BLACKASH
BUSHFIRE CONSULTING

Bushfire Hazard Assessment

SSD-37486043

Concept Plan and Stage 2 Works

Oakdale East Industrial Estate

Horsley Park

Prepared for

Goodman Property Services (Aust.) Pty Ltd

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Version 1.3

6 June 2022

Project Name:	Oakdale East Industrial – SSD-37486043 (Concept Plan and Stage 2)
Site Details	Oakdale East Industrial Estate
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Contents

1. Summary

Table 1 is a summary of compliance with relevant documents and approaches to limit bushfire attack and meet the requirements of the NSW planning framework for new development in Bushfire Prone Areas.

Table 1: Summary

Planning for Bushfire Protection 2019 Classification	"Other" commercial/ industrial
Location	Lot 102 DP1268366 & 103 DP1268366
Local Government Area	Fairfield
Can this proposal comply with AS3959, 2009	AS3959, 2009 does not apply as a DTS Provision
Does this development comply with the requirements of *Planning for Bushfire Protection 2019?*	YES
Does this development comply with the Aims and objectives of *Planning for Bushfire Protection 2019?*	YES
Is referral to the NSW RFS required?	NO

Assessment Framework	☒ *Planning for Bushfire Protection 2019*
	☐ Meets the deemed to satisfy provisions
	☒ Alternate solution/ performance-based assessment

2. Introduction

Blackash Bushfire Consulting has been engaged by Goodman Property Services (Aust.) Pty Ltd (Goodman) to provide a Bushfire Hazard Assessment report to support a State Significant Development application for the proposed Concept Plan across Goodman's Oakdale East Industrial Estate ("Estate") and approval for Stage 2 of works at the Estate.

The Estate is shown in Figure 1 and forms part of the larger Oakdale Industrial Estate which is part of the Western Sydney Employment Area [WSEA] and is owned by a Joint Venture (JV) between Goodman and Brickworks Limited (Brickworks, parent company of the Austral Brick Company Pty Ltd).

The site has bushfire prone land adjoining it and bushfire has been a key consideration in the design process. Commercial and industrial development is designated as "other" development in PBP 2019. As "other" development, a key issue for the proposal will be meeting the aim and objectives of *Planning for Bushfire Protection* and the performance requirements for commercial and industrial development.

This report has been completed having regard to Secretary for Planning and Environment's (the Secretary) Environmental Assessment Requirements (SEARs) issued for the proposal on 1 March 2022. The SEARs require the following in relation to bushfire:

> *"a bush fire assessment report prepared by an accredited consultant that demonstrates the development meets the aims and objectives of Planning for Bushfire Protection 2019."*

The proposed industrial facility is required to respond and implement an appropriate level of bushfire protection measures, as per Planning for Bushfire Protection 2019 (PBP 2019). This report will demonstrate that an appropriate combination of protection measures has been provided to meet the aims and objectives, and the provisions of Section 8.3.1 and 8.3.10, of *Planning for Bush Fire Protection 2019*.

This assessment has been prepared by Corey Shackleton, Principal Bushfire & Resilience (FPAA BPAD Level 3 Certified Practitioner No. BPD-L3-34603) who is recognised by the NSW RFS as qualified in bushfire risk assessment and have been accredited by the Fire Protection Association of Australia as a suitably qualified consultant to undertake alternative solution proposals.

3. Site Context

The Estate is shown in Figure 1 and forms part of the larger Oakdale Industrial Estate which is part of the Western Sydney Employment Area [WSEA] and is owned by a Joint Venture (JV) between Goodman and Brickworks Limited (Brickworks, parent company of the Austral Brick Company Pty Ltd).

The site is in the Fairfield City Local Government Area (LGA) in the south-western part of the WSEA. The site is legally described as Lot 102 and Lot 103 in DP1268366.

The Estate is bound to the north by the Water NSW Pipeline and to the east by the Reedy Creek riparian corridor. Land further to the east and to the south is existing rural development, while west of the Estate is existing industrial development within the Goodman's Oakdale Central Estate.

Given the existing land use the Estate site is almost entirely cleared, with the Reedy Creek area in the east forming the only area of bushland / bushfire hazard within the site.

The rehabilitation development application that is currently with council for assessment considers the removal of vegetation.

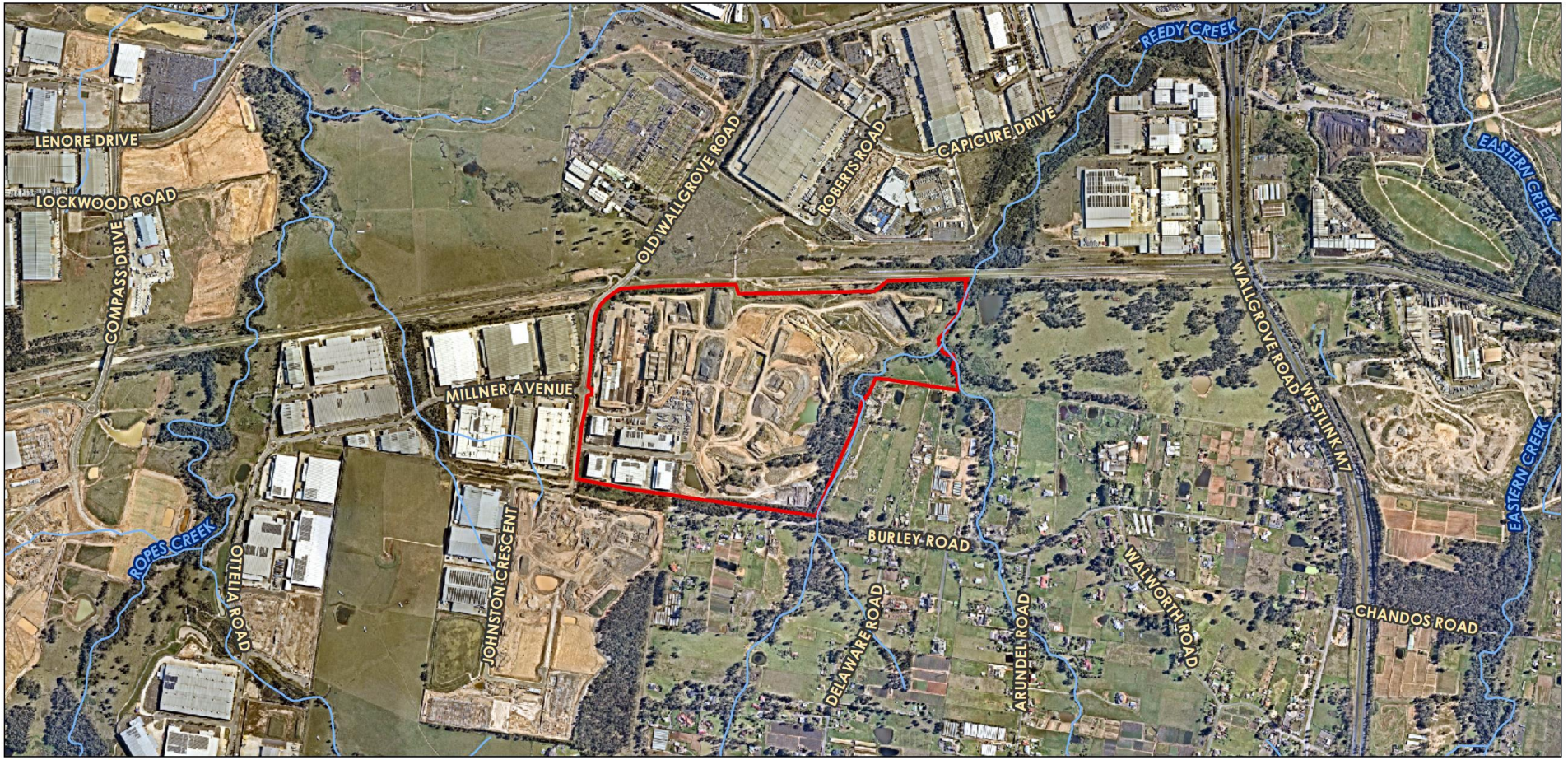


Figure 1: Site/Precinct Locations

4. Legislative Framework

The proposed industrial development is designated as "other" development by the PBP 2006 and PBP 2019. The NSW RFS has reviewed PBP 2006 and now released a new document known as *Planning for Bushfire Protection 2019* (PBP 2019) and the NSW RFS has requested that all new proposals are assessed against PBP 2019.

The site is identified as 'bushfire prone land' (see Figure 2) for the purposes of Section 10.3 of the *Environmental Planning and Assessment Act, 1979* (EPA Act) and the legislative requirements for development on bushfire prone lands are applicable. All development on bushfire prone land must consider and comply with PBP 2019. However, industrial development has considerable flexibility and the nature of the development often results in the structures providing a higher degree of bushfire resistance than required by the NSW RFS.

As "other" development, the proposed industrial development and future development is addressed through demonstrating compliance with the aim and objectives of PBP.

Under the building classification system within the *National Construction Code* (NCC), Class 5 to 8 buildings include offices, shops, factories, warehouses, public car parks and other commercial and industrial facilities. The NCC does not provide for any bushfire specific performance requirements for these classes of building. As such the *Australian Standard for Construction of Buildings in Bushfire Prone Areas* (AS 3959) and the NASH Standard are not considered as a set of 'deemed to satisfy' provisions. However, compliance with AS 3959 and NASH should be considered when meeting the aims and objectives of PBP.

Whilst bushfire is not captured in the NCC for Class 5-8 buildings or storage of the pallets, PBP 2019[1] articulates the following objectives which will be applied in relation to access, water and services, and emergency and evacuation planning:

- *to provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupant egress for evacuation;*
- *to provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development;*
- *to provide adequate services of water for the protection of buildings during and after the passage of bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building; and*

[1] Planning for Bushfire Protection 2019 (p.76)

- *provide for the storage of hazardous materials away from the hazard wherever possible.*

The general fire safety construction provisions (of the NCC) are taken as acceptable solutions, however construction requirements for bush fire protection will need to be considered on a case-by-case basis.

Because of their size, complexity, importance and/or potential impact, the Department of Planning, Industry and Environment (DPIE) is predominantly responsible for assessing development applications relating to State Significant Development. The Minister for Planning is the consent authority for SSD applications.

Applications designated as state significant projects are exempt from requiring a bushfire safety authority (BFSA). Given their scale however, the requirements of PBP should still be applied, and consultation with the NSW RFS has already occurred as part of the original SSD approval process.

5. Bushfire Prone Land

Bushfire prone land maps provide a trigger for the development assessment provisions and consideration of sites that are bushfire prone.

Bushfire prone land (BFPL) is land that has been identified by council, which can support a bushfire or is subject to bushfire attack. Bushfire prone land maps are prepared by local council and certified by the Commissioner of the NSW RFS.

Figure 2 shows the Bushfire Prone Land Map for the site. The extract from the Fairfield City Bushfire Prone Map shows that the area associated with Reedy Creek in the east of the site contains a mixture of Category 1 and Category 2 Bushfire Prone Vegetation. A narrow strip of vegetation along Burley Road has been mapped as Category 2 Bushfire Prone Vegetation but this is considered a low bushfire risk.

The proposed Stage 2 works at the Estate (Precincts 1 &3) are not located on bush fire prone land.

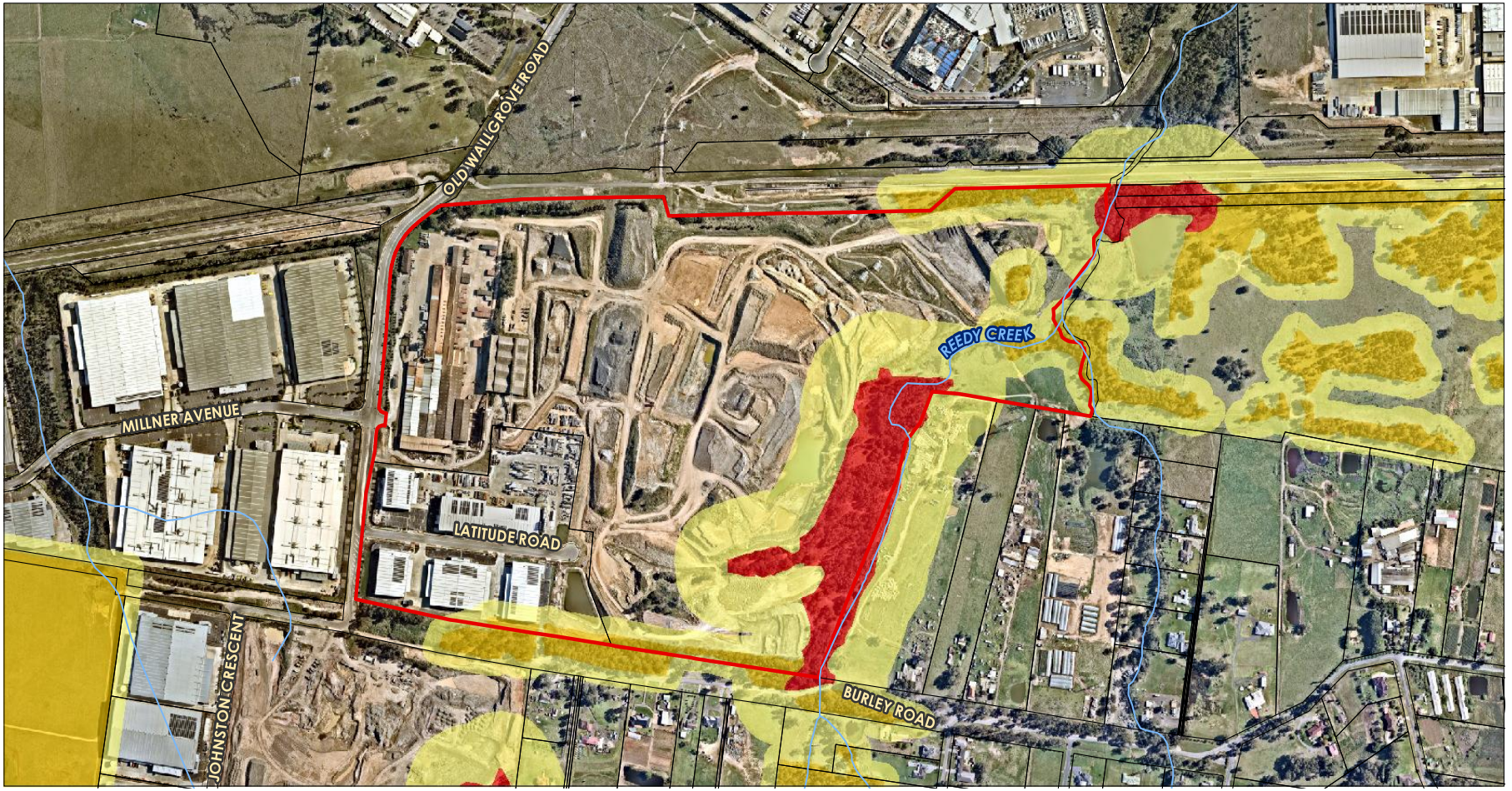


Figure 2: Bushfire Prone Land

6. The Proposal

This application seeks approval for a Concept Plan across Goodman's Oakdale East Industrial Estate ("Estate") and approval for Stage 2 of works at the Estate.

Stage 1 of the works were completed in September 2021 and included Precinct 1 building and infrastructure works as indicated on the proposed Estate Masterplan.

The Concept Plan is proposed to set the development controls for the Estate which will override the Development Control Plan ("DCP") that is currently with Department of Planning and Environment (DPE) for consideration. This DCP has been lodged with DPE to support the Rehabilitation Development Application that is currently with Fairfield City Council for consideration.

The Rehabilitation Development Application seeks approval for works only to Precinct 1 expansion, Precincts 2, 3 and 4 and includes the following (this application excludes works to Precinct 5):

- Cut and Fill works to provide bulk pad levels;
- Provision of Estate stormwater infrastructure including completion of detention basins and swales;
- Demolition of the Brick Factory and rehabilitation of the surrounding land;
- Installation of 1 x retaining wall on the eastern portion of Precinct 3;
- Geotech and Aboriginal heritage considerations.

The proposed Concept Plan approval seeks approval for:

- The proposed Estate masterplan allowing development of 303,009 sqm of GLA;
- 24/7 hours of operation;
- Building Height of 43m for Precinct 3 (excluding roof-top plant and solar) and 15m (excluding roof-top plant and solar) to the remainder of the Estate;
- Estate subdivision;
- Estate wide planning controls as shown in the EIS
- Construction hours 7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday
- Geotech and Aboriginal heritage considerations for Precinct 5

The Stage 2 works considered under this application include the following:

- Cut and fill works to Precinct 5 only to provide bulk pad level;
- Completion of lead-in infrastructure works including intersection upgrades at Millner Ave / Old Wallgrove Road and Lenore Drive / Old Wallgrove Road
- Clearing of 0.44 ha of native vegetation

- Completion of the internal road network (incl. the proposed private driveway providing access to Precinct 5 as well as all other roads shown on the proposed masterplan);
- Reticulation of services infrastructure to provide serviced development pads to all precincts;
- Completion of retaining walls across the entire Estate;
- Completion of Building works to Precinct 1 expansion and Precinct 3 including any ancillary on lot infrastructure and detailed civil works required;

Precinct 1 expansion:

- Construction, operation, fit-out and use approval of a warehouse with ancillary office spanning 3,122 sqm of GLA;
- 24/7 hours of operation;
- 15m building height (excluding solar and rooftop plant)

Precinct 3:

- Construction, operation, fit-out and use approval of a temperature controlled automated distribution centre;
- Total GLA of 96,810 sqm including 10,009 sqm of which is for future expansion;
- In addition to this, 38,050 sqm of mezzanines will be installed within the premises;
- 43m building height (excluding solar and rooftop plant)
- Storage of dangerous goods and flammable goods that exceed the SEPP33 threshold; and
- 24/7 hours of operation.

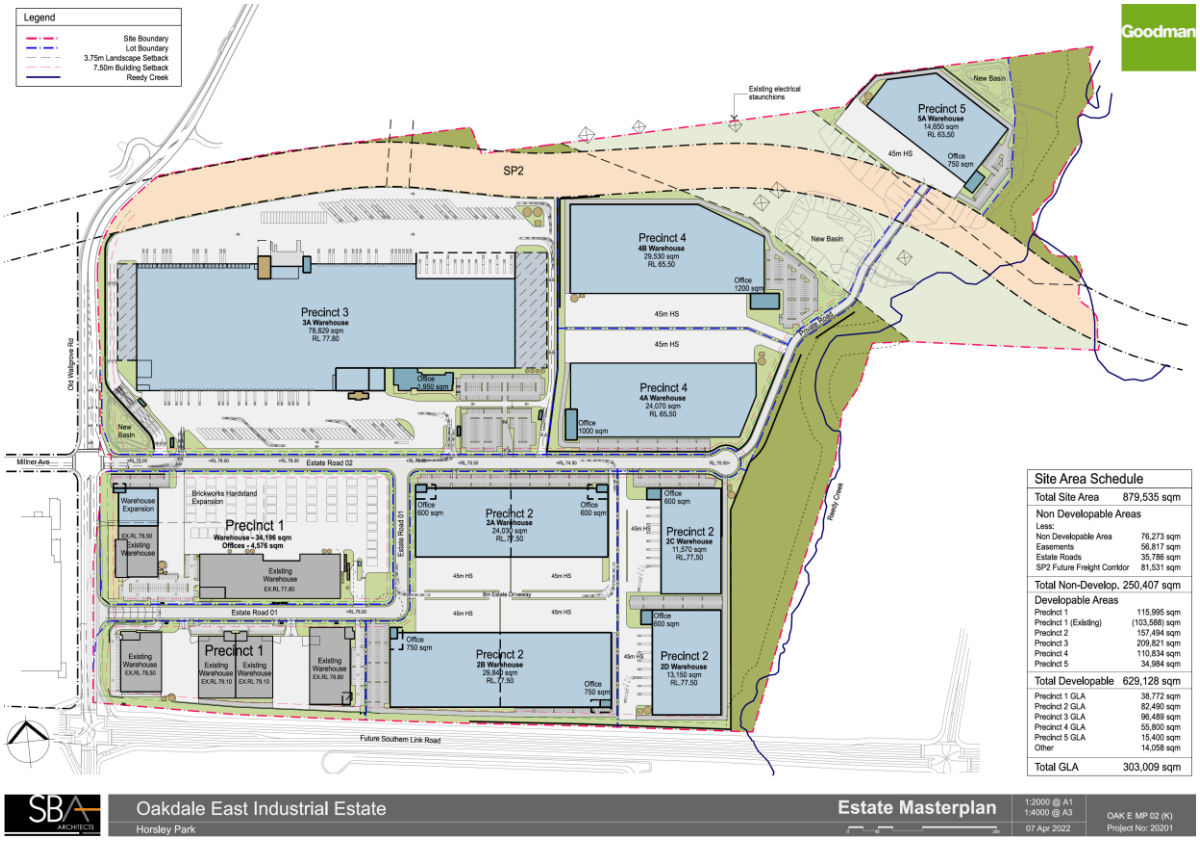


Figure 3: Oakdale East Estate Concept Masterplan

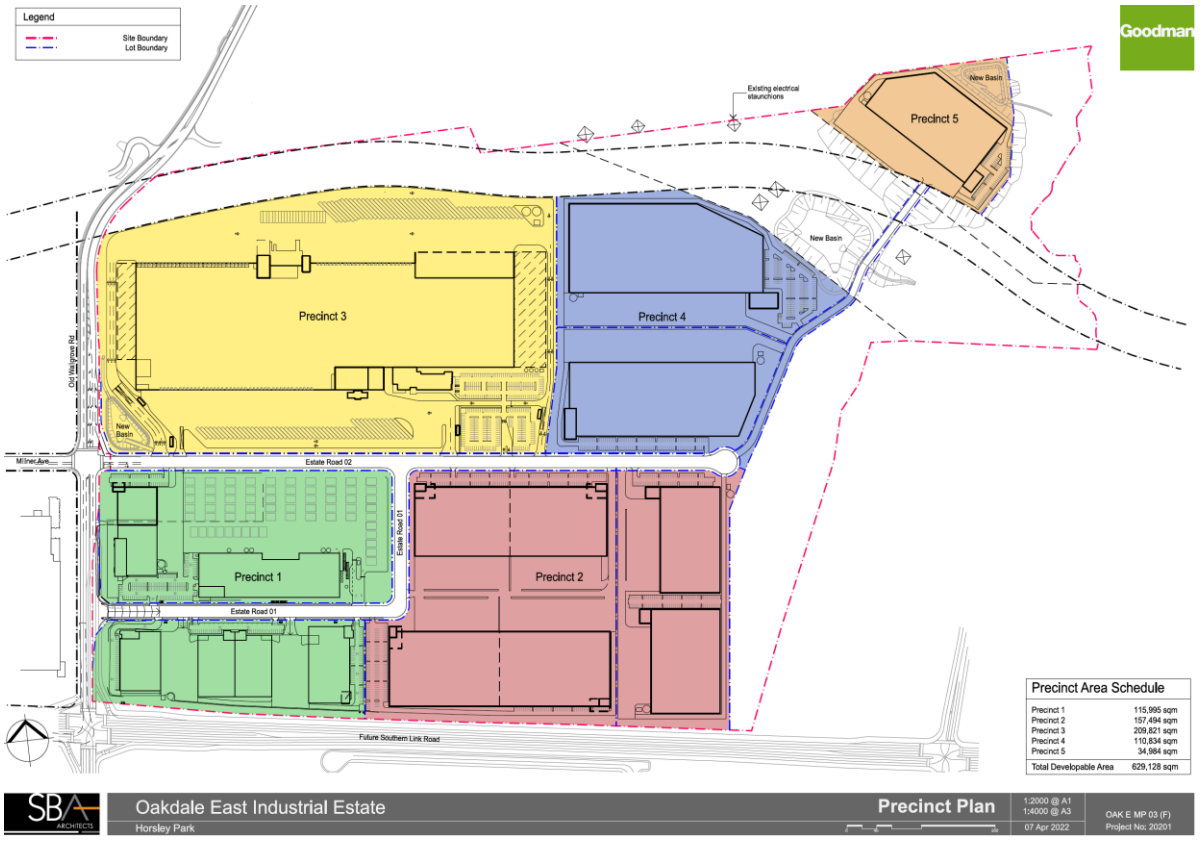


Figure 4: Proposed Estate Precincts

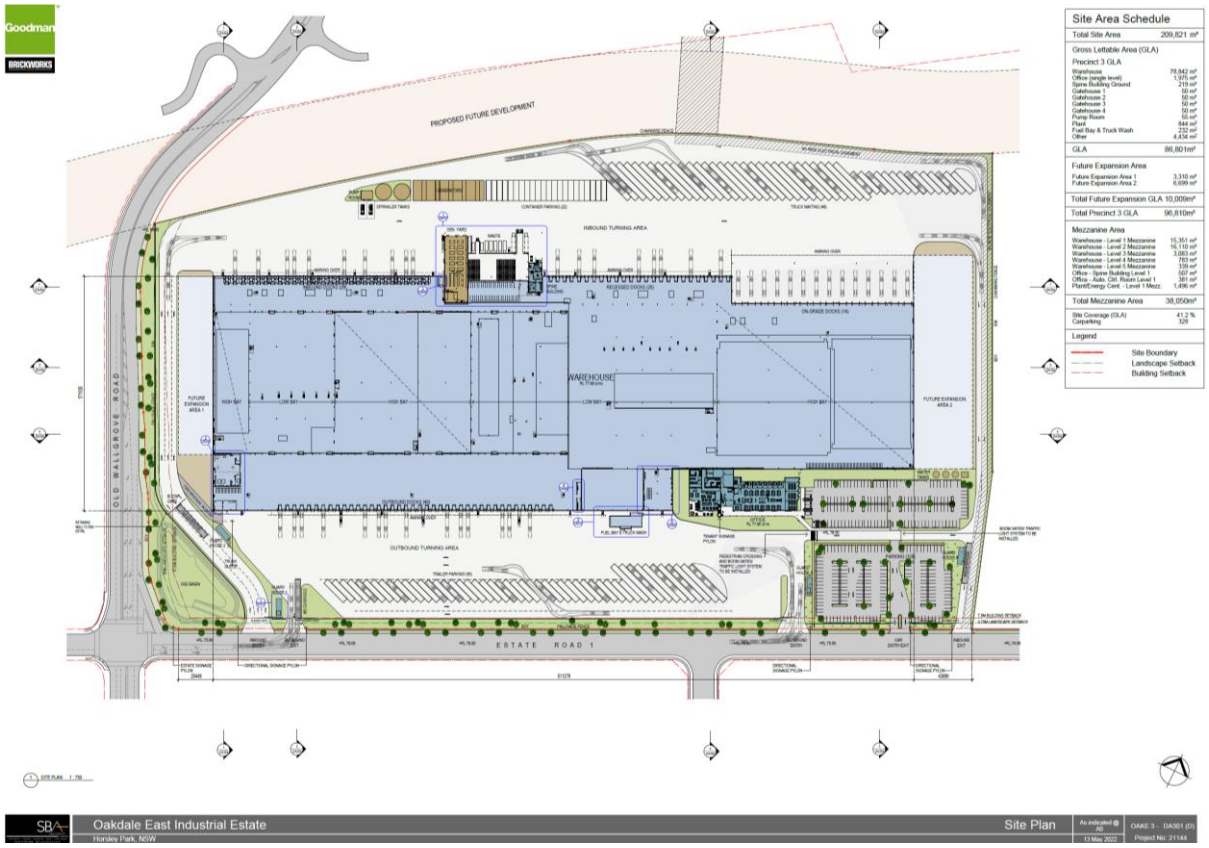


Figure 5: Proposed Precinct 3 Building

7. Site Assessment Methodology

The Bushfire Assessment Report is based on an assessment of the site utilising the following resources:

- *Planning for Bushfire Protection* (NSW RFS, 2019);
- Aerial mapping;
- Site Inspection; and
- Detailed GIS analysis.

The methodology used in this assessment is in accordance with PBP and is outlined in the following sections.

7.1. Bushfire Hazard

An assessment of the bushfire hazard is necessary to determine the application of bushfire protection measures such as Asset Protection Zone (APZ) locations and dimensions and future building levels.

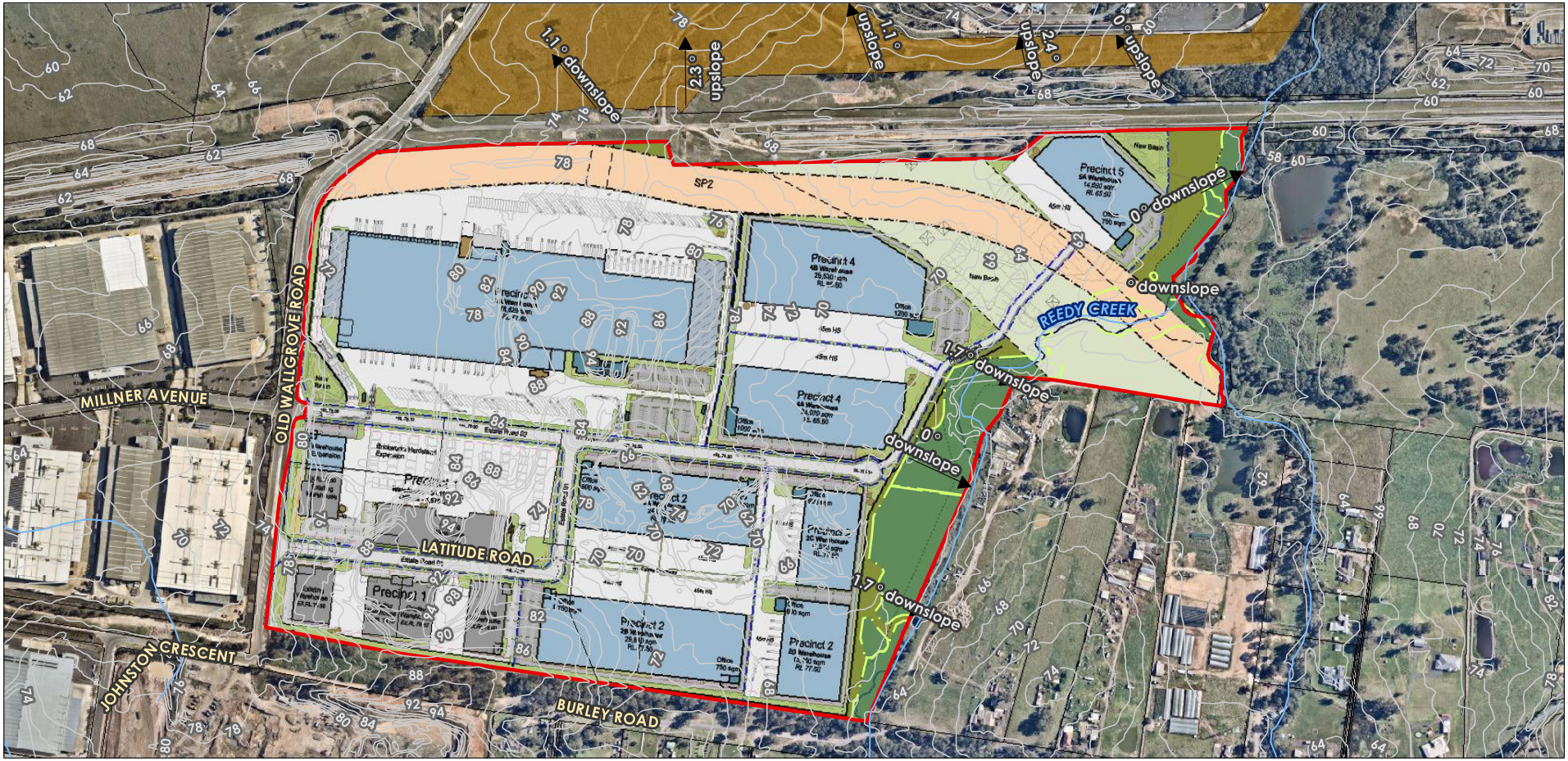
The vegetation formations (bushfire fuels) and the topography (effective slope) combine to create the bushfire threat that may affect bushfire behaviour at the site and which determine the planning and building response of PBP 2019.

7.2. Vegetation

Predominant Vegetation is classified by structure or formation using the system adopted by Keith (2004) and by the general description using PBP 2019. Vegetation types give rise to radiant heat and fire behaviour characteristics.

The predominant vegetation is determined over a distance of at least 140 metres in all directions from the proposed site boundary or building footprint on the development site. Where a mix of vegetation types exist, the type providing the greater hazard is said to predominate.

Pockets of land within and adjoining the site have been identified as bushfire prone land (see Figure 2). Aside from the riparian corridors associated with Reedy Creek, all other bushfire prone vegetation within the site will be removed (see Figure 6). The Reedy Creek riparian corridor is Forested Wetland and exists only within the isolated corridor associated with the creek. The corridor varies from 20-100 metres wide and considered a Short Fire Run. A narrow band of woodland runs with the northern portion of the Burley Road Reserve, however this is very narrow and isolated and considered a low hazard. Notwithstanding, this will be removed as part of future road upgrades.



Legend

- Watercourse
- Contour - 2m
- Vegetation Retained
- Lot
- Subject Land

Vegetation Formation

- Grassland
- Forested Wetlands

N

DKGIS

Date: 8/04/2022

0 75 150 300

Metres

Coordinate System: GDA 1994 MGA Zone 56

Imagery: © Nearmap

Figure 6: Vegetation and Slope

7.3. Slopes Influencing Bushfire Behavior

The 'effective slope' influencing fire behaviour approaching the sites has been assessed in accordance with the methodology specified within PBP 2019. This is conducted by measuring the worst-case scenario slope where the vegetation occurs over a 100 metre transect measured outwards from the development boundary or the existing/ proposed buildings.

The land is flat within the forested wetland in the Reedy Creek riparian corridor (Figure 6).

7.4. Fire Weather

The fire weather is dictated by PBP and assumes a credible worst-case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The sites have a Fire Danger Index (FDI) of 100 as per PBP 2019.

7.5. Asset Protection Zones

An Asset Protection Zone (APZ) is a buffer zone between a bushfire hazard and buildings. The APZ is managed progressively to minimise fuel loads and reduce potential radiant heat levels, flame, smoke and ember attack. The appropriate APZ distance is based on vegetation type, slope and the nature of the development.

The APZ can include roads or properties managed to be consistent with APZ standards set out in NSW RFS document *Standards for Asset Protection Zones*. The APZ provides a fuel-reduced, physical separation between buildings and bush fire hazards is a key element in the suite of bush fire measures and dictates the type of construction necessary to mitigate bushfire attack.

PBP 2019 requires APZs for commercial and industrial development to provide a defendable space and minimise material ignition. APZs are shown in Figure 7 and are compliant with PBP 2019.

The site will be managed and maintained to prevent the spread of a bushfire towards the building and to prevent the spread of fire onto or from the site in accordance with section 63 of the *Rural Fires Act, 1997* (RF Act). The areas around the buildings is cleared and maintained to mineral earth or non-combustible surfaces and is not a fire hazard.
Tables 2 - 6 (below) provide a summary of the APZ for the proposed precincts and Figure 6 provides a depiction of the APZ.

Table 2: APZ Assessment – Precinct 1.

Direction	Slope	Vegetation	Flame Zone Width	APZ Proposed
North	NA	No hazard	Nil	NA
East	NA	No hazard	Nil	NA
South	NA	No hazard	Nil	NA
West	NA	No hazard	Nil	NA

Table 3: APZ Assessment – Precinct 2.

Direction	Slope	Vegetation	Flame Zone Width	APZ Proposed
North	NA	No hazard	Nil	NA
East	Level	Forested Wetland	5-7 metres	>20 metres
South	NA	No hazard	Nil	NA
West	NA	No hazard	Nil	NA

Table 4: APZ Assessment – Precinct 3.

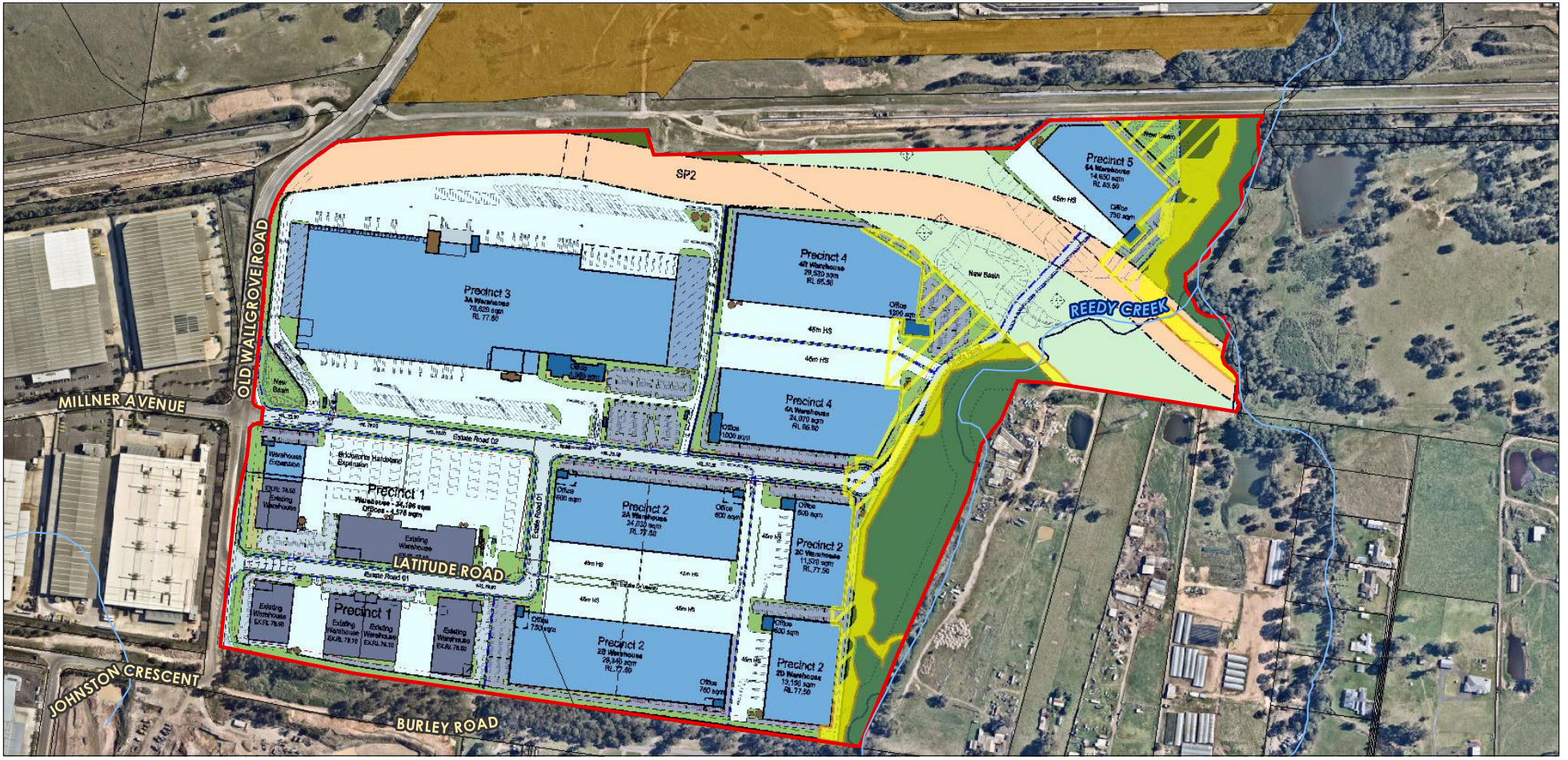
Direction	Slope	Vegetation	Flame Zone Width	APZ Proposed
North	NA	No hazard	Nil	NA
East	NA	No hazard	Nil	NA
South	NA	No hazard	Nil	NA
West	NA	No hazard	Nil	NA

Table 5: APZ Assessment – Precinct 4.

Direction	Slope	Vegetation	Flame Zone Width	APZ Proposed
North	NA	No hazard	Nil	NA
East	Level	Forested Wetland	7 metres	>22 metres
South	NA	No hazard	Nil	NA
West	NA	No hazard	Nil	NA

Table 6: APZ Assessment – Precinct 5.

Direction	Slope	Vegetation	Flame Zone Width	APZ Proposed
North	NA	No hazard	Nil	NA
East	Level	Forested Wetland	7 metres	>22 metres
South	NA	No hazard	Nil	NA
West	NA	No hazard	Nil	NA



Legend

- Watercourse
- Lot
- Subject Land

Vegetation Formation

- Grassland
- Forested Wetlands

Asset Protection Zone

- Asset Protection Zone (maximum)
- Asset Protection Zone (minimum 22m)

N

DKGIS

Date: 8/04/2022

0 75 150 300

Metres

Coordinate System: GDA 1994 MGA Zone 56

Figure 7: Asset Protection Zones

7.6. Bushfire Attack Levels

The Bushfire Attack Level (BAL) is a means of measuring the severity of a building's or sites potential exposure to ember attack, radiant heat and direct flame contact. In the Building Code of Australia, the BAL is used as the basis for establishing the requirements for residential construction to improve protection of building elements.

The Bushfire Attack Levels to the site have been determined based on the requirements of PBP 2019 through Table A1.12.5 and is shown in Table 7. As "Other" development, the development must comply with objective 3 of PBP 2019 which requires that the development:

3. *Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent the likely fire spread to buildings.*

Asset Protection Zones (see section 7.5) will be provided around the development that will include perimeter roads and hardstand areas. Where required, the buildings will be constructed to meet the relevant requirements of AS3959-2018 as identified in PBP 2019 and modelled based on details in section 7.6.1 of this report.

The building requirements for design and construction vary according to the bushfire attack level for the building. The building requirements for each BAL are set out in *Australian Standard: 3959 Construction of buildings in bushfire-prone areas 2009 (AS3959)*.

Table 7: Acceptable Solution Bushfire Attack Levels (source PBP 2019 Table A1.12.5)

KEITH VEGETATION FORMATION		BUSH FIRE ATTACK LEVEL (BAL)				
		BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
		Distance (m) asset to predominant vegetation class				
ALL UPSLOPE AND FLAT LAND	Rainforest	< 8	8 -< 11	11 -< 16	16 -< 23	23 -< 100
	Forest (wet and dry sclerophyll) including Coastal Swamp Forest, Pine Plantations and Sub-Alpine Woodland	< 18	18 -< 24	24 -< 33	33 -< 45	45 -< 100
	Grassy and Semi-Arid Woodland (including Mallee)	< 9	9 -< 12	12 -< 18	18 -< 26	26 -< 100
	Forested Wetland (excluding Coastal Swamp Forest)	< 7	7 -< 10	10 -< 14	14 -< 21	21 -< 100
	Tall Heath	< 12	12 -< 16	16 -< 23	23 -< 32	32 -< 100
	Short Heath	< 7	7 -< 9	9 -< 14	14 -< 20	20 -< 100
	Arid-Shrublands (acacia and chenopod)	< 5	5 -< 6	6 -< 9	9 -< 14	14 -< 100
	Freshwater Wetlands	< 4	4 -< 5	5 -< 7	7 -< 11	11 -< 100
	Grassland	< 8	8 -< 10	10 -< 15	15 -< 22	22 -< 50

The Bushfire Attack Levels for the Estate have been refined based on site specific Radiant Heat Modelling. See Section 7.6.1. There are no construction requirements for Precincts 1 and 3.

Tables 8 - 12 (below) provides a summary of the Bushfire Attack Levels assessment, while Figure 8 provides a detailed map of the BALs as they apply across the buildings.

Table 8: Bushfire Attack Levels – Precinct 1.

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	NA	No hazard	NA	No Requirement
East	NA	No hazard	NA	No Requirement
South	NA	No hazard	NA	No Requirement
West	NA	No hazard	NA	No Requirement

Table 9: Bushfire Attack Levels – Precinct 2.

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	NA	No hazard	Nil	See Figure 7*
East	Level	Forested Wetland	>20 metres	See Figure 7*
South	NA	No hazard	Nil	See Figure 7*
West	NA	No hazard	Nil	See Figure 7*

**Note: The extent of the BAL for the building is depicted in detail in Figure 7 and Appendix 2 shows the detailed modelling results.*

Table 10: Bushfire Attack Levels – Precinct 3.

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	NA	No hazard	NA	No Requirement
East	NA	No hazard	NA	No Requirement
South	NA	No hazard	NA	No Requirement
West	NA	No hazard	NA	No Requirement

Table 11: Bushfire Attack Levels – Precinct 4.

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	NA	No hazard	Nil	See Figure 7*
East	Level	Forested Wetland	>22 metres	See Figure 7*
South	NA	No hazard	Nil	See Figure 7*
West	NA	No hazard	Nil	See Figure 7*

**Note: The extent of the BAL for the building is depicted in detail in Figure 7 and Appendix 2 shows the detailed modelling results.*

Table 12: Bushfire Attack Levels – Precinct 5.

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	NA	No hazard	Nil	See Figure 7*
East	Level	Forested Wetland	>22 metres	See Figure 7*
South	NA	No hazard	Nil	See Figure 7*
West	NA	No hazard	Nil	See Figure 7*

**Note: The extent of the BAL for the building is depicted in detail in Figure 7 and Appendix 2 shows the detailed modelling results.*

7.6.1. Radiant Heat Modelling

Detailed radiant heat modelling has been undertaken for the eastern elevations of Precinct 2, 4 and 5 due to the site-specific inputs. Table 13 below is a summary of the key inputs, while the detailed outputs can be found in Appendix 2. This modelling underpins the BAL mapping for the estate.

Table 13: Performance Criteria and Modelling for the eastern elevations.

Precinct	Slope	Vegetation	Separation	Short Fire Run	Radiant Heat	Flame Length
2	0°	Coastal Floodplain Forest	5 metres	80 metres	33.55kW/m2	5.008 metres
4	0°	Coastal Floodplain Forest	7 metres	Not Used*	37.73kW/m2	8.21 metres
5	0°	Coastal Floodplain Forest	7 metres	Not Used*	37.73kW/m2	8.21 metres

*****Note: Despite the SFR being appropriate for these precincts, it has not been used. This provides additional conservatism in the design.*

There are no construction requirements for Precincts 1 and 3.

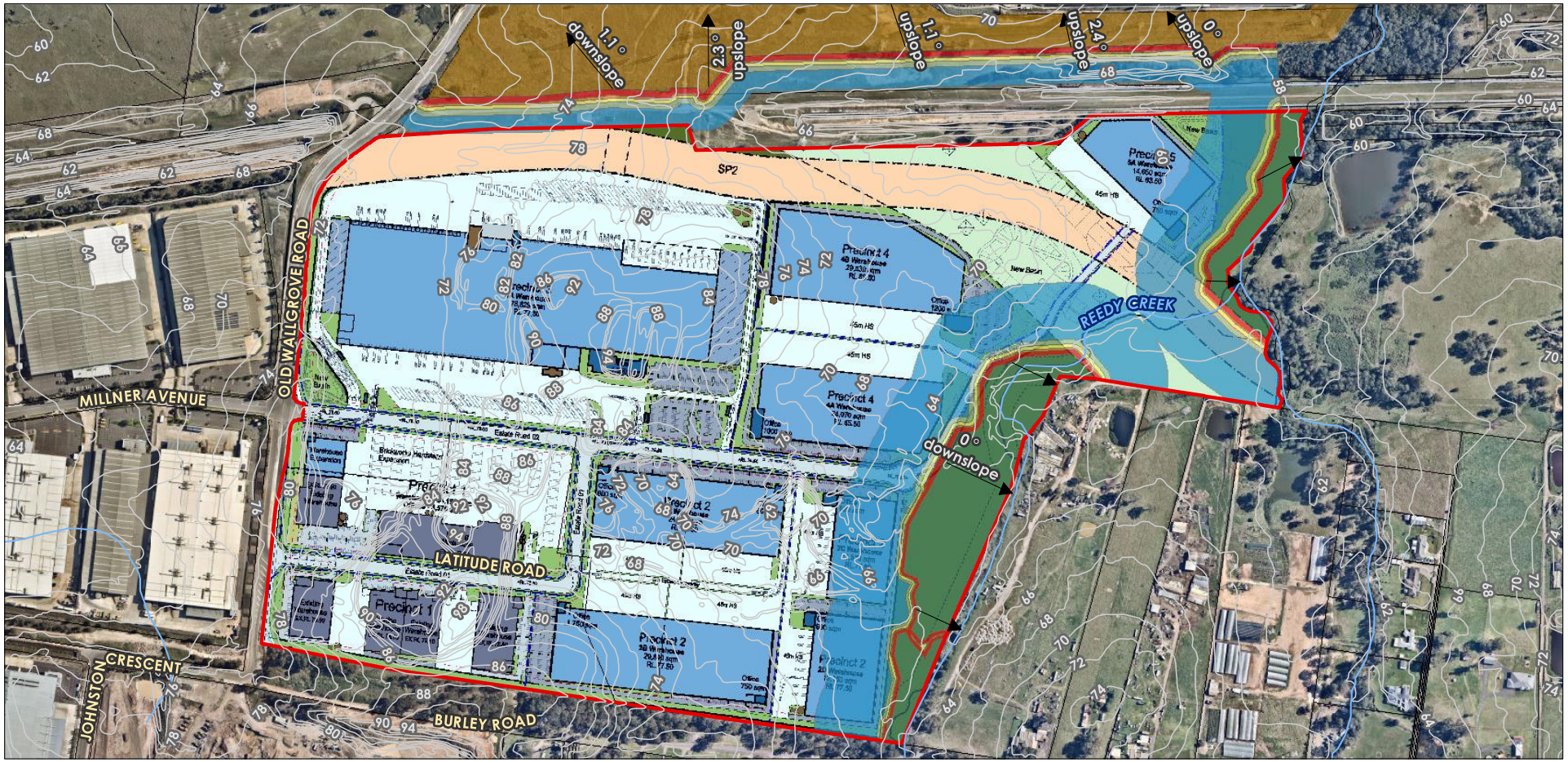
7.6.2. Application of AS3959 (2018)

Construction must comply with the corresponding Bushfire Attack Level (BAL) as shown in Figure 7.

The application of each BAL is as defined on Figure 8 and not broadly applied across the entire elevation/building. The construction must comply with corresponding sections of the Australian Standard AS3959-2018 *Construction of buildings in bush fire-prone areas* or NASH Standard (1.7.14 updated) *National Standard Steel Framed Construction in Bushfire Areas* – 2014 as appropriate, and Section 7.5 of *Planning for Bush Fire Protection 2019*.

The construction for the remainder of the proposed buildings not denoted with a BAL in Figure 8 is greater than 100 metres from any bushfire hazard. Consistent with AS3959, construction greater than 100 metres from a bushfire hazard is classified as BAL-Low. AS3959 describes BAL-Low as "*There is insufficient risk to warrant specific construction requirements*". Therefore, the construction for the remainder of the proposed building not denoted with a BAL in Figure 8, is appropriately BAL-Low.

The construction of the buildings in this manner complies with *Planning for Bush Fire Protection 2019* and the National Construction Code (NCC).



Legend

- Watercourse
- Contour - 2m
- Lot
- Subject Land

Vegetation Formation

- Grassland
- Forested Wetlands

Bushfire Attack Level (BAL)

- BAL - Flame Zone
- BAL - 40
- BAL - 29
- BAL - 19
- BAL - 12.5

N

DKGIS
Date: 8/04/2022

0 75 150 300
Metres

Coordinate System: GDA 1994 MGA Zone 56
Imagery: © Nearmap

Figure 8: Bushfire Attack Levels

8. Access

PBP 2019 requires that the design of access roads enables safe access and egress for people attempting to leave the area while emergency service personnel are arriving to undertake firefighting operations.

Figure 3 shows the Estate Masterplan which includes the access to the site.

Vehicular access to the Estate will be provided via Old Wallgrove Road which connects in the western part of the Estate. Old Wallgrove Road links well into the broader public road network, including to Burley Road in the south and through to the Westlink M7 in the northeast.

The Estate road network will be constructed to provide heavy rigid and articulated vehicle access to each of the proposed buildings. This internal road network is designed to provided access for a prime mover and semi-trailer. This design is more than adequate to accommodate fire-fighting appliances like NSW RFS Category 1 Tankers and Fire & Rescue NSW Composite and Aerial Appliances.

The Estate design provides access around each of the proposed facilities and to the bushfire prone vegetation within the corridor along the western boundary. This is provided by a perimeter service road. Precinct 5 is accessed via an extension to the internal Estate Road (No.02). The road to Precinct 5 complies with PBP 2019 and given the low bushfire risk to the site, is considered to provide safe operational access while occupants may be leaving the area.

Given the comprehensive nature of the road design, access complies with the requirements of PBP 2019.

9. Water Supply and Utilities

PBP 2019 (p. 47) requires that adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building.

Suitable water supply arrangements will be provided for firefighting that meet the NSW RFS requirements. A reticulated water supply for potable water supply and fire hydrants will be provided to the site. The fire-fighting water supply to the proposed buildings shall comply with the Building Code of Australia [BCA] and A.S. 2419.1 – 2005.

10. Emergency Management Arrangements

Emergency management arrangements for each building will be demonstrated through a separate Bushfire Emergency Management and Evacuation Plan which will be provided prior to occupation that will include triggers for closing the site and what to do in the event of a bushfire emergency.

11. Assessment Against the Aim and Objective of PBP

All development in Bushfire Prone Areas needs to comply with the aim and objectives of PBP. Table 14 shows the compliance with PBP.

Table 14: Compliance with Aim & Objectives of PBP.

Aim	Meets Criteria	Comment
The aim of PBP is to use the NSW development assessment system to provide for the protection of human life (including fire fighters) and to minimise impacts on property from the threat of bushfire, while having due regard to development potential, onsite amenity and the protection of the environment.	Yes	Landscaping, defendable space, access and egress, emergency risk management and construction standards are in accordance with the requirements of PBP and the aims of PBP have been achieved.
Objectives	**Meets Criteria**	**Comment**
Afford occupants of any building adequate protection from exposure to a bushfire.	Yes	The development provides opportunity for all occupants to be shielded from any external bushfire. Construction material will comply with the relevant AS3959 requirements.
Provide for a defendable space to be located around buildings.	Yes	Defendable space is provided around all buildings.
Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent the likely fire spread to buildings.	Yes	All buildings are separated from the vegetated areas and provide APZs and commensurate construction in accordance with AS3959.
Ensure that safe operational access and egress for emergency service personnel and occupants is available.	Yes	The site has direct access to public roads, and access and egress for emergency vehicles and evacuation is adequate. The development provides for the movement of heavy articulated trucks about the site.
Provide for ongoing management and maintenance of bushfire protection measures.	Yes	The site will be managed by Goodman including all APZ and landscaping in accordance with PBP 2019.
Ensure that utility services are adequate to meet the needs of firefighters.	Yes	Utility services are adequate to meet the needs of firefighters (and others assisting in bushfire fighting).

The suite of bushfire protection measures provided for the proposed development satisfies the objectives for buildings of Class 5-8 under the NCC as identified in section 8.3.1 of PBP 2019.

12. Recommendations

The following recommendations are made to ensure the Oakdale East Estate is provided with adequate bushfire protection in accordance with PBP:

Recommendation 1: At the commencement of building works and in perpetuity, the entirety of Precincts 2, 4 and 5 shall be maintained as an Asset Protection Zone. The APZ shall be established and maintained as an inner protection area as outlined within *Planning for Bushfire Protection 2019* and the NSW RFS document '*Standards for Asset Protection Zones*'.

Recommendation 2: Fire hydrants are provided in accordance with Building Code of Australia E1.3, AS2419.1:2005, including the ring main requirements for large, isolated buildings and those identified in Section 9.

Recommendation 3: Buildings are constructed in accordance *Australian Standard AS 3959-2009 Construction of buildings in bushfire-prone areas* (AS 3959-2018) to the extent identified in Figure 8.

Recommendation 4: All proposed roads must comply with section 5.3.2 of *Planning for Bush Fire Protection 2019* as appropriate.

13. Conclusion

The Bushfire Hazard Assessment to support a State Significant Development (SSD) application for the proposed Concept Plan across Goodman's Oakdale East Industrial Estate and approval for Stage 2 of works at the Estate.

The site is on bushfire prone land. Commercial and industrial development is designated as "other" development in PBP 2019. As "other" development, the proposed development has considerable flexibility, and the nature of the development often results in the structures providing a higher degree of bushfire resistance than that specified by PBP and AS3959.

The site is in a low-risk bushfire prone area and the proposed precincts can respond and implement an appropriate level of bushfire protection measures, as per PBP 2019.

This Report is a Bush Fire Hazard Assessment that demonstrates that an appropriate combination of protection measures has been provided to ensure the proposed development meets the aim and objectives, and the provisions of Section 8.3.1 and 8.3.10, of *Planning for Bush Fire Protection 2019*.

Corey Shackleton | Principal Bushfire & Resilience
Blackash Bushfire Consulting
B.Sc., Grad. Dip. (Design for Bushfire Prone Areas)
Fire Protection Association of Australia BPAD Level 3 - 34603

Appendix 1: References

Australian Building Codes Board Building Code of Australia Volumes 1&2
Councils of Standards Australia AS3959 (2018) – Australian Standard Construction of buildings in bushfire-prone areas

Keith, David (2004) – Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT. The Department of Environment and Climate Change

NSW Rural Fire Service (2015) Guide for Bushfire Prone Land Mapping

NSW Rural Fire Service (NSW RFS). 2006. Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners. Australian Government Publishing Service, Canberra

NSW Rural Fire Service (NSW RFS). 2019. Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners.

NSW Government (1979) Environmental Planning and Assessment Act 1979. NSW Government Printer

Appendix 2: Radiant Heat Modelling

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 2

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
urface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
verage elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	5	Metres	Target elevation of receiver	2	Metres
ffective slope	0	Degrees	mbient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	80	Metres
nominal head width		Metres			

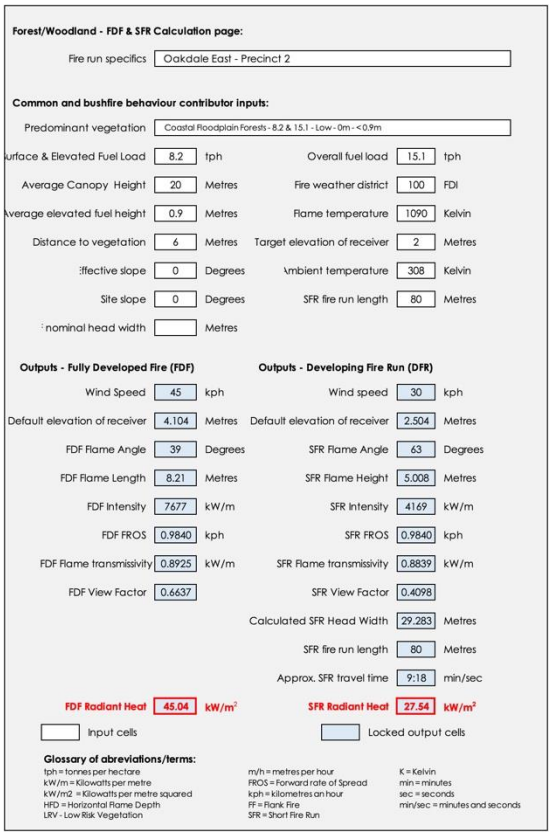
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	31	Degrees	SFR Flame Angle	58	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8983	kW/m	SFR Flame transmissivity	0.8889	kW/m
FDF View Factor	0.8180		SFR View Factor	0.4964	
			Calculated SFR Head Width	29.283	Metres
			SFR fire run length	80	Metres
			Approx. SFR travel time	9:18	min/sec
FDF Radiant Heat	55.87	kW/m²	SFR Radiant Heat	33.55	kW/m²

Input cells | Locked output cells

Glossary of abbreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 2: BAL-40



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 2

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
urface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
verage elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	6	Metres	Target elevation of receiver	2	Metres
ffective slope	0	Degrees	mbient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	80	Metres
nominal head width		Metres			

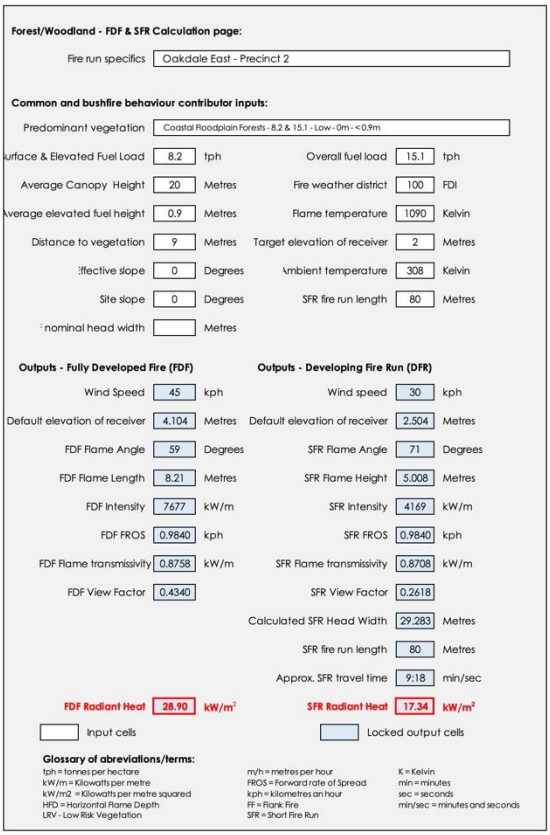
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	39	Degrees	SFR Flame Angle	63	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8925	kW/m	SFR Flame transmissivity	0.8839	kW/m
FDF View Factor	0.6637		SFR View Factor	0.4098	
			Calculated SFR Head Width	29.283	Metres
			SFR fire run length	80	Metres
			Approx. SFR travel time	9:18	min/sec
FDF Radiant Heat	45.04	kW/m²	SFR Radiant Heat	27.54	kW/m²

Input cells | Locked output cells

Glossary of abbreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 2: BAL-29



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 2

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
urface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
verage elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	9	Metres	Target elevation of receiver	2	Metres
ffective slope	0	Degrees	mbient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	80	Metres
nominal head width		Metres			

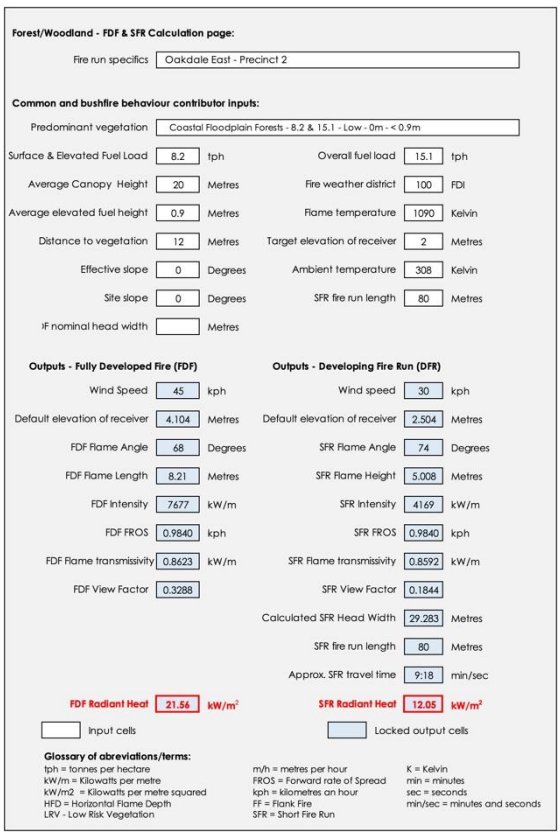
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	59	Degrees	SFR Flame Angle	71	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8758	kW/m	SFR Flame transmissivity	0.8708	kW/m
FDF View Factor	0.4340		SFR View Factor	0.2618	
			Calculated SFR Head Width	29.283	Metres
			SFR fire run length	80	Metres
			Approx. SFR travel time	9:18	min/sec
FDF Radiant Heat	28.90	kW/m²	SFR Radiant Heat	17.34	kW/m²

Input cells | Locked output cells

Glossary of abbreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 2: BAL-19



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 2

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	12	Metres	Target elevation of receiver	2	Metres
Effective slope	0	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	80	Metres
FF nominal head width		Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	68	Degrees	SFR Flame Angle	74	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8623	kW/m	SFR Flame transmissivity	0.8592	kW/m
FDF View Factor	0.3288		SFR View Factor	0.1844	
			Calculated SFR Head Width	29.283	Metres
			SFR fire run length	80	Metres
			Approx. SFR travel time	9:18	min/sec
FDF Radiant Heat	21.56	kW/m²	SFR Radiant Heat	12.05	kW/m²

Input cells | Locked output cells

Glossary of abbreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 2: BAL-12.5

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Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 4

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	7	Metres	Target elevation of receiver	2	Metres
Effective slope	0	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length		Metres
IF nominal head width		Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	47	Degrees	SFR Flame Angle	1	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8867	kW/m	SFR Flame transmissivity	0.8854	kW/m
FDF View Factor	0.5597		SFR View Factor	0.0000	
			Calculated SFR Head Width	0.000	Metres
			SFR fire run length	0	Metres
			Approx. SFR travel time	0:00	min/sec
FDF Radiant Heat	37.73	kW/m²	**SFR Radiant Heat**	0.00	kW/m²

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 4 & 5: BAL-40

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 4

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	9	Metres	Target elevation of receiver	2	Metres
Effective slope	0	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length		Metres
IF nominal head width		Metres			

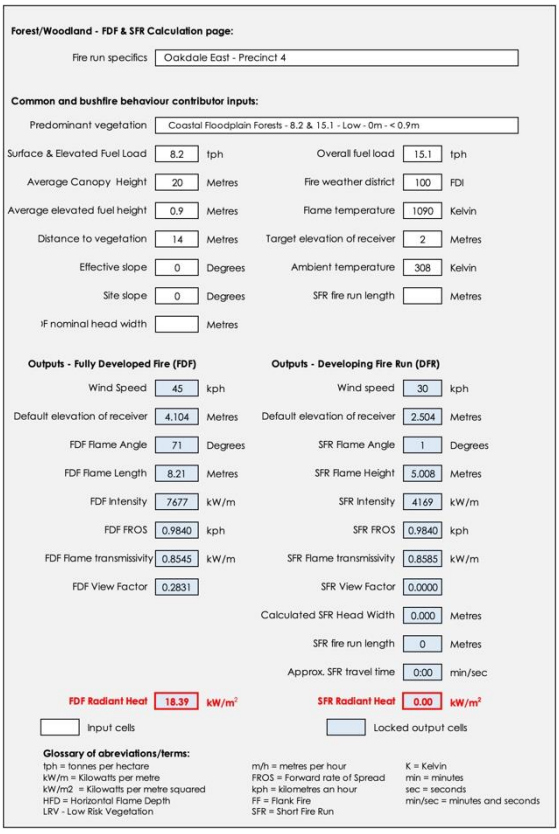
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	59	Degrees	SFR Flame Angle	1	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8758	kW/m	SFR Flame transmissivity	0.8773	kW/m
FDF View Factor	0.4340		SFR View Factor	0.0000	
			Calculated SFR Head Width	0.000	Metres
			SFR fire run length	0	Metres
			Approx. SFR travel time	0:00	min/sec
FDF Radiant Heat	28.90	kW/m²	**SFR Radiant Heat**	0.00	kW/m²

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 4 & 5: BAL-29



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 4

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	14	Metres	Target elevation of receiver	2	Metres
Effective slope	0	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length		Metres
IF nominal head width		Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	71	Degrees	SFR Flame Angle	1	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8545	kW/m	SFR Flame transmissivity	0.8585	kW/m
FDF View Factor	0.2831		SFR View Factor	0.0000	
			Calculated SFR Head Width	0.000	Metres
			SFR fire run length	0	Metres
			Approx. SFR travel time	0:00	min/sec
FDF Radiant Heat	18.39	kW/m²	**SFR Radiant Heat**	0.00	kW/m²

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 4 & 5: BAL-19

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Oakdale East - Precinct 4

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Coastal Floodplain Forests - 8.2 & 15.1 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	8.2	tph	Overall fuel load	15.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	0.9	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	21	Metres	Target elevation of receiver	2	Metres
Effective slope	0	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length		Metres
IF nominal head width		Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	4.104	Metres	Default elevation of receiver	2.504	Metres
FDF Flame Angle	78	Degrees	SFR Flame Angle	1	Degrees
FDF Flame Length	8.21	Metres	SFR Flame Height	5.008	Metres
FDF Intensity	7677	kW/m	SFR Intensity	4169	kW/m
FDF FROS	0.9840	kph	SFR FROS	0.9840	kph
FDF Flame transmissivity	0.8306	kW/m	SFR Flame transmissivity	0.8355	kW/m
FDF View Factor	0.1881		SFR View Factor	0.0000	
			Calculated SFR Head Width	0.000	Metres
			SFR fire run length	0	Metres
			Approx. SFR travel time	0:00	min/sec
FDF Radiant Heat	11.88	kW/m²	**SFR Radiant Heat**	0.00	kW/m²

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

Precinct 4 & 5: BAL-12.5