Macedon Gas Project

Compliance Assessment Report

Australian Operations

27th January 2023

Issued for Use

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1. Introduction

The Macedon gas project develops natural gas from the Macedon field in production lease WA-42-L for Western Australia's domestic gas market.

The project comprises a pipeline from subsea production wells to an onshore gas processing facility, located in the Ashburton North Strategic Industrial Area (ANSIA), approximately 17 kilometres southwest of Onslow. After the gas is processed, it is transferred via a sales gas pipeline to the Dampier to Bunbury Natural Gas Pipeline (DBNGP, Figure 1).

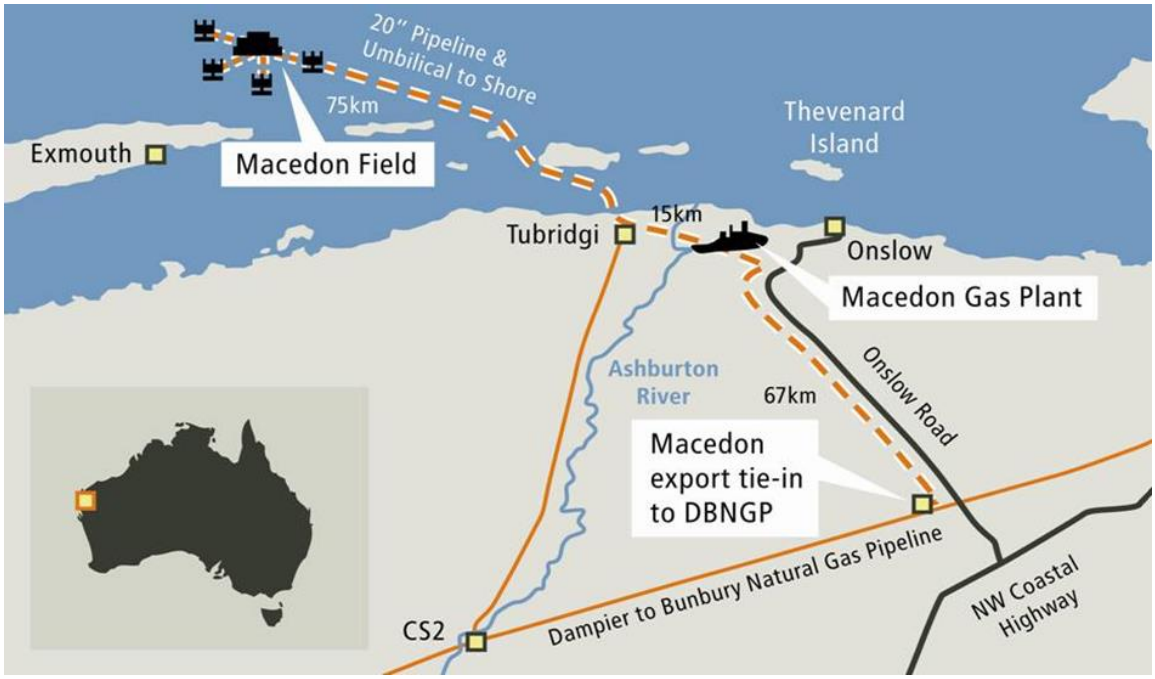


Figure 1: Macedon Gas Project Location

The Macedon Gas Plant lease area for the gas processing facility and associated infrastructure, including the ground flares and evaporation pond areas are shown in Figure 2.

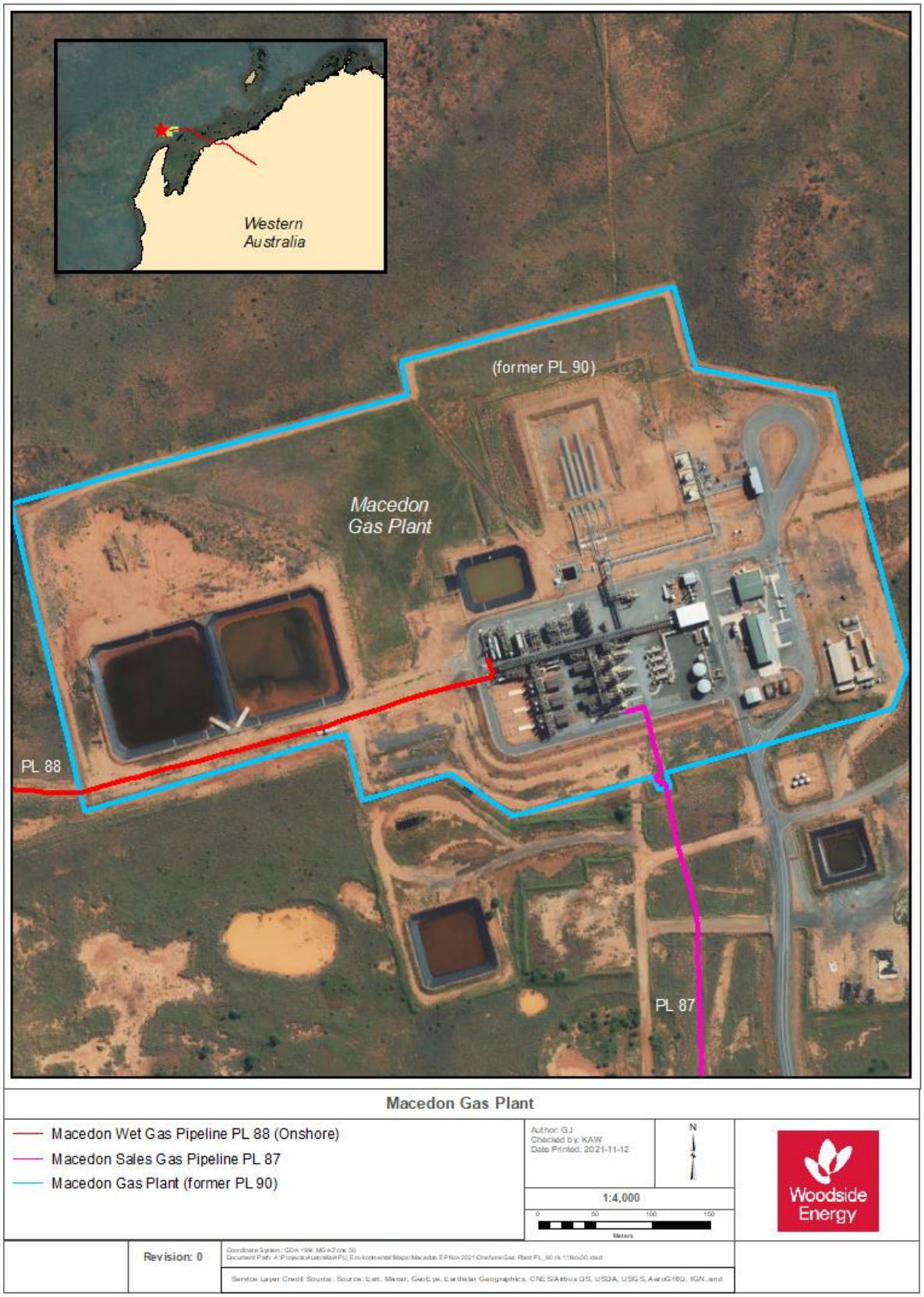


Figure 2: Macedon Gas Plant Leases and Layout

1.1 Purpose of the Compliance Assessment Report

The purpose of this Compliance Assessment Report (CAR) is to assess compliance at the Macedon Gas Plant with the Environment Protection Authority (EPA) Statement 844 dated 28 October 2010 in accordance with the Compliance Assessment Plan, approved on 18 March 2011.

The CAR 2022 covers activities undertaken during the period 1 January 2022 to 31 December 2022.

1.2 Compliance Assessment Reporting Requirements

This report meets the intent of the compliance reporting requirements as defined in the Macedon Gas Project Compliance Assessment Plan (PMA-BHP-EN-EIA-0002).

1.3 Endorsement of CAR

This Compliance Assessment Report has been endorsed by Francis Bolzan, Vice President FPSO & Macedon, Australian Operations.

2. Project Status

2.1 Current Status of Project

The project is currently in the operational phase.

2.2 Project Activities covered by CAR

This CAR covers the following project activities undertaken in the period 1 January 2022 to 31 December 2022:

1) Operations, 1 January 2022 to 31 December 2022.

3. Compliance with Ministerial Statement 844

3.1 Compliance with Conditions

Operation of the Macedon Gas Project is compliant with Ministerial Statement No. 844 as reported in Table 1.

3.2 Rehabilitation Monitoring

In March 2012, BHP Petroleum (now Woodside Energy Global Pty Ltd) commenced rehabilitation of 285 hectares of an area approved for clearing for gas pipelines. Monitoring of the rehabilitation was required to demonstrate that, within three years of commencement of rehabilitation, the reinstated vegetation had species diversity not less than 60 percent of the known original species diversity and weed coverage which was equal to or less than the pre-clearing levels (Condition 8 of Ministerial Statement 844).

Monitoring of transects along the Macedon Gas Pipeline was completed by Astron in 2010 (the baseline survey prior to clearing) and then post-rehabilitation in 2013, 2014 and 2015 by Astron, and by Biota Environmental Sciences in 2017, 2019, 2021 and 2022. There was no vegetation rehabilitation survey completed in 2020 due to Covid restrictions impacting on personnel movements and availability, and later, affecting the optimal timing of the survey (i.e. after adequate rainfall).

For the 2022 reporting year, the field survey was completed between 18-20 May 2022. Ten rehabilitation sites were assessed in historically disturbed areas, with seven of these also having an associated analogue site located in a nearby undisturbed area. Monitoring was completed according to the methodology established by Astron. To summarise the development of vegetation along the rehabilitation transects, each transect was also ranked according to a predefined rehabilitation scale. A summary of the results from the 2022 Rehabilitation Monitoring Survey is provided below and the full report is provided in Appendix 1.

A total of 72 native vascular flora species from 46 genera and 18 families were recorded from the 17 transects in 2022. Two weed species were recorded: **Cenchrus ciliaris* and **C. setiger.*

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

(1) Species diversity is not less than 60 per cent of the known original species diversity.

This criterion has been met for species richness in the monitored transects, with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is again considered to be 'Excellent' and would be expected to continue to develop towards pre-clearing floristic community in the longer term.

(2) Weed coverage is equal to or less than that of pre-cleared levels.

The criterion for Condition 8 in MS844 has not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2022 with regards to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2022 survey results to those of 2021, **Cenchrus ciliaris* and **C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at both BHPPD-29 and BHPPD-30, but increased significantly at BHPPD-31. Provided that continued spraying of these species within the rehabilitated areas is undertaken over the course of the next few years, it would be expected that the cover of **Cenchrus* spp. will tend towards pre-clearing levels.

A spraying program involving targeted application of herbicide to the introduced tussock grasses occurred during May 2022, however due to a number of operational constraints, the full program was not able to be completed.

3.3 Greenhouse Gas (GHG) Emissions and Intensity

Annual GHG emissions for the period 1 January 2022 to 31 December 2022 were 83,653 tonne equivalent of carbon dioxide (t CO2-e); carbon emissions intensity for the period was 7.08 t CO2-e per 1,000 barrels of oil equivalent production. Recorded emissions were slightly lower than those recorded previously and lower than those provided in the Final Environmental Performance Standard (EPS) (85,000 t CO2-e); variance between predicted and actual emissions is due to higher production rates used to estimate carbon emissions in the EPS when compared to current operations.

3.3.1 GHG Reduction Measures Investigated

Details of improvements in equipment, technology or procedures were investigated prior to development of the Macedon Project in 2010 through an energy optimisation study. The aim of the study was to identify cost effective projects, which would reduce energy and greenhouse gas emission across all operations of the Macedon Gas Project and incorporate these into the design of the Macedon Gas Project.

Woodside Energy continues to identify and evaluate GHG reduction opportunities through internal processes designed to implement greenhouse gas abatement measures, in addition to routine tracking of emissions against targets to further identify opportunities for reduction.

3.3.2 GHG Reduction Measures Implemented

Several improvements in equipment, technology and procedures identified in the Macedon Gas Project energy optimisation study were implemented in design including:

- Low resistance internal pipeline coating;
- Waste heat recovery; and
- Equipment selection designed to minimise facility pressure drop.

Recent emissions reduction initiatives implemented for the Macedon facility include:

- Installation of a solar PV system and Battery Energy Storage System (BESS) at the Macedon metering station;
- Fuel gas usage optimisation; and
- Completion of an aerial methane baseline survey.

4. Audit Table

Table 1: Audit Table

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M1.1	Implementation	The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.	Project implemented in accordance with these criteria	Compliance Assessment Report (CAR)	Min for Env		Overall		C	2022 CAR (this document)
844:M2.1	Proponent Nomination and Contact Details	The proponent for the time being nominated by the Minister under sections 38(6) or 38(7) of the Act is responsible for the implementation of the proposal.			Min for Env		Overall		C	Proponent is Woodside Energy Global Pty Ltd
844:M2.2	Proponent Nomination and Contact Details	The proponent shall notify the CEO of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.	Letter notifying CEO of any change in proponent details	Letter notifying CEO of any change in proponent details	CEO		Overall	Within 30 days of such change	C	Updated July 2022 (Form 3 submitted 14.07.2022)
844:M3.1	Time Limit of Authorisation	The authorisation to implement the proposal provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.	Implement project		Min for Env		Overall	Commence implementation by 27 October 2015	CLD	Implementation commenced in 2011 OEPA Desktop Audit report 31.08.2012
844:M3.2	Time Limit of Authorisation	The proponent shall provide the CEO with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.	Letter notifying CEO that proposal has substantially commenced	Letter to the CEO demonstrating that the proposal has substantially commenced	CEO		Overall	Within one month of commencement	CLD	Letter sent to CEO dated 16.01.2012 OEPA Desktop Audit report 31.08.2012
844:M4.1	Compliance Reporting	The proponent shall prepare and maintain a compliance assessment plan (CAP) to the satisfaction of the CEO.	CAP will be developed prior to implementation and maintained	CAP	CEO		Overall	Prior to implementation and ongoing	C	OEPA accepted 18.03.2011 (CAP latest version following annual review, dated 27.01.2023)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M4.2	Compliance Reporting	The proponent shall submit to the CEO the CAP required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner. The CAP shall indicate: • the frequency of compliance reporting; • the approach and timing of compliance assessments; • the retention of compliance assessments; • the method of reporting of potential non-compliances and corrective actions taken; • the table of contents of compliance assessment reports; and • public availability of compliance assessment reports.	CAP will be developed prior to implementation and submitted to CEO	CAP	CEO		Pre-construction	At least six months prior to the first CAR required by Condition 4-6, or prior to implementation, whichever is sooner	CLD	OEPA accepted 18.03.2011
844:M4.3	Compliance Reporting	The proponent shall assess compliance with conditions in accordance with the CAP required by condition 4-1.	Prepare Compliance Assessment Report (CAR)	CAR	Min for Env		Overall	When requested by the CEO	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR; 2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR 2022 CAR (this document)
844:M4.4	Compliance Reporting	The proponent shall retain reports of all compliance assessments described in the CAP required by condition 4-1 and shall make those reports available when requested by the CEO.	CAR to include compliance assessments (audit table), retain CAR for the life of the project in electronic and hard copy format	CAR	CEO		Overall	Annual	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR, 2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR 2022 CAR (this document)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M4.5	Compliance Reporting	The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.	Advise CEO of potential non-compliance in writing	Log of phone call, email or letter	CEO		Overall	Within seven days of that non-compliance being known	C	Non-compliance related to condition 8 (below).
844:M4.6	Compliance Reporting	The proponent shall submit to the CEO the first CAR fifteen months from the date of issue of this Statement addressing the twelve month period from the date of issue of this Statement and then annually from the date of submission of the first CAR. The CAR shall: • be endorsed by the proponent's Managing Director or a person delegated to sign on the Managing Director's behalf; • include a statement as to whether the proponent has complied with the conditions; • identify all potential non-compliances and describe corrective and preventative actions taken; • be made publicly available in accordance with the approved CAP; and • indicate any proposed changes to the CAP required by condition 4-1.	CAR will be issued Make CAR publicly available in accordance with 'Proposal Implementation Monitoring Branch – Draft Fact Sheet 1 – Making Documents Publicly Available – April 2010'	CAR	CEO		Overall	Annually by 28 January each year with the first CAR due 28 January 2012	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR; 2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR 2022 CAR (this document)
844:M5.1	Non-Indigenous Marine Species	Prior to mobilisation of vessels and submersible equipment for the construction of the Macedon Gas Project marine pipeline and umbilical, the proponent shall update the Introduced Marine Pest Management Procedure contained in Appendix Q of the Final EPS to be consistent with the Commonwealth and State guidelines approved and published at that time, to the satisfaction of the CEO on advice from the Department of Fisheries.	Revise and obtain approval of Introduced Marine Pest Management Procedure (IMP MP)	IMP MP	CEO	DPIRD	Pre-construction	Prior to mobilisation of vessels and submersible equipment for the construction of the Macedon Gas Project marine pipeline and umbilical	CLD	Letter of Approval from CEO of EPA received 28.11.2011
844:M5.2	Non-Indigenous Marine Species	The proponent shall implement the updated Introduced Marine Pest Management Procedure for the construction and maintenance of the	Offshore pipelay and maintenance	Inspection of IMP MP vessel risk assessments,	Min for Env		Overall	For the construction and maintenance of the Macedon Gas	C	IMP MP implemented during construction phase

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		Macedon Gas Project marine pipeline and umbilical.	implemented in compliance with IMP MP	certificates of vessel cleanliness				Project marine pipeline and umbilical		Pipeline maintenance survey completed in accordance with IMP MP
844:M6.1	Marine Fauna	The proponent shall not cause physical damage to turtles, disrupt turtle nesting behaviour or cause a change to hatchling orientation in waters and/or beaches adjacent to the pipeline shore crossing during construction.	Implement Marine Turtle Impacts Management Protocol (MTI MP)	Implementation of MTI MP, Marine Fauna Observer logs	Min for Env		Construction	During construction	C	Shore crossing complete, no impacts to marine turtles recorded
844:M6.2	Marine Fauna	If the pipeline shore crossing is to take place between 1 November and 30 April the proponent shall prepare a MTI MP to the satisfaction of the CEO on advice from the DEC prior to undertaking the shore crossing. The protocol shall include: 1. employment of a suitably qualified marine fauna observer; 2. indicators for determining if and when there is potential for impacts on turtle nesting or hatchling emergence; 3. management responses to evidence of turtle activity; and 4. triggers for stopping construction activities pending further consultation with the DEC; and 5. when resumption of activities can take place, on advice of the DEC.	Prepare MTI MP	Approval of MTI MP	CEO	DBCA	Construction	Prior to undertaking the shore crossing, if the pipeline shore crossing is to take place between 1 November and 30 April	CLD	Letter of Approval from CEO of EPA received 31.10.2011
844:M6.3	Marine Fauna	The proponent shall implement the MTI MP if undertaking the pipeline shore crossing between 1 November and 30 April.	Implement MTI MP	Marine Fauna Observer logs	Min for Env		Construction	If undertaking the pipeline shore crossing location between 1 November and 30 April	CLD	Pipeline shore crossing complete. MTI MP implemented for shore crossing
844:M6.1 A	Pipeline Route – State waters	Subject to complying with the separation distances in condition 7-1, the pipeline within State waters shall be laid/constructed within the corridor	Install pipeline in corridor delineated in Schedule 2	Pipelay vessel logs, as-built survey of route	Min for Env		Construction	During offshore pipeline construction	CLD	Pipeline installed within corridor

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		delineated by the coordinates specified in Schedule 2.								
844:M7.1	Benthic Primary Producer Habitat	The proponent shall undertake all works in a manner that ensures that the loss of Benthic Primary Producer Habitat (BPPH) within the Local Assessment Area, as defined in Figure 3, does not exceed 1% for any habitat type and is minimised by maintaining the following separation distances during construction of the marine pipeline and umbilical : (1) pipeline to primary feature – 700 metres; (2) pipeline to secondary feature – 600 metres; (3) vessel movement/anchor to primary feature – 200 metres; and (4) vessel movement/anchor to secondary feature – 100 metres. Note: "loss" is loss that does not recover within 5 years, "primary feature" and "secondary feature" are as defined in Figure 18 of the Final EPS and not a feature for which proposed impacts are described in section 8.4.4.5 of the Final EPS.	Maintain separation distance during offshore pipelay as per Condition 7-1	Pipelay vessel logs, as-built survey of route, BPPH survey and loss calculations	Min for Env		Construction	During offshore pipeline construction	CLD	Letter of Approval from CEO of EPA received 23.09.2013
844:M7.2	Benthic Primary Producer Habitat	The proponent shall survey the direct loss of BPPH against the criteria in condition 7-1 starting within one month of completion of the marine pipeline and umbilical.	Survey and calculate loss of BPPH	Post construction as built survey of route, BPPH survey and loss calculations	Min for Env		Overall	Commencing within one month of completion of the marine pipeline and umbilical	CLD	Letter of Approval from CEO of EPA received 23.09.2013
844:M7.3	Benthic Primary Producer Habitat	Notwithstanding condition 7-1, if monitoring detects that construction activities have contributed to a loss of greater than 1% in any habitat type within the management unit, as defined in Figure 3, the proponent shall notify the CEO of the strategies to be implemented	Develop strategies for recovery and rehabilitation of BPPH	Post construction as-built survey, strategies	CEO		Overall	If monitoring detects that construction activities have contributed to a loss greater than 1% in any habitat type within the management unit,	C	No exceedance of loss >1% in any habitat type

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		to enhance recovery and rehabilitate the impacted BPPH.						as defined in Figure 3		
844:M8.1	Terrestrial Vegetation	Within two months following completion of construction of the gas plant and associated pipelines, the proponent shall commence rehabilitation of the temporarily cleared areas of the site that are no longer being utilised to achieve re-establishment of vegetation, such that the following criteria are met across the distribution of the disturbance footprint within three years of commencement of rehabilitation: (1) Species diversity is not less than 60 percent of the known original species diversity; (2) Weed coverage is equal to or less than that of pre-cleared levels. Note: The original species diversity and weed coverage must be determined prior to clearing or from analogue sites approved by the CEO on advice from the DEC.	Undertake rehabilitation of temporarily cleared areas (gas plant and pipelines) as per Condition 8-1	Rehabilitation monitoring reports, rehabilitation completion criteria: Species diversity greater than 60% of pre-disturbance Weed coverage less than pre-disturbance levels	CEO	DBCA	Overall	Commence rehabilitation within two months following completion of construction of the gas plant and associated pipelines and meet criteria within three years of commencement of rehabilitation	NC	Rehabilitation has been completed of temporary disturbed areas. Results from the recent rehabilitation survey undertaken in May 2022 indicated the criterion for Condition 8 in MS844 has not been met during the FY22 period but is expected to be met longer term. One transect out of the 17 monitored transects did not meet the criterion for species diversity and three transects did not meet the criterion for weed coverage. Refer to Rehabilitation Monitoring section in this report.
844:M8.2	Terrestrial Vegetation	In liaison with the DEC, the proponent shall monitor progressively the performance of rehabilitation for a range of sites against the criteria in condition 8-1 based on appropriately timed surveys after rain, until the completion criteria are met. The surveys shall be conducted annually unless otherwise agreed by the CEO.	Monitor rehabilitation success against rehabilitation completion criteria, conduct surveys in accordance with Condition 8-2	Rehabilitation monitoring report, rehabilitation completion criteria: Species diversity greater than 60%of pre-disturbance Weed coverage equal to or less than pre-disturbance levels Correspondence with DPAW	CEO	DBCA	Overall	Appropriately timed after rain on an annual basis unless otherwise agreed by the CEO until the completion criteria are met	C	Rehabilitation Survey undertaken in 2022 (Appendix 1 of this document)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M8.3	Terrestrial Vegetation	The proponent shall include a rehabilitation monitoring report in the CAR referred to in condition 4-6 commencing from the date rehabilitation was commenced. The report shall address in the report the following: 1. The progress made towards meeting the criteria required by condition 8-1; and 2. Contingency management measures in the event that the criteria required by condition 8-1 are unlikely to be met.	Submit rehabilitation monitoring report	Rehabilitation monitoring report, rehabilitation completion criteria: Species diversity greater than 60%of pre-disturbance Weed coverage equal to or less than pre-disturbance levels	Min for Env		Overall	Commencing from the date rehabilitation was commenced and on an annual basis	C	Rehabilitation monitoring report attached as Appendix 1 of the 2022 CAR (this document)
844:M9.1	Terrestrial Fauna	The proponent shall prevent the death of fauna that becomes entrapped in the onshore pipeline trenches by employing a fauna clearing person or persons to remove trapped fauna from any open pipeline trench.	Fauna clearing person(s) to remove fauna from open pipeline trench	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.2	Terrestrial Fauna	The length of open trenches shall not exceed a length capable of being inspected and cleared by a fauna clearing person within the time frame specified in condition 9-4.	Clear open trench within identified timeframes specified in Condition 9-4	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.3	Terrestrial Fauna	Fauna refuges providing suitable shelter from the sun and predators for trapped fauna shall be placed in the trench at intervals not exceeding 50 metres.	Fauna refuges installed in open trench at intervals < 50m	Daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.4	Terrestrial Fauna	Inspection and clearing of fauna from trenches by a fauna clearing person shall occur twice daily and not more than half an hour prior to the backfilling of trenches, with the first daily inspection and clearing to be undertaken no later than 3.5 hours after sunrise, and the second inspection and clearing to be undertaken daily between the hours of 3:00 pm and 6:00 pm.	Clear open trench within identified timeframes	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Twice daily and not more than half an hour prior to the backfilling of trenches, with the first daily inspection and clearing to be undertaken no later than 3.5 hours after sunrise, and the second inspection and clearing to be	CLD	Trenching complete

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
								undertaken daily between the hours of 3:00 pm and 6:00 pm		
844:M9.5	Terrestrial Fauna	In the event of rainfall, the proponent shall, following the clearing of fauna from the trench, pump out significant pooled water in the open trench (with the exception of groundwater) and discharge it to adjacent vegetated areas in a manner that does not cause erosion.	Pump out significant pooled water in open trench	Daily logs	Min for Env		Construction	In the event of rainfall, following the clearing of fauna from the trench	CLD	Trenching complete. No loss of fauna during pipeline construction. Small losses due to groundwater flooding in trenches.
844:M10.1	Emissions to Air	The proponent shall install equipment and manage ongoing operations such that best practice for a petroleum gas/condensate facility in respect to volatile organic compounds and oxides of nitrogen emissions is achieved.	Install equipment as detailed in Air Emissions Best Practice Report (AEBPR) and manage ongoing operations	Approved AEBPR, CAR	Min for Env		Overall	Construction and ongoing operations	C	Equipment identified in AEBPR installed and operated. Emission testing demonstrates effective management of VOC and NOx
844:M10.2	Emissions to Air	The proponent shall provide reports showing the basis on which 'best practice' was determined, to the satisfaction of the CEO, as follows: 1. for plant and equipment – prior to applying for a Works Approval under Part V of the Act; and 2. for ongoing management of operations – prior to applying for a Licence under Part V of the Act.	Prepare AEBPR for selection of equipment and ongoing management of operations	Approved AEBPR, CAR	CEO		Overall	Prior to applying for a Works Approval (for plant and equipment) and prior to applying for a Part V licence (for ongoing management of operations)	CLD	Approval of AEBPR received from CEO of EPA in letter dated 07.07.2011
844:M11.1	Greenhouse Gas Abatement	For the life of the project, the proponent shall include in the CARs referred to in Condition 4-6 the following: 1. annual greenhouse gas (GHG) emissions and intensity resulting from the operation of the project in comparison to the annual emissions predicted in the Final EPS and reasons for any variance; 2. details of improvements in equipment, technology or procedures investigated	CAR to include GHG emissions and intensity (including comparison to annual emissions predicted in the Final EPS and reasons for any variance) and proposed and implemented GHG reduction methods	CAR	Min for Env		Operation	For the life of the project	C	2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR, 2022 CAR (this document, see Section above on GHG)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		by the proponent that would reduce greenhouse gas emissions; and 3. details of improvements in equipment, technology or procedures implemented by the proponent that will reduce greenhouse gas emissions.								
844:M12.1	Decommissioning	At least six months prior to the anticipated date of closure, the proponent shall submit a Final Decommissioning Plan designed to ensure that the site is suitable for future land uses, for approval of the CEO. The Final Decommissioning Plan shall set out procedures and measures for: 1. removal or, if appropriate, retention of plant and infrastructure; and 2. remediation or rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s).	Submit Final Decommissioning Plan	Approval of Final Decommissioning Plan	CEO		Operation	At least six months prior to the anticipated date of closure	NR	
844:M12.2	Decommissioning	The proponent shall implement the Final Decommissioning Plan required by condition 12-1 from the date of closure until such time as the Minister determines, on advice of the CEO, that the proponent's decommissioning responsibilities have been fulfilled.	Implement Final Decommissioning Plan	Decommissioning and rehabilitation monitoring reports	Min for Env	CEO	Decommission-ing	From the date of closure until such time as the Minister determines, on advice of the CEO, the proponent's decommissioning responsibilities have been fulfilled	NR	
844:M12.3	Decommissioning	The proponent shall make the Final Decommissioning Plan required by condition 12-1 publicly available in a manner approved by the CEO.	Make Final Decommissioning Plan publicly available	Final Decommissioning Plan available as directed by CEO	CEO		Overall	Within two weeks of receiving approval for the final Decommissioning Plan	NR	

Note:

- 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 = Minister's condition; P = Proponent's commitment; A= Audit specification; N= Procedure
- Any elements with status = "Audited by proponent only" are legally binding but are not required to be addressed specifically in compliance reports, if complied with
- Acronyms list:- Min for Env = Minster for the Environment; CEO = Chief Executive Officer of OEPA; OEPA = Office of the Environmental Protection Authority; EPA = Environmental Protection Authority; DBCA = Department of Biodiversity, Conservation and Attractions (formerly Department of Environment and Conservation (DEC)); DMIRS = Department of Mines, Industry Regulation and Safety (formerly Department on Mines and Petroleum (DMP)); DoH = Department of Health; DPIRD = Department of Primary Industries and Regional Development (formerly Department of Fisheries (DoF))
- Status: C – Compliant (implementation of the proposal has been carried out in accordance with the requirements of the audit element); NC – Non-compliant; CLD – Completed (A requirement with a finite period of application has been satisfactorily completed); NR – Not required at this stage.
- Abbreviations: MTI MP - Marine Turtle Impact Management Plan; IMP MP - Introduced Marine Pest Management Plan; AEBPR - Air Emissions Best Practice Report; GHG - Greenhouse Gas

5. Non-compliance and Corrective/Preventative Actions

5.1 Non-Compliance

During the period covered by this CAR (1 January 2022 to 31 December 2022), there was a non-compliance with condition 8.1 with regard to meeting species diversity and weed coverage criteria for the re-establishment of terrestrial vegetation.

As presented in above Section 'Rehabilitation Monitoring', one transect out of the 17 monitored transects did not meet the criterion for species diversity, however it is likely the area did not receive adequate rainfall compared to the other sites. In the absence of threatening factors, it is anticipated that this transect will once again be considered "excellent" and expected to continue to develop towards pre-clearing floristic diversity in the longer term. Three transects did not meet the criterion regarding weed coverage. Introduced tussock grasses *Cenchrus ciliaris* and *C. setiger* have decreased in abundance at two transect sites, but increased significantly at one transect site. With continued spraying, it is expected the coverage of *Cenchrus* spp. will tend towards pre-clearing levels.

5.2 Corrective/Preventative Actions

The monitoring of rehabilitation is ongoing on a yearly basis, with no additional actions required to improve species diversity. An additional weed spraying event is planned for FY23, dependent on suitable conditions for weed growth, and the frequency of these events will be re-evaluated for future years.

6. Changes to the Compliance Assessment Plan

The following changes have been incorporated into the Compliance Assessment Plan (Revision 13, January 2023):

Change key contacts in Section 2:

- Steve Jeffcote – Environment Manager, Australian Operations; email steve.jeffcote@woodside.com

Change to person authorised to sign in Section 3.1:

- Francis Bolzan – Vice President FPSO & Macedon, Australian Operations

7. References

BHP Billiton Petroleum 2010, Macedon Gas Project Environmental Protection Statement, July 2010 – Final. BHP Billiton Petroleum, Perth.

BHP Petroleum Macedon Gas Project – Compliance Assessment Plan, (PMA-BHP-EN-EIA-0002).

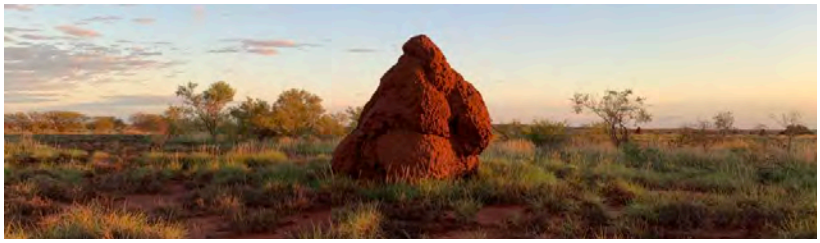
Department of Parks and Wildlife 2013, Weed Prioritisation Process for DPaW (formerly DEC) – "An Integrated Approach to Weed Management on DPaW-Managed Lands in WA", Government of Western Australia, Perth.

Australian Weeds Committee 2012, Weeds of National Significance 2012, Department of Agriculture, Fisheries and Forestry, Canberra.

APPENDIX 1: Macedon Rehabilitation Monitoring Report

Biota Environmental Sciences

Macedon Gas Pipeline Rehabilitation Survey 2022



Prepared for Woodside

July 2022

Biota Environmental Sciences

ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 1593

Prepared by: T. Hounsham, S. Werner

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Macedon Pipeline Rehabilitation Survey 2022

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1.0 Summary

1.1 Background

On 1st June 2022, BHP Petroleum and Woodside merged and on 11th July 2022, BHP Petroleum Pty Ltd changed its company name to Woodside Energy Global Pty Ltd (Woodside).

In 2012, Woodside commenced the rehabilitation of a 285 ha area that had been cleared along the Macedon Gas Pipeline, south of Onslow. As part of a condition of the environmental approval of the Macedon project (Condition 8 of Ministerial Statement 844 (MS844); Minister for Environment 2010), monitoring was required to demonstrate that the reinstated vegetation met the following criteria within three years of commencement of rehabilitation:

(1) Species diversity is not less than 60 per cent of the known original species diversity.

(2) Weed coverage is equal to or less than that of pre-cleared levels.

A monitoring program was developed by Astron Environmental Services (Astron 2012). Annual monitoring was subsequently undertaken by Astron in May 2013, July 2014, September/October 2015 (collectively reported in Astron 2016), and then by Biota Environmental Sciences (Biota) in 2017, 2019 and 2021 (Biota 2017, 2019, and 2021 respectively).

In 2022, Biota were again commissioned to undertake the annual monitoring survey of the Macedon Gas Pipeline, which was completed between 18 and 20 May 2022.

1.2 Methodology

The field survey was completed between 18-20 May 2022. Ten rehabilitation sites were assessed in historically disturbed areas, with seven of these also having an associated analogue site located in a nearby undisturbed area. Monitoring was completed according to the methodology established by Astron (2012). To summarise the development of vegetation along the rehabilitation transects, each transect was also ranked according to a predefined rehabilitation scale.

1.3 Results and Conclusions

A total of 72 native vascular flora species from 46 genera and 18 families were recorded from the 17 transects in 2022. Two weed species were recorded: **Cenchrus ciliaris* and **C. setiger*.

1.3.1 Satisfaction of Completion Criteria

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

(1) Species diversity is not less than 60 per cent of the known original species diversity.

This criterion has been met for species richness in the monitored transects, again with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is considered to be 'Excellent' and would be expected to continue to develop towards a floristic community and composition more aligned with pre-clearing levels in the longer term.

(2) Weed coverage is equal to or less than that of pre-cleared levels.

The criterion for Condition 8 in MS844 has again not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2022 with regard to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2022 result to that of 2021, **Cenchrus ciliaris* and **C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at both BHPPD-29 and BHPPD-30, but increased significantly at BHPPD-31. Provided that continued spraying of these species within the rehabilitated areas is undertaken at the appropriate times and intensity of effort over the course of the next few years, it would be expected that the cover of **Cenchrus* spp. will tend towards pre-clearing levels.

1.3.2 Rehabilitation within the Mt Minnie Conservation Area

While most of the rehabilitation transects sampled in the Mt Minnie conservation area show Good to Excellent vegetation development, with few or no weeds, two transects at the southern end of the study area remain in relatively Poor condition, with a third considered to be Good.

- Transect BHPPD-29 is considered Fair, with a somewhat moderate cover of **Cenchrus ciliaris* tussock grasses (8.15%) and no development of spinifex or perennial shrubs over the course of monitoring. Importantly, **Cenchrus* cover has decreased by 14.05% since the last monitoring survey in 2021.
- Transect BHPPD-30 is considered Poor. It shows a reasonable development of both spinifex and perennial shrub cover, but the cover of **Cenchrus* has remained high (36.3%) despite a decrease of 8.75% since the last monitoring survey in 2021. Perennial *Acacia* shrubs have also decreased.
- Transect BHPPD-31 is considered Very Poor in 2022: spinifex cover has decreased by approximately 25% to less than pre-clearing levels, with **Cenchrus* cover increasing by 42.45%.

1.3.3 Likely Progression of Vegetation along Rehabilitation Transects

Prior to the 2019 survey, DBCA requested discussion of the likely progression of revegetation in the rehabilitation areas situated within the Mt Minnie conservation area in the short term (2-5 years), medium term (5-10 years) and long term (10-20 years). Based on the data recorded from the monitoring transects in these areas to date, vegetation development is clearly variable in different areas, and would be expected to progress differently over time.

- Transects ranked as 'Excellent' in 2022 (Table 5.5) comprise **BHPPD-22, BHPPD-24, BHPPD-25, BHPPD-26** and **BHPPD-28**. Vegetation at these transects is relatively comparable to that which existed prior to clearing, with a similar or sometimes greater amount of vegetation cover and no weeds, other than a presence of a single juvenile **Cenchrus ciliaris* individual within the strip transect at **BHPPD-22** and a **Cenchrus* cover of 0.2% recorded at **BHPPD-28**. This vegetation would be expected to continue to develop in the short-term, with additional species recruiting from the soil seed bank and adjacent areas. In the medium and long-term, vegetation at the rehabilitation transects would be expected to remain stable over time, with major changes arising only due to disturbance events such as fire, or long-term shifts in the amount of rainfall received.

- Transects ranked as 'Good' in 2022 (Table 5.5) comprise **BHPPD-23** and **BHPPD-27**. The cover of native perennial vegetation along these transects is generally approaching the percentage recorded prior to clearing in 2010, although the proportions of shrubs and spinifex are often dissimilar (typically more shrubs and less spinifex). Weeds are generally absent or provide negligible cover, except for a small number of seedlings re-establishing at **BHPPD-23** in 2021 at 0.45% cover and increasing to 5% cover in 2022. It would be expected that the native vegetation cover would increase to reach the pre-clearing levels within 5 years and would then remain stable over time. Unless spot spraying is undertaken at **BHPPD-23**, it would be expected that **Cenchrus* spp. levels would continue to increase over the short-term.

- A single transect, **BHPPD-30,** ranked as 'Poor' in 2022 (Table 5.5). Spinifex has re-established within the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 35-37% since 2021; perennial shrubs (*Acacia* and *Senna*) have decreased since the last phase and annual grasses are absent all together; the cover of **Cenchrus* remains high despite a decrease of 9% since the last monitoring survey in 2021. It would be expected that the native vegetation cover would decrease over the short-term, and annual grasses and herbs would not repopulate to pre-clearing levels unless the population of **Cenchrus* spp. in the surrounding vegetation is controlled in the medium to long-term.

- A single transect, **BHPPD-29**, ranked as 'Fair' in 2022 (Table 5.5). Although there is a lack of development of perennial vegetation at **BHPPD-29** (no hummock grassland of *Triodia glabra* and no shrubland of *Acacia synchronicia* and *A. xiphophylla* that existed prior to clearing), the current cover of **Cenchrus* spp. at this transect (8.15%) has been reduced greatly from the 70% recorded in 2017, and has also decreased by 14.05% from the previous monitoring survey in 2021. It is expected that in the short term, with continued spraying, that the level of **Cenchrus* spp. will continue to decline. It would only be expected that the perennial *Acacia* shrubs and *Triodia* hummocks would become established in the medium to long-term given favourable conditions and the absence of competition from **Cenchrus* spp.

- A single transect, **BHPPD-31**, ranked as 'Very Poor' in 2022 (Table 5.5). At **BHPPD-31**, it is unlikely that the cover of *Acacia xiphophylla* will return to pre-clearing levels of 72%, with colonisation of *A. bivenosa* shrubs along this transect only likely in the very long-term. Spinifex cover has remained steady since 2021 but still 26% less than pre-clearing levels, and the cover of **Cenchrus* has increased significantly from 31.2% in 2021 to 73.65% in 2022. The greater area surrounding **BHPPD-31** continues to support large, permanent populations of *A. xiphophylla,* and as whole presents as a stable, healthy vegetation unit.

For both transects (**BHPPD-30** and **BHPPD-31**), the presence of relatively substantial amounts of **Cenchrus* spp. is likely to influence the development of native vegetation, through competition for resources and allelopathy. In the short to medium term, it is expected that the cover of native vegetation may still increase, however it is also likely that the cover of **Cenchrus* spp. will continue to remain steady or increase unless continued herbicide spraying is undertaken.

The presence of **Cenchrus* spp. is not the only factor influencing slow revegetation, however it is likely to be a significant factor over time, particularly for transects at which the cover of weeds is still moderate or high following herbicide spraying. Given the amount of **Cenchrus* spp. cover currently recorded at **BHPPD-29, BHPPD30** and **BHPPD-31**, these infestations would be expected to increase again in the short to medium term, and would likely suppress the regeneration of native perennial vegetation. It is unlikely that native vegetation would be able to re-establish to a similar state as was present prior to clearing, without continued weed control efforts.

To ameliorate the current long-term trend of a relatively stable, or increasing, **Cenchrus* population (specifically in the south-eastern end of the study area), it is recommended that the herbicide treatment plan is a bi-annual occurrence for at least seven years to eradicate the species from the soil seedbank.

1.3.4 DBCA (2018) Recommendations

With regards to meeting the four recommendations outlined by the DBCA (2018):

- Recommendation 1 (continual rehabilitation activities and weed monitoring) has been partially met by continual activities (herbicide application, last weed treatment occurring in November 2021), and by both the survey and content of this rehabilitation monitoring report.
- Recommendations 2 (identification of contingency management measures to be implemented), 3 (contingency management measures to date), and 4 (recognition of the access track acting as a potential weed vector) have been addressed within this rehabilitation monitoring report.

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2.0 Introduction

2.1 Project Background

On 1st June 2022, BHP Petroleum and Woodside merged and on 11th July 2022, BHP Petroleum Pty Ltd changed its company name to Woodside Energy Global Pty Ltd (Woodside).

Woodside constructed and operates the Macedon Gas Pipeline, which is associated with its Macedon Gas Development near Onslow. In 2010, prior to the commencement of vegetation clearing along the Macedon Gas Pipeline, Astron completed a baseline monitoring survey (Astron 2010) with the purpose of establishing permanent monitoring sites, determining baseline levels of diversity and weed cover, and acquiring vegetation data against which to assess completion criteria contained in Condition 8 of Ministerial Statement 844 (MS844) (Minister for Environment 2010).

In 2012, Woodside commenced the rehabilitation of a 285 ha area that was cleared along the Macedon Gas Pipeline. As part of a condition of the environmental approval of the Macedon project (Condition 8 of Ministerial Statement 844 (MS844); Minister for Environment 2010), monitoring was required to demonstrate that revegetation met the following criteria within three years of commencement of rehabilitation:

(1) *Species diversity is not less than 60 per cent of the known original species diversity.*

(2) *Weed coverage is equal to or less than that of pre-cleared levels.*

A monitoring program was developed by Astron (2012), and annual monitoring was subsequently undertaken by Astron in May 2013, July 2014, September/October 2015 (collectively reported in Astron 2016), and then by Biota in 2017, 2019 and 2021 (Biota 2017, 2019, and 2021 respectively).

Following comment on the 2017 results and requests for further information received from the DBCA regarding the infestations of **Cenchrus* spp. within the ex-Mt Minnie pastoral exclusion, Woodside appointed a contractor to complete weed spraying of **Cenchrus* spp. in Q3 of 2018 along the section of ROW within the Mt Minnie conservation area. Woodside then commissioned an additional phase of monitoring in 2019 to assess whether both Condition 8 of MS844 had been met, and if the level of **Cenchrus* spp. within the Mt Minnie conservation area has decreased. Results from the 2019 survey indicated that the two criteria above had not been met.

2.2 DBCA Review of 2017 Monitoring Phase

Prior to 2019 survey, the DBCA reviewed the results of the 2017 monitoring report (Biota 2017), and provided the following four recommendations regarding the rehabilitation and ongoing monitoring of the project:

(1) *That the proponent continues rehabilitation activities and weed monitoring along the section of the Macedon gas pipeline within the former Mount Minnie pastoral lease.*

(2) *That the rehabilitation monitoring report identifies contingency management measures to be implemented to meet the completion criteria, particularly given that some areas along the gas pipeline disturbance corridor within the former Mount Minnie pastoral lease do not appear to be meeting completion criteria required by Condition 8-3 under MS 844.*

(3) *That the rehabilitation monitoring report includes information on the rehabilitation and weed contingency management measures implemented to date.*

(4) *That the rehabilitation monitoring report recognises that the existing pipeline access track is likely to be providing a potential vector for weed introduction along the pipeline disturbance corridor, particularly in areas that are currently weed free or where vegetation has not become established* (DBCA 2018).

2.3 Scope and Objectives

Biota was commissioned to undertake an additional monitoring survey of the Macedon Gas Pipeline situated within the proposed Mt Minnie conservation area (hereafter referred to as the 'study area') in 2022 (Figure 2.1). The principal aims of the study, as identified by Woodside, were to:

1. conduct the annual rehabilitation monitoring in 2022 (timed appropriately after rainfall) to measure spatial and temporal changes of vegetation in both analogue and rehabilitated transects located within the Mt Minnie conservation area; and
2. complete subsequent reporting and statistical analyses in accordance with Section 3.10 of the BHP guidance document (BHP Iron Ore 2016) and the *BHP Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012).

These aims were met by conducting a desktop study of existing reports and supporting data sets (Astron 2009, 2013, 2014, 2016, Biota 2017, 2019, 2021), together with information available for the locality (see Section 4.0). This was followed by a field survey in May 2022 to repeat the monitoring following appropriate rainfall conditions (Section 3.0).

The approach and methodology used for the 2022 rehabilitation monitoring survey was carried out with consideration of the following:

- the monitoring methodology as outlined in the *BHP Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012) (hereafter referred to as the 'current monitoring procedure');
- *Document Review Comments Sheet: Macedon Gas Pipeline Rehabilitation Survey – 2017* (DBCA 2018)
- *BHP Iron Ore Guidance for Vegetation and Flora Surveys* (0124627) (BHP Iron Ore 2016);
- *BHP Iron Ore Biodiversity Survey Spatial Data Requirements* (SPR-IEN-EMS-015) (BHP 2020); and
- Environmental Protection Authority (EPA) "*Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*" (EPA 2016).

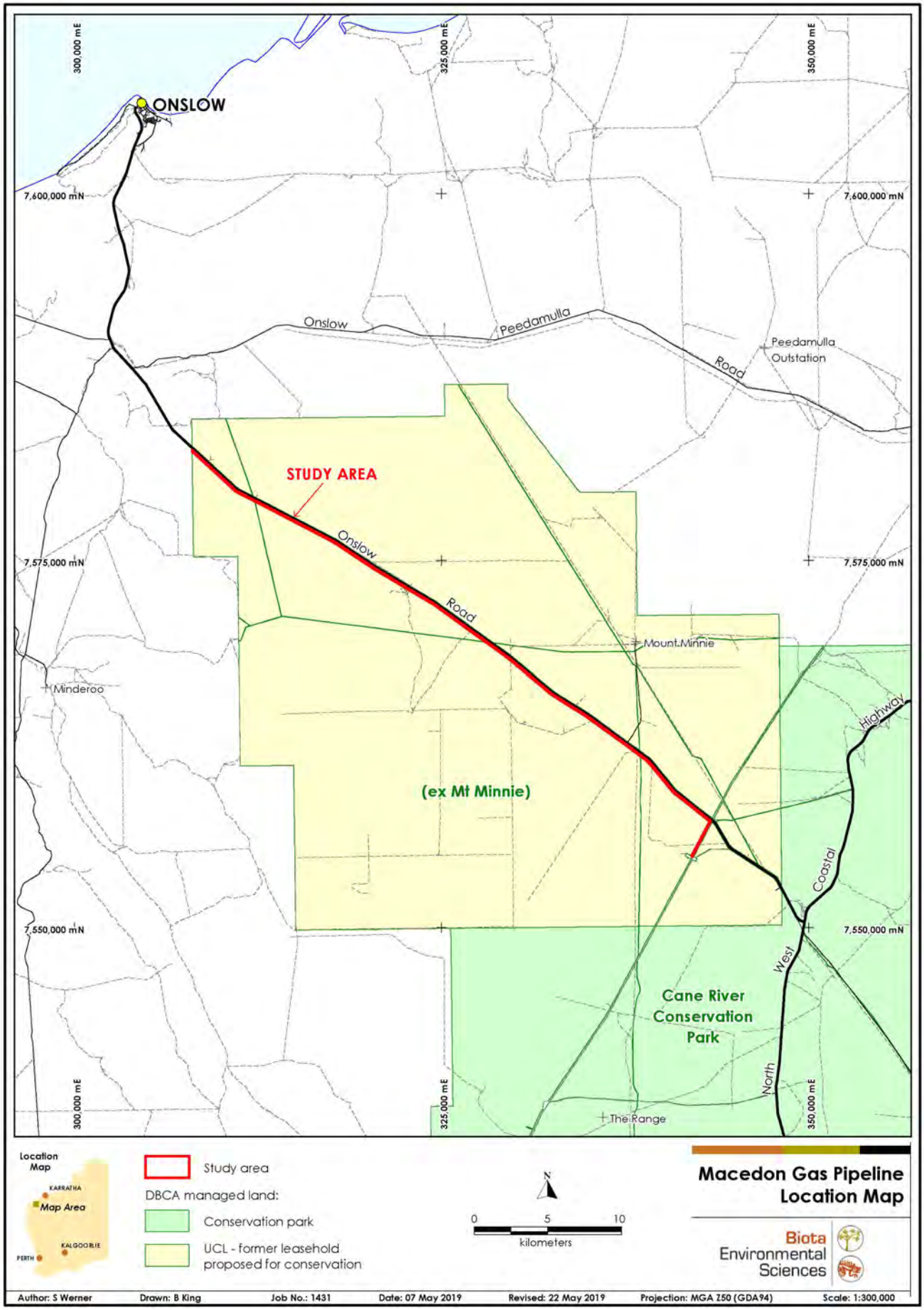

Figure 2.1: Location of the Macedon Gas Pipeline study area in which the current rehabilitation monitoring survey was completed.

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3.0 Methodology

3.1 Survey Team and Timing

The field survey was conducted by Scott Werner (Senior Biologist) and Thomas Hounsham (Botanist), both of whom have experience conducting biological surveys in the Pilbara region (Table 3.1).

Monitoring of the analogue and rehabilitation transects was conducted between 18-20 May 2022 and followed appropriate rainfall to ensure that adequate survey information was collected (see Section 3.1.1).

Table 3.1: Summary of Biota personnel involved in the 2022 Macedon Gas Pipeline rehabilitation monitoring.

Name	Position	Qualification	Years of Experience	Flora Licence No.†
Scott Werner	Senior Biologist	BSc. Hons.	12	FB62000038-2
Thomas Hounsham	Botanist	BSc.	1	FB62000390

† Flora Taking (Biological Assessment) Licence under Regulation 62 of the *Biodiversity Conservation Regulations 2018* (previously *Wildlife Conservation Act 1950*) (required to collect flora specimens).

3.1.1 Climate

Seasonal timing, particularly the amount of rainfall received prior to a survey, can have a significant influence on the species abundance and diversity recorded during a field survey. Rainfall data for the locality were compiled and compared to long-term monthly data (Figure 3.1). Data from the Bureau of Meteorology weather recording station at Onslow Airport (#5017)[1] show that rainfall in the six months prior to the current monitoring survey (December 2021 to May 2022) totalled 275.2 mm, which is 195.1 mm more than the total of the long-term monthly medians[2] for the locality during those months (80.1 mm). The last substantial rainfall events prior to the 2022 rehabilitation monitoring survey were recorded on the day prior to the survey (54 mm) and on the morning of the first day of the survey, when 87.6 mm was received.

Since the commencement of monitoring in 2010, the amount of rainfall received prior to each phase has varied (Table 3.2). While the baseline survey in 2010 was completed during dry conditions, the first two post-rehabilitation surveys in 2013 and 2014 were undertaken following adequate rainfall. The 2015 survey was completed following three months of below average rainfall, which is typical for spring in the Pilbara region. The survey in 2017 was undertaken following the third wettest period experienced over the course of the program, and approximately three to six weeks after significant rainfall events. The survey in 2019 was undertaken four to five weeks following the first significant rainfall event received in the Onslow locality for the 2018/2019 "wet season", with additional rainfall received leading up to the survey. The 2021 survey was undertaken following the second wettest period experienced over the course of monitoring.

The current survey in 2022 commenced approximately 6-7 weeks following the first significant rainfall event received in the Onslow locality in 2022, with additional significant rainfall received at both five days and the day before the survey. The survey was therefore undertaken during a period that would be considered optimal for general collection of flora and ideal for the determination of **Cenchrus* spp. in the field.

[1] The Onslow Airport weather recording station is located approximately 23 km north-northwest of the closest transect, and 62 km northwest of the farthest transect.

[2] From a meteorological perspective, the median is usually the preferred measure of 'typical' rainfall due to the high temporal variability of rainfall in most regions.

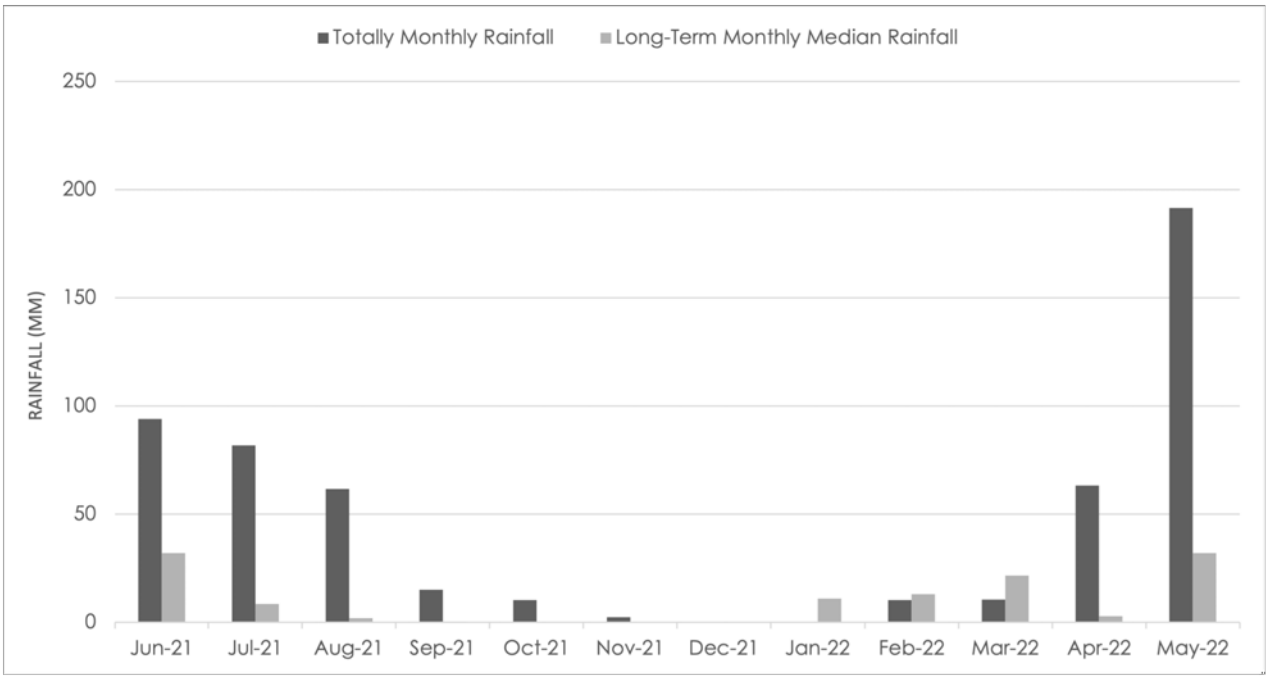


Figure 3.1: Total monthly rainfall at Onslow Airport recording station (#5017) for the 12 months preceding the survey, compared to the long-term monthly median (2021-2022).
Data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

Table 3.2: Summary of timing and seasonal conditions for the Macedon Gas Pipeline rehabilitation monitoring surveys completed to date.

Survey Timing	Rainfall in the Six Months Preceding the Survey	Rainfall in the Three Months Preceding the Survey
Baseline Survey		
14 – 19 October 2010	28.0 mm (Apr – Sep 2010)	14.8 mm (Jul – Sep 2010)
Post–Rehabilitation Surveys		
3 – 8 May 2013	131.6 mm (Nov 2012 – Apr 2013)	72.2 mm (Feb – Apr 2013)
8 – 12 July 2014	97.6 mm (Jan – Jun 2014)	83.2 mm (Apr – June 2014)
30 September – 4 October 2015	89.2 mm (Apr – Sep 2015)	13.4 mm (Jul – Sep 2015)
13 – 17 March 2017	218.2 mm (Sep 2016 – Feb 2017)	215.2 mm (Dec 2016 – Feb 2017)
30 March – 2 April 2019	62.8 mm (Oct 2018 – Mar 2019)	40.8 mm (Jan 2018 – Mar 2019)
5 – 7 May 2021	251.6 mm (Nov 2020 – Apr 2021)	50.2 mm (Feb 2021 – Apr 2021)
18 – 20 May 2022	275.2 mm (Dec 2022 – May 2022)	265.0 mm (Mar 2022 – May 2022)

3.2 Monitoring Methodology

The survey methodology for the 2022 rehabilitation monitoring survey was consistent with that outlined in the current monitoring procedure (Astron 2012) and the most recent survey completed (Biota 2021).

3.2.1 Rehabilitation and Analogue Transects

In 2010, Astron established and assessed 56 line-intercept transects along the Macedon Gas Pipeline to provide baseline monitoring data, consisting of 31 rehabilitation transects established within the 30 m wide pipeline construction corridor and 25 analogue transects located outside

the pipeline corridor. Each 20 m transect was installed perpendicular to the pipeline corridor and marked with a fence dropper at each end. The spatial distribution of transects was selected to sample eight geomorphic units spanning the length of the Macedon Gas Pipeline (Astron 2010). In 2013, an additional 1 m x 20 m 'fixed-point strip transect' was monitored for each transect to ensure uncommon species were detected. This strip transect was positioned along the left side of each line intercept transect, and has been monitored during each subsequent monitoring survey. Monitoring sites consist of both an analogue and rehabilitation transect, with the exception of three sites that solely consist of rehabilitation transects without a paired analogue (see Table 3.3).

Ten of the monitoring sites in the southern section of the study area (sites 22 to 31) are located within the Mt Minnie pastoral lease. This lease was purchased by the State Government in 1996 for the purposes of conservation and is now managed by DBCA. It is proposed to be added to the Cane River Conservation Park in future (see Section 4.1). For the purposes of this report, we have referred to this area as the "Mt Minnie conservation area". Given its management interest in the area, DBCA is particularly interested in the progress of the rehabilitation in the 10 sites at the southern end of the study area.

The current survey comprised resampling of 17 transects along the Macedon Gas Pipeline corridor that are situated within the Mt Minnie conservation area (comprising 10 rehabilitation and seven analogue transects) (see Table 3.3). Sites situated outside of the Mt Minnie Pastoral Lease were not required to be monitored in 2021. Locations of all transects monitored in 2021 are presented in Figure 3.2 to Figure 3.4, with transect coordinates listed in Appendix 1.

Table 3.3: Summary of monitoring sites assessed in 2021.

Monitoring Sites§	Line-Intercept Transects Reassessed in 2022 (Total Number of Transects)	
	Rehabilitation	Analogue
22, 23, 24, 26, 28, 29, 30	Yes (7)	Yes (7)
25, 27, 31	Yes (3)	No
Total	**10**	**7**

§ Monitoring site labels as per Appendix A of Astron (2016).

3.2.2 Assessment of Transects

Rehabilitation and vegetation assessments were conducted for each of the 17 line-intercept transects (10 rehabilitation and seven analogue). The following data were collected:

- all vascular plant species (including weeds) present along the transect, and also within the adjacent 1 m x 20 m fixed-point strip transect;
- the length of intercept for each flora species recorded along the transect; and
- two photographs (one from each end of the transect, oriented along the length of the transect).

3.2.3 Flora Specimen Identification, Nomenclature and Data Entry

Common taxa that were well known to the survey botanists were identified in the field, with voucher specimens of all other species collected. Plant specimens were identified in Perth using published and unpublished taxonomic keys and resources available at the WA Herbarium.

Nomenclature used in this report is consistent with the current listing of WA flora recognised by the WA Herbarium on FloraBase[3] at the time of preparation of this report.

All flora data were entered into Excel spreadsheets, maintaining consistency with the data format from previous phases, and that established by Astron during the initial phase of monitoring (Astron 2010).

[3] http://florabase.dpaw.wa.gov.au

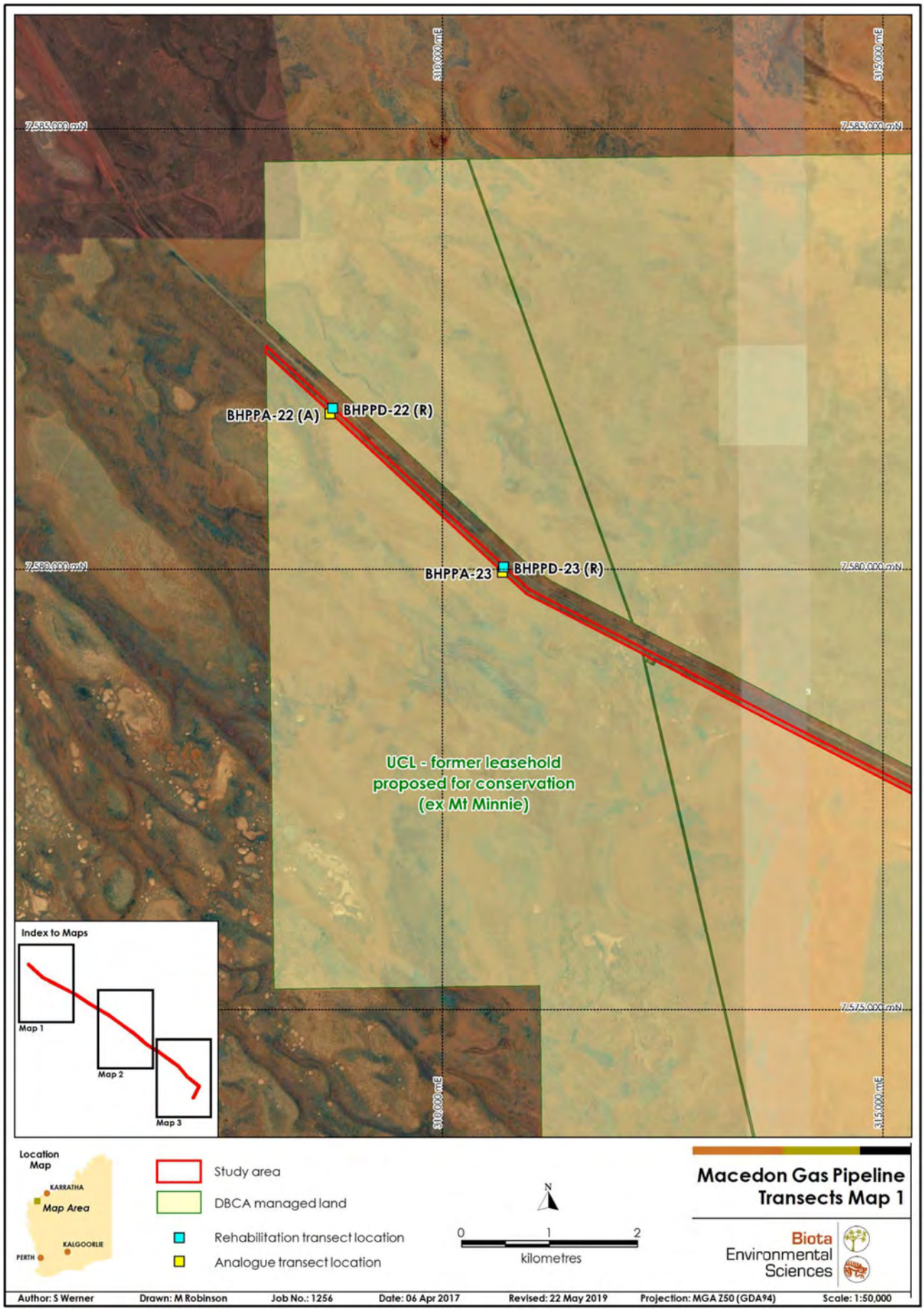


Figure 3.2: Monitoring transect locations (Map 1).

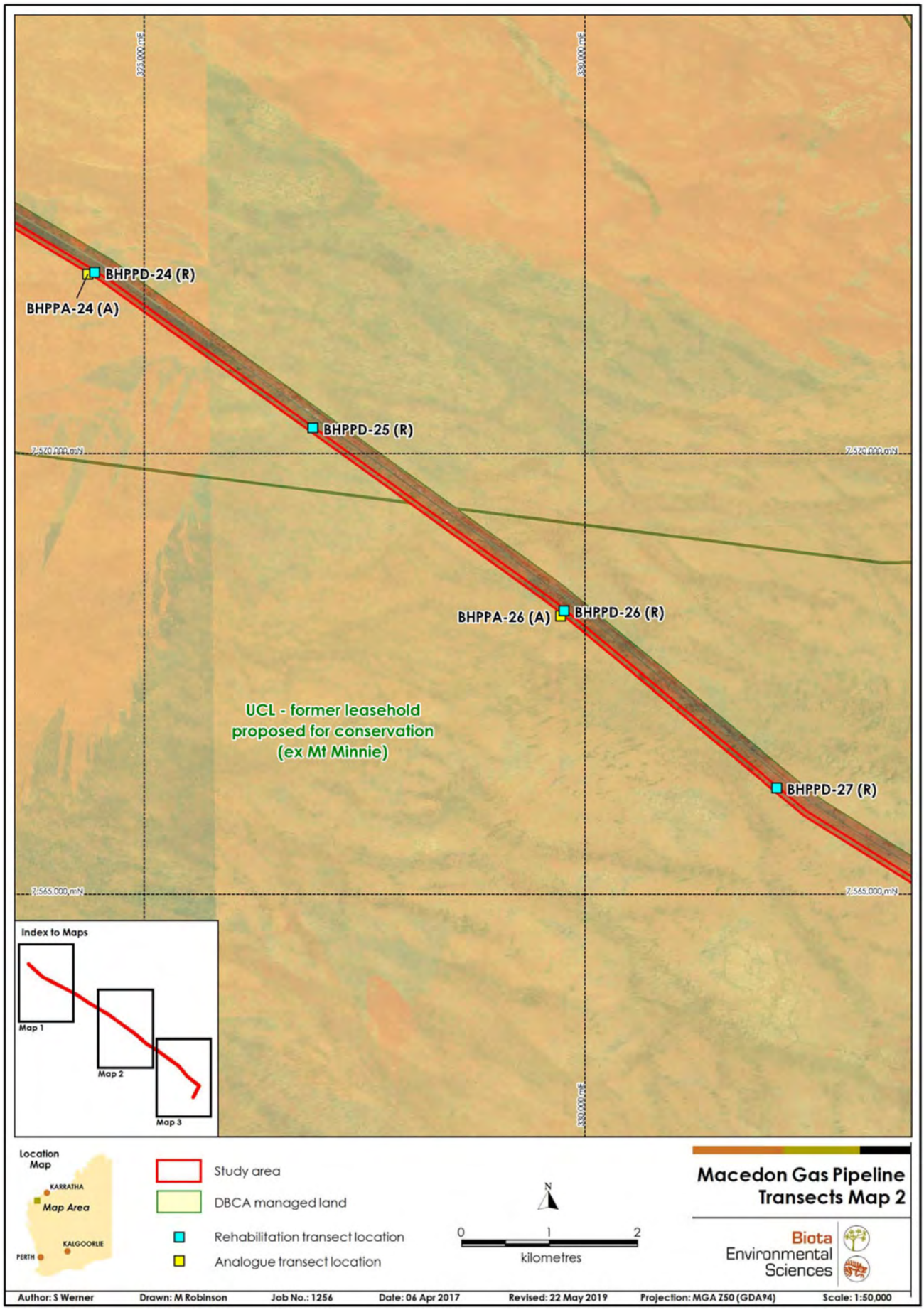


Figure 3.3: Monitoring transect locations (Map 2).

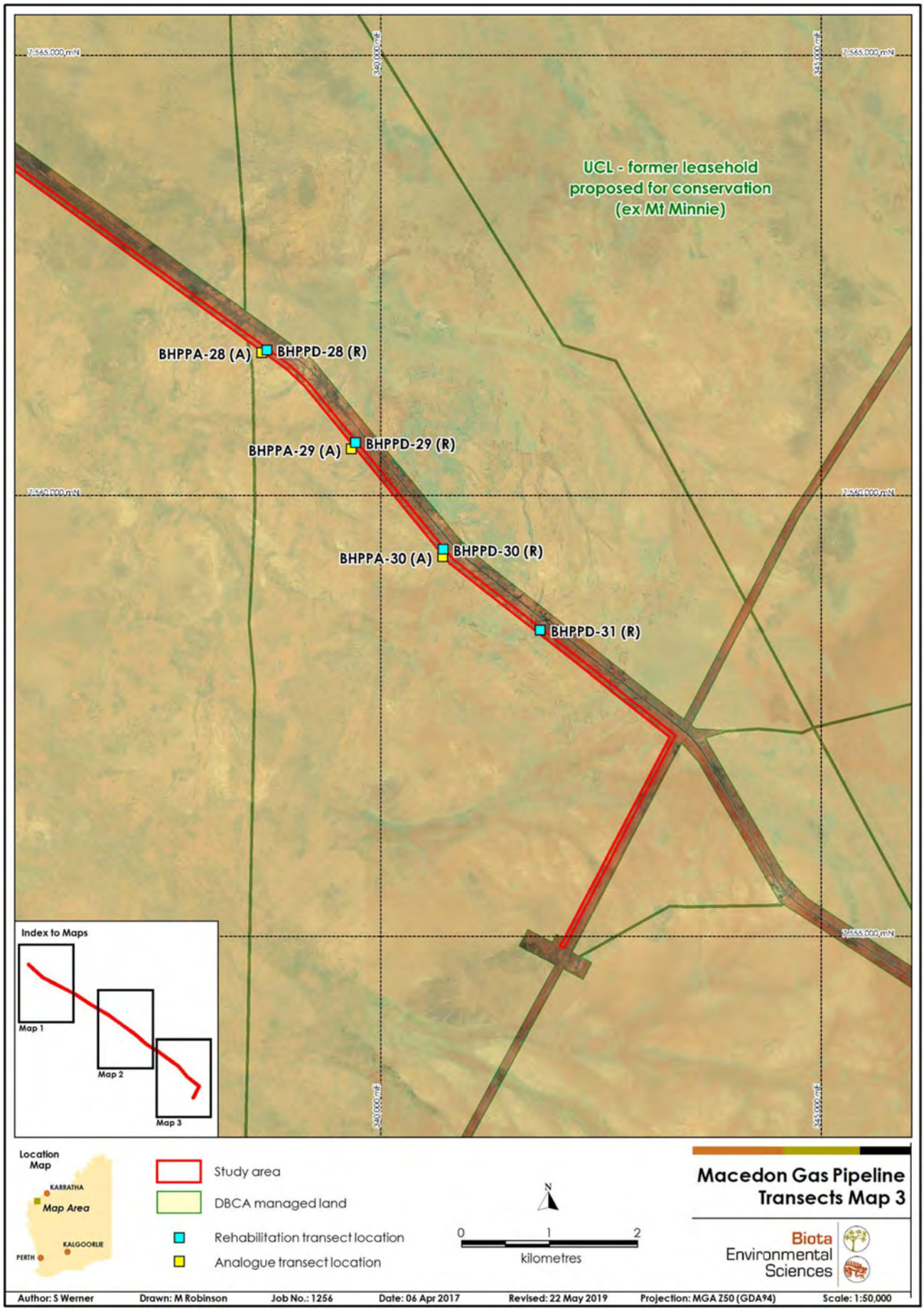


Figure 3.4: Monitoring transect locations (Map 3).

3.3 Data Analysis and Presentation

The *BHP Billiton Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012) specifies two statistical analyses to be undertaken:

1. The average percent covers for native species along the analogue and rehabilitation transects should be tested for significant differences using a non-parametric Multivariate Analysis of Variance (MANOVA); the same analysis should also be completed for the average percent cover of weeds along the analogue and rehabilitation transects.
2. Change in the vegetation community over time should be evaluated through a two-way Analysis of Similarity (ANOSIM) of the species percentage foliar cover (presumably comprising the line transect data), using transect type (rehabilitation / analogue) nested within the survey year.

Results in the Astron (2016) monitoring report were analysed in this way. Data were also tabulated and presented graphically, with transect data always separated by treatment (rehabilitation or analogue) but typically averaged across either the treatment or three broad habitat classes: clay pan/floodplain, open plain or sand dune.

The size of the error bars on some of these graphs indicated a large amount of variability in the data around the calculated means, suggesting that the transects were dissimilar for some values and may not have been developing equivalently. The significant "site" interaction values presented for some of the statistical analyses also suggested this. In addition, averaging of transect data prevented any close inspection of the results that applied specifically to the Mt Minnie conservation area. For this study we have therefore elected to present the data for individual transects separately wherever possible and for all sampling events, so as not to obscure any differences between transects. We also applied a more rigorous analysis of trends over time, including floristic clustering analyses, rather than the multivariate analysis of variance suggested by Astron (2016).

Clustering analyses were carried out using PRIMER v6 and used to examine the relationships between both the floristic composition of the individual transects in 2010 vs. 2021, and of each transect compared to its paired analogue. The following protocols were used:

- All native species (both perennial and annual) present at each site were included in the data set; weeds were removed.
- The data were prepared as a matrix of the presence / absence of each species at each site in 2010 and 2021; this was based on the combined data from the line transect (for 2010 and 2021) and the strip transect (2021 only).
- The Bray-Curtis coefficient was used to produce a similarity matrix, and a cluster analysis was then performed using the group average method. The clusters were tested for significance using the similarity profile permutation test (SIMPROF).

Representative outputs from the clustering analyses are presented as both floristic dendrograms and non-metric, multi-dimensional scaling (NMDS) ordination plots in Section 5.2.2.

To broadly summarise the current development of vegetation along the rehabilitation transects, each transect was also ranked according to the scale presented in Table 3.4 (see Section 5.5). Note that the criteria were developed with particular consideration of the requirements of the current study and the vegetation types being sampled, and would not necessarily be directly relevant to other areas (for example, vegetation types that have a naturally low level of cover provided by perennial species, or that are substantially invaded by other weed species).

Table 3.4: Ranking categories for overall development of vegetation along the rehabilitation transects.

Ranking	Criteria
Excellent	The cover of perennial vegetation along the transect is equivalent to the pre-clearing cover, floristic composition is similar to the original, AND the cover of *Cenchrus* is negligible (<0.5%).
Good	The cover of perennial vegetation along the transect is approaching the pre-clearing cover, AND floristic composition is similar to the original OR the cover of *Cenchrus* is negligible to low (<10%).
Fair	There is limited re-establishment of perennial vegetation along the transect (<20% cover) AND the cover of *Cenchrus* is negligible to very low (<5%).
Poor	A moderate amount of perennial vegetation has established on the transect (<45% cover), however the floristic composition is dissimilar to the original AND the cover of *Cenchrus* is low to high (10-45%) and increasing.
Very Poor	Minimal perennial vegetation has established on the transect (<5% cover), the floristic composition is dissimilar to the original AND the cover of *Cenchrus* is high to very high (>35%).

3.4 Study Limitations

The aims of the current monitoring survey were to provide a reliable post-rehabilitation comparison of the ecological attributes of the analogue and rehabilitation transects. However, there are potential constraints and limitations to this study (specifically the current phase) that must be considered when reviewing and interpreting the results:

1. In 2022, and all previous monitoring phases from 2017-2021, some fence-droppers marking the start and end points of each transect were missing due to works conducted along the ROW track situated within the study area. These points were located as accurately as possible using supplied GPS coordinates, however the fence droppers were not re-established in this monitoring phase. Considering the accuracy of handheld GPS units, missing fence droppers at sites have implications for repeated sampling and subsequent analyses (repeatability).
2. Fire history varies for some transects. While most have not been burnt since 2010, three analogue transects (BHPPA-24, BHPPA-26 and BHPPA-28) and two rehabilitation transects (BHPPD-25 and BHPPD-26) have been burnt at some point since the monitoring programme began (see Section 5.2.1 and Appendix 2). These disturbance events have affected the flora data recorded, and this needs to be taken into consideration when interpreting the results.
3. Some combinations of landform setting, hydrological function, and vegetation within the rehabilitation corridor were not replicated within analogue areas. Assessment of change relies largely on comparing post-impact data to that of the baseline phases, or to paired analogue transects. Three of the rehabilitation transects surveyed in 2022 do not have a paired analogue, as was the case in 2017, 2019, and 2021.
4. Significant amounts of rainfall in the days preceding the survey appear to have reached the northwest section of the study area, more so than the southeast; the opposite to what was observed in the previous phase of monitoring in 2021. Considering the sporadic and localised nature of rainfall in the Pilbara bioregion, it is expected that the study area would receive varying amounts of rainfall across its length, given its size and linear shape.

4.0 Background to the Study Area

4.1 Conservation Reserves in the Locality

The main conservation reserve in the locality is the Cane River Conservation Park, situated approximately 100 km southeast of Onslow. This reserve includes several landforms and vegetation types of particular significance that are not found in other conservation reserves in the Pilbara.

The current extent of the Cane River Conservation Park is proposed to be increased through the addition of two areas: an exclusion including the Nanutarra pastoral lease to the south, and the Mt Minnie conservation area to the north (see Figure 2.1). This is part of a broader State-wide process of pastoral lease exclusions for public purposes, specifically conservation, which has the intention of providing a more comprehensive, adequate and representative reserve system (EPA 2014).

Approximately 48 km of the Macedon Gas Pipeline runs parallel to Onslow Road through a development corridor that traverses the proposed Mt Minnie conservation area (see Figure 2.1). The 10 rehabilitation transects in this section (BHPPD-22 to BHPPD-31) are situated within the development corridor, while the seven paired analogue transects (BHPPA-22 to BHPPA-24, BHPPA-26, and BHPPA-28 to BHPPA-30) are located within the Mt Minnie conservation area (and thus within the proposed Cane River Conservation Park). DBCA is particularly interested in the presence of weeds through this section of the Macedon Gas Pipeline, given the potential for spread into the adjacent proposed reserve.

4.2 Surface Hydrology

The surface hydrology within the study area varies considerably, given that it intersects three separate land systems. The broader area is characterised by extensive sandy plains, longitudinal dunes, and numerous round and elongated claypans varying in extent from 20 m to 400 m situated between these dunes (Payne et al. 1988).

Broad, usually unchannelled, drainage floors occupy the majority of the sandy plains in the area, with these soils susceptible to water erosion. The deep loam and clay soils of the area are subject to irregular flooding, with the loams becoming very powdery when dry, resulting in susceptibility to erosion (Payne et al. 1988).

Drainage throughout the length of the study area is typically broad and diffuse across areas consisting mainly of colluvial sediments (Payne et al. 1988). The land systems occurring in the study area generally exhibit the following drainage characteristics (from Payne et al. 1988, van Vreeswyk et al. 2004):

- Uaroo land system – mainly depositional surfaces with occasional stony rises and low hills; some through drainage by broad unchannelled tracts receiving sheet flow.
- Giralia land system – broad non-saline plains with no organised drainage, however through-flow areas receive more concentrated sheet flow than the adjacent plains.
- Stuart land system – gently undulating plains with minor hills, and drainage tracts that experience through-flow.

4.3 Vegetation and Flora

Vegetation of the study area was described and mapped by Astron (2009) and largely reflects the array of vegetation types typically seen in the locality. Previous surveys completed in the Onslow area have identified a diverse suite of native flora, as well as a number of introduced flora species (Biota 2010, ENV 2011).

A total of 39 vegetation associations were identified by Astron (2009) within the Macedon Gas Pipeline corridor, 15 of which occur in the current study area. The 39 vegetation associations were grouped according to their occurrence on 11 landforms, and subsequently termed 'vegetation types'. The representation of transects surveyed during the current phase across each vegetation type is shown in Table 4.1.

Table 4.1: Distribution of transects resampled during current phase of monitoring based on vegetation types identified by Astron (2009).

Vegetation Type & No. of Vegetation Associations (Astron 2009)		Current Study	
		No. of Analogue Transects	No. of Rehabilitation Transects
Crests and upper slopes of inland sand dunes supporting *Grevillea eriostachya* or *Hakea stenophylla* shrubs, *Acacia* sp., *Crotalaria cunninghamii* over mixed low shrubs over *Triodia epactia* 'sens. lat.' or *T. glabra* hummock grasslands.	2 (13%)	1 (14%)	1 (10%)
Sandy/loamy plains supporting *Eucalyptus* and *Corymbia* low trees in patches over mixed shrubs over *Triodia glabra* hummock grasslands; some vegetation types characterised by an upper storey of *Hakea chordophylla* or *Grevillea wickhamii.*	9 (60%)	2 (29%)	3 (30%)
Lower, often stony plains supporting *A. xiphophylla* and other *Acacia* species shrublands over *Triodia* hummock grasslands, occasionally with a *Corymbia* isolated low trees overstorey.	3 (20%)	3 (43%)	5 (50%)
Internal, undirected drainages supporting **Prosopis*, *Acacia* or *Eucalyptus victrix* shrubland/low woodland over mixed shrubs and mixed tussock grassland, occasionally *Triodia* hummock grassland.	1 (7%)	1 (14%)	1 (10%)
Total	**15**	**7**	**10**

NB. Percentages reflect proportion of the total for each column.

5.0 Results and Discussion

Summarised data for each transect across all phases of monitoring (2010 – 2022) are presented in Appendix 2, with a list of vascular flora species recorded during each year of monitoring presented in Appendix 3 and summarised in Table 5.1.

5.1 Overview of Flora Recorded in 2022

A total of 72 native vascular flora species from 46 genera and 18 familes were recorded from the 17 transects resampled in 2022. Two weed species were recorded from the study area (**Cenchrus ciliaris* and **C. setiger*).

The mean species per transect (as a way of accounting for varying survey effort) is comparable across years given the rainfall received at the time of each monitoring phase (see Table 3.2). The low number of species recorded in 2010 reflects the lack of sampling along the strip transects, which were implemented in 2013, and may have also been affected by the dry conditions in that year. In 2022, only the section of gas pipeline situated within the Mt Minnie conservation area was surveyed (17 transects in total).

Table 5.1: Number of species recorded from the current study area in each year of monitoring (includes opportunistic records of weeds).

	2010	2013	2014	2015	2017	2019	2021	2022
Number of Native Species	39	117	144	136	104	29	98	72
Number of Weed Species	3	3	3	4	4	2	2	2
Number of Transects	56	56	56	56	56	17	17	17
Mean Species/Transect	0.70	2.09	2.57	2.43	1.86	1.70	5.76	4.23

5.1.1 Species of Conservation Significance

One Priority 1 species was recorded from the study area in the current phase of monitoring: *Abutilon* sp. Onslow (F. Smith s.n. 10/9/61). This taxon was recorded as a presence from within the strip-transect at analogue site BHPPA-23.

5.2 Species Diversity

Results from the monitoring program are discussed below against the relevant criterion from Condition 8 of MS844:

(1) Species diversity is not less than 60% of the known original species diversity.

5.2.1 Species Richness

As in previous phases, one measure of diversity used to assess this criterion was species richness, with only native species considered. To compare the 2022 species richness against the baseline values, only those species recorded along the line transect were considered, as the extra sampling along the strip transect was not implemented until 2013. Two baseline species diversity values were considered: the 2010 species richness from the rehabilitation transect, and the 2010 species richness from the equivalent analogue. These values are shown in Table 5.2, Figure 5.1 and Figure 5.2.

When using the simple number of native species as the measure of diversity, all but one rehabilitation transect and one analogue transect meet the criterion of "*not less than 60% of the known original species diversity*", with most transects equalling or exceeding the original species richness. The transects that did not meet the criterion comprised:

- BHPPD-24: only two native species (*Triodia glabra* and *Corymbia hamersleyana*) were recorded along this line transect in 2022, compared to four species recorded from the same transect in 2010 (*Acacia ancistrocarpa*, *A. bivenosa*, *Eucalyptus xerothermica*, and *Triodia glabra*) and three species recorded from the paired analogue, BHPPA-24, in 2010 (*Acacia ancistrocarpa*, *Corymbia hamersleyana*, and *Triodia glabra*).

  Acacia bivenosa and *A. ancistrocarpa* were recorded in five out of the last seven previous phases but were not recorded in both the 2021 and 2022 phases. It is plausible that the shrubs have senesced after re-establishing in 2014 and persisting for four phases through to 2019, or that the line-intercept was misaligned due to missing transect pegs.

It should be noted that, depending on the nature of the habitat, high species richness is not necessarily indicative of the development of a satisfactory level of vegetation. Some intact vegetation types naturally have very low species richness (less than five species in a 50 m^2 area; e.g. some wetlands, spinifex plains, and samphire vegetation).

Table 5.2: Native species richness of rehabilitation line transects in 2022 compared to 2010 for both the same transect and for the paired (or equivalent) analogue.
Richness calculated for the line transect only, as the strip transect was not sampled in 2010.

		Rehabilitation Transect Compared to Itself		Rehabilitation Transect Compared to Paired (or Equivalent †) Analogue		
Rehabilitation Transect	**2022 Species Richness**	**2010 Species Richness**	**Criterion Met? (2022 Species Richness as % of Original)**	**Analogue Transect**	**2010 Species Richness**	**Criterion Met? (2022 Species Richness as % of 2010 Analogue)**
BHPPD-22	4	6	Yes (67%)	BHPPA-22	3	Yes (133%)
BHPPD-23	10	6	Yes (167%)	BHPPA-23	4	Yes (250%)
BHPPD-24	2	4	No (50%)	BHPPA-24 ß	3	No (50%)
BHPPD-25 ß	4	5	Yes (67%)	BHPPA-26 †, ß	3	Yes (133%)
BHPPD-26 ß	2	3	Yes (67%)	BHPPA-26 ß	3	Yes (67%)
BHPPD-27	3	3	Yes (100%)	BHPPA-26 †, ß	3	Yes (100%)
BHPPD-28	11	3	Yes (367%)	BHPPA-28 ß	3	Yes (367%)
BHPPD-29	5	3	Yes (167%)	BHPPA-29	3	Yes (167%)
BHPPD-30	6	2	Yes (300%)	BHPPA-30	2	Yes (300%)
BHPPD-31	5	4	Yes (125%)	BHPPA-30 †	3	Yes (167%)

† Selected as the closest analogue transect in a similar topographic position and vegetation type.

ß Transect has been burnt approximately <10 years prior to 2022 survey.

Long undisturbed spinifex hummock grasslands are frequently species poor and, particularly where spinifex cover is high, species numbers may not vary substantially in different seasons. However, following ground clearing or post-fire, species richness typically increases dramatically with the establishment of "pioneer" colonising species, such as members of the Malvaceae and Fabaceae families; annual herbs and grasses are also typically more abundant in the early stages of regeneration. Species richness then typically declines as the vegetation matures, with the senescence of the early seral species, and annuals becoming crowded out as the spinifex hummocks occupy more of the available ground. These trends are apparent in analogue sites following fire (Figure 5.1).

The fact that all but one rehabilitation transect (BHPPD-24) and its paired analogue transect (BHPPA-24) exceeded 60% of the original species richness is expected given the age of the rehabilitation areas.

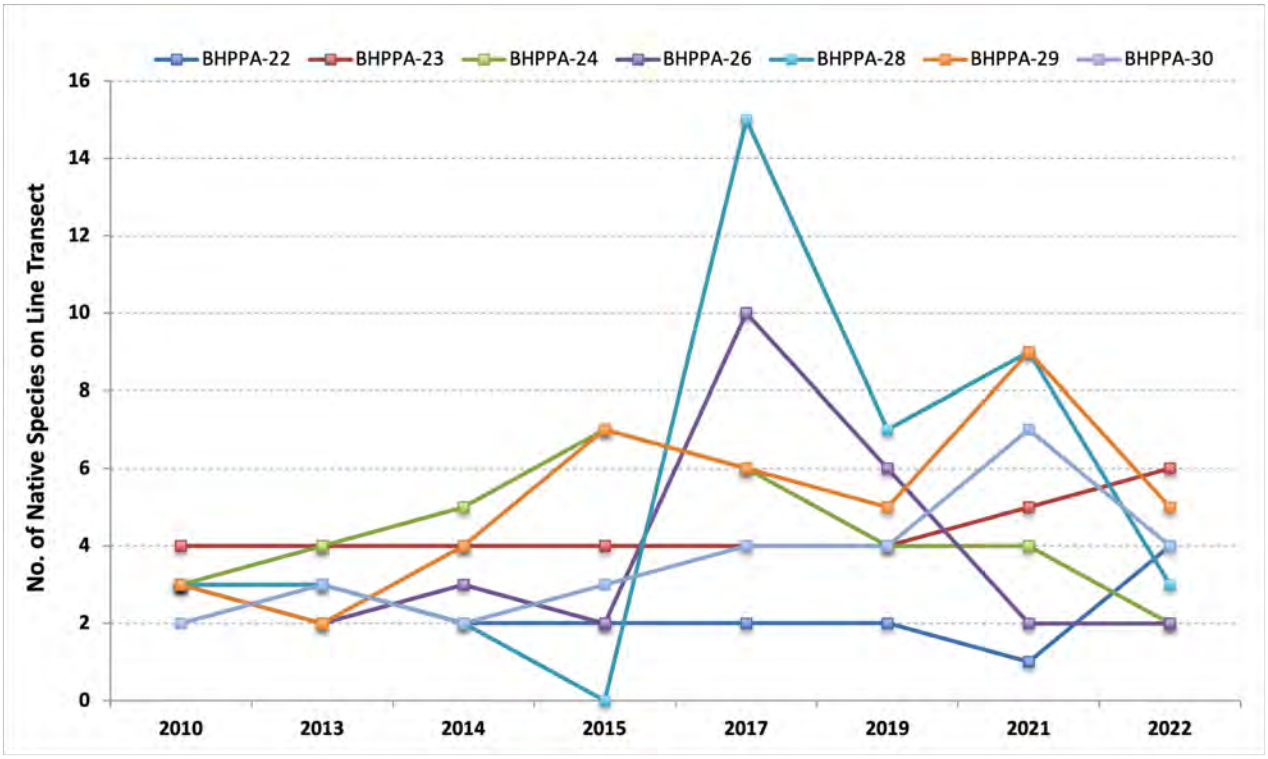


Figure 5.1: **Native species richness recorded on line transects at analogue sites.**
Note the dramatic increase in richness following fires prior to the 2015 monitoring phase at transect BHPPA-28 and prior to the 2017 monitoring phase at BHPPA-26, with a return to pre-fire numbers beginning to show in from 2019 onwards.

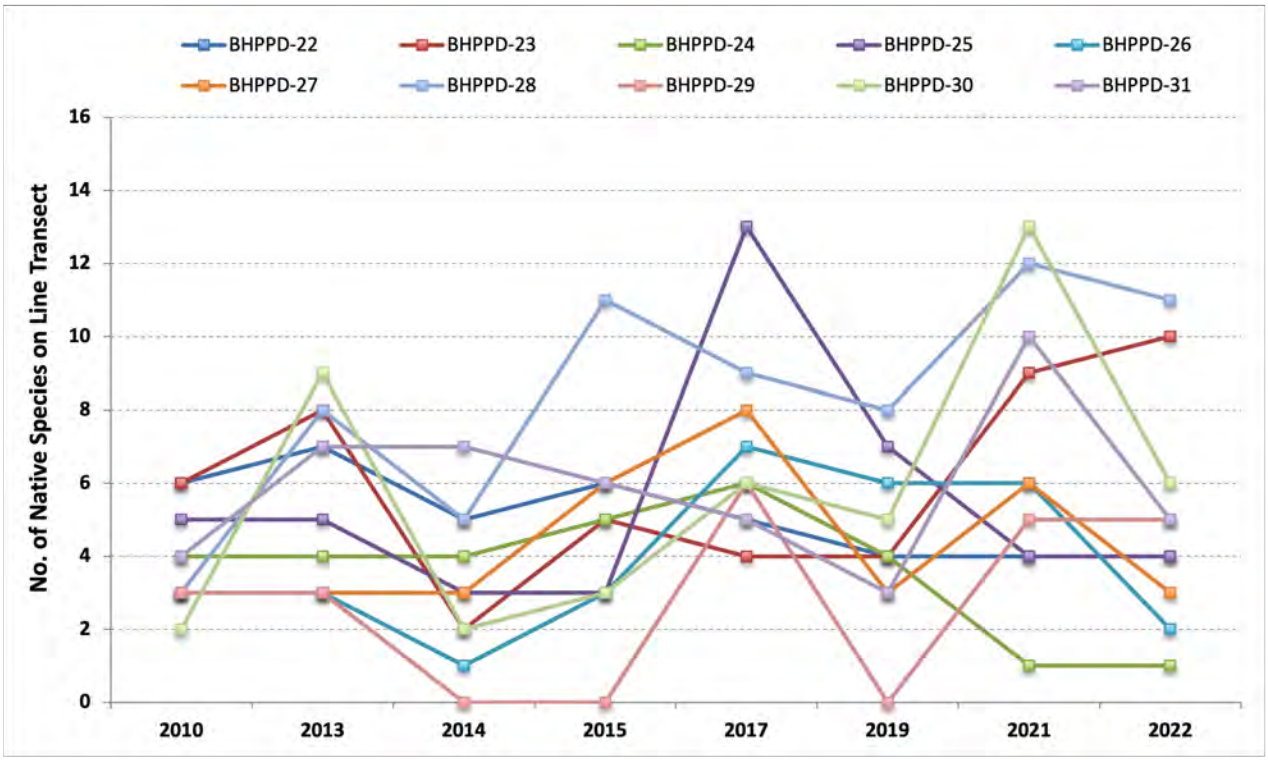


Figure 5.2: **Native species richness recorded on line transects at rehabilitation sites.**
2010 represents the pre-clearing monitoring phase; at least 60% of the 2010 species richness was recorded at all transects in 2022 except BHPPD-24.

5.2.2 Similarity of Species Composition

Another measure that should be considered within the broad context of the original "diversity" is the similarity of the species present in the rehabilitation areas in relation to those present in the pre-clearing vegetation and also those in the relevant analogue site. Floristic clustering analyses were run using PRIMER to investigate this aspect. The first analysis used the presence/absence data for native species in 2010 and 2022 and was run separately for the analogue transects (Figure 5.3) and rehabilitation transects (Figure 5.4).

For the analogue transects, the major findings were as follows:

- *Triodia glabra* was the main driver of similarity within 2010 and 2022 transects (contributing to 75% and 80% of the overall cumulative similarity respectively).
- The average dissimilarity between 2010 and 2022 was 69% with differences in presence/absence of *Acacia ancistrocarpa, A. xiphophylla,* contributing to 21% of that dissimilarity, and species only recorded in 2022 (*Codonocarpus cotinifolius, Acacia stellaticeps,* and *Ptilotus polystachyus*) contributing to 11% dissimilarity.
- All analogue transects had a more similar floristic composition in 2022 to that recorded from the same transect in 2010, rather than to other transects in the current phase, with the exception of BHPPA-26, which was considered to be more similar to BHPPA-28 from 2010.
- A single transect in 2022 (BHPPA-28) grouped together with 11 other transects at a similarity level of 15%, and was considered to not be significantly similar to any other transect from both years. Given that only three species were recorded from this transect in both 2010 and 2022, it is highly likely that this separation in 2022 is due to two perennials that were unique to each year (*Acacia inaequilatera* in 2010 and *Codonocarpus cotinifolius* in 2022).
- The key species leading to clustering at significant similarity within the analogue transects in Figure 5.3 are:
    - BHPPA-22: *Triodia schinzii*;
    - BHPPA-23: *Acacia bivenosa* and *Triodia epactia;*
    - BHPPA-24, BHPPA-26, and BHPPA-28 (2010): *Corymbia hamersleyana* and *Acacia ancistrocarpa;*
    - BHPPA-29 and BHPPA-30: *Acacia xiphophylla.*

For the rehabilitation transects:

- *Triodia glabra* was again the main driver of similarity in within 2010 and 2022 transects (contributing to 73% and 75% of the overall cumulative similarity respectively).
- The separation of mostly all transects from their year equivalent can be attributed to the number of unique species recorded within the two phases. Collectively, nine unique species contribute to 28% of the overall dissimilarity between rehabilitation transects in 2010 and 2022.
- Transect BHPPD-30 in 2022 was considered significantly differently to all other rehabilitation transects from both years because of the presence of *Acacia synchronicia*.
- 2022 Transects BHPPD-28, BHPPD-29, BHPPD-31 grouped together at approximately 25% similarity due to several shared annual grasses and herbs that were not recorded elsewhere. It is also these shared annual grasses and herbs that led to this group of three transects being considered significantly dissimilar to the larger cluster of 16 transects.
- Transects BHPPD-26 from both 2010 and 2022 grouped together at a significantly high level of similarity (80%) due to the presence of *Acacia ancistrocarpa*. Over the course of four phases of monitoring site BHPPD-26 has always presented as the most stable and consistent site in terms of native species composition and structure.
- Transect BHPPD-22 from 2010 and 2022 clustered together at a similarity level of 60%. This is not unexpected as this is the only transect located on fine red sand dunes dominated by the hummock grass *Triodia schinzii.*

- Transects BHPPD-23, BHPPD-24, BHPPD-25, BHPPD-27, and BHPPD- 28 didn't cluster closely together across years. The difference in dominant perennial species recorded at these transects in 2010 and 2021 will continue to see them not cluster together from different phases. The species recorded driving the separations are:
    - BHPPD-23: *Acacia stellaticeps, A. trachycarpa, Eriachne aristidea;*
    - BHPPD-24: *Acacia bivenosa;*
    - BHPPD-25: *Corymbia hamerselyana, Eucalyptus xerothermica, Acacia coriacea, Triodia epactia;*
    - BHPPD-27: *Acacia inaequilatera, Aristida contorta;*
    - BHPPD-28: *Abutilon lepidum, Iseilema dolichotrichum, Ptilotus* spp.

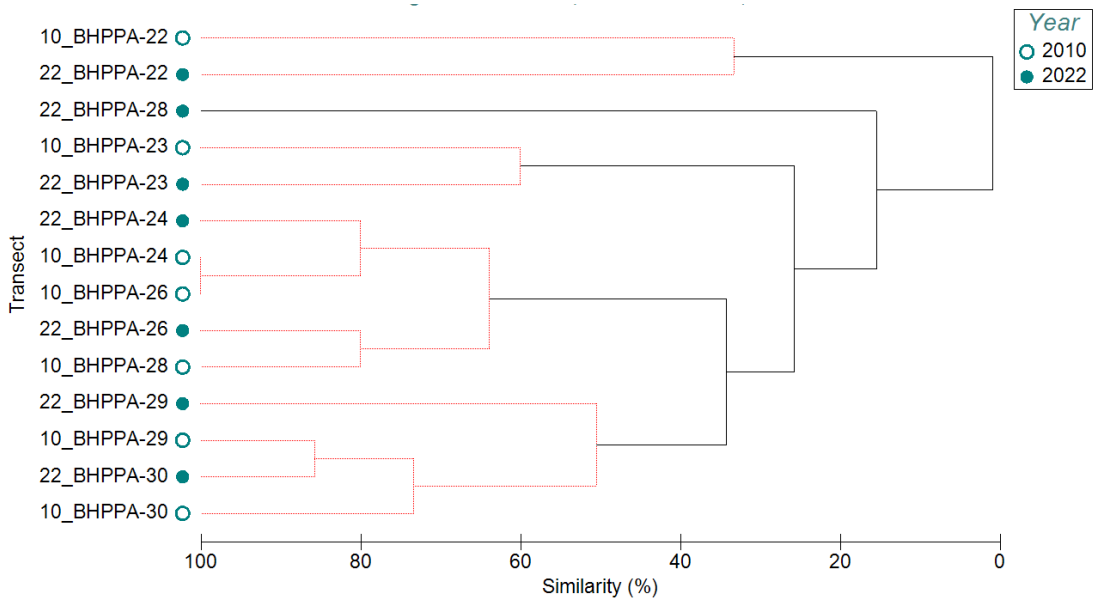


Figure 5.3: Dendrogram showing clustering of the analogue transects based on the species recorded in 2010 and 2022.
Red lines indicate that sites are not significantly different (p>0.05) from each other (SIMPROF test).

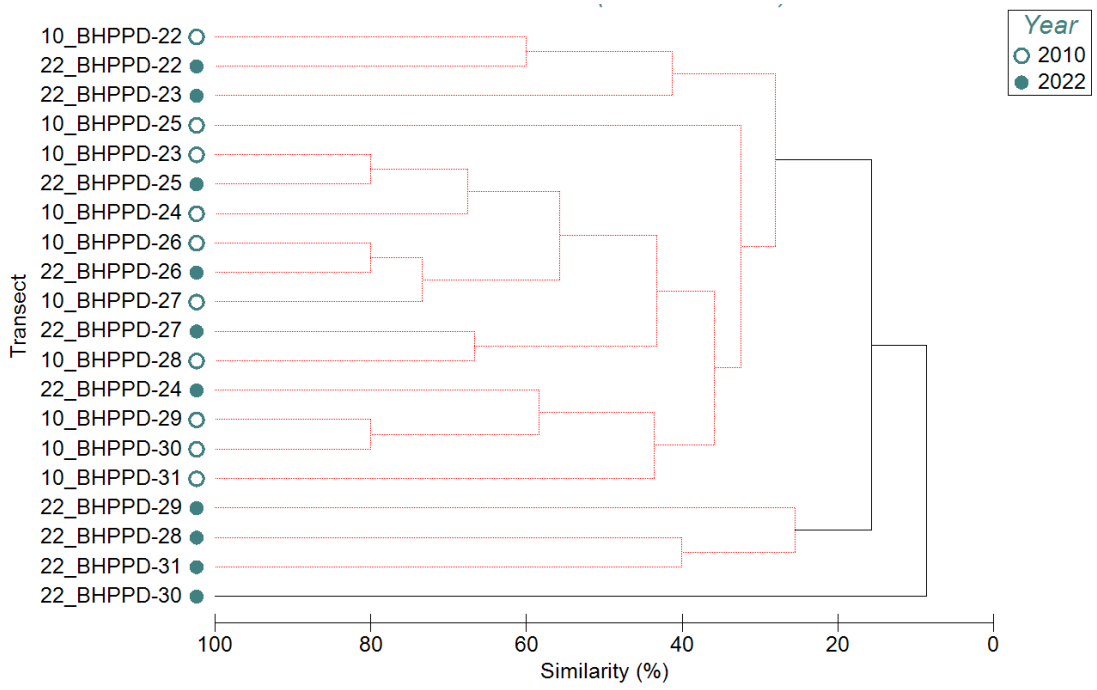


Figure 5.4: Dendrogram showing clustering of the rehabilitation transects based on the species recorded in 2010 and 2022.
Red lines indicate that sites are not significantly different (p>0.05) from each other (SIMPROF test).

The second clustering analysis used presence/absence data for native species from 2022 only, but for all transects sampled (both the rehabilitation transects and the analogues). This identified three significantly different floristic groups: all with multiple sites, and all including both analogue and rehabilitation transects within the same group with the exception of site 28 (see Figure 5.5, Figure 5.6 and Table 5.3).

The site groupings can be summarised through the three broad groups shown in Figure 5.5, which are briefly described below:

1. The first group (FGp 1) comprised the transects containing the only records of *Triodia schinzii* which is indicative of red sand dunes and/or deep red sand plains. The herbs *Bonamia alatisemina*, *Cassytha capillaris*, and woody shrub *Petalostylis cassioides*, were only recorded in this group.
2. The second group (FGp 2) included transects that typically occupy the low-lying, stony open gibber plain with a fine clayey-loam substrate and scattered mixed quartz of the Stuart land system. This was also the only floristic group to record covers of the perennial shrubs *Acacia inaequilatera*, *A. synchronicia*, and *A. xiphophylla*.

   These transects are likely separated from the remainder and loosely grouped together due to the presence of the dominating Acacia species *Acacia xiphophylla, A. inaequilatera,* and *A. synchronicia.*

   Additionally, a shared absence/presence of the following species results in the separation from the combined broader grouping of FGp 3 (see Figure 5.5 and 5.6):

   a. The overall presence of annual grasses and herbs (particularly notable suggesting that the transects located in south-eastern half of the linear study area most likely received more localised rainfall preceding the survey).
   b. The specific absence of *Acacia stellaticeps, Scaevola spinescens, Indogofera boviperda var. boviperda, Indigfoera colutea,* and *Corymbia hamersleyana* typically not recorded in this landform, is a major influence on the separation of this grouping from FGp 3.
3. The third group (FGp 3) comprised transects with *Acacia* spp., *Triodia glabra* and other species typically associated with sandy substrates on open plains. Key findings include:
   a. grouped at 22% similarity.
   b. consisted of open plains with a mix of several mature *Acacia* species: *A. ancistrocarpa, A. bivenosa,* and *A. stellaticeps.*
   c. These transects are likely separated from FGp 2 and loosely grouped together due to the absence of annual grasses (genera *Cynodon, Dactyloctenium, Enneapogon, Eragrostis, Iseilema*) and herbs (genera *Gomphrena*, *Ptilotus*) recorded In transects in FGp 2, together with the only records of *Corymbia hamersleyana, Scaevola spinescens, Tephrosia* sp. B. Kimberley Flora (C.A. Gardner 7300), *Indigofera colutea,* and *Indigofera boviperda.*

The number of annual/bi-annual herbs and grasses that were recorded during this phase (and that of the previous phase in 2021) was due to the preceding amount of rainfall, had an influence on the clustering of transects into floristic groups (especially FGp 2 and FGp 3). In comparison, the floristic groups identified through this identical analysis in the 2019 phase (Biota 2019) were highly driven by mainly perennial shrubs and hummock grasses.

For those transects with paired analogues, all but one clustered within the same floristic group, indicating similar floristic composition. The transect that clustered separately from its analogue comprised BHPPD-28:

- The inclusion of BHPPA-28 into FGp 3 (and separation from BHPPD-28) is due to both the presence of *Codonocarpus cotinifolius* at BHPPA-28 at 7.75% and the absence of *Acacia inaequilatera* at BHPPA-28.

- BHPPD-28 recorded the presence of multiple annual grasses and herbs, whereas BHPPA-28 did not.
- BHPPD-28 had a 33.1% cover of *Triodia glabra*, whereas BHPPA-28 only recorded a presence (0.1%) of this species.

Overall, these results indicate significant similarity in terms of floristic composition between the rehabilitation transects and the appropriate analogue transects in 2022, but of variable similarity with the original floristic composition recorded in the pre-clearing vegetation.

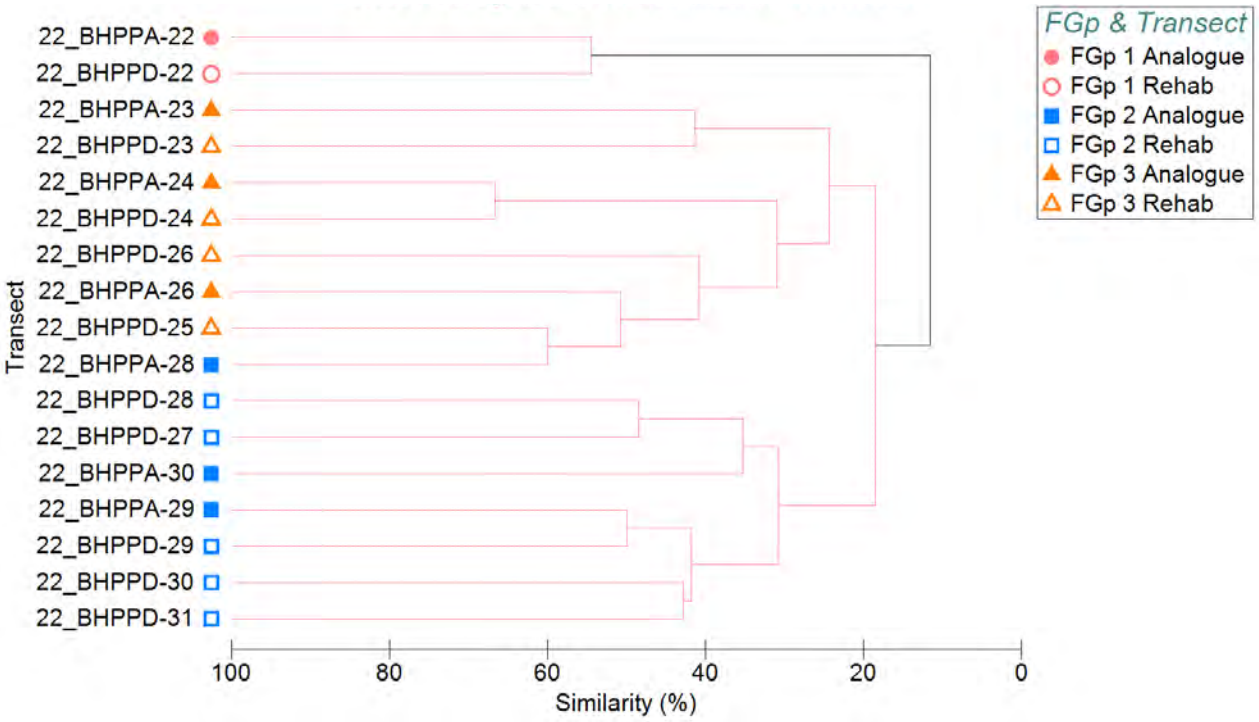


Figure 5.5: Results of the floristic clustering analysis carried out on the 2022 data for the monitoring transects (presence/absence of native species only).
Red lines indicate that sites are not significantly different from each other (SIMPROF test).

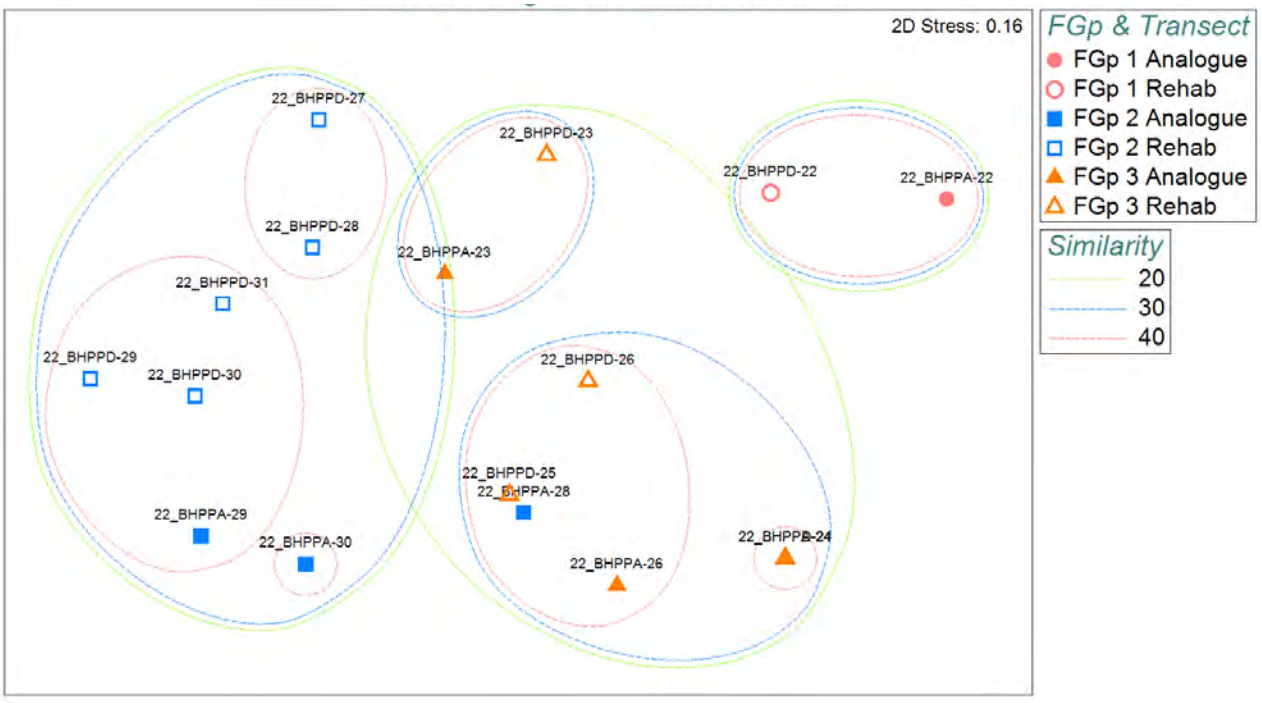


Figure 5.6: NMDS plot of 2022 data for the monitoring transects (presence-absence of native species only).

Table 5.3: Floristic groups identified by the clustering analysis of 2022 presence/absence data for native species at each site.

Floristic Group	Transect		Comments
	Analogue	Rehabilitation	
FGp 1	BHPPA-22	BHPPD-22	This floristic group contained all records of the species *Triodia schinzii*, which is indicative of red sand dunes and/or deep red sand plains: both BHPPA-22 and BHPPD-22 are the only transects situated within the sand dunes landform. The herbs *Bonamia alatisemina*, *Cassytha capillaris*, and woody shrub *Petalostylis cassioides*, were only recorded at site 22. The rehabilitation transect in this sub-group was in Excellent condition again in 2022, with well-developed native vegetation.
FGp 2	NA	BHPPD-27	Species that were present in the groups transects and influenced clustering were: *Acacia xiphophylla, Acacia inaequilatera, Codonocarpus cotinifolius, Ptilotus astrolasius, Iseilema dolichotrichum, Aristida contorta, Gomphrena canescens, Trianthema triquetrum, Ptilotus exaltatus, Dactyloctenium radulans, Portulaca oleracea, and Salsola australis.*
	(group 3)†	BHPPD-28	The absence of the perennial shrubs/trees *Acacia stellaticeps, Scaevola spinescens, Indogofera boviperda var. boviperda, Indigfoera colutea var. colutea, and Corymbia hamersleyana* typically not recorded in this landform, is a major influence on the separation of this grouping from FGp 3.
	BHPPA-29	BHPPD-29	This group contained all records of the species: *Acacia inaequilatera, A. xiphophylla, A. synchronicia, Aristida contorta, Boerhavia occinea, Cynodon prostrates, Dactyloctenium radulans, Enchylaena tomentosa, Enneapogon caerulescens, Eragrostis pergracilis, E. tenellula, Eriachne aristidea, E. pulchella subsp. pulchella, Euphorbia vaccaria var. vaccaria, Gomphrena canescens, G. cunninghamii, Iseilema dolichotrichum, I. eremaeum, I. vaginiflorum, Maireana planifolia, Mollugo molluginea, Paspalidium clementii, Portulaca oleracea, Ptilotus astrolasius, P. exaltastus, Rhynchosia minima, Salsola australis, Senna notabilis, Sida fibulifera, Solanum lasiophyllum, Sorghum oplumosum, Sporobolus australasicus, Stemodia grossa, Trianthema triquetrum, and Trachymene pilbarensis.*
	BHPPA-30	BHPPD-30	
	NA	BHPPD-31	This was also the only floristic group to record covers of the perennial shrubs *Acacia inaequilatera*, *A. synchronicia*, and *A. xiphophylla*. These Acacia species are indicative of transects in lower-lying positions in the landscape, in this instance a stony open (gibber) plain with a fine clayey-loam substrate and scattered mixed quartz. The rehabilitation transects in this group were considered to range from Very Poor to Excellent in terms of their native vegetation development (see Table 5.5 for an overview).
FGp 3	BHPPA-23	BHPPD-23	This group contained all records of the species: *Bulbostylis barbata, Codonocarpus cotinifolius, Corymbia hamersleyana, Indogofera boviperda* subsp. *boviperda, Indigofera colutea, Phyllanthus erwinii, Pluchea dentex, Scaevola spinescens*, and *Tephrosia* sp. B. Kimberley Flora (C.A. Gardner 7300). These species are indicative of the open sandy loam plains vegetation that dominates the locality. The continued absence of annual grasses recorded in FG2 (genera *Cynodon, Dactyloctenium, Enneapogon, Eragrostis, Iseilema*) and herbs (genera Gomphrena, Ptilotus), results in the separation from FGp 2 (see Figure 5.5 and 5.6). Three of the four rehabilitation transects in this grouping all showed Excellent development of native vegetation in 2022, with BHPPD-23 rated as Good; resulting in no change in ratings from 2021 to 2022.
	BHPPA-24	BHPPD-24	
	NA	BHPPD-25	
	BHPPA-28	(group 2)†	
	BHPPA-26	BHPPD-26	

† Paired analogue/rehabilitation transect is clustered within a separate floristic group.

5.3 Introduced Flora (Weeds)

Two perennial weed species were recorded from the study area in 2022, neither of which were new for the monitoring program:

- Live individuals of **Cenchrus ciliaris* and/or **C. setiger* were recorded from six of the rehabilitation transects (along five of the line transects, and in a single strip-transect; see Table 5.4). In contrast, **Cenchrus* spp. were recorded from a single analogue site (within the strip-transect at BHPPA-30).

The data for **Cenchrus* spp. are discussed further below in relation to the relevant criterion from Condition 8-1 of MS844:

(2) Weed coverage is equal to or less than that of pre-cleared levels.

5.3.1 **Cenchrus* spp.

While **Cenchrus* spp. are not listed as either declared pests or Weeds of National Significance (WONS), they are significant environmental weeds. They are aggressive and effective competitors for resources and space, have the potential to increase the fuel load (leading to more frequent and/or hotter fires), and regenerate quickly following fire and cessation of drought. In addition, **Cenchrus ciliaris* is believed to have the capacity for allelopathy, or biochemical inhibition of other plant species (see Cheam 1984a, 1984b).

The DBCA *Weed Prioritisation Process for the Pilbara* (WPP; Department of Parks and Wildlife 2013) ranks these species as highly invasive and with the potential for serious environmental impact, but widespread through the region and therefore having a low feasibility for control. However, the process does identify **Cenchrus* spp. as being a priority for management when there is potential for impact to the conservation estate (e.g. at Barrow Island Nature Reserve).

Records of **Cenchrus* spp. at the monitoring sites over the course of the program are presented in Table 5.4 and Figure 5.7, and are summarised below:

2013

In 2013, when the additional strip transect monitoring technique was implemented, **Cenchrus ciliaris* was not recorded from either of the rehabilitation transects at which it was found in 2010, however it was recorded along the line transects at seven other rehabilitation sites. This species was also recorded from only the strip transect at one rehabilitation site and at two analogues sites. In addition, **Cenchrus setiger* was recorded from the strip transect only at rehabilitation transect BHPPD-18. It is possible that these records of **Cenchrus* species from the strip transects may not truly represent "new" records for these four transects, as these species may have already been present at these sites in 2010, but not recorded due to the differing methodology. The apparent increase in records between 2010 and 2013 likely reflect the better seasonal conditions in which the latter survey was conducted.

2014 and 2015

Over the next two monitoring phases, it appears that both the cover and distribution of **Cenchrus* spp. increased in the study area, particularly in the rehabilitation areas (Table 5.4 and Figure 5.7). In 2014, **Cenchrus ciliaris* was recorded from the same two analogue transects but from 13 rehabilitation transects, with **C. setiger* co-occurring at six of the latter (BHPPD-12, BHPPD-13, BHPPD-16, BHPPD-18, BHPPD-23 and BHPPD-31). The cover of **Cenchrus* spp. increased from 2013 to 2014 at all of the rehabilitation transects, in some cases substantially (e.g. at BHPPD-15, BHPPD-16 and BHPPD-31). In 2015, **Cenchrus ciliaris* was recorded from at least one of the same analogue transects (while no data were provided for BHPPA-12, it is likely that the species was again present along the strip transect at this site). **Cenchrus ciliaris* was also recorded from 10 of the rehabilitation sites, with **C. setiger* recorded only from the strip transect at BHPPD-18. The cover of

*Cenchrus spp. at the sites in 2015 showed no consistent pattern compared to 2014, decreasing at seven sites and increasing at seven.

Table 5.4: Cover and presence of *Cenchrus spp. at monitoring transects within the Mt Minnie conservation area from 2010 to 2022.

Transect	2010	2013	2014	2015	2017	2019	2021	2022	Change in % Cover	
									2021 to 2022	2010 to 2022
Analogue										
BHPPA-23	-	-	-	-	+	-	-	-	-	-
BHPPA-29	-	+	+	1.90	2.50	9.70	-	-	-	-
BHPPA-30	-	-	-	-	-	+	0.35	+	-0.35	+
Rehabilitation										
BHPPD-22	-	-	-	-	-	-	-	+	+	+
BHPPD-23	-	1.00	3.00	4.00	+	-	0.45	5.00	4.55	5.00
BHPPD-28	-	-	-	-	0.40	+	+	0.20	0.20	0.20
BHPPD-29	-	7.00	15.00	3.30	70.15	21.55	24.20	8.15	-14.05	24.20
BHPPD-30	-	2.50	10.00	1.05	27.95	27.00	45.05	36.30	-8.75	36.30
BHPPD-31	-	5.25	19.25	12.35	27.35	1.90	31.20	73.65	42.45	73.65

Values are the percentage of the 20 m line transect occupied by each species at each site.
+ indicates presence only in the 1 m wide strip transect, which was utilised from 2013 onwards.

2017

In 2017, *Cenchrus ciliaris was recorded from both analogue sites at which it was previously recorded; it was also recorded in the strip transect only at a third analogue (BHPPA-23), together with *Cenchrus setiger. The cover of *Cenchrus ciliaris at analogue transect BHPPA-29 showed a slight increase compared to 2015. In terms of the rehabilitation transects, *Cenchrus spp. were recorded from all transects from which they had previously been recorded, and a small amount was recorded from a new rehabilitation transect (BHPPD-28). Sterile *Cenchrus sp. was recorded along the line transect at BHPPD-17, with *C. ciliaris confirmed from the strip transect at this site. *Cenchrus ciliaris was present along the line transects at all the remaining rehabilitation sites, except for BHPPD-11, BHPPD-13 and BHPPD-19, where it occurred only in the strip transects. *Cenchrus setiger occurred along the line transect at BHPPD-13 and co-occurred with *C. ciliaris along the line transect at BHPPD-18 and BHPPD-31; it also occurred in relatively small amounts at BHPPD-16, and was recorded from the strip transect only at BHPPD-15.

2019

In 2019, *Cenchrus ciliaris was recorded from analogue site BHPPA-29 at which it was previously recorded; it was also recorded in the strip transect only at BHPPA-30 for the first time. The percentage cover of *Cenchrus ciliaris at analogue transect BHPPA-29 showed an increase of 7.2% from 2017. In terms of the rehabilitation transects, *Cenchrus spp. were recorded from all transects from which they had previously been recorded, except for BHPPD-23 where it was absent in 2019. *Cenchrus setiger co-occurred with *C. ciliaris along the line transect at BHPPD-31.

From 2017 to 2019, the cover of *Cenchrus spp. decreased at four of the rehabilitation sites, including at BHPPD-28 where *Cenchrus was no longer recorded along the line transect but only in the strip transect, and at BHPPA-23 where *C. ciliaris and *C. setiger were no longer recorded in the strip-transect. Substantial decreases in cover were observed at BHPPD-29 and BHPPD-31 following herbicide treatment (see Plate 5.1, Plate 5.3, Figure 5.7). There was essentially no change in *Cenchrus cover at the remaining site (BHPPD-30; Plate 5.2). The cover of *Cenchrus species along the line transects at four rehabilitation sites was greater than that of pre-cleared levels, with all four situated in the Mt Minnie conservation area (BHPPD-28 to BHPPD-31).

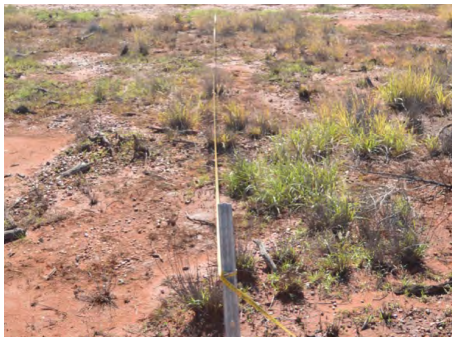
A  B  C  D 

Plate 5.1: *Cenchrus at site BHPPD-29 in 2017 (A); 2019 (B); 2021 (C); and 2022 (D).

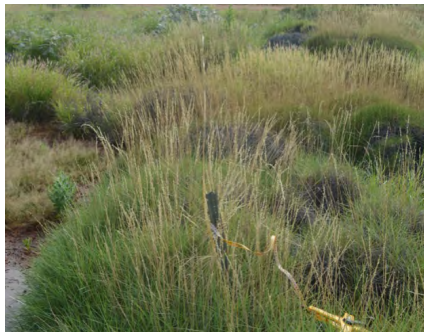
E  F  G  H 

Plate 5.2: *Cenchrus at site BHPPD-30 in 2017 (E); 2019 (F); 2021 (G); and 2022 (H).

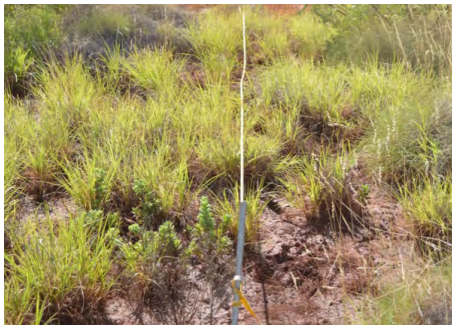
I  J  K  L 

Plate 5.3: *Cenchrus at site BHPPD-31 in 2017 (I); 2019 (J); 2021 (K); and 2022 (L).

2021

In 2021, *Cenchrus ciliaris* was not recorded from analogue site BHPPA-29 at which it was previously recorded; it was recorded along the line transect of BHPPA-30 for the first time, having only previously been recorded within the strip transect of BHPPA-30. The cover of *Cenchrus ciliaris* at analogue site BHPPA-29 decreased to 0% in 2021 from 9.7% in 2019; with a small increase of 0.35% at the analogue site BHPPA-30. In terms of the rehabilitation transects, *Cenchrus* spp. were recorded from all the transects where they had been previously recorded, including the reoccurrence of *Cenchrus* spp. within BHPPD-23 where it had been absent in 2019. *Cenchrus setiger* co-occurred with *C. ciliaris* within BHPPD-30 and BHPPD-23.

From 2019 to 2021, the cover of *Cenchrus* spp. increased at four of the rehabilitation sites (BHPPD-23, BHPPD-29, BHPPD-30 and BHPPD-31) with one site (BHPPD-28) only recording *Cenchrus* spp. within the strip transect. Substantial increases in cover were observed at BHPPD-30 (Plate 5.2) and BHPPD-31(Plate 5.2), 18.05% and 29.30% respectively. Site BHPPD-23 saw the reoccurrence of *Cenchrus* spp., with an increase of 0.45%, when it was not recorded in the 2019 monitoring in either the strip or line transect. The cover of *Cenchrus* species within five rehabilitation sites is currently greater than that of pre-cleared levels (Table 5.4), with four situated in the Mt Minnie conservation area (BHPPD-28 to BHPPD-31).

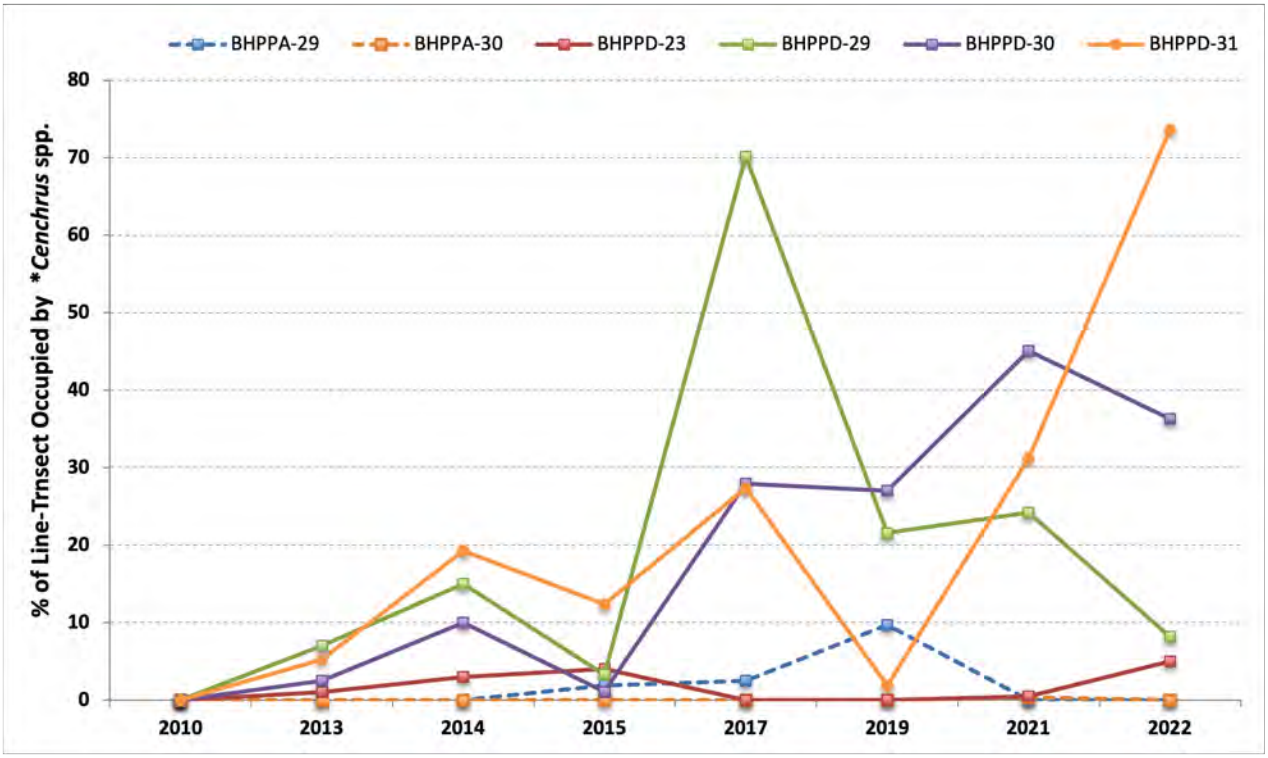


Figure 5.7: **Cover of *Cenchrus* spp. recorded along line transects across all monitoring phases.**
2010 represents pre-clearing monitoring.

2022

In 2022, *Cenchrus* was again recorded at analogue site BHPPA-30, this time as only a presence, down from 0.35% in 2021. Additionally, for the first time since monitoring began, *Cenchrus* was recorded as a presence within the strip-transect at rehabilitation site BHPPD-22 (Table 5.4).

A decrease in the cover of *Cenchrus* at rehabilitation transects BHPPD-29 (-14.05%; Plate 5.1) and BHPPD-30 (-8.75%) was observed in 2022 (Table 5.4, Figure 5.7); however, a significant increase in the cover of *Cenchrus* (42.45%) was recorded at BHPPD-31, with the highest levels of infestation recorded at this transect in the last two phases.

Importantly, three rehabilitation transects with high *Cenchrus* spp. cover (BHPPD-29, BHPPD-30 and BHPPD-31) are located in the southern end of the study area within the Mt Minnie conservation area

(Table 5.4). It is clear from the data that with regards to *Cenchrus spp., the level of weed coverage at three of the rehabilitation transects (BHPPD-29, BHPPD-30, and BHPPD-31) is not equal or less than the pre-cleared levels but is considerably higher. The rehabilitation in these areas therefore does not meet Condition 8-1 of MS844. Notwithstanding the potential that the monitoring conducted during the dry year in 2010 substantially underestimated both the number of sites at which *Cenchrus spp. was present and the amount of cover of *Cenchrus spp. at those sites, there is an increase at several sites over subsequent years, with decreases or plateaus following appropriate herbicide application (Table 5.4, Figure 5.7).

5.4 Development of Vegetation Cover

In addition to species diversity and weed coverage, a third parameter warrants investigation: the degree of development of vegetation in the rehabilitation areas. The amount of cover provided by native plants at each transect was calculated for the different growth form and longevity classes (i.e. hummock grasses, perennial tussock grasses, shrubs and trees, and annual grasses and annual herbs). This is presented along with the cover of *Cenchrus spp. in Appendix 2.

Some of the rehabilitation transects have clearly developed a substantially higher cover of vegetation post-clearing than others, and the proportion of the different life form classes has often changed over the six monitoring phases since the areas were cleared. This information has been incorporated into the qualitative assessment in Section 5.5.

5.5 Summary Overview of Transect Condition

The data recorded during the survey were summarised to provide a broad qualitative assessment of the transects monitored in 2022. Transects were assigned to one of five categories (Excellent, Good, Fair, Poor or Very Poor) depending on the degree of perennial native vegetation cover, its similarity to original vegetation composition, and the level of invasion by weeds (principally *Cenchrus spp.; see Table 3.4). The effect of fire was excluded from this process as far as possible. Most of the analogue transects monitored in 2022 (86%; six of the seven) were in Excellent condition, with the exception of BHPPA-30 in the Mt Minnie conservation area; this transect was ranked as Very Good to take into account the presence of juvenile *Cenchrus ciliaris individuals within the strip-transect (0.1% cover).

The majority (7 of 10) of the rehabilitation transects were ranked as being in Excellent or Good condition, with five transects ranked as Excellent and two ranked as Good (see Table 5.5). The remaining three transects were ranked as Fair (BHPPD-29), Poor (BHPPD-30) and Very Poor (BHPPD-31), reflecting the lack of development of native vegetation and/or substantial development of weeds.

Rehabilitation transects BHPPD-29 and BHPPD-30 have both improved in qualitative assessment of vegetation development since 2021; whereas BHPPD-31 has declined in overall development of native vegetation, mainly due to the increase in cover of *Cenchrus recorded in 2022. The remaining transects exhibited a similar level of vegetation development in 2022 to that observed in 2021.

Table 5.5: Qualitative assessment of the development of vegetation on the rehabilitation transects in 2021.

Transect	2017	2019	2021	2022 - Overall Ranking and Comments
BHPPD-22	**Excellent**	**Excellent**	**Excellent**	**Excellent** Perennial *Acacia* mature and flowering; spinifex is above pre-clearing levels and has been steady over the last four phases, increasing again in 2022. Presence of a single juvenile **Cenchrus ciliaris* individual recorded in 2022 within the strip-transect.
BHPPD-23	**Good**	**Good**	**Good** (towards Excellent)	**Good (verging on Fair)** Spinifex cover steady from 2021 with an increase in *Triodia glabra* recorded; currently more than twice that of pre-clearing levels; *Acacia ancistrocarpa* has increased in cover, exceeding pre-clearing levels. *Acacia bivenosa, A. stellaticeps*, and *A. trachycarpa* yet to approach pre-clearing levels. **Cenchrus* spp. increased from 0.45% to 5% in 2022.
BHPPD-24	**Excellent**	**Excellent**	**Excellent**	**Excellent** Steady cover of mature spinifex since 2017 which is still 15% greater than the pre-clearing levels; the cover of spinifex appear to be at a level that is representative of the surrounding vegetation; *Acacia* spp. appear to be dead and absent in the 2022 monitoring again; no weeds recorded within the sites and surrounding vegetation.
BHPPD-25	**Good**	**Good**	**Excellent**	**Excellent** Spinifex has regenerated to the levels prior to the 2017 fire and increased from 2021 levels. Mature *Acacia* spp. present; spinifex and Acacia spp. appear to be at a level that is representative of the greater area; as expected with trees post-clearing, scattered *Corymbia hamersleyana* and *Eucalyptus xerothermica* are still absent; no weeds recorded within the sites and surrounding vegetation.
BHPPD-26	**Good**	**Good**	**Excellent**	**Excellent** Almost identical to analogue site (strata and species composition): spinifex and *Acacia* spp. cover has exceeded pre-clearing levels with the continued absence of *Corymbia hamersleyana;* annual grasses and herbs have mostly disappeared since 2021; no weeds have been recorded within the sites or in the surrounding vegetation; the Rehabilitation and Analogue sites are very similar in terms of strata and percentage cover.
BHPPD-27	**Fair**	**Excellent**	**Good** (towards Excellent)	**Good (verging on Excellent)** Spinifex cover has continually increased since 2013 to half of pre-clearing levels in 2022. Decrease in both *Acacia ancistrocarpa*, and *A. inaequilatera* in 2022; overall there is positive indication that vegetation structure is tending towards its natural state; decrease in annual grasses *Aristida contorta* and *Paspalidium clementii*; no weeds were recorded within the sites or in the surrounding vegetation.

Transect	2017	2019	2021	2022 - Overall Ranking and Comments
BHPPD-28	**Excellent**	**Excellent**	**Excellent**	**Excellent** Spinifex cover has again decreased since 2019 but is more or less at pre-clearing levels in 2022; cover of *Acacia* spp. shrubs is still low compared to pre-clearing with mature *Acacia ancistrocarpa* and *A. bivenosa* in the surrounding non-cleared vegetation; less mature Acacia's appear to be present over the clearing footprint; the cover of **Cenchrus* was recorded as 0.2% along the line-intercept and the cover in the surrounding rehabilitated area is minimal.
BHPPD-29	**Very Poor**	**Poor**	**Poor**	**Fair** No spinifex or *Acacia*'s have established along the transect (or in the surrounding cleared footprint) following clearing; cover of **Cenchrus* has reduced by two thirds but remains similar to that in 2013. *Cenchrus* spp. decreased by 14.05% in 2022. Overall, the Rehabilitation site does not represent pre-clearing vegetation cover levels.
BHPPD-30	**Poor**	**Poor**	**Very Poor**	**Poor** Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 35-37% since 2021; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual grasses are absent all together; the cover of **Cenchrus* remains high despite a decrease of 9% since the last monitoring survey in 2021.
BHPPD-31	**Poor**	**Good**	**Poor**	**Very Poor** Spinifex cover remains steady since 2021 but is still 26% less than pre-clearing levels; the cover of *Acacia* species is non-existent with the Acacias in the greater area (not cleared) in healthy condition and flowering; there was a large decrease in in annual grasses and herbs; **Cenchrus* cover increased significantly by 42%.

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6.0 Conclusions

6.1 Satisfaction of Completion Criteria

When assessing rehabilitation progress against the completion criteria, consideration needs to be given to the existing pipeline access track, and its potential to act as a vector for weed introduction along the pipeline disturbance corridor, particularly in areas that are currently weed free or where vegetation has not become adequately established.

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

(1) Species diversity is not less than 60 per cent of the known original species diversity.

This criterion has been met for species richness in the monitored transects, again with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is considered to be 'Excellent' and would be expected to continue to develop towards a floristic community and composition more aligned with pre-clearing levels in the longer term.

(2) Weed coverage is equal to or less than that of pre-cleared levels.

The criterion for Condition 8 in MS844 has again not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2022 with regard to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2022 result to that of 2021, **Cenchrus ciliaris* and **C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at both BHPPD-29 and BHPPD-30, but increased significantly at BHPPD-31. Provided that continued spraying of these species within the rehabilitated areas is undertaken at the appropriate times and intensity of effort over the course of the next few years, it would be expected that the cover of **Cenchrus* spp. will tend towards pre-clearing levels.

6.2 Rehabilitation within the Mt Minnie Conservation Area

While most of the rehabilitation transects sampled in the Mt Minnie conservation area show Good to Excellent vegetation development, with few or no weeds, two transects at the southern end of the study area remain in relatively Poor condition, with a third considered to be Good.

- Transect BHPPD-29 is considered Fair, with a somewhat moderate cover of **Cenchrus ciliaris* tussock grasses (8.15%) and no development of spinifex or perennial shrubs over the course of monitoring. Importantly, **Cenchrus* cover has decreased by 14.05% since the last phase.
- Transect BHPPD-30 is considered Poor. It shows a reasonable development of both spinifex and perennial shrub cover, but the cover of **Cenchrus* has remained high (36.3%) despite a decrease of 8.75% since the last monitoring phase. Perennial *Acacia* shrubs have also decreased.
- Transect BHPPD-31 is considered Very Poor in 2022: spinifex cover has decreased by approximately 25% to less than pre-clearing levels, with **Cenchrus* cover increasing by 42.45%.

6.3 Likely Progression of Rehabilitation Transect Vegetation

Prior to the 2019 survey, DBCA requested discussion of the likely progression of revegetation in the rehabilitation areas situated within the Mt Minnie conservation area in the short term (2-5 years), medium term (5-10 years) and long term (10-20 years). Based on the data recorded from

the monitoring transects in these areas to date, vegetation development is clearly variable in different areas, and would be expected to progress differently over time.

Transects ranked as 'Excellent' in Table 5.5 comprise **BHPPD-22, BHPPD-24, BHPPD-25, BHPPD-26** and **BHPPD-28**. Vegetation at these transects is relatively comparable to that which existed prior to clearing, with a similar or sometimes greater amount of vegetation cover and no weeds, other than a presence within the strip transect at **BHPPD-22** and a cover of 0.2% recorded at **BHPPD-28**. This vegetation would be expected to continue to develop in the short term, with additional species recruiting from the soil seed bank and adjacent areas. In the medium and long term, vegetation at the rehabilitation transects would be expected to remain stable over time, with major changes arising only due to disturbance events such as fire, or long-term shifts in the amount of rainfall received.

Transects ranked as 'Good' in Table 5.5 comprise **BHPPD-23** and **BHPPD-27**. The cover of native perennial vegetation along these transects is generally approaching the percentage recorded prior to clearing in 2010, although the proportions of shrubs and spinifex are often dissimilar (typically more shrubs and less spinifex). Weeds are generally absent or provide negligible cover, except for a small number of seedlings re-establishing at **BHPPD-23** in 2021 at 0.45% cover and increasing to 5% cover in 2022. It would be expected that the native vegetation cover would increase to reach the pre-clearing levels within 5 years and would then remain stable over time. Unless spot spraying is undertaken at **BHPPD-23**, it would be expected that **Cenchrus* spp. levels would continue to increase over the short term.

Transects ranked as 'Poor' in Table 5.5 comprise **BHPPD-30**. Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 35-37% since 2021; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual grasses are absent all together; the cover of **Cenchrus* remains high despite a decrease of 9% since the last monitoring phase. It would be expected that the native vegetation cover would decrease over the short-term, and annual grasses and herbs would not repopulate to pre-clearing levels unless the population of **Cenchrus* spp. in the surrounding vegetation is controlled in the medium to long-term

Transects ranked as 'Fair' in Table 5.5 comprise **BHPPD-29**. Although there is a lack of development of perennial vegetation at **BHPPD-29** (no hummock grassland of *Triodia glabra* and no shrubland of *Acacia synchronicia* and *A. xiphophylla* that existed prior to clearing), the current cover of **Cenchrus* spp. at this transect (8.15%) has been reduced greatly from the 70% recorded in 2017, and has also decreased by 14.05% from the previous 2021 monitoring phase. It is expected that in the short term, with continued spraying, that the level of **Cenchrus* spp. will continue to decline. It would only be expected that the perennial *Acacia* shrubs and *Triodia* hummocks would become established in the medium to long term given favourable conditions and the absence of competition from **Cenchrus* spp.

Transects ranked as 'Very Poor' in Table 5.5 comprise **BHPPD-31**. At **BHPPD-31**, it is unlikely that the cover of *Acacia xiphophylla* will return to pre-clearing levels of 72%, with colonisation of *A. bivenosa* shrubs along this transect only likely in the very long-term. Spinifex cover has remained steady since 2021 but still 26% less than pre-clearing levels, and the cover of **Cenchrus* has increased significantly from 31.2% in 2021 to 73.65% in 2022. The greater area surrounding **BHPPD-31** continues to support large, permanent populations of *A. xiphophylla*, and as whole presents as a stable, healthy vegetation unit.

For both transects (**BHPPD-29** and **BHPPD-31)**, the presence of relatively substantial amounts of **Cenchrus* spp. is likely to influence the development of native vegetation, through competition for resources and allelopathy. In the short to medium term, it is expected that the cover of native vegetation may still increase, however it is also likely that the cover of **Cenchrus* spp. will continue to remain steady or increase unless continued herbicide spraying is undertaken.

The presence of **Cenchrus* spp. is not the only factor influencing slow revegetation, however it is likely to be a significant factor over time, particularly for transects at which the cover of weeds is

still moderate or high following herbicide spraying. Given the amount of *Cenchrus spp. cover currently recorded at **BHPPD-29, BHPPD30** and **BHPPD-31**, these infestations would be expected to increase again in the short to medium term, and would likely suppress the regeneration of native perennial vegetation. It is unlikely that native vegetation would be able to re-establish to a similar state as was present prior to clearing, without continued weed control efforts.

To ameliorate the current long-term trend of a relatively stable, or increasing, *Cenchrus population (specifically in the south-eastern end of the study area), it is recommended that the herbicide treatment plan is a bi-annual occurrence for at least seven years to eradicate the species from the soil seedbank.

6.4 Recommendations of DBCA Review

With regards to meeting the four recommendations outlined by the DBCA in 2018 (see Section 2.2):

Recommendation 1

Woodside completed a weed survey of the ROW in July 2018, and appointed a contractor to complete herbicide spraying of *Cenchrus spp. infestations and individuals along the section situated within the proposed Mt Minnie conservation area in Q3 of the same year, July of 2019, October 2020, and November 2021.

Additionally, Woodside commissioned Biota to undertake additional phases of rehabilitation and weed monitoring in March/April 2019, May 2021, and May 2022 following appropriate rainfall.

Recommendation 2

In order to address completion criteria required by Condition 8-3 under MS844, it is again recommended that the following contingency management measures are implemented:

a) for the pipeline disturbance corridor, especially the section within the Mt Minnie conservation area, it is recommended that as a minimum standard, ongoing herbicide spraying of *Cenchrus spp. is undertaken when conditions are appropriate. Additionally, opportunistic (reactive) spraying of populations should be undertaken following appropriate rainfall events (6.5-20 mm over consecutive days) to ensure both mature individuals and germinating seedlings are targeted.

b) that vehicles and machinery utilising the ROW within the pipeline gas corridor adhere to the current Woodside weed hygiene management practices.

Recommendation 3

To date, Woodside has completed herbicide spraying of *Cenchrus spp. populations in Q3 of 2018, July of 2019, October 2020, and November 2021. Additionally, weed hygiene protocols have been implemented and utilised for all vehicles and machinery traversing the ROW within the Mt Minnie conservation area.

Recommendation 4

Woodside, along with the results and conclusions of this report, recognises that the existing pipeline access track is likely to be acting as a potential vector for weed introduction along the pipeline disturbance corridor. Current weed hygiene protocols are in place to prevent the spread of weeds along the pipeline access track. Appropriate weed hygiene signage along the length of the access track, as well as appropriately timed, herbicide application to *Cenchrus spp. populations, will need to be adopted as a continual, ongoing effort for a number of years in order to control and prevent the spread of weeds into the surrounding vegetation.

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Appendix 1

2022 Monitoring Transect Coordinates

ANALOGUE TRANSECTS

Transect ID	Peg Location – 0 m (start)		Peg Location – 20 m (end)	
	Easting	Northing	Easting	Northing
BHPPA-22	308722	7581767	308707	7581757
BHPPA-23	310680	7579965	310663	7579949
BHPPA-24	324359	7572037	324352	7572018
BHPPA-26	329727	7568156	329716	7568139
BHPPA-28	338649	7561624	338638	7561607
BHPPA-29	339668	7560530	339663	7560510
BHPPA-30	340703	7559306	340696	7559287

REHABILITATION TRANSECTS

Transect ID	Peg Location – 0 m (start)		Peg Location – 20 m (end)	
	Easting	Northing	Easting	Northing
BHPPD-22	308753	7581829	308743	7581814
BHPPD-23	310693	7580026	310681	7580010
BHPPD-24	324437	7572060	324428	7572043
BHPPD-25	326911	7570292	326903	7570273
BHPPD-26	329764	7568214	329760	7568195
BHPPD-27	332180	7566205	332173	7566188
BHPPD-28	338709	7561652	338704	7561632
BHPPD-29	339711	7560604	339703	7560590
BHPPD-30	340706	7559391	340699	7559379
BHPPD-31	341811	7558474	341800	7558458

Appendix 2

Transect Photographs and Summarised Data (2010-2022)

Photographs of transects over the course of the monitoring program, together with summarised data from the monitoring transects

Cover of each lifeform category along the line transect:

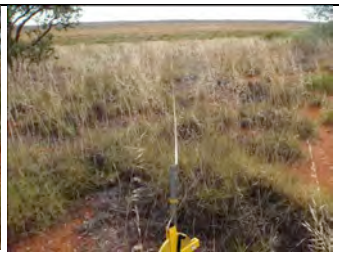
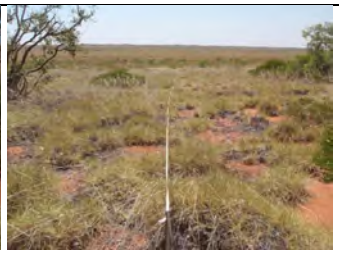
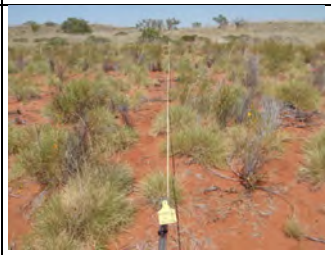
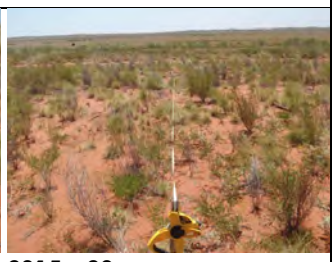
Values in table are the percentage of the 20 m line transect occupied by each native lifeform category at each site, along with the percentage occupied by weeds. (Note that *C*enchrus* tussock grasses were the only weeds recorded on the line transects, although other weeds were sometimes present in the broader sites.)

Covers and presence of individual species:

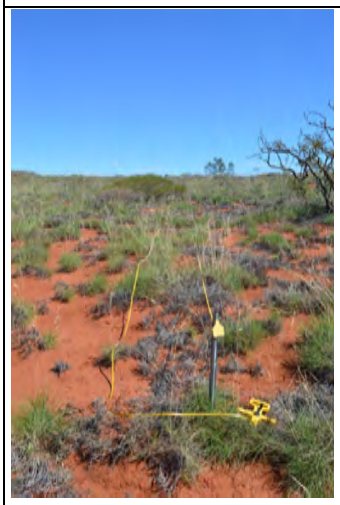
Values in table are the percentage of the 20 m line transect occupied by each species at each site.

+ indicates additional species present in 1 m wide strip transect (note that the strip transect was only utilised from 2013 onwards).

Site 22 (Mt Minnie conservation area)

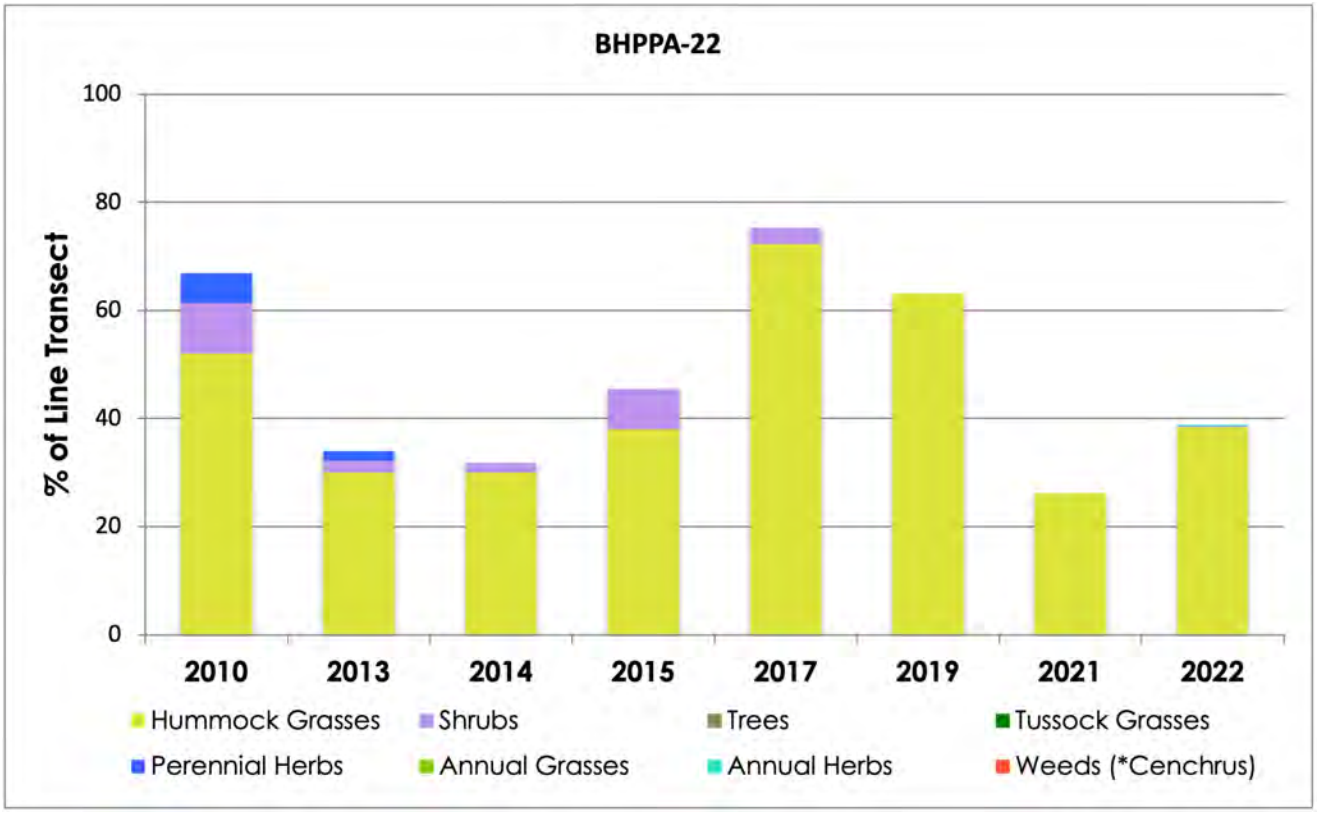
Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

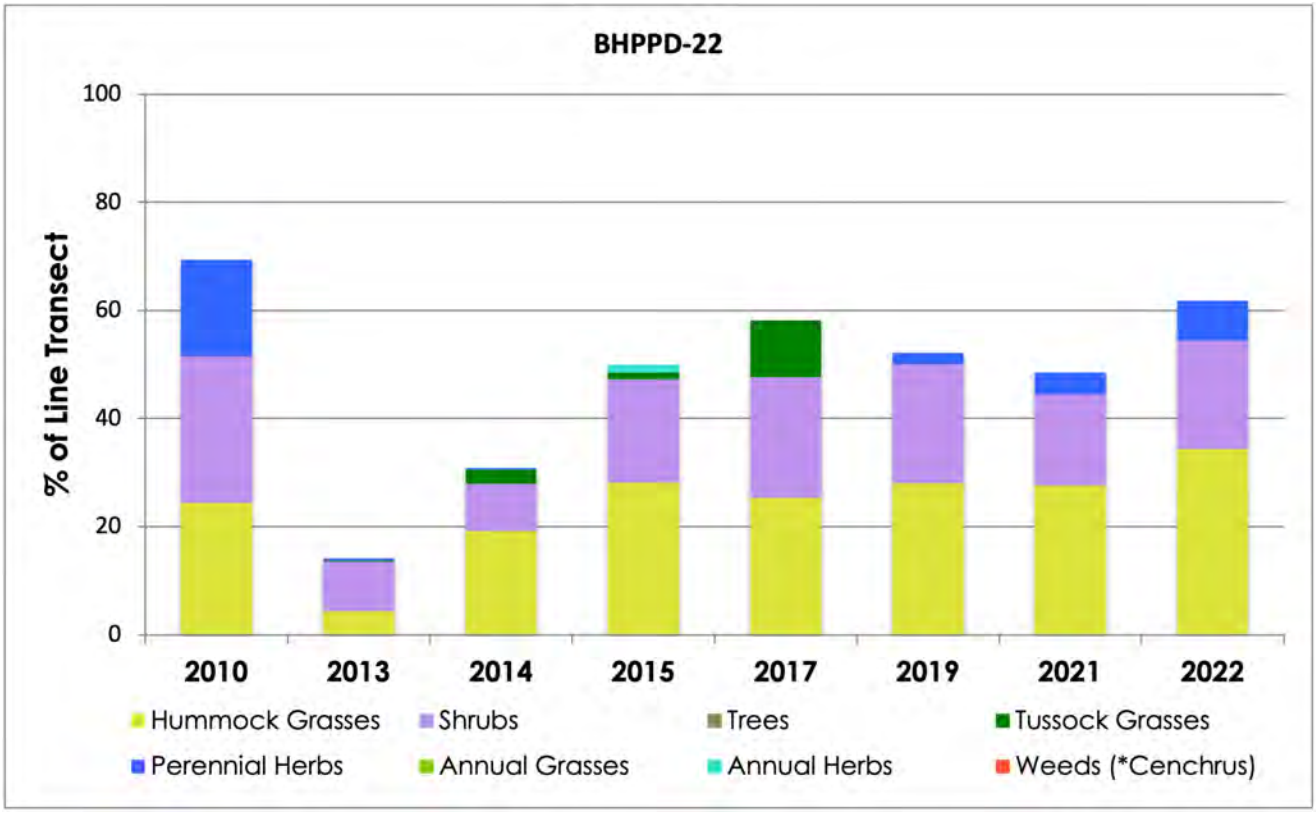
Site 22 (Mt Minnie conservation area)

Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-22	2010	52.05	9.30			5.55			
	2013	30.00	2.25			1.75			
	2014	30.00	1.75						
	2015	38.00	7.50						
	2017	72.25	3.05						
	2019	63.20							
	2021	26.15							
	2022	38.40	0.10			0.10		0.25	
Rehab BHPPD-22	2010	24.40	27.15			17.80			
	2013	4.40	9.10		0.25	0.35			
	2014	19.20	8.70		2.60	0.40			
	2015	28.20	19.10		1.25			1.45	
	2017	25.35	22.30		10.55				
	2019	28.05	22.05			2.05			
	2021	27.60	16.90			4.05			
	2022	34.40	20.05			7.40			




BHPPD-22
% of Line Transect
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 22 (Mt Minnie conservation area)

Cover and presence of individual species:

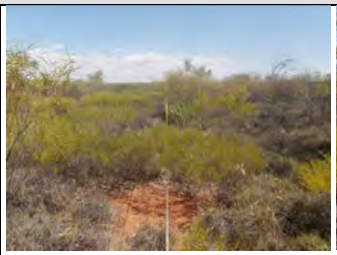
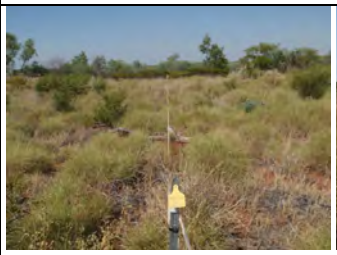
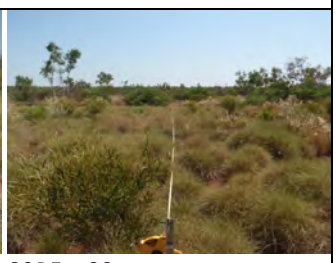
	BHPPA-22								BHPPD-22							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae																
Ptilotus polystachyus								0.25								+
Convolvulaceae																
Bonamia alatisemina								0.10			0.40		+			+
Bonamia erecta			+	+	+		+	+								
Polymeria lanata										0.35						
Fabaceae																
Acacia stellaticeps							+	0.10	12.30	0.10	+	6.40	12.10	22.05	16.90	20.05
Petalostylis cassioides										8.75	8.70	12.70	10.20			+
Swainsona ?kingii												1.45				
Goodeniaceae																
?Goodenia microptera				+												
Scaevola parvifolia											+	+	+			
Lamiaceae																
Dicrastylis cordifolia	9.30	2.25	1.75	7.50	3.05	+			7.85	0.25	+	+	+			
Quoya paniculata									7.00							
Lauraceae																
Cassytha capillaris					+								+	+	4.05	7.40
Cassytha sp.	5.55	1.75							17.8							
Malvaceae																
Corchorus sp.								+								
Poaceae																
Aristida holathera var. *holathera*										+		+				
**Cenchrus ciliaris*																+
Eragrostis eriopoda										0.25	2.60	1.25	10.55			
Triodia epactia									22.45	4.15	18.45					
Triodia schinzii	52.05	30.00	30.00	38.00	72.25	63.20	26.15	38.40			+	25.80	21.85	28.05	22.15	25.55
Triodia glabra									1.95	0.25	0.75	2.40	3.50	+	5.45	9.85
Proteaceae																
Grevillea stenobotrya												+	+			
Total no. of native species	**3**	**3**	**3**	**4**	**4**	**2**	**3**	**6**	**6**	**8**	**9**	**10**	**10**	**4**	**4**	**7**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Comments regarding site:

Rehabilitation is again in excellent condition in 2022; perennial shrub *Acacia stellaticeps* mature and flowering; spinifex is above pre-clearing levels and has been steady over the last five phases of monitoring and is representative of the greater area (as mentioned in previous monitoring reports *Triodia schinzii* has either replaced *T. epactia*, or the soft spinifex was misidentified in the early phases); in comparison there has been a 12% reduction in spinifex cover within the Analogue site since 2010,

but an increase of 12% since the last phase in 2021; perennial herbs have increased (e.g. *Cassytha capillaris*) showing a trend towards pre-clearing levels; **Cenchrus ciliaris* was recorded as a presence for the first time in 2022..

Site 23 (Mt Minnie conservation area)

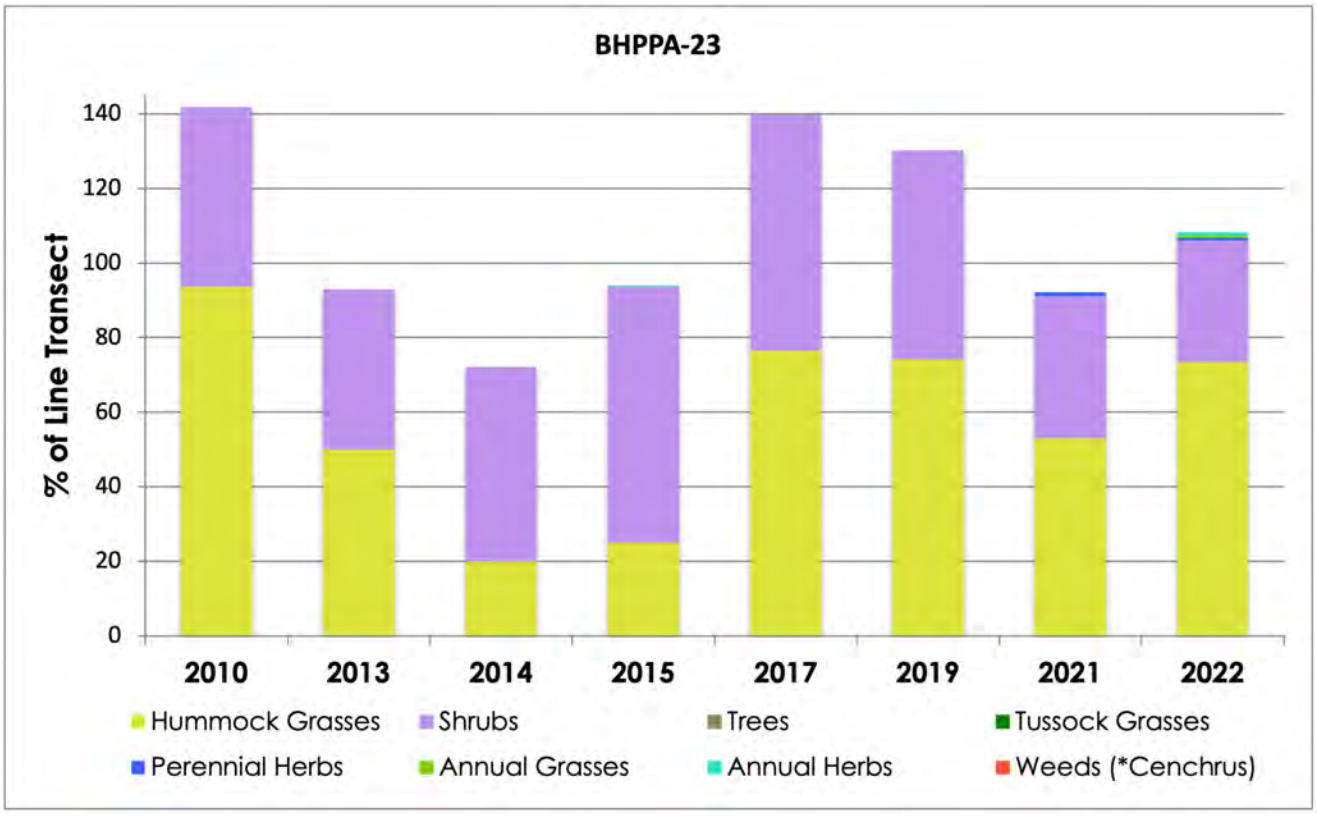
Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

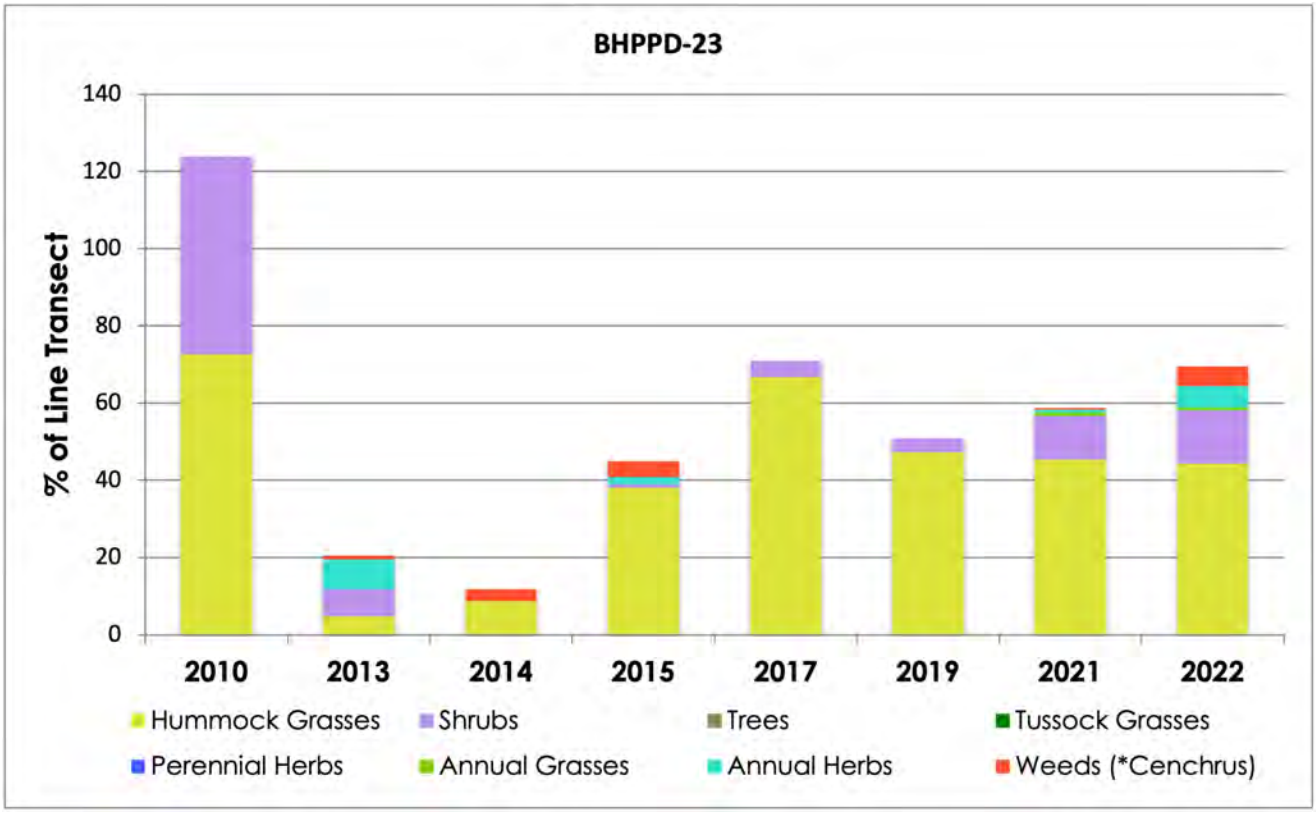
Site 23 (Mt Minnie conservation area)

Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-23	2010	93.70	48.25						
	2013	50.00	43.00						
	2014	20.00	52.10						
	2015	25.00	68.70					0.25	
	2017	76.55	63.15						
	2019	74.30	55.95						
	2021	53.00	38.15			1.00			
	2022	73.50	32.50			0.75	0.65	0.95	
Rehab BHPPD-23	2010	72.70	51.25						
	2013	4.75	7.00					7.75	1.00
	2014	8.75							3.00
	2015	38.05	0.85					2.00	4.00
	2017	66.75	4.15						
	2019	47.20	3.65						
	2021	45.30	11.45				0.90	0.65	0.45
	2022	44.35	13.85				0.65	5.60	5.00




BHPPD-23
% of Line Transect
140
120
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 23 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPA-23								BHPPD-23							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae																
Ptilotus axillaris										1.00					+	
Ptilotus polystachyus										4.75		0.10			+	5.50
Araliaceae																
Trachymene oleracea								+								
Asteraceae																
Pluchea dentex																+
Pluchea dunlopii				+												
Streptoglossa decurrens				+											+	
Boraginaceae																
Heliotropium crispatum							+	0.95		2.00					+	
Chenopodiaceae																
Dysphania rhadinostachya subsp. rhadinostachya															+	
Cleomaceae																
Arivela viscosa															+	0.10
Convolvulaceae																
Bonamia erecta										+	+	+				
Evolvulus alsinoides var. *villosicalyx*					+											+
Cyperaceae																
Bulbostylis barbata											+				0.65	+
Euphorbiaceae																
Euphorbia tannensis															+	
Euphorbia tannensis subsp. *eremophila*								+								
Euphorbia boopthona																+
Fabaceae																
Acacia ancistrocarpa									8.55		+	0.85	2.75	3.65	3.50	9.9
Acacia bivenosa	40.50	37.50	43.50	56.05	55.25	55.95	37.40	32.50	4.05		+	+			+	
Acacia stellaticeps									30.90			+	1.40	+	5.20	3.45
Acacia synchronicia	7.75	5.50	8.60	12.65	7.90	+	0.75	+								
Acacia trachycarpa									7.75							
Indigofera boviperda subsp. *boviperda*								+				+			2.30	0.30
Indigofera colutea								+		+		1.90			+	+
Petalostylis cassioides												+				
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)					+					+	+					+
Goodeniaceae																

	BHPPA-23								BHPPD-23							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Goodenia microptera				0.25						+						
Lauraceae																
Cassytha capillaris							1.00	0.75								
Malvaceae																
Abutilon lepidum										1.00					0.45	+
Abutilon otocarpum										3.00						0.20
Abutilon ?sp. Onslow (F. Smith s.n. 10/9/61)							+	+								
Abutilon sp.				+												
Corchorus sidoides subsp. *sidoides*															+	
Hibiscus sturtii												+				
Hibiscus sturtii var. *campylochlamys*					+											
Hibiscus sturtii var. *platychlamys*											+					
Sida arsiniata												+				
Sida cardiophylla							+									
Sida fibulifera								+		3.00					+	+
Sida sp.				+						+	+					
Montiaceae																
Calandrinia sp.																+
Phyllanthaceae																
Dendrophyllanthus erwinii															+	+
Nellica maderaspatensis				+												
Poaceae																
**Cenchrus ciliaris*					+					1.00	2.00	2.00	+		+	1.15
**Cenchrus setiger*					+						1.00	2.00			0.45	3.85
Eriachne aristidea																0.35
Paspalidium clementii								0.65							0.90	0.30
Sporobolus australasicus								+								
Triodia epactia	92.45	30.00	15.00	25.00	70.65	61.00	27.45	45.75	66.55	4.50	7.50	30.00	62.00	47.20	36.65	28.45
Triodia glabra	1.25	20.00	5.00		5.90	13.30	25.55	27.75	6.15	0.25	1.25	8.05	4.75	+	8.65	15.90
Yakirra australiensis var. australiensis															+	
Portulacaceae																
Portulaca oleracea										✓						
Total no. of native species	**4**	**4**	**4**	**9**	**7**	**4**	**8**		**6**	**14**	**9**	**12**	**4**	**4**	**21**	**20**
Total no. of weed species	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**	**2**	**2**	**1**	**0**	**2**	**2**

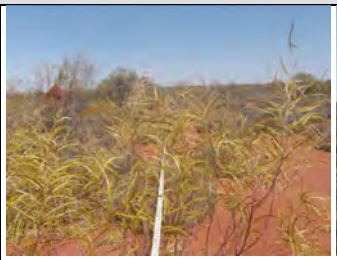
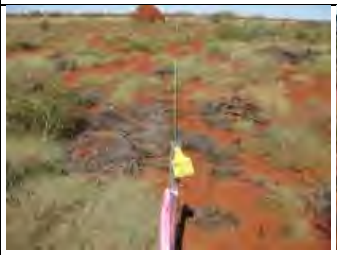
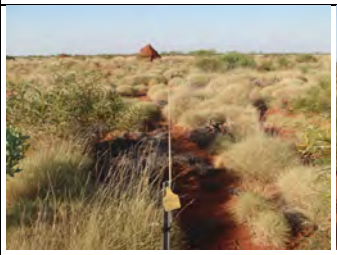
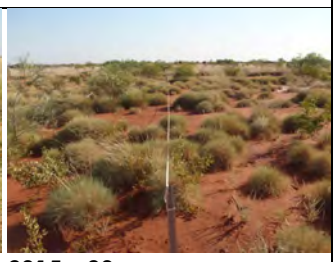
Comments regarding site:

Rehabilitation is in very good condition in 2022; spinifex is mature and cover steady from 2021 with an increase in *Triodia glabra* recorded, it is currently more than twice that of pre-clearing levels; *Acacia ancistrocarpa* has increased in cover, exceeding pre-clearing levels but noticeably *Acacia bivenosa*, *Acacia stellaticeps*, and *Acacia*

trachycarpa are yet to approach pre-clearing levels, with very few having colonised within the clearing footprint; a relatively small percentage of **Cenchrus* was recorded in the transect and in the surrounding vegetation in 2022 suggesting that since herbicide application events prior to the survey the weed looks to be naturally re-establishing in the area.

The Analogue site is showed an increase in overall spinifex cover in 2022, but still remains 20% lower than pre-clearing levels; the 2022 monitoring picked up a number of new perennial shrubs and annual herbs.

Site 24 (Mt Minnie conservation area)

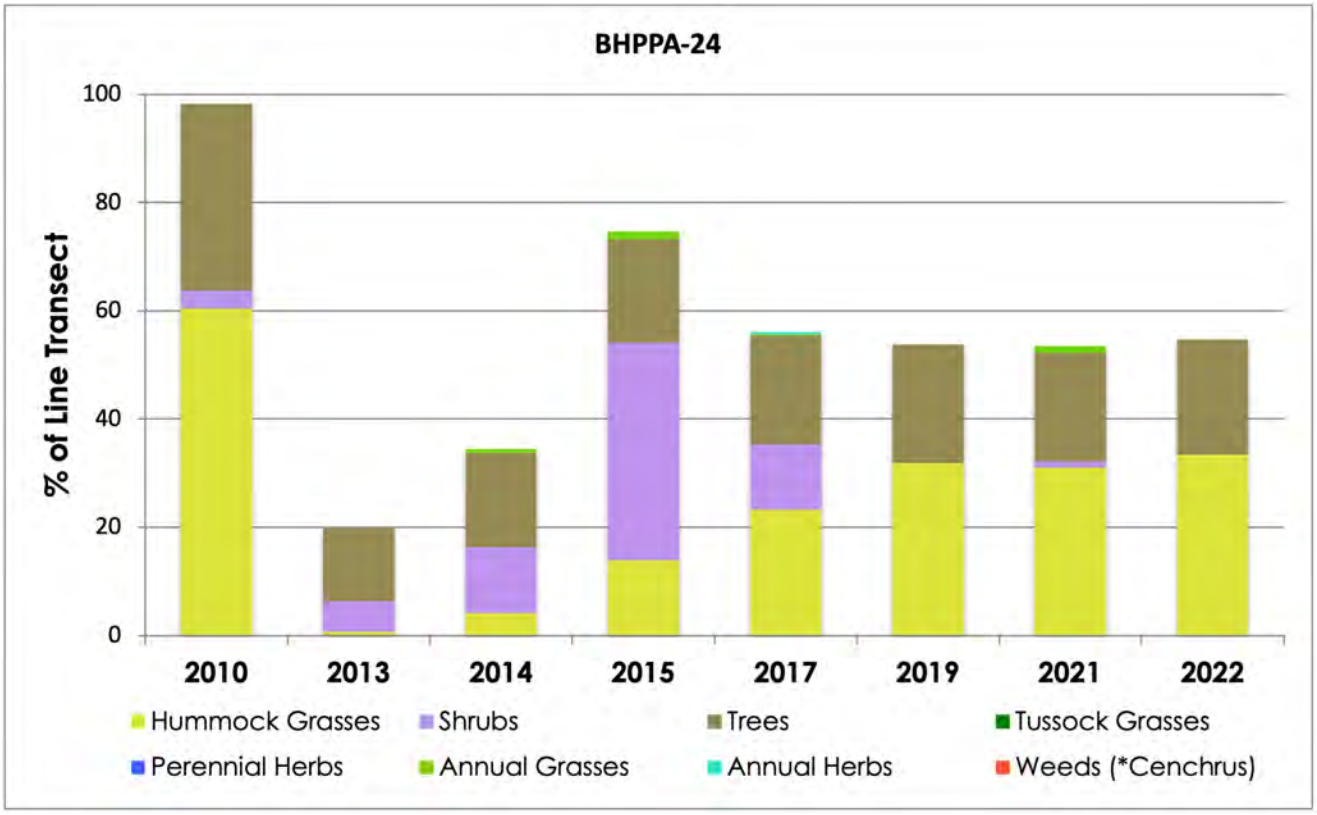
Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m (burnt)	2013 – 20 m (burnt)	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

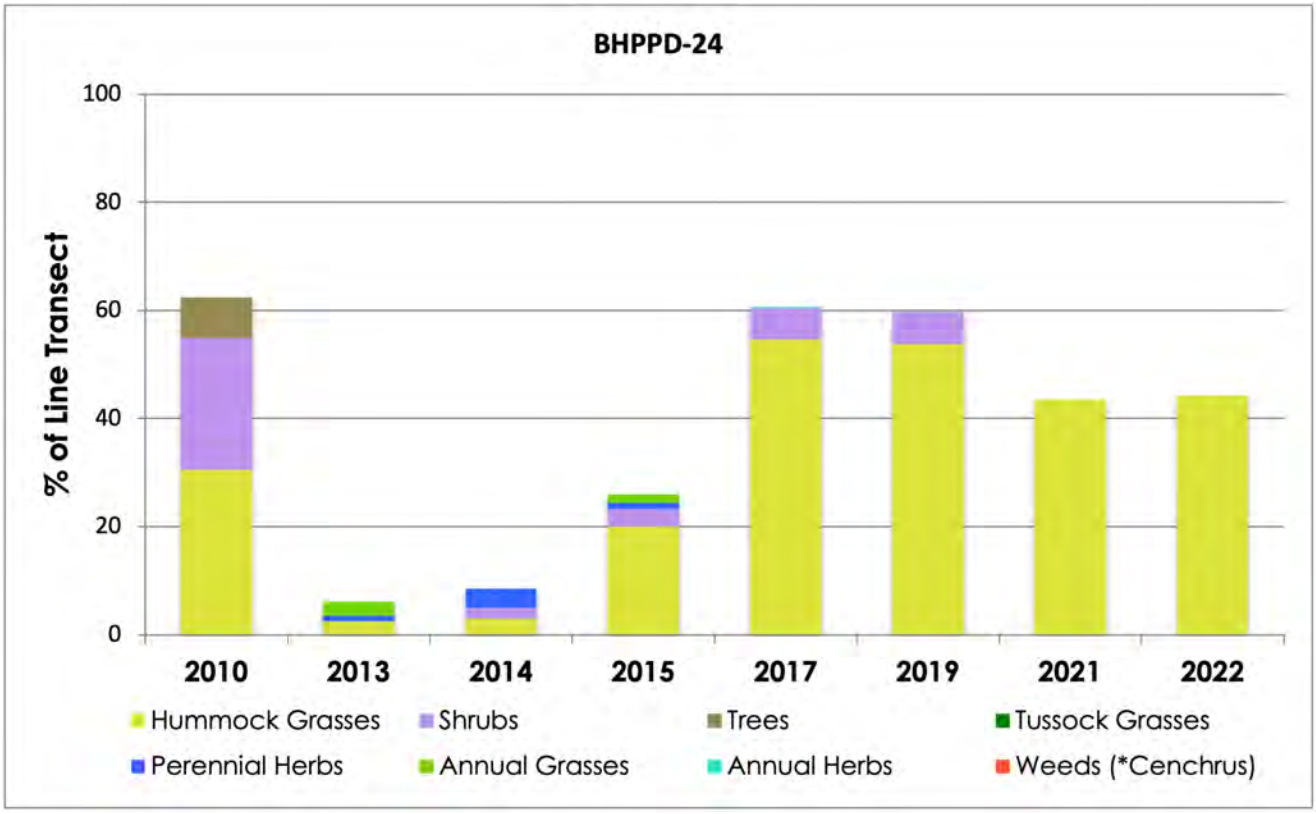
Site 24 (Mt Minnie conservation area)

Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect (NB. BHPPA-24 was burnt prior to the 2013 survey)**:**

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-24	2010	60.50	3.30	34.50					
	2013	0.75	5.60	13.50					
	2014	4.15	12.20	17.40			0.75		
	2015	13.90	40.25	19.05			1.45		
	2017	23.25	12.05	20.15			0.25	0.40	
	2019	31.85		21.95					
	2021	31.05	1.20	20.00			1.25		
	2022	33.40		21.30					
Rehab BHPPD-24	2010	30.50	24.40	7.50					
	2013	2.50				1.00	2.65		
	2014	3.00	1.95			3.60			
	2015	20.00	3.25			1.20	1.55		
	2017	54.60	5.85					0.25	
	2019	53.80	5.90						
	2021	43.55							
	2022	44.30							




BHPPD-24
% of Line Transect
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 24 (Mt Minnie conservation area)

NB. Analogue transect BHPPA-24 was burnt prior to the 2013 survey.

Cover and presence of individual species:

	BHPPA-24								BHPPD-24							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae																
Ptilotus axillaris											+				+	
Ptilotus fusiformis											+					
Cleomaceae																
Cleome uncifera				+												
Convolvulaceae																
Bonamia alatisemina					+						3.60					
Bonamia erecta		5.35	10.75	17.90	8.55		1.20	+		+	+	1.65	2.30		+	+
Evolvulus alsinoides												1.20				
Evolvulus alsinoides var. *villosicalyx*				+												
Polymeria lanata										1.00						
Cyperaceae																
Bulbostylis barbata					0.40								0.25			
Fabaceae																
Acacia ancistrocarpa	3.30			+		+			21.25		+	+	2.50	4.75		
Acacia bivenosa									3.15		+	+	0.75	0.65		
Indigofera boviperda subsp. *boviperda*			+	+						+	+					
Indigofera sp.				+												
Isotropis atropurpurea			+	18.05	3.50						+	+				
Tephrosia uniovulata											+					
Goodeniaceae																
Goodenia microptera				+												
Scaevola spinescens										+	0.35	+	0.30	+	+	+
Malvaceae																
Corchorus sidoides		0.25	1.45	4.30												
Sida cardiophylla											1.60	1.60				
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		+	+							+						
Myrtaceae																
Corymbia hamersleyana	34.50	13.50	17.40	19.05	20.15	21.95	20.00	21.30								
Eucalyptus xerothermica									7.50							
Poaceae																
Aristida contorta		+														
Aristida holathera var. *holathera*			0.75	1.15		+	1.25			2.00	+	+			+	
Eriachne aristidea		+		0.30						+		1.55				
Eriachne pulchella var. *pulchella*					0.25											

	BHPPA-24								BHPPD-24							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Iseilema vaginiflorum										+						
Paspalidium clementii				+	+											
Paspalidium sp.										0.65						
Triodia glabra	60.50	0.75	4.15	13.90	23.25	13.30	31.05	33.40	30.50	2.50	3.00	20.00	54.60	+	43.55	44.30
Proteaceae																
Grevillea striata							✓									
Total no. of native species	**3**	**7**	**8**	**14**	**8**	**4**	**5**	**3**	**4**	**10**	**13**	**10**	**6**	**4**	**5**	**3**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Comments regarding site:

Rehabilitation is in excellent condition in 2022; there has been a relatively steady cover of mature spinifex since 2017 which is still 15% greater than the pre-clearing levels; the cover of spinifex appear to be at a level that is representative of the surrounding vegetation; *Acacia* spp. appear to be dead and absent in the 2022 monitoring again; no weeds were recorded within the sites and surrounding vegetation.

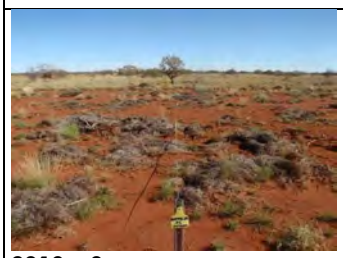
The spinifex and tree cover has remained steady within the Analogue site and still recovering from the fire prior to 2013 with the increase of annual grasses and perennial shrubs recorded.

Site 25 (Mt Minnie conservation area)
(no analogue transect)

Rehabilitation Transect BHPPD-25

2010 – 0 m

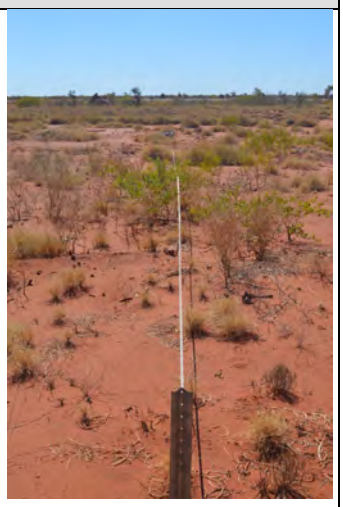
2010 – 20 m



2013 – 0 m

2013 – 20 m

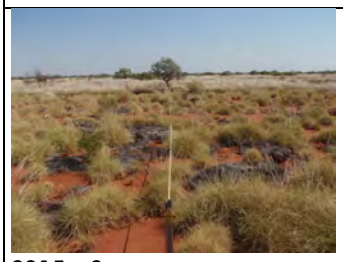
2019 – 0 m



2019 – 20 m

2014 – 0 m

2014 – 20 m



2015 – 0 m

2015 – 20 m

2021 – 0 m

2021 – 20 m

2017 – 0 m (patchily burnt)

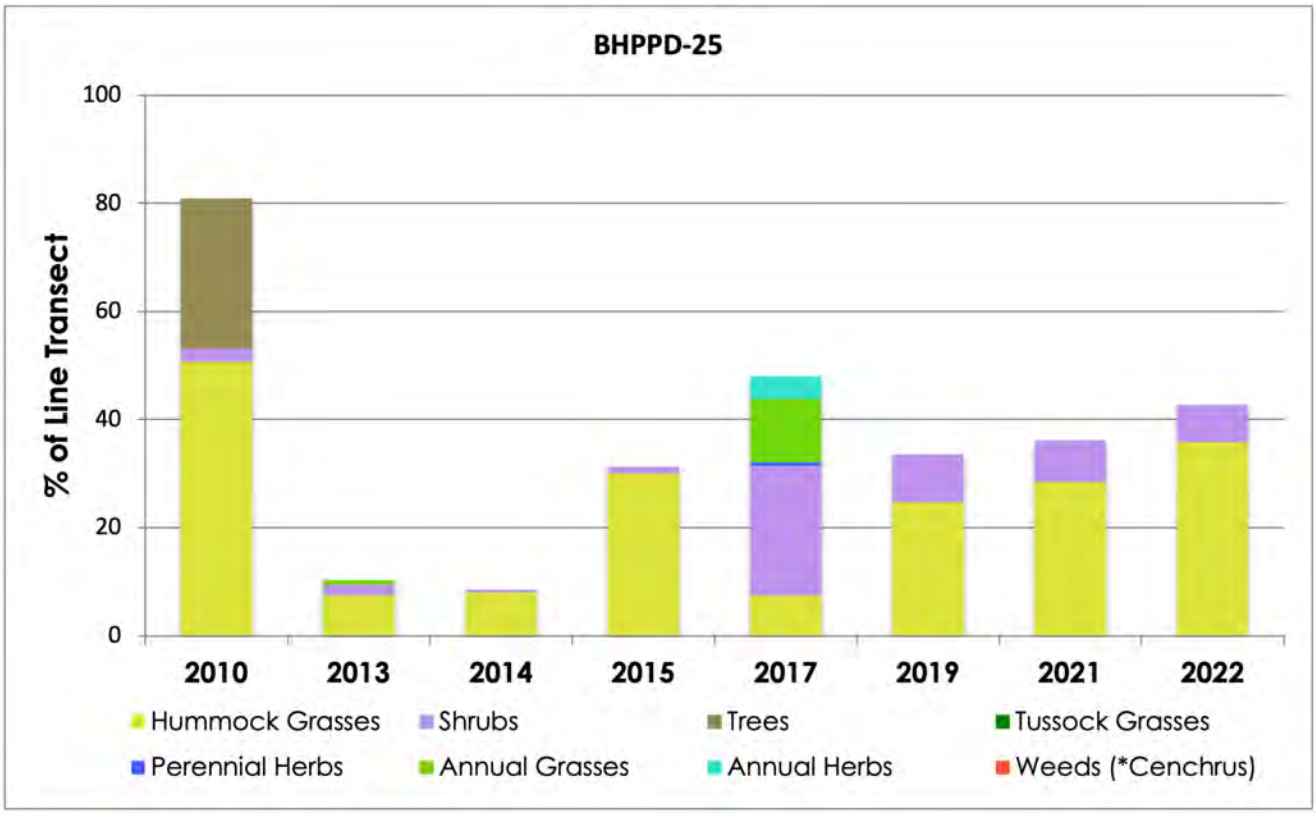
2017 – 20 m (patchily burnt)

2022 – 0 m

2022 – 20 m

Cover of each lifeform category along the line transect (NB. Patchily burnt prior to 2017 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Rehab BHPPD-25	2010	50.70	2.50	27.75					
	2013	7.50	2.00				0.75		
	2014	8.00	0.55						
	2015	30.00	1.25						
	2017	7.45	24.05			0.55	11.75	4.15	
	2019	24.75	8.80						
	2021	28.45	7.65						
	2022	35.80	6.90						



Site 25 (Mt Minnie conservation area)

NB. Patchily burnt prior to 2017 survey.

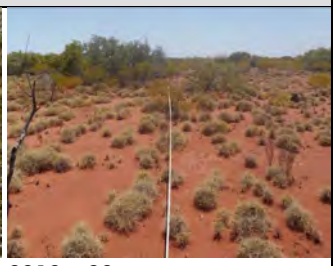
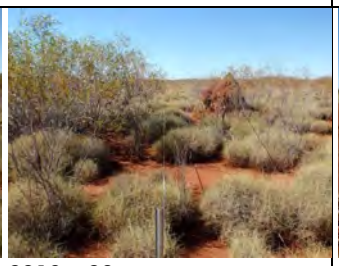
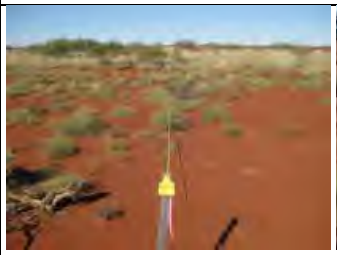
Cover and presence of individual species:

	BHPPD-25							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae								
Ptilotus axillaris					2.75			
Ptilotus fusiformis					+			
Boraginaceae								
Heliotropium crispatum					+			
Heliotropium inexplicitum					+			
Convolvulaceae								
Bonamia alatisemina			+		0.55			
Polycarpaea corymbosa var. *corymbosa*					+			
Cyperaceae								
Bulbostylis barbata			+		0.35			
Euphorbiaceae								
Euphorbia vaccaria var. *vaccaria*					+			
Fabaceae								
Acacia ancistrocarpa					1.90	3.20	3.30	5.45
Acacia bivenosa					+	+	4.35	1.45
Acacia coriacea	2.50							
Indigofera boviperda subsp. *boviperda*					2.10	+		
Senna notabilis		+			2.65			
Tephrosia uniovulata					13.30	1.85	+	
Goodeniaceae								
Goodenia microptera					1.05			
Malvaceae								
Corchorus sidoides subsp. *vermicularis*					3.15			
Sida sp. Pilbara (A.A. Mitchell PRP 1543)						+		
Molluginaceae								
Mollugo molluginea					+			
Myrtaceae								
Corymbia hamersleyana	10.50							
Eucalyptus xerothermica	17.25							
Poaceae								
Aristida contorta		+						
Aristida holathera var. *holathera*		+			10.85		+	
Eriachne aristidea		0.50			0.90			
Eriachne pulchella var. *pulchella*		+			+			
Paspalidium sp.		0.25						
Triodia epactia	35.95	4.10	3.00	15.00	7.45	14.80	16.00	11.85
Triodia glabra	14.75	3.40	5.00	15.00	+	+	12.45	23.95
Solanaceae								
Solanum lasiophyllum		2.00	0.55	1.25	0.95			
Total no. of native species	**5**	**9**	**5**	**3**	**22**	**7**	**6**	**4**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

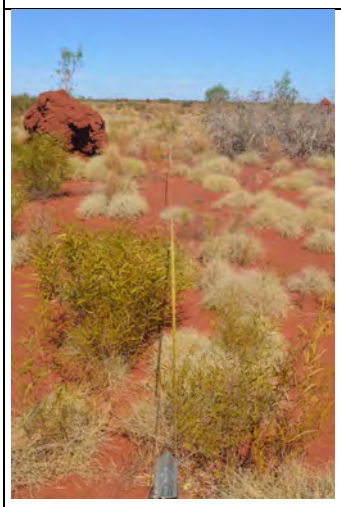
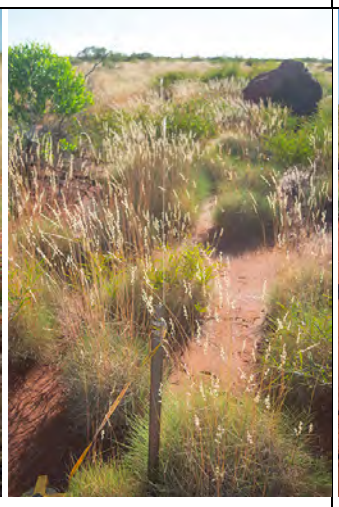
Comments regarding site:

Rehabilitation has remained as Excellent condition 2022; spinifex has regenerated to the levels prior to the fire that preceded the 2017 monitoring phase, and increased from 2021 levels, further supporting the expectation that it would continue to increase towards the pre-clearing levels over the course of the next few years; mature *Acacia* spp. present; spinifex and Acacia spp. appear to be at a level that is representative of the greater area; as expected with trees post-clearing, scattered *Corymbia hamersleyana* and *Eucalyptus xerothermica* are still absent within the clearing footprint; no weeds have been recorded within the sites and surrounding vegetation.

Site 26 (Mt Minnie conservation area)

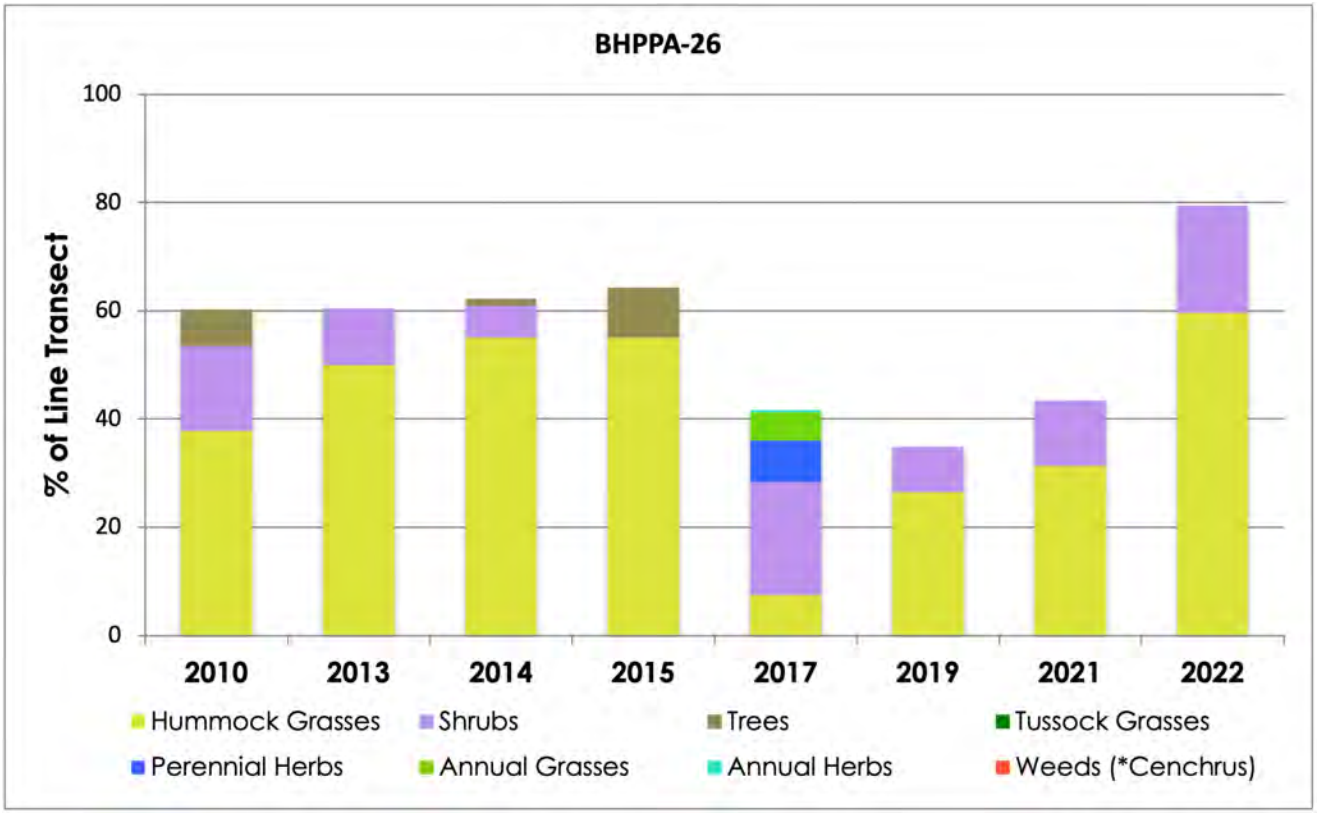
Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m (burnt)	2017 – 20 m (burnt)	2017 – 0 m (burnt)	2017 – 20 m (burnt)

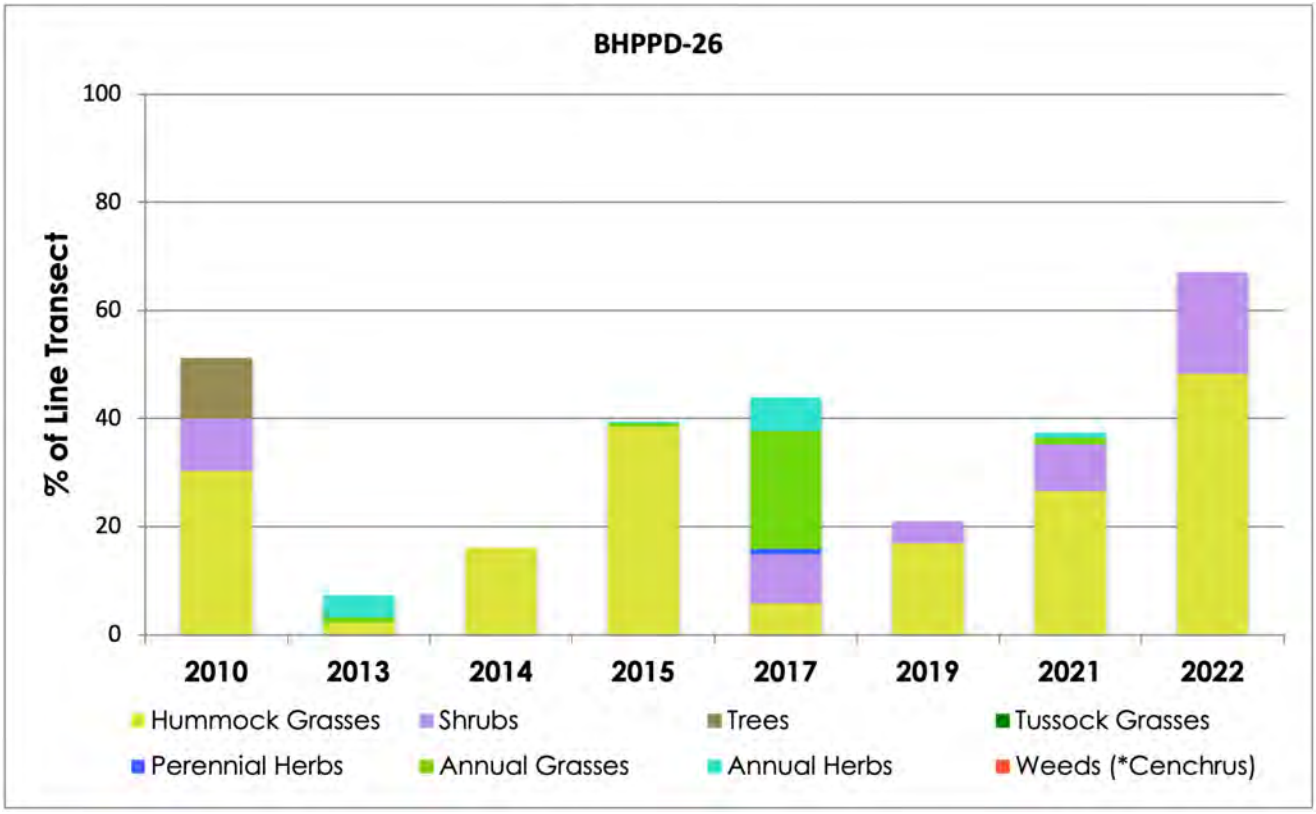
Site 26 (Mt Minnie conservation area)

Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect (NB: Both transects were burnt prior to the 2017 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-26	2010	37.85	15.60	6.75					
	2013	50.00	10.50						
	2014	55.00	5.95	1.25					
	2015	55.00		9.25					
	2017	7.50	20.85			7.70	5.15	0.50	
	2019	26.50	8.40						
	2021	31.35	12.05						
	2022	59.60	19.90						
Rehab BHPPD-26	2010	30.30	9.65	11.25					
	2013	2.25					1.00	4.00	
	2014	16.15							
	2015	38.45					0.70	0.35	
	2017	5.80	9.05			1.00	21.90	6.20	
	2019	16.95	4.00						
	2021	26.60	8.60				1.25	0.90	
	2022	48.25	18.90						




BHPPD-26
% of Line Transect
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 26 (Mt Minnie conservation area)

NB: Both the analogue and rehabilitation sites were burnt prior to the 2017 survey.

Cover and presence of individual species:

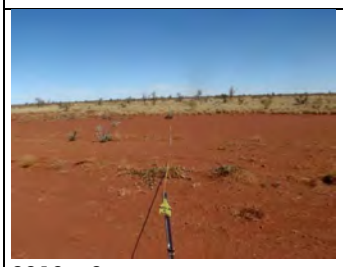
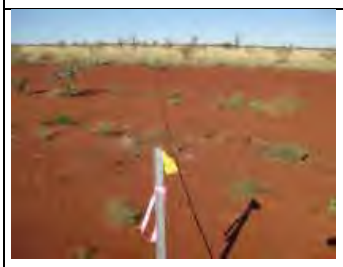
	BHPPA-26								BHPPD-26							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae																
Ptilotus axillaris							+						+		+	+
Ptilotus fusiformis					+					4.00	+	0.35	6.20		+	
Chenopodiaceae																
Dysphania sp.					+								+		+	
Convolvulaceae																
Bonamia alatisemina					7.70								1.00			
Bonamia erecta					+								+		+	+
Bonamia pilbarensis															0.50	
Evolvulus alsinoides var. *villosicalyx*												+				
Cyperaceae																
Bulbostylis barbata					0.50		+				+		+		0.90	+
Fabaceae																
Acacia ancistrocarpa	15.60	10.50	5.95		0.75	8.40	12.05	19.90	9.65	+	+	+	+	1.1	7.75	18.90
Indigofera boviperda subsp. *boviperda*					7.70		+	+					1.05		0.35	
Indigofera colutea																+
Isotropis atropurpurea					7.95	+							8.00	+		
Senna notabilis					1.95								+			
Malvaceae																
Abutilon otocarpum													+			
Corchorus sidoides subsp. *vermicularis*					2.50	+							+	+		
Hannafordia quadrivalvis subsp. *recurva*														2.90		
Sida sp. Pilbara (A.A. Mitchell PRP 1543)												+				
Triumfetta ramosa													+			
Molluginaceae																
Mollugo molluginea					+								+			
Myrtaceae																
Corymbia hamersleyana	6.75	+	1.25	9.25		+			11.25							
Poaceae																
Aristida contorta							+						+			
Aristida holathera var. *holathera*					3.65	+						0.70	8.50	+	+	
Aristida sp.															1.25	
Eragrostis eriopoda										+	+					
Eragrostis tenellula					+								+			
Eriachne aristidea					1.50					+	+		13.40			
Eriachne pulchella subsp. *pulchella*															+	
Paspalidium sp.										1.00	+					
Sporobolus australasicus																+

Triodia glabra	37.85	50.00	55.00	55.00	7.50	26.50	31.35	59.60	30.30	2.25	16.15	38.45	5.80	16.95	26.60	48.25
Total no. of native species	**3**	**3**	**3**	**2**	**15**	**6**	**6**	**3**	**3**	**6**	**7**	**6**	**19**	**6**	**12**	**6**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Comments regarding site:

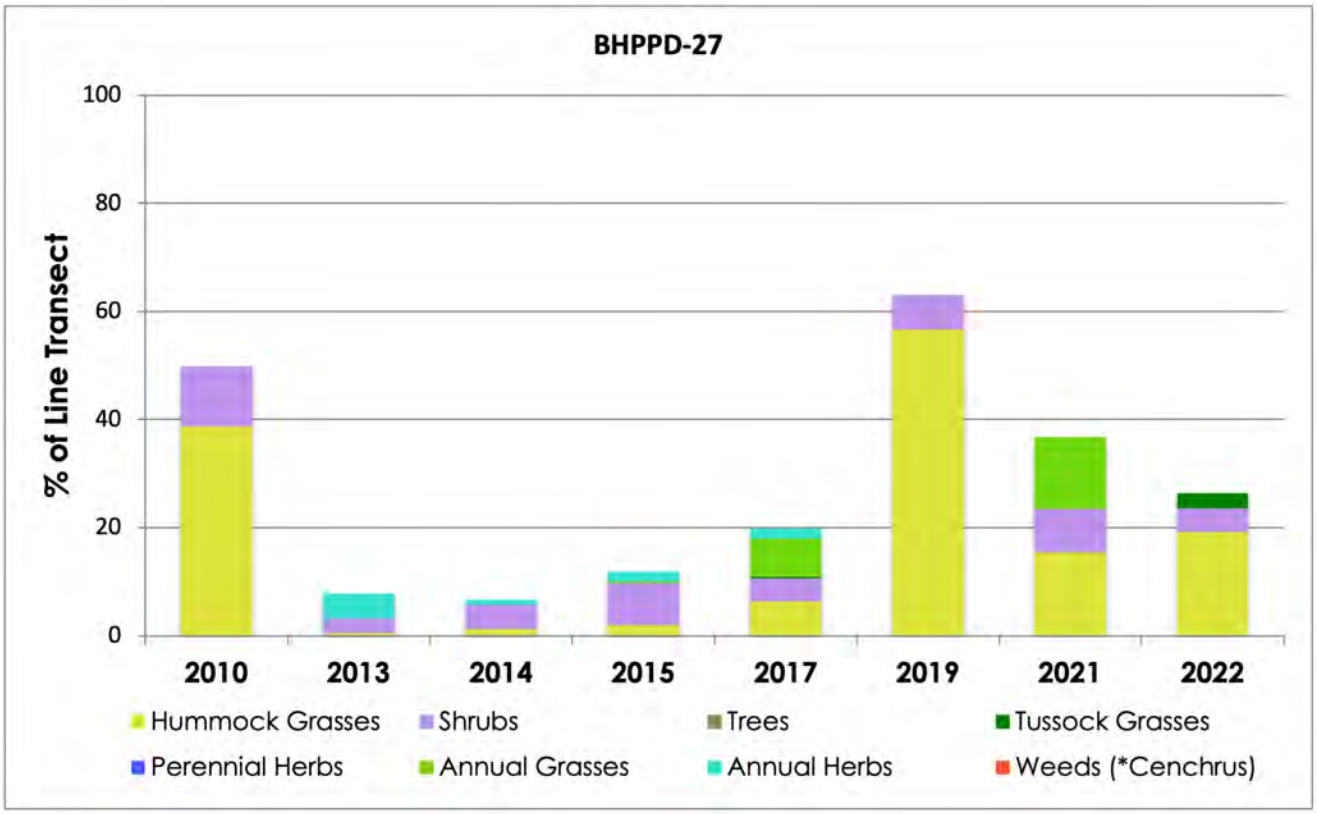
Rehabilitation has remained in excellent condition in 2022; spinifex and *Acacia* spp. cover has exceeded pre-clearing levels with the continued absence of *Corymbia hamersleyana* (this can also be said for the Analogue site which is still recovering from the fire prior to 2017); annual grasses and herbs have largely disappeared since 2022; no weeds have been recorded within the sites or in the surrounding vegetation; the Rehabilitation and Analogue sites are very similar in terms of strata and percentage cover.

Site 27 (Mt Minnie conservation area)
(no analogue transect)

Rehabilitation Transect BHPPD-27			
 2010 – 0 m	 2010 – 20 m	 2019 – 0 m	 2019 – 20 m
 2013 – 0 m	 2013 – 20 m		
 2014 – 0 m	 2014 – 20 m	 2021 – 0 m	 2021 – 20 m
 2015 – 0 m	 2015 – 20 m		
 2017 – 0 m	 2017 – 20 m	 2022 – 0 m	 2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Rehab BHPPD-27	2010	38.70	11.20						
	2013	0.50	2.75					4.50	
	2014	1.25	4.50					0.85	
	2015	2.00	7.80				0.25	1.75	
	2017	6.30	4.30		0.30		7.05	1.85	
	2019	10.00	6.40						
	2021	15.45	8.05				13.30		
	2022	19.20	4.40		2.75				



Site 27 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPD-27							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Amaranthaceae								
Ptilotus astrolasius							0.10	
Ptilotus axillaris		4.50	+	1.00	1.70			+
Ptilotus exaltatus							+	+
Ptilotus fusiformis		+	0.85		+			
Ptilotus polystachyus							+	+
Boraginaceae								
Heliotropium inexplicitum				0.75				
Chenopodiaceae								
Dysphania rhadinostachya			+					
Dysphania sp.					+			
Cleomaceae								
Arivela uncifera							+	
Cyperaceae								
Bulbostylis barbata			+		+		+	
Euphorbiaceae								
Euphorbia australis				+				
Euphorbia vaccaria var. *vaccaria*					+			
Fabaceae								
Acacia ancistrocarpa	2.05					+	0.55	
Acacia inaequilatera	9.15	2.75	4.50	6.80	2.60	6.40	7.40	4.40
Indigofera boviperda subsp. *boviperda*			+	+	1.70		+	
Senna notabilis				1.00				
Goodeniaceae								
Goodenia microptera					+			
Molluginaceae								
Mollugo molluginea		+		+	+			+
Nyctaginaceae								
Boerhavia coccinea					0.15			
Poaceae								
Aristida contorta			+		6.90		12.65	2.75
Aristida holathera var. *holathera*				0.25				
Dichanthium sericeum subsp. *humilius*							+	
Eriachne aristidea							+	+
Eriachne pulchella var. *pulchella*		+	+		+		+	+
Panicum sp.					0.30			
Paspalidium clementii							0.65	+
Sporobolus australasicus					0.15			+
Triodia glabra	38.70	0.50	1.25	2.00	6.30	10.00	15.45	19.20
Yakirra australiensis var. *australiensis*		+		+				
Portulacaceae								
Portulaca oleracea							+	
Portulaca sp.								+
Zygophyllaceae								
Tribulus hirsutus							+	
Tribulus macrocarpus							+	
Total no. of native species	**3**	**7**	**9**	**10**	**15**	**3**	**17**	
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

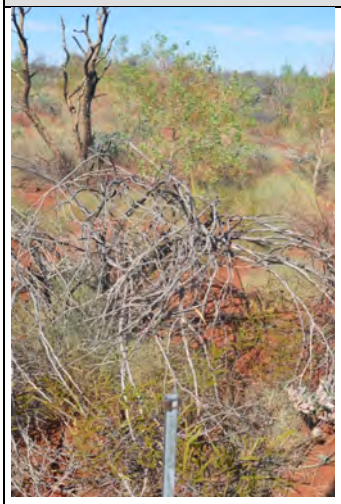
Comments regarding site:

Rehabilitation has remained as good condition in 2022; spinifex cover has continually increased since 2013 to half of pre-clearing levels in 2022. The decrease in both *Acacia ancistrocarpa*, and *A. inaequilatera* in 2022 may be due to seasonal conditions; overall there is positive indication that vegetation structure is tending towards its natural state, and would likely be evident in further phases of monitoring given appropriate rainfall; there has also been a decrease in annual grasses like *Aristida contorta* and *Paspalidium clementii*; no weeds were recorded within the sites or in the surrounding vegetation.

Site 28 (Mt Minnie conservation area)

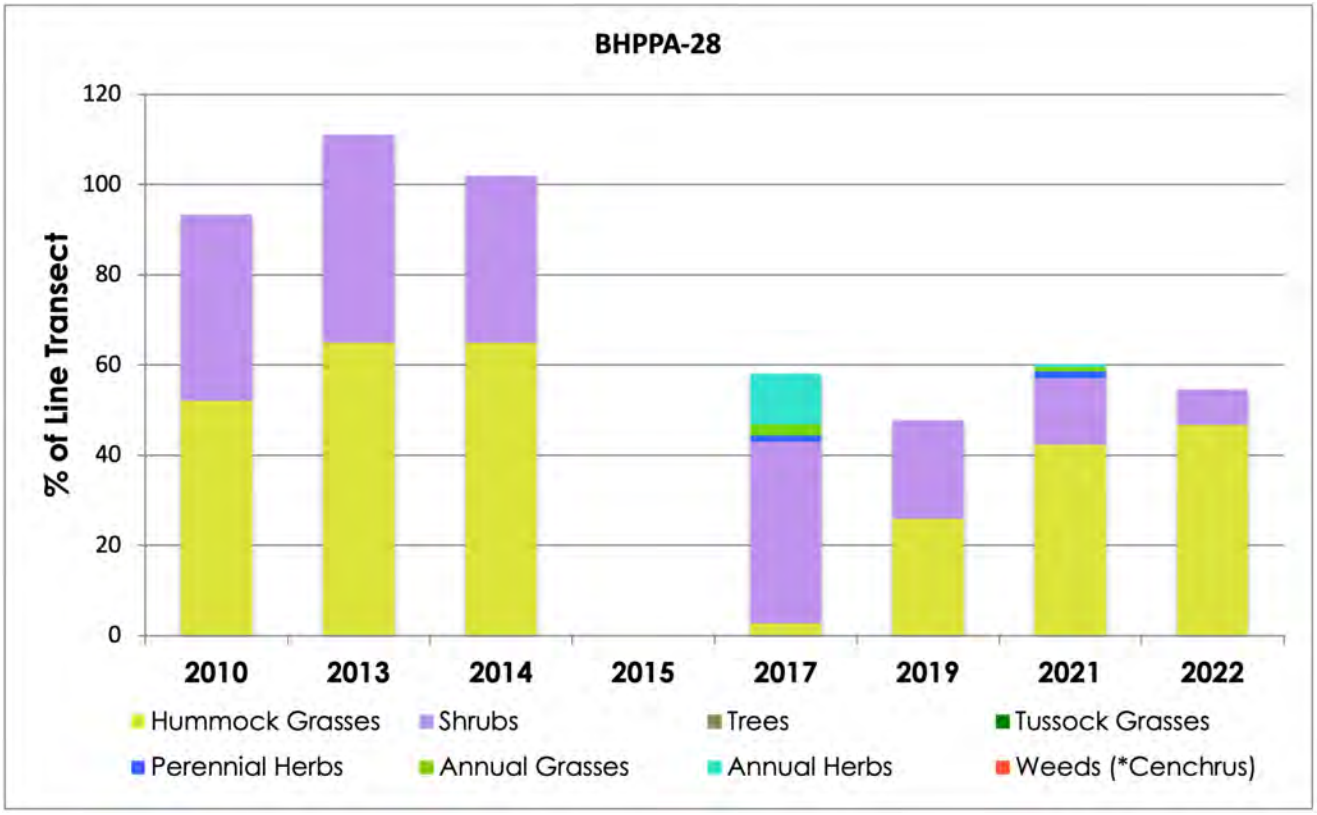
Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m (burnt)	2015 – 20 m (burnt)	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

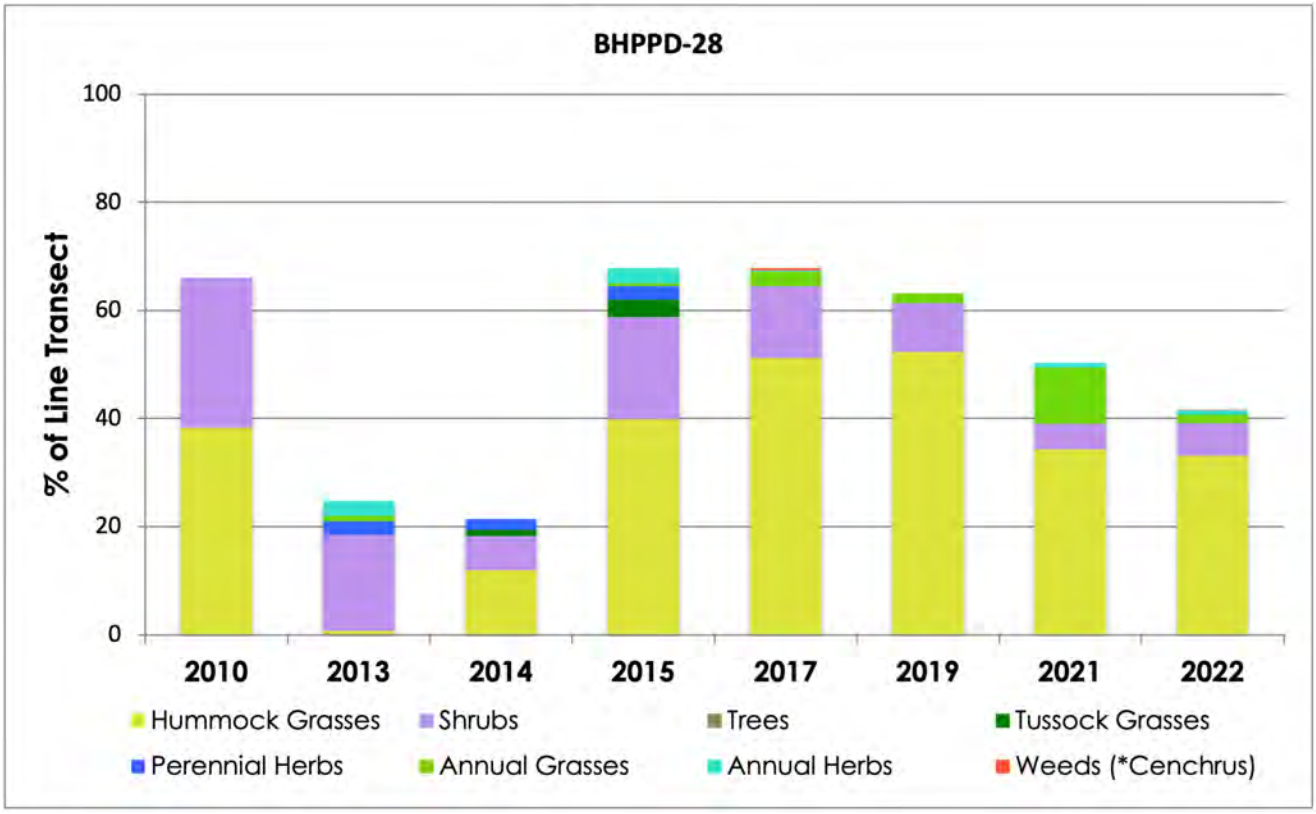
Site 28 (Mt Minnie conservation area)

Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect (BHPPA-28 was burnt immediately prior to 2015 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-28	2010	52.10	41.30						
	2013	65.00	46.00						
	2014	65.00	37.00						
	2015	Burnt	Burnt						
	2017	2.70	40.25			1.45	2.45	11.20	
	2019	25.95	21.85						
	2021	42.35	14.75			1.50	1.00	0.65	
	2022	46.70	7.85						
Rehab BHPPD-28	2010	38.35	27.70						
	2013	0.75	17.75			2.50	1.00	2.75	
	2014	11.90	6.40		1.15	1.95			
	2015	39.85	18.90		3.25	2.55	0.50	2.75	
	2017	51.20	13.30				2.75	0.15	0.40
	2019	52.35	9.05				1.75		
	2021	34.25	4.85				10.30	0.85	
	2022	33.10	6.10				1.55	0.75	0.20




BHPPD-28
% of Line Transect
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 28 (Mt Minnie conservation area)

NB: Analogue transect BHPPA-28 was burnt immediately prior to the 2015 survey.

Cover and presence of individual species:

	BHPPA-28								BHPPD-28							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Aizoaceae																
Trianthema triquetrum															0.10	+
Amaranthaceae																
Gomphrena canescens											+					
Gomphrena cunninghamii																0.10
Ptilotus astrolasius					+	3.80	2.55								0.15	3.70
Ptilotus axillaris					+		+			1.50		2.75			0.75	0.10
Ptilotus exaltatus																+
Ptilotus nobilis											+					
Ptilotus polystachyus							+								+	+
Asteraceae																
Streptoglossa decurrens					+		+					+				
Caryophyllaceae																
Polycarpaea corymbosa var. *corymbosa*											+				+	
Chenopodiaceae																
Dysphania kalpari							0.30									
Dysphania rhadinostachya							+			+	+				+	
Dysphania sp.																+
Salsola australis					1.30			+		+	+				+	0.65
Convolvulaceae																
Bonamia alatisemina					0.95						+					
Evolvulus alsinoides var. *villosicalyx*												0.75			+	
Polymeria lanata										+						
Cucurbitaceae																
Cucumis variabilis										+						
Cyperaceae																
Bulbostylis barbata			+				+	+					0.15		+	
Cyperaceae sp.										2.50						
Euphorbiaceae																
Euphorbia vaccaria var. *vaccaria*					+		+									
Fabaceae																
Acacia ancistrocarpa	24.55	31.25	37.00			6.35	+	0.10			+	3.75		+	+	0.40
Acacia bivenosa					0.30	+	+	+	20.75	+	+	2.50		+		
Acacia inaequilatera	16.75	14.75			+	+			6.95	+	+	0.75	0.15	1.60	+	0.50
Acacia stellaticeps							0.70									
Acacia synchronicia													11.60			

	BHPPA-28								BHPPD-28							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Acacia trachycarpa							1.65									
Cullen leucanthum					1.30											
Cullen martinii					3.75											
Indigofera boviperda subsp. *boviperda*					17.45	4.25				0.75	4.90	10.65	0.75	4.80		
Senna notabilis					0.90					15.25		+	+	1.95	0.90	0.25
Goodeniaceae																
Goodenia microptera					4.00		0.35			1.25					+	
Gyrostemonaceae																
Codonocarpus cotinifolius					6.75	7.45	9.85	7.75								
Malvaceae																
Abutilon fraseri subsp. *fraseri*					3.45											
Abutilon lepidum							+			+	+	+	0.60	0.70	3.35	1.25
Abutilon sp. Pilbara (W.R.Barker 2025)															+	
Corchorus laniflorus												1.25				
Corchorus sidoides										+	+	+				
Corchorus sidoides subsp. *vermicularis*					+		+								+	
Hannafordia quadrivalvis subsp. *recurva*															0.45	
Triumfetta ramosa										1.75	1.50	+				
Molluginaceae																
Mollugo molluginea					0.50		1.50			+	1.95	1.80			+	
Nyctaginaceae																
Boerhavia coccinea					5.90											
Poaceae																
**Cenchrus ciliaris*													0.40	+	+	0.20
Aristida contorta							+								2.40	
Aristida holathera var. *holathera*					2.45								2.65	1.75		
Enneapogon caerulescens															+	+
Eragrostis eriopoda											1.15	3.25				
Eragrostis pergracilis										+					2.10	
Eragrostis tenellula															3.25	+
Eriachne aristidea							1.00			+	+	0.50			0.80	
Eriachne pulchella subsp. *pulchella*															+	
Iseilema dolichotrichum													+			
Iseilema vaginiflorum										+					+	0.10
Paspalidium clementii							+			1.00					1.75	
Paspalidium rarum															+	
Sporobolus australasicus											+		0.10		+	1.45
Triodia glabra	52.10	65.00	65.00		2.70	25.95	42.35	46.70	38.35	0.75	11.90	39.85	51.20	52.35	34.25	33.10

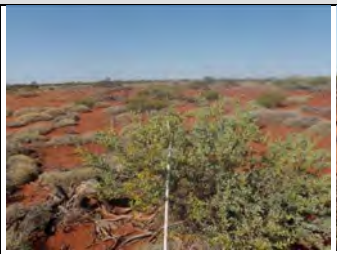
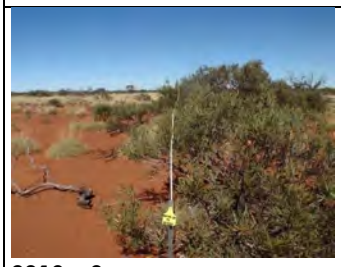
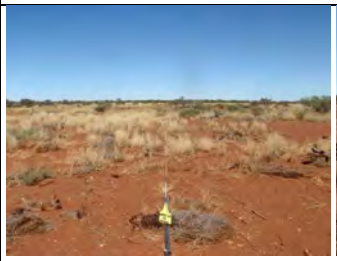
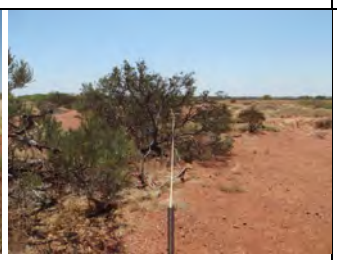
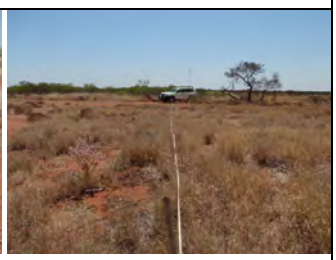
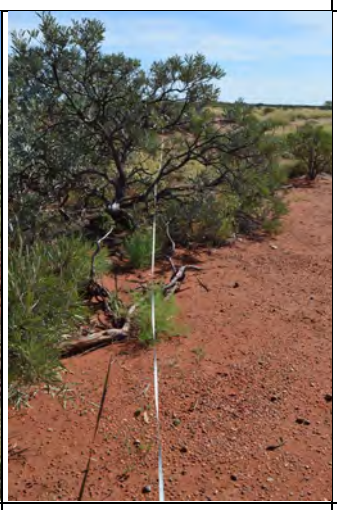
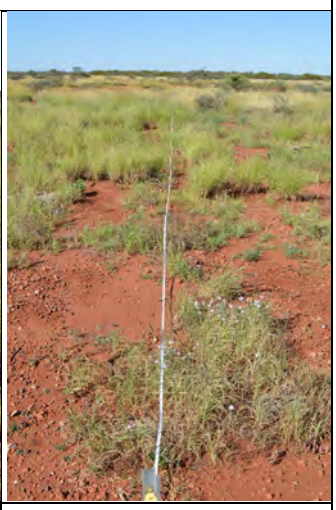
	BHPPA-28								BHPPD-28							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Portulacaceae																
Portulaca oleracea							+				+				+	+
Solanaceae																
Solanum diversiflorum					+											
Surianaceae																
Stylobasium spathulatum													0.20			
Zygophyllaceae																
Tribulus hirsutus															+	
Total no. of native species	**3**	**3**	**3**	**0**	**21**	**7**	**22**	**6**	**3**	**20**	**19**	**16**	**11**	**8**	**31**	**18**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**

Comments regarding site:

Rehabilitation is again in excellent condition in 2022; spinifex cover has again decreased since 2019 but is more or less at pre-clearing levels in 2022; cover of *Acacia* spp. shrubs is still low compared to pre-clearing with mature *Acacia ancistrocarpa* and *A. bivenosa* reaching 200cm in height and *Senna artemisioides* subsp. *oligophylla* reaching 150cm in the surrounding non-cleared vegetation; less mature Acacia's appear to be present over the clearing footprint; the cover of **Cenchrus* was recorded as 0.2% along the line-intercept and the cover in the surrounding rehabilitated area is minimal.

Species diversity is slightly less in both the Rehabilitation and Analogue transects in 2022 which is most likely due to seasonal conditions. However the high amount of rainfall received in the days prior to the survey would allow for annual grasses and herbs to establish post-2022 survey. Spinifex cover has again increased in 2022 within the Analogue site to pre-fire levels.

Site 29 (Mt Minnie conservation area)

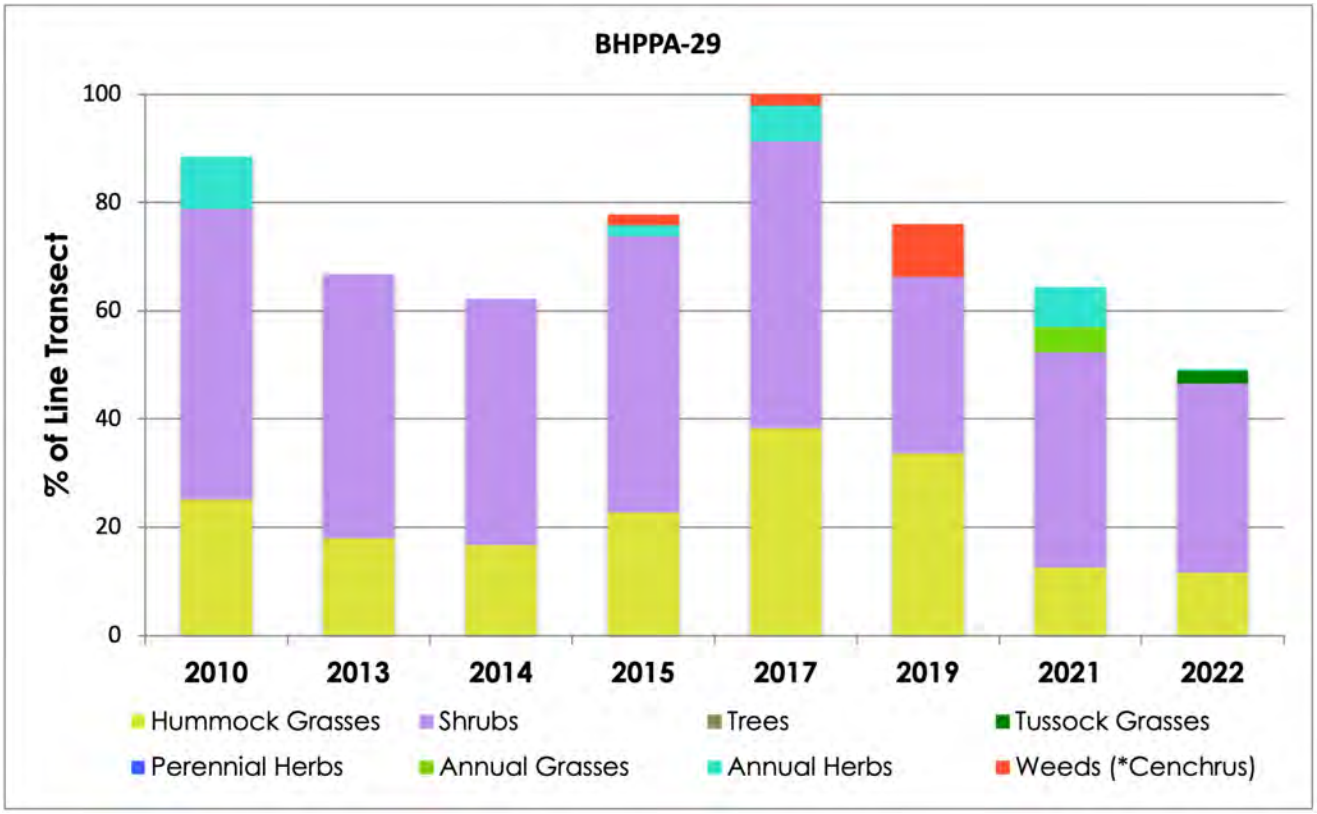
Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

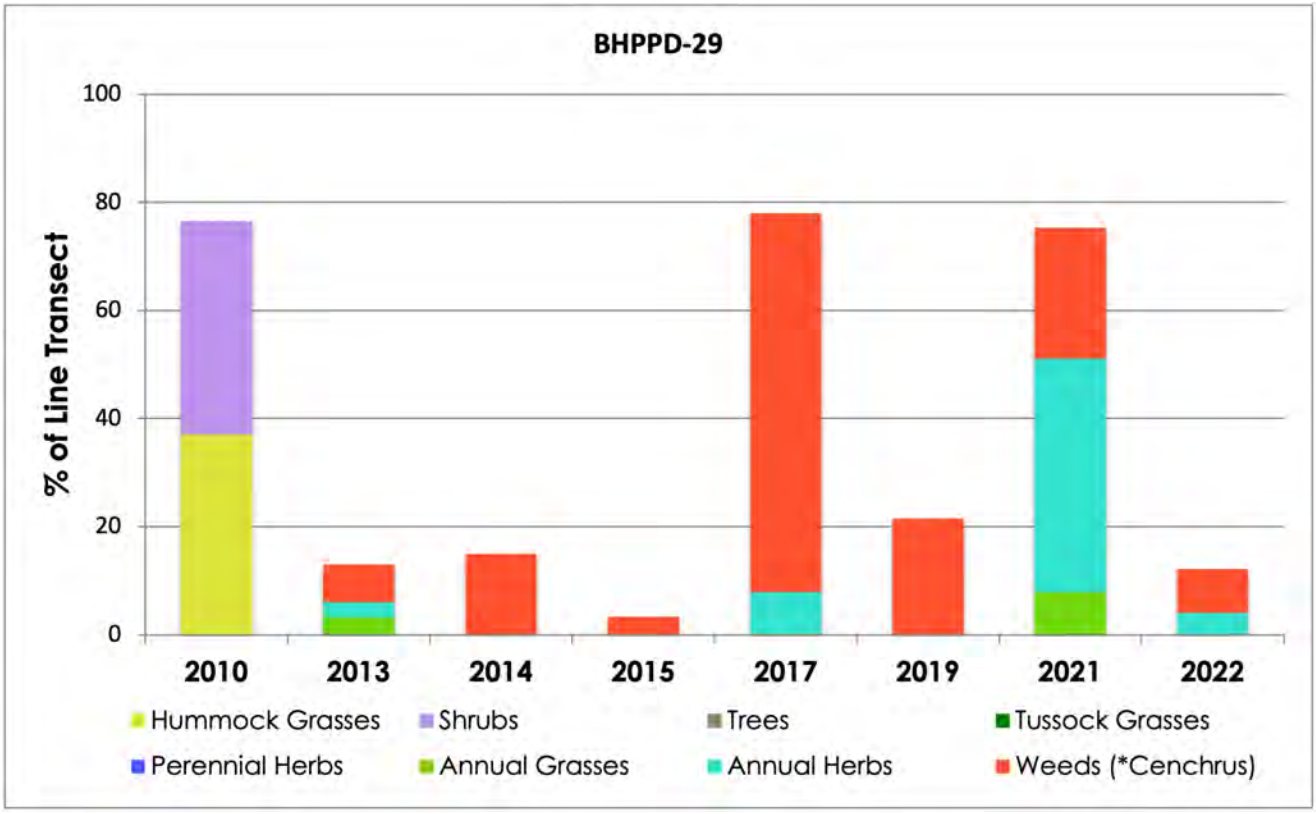
Site 29 (Mt Minnie conservation area)

Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-29	2010	25.15	53.70					9.60	
	2013	18.00	48.75						
	2014	16.75	45.50						
	2015	22.70	51.00					2.15	1.90
	2017	38.30	53.00					6.60	2.50
	2019	33.70	32.60						9.70
	2021	12.55	39.75				4.70	7.45	
	2022	11.65	34.90		2.40			0.25	
Rehab BHPPD-29	2010	37.10	39.50						
	2013						3.25	2.75	7.00
	2014								15.00
	2015								3.30
	2017						0.25	7.65	70.15
	2019								21.55
	2021						7.85	43.30	24.20
	2022						0.10	3.95	8.15




BHPPD-29
% of Line Transect
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 29 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPA-29								BHPPD-29							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Aizoaceae																
Trianthema triquetrum		+	+				3.95	0.25			+		0.50		24.60	3.70
Amaranthaceae																
Amaranthus cuspidifolius							0.25								+	
Amaranthus ? interruptus					+											
Amaranthus sp.								+								
Amaranthus undulatus		+		1.30						+	+					
Gomphrena affinis subsp. *pilbarensis*					+								6.15		+	
Gomphrena canescens		+		+						+	+					+
Ptilotus astrolasius															+	
Ptilotus axillaris																0.15
Ptilotus exaltatus (was *nobilis*)											+	+	0.30		+	
Asteraceae																
Streptoglossa decurrens															+	
Chenopodiaceae																
Dysphania rhadinostachya															+	
Enchylaena tomentosa																+
Maireana villosa													+			
Salsola australis	9.60			0.85	6.50			+			+	+	+			+
Fabaceae																
Acacia ancistrocarpa										+	+					
Acacia synchronicia									25.00							
Acacia xiphophylla	53.70	48.75	45.50	50.25	52.00	32.60	39.75	34.90	14.50							
Malvaceae																
Abutilon fraseri subsp. *fraseri*					1.00	+		+								
Abutilon lepidum				0.75												
Abutilon ?sp. Pilbara (W.R.Barker 2025)							+									
Corchorus laniflorus															+	
Hibiscus sturtii var. *grandiflorus*															+	
Sida fibulifera											+					
Nyctaginaceae																
Boerhavia coccinea					+					1.50	+		0.50		+	
Poaceae																
Aristida contorta							0.30									
Aristida sp.								+								
**Cenchrus ciliaris*		+	+	1.90	2.50	9.70				7.00	15.00	3.30	70.15	21.55	24.20	8.15
**Cenchrus setiger*																+
Cynodon prostratus		+	+		+		4.00	2.40								

	BHPPA-29								BHPPD-29							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Dactyloctenium radulans							+	0.15								0.30
Enneapogon caerulescens										+	+				+	
Eragrostis tenellula							+									
Paspalidium clementii							0.40								1.00	
Sporobolus australasicus		+			+					3.25	+		0.25		6.85	0.10
Sporobolus actinocladus																+
Triodia epactia			7.50	5.50	2.00	12.80										
Triodia glabra	25.15		1.75	9.10	+	+	4.75	11.65	37.10							
Triodia wiseana		18.00	7.50	8.10	36.30	20.90	7.80									
Portulacaceae																
Portulaca oleracea		+	+		0.10		3.25			1.25			0.20		18.70	
Portulaca sp. *oleraceae/intraterranea*								+								0.10
Zygophyllaceae																
Tribulus astrocarpus							+									
Total no. of native species	**3**	**8**	**7**	**8**	**12**	**5**	**13**	**10**	**3**	**7**	**10**	**2**	**8**	**0**	**14**	**9**
Total no. of weed species	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**2**

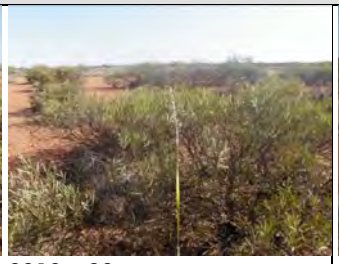
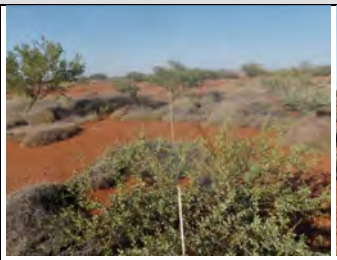
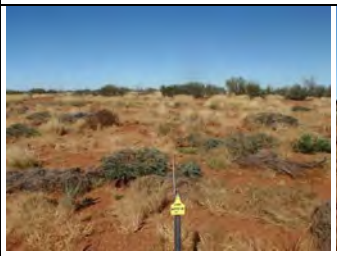
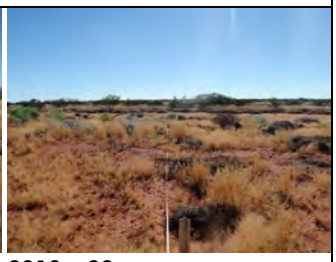
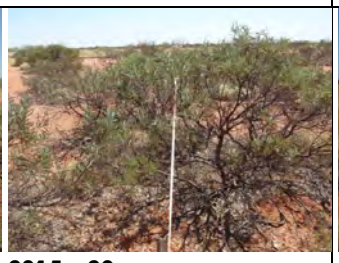
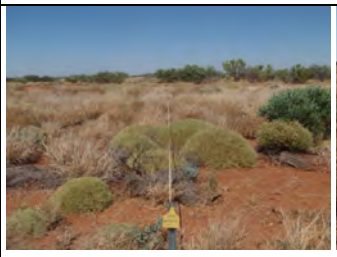
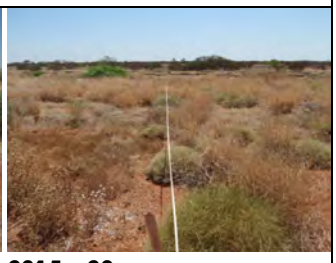
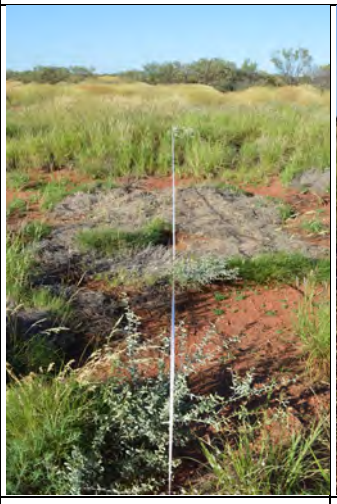
Comments regarding site:

Rehabilitation has gone from poor condition in 2021 to fair condition in 2022; no spinifex or *Acacia's* have established along the transect (or in the surrounding cleared footprint heading north and south) following clearing, however the cover of **Cenchrus* has reduced by two thirds but remains similar to the 2013 phase of monitoring. However, following the application of herbicide in 2018, **Cenchrus* cover was reduced from 70% to 21%, minimising competition and allowing for the establishment and increase (40%) in native annual grasses and herbs. Overall the Rehabilitation site does not represent pre-clearing vegetation cover levels.

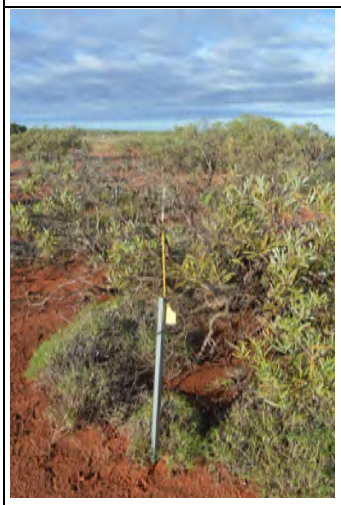
In 2017 the pipeline corridor either side of rehabilitation transect was dominated by mature **Cenchrus* populations, with high cover of **Cenchrus* tussocks to the southeast, and significant colonisation of bare areas by juvenile **Cenchrus* to the northwest. These populations were targeted with herbicide in 2018 and appear to have died off in the 2019 monitoring phase but with discontinuation of herbicide treatment those large populations have again returned.

The Analogue site saw a decrease in spinifex and perennial shrub covers and an increase in native annuals; with no weeds recorded during the 2022 monitoring phase.

Site 30 (Mt Minnie conservation area)

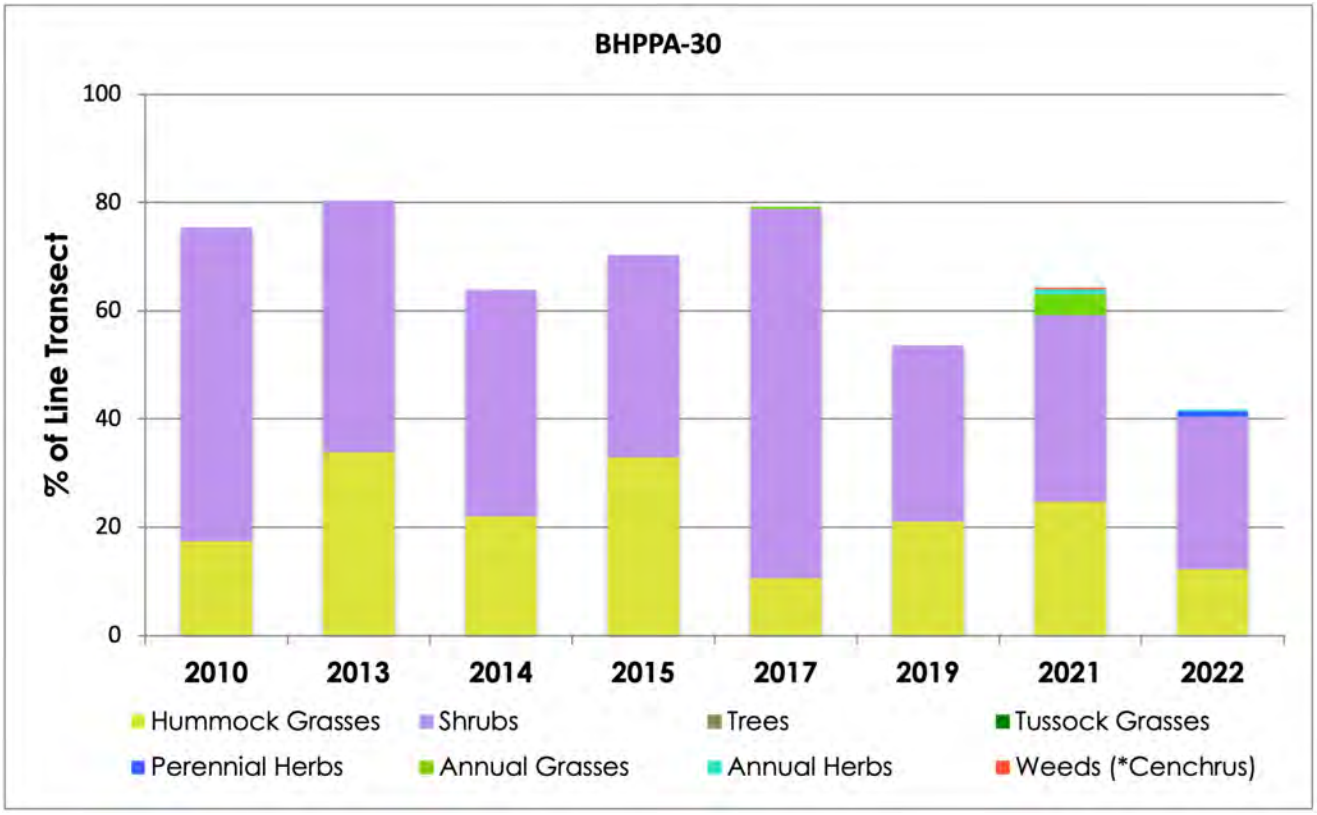
Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m

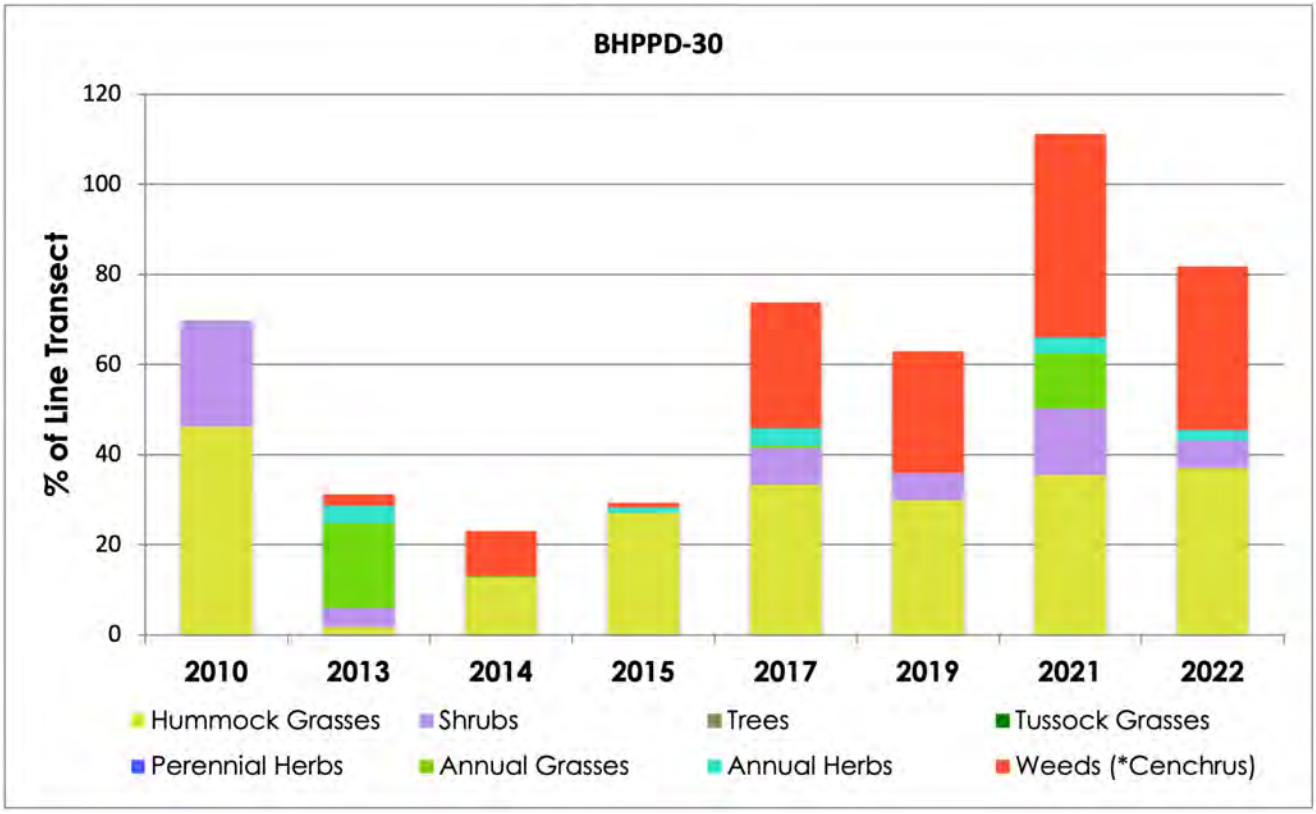
Site 30 (Mt Minnie conservation area)

Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m
			
2022 – 0 m	2022 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Analogue BHPPA-30	2010	17.50	57.90						
	2013	33.85	46.50						
	2014	22.00	41.90						
	2015	32.95	37.40						
	2017	10.55	68.25				0.45		
	2019	21.05	32.50						
	2021	24.70	34.50				3.90	0.85	0.35
	2022	12.25	28.20			0.95		0.40	
Rehab BHPPD-30	2010	46.25	23.50						
	2013	1.75	4.25				18.75	3.95	2.50
	2014	12.70					0.35		10.00
	2015	27.10						1.20	1.05
	2017	33.35	8.20				0.50	3.80	27.95
	2019	29.95	5.95						27.00
	2021	35.55	14.65				12.20	3.70	45.05
	2022	37.05	6.10					2.30	36.30




BHPPD-30
% of Line Transect
120
100
80
60
40
20
0
2010
2013
2014
2015
2017
2019
2021
2022
Hummock Grasses
Shrubs
Trees
Tussock Grasses
Perennial Herbs
Annual Grasses
Annual Herbs
Weeds (*Cenchrus)

Site 30 (Mt Minnie conservation area)

Cover and presence of individual species:

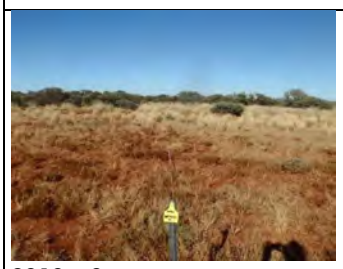
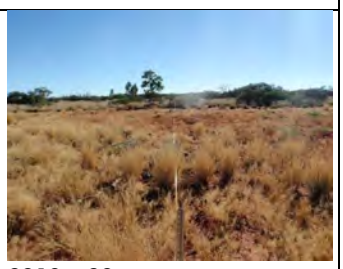
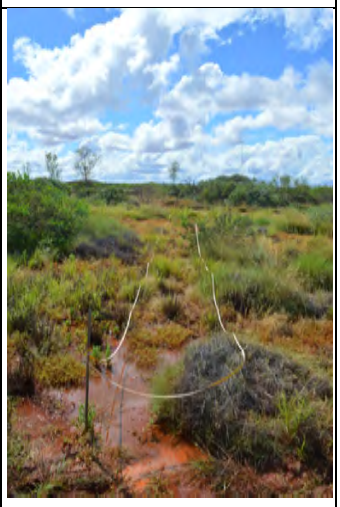
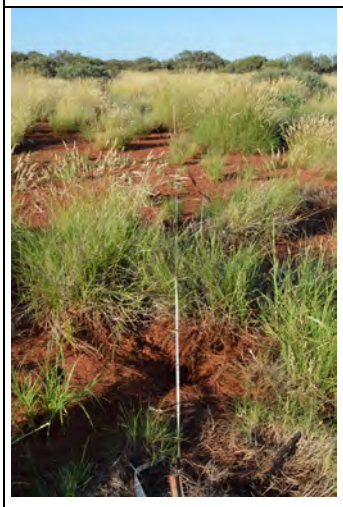
	BHPPA-30								BHPPD-30							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Aizoaceae																
Trianthema triquetrum							+								1.05	
Amaranthaceae																
Amaranthus cuspidifolius							+								+	
Gomphrena affinis *subsp. pilbarensis*													0.45		+	
Gomphrena canescens											+					0.25
Ptilotus astrolasius										+	+					+
Ptilotus axillaris							+								+	
Ptilotus exaltatus (was *nobilis*)					+		0.85	+							+	+
Asteraceae																
Pterocaulon sphaeranthoides											+					
Streptoglossa bubakii										+	+				+	
Brassicaceae																
Lepidium phlebopetalum															+	
Chenopodiaceae																
Dysphania rhadinostachya							+									
Maireana planifolia			+	0.40	1.20	1.25	0.80	0.95								
Salsola australis					+		+	0.40		2.25	+	1.20	3.35		2.65	2.05
Cyperaceae																
Bulbostylis barbata										0.20					+	
Fabaceae																
Acacia synchronicia									23.50		+		6.15	2.35	4.55	1.50
Acacia xiphophylla	57.90	46.50	41.90	37.00	67.05	31.25	33.70	28.20								
Senna notabilis							+			4.25	+		+		1.45	
Goodeniaceae																
Goodenia microptera															+	
Nyctaginaceae																
Boerhavia coccinea										1.50	+				+	+
Malvaceae																
Corchorus laniflorus							+									
Corchorus sidoides var. *vermicularis*						+								+		
Poaceae																
**Cenchrus ciliaris*						+	0.35	+		2.50	10.00	1.05	27.95	27.00	45.05	36.30
Cynodon prostratus										4.00	+				+	
Dactyloctenium radulans											+		0.50		3.05	+
Dichanthium sericeum										1.75	0.35				+	
Enneapogon caerulescens							+									
Eragrostis pergracilis										1.00						

	BHPPA-30								BHPPD-30							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Eragrostis tenellula							+								+	
Eriachne pulchella subsp. *pulchella*							0.25									
Iseilema dolichotrichum							+									
Iseilema vaginiflorum										+					0.95	
Paspalidium clementii					0.45		3.65	+							2.35	
Paspalidium sp.										+						
Sporobolus australasicus										12.00					5.85	+
Triodia epactia												4.70		8.95	9.50	37.05
Triodia glabra	17.50	15.25						12.25	46.25							+
Triodia wiseana		18.60	22.00	32.95	10.55	21.05	24.70			1.75	12.70	22.40	33.35	21.00	26.05	
Portulacaceae																
Portulaca oleracea							+								+	
Portulaca sp. *oleraceae/intraterranea*								+								
Solanaceae																
Solanum horridum											+			+	4.10	+
Solanum lasiophyllum													2.05	3.60	4.55	4.60
Total no. of native species	**2**	**3**	**3**	**3**	**6**	**4**	**17**	**7**	**2**	**13**	**13**	**3**	**7**	**6**	**25**	**13**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Comments regarding site:

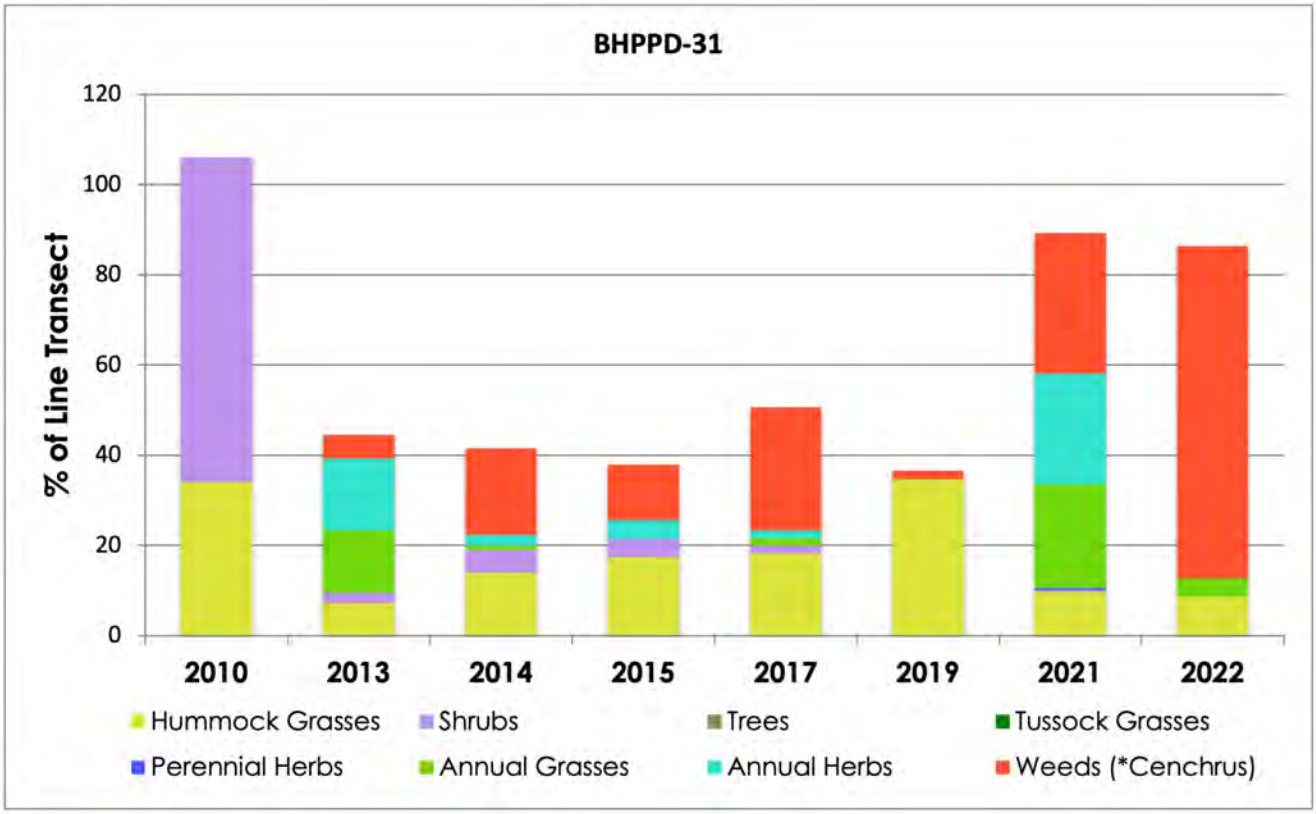
The Rehabilitation has gone from very poor condition in 2021 to poor condition in 2022; spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 35-37% since 2021; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual grasses are absent all together; the cover of **Cenchrus* remains high despite a decrease of 9% since the last monitoring phase. The application of herbicide in 2018 is evident in some patches of **Cenchrus*, but it appears to have had minimal impact upon the substantial populations, with the establishment of *Cenchrus still found within the Analogue site (recorded over the last three phases).

Site 31 (Mt Minnie conservation area)
(no analogue transect)

Rehabilitation Transect BHPPD-31			
			
2010 – 0 m	2010 – 20 m	2019 – 0 m	2019 – 20 m
			
2013 – 0 m	2013 – 20 m		
			
2014 – 0 m	2014 – 20 m	2021 – 0 m	2021 – 20 m
			
2015 – 0 m	2015 – 20 m		
			
2017 – 0 m	2017 – 20 m	2022 – 0 m	2022 – 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus*)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Rehab BHPPD-31	2010	34.05	72.05						
	2013	7.25	2.25				13.75	16.00	5.25
	2014	14.00	4.95				1.00	2.35	19.25
	2015	17.50	3.90					4.20	12.35
	2017	18.20	1.80				1.55	1.75	27.35
	2019	34.65							1.90
	2021	9.75	0.40			0.40	23.00	24.50	31.20
	2022	8.60					4.10		73.65



Site 31 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPD-31							
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Aizoaceae								
Trianthema triquetrum		15.00					23.15	+
Amaranthaceae								
Ptilotus axillaris								+
Ptilotus exaltatus							0.75	
Asteraceae								
Streptoglossa decurrens							+	
Chenopodiaceae								
Cleome viscosa								+
Cleomaceae								
Dysphania rhadinostachya							+	
Dysphania sp.		+						
Maireana sp.		2.25	2.50					
Salsola australis		+	2.35	4.20	1.75			+
Cyperaceae								
Bulbostylis barbata							0.35	
Euphorbiaceae								
Euphorbia boophthona							+	
Fabaceae								
Acacia bivenosa		+	0.25	2.50	1.80	+		+
Acacia synchronicia							+	+
Acacia xiphophylla	68.15							
Crotalaria medicaginea var. *neglecta*							+	
Rhynchosia minima							+	+
Senna artemisioides subsp. *oligophylla* 'thinly sericeous'	3.90							
Senna notabilis							0.30	
Malvaceae								
Hibiscus sturtii			+	0.15				
Sida echinocarpa							0.10	
Sida fibulifera			2.20	1.25	+			+
Iseilema eremaeum								+
Sida sp.		+						
Plantaginaceae								
Stemodia grossa		+	+					+
Poaceae								
**Cenchrus ciliaris*		5.25	7.55	4.75	13.15	1.00	31.20	+
**Cenchrus setiger*			11.70	7.60	14.20	0.90	+	73.65
Dactyloctenium radulans		1.00	1.00		1.55		6.95	+
Eragrostis cumingii					+			
Eragrostis dielsii		0.75						
Eragrostis tenellula							+	
Iseilema dolichotrichum							+	3.45
Iseilema vaginiflorum								0.35
Sporobolus australasicus		12.00	+	+			16.05	0.30
Triodia epactia			8.50	12.50	17.20	16.10	+	
Triodia glabra	28.10	7.25	5.50	5.00	1.00	18.55	9.75	8.60
Triodia ? schinzii	5.95							
Portulacaceae								
Portulaca oleracea		1.00	+		+		0.25	
Solanaceae								
Solanum diversiflorum							+	
Total no. of native species	**4**	**12**	**11**	**7**	**8**	**3**	**19**	**17**
Total no. of weed species	**0**	**1**	**2**	**2**	**2**	**2**	**2**	**2**

Comments regarding site:

The Rehabilitation decreased to a very poor condition in 2022; spinifex cover remains steady since 2021 but is still 26% less than pre-clearing levels; the cover of *Acacia* species is non-existent with the Acacias in the greater area (not cleared) in healthy condition and flowering; there was a large decrease in in annual grasses and herbs, but this is due to seasonal conditions and the large amount of rainfall received prior to the 2022 survey; **Cenchrus* cover increased significantly by 42%.

Appendix 3

Vascular Flora Species List (2010 -2022)

N.B. The relatively low number of species recorded in 2019, 2021, and 2022 is due to the fact that only the section of sales gas pipeline situated within the Mt Minnie conservation area was surveyed during this phase (17 transects in total, compared to 56 in previous phases).

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Aizoaceae	*Trianthema pilosum*		+	+	+				
	Trianthema triquetrum		+	+		+		+	+
	Trianthema turgidifolium	+	+	+	+	+			
Amaranthaceae	*Amaranthus cuspidifolius*							+	
	Amaranthus ? interruptus					+			
	Amaranthus undulatus		+	+	+				
	Gomphrena affinis subsp. *pilbarensis*					+		+	
	Gomphrena canescens		+	+	+				+
	Gomphrena cunninghamii								+
	Ptilotus appendiculatus				+				
	Ptilotus arthrolasius					+			
	Ptilotus astrolasius		+	+		+	+	+	+
	Ptilotus axillaris		+	+	+	+		+	+
	Ptilotus exaltatus (formerly *Ptilotus nobilis* subsp. *nobilis*)		+	+	+	+		+	+
	Ptilotus fusiformis		+	+	+	+		+	
	Ptilotus gomphrenoides		+						
	Ptilotus latifolius		+	+	+				
	Ptilotus murrayi			+					
	Ptilotus polystachyus		+	+	+			+	+
	Ptilotus villosiflorus				+				
	Ptilotus xerophilus			+	+				
Araliaceae	*Trachymene pilbarensis*			+					
Asteraceae	*Calotis porphyroglossa*				+				
	Pluchea dentex								+
	Pluchea dunlopii				+				
	Pluchea rubelliflora				+				

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Asteraceae (cont.)	*Pterocaulon sphaeranthoides*			+					
	Streptoglossa bubakii		+	+	+	+		+	
	Streptoglossa decurrens			+	+	+		+	
	Streptoglossa odora				+				
Boraginaceae	*Heliotropium crispatum*		+	+	+	+		+	
	Heliotropium curassavicum				+				
	Heliotropium glanduliferum		+	+	+				
	Heliotropium inexplicitum				+	+			
	Trichodesma zeylanicum			+	+				
	Trichodesma zeylanicum var. *grandiflorum*					+			
Brassicaceae	*Lepidium phlebopetalum*							+	
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*			+		+		+	
Chenopodiaceae	*Atriplex codonocarpa*				+				
	Atriplex semilunaris					+			
	Atriplex sp. (inadequate material)			+					
	Dysphania kalpari			+				+	
	Dysphania rhadinostachya		+	+				+	
	Dysphania sp. (inadequate material)		+			+		+	+
	Enchylaena tomentosa								+
	Maireana planifolia			+	+	+	+	+	
	Maireana villosa					+			
	Maireana sp. (inadequate material)		+	+					
	Neobassia astrocarpa			+	+				
	Salsola australis	+	+	+	+	+		+	+
	Sclerolaena burbidgeae				+				
	Sclerolaena costata				+				
	Sclerolaena recurvicuspis					+			
	Tecticornia auriculata				+				

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Chenopodiaceae (cont.)	*Tecticornia halocnemoides* (subsp. not determined)	+	+	+					
	Tecticornia halocnemoides subsp. *tenuis*				+				
	Tecticornia indica	+	+	+	+				
Cleomaceae	*Arivela uncifera*				+			+	
	Arivela viscosa							+	+
Convolvulaceae	*Bonamia alatisemina*			+	+	+			+
	Bonamia erecta		+	+	+	+		+	+
	Bonamia pilbarensis							+	
	Cressa australis			+	+				
	Evolvulus alsinoides (sterile; var. not determined)				+			+	
	Evolvulus alsinoides var. *villosicalyx*		+	+	+	+		+	+
	Ipomoea coptica				+	+			
	Ipomoea muelleri		+	+	+	+			
	Ipomoea polymorpha				+	+			
	Ipomoea sp. (inadequate material)			+					
	Operculina aequisepala				+				
	Polymeria ambigua		+	+					
	Polymeria lanata		+						
Cucurbitaceae	*Cucumis variabilis*		+						
Cyperaceae	*Bulbostylis barbata*		+	+	+	+		+	+
	Cyperus bulbosus			+	+				
	Cyperaceae sp. (inadequate material)		+						
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	+	+	+	+				
	Euphorbia australis (var. not determined)				+				
	Euphorbia boophthona			+				+	+
	Euphorbia coghlanii		+	+					
	Euphorbia myrtoides			+	+	+			
	Euphorbia tannensis subsp. *eremophila*			+				+	

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Euphorbiacae (cont.)	*Euphorbia vaccaria* var. *vaccaria*					+		+	
	Euphorbia sp. (inadequate material)		+	+					
Fabaceae	*Acacia ancistrocarpa*	+	+	+	+	+	+	+	+
	Acacia bivenosa	+	+	+	+	+	+	+	+
	Acacia coriacea	+	+	+	+				
	Acacia gregorii	+							
	Acacia inaequilatera	+	+	+	+	+	+	+	+
	Acacia sclerosperma subsp. *sclerosperma*				+				
	Acacia stellaticeps	+	+	+	+	+	+	+	+
	Acacia synchronicia	+	+	+	+	+	+	+	
	Acacia tetragonophylla	+	+	+	+			+	
	Acacia trachycarpa	+						+	
	Acacia xiphophylla	+	+	+	+	+	+	+	+
	Aenictophyton reconditum		+	+					
	Crotalaria cunninghamii subsp. *sturtii*		+	+	+	+			
	Crotalaria medicaginea var. *neglecta*		+	+	+	+		+	
	Crotalaria ramosissima			+	+	+			
	Cullen cinereum		+	+	+				
	Cullen leucanthum		+		+	+			
	Cullen martinii		+	+	+	+		+	
	Desmodium filiforme			+		+		+	
	Indigofera boviperda subsp. *boviperda*		+	+	+	+	+	+	+
	Indigofera colutea		+	+	+	+		+	+
	Indigofera linifolia		+	+	+	+		+	
	Indigofera linnaei				+				
	Indigofera sp. (inadequate material)				+				
	Isotropis atropurpurea			+	+	+	+		

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Fabaceae (cont.)	*Lotus cruentus*			+					
	Petalostylis cassioides		+	+	+	+			+
	**Prosopis* sp. (inadequate material)				+	+			
	Rhynchosia minima		+	+	+			+	+
	Senna artemisioides subsp. *oligophylla* '(thinly sericeous form)'	+							
	Senna notabilis		+	+	+	+	+	+	+
	Sesbania cannabina				+	+			
	Swainsona kingii			+	+			+	
	Swainsona pterostylis		+	+	+				
	Tephrosia clementii							+	
	Tephrosia uniovulata		+	+		+	+	+	
	Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)		+	+	+	+		+	+
	Tephrosia sp. (inadequate material)				+				
	**Vachellia farnesiana*	+	+	+	+	+			
Frankeniaceae	*Frankenia pauciflora*	+	+	+	+				
Gentianaceae	*Schenkia clementii*				+				
Geraniaceae	*Erodium cygnorum*			+					
Goodeniaceae	*Goodenia forrestii*		+	+	+	+			
	Goodenia microptera		+	+	+	+		+	
	Goodenia tenuiloba		+	+	+				
	Scaevola parvifolia			+	+	+			
	Scaevola sericophylla	+	+	+	+	+			
	Scaevola spinescens		+	+	+	+	+	+	+
Gyrostemonaceae	*Codonocarpus cotinifolius*					+	+	+	
Haloragaceae	*Haloragis gossei*		+	+					
Lamiaceae	*Dicrastylis cordifolia*	+	+	+	+	+	+		
	Quoya loxocarpa					+			
	Quoya paniculata	+	+	+	+				

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Lauraceae	*Cassytha capillaris*	+			+	+	+	+	+
	Cassytha sp. (inadequate material)	+	+	+	+				
Malvaceae	*Abutilon fraseri* subsp. *fraseri*					+	+		
	Abutilon lepidum		+	+	+	+	+	+	+
	Abutilon otocarpum		+			+			+
	Abutilon sp. Pilbara (W.R.Barker 2025)							+	
	Abutilon sp. Onslow (F. Smith s.n. 10/9/61) – **Priority 1**							+	
	Abutilon sp. (inadequate material)		+	+	+				
	Alyogyne pinoniana var. *pinoniana*	+			+	+			
	Corchorus laniflorus				+			+	
	Corchorus sidoides (inadequate material)		+	+	+				
	Corchorus sidoides subsp. *sidoides*							+	
	Corchorus sidoides subsp. *vermicularis*					+	+	+	
	Hannafordia quadrivalvis subsp. *recurva*			+	+		+	+	
	Hibiscus brachychlaenus				+	+			
	Hibiscus sturtii (inadequate material)		+	+	+				
	Hibiscus sturtii var. *campylochlamys*					+			
	Hibiscus sturtii var. *grandiflorus*							+	
	Hibiscus sturtii var. *platychlamys*			+	+				
	Hibiscus sp. (inadequate material)		+	+					
	Lawrencia viridigrisea			+	+				
	Melhania oblongifolia			+		+			
	Sida arsiniata				+			+	
	Sida cardiophylla			+	+			+	
	Sida fibulifera		+	+	+	+		+	+
	Sida ? intricata		+						
	Sida rohlenae subsp. *rohlenae*		+	+	+				
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)		+	+	+		+		

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Malvaceae (cont.)	*Sida* sp. (inadequate material)		+	+	+	+			
	Triumfetta ramosa		+	+	+	+			
	? Triumfetta sp. (inadequate material)		+						
Marsileaceae	*Marsilea hirsuta*				+	+			
Molluginaceae	*Trigastrotheca molluginea*		+	+	+	+		+	
Myrtaceae	*Corymbia hamersleyana*	+	+	+	+	+	+	+	
	Eucalyptus victrix	+	+	+	+				
	Eucalyptus ? victrix (inadequate material)	+							
	Eucalyptus xerothermica	+							
Nyctaginaceae	*Boerhavia coccinea*		+	+		+		+	+
	Boerhavia sp. (inadequate material)			+					
Phyllanthaceae	*Dendrophyllanthus erwinii* (formerly *Phyllanthus erwinii*)							+	+
	Nellica maderaspatensis (formerly *Phyllanthus maderaspatensis*)			+	+				
Plantaginaceae	*Stemodia grossa*		+	+					+
Poaceae	*Aristida contorta*		+	+		+		+	+
	Aristida holathera var. *holathera*		+	+	+	+	+	+	
	**Cenchrus ciliaris*	+	+	+	+	+	+	+	+
	**Cenchrus setiger*		+	+	+	+	+	+	+
	**Cenchrus* sp. (inadequate material)					+			+
	Chloris pumilio		+	+	+	+			
	Chrysopogon fallax			+					
	Cynodon prostratus		+	+		+		+	
	Dactyloctenium radulans		+	+		+		+	+
	Dichanthium sericeum subsp. *humilius*		+	+				+	
	Enneapogon caerulescens		+	+				+	+
	Eragrostis cumingii					+			
	Eragrostis dielsii		+						
	Eragrostis eriopoda		+	+	+	+			

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Poaceae (cont.)	*Eragrostis pergracilis*		+	+	+	+		+	
	Eragrostis tenellula					+		+	+
	Eragrostis sp. (inadequate material)	+							
	Eriachne aristidea		+	+	+	+		+	+
	Eriachne benthamii	+	+	+	+				
	Eriachne obtusa			+	+				
	Eriachne pulchella var. *pulchella*		+	+		+		+	+
	Eriachne sp. (inadequate material)	+							
	Eulalia aurea	+	+	+	+	+			
	Iseilema dolichotrichum					+		+	+
	Iseilema eremaeum								
	Iseilema vaginiflorum		+	+	+			+	+
	Panicum decompositum				+				
	Panicum sp. (inadequate material)					+			
	Paractaenum refractum		+	+					
	Paspalidium clementii		+		+	+		+	+
	Paspalidium rarum							+	
	Paspalidium sp. (inadequate material)		+	+					
	Setaria dielsii				+				
	Sorghum plumosum		+	+	+				
	Sporobolus actinocladus								+
	Sporobolus australasicus		+	+	+	+		+	+
	Sporobolus mitchellii		+	+	+	+			
	Triodia epactia	+	+	+	+	+	+	+	+
	Triodia glabra	+	+	+	+	+	+	+	+
	Triodia schinzii	+	+	+	+	+	+	+	+
	Triodia ? schinzii (inadequate material)	+							
	Triodia wiseana		+	+	+	+	+	+	

		Astron				Biota			
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2022**
Poaceae (cont.)	*Urochloa holosericea* subsp. *velutina*					+			
	Yakirra australiensis var. *australiensis*		+		+	+		+	
	Poaceae sp. (inadequate material)	+							
Polygalaceae	*Polygala isingii*			+					
Portulacaceae	*Calandrinia* sp. (inadequate material)			+					+
	Portulaca oleracea		+	+		+		+	+
Proteaceae	*Grevillea eriostachya*	+	+	+	+				
	Grevillea stenobotrya	+	+	+	+	+		+	
Sapindaceae	*Diplopeltis eriocarpa*	+	+	+	+				
Solanaceae	*Nicotiana occidentalis*			+					
	Nicotiana rosulata			+	+				
	Solanum diversiflorum					+		+	
	Solanum horridum			+			+	+	+
	Solanum lasiophyllum		+	+	+	+	+	+	+
Surianaceae	*Stylobasium spathulatum*					+			
Zygophyllaceae	*Tribulus astrocarpus*							+	
	Tribulus hirsutus		+	+				+	
	Tribulus occidentalis					+			
	Tribulus macrocarpus							+	
	Tribulus sp. (inadequate material)		+	+					
	Zygophyllum retivalve			+					

Macedon Gas Project

Compliance Assessment Report

Head Office
Mia Yellagonga
11 Mount Street
Perth WA

T: +61 8 9348 4000
www.woodside.com