: Block Q6 West - looking east - south - west, January 2021

Plate 55: Block Q6 West - looking east - south - west, October 2021

Plate 56: Block Q6 West - looking east - south - west, February 2022

APPENDIX B: NORTH DUNES EXTENSION BLOCKS Q1 TO Q6 GROWTH PARAMETER COMPARISON CHARTS

The following charts compare the different growth parameters at the same growth as measured from the commencement of rehabilitation. The charts are presented in the same order as the parameter tables in Section 3.

Chart 11 shows the avwerage vegetative cover over the course of the rehabailtation. Variations due to the weed control works are evident for blocks Q1, Q2 and Q5. The reduction n cover fro Block Q3 was attributed to drought, but the adjoining Block Q4, rehabilitated at the same time did not experience the same reduction.This may be attributed to alarger number of plants germinating resulting in greater copetition when below average ranifall was experienced.

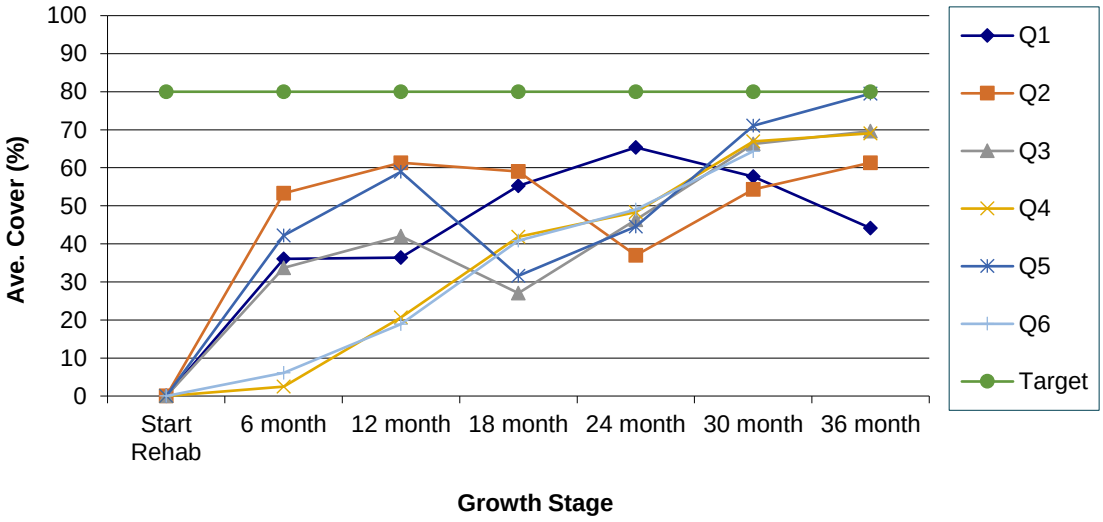


Chart 11: Comparison of average foliage cover across the blocks

Chart 12 shows the average height of all species for the NDE. Generally, the trend is for increased heights with the exception of Block Q2 where weed control efforts removed many of the plants contributing to the vegetation. Block Q5 has outpaced the other blocks due to the pre-dominance of fast-growing *Acacia longifolia.*

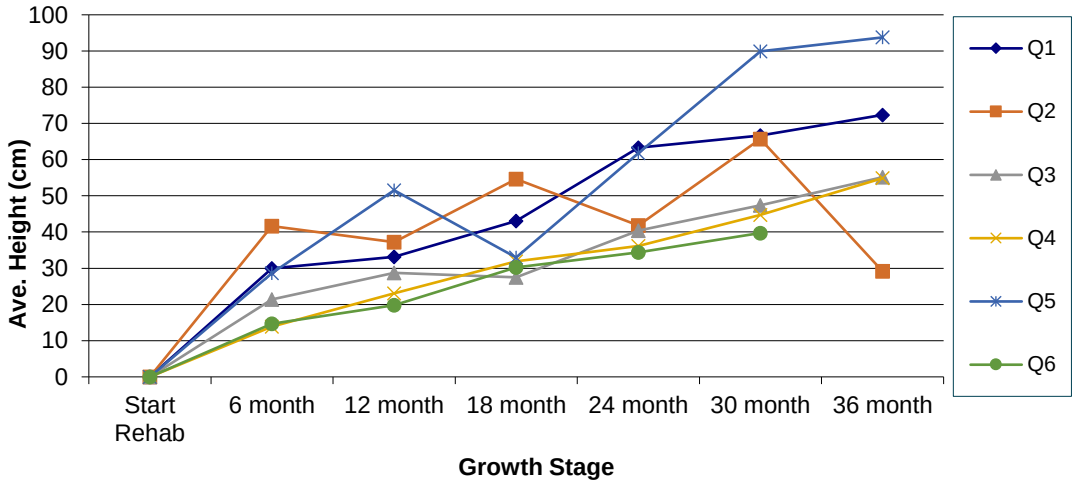


Chart 12: Comparison of average height of all strata. The target of 230 cm is not shown

Chart 13 shows the average number of plants per plot across the blocks. Most blocks are below the atregt of 40 plants, Block Q6 the exception at the 30 month point. The very high number of plants in Block Q3 at the 6 and 12 month point are evident which is postulated to have contributed to the sharp decline in cover shown in **Chart 11** for this block.

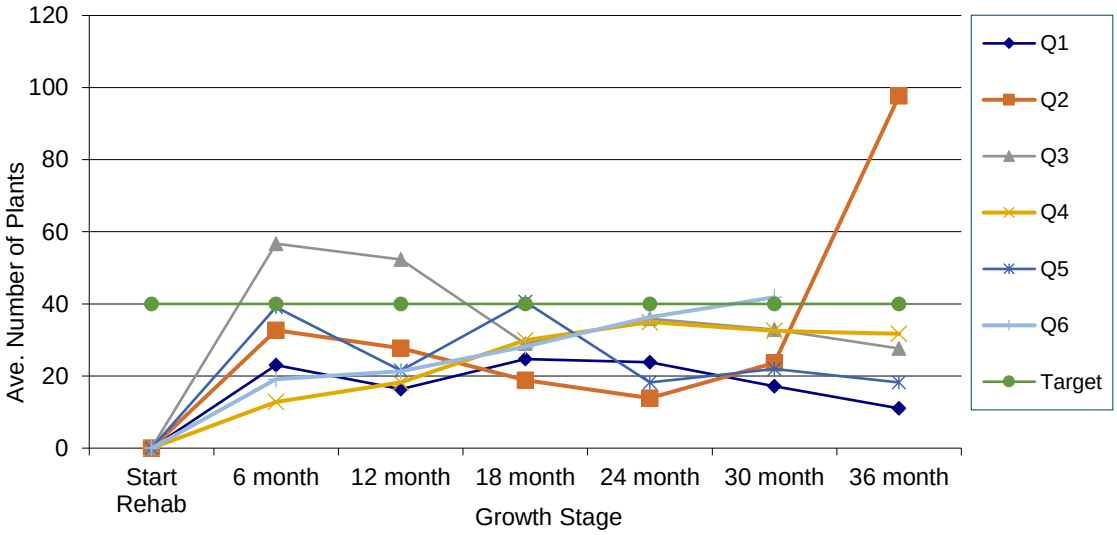


Chart 13: Comparison of the average number of plants

Chart 14 shows the average numberof all speceis per plot. Blocks Q3, Q4 and Q5 have a disticntly higer number of speceis compared to Blocks Q1, Q2 and Q5 – this quite clearly shows the differnce in the quality of the rehabiltaion between the two sectiosn of NDE.

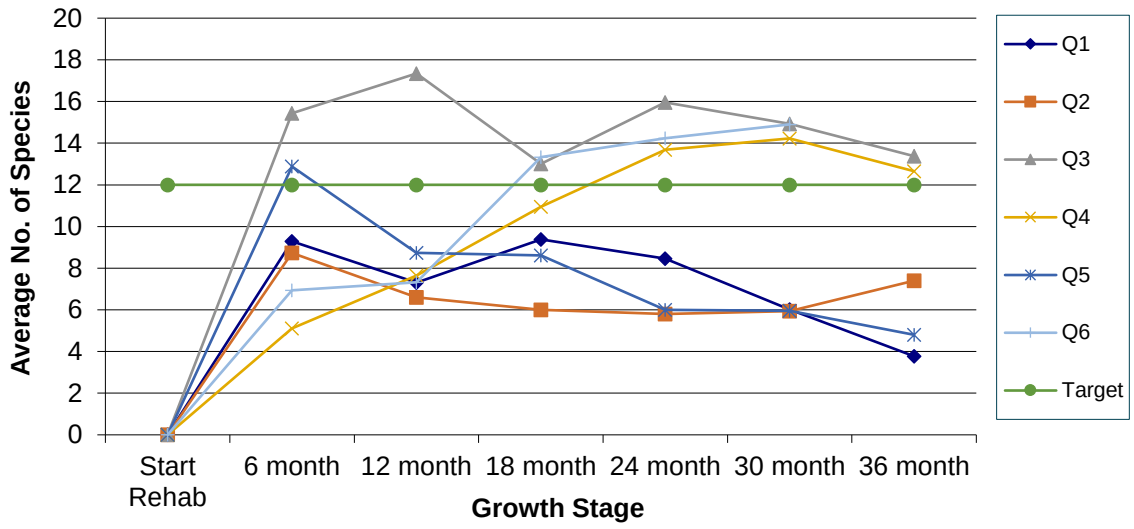


Chart 14: Comparison of average total species per plot. The target is 12 native species per plot

Chart 15 shows the comparison of the average numbers on plants from the Fire Tolerant Species per plot. All blocks are at or above the target of one plant from this sub-group of speceis. Block Q5, with its peviously mentioned high number of *A. longifolia* considerably exceeds the target.

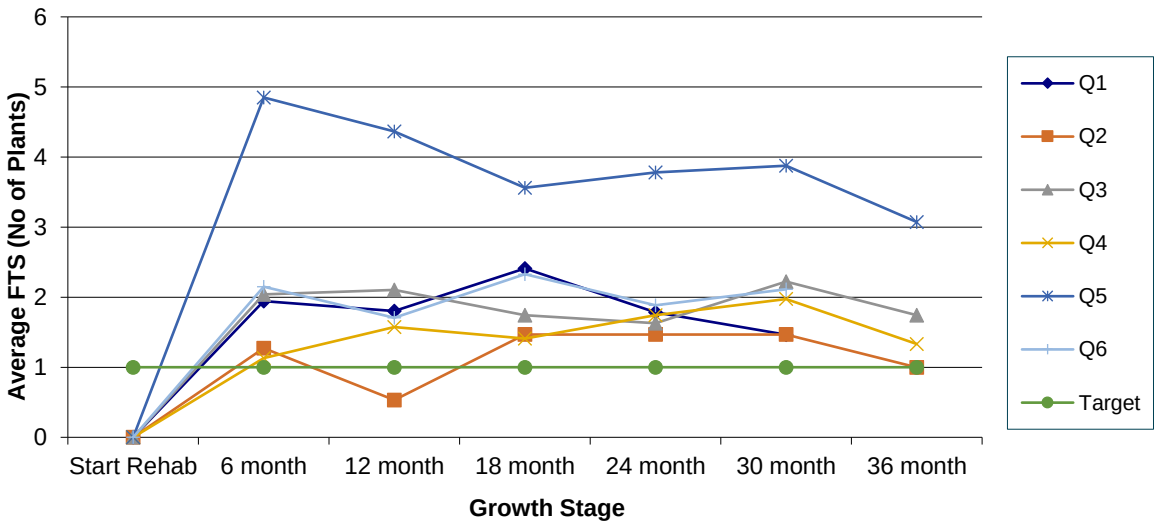


Chart 15: Comparison of numbers of plants of the Fire Tolerant Species per plot. Target is 1 plant per plot

Chart 16 shows the number of ground stratum species as a proportion of the total number of species per plot. The three bocks with high numbers of weeds have the highest proportion of ground stratum species – this being the most common stratum of weeds. The target of 27% of ground stratum species has never been achieved across any of the rehabilitation in the sand extraction complex, not just the NDE. The lack of other species in the remaining stratum increases the relative proportion of the species in this stratum.

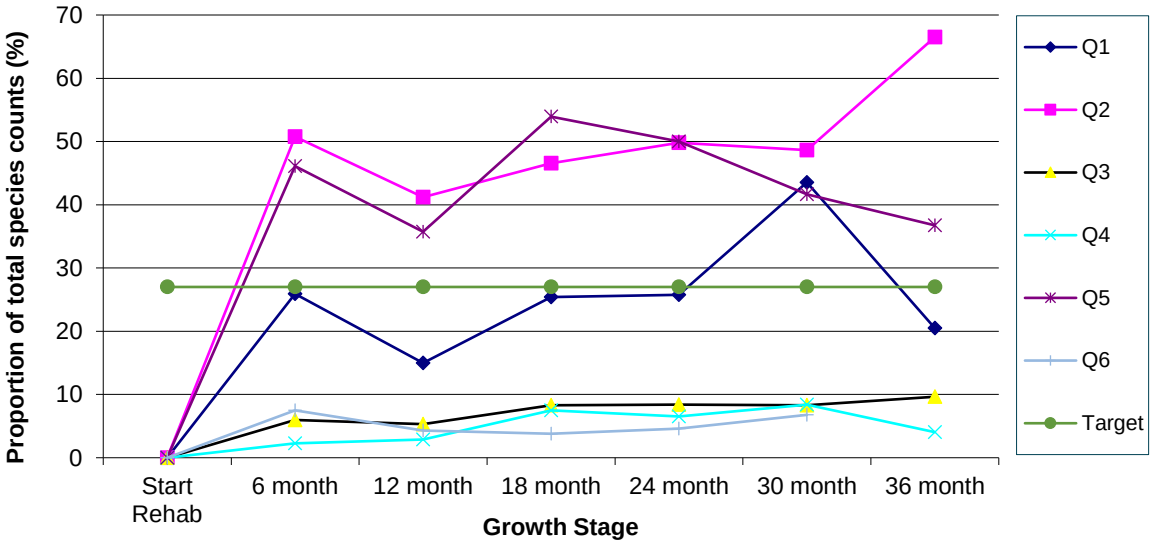


Chart 16: Comparison of the average proportion of ground species recorded per plot

Chart 17 shows the number of shrub stratum species as a proportion of the total number of species per plot. This stratum dominates the native revegetation, with most of this stratum self-germinating from the topsoil seed bank that is respread over the target area. A high proportion of shrubs indicates topsoil sourced from good quality native vegetation that has been rapidly respread and not allowed to degrade in stockpiling. Again, this highlights the difference between the two areas, with the poorer quality blocks, having a much lower proportion of shrub species from the start of rehabilitation.

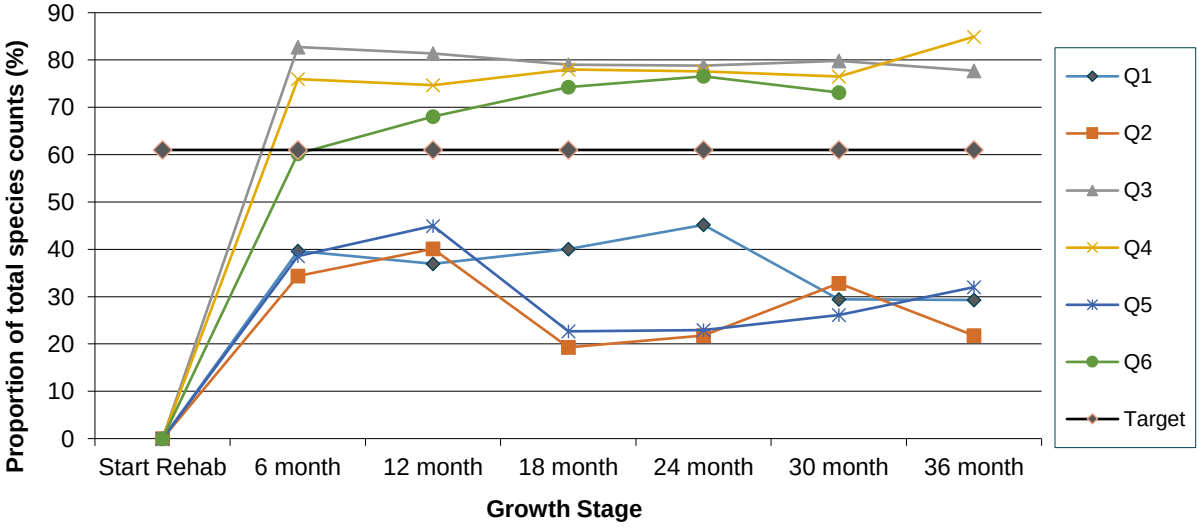


Chart 17: Comparison of the average proportion of shrub species recorded per plot

Chart 18 shows the number of midstory stratum species as a proportion of the total number of species per plot. The species in this stratum are largely planted, three of the four common, native midstory species, when this stratum proportion is high, it indicates that total species numbers are very low, or that high proportion of planting has occurred (Block Q6).

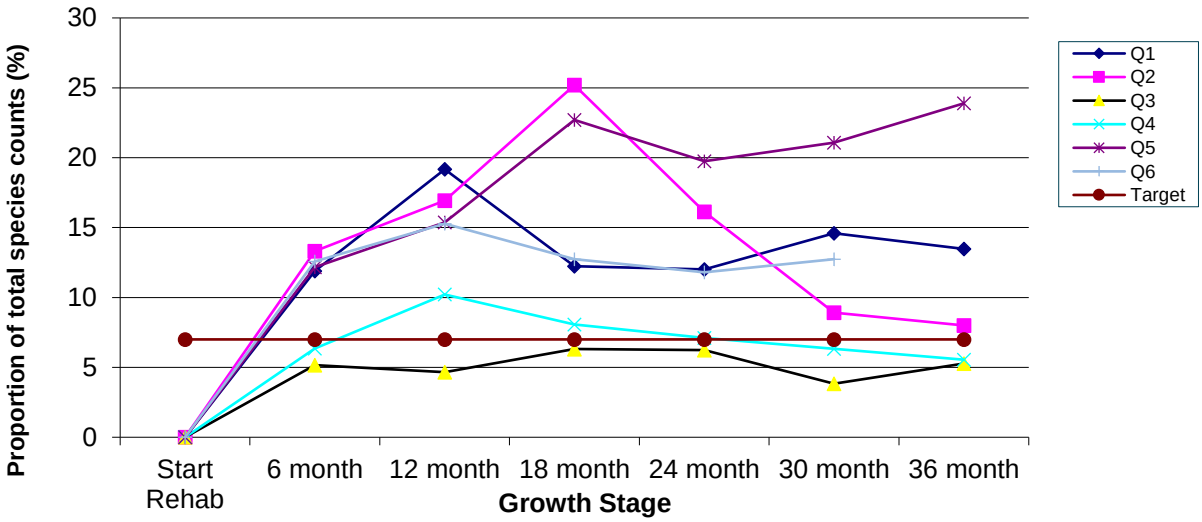


Chart 18: Comparison of the average proportion of midstory species recorded per plot

Chart 19 shows the number of overstory stratum species as a proportion of the total number of species per plot. Of the possible 16 overstory species that have been recorded across all of the sand extraction areas ay Oyster Cove, only four are common and they are overwhelmingly planted in the first instance. This shows in the high early proportions of this stratum, that gradually declines as more species recorded. But, as for the midstory stratum, if the proportion remains high it generally indicates a low overall number of species, and hence low diversity.

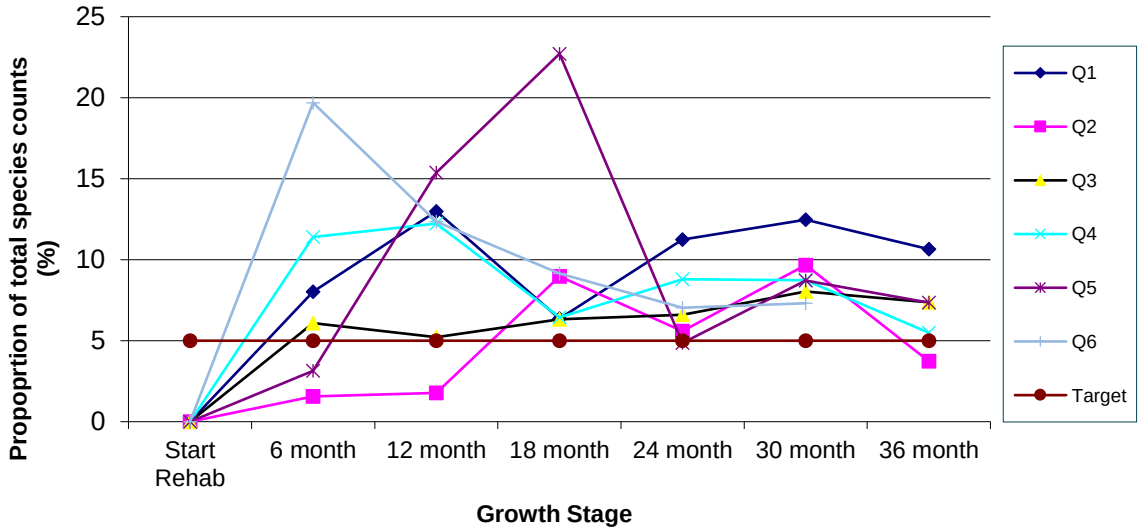


Chart 19: Comparison of the average proportion of overstory species recorded per plot

APPENDIX C: PREDICTIVE TRENDS

Available Data

Data is available for the first year post the 3 Year Monitoring, i.e., 4 Year, for Block Q1. Blocks Q2 to Q5 have been surveyed for 36 months (six monitoring events) and Block Q6 has now been surveyed for the fifth time this survey i.e., 30 months or rehabilitation.

Changes to Predictive Modelling

Given the relatively short period of time that the Extension has been subject to monitoring, the predictive models will be subject to change with the collection of additional data. Feedback from the 2016 AEMR for the Tanilba North Dunes Monitoring was to include Post 3-year data in the predictive modelling where this data was available. The "Available Data" outlined above will include this data when it becomes available in the future.

Results

The results derived from **Chart 20** and **Chart 21** indicate a relatively common trend for all blocks in cover and height.

Cover

Based on the surveyed data vegetative cover is predicted to be achieved between 3.5 and 5.5 years since the start of rehabilitation, with Blocks Q4 and Q6 – apparently unaffected by the drought – achieving cover in the shortest period of time (**Chart 20**). The rapid growth that occurs during this initial stage of rehabilitation (0-18 months) appears to have been affected by the drought, with Blocks Q1, Q2 and Q5 experiencing a period of regression in the average cover, thereby extending the period required to reach the target, with a decreased rate of increase from this year onwards. The high proportion of exotic grass and forb species which die-back rapidly during drought, but then grow back equally as fast once conditions improve has contributed to the apparent volatility of the cover data in these three blocks. The cover data does not make the distinction between exotic and native species. It is not apparent why Bl Q3 also displays the volatility, as it has only had a very low number of weed species present. Nor is it apparent why Bl Q4 has not recorded the reduction in average cover that the other blocks have shown. Block 6 was rehabilitated after the initial drought period and hence was not as affected.

Height

The effect of the drought was very pronounced for the time predicted to achieve target height with all blocks recording longer time periods post this survey (**Chart 21**). The effects of the last drought have largely been overcome with the most recent seasons of above average rainfall. The species mix in each of the blocks will affect the time to taken to achieve the target height. For instance, Block 5 is predicted to achieve the target by January 2026, which can be attributed to the dominance of the fast-growing *Acacias.* When these senesce, it is predicted that the average height will decrease. Other blocks such as Blocks 3 and 6 with a high degree of diversity, especially in the shrub stratum, are predicted to take longer to achieve the target height. The continued growth of the canopy species will eventually contribute more to the average height with time.

A Cautionary Note

Development of plants and communities over time is not a linear process. Combinations of allometry and complex thinning laws have been shown to govern how individuals and communities develop. Furthermore, the overall development of the total respiratory surface (green area) at any given location has been shown to be a function of the evaporative thermodynamics at the locality (See the attached bibliography for a selection of relevant references). Nor do the predictive models take into account disturbances such as fire or drought which has affected all blocks during the course of the rehabilitation, or likewise the restorative effects of sustained rainfall once the drought has broken. Nor do they account for a restart in rehabilitation as has occurred in the northern section of Block Q1.

References

Adler, F.R. (1996) A Model of Self-Thinning through Local Competition Proceedings of the National Academy of Sciences of the United States of America, (93)18 9980-9984.

Damuth, J.D. (1998) Common rules for plants and animals Nature (395) 115-116

Enquist, B.J., Brown, J.H. and West, G.B. (1998) Allometric scaling of plant energetics and population density Nature (395) 163-165.

Marquet, P.A. (2000) Invariants, Scaling Laws, and Ecological Complexity. Science, New Series, (289), 5484 1487-1488.

Pedersen, D. (2009) Post 3-Year Surveys for Zone 1, November 2009, Annual Monitoring of the Vegetation Rehabilitation at Tanilba Northern Dune, Unpublished report for Unimin Australia.

Roderick, M. L. and Barnes B. (2004) Self-thinning of plant populations from a dynamic viewpoint Functional Ecology 18 197–203

Specht RL and Specht A (1999) Australian Plant Communities, Dynamics of Structure, Growth and Biodiversity, Oxford University Press.

Wang, G., Yuan, J., Wang, X., Xaio, S., and Huang, W. (2004) Competitive regulation of plant allometry and a generalized model for the plant self-thinning process. Bulletin of Mathematical Biology 66 (6) 1875-1885.

Yoda, K., Kira, T., Ogawa, H. and Hozumi, K. (1963) Self-thinning in overcrowded pure stands under cultivated and natural conditions. Journal of Biology, Osaka City University 14: 107-129

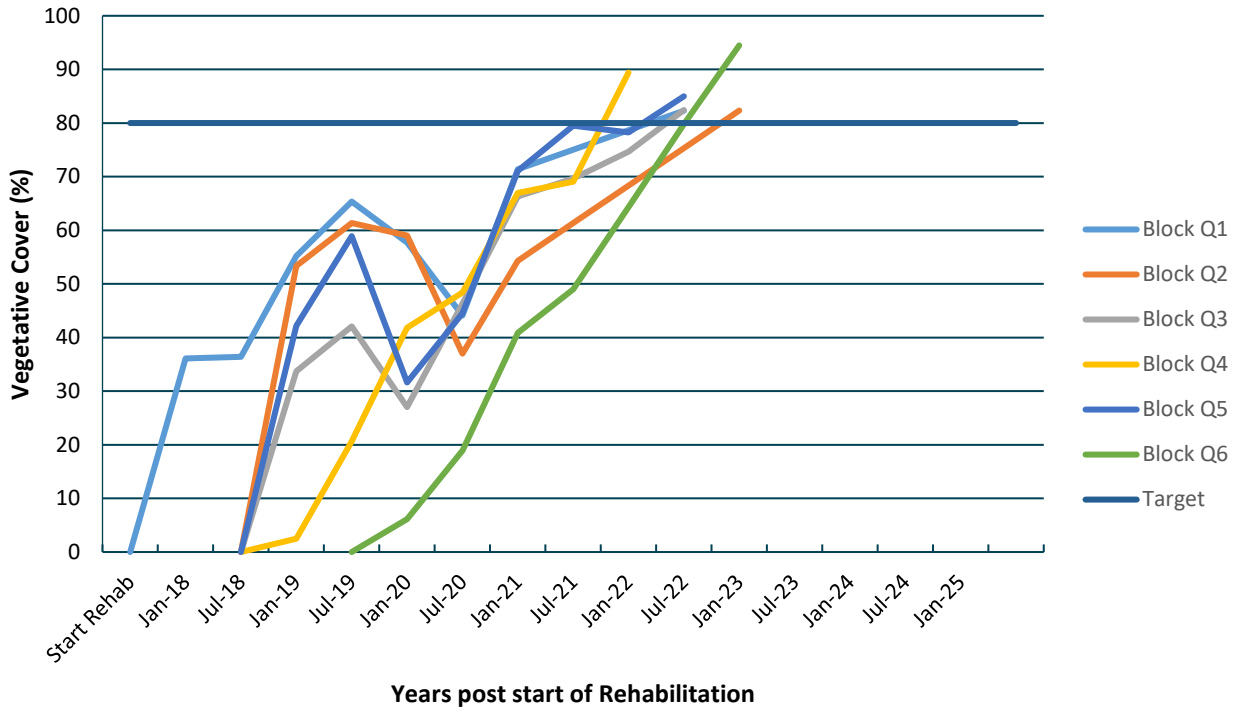


Chart 20: The predicted dates since the commencement of rehabilitation for Blocks Q1 to Q6 to reach 80% foliage cover. Data for Block Q1 is based on seven surveys, Blocks Q2 – Q5 based on six surveys, Block Q6 based on five surveys

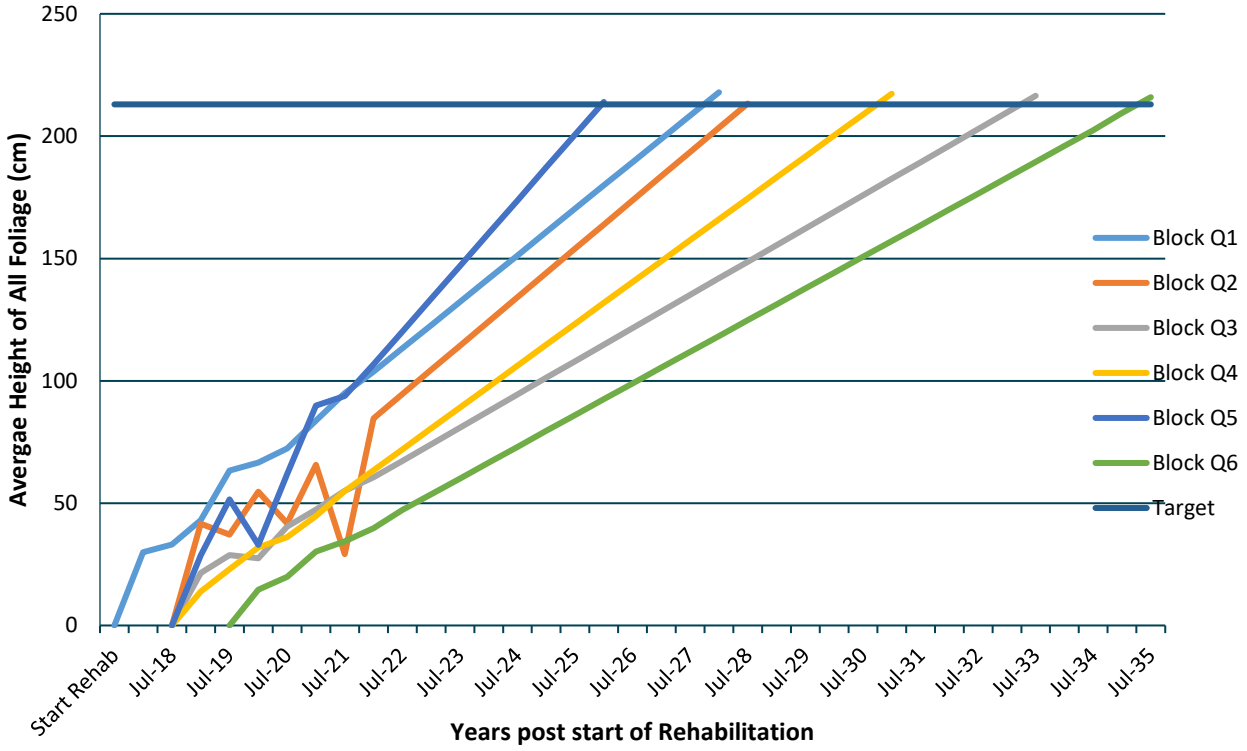


Chart 21: The predicted dates since the commencement of rehabilitation for Blocks Q1 to Q6 to reach target average height (213 cm). Data for Block Q1 is based on seven surveys, Blocks Q2 – Q5 based on six surveys, Block Q6 based on five surveys

APPENDIX D: SPECIES LIST BY REHABILITATION BLOCK - JULY 2021 AND FEBRUARY 2022

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Fabaceae (Mimosoideae)	*Acacia baueri*	Ground				0	1	0	0	1
Fabaceae (Mimosoideae)	*Acacia irrorata*	Shrub				0	0	0	0	0
Fabaceae (Mimosoideae)	*Acacia longifolia*	Shrub		4	2	1	1	0	1	1
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Shrub		2		1	1	1	0	1
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Shrub		4		1	1	1	1	1
Apiaceae	*Actinotus helianthi*	Shrub		2		1	1	1	1	1
Euphorbiaceae	*Amperea xiphoclada*	Shrub				0	0	0	0	1
Myrtaceae	*Angophora costata*	Overstorey				0	0	0	1	0
Fabaceae (Faboideae)	*Aotus ericoides*	Shrub		1		0	0	0	0	1
Ericaceae (Epacridoideae)	*Astroloma pinilfolium*	Shrub				1	0	0	0	0
Rutaceae	*Boronia pinnata*	Shrub				0	0	1	0	0
Fabaceae (Faboideae)	*Bossiaea ensata*	Shrub				0	1	1	0	1
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Shrub		2		0	1	1	1	1
Fabaceae (Faboideae)	*Bossiaea rhombifolia*	Shrub		2		0	0	0	1	0
Myrtaceae	*Calytrix tetragona*	Shrub				0	1	0	0	0
Cyperaceae	*Caustis recurvata*	Shrub				1	1	1	1	1
Polygalaceae	*Comesperma ericinum*	Shrub				0	0	1	0	0
Proteaceae	*Conospermum taxifolium*	Shrub				0	1	0	0	1

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Poaceae	*Cynodon dactylon*	Ground				1	0	0	0	0
Goodeniaceae	*Dampiera stricta*	Shrub				0	1	0	0	0
Phormiaceae	*Dianella sp.*	Ground		2	2	1	0	0	1	0
Poaceae	*Digitaria sanguinalis*	Ground				0	0	0	1	0
Fabaceae (Faboideae)	*Dillwynia retorta*	Shrub		2		0	1	1	1	1
Sapindaceae	*Dodonaea triquetra*	Shrub		2	2	1	0	0	1	0
Poaceae	*Eragrostis brownii*	Ground				1	0	0	0	0
Rutaceae	*Eriostemon australasius*	Shrub				0	1	1	0	1
Myrtaceae	*Eucalyptus robusta*	Overstorey		3	2	0	1	0	1	1
Myrtaceae	*Euryomyrtus ramosissima*	Shrub		2		0	1	1	1	1
Cyperaceae	*Gahnia spp.*	Shrub		1		0	1	1	0	1
Fabaceae (Faboideae)	*Gompholobium glabratum*	Shrub				0	0	1	0	0
Fabaceae (Faboideae)	*Gompholobium virgatum*	Shrub		1		0	1	1	1	1
Haloragaceae	*Gonocarpus teucrioides*	Ground		3		0	0	0	0	0
Haemodoraceae	*Haemodorum planifolium*	Shrub				0	0	1	0	0
Fabaceae (Faboideae)	*Hardenbergia violacea*	Ground				0	0	0	1	0
Myrtaceae	*Harmogia densifolia*	Shrub				0	1	1	0	1
Dilleniaceae	*Hibbertia acicularis*	Shrub				0	1	1	0	1
Dilleniaceae	*Hibbertia fasciculata*	Shrub				0	1	1	0	1
Dilleniaceae	*Hibbertia linearis*	Shrub		2		1	1	1	1	1
Restionaceae	*Hypolaena fastigiata*	Ground				0	1	1	0	1

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Proteaceae	*Isopogon anemonifolius*	Shrub				0	1	0	0	0
Fabaceae (Faboideae)	*Kennedia rubicunda*	Shrub				0	0	0	1	0
Santalaceae	*Leptomeria acida*	Shrub				0	1	1	0	1
Restionaceae	*Lepyrodia scariosa*	Ground		2		0	0	0	0	0
Ericaceae (Epacridoideae)	*Leucopogon ericoides*	Shrub		2		0	1	1	1	1
Ericaceae (Epacridoideae)	*Leucopogon juniperinus*	Shrub				0	1	1	0	1
Ericaceae (Epacridoideae)	*Leucopogon virgatus*	Shrub		1		0	0	1	0	0
Lomandraceae	*Lomandra glauca*	Ground		1		0	1	1	0	1
Lomandraceae	*Lomandra longifolia*	Ground		2	1	0	0	0	0	0
Myrtaceae	*Melaleuca quinquenervia*	Overstorey				0	0	0	0	1
Ericaceae (Epacridoideae)	*Monotoca elliptica*	Midstorey				0	1	1	0	1
Ericaceae (Epacridoideae)	*Monotoca scoparia*	Shrub		1		1	1	1	1	1
Myrtaceae	*Ochrosperma lineare*	Shrub				0	0	0	1	0
Olacaceae	*Olax stricta*	Shrub				0	1	0	0	0
Proteaceae	*Persoonia lanceolata*	Shrub		2	2	0	1	1	1	1
Proteaceae	*Petrophile pulchella*	Shrub				0	0	0	0	0
Rutaceae	*Philotheca salsolifolia*	Shrub				0	1	1	0	1
Thymelaeaceae	*Pimelea linifolia*	Shrub		2		1	1	1	1	1

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Apiaceae	*Platysace ericoides*	Shrub		2		1	1	1	1	1
Apiaceae	*Platysace linearifolia*	Shrub				0	0	1	0	0
Rhamnaceae	*Pomax umbellata*	Ground		4	1	1	1	0	0	1
Phyllanthaceae	*Poranthera microphylla*	Ground				0	0	0	0	1
Picrodendraceae	*Pseudanthus orientalis*	Shrub				0	1	1	0	1
Dennstaedtiaceae	*Pteridium esculentum*	Shrub		2		1	0	0	1	0
Euphorbiaceae	*Ricinocarpos pinifolius*	Shrub		2		0	0	1	0	1
Cyperaceae	*Schoenus ericetorum*	Ground				0	1	1	0	1
Cyperaceae	*Schoenus turbinatus*	Ground				0	1	0	0	0
Elaeocarpaceae	*Tetratheca thymifolia*	Shrub				0	1	1	0	1
Anthericaceae	*Tricoryne elatior*	Ground			2	1	0	0	0	0
Ericaceae (Epacridoideae)	*Woollsia pungens*	Shrub				0	1	1	0	1
Apiaceae	*Xanthosia pilosa*	Shrub		2		0	1	1	0	1
Proteaceae	*Banksia aemula*	Midstorey		2	3	1	1	1	1	1
Myrtaceae	*Corymbia gummifera*	Overstorey		3	3	1	1	1	1	1
Myrtaceae	*Eucalyptus piperita*	Overstorey			3	0	1	1	1	1
Myrtaceae	*Leptospermum polygalifolium*	Midstorey		3	3	1	0	1	1	1
Myrtaceae	*Leptospermum trinervium*	Midstorey				0	1	1	0	1
Myrtaceae	*Melaleuca nodosa*	Overstorey		3	3	1	1	1	1	1
Xanthorrhoeaceae	*Xanthorrhoea glauca*	Shrub		2	1	1	1	1	1	1
Fabaceae (Mimosoideae)	*Acacia mearnsii*	Midstorey	Y			0	0	0	1	0

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Fabaceae (Mimosoideae)	*Acacia falcata*	Midstorey	Y			0	0	0	1	0
Asteraceae	*Acanthospermum australe*	Ground	Y			0	0	0	0	1
Poaceae	*Axonopus fissifolius*	Ground	Y			0	0	0	1	0
Poaceae	*Briza maxima*	Ground	Y		2	0	0	0	0	0
Asteraceae	*Conyza bonariensis*	Ground	Y	4	5	0	0	0	0	1
Asteraceae	*Conyza spp.*	Ground	Y			1	0	0	1	0
Cyperaceae	*Cyperus aggregatus*	Ground	Y		2	0	0	0	0	0
Chenopodiaceae	*Dysphania ambrosioides*	Shrub	Y	1	2	1	0	0	0	0
Poaceae	*Eleusine indica*	Ground	Y		1	0	0	0	0	0
Poaceae	*Eragrostis curvula*	Ground	Y	4	3	1	0	0	1	1
Colchicaceae	*Gloriosa superba*	Shrub	Y			0	0	0	0	0
Verbenaceae	*Lantana camara*	Shrub	Y		1	0	0	0	0	0
Myrtaceae	*Leptospermum laevigatum*	Midstorey	Y	2	2	1	0	0	1	1
Primulaceae	*Lysimachia arvensis*	Ground	Y			1	0	0	0	0
Poaceae	*Megathyrsus maximus*	Ground	Y	2		0	0	0	0	0
Poaceae	*Melenis repens*	Ground	Y	3	3	1	0	0	1	1
Onagraceae	*Oenothera mollissima*	Ground	Y			0	0	0	0	1
Rubiaceae	*Richardia humistrata*	Ground	Y		1	1	0	0	0	0
Rubiaceae	*Richardia brasiliensis*	Ground	Y			0	0	0	0	0
Poaceae	*Setaria parviflora*	Ground	Y	1		1	0	0	0	0
Malvaceae	*Sida rhombifolia*	Shrub	Y			1	0	0	1	0

Family Name	Scientific Name	Stratum	Exotic	BI Q1		BI Q2	BI Q3	BI Q4	BI Q5	BI Q6
				Q46	Q47					
Asteraceae	*Taraxacum officinal*	Ground	Y			1	0	0	0	0
Verbenaceae	*Verbena bonariensis*	Shrub	Y			1	0	0	0	0
Iridaceae	*Watsonia meriana*	Ground	Y		1	0	0	0	0	0
		Total Species		**41**	**25**	**33**	**47**	**45**	**38**	**54**
		Total Native spp.		**34**	**14**	**22**	**47**	**45**	**30**	**48**
		Total Exotic spp.		**7**	**11**	**11**	**0**	**0**	**8**	**6**
		Native Overstorey		**3**	**4**	**2**	**4**	**3**	**5**	**5**
		Native Midstorey		**2**	**2**	**2**	**3**	**4**	**3**	**4**
		Native Shrub		**23**	**4**	**13**	**34**	**35**	**20**	**33**
		Native Ground		**6**	**4**	**5**	**5**	**3**	**3**	**5**

APPENDIX E: STAFF CONTRIBUTIONS

The following staff members were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Nigel Fisher	BSc (Hons) PhD	Senior Restoration Ecologist	Field Work, Reporting, Project Management
Gayle Joyce	BSc Forestry (Hons 1)	GIS Specialist	GIS and Mapping