PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL
Approval no: DEV2023/1458
Date: 4 November 2025

Queensland Government

covey

Report

Bushfire Management Plan

LOCATION: AURA LAKES PRECINCT 18 (PART OF)

CLIENT: STOCKLAND DEVELOPMENT PTY LTD

Project Ref 243987/ N25-0317 Issue B

September 2025

DOCUMENT ISSUE APPROVAL

Project Title:	Bushfire Management Plan
Project Location:	Gagalba
Project Address:	Aura Lakes Precinct 18 (part of), Gagalba
Client:	Stockland Development Pty Ltd
Project No:	243987
Report No:	N25-0317
Issue:	B
Date:	September 2025
Distribution:	Client
	Covey Associates

© Copyright **Covey Associates Pty Ltd** (2025).

This document is the property of **Covey Associates Pty Ltd**. This document and the information contained in it are solely for the use of the authorised recipient and this document may not be used, copies of reproduced in whole or part for any purpose other than that for which it was supplied by Covey Associates Pty Ltd. **Covey Associates Pty Ltd** makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document, or the information contained in it.

COPYRIGHT NOTICE: Parts of this document contain material originally prepared by:

Land and Environment Consultants Pty Ltd (2024), Urbis Pty Ltd (2024) and SMEC (2023).

Author:
Madeline Dooley

Bushfire Consultant / Ecologist
BEnvSc Hons (Ecology and Conservation)

Reviewed:

Anthony Power
Bushfire Technical Lead

GDDDBPA UWS, Grad Dip Urb & Reg Plan, Grad Cert Nat Res UNE, Dip Hort, Dip Arb, AILA

Executive Summary

Covey Associates have prepared this Bushfire Management Plan (BMP) to support a minor change application to the approved Reconfiguring a Lot (ROL) Development Application (DA) for part of Precinct 18 of the Aura Lakes Masterplan. This report encompasses the DA1 / ROL1 being made under the Caloundra South Urban Development Area Development Scheme for part of Lot 3 on SP334586 and Lot 2 on SP334580 being submitted to Economic Development Queensland.

Part of the site is identified as a Bushfire Prone Area within a previous BMP, *Bushfire Management Plan: Aura Lakes Context Plan*, by Land and Environment Consultants (2024). This BMP assesses the risk of the proposed development within the defined Bushfire Prone Area, assessed against the example Bushfire Overlay Code in the *Natural Hazards, Risk and Resilience – Bushfire, State Planning Policy State Interest Guidance Material* (Queensland Government, 2019). The requirements and a description of how these code requirements are addressed in the proposed development design are detailed in Section 6 of this report.

This BMP focuses solely on bushfire-related risk and mitigation strategies. Further investigations may be required to support a development application, e.g. Engineering Services Report, ecological assessments or others.

Subject to the mitigation measures detailed in this BMP being complied with, the bushfire hazard level, bushfire-related risk level and RHF level applicable to the proposed development are considered reasonable and should not prohibit the development of the site.

The outcomes of this Bushfire Management Plan have identified that:

- All proposed residential allotments are subject to Radiant Heat Flux (RHF) of less than 29kW/m^2 within the Precinct 18 development area of Gagalba as part of the ROL1 development area.
    - 34 residential lots that adjoin Bells Creek Arterial Road are subject to RHF less than 12kW/m^2, though they are within 100 metres of identified bushfire prone vegetation and will require BAL construction standards to be applied.
- It has been demonstrated that the proposed State Primary School is not impacted by RHF 10kW/m^2.
- The landscape design for proposed stormwater treatment basins align with the vegetation hazard class per this BMP, in terms of species selection and vegetation structure; or a lower risk vegetation class.
- All future landscape design during the operational works phases of the development shall not exacerbate or increase existing bushfire prone vegetation hazards identified in this report. This includes any planting of vegetation that does not align with Clause 2.2.3.2 of AS3959:2018.

Abbreviations Used in Report

Abbreviation	Full Meaning
AS3959	AS 3959:2018 – Construction of Buildings in bushfire-prone areas
AWS	Automatic Weather Station
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BMP	Bushfire Management Plan
BRC	Bushfire Resilient Communities
DA	Development Application
FFDI	Forest Fire Danger Index
NCC	National Construction Code of Australia
RHF	Radiant Heat Flux
ROL	Reconfiguring a Lot
SPP	State Planning Policy
VHC	Vegetation Hazard Class
w	Understorey fuel load
W	Total fuel load

Supporting Documentation		
Document	**Prepared by**	**Abbreviation**
Bushfire Management Plan: Aura Lakes Aura Lakes Precinct 18 (part of)	*Land and Environment Consultants Pty Ltd (4 July 2024)*	**Precinct 18 BMP (2024)**
Bushfire Management Plan: Aura Lakes Context Plan	*Land and Environment Consultants Pty Ltd (4 June 2024)*	**Context BMP**
Aura Lakes Gagalba Lakes Statement of Landscape Intent	*Urbis Pty Ltd (10 April 2024)*	**SLI**
Environmental Rehabilitation Plan – Aura Precincts 17, 18 and 19 and Part Precinct 6. Caloundra South Priority Development Area. Document number 30031518.	*SMEC (9 February 2023)*	**ERP**

Contents

1 Introduction 1
1.1 Scope 1
1.2 Objectives 1
1.3 Document Review 1
1.4 Planning Context 2
1.4.1 Existing Bushfire Management Plan – Aura Lakes Context Plan 2
1.4.2 SPP - Natural hazards, risk and resilience state interest – Bushfire 3
1.4.3 Bushfire Prone Designation 3
1.5 Bushfire Regulatory Context 3
2 Site Details 5
2.1 Proposed Development 5
2.2 Access 5
2.3 Water Supply 5
3 Bushfire Hazard 7
3.1 Site Topography 9
3.2 Weather 11
3.2.1 Fire Danger Season 11
3.2.2 Rainfall 13
3.2.3 Wind Speed & Direction 13
3.2.4 Generalised Extreme Value 15
3.2.5 Selection of FFDI value using SPP 16
3.2.6 Climate Change Impact on FFDI 16
3.3 Bushfire Fuels 17
3.3.1 Site Assessment 17
3.3.2 Post-Development Vegetation 17
3.4 Summary 18
4 Bushfire Assessment 22
4.1 Bushfire Impact Analysis and RHF Ratings 22
4.1.1 Vegetated areas excluded from RHF assessment 23
4.1.2 Results 24
4.2 Potential human impact and sheltering sites 24
5 Bushfire Mitigation Measures 27

5.1 Setbacks / RHF exposure 27
5.1.1 Asset Protection Zone 27
5.1.2 National Construction Code (NCC) 27
5.2 Access 27
5.3 Fire-fighting Water Supply 28
5.4 Bushfire Landscaping Guidelines 28
5.5 Grassland Maintenance 29
6 Performance Criteria and Compliance 30
7 Conclusion 40
References 41
Appendix A 43
Appendix B 46

Figures

Figure 1-1. Bushfire Management Context Plan (Land and Environment Consultants Pty Ltd) 3
Figure 2-1. ROL1 Proposed Development Layout 6
Figure 3-1. BPA per SPP (top) and specific to Aura Lakes context plan (bottom) (Land and Environment Consultants 2024). 8
Figure 3-2. Slope analysis of post-development topography – (including planned earthworks). 10
Figure 3-3. Accumulated FFDI by Month for Beerburrum AWS 11
Figure 3-4 - Annual Rainfall vs Accumulated FFDI 13
Figure 3-5. Wind Rose and accumulated days (count) for 'Low to Moderate' (0<FFDI<12), 'High'(12<FFDI<25), 'Very High' (25<FFDI<50) Fire Danger Rating Days and 'Max FFDI for each wind direction'. 14
Figure 3-6. GEV Regression analysis Beerburrum (2000-2024) y axis = FFDI; x axis = recurrence years. 15
Figure 3-7. Pre-development Vegetation Hazard Class within ROL1 development extent and site assessment photo points. 19
Figure 3-8. Post-development Vegetation Hazard Class within 150 m of ROL1 development. 20
Figure 3-9. Proposed WSUD Layout provided by Stantec (August 2025). 21
Figure 4-1. Vegetation Hazard Class with Small Patch and Narrow Corridors filter applied. 25
Figure 4-2. Radiant heat flux modelling output and lot exposure eastern. 26
Figure 5-1. Vehicle Turning Points (Queensland Fire and Emergency Services, 2019b). 28
Figure 5-2. Low Threat vegetation (left) and Low Threat public open space (right). 29

Figure 5-3. AS3959 Exclusions—Low threat vegetation and non-vegetated areas. 29

Tables

Table 3-1 - Highest Ranked FFDI for Beerburrum AWS 2000-2024 12

Table 3-2. GEV Recurrence Interval of FFDI Beerburrum (2000-2024) 15

Table 3-3. Site post-development VHC. 18

Table 4-1. VHC fuel loading, vegetation prone type and Rate of Spread model adopted 22

Table 4-4. Radiant heat flux impacts (Penney et al., 2020). 24

Table 6-1. Satisfaction of the SPP guidance material example Bushfire Overlay Code. 30

1 Introduction

1.1 Scope

The proponent, Stockland Development Pty Ltd (Stockland), engaged Covey Associates Pty Ltd (Covey) to prepare a site-specific Bushfire Management Plan (BMP) to support the minor change application to the approved Development Permit for Reconfiguring a Lot (ROL) for part of Precinct 18 of the Aura Lakes master-planned development. The proposed Precinct 18 development extent is located within part of Lot 3 on SP333886 and Lot 2 on SP334580 (the site). A minor change application is being made for the proposed development under the Caloundra South Urban Development Area Development Scheme. Economic Development Queensland is the assessment authority (refer to Figure 2-1 in Section 2).

Per the Caloundra South Urban Development Area Development Scheme, the proposed development is required to achieve the objectives of the State Planning Policy – Part E Natural hazards, risk and resilience (The State of Queensland, 2017). Part of the site has been identified as a bushfire hazard area by the Aura Lakes Bushfire Prone Area map, which was prepared by Land and Environment Consultants, 2024, within the *Bushfire Management Plan: Aura Lakes Context Plan* (refer to Figure 3-1 in Section 3).

As such, this BMP assesses the risk of the proposed development being located within a mapped Bushfire Prone Area, and details how the recommended bushfire mitigation measures achieve the purpose and outcomes, in accordance with the example Bushfire Overlay Code in the *Natural Hazards, Risk and Resilience – Bushfire, State Planning Policy State Interest guidance material* (Queensland Government, 2019) (SPP guidance material).

1.2 Objectives

The objectives of the BMP are to:

1. Achieve consistency with purposes and policy measures of the SPP guidance material, *Bushfire Resilient Communities Technical Reference Guide for State Planning Policy State Interest 'Natural Hazards, Risk and Resilience – Bushfire'* (BRC) (Queensland Fire and Emergency Services, 2019a) and the *Bushfire Management Plan: Aura Lakes Context Plan* (Context BMP; Land and Environment Consultants, 2024),
2. Understand and document the extent of potential bushfire risk for the BMP area by undertaking a Radiant Heat Flux (RHF) assessment, and
3. Devise bushfire risk mitigation measures for all land subject to the plan, with due regard for people, property, infrastructure, and the environment.

Per the requirements of BRC, the BMP includes an assessment of all lands surrounding the site to 150 meters.

1.3 Document Review

Covey recommends reviewing this BMP after 5 years from the date of issue, or sooner if there is a revision to the development or surrounding landscape that may necessitate review of the bushfire risk.

1.4 Planning Context

1.4.1 Existing Bushfire Management Plan – Aura Lakes Context Plan

The *Bushfire Management Plan: Aura Lakes Context Plan* was previously developed by Land and Environment Consultants Pty Ltd (2024), and provided to Covey by Stockland, to illustrate the intent of development and possible uses and conservation areas within the site. A summary of the mitigation measures detailed in Section 5 and Section 6 of the *Context BMP* are outlined below:

- The preliminary bushfire hazard setbacks of the *Context BMP* (reproduced in Figure 1-1) are to be implemented to ensure future allotments or development footprints are separated suitably from hazardous vegetation,
- Allotments should be separated from hazardous vegetation with esplanade roads, linear parks and/or lifestyle buffers (refer to Appendix A in *Context BMP*) where practical or be of a size which can accommodate a bushfire hazard setback from adjoining hazardous vegetation and development footprint,
- Bushfire hazard setbacks should be located outside of the stormwater management area and the Bells Creek corridor and environmental buffers,
- Future development applications must not rely on Sunshine Coast Council to maintain vegetation for the purpose of providing a bushfire hazard setback unless the maintenance is within a park,
- The sports, recreation and linear parks should be maintained as low fuel hazard areas with discontinuous bushfire fuels which consist of hardened areas or turf and grass maintained to 10 cm,
- Gardens within the sports, recreation and linear parks are to be separated from any adjoining areas of hazardous vegetation and be regularly maintained,
- Scattered trees planted within the sports, recreation and linear parks should not overhang the boundaries of adjoining allotments,
- Landscaping should be designed in accordance with Part 5 of Bushfire Resilient Building Guidance for Queensland Homes (CSIRO, 2020) in allotments associated with residential, mixed-use, school, community centre, neighbourhood meeting room and centre and district centre land uses with plant selection that favours the list of plant species in Appendix E of the *Context BMP*,
- The future allotments are to be connected to a reticulated mains water supply, with fire hydrants located within the future road reserve in accordance with the South-East Queensland (SEQ) Water Supply Code,
- In accordance with the Fire hydrant and vehicle access guidelines which defers to the *Road Planning and Design Manual – 2nd Edition (*DTMR 2013), roads and driveways must be designed and constructed to meet the requirements for an urban fire truck,
- Prior to the development of the proposed sub-arterial and trunk roads, existing access tracks must be maintained to allow emergency access and egress (refer to Figure 1-1),
- Where buildings are constructed within 100 m of hazardous vegetation, these must be designed and constructed in accordance with the relevant BAL construction specifications in AS 3959-2018 as required under the *Building Code of Australia* (ABCB 2023), and,
- Services, i.e., water, electricity, gas, and communications, must be installed underground.

Coveys considered the above mitigation measures outlined within the *Context BMP* as part of the development of this BMP.

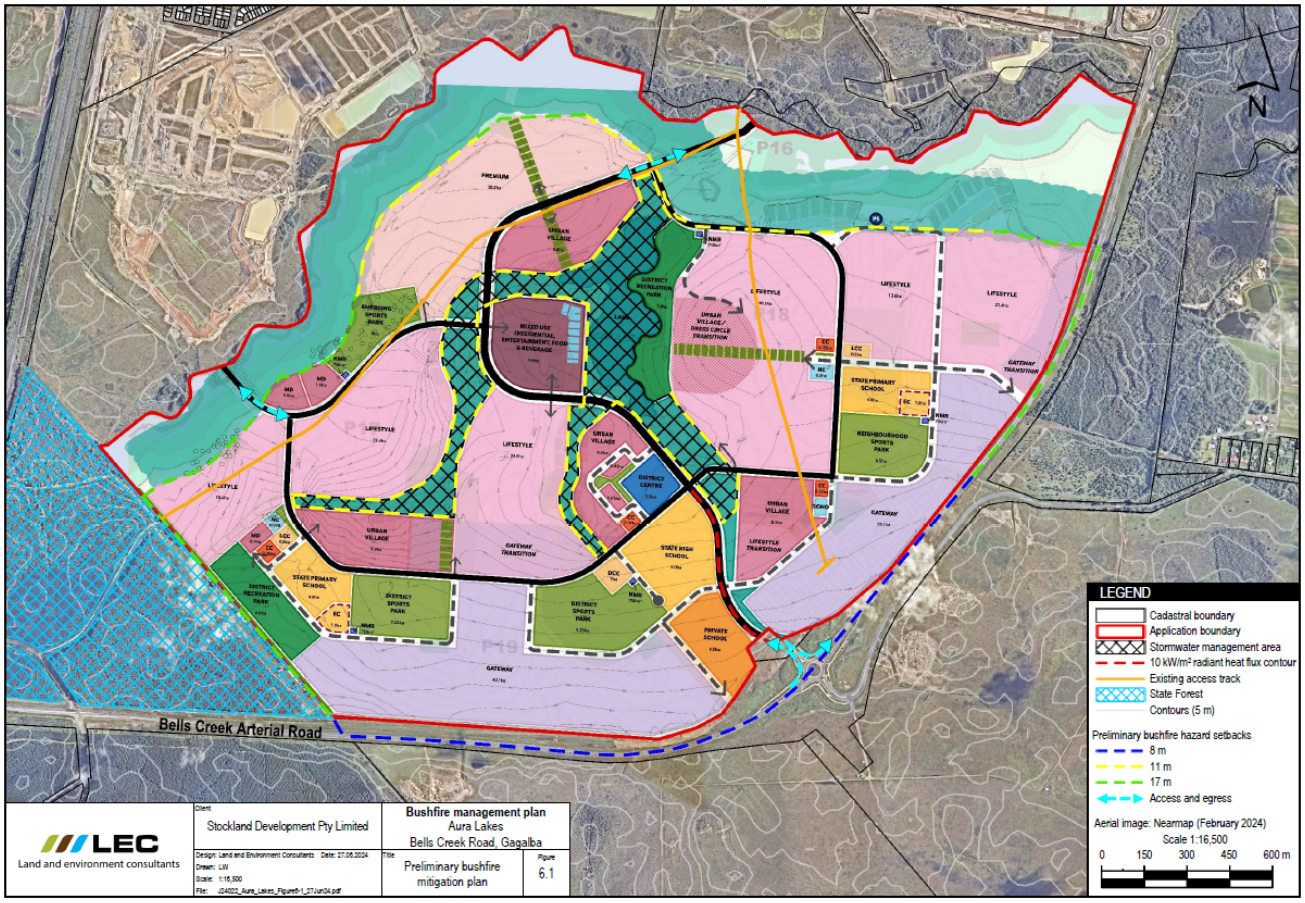


Figure 1-1. Bushfire Management Context Plan (Land and Environment Consultants Pty Ltd)

1.4.2 SPP - Natural hazards, risk and resilience state interest – Bushfire

The SPP - *Natural hazards, risk and resilience state interest – Bushfire*, identifies two ways a site may be designated as bushfire-prone. These are as follows:

1. If the land is identified by a local government in a local planning instrument as a bushfire-prone area, based on a localised bushfire study, prepared by a suitably qualified person; or
2. If the local government has not identified bushfire-prone areas in a local planning instrument in accordance with (1) above, the area is shown on the State Planning Policy Interactive Mapping System as a bushfire-prone area.

1.4.3 Bushfire Prone Designation

A localised bushfire study was prepared by Land and Environment Consultants in 2024 for the Aura Lakes Masterplan. As outlined, part of the site is identified as a bushfire hazard area by the Aura Lakes *Bushfire Prone Area Map* (refer to Figure 3-1 in Section 3). Further, formal designation of an area as "Bushfire Prone" provides the legislative trigger to enforce all Building Classes to be constructed per AS 3959 – 2018 Construction of buildings in bushfire prone areas (AS3959).

1.5 Bushfire Regulatory Context

The following regulatory documents are identified as being referenced to provide the performance criteria and technical specifications for this Bushfire Management Plan:

1. The State of Queensland (2017). State Planning Policy.

2. Queensland Government (2019). Natural hazards, risk and resilience – Bushfire. State Planning Policy – state interest guidance material.
3. Queensland Government (2021). Natural hazards, risk and resilience state interest – Bushfire. Example planning scheme assessment benchmarks.
4. Queensland Fire and Emergency Services (2019a). Bushfire Resilient Communities. Technical Reference Guide for the State Planning Policy State Interest "Natural Hazards, Risk and Resilience-Bushfire".
5. Queensland Fire and Emergency Services (2019b). Fire Hydrant and Vehicle Access Guidelines for Residential, Commercial and Industrial Lots.
6. Standards Australia (2018). AS 3959 - 2018 Construction of buildings in bushfire-prone areas: SAI Global.
7. SAI Global (2021). AS 2419.1:2021 Fire Hydrant Installations for Buildings; Australian Standards.

2 Site Details

The site is located along the north-western side of Bells Creek Arterial Road, approximately 2.6 kilometres east of Bruce Highway at Gagalba (Figure 2-1). The land adjacent to the site to the north, north-west, and south-west, and within the context plan area, is planned for future development, which will include a mix of residential, educational, recreational, and drainage uses. The Bells Creek Arterial Road will facilitate access to and from the proposed development until the sub-arterial and trunk road network within the context plan area is established. The future sub-arterial and trunk road networks will provide connections to the Bruce Highway to the west, Roys Road on the western side of the highway overpass, and Caloundra Road to the north.

Currently, the site and land within the context plan area consist of grass paddocks used for grazing livestock. Further, a large patch of continuous bushland vegetation is located to the north-east of the site and within the broader landscape, pine plantations are to the south-west.

2.1 Proposed Development

Figure 2-1 details the subdivision plan for the proposed development, including the layout of roads, residential lots and open spaces. A total of 816 lots will be created, including parks, open spaces, and several large allotments that are designated for a childcare centre, a state primary school, emerging community uses, and multiple residential uses (e.g., townhouses). In accordance with Table 3 of the SPP – State Interest Guidance Material, Natural hazards, risk and resilience – Bushfire, the childcare centre and state primary school are defined as *Vulnerable Uses*. Vulnerable uses are considered to be more vulnerable to the effects of bushfire attack, therefore require specific bushfire mitigation requirements (Queensland Government, 2019).

There are several open space allotments within the development which include drainage, neighbourhood recreation parks, linear open spaces, local recreation parks, road reserve landscape buffers and a sports field. The Statement of Landscape Intent (SLI) defines the proposed landscaping within these areas. Consistent with the *Context BMP* and *Bushfire Management Plan: Aura Lakes Aura Lakes Precinct 18* (Precinct 18 BMP, 2024), the neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers, and sports field will be kept as low bushfire hazard areas. Further details of proposed mitigation measures for landscaping are outlined in Section 5.

The extent of the ROL1 development includes early works to begin construction on the Sewer Pump Station and vegetation rehabilitation that exist within a future development stage; these works can be seen as the northernmost extent shown on Figure 2-1.

2.2 Access

Prior to plan sealing of the master planned community, the proposed development will be accessed via a new sub-arterial road connected to the Bells Creek Arterial Road and two main sub-arterial access points connecting to future proposed developments to the north and west. Until the proposed development is complete, the applicant will maintain existing vehicle access tracks within the context plan area to allow access and egress to private and emergency vehicles.

2.3 Water Supply

The proposed development will be connected to a reticulated mains water supply, with fire hydrants located within the future road reserve per the South-East Queensland (SEQ) Water Supply Code, including the provision of fire hydrants.

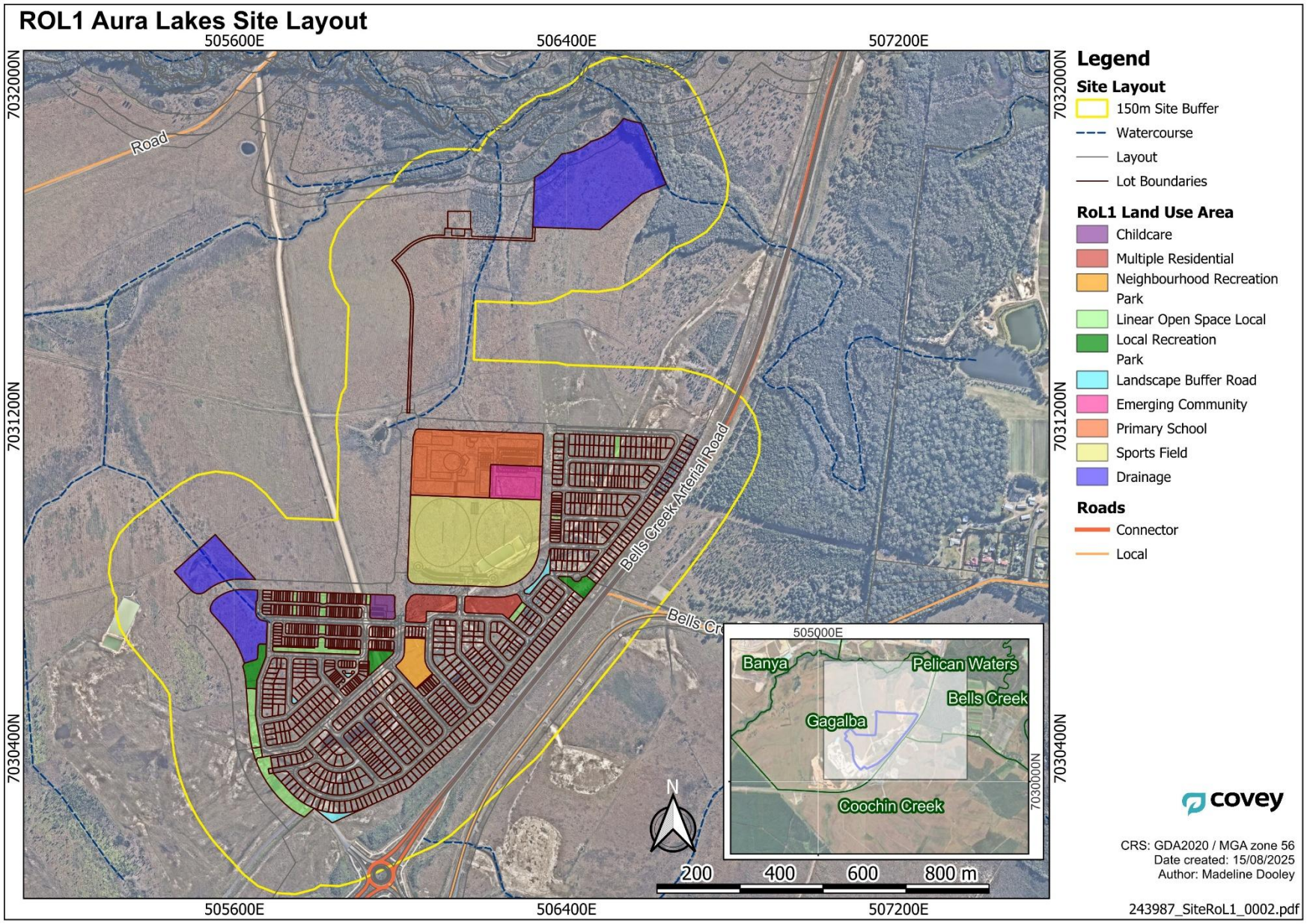
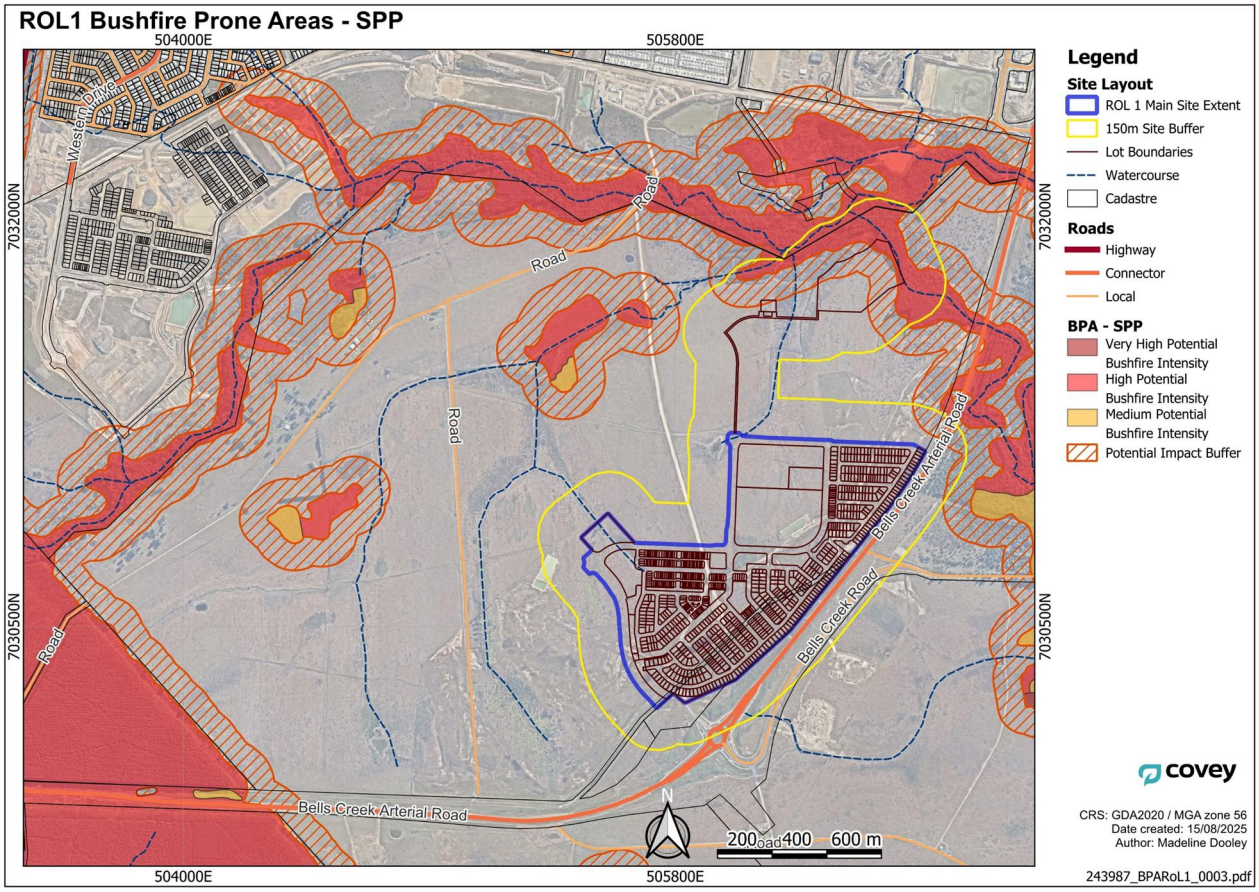


Figure 2-1. ROL1 Proposed Development Layout

3 Bushfire Hazard

The ROL1 site itself is not identified as a Bushfire Prone Area (BPA) under the SPP mapping, however, the BPA Potential Impact Buffer is mapped in vegetation within 150 m of the site boundary to the northeast. Further, parts of the site are identified as bushfire hazard areas within a site-specific BPA extent prepared for the proposed Aura Lakes Context Plan by Land and Environment Consultants (LEC, 2024) within the *Context BMP*. LEC developed this mapping based on the concept layout plan of the development (Figure 3-1), which includes proposed rehabilitation works. The BPA map by LEC identified the proposed stormwater management structures as a Medium Potential Bushfire Intensity. Further, the potential bushfire intensity calculations within the Precinct 18 BMP (2024) prepared by LEC confirmed that vegetation adjoining the site to the east and proposed vegetation within the drainage structures are bushfire prone areas.

Since the development of the site-specific BPA shown within the *Context BMP* and *Precinct 19 BMP*, the landscaping within the proposed stormwater management structures (drainage areas) has been refined and the extent of the bushfire hazardous vegetation has been modified. Further details of the post-development bushfire hazard areas are outlined in Section 3.3.2 of this report.



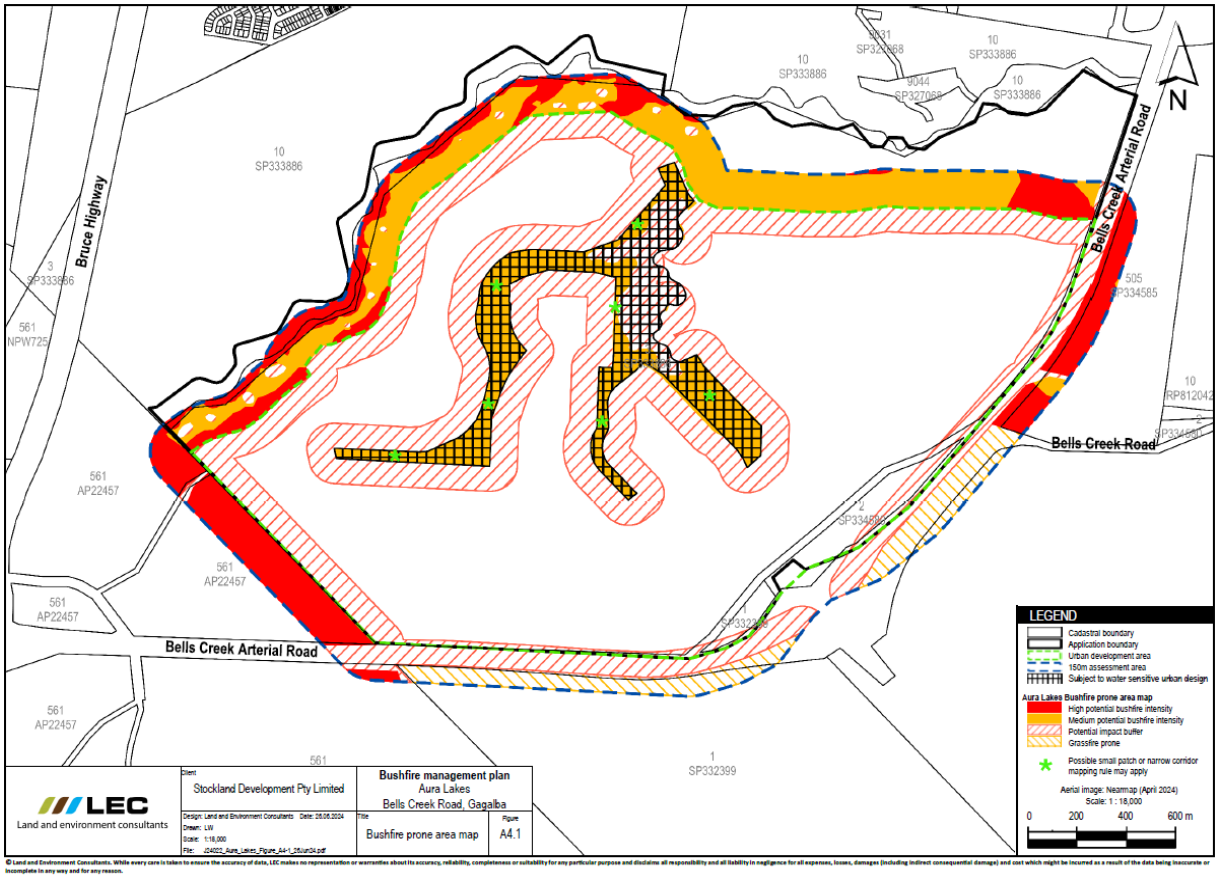


Figure 3-1. BPA per SPP (top) and specific to Aura Lakes context plan (bottom) (Land and Environment Consultants 2024).

3.1 Site Topography

Topography was verified during the site assessment and was considered consistent with the Digital Elevation Model obtained from *Elvis - Elevation and Depth - Foundation Spatial Data (n.d.)*. Covey merged the site Digital Elevation Model (5m resolution) with the site's planned earthworks to complete a post-development slope analysis (Figure 3-2). The slope analysis confirms that the site is and will be mostly flat, gently sloping to the south. A creek at the northern extent of the site comprises a slightly steeper area. Further, the stormwater management drainage area to the northwest of the development contains a shallow embankment.

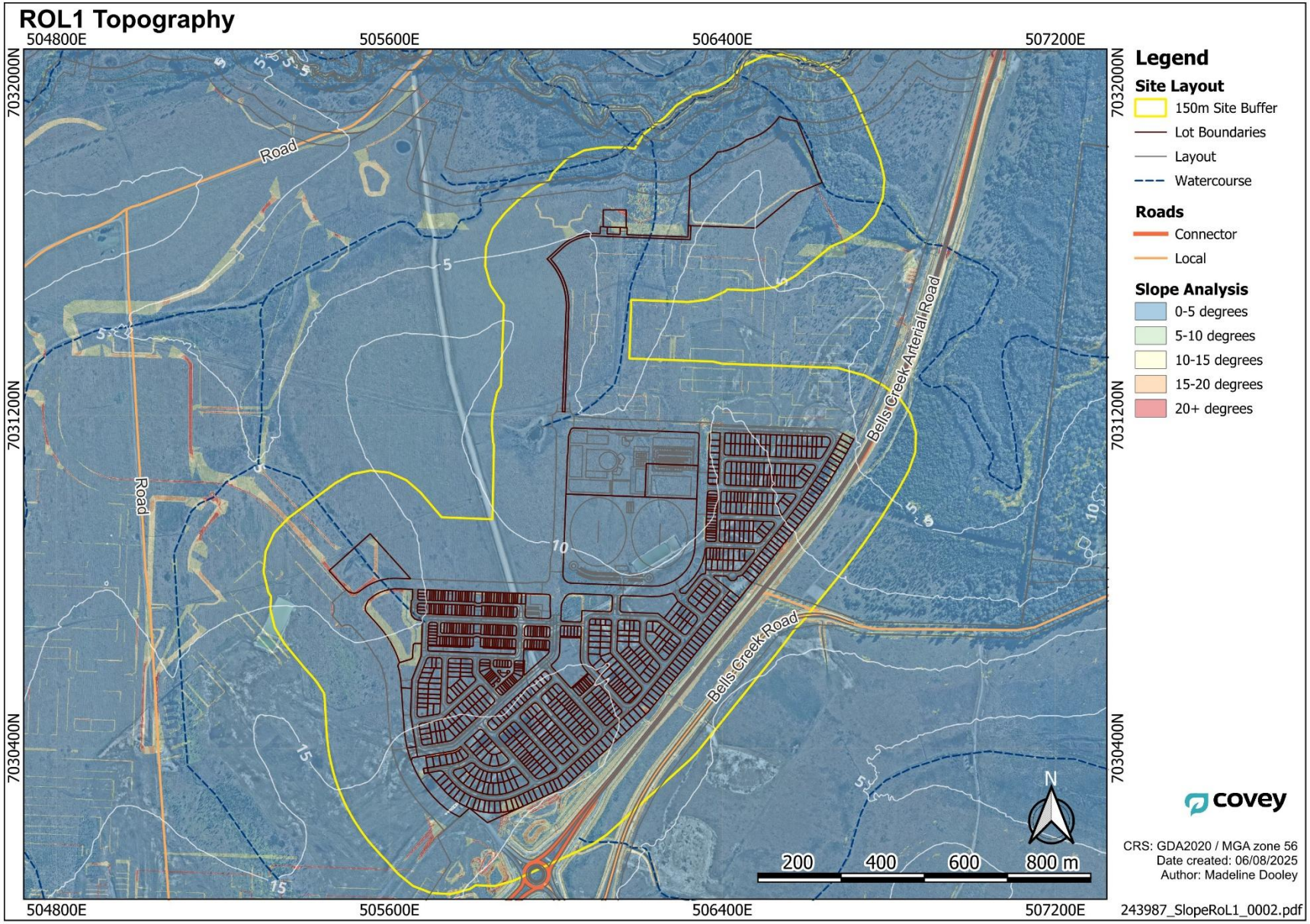


Figure 3-2. Slope analysis of post-development topography – (including planned earthworks).

3.2 Weather

An assessment of the recent past weather patterns and trends was analysed for the local area using data extracted from the Bureau of Meteorology (BoM) recorded from Automatic Weather Stations (AWS). For this site, we analysed data from Beerburrum AWS from 2000 – 2025 (AWS 40284); which is approximately 15.2 km south-southwest of the development site. To ensure a complete year-to-year assessment of historic weather, the assessment period has been stopped at the end of 2024.

3.2.1 Fire Danger Season

Fire weather refers to meteorological conditions that promote bushfire spread, making wildfire suppression more challenging. Fire weather can be influenced by many local factors, including temperature, wind, relative humidity, and drought factor – all of which are used to calculate the Forest Fire Danger Index (FFDI[1]). Fire risk is typically linked to the occurrence of fire weather days or sequences of days of FFDI above 25 (Queensland Parks and Wildlife Service, 2013).

Analysis of monthly FFDI distribution indicates that fire weather is typically elevated between July and November, peaking in August and September (seasonal weather dependant) (Figure 3-3). However, fire occurrences can have a random nature, and a few short, sharp fire weather periods can result in fires that cause, or have the potential to cause, major damage. Damaging fires can occur in any given year, despite some years being drier and hotter than others.

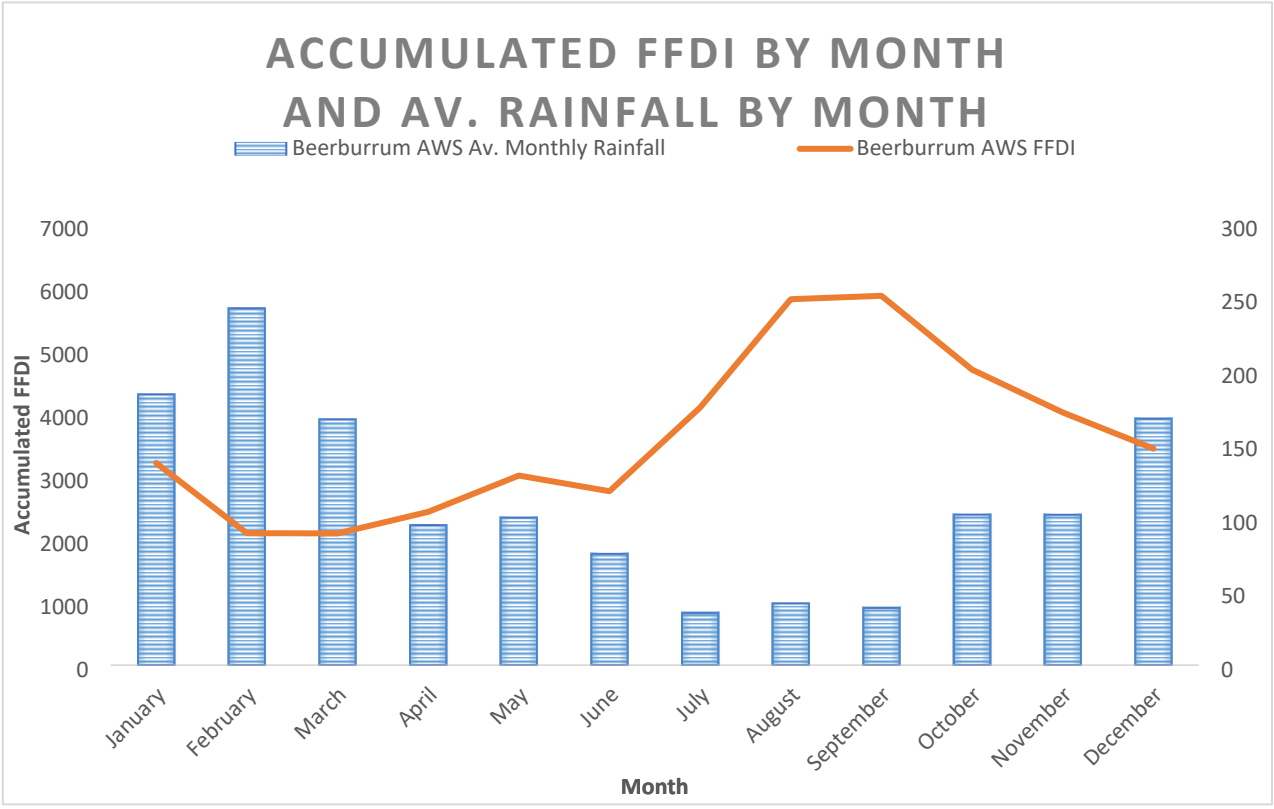


Figure 3-3. Accumulated FFDI by Month for Beerburrum AWS

[1] FFDI were used in this report, instead of the new Australian Fire Danger Rating System and Fire Behavior index, as the data we analyzed was historical. Also, FFDI values are used as input for in RHF modeling.

Table 3-1 provides the top 15 highest-ranked FFDIs over the period of analysis (approximately twenty-four years for Beerburrum from 2000-2024). These show that the highest-ranked fire danger days are typically associated with:

- Air temperature (>30℃);
- Low RH (≤18%);
- Typically, light wind speeds[2] from a westerly arc.
- Relatively dry conditions (Drought Factor typically ≥ 9.5).

The year 2019 stands out as the worst year on record between 2000 to 2024, on the basis of low annual rainfall accumulation through the year and high temperatures, combined with low relative humidity influenced by the dry inland air from westerly winds.

Table 3-1 - Highest Ranked FFDI for Beerburrum AWS 2000-2024

Rank	FFDI	FDR	Date	Month	T (°C)	Dew Point [°C]	RH [%]	Wind Speed [km/hr]	Wind direction [deg]	Wind Cardinal Direction	KBDI	Drought Factor
1	47.8	Very High	16/11/2014	November	43	8.7	13	14.8	270	W	159	10
2	44.0	Very High	8/11/2019	November	38.2	-1.8	8	11.2	310	WNW	122	9.9
3	41.2	Very High	6/09/2019	September	33.7	-3.5	7	13	310	WNW	135	10
4	38.3	Very High	8/10/2004	October	37.7	5.7	13	13	250	WSW	180	10
5	38.0	Very High	6/10/2005	October	38.8	5.4	14	13	270	W	142	9.9
6	37.2	Very High	4/12/2012	December	40.1	7.5	15	13	250	WSW	158	9.6
7	36.4	Very High	28/09/2017	September	38.2	9.7	15	13	330	NW	169	10
8	36.1	Very High	27/09/2003	September	34.7	2.3	13	14.8	250	WSW	146	10
9	36.0	Very High	7/10/2001	October	33.8	2.6	11	13	270	W	172	10
10	35.3	Very High	2/12/2018	December	39.1	10.4	18	14.8	310	WNW	141	10
11	35.2	Very High	7/10/2013	October	36.7	3.8	12	9.4	250	WSW	143	10
12	34.8	Very High	4/09/2019	September	33.3	-3.8	9	9.4	220	SSW	129	10
13	34.5	Very High	4/01/2014	January	43.4	15.5	18	9.4	260	WSW	162	9.6
14	33.8	Very High	9/09/2000	September	29.2	0.8	13	20.5	260	WSW	126.1	9.9
15	33.7	Very High	7/10/2012	October	36.4	3.6	13	9.4	240	SW	142	10

[2] Based on the Beaufort wind scale – refer to Wind - Reference material - Marine Knowledge Centre for more information

3.2.2 Rainfall

The occurrence of days with high fire danger is also influenced by annual rainfall by virtue of the Keetch-Byram Drought Index (KBDI) and Drought Factor (DF). As seen for the analysed AWS, where typically low annual rainfall results in higher accumulated annual FFDIs (Figure 3-4). Accumulated annual FFDI is the summed value of all FFDI's for each year of the analysis. Conversely, years of above-average rainfall can lead to increased vegetation growth. Therefore, although high rainfall levels are less conducive to extensive wildfire impact in the short term, this effect might be reversed in successive years, especially if a period of drought follows. As such, having an above-average year of rainfall cannot be perceived as reducing the ongoing fire risk.

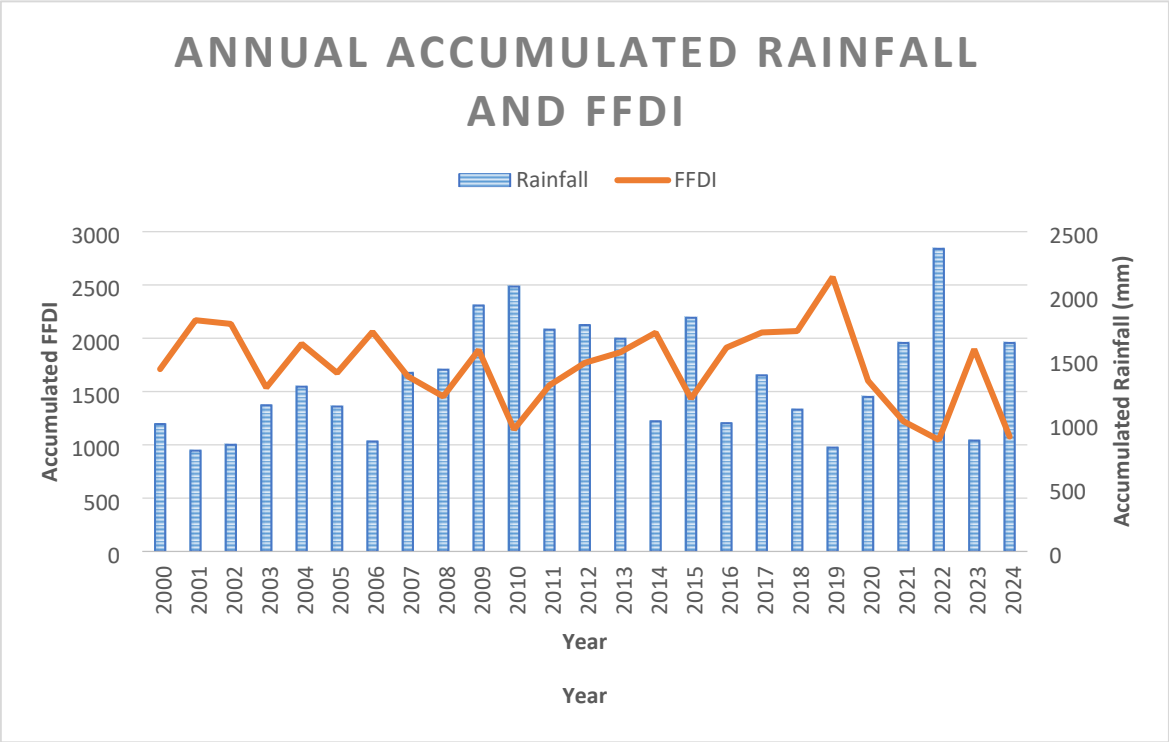


Figure 3-4 - Annual Rainfall vs Accumulated FFDI

3.2.3 Wind Speed & Direction

Fire weather patterns are closely related to wind direction and synoptic meteorological conditions. Figure 3-5 shows an analysis of wind directions for FFDI classes 0-11, 12-24, 25-49, and 50-74 for Beerburrum AWS assessed period (2000 to 2024). FFDIs greater than 50 have not occurred over the assessed period. The analysis reveals that FFDI values above 25 tend to originate from a westerly arc, influenced by inland continental dry winds. Winds associated with lower FFDIs tend to be easterlies and have higher relative humidity associated under a maritime influence.

Figure 3-5. Wind Rose and accumulated days (count) for 'Low to Moderate' (0<FFDI<12), 'High'(12<FFDI<25), 'Very High' (25<FFDI<50) Fire Danger Rating Days and 'Max FFDI for each wind direction'.

3.2.4 Generalised Extreme Value

A Generalised Extreme Value Analysis (GEV), a regression technique was completed to determine the Annual Exceedance Probability (AEP) of FFDI values. The GEV technique is frequently used to predict extreme weather such as storms, cyclones and flooding events (Douglas et al., 2014). Covey completed a GEV analysis based on the recorded FFDI data at Beerburrum AWS for the study period (Figure 3-6).

$$y = 31.5302 + 4.4525 \times \ln(x) \qquad (r^2 = 0.9848) \qquad \text{(Beerburrum AWS)}$$

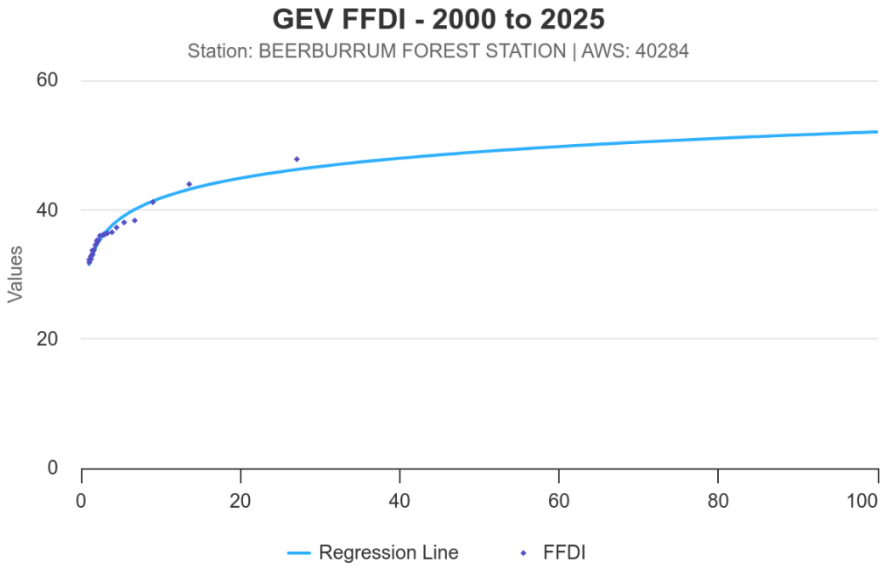


Figure 3-6. GEV Regression analysis Beerburrum (2000-2024) y axis = FFDI; x axis = recurrence years.

This analysis provides an indication of the AEP or Annual Return Interval (ARI) of fire weather. Table 3-2 contains the calculated FFDI values for key return intervals. It is important to note that the GEV recurrence value indicates the likely return period of fire weather and not a fire event. Extreme fire weather may come and go without a fire occurring. Therefore, the probability of a fire occurring within the right position within the landscape during these periods of extreme weather and impacting the development are orders of magnitude lower. The ARI FFDI reflects existing baseline conditions and not ARIs, inclusive of the effect of climate change.

Table 3-2. GEV Recurrence Interval of FFDI Beerburrum (2000-2024)

Annual Recurrence Interval (Years)	Beerburrum AWS FFDI
1	32
20	45
25	46
50	49
100	52
200	55
500	59

3.2.5 Selection of FFDI value using SPP

Per the recommendations of BRC for undertaking Method 2 Radiant Heat Flux (RHF) calculation method, the mapped SPP 1:20 year ARI FFDI spatial data (available at BRC MapViewer) has been adopted for the RHF analysis within this BMP. The SPP-prescribed spatial FFDI for the site is 53, and for the Beerburrum BoM AWS location, 54. This calculation of the FFDI ARI are based on an A1F1 climate change scenario (Queensland Fire and Emergency Services, 2019a)

The SPP mapped FFDI spatial data, created in 2014, doesn't consider the latest 10 years of weather data. Our GEV analysis indicate that these values approximately represent a 1 in 124-year recurrence Interval for the site under baseline conditions

Note, that the SPP prescribed FFDI is higher than the results of our analysis. This difference can be attributed to the difference in the way the ARIs are determined as discussed above. Per the recommendations of BRC Method 2, an FFDI of 53 was used in the radiant heat flux (RHF) analysis outlined in Section 4 of the SPP.

3.2.6 Climate Change Impact on FFDI

Climate change relative to the project site can be referenced in the *Climate Change in Australia Report for East Coast Cluster* developed by CSIRO and BOM (A. Dowdy et al., 2015), key findings for projected climate change within the East Coast Cluster is summarised below:

Very high confidence in:

- Higher temperatures,
- Hot and more frequent hot days, with less frost, and

High Confidence in:

- Increased intensity of heavy rainfall events, though changes to drought less clear,
- Increase evaporation rates and reduced soil moisture,
- Little change in solar radiation and reduced humidity throughout the year,
- Some decrease in Winter wind speed, with fewer East Coast Lows,
- A harsher Fire Weather climate is expected in the future.

Climate modelling projections for predicted fire weather and fire danger based on the latest IPCC reports (AR5 and AR6) are available and could provide valuable information when assessing potential future fire risk to the site – as projections exist from the current year to 2100. These climate models have been developed by the Department of Environment and Science, based on accepted climate models and data, and are available in gridded format relative to the project site (CSIRO et al., 2021).

It should be noted that fire weather and fire behaviour are, by nature, difficult to predict with certainty. Therefore, the following limitations exist when predicting bushfires and designing for bushfire mitigation:

- Fire behaviour at elevated FFDIs and under the influence of fire-induced winds driven by strong convection rates can become erratic and thus can be beyond the bounds of predictive models (Cruz et al., 2012); and
- Human-induced climate change may exacerbate fire behaviour and affect vegetation structure and floristics in different ways to those assumed in this project (A. J. Dowdy, 2018).

3.3 Bushfire Fuels

Fuel load and arrangement significantly impact bushfire behaviour's potential severity and scale. Fuel characteristics vary along with changes in type, density and extent of vegetation communities and land uses. As such, the vegetation within the Precinct 18 site and 150 m surrounding the site was classified into Vegetation Hazard Classes (VHC) (Queensland Fire and Emergency Services, 2019a) based on existing and proposed vegetation using information gathered from:

- Aura Lakes Statement of Landscape Intent (Urbis, 2023),
- Caloundra South Priority Development Area Environmental Rehabilitation Plan (SMEC, 2023),
- Bushfire Management Plan: Aura Lakes Context Plan (LEC, 2024),
- Bushfire Management Plan: Aura Lakes Aura Lakes Precinct 18 (part of) (LEC, 2024),
- Site-verified vegetation information from field observations,
- State Regional Ecosystem spatial data (https://qldspatial.information.qld.gov.au/catalogue),
- State Vegetation Hazard Class (Queensland Fire and Emergency Services, 2023), and
- Aerial imagery.

Per the BRC document, VHC's are considered as bushfire prone, grassfire prone or non-bushfire prone. Only bushfire-prone VHCs are required to be assessed for the purposes of RHF calculation.

3.3.1 Site Assessment

A site inspection was undertaken on the 6th of June 2025 to confirm the current land use and management, vegetation characteristics and verify the topography across the site (Figure 3-7, refer to Appendix A for photos). The inspection confirmed that the site and surrounding land are currently utilised for grazing livestock, with much of the site consisting of grassy paddocks. Several small areas contain patches of regrowth *Acacia sp.* and Pine trees. Surrounding land uses in the broader area include proposed future development areas, Pine plantations and vegetated creek lines. The Pine Plantations are located on the western side of the Bruce Highway, are more than 150 meters from the site and therefore do not require specific assessment. A corridor of remnant vegetation is located along Bells Creek, and Beerwah State Forest south-west of the site.

3.3.2 Post-Development Vegetation

Table 3-3 and Figure 3-8 detail the post-development VHC types and extent, as per the Development Layout Plan, SLI, ERP, site assessment, and finalised Water Sensitive Urban Design (WSUD) layout provided by Stantec. Covey has assumed that the adjoining future development stages will be constructed generally per the approved context plan. As such, these areas have been mapped as *VHC 42.6 – Nil to very low vegetation cover*. However, in the interim, before the development of areas to the north, south and west of Precinct 18, it is assumed that these areas will remain as grassland (VHC 40.4). Vegetation adjoining the eastern site boundary has also been classified as *VHC 40.4 – Low grass or tree cover,* which is defined as "Grass-fire Prone". All temporary and permanent grassland areas will need to be maintained and managed, before and after construction of the development to restrict the growth of grass and bushfires (as outlined in Section 5).

Covey also assumed that the vegetation palette within the rehabilitation environmental buffer area along Bells Creek Road will follow that described for each Habitat Management Unit per Table 2-2 of the *Environmental Rehabilitation Plan* (ERP) prepared by SMEC (2023). As such, the selected VHC classes identified align with the "Target Communities" within the ERP, per the existing *Context BMP* (June 2024) and Aura Lakes Precinct 18 BMP (July 2024). These patches of vegetation have been identified as *VHC 22.1 – Melaleuca open forest* and *VHC 29.3 – Heathlands*

The proposed WSUD area in the south-western extent consists of bio-basins, sediment-basins, wetlands and access tracks, per the design layout provided by Stantec (Figure 3-9). The bio-basin and sediment-basin areas were classified as VHC 29.3, and the surrounding vegetation up to the drainage batters was classified as VHC 22.1 based on the species planting schedule provided. The wetlands were assigned *VHC – 43.6 Water bodies or very low vegetation cover*, assuming these areas will be permanently inundated with water. The drainage areas in the northern portion of the site have been classified as VHC 29.3, with the wetland areas as VHC 43.6.

In accordance with the *Context BMP* and Precinct 18 BMP (2024) the neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers and sports field will be managed landscapes and therefore a non-bushfire prone VHC. Specifically, the neighbourhood sports park is identified as *VHC 41.4 – Discontinuous low grass or tree cover*, and the neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers and sports field have been identified as *VHC 39.2 – Discontinuous low to moderate tree cover in built-up areas*.

To conclude, the bushfire-prone vegetation within the site and 150 m surrounding the Precinct 18 boundary comprises the mapped VHC 9.1, VHC 22.1 and VHC 29.3. These areas are located within the stormwater management (drainage) areas and the rehabilitation corridor east of Bell's Creek Road. These areas were used to model RHF to determine the level of bushfire exposure on the proposed lots as detailed in Section 4.

Table 3-3. Site post-development VHC.

VHC	VHC Description	Prone Type per BRC
VHC 9.1	Moist to dry eucalypt open forests on coastal lowlands and ranges	Bushfire Prone
VHC 22.1	Melaleuca open forests on seasonally inundated lowland coastal swamps	Bushfire Prone
VHC 29.3	Heathlands and associated scrubs and shrublands	Bushfire Prone
VHC 39.2	Discontinuous low to moderate tree cover in built-up areas	Non-bushfire prone
VHC 40.4	Continuous low grass or tree cover	Grassfire prone
VHC 41.4	Discontinuous low grass or tree cover	Grassfire Prone
VHC 42.6	Nil to very low vegetation cover	Non-bushfire-prone
VHC 43.6	Water bodies or very low vegetation cover	Non-bushfire-prone

3.4 Summary

The proposed development is situated in a largely flat area currently utilised for livestock grazing. The site is bounded by a pine plantation to the southwest and future melaleuca and heathland revegetated areas along Bells Creek, with areas planned for future development located to the north, northwest and west. Based on analysis of Beerburrum AWS weather data, the baseline 1-in-20-year recurrence FFDI is 45; and the highest recorded FFDI was 47.8, in 2014. Climate change modelling completed by the CSIRO and included in the BRC document projects an ARI 1:20 FFDI of 53 for the site. Note that, in our Radiant Heat Flux analysis, we adopted FFDI 53 per SPP. Higher fire risk is expected to be associated with westerly wind arcs, under inland continental dry winds influence, high temperatures (above 30°C), low relative humidity (≤18%) and relatively dry conditions (Drought Factor typically ≥ 9.5). Bushfire-prone vegetation has been identified as a patch of vegetation east of Bells Creek Arterial Road within the rehabilitation environmental buffer and the proposed drainage structures within the Precinct 18 development extent.

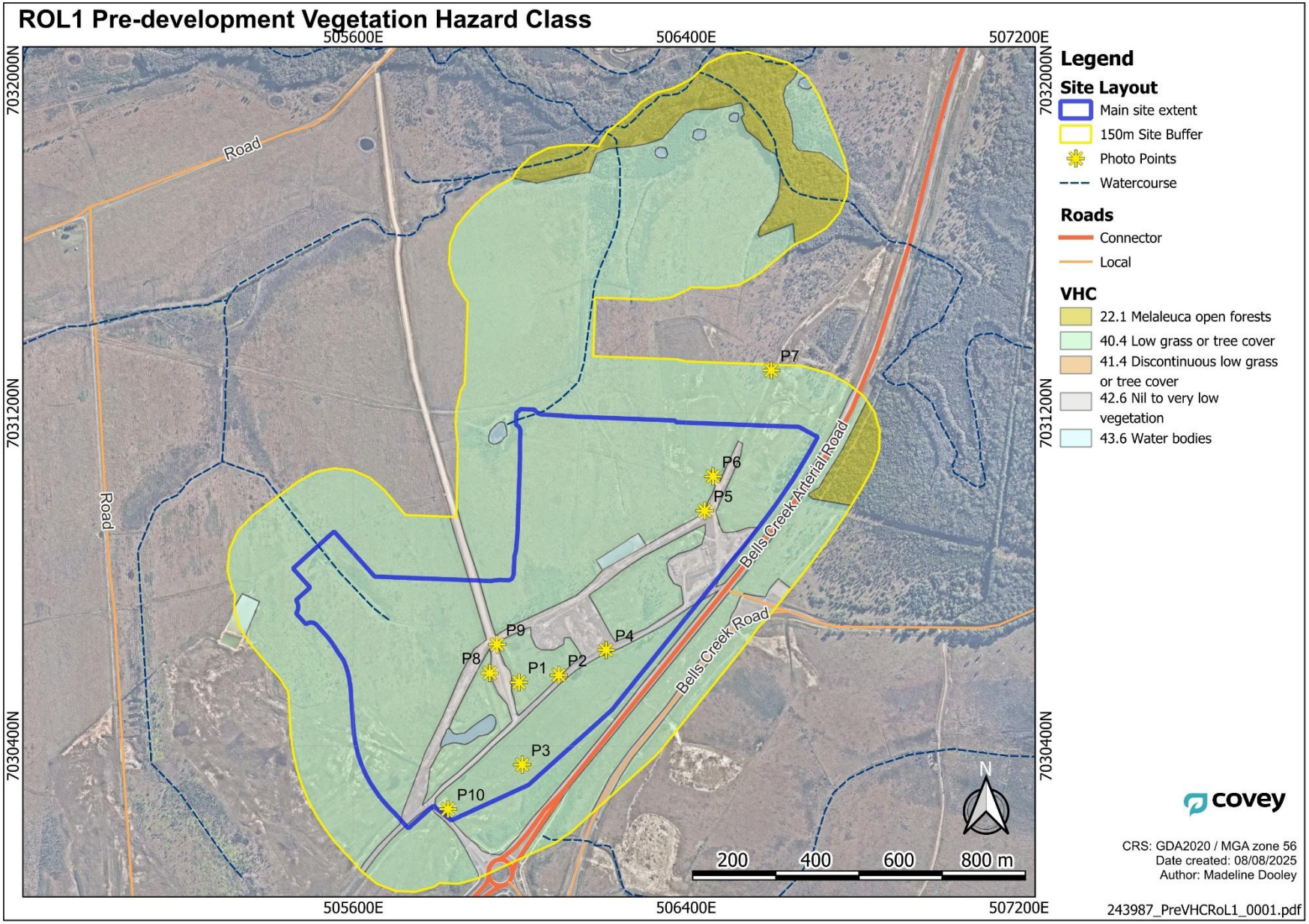


Figure 3-7. Pre-development Vegetation Hazard Class within ROL1 development extent and site assessment photo points.

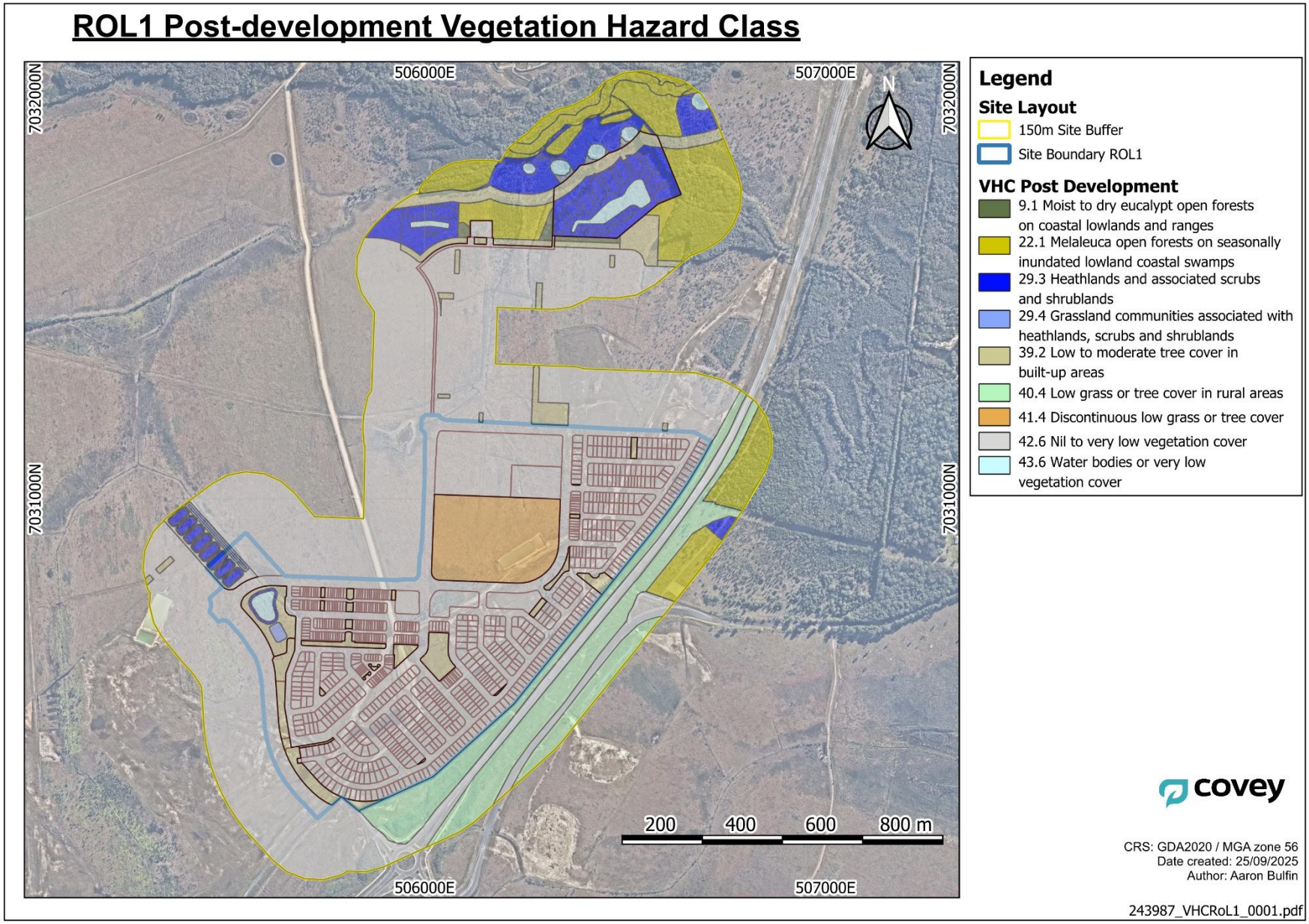


Figure 3-8. Post-development Vegetation Hazard Class within 150 m of ROL1 development.

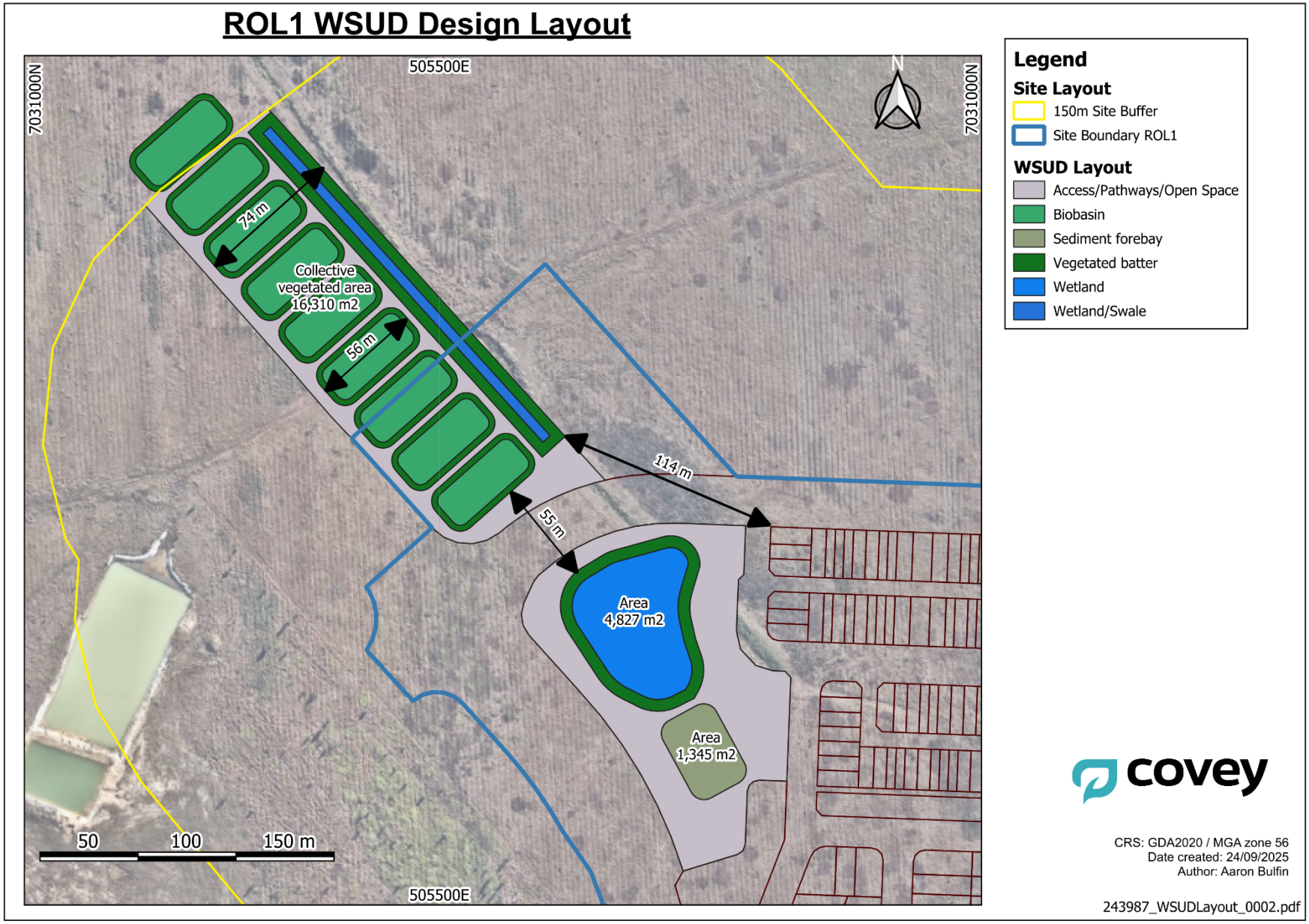


Figure 3-9. Proposed WSUD Layout provided by Stantec (August 2025).

4 Bushfire Assessment

4.1 Bushfire Impact Analysis and RHF Ratings

Radiant Heat Flux (RHF) modelling identifies the rate at which heat transfers to a receiver from a potential fire and how the energy dissipates with increasing distance from the fire. Covey completed Radiant Heat Flux modelling per Method 2 of AS3959, with the adoption of BRC prescribed Forest Fire Danger Index (FFDI) and fuel loads from the SPP (Table 4-1). Also, given that vulnerable uses are included in the proposed development, Covey undertook two RHF models, adopting:

1. 1,090°K flame temperature for residential, mixed-use and community centre uses; and
2. 1,200°K flame temperature for schools and childcare.

Note that the proponent indicated that mixed-use developments and community centres will not include vulnerable uses or essential infrastructure.

Covey completed the RHF model using Inferno modelling software, developed in-house by Covey (refer to Appendix B for further details). The model incorporated the following input values, satisfying BRC:

- A FFDI of 53, representing the 1 in 20 ARI fire weather event (Queensland Fire and Emergency Services, 2019a).
- State Planning Policy fuel load values per Table 4-1. Vegetation bushfire-prone type, understorey and total fuel loading (referred to as w and W, respectively) were derived from BRC.

According to Section 7.6 of the BRC, radiant heat flux is not required to be calculated for grassfire-prone VHCs or low-hazard VHC's (Queensland Fire and Emergency Services, 2019a). VHC 40.4 is considered *grassfire prone* and 39.2, 41.4, 42.6 and 43.6 are *low hazard* and contain *discontinuous bushfire fuel*; as such, these vegetation communities were not included in the RHF model (refer to BRC Figure 14 and s 7.6(5)).

Additionally, Bushfire Prone VHC's within the identified WSUD areas (VHC 29.3 and VHC 29.4) have not been incorporated into the RHF assessment and modelling within this BMP, further details are provided below.

Table 4-1. VHC fuel loading, vegetation prone type and Rate of Spread model adopted

VHC	VHC Description	Vegetation Type	*w* (t/ha)	*W* (t/ha)	Prone Type	Modelled
VHC 9.1	Moist to dry eucalypt open forests on coastal lowlands and ranges	Forests	21	24.2	Bushfire	Y
VHC 22.1	Melaleuca open forests on seasonally inundated lowland coastal swamps	Forests	23.4	28.4	Bushfire	Y
VHC 29.3	Heathlands and associated scrubs and shrublands	Scrub	14.5	20.1	Bushfire	N
VHC 29.4	Grassland communities associated with heathlands, scrubs and shrublands	Scrub	9.2	11.2	Bushfire	N
VHC 39.2	Discontinuous low to moderate tree cover in built-up areas	Low-threat	5	8	Low Hazard	N
VHC 40.4	Continuous low grass or tree cover	Grassland	4.5	5	Grassfire	N
VHC 41.4	Discontinuous low grass or tree cover	Low-threat	2.5	3	Low Hazard	N
VHC 42.6	Nil to very low vegetation cover	Low-threat	2	2	Low Hazard	N
VHC 43.6	Water bodies or very low vegetation cover	Low-threat	0	0	Low Hazard	N

4.1.1 Vegetated areas excluded from RHF assessment

Section 4.2.6 of BRC outline small patch and narrow corridor mapping rules which suggest that small patches of vegetation (<3 ha) and corridors of flammable vegetation less than 50 m in width are unlikely to support a fully developed flame front (Queensland Fire and Emergency Services, 2019a). Patches of vegetation < 3 hectares that are surrounded by non-continuous fuel and are further than 100 m away from any other continuous fuel vegetation patch larger than 2 hectares, are less likely to ignite due to being disconnected from continuous bushfire fuel that carry a running fire front (Leonard & Opie, 2017). Further, if a fire starts from a point ignition within this vegetation, it is less likely that these areas will support the development of a hazardous running fire because this requires sufficient distance and area. A fire within small patches and narrow corridors is expected to be narrower in width and therefore lower intensity (Leonard & Opie, 2017).

4.1.1.1 WSUD Areas within 150 meters of Precinct 18

The WSUD areas in the southwest of the development consist of two drainage areas that were determined as bushfire-prone areas. Based on the Water By Design (2024) landscape guidelines, the bio-basins and associated batters can be classified as VHC 29.3. The wetland is assumed to be permanently inundated, therefore was classified as VHC 43.6. Given the intent of the sediment forebay and the wetland/swale, the VHC would resemble more as an open grassland vegetation; to be conservative VHC 29.4 has been used.

Collectively the wetland and sediment forebay shown in Figure 3-9 has an area less than 1 hectare in size, and is separated by 55 metres from the WSUD landscaped areas to the north. Given the wetland area is designated as VHC 43.6, the remaining vegetation within this southern extent of WSUD devices have been excluded from assessment.

The northern extent of these WSUD devices (Figure 3-9) has a collective vegetated area of less than 2 hectares in size. The widest section of continuous fuel is 56 metres across the bio-basins. The masterplan shows that these WSUD areas will be surrounded by discontinuous and low hazard VHC. All bio-basins are separated from one another by a 3-metre-wide access track; the fuel connectivity is thus discontinuous across this area. The wetland/swale forms part of the stormwater treatment recirculation system within the Gagalba development, and water will be pumped from the lake to the top of the system and through the WSUD and swales to continually improve water quality. As a result, the vegetation moisture is understood to remain moderate to high in perpetuity and can be reasonably expected to lower the probability and intensity of any small fires that may occur.

Given the above attributes of the WSUD areas (Figure 3-9), including the isolation of the bushfire prone vegetation within the broader landscape, the ignition probability and overall potential impact is relatively low. It is considered to pose little to no bushfire risk for this development or adjoining future development areas and has been excluded from RHF assessment within this BMP.

4.1.1.2 Vegetated areas beyond 150 meters of Precinct 18

Within the ROL1 development application for Precinct 18 there will be future works brought forward within future Precincts including sewer pump station, vegetation works, and WSUD devices. Given that the identified bushfire prone VHCs within this future works area is further than 150 meters from the Precinct 18 residential and community development area, RHF assessment from this vegetation has been excluded within this BMP.

These vegetated areas and WSUD devices will likely need RHF assessment within future bushfire assessment and reporting to support these future development areas.

4.1.2 Results

The SPP guidance material (Queensland Government, 2019) states that development footprints be exposed to less than 29 kW/m^2 RHF, and vulnerable uses to be exposed to less than 10 kW/m^2 RHF (calculated with an input flame temperature of 1,200°K).

Based on the RHF modelling results, all the proposed lots within ROL1 are located to have an RHF of less than 29 kW/m^2 during credible worst-case bushfire events impacting the development (Figure 4-2). Several lots are located within 100 m of hazardous vegetation (shown as RHF <12.5 kW/m^2 in Figure 4-2). Per the Building Code of Australia, any buildings within these allotments (or within 100 m of hazardous vegetation) must be designed and constructed with the relevant Bushfire Attack Level (BAL) construction standards per Australian Standard, AS3959:2018 (refer to Section 5 for further information). The vulnerable uses which comprise the childcare centre and state primary school are exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature).

Note that a BAL assessment may be required to be undertaken in accordance with AS3959 before construction works of the buildings on the created lots. A Bushfire Attack Level (BAL) assessment does not form part of the assessment within this report.

4.2 Potential human impact and sheltering sites

Radiant heat flux and expected impacts on the human body are outlined in Table 4-2 for reference.

Table 4-2. Radiant heat flux impacts *(Penney et al., 2020)**.***

Radiant Heat Flux (kW/m^2)	Human effect
30	Significant chance of instantaneous fatality for unprotected exposed persons.
23.5	Likely fatality for extended exposure and chance of instantaneous fatality for unprotected exposed persons.
16.7	Significant chance of fatality for unprotected extended exposure.
10	Tenability threshold for bushfire fighters.
5	Limited human trials indicated no adverse effects
4.2	Will cause pain in 15-20 seconds of unprotected exposure. It will cause injury after 30 seconds of unprotected exposure.
3	Operational threshold for bushfire fighters attempting suppression.
2.5	Level of exposure permitted for evacuating occupants in the Building Code of Australia
2.1	Minimum heat radiation required to cause pain after 60 seconds of unprotected exposure
1.3	Exposure from mid-day sun

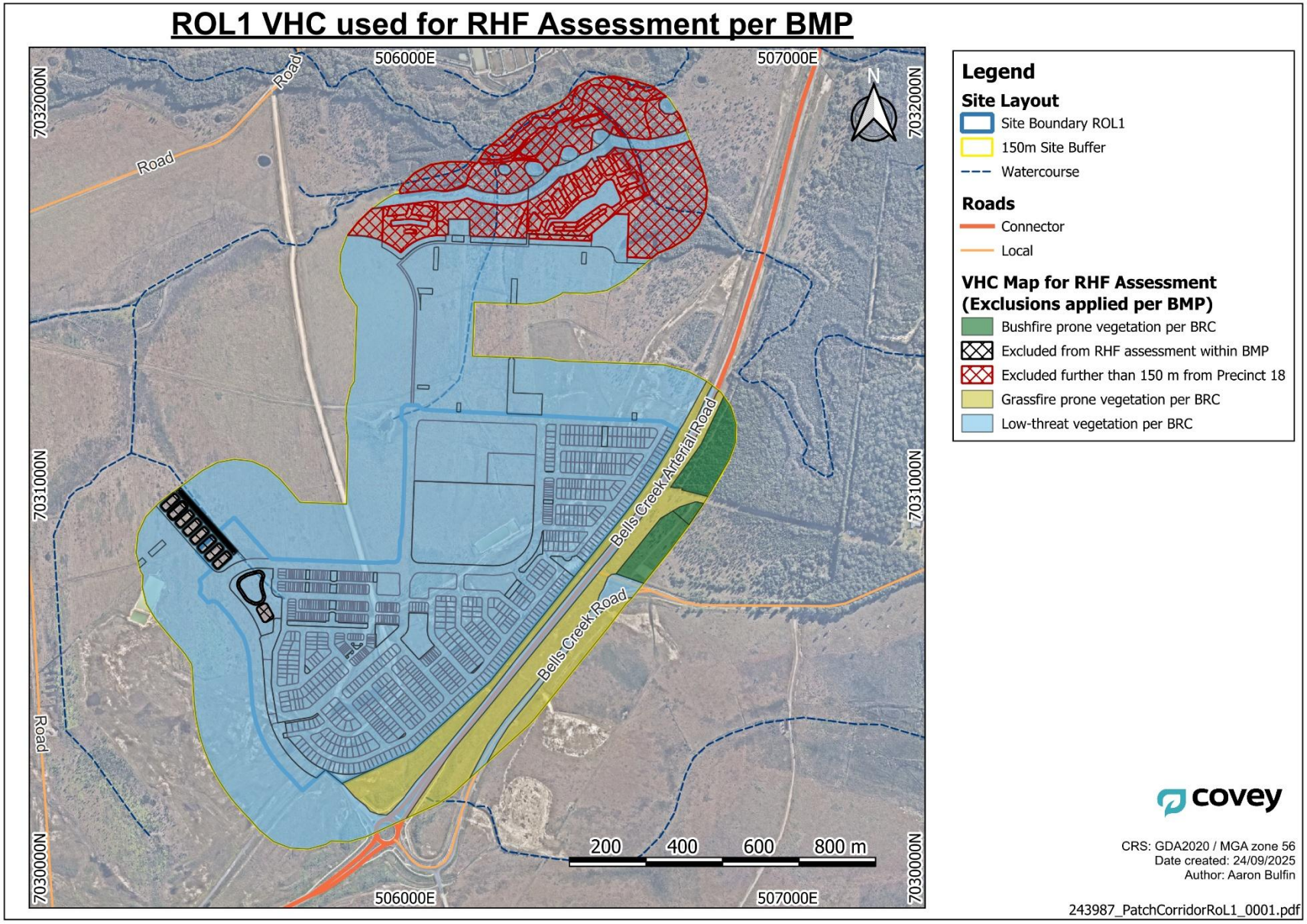


Figure 4-1. Vegetation Hazard Class with Small Patch and Narrow Corridors filter applied.

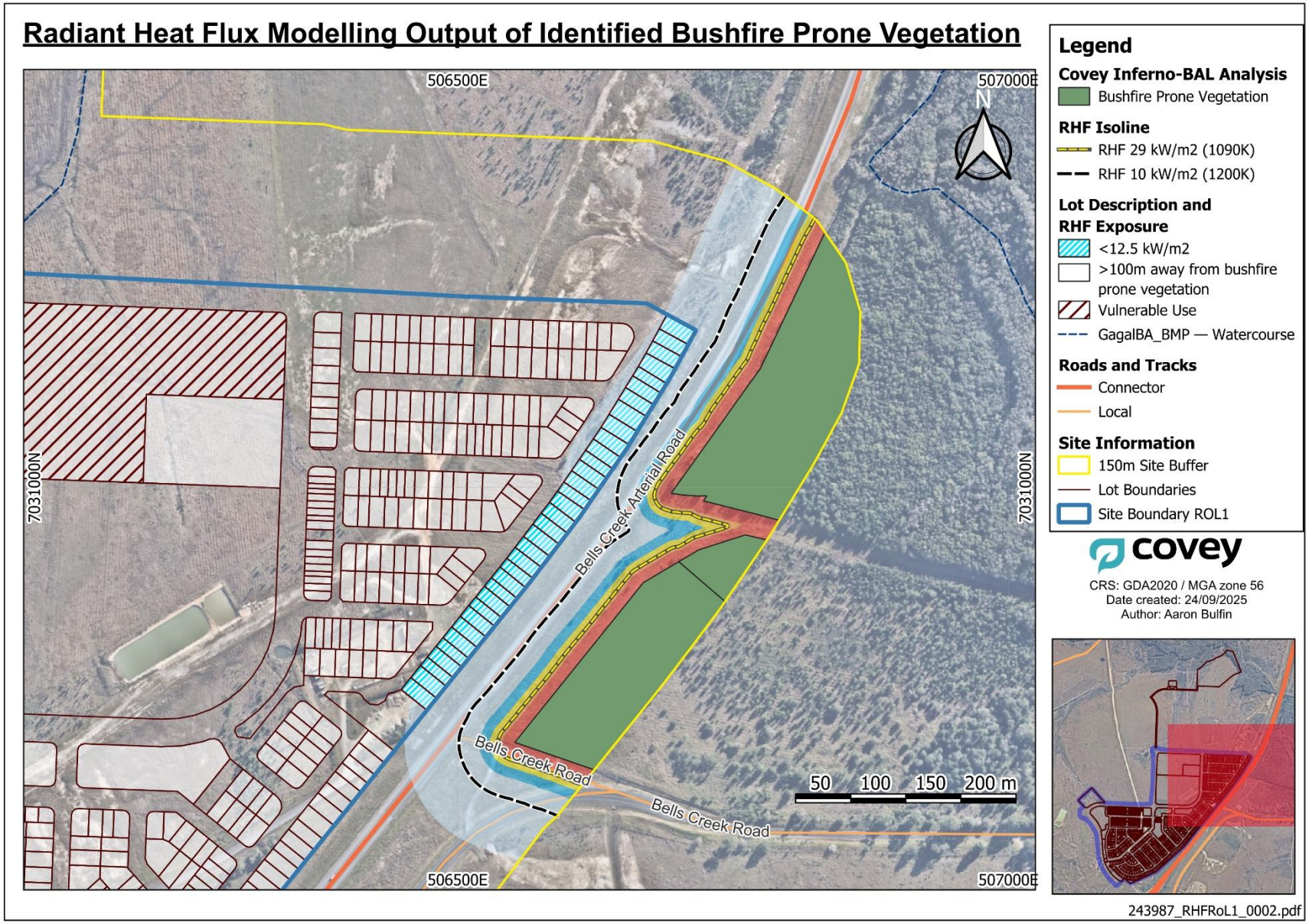


Figure 4-2. Radiant heat flux modelling output and lot exposure eastern.

5 Bushfire Mitigation Measures

The following section outlines bushfire mitigation measures to be incorporated into the proposed development design. These measures aim to comply with the BRC and SPP guidance material. Provided that the mitigation measures outlined in this section are implemented, the bushfire risk for the proposed development is deemed to be acceptable.

5.1 Setbacks / RHF exposure

The modelling indicates that all of the proposed lots within ROL1 provide a suitable setback from bushfire hazard vegetation so that they will be exposed to less than 29 kW/m^2 RHF per BRC (Figure 4-2). This is consistent with the mitigation measures outlined in the *Context BMP* which requires suitable setbacks from bushfire hazard vegetation. The proposed lots dedicated to childcare and a state primary school, which are defined as vulnerable uses, are exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature).

5.1.1 Asset Protection Zone

All neighbourhood recreation parks; linear open spaces, local recreation parks, landscape buffers and sports fields should be maintained as Asset Protection Zones . Within APZs, vegetation should be modified and/or maintained to reduce fuel load and mechanisms of bushfire attack, such as flame and radiant heat. These areas should comprise only low-threat vegetation as defined in AS3959 and managed in a minimal fuel condition, such as mown grass and maintained public reserves, parklands, and nature strips. Specifically, APZs are to ensure that building envelopes are exposed to less than 29 kW/m^2 in perpetuity. The APZs are to follow the Bushfire Landscaping Guidelines detailed in Section 5.4.

5.1.2 National Construction Code (NCC)

Several allotments are located within 100 m of hazardous vegetation, exposed to RHF <12.5 kW/m^2. Any buildings within these lots are required to be constructed with the relevant BAL specifications per AS3959:2018. While this assessment is focused on planning legislation, the Bushfire Prone Area overlay also triggers buildings to be constructed in accordance with Building Code of Australia (BCA). The BCA requires Class 1, Class 2, Class 3 buildings, and a Class 10a building or deck associated with a Class 1, 2 or 3 to be constructed per AS 3959-2018 (National Construction Code, 2022a, 2022b). The NCC was updated in 2022, and certain Class 9 Buildings are now subject to additional bushfire requirements; refer to Part G5 and Specification 43 of NCC Volume 1 (National Construction Code, 2022).

A Bushfire Attack Level assessment may be required to be undertaken per AS3959 before construction works of the buildings on the created lots, and do not form part of the assessment within this report.

5.2 Access

At master planned community plan sealing, the proposed development will be accessed via a new sub-arterial road connected to the Bells Creek Arterial Road and two main sub-arterial access points connecting to future proposed developments to the north and west. Until the proposed development is completed, existing vehicle access tracks within the context plan area will be maintained to allow access and egress to two-wheel drive private and emergency vehicles.

The design and construction of infrastructure is to ensure accessibility to all existing and proposed infrastructure to emergency services. Access roads, including internal driveways are to follow *Fire hydrant and vehicle access guidelines* (Queensland Fire and Emergency Services, 2019c). This guideline defers to the *Road Pl*

anning and Design Manual – 2nd Edition (Department of Transport and Main Roads, 2021). Access design and construction should incorporate the following parameters:

- Minimum roadway clearance of 3.5 m wide by 4.8 m high to allow access for a fire truck;
- Be accessible in all weather conditions and able to accommodate a vehicle of 15 tonnes for the trafficable road width;
- Road grades must facilitate the safe passage of fire trucks;
- Roads must allow for fire trucks to turn at the end of dead-end roads; and
- Provision is made for fire trucks to turn at the end of dead-end roads (Figure 5-1)

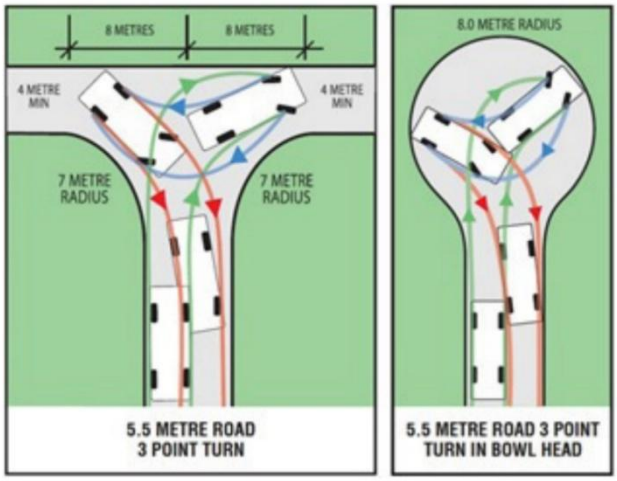


Figure 5-1. **Vehicle Turning Points** (Queensland Fire and Emergency Services, 2019b).

5.3 Fire-fighting Water Supply

The proposed development will be conditioned to provide a connection to the mains water supply, including for firefighting purposes. Provision will be made to connect to the water mains supply, with suitable allocation of fire-fighting infrastructure (hydrants) in accordance with the SEQ Water Supply Code and the *Australian Standard – Fire hydrant installations system design, installation and commissioning* (AS 2419.1:2021).

5.4 Bushfire Landscaping Guidelines

Landscaping within the site, including areas mapped as low-hazard vegetation (refer to Section 3.3 and 5.1.1 of this BMP) should utilise plant species that do not exacerbate the level of bushfire threat. Aside from the drainage areas, the landscaping design within the proposed development must not constitute a bushfire threat and should be in line with the SLI (Urbis 2024). The proposed neighbourhood recreation parks, linear open spaces, local recreation parks, landscape buffers and sports field should all be maintained regularly to reduce woody regrowth, weeds and keep grass mown to no more than 100 mm, per exclusions under AS3959 2.2.3.2 (f). These areas are to be maintained in minimal fuel condition and comprise only low-threat vegetation.

Landscaping within these areas should align with Low Threat exclusion clauses defined in AS3959, S2.2.3.2. Examples include:

(i) Landscaping design within the low fuel zone, being consistent with AS3959 S2.2.3.2(f) to ensure vegetation does not create vertically and horizontally continuous fuel structures that may contribute to bushfire intensity (Figure 5-2);

(ii) Where areas of bushland are to be included as part of landscaping design in the low fuel zone, ensure they are consistent with AS3959 S2.2.3.2, being less than 0.25 ha in area and not within 20 m of each other or proposed dwellings (
Figure 5-3);

(iv) Utilise non-vegetated areas within the development consistent with AS3959 S2.2.3.2 (e) to provide enhanced separation between buildings and vegetation identified as a bushfire threat external to the site boundaries; and,

(v) Utilise 'Fire-Wise' plant species that are resistant to the effects of fire (guidance can be found at http://www.cfa.vic.gov.au/plan-prepare/landscaping-for-bushfire).

Figure 5-2. Low Threat vegetation (left) and Low Threat public open space (right).

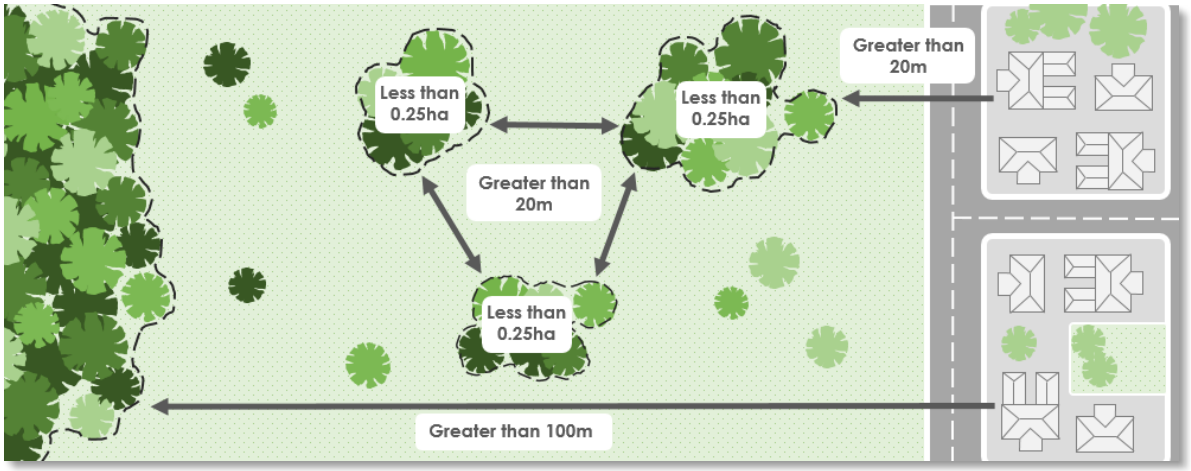


Figure 5-3. AS3959 Exclusions—Low threat vegetation and non-vegetated areas.

5.5 Grassland Maintenance

As outlined above, vegetation surrounding the proposed development is expected to be maintained as grassland in the interim period before the adjoining developments are constructed. Within 150 m of the ROL1 development, grassland should be mown and/or slashed regularly to ensure that the grass is always maintained to a height of less than 100 mm, to remain consist with Low Threat Vegetation exclusions under AS3959 2.2.3.2(f).

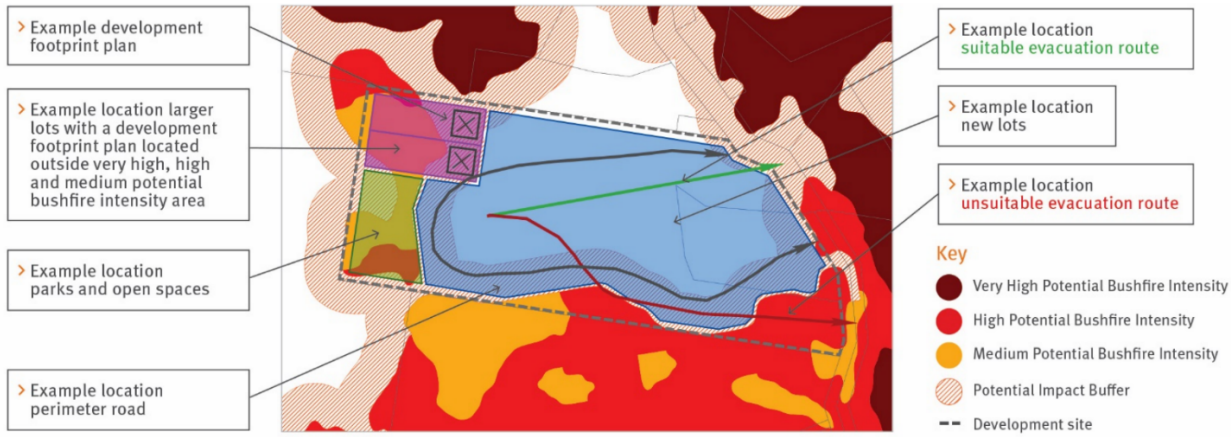
6 Performance Criteria and Compliance

This BMP applies acceptable outcomes to achieve the Performance Outcomes as detailed in the example Bushfire Overlay Code of the SPP guidance material (Queensland Government, 2019). The Performance Outcomes detailed in the SPP guidance material are addressed in the development design are summarised in Table 6-1.

Table 6-1. Satisfaction of the SPP guidance material example Bushfire Overlay Code.

Performance Outcomes	Acceptable Outcomes	Development Compliance
Section A Reconfiguring a lot (RaL) – where creating lots of more than 2,000 square metres		
PO1 The subdivision layout: a. enables future buildings to be located away from slopes and landforms that expose people or property to an intolerable risk to life or property; and b. facilitates emergency access and operational space for firefighters in a reduced fuel area between future buildings and structures and hazardous vegetation, that reduce risk to an acceptable or tolerable level. Note – An applicant may seek to undertake a site-level verification of the location and nature of hazardous vegetation and resulting potential bushfire intensity levels, for example where changes in foliage have occurred (e.g. as a consequence of adjoining permanent urban development) or where an applicant seeks to verify the regional ecosystem map inputs. This verification should form part of a bushfire hazard assessment in accordance with the methodology in the QFES Bushfire resilient communities document. The outcomes of this assessment can demonstrate how an alternate solution to the acceptable outcome can deliver an acceptable or tolerable level of risk.	**AO1.1** A development footprint plan is identified for each lot that avoids ridgelines, saddles and crests where slopes exceed 15 per cent. **AO1.2** A development footprint plan is identified for each lot that is separated from the closest edge to the adjacent mapped medium, high or very high potential bushfire intensity area by: a. a distance that is no closer than the distances specified in Table 5 at all development footprint plan boundaries; or b. a distance that achieves a radiant heat flux level of 29 kW/m^2 or less at all development footprint plan boundaries. Note – This separation area is often termed an asset protection zone. Note – The radiant heat flux levels can be established by undertaking a bushfire hazard assessment in accordance with the methodology in the QFES Bushfire resilient communities document.	**Compliant** Six proposed lots cover more than 2,000 m^2. These incorporate the emerging community uses, multiple residential areas, the childcare centre and a State primary school. All lots of more than 2,000 m^2 within the development are exposed to less than 29 kW/m^2. The proposed lots dedicated to childcare and state primary school (vulnerable uses) are exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature).
PO2 The subdivision layout enables: a. future buildings to be located as close as possible to property entrances to facilitate safe evacuation during a bushfire event; and b. future site access to be located and designed to allow safe evacuation of the site by occupants and maintain access by emergency services under critical event conditions.	**AO2** A development footprint plan is identified for each lot that: a. is located within 60 metres of the street frontage; and b. sited to enable a route between the development footprint plan and the street frontage with a gradient that does not exceed of 12.5 per cent.	**Compliant** The site is largely flat and all proposed lots will have access via a street frontage. The proposed development is to ensure accessibility to all existing and proposed infrastructure to emergency services. Access roads, including internal driveways are to follow Fire hydrant and vehicle access guidelines (Queensland Fire and Emergency Services, 2019c). This guideline defers to the Road Planning and Design Manual – 2nd Edition (Department of Transport and Main Roads, 2021).

Section B Reconfiguring a lot (RaL) – where creating lots of 2,000 square metres or less		
PO3 The subdivision layout: a. avoids creating lots on slopes and landforms that expose people or property to an intolerable risk to life or property; and b. facilitates emergency access and operational space for firefighters in a reduced fuel area between future buildings and structures and hazardous vegetation, that reduce risk to an acceptable or tolerable level. Note – An applicant may seek to undertake a site-level verification of the location and nature of hazardous vegetation and resulting potential bushfire intensity levels, for example where changes in foliage have occurred (e.g. as a consequence of adjoining permanent urban development) or where an applicant seeks to verify the regional ecosystem map inputs. This verification should form part of a bushfire hazard assessment, in accordance with the methodology in the QFES Bushfire resilient communities document. The outcomes of this assessment can demonstrate how an alternate solution to the acceptable outcome can deliver an acceptable or tolerable level of risk.	**AO3.1** The subdivision layout results in lots that are sited so that they are separated from the closest edge to the adjacent mapped medium, high or very high potential bushfire intensity area by: a. a distance that is no closer than the distances specified in Table 5 at all lot boundaries; or b. a distance that achieves a radiant heat flux level of 29 kW/m^2 or less: i. at the building envelope, if identified at RaL stage; or ii. where a building envelope is not identified, at all lot boundaries. Note – This separation area is often termed an asset protection zone. Note – The radiant heat flux levels can be established by undertaking a bushfire hazard assessment in accordance with the methodology in the QFES Bushfire resilient communities document. Note – For staged developments, temporary separation areas may be absorbed as part of subsequent stages. Note – Existing cleared areas external to the site may only be used in calculating necessary separation where tenure ensures that the land will remain cleared of hazardous vegetation (for example the land is a road, watercourse or highly managed park in public ownership). **AO3.2** The subdivision layout does not create lots that are within bushfire prone areas and on ridgelines, saddles and crests where slopes exceed 15 per cent (roads and parks may be located in these areas).	**Compliant** The RHF modelling indicates that all of the proposed residential lots will be exposed to less than 29 kW/m^2 RHF per BRC (Figure 4-2). All neighbourhood recreation parks, linear open spaces, local recreation parks, landscape buffers and sports fields must be maintained in a minimal fuel condition with low threat vegetation so that the building envelopes remain exposed to less than 29 kW/m^2 in perpetuity. These open space areas are to follow the Bushfire Landscaping Guidelines detailed in Section 5.4. The site lacks steep slopes or ridgelines, that would increase bushfire risk and affect the design of the proposed allotments.
Section C Reconfiguring a lot (RaL) – where creating more than 20 lots		
PO4 The subdivision layout is designed to minimise the length of the development perimeter and number of lots exposed to hazardous vegetation. Note – For example, avoid finger-like subdivision patterns or substantive vegetated corridors between lots.	**AO4** No acceptable outcome is prescribed.	**Compliant** All proposed lots adjacent to an area of assessable bushfire hazardous vegetation within this assessment have been sited to ensure a suitable buffer is in place through the implementation of a road network. This will allow all proposed residential and community centre lots to be exposed to less than 29 kW/m^2; and vulnerable uses to be exposed to less than 10 kW/m^2 (Figure 4-2)

		No finger-like subdivision patterns or significant vegetation corridors have been included in the proposed development.
PO5 The subdivision layout provides for adequate access and egress and safe evacuation routes, to achieve an acceptable or tolerable risk to people.	**AO5.1** The subdivision layout: a. avoids the creation of bottle-neck points in the movement network within the development (for example, avoids hourglass patterns); and b. ensures the road network has sufficient capacity for the evacuating population. **AO5.2** The subdivision layout ensures evacuation routes: a. direct occupants away from rather than towards or through areas with a greater potential bushfire intensity; and b. minimise the length of route through bushfire prone areas. Refer Figure 5.	**Compliant dependent on approval of adjoining stages** The proposed development assessed within this BMP provides a design layout that demonstrates suitable separation from bushfire hazards to proposed development lots, provides a suitable road network that will allow for access of emergency vehicles, and egress of residents away from approaching bushfire risks. The proposed road network has been designed to limit the amount of dead-ends (cul-de-sacs), and ensures sufficient roadway width to allow for two-way passing and access of larger emergency service vehicles. Until the proposed development is completed, existing vehicle access tracks within the context plan area will be maintained to allow access and egress to private and emergency vehicles. The design and construction of infrastructure is to ensure accessibility to all existing and proposed infrastructure to emergency services. Access roads, including internal driveways are to follow Fire hydrant and vehicle access guidelines (Queensland Fire and Emergency Services, 2019c). This guideline defers to the Road Planning and Design Manual – 2nd Edition (Department of Transport and Main Roads, 2021).
 *Figure 5 – Subdivision layout and evacuation routes*		
PO6	**AO6.1**	**Compliant**

The subdivision layout provides adequate buffers between hazardous vegetation and development. Note – An applicant may seek to undertake a site-level verification of the location and nature of hazardous vegetation and resulting potential bushfire intensity levels, for example where changes in foliage have occurred (e.g. as a consequence of adjoining permanent urban development) or where an applicant seeks to verify the regional ecosystem map inputs. This verification should form part of a bushfire hazard assessment, in accordance with the methodology in the QFES Bushfire resilient communities document. The outcomes of this assessment can demonstrate how an alternate solution to the acceptable outcome can deliver an acceptable or tolerable level of risk.	The subdivision layout results in an asset protection zone being located to create a separation area from adjacent mapped medium, high or very high potential bushfire intensity areas. **AO6.2** The asset protection zone is comprised of: a. parks and open spaces; and/or b. lots greater than 2000 square metres; and/or c. public roads (termed perimeter roads). Note – Parks and open space may be located within the mapped medium, high and very high potential bushfire intensity areas to create a separation between the development and the balance of the bushfire prone area. Note – Portions of lots greater than 2000 square metres may be located within the mapped medium, high and very high potential bushfire intensity areas. Refer Figure 5. **AO6.3** Where the asset protection zone includes lots greater than 2000 square metres a development footprint plan is identified for each lot that is located in accordance with AO1.2.	The modelling indicates that all of the proposed residential lots will be exposed to less than 29 kW/m^2 RHF per BRC (Figure 4-2). All neighbourhood recreation parks, linear open spaces, local recreation parks, landscape buffers and sports fields must be maintained in a minimal fuel condition with low threat vegetation to be considered an APZ. Within APZ, vegetation should be modified and/or maintained to reduce fuel load and mechanisms of bushfire attack such as flame and radiant heat. Specifically, APZs are to ensure that building envelopes are exposed to less than 29 kW/m^2 in perpetuity. The APZs are to follow the Bushfire Landscaping Guidelines detailed in section 5.4. The proposed lots dedicated to a childcare centre and the state primary school (vulnerable uses) are exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature). All proposed lots adjacent to an area of assessable bushfire hazardous vegetation within this assessment have been sited as to ensure a suitable buffer is in place through the implementation of a road network or APZ if required.
PO7 Parks or open space provided as part of the asset protection zone do not create additional bushfire prone areas. Note –The undertaking of a bushfire hazard assessment, in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this performance outcome.	**AO7** Where the asset protection zone includes parks or open spaces, they: a. comprise only low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parklands, cultivated gardens and nature strips; or b. are designed to ensure a potential available fuel load is maintained at less than eight tonnes/hectare in aggregate and with a fuel structure that remains discontinuous. Note – Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack, for example short-cropped grass to a nominal height of 10 centimetres.	**<u>Compliant</u>** Landscaping within the site, including areas mapped as low-hazard vegetation, such as neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers and sports field, (refer to Section 3.3 and 5.1.1 of this BMP) should utilise plant species that do not exacerbate the level of bushfire threat. The landscaping design within the proposed development must not constitute a bushfire threat and should be in line with SLI (Urbis 2024). Further, during the interim period where adjoining developments have not been constructed, grassland surrounding the Precinct 18 and ROL1 area is to be regularly maintained to remain consist with Low Threat Vegetation exclusions

		under AS3959 2.2.3.2(f) (mown grass no taller than 100 mm).
PO8 Perimeter roads are accessible for fire-fighting vehicles, to facilitate emergency access and operational space for fire-fighting, maintenance works and hazard reduction activities.	**AO8.1** Where the asset protection zone includes a perimeter road it: a. has a two-lane sealed carriageway clear of hazardous vegetation; and b. is connected to the wider public road network at both ends and at intervals of no more than 200 metres; and c. does not include design elements that may impede access for fire-fighting and maintenance for fire-fighting purposes (for example traffic calming involving chicanes). **AO8.2** Where the subdivision contains a reticulated water supply, the road network and fire hydrants are designed and installed in accordance with: a. *Fire Hydrant and Vehicle Access Guidelines for residential, commercial and industrial lots*, Queensland Fire and Emergency Services, 2015, unless otherwise specified by the relevant water entity; and b. the *Road Planning and Design Manual 2nd edition*, Department of Transport and Main Roads, 2013.	**Compliant** A perimeter road is to be established around the outer edge of the proposed lots adjacent to bushfire prone vegetation. This perimeter road will be connected to the wider public road network. The proposed road network has been designed to limit the number of dead-ends (cul-de-sacs), and ensures sufficient roadway width to allow for two-way passing and access of larger emergency service vehicles. The proposed development will be conditioned to provide connection to mains water supply, with provision of a piped water network capable of supplying sufficient flow and pressure for fire-fighting purposes. Provision will be made to connection to water mains supply, with suitable allocation of fire-fighting infrastructure (hydrants) in accordance with the local water retailer's specifications and the Australian Standard – Fire hydrant installations system design, installation and commissioning (AS 2419.1:2021).
Section D Reconfiguring a lot (RaL) – where creating additional lots for the purpose of residential development and a reticulated water supply is not provided		
PO9 The subdivision layout provides for perimeter roads or fire trail and working areas that are accessible by the type of fire-fighting vehicles servicing the area, to facilitate emergency access and operational space for fire-fighting, maintenance works and hazard reduction activities.	**AO9** The subdivision layout includes: a. a fire trail and working area designed and constructed in accordance with the design parameters in Table 6 that separates the residential lot or development footprint plan from adjacent mapped medium, high or very high potential bushfire intensity areas; or b. a perimeter road designed and constructed in accordance with AO8.1. Refer Figure 6.	**Not Applicable** The development is to provide connection to mains water supply.

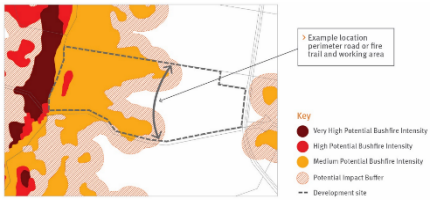
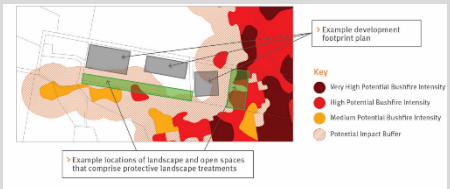


Figure 6 – Siting of fire trail and working area

Section E Material change of use		
PO10 Site layout achieve an acceptable or tolerable risk to people. Landscape or open space provided as part of the development: a. acts as a buffer between hazardous vegetation and development; and b. does not create additional bushfire prone areas. Note – An applicant may seek to undertake a site-level verification of the location and nature of hazardous vegetation and resulting potential bushfire intensity levels, for example where changes in foliage have occurred (e.g. as a consequence of adjoining permanent urban development) or where an applicant seeks to verify the regional ecosystem map inputs. This verification should form part of a bushfire hazard assessment in accordance with the methodology in the QFES Bushfire resilient communities document. The outcomes of this assessment can demonstrate how an alternate solution to the acceptable outcome can deliver an acceptable or tolerable level of risk.	**AO10.1** Site layout places the landscape and open spaces within the site between premises and adjacent mapped medium, high or very high potential bushfire intensity areas. Refer Figure 7. **AO10.2** This landscaping and open space comprises protective landscape treatments that: a. comprise only low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses and cultivated gardens; or b. are designed to ensure a potential available fuel load is maintained at less than 8 tonnes/hectare in aggregate and that fuel structure remains discontinuous. Note – Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack, for example short-cropped grass to a nominal height of 10 centimetres.	**Compliant** All proposed lots adjacent to an area of assessable bushfire hazardous vegetation within this assessment have been sited to ensure a suitable buffer is in place through the implementation of a road network or APZ if required. This will allow all proposed residential and community centre lots to be exposed to less than 29 kW/m^2; and vulnerable uses to be exposed to less than 10 kW/m^2 (Figure 4-2). Landscaping within the site, including areas mapped as low hazard vegetation, such as neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers and sports field, (refer to Section 3.3 and 5.1.1 of this BMP) should utilise plant species that do not exacerbate the level of bushfire threat. The landscaping design within the proposed development must not constitute a bushfire threat and should be in line with SLI (Urbis 2024). Further, during the interim period where adjoining developments have not been constructed, grassland surrounding the Precinct 18 and ROL1 is to be regularly maintained to remain consist with Low Threat Vegetation exclusions under AS3959 2.2.3.2(f) (mown grass no taller than 100 mm)
 *Figure 7 – Siting of protective landscape treatments*		
PO11 The development establishes evacuation areas, to achieve an acceptable or tolerable risk to people.	**AO11** If in an isolated location, development establishes direct access to a safe assembly/evacuation area.	**Not Applicable** The proposed development is not situated in an isolated area. However, the proposed state primary school and sports park are

	Note – Guidance on identifying safe evacuation areas is contained in the QFES Bushfire resilient communities document.	outside the bushfire hazard zone and would serve as safe locations for assembly or evacuation if needed.
PO12 If on a lot of over 2000m^2, where involving a new premises or an existing premises with an increase in development footprint, development: a. locates occupied areas as close as possible to property entrances to facilitate safe evacuation during a bushfire event; and b. ensures vehicular access is located and designed to allow safe evacuation of the site by occupants and maintain access by emergency services under critical event conditions.	**AO12** No acceptable outcome is prescribed.	**Not Applicable**
PO13 Development is located within a reticulated water supply area or includes a dedicated static water supply that is available solely for fire-fighting purposes and can be accessed by fire-fighting vehicles. Note – Swimming pools, farm ponds and dams are not considered reliable sources of static water supply in Queensland due to regular drought events. [Note for Local Government – Information on how to provide an appropriate static water supply, may form a condition of a development approval. For further information on preferred solutions refer to the QFES Bushfire resilient communities document.]	**AO13** No acceptable outcome is prescribed.	**Compliant** The proposed development will be conditioned to provide connection to mains water supply, with provision of a piped water network capable of supplying sufficient flow and pressure for fire-fighting purposes. Provision will be made to connection to water mains supply, with suitable allocation of fire-fighting infrastructure (hydrants) in accordance with the local water retailer's specifications and the Australian Standard – Fire hydrant installations system design, installation and commissioning (AS 2419.1:2021).
PO14 Vulnerable uses listed in Table 7 are not established or intensified within a bushfire prone area unless: a. there is an overriding need in the public interest for the new or expanded service the development provides; and b. there are no other suitable alternative locations within the required catchment; and c. site planning can appropriately mitigate the risk (for example, siting ovals for an educational establishment between the hazardous vegetation and structures. Note – The preparation of a bushfire management plan in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this performance outcome.	**AO14** No acceptable outcome is prescribed	**Compliant** The proposed lots dedicated to childcare centre and state primary school (vulnerable uses) are exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature). All proposed lots adjacent to an area of assessable bushfire hazardous vegetation within this assessment have been sited as to ensure a suitable buffer is in place through the implementation of a road network or APZ if required.
PO15	**AO15**	**Not Applicable**

Community infrastructure providing essential services listed in Table 7 are not established within a bushfire prone area unless: a. there is an overriding need in the public interest for the new or expanded service the development provides (for example, there are no other suitable alternative locations that can deliver the required level of service or meet emergency service response times during and immediately after a bushfire event); and b. the infrastructure can function effectively during and immediately after a bushfire event. Note – The preparation of a bushfire management plan in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this performance outcome.	No acceptable outcome is prescribed.	The proponent has indicated that proposed community centres (including Local, District, Neighbourhood Community Centres) are largely intended for commercial uses such as shops, amenities and food and drink outlet. Any community infrastructure providing essential services is to be exposed to less than 10 kW/m^2 (calculated with an input 1,200°K flame temperature).
PO16 Development avoids or mitigates the risks to public safety and the environment from the manufacture or storage of materials listed in Table 7 that are hazardous in the context of bushfire to an acceptable or tolerable level. Note – The preparation of a bushfire management plan in accordance with the methodology in the *QFES Bushfire resilient communities* document may assist in demonstrating compliance with this acceptable outcome. Editor's note – In addition to the requirements of this code the *Work Health and Safety Act 2011* and associated Regulation and Guidelines, the *Environmental Protection Act 1994* and the relevant building assessment provisions under the *Building Act 1975* contain requirements for the manufacture and storage of hazardous substances. Information is provided by Business Queensland on the requirements for storing and transporting hazardous chemicals, available at: www.business.qld.gov.au/running-business/protecting-business/risk-management/hazardous-chemicals/storing-transporting.	**AO16** No acceptable outcome is prescribed.	**Not Applicable** The proposed development does not involve from the manufacture or storage of hazardous materials from a bushfire perspective.
Section F Where involving an asset protection zone		
PO17 Asset protection zones are designed and managed to ensure they do not increase the potential for bushfire hazard. Note – The preparation of a landscape management plan undertaken in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this performance outcome.	**AO17.1** Landscaping treatments within any asset protection zone comprise only low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks. Note – Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack,	**Not Applicable** Landscaping within the site, including areas mapped as low hazard vegetation, such as neighbourhood recreation park, linear open spaces, local recreation park, landscape buffers and sports field, (refer to Section 3.3 and 5.1.1 of this BMP) should utilise plant species that do not exacerbate the level of bushfire threat. The landscaping design within the proposed development must not

	for example short-cropped grass to a nominal height of 10 centimetres. OR **AO17.2** Landscaping management within any asset protection zone maintains a: a. potential available fuel load which is less than eight tonnes/hectare in aggregate; and b. fuel structure which is discontinuous. Note – The preparation of a landscape management plan undertaken in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this acceptable outcome.	constitute a bushfire threat and should be in line with SLI (Urbis 2024). Further, during the interim period where adjoining developments have not been constructed, grassland surrounding the Precinct 18 is to be regularly maintained to remain consist with Low Threat Vegetation exclusions under AS3959 2.2.3.2(f) (mown grass no taller than 100 mm). All neighbourhood recreation parks, linear open spaces, local recreation parks, landscape buffers and sports fields must be maintained in a minimal fuel condition with low threat vegetation to be considered an APZ. Within APZ, vegetation should be modified and/or maintained to reduce fuel load and mechanisms of bushfire attack such as flame and radiant heat. Specifically, APZs are to ensure that building envelopes are exposed to less than 29 kW/m^2 in perpetuity. The APZs are to follow the Bushfire Landscaping Guidelines detailed in section 5.4.
Section G Where planning provisions or conditions of approval require revegetation or rehabilitation		
PO18 Revegetation or rehabilitation areas are designed and managed to ensure they do not result in an unacceptable level of risk or an increase in bushfire intensity level. Note – The undertaking of a bushfire hazard assessment in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this performance outcome.	AO18.1 Required revegetation or rehabilitation: a. is located outside of any asset protection zone; or b. maintains a potential available fuel load which is less than eight tonnes/hectare in aggregate and fuel structure which is discontinuous. Note – The preparation of a landscape management plan undertaken in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with acceptable outcome (b). **AO18.2** Revegetation or rehabilitation of areas located within mapped medium, high or very high potential bushfire intensity areas, revegetate and rehabilitate in a manner that maintains or reduces the existing fuel load. OR Revegetation or rehabilitation of areas located within the mapped potential impact buffer area, revegetate and rehabilitate in a	**Compliant** The rehabilitation plan detailed by SMEC (2023) was taken in consideration in the preparation of this BMP. The proposed development incorporates appropriate setbacks from the potential bushfire hazard arising from rehabilitated areas (Figure 4-2).

	manner that maintains or reduces the existing fuel load. Note – The preparation of a vegetation management plan undertaken in accordance with the methodology in the QFES Bushfire resilient communities document may assist in demonstrating compliance with this acceptable outcome.	

7 Conclusion

The site is subject to a medium potential bushfire intensity per BPA specific to Aura Lakes context plan (Section 3 of BMP). This BMP detailed the bushfire hazards to which the development is exposed and the bushfire mitigation measures required to be implemented to reduce the risk to acceptable levels per *Natural Hazards, Risk and Resilience, State Planning Policy State Interest guidance material* (Queensland Government, 2019) and BRC. Specifically, this report outlines the required bushfire mitigation measures required for the development to satisfy Bushfire Overlay Code Assessment Criteria (Section 5 and 6 respectively).

This BMP has identified that:

- All proposed residential allotments are subject to Radiant Heat Flux (RHF) less than 29kW/m^2 within the Precinct 18 development area of Gagalba as part of the ROL1 development area.
    - 34 residential lots that adjoin Bells Creek Arterial Road are subject to RHF less than 12kW/m^2 though as they are within 100 metres of identified bushfire prone vegetation, will require BAL construction standards applied.
- It has been demonstrated that the proposed State Primary School is not impacted by RHF 10kW/m^2
- The landscape design for proposed stormwater treatment basins align with the vegetation hazard class per this BMP, in terms of species selection and vegetation structure; or a lower risk vegetation.
- All future landscape design as it is developed within operational works phases of the development shall not exacerbate or increase bushfire prone vegetation from what has been assessed, this includes any planting of vegetation that does not align with Clause 2.2.3.2 of AS3959:2018.

Provided the bushfire mitigation measures detailed in this BMP are implemented, the bushfire hazard level, bushfire-related risk level and RHF level applicable to the proposed development are not considered unreasonable and should not prohibit the development of the site.

This BMP focused solely on bushfire-related risk and mitigation strategies, and further investigations, such as an engineering services report or ecological assessments, might be required to support a development application.

References

Australian Standards. (2018). *AS 3959:2018 Construction of buildings in bushfire-prone areas*. SAI Global Limited.

Australian Standards. (2021). *AS 2419.1:2021 Fire Hydrant Installations, Part 1: System design, installation and commissioning*. https://infostore.saiglobal.com/en-au/Standards/AS-2419-1-2017-99264_SAIG_AS_AS_208705/

Cruz, M. G., Sullivan, A. L., Gould, J. S., Sims, N. C., Bannister, A. J., Hollis, J. J., & Hurley, R. J. (2012). Anatomy of a catastrophic wildfire: The Black Saturday Kilmore East fire in Victoria, Australia. *Forest Ecology and Management*, *284*, 269–285. https://doi.org/10.1016/j.foreco.2012.02.035

CSIRO. (2020). *Bushfire Resilient Building Guidance for Queensland Homes*. www.qra.qld.gov.au

CSIRO, Bureau of Meteorology, & Australian Energy Market Operator. (2021). *ESCI Project Final Report*.

Department of Transport and Main Roads. (2021). *Road Planning and Design Manual*.

Douglas, G., He, Y., Xiang, Y., & Morris, E. C. (2014). Use of the extreme value analysis in determining annual probability of exceedance for bushfire protection design. *Fire Safety Science*, *11*(January 1994), 1379–1392. https://doi.org/10.3801/IAFSS.FSS.11-1379

Dowdy, A., Abbs, D., Bhend, J., Chiew, F., Church, J., Ekström, M., Kirono, D., Lenton, A., Lucas, C., McInnes, K., Moise, A., Monselesan, D., Mpelasoka, F., Webb, L., & Whetton, P. (2015). East Coast Cluster Report. In M. Ekström, P. Whetton, C. Gerbin, M. Grose, L. Webb, & J. Risbey (Eds.), *Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*. CSIRO and Bureau of Meteorology.

Dowdy, A. J. (2018). Climatological variability of fire weather in Australia. *Journal of Applied Meteorology and Climatology*, *57*(2), 221–234. https://doi.org/10.1175/JAMC-D-17-0167.1

Elvis - Elevation and Depth - Foundation Spatial Data. (n.d.). Retrieved May 19, 2022, from https://elevation.fsdf.org.au/

Leonard, J., & Opie, K. (2017). *Estimating the potential bushfire hazard of vegetation patches and corridors*.

National Construction Code. (2019). *Building Code of Australia: Volume One*.

National Construction Code. (2022). *Building Code of Australia: Volume One*.

Penney, G., Habibi, D., & Cattani, M. (2020). *A handbook of wildfire engineering: Guidance for wildfire suppression and resilient urban design*. Bushfire and Natural Hazards CRC. https://ro.ecu.edu.au/ecuworkspost2013/8675/

Queensland Fire and Emergency Services. (2019a). *Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest "Natural Hazards, Risk and Resilience-Bushfire."* http://www.ausgoal.gov.au/

Queensland Fire and Emergency Services. (2019b). *Fire Hydrant and Vehicle Access Guidelines for Residential, Commercial and Industrial Lots*.

Queensland Fire and Emergency Services. (2019c). *Fire Hydrant and Vehicle Access Guidelines for Residential, Commercial and Industrial Lots*.

Queensland Fire and Emergency Services. (2023). *Bushfire prone area - Vegetation hazard class - Queensland series*. https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={14E905E9-0B0B-41D5-9CA7-C7E563AC69DF}

Queensland Government. (2019). *Natural hazards, risk and resilience - Bushfire - State Planning Policy – state interest guidance material*. www.dsdmip.qld.gov.au.

Queensland Government. (2021). *Natural hazards, risk and resilience state interest – Bushfire*.

Queensland Parks and Wildlife Service. (2013). *Planned Burn Guidelines: Einasleigh Uplands Bioregion of Queensland*.

The State of Queensland. (2017). *State Planning Policy*. www.dilgp.qld.gov.au.

Water By Design. (2024). *Bioretention Technical Design Guidelines*. www.waterbydesign.com.au.

Appendix A

Site Assessment Photos

Photo Point 1 – Cleared Grassy Paddocks	***Photo Point 2 – Regrowth Pine Trees***
Photo Point 3 – Cleared Grassy Paddocks	***Photo Point 4 – Regrowth Pine Trees***
Photo Point 5 – Regrowth Acacia sp.	***Photo Point 6 – Scattered Acacia sp.***

Photo Point 7 – Patch of Pine trees	***Photo Point 8 – Construction area***
Photo Point 9 – Road construction	***Photo Point 10 – Site and looking to Bells Creek Arterial Rd***

Appendix B

Inferno-BAL

Inferno-BAL is a module of the Inferno geospatial system designed by Covey Associates, to calculate radiant heat flux and Bushfire Attack Level (BAL) from Method 2 in the AS3925 standard. Rather than calculating radiant heat flux at a single point, Inferno-BAL assesses heat flux at each point within a given area. This allows contours of radiant heat flux to be determined, as well as the maximum potential radiant heat flux and subsequent BAL level over plots and structures. The system is designed to work over very large areas (10s of kilometres) at high spatial resolution (meter scale). All intensive computations utilise graphics processing units (GPUs) where possible allowing the rapid calculation of radiant heat flux over these large spatial scales. The system also utilises a server-driven approach where calculations can be queued until resources are available, then data delivered on request.

The heat flux calculations require the following to determine flame length:

- the vegetation characteristics, i.e., fuel type and fuel load;
- the distance to the vegetation patch;
- the site slope between the calculation point and the vegetation patch; and,
- the effective slope under the vegetation influencing the fire behaviour.

To obtain the above information, Inferno-BAL requires the following inputs:

- a digital elevation map, giving the vertical height above a given datum, and
- a geo-located vector data set consisting of flammable vegetation polygons.
  Each vegetation polygon, or patch, must encode total and surface fuel loads, and fuel type (Forest, Woodlands, Shrublands, Scrub, Mallee, Rainforest, Moorlands or, Grassland – per AS 3959). This can be encoded as a field within the polygon data, or the values can be populated using a code from an auxiliary table.

If required, an additional vector data set representing building envelopes can be included in the model to obtain the aggregate maximum radiant heat flux over spatially specified polygons.

Pre-Processing

Given that (1) radiant heat flux calculations are computationally intensive and (2) Inferno-BAL was designed to be able to calculate radiant heat flux over entire Local Government Areas, each combination of fuel load and fuel type is categorised and the RHF calculations are run only on nearest vegetation type/load combination. Specifically, the software undertakes the following pre-processing actions:

1. Verify the input layers;
2. Rate-of-spread model and fuel load values are populated for each vegetation patch.
   Any patches with an un-burnable fuel type are removed (e.g., VHC 43.6 waterbodies).
3. All combination of fuel type and fuel load are categorised, and each combination assigned an ID.
4. For each unique ID the polygon nearest to the calculation point, is used in radiant heat flux calculations.

An example of this categorisation is shown in Figure 1. The four vegetation patches depicted are classified as ID 1 (Grass fuel type of 1 t/ha fuel load), ID 2 (Grass fuel type of 0.5 t/ha fuel load, and ID 3 (Forest fuel type of 10 t/ha). The radiant heat flux calculation is performed three times, one for each of the nearest ID patches. In this case, the grass patch of ID 1 located at a greater distance from the calculation point (shown with a dashed line) is not included in the radiant heat flux model.

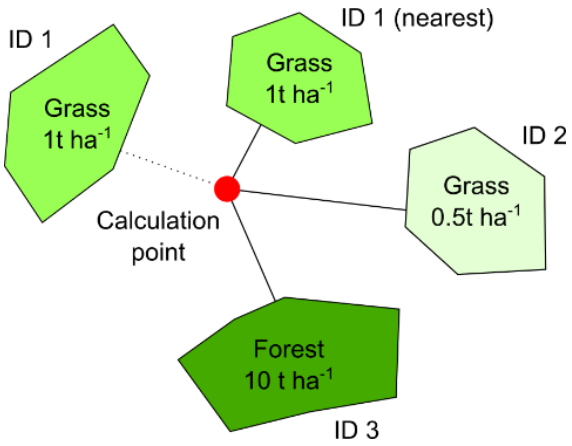


Figure 1 – Pre-processing of vegetation.

Note that this methodology may, in very marginal cases, result in a potential underestimation of radiant heat flux. This would only occur if ID patches at further distances were located on very steep terrain. This shortcoming will be addressed in future revisions of the system.

Distance Calculation

The distance is determined by searching for the point on the nearest edge over all polygons surrounding the calculation point. Once this nearest point is found the direction and distance to the patch can be found from the vector connecting the calculation point to the point on the edge (as shown by the arrow in Figure 2).

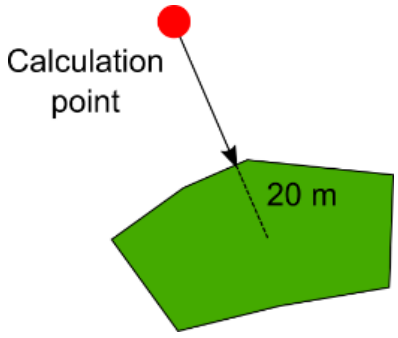


Figure 2 - Path to assess effective slope.

Site Slope Calculation

The site slope is calculated using the arctangent of the difference in elevation over the vector divided by the length of the vector. The site slope is clamped from -20 to 20 degrees, as in the AS3959 Method 2 standard.

Effective Slope Calculation

The effective slope is determined by extending a path 20 m into the vegetation patch (as shown by the dashed line in Figure 2) and calculating the slope over this path, per the method used in site slope calculations. The effective slope is clamped from -15 to 30 degrees, as in the AS3959 Method 2 standard.

Radiant Heat Flux calculation

The encoded vegetation characteristics from the vegetation vector layer are then used to determine which of the eight AS 3959 rate-of-spread models to adopt. From each of these a model for flame length is used (which may depend on an intermediate fire intensity empirical model for some fuel types, as in the AS3959 standard Eqns. B3, B4 and B5). The flame length is then used in the AS3959 iterative process to determine the flame angle giving the view factor, and hence maximum radiant heat flux, at the calculation point. This step involves some significant assumptions as outlined in the AS3959 standard, including the application of an empirical model for the atmospheric transmissivity (Eq. B9) and use of formula for view factor assuming a rectangular flame with a fixed width (Eq. B8 of AS 3959).

This process is repeated for each of the vegetation IDs and the maximum value over all these calculations is used as the final value of the radiant heat flux. The final steps in the process are to find the maximum radiant heat flux in each polygon plot, if supplied, and to categorise these into the BAL levels and to generate the vector isolines of the radiant heat flux.