BHP Nickel West
Mt Keith Satellite Project

COMPLIANCE ASSESSMENT REPORT 2020

STATEMENT 1087

March 2021

Document Amendment Record

Version	Page No.	Version Description	Key Changes	Date
A	-	Draft for BHP Internal Review BHP Nickel West HSEC (S Hawkins, G Manning)	-	04.02.2021
B	-	Draft for BHP Approval BHP Nickel West HSEC (S Hawkins, G Manning)	-	15.03.2021
0	-	Final for BHP issue to EPA BHP Nickel West HSEC (S Hawkins, G Manning)	-	25.03.2021

Endorsement

I have reviewed this Compliance Assessment Report prepared to meet the requirements of Condition 4-6 of the Statement 1087 approval for the Mt Keith Satellite Project, and accept that the information provided is an accurate account of the activities undertaken during the reporting period.

Christopher Stone

General Manager Northern Operations

BHP Billiton Nickel West Pty Ltd

25 March 2021

Executive Summary

BHP Billiton Nickel West Pty Ltd (BHP Nickel West) was granted environmental approval of the Mt Keith Satellite Project (the 'Project') in December 2018 by the Western Australian Minister for Environment in accordance with Section 45(5) of the *Environmental Protection Act 1986* (WA).

Works on the Project commenced in February 2019, which to date have included the clearing and establishment of the initial operating areas (Haul Road, Mine Pits, Waste Rock Landform and Mine Ore Pad) and the commencement of productive mining of ore from both the Six Mile Well Mine Pit and the Goliath Mine Pit. Implementation of the Project is currently expected to continue until approximately 2030+.

Condition 4-6 of the Statement 1087 approval requires BHP Nickel West to submit an annual Compliance Assessment Report which outlines the status of implementation of the Project and compliance with the approval conditions. This Report outlines the implementation status and compliance for the Project covering the period of 28 December 2019 to 31 December 2020. BHP Nickel West was in compliance with all conditions of the Statement 1087 approval during the reporting period.

Contents

Document Amendment Record 2
Endorsement 2
Executive Summary 3
1.Introduction 5
2.Purpose and Scope 7
3.Project Status 7
4.Statement of Compliance 7
4.1Audit Table 8
5.Proposed Changes to the Compliance Assessment Plan 16
6.References 17
7.Appendices 19
7.1 Appendix 1 - BHP Nickel West Statement of Compliance
7.2 Appendix 2 – Groundwater Abstraction Monitoring Data
7.3 Appendix 3 – Stantec (2021) 2020 Flora and Vegetation Monitoring Report
7.4 Appendix 4 – Astron (2021) Remote Sensing Desktop Assessment
7.5 Appendix 5 - Hydrological Processes EMP
7.6 Appendix 6 - Mine Closure Plan

1. Introduction

The Mt Keith Satellite Project (the 'Project') is for a satellite mining operation as an extension to the existing Mt Keith Nickel Mine[1]. The Project comprises two Mine Pits, a Waste Rock Landform, Support Infrastructure and a Haul Road, requiring the clearing of up to 1,069 hectares (ha) of native vegetation within a Development Envelope of 1,265 ha, as identified by Figure 1.

BHP Billiton Nickel West Pty Ltd (BHP Nickel West) referred the Project to the Environmental Protection Authority (EPA) in May 2017 in accordance with Section 38 of the *Environmental Protection Act 1986* (WA) (BHP Nickel West 2017). The EPA (2017) determined the Project required an environmental assessment, with the key assessment factors including 'Flora and Vegetation', 'Inland Waters', 'Social Surroundings' (Aboriginal Heritage) and 'Air Quality'. An 'Environmental Review' document (Environmental Impact Assessment) assessing the potential environmental effects of the Project was additionally prepared to assist the EPA assessment (BHP Nickel West 2018a).

The EPA (2018) assessment concluded the Project could be implemented subject to recommended conditions to ensure the potential environmental effects of the Project were appropriately managed. Following the advice of the EPA (2018), the Project was subsequently approved by the WA Minister for Environment (2018) through the Statement 1087 approval granted in accordance with Section 45(5) of the *Environmental Protection Act 1986* (WA).

Implementation of the Project commenced in February 2019, which to date has included the clearing and establishment of the initial operating areas (Haul Road, Mine Pits, Waste Rock Landform and Mine Ore Pad) and the commencement of productive ore mining from both the Six Mile Well Mine Pit and the Goliath Mine Pit.

Implementation of the Project is expected to occur over a period of 10+ years, with the cessation of mining (and the commencement of mine closure) estimated to occur from approximately 2030+.

[1] Note: The Mt Keith Nickel Mine commenced operations in 1993. The existing components of the Mt Keith Nickel Mine do not form part of the approved Project, and accordingly, are not addressed within this CAR document.

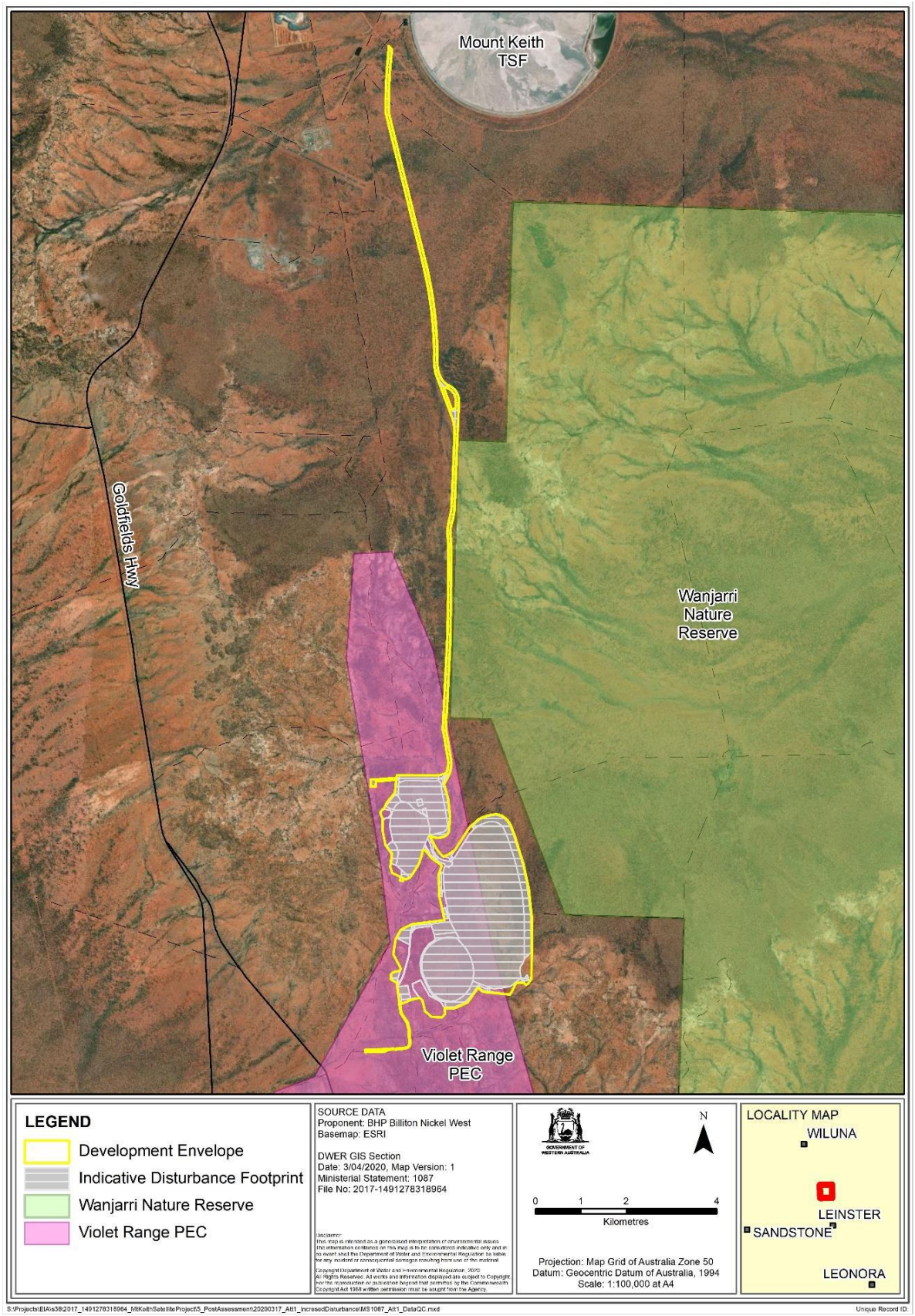

Figure 1. Project Area (Source: WA Minister for Environment 2018 (as amended))

2. Purpose and Scope

Condition 4-6 of the Statement 1087 approvals requires the submission of an annual Compliance Assessment Report (CAR) document which outlines the status of implementation of the Project and compliance with the approval conditions.

This CAR outlines the implementation and compliance status of the Project for the period of 28 December 2019 to 31 December 2020, and aligns with the requirements of the approved Compliance Assessment Plan (BHP Nickel West 2020a) under Condition 4-1 of the Statement 1087 approval.

This CAR document is the second CAR document to be submitted for the Project under the Statement 1087 approval, following from the first CAR document submitted in 2020 (BHP Nickel West 2020b).

This CAR document also follows a separate Audit Report prepared by the State Department of Water and Environmental Regulation (DWER) (DWER 2020a) from 2020 which independently verified BHP Nickel West's ongoing compliance with the conditions of the Statement 1087 approval.

3. Project Status

BHP Nickel West commenced implementation of the Project in February 2019. To date, implementation of the Project has included:

- Clearing and establishment of the initial operating areas (Haul Road, Mine Pits, Waste Rock Landform and Mine Ore Pad); and
- Commencement of productive mining of ore from both the Six Mile Well Mine Pit and the Goliath Mine Pit.

Ore supplied from the Project is now the primary product processed at the Mt Keith Nickel Mine.

Implementation of the Project is expected to occur over a period of 10+ years, with the cessation of mining (and the commencement of mine closure) estimated to occur from approximately 2030+.

4. Statement of Compliance

A completed Audit Table (consistent with the approved Compliance Assessment Plan (BHP Nickel West 2020a)) is provided in Section 4.1 to outline compliance with the conditions of the Statement 1087 approval. The Audit Table verifies that BHP Nickel West was in compliance with all conditions of the Statement 1087 approval during the reporting period. Nil non-compliance items occurred during the reporting period.

A completed and signed Statement of Compliance form (prepared using the DWER (2018) form *'PAF2 - Statement of Compliance – 2018'*) is provided at Appendix 1.

4.1 Audit Table

AUDIT TABLE
Mt Keith Satellite Project, Statement No.1087

• Phases that apply in this table = Pre-Construction, Construction, Operation, Decommissioning, Overall (several phases).
• This audit table is a summary and timetable of conditions and commitments applying to this project. Refer to the Minister's Statement for full detail/precise wording of individual elements.
• Code prefixes: M = Implementation condition; P = Proponent's commitment; N = Procedure.
• Compliance status: C = Compliant, CLD = Completed, NC = Non-compliant, NR = Not required at this stage. Please note terms NA = Not Audited and VR = Verification Required are only for EPA use. IP = In Process may only be used by the proponent in circumstances outlined in Section 2.8 of the *Post Assessment Guideline for Preparing an Audit Table.*

Table 1: Mt Keith Satellite Operation Audit Table (28 December 2019 to 31 December 2020).

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
1087:M1.1	**Proposal Implementation**	When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Table 2 of Schedule 1, unless amendments to the proposal and the authorised extent of the proposal have been approved under the EP Act.	Implement the Project in accordance with criteria outlined in Schedule 1.	Compliance Assessment Reports.	Overall	For the life of the Proposal.	COMPLIANT	Table 2 of Schedule 1 of the Statement 1087 approval, as amended by Attachment 1 to the Statement 1087 approval under s45C in September 2020, authorises the clearing of up to 1,069 hectares (ha) of native vegetation within a 1,265 ha Development Envelope. To date, a total of 622.7 ha of native vegetation has been cleared within the Development Envelope; being within the total 1,069 ha authorised limit. No clearing of native vegetation beyond the Development Envelope has been undertaken for the Project. The area of native vegetation clearing undertaken to date, and the extent of the approved Development Envelope, is identified at Figure 2. Table 2 of Schedule 1 of the Statement 1087 approval authorises groundwater abstraction (mine pit dewatering) of up to 0.4 gigalitres (GL) per year (y) using bores and pit sumps. A total of 0.36 GL (355,819 kilolitres (kL)) of groundwater was abstracted during the reporting period; being within the 0.4 GL/y authorised limit. Groundwater abstractions records to verify the mine pit dewatering volumes from each bore/sump is provided in Appendix 2.
1087:M2.1	**Contact Details**	The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty-eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.	Notify the CEO of any change in proponent details.	Written notification to the CEO of any change in proponent details.	Overall	Within 28 days of such change.	NOT REQUIRED	No change to the Proponent name, physical address or postal address has occurred during the reporting period, and accordingly, no notification to the DWER CEO has been required.
1087:M3.1	**Time Limit for Proposal Implementation**	The proponent shall not commence implementation of the proposal after five (5) years from the date on this Statement, and any commencement, prior to this date, must be substantial.	Notify the CEO advising proposal has not commenced implementation.	Written notification to the CEO.	Overall	After 28 December 2023.	COMPLETED	Implementation of the Project commenced in February 2019 with the construction and operation of the Project. Implementation of the Project is considered to be 'substantial'. Compliance with Condition 3-1 is now completed.
1087:M3.2	**Time Limit for Proposal Implementation**	Any commencement of implementation of the proposal, on or before five (5) years from the date of this Statement, must be demonstrated as substantial by providing the CEO with written evidence, on or before the expiration of five (5) years from the date of this Statement.	N/A.	Compliance Assessment Reports.	Overall	Within 5 years from the date of Statement 1087, being on or before 28 December 2023.	COMPLETED	Implementation of the Project commenced in February 2019 with the construction and operation of the Project. Implementation of the Project is considered to be 'substantial'. Written evidence demonstrating substantial commencement of the Project was provided to the DWER CEO in March 2020 through submission of the first CAR document (BHP Nickel West 2020b). Compliance with Condition 3-2 is now completed.
1087:M4.1	**Compliance Reporting**	The proponent shall prepare, and maintain a Compliance Assessment Plan which is submitted to the CEO at least six (6) months prior to the first Compliance Assessment Report required by condition 4-6, or prior to implementation of the proposal, whichever is sooner.	Submit Compliance Assessment Plan to the CEO.	Compliance Assessment Plan (this document).	Pre-construction	At least six (6) months prior to the first Compliance Assessment Report required by condition 4-6, or prior to implementation of the proposal, whichever is sooner.	COMPLIANT	A Compliance Assessment Plan (CAP) document (BHP Nickel West 2019a) was initially submitted to the DWER CEO in September 2019, with the DWER CEO granting initial approval of the CAP document in October 2019. The current version of the CAP document (Revision 2, BHP Nickel West 2020a) was approved by the DWER CEO in October 2020 (DWER 2020b).

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
								BHP Nickel West will continue to review and maintain the CAP document, as required from time to time, to ensure ongoing compliance with Condition 4-1.
1087:M4.2	**Compliance Reporting**	The Compliance Assessment Plan shall indicate: (1) the frequency of compliance reporting; (2) the approach and timing of compliance assessments; (3) the retention of compliance assessments; (4) the method of reporting of potential non-compliances and corrective actions taken; (5) the table of contents of Compliance Assessment Reports; and (6) public availability of Compliance Assessment Reports.	Submit Compliance Assessment Plan to the CEO.	Compliance Assessment Plan (this document).	Pre-construction	At least six (6) months prior to the first Compliance Assessment Report required by condition 4-6, or prior to implementation of the proposal, whichever is sooner.	COMPLIANT	A Compliance Assessment Plan (CAP) document (BHP Nickel West 2019a) was initially submitted to the DWER CEO in September 2019, with the DWER CEO granting initial approval of the CAP document in October 2019. The current version of the CAP document (Revision 2, BHP Nickel West 2020a) was approved by the DWER CEO in October 2020 (DWER 2020b). In accordance with Condition 4-2, the approved CAP document identifies: • frequency of compliance reporting; • approach and timing of compliance assessments; • retention of compliance assessments; • method of reporting of potential non-compliances and corrective actions taken; • table of contents of Compliance Assessment Reports; and • public availability of Compliance Assessment Reports. BHP Nickel West remains in compliance with the requirements of Condition 4-2.
1087:M4.3	**Compliance Reporting**	After receiving notice in writing from the CEO that the Compliance Assessment Plan satisfies the requirements of condition 4-2 the proponent shall assess compliance with conditions in accordance with the Compliance Assessment Plan required by condition 4-1.	Implementation of Compliance Assessment Plan.	Notice in writing from the CEO and Compliance Assessment Reports.	Overall	Ongoing as per requirements of CAP.	COMPLIANT	Notice in writing that the current version of the CAP document satisfies Condition 4-2 was received from the DWER CEO in October 2020. This Compliance Assessment Report (CAR) document provides an assessment of compliance with the conditions of the Statement 1087 approval consistent with the approved CAP document. Submission of this CAR document ensures that BHP Nickel West remains in compliance with the requirements of Condition 4-2.
1087:M4.4	**Compliance Reporting**	The proponent shall retain reports of all compliance assessments described in the Compliance Assessment Plan required by condition 4-1 and shall make those reports available when requested by the CEO.	Retain records in accordance with Compliance Assessment Plan.	Written response to request by CEO.	Overall	When requested by CEO.	COMPLIANT	Submitted CAR documents will be retained by BHP Nickel West for the duration of the Project in accordance with standard document control practices, as outlined within the approved CAP document. No requests were received from the DWER CEO during the reporting period to make additional copies of the submitted CAR documents available.
1087:M4.5	**Compliance Reporting**	The proponent shall advise the CEO of any potential non-compliance within seven (7) days of that non-compliance being known.	Notification of the CEO via an email to compliance@dwer.wa.gov.au which will include any corrective actions taken to address the potential non-compliance.	Written correspondence to CEO.	Overall	Within 7 days of the potential non-compliance being known.	COMPLIANT	Nil potential non-compliance items were identified for the Project during the reporting period. Accordingly, BHP Nickel West has not been required to provide advice to the DWER CEO of any potential non-compliance during the reporting period.
1087:M4.6.1	**Compliance Reporting**	The proponent shall submit to the CEO the first Compliance Assessment Report fifteen (15) months from the date of issue of this Statement addressing the twelve (12) month period from the date of issue of this Statement and then annually from the date of submission of the first Compliance Assessment Report, or as otherwise agreed in writing by the CEO.	Submit Compliance Assessment to the CEO.	Compliance Assessment Reports.	Overall	The first report to be submitted by 28 March 2020 and from then on annual by 28 March each year.	COMPLIANT	The first CAR document (BHP Nickel West 2020b) was submitted to the DWER CEO in March 2020 addressing compliance with the conditions for the first 12 month period following the granting of the Statement 1087 approval. This CAR document presents the second report addressing compliance with the conditions of the Statement 1087 approval, and is submitted annually after the first CAR document) for a reporting period covering 28 December 2019 to 31 December 2020.

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
								As outlined in Section 5 *Proposed Changes to the Compliance Assessment Plan*, BHP Nickel West proposes that future CAR documents cover the financial year period 1 July to 30 June, with submission by 30 October (to align to other standard Government financial year reporting requirements). The request for agreement of the DWER CEO for this change is outlined in Section 5.
1087:M4.6.2	**Compliance Reporting**	The Compliance Assessment Report shall: (1) be endorsed by the proponent's Chief Executive Officer or a person delegated to sign on the Chief Executive Officer's behalf; (2) include a statement as to whether the proponent has complied with the conditions; (3) identify all potential non-compliances and describe corrective and preventative actions taken; (4) be made publicly available in accordance with the approved Compliance Assessment Plan; and (5) indicate any proposed changes to the Compliance Assessment Plan required by condition 4-1.	Compliance Assessment Report developed in accordance with the approved Compliance Assessment Plan.	Compliance Assessment Reports.	Overall	The first report to be submitted by 28 March 2020 and from then on annual by 28 March each year.	COMPLIANT	This CAR document has been endorsed by the General Manager of BHP Nickel West, as an authorised delegate of the CEO of BHP Nickel West. BHP Nickel West has complied with all conditions of the Statement 1087 approval during the reporting period. Statements to this effect are included within this CAR document. Nil potential non-compliances with the conditions of the Statement 1087 approval occurred during the reporting period. Accordingly, no corrective or preventative actions have been required to address potential non-compliances. Following approval of this CAR document by the DWER CEO, this CAR document will be made publicly available through the BHP Nickel West website as outlined by the approved CAP report (refer to https://www.bhp.com/sustainability/environment/regulatory-information/). Proposed changes to the CAP document are outlined in Section 5 *Proposed Changes to the Compliance Assessment Plan*.
1087:M5.1	**Public Availability of Data**	Subject to condition 5-2, within a reasonable time period approved by the CEO of the issue of this Statement and for the remainder of the life of the proposal the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)) management plans and reports relevant to the assessment of this proposal and implementation of this Statement.	To be determined in consultation with CEO.	Written advice from CEO confirming manner approved.	Overall	To be determined in consultation with the CEO.	COMPLIANT	Environmental data, management plans and reports relevant to the EPA assessment of the Project are publicly available through the EPA website (refer to https://www.epa.wa.gov.au/proposals/mt-keith-satellite-project). This public availability of the Project assessment information is considered to be appropriate, with further actions for the public availability of the assessment information by BHP Nickel West not considered to be considered necessary. Environmental data, management plans and reports relevant to the implementation of the Statement 1087 approval are publicly available through the BHP website (refer to https://www.bhp.com/sustainability/environment/regulatory-information/). To date, this publicly available information includes: • Flora and Vegetation Environmental Management Plan (EMP) (BHP Nickel West 2019b); • Compliance Assessment Plan (BHP Nickel West 2020a); and • Compliance Assessment Report 2019 (BHP Nickel West 2020b). Following approval by the DWER CEO, this CAR document will additionally be made publicly available through the BHP website. To note, the DWER CEO has not provided written advice to BHP Nickel West on the approved manner or the timing for the public availability of information required under Condition 5-1 of the Statement 1087 approval. BHP Nickel West consider the above actions for public availability to meet the intent of Condition 5-1 and the objectives of the DWER CEO for the public availability of environmental data, management plans and reports.
1087:M5.2	**Public Availability of Data**	If any data referred to in condition 5-1 contains particulars of: (1) a secret formula or process; or (2) confidential commercially sensitive information; the proponent may submit a request for approval from the CEO to not make these data publicly available. In making such a request the proponent	Proponent request to CEO to not make certain data publicly available, including explanation and reason why.	Notice in writing to CEO notifying of any information not to be made publicly available.	Overall	As required from time to time.	NOT REQUIRED	No requests were made by BHP Nickel West to the CEO DWER to not make environmental data publicly available during the reporting period. Consistent with standard practices, BHP Nickel West will seek to ensure public availability of all environmental data which relates to the implementation of, and compliance with, the Statement 1087 approval.

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
		shall provide the CEO with an explanation and reasons why the data should not be made publicly available.						
1087:M6.1	**Flora and Vegetation Management Plan**	The proponent shall implement the proposal to meet the following environmental objective: (1) Avoid, where possible, and minimise indirect impacts as far as practicable to Priority flora, the Violet Range PEC and the Wanjarri Nature Reserve.	Implement the proposal in accordance with the Flora and Vegetation Environmental Management Plan (FVEMP).	MKS FVEMP. Compliance Assessment Reports.	Overall	The first report to be submitted by 28 March 2020 and from then on annual by 28 March each year.	COMPLIANT	BHP Nickel West has implemented the Project to avoid and minimise, where possible, indirect effects to DBCA-classified 'priority' flora taxa, the Violet Range 'priority' ecological community and the adjacent 'Class A' Wanjarri Nature Reserve. The avoidance / minimisation measures have been implemented through the Flora and Vegetation EMP (BHP Nickel West 2019b) (as described below under Condition 6-3).
1087:M6.2	**Flora and Vegetation Management Plan**	In order to meet the requirements of condition 6-1, the proponent shall implement the Flora and Vegetation Environmental Management Plan (Version 0, September 2018).	Implement the proposal in accordance with the FVEMP.	MKS FVEMP Compliance Assessment Reports.	Overall	Throughout the life of the Project. Annual compliance assessment reporting commencing 28 March 2020.	NOT REQUIRED	The Flora and Vegetation EMP dated September 2018 (Version 0) submitted during the Project assessment phase has since been revised in accordance with Condition 6-3 (below). Accordingly, implementation of the previous revision of the Flora and Vegetation EMP under Condition 6-2 is no longer required, with implementation of the revised/approved Flora and Vegetation EMP to be regulated in accordance with Condition 6-3 (as addressed below).
1087:M6.3	**Flora and Vegetation Management Plan**	The proponent shall implement the most recent version of the Flora and Vegetation Environmental Management Plan which the CEO has confirmed by notice in writing, addresses the requirements of condition 6-1, on advice of the Department of Biodiversity, Conservation and Attractions.	Implement the current and most recent version of the FVEMP.	Written notice from CEO confirming the FVEMP addresses condition 6-1, on advice from DBCA. Compliance Assessment Reports	Overall	Throughout the life of the Project. Annual compliance assessment reporting commencing 28 March 2020.	COMPLIANT	The current revision of the Flora and Vegetation EMP (BHP Nickel West 2019b, Revision 0.2) was approved by the DWER CEO in February 2021 (DWER 2021). Consistent with the approved Flora and Vegetation EMP, the environmental management actions implemented to minimise the direct and potential indirect effects of the Project to flora and vegetation values has included: • Implementation of the Environmental Heritage Impact Assessment process (internal process) prior to land disturbance (control of direct effects). • Environmental monitoring within pre-defined quadrats for: ○ DBCA-classified 'priority' native flora taxa (tagged individuals); ○ vegetation communities; and ○ introduced flora taxa (weeds) at defined monitoring sites located in close proximity to Project and distant from the Project (control sites). • Hygiene inspections of equipment and vehicles to minimise the risk of introduction of introduced flora taxa (weeds), with targeted spray control for any identified infestations. The key environmental outcomes from the implementation of the management actions in the Flora and Vegetation EMP has notably included: • All clearing of native vegetation for the Project has occurred within the authorised Development Envelope (spatial area), and within the total authorised clearing limit (area in hectares); • Maintenance of plant health condition of tagged DBCA-classified 'priority' flora taxa adjacent to the Project (compared to control sites); • No measurable effect to vegetation condition in proximity to the Project (including for the Violet Range 'priority' ecological community and the adjacent 'Class A' Wanjarri Nature Reserve), with no measured exceedance of trigger criteria or threshold criteria; and • No recorded new infestations of introduced flora taxa, and no exceedance of trigger criteria or threshold criteria for the extent of weed occurrence. The results of the environmental monitoring which demonstrate the above key outcomes are outlined within the following consultant reports: • Stantec Australia Pty Ltd (2021) *Mt Keith Satellite 2020 Flora and Vegetation Monitoring Report*. Report prepared by Duncan L of

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
								Stantec Australia Pty Ltd for BHP Billiton Nickel West Pty Ltd. March 2021. • Astron Environmental Services Pty Ltd (2021) *Mt Keith Remote Sensing Analysis.* Report prepared by Fisk C (Dr.) of Astron Environmental Services Pty Ltd for BHP Billiton Nickel West Pty Ltd. March 2021. A copy of the environmental monitoring reports by Stantec (2021) and Astron 2021) are provided in Appendix 3 and Appendix 4, respectively. The Stantec (2021) monitoring report outlines a general decline in flora and vegetation health condition at both 'impact' and 'control' monitoring sites. This is further highlighted in the Astron (2021) remote sensing data which confirms the health condition decline occurring over a much larger area. The recording of the health condition decline across a broad spatial area indicates the decline is not caused by the Project. Review of meteorological data for the local area suggests the health condition decline can be attributed to an extended 2-year period of substantially low rainfall; with the 2019 rainfall (~ 140 mm) followed by 2020 rainfall (~100 mm) representing a 45 % then a 60 % decline in comparison to the long-term annual average rainfall (~ 250 mm/y) (BoM 2021a, 2021b). This rainfall data includes multiple months in which either Nil or < 0.1 mm of rainfall fell over consecutive months. Whilst acknowledging that the declining rainfall may have had a detrimental effect to the environmental values present (flora and vegetation, terrestrial fauna), it can be reasonably expected that a return to near-average annual rainfall over multiple future years will enable the recovery of the vegetation health condition. To note, the environmental monitoring completed during 2019 and 2020 for DBCA-classified 'priority' flora taxa has occurred at a quarterly frequency (first 2 years of Project operations in spring, summer, autumn and winter). As outlined within the approved Flora and Vegetation EMP (BHP Nickel West 2019b), future environmental monitoring DBCA-classified 'priority' flora taxa will be undertaken at an annual frequency (spring). The environmental monitoring for vegetation condition will remain unchanged, with monitoring to continue at an annual frequency (spring).
1087:M6.4	**Flora and Vegetation Management Plan**	The proponent shall continue to implement the Flora and Vegetation Environmental Management Plan (Version 0, September 2018), or any subsequent revisions as approved by the CEO in condition 6-3, until the CEO has confirmed by notice in writing that the plan meets the objective specified in condition 6-1.	Implement the current and most recent version of the FVEMP.	Compliance Assessment Reports. Written notice from CEO confirming that the objective specified in condition 6-1 has been met.	Overall	Throughout the life of the Project until CEO confirms in writing that the objective specified in condition 6-1 has been met. Annual compliance assessment reporting commencing 28 March 2020.	COMPLIANT	The Flora and Vegetation EMP (BHP Nickel West 2019b, Revision 0.2) continues to be implemented for the Project as described above under Condition 6-3.
1087:M7.1	**Aboriginal Heritage**	Prior to the commencement of ground-disturbing activities, the proponent shall consult with the Tjiwarl Native Title Claim Group and ensure that the proponent has complied with its obligations under the *Aboriginal Heritage Act 1972.*	Consult with the Tjiwarl Native Title Claim Group and comply with obligations under the *Aboriginal Heritage Act 1972.*	Compliance Assessment Report.	Pre-construction	Prior to commencement of ground-disturbing activities.	COMPLETED	As described within the first CAR document (BHP Nickel West 2020b), consultation with the Tjwarl Native Title Claim Group and BHP Nickel West occurred prior to the commencement of ground disturbing activities for the Project, with a summary of this consultation supplied to the DWER CEO to verify compliance with Condition 7-1. The requirements of Condition 7-1 for consultation prior to the commencement of ground disturbing activities has been completed. To note, ongoing consultation with the Tjwarl Native Title Claim Group and BHP Nickel West will continue to occur during operation of the Project in accordance with the cultural agreement between the parties. Further reporting under Condition 7-1 of the Statement 1087 for consultation with the Tjwarl Native Title Claim Group during ongoing operations is not proposed (as Condition 7-1 relates only to pre-construction consultation).

AUDIT CODE	SUBJECT	REQUIREMENT	HOW	EVIDENCE	PHASE	TIMEFRAME	STATUS	FURTHER INFORMATION
								BHP Nickel West obtained Consent approval under Section 18 of the *Aboriginal Heritage Act 1972* (WA) prior to the commencement of commencement of ground disturbing activities for the Project which may affect sites or objects of Aboriginal heritage value (WA Minister for Aboriginal Affairs 2019). The requirements of Condition 7-1 for compliance with obligations under the *Aboriginal Heritage Act 1972* (WA) prior to the commencement of ground disturbing activities has been completed. To note, ongoing compliance with the *Aboriginal Heritage Act 1972* (WA) will continue to occur during operation of the Project in accordance with the granted Section 18 Consent approval. Further reporting under Condition 7-1 of the Statement 1087 for compliance with the *Aboriginal Heritage Act 1972* (WA) and the conditions of the Section 18 Consent is not proposed (as Condition 7-1 is only applicable for pre-construction), with ongoing compliance to be reported through the State Department of Planning, Lands and Heritage.
1087:M8.1	**Greenhouse Gas Reporting**	The proponent shall publicly report the greenhouse gas emissions from the proposal on an annual basis, in a manner approved by the CEO.	To be determined in consultation with CEO.	Written notice form CEO approving manner of reporting.	Overall	Throughout the life of the Project. Annual reporting in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS).	COMPLIANT	As identified in the first CAR document, BHP Nickel West reports greenhouse gas emissions through NGERS, with the first report on greenhouse gas emissions from the Project submitted during 2020. The NGERS provides a national framework for all large companies to report emissions data, with the NGERS website providing the repository for all emissions data across Australia. As acknowledged by the DWER (2020a) Compliance Audit, emissions data from the Project will continue to be publicly reported through the NGERS framework as the manner approved by the DWER CEO (in lieu of reporting through an annual CAR document).

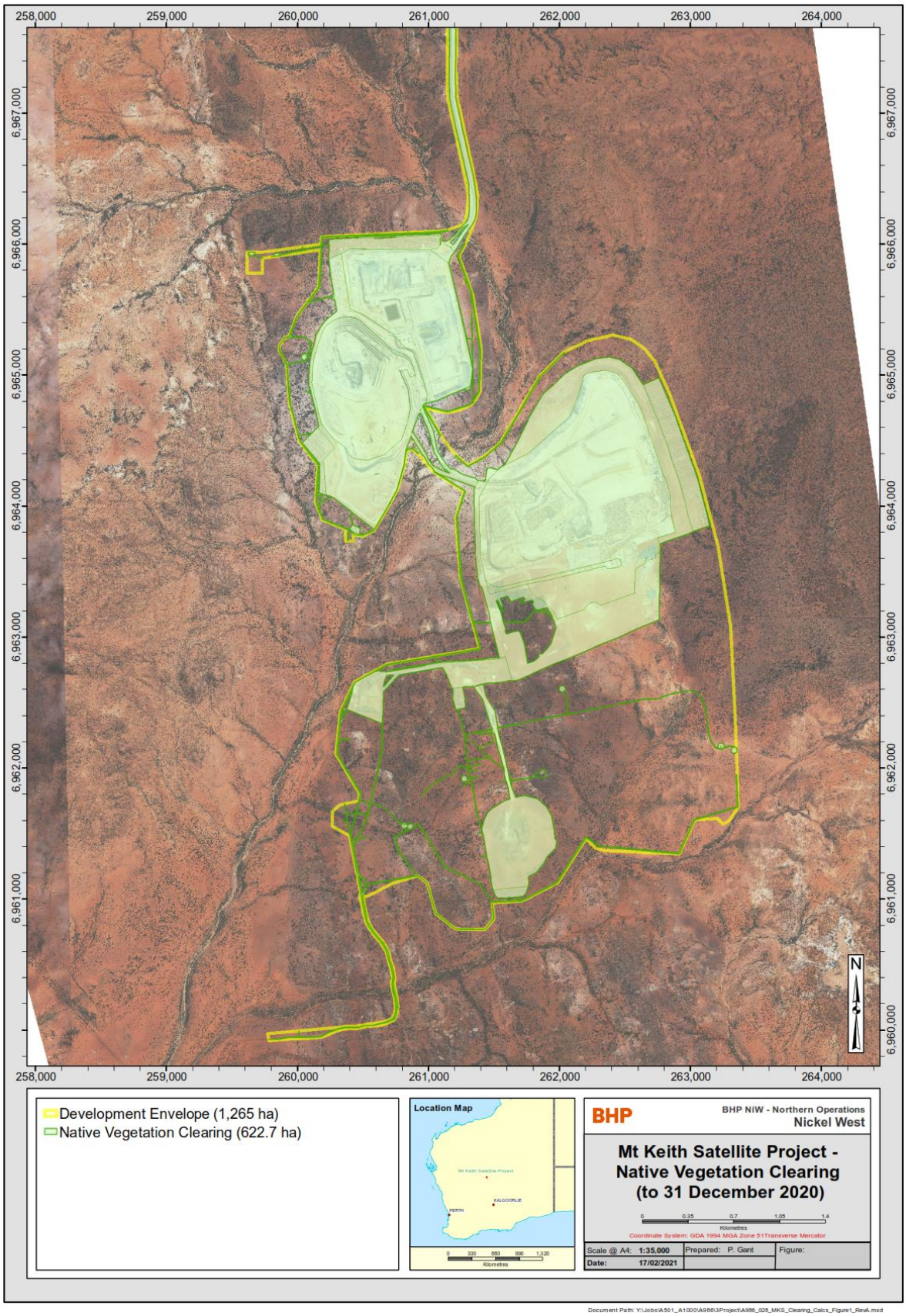

Figure 2a. Native Vegetation Clearing within Development Envelope (refer Condition 1-1). A total of 622.7 ha of native vegetation clearing has occurred within the Development Envelope; being within the total 1,069 ha clearing limit authorised under the Statement 1087 approval.

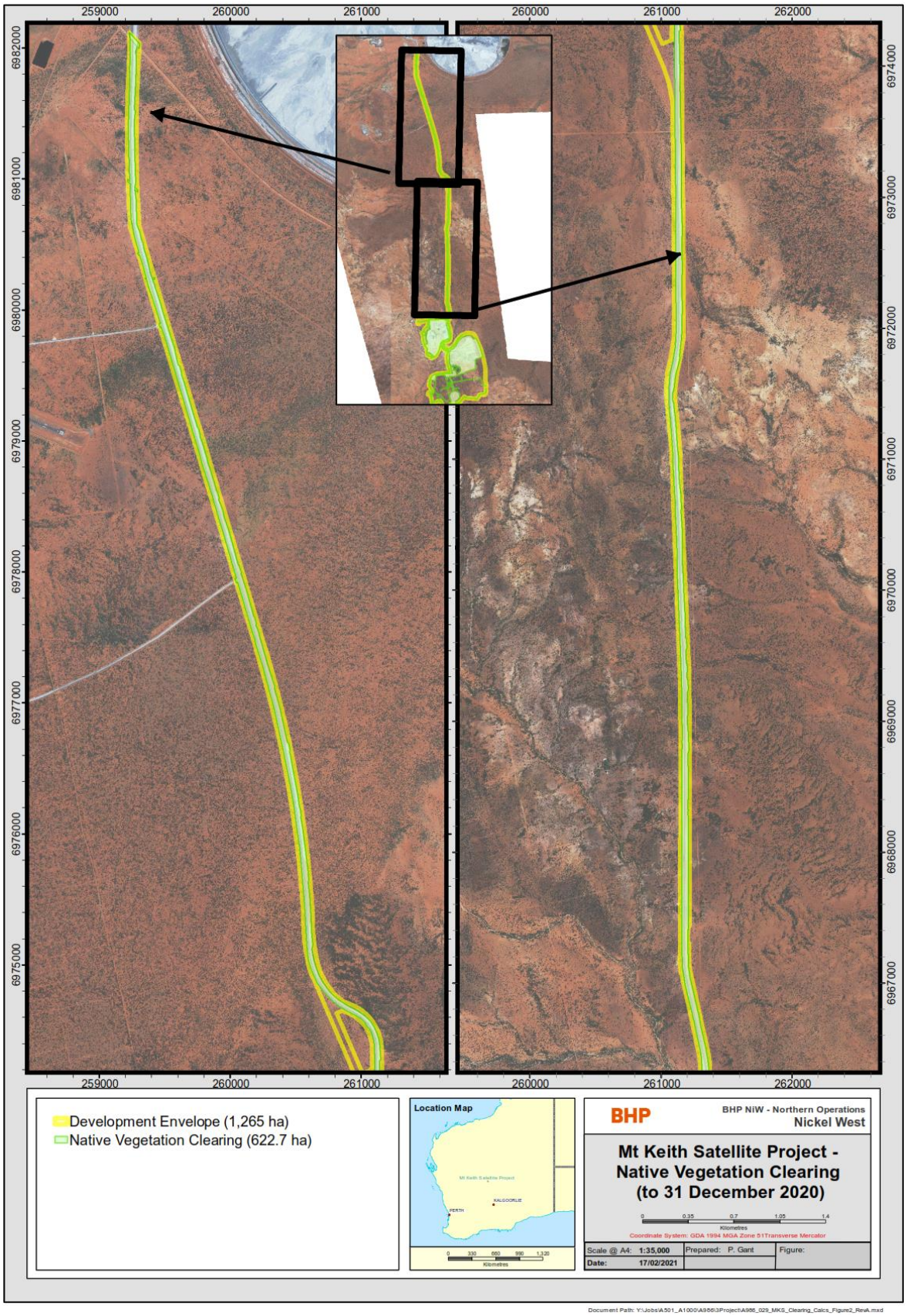

Figure 2b. Native Vegetation Clearing within Development Envelope (refer Condition 1-1). A total of 622.7 ha of native vegetation clearing has occurred within the Development Envelope; being within the total 1,069 ha clearing limit authorised under the Statement 1087 approval.

5. Proposed Changes to the Compliance Assessment Plan

BHP Nickel West has reviewed the approved CAP document (BHP Nickel West 2020a) and proposes the following changes to the CAP document:

- It is proposed that future CAR documents will cover a financial year period 1 July to 30 June annually, with submission by 30 October. The purpose of this proposed change is to better align the compliance reporting timeframes with other standard Government reporting requirements for BHP Nickel West, as well as to provide a sufficient time (4 months) for both the receipt of input external reports (e.g. consultant flora and vegetation monitoring reports) and the drafting of the CAR documentation by BHP Nickel West personnel.

  Subject to agreement on the above change, the next CAR document would then be due 30 October 2021 covering the period 1 January 2021 to 30 June 2021 (6 month period), before then moving to reporting on the full financial year (12 month period) in subsequent reports.

- The CAP document in Section 2.6 identifies that annual CAR documents will include monitoring data collected to support the Hydrological Processes EMP (BHP Nickel West 2018b). As the Hydrological Processes EMP is not regulated by the conditions of the Statement 1087 approval, it is proposed the CAP document is amended to remove reference to reporting such data within future annual CAR documents. Whilst noting this requested change, it should be noted that groundwater abstraction data will continue to be reported to DWER CEO in accordance with Condition 1-1 of the Statement 1087 approval (as provided in this CAR document).

- The CAP document in Section 2.6 identifies that annual CAR documents will include monitoring data collected to support the Mine Closure Plan (BHP Nickel West 2019c). As the Mine Closure Plan is not regulated by the conditions of the Statement 1087 approval, it is proposed the CAP document is amended to remove reference to reporting such data within future annual CAR documents. The Mine Closure Plan is regulated by DMIRS under the *Mining Act 1978* (WA), with BHP Nickel West to continue to report on the monitoring data for the Mine Closure Plan through that process.

BHP Nickel West respectfully requests written notice from the DWER CEO that the above changes to the CAP document are acceptable. Following confirmation from the DWER CEO that the proposed changes are acceptable, BHP Nickel West will submit a revised CAP document (incorporating the above changes) to the DWER CEO for approval in accordance with Condition 4-1.

6. References

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7. Appendices

7.1 Appendix 1 - BHP Nickel West Statement of Compliance

POST ASSESSMENT FORM 2

Statement of Compliance

Proposal and Proponent Details

Proposal Title	Mt Keith Satellite Project
Statement Number	1087
Proponent Name	BHP Billiton Nickel West Pty Ltd
Proponent's Australian Company Number *(where relevant)*	ACN 004 184 598

Statement of Compliance Details

Reporting Period	29/03/20 to 31/12/20

Implementation phase(s) during reporting period (please tick ✓ relevant phase(s))							
Pre-construction		Construction	✓	Operation		Decommissioning	

Audit Table for Statement addressed in this Statement of Compliance is provided at Attachment:	Table 1
An audit table for the Statement addressed in this Statement of Compliance must be provided as Attachment 2 to this Statement of Compliance. The audit table must be prepared and maintained in accordance with the Department of Water and Environmental Regulation (DWER) *Post Assessment Guideline for Preparing an Audit Table*, as amended from time to time. The 'Status Column' of the audit table must accurately describe the compliance status of each implementation condition and/or procedure for the reporting period of this Statement of Compliance. The terms that may be used by the proponent in the 'Status Column' of the audit table are limited to the Compliance Status Terms listed and defined in Table 1 of Attachment 1.	

Were all implementation conditions and/or procedures of the Statement complied with within the reporting period? (please tick ✓ the appropriate box)			
No (please proceed to Section 3)		Yes (please proceed to Section 4)	✓

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance. INITIALS:

POST ASSESSMENT FORM 2

Details of Non-compliance(s) and/or Potential Non-compliance(s)

The information required Section 3 must be provided for each non-compliance or potential non-compliance identified during the reporting period covered by this Statement of Compliance.

Non-compliance/potential non-compliance 7-1

Which implementation condition or procedure was non-compliant or potentially non-compliant?
Was the implementation condition or procedure non-compliant or potentially non-compliant?
On what date(s) did the non-compliance or potential non-compliance occur (if applicable)?
Was this non-compliance or potential non-compliance reported to the Chief Executive Officer, DWER?
☐ Yes ☐ Reported to DWER verbally Date _____ ☐ Reported to DWER in writing Date _____ ☐ No
What are the details of the non-compliance or potential non-compliance and where relevant, the extent of and impacts associated with the non-compliance or potential non-compliance?
What is the precise location where the non-compliance or potential non-compliance occurred (if applicable)? (please provide this information as a map or GIS co-ordinates)
What was the cause(s) of the non-compliance or potential non-compliance?
What remedial and/or corrective action(s), if any, were taken or are proposed to be taken in response to the non-compliance or potential non-compliance?
What measures, if any, were in place to prevent the non-compliance or potential non-compliance before it occurred? What, if any, amendments have been made to those measures to prevent re-occurrence?
Please provide information/documentation collected and recorded in relation to this implementation condition or procedure: • in the reporting period addressed in this Statement of Compliance; and • as outlined in the approved Compliance Assessment Plan for the Statement addressed in this Statement of Compliance. (the above information may be provided as an attachment to this Statement of Compliance)

For additional non-compliance or potential non-compliance, please duplicate this page as required.

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance. INITIALS:

POST ASSESSMENT FORM 2

Proponent Declaration

I, Christopher Stone, General Manager Northern Operations, *(full name and position title)* declare that I am authorised on behalf of BHP Billiton Nickel West Pty Ltd *(being the person responsible for the proposal)* to submit this form and that the information contained in this form is true and not misleading.

Signature: Date: 25 March 2021

Please note that:

it is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give or cause to be given information that to his knowledge is false or misleading in a material particular; and

the Chief Executive Officer of the DWER has powers under section 47(2) of the *Environmental Protection Act 1986* to require reports and information about implementation of the proposal to which the statement relates and compliance with the implementation conditions.

Submission of Statement of Compliance

One hard copy and one electronic copy (preferably PDF on CD or thumb drive) of the Statement of Compliance are required to be submitted to the Chief Executive Officer, DWER, marked to the attention of Manager, Compliance (Ministerial Statements).

Please note, the DWER has adopted a procedure of providing written acknowledgment of receipt of all Statements of Compliance submitted by the proponent, however, the DWER does not approve Statements of Compliance.

Contact Information

Queries regarding Statements of Compliance, or other issues of compliance relevant to a Statement may be directed to Compliance (Ministerial Statements), DWER:

Manager, Compliance (Ministerial Statements)

Department of Water and Environmental Regulation

❑ Postal Address: Locked Bag 10
❑ Joondalup DC
WA 6919

Phone: (08) 6364 7000

Email: compliance@dwer.wa.gov.au

Post Assessment Guidelines and Forms

Post assessment documents can be found at www.epa.wa.gov.au

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance. INITIALS:

ATTACHMENT 1

Table 2 Compliance Status Terms

Compliance Status Terms	Abbrev	Definition	Notes
Compliant	C	Implementation of the proposal has been carried out in accordance with the requirements of the audit element.	This term applies to audit elements with: • ongoing requirements that have been met during the reporting period; and • requirements with a finite period of application that have been met during the reporting period, but whose status has not yet been classified as 'completed'.
Completed	CLD	A requirement with a finite period of application has been satisfactorily completed.	This term may only be used where: • audit elements have a finite period of application (e.g. construction activities, development of a document); • the action has been satisfactorily completed; and • the DWER has provided written acceptance of 'completed' status for the audit element.
Not required at this stage	NR	The requirements of the audit element were not triggered during the reporting period.	This should be consistent with the 'Phase' column of the audit table.
Potentially Non-compliant	PNC	Possible or likely failure to meet the requirements of the audit element.	This term may apply where during the reporting period the proponent has identified a potential non-compliance and has not yet finalized its investigations to determine whether non-compliance has occurred.
Non-compliant	NC	Implementation of the proposal has not been carried out in accordance with the requirements of the audit element.	This term applies where the requirements of the audit element are not "complete" have not been met during the reporting period.
In Process	IP	Where an audit element requires a management or monitoring plan be submitted to the DWER or another government agency for approval, that submission has been made and no further information or changes have been requested by the DWER or the other government agency and assessment by the DWER or other government agency for approval is still pending.	**The term 'In Process' may not be used for any purpose other than that stated in the Definition Column.** The term 'In Process' may not be used to describe the compliance status of an implementation condition and/or procedure that requires implementation throughout the life of the project (e.g. implementation of a management plan).

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance. INITIALS:

7.2 Appendix 2 – Groundwater Abstraction Monitoring Data

MT KEITH SATELLITE PROJECT
WATER METER READINGS

ID	METER DESCRIPTION	JAN-20	FEB-20	MAR-20	APR-20	MAY-20	JUN-20	JUL-20	AUG-20	SEP-20	OCT-20	NOV-20	DEC-20	ANNUAL TOTAL
MKS1	MKS MINE - In pit dewatering	56,500	66,000	60,000	21,700	28,986	27,314	26,080	15,544	0	0	7,217	8,821	318,162
MKS2	MKS MINE - Ex pit bore	0	0	0	0	0	0	0	0	0	0	0	0	0
MKS3	MKS MINE - SMW Shaft	0	6,300	5,000	0	10,096	1,701	2,828	2,464	1,831	1,648	2,605	3,184	37,657
MKS4	MKS MINE - QUBE Standpipe	0	0	0	0	0	0	0	0	0	0	0	0	0
MKS5	MKS MINE - Turkeys Standpipe	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONTHLY TOTAL	56,500	72,300	65,000	21,700	39,082	29,015	28,908	18,008	1,831	1,648	9,822	12,005	355,819

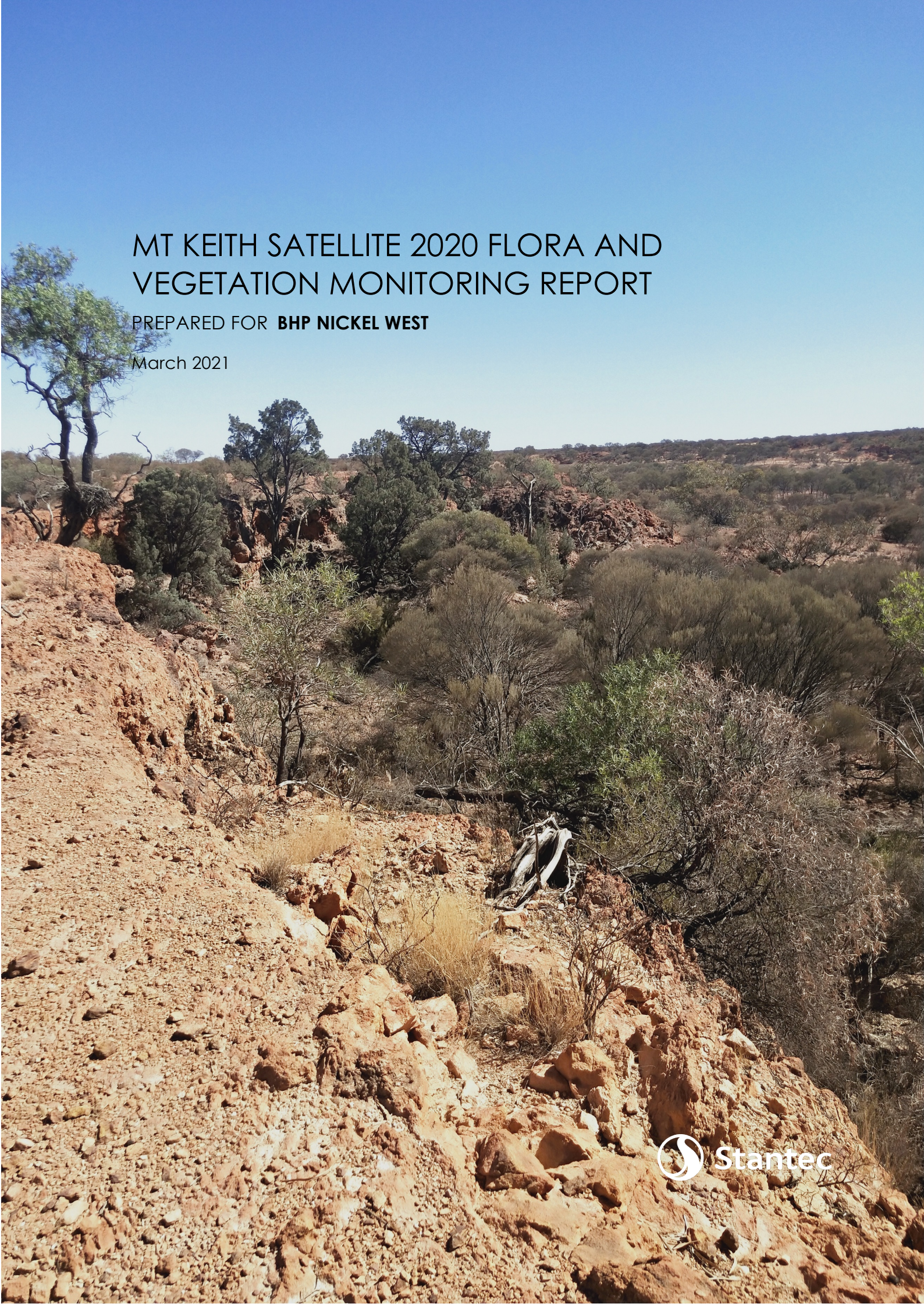
Volumes in kilolitres (kL)

7.3 Appendix 3 – Stantec (2021) Mt Keith Satellite 2020 Flora and Vegetation Monitoring Report

MT KEITH SATELLITE 2020 FLORA AND VEGETATION MONITORING REPORT

PREPARED FOR **BHP NICKEL WEST**

March 2021



Stantec

This document has been prepared for the benefit of BHP Nickel West. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Stephanie Kemp	Natasha Banning

PREPARED BY		
Laurren Duncan	.....	12/10/2020
CHECKED BY		
Ben McMillan	.....	24/02/2021
REVIEWED BY		
Natasha Banning	.....	03/03/2021
APPROVED FOR ISSUE BY		
Natasha Banning	.....	03/03/2021

PERTH
Ground Floor, 226 Adelaide Terrace, PERTH, WA 6000
TEL +61 (08) 6222 7000

Executive summary

Stantec Australia Pty Ltd (Stantec) was commissioned in 2020 by BHP Nickel West to undertake flora and vegetation monitoring at the Mt Keith Satellite Project (MKS project) to meet the requirements of the Flora and Vegetation Environmental Management Plan – Mt Keith Satellite Project, approved under MS1087. The flora and vegetation monitoring program, established in December 2018, consists of quarterly Priority Flora health monitoring and annual vegetation condition monitoring. This report details the findings of the annual vegetation condition monitoring program conducted in September 2020, and a summary of the quarterly Priority Flora assessments undertaken in 2020.

With the development of the MKS project there were potential indirect impacts associated with the construction of the haul road and other mine infrastructure. Those impacts include habitat fragmentation, alteration of surface water flows, and the spread of weeds. As part of the FVEMP, thirty-eight vegetation quadrats were monitored: 26 'impact' quadrats within or adjacent to the MKS development envelope and 12 'control' quadrats in areas considered unaffected by MKS operations. Additionally, the health of four Priority Flora species were monitored quarterly across eleven sites. Six of those sites were adjacent to mine infrastructure or the haul road and were assigned as 'impact' sites. Five Priority Flora sites outside of the impact area were assigned as 'control' sites.

Generally, the health of Priority Flora diminished during the 2020 monitoring period compared to the 2019 monitoring period across both impact and control sites. Between 2019 and 2020, a higher proportion of declining or dead individuals were recorded at both impact and control sites with a corresponding decrease in the proportion of both reproductive and vegetative plants. Furthermore, a total of 12 plant deaths were recorded in 2020 (two from control sites and ten from impact sites) compared to none in 2019. A large decrease in the percentage of vegetative plants was observed between the November 2019 and March 2020 assessments across the impact and control sites. Most impact and control sites did not recover between March 2020 and December 2020. The exception was the *Hybanthus floribundus* subsp. *chloroxanthus* control site which has recorded consistent improvement in plant health.

Despite the decline in Priority Flora health between 2019 and 2020, only two impact sites had lower plant health scores than their comparative control sites throughout 2020. These sites were the *Verticordia jamiesonii* site located east of the haul road, and the *Hibbertia* sp. Sherwood Breakaways site located west of the haul road. All other Priority Flora impact sites had plant health scores that were comparable or higher than their corresponding control sites.

Based on the quadrat assessments, limited conclusions could be made as to whether vegetation condition had been impacted by mining disturbances from the MKS project. A higher combined percentage of 'very good' to 'excellent' rated quadrats were recorded at the control quadrats compared to the haul road and infrastructure impact quadrats. However, the proportion of 'excellent' condition quadrats was highest at the haul road impact quadrats. Along the haul road, the 'excellent' condition quadrats were located along the middle section of the road, however there were also quadrats assessed as 'degraded' towards the northern section of the haul road. The interpretation of the 2020 monitoring was limited by the location of a number of control quadrats in similar proximity to the MKS project as impact quadrats.

Extended dry seasonal conditions and dust deposition may have impacted vegetation condition ratings and contributed to the declines in Priority Flora health observed in 2020. Prior to monitoring establishment, rainfall in 2018 was above average before becoming generally drier with below average rainfall recorded in 2019 and 2020. Dust deposition on the vegetation could be exacerbating water stress. Possible alterations to surface water flow from the MKS project could also alter water availability, however soil surface hydrology around the MKS project is unable to be inferred from the collected monitoring data.

Sightings of weed species were recorded at two Priority Flora control sites in July 2020 but they were not observed in subsequent September and December assessments. No weeds were recorded across the quadrats assessed in September 2020.

BHP Nickel West

Mt Keith Satellite 2020 Flora and Vegetation Monitoring Report

CONTENTS

Executive summary iii

1. Introduction 1

2. Climate and environment 2

3. Monitoring methods 3

3.1 Stantec personnel 3

3.2 Desktop assessment 3

3.3 Priority Flora monitoring 3

3.4 Vegetation condition monitoring 7

4. Results and discussion 12

4.1 Priority Flora monitoring 12

4.2 Vegetation condition monitoring 22

5. Limitations 26

5.1 Priority Flora monitoring 26

5.2 Vegetation condition monitoring 26

6. Conclusion 27

6.1 Priority Flora monitoring 27

6.2 Vegetation condition monitoring 27

7. References 30

LIST OF TABLES

Table 3-1: Stantec project staff experience 3

Table 3-2: Number of individuals assessed in July, September and December 2020 at the eleven Priority Flora sites 5

Table 3-3: Vegetation quadrats monitored at Mt Keith Satellite Operations in 2020 10

Table 6-1: Summary of Priority Flora site status in 2020, compared to 2019 28

Table 6-2: Summary of vegetation condition across the quadrats assessed in September 2020 29

LIST OF FIGURES

Figure 2-1: Monthly rainfall recorded at Leinster Aero weather station (station number 012314) from November 2018 to July 2020, compared with the Leinster Aero weather station monthly long-term average (1994 - 2020) *No monthly rainfall was included for December as monitoring was conducted at the beginning of the month. 2

Figure 3-1: Overview of Priority Flora sites monitored in July, September and December 2020 6

Figure 3-2: Schematic of a typical vegetation monitoring quadrat with corner posts at the at the north/north-west, south/south-west and east/north-east corner of the quadrat. Photo direction indicated by the arrow. 7

Figure 3-3: Overview of impact and control vegetation quadrats assessed in September 2020 9

Figure 4-1: Percentage of *Hybanthus floribundus* subsp. *chloroxanthus* individuals within each plant health category, across each impact and control site, from 2018 to 2020 13

Figure 4-2: *Hybanthus floribundus* subsp. *chloroxanthus* impact individual HFC_88 between July (left, with a score of 7b) and December 2020 (right, with a score of 7d); note heavy dust deposition on soil surface, and yellowing of foliage. 14

Figure 4-3: *Hybanthus floribundus* subsp. *chloroxanthus* control individual HFC_61 with nearby HFC_59, HFC_60, and HFC_62 between July (left) and December 2020 (right) 14

Figure 4-4: Percentage of *Hibbertia* sp. *Sherwood Breakaways* (R.J. Cranfield 6776) individuals within each plant health category, across each impact and control site, from 2018 to 2020 16

Figure 4-5: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) impact individual HSPSB_4 assessed in July (left, with a score of 2) and December 2020 (right, with a score of 1), note moderate dust deposition on soil surface 17

Figure 4-6: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) individuals assessed in December 2020, HSPSB_15 (left) and HSPSB_98 (right), both vegetative but with different coloured foliage 17

Figure 4-7: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) control individual HSPSB_105 assessed in July (left) and December 2020 (right) 17

Figure 4-8: Percentage of *Verticordia jamiesonii* individuals within each plant health category across each impact and control site from 2018 to 2020 19

Figure 4-9: *Verticordia jamiesonii* individuals assessed in December 2020, VJ_138 (left, with a score of 7b) and VJ_40 (right, with a score of 2), showing the difference in health, foliage colour and dust load 20

Figure 4-10: *Verticordia jamiesonii* control individual VJ_46 assessed in July (left, with a score 7d) and December 2020 (right, with a score of 3) 20

Figure 4-11: *Verticordia jamiesonii* control individual VJ_130 assessed in July (left, with a score 7c) and December 2020 (right, with a score of 3) 20

Figure 4-12: Percentage of *Eremophila* sp. long pedicels (G. Cockerton 1975) individuals within each plant health category across each impact and control site from 2018 to 2020 21

Figure 4-13: *Eremophila* sp. long pedicels individual, ESPLP_231, assessed in July (left, with a score of 3) and December 2020 (right, with a score of 1 after it was uprooted and blown to another location) 22

Figure 4-14: *Eremophila* sp. long pedicels individual, ESPLP_208, assessed in July (left, with a score of 7b) and December 2020 (right, with a score of 7c indicating reduced foliage) 22

Figure 4-15: Percentage of impact and control quadrats within each vegetation condition category in September 2020 23

Figure 4-16: Control quadrats, MKS EIA 36 (left) rated as 'very good' and MKS EIA 35 (right) rated as 'good', with substantial dust cover due to location next to the MKS haul road 24

Figure 4-17: Haul road impact quadrats MKS EIA 3 (left) rated as 'degraded' with substantial dust cover, and MKS EIA 6 rated as 'excellent' with minimal dust cover due to large bund north-west of the quadrat post 24

Figure 4-18: Infrastructure impact quadrats MKS EIA 14 (left) with historic shrub deaths and MKS EIA 18 recording substantial dust cover, both in 'good' condition 24

LIST OF APPENDICES

Appendix A Amendments to the FVEMP monitoring program in 2020
A.1 Priority Flora monitoring
A.2 Vegetation condition assessment
Appendix B Vegetation assessment criteria
Appendix C Plant health score maps December 2020
Appendix D Individual plant photographs and health ratings in December 2020
D.1 *Hybanthus floribundus* subsp. *chloroxanthus*
D.2 *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776)
D.3 Verticordia jamiesonii
D.4 *Eremophila* sp. long pedicels (G. Cockerton 1975)
Appendix E Priority Flora monitoring data 2018 to 2020
Appendix F Detailed quadrat assessments 2020
F.1 MKS EIA 1 - Haul Road Impact
F.2 MKS EIA 2 - Haul Road Impact
F.3 MKS EIA 3 - Haul Road Impact
F.4 MKS EIA 4 - Haul Road Impact
F.5 MKS EIA 5 - Haul Road Impact
F.6 MKS EIA 6 - Haul Road Impact
F.7 MKS EIA 7 - Haul Road Impact
F.8 MKS EIA 8 - Haul Road Impact
F.9 MKS EIA 9 - Haul Road Impact
F.10 MKS EIA 10 - Infrastructure Impact
F.11 MKS EIA 11 - Infrastructure Impact
F.12 MKS EIA 12 - Infrastructure Impact
F.13 MKS EIA 13 - Infrastructure Impact
F.14 MKS EIA 14 - Infrastructure Impact
F.15 MKS EIA 15 - Infrastructure Impact
F.16 MKS EIA 16 - Infrastructure Impact
F.17 MKS EIA 17 - Infrastructure Impact
F.18 MKS EIA 18 - Infrastructure Impact
F.19 MKS EIA 19 - Haul Road Impact
F.20 MKS EIA 20 - Haul Road Impact
F.21 MKS EIA 23 - Haul Road Impact
F.22 MKS EIA 24 - Haul Road Impact
F.23 MKS EIA 25 - Haul Road Impact
F.24 MKS EIA 26 - Haul Road Impact
F.25 MKS EIA 27 - Haul Road Impact
F.26 MKS EIA 28 - Haul Road Impact
F.27 MKS EIA 21 - Control

F.28 MKS EIA 22 - Control
F.29 MKS EIA 29 - Control
F.30 MKS EIA 30 - Control
F.31 MKS EIA 31 - Control
F.32 MKS EIA 32 - Control
F.33 MKS EIA 33 - Control
F.34 MKS EIA 34 - Control
F.35 MKS EIA 35 - Control
F.36 MKS EIA 36 - Control
F.37 MKS EIA 37 - Control
F.38 MKS EIA 38 - Control
Appendix G Vegetation condition rating maps 2020

1. Introduction

The Mt Keith Satellite (MKS) project is located in the north-eastern Goldfields region of Western Australia, within the Yakabindie and Mt Keith pastoral leases. The MKS operation is approximately 52 kilometres (km) northwest of Leinster, 15 km south of the existing Mt Keith Nickel Operation and immediately west of the Wanjarri Nature Reserve (WNR). Additionally, it resides within the Violet Range Priority Ecological Community (PEC) with Priority Flora populations adjacent to mine infrastructure. The MKS project was approved under Ministerial Statement 1087 and requires the implementation of the approved Flora and Vegetation Environmental Management Plan (FVEMP).

The initial disturbance began in in February 2019 with vegetation clearing and construction works followed by the commencement of mining operations in April 2019. With the development of the MKS project, potential indirect impacts on WNR, Violet Range PEC and Priority Flora were identified in previous baseline studies primarily attributed to the clearing of native vegetation associated with the construction of mine landforms (pits and waste rock dumps) and the transport corridor (haul road) (BHP Nickel West 2019). These include habitat fragmentation, the introduction or spread of weeds, altered fire regimes, altered surface water flows and dust deposition (BHP Nickel West 2019). Outside of MKS operations, grazing can occur due to the nearby pastoral stations and dry seasonal conditions have a considerable impact on vegetation health as most of the flora in this bioregion is reliant on sporadic rainfall and short-term moisture availability.

In order to assess potential impacts from the development of the MKS operation on the Violet Range PEC and WNR, 38 vegetation quadrats were established and monitored in December 2018, prior to any operation disturbance. Control quadrats that were outside of the impact area were also monitored.

Out of the fourteen priority-listed taxa recorded within the MKS project area, four were selected as indicator species of concern for quarterly monitoring due to their proximity to the MKS haul road or other mine features (BHP Nickel West 2019):

- *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) (P2);
- *Hybanthus floribundus* subsp. *chloroxanthus* (P3);
- *Verticordia jamiesonii* (P3); and
- *Eremophila* sp. long pedicels (G. Cockerton 1975) (P2).

Priority Flora sites that were outside of the impact area were also selected.

From December 2018 to March 2020, Western Botanical monitored vegetation condition and Priority Flora health quarterly. Stantec Australia Pty Ltd (Stantec) completed the quarterly Priority Flora health assessments in July, September and December 2020, and the annual vegetation condition monitoring in September 2020 as per the FVEMP.

Specifically, the objectives of the 2020 flora and vegetation monitoring program were to:

- undertake field monitoring of 38 vegetation quadrats and eleven Priority Flora sites according to the FVEMP (and the previous methodology of Western Botanical);
- compare vegetation condition between impact and control quadrat sites assessed in September 2020;
- assess long term changes in plant health of the Priority Flora sites since December 2018; and
- identify factors (if any) effecting vegetation condition and Priority Flora health, including impacts from mining related disturbances.

This report details the findings of the annual vegetation condition monitoring program as well as a summary of the quarterly Priority Flora assessments conducted by Stantec in 2020. Any assessments prior to July 2020 were reported on by Western Botanical but the data has been presented in this report for comparison.

2. Climate and environment

The MKS project is located within the Eastern Murchison sub-region of the Interim Biogeographic Regionalisation for Australia (IBRA version 7) (Department of Agriculture, Water and the Environment 2012). This subregion consists of extensive areas of elevated red/red-brown desert sandplains with minimal dune development, breakaway complexes, internal drainage and saline lake systems (Cowan 2001). The vegetation surrounding the MKS development envelope is primarily comprised of stoney, mulga shrublands (*Acacia aneura* complex) in association with various understorey genera, including *Senna*, *Eremophila*, and *Maireana* (BHP Nickel West 2019).

The climate is characterised as semi-desert to arid with hot, dry summers and cool, mild winters. The closest Bureau of Meteorology (BOM) weather station is Leinster Aero (station number 12314), located approximately 47 km away from the MKS project area. Leinster Aero has an average annual rainfall of 259 millimetres (mm) between 1994 and 2020 (BOM 2020). Generally, more rainfall is received in summer and early autumn, mainly linked to local thunderstorms or the influence of tropical cyclones to the north (Beard 1990, Pringle et al. 1994).

Since the flora and vegetation monitoring program was established in December 2018, rainfall has generally been below average. In particular, over the past twelve months a total of 106 mm of rainfall was recorded compared to the long-term average of 250 mm. In the three months prior to the September vegetation condition assessment 11 mm of rainfall was recorded whilst only 1 mm of rainfall was recorded between the Spring and Summer Priority Flora assessments (September and December 2020). It is assumed that the monthly rainfall volume recorded at the Leinster Aero weather station reflects the average rainfall received at the Priority Flora monitoring sites and the vegetation condition quadrats.

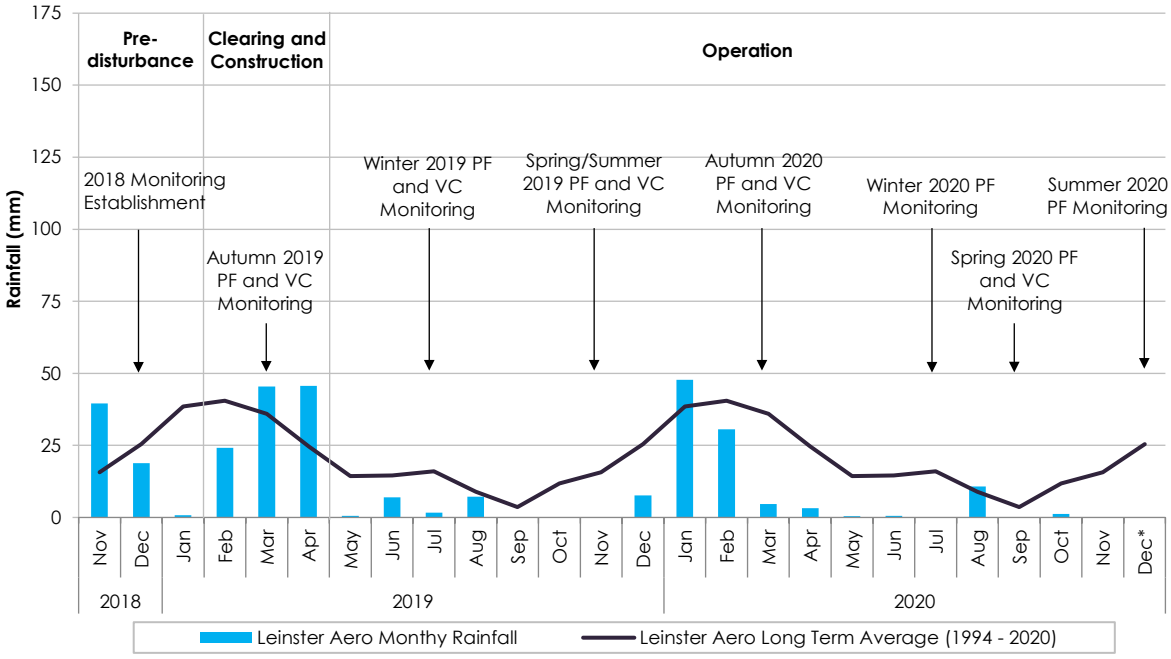


Figure 2-1: Monthly rainfall recorded at Leinster Aero weather station (station number 012314) from November 2018 to July 2020, compared with the Leinster Aero weather station monthly long-term average (1994 - 2020) *No monthly rainfall was included for December as monitoring was conducted at the beginning of the month.

3. Monitoring methods

3.1 Stantec personnel

Since July 2020 the monitoring has been undertaken by Stantec environmental scientists, Laurren Duncan (July, September and December) and Ben McMillan (September and December), and Stantec botanist, Julijanna Hantzis (July) (**Table 3-1)**. All field staff have previously conducted Priority Flora and vegetation condition assessments as well as rehabilitation monitoring across multiple mine sites in the Goldfields region. These include the Mt Keith Nickel Mine, Leinster Nickel Mine, and Sunrise Dam Gold Mine.

Table 3-1: Stantec project staff experience

Stantec Staff	Qualifications	Flora License	Professional Experience
Laurren Duncan	BSc (Environmental Science and Natural Resource Management)	FB62000014-2	2 years
Ben McMillan	BSc. (Environmental Biology), BSc. (Hons)	FB62000058-2	6 years
Julijanna Hantzis	BSc. (Environmental Biology)	FB2000132/TFL 21-1920	3 years

3.2 Desktop assessment

A desktop review of previous monitoring data and reports was conducted prior to undertaking the 2020 flora and vegetation monitoring program. Data and reports provided by BHP Nickel West included:

- The MKS Flora and Vegetation Environmental Management Plan (BHP Nickel West 2019)
- The MKS FVEMP Summary Monitoring Report for December 2018 to November 2019 (BHP Nickel West 2020a)
- Monitoring data from March 2020 collected by Western Botanical (BHP Nickel West 2020b)

Previous data from these sources were collated and used to ensure consistency in the field method and identify if modifications to the method were required.

All revisions to the Priority Flora and vegetation condition assessment methodology or monitoring design are detailed in **Appendix A.** Limitations associated with the monitoring design or methodology are detailed in **section 5**.

3.3 Priority Flora monitoring

3.3.1 Methodology

Fourteen priority-listed taxa were recorded within the MKS project area during baseline studies (BHP Nickel West 2019). Four of those were selected as indicator species of concern for ongoing monitoring due to their proximity of to either haul road of mine landforms and therefore risk of indirect impacts:

- *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) (P2);
- *Hybanthus floribundus* subsp. *chloroxanthus* (P3);
- *Verticordia jamiesonii* (P3); and
- *Eremophila* sp. long pedicels (G. Cockerton 1975) (P2).

For each indicator species two or more monitoring sites were established by Western Botanical in December 2018 including up to 25 individuals of the target taxa with a total of eleven Priority Flora sites established. The sites of each indicator species were then assigned as either an 'impact' or 'control' site. 'Impact' sites were assumed to be located in an area in which potential indirect environmental impacts on Priority Flora from the MKS project may occur. 'Control' sites were assumed to be situated a sufficient

distance from the MKS project that they were considered unlikely to be impacted by potential indirect environmental impacts. Based on on-ground observations, the site conditions (i.e. soil types, vegetation cover, topography) were assumed to be comparable between the 'impact' and 'control' sites.

Across each of the eleven total Priority Flora sites up to 25 individuals of each taxa at each site were:

- permanently tagged and labelled;
- marked using a GPS;
- photographed; and
- assigned a plant health score (**Appendix B**).

Comments were also given based on recent weather conditions, foliar condition, dust loads, interruptions to sheet flow, erosion, salt loads, weeds, or observable grazing which may be impacting the site. The individual plants consisted of both mature and juvenile individuals (with juvenile defined as being smaller in size than mature plants and with no evidence of reproductive maturity).

The plant health scoring system is based on plant foliage and the presence of reproductive features such as flowers, seeds or pods (**Appendix B**). The scores range from 1 to 7(a-d) and were split into four main categories in this report:

- 'Vegetative' which consists of scores 7a, 7b, 7c and 7d. Plant foliage is healthy, but may be actively growing (a), static (b) reduced (c) and/or pigmented (d) if it is normal for prevailing seasonal conditions.
- 'Reproductive' which does not directly measure plant health but indicates the priority flora site is reproducing. Scores can range from 4 to 6 depending on the stage of reproduction. While healthy foliage is expected there have been cases where observable reduced foliage has been recorded on reproductive plants.
- 'Declining' which represents observably reduced foliage (3) and/or partial canopy loss (2) due to extended dry seasonal conditions or abnormal localised impacts.
- 'Dead' which is the irreversible death of the plant and is given a score of 1.

The plant health scale used is a qualitative measure of plant health and with the change in monitoring personnel between Western Botanical and Stantec, personal interpretation of the plant health scale did affect plant health scores between March 2020 and July 2020. The plant health score of three plants at the *Hibbertia* sp. Sherwood Breakaways impact site and *Verticordia jamiesonii* control site in March 2020 was adjusted after the July 2020 assessment. Three individuals (VJ_119, HSPSB_11 and HSPSB_3) previously assessed as dead in March 2020, were reclassified as declining (2) in July 2020 as some living foliage remained.

3.3.2 Monitoring locations

The health of eleven known sites of Priority Flora were monitored by two Stantec environmental scientists in July, September and December 2020 (**Table 3-2**). The location of the sites in relation to MKS project and the haul road is provided in **Figure 3-1**. More detailed maps of each individual plant location have been provided as part of the Results and Discussion section.

Two *Eremophila* sp. long pedicels control sites were established in July 2020 and assessed starting from the July monitoring round upon request by BHP Nickel West (further information in **Appendix A**). Additionally, 17 *Hybanthus floribundus* subsp. *chloroxanthus* individuals were tagged and added to the existing sites near the Six Mile Well Pit, to increase the number of individuals assessed towards the ideal site count of 25, outlined in the FVEMP for the MKS project (BHP Nickel West 2019).

Table 3-2: Number of individuals assessed in July, September and December 2020 at the eleven Priority Flora sites

Priority Species	Tag ID	Site Type	Site Location	Count
Hybanthus floribundus subsp. *chloroxanthus* (P3) ^	HFC_51 to 62 and 253 to 257	Control	South of Six Mile Well Pit	17 (12)
	HFC_63 to 74 and 250 to 252	Impact	Southwest of Six Mile Well Pit	15 (12)
	HFC_75 to 90 and 241 to 249	Impact	West of Six Mile Well Pit	25 (16)
Hibbertia sp. Sherwood Breakaways (R.J. Cranfield 6776) (P2)	HSPSB_91 to 115	Control-east	Wanjarri Nature Reserve	25
	HSPSB_166 to 190	Control-west	Far West of Haul road	25
	HSPSB_1 to 25	Impact	East of Haul road	25
	HSPSB_141 to 165	Impact	West of Haul road	25
Verticordia jamiesonii (P3)	VJ_116 to 140	Control	Wanjarri Nature Reserve	25
	VJ_26 to 50	Impact	East of Haul road	25
Eremophila sp. long pedicels (G. Cockerton 1975) (P2) ^	ESPLP_191 to 215	Control-west	Western edge of Wanjarri Nature Reserve	25 (0)
	ESPLP_216 to 240	Control-north	Northern edge of Wanjarri Nature Reserve	25 (0)

^ Additional tagged individuals included in the July 2020 assessment - previous site sizes noted in brackets next to current site count

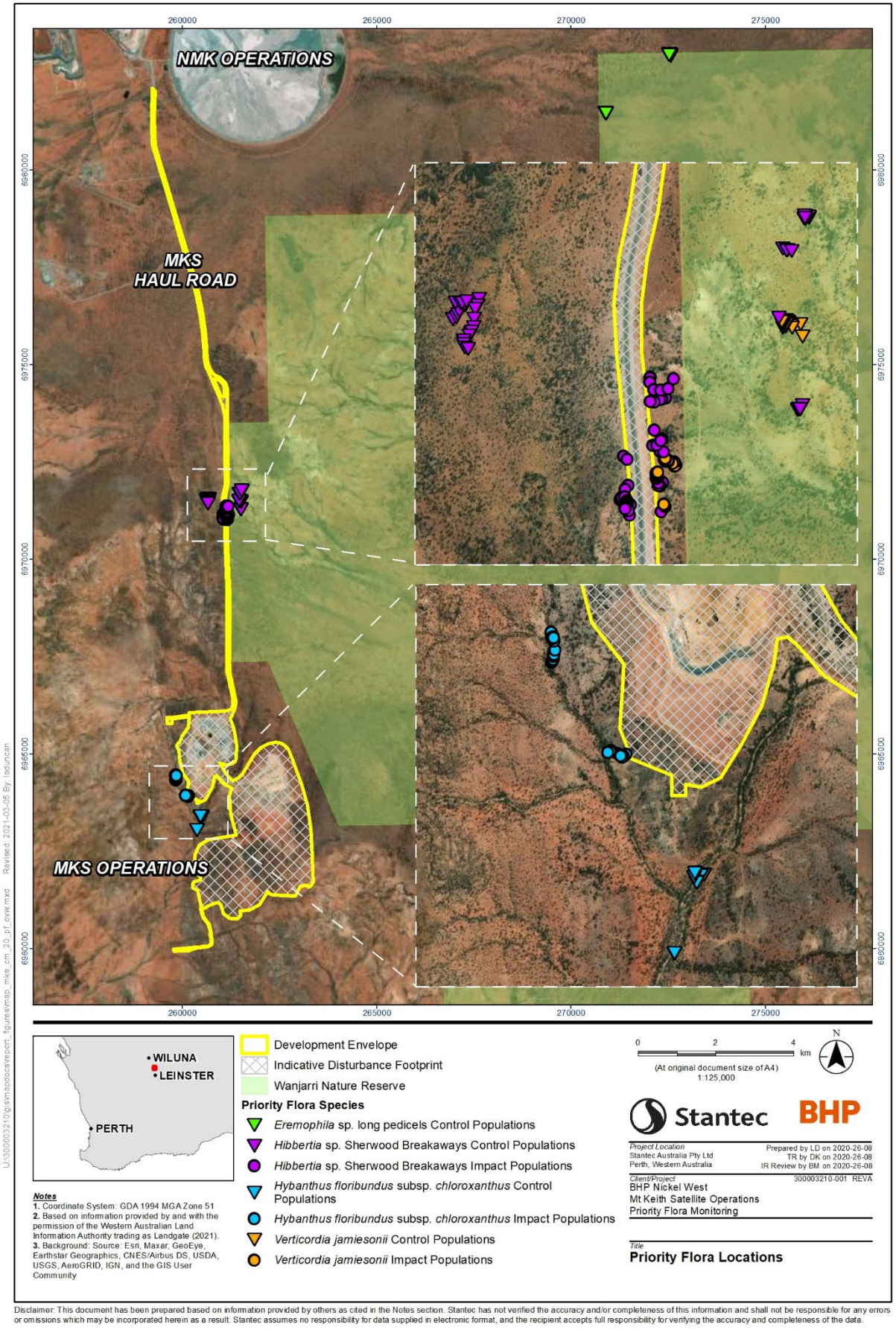


Figure 3-1: Overview of Priority Flora sites monitored in July, September and December 2020

3.4 Vegetation condition monitoring

3.4.1 Methodology

The vegetation condition monitoring was based on assessing of 14 m x 14 m quadrats, permanently marked by steel posts (**Figure 3-2**). These vegetation condition quadrats were established in December 2018 by Western Botanical and assigned as either an impact quadrat or control quadrat. Impact quadrats were assumed to be situated within the spatial area in which potential environment effects may occur, whilst control quadrats were assumed to be situated a sufficient distance away from the MKS project and unlikely to be impacted by the MKS project.

In September 2020, the impact quadrats were categorised based on their location to either the haul road or mine infrastructure. Generally, the quadrats were marked with four posts: one centre post and three corner posts situated at the north/north-west, south/south-west and east/north-east corner of the quadrat. However, due to the presence of tracks and bank structures, which overlap onto the quadrat area, not all quadrats have corner posts. Furthermore, some quadrats, situated within Wanjarri Nature Reserve, do not have any quadrat posts and are only marked by GPS.

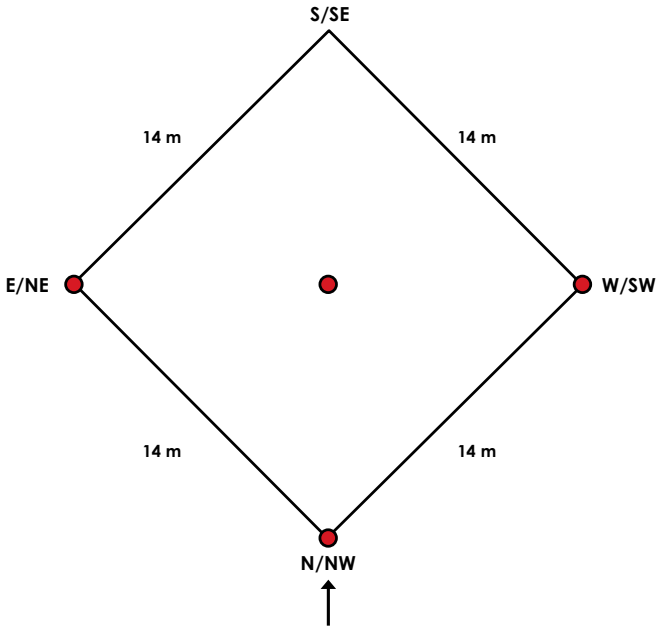


Figure 3-2: Schematic of a typical vegetation monitoring quadrat with corner posts at the at the north/north-west, south/south-west and east/north-east corner of the quadrat. Photo direction indicated by the arrow.

For each monitoring quadrat the following data were collected:

- one quadrat photograph; taken from the north or north-western corner of the quadrat;
- overall vegetation condition, assessed using the scale outlined by Keighery (1994) (**Appendix B**);
- overall extent of grazing impacts recorded as nil, light, medium or heavy (any grazing which appeared to have occurred in the last 12 months was considered 'recent grazing' and was determined by the field observer searching for evidence of recent grazing such as freshly broken stems and leaves, otherwise it was considered 'historic grazing');
- dust deposition from nearby mine infrastructure was recorded, considering dust on the soil surface as well as the vegetation;
- any maintenance required for the sites noted in the quadrat comments;
- if any weeds were present, the species was noted and total weed cover was estimated;

- the percentage cover of up to five dominant species were estimated (for this assessment, dominant species were defined as having a cover of 2% or more, or more than one individual within the quadrat, where cover can be less than 2%);
- the general plant health exhibited by each dominant species was assessed using the observable plant health scale which was based on plant foliage and the presence of reproductive features such as flowers, seeds or pods (BHP Nickel West 2019) (**Appendix B**);
- a species list of native perennials and annuals were also recorded.

While most plants were identified to species level, some plants were only identified to genus level due to a lack of identifying features (e.g. flowers or fruiting bodies) present at the time of assessment. The taxonomy of Mulga (*Acacia aneura* complex) was reviewed in 2012 and divided into several species that belong to the Mulga group (Maslin and Reid 2012). Where possible, each *Acacia aneura* complex individual recorded was identified to species level but if there were not enough identifying features it was recorded as *Acacia aneura*.

While monitoring data from previous vegetation condition assessments were supplied to Stantec prior to the September monitoring, the data was predominantly descriptive preventing any quantitative, long-term comparisons of vegetation condition or plant health over time. With the inclusion of vegetation condition ratings and plant health scores in assessment method for the September 2020 monitoring round (**Appendix B**) long term comparisons can be presented in future reporting.

3.4.2 Monitoring locations

The 38 monitoring quadrats were assessed by Stantec environmental scientists, Ben McMillan and Laurren Duncan, from the 7th - 14th of September 2020 (**Figure 3-3**). More detailed maps of each individual plant location have been provided as part of the results and discussion section. The 38 monitoring quadrats were classified as follows:

- 17 impact – haul road quadrats
- 9 impact – infrastructure quadrats
- 12 control quadrats

The broad vegetation community associations of each quadrat, determined from previous monitoring (BHP Nickel West 2019), are provided in **Table 3-3**, as well as their location relative to MKS project.

During the September assessment four impact quadrats were re-located further east to allow for safe access given their short distance from the haul road (MKS EIA 6, MKS EIA 24, MKS EIA 25 and MKS EIA 26). It was also noted that control quadrats, MKS EIA 35, MKS EIA 36 and MKS EIA 37, were established within 10 m of the haul road. These were monitored in September 2020, but their suitability for use as control quadrats in future monitoring rounds is discussed in this report.

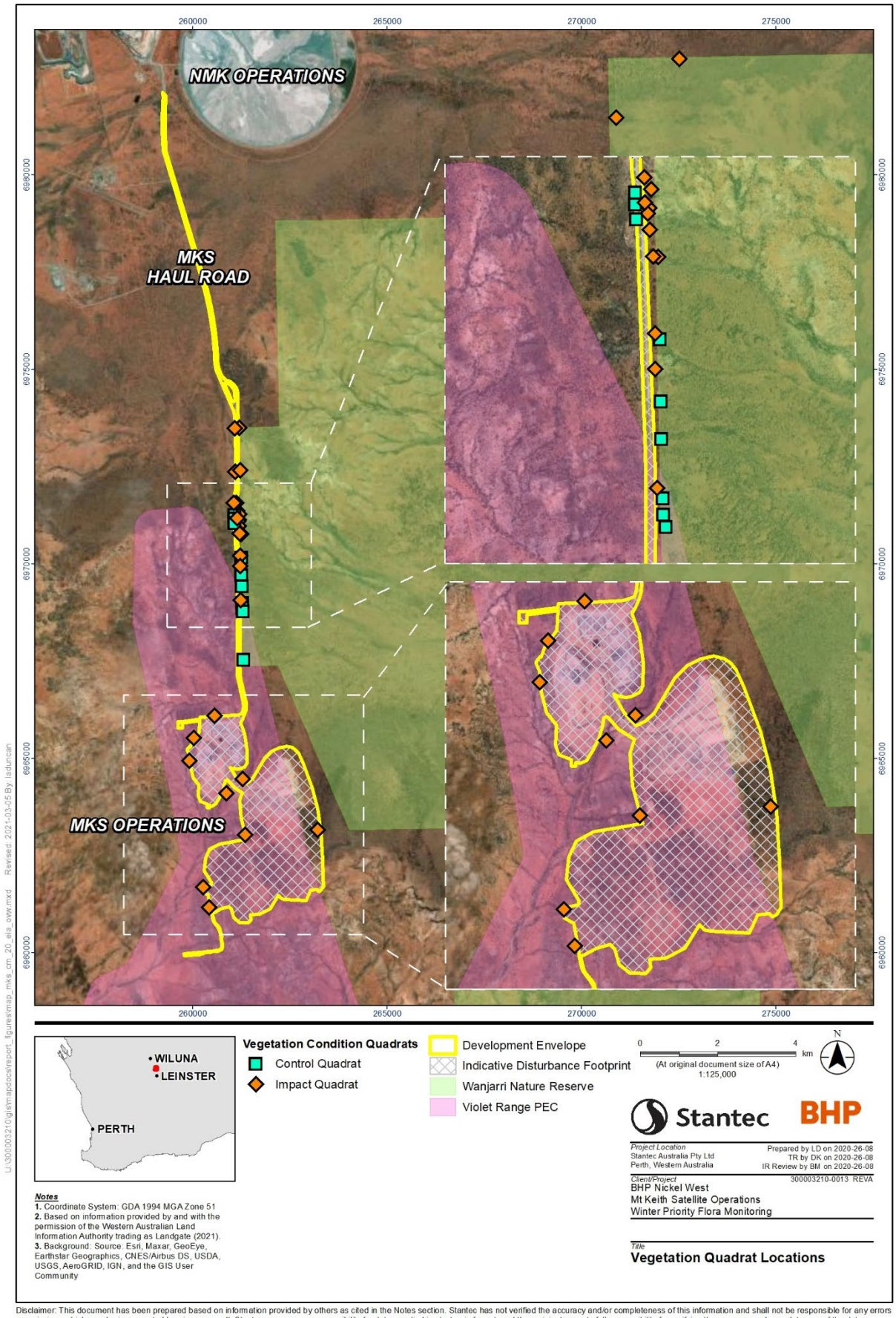


Figure 3-3: Overview of impact and control vegetation quadrats assessed in September 2020

Table 3-3: Vegetation quadrats monitored at Mt Keith Satellite Operations in 2020

Quadrat	Impact/ Control	Coordinates (GDA94) 51J	Approximate location	Vegetation Association (BHP Nickel West 2019)
MKS EIA 1	Impact – Haul Road	261082 6973489	~ 40 m west of MKS haul road	Drainage line Mulga shrubland
MKS EIA 2	Impact – Haul Road	261089 6972365	~ 40 m west of MKS haul road	Groved Mulga shrubland
MKS EIA 3	Impact – Haul Road	261117 6971563	~ 9 m west of haul road	Groved Mulga shrubland / Archaean granite geology
MKS EIA 4	Impact – Haul Road	261049 6971565	~ 75 m west of haul road	Groved Mulga shrubland/ Stony ironstone Mulga shrubland
MKS EIA 5	Impact – Haul Road	261204 6970774	~ 80 m east of haul road	Drainage line Mulga shrubland
MKS EIA 6	Impact – Haul Road	261139 6971172	~13 m east of haul road	Archaean granite geology
MKS EIA 7	Impact – Haul Road	261216 6970204	~ 90 m east of haul road	Drainage line Mulga shrubland
MKS EIA 8	Impact – Haul Road	261231 6969060	~ 60 m east of haul road	Stony ironstone Mulga shrubland
MKS EIA 9	Impact – Haul Road	261218 6969942	~95 m east of haul road	Weathered basalt, *Hakea leucoptera* subsp. *sericipes* / *Eremophila pantonii* shrubland
MKS EIA 10	Impact - Infrastructure	260553 6966093	~ 320 m north of Run-of-mine	Stony ironstone Mulga shrubland
MKS EIA 11	Impact - Infrastructure	260029 6965525	~ 250 m east of Run-of-mine	Stony ironstone low/Mulga shrubland
MKS EIA 12	Impact - Infrastructure	259909 6964937	~ 150 m east of Six Mile Well pit	Weathered basalt, *Hakea leucoptera* subsp. *sericipes* / *Eremophila pantonii* shrubland
MKS EIA 13	Impact - Infrastructure	260866 6964098	~ 80 m from Six Mile Well pit	Drainage line Mulga shrubland
MKS EIA 14	Impact - Infrastructure	263217 6963155	~ 400 m south-east of WRL	Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland
MKS EIA 15	Impact - Infrastructure	260412 6961163	~ 2.2 km south west of WRL, ~ 450 m from Jones Creek track	Mulga over *Maireana triptera* shrubland/ Drainage line Mulga shrubland
MKS EIA 16	Impact - Infrastructure	260261 6961683	~ 1.8 km south west of WRL, ~ 250 m from Jones Creek track	Drainage line Mulga shrubland
MKS EIA 17	Impact - Infrastructure	261346 6963029	~ 170 m from WRL	Drainage line Mulga shrubland
MKS EIA 18	Impact - Infrastructure	261285 6964460	~ 195 m south east of Run-of-Mine/ Six Mile Well	Drainage line Mulga shrubland
MKS EIA 19	Impact – Haul Road	270893 6981469	Wanjarri Nature Reserve	Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland

Quadrat	Impact/ Control	Coordinates (GDA94) 51J	Approximate location	Vegetation Association (BHP Nickel West 2019)
MKS EIA 20	Impact – Haul Road	272524 6982988	Wanjarri Nature Reserve	Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland
MKS EIA 23	Impact – Haul Road	261105 6971373	~ 25 m east of haul road	Granitic Mulga shrubland on Archaean geology
MKS EIA 24	Impact – Haul Road	261118 6971266	~ 10 m west from haul road	Granitic Mulga shrubland on Archaean geology.
MKS EIA 25	Impact – Haul Road	261127 6971134	~ 2 m east of haul road	Granitic Mulga shrubland on Archaean geology.
MKS EIA 26	Impact – Haul Road	261131 6971093	~ 7 m east of haul road	Granitic Mulga shrubland on Archaean geology.
MKS EIA 27	Impact – Haul Road	261122 6971012	~ 4 m west of haul road	Granitic Mulga shrubland on Archaean geology.
MKS EIA 28	Impact – Haul Road	261239 6970770	~ 110 m east of haul road, within Wanjarri Nature Reserve	Drainage line Mulga shrubland
MKS EIA 21	Control	261186 6973491	~ 60m from haul road, within Wanjarri Nature Reserve	Hardpan Mulga shrubland with *Acacia thoma* co- dominant
MKS EIA 22	Control	261218 6972404	~ 87 m from haul road, within Wanjarri Nature Reserve	Groved Mulga woodland
MKS EIA 29	Control	261255 6970160	~ 100 m east of haul road, within Wanjarri Nature Reserve	Drainage line Mulga shrubland
MKS EIA 30	Control	261261 6969699	~ 125 m east of haul road, within Wanjarri Nature Reserve	Drainage line Mulga shrubland
MKS EIA 31	Control	261263 6969421	~ 114 m east of haul road, within Wanjarri Nature Reserve	Drainage line Mulga shrubland
MKS EIA 32	Control	261277 6968983	~ 110 m east of haul road, within Wanjarri Nature Reserve	Stony ironstone Mulga shrubland
MKS EIA 33	Control	261280 6968863	~ 114 m east of haul road, within Wanjarri Nature Reserve	Stony ironstone Mulga shrubland
MKS EIA 34	Control	261298 6968771	~ 114 m east of haul road, within Wanjarri Nature Reserve	Stony ironstone low shrubland
MKS EIA 35	Control	261071 6971248	~ 3 m west of haul road	Stony ironstone Mulga shrubland
MKS EIA 36	Control	261071 6971159	~ 52 m west of haul road	Stony ironstone Mulga shrubland
MKS EIA 37	Control	261077 6971050	~ 48 m west of the haul road	Stoney ironstone low shrubland
MKS EIA 38	Control	261304 6967527	~ 130 m east of haul road	Stony ironstone low shrubland.

4. Results and discussion

4.1 Priority Flora monitoring

4.1.1 *Hybanthus floribundus* subsp. *chloroxanthus*

Three sites of *Hybanthus floribundus* subsp. *chloroxanthus* were assessed in 2020. The sites occupy the Mulga-dominated ephemeral drainage line the runs southward on the western side of the Six Mile Well pit. In July 2020, 17 additional Hybanthus floribundus subsp. chloroxanthus individuals were tagged and added to the existing sites near the Six Mile Well Pit to increase the number of individuals assessed towards the ideal site count of 25 outlined in the FVEMP. Each individual plant location is presented in **Appendix C** (**Figure C-1**). Individual plant health scores and photographs from the most recent assessment in December 2020 are shown in **Appendix D.1**. Photographs and scores from prior assessments in 2020 have been provided previously to BHPNW.

Across the impact sites, the combined percentage of vegetative and reproductive plants has remained generally consistent since a decrease was recorded between November 2019 and March 2020 (**Figure 4-1**, with raw data shown in **Appendix E**). Additionally, there has been no change in the number of plant deaths at either *Hybanthus floribundus* subsp. *chloroxanthus* impact site since March 2019. Small differences in the combined percentage of plants in each plant health category between March and July 2020 was the product of new plants being added to the impact and control sites in July 2020. In December 2020, the percentage of vegetative plants at the south-western and western impact sites were 80% and 90% respectively which were both higher than the control site. Across the 2020 assessments, most of the plants at the impact sites were dusty or had yellowing foliage due to water stress (**Figure 4-2**).

The percentage of vegetative plants at the control site has been increasing since March 2020 with almost 60% of the plants assessed as vegetative in December 2020 (**Figure 4-1, Appendix D.1**). Between November 2019 and March 2020, the combined percentage of vegetative and reproductive plants decreased from 100% to 33% which was a larger decline than observed at the impact sites. The foliage was generally yellow-green at most plants indicating some water stress (**Figure 4-3**). Dust was also noted on the plants. The dust observed at the control site may be due to its proximity (approximately 450 m downstream) to the MKS operations. Therefore, this control population may be indirectly impacted by MKS operations and may be an inappropriate location for a control site.

Prior to the March 2020 assessment, the majority of plants at the control sites were reproductive (**Figure 4-1**). Similarly, plants at the impact site were generally reproductive until the November 2019 assessment. Plants that were assessed as reproductive in prior to the November and March 2019 assessments may have also exhibited reduced foliage, however due to vegetation assessment criteria (**Appendix B**), only a reproductive score would be assigned. This may have masked any reduced foliage also occurring across both impact and control sites prior to March 2020.

No weeds were noted at any of the *Hybanthus floribundus* subsp. *chloroxanthus* sites during the December 2020 assessment. However, during the July 2020 assessment two weed species were observed near the southern *Hybanthus floribundus* subsp. *chloroxanthus* control site, **Sonchus oleraceus* and **Citrullus amarus*. Only one individual of each weed species was observed in July and they were not sighted in subsequent assessments; hence the risk to the control site was considered minor.

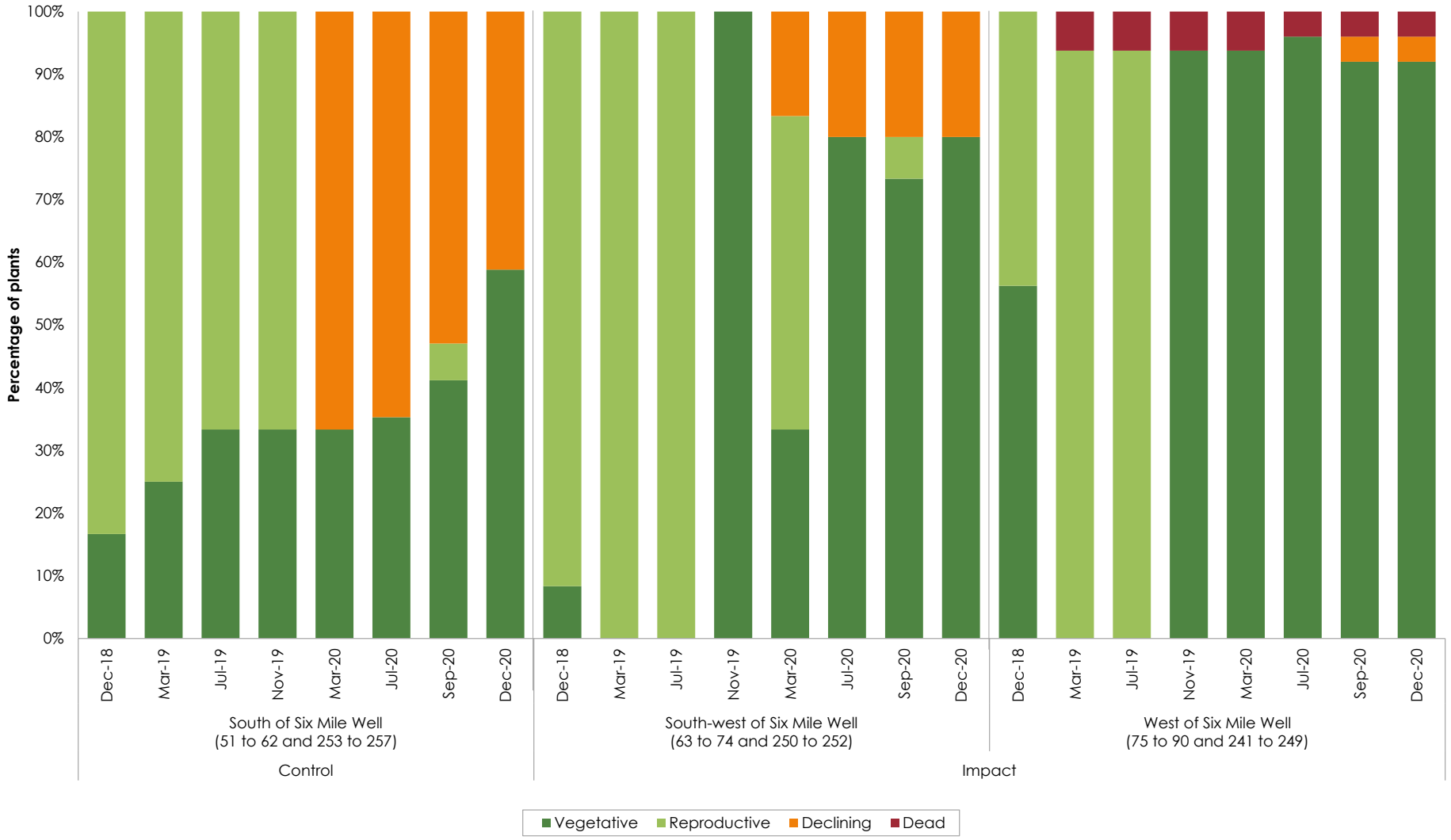


Figure 4-1: Percentage of *Hybanthus floribundus* subsp. *chloroxanthus* individuals within each plant health category, across each impact and control site, from 2018 to 2020

Figure 4-2: *Hybanthus floribundus* subsp. *chloroxanthus* impact individual HFC_88 between July (left, with a score of 7b) and December 2020 (right, with a score of 7d); note heavy dust deposition on soil surface, and yellowing of foliage.

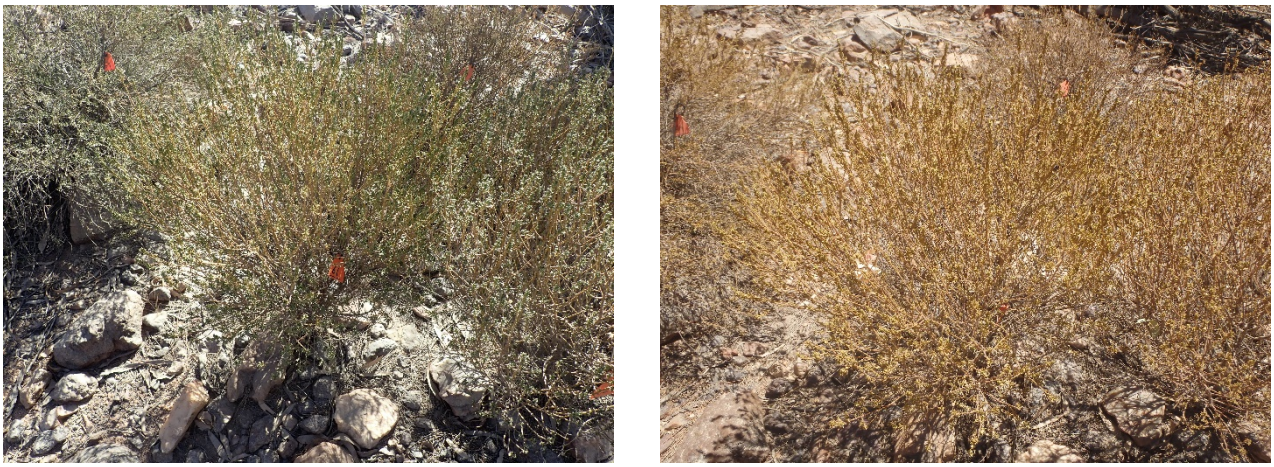


Figure 4-3: *Hybanthus floribundus* subsp. *chloroxanthus* control individual HFC_61 with nearby HFC_59, HFC_60, and HFC_62 between July (left) and December 2020 (right)

4.1.2 *Hibbertia* sp. Sherwood Breakaways

Four *Hibbertia* sp. Sherwood Breakaways sites were monitored in 2020. The sites are located on granitoid breakaways and laterite capped hills on either side of the MKS haul road. Detailed maps of each individual plant location are in **Appendix C** (**Figure C-3** and **Figure C-4**). Individual plant health scores and photographs from the most recent assessment in December 2020 are shown in **Appendix D.2.**

Changes in plant health ratings at the impact sites throughout 2020 have been relatively small since the sudden decline in plant health observed between November and March 2020 indicating a lack of recovery (**Figure 4-4**, with raw data shown in **Appendix E**). Between November and March 2020, the percentage of vegetative plants at the eastern and western impact sites decreased from 100% to 24% and 28% respectively. Since that initial decline six plant deaths have been recorded across the impact sites, half of which occurred between the last two assessments (September and December 2020) (**Figure 4-5**). The percentage of vegetative plants at the eastern impact site (32%) was the same as the western control site, but substantially lower than the control site in Wanjarri Nature Reserve (WNR). The western impact site had the lowest percentage of vegetative plants (16%) and the highest percentage of dead plants of all sites (20%). Throughout 2020 both impact sites were affected by dust deposition from the MKS haul road and purple foliage was noted on several individuals (**Figure 4-6**). The purple foliage is likely a phenological response to water stress generated from dry seasonal conditions and dust resulting in elevated anthocyanin pigments in the leaf tissue (Glover and Martin 2012).

The percentage of vegetative plants has gradually decreased at both control sites since the July 2020 assessment (**Figure 4-4, Appendix E**). The control site in WNR recorded a drop in plant health between the March and July 2020 assessments as observed at the impact sites but to a lesser degree. The percentage of vegetative plants at the WNR control decreased from 100% in March 2020 to 68% in December 2020. No data prior to March 2020 was available for the western control site but the percentage of vegetative plant decreased by 12 percentage points to 32% between March and December 2020. Similar to the impact sites, many plants at the control sites recorded purple foliage, likely in response to dry seasonal conditions, and no other impacts were observed (**Figure 4-7**).

No weed species were noted near the *Hibbertia* sp. Sherwood Breakaways sites between the July and December 2020 assessments.

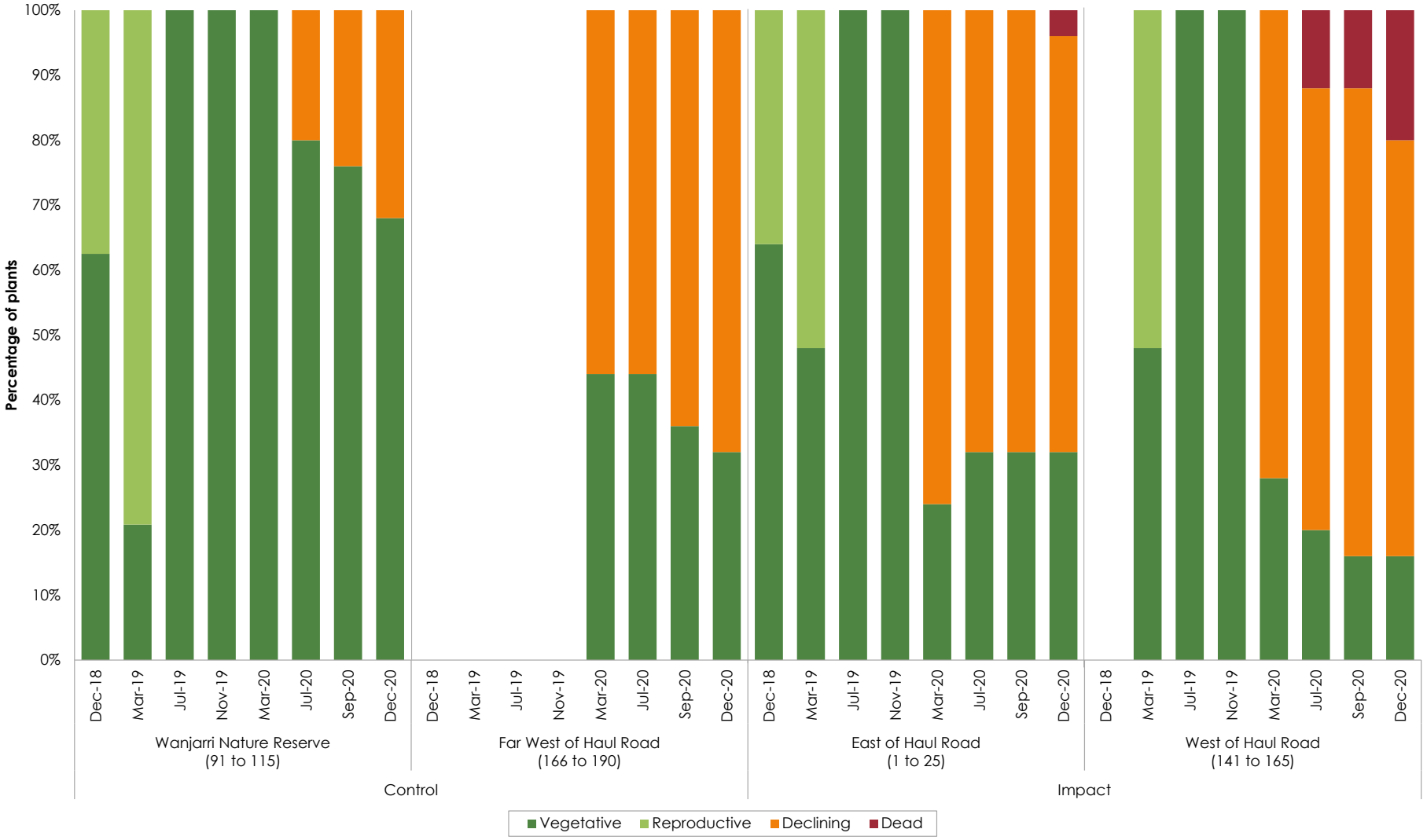


Figure 4-4: Percentage of *Hibbertia* sp. *Sherwood Breakaways* (R.J. Cranfield 6776) individuals within each plant health category, across each impact and control site, from 2018 to 2020

Figure 4-5: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) impact individual HSPSB_4 assessed in July (left, with a score of 2) and December 2020 (right, with a score of 1), note moderate dust deposition on soil surface

Figure 4-6: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) individuals assessed in December 2020, HSPSB_15 (left) and HSPSB_98 (right), both vegetative but with different coloured foliage

Figure 4-7: *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776) control individual HSPSB_105 assessed in July (left) and December 2020 (right)

4.1.3 Verticordia jamiesonii

Two *Verticordia jamiesonii* sites were monitored in 2020. The sites are situated on the eastern side of the MKS haul road on the same granitoid breakaways and laterite capped hills as *Hibbertia* sp. Sherwood Breakaways. Each individual plant location is presented in **Appendix C** (**Figure C-2, Figure C-3**) with plant health scores and photographs from the December 2020 assessment presented in **Appendix D.3.**

Plant health at the impact *Verticordia jamiesonii* site has substantially declined between November 2019 and December 2020 (**Figure 4-8,** with raw data shown in **Appendix E**). The percentage of vegetative and reproductive plants decreased from 100% to 12%, with most of the decline occurring between November 2019 and March 2020. Three plant deaths were recorded between 2019 and 2020 (VJ_30, VJ_47 and VJ_49). Despite the control site also recording a notable decrease in plant health over the same period, the percentage of vegetative and reproductive individuals was higher at the control site compared to the impact site in December 2020 (**Figure 4-9**). Similar to previous assessments, purple and yellow foliage was noted as well as moderate dust deposition (**Figure 4-10**) indicating that the plants were water stressed.

Plant health scores have progressively decreased at the control site since March 2020 assessment but to a lesser extent that the impact site (**Figure 4-8**, **Appendix E**). The percentage of vegetative and reproductive plant decreased from 100% in November 2019 to 40% in December 2020. One plant death was recorded in March 2020 (VJ_146). Extended dry seasonal conditions likely contributed the decline in plant health given the purple and yellow foliage observed on some plants (**Figure 4-11**).

No weed species were observed near the *Verticordia jamiesonii* sites during the December 2020 assessment.

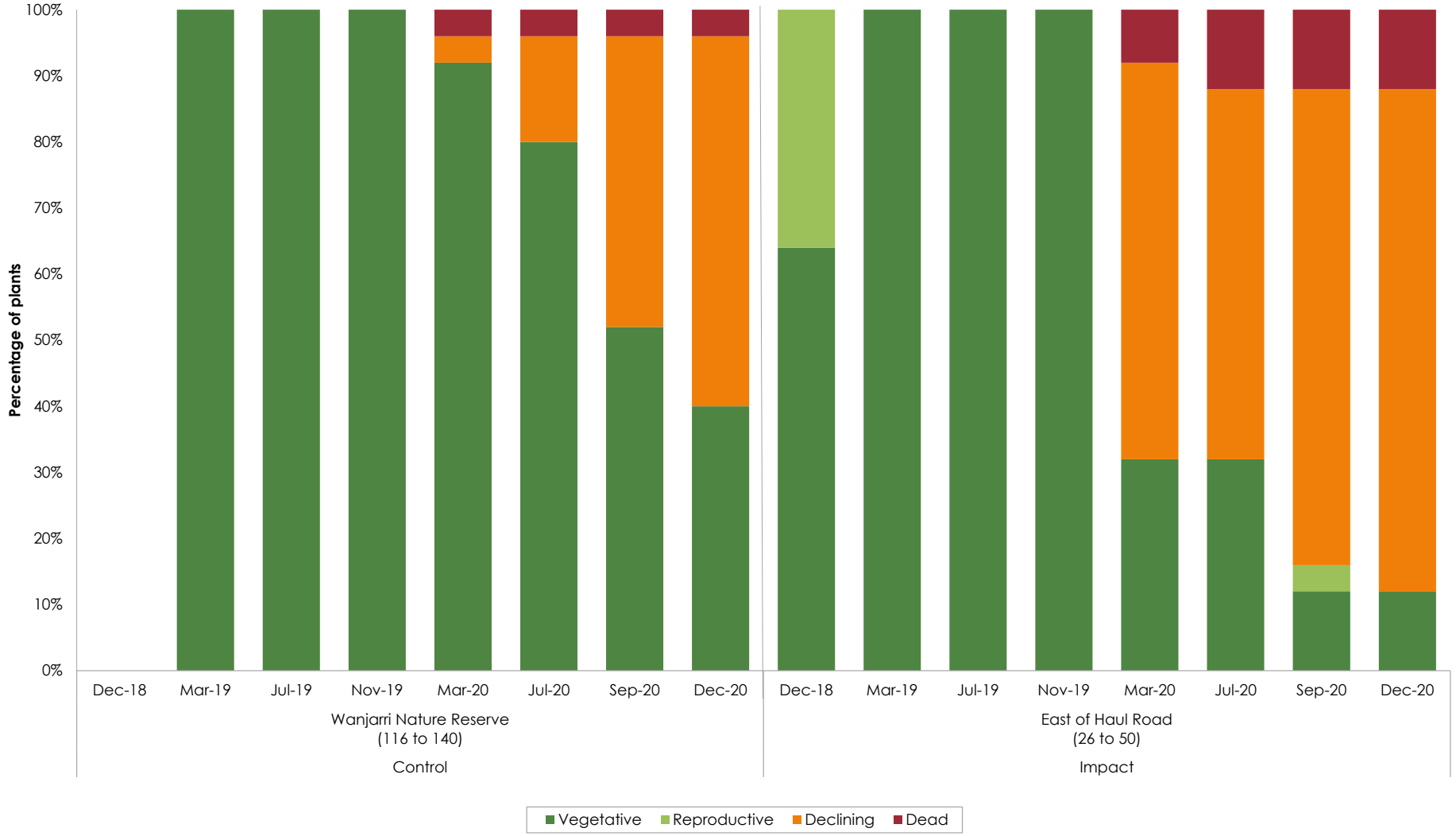


Figure 4-8: Percentage of *Verticordia jamiesonii* individuals within each plant health category across each impact and control site from 2018 to 2020

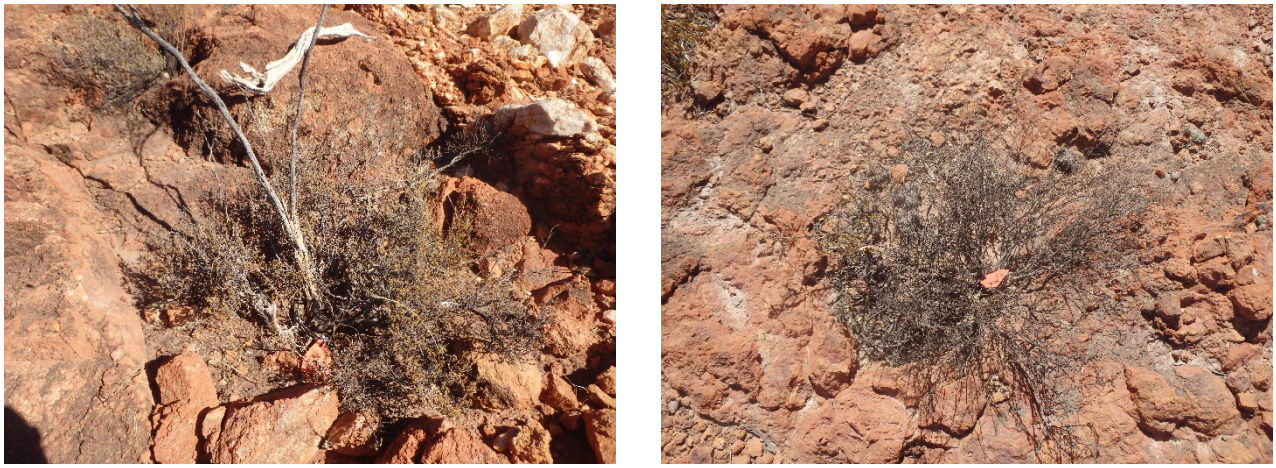


Figure 4-9: *Verticordia jamiesonii* individuals assessed in December 2020, VJ_138 (left, with a score of 7b) and VJ_40 (right, with a score of 2), showing the difference in health, foliage colour and dust load

Figure 4-10: *Verticordia jamiesonii* control individual VJ_46 assessed in July (left, with a score 7d) and December 2020 (right, with a score of 3)

Figure 4-11: *Verticordia jamiesonii* control individual VJ_130 assessed in July (left, with a score 7c) and December 2020 (right, with a score of 3)

4.1.4 *Eremophila* sp. long pedicels (G. Cockerton 1975)

Eremophila sp. long pedicels was first discovered at NMK in 1996 and is locally abundant on hardpan plains and adjacent sandplains near the margins of drainage lines downstream of the NMK central discharge tailings storage facility (CDTSF). Two control sites have been assessed since July 2020, both situated along the north-western corner of Wanjarri Nature Reserve (WNR), with no impact site identified. Prior to the July assessment, data on the health of individual plants was not collected but descriptive data was recorded during the vegetation condition assessments (detailed in **Appendix A**). Each individual plant location is presented in **Appendix C** (**Figure C-5**) with plant health scores and photographs from December 2020 presented in **Appendix D.4.**

Overall, only minor changes in plant health were observed at the *Eremophila* sp. long pedicels sites since the sites were established in July 2020 (**Figure 4-12,** with raw data shown in **Appendix E**). In December 2020, the northern WNR site had a higher percentage of plants in poorer health, with just over 60% considered declining and one death recorded (ESPLP_231). With grazing activity evident at both sites, it is likely that ESPLP_231 was uprooted by cattle (**Figure 4-13**). In comparison, 80% of the plants at the western WNR site were assessed as vegetative in December 2020.

Given the lack of data prior to July 2020, it is unknown if the individuals at both sites became stressed recently. Previous descriptive data indicates that both sites were generally vegetative between November 2019 and March 2020 (BHP Nickel West 2020a; BHP Nickel West 2020b). There was also evidence of reproductive individuals since 2018, given the abundance of old seeds observed at the base of multiple plants in the July assessment. During the 2020 assessments, foliage loss was noted as well as browning or yellowing leaves particularly on the stem ends (**Figure 4-14**). Dust from the WNR access track directly adjacent to each site contributed to come minor dust loading, but a similar amount was observed at both sites. It is likely that dry seasonal conditions contributed to the proportion of declining plants observed in 2020.

One small **Rumex vesicarius* (Ruby Dock) individual was observed near the western *Eremophila* sp. long pedicels site during the July 2020 assessment. However, it was not sighted in the subsequent assessments, presenting a low risk to the control site.

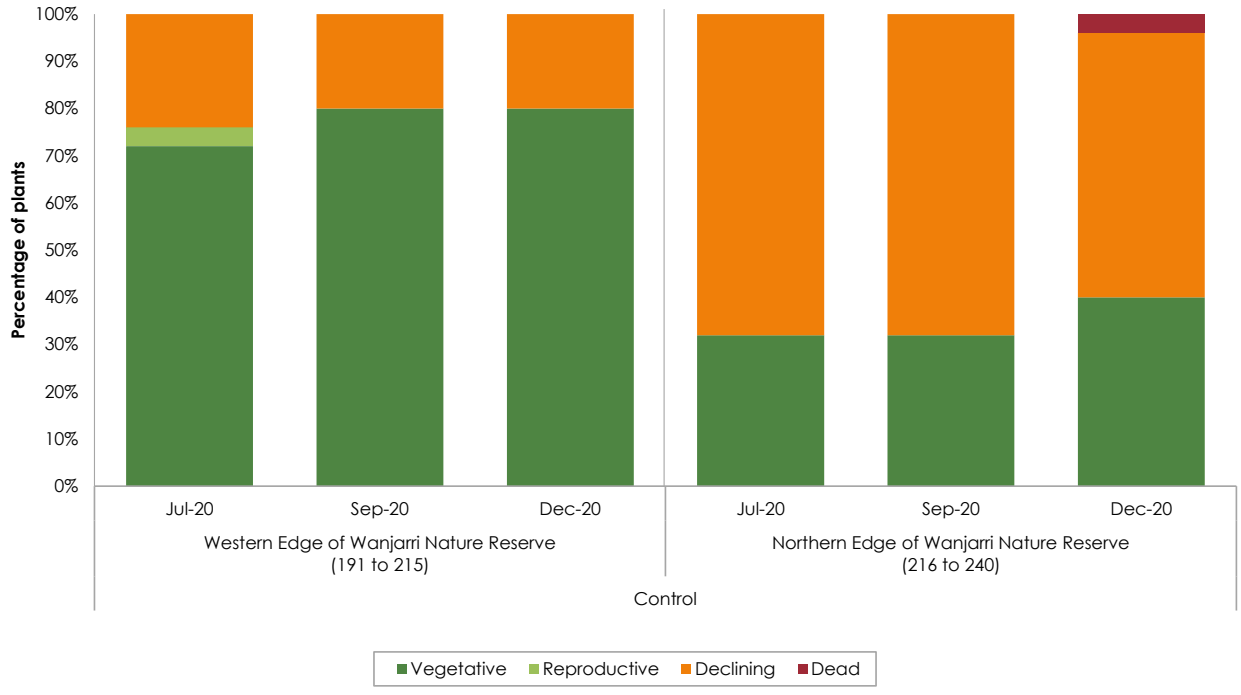


Figure 4-12: Percentage of *Eremophila* sp. long pedicels (G. Cockerton 1975) individuals within each plant health category across each impact and control site from 2018 to 2020

Figure 4-13: *Eremophila* sp. long pedicels individual, ESPLP_231, assessed in July (left, with a score of 3) and December 2020 (right, with a score of 1 after it was uprooted and blown to another location)

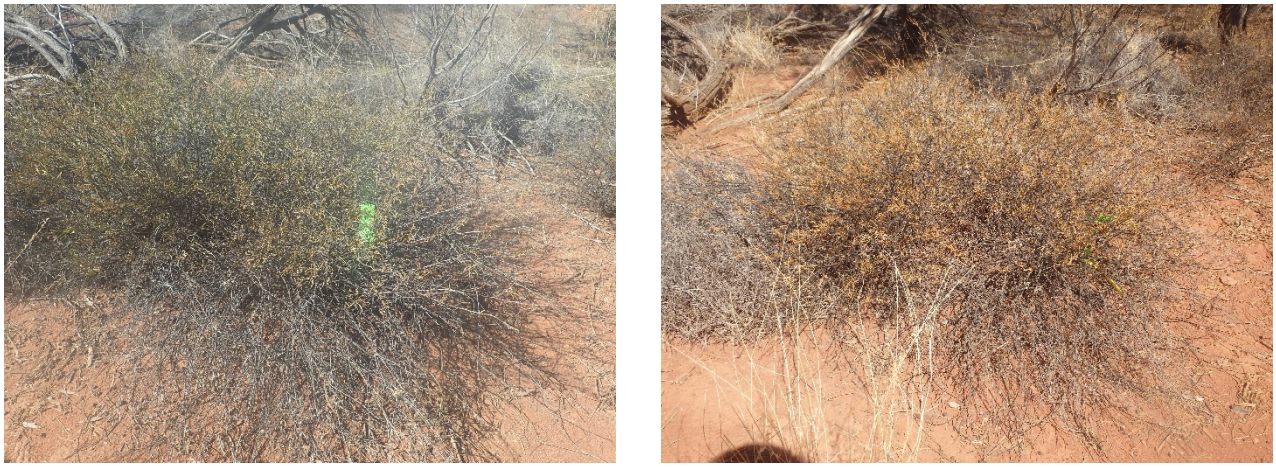


Figure 4-14: *Eremophila* sp. long pedicels individual, ESPLP_208, assessed in July (left, with a score of 7b) and December 2020 (right, with a score of 7c indicating reduced foliage)

4.2 Vegetation condition monitoring

A high proportion of the control quadrats, more than 80%, had vegetation condition ratings of either 'excellent' or 'very good', with none rated below the 'good' category (**Figure 4-15**). Vegetation condition at two of the control quadrats, MKS EIA 32 and MKS EIA 34, were rated as 'excellent' while two control quadrats, MKS EIA 35 and MKS EIA 37, were rated as 'good' (raw data presented in **Appendix F**).

Light to medium grazing (recent and historic) was noted at some of the control quadrats as well as light to heavy dust deposition, particularly at control quadrats MKS EIA 35 and MKS EIA 36. Most of the dust deposition observed at those quadrats was attributed to the proximity of the quadrats to the haul road (**Figure 4-16**; quadrat locations presented in **Appendix G**). Control quadrats MKS EIA 35, MKS EIA 36 and MKS EIA 37 were all within 10 m of the MKS haul road so these results confirm that they were unsuitable controls that may have negatively skewed overall vegetation condition percentages.

While the impact quadrats adjacent to the haul road had the highest proportion of quadrats assessed as 'excellent', they also had the highest proportion of 'degraded' quadrats in 2020 (**Figure 4-15**). The quadrats with 'excellent' condition ratings were situated adjacent to a large bund along the edge of the haul road which may have provided protection from dust deposition (**Figure 4-17, Appendix G**). The quadrats considered 'degraded' (MKS EIA 1 and MKS EIA 2) were situated along the northern section of the haul road. Most quadrats recorded dust on plant foliage and the soil surface which may have contributed to water stress.

The impact quadrats adjacent to mine infrastructure were rated as 'good' or 'very good', but had less 'very good' quadrats than the control quadrats (**Figure 4-15**). Most of the mine infrastructure impact quadrats were in 'good' condition and were situated adjacent to the Run of Mine Pad and Six Mile Well Pit (**Appendix G**). Multiple understorey shrub deaths were noted across those quadrats which may be a result of historic grazing or species-specific vulnerabilities to water stress (**Figure 4-18**). Dust impacted most of the quadrats, with the heaviest observed at MKS EIA 18 and MKS EIA 17 (**Appendix F**).

Given the vegetation associations observed at MKS were predominantly Mulga shrublands, the most frequently assessed species was the *Acacia aneura* complex recorded in 10 control quadrats and 22 impact quadrats (includes *A. aneura*, *A. pteraneura*, *A. aptaneura*, *A. caesaneura* and *A. craspedocarpa*). Across the control and impact quadrats, the highest plant covers and health ratings were assigned to tree species (with species data in **Appendix F**). Meanwhile, the smaller shrub and herb species were generally classified as 'declining', particularly *Sida ectogama*, *Ptilotus obovatus* and multiple *Dodonaea* species which were also common across most of the impact and control transects. It is likely that these species were more vulnerable to dry conditions and dust deposition compared to larger shrub and tree species.

Weeds were not observed across any of the vegetation quadrats in 2020.

Vegetation condition assessments prior to September 2020 were predominantly descriptive preventing any quantitative, long-term comparisons of vegetation condition or plant health over time. The inclusion of vegetation condition ratings and plant health scores in September 2020 assessment method now provide a revised 'baseline' which can be used for future comparisons.

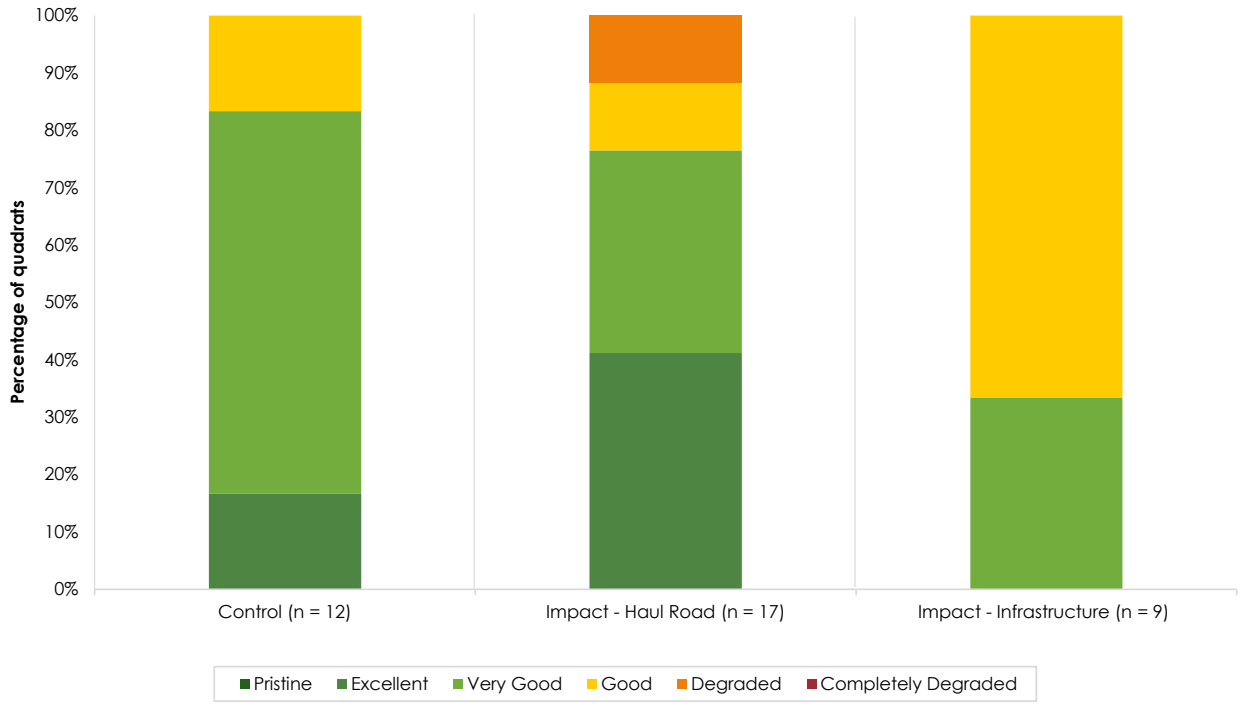


Figure 4-15: Percentage of impact and control quadrats within each vegetation condition category in September 2020


Figure 4-16: Control quadrats, MKS EIA 36 (left) rated as 'very good' and MKS EIA 35 (right) rated as 'good', with substantial dust cover due to location next to the MKS haul road


Figure 4-17: Haul road impact quadrats MKS EIA 3 (left) rated as 'degraded' with substantial dust cover, and MKS EIA 6 rated as 'excellent' with minimal dust cover due to large bund north-west of the quadrat post


Figure 4-18: Infrastructure impact quadrats MKS EIA 14 (left) with historic shrub deaths and MKS EIA 18 recording substantial dust cover, both in 'good' condition

5. Limitations

There are limitations associated with the design of the monitoring program that should be considered when reviewing the findings of this report.

5.1 Priority Flora monitoring

As discussed in **Appendix A**, no *Eremophila* sp. long pedicels impact site was identified upon desktop assessment and on-ground verification. Without an *Eremophila* sp. long pedicels impact site, the inclusion of this species in the monitoring program cannot contribute to overall conclusions of Priority Flora health within the potential impact area of the MKS project.

The position of the *Hybanthus floribundus* subsp. *chloroxanthus* control site was likely too close to the MKS project to provide a reliable comparison of plant health between control and impact sites of that taxa. The control site was approximately 450 m downstream of the MKS project and recorded dust deposition as well as lower plant health scores compared to its respective impact sites (located less than 230 m from the MKS project).

Certain factors should be considered when assessing change in plant health scores between monitoring rounds. A decline in plant health (or mortality) may occur at either 'impact' or 'control' sites for reasons other than the environmental effects of the MKS project. Non-project related disturbances may include climate factors (e.g. rainfall, wind) which may have localised effects depending on vegetation or soil properties or geology and topography or anthropogenic factors such as pastoral activities (e.g. grazing, weed spreading or dust-generation through track use). Where possible, observable differences related to non-project disturbances, for example recent grazing activity, were recorded during field monitoring.

With the inclusion of both mature and juvenile individuals at each impact and control Priority Flora site it may also be expected that some mature individuals will naturally decline in health and senesce (reach mortality) over multiple years of monitoring across both impact and control sites. When plants reach mortality they are not immediately replaced, but are retained in the dataset. While this tracks the number of dead plants at the location over time, it does not provide an indication of new individuals that may have emerged since December 2018. In the event a dead plant can no longer be visibly located and assessed, sampling intensity can be maintained by including new individuals at the site where feasible.

5.2 Vegetation condition monitoring

Between December 2018 and March 2020, only descriptive data on vegetation condition was collected quarterly for each quadrat. However, the revised methodology introduced in September 2020 (**Section 3.4.1**) incorporates previously collected descriptive data (listed in **Appendix A**) with quantitative comparisons of vegetation condition, plant cover, and plant health between quadrats (**Section 3.4.1**). As this is the first assessment where the revised methodology has been used, no long-term changes in vegetation condition ratings, estimated plant cover, plant health scores or weed cover could be directly compared to previous assessments. This may limit overall conclusions on whether vegetation condition has been impacted by mining disturbances since the previous data is unstandardised between assessments.

There are limitations associated with the spatial distribution of the impact and control quadrats that could influence any overall impact-control comparisons. Control quadrats MKS EIA 35, MKS EIA 36 and MKS EIA 37 were established within 10 of the haul road and are unsuitable to use as control quadrats for comparison (**Figure 3-3**). Additionally, impact quadrats MKS EIA 19 and MKS EIA 20 were located approximately 12 km from the MKS haul road and 18 km from the MKS mine infrastructure. It is unlikely that these quadrats assess impacts on vegetation associated with the MKS operations given their distance from the MKS operations. There is also a lack of control quadrats that represent the vegetation associations near the mine infrastructure where nine impact quadrats are situated.

There are limitations associated with the use of plant health scores and vegetation condition ratings in assessing the impact of mining disturbance on vegetation. Primarily, the assignment of vegetation condition ratings can vary based on the assessor, the time of year the assessment was made and the amount of time since the initial disturbance (EPA 2016). It is also partially influenced by the assessor's previous knowledge of what that vegetation looked like historically and how that vegetation type would appear when it is in good condition (EPA 2016).

6. Conclusion

6.1 Priority Flora monitoring

Generally, Priority Flora health declined across the control and impact sites between 2019 and 2020. A higher proportion of declining or dead individuals were recorded across all impact and control sites in 2020 compared to 2019. Furthermore, twelve plant deaths were recorded in 2020 compared to zero in 2019, ten of which were from impact sites and 2 from control sites (**Table 6-1**).

The largest decrease in the combined percentage of vegetative and reproductive plants occurred between November 2019 and March 2020 across almost all impact and control sites. Since then, declines in plant health have been observed at both impact and control *Verticordia jamiesonii* sites and both *Hibbertia* sp. Sherwood Breakaways control sites. All other sites remained stable except for the *Hybanthus floribundus* subsp. *chloroxanthus* control site where plant health recovered.

Two impact sites recorded a lower proportion of individuals in the vegetative or reproductive plant health categories than their comparative control populations (**Table 6-1**). These sites were the *Verticordia jamiesonii* impact site, and one of the *Hibbertia* sp. Sherwood Breakaways impact sites. On the contrary, both *Hybanthus floribundus* subsp. *chloroxanthus* impact sites recorded higher proportions of vegetative or reproductive individuals than the control site. Plant health was comparable between one *Hibbertia* sp. Sherwood Breakaways impact site and one control.

The lack of plant health recovery at control and impact sites between March and December 2020 is likely due to extended dry seasonal conditions. Rainfall was above average prior to monitoring establishment in 2018, however 2019 and 2020 were generally drier with below average rainfall recorded across most months. Extended periods of low rainfall could result in foliage loss or plant deaths given the Priority Flora are reliant on short-term moisture availability (BHP Nickel West 2019). Dust accumulation alone may not have a significant impact on plant health over time, however it is possible that dust could contribute to poorer plant health in already water stressed vegetation (Matsuki *et al.* 2016). Possible interruptions to sheet flow caused by the MKS project could also reduce water availability, however soil surface hydrology around the MKS project is unable to be inferred from the collected monitoring data. Singular sightings of some weed species were recorded at two control sites in July 2020 but they were not observed in subsequent assessments presenting a minor risk to those sites. Grazing had minimal impact on the health of most Priority Flora species.

6.2 Vegetation condition monitoring

A higher combined percentage of 'very good' to 'excellent' rated quadrats were recorded at the control quadrats compared to the haul road and infrastructure impact quadrats (**Table 6-2**). However, the proportion of 'excellent' condition quadrats was highest at the haul road impact quadrats compared to the mine infrastructure and control quadrats. The vegetation with the highest condition rating of 'excellent' were recorded at impact quadrats situated at the middle section of the haul road, adjacent to a large bund which may have provided protection from dust deposition. Meanwhile the vegetation with the lowest rating of 'degraded' (impact quadrats MKS EIA 1 and MKS EIA 2) was situated at the northern section of the haul road.

The *Acacia aneura* complex was commonly recorded across the quadrats and was generally in healthy condition, while shrubs such as *Ptilotus obovatus*, *Sida ectogama* and *Dodonaea* species had the poorest plant health. It is likely that these species were more vulnerable to dry conditions and dust deposition compared to larger shrub and tree species.

Limited conclusions can be made as to whether vegetation condition had been impacted by mining disturbances from MKS operations. Control quadrats MKS EIA 35, MKS EIA 36 and MKS EIA 37 were unsuitable for comparison with impact quadrats as they were in similar proximity to the MKS operation as the impact quadrats and were just as likely to receive indirect impacts from the MKS operations. Furthermore, the lack of past vegetation condition data also limits overall conclusions as trends in vegetation condition could not be compared to changes in rainfall or the level of disturbance.

Vegetation condition scores of 'good' or less across the impact and control quadrats were likely due to a combination of extended dry seasonal conditions, dust deposition and potential interruptions to sheet flow. Light grazing was noted across most quadrats but did not have a major impact on vegetation condition overall. No weeds were recorded across the quadrats assessed in 2020.

Table 6-1: Summary of Priority Flora site status in 2020, compared to 2019

Species	Site Type	Location	Summary	Potential impacts
Hybanthus floribundus subsp. *chloroxanthus* (P3)	Impact	South-west of Six Mile Well Pit	Little change in plant health. No plant deaths.	Dry seasonal conditions since the November 2019 assessment, dust deposition and potential interruptions to sheet flow.
		West of Six Mile Well Pit	Little change in plant health. No new deaths in 2020. Healthiest site in December 2020.	
	Control	South of Six Mile Well Pit	Largest increase in the percentage of vegetative plants. No plant deaths.	Dry seasonal conditions since the November 2019 assessment, mild dust deposition and potential interruptions to sheet flow.
Hibbertia sp. Sherwood Breakaways (R.J. Cranfield 6776) (P2)	Impact	East of Haul road	Decrease in percentage of vegetative plants. One plant death (HSPSB_4).	Dry seasonal conditions since the November 2019 assessment, dust deposition and potential interruptions to sheet flow.
		West of Haul road	Decrease in percentage of vegetative plants. Five plant deaths (HSPSP_141, HSPSP_142, HSPSP_144, HSPSP_152, HSPSP_153).	
	Control	Wanjarri Nature Reserve	Decrease in the percentage of vegetative plants. No plant deaths. Healthiest site in 2020.	Dry seasonal conditions since the November 2019 assessment.
		Far West of Haul road	Decrease in the percentage of vegetative plants. No plant deaths.	
Verticordia jamiesonii (P3)	Impact	East of Haul road	Decline in percentage of vegetative/reproductive plants. Three plant deaths in 2020 (VJ_30, VJ_47, VJ_49).	Dry seasonal conditions since the November 2019 assessment, dust deposition and potential interruptions to sheet flow.
	Control	Wanjarri Nature Reserve	Largest decrease in the percentage of vegetative/reproductive plants. One plant death in 2020 (VJ_146). Healthiest site in 2020.	Dry seasonal conditions since the November 2019 assessment.
Eremophila sp. long pedicels (G. Cockerton 1975) (P2)	Control	Western edge of Wanjarri Nature Reserve	Little change in plant health since July. No plant deaths in 2020. Healthiest site in 2020.	Dry seasonal conditions since the November 2019 assessment. Mild dust deposition.
		Northern edge of Wanjarri Nature Reserve	Slight increase in percentage of vegetative plants since July. One plant death in 2020 (ESPLP_231).	

Table 6-2: Summary of vegetation condition across the quadrats assessed in September 2020

Disturbance Category	Monitoring Site Name	Vegetation Condition Rating	Grazing	Weed Cover (%)
Impact – Haul Road	MKSEIA 1	Degraded	Light	Nil
	MKSEIA 2	Degraded	Light - Historic	Nil
	MKSEIA 3	Good	Nil	Nil
	MKSEIA 4	Good	Nil	Nil
	MKSEIA 5	Very Good	Light - Historic	Nil
	MKSEIA 6	Excellent	Light	Nil
	MKSEIA 7	Very Good	Light - Historic	Nil
	MKSEIA 8	Very Good	Light	Nil
	MKSEIA 9	Excellent	Nil	Nil
	MKSEIA 19	Excellent	Light - Historic	Nil
	MKSEIA 20	Very Good	Light - Historic	Nil
	MKSEIA 23	Excellent	Light - Historic	Nil
	MKSEIA 24	Excellent	Light	Nil
	MKSEIA 25	Excellent	Light	Nil
	MKSEIA 26	Excellent	Nil	Nil
	MKSEIA 27	Very Good	Nil	Nil
	MKSEIA 28	Very Good	Light - Historic	Nil
Impact - Infrastructure	MKSEIA 10	Good	Light	Nil
	MKSEIA 11	Good	Light - Historic	Nil
	MKSEIA 12	Good	Light	Nil
	MKSEIA 13	Very Good	Light	Nil
	MKSEIA 14	Good	Light	Nil
	MKSEIA 15	Very Good	Light - Historic	Nil
	MKSEIA 16	Very Good	Light - Historic	Nil
	MKSEIA 17	Good	Light - Historic	Nil
	MKSEIA 18	Good	Light - Historic	Nil
Control	MKSEIA 21	Very Good	Medium	Nil
	MKSEIA 22	Very Good	Light - Historic	Nil
	MKSEIA 29	Very Good	Light	Nil
	MKSEIA 30	Very Good	Light	Nil
	MKSEIA 31	Very Good	Light - Historic	Nil
	MKSEIA 32	Excellent	Light	Nil
	MKSEIA 33	Very Good	Light	Nil
	MKSEIA 34	Excellent	Light	Nil
	MKSEIA 35	Good	Light	Nil
	MKSEIA 36	Very Good	Light	Nil
	MKSEIA 37	Good	Light - Historic	Nil
	MKSEIA 38	Very Good	Light - Historic	Nil

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Appendices

Appendix A Amendments to the FVEMP monitoring program in 2020

A.1 Priority Flora monitoring

From to the desktop assessment and on-ground verification in the field it was determined that no impact sites of *Eremophila* sp. long pedicels were monitored in previous assessments since there were no plants/extant sites of this taxon within or adjacent to MKS. However, two sites of this species were mentioned in previous Priority Flora health assessment reports within the Wanjarri Nature Reserve (BHP Nickel West 2020a). Previous observations of these sites were only recorded during the MKS Annual Flora and Vegetation Monitoring report as these sites were present at quadrats MKS EIA 19 and MKS EIA 20. During the July 2020 monitoring round, BHP Nickel West requested that Stantec establish two sites of 25 individually tagged plants to assess along with the other Priority Flora sites.

It was also identified that each *Hybanthus floribundus* subsp. *chloroxanthus* sites only had between 12 and 16 monitored individuals while the specified number of plants per site was 25 as outlined in the FVEMP for the MKS project (BHP Nickel West 2019). During field monitoring at those sites other plants of that species were identified therefore Stantec tagged and assessed an additional 17 *Hybanthus floribundus* subsp. *chloroxanthus* individuals at those existing sites near the Six Mile Well Pit. This increased the sample size of each of the control and impact sites thereby increasing the reliability of the results.

A.2 Vegetation condition assessment

Based on the data and reports reviewed in the desktop assessment, the vegetation condition assessment methodology was modified to align with the requirements outlined in the MKS FVEMP (BHP Nickel West 2019). Prior to the July 2020 Priority Flora assessment, descriptive data on vegetation condition was collected quarterly for each quadrat with observations including:

- vegetation type and species composition;
- projected foliar cover, general health and height of species within the quadrat;
- landform features and soil surface condition;
- prevailing weather conditions;
- any operational, pastoral, or climatic factors that may be impacting vegetation condition.

The modified methodology incorporates the above observations with quantitative comparisons of vegetation condition and plant health between quadrats. The main additions include:

- overall vegetation condition ratings, assessed using the scale outlined by Keighery (1994) (**A.1**);
- estimated plant cover for up to five dominant species within the quadrat;
- plant health ratings assigned to each of the five selected dominant species using the observable plant health scale (BHP Nickel West 2019; **A.1**);
- weed cover estimated if present;
- the extent of grazing rated as nil, light, medium or heavy;

This revised methodology was implemented during the September 2020 assessment, as such, no long-term changes in vegetation condition ratings, estimated plant cover, plant health scores or weed cover could be directly compared to previous assessments. Additionally, the vegetation condition assessments from December 2018 to March 2020 were conducted quarterly with the Priority Flora assessment, but it was identified by BHP Nickel West that the monitoring was only required annually.

Appendix B Vegetation assessment criteria

Table B-1: Observable Plant Condition Scale (BHP Nickel West 2019)

Category	Score	Descriptor	Prevailing Conditions	Observations
Vegetative	7 a-d	Plants vegetative	Normal, dry season	Foliage healthy and normal for prevailing seasonal conditions. Foliage may be **(a)** actively growing, **(b)** static or **(c)** reduced and/or **(d)** may demonstrate variable levels of auxiliary pigments (anthocyanins). No flower buds initiated, no flowers present, no fruits attached to plant.
Reproductive	6	Plants pre-reproductive	Normal, soon after rainfall	Foliage healthy and normal for prevailing seasonal conditions. Flower buds initiated but no flowers open, no fruits attached to plant.
	5	Plants reproductive	Normal, following sufficient rainfall	Foliage healthy and normal for prevailing seasonal conditions. Flowers open, developing fruits may be attached to plant.
	4	Plants post-reproductive	Normal, drying season, following sufficient rainfall	Foliage healthy and normal for prevailing seasonal conditions. No flowers present. Current season fruits containing viable seeds may be attached to plant and/or the plant may have recently dehisced viable seeds.
Declining	3	Plants exhibiting reduced foliage	Either (a) Reflecting extended dry seasonal conditions; or (b) Abnormal, localised impacts possible, requires investigation	Foliage observably reduced and not normal for prevailing seasonal conditions. Plants exhibiting discoloured-yellowed leaves, increased leaf fall.
	2	Plants with partial dead canopies	Abnormal, localised impacts possible, requires investigation	Foliage observably reduced and not normal for prevailing seasonal conditions. A portion (estimate % of plant canopy is alive) of the plant canopy is alive while a proportion is dead (dried leaves attached or dead stems held within plant canopy).
Dead	1	Plant completely dead	Abnormal, localised impacts possible, requires investigation	No live foliage held on plant, no live bark observable, irreversible death of plant.

Table B-2: Vegetation Condition Scale (Keighery, 1994)

Category	Description
Pristine	Pristine or nearly so. No obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix C Plant health score maps December 2020

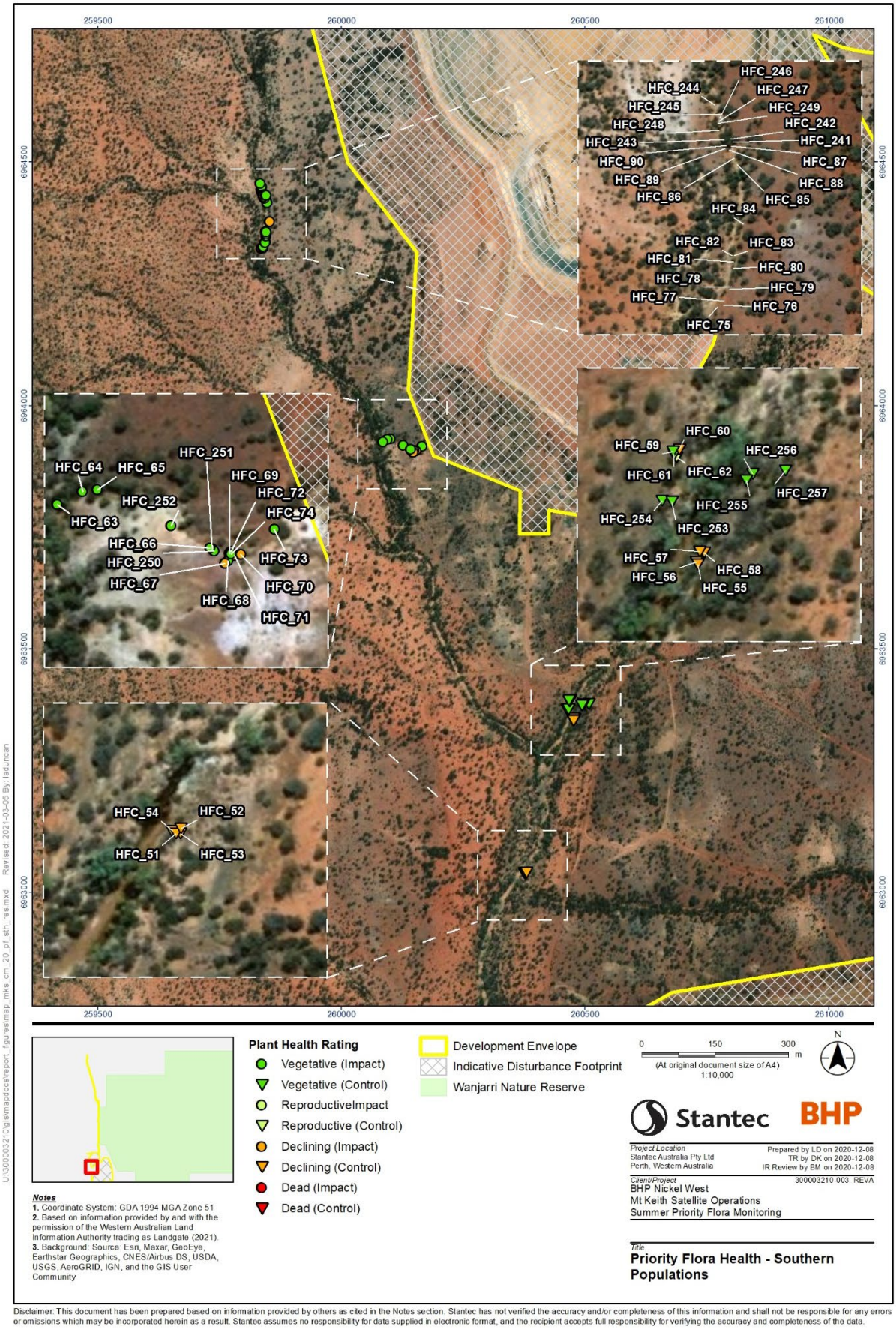

Figure C-1: Visual representation of the plant health scores of all *Hybanthus floribundus* subsp. *chloroxanthus* individuals assessed in December 2020

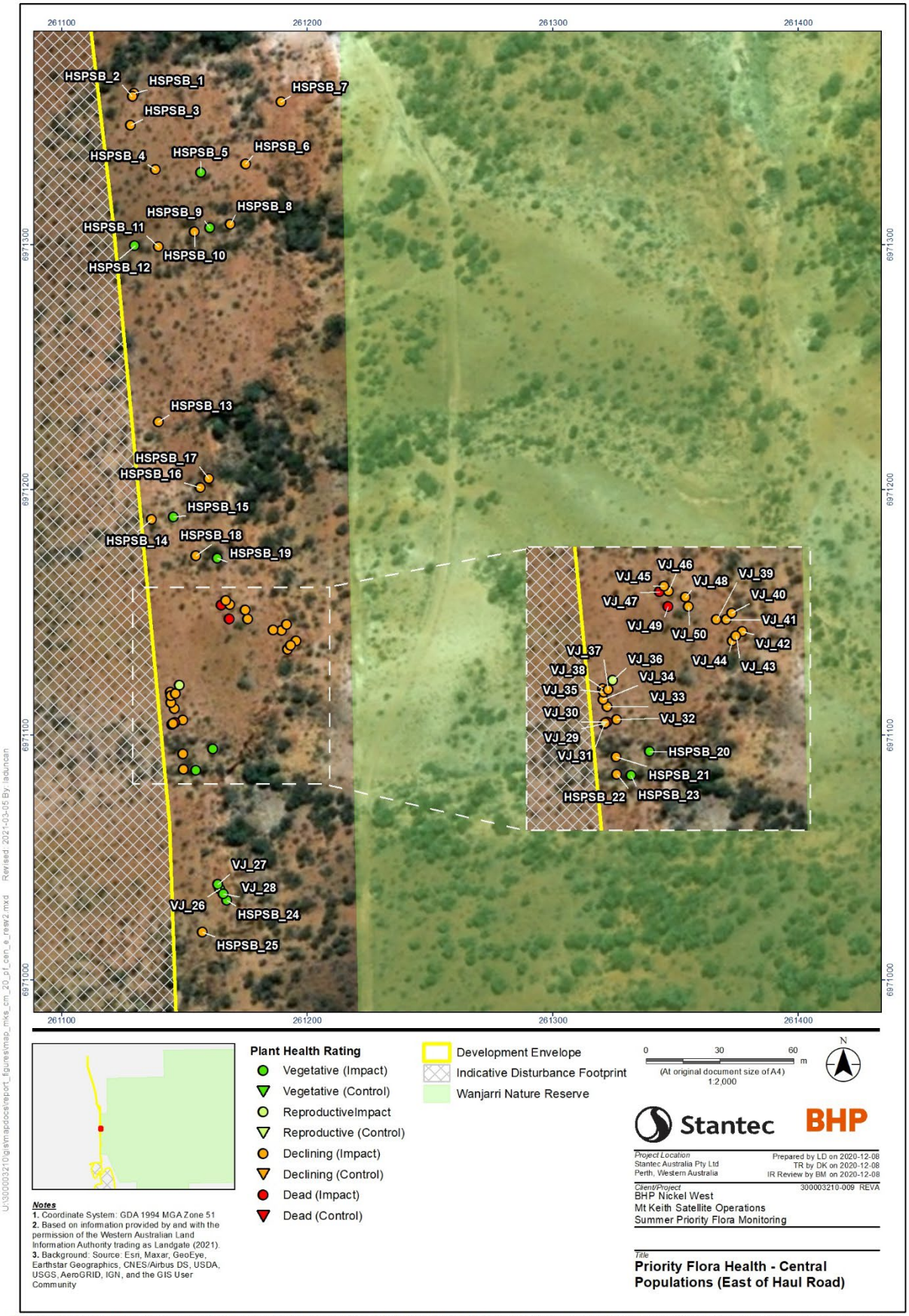

Figure C-2: Visual representation of the plant health scores of *Hibbertia* sp. Sherwood Breakaways and *Verticordia jamiesonii* individuals east of the haul road, assessed in December 2020

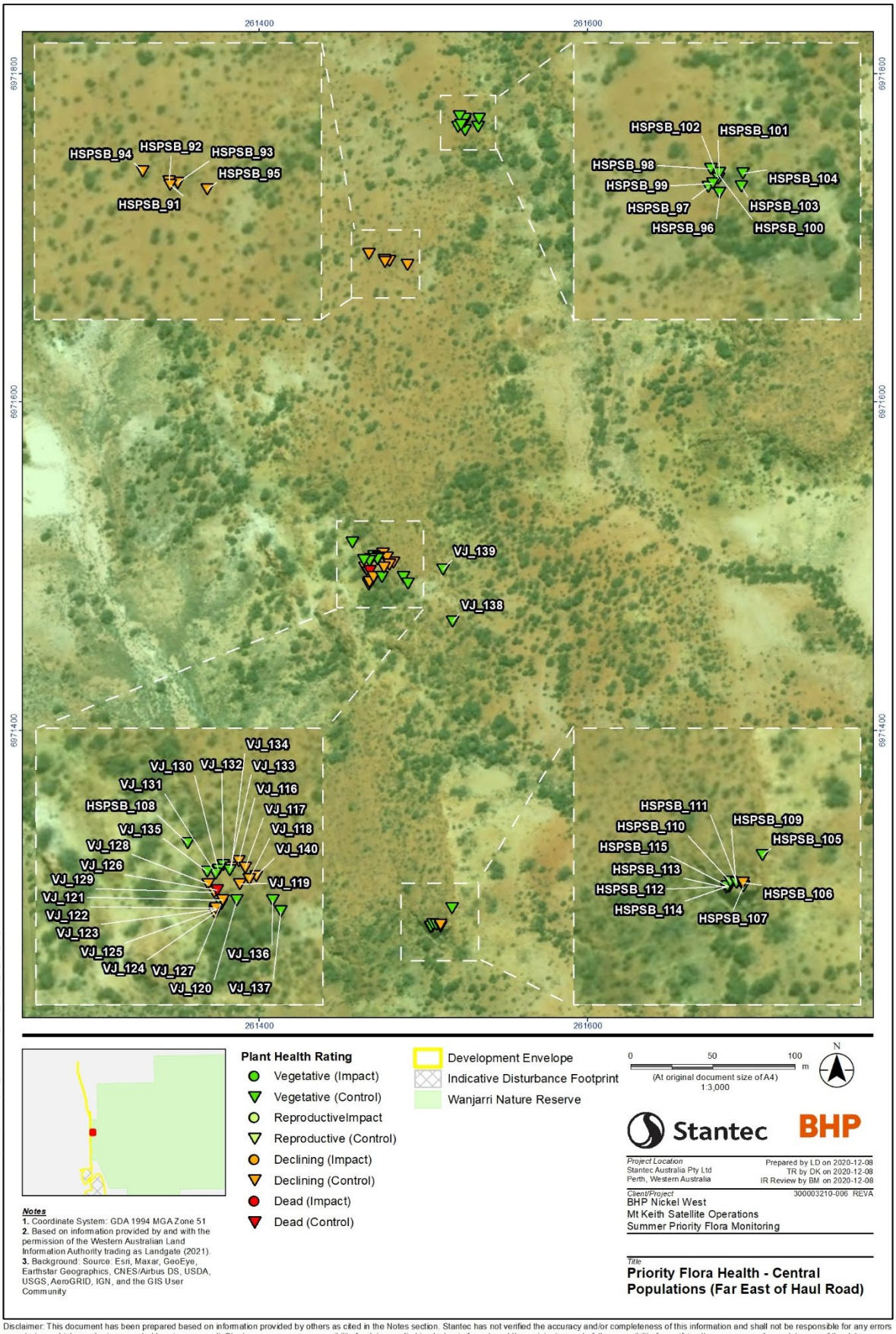

Figure C-3: Visual representation of the plant health scores of *Hibbertia* sp. Sherwood Breakaways and *Verticordia jamiesonii* individuals far east of the haul road, assessed in December 2020

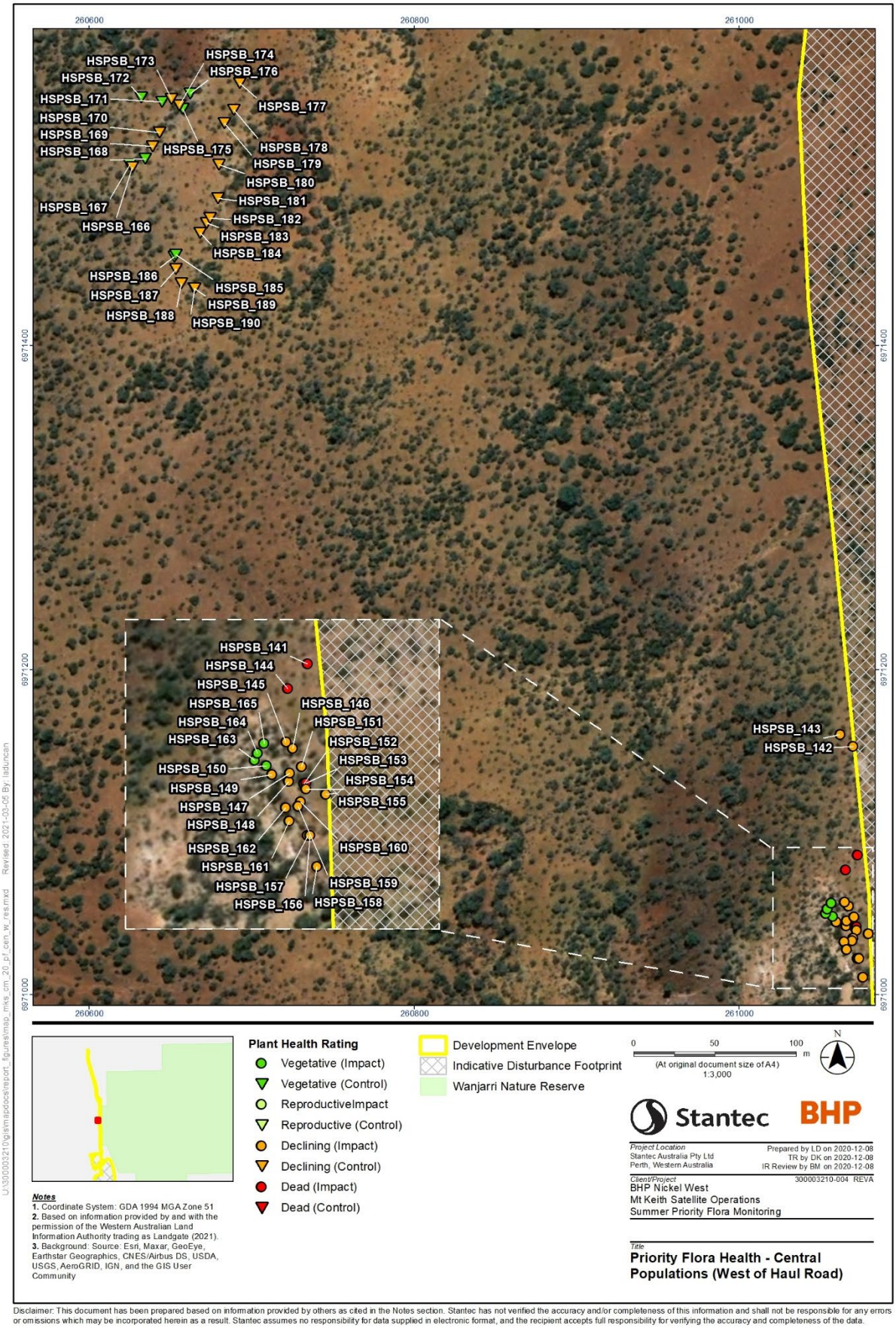

Figure C-4: Visual representation of the plant health scores of *Hibbertia* sp. Sherwood Breakaways individuals west of the haul road, assessed in December 2020

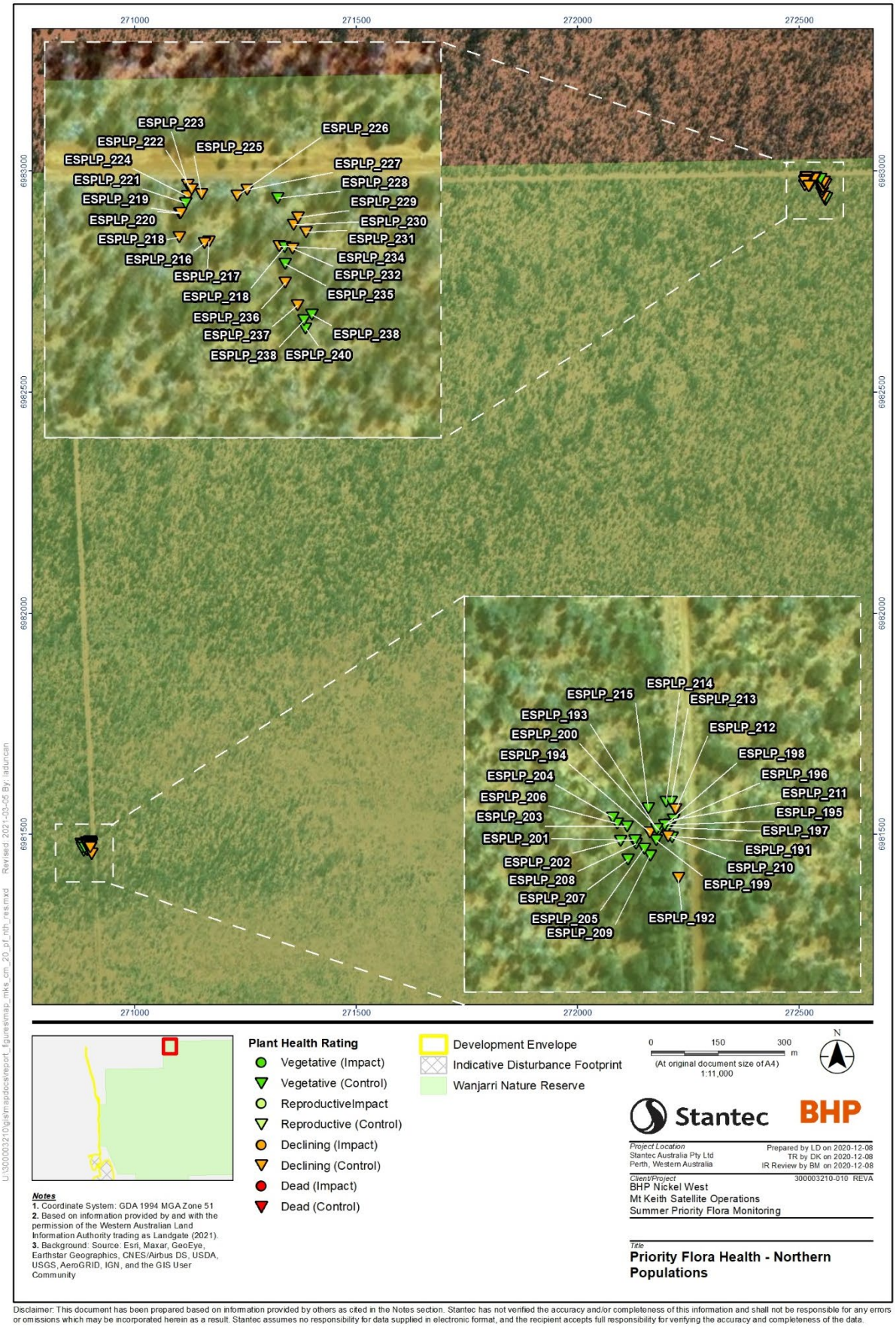

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Figure C-5: Visual representation of the plant health scores of *Eremophila* sp. long pedicels individuals assessed in December 2020

Appendix D Individual plant photographs and health ratings in December 2020

D.1 *Hybanthus floribundus* subsp. *chloroxanthus*

Table D-1: Photograph and plant health rating of *Hybathus floribundus* subsp. *chloroxanthus* individuals located at the control site south of Six Mile Well Pit for the December 2020 assessment

Site: Control, South of Six Mile Well Pit (Tag ID 51 to 62 and 253 to 257)					
Tag ID	HFC_51	HFC_52	HFC_53	HFC_54	HFC_55
Photo					
Category (score)	Vegetative (7c)	Declining (2)	Vegetative (7c)	Declining (3)	Declining (3)
Tag ID	HFC_56	HFC_57	HFC_58	HFC_59	HFC_60
Photo					
Category (score)	Declining (2)	Declining (2)	Declining (3)	Vegetative (7d)	Declining (3)
Tag ID	HFC_61	HFC_62	HFC_253	HFC_254	HFC_255
Photo					
Category (score)	Vegetative (7b)	Vegetative (7b)	Vegetative (7d)	Vegetative (7d)	Vegetative (7b)

Site: Control, South of Six Mile Well Pit (Tag ID 51 to 62 and 253 to 257)					
Tag ID	HFC_256	HFC_257			
Photo					
Category (score)	Vegetative (7b)	Vegetative (7b)			

Table D-2: Photograph and plant health rating of *Hybathus floribundus* subsp. *chloroxanthus* individuals located at the impact site south-west of Six Mile Well Pit for the December 2020 assessment

	Site: Impact, South-west of Six Mile Well Pit (Tag ID 63 to 74 and 250 to 252)				
Tag ID	HFC_63	HFC_64	HFC_65	HFC_66	HFC_67
Photo					
Category (score)	Vegetative (7d)	Vegetative (7c)	Vegetative (7c)	Vegetative (7c)	Declining (3)
Tag ID	HFC_68	HFC_69	HFC_70	HFC_71	HFC_72
Photo					
Category (score)	Vegetative (7c)	Vegetative (7b)	Declining (2)	Declining (2)	Vegetative (7a)
Tag ID	HFC_73	HFC_74	HFC_250	HFC_251	HFC_252
Photo					
Category (score)	Vegetative (7c)	Vegetative (7b)	Vegetative (7a)	Vegetative (7b)	Vegetative (7d)

Table D-3: Photograph and plant health rating of *Hybathus floribundus* subsp. *chloroxanthus* individuals located at the impact site west of Six Mile Well Pit for the December 2020 assessment

	Site: Impact, West of Six Mile Well Pit (Tag ID 75 to 90 and 241 to 249)				
Tag ID	HFC_75	HFC_76	HFC_77	HFC_78	HFC_79
Photo					
Category (score)	Dead (1)	Vegetative (7c)	Vegetative (7d)	Vegetative (7b)	Vegetative (7b)
Tag ID	HFC_80	HFC_81	HFC_82	HFC_83	HFC_84
Photo					
Category (score)	Vegetative (7b)	Vegetative (7b)	Vegetative (7d)	Vegetative (7c)	Declining (3)
Tag ID	HFC_85	HFC_86	HFC_87	HFC_88	HFC_89
Photo					
Category (score)	Vegetative (7d)	Vegetative (7b)	Vegetative (7a)	Vegetative (7b)	Vegetative (7d)

	Site: Impact, West of Six Mile Well Pit (Tag ID 75 to 90 and 241 to 249)				
Tag ID	HFC_90	HFC_241	HFC_242	HFC_243	HFC_244
Photo					
Category (score)	Vegetative (7d)	Vegetative (7b)	Vegetative (7b)	Vegetative (7b)	Vegetative (7d)
Tag ID	HFC_245	HFC_246	HFC_247	HFC_248	HFC_249
Photo					
Category (score)	Vegetative (7a)	Vegetative (7d)	Vegetative (7c)	Vegetative (7c)	Vegetative (7c)

D.2 *Hibbertia* sp. Sherwood Breakaways (R.J. Cranfield 6776)

Table D-4: Photograph and plant health rating of *Hibbertia* sp. Sherwood Breakaways individuals located at the impact site east of the haul road for the December 2020 assessment

	Site: Impact, East of Haul Road (Tag ID 1 to 25)				
Tag ID	HSPSB_1	HSPSB_2	HSPSB_3	HSPSB_4	HSPSB_5
Photo					
Category (score)	Declining (2)	Declining (2)	Declining (2)	Dead (1)	Vegetative (7d)
Tag ID	HSPSB_6	HSPSB_7	HSPSB_8	HSPSB_9	HSPSB_10
Photo					
Category (score)	Declining (3)	Declining (3)	Declining (3)	Vegetative (7b)	Declining (2)
Tag ID	HSPSB_11	HSPSB_12	HSPSB_13	HSPSB_14	HSPSB_15
Photo					
Category (score)	Declining (2)	Vegetative (7d)	Declining (2)	Declining (3)	Vegetative (7d)

	Site: Impact, East of Haul Road (Tag ID 1 to 25)				
Tag ID	HSPSB_16	HSPSB_17	HSPSB_18	HSPSB_19	HSPSB_20
Photo					
Category (score)	Declining (3)	Declining (2)	Declining (2)	Vegetative (7c)	Vegetative (7d)
Tag ID	HSPSB_21	HSPSB_22	HSPSB_23	HSPSB_24	HSPSB_25
Photo					
Category (score)	Declining (3)	Declining (2)	Vegetative (7d)	Vegetative (7d)	Declining (3)

Table D-5: Photograph and plant health rating of *Hibbertia* sp. Sherwood Breakaways individuals located at the impact site west of the haul road for the December 2020 assessment

	Site: Impact, West of Haul Road (Tag ID 141 to 165)				
Tag ID	HSPSB_141	HSPSB_142	HSPSB_143	HSPSB_144	HSPSB_145
Photo					
Category (score)	Dead (1)	Dead (1)	Declining (2)	Dead (1)	Declining (2)
Tag ID	HSPSB_146	HSPSB_147	HSPSB_148	HSPSB_149	HSPSB_150
Photo					
Category (score)	Declining (2)	Declining (2)	Declining (2)	Declining (2)	Vegetative (7c)
Tag ID	HSPSB_151	HSPSB_152	HSPSB_153	HSPSB_154	HSPSB_155
Photo					
Category (score)	Declining (3)	Dead (1)	Dead (1)	Declining (2)	Declining (2)

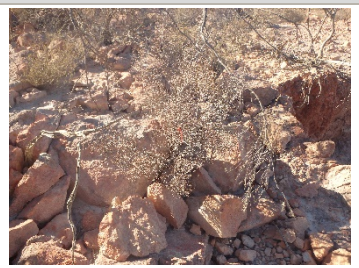
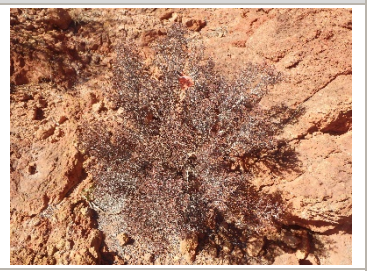
	Site: Impact, West of Haul Road (Tag ID 141 to 165)				
Tag ID	HSPSB_156	HSPSB_157	HSPSB_158	HSPSB_159	HSPSB_160
Photo					
Category (score)	Declining (3)	Declining (2)	Declining (2)	Declining (2)	Declining (3)
Tag ID	HSPSB_161	HSPSB_162	HSPSB_163	HSPSB_164	HSPSB_165
Photo					
Category (score)	Declining (2)	Declining (2)	Vegetative (7c)	Vegetative (7b)	Vegetative (7b)

Table D-6: Photograph and plant health rating of *Hibbertia* sp. Sherwood Breakaways individuals located at the impact site far west of the haul road for the December 2020 assessment

	Site: Impact, Far West of Haul Road (Tag ID 166 to 190)				
Tag ID	HSPSB_166	HSPSB_167	HSPSB_168	HSPSB_169	HSPSB_170
Photo					
Category (score)	Declining (2)	Vegetative (7c)	Vegetative (7d)	Vegetative (7d)	Declining (3)
Tag ID	HSPSB_171	HSPSB_172	HSPSB_173	HSPSB_174	HSPSB_175
Photo					
Category (score)	Vegetative (7d)	Vegetative (7d)	Declining (3)	Declining (3)	Vegetative (7d)
Tag ID	HSPSB_176	HSPSB_177	HSPSB_178	HSPSB_179	HSPSB_180
Photo					
Category (score)	Vegetative (7d)	Declining (2)	Declining (2)	Declining (3)	Declining (2)

	Site: Impact, Far West of Haul Road (Tag ID 166 to 190)				
Tag ID	HSPSB_181	HSPSB_182	HSPSB_183	HSPSB_184	HSPSB_185
Photo					
Category (score)	Declining (2)	Declining (3)	Declining (2)	Declining (2)	Declining (3)
Tag ID	HSPSB_186	HSPSB_187	HSPSB_188	HSPSB_189	HSPSB_190
Photo					
Category (score)	Declining (3)	Declining (3)	Declining (3)	Vegetative (7c)	Declining (2)

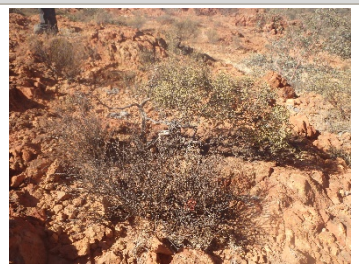
Table D-7: Photograph and plant health rating of *Hibbertia* sp. Sherwood Breakaways individuals located at the control site in Wanjarri Nature Reserve for the December 2020 assessment

	Site: Control, Wanjarri Nature Reserve (Tag ID 91 to 115)				
Tag ID	HSPSB_91	HSPSB_92	HSPSB_93	HSPSB_94	HSPSB_95
Photo					
Category (score)	Declining (2)	Declining (2)	Declining (2)	Declining (2)	Declining (3)
Tag ID	HSPSB_96	HSPSB_97	HSPSB_98	HSPSB_99	HSPSB_100
Photo					
Category (score)	Vegetative (7d)	Vegetative (7b)	Vegetative (7b)	Vegetative (7d)	Vegetative (7d)
Tag ID	HSPSB_101	HSPSB_102	HSPSB_103	HSPSB_104	HSPSB_105
Photo					
Category (score)	Vegetative (7d)	Vegetative (7d)	Vegetative (7d)	Vegetative (7b)	Vegetative (7d)

	Site: Control, Wanjarri Nature Reserve (Tag ID 91 to 115)				
Tag ID	HSPSB_106	HSPSB_107	HSPSB_108	HSPSB_109	HSPSB_110
Photo				See photo point below	
Category (score)	Declining (2)	Vegetative (7d)	Vegetative (7d)	Declining (3)	Vegetative (7d)
Tag ID	HSPSB_111	HSPSB_112	HSPSB_113	HSPSB_114	HSPSB_115
Category (score)	Vegetative (7d)	Declining (3)	Vegetative (7d)	Vegetative (7d)	Vegetative (7d)
Photo point **Photo point established in September 2020 due to plant location on edge of breakaway*					

D.3 *Verticordia jamiesonii*

Table D-8: Photograph and plant health rating of *Verticordia jamiesonii* individuals located at the control site in Wanjarri Nature Reserve for the December 2020 assessment

	Site: Control, Wanjarri Nature Reserve (Tag ID 116 to 140)				
Tag ID	VJ_116	VJ_117	VJ_118	VJ_119	VJ_120
Photo					
Category (score)	Declining (2)	Declining (3)	Declining (3)	Declining (2)	Vegetative (7b)
Tag ID	VJ_121	VJ_122	VJ_123	VJ_124	VJ_125
Photo					
Category (score)	Declining (3)	Declining (3)	Vegetative (7d)	Declining (3)	Declining (3)
Tag ID	VJ_126	VJ_127	VJ_128	VJ_129	VJ_130
Photo					
Category (score)	Dead (1)	Vegetative (7d)	Declining (3)	Declining (2)	Declining (3)

	Site: Control, Wanjarri Nature Reserve (Tag ID 116 to 140)				
Tag ID	VJ_131	VJ_132	VJ_133	VJ_134	VJ_135
Photo					
Category (score)	Vegetative (7c)	Vegetative (7d)	Vegetative (7b)	Declining (2)	Vegetative (7d)
Tag ID	VJ_136	VJ_137	VJ_138	VJ_139	VJ_140
Photo					
Category (score)	Vegetative (7c)	Declining (3)	Vegetative (7b)	Vegetative (7d)	Declining (2)

Table D-9: Photograph and plant health rating of *Verticordia jamiesonii* individuals located at the impact site east of the haul road for the December 2020 assessment

	Site: Impact, East of Haul Road (Tag ID 26 to 50)				
Tag ID	VJ_26	VJ_27	VJ_28	VJ_29	VJ_30
Photo					
Category (score)	Vegetative (7b)	Vegetative (7b)	Vegetative (7b)	Declining (3)	Dead (1)
Tag ID	VJ_31	VJ_32	VJ_33	VJ_34	VJ_35
Photo					
Category (score)	Declining (3)	Declining (3)	Declining (2)	Declining (3)	Declining (2)
Tag ID	VJ_36	VJ_37	VJ_38	VJ_39	VJ_40
Photo					
Category (score)	Declining (3)	Declining (3)	Declining (3)	Declining (2)	Declining (2)

	Site: Impact, East of Haul Road (Tag ID 26 to 50)				
Tag ID	VJ_41	VJ_42	VJ_43	VJ_44	VJ_45
Photo					
Category (score)	Declining (3)	Declining (2)	Declining (3)	Declining (2)	Declining (3)
Tag ID	VJ_46	VJ_47	VJ_48	VJ_49	VJ_50
Photo					
Category (score)	Declining (3)	Dead (1)	Declining (2)	Dead (1)	Declining (3)

D.4 *Eremophila* sp. long pedicels (G. Cockerton 1975)

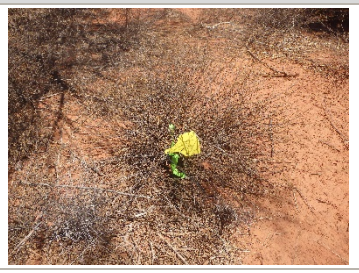
Table D-10: Photograph and plant health rating of *Eremophila* sp. long pedicels individuals located at the control site on the western edge of Wanjarri Nature Reserve for the December 2020 assessment

	Site: Control, Western edge of Wanjarri Nature Reserve (Tag ID 191 to 215)				
Tag ID	ESPLP_191	ESPLP_192	ESPLP_193	ESPLP_194	ESPLP_195
Photo					
Category (score)	Declining (3)	Declining (2)	Vegetative (7d)	Declining (7d)	Declining (3)
Tag ID	ESPLP_196	ESPLP_197	ESPLP_198	ESPLP_199	ESPLP_200
Photo					
Category (score)	Vegetative (7d)	Vegetative (7c)	Declining (3)	Vegetative (7d)	Vegetative (7d)
Tag ID	ESPLP_201	ESPLP_202	ESPLP_203	ESPLP_204	ESPLP_205
Photo					
Category (score)	Vegetative (7b)	Vegetative (7b)	Vegetative (7d)	Vegetative (7b)	Vegetative (7b)

	Site: Control, Western edge of Wanjarri Nature Reserve (Tag ID 191 to 215)				
Tag ID	ESPLP_206	ESPLP_207	ESPLP_208	ESPLP_209	ESPLP_210
Photo					
Category (score)	Vegetative (7d)	Vegetative (7c)	Vegetative (7c)	Vegetative (7d)	Vegetative (7c)
Tag ID	ESPLP_211	ESPLP_212	ESPLP_213	ESPLP_214	ESPLP_215
Photo					
Category (score)	Vegetative (7c)	Declining (3)	Vegetative (7c)	Vegetative (7c)	Declining (3)

Table D-11: Photograph and plant health rating of *Eremophila* sp. long pedicels individuals located at the control site on the northern edge of Wanjarri Nature Reserve for the December 2020 assessment

	Site: Control, Northern edge of Wanjarri Nature Reserve (Tag ID 216 to 240)				
Tag ID	ESPLP_216	ESPLP_217	ESPLP_218	ESPLP_219	ESPLP_220
Photo					
Category (score)	Declining (2)	Declining (2)	Declining (3)	Vegetative (7d)	Vegetative (7c)
Tag ID	ESPLP_221	ESPLP_222	ESPLP_223	ESPLP_224	ESPLP_225
Photo					
Category (score)	Vegetative (7c)	Declining (2)	Declining (3)	Declining (3)	Declining (2)
Tag ID	ESPLP_226	ESPLP_227	ESPLP_228	ESPLP_229	ESPLP_230
Photo					
Category (score)	Declining (2)	Declining (2)	Vegetative (7c)	Declining (3)	Declining (2)

	Site: Control, Northern edge of Wanjarri Nature Reserve (Tag ID 216 to 240)				
Tag ID	ESPLP_231	ESPLP_232	ESPLP_233	ESPLP_234	ESPLP_235
Photo					
Category (score)	Dead (1)	Vegetative (7d)	Vegetative (7d)	Declining (2)	Vegetative (7b)
Tag ID	ESPLP_236	ESPLP_237	ESPLP_238	ESPLP_239	ESPLP_240
Photo					
Category (score)	Declining (3)	Declining (3)	Vegetative (7d)	Vegetative (7d)	Vegetative (7d)

Appendix E Priority Flora monitoring data 2018 to 2020

Table E-1: *Hybanthus floribundus* subsp. *chloroxanthus* monitoring data from 2018 to 2020

					Number of individual plants in each health category												
					Vegetative					Reproductive				Declining			Dead
	Tag #	Site Type / Location	Count	Date*	7a	7b	7c	7d	Total	6	5	4	Total	3	2	Total	1
Hybanthus floribundus subsp. *chloroxanthus* (P3)	HFC 51 to 62 and 253 to 257	Control, south of Six Mile	12	Dec-18	0	0	0	2	2	10	0	0	10	0	0	0	0
			12	Mar-19	0	2	0	1	3	0	9	0	9	0	0	0	0
			12	Jul-19	0	2	0	2	4	8	0	0	8	0	0	0	0
			12	Nov-19	0	2	0	2	4	8	0	0	8	0	0	0	0
			12	Mar-20	0	4	0	0	4	0	0	0	0	0	8	8	0
			17	Jul-20	0	5	1	0	6	0	0	0	0	9	2	11	0
			17	Sep-20	0	5	1	1	7	0	0	1	1	6	3	9	0
			17	**Dec-20**	**0**	**5**	**2**	**3**	**10**	**0**	**0**	**0**	**0**	**4**	**3**	**7**	**0**
	HFC 63 to 74 and 250 to 252	South-west of Six Mile	12	Dec-18	0	0	0	1	1	11	0	0	11	0	0	0	0
			12	Mar-19	0	0	0	0	0	0	12	0	12	0	0	0	0
			12	Jul-19	0	0	0	0	0	12	0	0	12	0	0	0	0
			12	Nov-19	0	0	12	0	12	0	0	0	0	0	0	0	0
			12	Mar-20	0	4	0	0	4	2	4	0	6	0	2	2	0
			15	Jul-20	3	5	4	0	12	0	0	0	0	1	2	3	0
			15	Sep-20	0	3	6	2	11	1	0	0	1	0	3	3	0
			15	**Dec-20**	**2**	**3**	**5**	**2**	**12**	**0**	**0**	**0**	**0**	**1**	**2**	**3**	**0**
	HFC 75 to 90 and 241 to 249	West of Six Mile	16	Dec-18	0	9	0	0	9	7	0	0	7	0	0	0	0
			16	Mar-19	0	0	0	0	0	0	15	0	15	0	0	0	1
			16	Jul-19	0	0	0	0	0	15	0	0	15	0	0	0	1
			16	Nov-19	0	0	15	0	15	0	0	0	0	0	0	0	1
			16	Mar-20	0	14	1	0	15	0	0	0	0	0	0	0	1
			25	Jul-20	9	11	3	1	24	0	0	0	0	0	0	0	1
			25	Sep-20	1	9	1	12	23	0	0	0	0	1	0	1	1
			25	**Dec-20**	**2**	**10**	**5**	**6**	**23**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**

Table E-2: *Hibbertia* sp. Sherwood Breakaways monitoring data from 2018 to 2020

					Number of individual plants in each health category													
					Vegetative					Reproductive				Declining			Dead	
	Tag #	Site Type / Location	Count	Date*	7a	7b	7c	7d	Total	6	5	4	Total	3	2	Total	1	
Hibbertia sp. Sherwood Breakaways (R.J. Cranfield 6776) (P2)	HSPSB 91 to 115	Control, Wanjarri Nature Reserve	24	Dec-18	0	6	2	7	15	9	0	0	9	0	0	0	0	
			24	Mar-19	0	4	0	1	5	1	18	0	19	0	0	0	0	
			25	Jul-19	0	0	1	24	25	0	0	0	0	0	0	0	0	
			25	Nov-19	0	1	0	24	25	0	0	0	0	0	0	0	0	
			25	Mar-20	0	14	4	7	25	0	0	0	0	0	0	0	0	
			25	Jul-20	0	12	1	7	20	0	0	0	0	4	1	5	0	
			25	Sep-20	0	6	2	11	19	0	0	0	0	2	4	6	0	
			25	**Dec-20**	**0**	**5**	**0**	**12**	**17**	**0**	**0**	**0**	**0**	**3**	**5**	**8**	**0**	
	HSPSB 1 to 25	East of Haul road	25	Dec-18	0	9	0	7	16	0	9	0	9	0	0	0	0	
			25	Mar-19	0	8	0	3	11	2	12	0	14	0	0	0	0	
			25	Jul-19	0	0	0	25	25	0	0	0	0	0	0	0	0	
			25	Nov-19	0	2	0	23	25	0	0	0	0	0	0	0	0	
			25	Mar-20	0	5	0	1	6	0	0	0	0	0	19	19	0	
			25	Jul-20	0	3	2	3	8	0	0	0	0	11	6	17	0	
			25	Sep-20	0	2	1	5	8	0	0	0	0	9	8	17	0	
			25	**Dec-20**	**0**	**1**	**1**	**6**	**8**	**0**	**0**	**0**	**0**	**9**	**7**	**16**	**1**	
	HSPSB 141 to 165	West of Haul Road	25	Dec-18	0													
			25	Mar-19	0	4	0	8	12	0	13	0	13	0	0	0	0	
			25	Jul-19	0	3	0	22	25	0	0	0	0	0	0	0	0	
			25	Nov-19	0	0	0	25	25	0	0	0	0	0	0	0	0	
			25	Mar-20	0	7	0	0	7	0	0	0	0	0	18	18	0	
			25	Jul-20	0	4	0	1	5	0	0	0	0	9	8	17	3	
			25	Sep-20	0	4	0	0	4	0	0	0	0	10	8	18	3	
			25	**Dec-20**	**0**	**2**	**2**	**0**	**4**	**0**	**0**	**0**	**0**	**3**	**13**	**16**	**5**	
	HSPSB 166 to 190	Far West of Haul Road	25	Dec-18	Previous results not available at time of reporting.													
			25	Mar-19														
			25	Jul-19														
			25	Nov-19														
			25	Mar-20	0	2	2	7	11	0	0	0	0	0	14	14	0	

					Number of individual plants in each health category												
					Vegetative					Reproductive				Declining			Dead
	Tag #	Site Type / Location	Count	Date*	7a	7b	7c	7d	Total	6	5	4	Total	3	2	Total	1
			25	Jul-20	0	0	2	9	11	0	0	0	0	11	3	14	0
			25	Sep-20	0	0	2	7	9	0	0	0	0	10	6	16	0
			25	**Dec-20**	**0**	**0**	**2**	**6**	**8**	**0**	**0**	**0**	**0**	**9**	**8**	**17**	**0**

Table E-3: *Verticordia jamiesonii* monitoring data from 2018 to 2020

					Number of individual plants in each health category												
					Vegetative					Reproductive				Declining			Dead
	Tag #	Site Type / Location	Count	Date*	7a	7b	7c	7d	Total	6	5	4	Total	3	2	Total	1
Verticordia jamiesonii (P3)	VJ 116 to 140	Wanjarri Nature Reserve	25	Dec-18	Not assessed in December 2018.												
			25	Mar-19	0	25	0	0	25	0	0	0	0	0	0	0	0
			25	Jul-19	0	13	4	8	25	0	0	0	0	0	0	0	0
			25	Nov-19	0	0	0	25	25	0	0	0	0	0	0	0	0
			25	Mar-20	0	13	9	1	23	0	0	0	0	0	1	1	1
			25	Jul-20	0	7	6	7	20	0	0	0	0	3	1	4	1
			25	Sep-20	0	4	4	5	13	0	0	0	0	7	4	11	1
			25	**Dec-20**	**0**	**3**	**2**	**5**	**10**	**0**	**0**	**0**	**0**	**9**	**5**	**14**	**1**
	VJ 26 to 50	East of Haul Road	25	Dec-18	0	13	0	3	16	7	0	2	9	0	0	0	0
			25	Mar-19	0	21	0	4	25	0	0	0	0	0	0	0	0
			25	Jul-19	0	3	0	22	25	0	0	0	0	0	0	0	0
			25	Nov-19	0	3	0	22	25	0	0	0	0	0	0	0	0
			25	Mar-20	0	8	0	0	8	0	0	0	0	0	15	15	2
			25	Jul-20	4	0	0	4	8	0	0	0	0	13	1	14	3
			25	Sep-20	0	3	0	0	3	1	0	0	1	14	4	18	3
			25	**Dec-20**	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**11**	**8**	**19**	**3**

Table E-4: *Eremophila* sp. long pedicels monitoring data from 2018 to 2020

					Number of individual plants in each health category													
					Vegetative					Reproductive				Declining			Dead	
	Tag #	Site Type / Location	Count	Date*	7a	7b	7c	7d	Total	6	5	4	Total	3	2	Total	1	
Eremophila sp. long pedicels (G. Cockerton 1975) (P2)	ESPLP 191 to 215	Control/ Western Edge of Wanjarri Nature Reserve	0	Dec-18	Previous data was descriptive and therefore no plant health scores were given.													
			0	Mar-19														
			0	Jul-19														
			0	Nov-19														
			0	Mar-20														
			25	Jul-20	0	4	14	0	18	0	0	0	1	6	0	6	0	
			25	Sep-20	0	4	8	8	20	0	0	0	0	5	0	5	0	
			25	**Dec-20**	**0**	**4**	**6**	**10**	**20**	**0**	**0**	**0**	**0**	**4**	**1**	**5**	**0**	
	ESPLP 216 to 240	Control/ Northern Edge of Wanjarri Nature Reserve	0	Dec-18	Previous data was descriptive and therefore no plant health scores were given.													
			0	Mar-19														
			0	Jul-19														
			0	Nov-19														
			0	Mar-20														
			25	Jul-20	0	1	7	0	8	0	0	0	0	11	6	17	0	
			25	Sep-20	0	1	1	6	8	0	0	0	0	7	10	17	0	
			25	**Dec-20**	**0**	**1**	**2**	**7**	**10**	**0**	**0**	**0**	**0**	**6**	**8**	**14**	**1**	

* Data presented from December 2018 to March 2020 was collected by Western Botanical (BHP Nickel West 2020b) and from July 2020 onwards the data was collected by Stantec

Appendix F Detailed quadrat assessments 2020

F.1 MKS EIA 1 - Haul Road Impact

Site ID: MKS EIA 1	Co-ordinates: 51 J 261082 6973489
Location: ~ 40 m west of haul road **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Degraded **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** Drainage at this site is from south-east to north-west. Subject peg had to be reinstated, removed in grading of fence line track. Vegetation showing some very recent deaths. Heavily impacted by dust due to proximity to haul road. Loss of foliage on *Acacia* trees. Stressed vegetation, particularly *S. ectogama* which has lost most foliage. Ants present. Cryptograms present but covered in dust. Rabbit warrens observed.

Species	Cover (%)	Plant Health Score	Comments
Aristida jerichoensis	60	7b	Dry. Good cover.
Sida ectogama	15	2	Covered in dust. Loss of foliage.
Acacia aneura	30	2	Covered in dust. Loss of foliage.
Eremophila latrobei	<2	2	Dusty. Stressed.
Eremophila galeata	2	2	Dusty. Stressed.

Other species: *Acacia ramulosa* var. *linophylla*, *Acacia quadrimarginea*

F.2 MKS EIA 2 - Haul Road Impact

Site ID: MKS EIA 2	Co-ordinates: 51 J 261089 6972365
Location: ~ 40 m west of MKS haul road **Veg. Type:** Groved Mulga shrubland **Veg. Condition:** Degraded **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** Water stressed vegetation. Multiple dead shrubs. Heavy dust cover over plants. Kangaroo scats and termite mounds present. Internal drainage in Grove.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	50	4	Okay, but dusty and dry.
Eucalyptus lucasii	2	7b	Mostly outside quadrat.
Acacia tetragonophylla	2	4	Post-flowering. Partially dead canopy.
Sida ectogama	<2	2	Little live foliage remaining.
Eremophila latrobei	<2	2	Little live foliage remaining. Dusty. Yellowing.

Other species: *Eremophila pungens* (P4)

F.3 MKS EIA 3 - Haul Road Impact

Site ID: MKS EIA 3	Co-ordinates: 51 J 261117 6971563
Location: ~ 9 m west of haul road	**Comments:** Soil surface 95% gravely stones, 5% silty sand and clay. All plants are water stressed. Some dead shrubs present. Dust affected. Track runs through the quadrat.
Veg. Type: Groved Mulga shrubland / Archaean granite geology	
Veg. Condition: Good	
Grazing: Nil	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Eremophila galeata	5	2	Partially dead canopy.
Acacia pruinocarpa	2	7b	Good condition.
Ptilotus obovatus	<2	2	Partially dead canopy.
Senna glaucifolia	<2	7c	Good condition.
Solanum lasiophyllum	<2	2	Very stressed.

Other species: *Dodonaea petiolaris, Acacia aneura.*

F.4 MKS EIA 4 - Haul Road Impact

Site ID: MKS EIA 4	Co-ordinates: 51 J 261049 6971565
Location: ~ 75 m west of haul road **Veg. Type:** Groved Mulga shrubland/ Stony ironstone Mulga shrubland **Veg. Condition:** Good **Grazing:** Nil **Weed cover:** Nil **Photo direction:** NW	**Comments:** Cleared road and soil bund. This area gets a lot of dust from vehicular traffic and this is clearly visible on Mulga, *Senna* and *Eremophila* species. Drainage is west to south west so it is expected that the haul road may have minimal impact on sheet flow. No cryptograms. Historical *Acacia* deaths. Directly adjacent to haul road. Soil surface is has high dust coverage.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	15	7b	Dust affected.
Eremophila galeata	2	2	Very stressed.
Ptilotus obovatus	<2	2	Very stressed.
Eremophila latrobei	<2	2	Very stressed.
-	-	-	-

Other species: *Senna glaucifolia, Eragrostis* sp.

F.5 MKS EIA 5 - Haul Road Impact

Site ID: MKS EIA 5	Co-ordinates: 51 J 261204 6970774
Location: ~ 80 m east of haul road **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** N	**Comments:** Site lies 100m downstream from the MKS haul road and about 15m west of the WNR track. Minor drainage line drains from southern end of the breakaway in a south-east direct into the Wanjarri Nature Reserve. The haul road interrupts that drainage path. No annuals. Cryptograms on soil surface. Litter present under trees. Pedstalling erosion present. Vegetation is water stressed and dust affected. Historical *Acacia* deaths recorded. Termite mounds and kangaroo scats observed.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	15	7b	Good condition.
Acacia tetragonophylla	15	4	Old flowers still attached to plant.
Sida ectogama	25	3	Dry, foliage loss observed.
Eremophila pungens (P4)	5	7b	Good condition.
Eremophila forrestii	2	3	Dry, foliage loss observed.

Other species: *Acacia craspedocarpa, Eremophila galeata, Eremophila jucunda* subsp. *jucunda, Aristida jerichoensis, Enneapogon ?caerulescens, Eremophila compacta, Senna* sp Meekatharra (EIA_5_001).

F.6 MKS EIA 6 - Haul Road Impact

Site ID: MKS EIA 6	Co-ordinates: 51 J 261139 6971172
Location: ~13 m east of haul road **Veg. Type:** Archaean granite geology **Veg. Condition:** Excellent **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** Post has WB 30 on it and all four posts are installed. All vegetation is in good condition considering dry seasonal conditions. Minimal dust impact, partially protected by large bund along the edge of the haul road observed at time of assessment.

Species	Cover (%)	Plant Health Score	Comments
Callitris columellaris	10	7b	Good condition.
Thryptomene sp. Leinster (P3)	30	7b	Good condition.
Acacia pruinocarpa	2	7b	Good condition.
Acacia quadrimarginea	10	7b	Good condition.
Eriachne mucronata	2	3	Dry, with dead patches.

Other species: *Acacia rhodophloia, Acacia aneura, Hibbertia* sp Sherwood Breakaways (P2), *Hakea leucoptera, Acacia tetragonophylla, Dodonaea petiolaris.*

F.7 MKS EIA 7 - Haul Road Impact

Site ID: MKS EIA 7	Co-ordinates: 51 J 261216 6970204
Location: ~ 90 m east of haul road **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** N	**Comments:** Drainage from the west, interrupted by haul road. Two posts installed. Kangaroo scats and termite mounds were present. Litter present under large *Acacia* shrubs. Half of quadrat dominated by vegetation, but other half is almost bare. Historic shrub deaths to the west of the quadrat. Upper storey healthy while lower storey was water stressed. Dust affected.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	30	7b	Lower branches have reduced foliage. Previously grazed.
Eremophila forrestii	<2	7b	Healthy adult beneath Mulgas.
Sida ectogama	20	3	Dusty and stressed. Some foliage loss.
Eremophila granitica	<2	3	Dusty and stressed. Some foliage loss.
Acacia thoma	30	7b	Good condition.

Other species: *Eremophila galeata, Acacia aneura sens. lat., Eremophila latrobei, Acacia quadrimarginea.*

F.8 MKS EIA 8 - Haul Road Impact

Site ID: MKS EIA 8	Co-ordinates: 51 J 261231 6969060
Location: ~ 60 m east of haul road **Veg. Type:** Stony ironstone Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light **Weed cover:** Nil **Photo direction:** N	**Comments:** This site may dependent on sheet flow from the west. All vegetation in good condition. Site is covered in stony ferruginous rocks and boulders. No annuals at time of assessment. Evidence of grazing, possibly historic. Termite mounds and rabbit warrens present. Dead grasses and shrubs observed. Litter present under *Acacias*.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	20	7b	Healthy adult individuals.
Psydrax suaveolens	5	7b	Large healthy adult.
Eremophila spectabilis	10	7b	Dry, but full canopy.
Eremophila latrobei	<2	7d	Stressed individuals under *Acacias*.
Senna glaucifolia	<2	7a	New growth evident on stems.

Other species: *Eriachne helmsii, Eremophila jucunda* subsp. *jucunda, Solanum lasiophyllum, Monachather paradoxus, Ptilotus schwartzii.*

F.9 MKS EIA 9 - Haul Road Impact

Site ID: MKS EIA 9	Co-ordinates: 51 J 261218 6969942
Location: ~95 m east of haul road	**Comments:** Soil surface is 95% quartz, ironstone rocks and gravel with 5% silty sand. No cryptograms observed. Site is on a low rise, higher than surrounding landscape and unlikely to be affected by interruption to drainage due to the haul road. Many young *Hakea leucoptera* observed. Many *Maireana*s stressed. No annuals. Less impacted by dust than other quadrats observed despite being closer to the haul road. *Eremophila pantonii* flowering outside quadrat.
Veg. Type: Weathered basalt, *Hakea leucoptera* subsp. *sericipes*/ Eremophila pantonii shrubland	
Veg. Condition: Excellent	
Grazing: Nil	
Weed cover: Nil	
Photo direction: N	

Species	Cover (%)	Plant Health Score	Comments
Hakea leucoptera subsp. *sericipes*	10	4	Healthy. Old seed pods present. Many juveniles.
Maireana triptera	<2	3	Stressed. Loss of foliage.
Senna sp. Meekatharra	<2	7b	Dusty, but healthy. Juveniles present.
Eremophila pantonii	<2	7b	Healthy. Some young plant present.
-	-	-	-

Other species: *Atriplex semilunaris, Ptilotus obovatus, Maireana georgei.*

F.10 MKS EIA 10 - Infrastructure Impact

Site ID: MKS EIA 10	Co-ordinates: 51 J 260553 6966093
Location: ~ 320 m north of Run-of-mine **Veg. Type:** Stony ironstone Mulga shrubland **Veg. Condition:** Good **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** No annuals. Note east peg is 8m from center peg (closer than standard 10m distance). Drainage comes from the west, the Run-of-mine is north of the quadrat so drainage should not be interrupted. Previously noted *Acacia pruinocarpa* is dead. Dust present on vegetation. Low cover of cryptograms present. Very bare quadrat. Litter present under *Acacias*. Some understorey shrub death. Old rabbit warrens present. Vegetation is dry, reflecting extended dry seasonal conditions.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	5	7b	Some dust, full canopy.
Ptilotus schwartzii	<2	5	Actively flowering.
Eremophila forrestii	<2	3	Some loss of foliage. Lots of dust present.
Eremophila spectabilis	<2	7d	Very dry. Yellowing leaves. Dusty.
Ptilotus obovatus	<2	3	Very dry, foliage loss.

Other species: *Acacia aneura sens. lat., Eremophila latrobei, Solanum lasiophyllum, Psydrax suaveolens.*

F.11 MKS EIA 11 - Infrastructure Impact

Site ID: MKS EIA 11	Co-ordinates: 51 J 260029 6965525
Location: ~ 250 m east of Run-of-mine **Veg. Type:** Stony ironstone low/Mulga shrubland **Veg. Condition:** Good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** 100% rocky laterite with quartz stones and gravel. Lichens present on rocks. Light dust layer visible on rocks. Dry vegetation, with sparse cover. Many dead understorey plants, particularly P. schwartzii. Likely affected by extended dry seasonal conditions. Note: This site is positioned perpendicular to the MKS clearing edge and transversely across the slope.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	2	7c	Healthy. Previously grazed, with browse line observed.
Acacia quadrimarginea	<2	2	Loss of 70% foliage.
Thryptomene sp. Leinster (P3) (EIA_11_001)	<2	7b	Healthy individuals.
Eremophila latrobei	<2	7d	Reasonably healthy. Dry.
Ptilotus obovatus	<2	3	Dry. Some foliage loss.

Other species: *Harnieria kempeana, Senna* sp. Meekatharra, *Ptilotus schwartzii.*

F.12 MKS EIA 12 - Infrastructure Impact

Site ID: MKS EIA 12	Co-ordinates: 51 J 259909 6964937
Location: ~ 150 m east of Six Mile Well pit	**Comments:** High dust load present on foliage. No annuals. All *Maireana* sp. plants very stressed, likely reflecting extended dry seasonal conditions. Rabbit scats and burrows observed. No cryptograms present.
Veg. Type: Weathered basalt, *Hakea leucoptera* subsp. ser/ Ere pan shrubland	
Veg. Condition: Good	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Eremophila pantonii	10	7b	
Acacia aneura sens. lat.	15	4	
Maireana triptera	2	2	Very stressed.
Senna artemisioides subsp. *helmsii*	<2	2	Loss most of canopy.
Grevillea inconspicua (P4) (EIA_12_001)	2	7b	

Other species: *Eremophila scoparia, Hakea leucoptera* subsp. *sericipes, Ptilotus obovatus, Maireana georgei, Maireana tomentosa.*

F.13 MKS EIA 13 - Infrastructure Impact

Site ID: MKS EIA 13	Co-ordinates: 51 J 260866 6964098
Location: ~ 80 m from Six Mile Well pit **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments**: Only middle post present. All vegetation in good condition, most are vegetative. Creek bed at the site is normal with healthy fringing grasses and a sandy creek bed. On western bank of Jones Creek. Creek banks composed of silty sand overlaying polymictic rocks including weather sandstone and concreted Wiluna hardpan. *Eucalyptus camaldulensis* in healthy condition. Some historic shrub death. Vegetation covered in dust and soil surface. Ants present.

Species	Cover (%)	Plant Health Score	Comments
Acacia caesaneura	15	7c	
Acacia burtikii	10	7b	
Themeda triandra	15	7b	
Dodonaea viscosa	5	7d	
Dodonaea rigida (EIA_13_012)	5	5	

Other species: *Duperreya sericea (EIA_13_005), Grevillea inconspicua, Santalum spicatum, Eucalyptus camaldulensis, Eremophila granitica, Hemigenia exilis* (P4), *Ptilotus obovatus, Eremophila pantonii, Eremophila oldfieldii, Hybanthus floribundus* subsp. *chloroxanthus* (P3)

F.14 MKS EIA 14 - Infrastructure Impact

Site ID: MKS EIA 14	Co-ordinates: 51 J 263217 6963155
Location: ~ 400 m south-east of WRL	**Comments:** Eastern side of MKS, outside clearing margin. Minimal impact from MKS. Previous *Acacia* deaths observed. Track runs through quadrat. Vegetation in good condition.
Veg. Type: Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland	
Veg. Condition: Good	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia caesaneura	15	7b	
Acacia ramulosa var. *linophylla*	5	7b	
Triodia basedowii	2	7b	
Eragrostis sp.	<2	7b	
-	-	-	-

Other species: *Eremophila spectabilis*

F.15 MKS EIA 15 - Infrastructure Impact

Site ID: MKS EIA 15	Co-ordinates: 51 J 260412 6961163
Location: ~ 2.2 km south west of WRL, ~ 450 m from Jones Creek track	**Comments:** Historical *Acacia* deaths. Kangaroo scats present. Several dead *Maireana* individuals. Annual grass cover. Dust affected *Acacias*. This site is a minor drainage line within a stony plain. Drainage here is from the east, from the south-western corner of the MKS development envelope. Minor risk from changed hydrological conditions.
Veg. Type: Mulga over *Maireana triptera* shrubland/ Drainage line Mulga shrubland	
Veg. Condition: Very good	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Ptilotus obovatus	5	5	Some foliage loss but flowering.
Acacia aneura	40	7b	Historic browsing lines.
Eremophila galeata	5	7b	Green foliage on end of stems, browning at base.
Aristida jerichoensis	40	7b	High cover.
Senna artemisioides subsp. *helmsii*	2	2	Little foliage remaining.

Other species: *Maireana ?georgei, Solanum lasiophyllum.*

F.16 MKS EIA 16 - Infrastructure Impact

Site ID: MKS EIA 16	Co-ordinates: 51 J 260261 6961683
Location: ~ 1.8 km south west of WRL, ~ 250 m from Jones Creek track **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** Dust on foliage. Risk of water starvation or increased sedimentation from adjacent mining operations. All vegetation in condition for dry extended seasonal conditions. Cryptograms are present but dry. Dust on foliage of most species. High grass cover. Stream channel showing clayey sand on banks and stony stream bed. This site lies downslope of the MKS development with a large proportion of its catchment interrupted by MKS. Dead *Acacia tetragonophylla* present and annual species.

Species	Cover (%)	Plant Health Score	Comments
Sida ectogama	5	7b	Dusty
Eremophila granitica	5	7d	Browning of stem ends.
Eremophila galeata	5	7d	Browning foliage and foliage loss.
Acacia ?craspedocarpa (hybrid) (EIA_16_001)	25	7c	
Acacia aptaneura (EIA_16_002)	60	7c	

Other species: *Psydrax suaveolens, Solanum lasiophyllum, Ptilotus obovatus, Aristida jerichoensis*

F.17 MKS EIA 17 - Infrastructure Impact

Site ID: MKS EIA 17	Co-ordinates: 51 J 261346 6963029
Location: ~ 170 m from WRL	**Comments:** Dust on foliage. All vegetation in good condition. Dry but healthy cryptograms. Very dusty. Browse lines across lower *Acacia* branches. This site lies downslope of the MKS development and will some of its catchment interrupted.
Vegetation Type: Drainage line Mulga shrubland	
Veg. Condition: Good	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura sens. lat.	70	3	Reduced foliage, grazed.
Acacia craspedocarpa	5	3	Loss of foliage on lower branches.
Sida ectogama	5	3	Very dusty. Some loss of foliage.
Cymbopogon ambiguus	5	4	Healthy. Post seeding.
Acacia pteraneura (EIA_17_001)	5	7b	Healthy. Some insect galls. Dusty.

Other species: *Ptilotus obovatus, Acacia quadrimarginea, Santalum lanceolatum, Senna artemisioides* subsp. *helmsii.*

F.18 MKS EIA 18 - Infrastructure Impact

Site ID: MKS EIA 18	Co-ordinates: 51 J 261285 6964460
Location: ~ 195 m south east of Run-of-Mine/ Six Mile Well **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** Jones Creek, upstream of bridge crossing on the eastern bank. Grasses on edge of the creek are stressed, dusty and grazed. *Eucalyptus camaldulensis* are healthy. Heavy dust load on most shrubs and grasses. Soil surface also covered in dust. Ants present.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	25	7d	
Santalum spicatum	20	7b	
Aristida jerichoensis	10	7b	
Acacia burkittii	10	5	Pods on plants.
Themeda triandra	5	7b	

Other species: *Santalum lanceolatum, Acacia aneura sens. lat. Aristide jerichoensis, Eucalyptus camaldulensis, Eragrostis eriopoda, Eremophila gilesii, Sida ectogama, Maireana tomentosa.*

F.19 MKS EIA 19 - Haul Road Impact

Site ID: MKS EIA 19	Co-ordinates: 51 J 270893 6981469
Location: Wanjarri Nature Reserve	**Comments:** All vegetation is aestivating and reflecting extended dry seasonal conditions. Most plants reasonably healthy but dry. No impacts likely.
Veg. Type: Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland	
Veg. Condition: Excellent	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Triodia basedowii	10	3	
Acacia aneura	20	7b	
Acacia burkittii	5	7b	
Eragrostis eriopoda	2	4	Post flowering.
Acacia ?tetragonophylla	5	7c	

Other species: *Eremophila spectabilis, Psydrax suaveolens, Eremophila* sp. long pedicels (P2)..

F.20 MKS EIA 20 - Haul Road Impact

Site ID: MKS EIA 20	Co-ordinates: 51 J 272524 6982988
Location: Wanjarri Nature Reserve	**Comments:** *Eremophila* sp. long pedicels occurring in patches under Mulga with older seed pods present. Very dry vegetation. Cryptograms present but dry. Grasses are dry. No impacts from MKS, but nearby WNR track and grazing observed.
Veg. Type: Sandplain Mulga spinifex shrubland/ Hardpan Mulga shrubland	
Veg. Condition: Very good	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Eragrostis eriopoda	10	4	
Triodia basedowii	15	4	
Acacia ramulosa var. *linophylla*	20	7c	
Acacia tetragonophylla	2	3	
Eremophila spectabilis	5	3	

Other species: *Acacia caesaneura, Ptilotus obovatus.*

F.21 MKS EIA 23 - Haul Road Impact

Site ID: MKS EIA 23	Co-ordinates: 51 J 261137 6971361
Location: ~ 25 m east of haul road	**Comments:** Previously cleared by haul road, need to move quadrat. Minimal dust load despite close distance from haul road. Foliage loss across multiple species but all plants are vegetative.
Veg. Type: Granitic Mulga shrubland on Archaean geology	
Veg. Condition: Excellent	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia quadrimarginea	10	7b	
Callitris columellaris	5	7b	
Thryptomene sp. Leinster (P3)	15	7c	
Ptilotus obovatus	2	3	
Dodonaea petiolaris	2	3	

Other species: *Eriachne helmsii, Acacia aneura, Hibbertia sp. Sherwood Breakaways (P2), Eriachne mucronata, Asteraceae* sp.

F.22 MKS EIA 24 - Haul Road Impact

Site ID: MKS EIA 24	Co-ordinates: 51 J 261187 6971273
Location: ~ 10 m west from haul road	**Comments:** Looking southwards parallel to the haul road. No annuals. Most shrubs are vegetative, but dry. Minimal dust load on vegetation. Quadrat re-established due to quadrat being too close to haul road.
Veg. Type: Granitic Mulga shrubland on Archaean geology.	
Veg. Condition: Excellent	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Thryptomene sp. Leinster (P3)	20	7b	
Dodonaea petiolaris	<2	3	Yellowing and foliage loss.
Eriachne mucronata	<2	2	
-	-	-	-
-	-	-	-

Other species: *Hibbertia* sp. Sherwood Breakaways (P2).

F.23 MKS EIA 25 - Haul Road Impact

Site ID: MKS EIA 25	Co-ordinates: 51 J 261174 6971135
Location: ~ 2 m east of haul road	**Comments:** Looking south, haul road to right. Quadrat moved away from haul road downslope from the MKS haul road. All vegetation in good condition. Light dust impact. No cryptograms.
Veg. Type: Granitic Mulga shrubland on Archaean geology.	
Veg. Condition: Excellent	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia pruinocarpa	5	7b	Good condition.
Acacia rhodophloia	2	7b	Good condition.
Acacia aneura	5	7d	Some minor foliage loss and browning of leaves observed.
Thryptomene sp. Leinster (P3)	2	7b	Good condition.
Dodonaea petiolaris	<2	3	Some foliage loss of yellowing of leaves.

Other species: *Eriachne mucronata.*

F.24 MKS EIA 26 - Haul Road Impact

Site ID: MKS EIA 26	Co-ordinates: 51 J 261162 6971094
Location: ~ 7 m east of haul road	**Comments:** Moved quadrat away from haul road. Most plants are vegetative, but smaller lower storey shrubs are losing foliage. Small dust load.
Veg. Type: Granitic Mulga shrubland on Archaean geology.	
Veg. Condition: Excellent	
Grazing: Nil	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Callitris columellaris	15	7b	
Thryptomene sp. Leinster (P3)	10	7b	
Dodonaea petiolaris	5	3	
Acacia pruinocarpa	5	7b	
Acacia rhodophloia	2	7b	

Other species: *Acacia aneura, Hakea leucoptera, Verticordia jamiesonii* (P3), *Acacia quadrimarginea, Eriachne mucronata.*

F.25 MKS EIA 27 - Haul Road Impact

Site ID: MKS EIA 27	Co-ordinates: 51 J 261177 6970972
Location: ~ 4 m west of haul road	**Comments:** Southern edge of Breakaway landform. Haul interrupts surface drainage from west to east. Mid slope from MKS haul road. Lichens present. Little under trees. Light dust load. Dry but vegetative shrubs.
Vegetation Type: Granitic Mulga shrubland on Archaean geology.	
Veg. Condition: Very good	
Grazing: Nil	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	40	7b	
Dodonaea petiolaris	<2	3	
Scaevola spinescens	2	7b	
Sida ectogama	<2	3	
Eremophila pungens (P4)	2	7d	

Other species: *Eremophila shonae, Thryptomene* sp. Leinster (P3).

F.26 MKS EIA 28 - Haul Road Impact

Site ID: MK SEIS 28	Co-ordinates: 51 J 261239 6970770
Location: ~ 110 m east of haul road, within WNR **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** Site lies 100m downstream of the newly constructed road. The WNR fence line track is nearby with a high bund east of the track. Ants and termite mounds were present. Cryptograms on soil surface. Light dust load. At base of drainage line, depression in landscape.

Species	Cover (%)	Plant Health Score	Comments
Sida ectogama	30	3	
Eremophila galeata	5	5	Flowering.
Acacia aneura	25	4	Old pods present.
Acacia quadrimarginea	15	7c	
Eremophila jucunda subsp. *jucunda*	2	3	

Other species: *Senna* sp. Meekatharra, *Sida ectogama, Enneapogon* sp., *Eremophila shonae, Senna glaucifolia, Dodonaea petiolaris.*

F.27 MKS EIA 21 - Control

Site ID: MKS EIA 21	Co-ordinates: 51 J 261186 6973491
Location: ~ 60m from haul road, within WNR	**Comments:** Old 4WD track nearby. No posts established at quadrat. Heavy dust load. Almost all plants are vegetative, but dry and dusty. Grazing of grasses evident. Soil is a red silty sand with abundant but discontinuous ferruginous pizolitic gravel.
Vegetation Type: Hardpan Mulga shrubland with Aca tho co- dominant	
Veg. Condition: Very good	
Grazing: Medium	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Acacia thoma	30	7b	Healthy but smothered in dust.
Acacia aneura	10	7b	High dust load.
Eremophila jucunda subsp. *jucunda*	5	7d	
Eremophila spectabilis	5	7d	
Eragrostis eriopoda	2	4	Post flowering.

Other species: *Solanum lasiophyllum, Eriachne mucronata.*

F.28 MKS EIA 22 - Control

Site ID: MKS EIA 22			Co-ordinates: 51 J 261218 6972404
Location: ~ 87 m from haul road, within WNR **Vegetation Type:** Groved Mulga woodland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** N	**Comments:** Almost all plants are water stressed. Control quadrat is close to MKS haul road and receives dust from the road. 10 m away from the WNR track. Historical *Acacia* deaths observed.		
Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	20	7b	
Sida ectogama	5	3	
Aristida jerichoensis	<2	4	Post flowering.
Eremophila latrobei	<2	2	
-	-	-	-
Other species: *Solanum lasiophyllum*.			

F.29 MKS EIA 29 - Control

Site ID: MKS EIA 29	Co-ordinates: 51 J 261255 6970160
Location: ~ 100 m east of haul road, within WNR **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** Monitoring peg is approximately 15 m east of the WNR track in a minor drainage. Vegetation in good condition, but dry. Centre post installed. Minor pedestalling western side of quadrat. Lower dust load than the other quadrats. Historic *Acacia* deaths. Ants present. Dead *Maireana* shrubs in center of quadrat.

Species	Cover (%)	Plant Health Score	Comments
Acacia quadrimarginea	25	7b	Browsing lines across lower branches.
Sida ectogama	5	3	
Acacia aneura	10	7b	
Eremophila jucunda subsp. *jucunda*	<2	3	Dusty. Stressed.
-	-	-	-

Other species: *Acacia caesaneura, Eremophila forrestii, Aristida jerichoensis, Acacia thoma, Eremophila galeata.*

F.30 MKS EIA 30 - Control

Site ID: MKS EIA 30	Co-ordinates: 51 J 261261 6969699
Location: ~ 125 m east of haul road, within WNR	**Comments:** Monitoring peg is approximately 15m east of the WNR track a minor drainage line. Cryptograms present on soil surface. Dusty vegetation.
Veg. Type: Drainage line Mulga shrubland	
Veg. Condition: Very good	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Sida ectogama	15	3	
Acacia caesaneura	30	4	Old seed pods on *Acacia caesaneura*.
Dodonaea petiolaris	<2	7d	
Eremophila galeata	<2	3	
-	-	-	-

Other species: *Acacia aneura, Eremophila forrestii, Solanum lasiophyllum, Psydrax suaveolens, Acacia quadrimarginea.*

F.31 MKS EIA 31 - Control

Site ID: MKS EIA 31	Co-ordinates: 51 J 261263 6969421
Location: ~ 114 m east of haul road, within WNR **Veg. Type:** Drainage line Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** NW	**Comments:** Monitoring peg is approximately 10m east of the WNR track in a minor drainage line. Soil surface is intact with a clay and cryptogram crust. No annuals. All vegetation in good condition considering extended dry seasonal conditions. Insect galls on vegetation. Only middle post installed. Some dust present on vegetation. Grazing observed with browsing lines across *Acacia* shrubs/trees.

Species	Cover (%)	Plant Health Score	Comments
Sida ectogama	10	2	Dusty. Stressed.
Eremophila latrobei	<2	7b	
Acacia caesaneura	30	7b	
Eremophila spectabilis	<2	7c	Small individual under Mulgas.
Eriachne helmsii	<2	7b	

Other species: *Acacia aneura, Ptilotus obovatus, Eremophila jucunda* subsp. *jucunda.*

F.32 MKS EIA 32 - Control

Site ID: MKS EIA 32	Co-ordinates: 51 J 261277 6968983
Location: ~ 110 m east of haul road, within WNR **Veg. Type:** Stony ironstone Mulga shrubland **Veg. Condition:** Excellent **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** Site is 100% covered in stony ferruginous rocks and boulders. No annuals at time of assessment. All vegetation vegetative. Only middle post installed. Grassed grazed to butts. Vegetation dry, likely due to extended dry seasonal conditions. Leaf litter present under *Acacias*.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	15	7b	
Acacia thoma	10	7b	
Eremophila spectabilis	<2	7c	
Eremophila latrobei	<2	7b	
Senna glaucifolia	<2	7b	One healthy individual.

Other species: *Acacia aneura sens. lat., Eriachne mucronata, Eremophila jucunda* subsp. *jucunda, Ptilotus schwartzii.*

F.33 MKS EIA 33 - Control

Site ID: MKS EIA 33	Co-ordinates: 51 J 261280 6968863
Location: ~ 114 m east of haul road, within WNR	**Comments:** Site is very bare. Multiple dead *Maireana* sp. individuals. Only middle post present. Cryptograms on soil surface. Some pedestalling erosion present. Dry vegetation.
Veg. Type: Stony ironstone Mulga shrubland	
Veg. Condition: Very good	
Grazing: Light	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Senna sp. Meekatharra	10	7b	Fallen over tree, living and healthy.
Acacia aneura sens. lat.	15	7b	Some insect galls.
Dodonaea petiolaris	<2	3	Stressed. Loss of foliage.
Maireana sp.	<2	2	Only few individuals remaining.
Ptilotus obovatus	<2	2	

Other species:

F.34 MKS EIA 34 - Control

Site ID: MKS EIA 34	Co-ordinates: 51 J 261298 6968771
Location: ~ 114 m east of haul road, within WNR **Veg. Type:** Stony ironstone low shrubland **Veg. Condition:** Excellent **Grazing:** Light **Weed cover:** Nil **Photo direction:** NW	**Comments:** Quadrat situated on a rocky outcrop next to WNR track. Dominated by Thryptomene sp. Leinster (PX). Relatively impacted by road. Lichens present on rocks. Some vegetation affected by extended dry seasonal conditions (P. schwartzii, D. rigida).

Species	Cover (%)	Plant Health Score	Comments
Thryptomene sp. Leinster (P3)	20	7b	
Acacia pruinocarpa	5	7b	Few adolescent trees.
Dodonaea rigida (EIA_13_012)	<2	3	
Ptilotus schwartzii	<2	2	
-	-	-	-

Other species: *Acacia quadrimarginea.*

F.35 MKS EIA 35 - Control

Site ID: MKS EIA 35	Co-ordinates: 51 J 261071 6971248
Location: ~ 3 m west of haul road	**Comments:** Half quadrat on haul road boundary, should be moved. Sparse vegetation present. Dust on rocks and soil surface. Plants in good condition. Cryptograms present but covered in dust and dry.
Veg. Type: Stony ironstone Mulga shrubland	
Veg. Condition: Good	
Grazing: Light	
Weed cover: Nil	
Photo direction: W	

Species	Cover (%)	Plant Health Score	Comments
Eremophila latrobei	<2	2	Stressed.
Acacia aneura	<2	7c	Dusty.
Ptilotus obovatus	<2	5	Flowering, some foliage loss.
Thryptomene sp. Leinster (P3)	<2	7b	Dusty and dry.
Acacia rhodophloia	<2	7b	

Other species: *Maireana triptera, Eremophila forrestii, Acacia pruinocarpa, Eremophila pungens* (P4), *Maireana georgei, Senna glaucifolia.*

F.36 MKS EIA 36 - Control

Site ID: MKS EIA 36	Co-ordinates: 51 J 261071 6971159
Location: ~ 52 m west of haul road **Veg. Type:** Stony ironstone Mulga shrubland **Veg. Condition:** Very good **Grazing:** Light **Weed cover:** Nil **Photo direction:** N	**Comments:** Dust impacts on flora and vegetation. Soil is firm silty with abundant discontinuous lag gravel of angular quartz and subangular ironstone. Site slope towards the new haul road, which intercepts drainage from the easterly direction. Shrubs in good condition. Light browsing present. Some cryptograms and ants present.

Species	Cover (%)	Plant Health Score	Comments
Acacia aneura	<2	7c	Grazing line.
Acacia rhodophloia	10	7b	Grazing line,
Thryptomene sp. Leinster (P3)	5	7b	
Acacia pruinocarpa	<2	7b	Large adult outside quadrat, but juvenile within.
Dodonaea rigida (EIA_13_012)	<2	3	Dry.

Other species: *Eremophila forrestii, Acacia aneura sens. lat., Ptilotus obovatus.*

F.37 MKS EIA 37 - Control

Site ID: MKS EIA 37	Co-ordinates: 51 J 261077 6971050
Location: ~ 48 m west of the haul road **Vegetation Type:** Stoney ironstone low shrubland **Veg. Condition:** Good **Grazing:** Light, historic **Weed cover:** Nil **Photo direction:** N	**Comments:** Dust impacts likely on flora and vegetation, with dust covering soil surface. Site has shallow silty sand over extensive outcropping and sub cropping weather granite. Area subject to dust from vehicular movement on MKS haul road. Quadrat should be moved back. Historic shrubs death observed. *Acacia* in good condition considering extended dry seasonal conditions and proximity to haul road. Scats, termite mounds and lichen present.

Species	Cover (%)	Plant Health Score	Comments
Acacia pruinocarpa	10	7b	
Acacia quadrimarginea	2	7b	
Dodonaea rigida (EIA_13_012)	<2	7b	Dust present.
Thryptomene sp. Leinster (P3)	<2	7b	
Eremophila forrestii	<2	7c	Dust present.

Other species: *Acacia rhodophloia, Ptilotus obovatus.*

F.38 MKS EIA 38 - Control

Site ID: MKS EIA 38	Co-ordinates: 51 J 261304 6967527
Location: ~ 130 m east of haul road	**Comments:** Dust impacts and flora and vegetation. Ants and multiple rabbit warrens. Litter under trees. *Maireana* sp. individuals very dry, likely due to extended dry seasonal conditions.
Veg. Type: Stony ironstone low shrubland.	
Veg. Condition: Very good	
Grazing: Light, historic	
Weed cover: Nil	
Photo direction: NW	

Species	Cover (%)	Plant Health Score	Comments
Maireana triptera	15	2	Few dead individuals.
Acacia burkittii	15	7b	Insect galls.
Acacia aptaneura	10	7b	Browsing line.
Eremophila oldfieldii	5	7b	
Eremophila ?compacta (EIA_38_001)	<2	3	Very dry.

Other species: *Eremophila jucunda, Acacia aneura sens. lat., Eremophila granitica, Solanum lasiophyllum, Senna sp.*

Appendix G Vegetation condition rating maps 2020

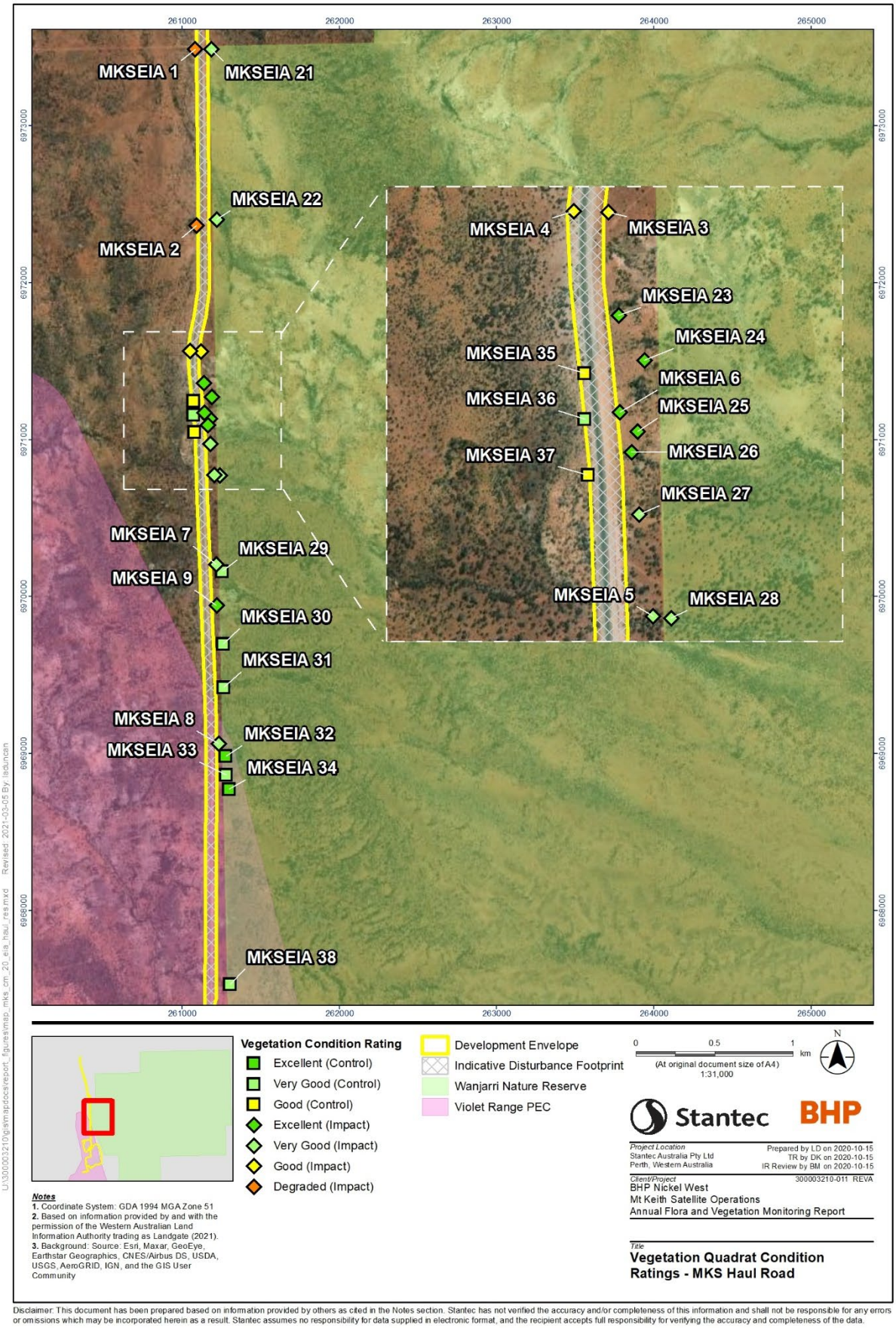


Figure F-1: Visual representation of the vegetation condition ratings for vegetation quadrats assessed in September 2020 situated along the MKS haul road.

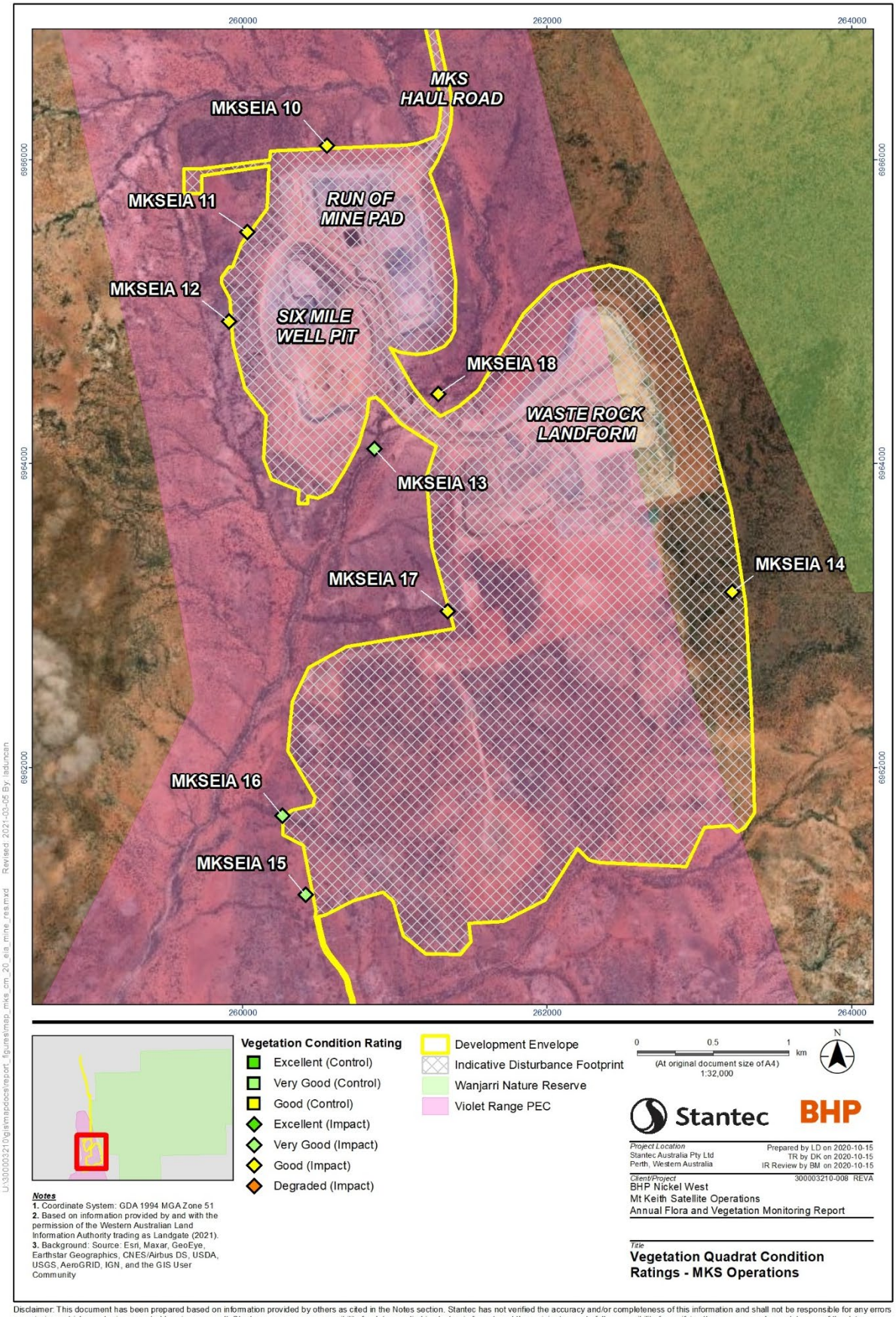


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Figure F-2: Visual representation of the vegetation condition ratings for vegetation quadrats assessed in September 2020 situated at MKS Operations.

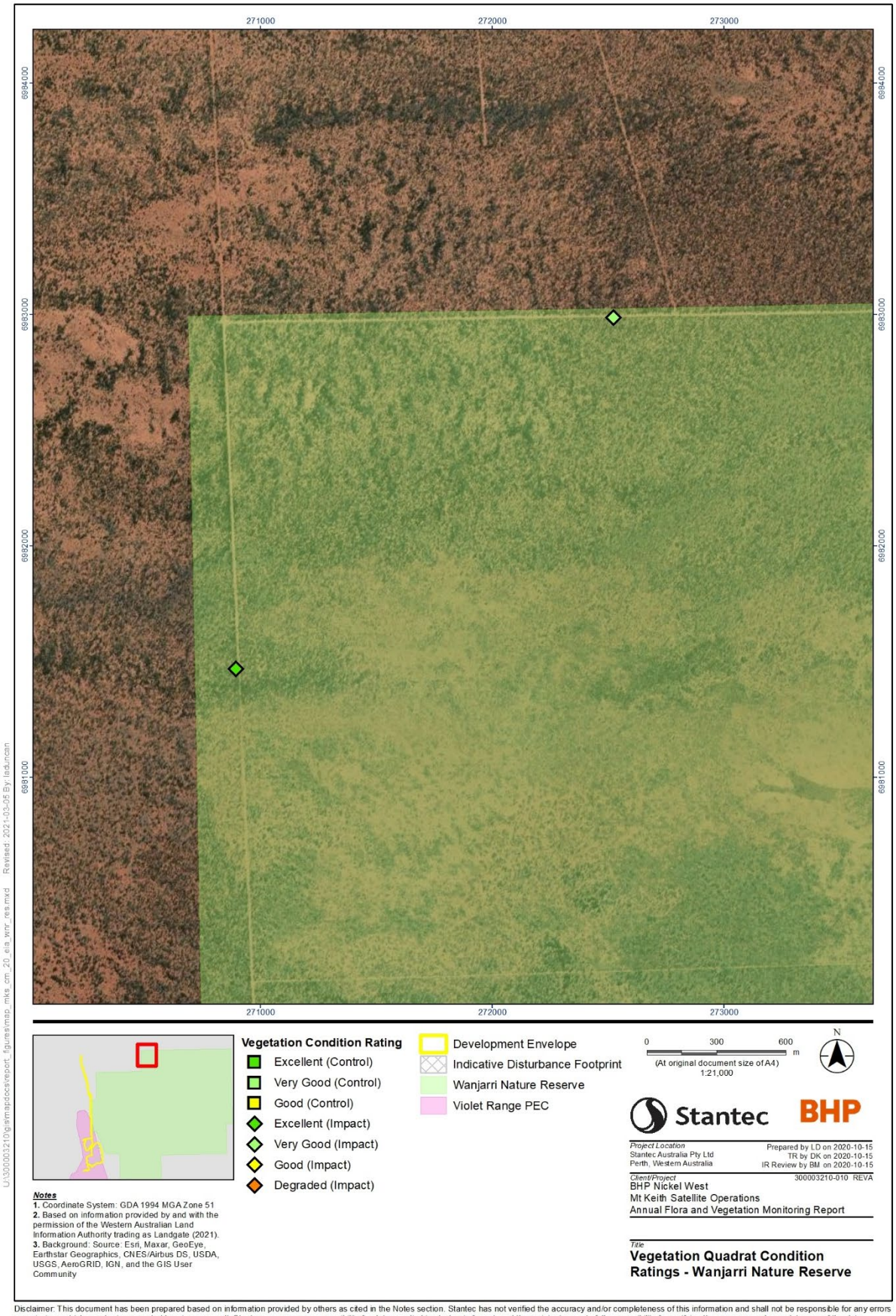

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Figure F-3: Visual representation of the vegetation condition ratings for vegetation quadrats assessed in September 2020 situated on the northern edge of Wanjarri Nature Reserve.

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7.4 Appendix 4 – Astron (2021) Mt Keith Remote Sensing Analysis

25 March 2021

Our Reference: 2471-21-EOLR-1Rev0_210325

Stuart Hawkins
Environmental Approvals Specialist (Consultant)
BHP Nickel West Operations
125 St Georges Terrace
Perth WA, 600

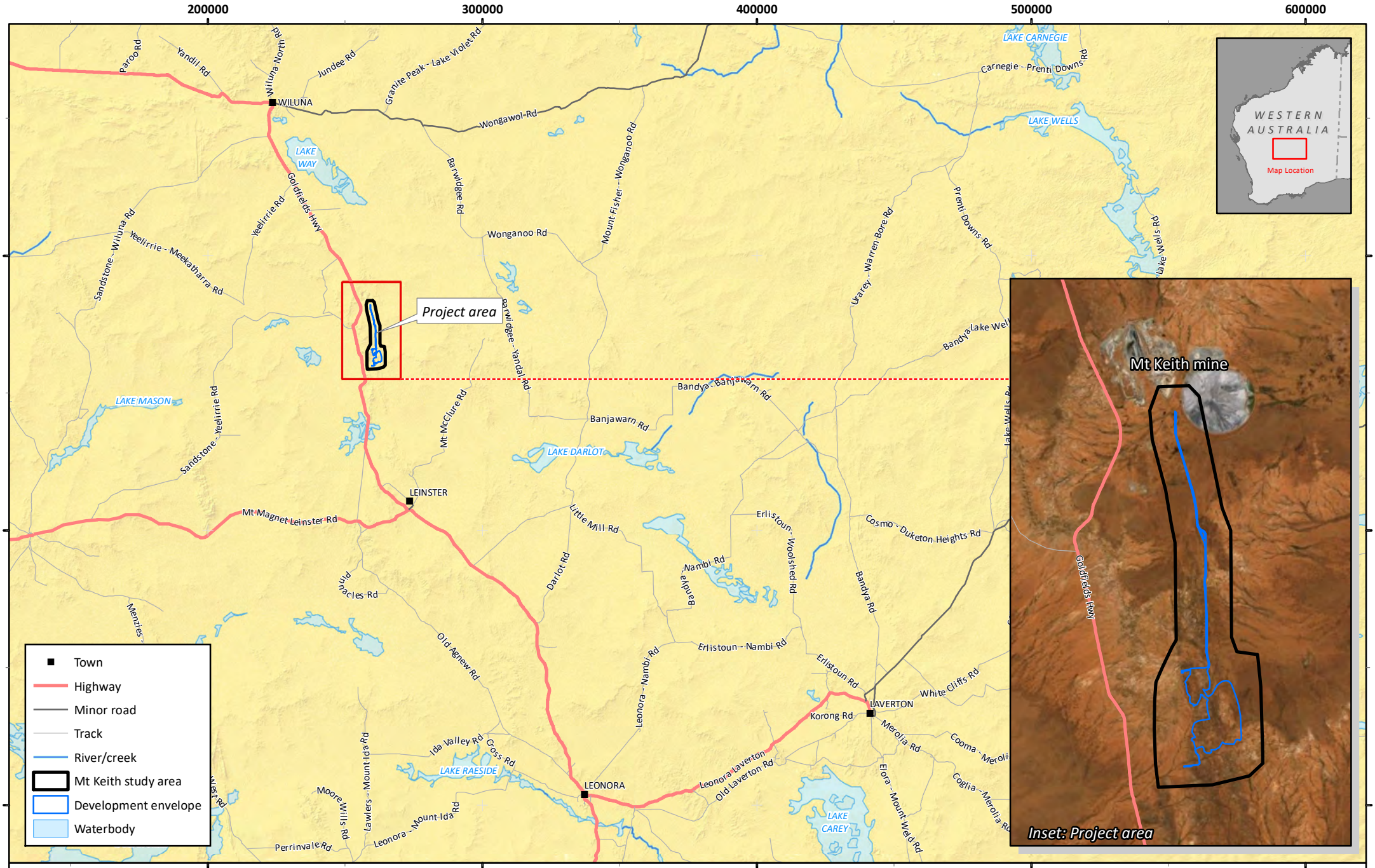
Dear Stuart,

Re: Mt Keith Vegetation Remote Sensing Analysis

1 Introduction

BHP Nickel West (NiWest) Operations requested Astron Environmental Services (Astron) to undertake a remote sensing analysis of vegetation condition encompassing the Mt Keith Satellite Project (the study area), approximately 18 km south of the Mt Keith mine operations. The study area is 109 km^2 and located within the Violet Range (Perseverance Greenstone Belt) vegetation complexes (banded ironstone formation) Priority Ecological Community (the Violet Range PEC) (Figure 1). The Wanjarri Nature Reserve, occurring on the eastern border of the development envelope of the study area, supports conservation significant flora and is the only reserve in the northern part of eastern Goldfields (CALM 1996) .

Stage One of the remote sensing analysis was completed by Astron in 2020 (Astron Environmental Services 2020) and focused on analysing the condition of the vegetation in the project area to fulfil compliance obligations outlined in the Mt Keith Satellite Project Flora and Vegetation Environmental Management Plan (FVEMP) (BHP Nickel West 2018). This was achieved by utilising medium resolution imagery (Sentinel-2) from 2015, 2017 and 2019. An index based on spectral properties that distinguish healthy vegetation from unhealthy vegetation was used to assess change from the baseline period to current year (2020). Stage Two will follow on from Stage One utilising Sentinel-2 and high-resolution (WorldView) satellite imagery from 2017 and 2020 to assess vegetation change from the baseline period (2017) to current (2020 year). The following report describes and discusses changes in vegetation condition across the Mt Keith Satellite Project.



BHP Nickel West
Mt Keith Remote Sensing Analysis

Figure 1: Project location

Scale: 1:1,750,000 at A4
Coordinate System: GDA 1994 MGA Zone 51

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delivering environmental intelligence™

Author: C. Fisk | Drawn: C. Dyde | Date: 23-03-2021 | Figure Ref: 2471-21-EODR-1RevA_210323_Fig01_Locn

2 Methods

2.1 Imagery Acquisition

Vegetation condition in the Mt Keith study area was analysed using Sentinel-2 and WorldView imagery. Sentinel-2 satellites were launched by the European Space Agency (ESA) in 2015 and the constellation consists of two satellites (S2a and S2b) that produce 10 m to 60 m resolution multispectral imagery. The Sentinel-2 sensors collect reflectance data across 13 bands within the electromagnetic spectrum including visible and near infrared (NIR) wavelengths (ESA 2015). Imagery has been available since June 2015 and is collected every 2 to 3 days.

Sentinel imagery was acquired from the Digital Earth Australia (DEA) National Computing Infrastructure platform. This platform provides the data in an analysis ready format, that have been corrected geometrically and atmospherically (DEA 2019). Since pixel values are available at surface reflectance, no further pre-processing is required before analysis.

WorldView-2 and WorldView-3 were launched by Maxar in 2009 and 2014, respectively. Both sensors collect reflectance data across eight multispectral bands within the electromagnetic spectrum including visible and near infrared (NIR) wavelengths. These sensors differ in their spatial resolution. WorldView-2 has a spatial resolution of 0.5 m to 2 m while WorldView-3 has a spatial resolution of 0.3 m to 1.2 m (GeoImage 2010, DigitalGlobe 2013).

The dates images were acquired for this study are outlined in Table 1. Since Sentinel was launched in 2015, the first available image for the study area that was suitable for analysis was 22 October 2015. The WorldView-2 imagery was acquired and prepared by Geoimage while the WorldView-3 Imagery was acquired through Maxar. Atmospheric correction was performed by Maxar while geometric correction was completed by Astron.

Table 1: Imagery acquired for vegetation assessment.

Sensor	Image Acquisition Date
Sentinel-2	21 September 2017
	12 September 2020
WorldView-2	21st September 2017
WorldView-3	29th September and 6th and 26th October [i]2020

2.2 Vegetation Analysis

For each image, the Modified Soil Adjusted Vegetation Index (MASVI) was derived from surface reflectance values. MSAVI (Equation 1) exploits the reflectance properties of live vegetation (low red range, high near infrared range reflectance) to distinguish vegetation from the surrounding environment while also accounting for the influence of bare soil (Qi et al. 1994).

$$\mathbf{MSAVI} = \frac{\mathbf{2} \times \boldsymbol{\rho}_{\boldsymbol{NIR}} + \mathbf{1} - \sqrt{(\mathbf{2} \times \boldsymbol{\rho}_{\boldsymbol{NIR}} + \mathbf{1})^2 - \mathbf{8} \times (\boldsymbol{\rho}_{\boldsymbol{NIR}} - \boldsymbol{\rho}_{\boldsymbol{R}})}}{\mathbf{2}}$$

Equation 1: The Modified Soil Adjusted Vegetation Index. Where ρ_{NIR} NIR band reflectance of the image, ρ_R: red band reflectance of the image.

The MSAVI layer were then used to produce change detection images between the baseline (2017) and the current (2020) layers. The method calculates per pixel change by subtracting the baseline image from the current 2020 layer. This produced the following MSAVI change layers:

- Sentinel MSAVI change from 2017 to 2020 (MSAVI layer 2020 – MSAVI layer 2017)
- WorldView MSAVI change from 2017 to 2020 (MSAVI layer 2020 – MSAVI layer 2017).

The MSAVI change values do not represent percent change. Values greater than 0 indicate a linear increase in MSAVI values between dates (for example 0.1 weak increase, >0.3 strong increase), values less than 0 indicate a decrease in MSAVI (for example -0.1 weak decrease, <-0.3 strong decrease) while 0 indicates no change. To test for statistically significant MSAVI change a cluster analysis was used and is discussed in more detail in the following paragraphs.

Using the MSAVI layers, the proportion of vegetation cover was calculated for each image date. By setting thresholds for the MSAVI layers based on the visual inspection of the data, binary layers were produced that represented vegetation and non-vegetation (referred to as 'landscape'). These were used to calculate the vegetation cover statistics. The binary layers were also vectorised to enable the extraction of MSAVI values from vegetation only (referred to as 'vegetation segments'). Images were produced to show the MSAVI change values to 2017 and 2020 within the vectorised vegetation segments defined at baseline (2017). Images simply showing MSAVI change across all features in the landscape throughout the time periods were also presented.

To identify hotspots of positive and negative vegetation change, geospatial cluster analysis was performed. This involves analysing change values for each pixel in the context of change values for neighbouring pixel values. The Getis-Ord statistic was calculated to separate aggregations of pixels with similar levels of change from areas of random change. For instance, positive clusters indicate pixels with positive change surrounded other pixels with positive change while differing from the general trend (Getis and Ord 1992). It is important to note that in case of a uniform trend, no clusters will be returned. Therefore, the cluster results should be viewed along with the change layers. The Getis-Ord statistic assigns a Z-score to each cluster - the statistical significance measured based on a monte-carlo approach. Then, from significant Z-scores, a kernel density calculation is performed to produce raster layers of MSAVI clusters. Colours indicate the clustering of different values; as an example, darker blue refers to the concentrated highly positive MSAVI values, while lighter colours mean clustered occurrence of lower MSAVI change values.

2.3 Auxiliary Data

To identify natural influences on vegetation condition within the study area, data on rainfall and fire history were collected and analysed.

Since the Bureau of Meteorology weather stations near the study area did not have rainfall data for the period after 2017, annual (October to September) and monthly rainfall data were sourced from Scientific Information for Land Owners (SILO) using the grid data of latitude -24.40 south and longitude 120.55 east (Queensland Government 2020).

Fire history for the area were extracted from the Northern Australian Fire Information (NAFI) database (Department of the Environment and Energy 2019). This database provides yearly division of fire boundary shapefiles with attributes including month of the event.

2.4 Project Personnel

Table 2 outlines the personal who prepared and reviewed the following report.

Table 2: List of personnel.

Personnel	Position	Role	Qualification
Dr. Claire Fisk	Remote Sensing Analyst	Data Analysis & Report Author	• PhD (Remote Sensing), University of Adelaide • Bachelor of Environmental Science (Honours), University of South Australia
Carl Dyde	Senior GIS Analyst	Map Preparation	• BSc (Marine and Environmental Science), Murdoch University
Dr Robert Archibald	Principal Scientist	Technical Review	• PhD (Biological Science), Murdoch University • Honours (Environmental Biology), Curtin University • Graduate Diploma (Landcare), Curtin University • BSc (Pop., Res. And Tech) Murdoch University
Haylea Warrener	Project Coordinator	Due Diligence Review	• Bachelor of Science (Honours), Murdoch University
Dr Jacob Delfos	Manager – Earth Observation	Approval	• PhD (Spatial Science), Curtin University • MSc (Physical Geography – Geographic Information Systems), Utrecht University, Netherlands

3 Results

3.1 Rainfall

The data extracted from the SILO data base (Figure 2) indicate that annual rainfall was above the long-term average (256 mm) from 2011 to 2016. A gradual decrease in rainfall occurred after the peak in 2015, until 2019 when rainfall fell to well below the long-term average. Rainfall measured in 2020 continues the downward trend in annual rainfall for the project area and was well below the average, with the lowest rainfall on record since 2010. Monthly rainfall totals in January, February, and August 2020 (Figure 3) were above the long-term monthly averages, but totals for other months were well below average.

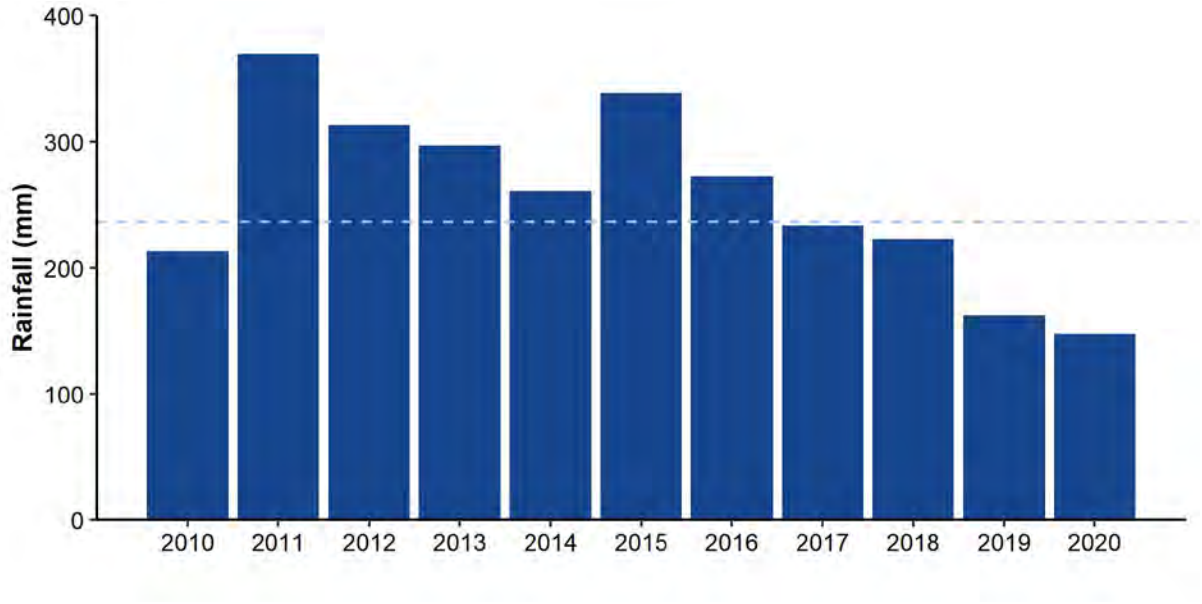


Figure 2: Rainfall total for 12-month periods from (1st October to 30th September) from 2010 to 2019 for the study area (data from SILO grid -27.40, 120.55). Dashed line represents the long-term average for the period 2010 to 2020.

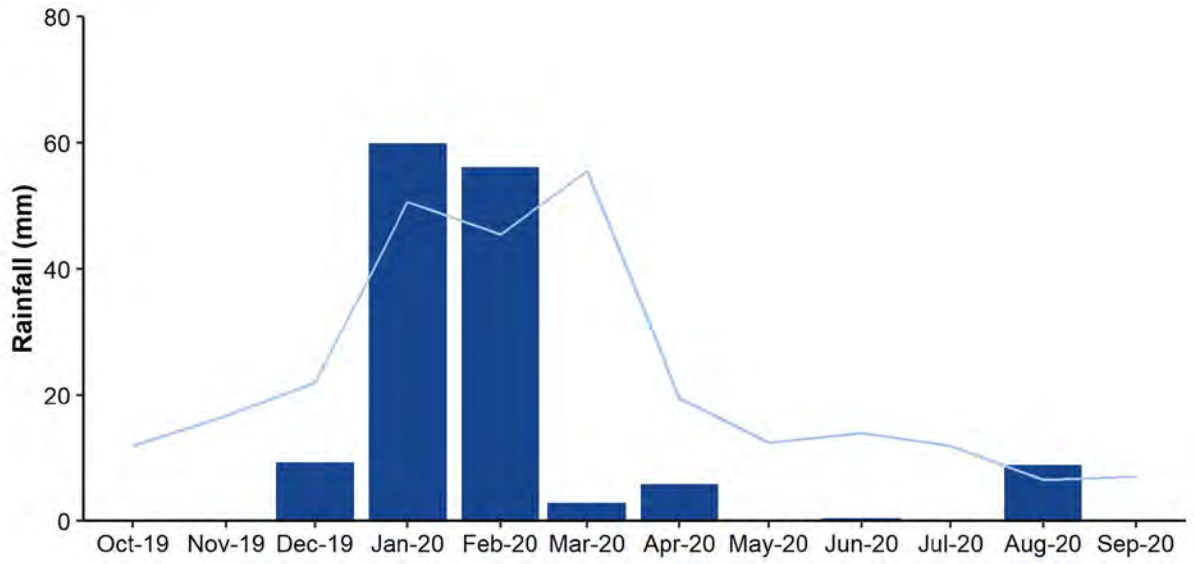


Figure 3: Monthly rainfall total for October 2019 to September 2020 (data from SILO grid -27.40, 120.55). Plotted line represents long-term monthly average (2010 to 2020).

3.2 Fire History

Based on the NAFI database, no fires were identified in the study area between January 2017 and December 2020. Visual examination of multispectral Sentinel imagery, WorldView imagery and the derived MSAVI layers also did not indicate any sign of fire disturbance.

3.3 MSAVI and Vegetation Cover

MSAVI statistics for the whole landscape (vegetation and non-vegetation) and for vegetation segments only were extracted from the four MSAVI raster layers (Table 3 and Table 4). The percentage of the landscape covered by vegetation for each year and binary threshold for MSAVI that separates vegetation from other features are also included in Table 3 and Table 4. Overall, higher MSAVI values were recorded in 2017 compared to the MSAVI values in 2020. Both the WorldView and Sentinel vegetation statistics describe similar trends present for both the landscape and vegetation segments only.

Table 3: Modified Soil Adjusted Vegetation Index (MSAVI) and vegetation cover statistics derived from Sentinel-2 data. For vegetation segments, the MSAVI threshold used to identify vegetation segments is indicated in brackets.

Statistics	Landscape (vegetation and non-vegetation)		Vegetation segments	
	2017	2020	2017 Cover (0.38)	2020 Cover (0.30)
5th percentile	0.21	0.14	0.38	0.30
Mean MSAVI	0.30	0.22	0.42	0.33
95th percentile	0.42	0.31	0.51	0.41
Standard Deviation	0.06	0.05	0.04	0.04
Vegetation Cover (%)*	11.8	7.1	-	-

*Vegetation segments were extracted based on cover; therefore, a cover calculation is not applicable for segments.

Table 4: Modified Soil Adjusted Vegetation Index (MSAVI) and vegetation cover statistics derived from WorldView-2 and WorldView-3 data. For vegetation segments, the MSAVI threshold used to identify vegetation segments is indicated in brackets.

Statistics	Landscape (vegetation and non-vegetation)		Vegetation segments	
	2017	2020	2017 Cover (0.27)	2020 Cover (0.25)
5th percentile	0.00	0.04	0.27	0.25
Mean MSAVI	0.14	0.18	0.35	0.32
95th percentile	0.36	0.31	0.49	0.46
Standard Deviation	0.13	0.08	0.07	0.07
Vegetation Cover (%)*	14.3	7.4	-	-

*Vegetation segments were extracted based on cover, therefore, a cover calculation is not applicable for segments.

3.4 MSAVI Change

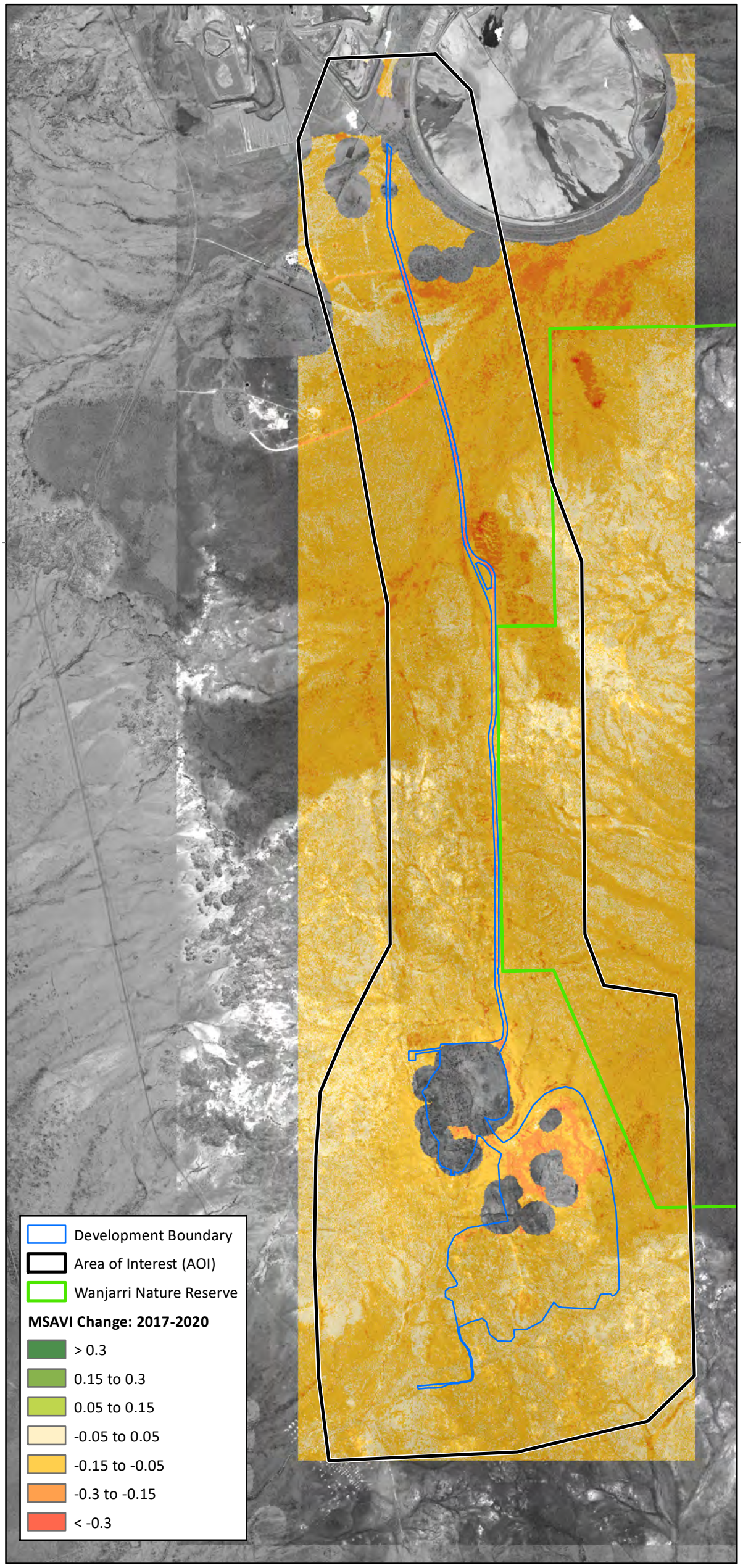
The MSAVI change statistics (Table 5) and change maps (Figure 4 and Figure 5) show that there was an overall decrease in MSAVI between 2017 and 2020. Similar to the negative change observed between 2017 and 2019 (Astron Environmental Services 2020), negative change observed (Figure 4) was more pronounced for vegetation along creek lines and for banded vegetation that is likely to be dependent on sheet flow of surface water following rainfall. The continued decrease in MSAVI can be explained by the continued decrease in annual rainfall (Figure 2). Vegetation in locations that typically receive surface water flows often display more pronounced fluctuation in greenness when there are significant upward or downward trends in rainfall. In some areas, negative MSAVI change can also be attributed to the clearing of vegetation for new infrastructure.

Table 5: MSAVI change derived for landscape and vegetation segments (based on the 2017 segment areas).

Statistics	Landscape (vegetation and non-vegetation)		2017 Vegetation segments	
	Sentinel-2 2017-2020	WorldView 2017-2020	Sentinel-2 2017-2020	WorldView 2017-2020
5th percentile	-0.16	-0.20	-0.13	-0.28
Mean MSAVI	-0.08	-0.05	-0.10	-0.11
95th percentile	-0.02	0.05	0.00	0.03
Standard Deviation	0.04	0.08	0.04	0.09

MSAVI Change Landscape

MSAVI Change Vegetation Segments



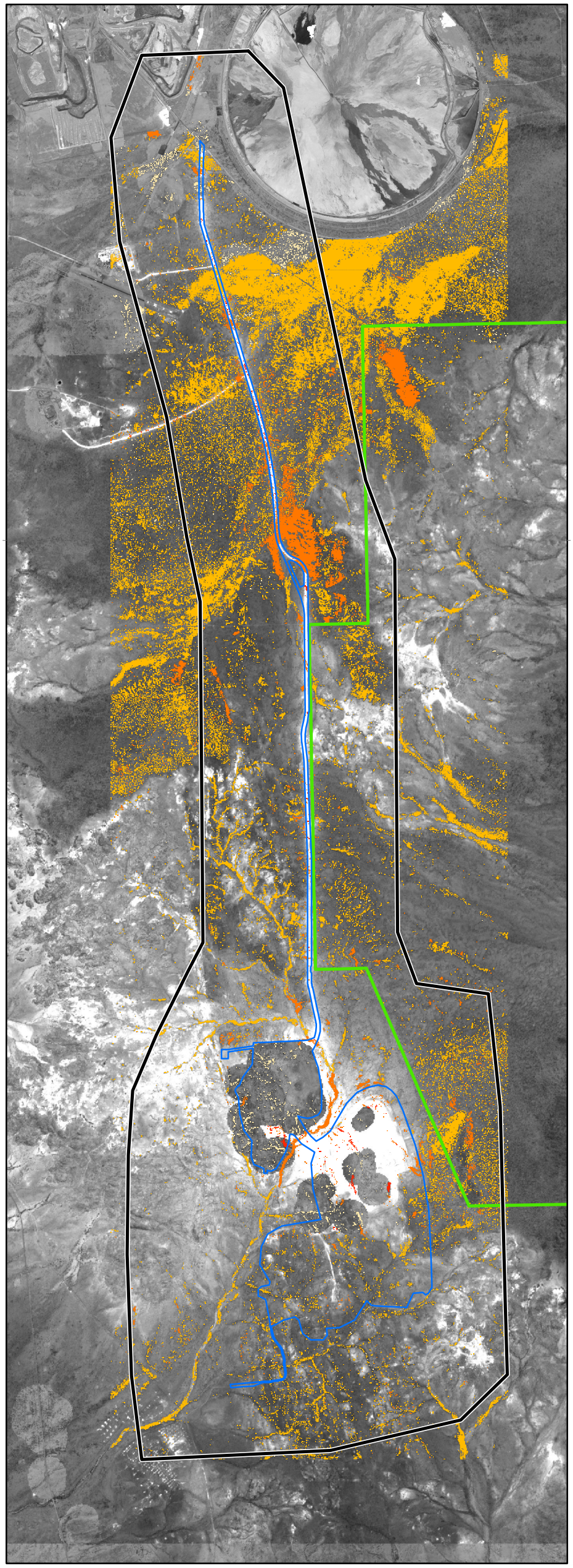


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Figure 4: Sentinel-2 Modified Soil Adjusted Vegetation Index Change September 2017 to September 2020

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Author: C. Fisk	Date: 15-03-2021
Drawn: C. Dyde	Figure Ref: 2471-21-EODR-1RevA_210315_Fig04_MSAVI_S2

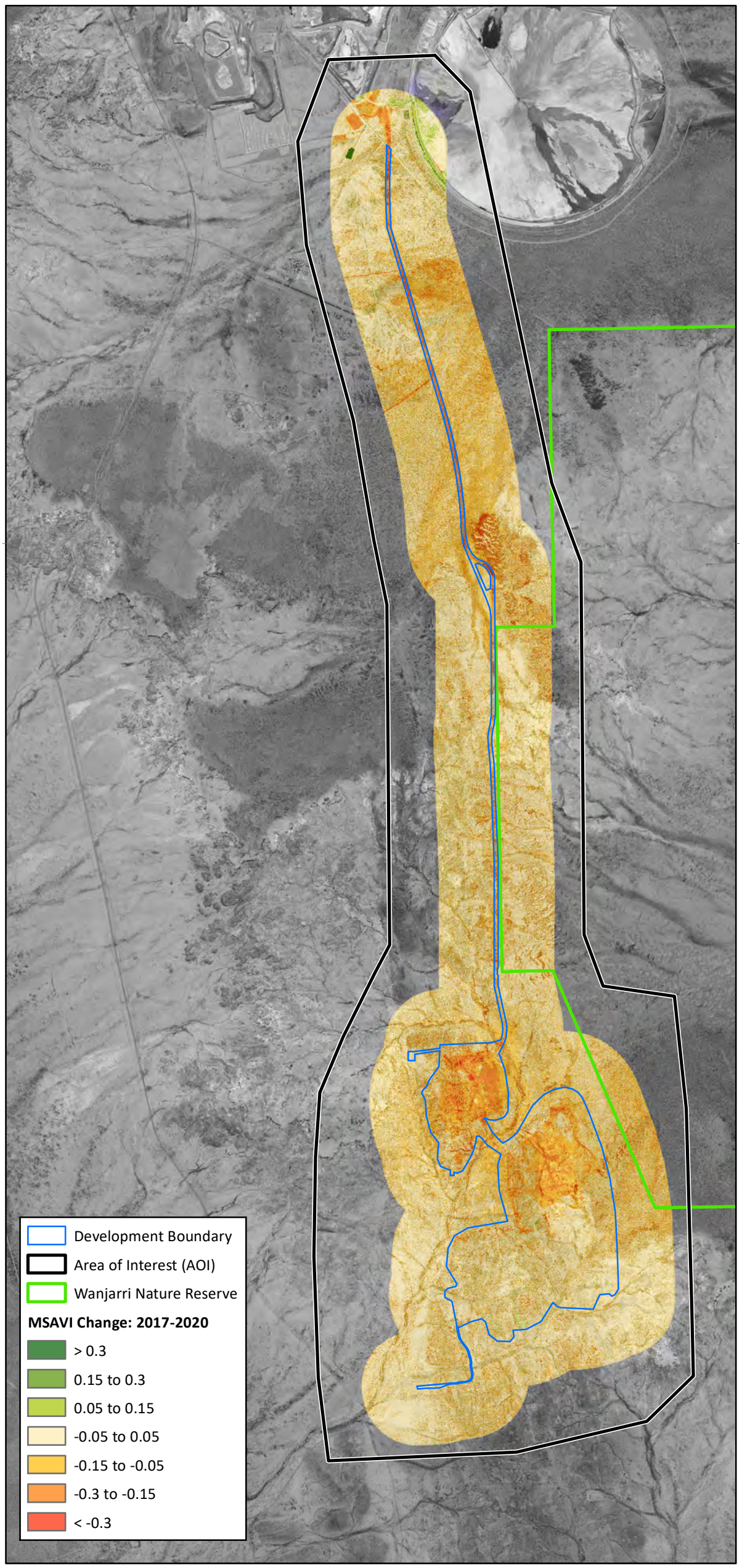
Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 4 5 Kilometres

N

MSAVI Change Landscape

MSAVI Change Vegetation Segments



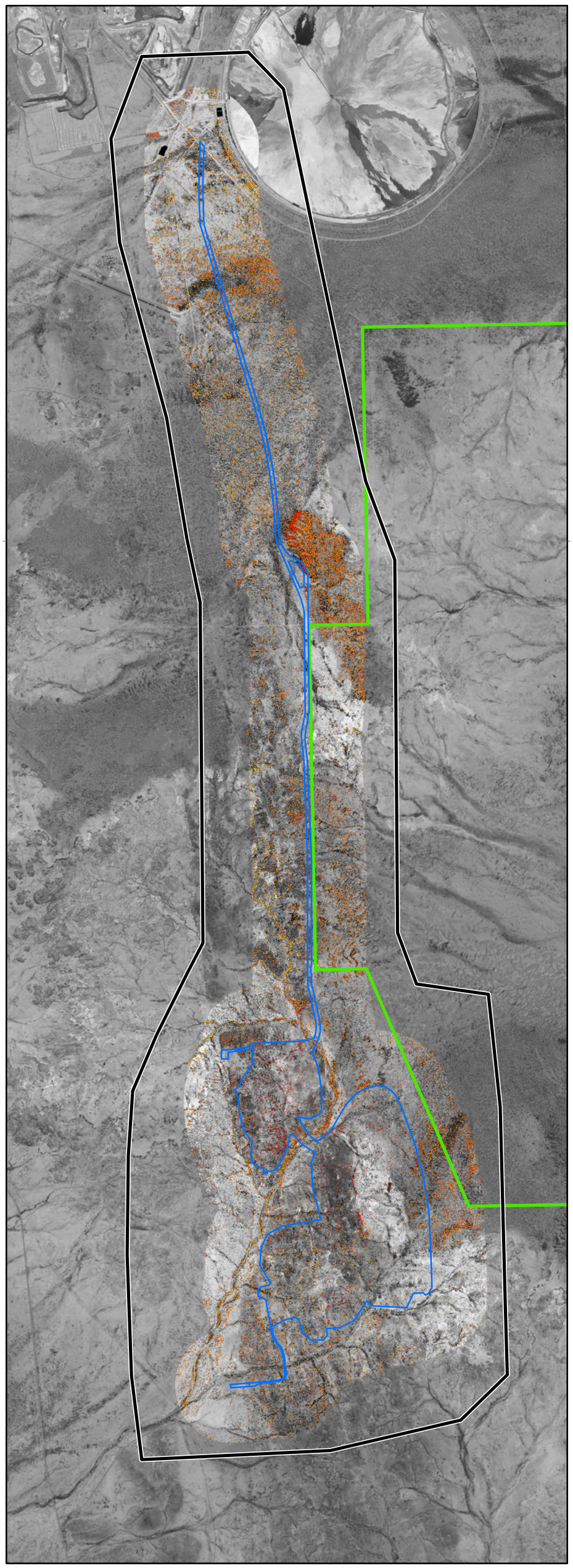


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Figure 5: WorldView Modified Soil Adjusted Vegetation Index Change September 2017 to September 2020

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Author: C. Fisk	Date: 15-03-2021
Drawn: C. Dyde	Figure Ref: 2471-21-EODR-1RevA_210315_Fig05_MSAVI_WV

Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 4 5 Kilometres

N

3.5 Cluster Analysis

The results of the cluster analysis (Figure 6 and Figure 7) derived from the 2017 to 2020 MSAVI change layer highlight areas of statistically significant change (hotspots). The WorldView and Sentinel cluster analysis returned negative value clusters associated with vegetation clearing for new infrastructure with the development boundary (approved Haul Road and Mine Area). Negative change clusters are also visible for vegetation along creek lines and sheet flow areas (Figure 6 Northern inset). This is consistent with the negative clusters associated with the 2017 to 2020 comparison (Astron Environmental Services 2020). Small areas of positive clusters are present, mostly in the north adjacent to the creek line. The cause of these clusters of increase is not clear.

255000
260000
265000
6980000
6975000
6970000
6965000
6960000

Area of Interest (AOI)
Development Boundary
Wanjarri Nature Reserve
Cluster Analysis
High : 0.1
Low : -0.1

2017

2020

2017

2020

m
0 200 400 600 800

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Figure 6: Sentinel-2 Cluster analysis September 2017 to September 2020

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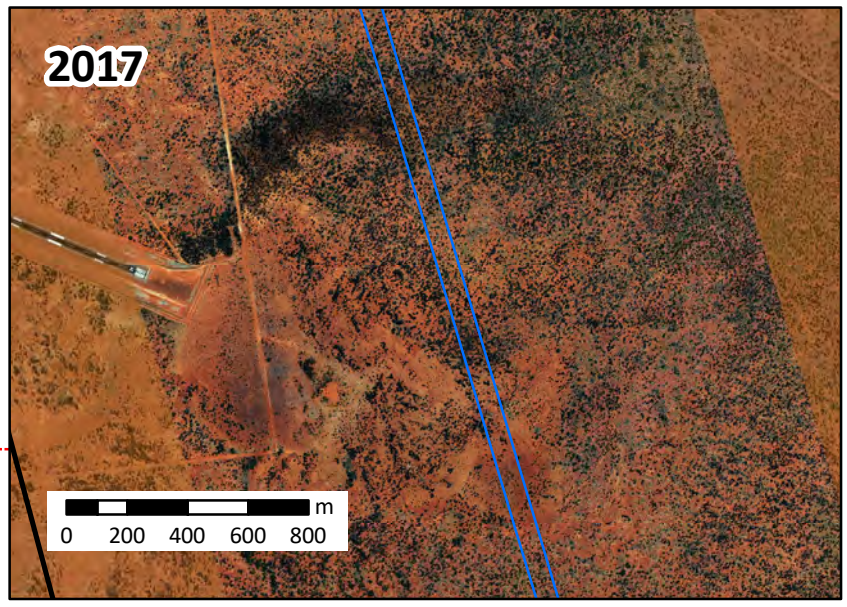
Author: C. Fisk	Date: 18-03-2021
Drawn: C. Dyde	Figure Ref: 2471-21-EODR-1RevA_210315_Fig06_Cluster_S2

Scale: 1:80,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 4 5 Kilometres
N

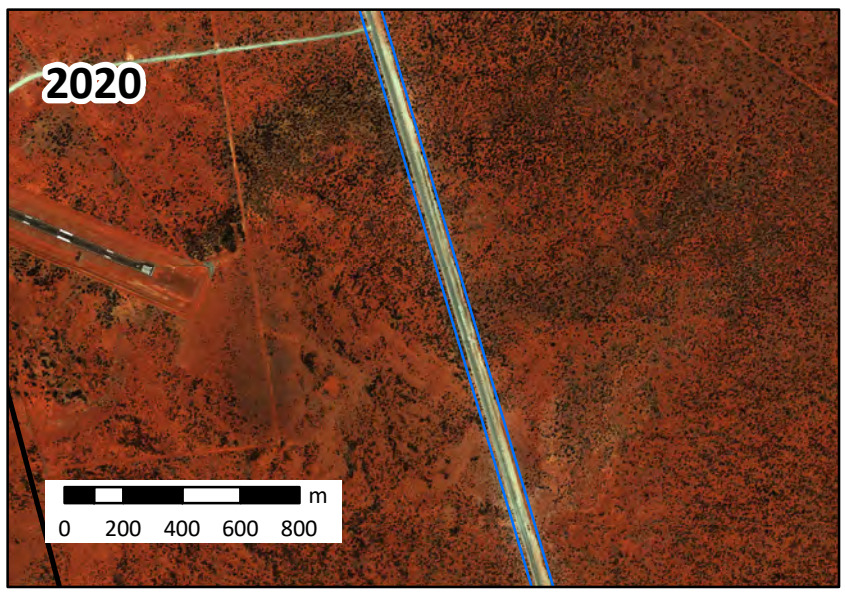
255000
260000
265000
6980000
6975000
6970000
6965000
6960000

Area of Interest (AOI)
Development Boundary
Wanjarri Nature Reserve
Cluster Analysis
High : 0.1
Low : -0.1

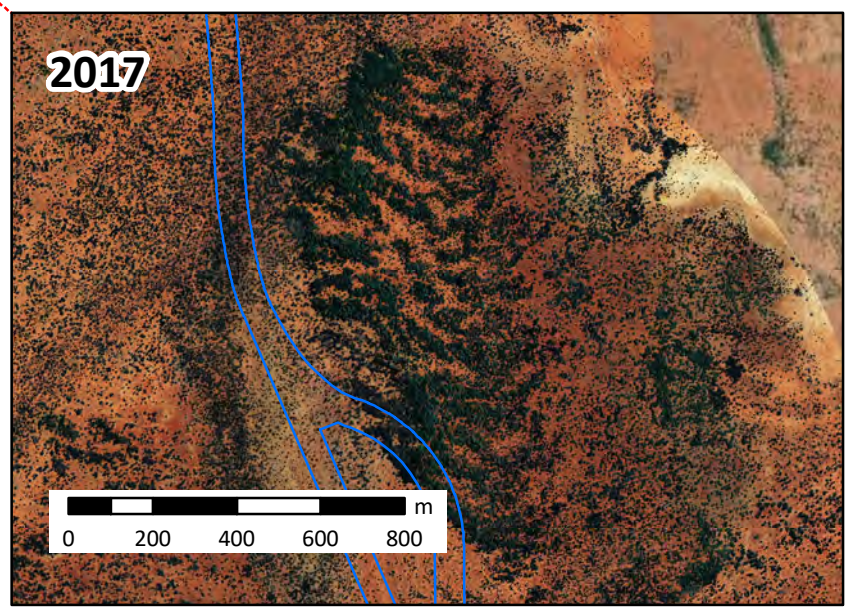
2017



2020



2017



2020

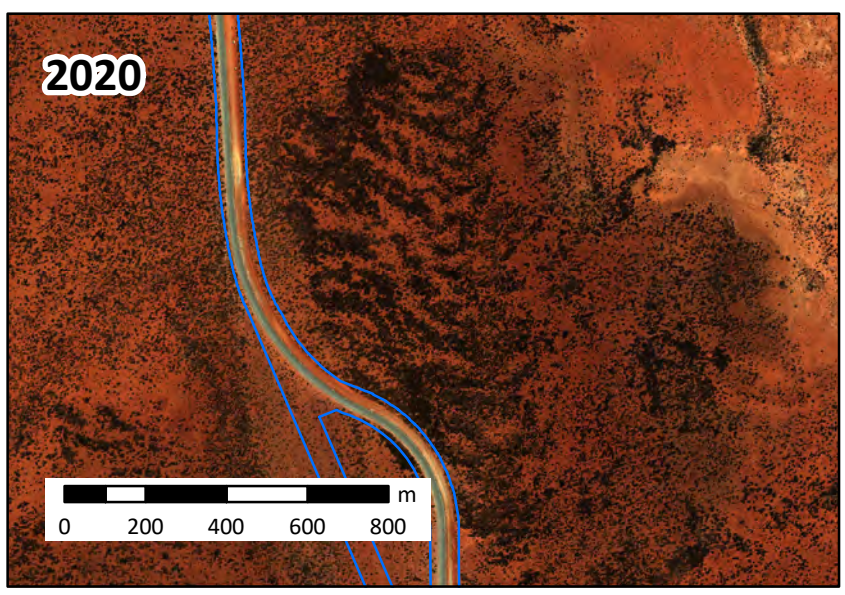


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Figure 7: WorldView Cluster analysis September 2017 to September 2020

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Author: C. Fisk	Date: 15-03-2021
Drawn: C. Dyde	Figure Ref: 2471-21-EODR-1RevA_210315_Fig07_Cluster_WV

Scale: 1:80,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
Kilometres
0 1 2 3 4 5
N

4 Conclusions

The Stage Two remote sensing desktop assessment of the Mt Keith Satellite Project involved the analysis of medium resolution Sentinel-2 and high-resolution WorldView multispectral imagery to describe patterns of changes in vegetation from the baseline period (2017) to the current period (2020).

Analyses show a decrease in overall vegetation condition between the baseline and current year (2020). This is consistent with the 2017 to 2019 assessment conducted as part of Stage One (Astron Environmental Services 2020). The widespread decline in vegetation health appears to be strongly influenced by the continuing decline in annual rainfall across since 2017.

As expected, direct disturbance to vegetation from clearing for approved infrastructure (Haul Road and Mine Area) was detected in the analysis.

This report was prepared by Dr Claire Fisk (Remote Sensing Analyst) and reviewed by Dr Robert Archibald (Principal Scientist). If you have any queries please do not hesitate to contact me or Project Coordinator, Haylea Warrener

Yours sincerely
ASTRON ENVIRONMENTAL SERVICES

Jacob Delfos
Manager - Earth Observation

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7.5 Appendix 5 - Hydrological Processes EMP

The CAP document prepared under Condition 4-1 of the Statement 1087 approval identifies that annual identifies that annual CAR reports will include monitoring information collected during implementation of the Hydrological Processes EMP. The Hydrological Processes EMP is not subject to the conditions of the Statement 1087 approval.

The Hydrological Processes EMP was implemented during the reporting period, key components include:

- Weather data;
- Jones Creek peak flow water level;
- Monitoring of groundwater bores; and
- No sediment or water pool sampling was conducted during the period.

With specific regard to groundwater, the quarterly monitoring has identified continued localised groundwater drawdown in the monitoring bores within close proximity to the Six Mile Well shaft; as predicted by modelling completed prior to Project implementation. The monitoring bores at the Goliath Mine Pit do not indicate notable groundwater drawdown.

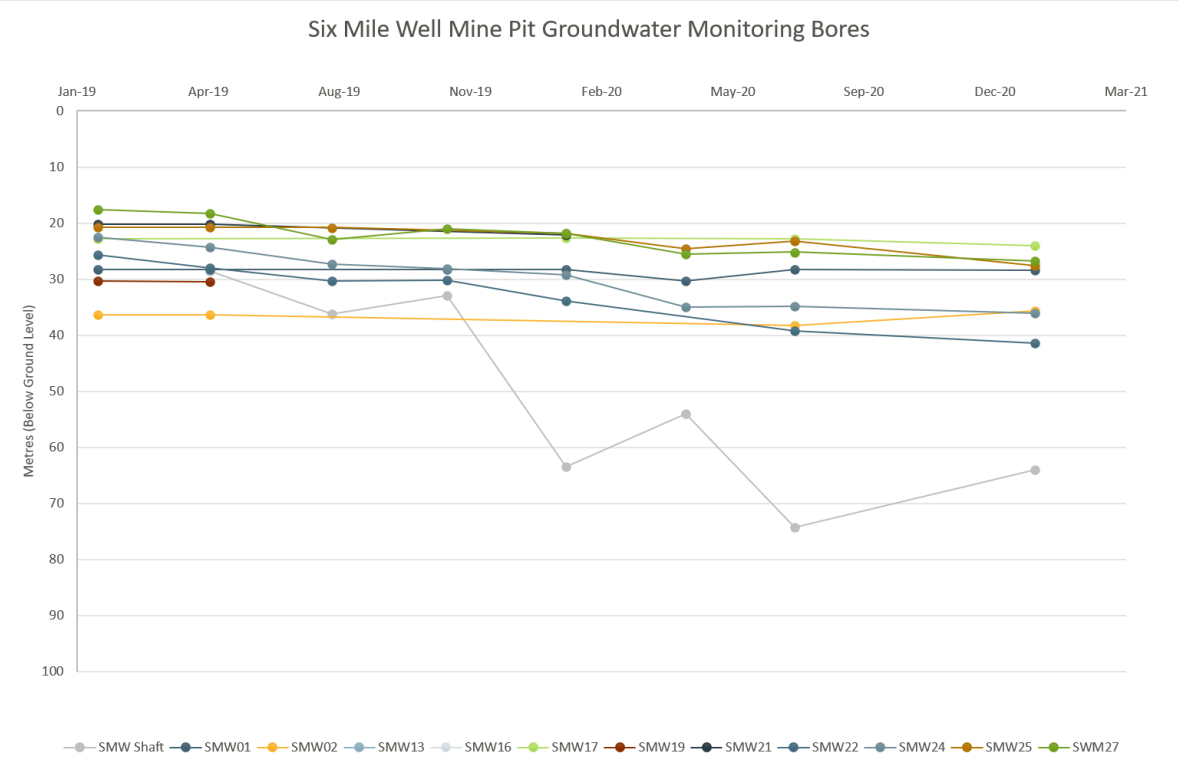

Figure A3-3: Six Mile Well Mine Pit Groundwater Monitoring Bore Levels 2019 to 2020.

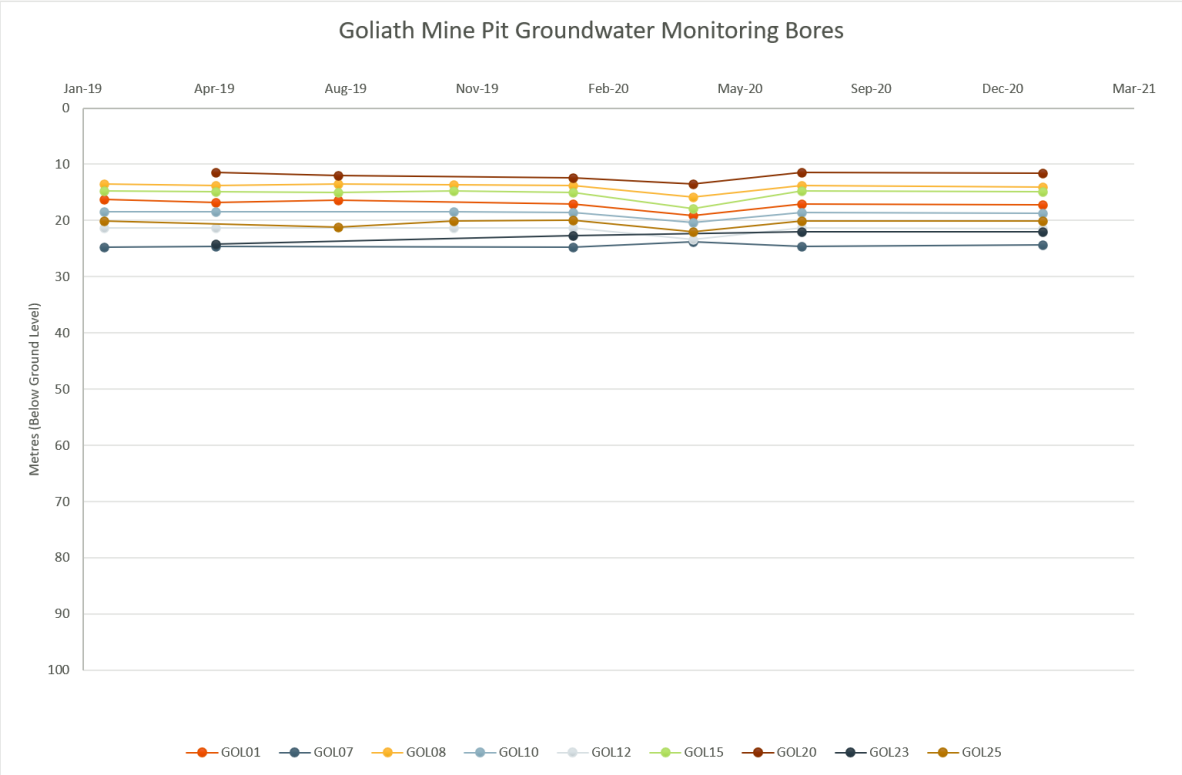

Figure A3-4: Goliath Mine Pit Groundwater Monitoring Bore Levels 2019 to 2020.

7.6 Appendix 6 - Mine Closure Plan

The CAP document prepared under Condition 4-1 of the Statement 1087 approval identifies that annual CAR reports will include environmental monitoring data which has been collected to support the Mine Closure Plan (BHP Nickel West 2019c). The Mine Closure Plan is not subject to the conditions of the Statement 1087 approval.

No environmental monitoring information to support the Mine Closure Plan was collected during the reporting period.