Banksia Beach Borefield

Annual Compliance Report 2019-2020

1st December 2020

SOURCE STORE SUPPLY

Contents

1. Executive Summary

This annual compliance report encompasses the sixth monitoring period of operation and management of the Banksia Beach Water Treatment Plant and Borefield under the Borefield Environmental Management Plan (BEMP) between the 1st September 2019 and 31st August 2020. This report addresses the requirements of conditions applied to the project under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A detailed review of the previous monitoring program, incorporating the recommendations of the three-year review and the subsequent GDE orientated review of the monitoring network, was presented to the Commonwealth Department of the Environment (DotE) in January 2014. The EPBC approval 2007/3396 was updated and approved to reflect the changes to the BEMP with the new approval conditions activated on the 17th April 2015. On the 3rd of August 2015 Seqwater submitted the updated and revised BEMP to DotE and was approved by DotE on the 18th August 2015.

During this reporting period (2019–2020) all 6 conditions for the controlled action were active. The Banksia Beach Water Treatment Plant has not been operational since April 2014 and has subsequently triggered the cold standby shutdown (shutdown >12months) monitoring and sampling regime as outlined within the BEMP. Therefore, no extraction from the Borefield has occurred. The conditions active during this reporting period (2019–2020) have been assessed for compliance. A summary of the results is presented in Table 1 and more detailed descriptions of the compliance assessment are presented in Sections 3.1 - 3.6.

The outcomes of the compliance assessment indicate no instances during this reporting period of any significant impact on EPBC Act listed species. All ongoing active EPBC conditions of approval will continue to be implemented during the operational phase of Banksia Beach Water Treatment Plant and Borefield.

2. Introduction

The Queensland Government mandated the implementation of a series of water infrastructure projects as part of a regional drought management strategy in response to the millennium drought (2001-2009) and the lack of security of potable water supplies in South East Queensland (SEQ).

In 2006, a new Part 8 was inserted in the *Water Regulation 2002*, outlining measures to be undertaken and outcomes to be achieved by service providers to ensure security of essential water supplies for the SEQ Region. One of the specified measures was the development of underground water resources at Bribie Island and in the area around Brisbane. Schedule 10B of the *Water Regulation 2002* required that this measure with respect to Bribie Island be completed by 31 December 2007, with the initial outcome of 10 megalitres (ML) of water production per day.

Investigation of the aquifer and groundwater modelling for Bribie Island clearly demonstrated that the sustainable combined production level at the proposed Banksia Beach water treatment plant (WTP) and the then existing Woorim WTP is limited to about 8 ML/d. The Queensland Government acknowledged this and the proposed extraction rate for the northern and southern borefields was formally revised on the 2nd November 2007 to 5 ML/day.

The Banksia Beach WTP was therefore developed for production of water not exceeding 4.32 ML/day (annual daily average) at a maximum daily rate of 5ML/day and totaling no more than 1580ML/year. The WTP sources water from the associated northern borefield via a reticulation pipeline to convey water extracted from the lower (regional) sand mass aquifer. The WTP at Woorim was decommissioned in 2008 by Seqwater due to poor infrastructure condition and poor source water quality to the plant. The balance of supply to Bribie Island is dictated by the regional supply model which outlines the supply and bulk water transfer arrangements intended to meet forecast demands, water security and cost. This plan ensures supply on the island is adequately met via the Banksia Beach WTP, the bulk water supply network or a combination of the two depending on the current grid arrangement.

As this development lies in close proximity to a site of national environmental significance, namely the Moreton Bay Ramsar Wetland, the project was referred to the Commonwealth Department of the Environment and Water Resources (DEWR) (Subsequent to the Referral the Department of the Environment, Water, Heritage and the Arts (DEWHA) pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Subsequently, DEWHA became the Department of Sustainability, Environment, Water, Populations and Communities - DSEWPaC, then, as of September 2013, became the Department of the Environment (DotE). The EPBC Act referral comprised a comprehensive Review of Environmental Factors. The DEWHA declared the project a controlled action under the *EPBC Act section 95a* under the controlling provision – Wetlands of international importance (sections 16 and 17B).

3. Conditions of Compliance

To demonstrate compliance with the individual EPBC Act conditions of approval, Table 1 summarises each condition number as per the controlled action approval notice of 17th April 2015. For Table 1, the status of the condition compliance is provided as well as a summary of condition compliance status. Further details of compliance status have been provided below this table.

Table 1: Reference Table for EPBC Act Controlled Action Conditions

Condition Number	Condition/Requirement	Status	Compliance assessment
EPBC 1	The approval holder must submit for approval by the Minister a BEMP designed to protect the ecological character of the Moreton Bay Ramsar wetlands. Once approved, the BEMP must be implemented. The approved BEMP must be published on the approval holder's website, with a location and/or metadata that enables easy discovery by relevant web searches, within one month of approval by the Minister. The approval holder must notify the Department within 5 business days of publishing the BEMP on its website. The BEMP must remain on the website for the period the approval has effect.	Ongoing	Compliant.
EPBC 2	In accordance with the yield identified in the BEMP, the approval holder must limit groundwater extraction from the Northern Borefield to no greater than an annual average of 4.32ML/day, at a maximum daily rate of 5ML/day and totalling no more than 1580ML/year, subject to the requirements of conditions 1,4 & 5.	Ongoing	Compliant.
EPBC 3	The approval holder must maintain accurate records of all measures taken to implement the BEMP according to conditions of this approval, and must make these records available to the Department on request. Within 3 months of every anniversary of the commencement of the action, the approval holder must publish a Compliance Report on its website addressing the implementation of the BEMP. The approval holder must also notify of any non-compliance with this approval to the Department in writing within 10 business days of becoming aware of the non-compliance. The approval holder must continue to annually publish the Compliance Report until such time as agreed in writing by the Minister. Such records may be subject to audit by the Department or be used to verify compliance with the conditions of the approval.	Ongoing	Non-compliant (partial data gaps)
EPBC 4	If the approval holder wishes to carry out any activity otherwise than in accordance with the BEMP, the person taking the action must submit to the Department for the Minister's written approval a revised version of the BEMP. The varied activity shall not commence until the Minister has approved the revised plan in writing. If the Minister approves the revised plan, that plan must be implemented in place of the plan originally approved. All revised plans approved by the Minister must be published on the approval holder's website within one month of their approval by the Minister.	Noted – general obligation condition	Compliant.
EPBC 5	If the Minister believes that it is necessary or convenient for the better protection of the relevant matters of environmental significance to do so, the Minister may request the approval holder to make specific revisions to the BEMP and submit the revised plan for the Minister's written approval. Once approved, the revised plan must be implemented. Unless the Minister has approved the revised plan, the approval holder must continue to implement the originally approved BEMP, as specified in the conditions.	Noted – general obligation condition	Compliant.
EPBC 6	Upon the direction of the Minister, the approval holder must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor and audit criteria must be approved by the Minister prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the Minister.	Noted – general obligation condition	Compliant.

3.1 EPBC Condition 1

On the 3rd August 2015 Seqwater submitted the updated and revised BEMP, designed to protect the ecological character of the Moreton Bay Ramsar wetlands. This was approved by DotE on the 18th August 2015. Implementation of the specific monitoring programs and other requirements can be found in section 4.

The BEMP was amended in February/March 2016 to include changes when the BBWTP is in cold standby shutdown (shutdown >12months) which are:

- No quarterly operational reports
- No CRG meetings unless specific issues arise
- No SWL and EC monitoring
- No quarterly assessment of meteorological data
- Continuation of vegetation transects surveys, soil moisture monitoring and NDVI will occur until baseline is established (Note: baseline established once information from any future differential changes can be statistically assessed).

The changes to the monitoring requirements in the BEMP were published on Seqwater's website on the 30th March 2016 within one month of receiving approval from DotE (23rd March 2016). Notification to DotE occurred on the 30th of March 2016 within 5 days of publishing the BEMP on Seqwater's website. In accordance with condition 1 of the EPBC approval the BEMP is now available on Seqwater's website at https://www.seqwater.com.au/corporate-publications

Status – Compliant

3.2 EPBC Condition 2

The BBWTP has not been operational since April 2014 and has subsequently triggered the cold standby shutdown (shutdown >12months) monitoring and sampling regime as outlined within the BEMP. No extraction from the borefield has occurred during the reporting period.

Status – Compliant

3.3 EPBC Condition 3

This Annual compliance report fulfills the requirement of EPBC condition 3 addressing implementation of the BEMP within 3 months of the anniversary date. For the purposes of this report the anniversary date is September 1st with the Annual Compliance report due December 1st.

Seqwater notified DAWE via email on 4th June 2020 that following a wildfire through the Banksia Beach Water Treatment Plant (WTP) borefield in late August 2019, soil moisture data has not been able to be collected from the northern monitoring site, in accordance with the BEMP, since the *in-situ* soil moisture probe (SMP) was impacted by the fire on 21st August 2019. Seqwater has endeavored to arrange repair / replacement of the northern SMP however the ongoing state border closure has prevented the consultant (interstate- based) from attending site, to reinstate the probe. In preparation for the relaxation of border restrictions on 1st December 2020, communication has recommenced with the consultant regarding reinstatement of the probe, to resume data collection as soon as possible. Soil moisture data collection from the southern monitoring site (control site) has continued for the duration of the reporting period (2019-2020). DAWE acknowledged the impacts of the border closures on sourcing / replacing the soil moisture probe for the site and noted that Seqwater is working towards reinstatement of the probe. DAWE has requested that Seqwater notify the Department when installation of a new probe has occurred and data collection has resumed.

On 24th November 2020 it came to the attention of Seqwater that the National Park automated weather station (AWS) had ceased to transmit data from 31st December 2019. Seqwater is investigating this issue, and a site visit has been scheduled for December 2020 to conduct maintenance and commence works to reinstate the telemetry. Additional issues have also been identified with the wind and relative humidity sensors at the weather stations, which has resulted in inaccurate or absent data for these parameters. These issues are being investigated and repairs will commence during the December site visit. The collection of weather data (excluding relative humidity) from the Banksia Beach WTP AWS has continued for the duration of the 2019-2020 monitoring period.

As the Banksia Beach WTP has not been operational since April 2014, and therefore no extraction from the borefield has occurred since this time, it is not anticipated that the omission of the northern soil moisture data and weather data will have an impact on the long-term understanding of the system. As per the BEMP, in the event that weather data is unavailable from the National Park AWS or Banksia Beach WTP AWS, weather data from the Redcliffe and Beerburrum Bureau of Meteorology sites can be used where available.

No further compliance issues have occurred during the reporting period of September 2019 to August 2020.

Status – Non-compliant (partial data gaps)

3.4 EPBC Condition 4

No activities other than those in accordance to the BEMP were undertaken between the period of September 2019 and August 2020.

Status – Compliant.

3.5 EPBC Condition 5

No requests for revision of the BEMP by the Minister were received between the period of September 2019 and August 2020.

Status – Compliant.

3.6 EPBC Condition 6

No requests for an independent audit by the Minister were received between the period of September 2019 and August 2020.

Status – Compliant.

4. Implementation of the BEMP

a. Annual Monitoring Report

The Banksia Beach Water Treatment Plant has not been operational since April 2014 and has subsequently triggered the cold standby shutdown (shutdown >12months) monitoring and sampling regime as outlined within the BEMP. Therefore, an annual vegetation monitoring report on the groundwater dependant ecosystems (GDE's) was prepared covering the period from September 2019 to August 2020.

As the cold standby shutdown (shutdown >12months) has been triggered, it is expected that the ongoing vegetation monitoring events will establish baseline vegetation condition and determine the natural range of variation that occurs in terms of structure, composition and condition.

Overall the surveys to date indicate that the impact and control sites have broad similarities in structural and floristic attributes. The soil moisture data indicates that the shallow section of the soil profile at the impact site remains consistently more saturated than at the control site however the reasons for this are unknown. The increased water availability at the IPs is facilitating greater species richness and maintenance of a robust cover of shrubs and groundcovers. The shrubs and groundlayer plants were slow to regenerate after the August 2019 wildfire, probably due to the dry conditions however by April 2020, rebound in both species richness and shrub cover were measurable with this trend increasing through November 2020. Increases in shrub density and cover were facilitated by both coppice shoots and post fire recruitment of obligate seeder species. Increases in species richness are mostly accounted for with changes in richness of the shrub and forb lifeforms. This indicates a resilience of the heath vegetation to fire, although the post-fire community has not yet recovered to the higher species diversity of previous wet years. Burning during hot periods at times of low soil moisture availability may not be conducive to rapid regeneration of species richness nor structural complexity in wet heath communities.

The full monitoring report can be found in Appendix B.

b. Community Reference Group (CRG)

The BEMP was amended in February/March 2016 to include changes when the BBWTP is in cold standby shutdown (shutdown >12months) which resulted in the CRG only being required to meet in the event that specific issues arise during cold standby shutdown.

No CRG meetings were held during the 2019-2020 reporting period.

5. Conclusion

The BBWTP has not been operational since April 2014 and has subsequently triggered the cold standby shutdown (shutdown >12months) monitoring and sampling regime as outlined within the BEMP. Therefore, no extraction from the borefield has occurred between the period of September 2019 and August 2020. No instances occurred during this reporting period that had the potential to significantly impact EPBC Act listed species or matters of national significance.

Annual compliance reports will continue to be published on Seqwater's website in accordance to condition 1 of the EPBC approval. The required monitoring outlined within the BEMP will be collected by Seqwater and presented within the next annual compliance report to demonstrate continued compliance with the EPBC Act conditions of approval.

Discussions have commenced with DAWE regarding a proposal to amend the BEMP to optimise the monitoring program based on long term planning and the future status of the WTP. Banksia Beach WTP has remained in cold standby status for the past five years and monitoring conducted during this time has contributed to the long term understanding of the system.

6. Appendix A – EPBC Approval Conditions (2007/3396)

Australian Government
Department of the Environment

EPBC: 2007/3396

Contact Officer: Penny Godwin
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Facsimile: (02) 6274 1878
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Mr Daniel Spiller
General Manager – Asset Portfolio Development and Delivery
Seqwater
PO Box 16146
City East QLD 4002

Dear Mr Spiller

Banksia Beach Water Treatment Plant and Borefield (EPBC 2007/3396)
Variation to Conditions of Approval

I write in relation to the proposed variation to the conditions of approval for *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) approval 2007/3396.

Officers of the department have considered your request, and have found that it is in accordance with the requirements of section 143(1)(c) of the EPBC Act; being that the proposed variation is necessary or convenient for the protection of a matter of national environmental significance.

As delegate of the Minister for the Environment, I have decided to approve the variation to the conditions of the approval in accordance with the provisions of the EPBC Act. The action must now be undertaken in accordance with the varied conditions specified in the enclosed variation notification.

I note that the variation of conditions requires that a Borefield Environmental Management Plan (BEMP) is submitted for approval. I am advised that a BEMP was submitted to the Department in January 2015 and that this plan will require some minor amendments to meet the requirements of the varied approval conditions.

The variation of conditions of approval does not relieve the person to whom it has been granted from an obligation to comply with any other law of the Commonwealth, State or Territory that is applicable to do the action and to have any right, title or interest that is required to access land or waters and to do the action.

If you have any enquiries in relation to this matter, please contact Penny Godwin on 02 6275 9516.

S. Gaddes

Shane Gaddes
Assistant Secretary
Compliance & Enforcement Branch
Environment Assessment and Compliance Division

10 April 2015

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Australian Government
Department of the Environment

CORRECTION NOTIFICATION

VARIATION TO CONDITIONS ATTACHED TO APPROVAL
Banksia Beach Water Treatment Plant and Borefield, Bribie Island
(EPBC 2007/3396)

The variation to conditions attached to approval signed on 10/4/2015 contained an error.

The notice incorrectly stated "insert conditions 1-7".
The notice should read "insert conditions 1-6".

Person making correction

Name and position	Shane Gaddes Assistant Secretary Compliance and Enforcement Branch
signature	S.Gaddes
date of correction	17 April 2015

Australian Government
Department of the Environment

VARIATION TO CONDITIONS ATTACHED TO APPROVAL

Banksia Beach Water Treatment Plant and Borefield, Bribie Island (EPBC 2007/3396)

This decision to vary a condition of approval is made under section 143 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Approved action

Person to whom the approval is granted	Queensland Bulk Water Supply Authority **ABN 75 450 239 876**
Approved action	The Extraction of groundwater from Bribie Island to supply an incremental 5ML per day of drinking water to the existing Caboolture Shire Council delivery network, Queensland, (EPBC 2007/3396)

Variation

Variation of conditions of approval	The variation is: Delete conditions 1-8 and definitions and annexure 2 attached to the approval dated 7 April 2008, subsequently varied on 6 September 2011, and insert conditions 1-7 and definitions specified below
Date of effect	This variation has effect on the date the instrument is signed

Person authorised to make decision

Name and position	Shane Gaddes Assistant Secretary Compliance & Enforcement Branch
Signature	SGaddes
Date of decision	10 April 2015

Conditions attached to the approval

1. The **approval holder** must submit for approval by the **Minister** a **BEMP** designed to protect the ecological character of the Moreton Bay Ramsar wetlands. Once approved, the **BEMP** must be implemented. The approved **BEMP** must be published on the **approval holder's** website, with a location and/or metadata that enables easy discovery by relevant web searches, within one month of approval by the **Minister**. The **approval holder** must notify the **Department** within five **business days** of publishing the BEMP on its website. The BEMP must remain on the website for the period the approval has effect.

2. In accordance with the yield identified in the **BEMP**, the **approval holder** must limit groundwater extraction from the **Northern Borefield** to no greater than an annual average of 4.32ML/day, at a maximum daily rate of 5ML/day and totalling no more than 1580ML/year, subject to the requirements of conditions 1, 4 and 5.

3. The **approval holder** must maintain accurate records of all measures taken to implement the **BEMP** according to the conditions of this approval, and must make these records available to the **Department** on request. Within 3 months of every anniversary of the commencement of the action, the **approval holder** must publish a Compliance Report on its website addressing implementation of the **BEMP**. The **approval holder** must also notify any non-compliance with this approval to the **Department** in writing within 10 business days of becoming aware of the non compliance. The **approval holder** must continue to annually publish the Compliance Report until such time as agreed in writing by the **Minister**. Such records may be subject to audit by the **Department** or be used to verify compliance with the conditions of the approval.

4. If the **approval holder** wishes to carry out any activity otherwise than in accordance with the **BEMP**, the person taking the action must submit to the **Department** for the **Minister's** written approval a revised version of the BEMP. The varied activity shall not commence until the **Minister** has approved the revised plan in writing. If the **Minister** approves the revised plan, that plan must be implemented in place of the plan originally approved. All revised plans approved by the **Minister** must be published on the **approval holder's** website within one month of their approval by the **Minister**.

5. If the **Minister** believes that it is necessary or convenient for the better protection of the relevant matters of environmental significance to do so, the **Minister** may request the **approval holder** to make specific revisions to the **BEMP** and submit the revised plan for the **Minister's** written approval. Once approved, the revised plan must be implemented. Unless the **Minister** has approved the revised plan, the **approval holder** must continue to implement the originally approved **BEMP**, as specified in the conditions.

6. Upon the direction of the **Minister**, the **approval holder** must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor and audit criteria must be approved by the **Minister** prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the **Minister**.

Definitions

Approval Holder – means the person to whom the approval is granted

BEMP – means the Borefield Environmental Management Plan, as required under condition 2 and as amended in accordance with condition 4 or condition 5. The BEMP must include detailed management arrangements for ongoing ecological and groundwater monitoring, and reporting to the Department.

Department – means the Australian Government Department responsible for administration of the *Environment Protection and Biodiversity Conservation* Act 1999.

Minister – means the Minister responsible for administration of the *Environment Protection Biodiversity Conservation* Act 1999.

Northern Borefield – means the area identified as the northern borefield in the BEMP.

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7. Appendix B – Vegetation Surveys of the Groundwater Dependent Ecosystems (GDE)

Refer to report prepared by the consultant 3D Environmental (Rex D20/212892).

Bribie Island Borefield

Groundwater Dependent Ecosystems -

Annual Vegetation Monitoring Report April 2020 Survey

Prepared for Seqwater *by* 3D Environmental

Event 2_V2 November 2020

Document Control

Project No. 2020_193a
Project Manager: David Stanton
Client: Seqwater
Purpose: Annual vegetation monitoring report for Groundwater Dependent Ecosystems – Bribie Island Borefield – April 2020 Survey

Draft	Date Issued	Issued By	Checked	Purpose
Draft A	16 June 2020	Maddy Dyring	David Stanton	Initial draft
Draft B	09 July 2020	Maddy Dyring	David Stanton / Paul Williams	Updates following PW peer review
Final	09 September 2020	David Stanton		Updates following Seqwater review
Event 2_V1	29 November 2020	David Stanton		Updated report with data from November 2020 assessment
Event 2_V2	30 November 2020	David Stanton		Updated report with minor edits from T. Selman / Seqwater.

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1.0 Introduction

3d Environmental was engaged by Seqwater to complete the 2020 bi-annual monitoring event and report for groundwater dependent vegetation (otherwise referred to as groundwater dependent ecosystems or GDEs) at Seqwater's Banksia Beach Borefield and Water Treatment Plant, located on Bribie Island.

The Water Treatment Plant has not been operational since April 2014 and no water extraction has occurred. This shutdown in operations has triggered a requirement for the long-term monitoring and sampling regime as outlined within the Borefield Environmental Management Plan (BEMP). This assessment forms a component of the Annual Compliance Report for the borefield, the first of which was issued in December 2015 to address conditions of approval under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (EPBC Act 1999).

This report incorporates the results of a November 2020 survey event, following preparation of a baseline GDE assessment report which analysed data collected over five years' / ten survey events since project inception. The baseline assessment report (3d Environmental 2020) provides an assessment of current data trends to determine whether sufficient data had been collected to form a sound basis for prediction of the ecological impact associated with possible future groundwater extraction.

1.1 Previous Work and Assessment Approach

Two permanent monitoring locations were selected for vegetation monitoring in the *Groundwater Model Refinement, GDE Assessment and Monitoring Review* (SKM, 2013). The first monitoring location is in an area where drawdown in the shallow aquifer has been modelled as likely to occur and are referred to as Site 6 or the 'Impact Plots' (IPs 6a - c). The second monitoring location is located in an area outside of the predicted drawdown zone, referred to as Site 5 or the 'Control Plots' (CPs 5a - c).

Jacobs (2015) established two transects at each permanent monitoring location (impact and control localities). These were subsequently assessed for floristic composition and structure during two monitoring events completed in September 2014 and February 2015. These events were timed to coincide with the latter part of the dry season and the wet season respectively to account for seasonal responses in vegetation. An additional transect was added to each site by 3d Environmental in 2015. Ongoing vegetation monitoring events have occurred subsequent to the initial vegetation survey with a specific aim to establish baseline vegetation condition and determine the natural range of variation that occurs in terms of vegetation structure, composition and condition. The location of the monitoring sites is shown in **Figure 1**. As discussed in **Section 1.0**, a baseline assessment report was prepared following the April 2020 survey event (10 survey events) which identified that while sufficient data had been collected to determine the likely impact of groundwater abstraction, additional data collection was required to determine the reversibility of these impacts following restoration of a natural groundwater regime.

1.2 Purpose of Assessment and Scope

The overarching purpose of the vegetation monitoring program is to provide a temporal analysis of natural variations in the structural and floristic composition of coastal heathland that is supported by groundwater. This information is to provide a baseline against which the impacts of possible future groundwater abstraction on groundwater dependent vegetation can be measured. To accomplish this, the scope of the assessment includes:

1) The field assessment of the existing vegetation monitoring sites established by Jacobs (2015) and 3d Environmental (2016) utilising methods compatible with previous assessments.
2) Facilitate capture of NDVI imagery to coincide with the two current survey events (April 2019 and September 2019).
3) Analyse floristic data collected during the current survey in conjunction with complementary datasets (NDVI and Soil Moisture) to determine condition of vegetation at the control and impact sites as well as assesses seasonal variability. Comparison is to be made with previous monitoring survey results, primarily Jacobs (2015), 3d Environmental (2016, 2017, 2018 and 2019) to assist in the characterisation of the baseline condition of vegetation.

1.3 Background and Ecological Context

The monitoring sites assessed in this survey are located within 'wet heath' communities. All transects are mapped as occurring within Regional Ecosystem 12.2.12 (closed heath on seasonally waterlogged sand plains), which has an "Of Concern" status under Queensland's *Vegetation Management Act 1999*. Heath is an essentially treeless plant community dominated by low shrubs and various other ground flora. Australian heaths are invariably associated with oligotrophic (low nutrient) soils deficient in phosphorus and nitrogen (DERM 2010). Wet heaths rely on shallow groundwater for maintenance of their unique structure and composition and the shallow soil profile is likely to be saturated over a considerable proportion of the year.

Knowledge of vegetation dependence on groundwater is relatively undeveloped in the Australian context. Recent studies in coastal heathlands in eastern Australia indicate a need for longer term monitoring before definitive statements on the response of vegetation to groundwater drawdown can be made (Griffith et al 2015). Many inferences can be drawn from Western Australian examples where monitoring of coastal heath vegetation in the groundwater abstraction area of the Swan Coastal Plain has been continuous for several decades (Froend and Summer 2010; Froend et al 2004, Groom 2004, Groom 2003; Groom et al 2001; Groom 2000). The following key points, relevant to this study, can be drawn from these long-term monitoring studies:

- The response of terrestrial phreatophytes (species dependent on groundwater for survival) to declines in groundwater levels is unpredictable and variable.
- Phreatophytes associated with formerly shallow stable groundwater sources are likely to be more sensitive to groundwater decline than trees exposed to variable groundwater regimes.
- Rapid declines in groundwater are more likely to accelerate vegetation response with a threshold breach and rapid conversion of vegetation to an alternative ecohydrological state.
- Gradual reductions provide greater opportunity for recharge to occur and promotes gradual floristic transition.
- Protracted and extreme declines in groundwater may result in a change in species composition, as groundwater sensitive phreatophytes are replaced by species with a greater

ability to adapt to a drying sub-surface environment, or those species with deeper rooting systems.

In the context of Bribie Island, the shallow-rooted heath vegetation is formed by a mix of phreatophytes and facultative phreatophyes (i.e utilise groundwater but can survive without it). Wet heath vegetation typically has rooting material, mostly from sedges herbs and small shrubs, concentrated in the upper 15 cm of soil, the portion of the profile most exposed to periodic cycles of wetting and drying in response to rainfall. There are also a number of deeper rooted species such as *Banksia aemula* and broad-leaf paperbark (*Melaleuca quinquenervia)* with the ability to adapt relatively rapidly to changing groundwater levels through accelerated root growth (Griffith et al 2015). The predicted shallow groundwater level reductions created as a result of borefield abstraction for both the average and dry weather conditions are relatively limited with maximum predicted drawdowns of 0.2 m and 0.3 m respectively and drawdown impacts of 0.1 m extending into the eastern Ramsar area towards Welsby and South Welsby lagoons (Seqwater 2015). Based on Western Australian case studies where groundwater drawdown of several metres over a protracted period was required to illicit a measurable response in vegetation (Groom et al 2000a, 2000b, Groom 2003, 2004, Froend et al 2010), such minor reduction in groundwater levels are unlikely to promote any noticeable shift in the ecological state of vegetation within the drawdown area in the short term with detectible impacts likely over decadal cycles.

On North Stradbroke Island, a monitoring program between 1988 and 2006 in 18 Mile Swamp demonstrated some vegetation composition and structural changes associated with water extraction (Specht & Stubbs 2011). They found broad-leaf paperbark trees expanded into heath and sedgeland areas when water table levels fluctuated in response to drought and water extraction. The paperbarks rapidly grew in height and out competed sedges and smaller shrubs, such as *Leptospermum juniperinum*, thought to have shallower roots (Specht & Stubbs 2011). This vegetation change has increased the intensity of fires in 18 Mile Swamp, with smouldering bark from paperbarks capable of blowing across fire breaks (Kington et al 2016).

1.4 August 2019 Fire

An extremely hot fire engulfed an extensive area within the northern portion of Bribie Island National Park including the Banksia Beach borefield on 1 August 2019. Due to containment lines, habitats at Site 5 (control site) were not burnt, though a vast tract of wallum heathland north of Site 5, including Site 6 (impact site) was combusted. Visual inspection of the area burnt indicates the fire was particularly hot and resulted in combustion of nearly all ground fuel. The location of the fire relative to monitoring points is shown in **Figure 2**.

Figure 1. Location of monitoring transects at the Banksia Beach Borefield.

Figure 2. Extent of fire scarring from September 7 Spot Imagery with delineation between burnt and unburnt vegetation indicated by blue dashed line. Monitoring Site 5 has not been burnt.

2.0 Methods

2.1 Field Survey

Timing: The post-wet survey was completed on 08 April 2020 with a subsequent late dry season assessment completed on November 4th and 5th 2020.The timing of the post-wet season survey coincided with above average rainfall events in the preceding months of January, February and March while the late dry season event coincided with a period of below average rainfall in August, September and October 2020, following a relatively wet July (see **Section 2.4**) . Methods applied follow those of previous survey events except where stated.

Transect Methods: Methods for vegetation assessment followed those documented in Jacobs (2015) which was adapted from the Biocondition Methodology (Eyre et al 2015) to provide an assessment of vegetation composition and structure.

Each survey transect (plot) was formed by a central 50m transect marked with star pickets and a 50m tape measure stretched tightly between end points. The transect was extended 5m either side of the centreline to provide a 50 m x 10 m plot (0.05ha). Four transects (Plots 5a, 5b, 6a 6b) were established in September 2014 (each had a third star picket placed at the transect mid-point). An additional two transects (5c and 6c) were established in April 2016 although a central picket was not used for these. Specific details of data collected at each plot is provided below with deviations from the methods of Jacobs (2015) identified and discussed in the following sections:

- Canopy intercept of woody species over a measured centre line, from 0 to 50m separated into:
    - Tree (T1) structural layer being trees > 6m height.
    - Upper shrub (S1) structural layers, being shrubs > 1m height.
    - Lower shrub (S2) structural layers being shrubs in the height range of 0.5 to 1m[1].
    - Ground (G) being all floristic life forms <0.5m height.
- Species richness for all floristic lifeforms within each 0.05 ha plot totalled for the two survey events. Lifeforms allocated in the assessment are:
    - Trees (single stemmed woody plants > 6m).
    - Shrubs (woody multi-stemmed vegetation)
    - Forbs (herbaceous vegetation that is not a grass or other life form)
    - Native perennial grass / sedge / rush (includes graminoids such as sedges, tussock grasses and restionaceae species. Lomandra spp[2] have also included in this category).
    - Grasstree[3] (*Xanthorrhoea* spp.)
- Counts of woody species within the survey plots within height classes (Trees T1; Shrubs S1 and S2). Stem counts were completed in a 2m wide belt transect positioned either side of the centreline tape. This narrow width allows for the accuracy in stem counts required in repeat measure monitoring surveys.

[1] Shrubs in the 0.5 to 1m height range were included in the Ground (G) structural layer in Jacobs 2015.
[2] Included in the shrub category in Jacobs (2015) although overall cover very low.
[3] Not included in the biocondition methodology

- Groundcover of floristic lifeforms within 10 x 1m^2 quadrats placed at 10m intervals along the tape measure with the initial quadrat position (Q1) at the 4 – 5m interval on the left side of the tape measure and flipped to measure Q2 on the right. The final quadrats Q9 and Q10 were positioned at 44 – 45m on the left and right side of the transect respectively. Cover measurements utilised the Braun-Blanquet method including % proportions of:
    - Native Shrubs < 0.5m. (Specht & Stubbs 2011).
    - Native perennial grass/ sedge/ rush
    - Native forbs
    - Grasstrees
    - Exotic shrubs
    - Leaf litter (% of dead leaf matter)
    - Bare ground (exposed sand).
- Canopy heights were recorded for all canopy intercepts in the T1, S1 and S2 structural layers.

GPS localities of start and end points were recorded in the field and photographs were taken at the transect centre point from centre to start, centre to end, centre to north (right), centre to left. . A generalised plot layout is shown in **Figure 3.**

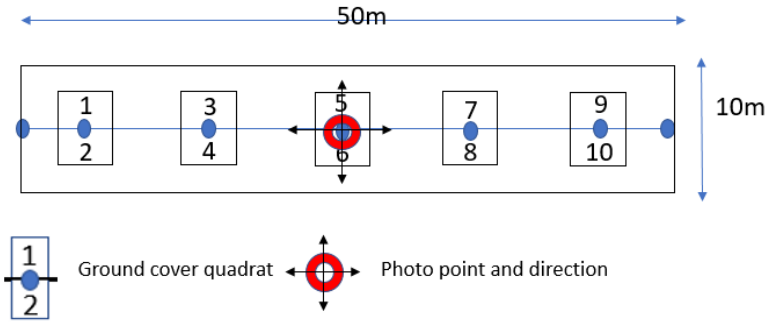

Figure 3. Survey plot layout.

In regard to the assessment of shrub cover, all shrubs >0.5 m height were attributed to the shrub layer and <0.5m to the ground layer, consistent with methods described in Neldner et al (2012). Previous surveys by Jacobs (2015) included shrubs <1m height to the ground layer, although this was considered impractical in this assessment due to the strong stratification of other groundcover components into the dense clumping cover typically < 0.5m height.

A total of six plots have been established throughout the course of the survey with plots 5a, 5b, 6a and 6b established by Jacobs (2015) in the previous survey event and an additional two sites (5c and 6c) established by 3d Environmental during the 2016 survey event. A summary of all sites is provided in **Table 1** with floristic and structural data from all transects provided in **Appendix A**.

Table 1. Monitoring sites established in the study area.

Transect No.	Purpose of Site	Lat. / Long. Start	Lat. / Long. Centre	Lat. / Long. Finish	Date Established
5a	Control	-26.9942 / 153.1587	-26.9942 / 153.15905	-26.9942 / 153.15932	26 September 2014
5b	Control	-26.9943 / 153.15879	-26.9944 / 153.15898	-26.9944 / 153.159319	26 September 2014
5c	Control	-26.9946 / 153.15883	NA	-26.9944 / 153.15929	4 April 2016
6a	Impact	-26.9856 / 153.15404	-26.9849 / 153.15425	-26.9847 / 153.154487	26 September 2014
6b	Impact	-26.9852 / 153.15415	-26.9852 / 153.154376	-26.9849 / 153.15458	26 September 2014
6c	Impact	-26.9852 / 153.15415	NA	-26.9849 / 153.15458	4 April 2016

2.2 Data Analysis

Field data was entered into biocondition datasheets for each individual transect. Data was then summarised to allow calculation of total per cent (%) cover of shrub layers, shrub density as well as components of the ground cover attributed to growth form, leaf litter and bare ground. Data from the April and November 2020 survey events is provided in **Appendix A**.

To allow an assessment of the natural variability of habitats within impact and control sites to be made, all transects were treated individually. ANOVA was used to determine the significance of any differences identified between mean values for structural and floristic features recorded during the data collection process. A Repeat Measures ANOVA, using data from the nine survey events (2016 through to 2020) was undertaken to evaluate the statistical significance of any changes over time in plant cover and richness data. It also allowed an assessment of whether there are consistent differences in any structural group abundance between CPs (5a - c) and IPs (6a - c). Statistical analysis was completed using GraphPad Prism (Version 8.3.1). Tests for normality and lognormailty were applied prior to ANOVA. As standard practice, p-value < 0.05 was considered indicative of a significant difference in mean values or variance.

2.3 NDVI Analysis

Fresh capture Spot 6 (SPOT6 1.5m Panchromatic 4-band Pan + Bundle imagery) imagery from Geoimage Pty Ltd was acquired to coincide (as close as possible) with the timing of the field survey events. Image capture was completed on the 15 April 2020 and 22 November 2020, corresponding with periods that were relatively cloud free. Raw data from the Spot 6 image was processed using the ArcGIS image server applying the following equation as standard process:

> ***NDVI = arctangent((IR – R)/(IR+R))*** where IR = pixel values from the infrared band, and; R = pixel values from the red band.

This produced a single-band dataset with negative values generated from water (and clouds), bare soil generating values of 0 and positive values produced by green/ living vegetation with greater NDVI values corresponding to varying abundance of green leafy biomass. NDVI values were measured in 1.5 m intervals along each transect for the April and October period with the same interval applied to previous capture periods to ensure consistency between datasets. All values were compiled into an Excel database for interpretation and graphical representation.

2.4 Climate Data

Automated weather stations (AWS) have been used throughout the extended period of the monitoring program to gather information on local rainfall patterns. A number of data gaps which resulted in lack of data continuity and consistency limited the utility of this data for representation of longer term seasonal rainfall trends. Data from the AWS at Banksia Beach for the period between 4th November 2020 and 5th November 2020 was however applied to analysis of soil moisture / rainfall relationships detailed in **Section 2.5**. For analysis of longer term rainfall trends over several years, the Bureau of Meteorology (BOM) 'Bribie Island Alert' recording station (-27.14, 153.3) in the township of Woorim was used to inform local rainfall patterns. These local patterns were compared to rainfall recorded at Beerburrum State Forest (-26.96, 152.967), a BOM recording station located approximately 10 km west of Bribie Island. Annual rainfall averages for this weather station date back to 1898 and were utilised during analysis of the climate data to supplement any identified information gaps and establish long-term trends.

2.5 Soil Moisture Data

Automated soil moisture loggers were installed at the location of the CPs (5a – 5c) (southern SMP) and IPs (6a – 6c) (northern SMP). Soil moisture data provides additional context to interpret changes in vegetation condition that could be attributed to seasonal cycles of wetting and drying. Sensors were installed to depths of 15 cm, 35 cm, 65 cm, 95 cm and 125 cm with automated readings provided between 1 September 2019 and 31 August 2020 for the southern impact site (Southern SMP). The soil moisture logger installed at the northern control site (Northern SMP) was destroyed during late August 2019 wildfires and the final reading for the monitoring period was on 21 August 2019 at 11:14 am, coincident with passing of an intense fire front. The northern SMP had not been repaired at completion of the November 2020 survey event, and data presented in this report is for the southern SMP only.

3.0 Results

Results of the assessment are detailed below and provide analysis of those factors considered critical to the assessment of vegetation condition, structure and floristic change. The analysis includes assessment of:

- Climate data;
- Soil moisture data;
- Shrub cover and stem density;
- Groundcover composition;
- Species richness; and
- NDVI Analysis.

Comparisons between control and impact sites are made and where possible, comparisons between the current and previous survey events back to the 2015 survey period are made.

3.1 Climate and Soil Moisture

Rainfall and soil moisture data are intimately linked and are dealt with consecutively in this section. As previously discussed in **Sections 2.4** and **Sections 2.5**, some datasets were incomplete and hence have applied for specific purposes only.

3.1.1 Climate data

Rainfall recorded at Beerburum State Forest for January, February and March immediately preceding the April 2020 survey was 642.6mm, which is well above the long-term historical average of 572.5mm for those months. February was extremely wet with 313.6 mm recorded. July 2020 received above average rainfall (82.8mm compared to a long term average of 62.7mm) and October received 135.2mm, the month prior to the late dry season assessment event, which is compared to a long term average of 91.4mm. Hence conditions prior to the November 2020 assessment could be considered relatively wet.

The Bribie Alert Station, provides a local comparison for the Beerburrum State Forest records indicating significantly greater rainfall occurred on Bribie Island than was recorded regionally. A massive rain event occurred on February 13th when 189mm was recorded, with 507mm falling throughout the month. Rainfall in July 2020 of 129mm was also considerably higher than recorded at Beerburrum SF, and much of this rainfall would have infiltrated rapidly into the groundwater table due to relatively low evaporation rates during the winter months. A comparison of rainfall trends is provided in **Figure 4**.

To place the vegetation surveys in the context of longer-term climatic cycles, a calculation of cumulative rainfall departure was completed for the period from January 1990 to July 2020 on the SILO climate dataset for Bribie Island (Banksia Beach grid) as shown in **Figure 5**. The calculation of CRD subtracts the long-term average monthly rainfall from the actual monthly rainfall and provides a monthly departure from average rainfall condition (Weber and Stewart 2004). Shallow aquifers, such as those hosted in Bribie Island sand mass tend to follow the same relative patterns in terms of depletion and recharge. The period between 2000 and 2009 was one of the driest on record, often termed the millennium drought. A strongly above average rainfall trend is evident between 2010 and 2014, with the surveys commencing in 2015, the point at which a strong drying trend was

initiated. In the context of broader climatic trends, the GDE surveys have been completed against a drying climatic cycle. There is a noted slight upward inflection on the CRD curve in 2020, although it is not possible to predict whether this inflection represents a shift toward a wetter climatic regime.

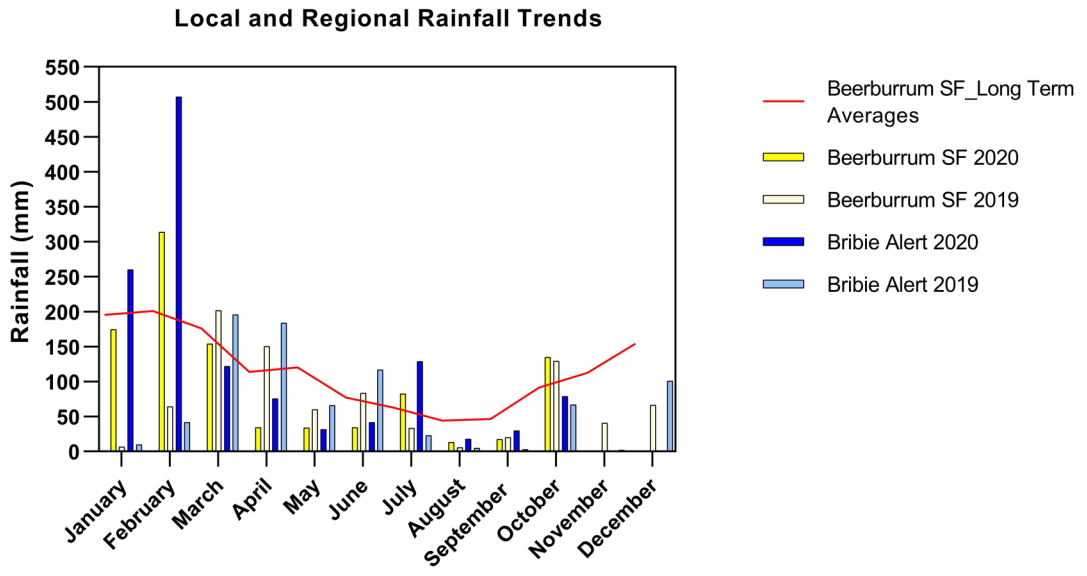

Figure 4. Regional rainfall recorded at Beerburum SF and Bribie Alert recording stations for January 2016 – November 2020.

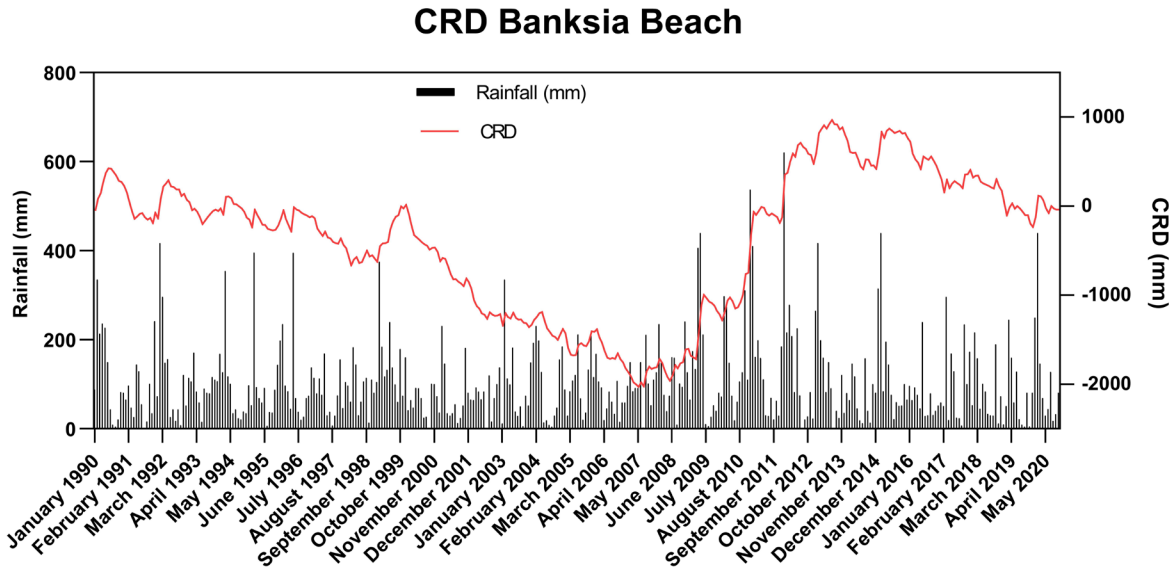

Figure 5. Cumulative rainfall departure calculated for the Banksia Beach grid (SILO 2020) with a slight upward inflection in the rainfall trend indicated for 2020 suggesting wetter conditions coincided with the 2020 surveys compared to previous years.

3.1.2 Soil moisture data

During the August 2019 fire, the northern SMP adjacent to IPs 6a – 6c was destroyed and therefore trends relating to soil moisture content at the northern transects were not available for this reporting period. Details of trends at the northern SMP from prior periods are provided in previous assessment reports.

In 2019, data from the northern SMP (IPs) demonstrated sustained periods of saturation at the 125 cm and 95 cm profiles (see monitoring report for the 2019 period). Data from the southern SMP in contrast demonstrated sustained periods when the sand profile shallower than 95cm is unsaturated with only minor response to recharge events, and extended periods where shallow soil moisture (measured at 15 cm) was below 20% total moisture content. As noted in the previous survey event, moisture content in the soil profile at 95 cm depth dropped below saturation for the first time during the ongoing monitoring program. This resulted in a drop in total moisture content from 40% to <20% which was sustained over a period of about a month. Recharge at 95cm depth only occurred after 169.8 mm fell in March 2019 with two significant rainfall events occurring on 16 March 2019 (56.8 mm) and 28 March (58.7 mm). Strong recharge following by rapid drainage at the 35 cm and 15 cm probes is indicated following significant rainfall in January 2020 (**Figure 6**). Further recharge occurred in February 2020 which resulted in sustained saturation of the 15cm and 35cm probes through to the end of April. The 15cm and 35cm moisture probes dried for a period of approximately 3 months between April and July 2020, becoming saturated in association with wet conditions in July with the 15cm probe again falling below saturation in late August 2020.

3.2 NDVI data analysis

Average NDVI data values for 2016, 2017, 2018, 2019 and 2020 are provided in **Figure 7** with a comparison of average NDVI values per assessment site provided in **Figure 8.** Full data plots for individual monitoring sites are provided in **Figure 9** for the CPs (5a to 5c) and **Figure 10** for the IPs (6a to 6c). Repeat measures ANOVA indicates significant difference in 'green-ness' is occurring between monitoring events ($F_{9,45} = 19.65$; $P<0.0001$), although differences in NDVI values occurring between survey plots is not significant ($F_{5,45} = 1.693$; $P = 0.1557$). This suggests that vegetation composition is evolving evenly across all sites between survey events, although the differences in 'green-ness' between monitoring sites during any given survey event are not significant.

A general increase in NDVI values, which commenced in April 2018 has continued though all datasets to the most recent event (November 2020), ignoring the sharply negative value shift that occurred at IPs (6a – c) in the October 2019 survey due to combustion of living cover in the August 2019 wildfire.

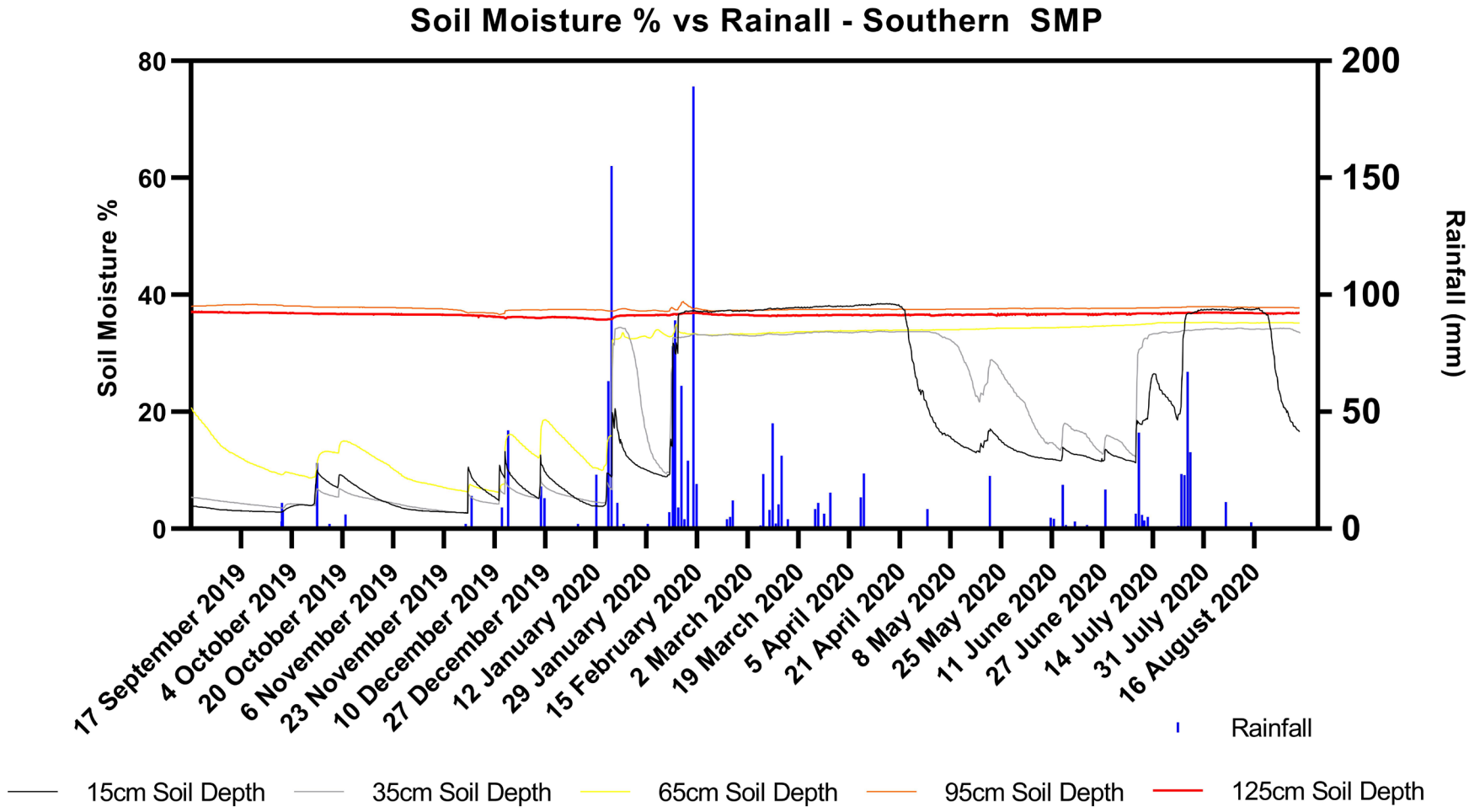

Figure 6. Southern Soil Moisture Potential Readings (September 2019 – August 2020)

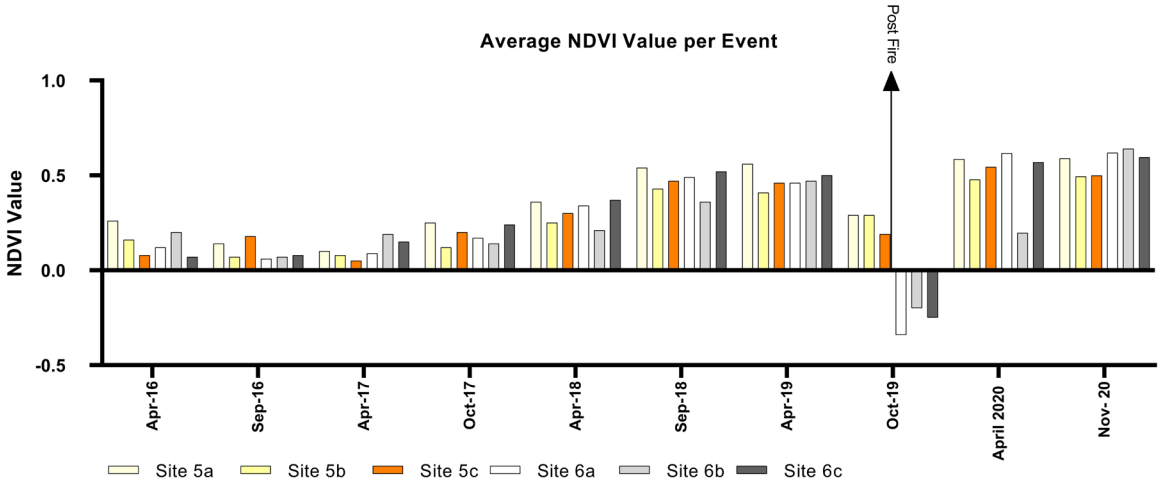

Figure 7. Average NDVI Values for the 2016, 2017, 2018, 2019 and 2020 survey periods.

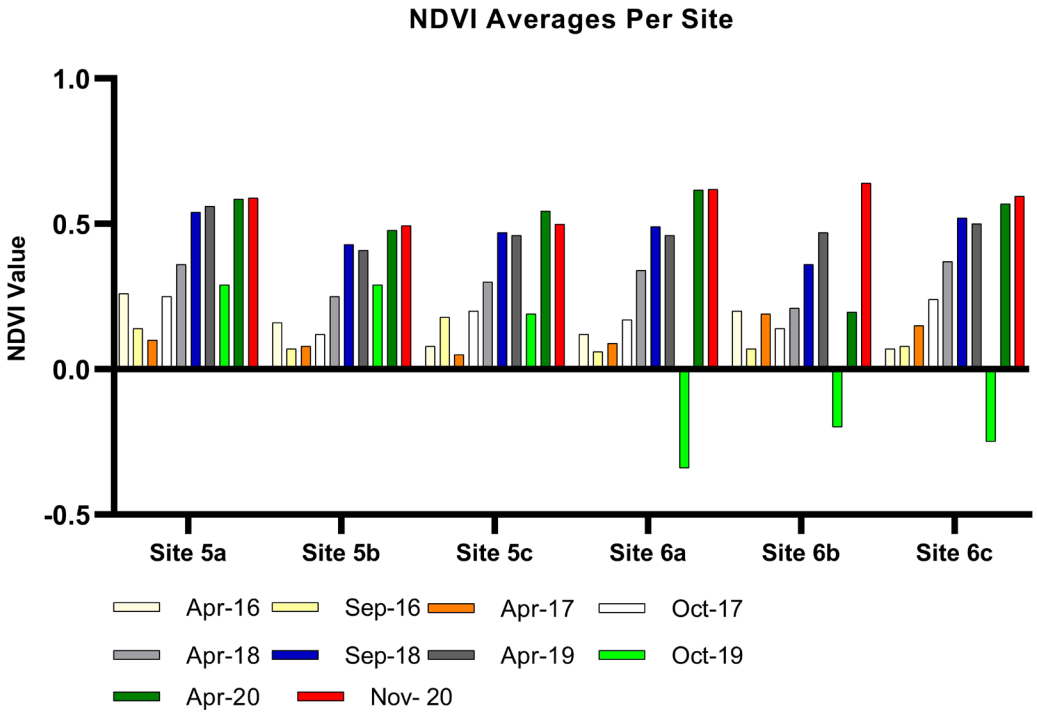

Figure 8. Evolution of NDVI values between monitoring sites indicating a generally progressive increase in NDVI values with each monitoring event.

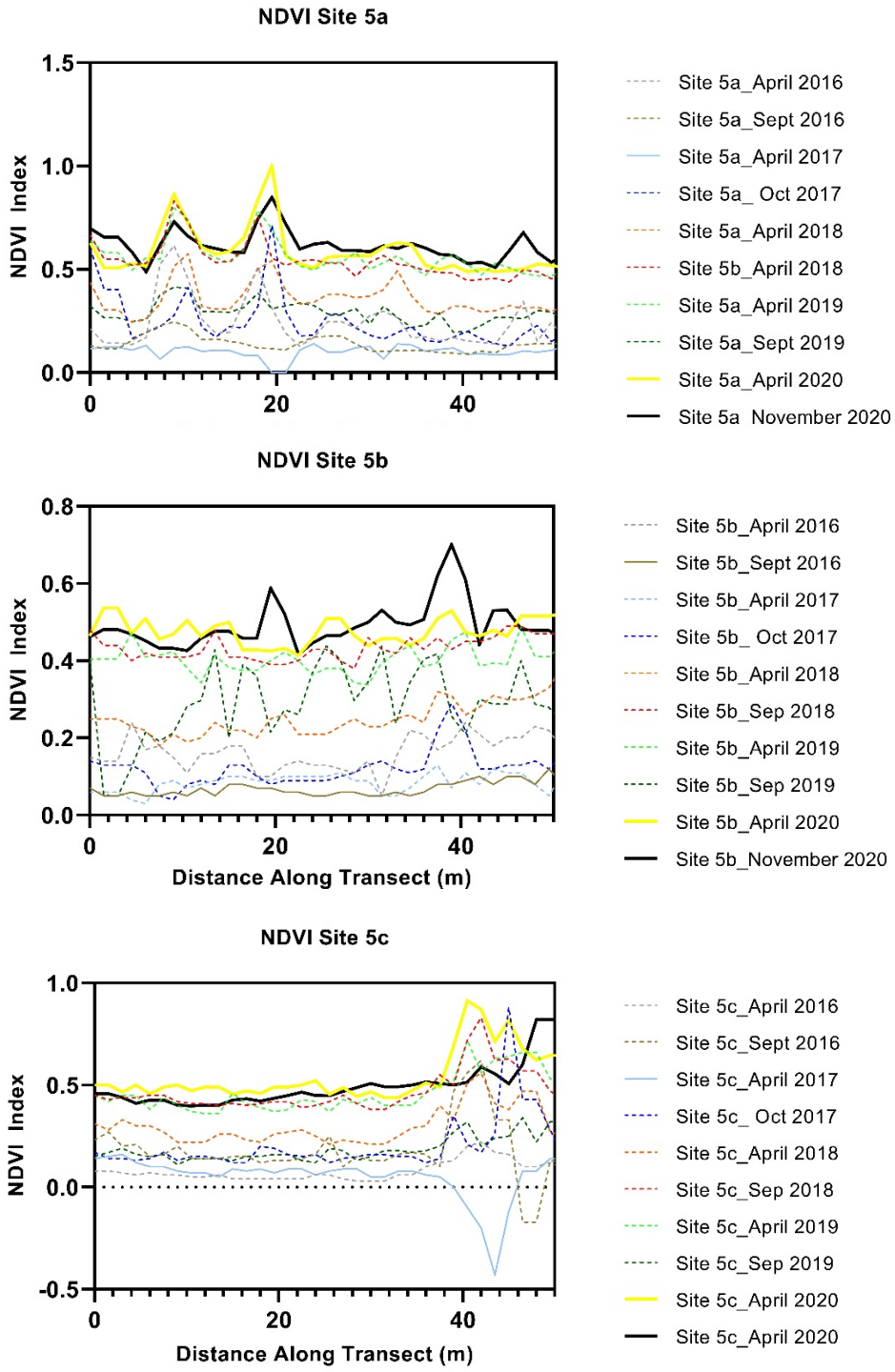

Figure 9. Evolution of NDVI profiles for individual survey plots at Control Sites (CP5a to CP5c) between survey events.

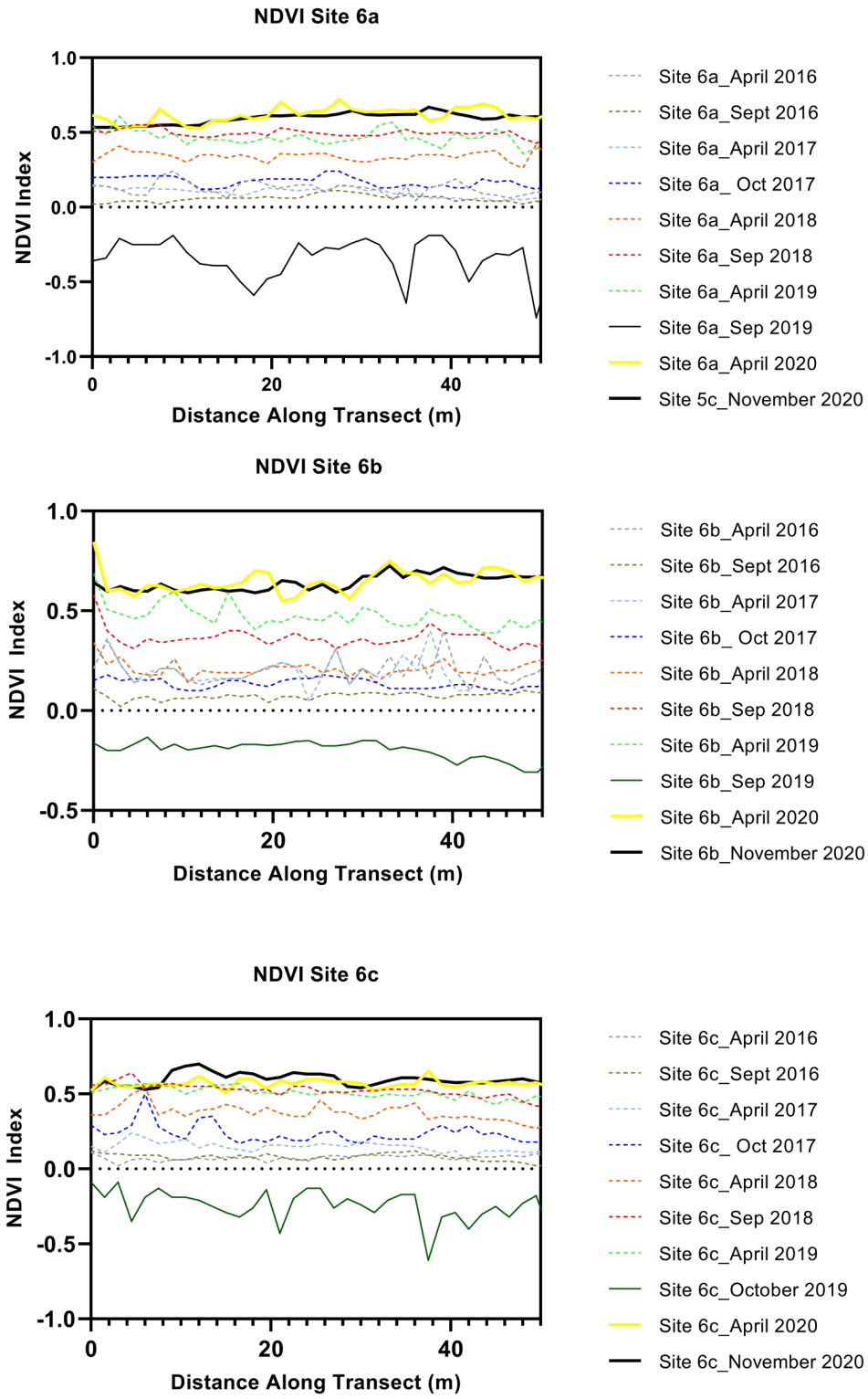

Figure 10. Evolution of NDVI profiles for individual survey plots at Impact Sites (CP6a to CP6c) between different capture periods.

3.3 Shrub Cover (%) and Stem Density

There is considerable variation in the % cover of shrubs >1m tall between survey periods for all survey sites and years (see **Figure 11**). Cover of shrubs > 1 m (%) decreased substantially in September 2018 and September 2019 across all sites, and have remained relatively stable in CPs (5a to 5c) for subsequent events, increasing slightly in the most recent survey event. The complete removal of shrubs in this size class from the IPs following the August 2019 fire event remains evident although there has been progressive migration of regenerating shrubs into 1m size class with each subsequent monitoring survey following the fire. A Repeat Measures ANOVA indicates that the temporal variation in shrub cover between survey events is highly significant ($F_{9,45}$ = 16.21, P < 0.0001). There are also significant differences in the cover of shrubs in the >1m size class between survey plots ($F_{5,45}$ = 4.29, P = 0.003), most significantly between the IPs and CPs, compounded by the impacts of wildfire. In the October 2019 monitoring event, it was noted that many of shrubs at the control site (5a to 5c), particularly *Persoonia virgata,* were dead with no regeneration occurring from basal stems or epicormic growth. There has also been no noticeable regeneration of shrubs in the taller size class observed in the either the April 2020 or November 2020 assessments at the CPs. Senescence of shrubs between survey events is particularly noticeable in the CPs in the site photographs (**Appendix A**).

In August 2019, fire reduced the % cover of 0.5 – 1 m sized shrubs to nil across all IPs (6a - c) and there were no shrubs in this size class recorded in CPs (5a- c) in the September 2019 monitoring event. The April 2020 survey recorded increased shrub cover in the 0.5 – 1m category for both CPs and IPs (**Figure 12**). Between the April 2020 and November 2020 assessment events, the increase in shrub at the CPs diminished, although regeneration of shrub cover in the smaller size class continued strongly at the IPs. The increase in shrub cover at the IPs is attributed to strong regeneration of the shrub layer following the 2019 fire event, gained mostly through coppicing or shrubs although strong regeneration of obligate seeders such as *Phyllota phylicoides* also contributed significantly to the increased shrub cover recorded in the November 2020 assessment event. Repeat Measures ANOVA indicates that temporal variation between survey events is statistically significant for shrubs in this size class ($F_{9, 45}$ = 2.99; P=0.007), strongly influenced by the August 2019 wildfire. When the CPs are analysed alone, the degree of significance is reduced ($F_{9,18}$ = 2.95, P = 0.024) indicating the greatest change in shrub cover in the 0.5 – 1m size class has occurred at the IPs. There is also a significant difference between shrub cover values for individual transects detected across all sites (both CPs and IPs) ($F_{5,45}$ = 10.62, P<0.0001).

As noted in previous assessments, IP sites (6a - c) have on average a much greater stem density (μ = 122 [excludes post fire impact values]), than CP sites (5a - c) (μ = 48) (**Figure 13**). A marked decrease in stem density across both IPs and CPs has been noted between the 2018 to 2019 survey events. At the IPs (6a to 6c) however, strong increases in stem density were recorded in the November 2020 assessment indicative of post fire structural recovery. Repeat Measures ANOVA indicates that the difference in stem density between CPs and IPs is statistically significant across all survey periods ($F_{5,3}$ = 16.72; P<0.0001). A strongly significant decrease in stem density also occurred at CPs (5a to 5c) between September 2018 and September 2019 ($F_{9,18}$ = 11.33, P = <0.0001) which were unaffected by

fire indicating the changes in stem density cannot be attributed to the fire alone and other causal factors must be in process.

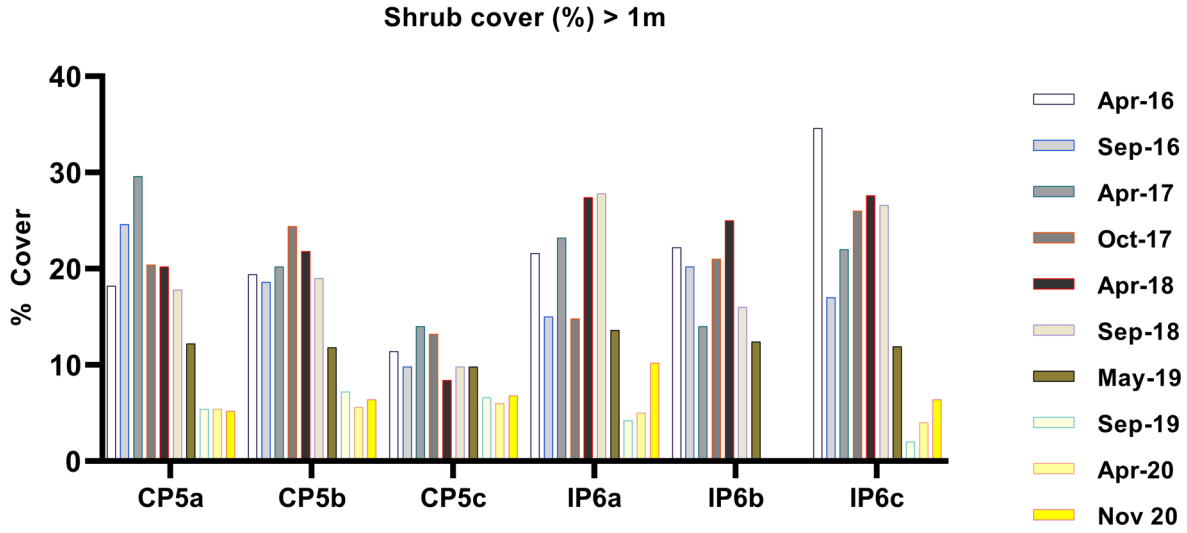

Figure 11. Cover (%) of shrubs in the > 1 m size class between assessment events.

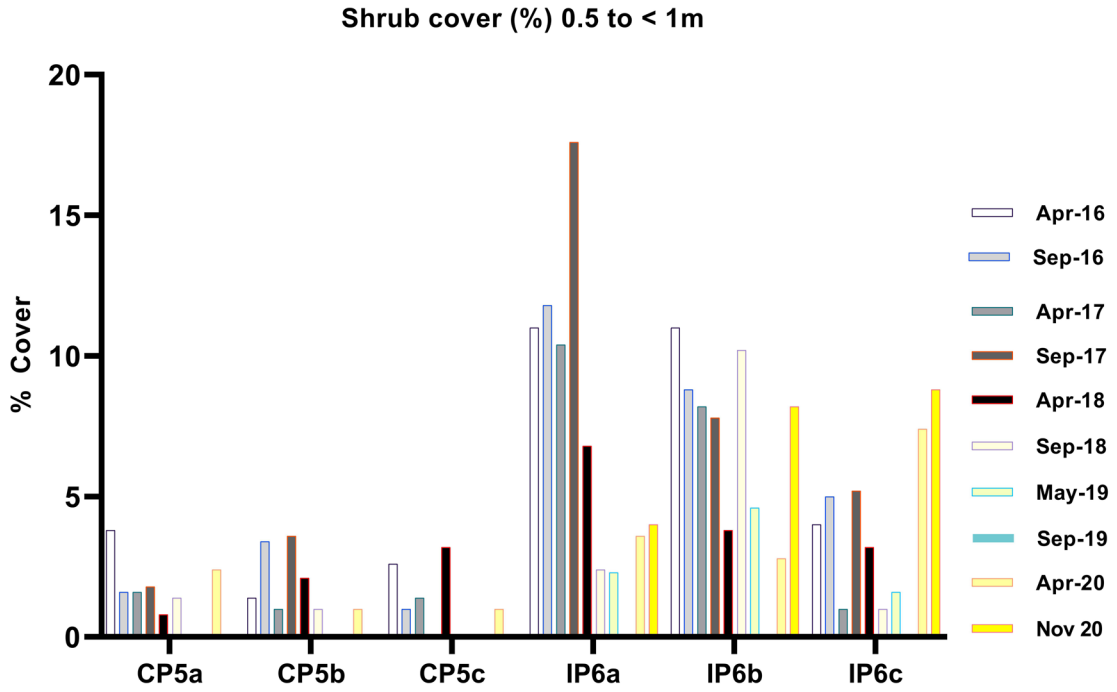

Figure 12. Shrub cover (%) 0.5 to < 1 m class size for all survey events.

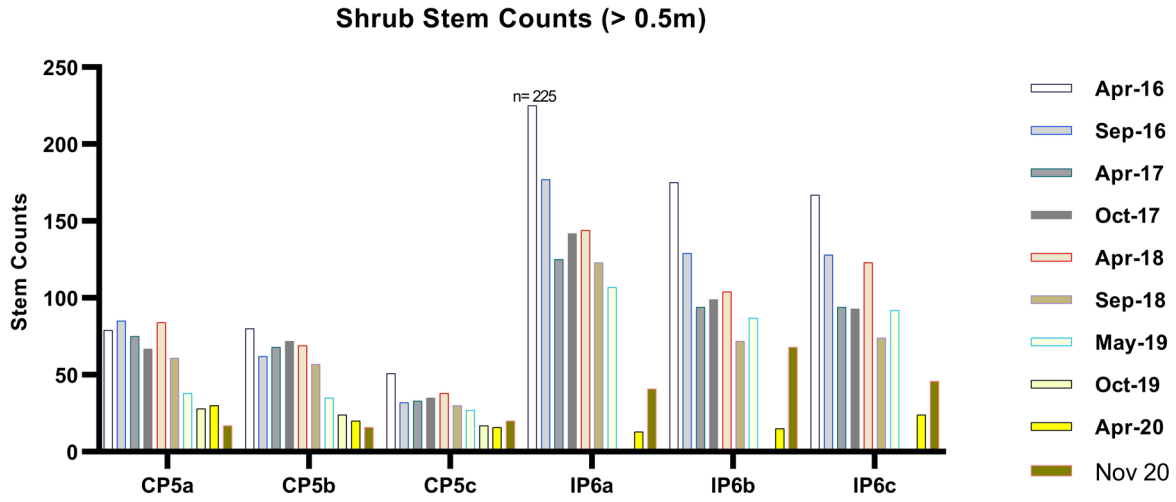

Figure 13. Stem counts for shrubs (> 0.5 m) across all sites (2016 – 2020).

3.4 Composition and Nature of Groundcovers

Previous monitoring events noted sharp and sustained changes in soil moisture for both impact and control sites in the upper 65cm of the soil profile has occurred. Extended periods were recorded when the upper 35cm of the soil profile had dried to <20% total soil moisture content, dropping to < 5% soil moisture between December 2018 and March 2019. Consistent with observations from previous monitoring events, the upper soil profile of the control site drains and dries more rapidly after rainfall than the impact site with shorter periods of saturation (see **Section 3.1.2**) and drying extending deeper into the soil profile.

The hydrological differences in the upper soil profile likely accounts for subtle differences in vegetation composition between impact and control localities. This would be particularly true in the shallow rooted groundcover layers which would be most exposed to drying in the upper soil profile. **Sections 3.4.1** to **Section 3.4.6** provides an analysis of the composition, structure and floristic trends of groundcover components of the monitoring sites. A statistical summary is provided in **Table 2** for all survey localities and contribution to total cover of various lifeforms over the 2016, 2017, 2018, 2019 and 2020 survey periods.

3.4.1 Native perennial grass / sedge / rush cover

The cover of living grass, sedge and rushes has changed subtly over a number of assessment periods (see **Figure 14**) indicating that the dominant rush species *Sporodanthus interruptus, Caustis recurvata* and *Baloskion tenuiculme* have remained relatively resilient despite an extended dry climatic event spanning the 2016 to 2020 monitoring periods. Little change in the cover of sedges and rushes was detected following the significant rainfall in February 2020.

Change in native grass and sedge cover (%) has been variable between survey events. Grass and sedges were not recorded in groundcover plots at Impact Plot 6c for the first time in 2019 since monitoring commenced, due to the August 2019 fire. Control plots not impacted by fire have

maintained similar grass and sedge cover (%) from April 2018 to April 2020 with the greatest sedge cover recorded since establishment of the monitoring program in the November 2020 assessment.

A Repeat Measures ANOVA applied to 2016 – 2020 data for the CPs (5a -5c) indicates that changes in native grass and sedge cover are significant between survey events ($F_{9,18}$ = 2.65, P = 0.037) and between individual plots ($F_{2,18}$ = 9.59, P = 0.0015) . If applied to the IPs (6a – 6c) alone, a Repeat Measures ANOVA demonstrates strongly significant differences between monitoring events ($F_{9,18}$ = 11.95, P = <0.0001), which can in part be attributed to cover changes induced by the August 2019 wildfire.

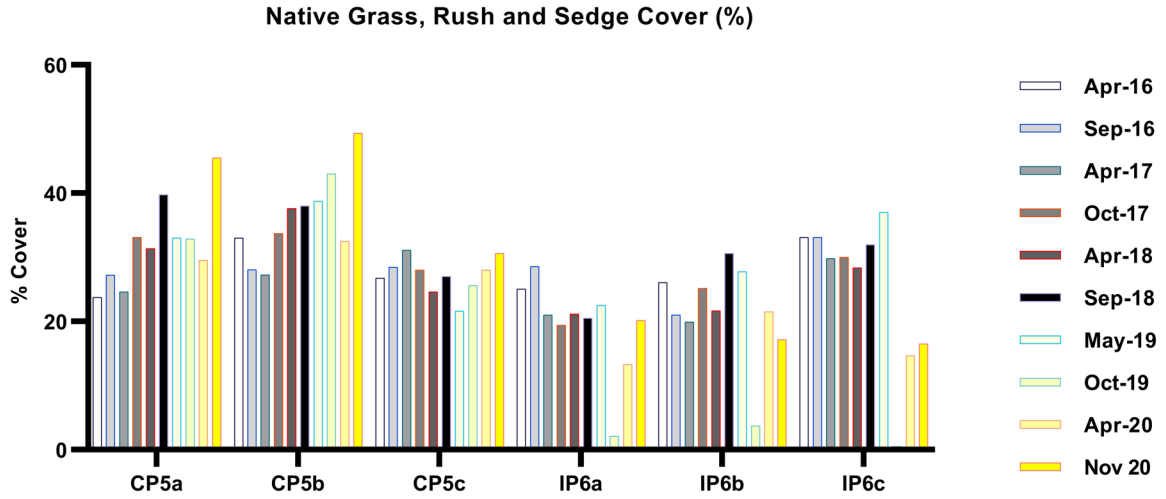

Figure 14. Cover (%) of native grasses, sedges and rushes across all sites (2016 – 2020).

3.4.2 Groundcover shrubs

Native shrub (< 0.5 m) cover (%) has generally been consistent between transects within any given survey year. However, a sharp decline in native shrub (< 0.5 m) cover (%) occurred at IP sites (6a - c) following the August 2019 wildfire (**Figure 15**). Significant post fire regeneration of groundcover shrubs occurred following the 2019 fire event with an increase of over 600% observed in shrub % cover at IP6c. At this site, cover increased from 4.85 % in October 2019 to 34.75 % in April 2020, remaining relatively stable in November 2020 (32.05%).

A Repeat Measures ANOVA applied to the IPs (6a - c) indicates that the measured reduction in shrub cover measured between the 2016 and 2020 surveys events is strongly significant ($F_{9, 18}$ = 19.30; P<0.0001), influenced by the loss of groundcover shrubs associated with the August 2019 wildfire event. Changes to groundcover shrub composition occurring betweens survey events is however not statistically significant at CPs (5a - c) ($F_{9,18}$ =0.72, P=0.69) which was not affected by the wildfire.

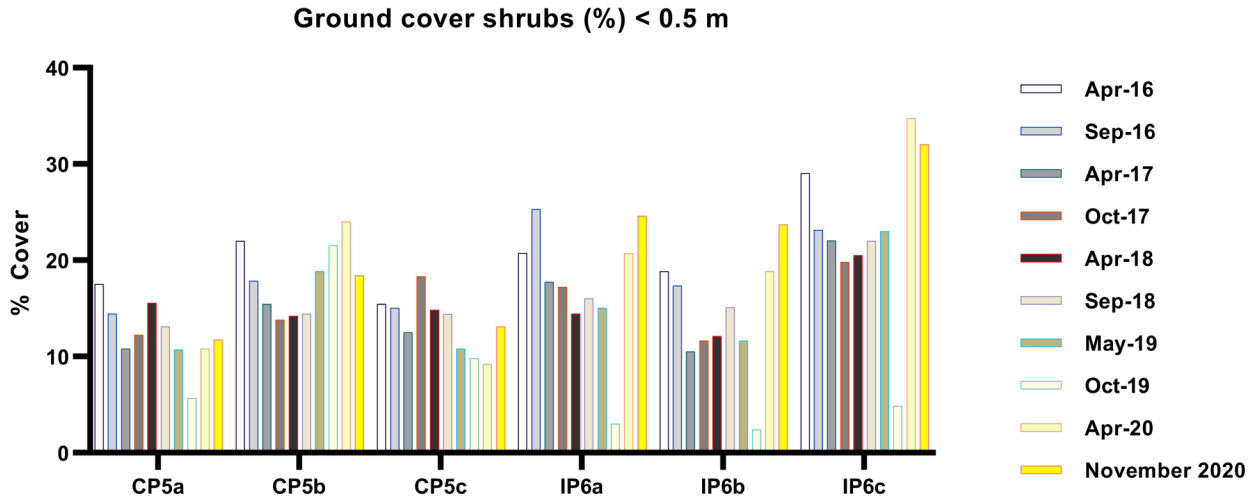

Figure 15. Cover (%) of groundcover shrubs (< 0.5 m) across all sites (2016 – 2020).

3.4.3 Groundcover forbs

The % cover of forbs within survey plots forms a relatively small proportion of the total groundcover values. Due to a general preference for mesic conditions, forb diversity and % cover are sensitive to droughting and vary according to seasonal conditions.

Preceding the October 2019 (post-fire) survey events, forb cover had been variable across all plots in response to rainfall, although displayed a relatively consistent range of values. Prior to the most recent survey, the highest % cover of forbs was recorded in the 2016 survey event (n = 2.85%) which followed an extremely wet year in 2015 (**Figure 16**). However, post-fire forb % cover at IP6a was recorded at 3.75% in the April 2020 event, which is a substantial increase from < 1% recorded during the 2019 survey event. At IP sites (6a - c) forb % cover had previously been decreasing since May 2019, although attained maximum values in April 2020 following the fire, with subsequent minor reductions in forb cover in November 2020. The increase in forb cover recorded in the April 2020 assessments at the IPs can generally be attributed to increases in *Hibbertia salicifilia, Drosera binnata* and *Pimelea liniifolia,* although general increases in cover were recorded for most forb species.

A Repeat Measures ANOVA indicates that the measured variation in forb cover between survey events for all sites is significant ($F_{9.45}$= 2.881; P=0.009), and a significant difference in forb cover between transects for all sites (both impact and control) is also detected ($F_{5,45}$ = 5.259, P=0.0007). The variation in the diversity and composition of forbs between survey events is discussed further in **Section 3.4.6**.

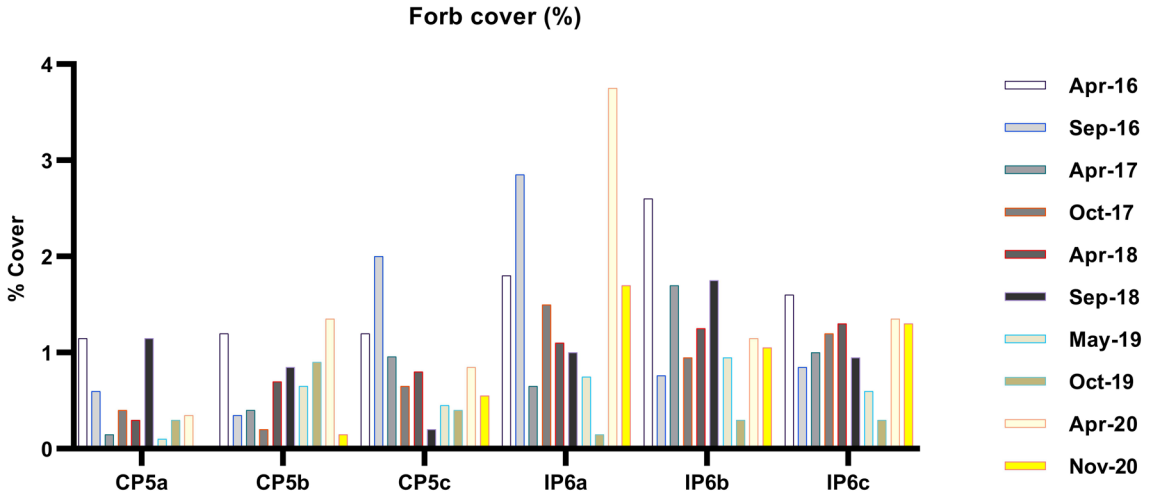

Figure 16. Forb cover (%) across all sites (2016 – 2020).

3.4.4 Grasstree cover

There remains considerable variation in grasstree % cover between sites and survey events. It is difficult to identify any firm trends and the variability in grass tree cover values appears independent of site locality and seasonal survey effort (**Figure 17**). However, a decrease in the recorded % cover of grasstree within groundcover plots was apparent in the October 2019 event across all sites, with large decreases at the IPs due to the August 2019 fire event. Grasstrees formed the most significant groundcover recorded at IPs (6a - c) in October 2019 indicating their relative resiliance and capacity to rapidly regenerate from fire. There has been a strong increasing trend in grasstree cover demonstrated at IP6a and IP6b that progressed through the April 2020 and November 2020 assessments, returning to near pre-fire cover levels. The fire event at the impact site has also stimulated intensive flowering, which is typical for the species (Taylor et al 1998). Site photographs in **Appendix A** indicate the flowering is specific to the impact site and is not occurring in the control locality (5a to 5c) which was not burnt.

A Repeat Measures ANOVA suggests that the variation in grasstree cover between seasonal survey efforts is strongly significant for all sites ($F_{9,45}$ = 5.36, P<0.0001). Temporal changes to grasstree cover are not significant when the IPs (5a – c) are assessed alone ($F_{9,18}$ = 2.058, P = 0.092) suggesting that the significant differences in grasstree cover measured between survey events may be attributed to the August 2019 wildfire.

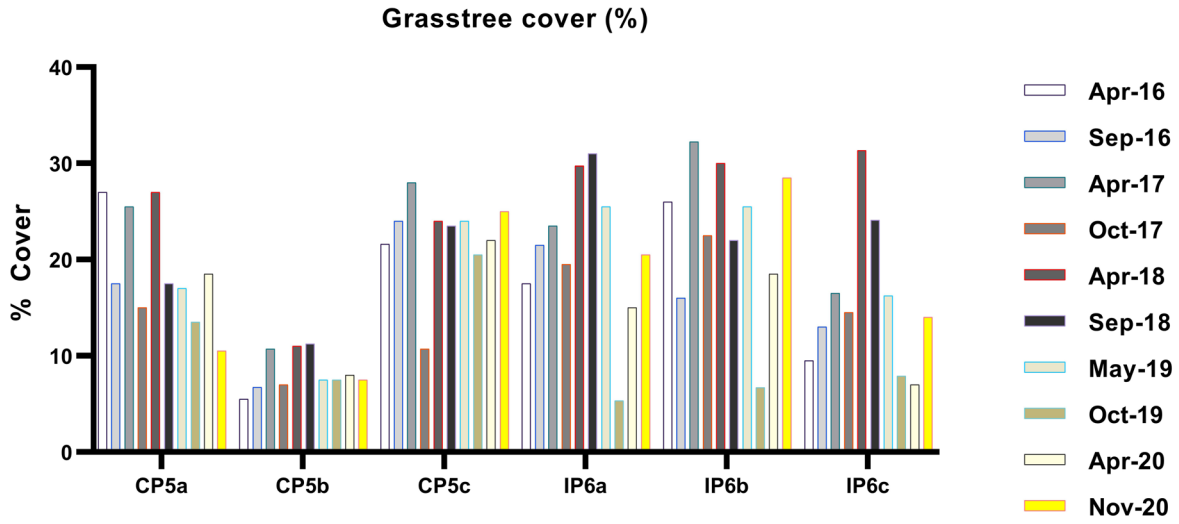

Figure 17. Grasstree groundcover (%) across all sites (2016 – 2020).

3.4.5 Total living groundcover

Total living groundcover represents the portion of the groundcover that is living with capacity for photosynthesis. Living groundcover values are balanced by leaf litter and small patches of bare ground (humic sand) which form a minor cover component at some sites. Total living groundcover can be used as a measure of the health or vigour of a vegetation community at a given point in time. The proportion (%) of living groundcover for all sites is provided in **Figure 18**. Living groundcover was substantially reduced at IPs in late 2019 due to wildfire which almost completely destroyed the groundcover layer.

Continuing ongoing trends observed during previous assessment periods, subtle variations occur between survey events at all survey localities although it is difficult to identify any strong links to indicate seasonality or differences between impact and control sites. Average living groundcover values across all survey years and transects is 63.45%. CPs (5a - c) are characterised by a slightly higher average living groundcover of 65.24%, compared to 61.66% for IPs (6a - c), although IP values were significantly affected by fire. A Repeat Measures ANOVA suggests that the variation in living groundcover between seasonal survey efforts for all sites spanning across all survey periods is statistically significant ($F_{9, 45} = 3.61$, p=0.0019) although values are not significant when CPs are assessed alone ($F_{9, 18} = 1.154$, p=0.38). Despite intense drought and drying of the upper soil profile over multiple monitoring events, living groundcover values have remained relatively robust which indicates that any decrease in cover for one particularly lifeform is compensated with increases in another. The only significant deviation in living groundcover values occurred at the IPs in October 2019 following wildfire, although by April 2020, living groundcover values had largely recovered to pre-disturbance levels.

Table 2. Summary of groundcover contribution by various lifeforms over the assessment periods from 2016 to 2020.

Plot Location / Survey Event	Forb % Cover	Sedge / Rush/ Grass % Cover	Shrub % Cover	Grasstree % Cover	Bare % Cover	Leaf % Cover	Exotics % Cover	Total % Cover
Plot 5a_Nov 2020	0	45.55	11.25	10.5	9.7	23	0	100
Plot 5a_April 2020	0.35	29.95	10.8	18.5	14.5	25.9	0	100
Plot 5a_April 2019	0.1	33.0	10.7	17	5	34.2	0	100
Plot 5a_October 2019	0.3	32.85	5.65	13.5	11.4	36.5	0	100
Plot 5a_April 2018	0.3	31.35	15.55	27	2.1	23.7	0	100
Plot 5a_September 2018	1.15	39.8	13.1	17.5	4.85	23.6	0	100
Plot 5a_April 2017	0.15	24.75	10.81	25.5	1.5	37.29	0	100
Plot 5a_October 2017	0.4	34	12.25	15	1.95	36.4	0	100
Plot 5a_April 2016	0.6	27.35	17.4	26	0.35	28.3	0	100
Plot 5a_September 2016	1.15	27.2	14.45	17.5	2.6	37.1	0	100
Plot 5b_Nov 2020	0.15	49.4	18.7	7.5	7	17.25	0	100
Plot 5b_April 2020	1.35	32.5	24	8	14.6	18.85	0	100
Plot 5b_April 2019	0.65	38.75	18.85	7.5	2.75	30.8	0	100
Plot 5b_October 2019	0.9	43.05	21.55	7.5	3.4	22.9	0	100
Plot 5b_April 2018	0.7	37.65	14.2	11	2	34.45	0	100
Plot 5b_September 2018	0.85	38	14.45	11.25	4.5	30.95	0	100
Plot 5b_April 2017	0.4	29.1	15.45	10.7	1.25	43.1	0	100
Plot 5b_October 2017	0.2	33.7	13.8	7	4.5	40.6	0.2	100
Plot 5b_April 2016	0.35	45.05	22	5.5	4	23	0.1	100
Plot 5b_September 2016	1.2	28.55	17.85	6.75	4.25	40.65	0.75	100
Plot 5c_Nov 2020	0.55	30.6	13.1	25	5.25	25.5	0	100
Plot 5c_April 2020	0.85	28.0	9.2	22	15.4	24.55	0	100
Plot 5c_April 2019	0.45	25.65	4.9	24	1.55	34.1	0	100
Plot 5c_October 2019	0.4	21.6	3.3	20.5	1.5	42.05	0	100
Plot 5c_April 2018	0.8	24.65	14.85	24	0	35.7	0	100
Plot 5c_September 2018	0.2	27	14.4	23.5	2.5	32.3	0.1	100
Plot 5c_April 2017	1.05	31.1	12.5	28	0	27.35	0	100

Plot Location / Survey Event	Forb % Cover	Sedge / Rush/ Grass % Cover	Shrub % Cover	Grasstree % Cover	Bare % Cover	Leaf % Cover	Exotics % Cover	Total % Cover
Plot 5c_October 2017	0.7	28	18.3	10.7	1.5	40.7	0.1	100
Plot 5c_April 2016	2	28.5	15.5	21.25	0.5	32.25	0	100
Plot 5c_September 2016	1.2	28.45	15.05	24	1.2	30.05	0.05	100
Plot 6a_November 2020	1.7	20.2	24.6	20.5	30.25	2.75	0	100
Plot 6a_April 2020	3.75	13.3	20.7	15	19.6	27.65	0	100
Plot 6a_April 2019	0.75	21.2	15.05	25.5	2.4	34.05	0	100
Plot 6a_October 2019	0.15	2.15	3	3	8.5	80.85	0	100
Plot 6a_April 2018	1.1	21.2	14.45	29.75	0	33.5	0	100
Plot 6a_September 2018	1	20.5	16	31	0	32	0	100
Plot 6a_April 2017	0.65	23	17.75	23.5	0	35.1	0	100
Plot 6a_October 2017	1.5	19.45	17.2	19.5	1	41.35	0	100
Plot 6a_April 2016	2.9	25.06	20.71	17.51	0	33.82	0	100
Plot 6a_September 2016	1.8	26.05	25.3	19.5	0.2	27.15	0	100
Plot 6b_April 2020	1.05	17.2	23.7	28.5	22.35	7.2	0	100
Plot 6b_April 2020	1.15	21.15	18.85	18.5	13.65	26.7	0	100
Plot 6b_April 2019	0.95	27.75	11.65	25.5	0.75	33.4	0	100
Plot 6b_October 2019	0.3	3.7	2.4	6.7	4.9	82	0	100
Plot 6b_April 2018	1.25	21.7	31.35	30	1.25	33.7	0	100
Plot 6b_September 2018	1.75	30.65	24.1	22	3.25	27.25	0	100
Plot 6b_April 2017	0.85	29.8	22.05	16.5	0	30.65	0.15	100
Plot 6b_October 2017	1.2	30	19.8	14.5	0.75	33.75	0	100
Plot 6b_April 2016	1.51	27.05	18.36	26	0	27.08	0	100
Plot 6b_September 2016	2.3	21.3	17.35	16	0.5	42.55	0	100
Plot 6c_April 2020	1.3	16.5	32.05	14	33.65	2.5	0	100
Plot 6c_April 2020	1.35	14.7	34.75	7	19.05	23.15	0	100
Plot 6c_April 2019	0.6	37	23	16.25	0.75	22.4	0	100
Plot 6c_October 2019	0.3	0.5	4.85	7.9	10	71.85	0	100
Plot 6c_April 2018	1.3	28.35	20.5	31.35	0.5	18	0	100

Plot Location / Survey Event	Forb % Cover	Sedge / Rush/ Grass % Cover	Shrub % Cover	Grasstree % Cover	Bare % Cover	Leaf % Cover	Exotics % Cover	Total % Cover
Plot 6c_September 2018	0.95	31.95	22	24.1	3.5	17.5	0	100
Plot 6c_April 2017	0.85	29.8	22.05	16.5	0	30.8	0	100
Plot 6c_October 2017	1.2	30	19.8	14.5	0.75	33.75	0	100
Plot 6c_April 2016	0.85	33.15	37.15	9.5	0.25	19.1	0	100
Plot 6c_September 2016	1.8	33.1	21.2	13	0.2	30.6	0.1	100

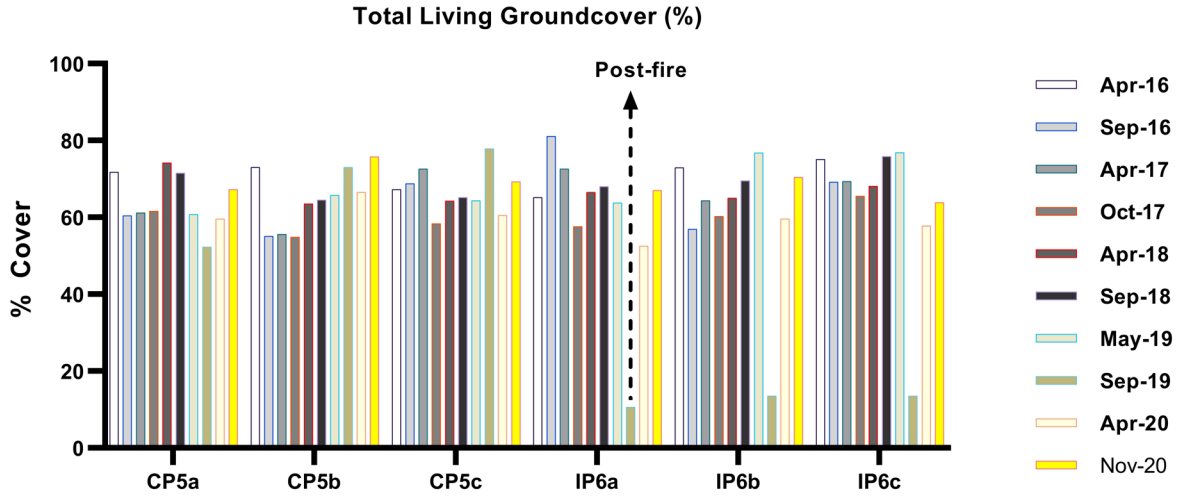

Figure 18. Total living groundcover (%) across all sites (2016 – 2020).

3.4.6 Species richness

Species richness has been calculated through combination of seasonal data for the 2016, 2017, 2018, 2019 and most recent 2020 assessment periods. For all sites and survey events, the highest species total was recorded in the September 2016 survey event (**Figure 19**). Species richness declined markedly in April 2017 and largely stabilised throughout 2018 with minor fluctuations in species richness occurring during subsequent assessment events.

There were declines in total species richness in the 2018 and 2019 assessment events, with reductions at the CPs dropping from a total of 38 species in the September 2018 monitoring event to 28 species in the October 2019 event (**Figure 19**). Similar declines in species richness were recorded within individual survey plots for both control (**Figure 20**) and impact sites (**Figure 21**).

As noted during the 2017 survey event, the decline in species richness recorded between September 2016 and April 2017 was typically in the range of 20 to 25% with a total of 43 species recorded in IP6c (the most floristically diverse survey plot) in the September 2016 survey period, dropping to 32 species recorded in the April 2017 event and plummeting to 11 recorded species in the October 2019 monitoring event following intense fire (**Figure 20**). Post fire recovery in species richness is occurring in IPs with 29 species recorded in April 2020 and 34 species recorded in November 2020, although this is still well short of the highest species counts (43). All life forms (except for grasstree) have been attributed with some loss of species richness.

All sites recorded moderate increases in species richness in the April 2020 assessment when compared to the 2019 period, and species counts either stabililised in the November 2020 assessment, or demonstrated slight increases at the IPs indicating an upward trajectory in species numbers. Two forb species (*Stylidium trichopodom* and *Microtis parviflora)* recorded in the April 2020 assessment event had not beed recorded in any prior survey events. *Microtis parviflora* was recorded in unburnt plots and stylidium in both burnt and unburnt. The groundcover sedge *Schoenus scabripes* was also recorded at plot 6b and 6c for the first time in the November 2020 assessment, and the threatened *Acacia baueri* (Vulnerable NC Act) was recorded at control plot 5a for the first time since surveys commenced.

The change in species diversity recorded between survey events is strongly statistically significant when all sites are assessed as indicated by a Repeat Measures ANOVA ($F_{19, 95}$ = 4.202; P=<0.0001) meaning that the changes are most likely attributed to changing site conditions, rather than natural variation alone. A list of species recorded during the survey periods attributed to individual survey plots is provided in **Appendix B**.

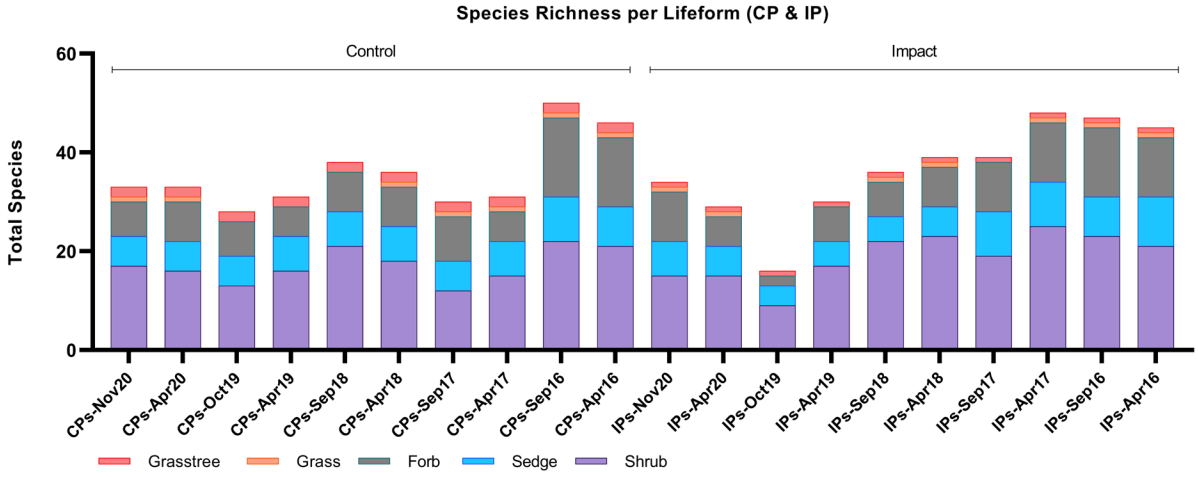

Figure 19. Number of species per lifeform across all survey sites (2016 – 2020).

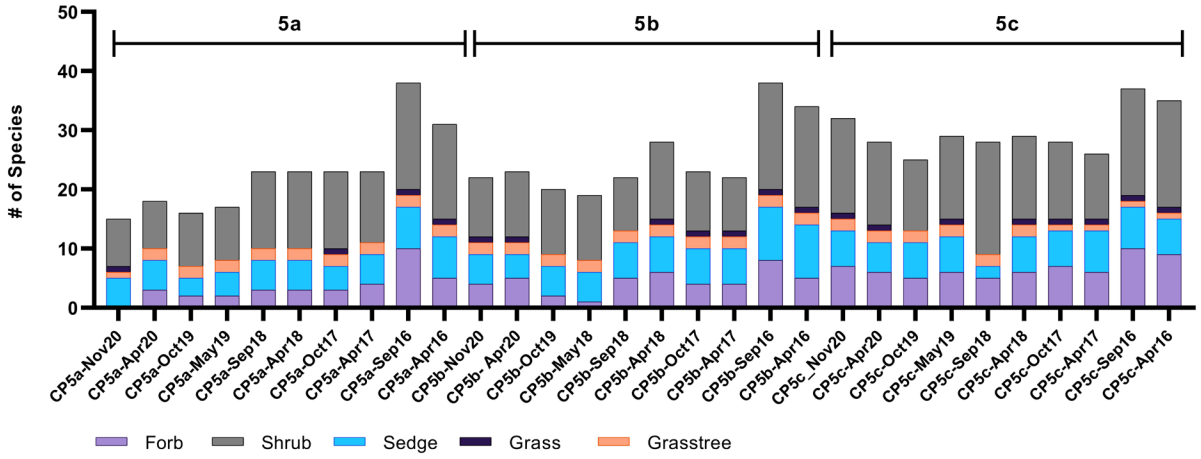

Figure 20. Species richness per life form in control plots across all survey events (2016 – 2020)

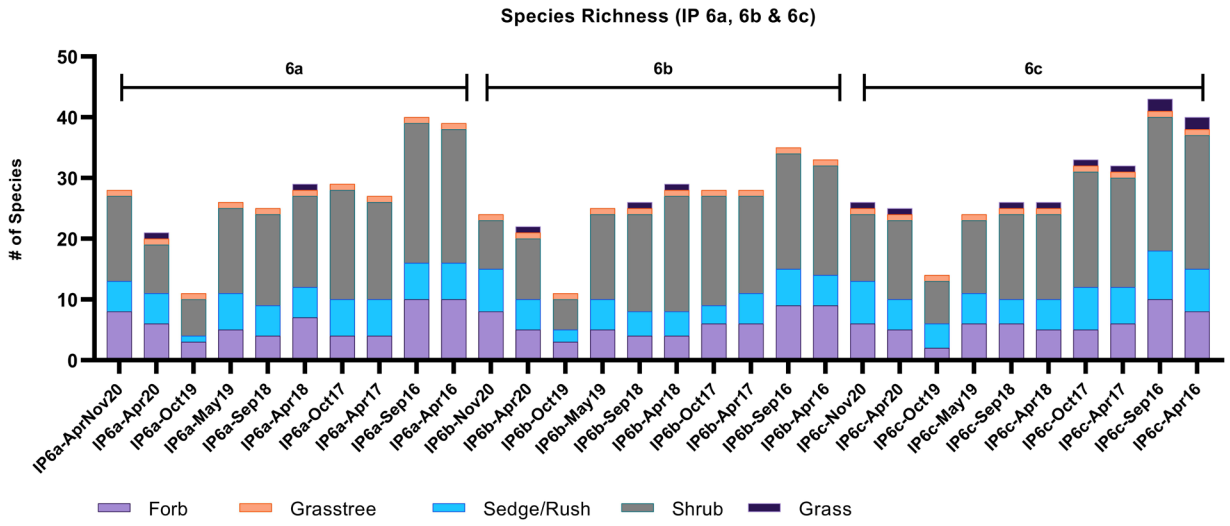

Figure 21. Species richness per life form in impact plots across all survey events (2016 – 2020)

4.0 Discussion and Summary

This is the sixth year of GDE vegetation monitoring at the Banksia Beach Borefield, and the tenth survey event to be undertaken by 3d Environmental on behalf of Seqwater. Spanning the six years of assessment, the major structural trends identified in the heathland monitoring sites include:

1. Highest floristic diversity was recorded in September 2016. This followed a very wet year in 2015 where 1538 mm was recorded at the AWS Bribie NP and 1839.4mm from the Beerburrum SF recording station (BOM 2020), which is well above the long term average annual rainfall of 1396 mm for the Beerburrum site.

2. A trend toward decreasing species richness was first detected in the April 2017 survey event, which coincided with below average rainfall recorded in 2016 and 2017 (1158 mm and 930 mm of rainfall respectively). Although varying between survey events, the generally low species richness was sustained through to October 2019 when it was at its lowest. This low point followed an extremely dry period in the preceding 6 months when only 354mm was recorded between April and September compared to a long term average of 465mm (from the Beerburrum SF recording station). Incremental increases in species richness have occurred at both the control and impact sites since October 2019 with strongest increases occurring at the impact site with post fire rebound in species numbers. The increase in species richness noted at all sites in the April 2020 and November 2020 survey events was only initiated following an extreme rainfall event in February 2020 which saturated the sand profile in the southern SMP below 15cm depth with saturation sustained until early May in 2020. it remains uncertain as to whether this trend of increased species richness will be sustained into future monitoring events. A Repeat Measures ANOVA identified the variations in species richness between monitoring events is statistically significant as is the strong reduction in species richness noted between 2017 and 2019.

3. Prior to 2020, a statistically significant decrease in the number and cover of shrubs in the 0.5m to <1m size class had been ongoing at both impact and control sites. Total shrub stem

densities in the 2019 monitoring period were the lowest of any survey event, although total destruction of shrub cover and stems occurred at IPs (6a – 6c) in association with the late August 2019 wildfire. The cover of shrubs (0.5 m to <1m) increased at all sites in April 2020 although gains were lost at the control site in the most recent survey. At fire affected sites (IPs 6a – 6c), strong increases in % cover and density of shrubs > 0.5m has been sustained through the 2020 survey events with a continuing upward trajectory recorded in November. A considerable proportion of the increased stem density is the result of rebound through fire induced germination of the obligate seeder species such as *Phyllota phyllocoides*.

4. Cover of shrubs in the >1 m size class at CPs (5a to 5c) in October 2019 had decreased to levels of around 3%, which is compared to the 30% cover recorded at CPs in April 2017. The reduction of shrub cover (%) for the >1 m size class was sustained in the April 2020 survey event with no indication of any significant recruitment or rebound in the November 2020 assessment. The loss of shrub cover was directly observable on the ground with dead stems evident, mostly *Persoonia virgata*. This may be because of possible shallow rooting depth of persoonia leaving it susceptible to droughting due to seasonal groundwater declines, or possibly senescence following maturity.

Rainfall and Soil Moisture: As noted in 2019, the below average rainfall resulted in drying of the soil profile at 95 cm depth at CPs (5a – 5c) where total soil moisture content fell from saturation (approx. 40% total moisture content) to <20% for a period of approximately one month between February and March. A reduction in soil moisture content in deeper regions of the soil profile is likely to have impacted deeper rooted shrub species including *Banksia aemula, Leptospermum polygalifolium* and *Melaleuca quinquenervia* which are all identified as known or potential facultative phreatophytes. Recharge of groundwater to saturation at 95 cm depth was recorded at CPs after a number of repeated intense rainfall events that occurred between February 6th and February 14th 2020 with over 500mm recorded for the month. Consistent saturation of the soil profile at the southern SMP occurred at shallow depths (15cm) between early February and April, and July to August 2020. This extended period of saturation may have initiated a recovery in shrub cover values and overall species richness. It is unknown if this saturation event will initiate recruitment and longer term recovery of shrubs in the taller > 1m size class.

Forbs, sedges and rushes and the more sensitive shrub species are likely to be exposed to fluctuations in the shallow soil moisture profile and would therefore be much more sensitive to seasonal and annual drying cycles. Furthermore, the comparative dryness of the upper soil profile at the CPs (5a to 5c) would render this location much more sensitive to fluctuations in rainfall than the impact site. The drier soil profile at the control site remains the most likely causal factor for the consistently lower measured floristic diversity when compared to the impact site. There is evidence from recently acquired Lidar data that the northern SMP (CP) lies at slighter higher elevation than the northern SMP (approximately 3.88m AHD compared to 3.57m at the southern SMP) on a broad NS trending dune ridge. It is therefore difficult to explain why saturation is retained for longer periods at the northern SMP compared to the south, and it may be due to differences in the depth or fracturing of the coffee rock aquitard, variations in topographic form, or man made factors such as constructed drainage which are much more pronounced at the southern site.

NDVI Data: The incremental increase in NDVI signatures measured between the 2017 and 2018 monitoring events with subsequent strong reduction in NDVI values in the October 2019 monitoring event is likely related to drying soil moisture conditions and below average rainfall in 2019. Average NDVI values increased in April 2020 to the highest levels recorded for any survey event, and these values were sustained in the November 2020 capture. It is possible that the increased 'green-ness' was facilitated by seasonally wet conditions prior to the 2020 survey which stimulated vegetative productivity across all sites. The rapid rebound in productivity in the IPs (6a – 6c) in the April 2020 assessment, which was either sustained or increased in the most recent survey event reflects a strong rebound in new growth following an intense fire event in August 2019. There are also likely to be the interacting effects of increased grasstree or sedge cover associated with some survey events, or apparent increased cover of the groundcover layers occurring as a result of senescence of the shrub layer. An apparent increase in cover of the groundcover layers may result in increased measures of green-ness which are artefact of reduced shrub cover rather than an actual increase in site based productivity.

Summary: Ecological data collected over several survey periods spanning 2015 to 2020 indicates that the control (CPs 5a - c) and impact sites (IPs 6a - c) are broadly similar in floristic attributes, with minor variation in structural features and species richness trends. The major structural difference between the CPs (5a- 5c) and IPs (6a - c) sites is a significantly higher cover and stem density for shrubs of all size classes at IPs, coupled with a generally higher species richness. It is apparent from the soil moisture data, that moisture content of the shallower portions of the soil profile are more consistently saturated at IPs (6a - c) although the reasons for the more sustained saturation remain obscure. The increased water availability at the IPs is facilitating greater species richness and maintenance of a robust cover of shrubs and groundcovers. The shrubs and groundlayer plants were slow to regenerate after the August 2019 wildfire, probably due to the dry conditions. By April 2020, rebound in both species richness and shrub cover were measurable with this trend increasing through November 2020. Increases in shrub density and cover were facilitated by both coppice shoots and post fire recruitment of obligate seeder species. Increases in species richness are mostly accounted for with changes in richness of the shrub and forb lifeforms. This indicates a resilience of the heath vegetation to fire, although the post-fire community has not yet recovered to the higher species diversity of previous wet years . Burning during hot periods at times of low soil moisture availability may not be conducive to rapid regeneration of species richness nor structural complexity in wet heath communities.

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6.0 Appendix

Appendix A - Monitoring Transects

Survey Locality 5a

Date of Assessment: 8.04.2020 / 04.11.2020.
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.9942/ 153.158764; *Centre* --26.9942/ 153.1590571; *Finish* - 26.9942/ 153.15932
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)
April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
17.3 – 18.2	*Agiortia pedicellata*	1.5	2		
23.2 – 24.4	*Agiortia pedicellata*	1.2	1.5		
36.2 – 36.8	*Leptospermum semibaccatum*			0.6	0.6
37.8 – 38.4	*Leptospermum semibaccatum*			0.6	0.5
Total Cover		2.7		1.2	
Average Height			1.75		0.55

* Projected over 100 m; ** Shrubs > 1m

November 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
17.6 – 19.4	*Agiortia pedicellata*	1.8	2.5		
23.4 – 24.2	*Agiortia pedicellata*	0.8	1.6		
Total Cover		2.6			
Average Height			2.1		0.55

* Projected over 100 m; ** Shrubs > 1m

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) November 2020
	S2	
Persoonia virgata	4	3
Leptospermum semibaccatum	5	
Agiortia pedicellata	10	9
Baeckea frutescens	1	
Leucopogon leptospermoides	8	3
*Pinus elliottii***	1	1
Melaleuca quinquenervia	0	1
Melaleuca quinquenervia	1	0
Totals	30	17

**projected count over 50 x 10m

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	30	10	10	10	15	5	25	10	5	40	29.95
	Sporodanthus interuptus	5						5			5	
	Lomandra elongata	0	0	2.5	2.5	0	0	0	1	1	1	
	Lomandra sp.											
	Baloskion tenuiculme	15	15	10	30	5	15	10	20	30	5	
Native forbs and other spp.	*Pimelea liniifolia*	.0	2.5	0	0	0	1	0	0	0	0	0.35
Native shrubs ,<1m	*Leucopogon leptospermoides*	2.5	0	2	0	1	5	25	5	2.5	0	10.8
	Baeckea frutescens			2.5	5	0	10	2.5	5	10	2.5	
	Strangea linearis	0	5	0	2.5	0	2.5	2.5	0	0	2.5	
	Leptospermum semibaccatum	0	0	0	0	10	0	30	30	0	0	
Grass Tree	*Xanthorrhoea fulva*	15	0	40	0	50	15	10	0	30	25	18.5
Cryptogams												
Bare Ground		35	57.5	33	25	14	30	12.5	27	11	14	14.5
Exotic Shrubs												
Leaf litter		15	10	5	25	5	29	12.5	27	11.5	5	25.9
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean October 2020
Native perennial grass / sedges	*Caustis recurvata*	25	10	20	30	0	10	25	20	10	40	45.55
	Sporodanthus interuptus						25	5				
	Lomandra elongata	0	1	5	2.5	0	0	0	0	0	0	
	Eriachne pallescens var. gracilis	1		1								

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean October 2020
	Baloskion tenuiculme	20	30	30	25	15	20	20	30	15	20	
Native forbs and other spp.	*Pimelea liniifolia*											0
Native shrubs ,<1m	*Leucopogon leptospermoides*			1			2.5		2.5	2.5		11.75
	Homoranthus virgatus							10	5	5		
	Baeckea frutescens				5					2.5		
	Strangea linearis		10	1	5			2		2.5	1	
	Ochrosperma lineare		2.5									
	Leptospermum semibaccatum					20	5	5	27.5			
	Acacia bauerii			1								
Grass Tree	*Xanthorrhoea fulva*	35	0	20	0	25	0	5	0	10	10	10.5
Cryptogams												
Bare Ground		10	10	11	15	5	5	10	15	10	5	9.7
Exotic Shrubs												
Leaf litter		9	36.5	10	17.5	35	32.5	18	5	42.5	24	23
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

Additional Species (50 x 50m plot) recorded in April and September surveys:

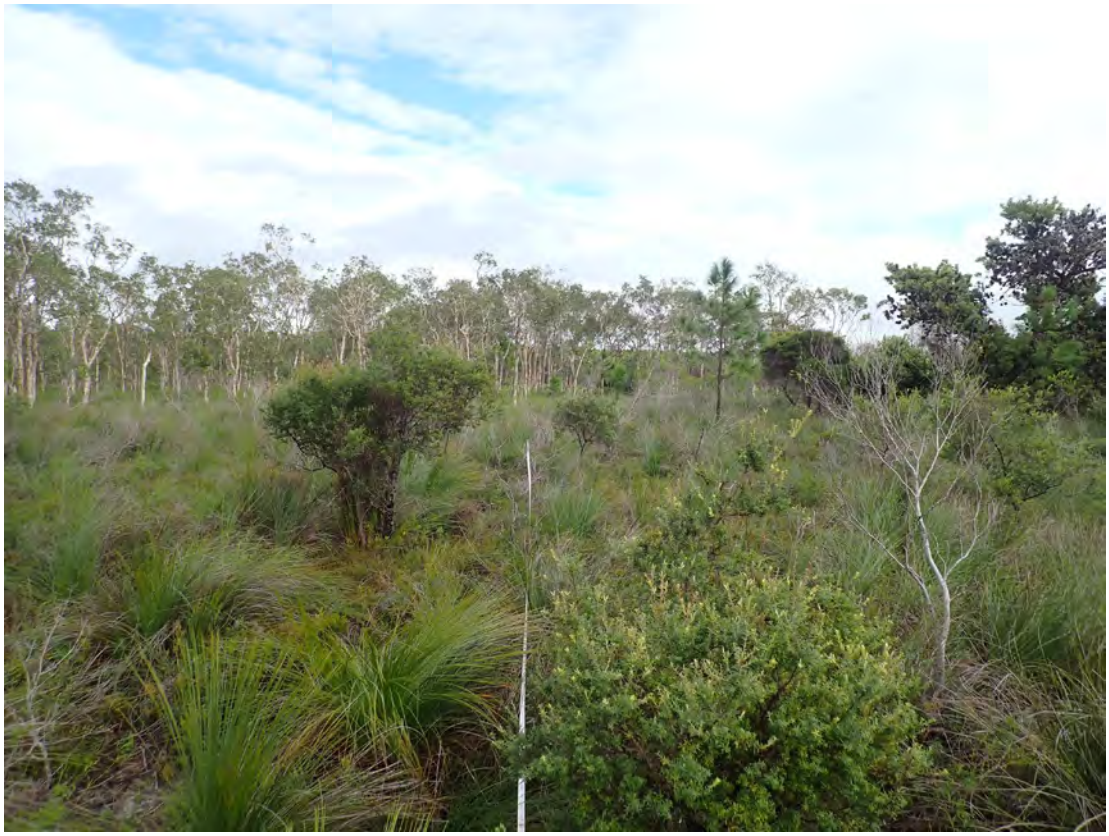
Hypolaena fastigiata, Patersonia sericea, Boronia falcifolia, Cassytha glabella,

Structural / Floristic Summary

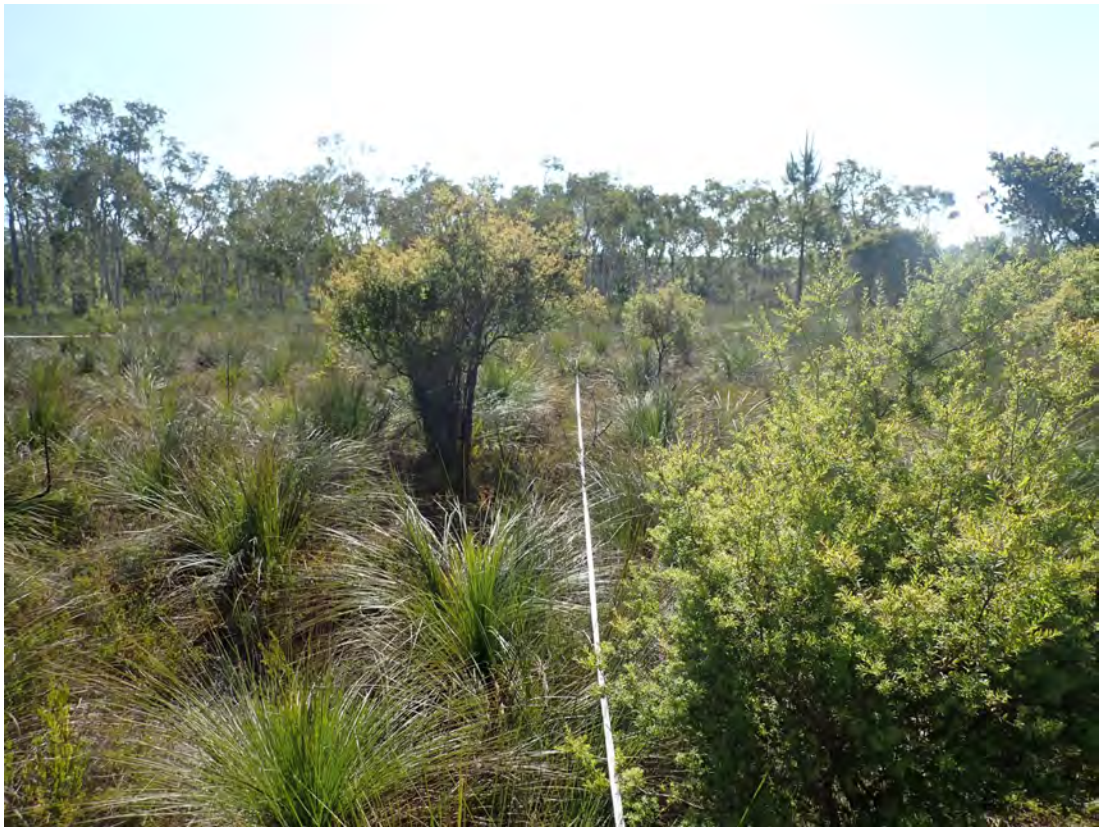
BioCondition Attribute		April 2020	Oct 2020
Native Plant Species Richness	Tree:		
	Shrub:	11	
	Grass Tree	2	
	Grass / Sedge / Rush	5	
	Forbs and other:	3	
Total Species No.**		21	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	2.7	2.6
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	1.2	0
	Average Height >1m	1.75	2.0
Native Ground cover (%):	Native perennial grass / sedge cover (%):	29.55	45.55
	Native shrubs (%)	10.8	11.75
	Grass tree	18.5	10.5

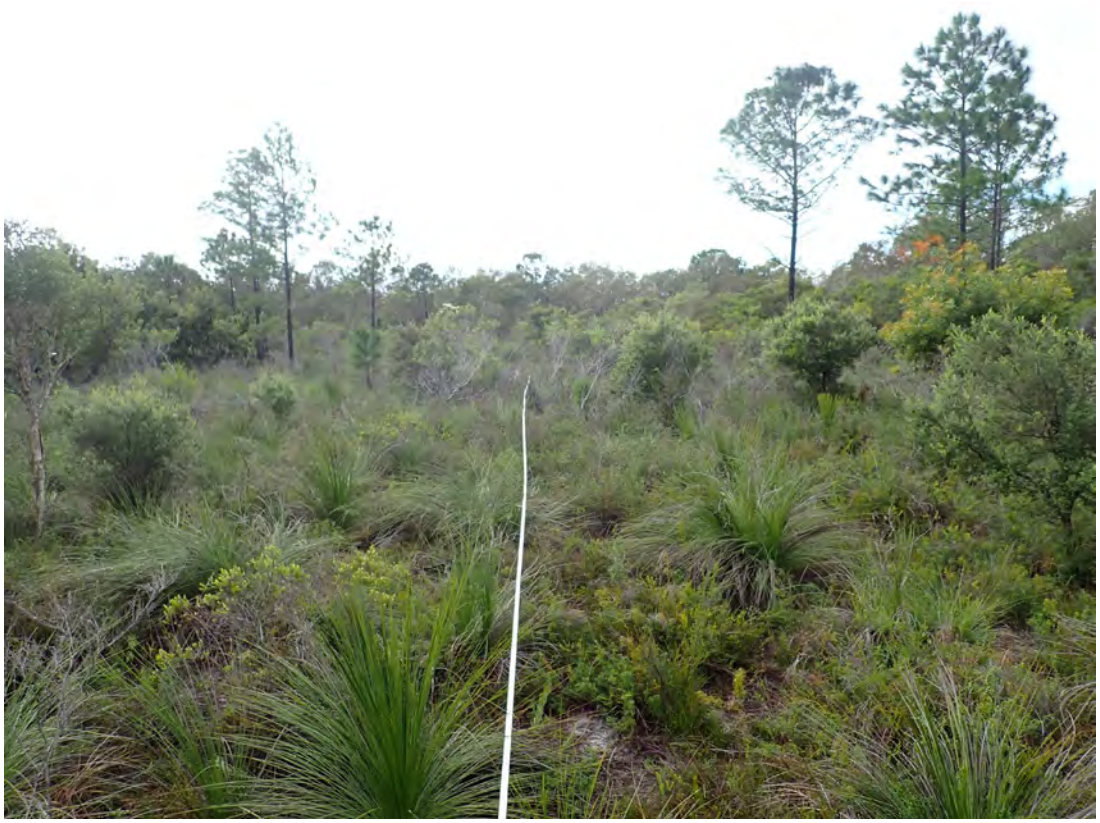
BioCondition Attribute		April 2020	Oct 2020
	Organic litter cover (%):	29.5	23
	Native forb cover	0.35	0
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses	0	0
	Non-native shrubs	0	0

**Excludes Exotic Species



Plot 5a – Centre to Start; April 2020 (Above) and Novemberl 2020 (Below).





Plot 5a – Centre to End; April 2020 (above) and November 2020 (below).

Plot 5a – Centre to North; April 20202 (Above) and November 2020 (Below).

Plot 5a – Centre to South: April 2020 (Above) and November 2020 (Below).

Plot 5a – Centre to Right: April 2019 (Above) and April 2020 (Below).

Survey Locality 5b

Date of Assessment: 8.04.2020 / 4.11.2020
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.9943/ 153.1587965; *Centre -26.9944*/ 153.1589816; *Finish* -26.9944/ 153.1593191
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
17.6 – 18.6	*Xanthorrhoea johnsonni*	1.0	1.0		
23.7 – 24.2	*Leucopogon leptospermoides*			0.5	0.6
43.2 – 44.0	*Persoonia virgata*	1.8	2.0		
Total Cover		2.8		0.5	
Average Height			1.56		0

** Shrubs > 1m

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
17.6 – 18.6	*Xanthorrhoea johnsonni*	1.0	1.0		
22.9 – 23.4	*Leucopogon leptospermoides*	0.5	0.6		
43.2 – 44.9	*Persoonia virgata*	1.7	2.5		
Total Cover		3.2		0	
Average Height			1.8		0

** Shrubs > 1m

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) April 2020
	S2	S2
Persoonia virgata	1	1
Leucopogon leptospermoides	2	2
Ochrosperma lineare		
Boronia falcifolia		
Leptospermum semibaccatum	6	5
Sprengelia sprengelioides		
Strangea linearis	2	2
Acacia flavescens	1	1
Epacris pulchella		
Agiortia pedicellata	3	3
Baeckea frutescens	2	
Xanthorrhoea johnsoni (from top of trunk	2	1
Leptospermum polygalifolium	1	1
*Pinus elliottii**	1	1
Totals	20	16

**projected count over 50 x 10m *Exotic species not counted in stem counts

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	40	5	10	25	15	5	5	10	15	10	32.5
	Baloskion tenuiculme	15	60	2.5	15	10	15	5	5	10	20	
	Lomandra elongata	0	5	1	0	0	2.5	2.5	0	0	0	
	Eriachne pallescens var. gracilis	1	0	0	1	0	0	0	0	0	0	
	Hypolaena fastigiata	0	0	1	2.5	1	2.5	2.5	1	0	0	
Native forbs and other spp.	*Pimelea liniifolia*	1	2.5	0		1	0	0	1	2.5		1.35
	Drosera binata	10	0	0	1	0	0	0	1	1	2.5	
Native shrubs ,<1m	*Leucopogon leptospermoides*	5	0	0	0	0	0	5	0	0		24
	Strangea linearis	2.5	0	0	0	2.5		5	0	0		
	Leptospermum semibaccatum	0	0	60	20	10	30	50	15	5	5	
	Baeckea frutescens	0	2.5	0	0	0	0	0	0	2.5	5	
	Ochrosperma lineare	0	0	0	0	0	10	0	0	0	0	
	Dillwynia floribunda	0	2.5	0	0	0	0	0	0	2.5	0	
Grass Tree	*Xanthorrhoea fulva*	25	0	10	0	25	0	0	5	15	0	8
Cryptogams		0	0	1	2.5	0	0	0	1	0	0	0.45
Bare Ground		5	20	7	28	17.5	32.5	12.5	28.5	2.5	0	14.6
Exotic Shrubs	*Pinus elliottii***	0	0	0	0	0	0	0	2.5	0	0	0.25
Leaf litter		10.5	5	7.5	5	19	5	15	30	49	42.5	18.85
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

Additional Species: *Cassytha glabella, Microtus parviflora, Patersonia sericea, Xyris complanata*

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	15	10	20	15	30	5	10	20	10	10	49.4
	Baloskion tenuiculme	56.5	55	15	40		20	30	15	30	45	
	Lomandra elongata		5				5					
	Eriachne pallescens var. gracilis											
	Hypolaena				2.5		5	10			15	

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	fastigiata											
Native forbs and other spp.	*Pimelea liniifolia*		0.5									0.15
	Cassytha glabella							1				
Native shrubs ,<1m	*Leucopogon leptospermoides*	2.5				10						18.4
	Strangea linearis				5	5		10			2.5	
	Leptospermum semibaccatum			20		5	30	25	10		10	
	Homoranthus virgatus		5			5			5		10	
	Epacris pulchella				2.5							
	Baeckea frutescens											
	Ochrosperma lineare				5	5		5			2.5	
	Dillwynia floribunda	1	1			1			1			
Grass Tree	*Xanthorrhoea fulva*	20	10	15		10			10	10		7.5
Cryptogams												0
Bare Ground		0	10	5	15	10	20	5		5		7
Exotic Shrubs	*Pinus elliottii***	1		1							1	0.3
Leaf litter		4	3.5	24	15	19	15	4	39	45	4	17.25
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

Additional Species: *Epacris pulchella, Cryptostylis erecta, Stackhousia nuda, Pimelia liniifolia, Xyris complanata. Blechnum indicum*

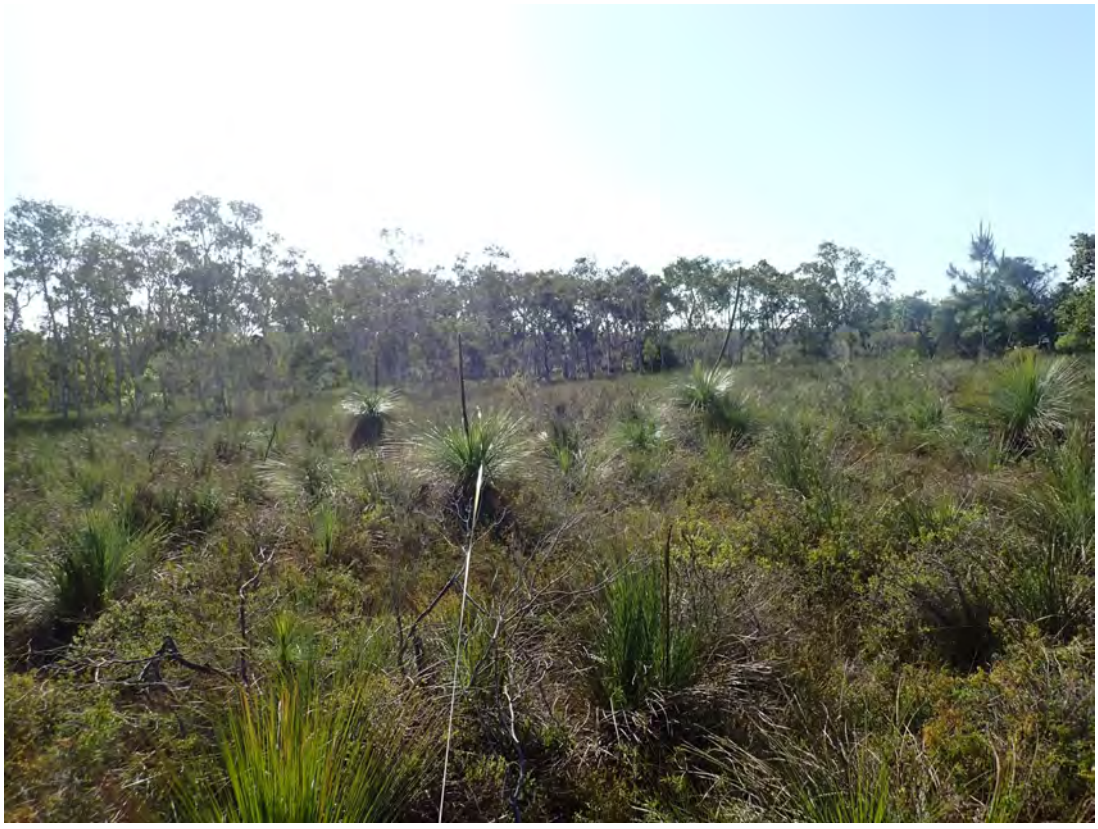
Structural / Floristic Summary

BioCondition Attribute		April 2020	October 2020
Native Plant Species Richness	Tree:		
	Shrub:	10	
	Grass Tree	2	
	Grass / Sedge	5	
	Forbs and other:	4	
Total Species No.**		21	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	3.12	3,6
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	0.5	0
Native Ground cover (%):	Native perennial grass / sedge cover (%):	32.5	49.4
	Native shrubs (%)	24	18.4
	Grass tree	8.0	7.5
	Organic litter cover (%):	18.85	17.25

BioCondition Attribute		April 2020	October 2020
	Native forb cover (%)	1.35	0.15
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses	0	0
	Non-native shrubs	0.2	0.3

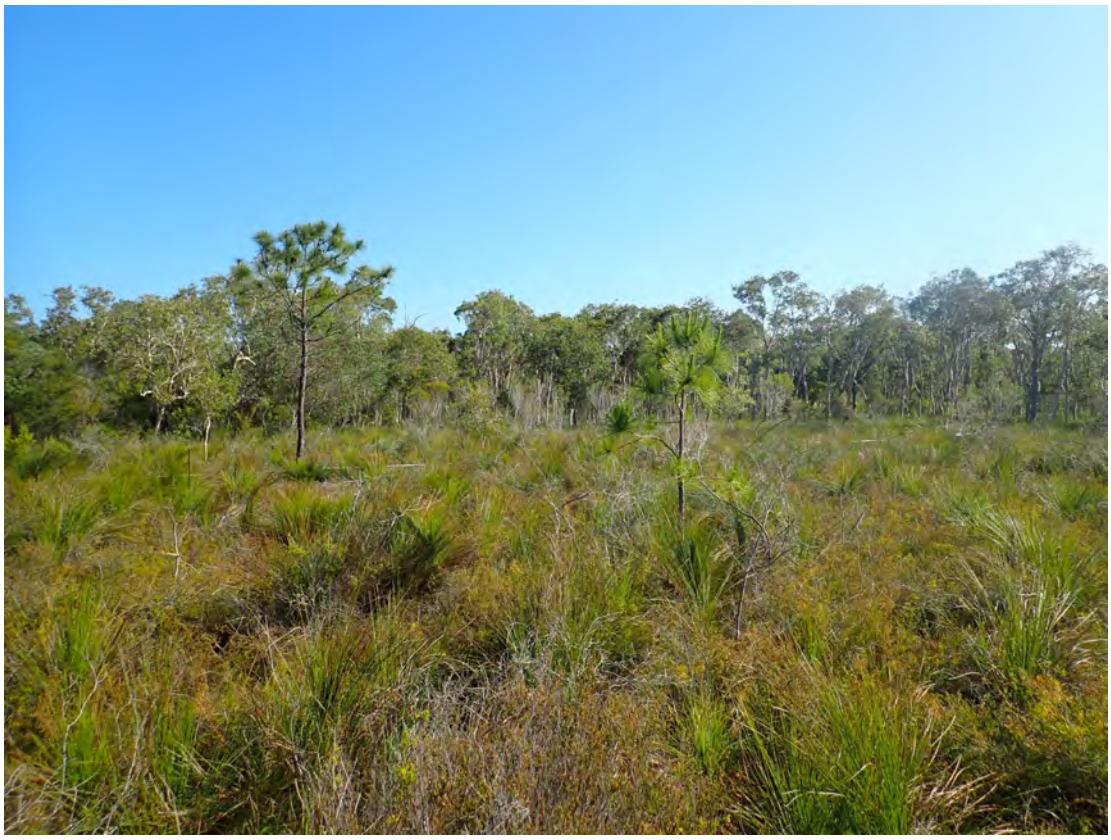
** Excludes Exotic Species

Plot 5b Centre to Start: April 2020 (above) and November 2020 (below).



Plot 5b – Centre to End: April 2020 (Above) and November 2020 (Below).

Plot 5b – Centre to South; April 2020 (Above) and November 2020 (Below).



Plot 5b – Centre to North: April 2020 (Above) and November 2020 (Below).

Survey Locality 5c

Date of Assessment: 8.04.2020 / 04.11.2020
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.99467/ 153.15883; *Finish* -26.99447/ 153.15929
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
12.8 – 13.5	*Persoonia virgata*	0.7	2.0		
15.1 – 15.8	*Persoonia virgata*	0.7	1.6		
37.3 – 37.8	*Agiortia pedicellata*	0.6	3.0		
39.5 – 40.0	*Baeckea frutescens*			0.5	0.6
47.7 – 48.2	*Persoonia virgata*	0.5	1.6		
49.5 – 50.0	*Agiortia pedicellata*	0.5	3.0		
Total Cover		3.0		0.5	
Average Height			2.24		0.6

*** Tree not included in cover calculation

November 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
15.3 – 16.1	*Persoonia virgata*	0.8	1.2		
49.1 – 50.0	*Agiortia pedicellata*	0.9	3.0		
Total Cover		3.4			
Average Height			2.1		

*** Tree not included in cover calculation

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2018	
Persoonia virgata	6	4
Leucopogon leptospermoides	1	2
Leptospermum semibaccatum	3	1
Epacris pulchella	1	0
Agiortia pedicellata	1	0
Leptospermum polygalifolium	1	3
Homoranthus virgatus	0	3
Baeckea frutescens	2	4

Melaleuca pachyphyllus	1	3
Totals	16	20

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	0	0	10	20	15	10	30	2.5	20	10	28
	Hypolaena fastigiata	0	0	0	0	0	0	2.5	0	2.5	2.5	
	Gahnia seiberiana	0	20	0	0	0	0	0	0	0	0	
	Sporodanthus interruptus	5	5	0	20	0	0	0	0	0	0	
	Baloskion tenuiculme	0	0	5		15	30	0	20	0	10	
	Lomandra elongata	0	0	15	5	0	0	0	2.5	0	0	
	Eriachne pallescens var. gracilis	0	0	2.5	5	0	0	0	0	0	0	
Native forbs and other spp.	*Pimelea liniifolia*	1	0	0	0	0	0	0	0	0	0	0.85
	Cryptostylis erecta	1	0.5	0	0	0	0	0		0	0	
	Cassytha glabella	0	0	0	0	0	0	0	1	0	1	
	Drosera binata	1	0	0	0	0	0	1	1	0	1	
Native shrubs ,<1m	*Leucopogon leptospermoides*	0	0	0	0	0	5	0	0	0	10	9.2
	Strangea linearis	0	0	0	2.5	10	0	0	0	0		
	Epacris pulchella											
	Leptospermum semibaccatum	0	0	0	0	5	5	5	20	10	10	
	Baeckea frutescens	5	10	0	0	0	0	0	1	1	5	
	Ochrosperma lineare											
	Persoonia virgata											
Grass Tree	*Xanthorhoea fulva*	40	40	20	40	10	10	15	15	20	10	22
Cryptogams												

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Bare Ground		0	0	24	5	0	5	25	18	41.5	35.5	15.4
Exotic Shrubs	*Pinus elliottii***											
Leaf litter		52	24.5	23.5	5	45	40	21.5	19	5	10	24.55
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*			10	10	15	15	20	20	10	10	30.6
	Hypolaena fastigiata	2.5						5		1	5	
	Gahnia seiberiana		20									
	Sporodanthus interruptus			5	15			10				
	Baloskion tenuiculme			15	10	20	40		15		30	
	Lomandra elongata			2.5								
	Eriachne pallescens var. gracilis											
Native forbs and other spp.	*Pimelea liniifolia*	1				2.5			1			0.55
	Unid-red leaf			1								
	Cassytha glabella											
	Drosera binata											
Native shrubs ,<1m	*Leucopogon leptospermoides*					5					10	13.1
	Strangea linearis				2.5	10			15	5		
	Epacris pulchella											
	Leptospermum semibaccatum						5	15		15	20	
	Dillwynnia floribunda			1								
	Baeckea frutescens	2.5										

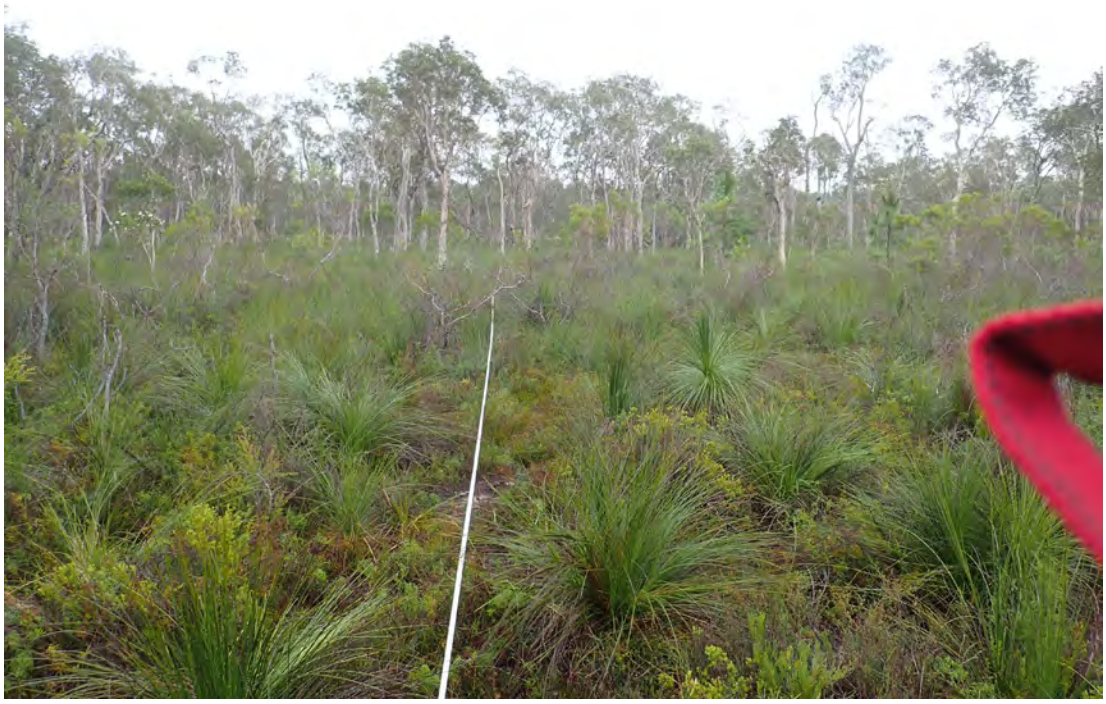
Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	Homoranthus virgata	10	10				5					
	Persoonia virgata											
Grass Tree	*Xanthorhoea fulva*	30	40	20	50	10	20	40	10	30		25
Cryptogams												
Bare Ground		0	0	10	5	2.5	5		20	5	5	5.25
Exotic Shrubs	*Pinus elliottii***											
Leaf litter		54	30	35.5	7.5	35	10	10	19	34	20	25.5
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

Additional Species:, *Pattersonia sericea, Austromyrtus dulcis, Blechnum cartilagineum, Banksia aemula, Melaleuca quinquenervia, Xanthorrhoea johnsonni, Cassytha glabella*

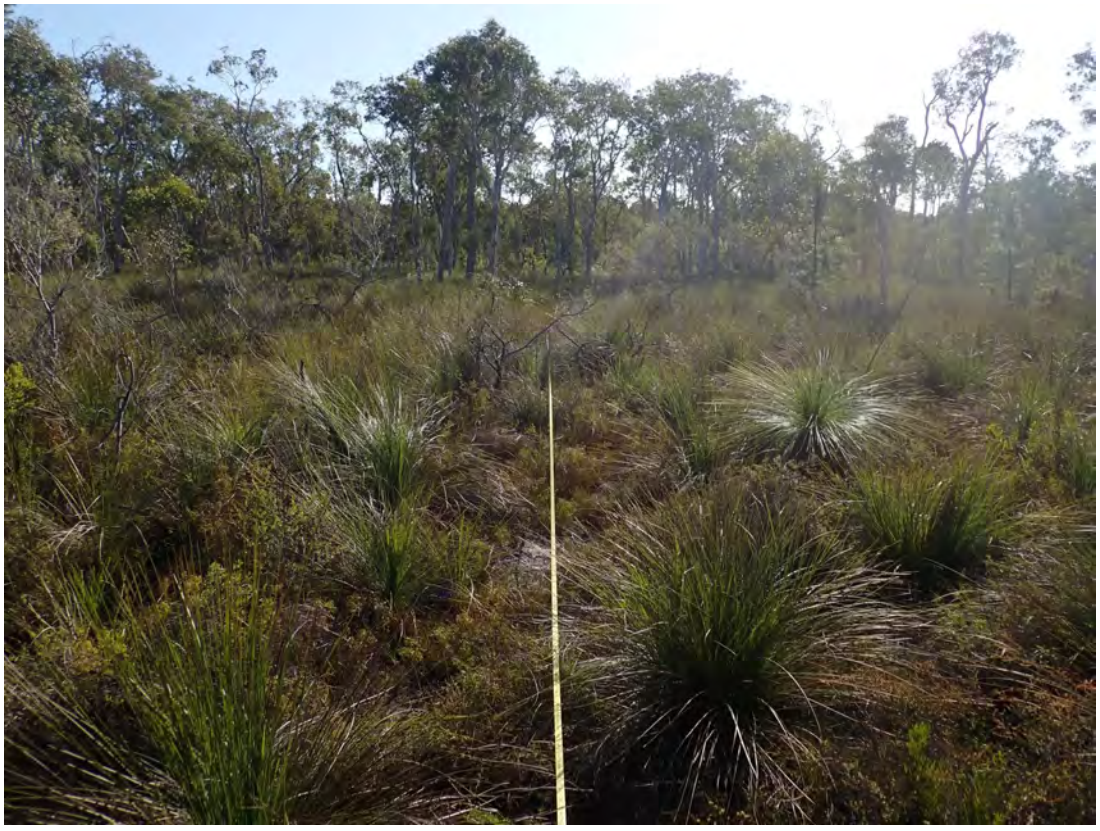
Structural / Floristic Summary

BioCondition Attribute		April 2020	November 2020
Native Plant Species Richness	Tree:	. .	
	Shrub:	16	
	Grass Tree	2	
	Grass / Sedge	7	
	Forbs and other:	7	
Total Species No.**		32	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	3.0	3.4
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	0.5	0
Native Ground cover (%):	Native perennial grass / sedge cover (%):	28	30.6
	Native shrubs (%)	9.2	13.1
	Grass tree	22	25
	Organic litter cover (%):	24.55	25.5
	Native forb cover (%)	0.85	0.55
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses%	0	0
	Non-native shrubs %	0	0

** Excludes Exotic Species



Plot 5c – Centre to Start: April 2019 (Above) and April 2020 (Below).



Plot 5c – Centre to End: April 2020 (Above) and November 2020 (Below).

Plot 5c – Centre to Right: April 2020 (Above) and November 2020 (Below).

Plot 5c – Centre to Left: April 2019 (Above) and April 2020 (Below).

Survey Locality 6a

Date of Assessment: 08.04.2020 / 05.11.2020
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.985 / 153.1540431; Centre -26.9849 / 153.1542562 *Finish* - 26.9847/ 153.1544874
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
3.2 – 5.0	*Banksia aemula*	1.8	2.5		
15.3 – 16.3	*Baeckea frutescens*			1.0	0.9
46.0 – 47.0	*Banksia oblongifolia*	0.7	1.1	0.8	0.7
Total Cover		2.5		1.8	
Average Height			1.8		0.8

*** Tree not included in cover calculation

November 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
2.7 – 5.0	*Banksia aemula*	2.3	2.5		
10 - 11	*Baeckea frutescens*	1	1		
11.6 – 12.7	*Baeckea frutescens*	1.1	1		
15 - 16	*Baeckea frutescens*			1	90
46.0 – 47.0	*Banksia oblongifolia*	0.7	1.1		
Total Cover		5.1		2	
Average Height			1.8		0.9

*** Tree not included in cover calculation

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) November 2020
	S2	
Persoonia virgata		
Banksia aemula		1
Banksia oblongifolia	7	12
Epacris pulchella		
Leptospermum liversidgei	2	
Leptospermum semibaccatum		

Boronia falcifolia		
Sprengelia sprengeliodes		
Leucopogon leptospermoides		
Baeckea frutescens	4	11
Dilwynnia floribunda		
Epacris obtusifolia		
Olax retusa		
Phyllota phyllocoides		16
Aotus lanigera		
Pultenaea palacea		
Leptospermum polygalifolium		1
Totals	13	41

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	2.5		2.5	0.5							13.3
	Sporodanthus interruptus	2.5	5	20	10	10	10	5	10	15	5	
	Hypolaena fastigiata	0	2.5	0	0	0	0	0	0	0	0	
	Eriachne pallescens var. gracilis	0	0	0	0	2.5	0	0	0	0	0	
	Lomandra elongata	10	0	15	0	2.5	0	0	0	2.5	0	
Native forbs and other spp.	*Pimelea liniifolia*	2	2.5	0	0.5	2.5	1	2	1	2.5	1	3.75
	Olax retusa	0	0	0	0	0	0	0	0	0	1	
	Drosera binata	5	2.5	1	1	2,5	1	0	0	0	0	
	Selaginella uliginosa	0	0	0	0	0	0	0	1	0	0	
	Hibbertia salicifolia	0	0	0	0	2.5	2.5	2.5	0	0	0	
Native shrubs ,<1m	*Boronia falcifolia*	0	0	1	0	0	0	0	0	0	0	20.7
	Baeckea imbricata											
	Leucopogon											

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	leptospermoides											
	Banksia oblongifolia	0	0	0	0	0	0	10	30	0	0	
	Leptospermum semibaccatum	30	20	25	15		0	0	0	1	0	
	Strangea linearis	0	0	0	5	5	5		15			
	Baeckea frutescens	0	0	0	0	0	5	5	10	10	10	
	Phyllota phylicoides	0	0	0	0	0	0	5	0	0	0	
Grass Tree	*Xanthorrhoea fulva*	2.5	0	2.5	10	30	10	30	10	15	40	15
Cryptogam												
Bare Ground		35.5	20	18	30	35	32.5	5	10	5	5	19.6
Exotic Shrubs												
Leaf litter		10	47.5	15	28	7.5	33	35.5	13	49	38	27.65
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	1		5	2.5	10	10					20.2
	Sporodanthus interruptus	5		2.5		5	2	12.5	10	15	10	
	Hypolaena fastigiata	5	5	1								
	Eriachne pallescens var. gracilis											
	Lomandra longifolia	10	1		5	2						
	Baloskion tenuiculme		40	25	15			2				
	Lomandra elongata				0.5							
Native forbs and other spp.	*Pimelea liniifolia*		2.5			0.5					2	1.7
	Selaginella uliginosa								2			
	Red leaf – Unid herb			1		0.5	0.5	2.5	1	1	2.5	
	Drosera binata											
	Xyris complanata						0.5					

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	Hibbertia salicifolia						0.5					
Native shrubs ,<1m	*Boronia falcifolia*	0.5				0.5				2		24.6
	Baeckea frutescens	1		20	50			2.5	10	5	15	
	Leucopogon leptospermoides		5	10								
	Banksia oblongifolia							5	25			
	Leptospermum semibaccatum	30	10									
	Strangea linearis		5			2.5	2.5		10			
	Leptospermum liversedgei				5	5						
	Conospermum taxiifolium					2						
	Phyllota phylicoides							10	5	5	2.5	
Grass Tree	*Xanthorrhoea fulva*	10		5	10	50	20	60	30		20	20.5
Cryptogam												
Bare Ground	Bare	35	16.5	20.5	12	22	64	5.5	7	72	48	30.25
Exotic Shrubs												
Leaf litter	Leaf	2.5	15	10								2.75
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

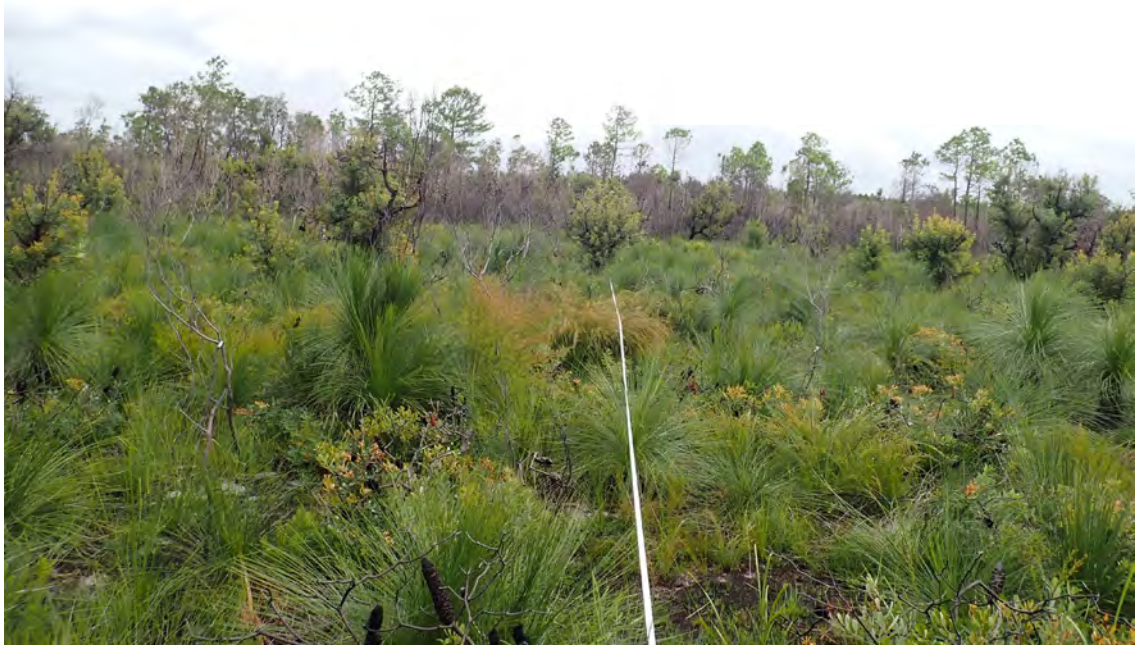
Additional Species: *Baeckea imbricata, Stylidium sp.*

Structural / Floristic Summary

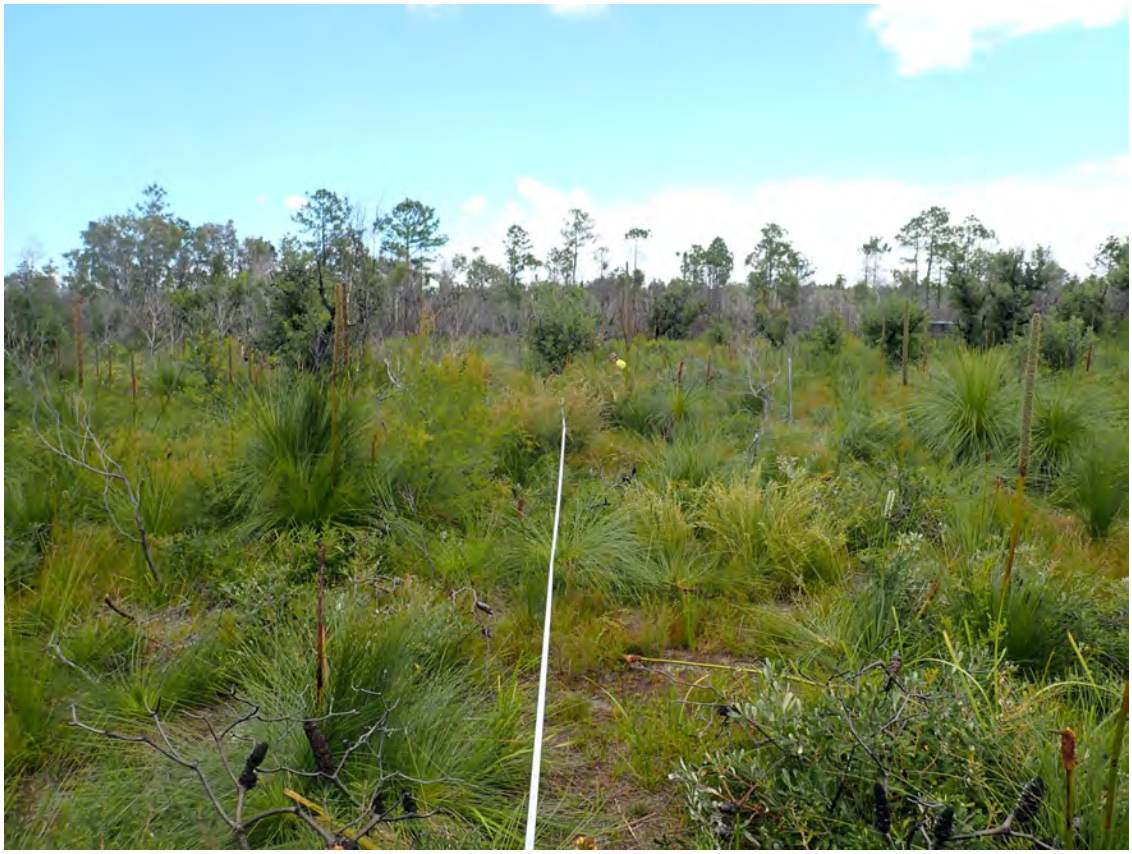
BioCondition Attribute		April 2020	
Native Plant Species Richness	Tree:		
	Shrub:	14	
	Grass Tree	1	
	Grass / Sedge	5	
	Forbs and other:	8	
Total Species**		28	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	2.5	13.2
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	1.8	2
Native Ground cover (%):	Native perennial grass / sedge cover (%):	13.2	20.2
	Native shrubs (%)	3.0	24.6
	Grass tree	15	20.5

BioCondition Attribute		April 2020	
	Organic litter cover (%):	27.9	2.75
	Native forb cover (%)	3.6	1.7
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses%	0	0
	Non-native shrubs %	0	0

**Excludes Exotic Species



Plot 6a – Centre to Start; April 2020 amd November 2020 (Below).



Plot 6a – Centre to End: April 2020 (Above) and November 2020 (Below).

Plot 6a – Centre North: April 2020 (Above) and November 2020 (Below)

Plot 6a – Centre to South: April 2020 (Above) and November 2020 (Below).

Survey Locality 6b

Date of Assessment: 08.04.2020/ 05.11.2020.
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.9852/ 153.1541529; Centre -26.985 / 153.1543768 *Finish* - 26.9849 / 153.1545859
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
16.7 – 18.1	*Banksia oblongifolia*			1.4	0.5
Total Cover				1.4	
Average Height					0.5

*** Tree not included in cover calculation

November 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
16.3 – 18.0	*Banksia oblongifolia*			1.7	0.9
18.8 – 19.3	*Leptospermum liversedgei*			0.5	0.6
21.1 – 22.2	*Baeckea frutescens*			1.1	0.8
34.8 – 35.2	*Phyllota phyllocoides*			0.4	0.6
36.7 – 37.1	*Phyllota phyllocoides*			0.4	0.9
Total Cover				4.1	0.9
Average Height					0.5

*** Tree not included in cover calculation

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) November 2020
	S2	
Persoonia virgata		
Banksia aemula	1	1
Banksia oblongifolia	5	9
Leptospermum liversidgei	3	3
Boronia falcifolia		
Leucopogon leptospermoides		1
Baeckea frutescens	6	21

Dilwynnia floribunda		
Epacris pulchella		
Epacris obtusifolia		
Phyllota phyllocoides		30
Leptospermum polgalifolium		3
Leptospermum semibaccatum		
Totals	15	68

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	5	5	1	0	0	0	0	0	2.5	2.5	21.25
	Sporodanthus interruptus	10	0	20	15	20	20	15	10	0	5	
	Eriachne pallescens var. gracilis	0	0	0	0	2.5	0	0	0	0	0	
	Lomandra elongata	0	0	0	10	0	0	0	5	10	10	
	Lomandra longifolia	15	3	0	0	0	0	0	0	0	0	
	Lomandra strappy	0	0	0	0	5	10	10	0	0	0	
	Balloskion tenuiculme											
Native forbs and other spp.	*Burchardia umbellata*											1.15
	Pimelia liniifolia	1	0	0	2.5	0	0	0	0	0	0	
	Drosera binata	0	0	1	1	2.5	1	0	0	0	0	
	Selaginella uliginosa	0	0	0	0	2.5	0	0	0	0	0	
	Aotus											
Native shrubs ,<1m	*Boronia falcifolia*	0	0	0	0	2.5	5	0	0	0	0	18.85
	Banksia oblongifolia	25	40	0	0	0	0	0	0	0	0	
	Strangea linearis	0	0	2.5	0	0	0	2.5	0	0	0	
	Leptospermum liversidgei	0	0	1	0	0	0	0	0	2.5	0	
	Leptospermum	10	10	30	5	0	0	0	0	0	0	

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	semibaccatum											
	Baeckea frutescens	0	0	0	10	0	0	0	5	10	10	
	Epacris pulchella											
	Phyllota phylicoides	0	0	0	0	0	0	5	10	2.5	0	
Grass Tree	*Xanthorrhoea fulva*	10	0	10	30	0	5	20	30	60	20	18.5
Cryptogams												
Bare Ground		14	15	17.5	10	35	15	10	10	10	0	13.65
Exotic Shrubs												
Leaf litter		10	27	17	16.5	30	44	37.5	30	2.5	52.5	26.7
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	0	0	0	0	2.5	0	0	0	1	0	17.2
	Sporodanthus interruptus	10	5	2.5	20	25	10	20	5	5	5	
	Eriachne pallescens var. gracilis											
	Lomandra elongata											
	Lomandra longifolia	15	10	0	0	5	5	0	0	0	0	
	Balloskion tenuiculme	0	0	0	0	5	15	0	0	0	0	
	Schoenus scabripes	0	0		9.5	0	0	0	0	0		
Native forbs and other spp.	*Burchardia umbellata*	0	0	0	0	0	5	0	0	0	1	1.05
	Pimelia liniifolia											
	Drosera binata											
	Selaginella uliginosa	0	0	0	0	0	1	0	0	0	1	

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
	Aotus											
	Red leaf – Unid herb	0	0	0	0	0	0	0	0	0	2.5	
Native shrubs ,<1m	*Boronia falcifolia*	0	0	0	1	5	5	2.5	0	0.5	0	23.7
	Banksia oblongifolia	30	40	0	0	0	0	0	0	0	0	
	Leucopogon leptospermoides	5	0	1	0	0	0	0	0	0	0	
	Strangea linearis			5								
	Leptospermum liversidgei											
	Leptospermum semibaccatum	5		40		1						
	Baeckea frutescens	0	0	0	10	10	2.5	5	10	0	2.5	
	Leptospermum polygalifolium	0	10	0	0	0	0	0	0	0	0	
	Epacris pulchella											
	Phyllota phylicoides	0	0	1	0	0	0	20	10	5	10	
Grass Tree	*Xanthorrhoea fulva*	25	10	20	30	0	0	30	60	60	50	28.5
Cryptogams												
Bare Ground	Bare	5	2	20.5	15	49	56.5	22.5	5	20	28	22.35
Exotic Shrubs												
Leaf litter	Leaf	5	23	10	14.5	0	0	0	10	9.5		7.2
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

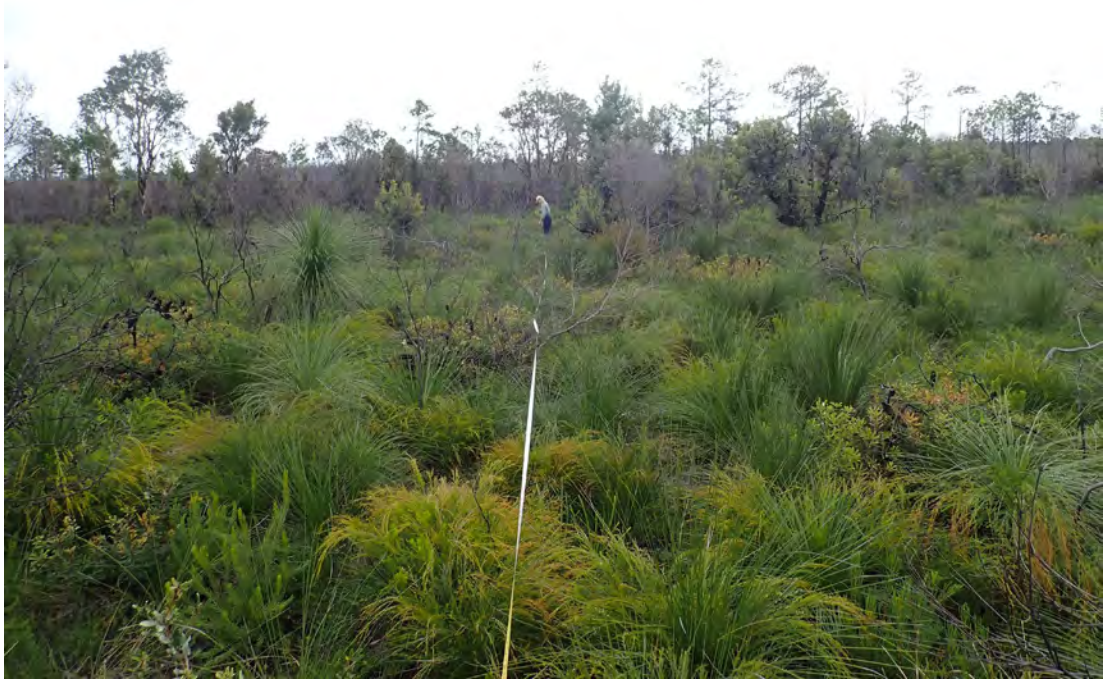
Additional Species: *Baeckea imbricata, Stackhousia nuda, Xyris complanata*

Structural / Floristic Summary

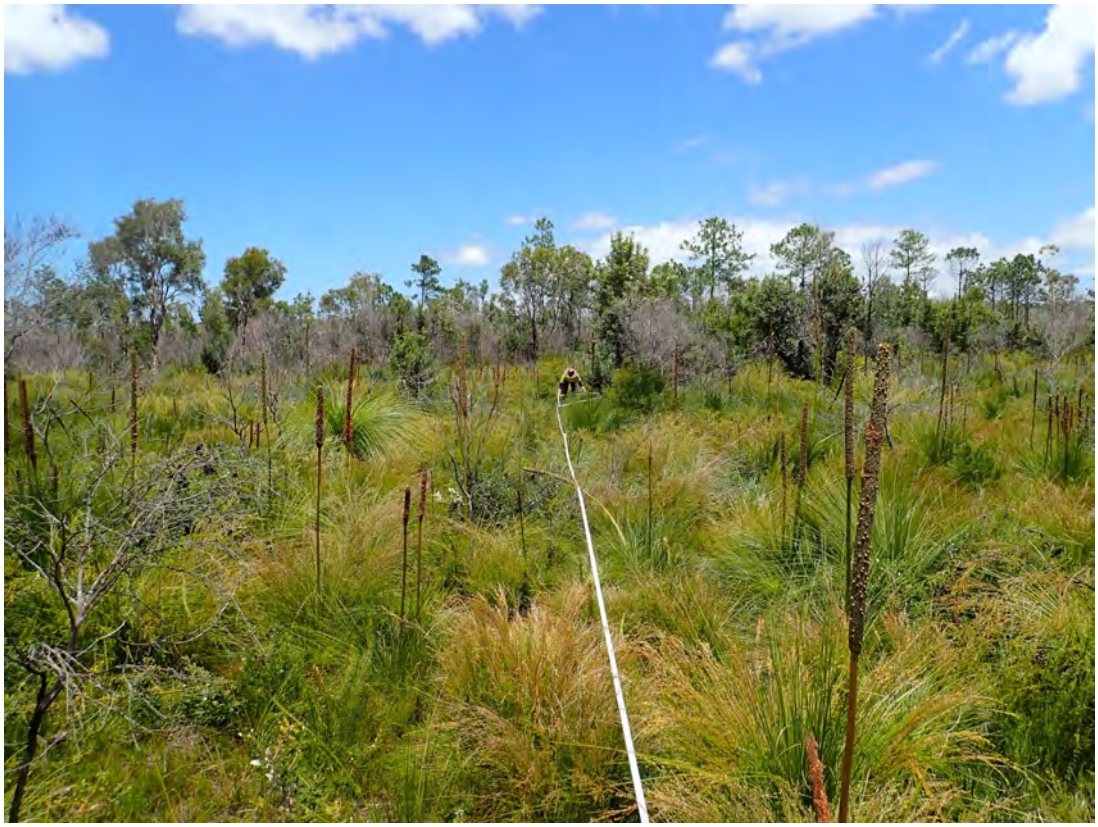
BioCondition Attribute		April 2020	November 2020
Native Plant Species Richness	Tree:		
	Shrub:	13	
	Grass Tree	1	
	Grass / Sedge	7	
	Forbs and other:	8	
Total Species No.**		29	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	0	0
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	1.4	4.1
Native Ground cover (%):	Native perennial grass /	21.25	17.2

BioCondition Attribute		April 2020	November 2020
	sedge cover (%):		
	Native shrubs (%)	18.85	23.7
	Grass tree	18.5	28.5
	Organic litter cover (%):	26.7	7.2
	Native forb cover (%)	1.15	1.05
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses%	0	0
	Non-native shrubs %	0	0

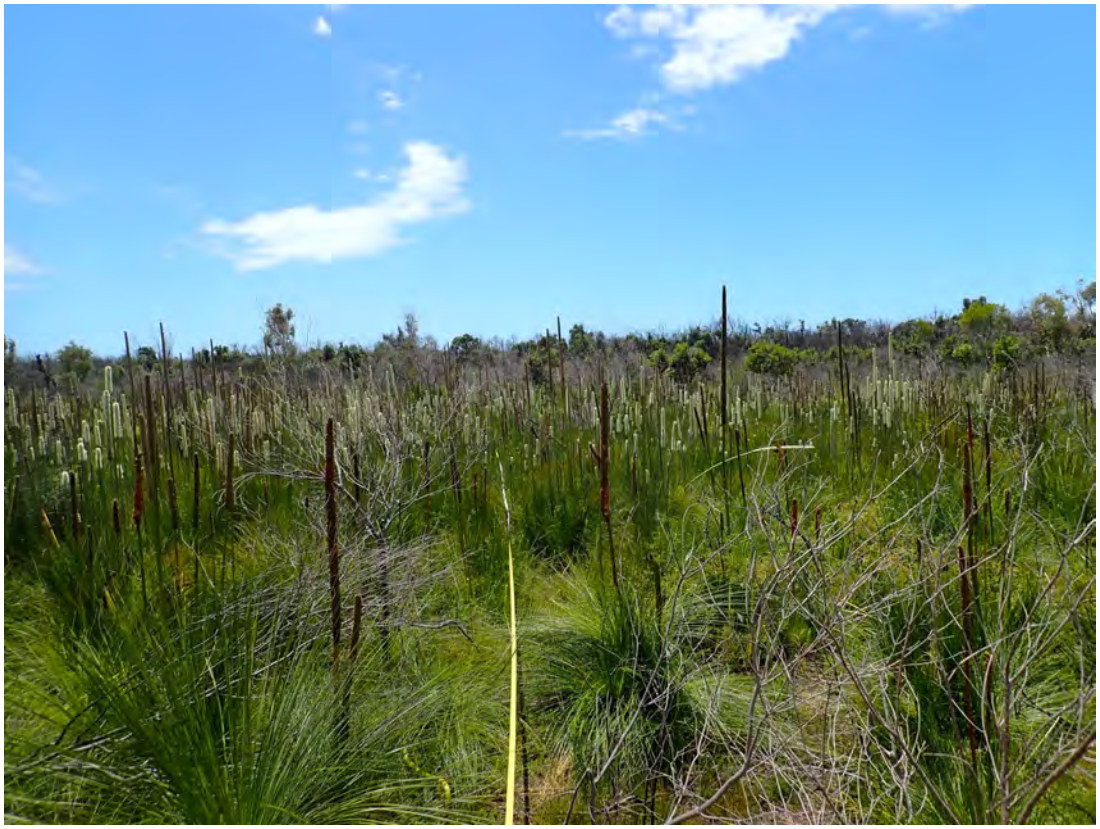
** Excludes Exotic Species



Plot 6b Centre to Start: April 2020 (Above) and November 2020 (Below).



Plot 6b – Centre to End: April 2020 (Above) and November 2020 (Below).



Plot 6b – Centre to North: April 2020 (Below) and October 2020 (Above).

Plot 6b – Centre to South: October 2019 (Above) and April 2020 (Below).

Survey Locality 6c

Date of Assessment: 08.04.2020/ 05.11.2020.
Plot Size:50 m linear transect (Canopy Cover); 50 x 4m transect for S2 shrubs >0.5m; 10 x 1m x 1m quadrats for Ground Cover.
Location (Plot Centreline): *Start* -26.9852/ 153.1541529; *Finish* -26.9849 / 153.1545859
Structure: Heath

Shrub Cover** – Canopy Intercept (>50cm) (summarised 50 m transect)

April 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
12.9 – 14.1	*Baeckea frutescens*			1.2	0.7
14.3 - 15	*Baeckea frutescens*			0.7	0.6
22.4 – 23.5	*Melaleuca quinquenervia*	1.1	3.0		
24.7 – 25.8	*Banksia oblongifolia*			1.1	0.8
30.5 – 31.2	*Leptospermum liversedgeii*			0.7	0.8
49.1 - 50	*Banksia aemula*	0.9	3.0		
Total Cover		2.0		3.70	
Average Height			3.0		0.7

November 2020

Intercept (m)	Species	Shrubs > 1m		Shrubs >0.5 to <1m	
		Intercept S1	Height (M)	Intercept S1	Height (M)
2.0 – 2.8	*Baeckea frutescens*			0.8	0.7
12.8 – 14.0	*Baeckea frutescens*			1.2	0.9
14.0 - 15	*Baeckea frutescens*			1.0	0.9
22.3 – 23.8	*Melaleuca quinquenervia*	1.5	3.0		
24.6 – 26.0	*Banksia oblongifolia*			1.4	0.6
38.4 – 40.1	*Leptospermum polygaliifolium*	1.7	1.0		
Total Cover		3.2		4.4	
Average Height			3.0		0.7

Stem Counts (50 x 4) – Shrubs > 0.5m

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) November 2020
	S1 – S2	
Persoonia virgata		
Banksia oblongifolia	8	13
Leucopogon leptospermoides		
Boronia falcifolia		
Phyllota phyllocoides		3
Baeckea frutescens	9	20
Leptospermum liversidgei	4	

Species	50 m x 4 m Stems (50x4m) April 2020	50 m x 4 m Stems (50x4m) November 2020
	S1 – S2	
Leptospermum polygalifolium		6
Eleocarpus reticulatus	1	1
Melaleuca quinquenervia	1	2
Banksia aemula	1	1
Agiortia pedicellata		
Epacris pulchella		
Totals	24	46

Ground Cover %- 1 x 1m Sub-plots

April 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	*Caustis recurvata*	1	5	0	0	2.5	0	5	0	2.5	10	14.7
	Sporodanthus interruptus	10	15	5	10	7.5	10	10	10	5	10	
	Lomandra elongata	0	0	0	10	0	0	0.5	0	0	0	
	Lomandra strappy	0	0	0	0	2.5	2.5	0	0	5	5	
	Eriachne pallescens var. gracilis	0	0	0	0	0	2.5	0	0	0	0.5	
	Lomandra longifolia											
	Baloskion tenuiculme											
Native forbs and other spp.	*Pimelea liniifolia*	0	1	1	0.5	2.5	1	0	0	0	0	1.35
	Cassytha glabella											
	Sellaginella uliginosa	0	0	0	2.5	0	0	0	0	0	0	
	Drosera binata	1	0	0	1	0	1	0.5	0.5	0	0	
	Hibbertia salicifolia	0	0	0	0	0	0.5	0	0	0	0	
	Stylidium sp.	0	0	0	0	0	0	0.5	0	0	0	
	Commosperma sphaericum											

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native shrubs ,<1m	*Boronia falcifolia*											34.75
	Olax retusa	0	0	0	0	0	0	0	0.5	0	0	
	Baeckea frutescens	0	0	50	0	0	25	0	0	0	15	
	Dyllwinia floribunda	0	0	0	0	0	0	0	2.5	0.5	0.5	
	Leucopogon leptospermoides	0	0	0	2.5	0	0	0	0	0	0	
	Banksia aemula	0	0	0	2.5	0	0	0	0	0	0	
	Banksia oblongifolia	0	5	30	0	0	25	25	70	70	0	
	Strangea linearis	2.0	0	0	0	10	0	0	0	0	0	
	Leptospermum semibaccatum	5	5	0	0.5	0.5	0	0	0	0	0.5	
Grass Tree	*Xanthorrhoea fulva*	10	10	0	0	30	0	5	0	0	15	7
Bare Ground	Bare	20	30	7	35	22	16	26	7.5	5	22	19.05
Leaf litter	Leaf	51	29	7	35.5	22.5	16.5	27.5	9	12	21.5	23.15
Timber (>/= 10cm)												
Total		100	100	100	100	100	100	100	100	100	100	100%

November 2020

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native perennial grass / sedges	Caustis recurvata	10	5	5				5		0.5	10	16.5
	Sporodanthus interruptus	10	15	5	20	10	10		5	5		
	Lomandra elongata											
	Lomandra longifolia			2.5	5		5	2.5		2.5	2	
	Eriachne pallescens var. gracilis											
	Baloskion tenuiculme							10	10	5	5	

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Native forbs and other spp.	Pimelea liniifolia											1.3
	Cassytha glabella											
	Sellaginella uliginosa				5			5				
	Burchardia umbellatum					1						
	Red leaf – Unid. Forb.						1					
	Xyris complanata									1		
Native shrubs ,<1m	Boronia falcifolia		0.5								0.5	32.05
	Olax retusa											
	Baeckea frutescens	5		50			10				20	
	Dyllwinia floribunda											
	Leucopogon leptospermoides			5								
	Banksia aemula				1							
	Banksia oblongifolia			15			25	5	70	50		
	Strangea linearis	15				5	3					
	Leptospermum semibaccatum	1	15				5					
	Pyllota phyllocoides		1		2.5	3	1				2	
	Leptospermum polygaliifolium							10				
Grass Tree	Xanthorrhoea fulva	10	20			40	10	5	10	15	30	14
Bare Ground	Bare	49	43.5	12.5	66.5	41	10	57.5	5	21	30.5	33.65
Leaf litter	Leaf			5			20					2.5
Timber (>/= 10cm)												

Ground Cover Type	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Mean April 2020
Total		100	100	100	100	100	100	100	100	100	100	100%

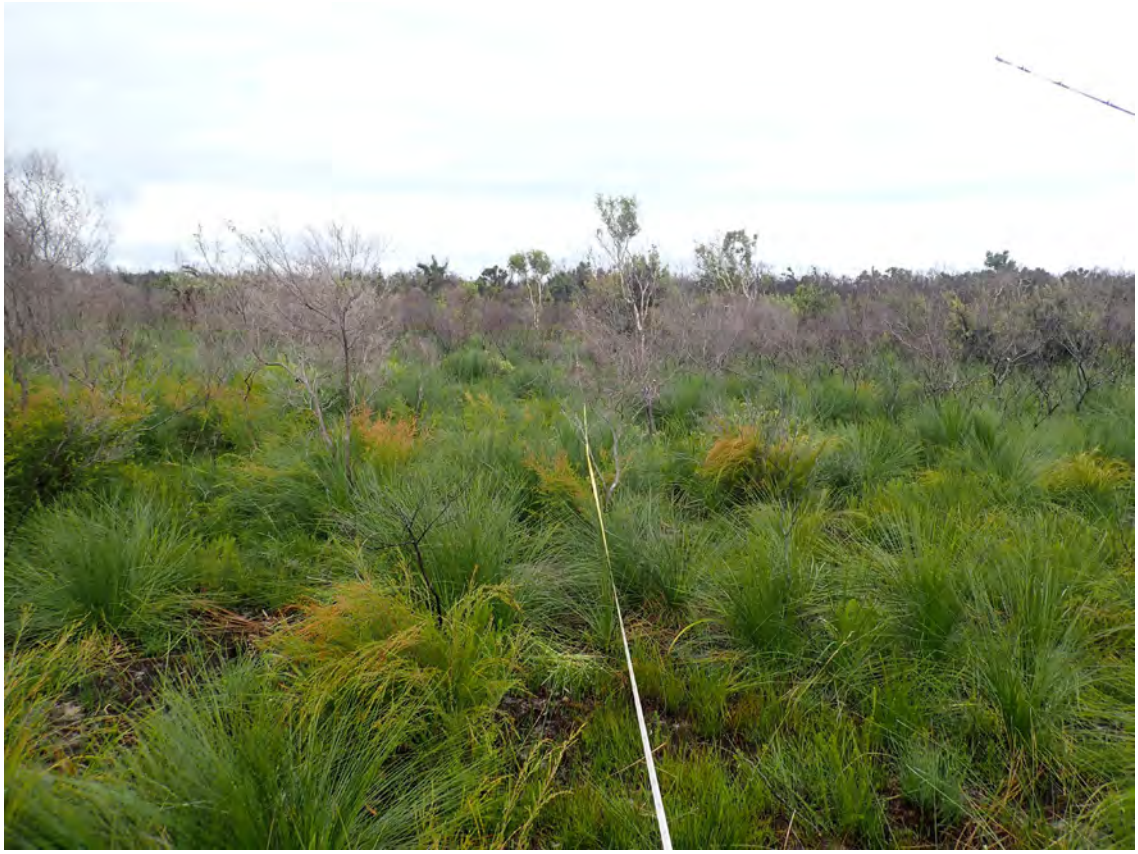
Additional Species: *Commosperma sphaericum, Schoenus scabripes*

Structural / Floristic Summary

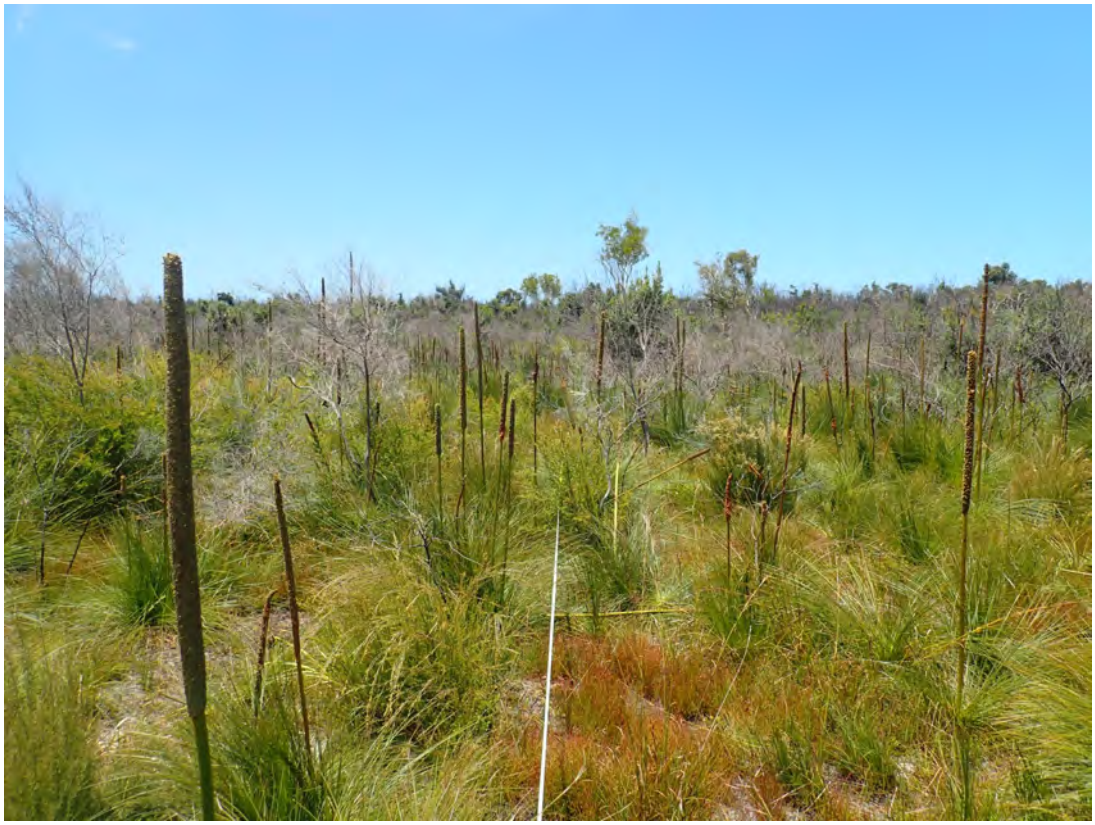
BioCondition Attribute		April 2020	November 2020
Native Plant Species Richness	Tree:	1	
	Shrub:	13	
	Grass Tree	1	
	Grass / Sedge	6	
	Forbs and other:	5	
Total Species No**		26	
Native Shrubs	Projected Canopy Cover – Shrubs > 1m (%)	2.0	3.2
	Projected Canopy Cover – Shrubs >0.5 to <1m (%)	3.7	4.4
Native Ground cover (%):	Native perennial grass / sedge cover (%):	14.7	16.5
	Native shrubs (%)	34.75	32.05
	Grass tree	7	14
	Organic litter cover (%):	23.15	2.5
	Native forb cover (%)	1.35	1.3
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare	0	0
Non-native plant cover	Non-native Grasses%	0	0
	Non-native shrubs %	0	0

**Excludes Exotic Species

Plot 6c – Centre to Start: April 2020 (Above) and November 2020 (Below).



Plot 6c Centre to End – April 2020 (Above) and November 2020 (Below).



Plot 6c – Centre to North: April 2020 (Above) and November 2020 (Below).

Plot 6c – Centre to South: April 2020 (Above) and November 2020 (Below).

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Appendix B – Site / Species Table - 2020 Surveys

Habit	Family	Species	Site 6a_April_2020	Site 6a_November_2020	Site 6b_April_2020	Site 6b_November_2020	Site 6c_April 2020	Site 6c_November 2020	Site 5a_April. 2020	Site 5a_November 2020	Site 5b_April 2020	Site 5b_November 2020	Site 5c_April_2020	Site 5c_November_2020
Forb	Blechnaceae	*Blechnum cartiligineum*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*
Forb	Colchicaceae	*Burchardia umbellata*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Dilleniaceae	*Hibbertia acicularis*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Dilleniaceae	*Hibbertia salicifolia*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Droseraceae	*Drosera binata*	*1*	*1*	*1*	*0*	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*0*
Forb	Fabaceae	*Mirbellia rubiifolia*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Iridaceae	*Patersonia sericea (fragilis)*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*0*	*1*	*1*
Forb	Lauraceae	*Cassytha glabella*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*1*	*1*
Forb	Laxmanniaceae	*Laxmannia compacta*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Laxmanniaceae	*Sowerbaea juncea*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Orchidaceae	*Microtus parviflora*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*
Forb	Orchidaceae	*Cryptostylis erecta*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*0*
Forb	Picrodendraceae	*Pseudanthus orientalis*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Polygalaceae	*Commosperma sphaericum*	*0*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Selaginellaceae	*Selaginella uliginosa*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Stackhousiaceae	*Stackhousia nuda*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*
Forb	Stylidiaceae	*Stylidium trichopodom*	*1*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Forb	Thymeleaceae	*Pimelea linifolia*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*1*	*1*
Forb	Xyridaceae	*Xyris complanata*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*
Forb		*Red - leaf herb*	*0*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Grass	Poaceae	*Themeda triandra*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Grass	Poaceae	*Eriachne pallescens var.*	*1*	*1*	*1*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*1*	*1*

Habit	Family	Species	Site 6a_April_2020	Site 6a_November_2020	Site 6b_April_2020	Site 6b_November_2020	Site 6c_April 2020	Site 6c_November 2020	Site 5a_April. 2020	Site 5a_November 2020	Site 5b_April 2020	Site 5b_November 2020	Site 5c_April_2020	Site 5c_November_2020
		gracillis												
Grass tree	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*1*
Grass tree	Xanthorrhoeaceae	*Xanthorrhoea fulva*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Sedge / Rush	Cyperaceae	*Cyperus sp. (gracilis?)*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Cyperaceae	*Schoenus calostachys*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Cyperaceae	*Schoenus scabripes*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Cyperaceae	*Gahnia seiberiana*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
Sedge / Rush	Cyperaceae	*Hypolaena fastigiata*	*1*	*1*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Sedge / Rush	Laxmanniaceae	*Lomandra longifolia*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Laxmanniaceae	*Lomandra elongata*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Sedge / Rush	Restionaceae	*Baloskion heterophylla*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Restionaceae	*Leptocarpus tenax*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Sedge / Rush	Restionaceae	*Baloskion tenuiculme*	*0*	*0*	*1*	*1*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Sedge / Rush	Restionaceae	*Sporodanthus interuptus*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*1*	*1*
Sedge / Rush	Restionaceae	*Caustis recurvata*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Shrub	Ericaceae	*Epacris obtusifolia*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Ericaceae	*Sprengelia sprengelioides*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*
Shrub	Ericaceae	*Agiortia pedicellata*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*0*
Shrub	Ericaceae	*Epacris pulchella*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*
Shrub	Ericaceae	*Leucopogon leptospermoides*	*1*	*1*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Shrub	Fabaceae	*Pultenaea robusta*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Fabaceae	*Pultenaea palaceae*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Habit	Family	Species	Site 6a_April_2020	Site 6a_November_2020	Site 6b_April_2020	Site 6b_November_2020	Site 6c_April 2020	Site 6c_November 2020	Site 5a_April. 2020	Site 5a_November 2020	Site 5b_April 2020	Site 5b_November 2020	Site 5c_April_2020	Site 5c_November_2020
Shrub	Fabaceae	*Aotus lanigera*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Fabaceae	*Dillwynia floribunda*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
Shrub	Fabaceae	*Phyllota phylicoides*	*0*	*1*	*1*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Mimosaceae	*Acacia baueri*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*
Shrub	Mimosaceae	*Acacia flavesecens*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*
Shrub	Myrtaceae	*Homoranthus virgatus*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*
Shrub	Myrtaceae	*Austromyrtus dulcis*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
Shrub	Myrtaceae	*Melaleuca pachyphyllus*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*
Shrub	Myrtaceae	*Ochrosperma lineare*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*0*
Shrub	Myrtaceae	*Baeckea imbricata*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Myrtaceae	*Leptospermum polygalifolium*	*0*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	*1*	*1*	*1*	*1*
Shrub	Myrtaceae	*Melaleuca quinquenervia*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*0*	*0*	*0*	*1*	*1*
Shrub	Myrtaceae	*Leptospermum semibaccatum*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Shrub	Myrtaceae	*Leptospermum liversidgei*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Myrtaceae	*Baeckea frutescens*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Shrub	Olacaceae	*Olax retusa*	*1*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Proteaceae	*Persoonia virgata*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*0*
Shrub	Proteaceae	*Conospermum taxifolium*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Proteaceae	*Strangea linearis*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Shrub	Proteaceae	*Banksia oblongifolia*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
Shrub	Proteaceae	*Banksia aemula*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*1*	*1*
Shrub	Rutaceae	*Boronia falcifolia*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*1*	*0*
Tree	Elaeocarpaceae	*Elaeocarpus*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*

Habit	Family	Species	Site 6a_April_2020	Site 6a_November_2020	Site 6b_April_2020	Site 6b_November_2020	Site 6c_April 2020	Site 6c_November 2020	Site 5a_April. 2020	Site 5a_November 2020	Site 5b_April 2020	Site 5b_November 2020	Site 5c_April_2020	Site 5c_November_2020
		reticulatus												
Tree	Pinaceae	*Pinus elliottii***	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*0*