

Appendix L Bushfire Management Plan

Bushfire management plan

Tarong West Wind Farm | Kingaroy | Queensland
Prepared for Tarong West Project Co Pty Ltd | 11 December 2024

Bushfire management plan

Final V4

Report 24066 | Tarong West Project Co Pty Ltd | 11 December 2024

Approved by Robert Janssen

Position Managing principal

Signature



Date 11 December 2024

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Version	Date	Prepared by	Reviewed by
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Disclaimer

Notwithstanding the precautions adopted in this report, it should always be remembered that bushfires burn under a range of conditions. An element of risk, no matter how small always remains, and although AS 3959-2018 is designed to improve the performance of such buildings, there can be no guarantee, because of the variable nature of bushfires, that any building will withstand bushfire attack on every occasion.

It should be noted that upon lodgement of a development proposal, State Government, council and/or the fire service may recommend additional construction requirements.

Although every care has been taken in the preparation of this report, Land and Environment Consultants Pty Ltd accept no responsibility resulting from the use of the information in this report.

1 Introduction

This bushfire management plan (**BMP**) has been prepared for the Tarong West Wind Farm (**the Project**) which is located approximately 25 kilometres (**km**) west of Kingaroy within the South Burnett Regional Council local government area in the Wide Bay Burnett region of Queensland.

The Project involves 16 properties described as lots 4 and 7/RP890694, lot 36/BO236, lot 6/BO250, lot 5/BO330, lot 44/FTZ37207, lot 43/FTZ37338, lots 60, 62 and 63/BO188, lots 64, 66 and 93/BO190, lot 67/BO490, lot 68/RP800291, lot 29/BO243 and lot 10/SP168643. These properties have a combined area of approximately 17,500 hectares (**ha**) and are hereafter referred to as **the Project area**.

The disturbance footprint for the Project is approximately 872 ha.

This BMP documents a bushfire hazard assessment for the above ground infrastructure areas and identifies strategies that will mitigate the potential risk of bushfire hazards for the construction and operation phases of the Project. It includes:

- an introduction (this section) and description of methods and information resources used for the preparation of this BMP;
- description of the Project area and the Project;
- bushfire hazard assessment;
- identification of bushfire hazards associated with the Project area and the Project;
- radiant heat exposure assessment; and
- a plan for mitigating the potential risk of bushfire hazards; and
- assessment of compliance with the example bushfire overlay code (**Bushfire overlay code**) in the *Natural Hazards, Risk and Resilience – Bushfire, State Planning Policy State Interest guidance material* (DSDSMIP 2019) (**SPP guidance material – bushfire**).

1.1 State approvals context

The State Assessment and Referral Agency (**SARA**) approved a development permit – material change of use for a wind farm and operational works for the clearing of native vegetation (the development permit) – SARA reference 2402-29136/SDA.

Condition 21 of the development permit states:

- a) Prepare a Bushfire Management Plan (BMP) addressing construction and operation activities which reflects the project layout plan referenced in Condition 1(a)s
- b) The BMP must:
 - i. be prepared by a suitably qualified person
 - ii. be prepared in consultation with the Queensland Fire and Emergency Services (QFES)
 - iii. include a fire hazard analysis
 - iv. include evacuation procedures for construction workers in the event of a bushfire emergency
 - v. include mitigation strategies to achieve the development outcomes in Part E of the State Planning Policy July 2017 – Natural Hazards, Risk and Resilience
 - vi. include details on consultation with all host lot owners.
- c) Provide details and confirmation that consultation with QFES has been undertaken to:
 - i. Office of The Assistant Commissioner.
 - ii. Queensland Fire and Emergency Services (sdu@qfes.qld.gov.au)
- d) Submit the BMP to:

- i. Department of Housing, Local Government, Planning and Public Works (windfarms@dsdilgp.qld.gov.au)
 - ii. South Burnett Regional Council
 - iii. Queensland Fire and Emergency Service (sdu@qfes.qld.gov.au).
- e) Operate the development in accordance with the BMP.
 - f) Maintain a copy of the BMP on-site (for example, at the site office) and ensure all relevant landowners, staff, contractors, workers, and site visitors are familiar with the relevant requirements of the BMP.

Note: Suitably qualified person means a person(s) who has professional qualifications, training, skills and/or experience relevant to area of expertise (bushfire management).

The Project area is identified as a bushfire prone area by the *Bushfire prone area map (Bushfire prone area map)* in the State Planning Policy interactive mapping system (**SPP IMS**). As a result, condition 21(a) of the development permit is seeking compliance with the example bushfire overlay code (**Bushfire overlay code**) in the *Natural Hazards, Risk and Resilience – Bushfire, State Planning Policy State Interest guidance material* (DSDMIP 2019) (**SPP guidance material – bushfire**) and *Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest ‘Natural Hazards, Risk and Resilience – Bushfire* (QFES 2019) (BRC guide). The BRC guide was prepared by the former Queensland Fire and Emergency Services now Queensland Fire Department (**QFD**) to provide technical guidance for the implementation of the SPP guidance material – bushfire.

Although not referred to in condition 21(a) of the development permit; consideration of guidelines in *Wind Farms and Bushfire Operations* (AFAC 2018) (**Wind farms and bushfire operations**) are also considered relevant to the construction and operation phases of the Project.

This BMP has been prepared to satisfy condition 21(a) of the development permit and demonstrates how compliance with the Bushfire overlay code will be achieved during the construction and operation phases of the Project.

Records of consultation with Project stakeholders about bushfire management for the construction and operation phase of the Project are documented separately to this BMP.

1.2 Commonwealth approvals context

The Project is deemed to be a controlled action and subject to approval pursuant to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**).

A public environment report (**PER**) will be assessed for the EPBC Act approval. With respect to guidelines, specifically section 7.1.12, to follow for the content of the PER, this BMP provides bushfire mitigation and management measures, including information on preventing the spread of bushfire that may start as a result of the construction and operation of the Project to areas outside of the proposed action area.

1.3 Bushfire management plan review

This BMP has been prepared to address the development application requirements for the Project. Upon appointment, the construction contractor and operation contractor may wish to prepare their own version of this BMP to distil matters which are specific to their contract and to include corporate documentation or procedures. Notwithstanding, this does not permit the construction contractor or operation contractor to change or deviate from the mitigation measures specified in Chapter 6.

1.4 Method

To meet requirements of the SPP guidance material – bushfire and BRC guide, the following tasks were undertaken:

- review of the Bushfire prone area map in the SPP IMS (DSDILGP 2022) and the Queensland regional ecosystem map, vegetation hazard class (**VHC**) map, severe fire weather map and fire history map in the QFD online mapping system (QFD 2022) (**Catalyst**);
- a drive over the Project area and field inspection of the above ground infrastructure areas for vegetation characteristics, current land management practices, slope and evidence of previous fires;
- consultation with landowners during the field inspection;
- bushfire hazard assessment in accordance with the method in the BRC guide;
- radiant heat exposure assessment using the Fire Protection Association of Australia *BAL calculator* V4.9 (**BAL calculator**) which models the 'method 2' bushfire attack level assessment procedure in the *Australian Standard (AS 3959-2018) Construction of buildings in bushfire prone areas*; and
- identification of mitigation measures required to reduce the potential risk of bushfire hazards to the construction and operation phases of the Project and for compliance with the Bushfire overlay code.

Aerial imagery of the Project area and measuring tools were accessed online from Google Earth and Queensland Globe to assist with validating observations and measurements made during the field inspection.

1.5 Suitably qualified person

This BMP was prepared by Robert Janssen who is a suitably qualified and experienced bushfire management consultant.

Robert is the managing principal at Land and Environment Consultants Pty Ltd (**LEC**) and has over 25 years of experience in bushfire planning and operations. He has prepared bushfire management plans for residential, commercial and industrial property developments, utilities, government facilities and conservation estates.

Robert's formal qualifications as an environmental scientist and consulting experience are coupled with 10 years of experience as a nationally accredited fire-fighter with the national parks and wildlife service in New South Wales and Queensland.

2 Description of the Project area and the Project

This chapter provides a description of the Project area and the Project.

2.1 The Project area

The location of the Project area is shown in Figure 2.1. It is approximately 17,500 ha, comprising four landowners and is located 25 km west of Kingaroy.

The Project area has been selected for its excellent wind resource and proximity to a Powerlink Queensland (**Powerlink**) high voltage overhead transmission line (**OHTL**) which transverses the Project area in a north-south direction.

Access and egress for the Project area is possible via the Kingaroy Burrandowan Road and Ironpot Road which are both connected to the Bunya Highway.

The Project area is predominantly agricultural land which is used for cattle grazing and dryland cropping. However, parts of the Project area consist of open forest and woodland vegetation.

Land adjoining the Project area is used for an agricultural purpose. Some of the properties to the south of the site host the Coopers Gap Wind Farm. The surrounding areas are accessible via a combination of public and private roads.

2.2 The Project

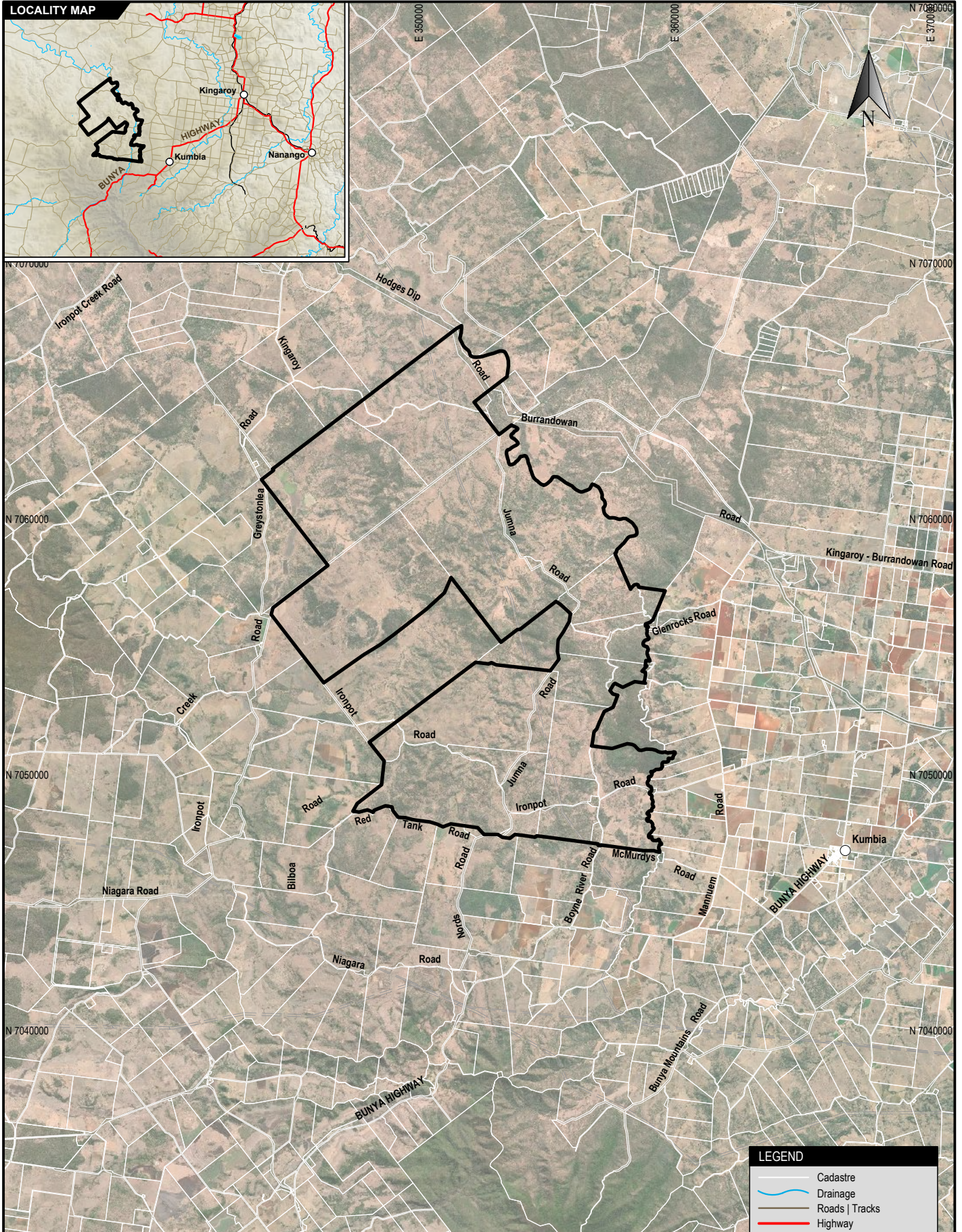
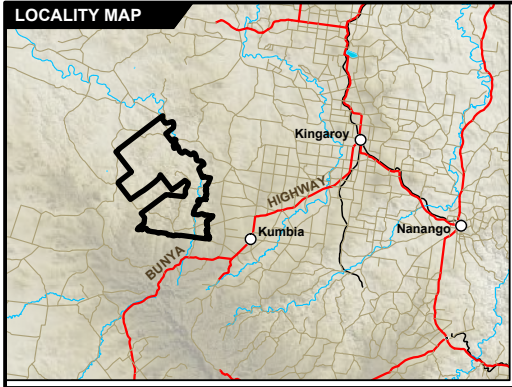
The current layout of the Project is shown in Figure 2.2 and includes the following infrastructure:

- up to 97 wind turbine generators (**T**);
- wind turbine generator foundations and hardstand areas;
- meteorology masts (**MM**);
- switching station and substation;
- underground and overhead transmissions lines;
- operation and maintenance facility;
- construction phase site compound, batching plant, laydown areas and borrow pits;
- access tracks; and
- helipad.

2.3 Bushfire prone area map

The Bushfire prone area map for the Project area is shown in Figures 2.3-2.5. They show the Project area is located within a combination of medium, high and very high potential bushfire intensity areas and potential impact buffer areas.

Please note, in this BMP the terms 'bushfire prone area' and 'bushfire hazard area' have the same meaning. Both terms mean an area of vegetation which is determined to have a potential bushfire intensity $\geq 4,000$ kilowatts/metre (**kW/m**) and the land within 100 m of this vegetation.




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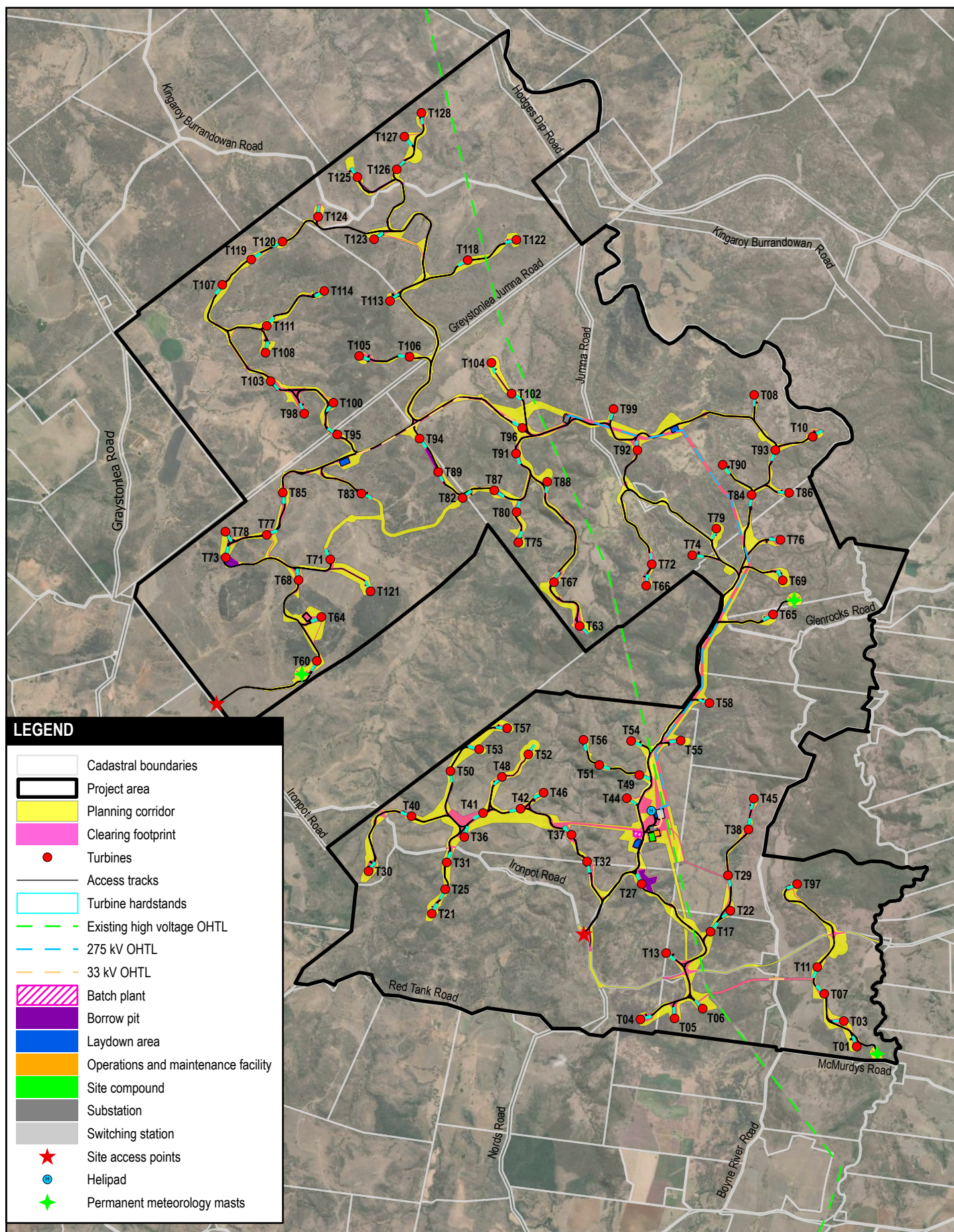
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- Drainage
- Roads | Tracks
- Highway
- City / Town
- The Project Area



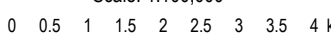
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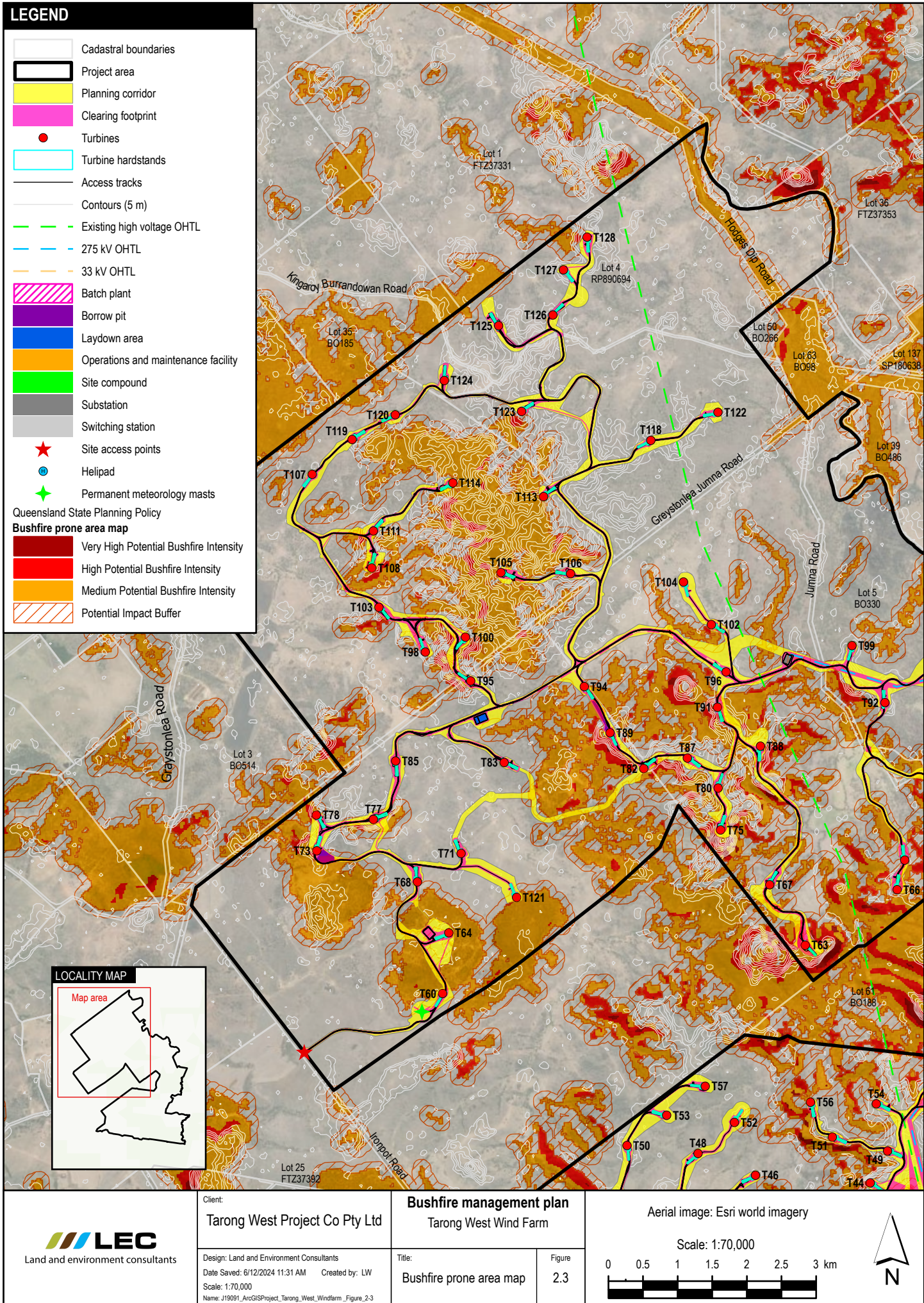
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	Cad File	234 Iron Leaf Wind Farm03.dwg	Rev C			
			2.1			

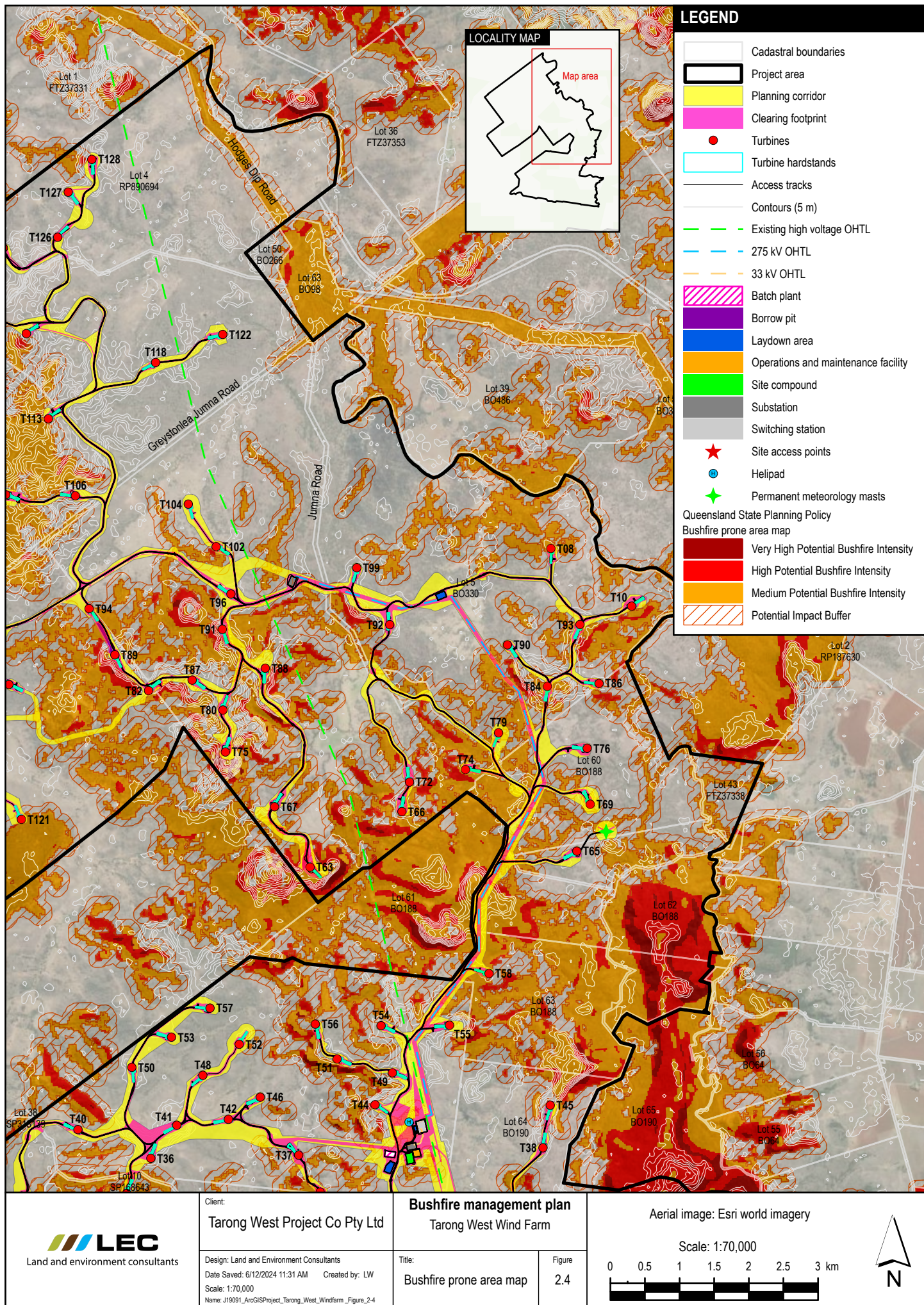
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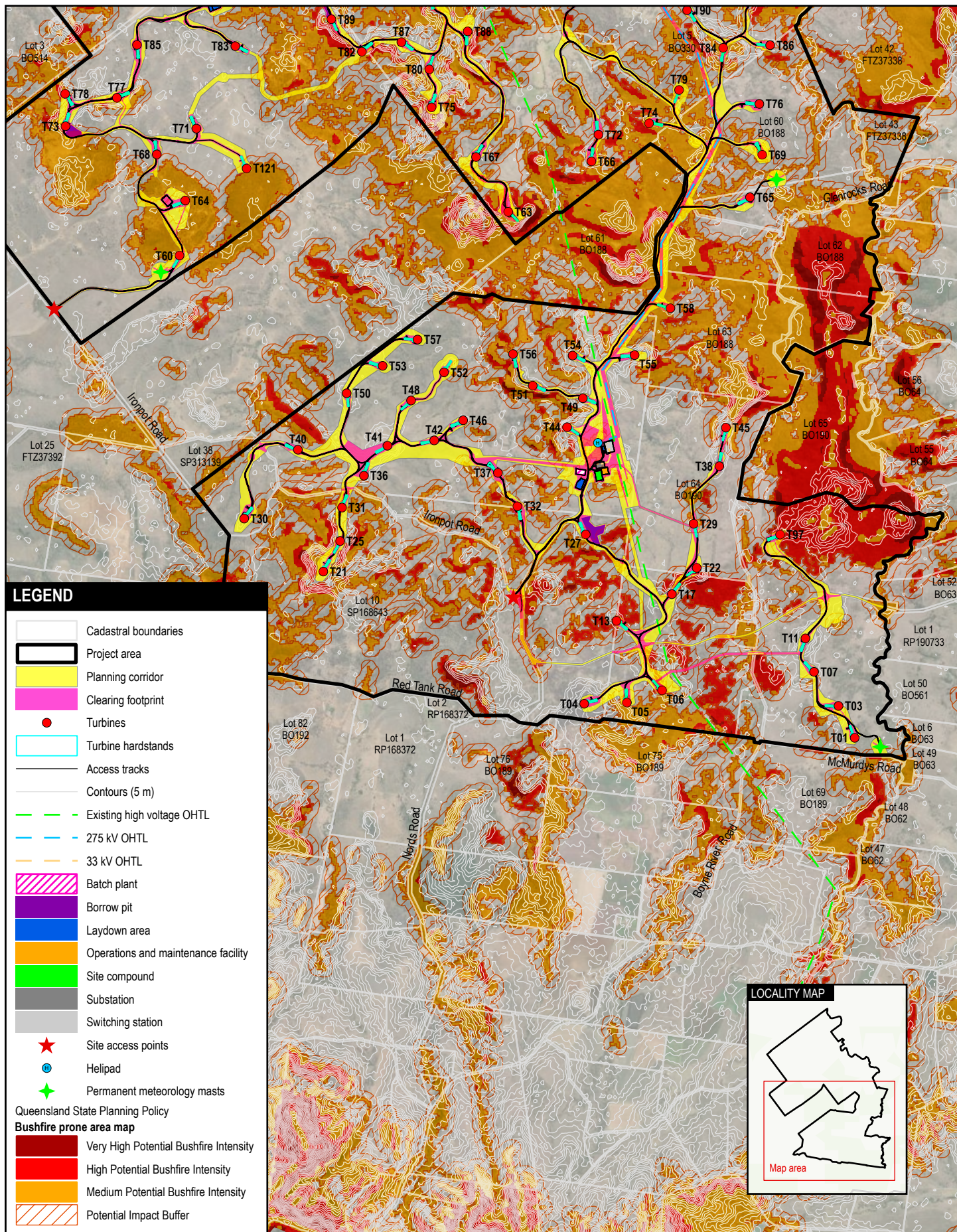




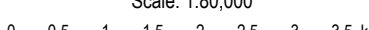
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3 Bushfire hazard assessment

This chapter provides details about the desktop review, field inspection and bushfire hazard assessment.

A drive over the Project area and inspection of above ground infrastructure areas was performed by LEC from 10-11 March 2020. Observations were recorded about current land use and management, vegetation characteristics, the slope of land and evidence of previous fires.

3.1 Severe fire weather

The severe fire weather map in Catalyst indicates the 5 % annual exceedance probability forest fire danger index (**FFDI**) for the Project area is 63. This FFDI value has been used for the potential bushfire intensity calculations in Section 3.5 and the radiant heat exposure assessment in Section 3.7.

3.2 Fire history

Fire history data in Catalyst indicates the Project area and adjoining land regularly burn. The burnt areas generally align with the medium, high and very high potential bushfire intensity areas shown in Figures 2.3-2.5.

3.3 Vegetation

The VHC map in Catalyst was reviewed to identify vegetation and fuel characteristics within the Project area. It was verified via a combination of field inspection and review of aerial imagery in Catalyst. The information is presented in Appendix 1 and indicates that most buildings and structures are adjacent to VHC 13.2 *Dry to moist eucalypt woodlands on undulating metamorphics and granite* (**VHC 13.2**) and VHC 40.4 *Continuous low grass or tree cover* (**VHC 40.4**). Other VHCs which occur within the site include VHC 10.1 *Spotted gum dominated open forests* (**VHC 10.1**) and VHC 16.1 *Eucalyptus dominated forest on drainage lines and alluvial plains* (**VHC 16.1**), although none of the infrastructure shown in Figure 2.2 is adjacent to VHC 16.1.

The potential fuel load of VHCs within the Project area are:

- VHC 10.1 - 20.8 tonnes/ha (**t/ha**);
- VHC 13.2 - 14.4 t/ha;
- VHC 16.1 – 16 t/ha; and
- VHC 40.4 – 5 t/ha.

The BRG guide defines VHC 10.1, VHC 13.2 and VHC 16.1 as having continuous fuel and being bushfire prone hazard types. It defines VHC 40.4 as also having continuous fuel and a grass fire prone hazard type. Therefore, these VHCs are referred to as **hazardous vegetation** in this BMP.

Photographs of the VHCs at the infrastructure areas are provided in Appendix 2.

Where infrastructure adjoined two VHCs, the VHC which is associated with the worst case bushfire attack scenario was used for the potential bushfire intensity calculations in Section 3.5 and the radiant heat exposure assessment in Section 3.7.

3.4 Topography

The topography of the site was assessed during the field inspection with a clinometer and varies from plains to rolling hills.

The range of slopes recorded under each VHC were:

- VHC 10.1 – 0-2 degrees (°);
- VHC 13.2 – 3-11°;
- VHC 16.1 – 4-5°; and
- VHC 40.4 – 2-6°.

The maximum recorded slope under each VHC was used for the potential bushfire intensity calculations in Section 3.5 and the radiant heat exposure assessment in Section 3.7.

3.5 Potential bushfire intensity calculations

The potential bushfire intensity of infrastructure areas was determined using the Queensland Public Safety Business Agency *Potential Bushfire Intensity Calculator* (version November 2014) which is an Excel spreadsheet calculator that models the bushfire hazard assessment method in the BRC guide.

The BRC guide defines bushfire prone area classes as follows:

- very high – potential bushfire intensity > 40,000 kW/m;
- high – potential bushfire intensity 20,000-40,000 kW/m;
- medium – potential bushfire intensity 4,000-20,000 kW/m; and
- non bushfire hazard - potential bushfire intensity <4,000 kW/m.

Results of the potential bushfire intensity calculations which determine the bushfire hazard class of the infrastructure areas shown in Figure 2.2 are presented in Appendix 3.

3.6 Bushfire prone areas

Results of the potential bushfire intensity calculations in Appendix 3 generally align with the Bushfire prone area map and confirm that the Project area is within a bushfire hazard area. Therefore, the construction and operation phases of the Project must comply with the Bushfire overlay code.

3.7 Radiant heat exposure assessment

The Bushfire overlay code and BRC guide require above ground infrastructure to be setback from hazardous vegetation by a distance which achieves a radiant heat flux level $\leq 29 \text{ kW/m}^2$. The exception is where the above ground infrastructure is associated with community infrastructure for essential services, ie the switching station and substation, which must be setback from hazardous vegetation by a distance which achieves a radiant heat flux level $\leq 10 \text{ kW/m}^2$ at the above ground infrastructure. These setbacks are referred to in this BMP as asset protection zones (APZs).

The APZs will minimise the impact of bushfire attack on above ground infrastructure and provide emergency services with access and an operational space for fire-fighter, maintenance works and bushfire fuel hazard reduction activities.

The radiant heat profile of bushfire attack on permanent above ground infrastructure, ie the switching station, substation, operations and maintenance facility and wind turbine generators was assessed using the BAL calculator.

The analysis of bushfire attack scenarios was based on VHCs observed during the field inspection, VHC mapping in Catalyst and the steepest slopes measured for VHCs during the desktop review and field inspection. Inputs used to assess the radiant heat profile of each bushfire attack scenario and results are provided in Appendix 4.

The APZs were identified for permanent above ground infrastructure based on results on the radiant heat exposure assessment and compliance with the radiant heat exposure outcomes of the Bushfire overlay code.

This BMP applies an APZ with a nominal cleared width of 10 m to the meteorology masts and temporary above ground infrastructure, ie the site compound, batching plant, laydowns areas and borrow pits.

The APZs around above ground infrastructure are summarised in Table 3.1.

Table 3.1 APZs around above ground infrastructure

10 m	15 m	20 m	45 m
T1, T3, T7, T30, T36, T37, T38, T40, T41, T42, T44, T45, T46, T48, T49, T50, T51, T52, T53, T54, T55, T56, T57, T65, T67, T68, T71, T73, T75, T76, T77, T78, T80, T82, T83, T85, T86, T87, T89, T92, T94, T96, T102, T103, T104, T105, T106, T107, T108, T111, T119, T120, T122, T123, T124, T125, T126, T127 and T128.	T22, T29 and T97.	T4, T5, T6, T8, T10, T11, T13, T17, T21, T25, T27, T31, T32, T58, T60, T63, T64, T66, T69, T72, T74, T79, T84, T88, T90, T91, T93, T95, T98, T99, T100, T113, T114, T118 and T121.	Switching station, and substation near T44. Substation near T99.
Borrow pit near T27		Operations and maintenance facility near T44.	
Site compound, batch plant and laydown area near T44.			
Borrow pit near T73			
Borrow pit near T89			
laydown area near T92.			
Laydown area near T95.			
MM1, MM60 and MM6569.			

Note 1 The locations of above ground infrastructure are shown in Figure 2.2.

Note 2 APZs may be refined and potentially reduced through detailed design and micro-siting of the Project.

APZs are not applied to access tracks, retaining walls, earthwork embankment batters, terraced walkways or transmissions lines. Notwithstanding, OHTLs are located within a vegetation clearing which is designed to be relevant to electricity transmission and distribution networks in Queensland.

The APZs are measured from:

- the electrical infrastructure within the switching station and substation;
- the external walls, supporting posts or columns of buildings and wind turbine generators; and
- compound fencing at the site compound, batch plant, laydown areas and borrow pits - if there is no compound fencing, the APZ can be measured from the location of temporary structures, plant, equipment and storage areas.

4 Bushfire hazards associated with the project area and the project

This chapter identifies bushfire hazards associated with the Project area and the Project.

4.1 Fire danger season

The fire danger season at the Project area starts in August, peaks in September and begins to fall in November, but will remain elevated until consistent summer rainfall occurs. Typically, the worst fire weather conditions will be experienced during the fire danger season when the wind direction is from the north or west.

An FFDI of 63, ie the 5% annual exceedance probability FFDI for the Project area, will be associated with hot, dry and windy conditions. If a bushfire starts and takes hold under these conditions, it will be difficult to control and fast moving in large areas of bushland vegetation.

The fire danger rating (**FDR**) system provides advice about the level of bushfire threat on a day. The most recent national FDR system was introduced in September 2022. It is based on a new fire behaviour index system and is no longer linked to FFDI values. The FDR system has four levels which are summarised below:

- moderate – most fires can be controlled;
- high – fires can be dangerous;
- extreme – fires will spread quickly and be extremely dangerous; and
- catastrophic – if a fire starts to take hold, it could result in the loss of life.

The FDRs will be monitored during both the construction and operations and maintenance phases of the Project.

4.2 Fire history

As discussed in Section 3.2, fire history data indicates that the Project area and adjoining land regularly burns.

Based on the fire history data and consultation with landowners during the field inspection it is considered almost certain that the Project's above ground infrastructure will be exposed to bushfire attack in the future.

4.3 Vegetation

The disturbance footprint of the Project will be cleared of vegetation in preparation for civil works.

The APZs will be established around above ground infrastructure as specified in Table 3.1 and will be maintained for the life of the Project.

The APZs will be either hardstand areas which are maintained free of weeds and grass or grass areas which are maintained at a nominal height of < 30 centimetres (**cm**).

4.4 Bushfire management within the project area

The Proponent and the construction contractor or operation contractor will be responsible for bushfire management within the disturbance footprint which is leased from the landowners of the Project area. The landowners hosting the Project are responsible for bushfire management in the balance of the Project area.

Notwithstanding, bushfire management is a landscape issue and there will be benefits for both the Project and landowners if they work collaboratively to manage bushfire hazards within the Project area.

4.5 Bushfire attack and the protection of above ground infrastructure

A bushfire in areas of woodland or open forest vegetation on steep slopes present the main issue for the protection of above ground infrastructure.

During fire weather conditions which correlate with the 5 % annual exceedance probability FFDI for the Project area, a bushfire in areas of woodland or open forest vegetation has potential to generate radiant heat energy up to 19,400 kW/m, which in combination with rolling hills will make fire-fighting operations and access difficult. Therefore, direct attack of a fire under these fire weather conditions and the protection of infrastructure may not always be possible.

4.6 Workforce

The Project will not result in the permanent exposure of large numbers of people to bushfire hazard. It is expected that the workforce will average approximately 170 full time equivalent (FTE) personnel over a construction period of approximately 30 months and will be reduced to approximately 12 FTE roles during the operation phase.

During the construction phase, it is expected that most of the workforce will live locally or in adjacent regional centres.

Workers employed for the operation phase of the Project are generally local people seeking employment, who are trained appropriately by the operation contractor.

4.7 Hazardous chemicals

Storage or handling of hazardous chemicals during the construction and operation phases of the Project will be in accordance with *Managing risks of hazardous chemicals in the workplace – Code of Practice* (SWA 2023), applicable safety data sheets, and otherwise in accordance with the *Queensland Work Health and Safety Act 2011* and its regulations.

4.8 Access

The Project will establish an access track network that will link the Project infrastructure to existing roads. Access tracks will be designed for heavy articulated vehicles and will meet the design standards for emergency vehicle access including (where required) the provision of turnaround areas on dead-end access tracks. If there are gates across access tracks, they will be at least 4 m wide.

In addition to the Project's access tracks and the road network, there are numerous minor roads and property access tracks which are of varying design and maintenance standards, they may require restoration prior to use for bushfire management operations.

The Project will be accessed from Ironpot Road as shown in Figure 2.2.

4.9 Rural Fire Brigade resources and capability

The local Rural Fire Brigades (RFBs) are voluntary primary producer brigades and have limited resources to respond to a fire ignition within the Project area. They are unlikely to have any training or experience operating around electrical infrastructure, ie the switching station and substation, and have limited capability to respond to structural fires.

Local RFB personnel may not be familiar with the layout of the Project and out of area RFBs will not be familiar with the location of the Project area, ie access roads, water points, terrain, etc.

4.10 Aerial fire-fighting operations

The wind turbine generators and meteorology masts are a navigation risk to pilots performing aerial fire-fighting operations.

4.11 Fire-fighter water supply

There will be dedicated fire-fighter water supply tanks for the construction and operation phases of the Project.

There are numerous dams within the Project area. However, the standard of vehicle access to them and the reliability of their water supply is unknown and they should not be relied upon.

4.12 Warning and evacuation requirements

Queensland emergency services use a range of methods to warn the community about bushfire, severe weather and other emergencies that require preparation and action at the property level. The construction workforce and operation workforce will be subject to advice and warnings by Queensland emergency services via radio, online media, and local community safety announcements.

A safety and emergency management plan and an evacuation plan will be prepared for the construction phase and operation phase of the Project. These plans will provide details of actions to be undertaken in response to a bushfire emergency. They are separate plans to this BMP.

4.13 Buildings

Offices and worker amenities that are required for the construction phase of the Project will be demountable buildings, ie temporary buildings, that will be located in a cleared compound.

Buildings associated with the operations and maintenance facility, switching station and substation will be designed to meet the fire resistance and safe access and egress requirements in the *National Construction Code–Building Code of Australia (NCC-BCA)* (volume 1) (ABCD 2022) and governing Queensland laws, codes and standards that apply to the building industry.

Fire detection and first attack fire-fighting equipment in buildings will comply with requirements in the NCC-BCA (volume 1) and any Queensland specific requirements.

5 Fire ignition risks

This chapter identifies fire ignition risks within the Project area.

5.1 Land use

The Project area consists of and adjoins freehold land tenures used for agricultural purposes, ie cattle grazing and dryland cropping.

The operation of equipment and machinery or hot works associated with agricultural activities could result in unplanned fires that impact on the Project, particularly on days with an FDR of extreme or catastrophic. In addition, landowners may light fires to burn waste or for bushfire fuel hazard reduction. Therefore, land which is used for agricultural activities is a potential bushfire hazard to the Project.

5.2 Overhead transmission lines

Powerlink high voltage OHTL are susceptible to 'flashover' which can cause a fire ignition in surrounding vegetation. Fires with a flame height greater than 1 m adjacent to or under high voltage OHTL have the potential to:

- create electrical arcs (known as flashovers) that can endanger people, animals and objects;
- damage or destroy wires, insulators and supports of the transmission line; and
- interrupt power supply to households, business and industry.

Vegetation under the Powerlink high voltage OHTL will be maintained in accordance with Powerlink's vegetation management specifications for high voltage overhead transmission lines (Powerlink 2018).

Wind turbine generators will be connected to substation by underground and overhead transmission lines. The risk of a fire ignition caused by these overhead transmission lines is minor when compared to the risk profile that exists for Powerlink's high voltage OHTL. Nonetheless, vegetation under these OHTL will be in accordance with *Energy Queensland - Vegetation Management Strategy – Version 2* (EQ 2023).

5.3 Lightning strike

A lightning strike could cause a fire within the Project area, particularly during the fire danger season, ie from late winter to early summer, when dry electrical storms most commonly occur.

The Australasian Fire and Emergency Service Authorities Council Limited suggests that it is possible that wind turbine generators may reduce the risk of bushfires caused by lightning strikes, given that wind turbine generators can attract lightning during thunderstorms. If struck by lightning, a wind turbine generator is not expected to start a fire as it has built-in fire protection mechanisms (AFAC 2018).

5.4 Mechanical or electrical fire

There is potential for a fire of electrical or mechanical origin to develop in the switching station, substation and wind turbine generators and result in a fire within the Project area. However, this situation is unlikely to occur as this infrastructure has built-in fire protection mechanisms (AFAC 2018) and will be surrounded by an APZ where vegetation is managed.

5.5 Construction activities

The use of tracked earthmoving machinery on rocky ground, vehicles driving or parking in long grass, hot works and people smoking has potential to cause a bushfire during the construction phase.

5.6 Operations and maintenance activities

Similar risks may exist during the operation phase of the Project that existed during the construction phase, ie vehicles driving or parking in long grass, hot works and people smoking. However, worker numbers will be significantly reduced and access throughout the Project area will be on formed access tracks, meaning vehicle and mobile plant movement off formed access tracks will rarely occur.

6 Bushfire mitigation plan

This chapter identifies bushfire mitigation measures that must be implemented during the construction and operation phases of the Project.

The bushfire mitigation measures will reduce the risk of bushfire hazards to a tolerable level which in this BMP means compliance with outcomes of the Bushfire overlay code.

It is the total of the mitigation measures in this chapter that will reduce the risk of bushfire hazards to a tolerable level. Failure to implement all of the mitigation measures in their entirety could result in an increased level of exposure to bushfire hazards.

6.1 Asset protection zones

The APZs shown in Figures 6.1-6.3 must be established and maintained around above ground infrastructure. The width of APZs must comply with the minimum widths specified for the above ground infrastructure in Table 3.1.

The APZs are measured from:

- the electrical infrastructure within the switching station and substation;
- the external walls, supporting posts or columns of buildings and wind turbine generators; and
- compound fencing at the site compound, batch plant, laydown areas and borrow pits - if there is no compound fencing, the APZ can be measured from the location of temporary structures, plant, equipment and storage areas.

The APZs must be cleared of vegetation and established as a gravel hardstand area or grass area. A gravel hardstand area must be maintained free of weeds and grass cover. Where establishing a gravel hardstand area is not practical, a grass area must be established. A grass area must be maintained free of woody vegetation and with grass cover which has a height of ≤ 30 cm.

The APZs must be inspected at regular times intervals during the calendar year and vegetation maintained in accordance with the specifications above.

6.2 Overhead transmission lines

Vegetation management under high voltage OHTL must be in accordance with Powerlink's vegetation management specifications for high voltage transmission lines (Powerlink 2018).

Vegetation management under OHTL which connect wind turbines generators to the substation must be in accordance with *Energy Queensland - Vegetation Management Strategy* (EQ 2022).

6.3 Cable pits

A 1 m wide area around cable pits must be maintained clear of all vegetation greater than 10 cm in height.

6.4 Vegetation waste

Vegetation cleared from the disturbance footprint during the construction phase must not be pushed into windrows. The cleared vegetation must be removed from the disturbance footprint or mulched, in which case the mulch can be used for erosion and sediment control within the disturbance footprint.

6.5 Access and evacuation

Formal access for the construction and operation phases of the Project is from entrance points along Ironpot Road. These entrance points and disturbance footprint where the access track network that will be constructed are shown in Figures 6.1-6.3.

As a minimum requirement, access tracks must meet the design specifications for category 1 fire-fighter vehicles by the New South Wales Rural Fire Service (NSW RFS 2016) which are summarised as follows:

- Width – The trafficable surface has a width of 4 m except for short constrictions to 3.5 m for no more than 30 m in length where an obstruction cannot be reasonably avoided or removed. Curves have a minimum inner radius of 6 m. The minimum distance between inner and outer curves is 6 m.
- Capacity – Trail surfaces and crossing structures are capable of carrying vehicles with a gross vehicle mass of 15 tonnes (t) and an axle load of 9 t.
- Grade and crossfall – The maximum grade of a trail is not more than 15 degrees. The crossfall of the trail surface is not more than 6 degrees. Drainage structures, feature crossings, or other significant changes in the grade of the trail shall be in accordance with the *Fire Trail Design, Construction and Maintenance Manual* (NSW DISCS 2017).
- Clearance – A minimum vertical clearance of 4 m is provided above the surface of the trafficable surface clear of obstructions.
- Passing – Capacity for passing is provided every 250 m comprising:
 - a widened trafficable surface of at least 6 m for a length of at least 20 m; or
 - a 6 m wide and 8 m long area clear of the trafficable surface with a minimum inner curve radius of 6 m and minimum outer radius of 12 m; or
 - a turnaround area is provided (as outlined below).
- Turnarounds – A turning area is provided at the termination of a trail and every 500 m and is achieved by:
 - an area clear of the trafficable surface, which is 6 m wide and 8 m deep, with a minimum inner curve radius of 6 m and minimum outer radius of 12 m; or
 - a turning circle of minimum 22 m diameter;
 - a T-junction with each terminating end of the junction being at least 10 m in length from the intersection of the roads and the inner radius of the intersection being at least 6 m; or
 - a fire trail or road intersection.

Drainage for access tracks must be designed and constructed in accordance with the *Fire Trail Design, Construction and Maintenance Manual* (NSW DISCS 2017).

Access tracks must be inspected at regular times intervals during the calendar year and maintained in accordance with the specifications above. Maintenance must occur prior to the annual fire danger season, ie prior to the end of August.

6.6 Fire-fighter water supply

Upon commencement of the construction phase, a fire-fighter water storage tank must be installed at the operations and maintenance facility and within the clearing footprint adjacent to T64. They must be made of metal or concrete and have a minimum capacity of 20,000 litres. The indicative locations of the fire-fighter water storage tanks are shown in Figures 6.1-6.3. The actual location must be within the approved disturbance footprint for the Project.

The fire-fighter water storage tanks must remain in place during both the construction phase and the operation phase. They must be kept full of water and must not be used for activities other than bushfire management.

The fire-fighter water storage tanks must be fitted with RFB fire-fighter fittings – we recommend contacting the local RFB to confirm the standard RFB fittings in use at the locality. All above ground fittings, ie connections, valves and pipes, must be made of metal.

The fire-fighter water storage tanks must have a hardstand area within 4 m of the inlet and outlet points. The hardstand area adjacent to the tanks must have the load bearing capacity and dimensions suitable for a heavy rigid vehicle to park.

The fire-fighter water storage tanks and fittings must be inspected annually and any required maintenance work undertaken prior to the annual fire danger season, ie prior to the end of August.

6.7 Wayfinding

Reflective wayfinding signage must be installed at the intersection of access tracks and identify the location of project infrastructure and fire-fighter water storage tanks.

Wayfinding signage must be based on a naming and marking convention which enhances accessibility for out of area fire-fighters. For example, marking the intersection of access tracks as A-B to indicate that it links landmark A to landmark B; landmarks used for this purpose must be identifiable on site and marked on any site mapping.

Access track marking must clearly indicate no through access tracks.

6.8 Buildings

Buildings must comply with the fire resistance and safe access and egress requirements under the NCC-BCA and governing Queensland laws, codes and standards that apply to the building industry.

Fire detection and first attack fire-fighting equipment in buildings must comply with specifications in the NCC-BCA and any Queensland specific requirements.

These matters will be dealt with in detail through the building certification and approvals process.

6.9 Meteorological masts

Meteorological masts are a potential hazard for aerial fire-fighting operations. Mitigation measures must be implemented for compliance with guidelines in Wind farms and bushfire operations.

6.10 Administrative controls

6.10.1 General

Hot works must be managed under a hot works permit system.

Hot works and other high fire risk activities, eg the operation of track machinery on rocky ground, must be monitored for ignitions and only performed if fire management controls are in place.

Vehicles and mobile plant and equipment must not be operated or parked in long grass, ie grass > 30 cm in height, unless fire management controls are in place.

Vehicles and mobile plant and equipment must be fitted with an ultra-high frequency (UHF) radio and portable fire extinguisher. The portable fire extinguisher must be suitable for extinguishing a fire associated with the vehicle or mobile plant and equipment.

Water carts/water tanks must be located adjacent to construction work areas during the fire danger season, ie from late winter until summer when significant rainfall occurs.

6.10.2 Information transfer

Prior to commencing the operations and maintenance phase of the Project, spatial data which identifies the location of access tracks and infrastructure must be provided to the QFD so that it can be uploaded into the QFD online incident management system and is readily available for bushfire emergency planning.

The Proponent must consult with the QFD to determine the information and data format requirements and the specifics of the data transfer.

6.10.3 Bushfire preparedness

The construction contractor and operation contractor must invite the local QFD and RFBs and landowners hosting the Project to participate in an annual bushfire preparedness meeting for the Project.

The meeting will be used to familiarise QFD and RFB personnel and landowners with the Project's infrastructure, access tracks, fire-fighter water storage tanks and fittings, communication procedures and safety requirements for operating within the Project area. It will also provide an opportunity to review any bushfire incidents within or adjacent to the Project area and any plans for hazard reduction burns by the landowners.

Opportunities to upgrade dams and access tracks located within the Project area must also be discussed at the preparedness meeting as these upgrades could have benefits for the Project.

The bushfire preparedness meeting also provides an opportunity to run a bushfire response training drill with the local QFD and RFBs.

6.10.4 Project rules and inductions

Access to the Project area during the construction and operation phases of the Project will be conditional on compliance with workers completing an induction and complying with entry rules, including rules regarding smoking.

Smoking must only be permitted in cleared areas, ie the site compound, laydown areas, operations and maintenance facility and wind turbine generator hardstands.

6.10.5 Safety documentation

Activities associated with the construction and operation phases of the Project must be governed by safety documentation, including safe work method statements. Activity specific bushfire risk management controls must be identified through the safety documentation. Where required, the safety documentation must be managed through a permit to work system which must provide an additional layer of control around bushfire risk management.

6.10.6 Monitor fire weather conditions

The FDRs and fire weather warnings must be monitored daily for the construction and operations and maintenance phases of the Project. The FDR and associated guidance from the QFD must be communicated to staff or contractors prior to commencing the day's work, ie during the daily pre-start safety brief.

The FDRs for the Project area are updated daily by the QFD and can be accessed online at <https://www.fire.qld.gov.au/prepare/bushfire/fire-danger-ratings> - search for Wide Bay and Burnett

district. Fire weather warnings are published online by the Bureau of Meteorology at <http://www.bom.gov.au/qld/index.shtml>.

Table 6.1 provides guidance on precautions for activities during the construction and operation phases on the Project in relation to FDRs.

Table 6.1 Fire Danger Rating activity guidelines

FDR	Fire danger guidance	Operational guidance
Moderate	<p>Plan and prepare.</p> <p>Most fires can be controlled.</p> <p>Stay up to date and be ready to act if there is a fire.</p>	<p>Maintain APZs.</p> <p>Access tracks are checked and maintained clear of obstacles.</p> <p>Fire extinguishers are checked and are operational.</p> <p>Fire-fighter water storage tanks are full and plumbing is checked and is operational.</p> <p>During construction - inspect any mulched piles of cleared vegetation for signs of combustion.</p> <p>Hot works are performed in accordance with a hot works permit.</p> <p>Monitor FDR conditions.</p>
High	<p>Be ready to act.</p> <p>Fires can be dangerous.</p> <p>Decide what you will do if a fire starts.</p> <p>There is a heightened risk. Be alert for fires in your area.</p> <p>If a fire starts, avoid bushfire prone areas.</p>	<p>Maintain APZs.</p> <p>Access tracks are checked and maintained clear of obstacles.</p> <p>Fire extinguishers are checked and are operational.</p> <p>Fire-fighter water storage tanks are full and plumbing is checked and is operational.</p> <p>During construction - inspect any mulched piles of cleared vegetation for signs of combustion.</p> <p>Construction and operation activities that may cause accidental ignitions, eg slashing and machine/vehicle operation in long grass, require a spotter and water cart to be present onsite.</p> <p>Hot works require additional approval from the construction contractor and the operation contractor or delegate and will occur under a permit to work system.</p> <p>Monitor FDR conditions.</p>
Extreme	<p>Fires will spread quickly and will be extremely dangerous.</p> <p>Make sure the Project is fire ready.</p> <p>If a fire starts, take immediate action.</p>	<p>Fire extinguishers are checked and are operational.</p> <p>Fire-fighter water storage tanks are full and plumbing is checked and is operational.</p> <p>During construction - inspect any mulched piles of cleared vegetation for signs of combustion.</p>

FDR	Fire danger guidance	Operational guidance
		<p>Fire weather warnings and restrictions imposed by the QFD must be observed.</p> <p>Construction and operation activities that may cause accidental ignitions, eg slashing and machine operation in long grass, are not permitted.</p> <p>Hot works must not occur in outdoor areas.</p> <p>Surveillance for fire ignitions and smoke plumes within and adjoining the Project area.</p> <p>Monitor FDR conditions.</p>
Catastrophic	<p>Do not enter bushfire prone areas.</p> <p>If a fire starts, it will potentially be life threatening.</p> <p>These are the most dangerous conditions for a fire.</p> <p>Stay safe by going to a safer location early.</p> <p>Buildings may not withstand fires in these conditions.</p>	<p>Fire weather warnings and restrictions imposed by the QFD must be observed.</p> <p>Surveillance for fire ignitions and smoke plumes within and adjoining the Project area.</p> <p>No construction activities are permitted (other than administrative activities which occur indoors).</p> <p>No operation activities are permitted (other than administrative activities which occur indoors).</p> <p>Monitor FDR conditions.</p>

6.10.7 High voltage overhead transmission lines

Fire-fighting operations near the Powerlink high voltage OHTL must be planned and implemented in accordance with the *National Guidelines on Electrical Safety for Emergency Service Personnel* (ENA DOC 008-2006) and Powerlink's instructions.

6.10.8 Communications planning

The following is in place by the time construction commences:

- all relevant staff are aware of the mitigation measures in this BMP;
- an emergency contact number is available online and is attended to at all times by trained staff;
- contingency communication systems are in place for the onsite representative of the construction contractor and operation contractor in case of failed telephone communication attempts;
- communication with the landowners hosting the Project to ensure that access to the Project area is not constrained for the local QFD and RFBs; and
- a mechanism to provide periodical updates to the landowners hosting the Project and the local QFD and RFBs as the Project is progressively built.

6.10.9 Emergency response planning

A separate emergency response plan must be prepared by the construction contractor for the construction phase of the Project and by the operation contractor for the operation phase of the Project.

The emergency response plan must include procedures to be followed in the event of a bushfire warning by the QFD and a bushfire within properties hosting the Project. It must also identify the location of safe assembly/evacuation areas and the access routes to these areas.

With regards to bushfire, a safe assembly or evacuation area must have a gravel surface or consist of low cut grass, ie grass slashed to a nominal height $\leq 30\text{cm}$, and must not be located in areas identified as a medium, high and very high potential bushfire intensity area or potential impact buffer area in Figures 2.3-2.5.

In the event of a fire ignition that cannot be safely extinguished with available resources, ie a bushfire, the following procedure must be followed:

1. Contact the QFD via a 000 call.
2. Notify property owners hosting the Project of the fire ignition.
3. Evacuate personnel and contractors to a safe assembly/evacuation area and account for all personnel and contractors.
4. Meet the QFD and provide information relevant to the bushfire emergency.
5. Resume construction or operational and maintenance works when advised by the QFD that it is safe to do so.

6.10.10 Fire-fighter operations plan

Prior to the operation phase of the Project, a fire-fighter operations plan must be prepared for the Project area and provided to the local RFBs. It must be in the format of a poster plan that can be rolled out and used in the field.

The fire-fighter operations plan must identify (as a minimum) the location of infrastructure, access tracks, water points and reference wayfinding signage. It must also include contact and communications information, instructions for operating around electrical infrastructure and operational guidelines for fire control.

6.10.11 Electrical safety

The Project must be operated in compliance with the Queensland *Electrical Safety Act 2002* and its regulations and the electrical safety codes of practice by the Electrical Safety Office of Queensland (ESO 2020a, ESO 2020b and ESO 2021).

Electrical equipment installed to support the operations and maintenance phase of the Project must be regularly inspected in accordance with the manufacturer's guidelines (where this applies) or in accordance with industry best practice.

6.10.12 Hazardous chemicals

Storage or handling of hazardous chemicals during the construction and operation phases of the Project must not occur in vegetated areas and must be in accordance with *Managing risks of hazardous chemicals in the workplace – Code of Practice* (SWA 2023), applicable safety data sheets, and otherwise in accordance with Queensland *Work Health and Safety Act 2011* and its regulations.

6.10.13 Shut down

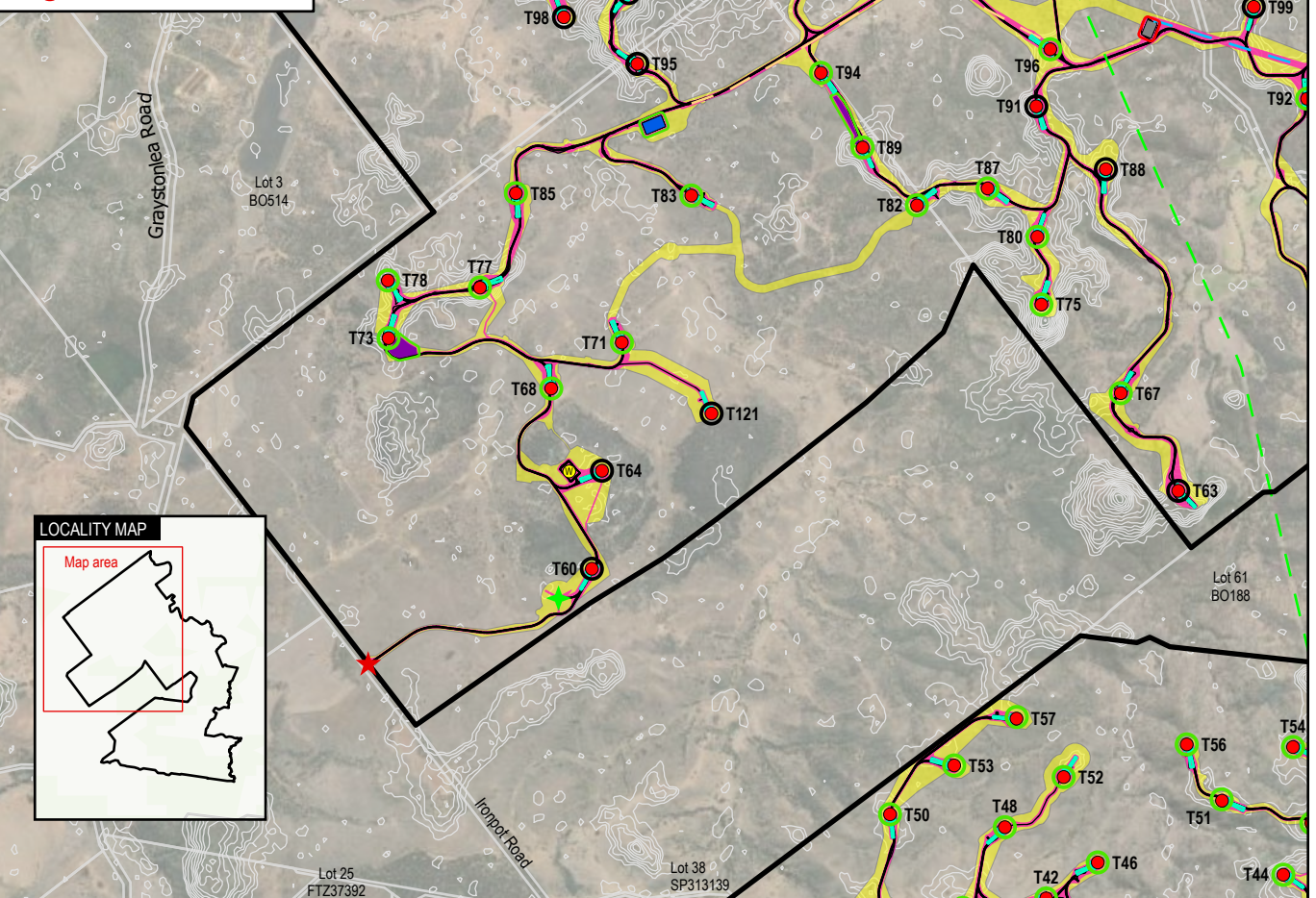
The wind turbine generators must be locked in a static position if advised by the QFD that aerial fire-fighting operations are to be undertaken within the properties hosting the Project. Protocols for the operation phase of the Project must be explicit about what party has the authority to lock wind turbine generators in a static position.

6.10.14 Lighting fires

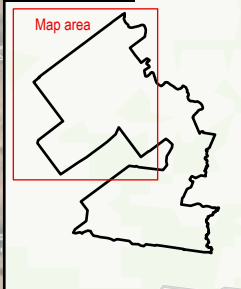
Lighting fires is prohibited within the Project area (unless requested by the QFD or RFB in response to a bushfire emergency, eg backburning containment lines to protect infrastructure).

LEGEND

	Cadastral boundary
	Project area
	Planning corridor
	Clearing footprint
	Turbines
	Turbine hardstands
	Access tracks
	Contours (5 m)
	Existing high voltage OHTL
	275 kV OHTL
	33 kV OHTL
	Batch plant
	Borrow pit
	Laydown area
	Operations and maintenance facility
	Site compound
	Switching station
	Substation
	Site access points
	Helipad
	Approximate location of static water storage tank
	Permanent meteorology masts
	10 m asset protection zone
	15 m asset protection zone
	20 m asset protection zone
	45 m asset protection zone



LOCALITY MAP



Land and environment consultants

Client:
Tarong West Project Co Pty Ltd

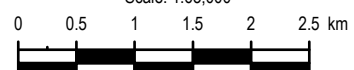
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Name: J19091_ArcGISProject_Tarong_West_Windfarm_Figure 6-1

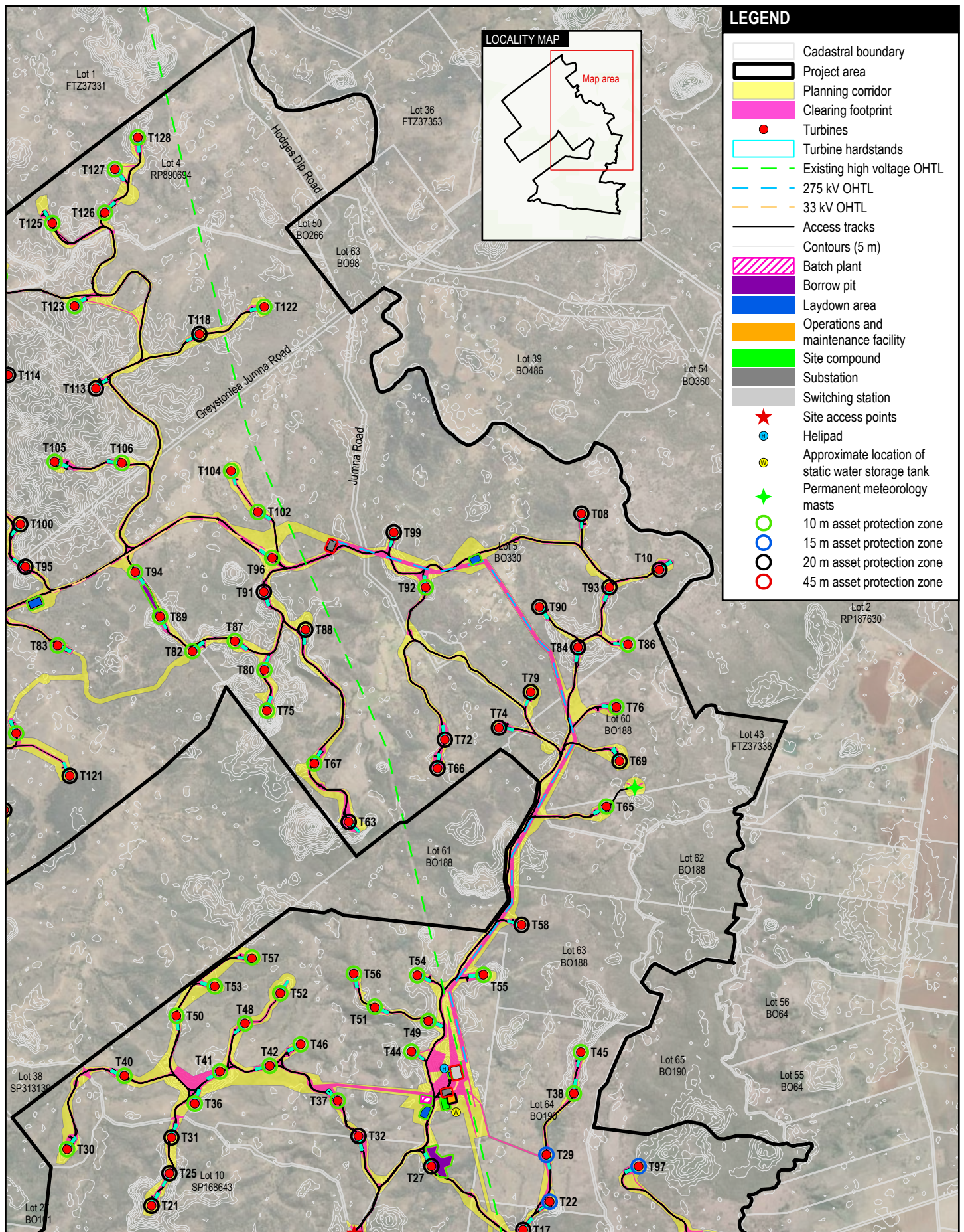
Bushfire management plan
Tarong West Wind Farm


Title:
Bushfire mitigation plan

Figure
6.1

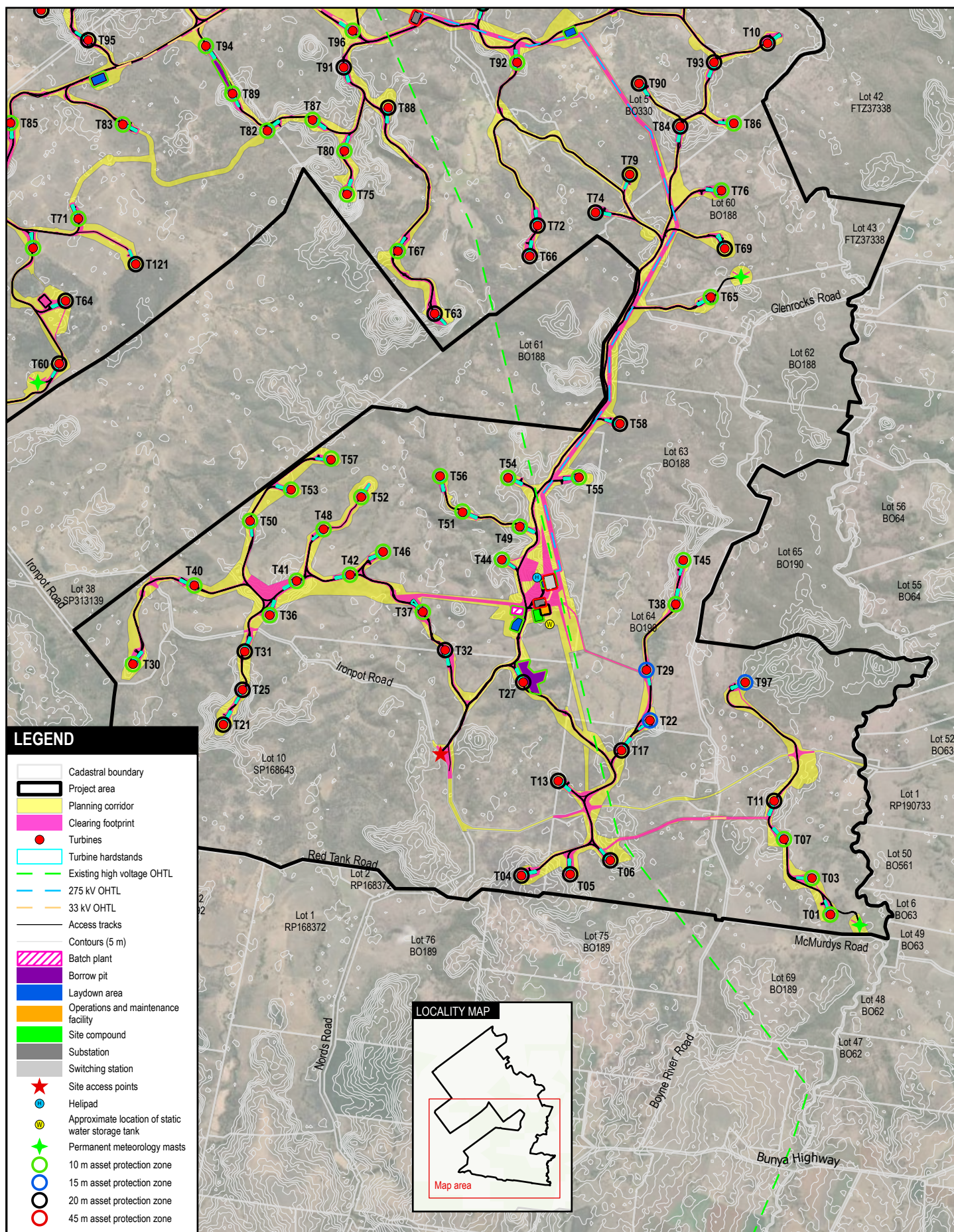
Aerial image: Esri world imagery
Scale: 1:65,000





 <p>Land and environment consultants</p>	<p>Client: Tarong West Project Co Pty Ltd</p> <p>Design: Land and Environment Consultants Date Saved: 6/12/2024 11:32 AM Created by: LW Scale: 1:75,000 Name: J19091_ArcGISProject_Tarong_West_Windfarm_Figure_6-2</p>	<p>Bushfire management plan Tarong West Wind Farm</p> <p>Title: Bushfire mitigation plan</p> <p>Figure 6.2</p>	<p>Aerial image: Esri world imagery</p> <p>Scale: 1:75,000</p> <p>0 0.5 1 1.5 2 2.5 3 km</p> 
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 Land and environment consultants	Client: Tarong West Project Co Pty Ltd		Bushfire management plan Tarong West Wind Farm		Aerial image: Esri world imagery Scale: 1:70,000  
	Design: Land and Environment Consultants Date Saved: 6/12/2024 11:32 AM Created by: LW Scale: 1:70,000 Name: J19091_ArcGISproject_Tarong_West_Windfarm_Figure_6-3	Title: Bushfire mitigation plan	Figure 6.3		

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7 Conclusion

This BMP has been prepared by a suitably qualified person and is in general accordance with requirements of the Bushfire overlay code and BRC guide. Its preparation involved an in-field inspection of the Project area and consultation with landowners hosting the Project.

The bushfire hazard assessment confirmed that the Project area is within a bushfire hazard area and the construction and operation phases of the Project must comply with the Bushfire overlay code. An assessment of compliance with the Bushfire overlay code is provided in Appendix 5.

Mitigation measures that must be implemented during the construction and operation phases of the Project are specified in Chapter 6. Upon appointment, the construction contractor and the operation contractor may wish to prepare their own version of this BMP to distil the matters which are specific to their contract or to include corporate documentation or procedures. Notwithstanding, this does not permit the construction contractor or operation contractor to change or deviate from the mitigation measures specified in Chapter 6.

There is an opportunity for refining the APZs through detailed design and micro-siting of the Project's infrastructure.

This BMP has been prepared to address SARA's development application requirements for the Project and to address the PER guideline requirements for the Tarong West Wind Farm. It also provides bushfire mitigation and management measures, including information on preventing the spread of bushfire that may start as a result of the construction and operation of the Project.

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Appendix 1 Summary of VHCs

Summary of VHCs

Infrastructure	Catalyst VHC	Ground truthed VHC via site visit and aerial imagery	Potential fuel load (tonnes/hectare) ¹	Prone type ¹	Fuel continuity ¹
<i>Wind turbine generators (T)</i>					
T1	VHC 40.4 <i>Continuous low grass or tree cover (VHC 40.4)</i>	VHC 40.4	5	Grass fire	Continuous
T3	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T4	VHC 13.2 <i>Dry to moist eucalypt woodlands on undulating metamorphics and granite (VHC 13.2)</i>	VHC 13.2	14.4	Bushfire	Continuous
T5	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T6	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T7	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T8	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T10	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T11	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T13	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T17	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T21	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T22	VHC 10.1 <i>Spotted gum dominated open forests (VHC 10.1)</i>	VHC 10.1	20.8	Bushfire	Continuous
T25	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T27	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T29	VHC 10.1	VHC 10.1	20.8	Bushfire	Continuous
T30	VHC 7.1 <i>Semi-evergreen to deciduous microphyll vine forest (VHC 7.1) and VHC 40.4</i>	VHC 40.4	5	Grass fire	Continuous
T31	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T32	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T36	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T37	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T38	VHC 40.4	VHC 40.4	5	Grass fire	Continuous

Infrastructure	Catalyst VHC	Ground truthed VHC via site visit and aerial imagery	Potential fuel load (tonnes/hectare) ¹	Prone type ¹	Fuel continuity ¹
T40	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T41	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T42	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T44	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T45	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T46	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T48	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T49	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T50	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T51	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T52	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T53	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T54	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T55	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T56	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T57	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T58	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T60	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T63	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T64	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T65	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T66	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T67	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T68	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T69	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T71	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T72	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T73	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T74	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T75	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T76	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T77	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T78	VHC 13.2 and VHC 40.4	VHC 40.4	5	Grass fire	Continuous

Infrastructure	Catalyst VHC	Ground truthed VHC via site visit and aerial imagery	Potential fuel load (tonnes/hectare) ¹	Prone type ¹	Fuel continuity ¹
T79	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T80	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T82	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T83	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T84	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T85	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T86	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T87	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T88	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T89	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T90	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T91	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T92	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T93	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T94	VHC 13.2	VHC 40.4	5	Grass fire	Continuous
T95	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T96	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T97	VHC 10.1	VHC 10.1	20.8	Bushfire	Continuous
T98	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T99	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T100	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T102	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T103	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T104	VHC 40.4	VHC 40.4	5	Grassfire	Continuous
T105	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T106	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T107	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T108	VHC 13.2 and VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T111	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T113	VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T114	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T118	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
T119	VHC 40.4	VHC 40.4	5	Grass fire	Continuous

Infrastructure	Catalyst VHC	Ground truthed VHC via site visit and aerial imagery	Potential fuel load (tonnes/hectare) ¹	Prone type ¹	Fuel continuity ¹
T120	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T121	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
T122	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T123	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T124	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T125	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T126	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T127	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
T128	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
Ancillary infrastructure					
Borrow pit near T27	VHC 13.2 and VHC 40.4	VHC 40.4	5	Grass fire	Continuous
Operations and maintenance facility, switching station and substation near T44	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
Helipad, site compound, batch plant and laydown area near T44	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
Borrow pit near T73	VHC 40.4	VHC 40.4	5	Grassfire	Continuous
Borrow pit near T89	VHC 13.2 and VHC 40.4	VHC 40.4	5	Grassfire	Continuous
Laydown area near T92	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
Laydown area near T95	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
Substation near T99	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
Meteorology masts					
Temporary					
TMM1	VHC 38.5 <i>Cropping and horticulture (VHC 38.5)</i>	VHC 40.4	5	Grass fire	Continuous
TMM60	VHC 13.2	VHC 13.2	14.4	Bushfire	Continuous
TMM65	VHC 40.4	VHC 40.4	5	Grass fire	Continuous
TMM69	VHC 40.4	VHC 40.4	5	Grassfire	Continuous

Infrastructure	Catalyst VHC	Ground truthed VHC via site visit and aerial imagery	Potential fuel load (tonnes/hectare) ¹	Prone type ¹	Fuel continuity ¹
<i>Permanent</i>					
MM1	VHC 38.5 <i>Cropping and horticulture</i> (VHC 38.5)	VHC 40.4	5	Grass fire	Continuous
MM60	VHC 13.2 and VHC 40.4	VHC 13.2	14.4	Bushfire	Continuous
MM6569	VHC 40.4	VHC 40.4	5	Grass Fire	Continuous
Notes	¹ Potential fuel load, prone type and fuel continuity taken from <i>Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience – Bushfire'</i> (QFD 2019)				

Appendix 2 Photographs of VHCs at infrastructure areas



Photograph 1 VHC 40.4 *Continuous low grass or tree cover* (VHC 40.4) between T64 and T71



Photograph 2 VHC 13.2 *Dry to moist eucalypt woodlands on undulating metamorphics and granite* (VHC 13.2) west of T73



Photograph 3 VHC 40.4 near T95



Photograph 4 VHC 40.4 near T123



Photograph 5 VHC 40.4 between T118 and T122



Photograph 6 VHC 40.4 east of T104



Photograph 7 VHC 16.1 *Eucalyptus* dominated forest on drainage lines and alluvial plains north of T99



Photograph 8 VHC 40.4 near T99



Photograph 9 VHC 40.4 near T74



Photograph 10 VHC 13.2 between T69 and T74



Photograph 11 VHC 13.2 north of T58



Photograph 12 VHC 13.2 near T58



Photograph 13 VHC 40.4 near T55



Photograph 14 VHC 13.2 near T44



Photograph 15 VHC 40.4 at T42



Photograph 16 VHC 40.4 near T41



Photograph 17 VHC 40.4 at T36



Photograph 18 VHC 13.2 at T27



Photograph 19 VHC 40.4 near T11



Photograph 20 VHC 40.4 south of T7

Appendix 3 Potential bushfire intensity calculations

Potential bushfire intensity calculations

Infrastructure	VHC	Potential fuel load (t/ha) ¹	Maximum slope under VHC (°)	Potential bushfire intensity (kW/m)	Bushfire hazard class
<i>Wind turbine generators (T)</i>					
T1	VHC 40.4 <i>Continuous low grass or tree cover (VHC 40.4)</i>	5	6	1,477	Non-bushfire hazard class ²
T3	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T4	VHC 13.2 <i>Dry to moist eucalypt woodlands on undulating metamorphics and granite (VHC 13.2)</i>	14.4	11	17,302	Medium
T5	VHC 13.2	14.4	11	17,302	Medium
T6	VHC 13.2	14.4	11	17,302	Medium
T7	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T8	VHC 13.2	14.4	11	17,302	Medium
T10	VHC 13.2	14.4	11	17,302	Medium
T11	VHC 13.2	14.4	11	17,302	Medium
T13	VHC 13.2	14.4	11	17,302	Medium
T17	VHC 13.2	14.4	11	17,302	Medium
T21	VHC 13.2	14.4	11	17,302	Medium
T22	VHC 10.1 <i>Spotted gum dominated open forests (VHC 10.1)</i>	20.8	2	19,400	Medium
T25	VHC 13.2	14.4	11	17,302	Medium
T27	VHC 13.2	14.4	11	17,302	Medium
T29	VHC 10.1	20.8	2	19,400	Medium
T30	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T31	VHC 13.2	14.4	11	17,302	Medium
T32	VHC 13.2	14.4	11	17,302	Medium
T36	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T37	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T38	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²

Infrastructure	VHC	Potential fuel load (t/ha) ¹	Maximum slope under VHC (°)	Potential bushfire intensity (kW/m)	Bushfire hazard class
T40	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T41	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T42	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T44	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T45	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T46	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T48	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T49	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T50	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T51	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T52	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T53	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T54	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T55	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T56	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T57	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T58	VHC 13.2	14.4	11	17,302	Medium
T60	VHC 13.2	14.4	11	17,302	Medium
T63	VHC 13.2	14.4	11	17,302	Medium
T64	VHC 13.2	14.4	11	17,302	Medium
T65	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T66	VHC 13.2	14.4	11	17,302	Medium
T67	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T68	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T69	VHC 13.2	14.4	11	17,302	Medium

Infrastructure	VHC	Potential fuel load (t/ha) ¹	Maximum slope under VHC (°)	Potential bushfire intensity (kW/m)	Bushfire hazard class
T71	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T72	VHC 13.2	14.4	11	17,302	Medium
T73	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T74	VHC 13.2	14.4	11	17,302	Medium
T75	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T76	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T77	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T79	VHC 13.2	14.4	11	17,302	Medium
T78	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T80	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T82	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T83	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T84	VHC 13.2	14.4	11	17,302	Medium
T85	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T86	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T87	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T88	VHC 13.2	14.4	11	17,302	Medium
T89	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T90	VHC 13.2	14.4	11	17,302	Medium
T91	VHC 13.2	14.4	11	17,302	Medium
T92	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T93	VHC 13.2	14.4	11	17,302	Medium
T94	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T95	VHC 13.2	14.4	11	17,302	Medium
T96	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T97	VHC 10.1	20.8	2	19,400	Medium

Infrastructure	VHC	Potential fuel load (t/ha) ¹	Maximum slope under VHC (°)	Potential bushfire intensity (kW/m)	Bushfire hazard class
T98	VHC 13.2	14.4	11	17,302	Medium
T99	VHC 13.2	14.4	11	17,302	Medium
T100	VHC 13.2	14.4	11	17,302	Medium
T102	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T103	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T104	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T105	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T106	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T107	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T108	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T111	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T113	VHC 13.2	14.4	11	17,302	Medium
T114	VHC 13.2	14.4	11	17,302	Medium
T118	VHC 13.2	14.4	11	17,302	Medium
T119	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T120	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T121	VHC 13.2	14.4	11	17,302	Medium
T122	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T123	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T124	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T125	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T126	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T127	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
T128	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
Ancillary infrastructure					

Infrastructure	VHC	Potential fuel load (t/ha) ¹	Maximum slope under VHC (°)	Potential bushfire intensity (kW/m)	Bushfire hazard class
Borrow pit near T27	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
Operations and maintenance facility, switching station and substation near T44	VHC 13.2	14.4	11	17,302	Medium
Helipad, site compound, batch plant and laydown area near T44	VHC 13.2	14.4	11	17,302	Medium
Borrow pit near T73	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
Borrow pit near T89	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
Laydown area and near T92	VHC 13.2	14.4	11	17,302	Medium
Laydown area near T95	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
Substation near T99	VHC 13.2	14.4	11	17,302	Medium
<i>Meteorology masts</i>					
<i>Temporary</i>					
TMM1	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
TMM60	VHC 13.2	14.4	11	17,302	Medium
TMM65	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
TMM69	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
<i>Permanent</i>					
MM1	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²
MM60	VHC 13.2	14.4	11	17,302	Medium
MM6569	VHC 40.4	5	6	1,477	Non-bushfire hazard class ²

Notes 1 Potential fuel load taken from *Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience – Bushfire'* (QFES 2019) (**BRC guide**).

 2 VHC 40.4 is defined as grass fire prone in the BRC guide.

Appendix 4 Radiant heat exposure assessment

Bushfire attack – Turbines (T)22, T29 and T97.

- Forest fire danger index - 63
- Vegetation - VHC 10.1 *Spotted gum dominated open forests*
- Understorey fuel load – 19.3 t/ha¹
- Total fuel load – 20.8 t/ha¹
- Effective slope – 2° down slope
- Site slope – 0° slope
- Flame width – 100 m

Note 1 Understorey fuel load and total fuel load taken from *Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience – Bushfire'* (QFES 2019) (**Bushfire resilient communities**)



Calculated August 30, 2022, 2:34 pm (MDc v.4.9)

J19091

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	63	Rate of spread	1.67 km/h
Vegetation classification	Forest	Flame length	13.38 m
Understorey fuel load	19.3 t/ha	Flame angle	53 °, 63 °, 71 °, 76 °, 77 ° & 83 °
Total fuel load	20.8 t/ha	Elevation of receiver	5.34 m, 5.96 m, 6.32 m, 6.49 m, 6.52 m & 6.64 m
Vegetation height	n/a	Fire intensity	18,000 kW/m
Effective slope	2 °	Transmissivity	0.874, 0.856, 0.832, 0.806, 0.793 & 0.73
Site slope	0 °	Viewfactor	0.5965, 0.4434, 0.2999, 0.2033, 0.1654 & 0.0449
Flame width	100 m	Minimum distance to < 40 kW/m²	11.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	14.9 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	21.8 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	30.9 m
		Minimum distance to < 10 kW/m²	36.7 m

Rate of Spread - McArthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Bushfire attack – T4, T5, T6, T8, T10, T11, T13, T17, T21, T25, T27, T31, T32, T58, T60, T63, T64, T66, T69, T72, T74, T79, T84, T88, T90, T91, T93, T95, T98, T99, T100, T113, T114, T118, T121, operations and maintenance facility, switching station and substation near T44, and substation near T99.

- Forest fire danger index - 63
- Vegetation - VHC 13.2 *Dry to moist eucalypt woodlands on undulating metamorphics and granite*
- Understorey fuel load – 12.8 t/ha¹
- Total fuel load – 14.4 t/ha¹
- Effective slope – 11° down slope
- Site slope – 0° down slope
- Flame width – 100 m

Note 1 Understorey fuel load and total fuel load taken from Bushfire resilient communities.



Calculated August 30, 2022, 2:39 pm (MDC v.4.9)

J19091

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	63	Rate of spread	2.06 km/h
Vegetation classification	Forest	Flame length	15.16 m
Understorey fuel load	12.8 t/ha	Flame angle	53 °, 63 °, 70 °, 75 °, 76 ° & 82 °
Total fuel load	14.4 t/ha	Elevation of receiver	6.05 m, 6.75 m, 7.12 m, 7.32 m, 7.35 m & 7.5 m
Vegetation height	n/a	Fire intensity	15,379 kW/m
Effective slope	11 °	Transmissivity	0.871, 0.852, 0.825, 0.8, 0.787 & 0.725
Site slope	0 °	Viewfactor	0.6004, 0.4475, 0.3013, 0.2054, 0.1669 & 0.0452
Flame width	100 m	Minimum distance to < 40 kW/m²	12.5 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	16.7 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	24.4 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	34.1 m
		Minimum distance to < 10 kW/m²	40.3 m

Rate of Spread - Mearthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Bushfire attack – T1, T3, T7, T30, T36, T37, T38, T40, T41, T42, T44, T45, T46, T48, T49, T50, T51, T52, T53, T54, T55, T56, T57, T65, T67, T68, T71, T73, T75, T76, T77, T78, T80, T82, T83, T85, T86, T87, T89, T92, T94, T96, T102, T103, T104, T105, T106, T107, T108, T111, T119, T120, T122, T123, T124, T125, T126, T127, T128.

- Forest fire danger index – 63
- Grass fire danger index – 90
- Vegetation - VHC 40.4 *Continuous low grass or tree cover*
- Understorey fuel load – 5 t/ha¹
- Total fuel load – 5 t/ha¹
- Effective slope – 6° down slope
- Site slope – 0° slope
- Flame width – 100 m

Note 1 Understorey fuel load and total fuel load taken from Bushfire resilient communities.



Calculated April 9, 2020, 11:58 am (MDC v.4.8)

J19091 (VHC 40.4)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	90	Rate of spread	17.7 km/h
Vegetation classification	Grassland	Flame length	8.06 m
Surface fuel load	5 t/ha	Flame angle	54 °, 64 °, 73 °, 78 °, 80 ° & 85 °
Overall fuel load	5 t/ha	Elevation of receiver	3.26 m, 3.62 m, 3.85 m, 3.94 m, 3.96 m & 4.01 m
Vegetation height	n/a	Fire intensity	45,726 kW/m
Effective slope	6 °	Transmissivity	0.885, 0.873, 0.854, 0.833, 0.82 & 0.748
Site slope	0 °	Viewfactor	0.5924, 0.4326, 0.2922, 0.1963, 0.1599 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m ²	6.7 m
Windspeed	n/a	Minimum distance to < 29 kW/m ²	9.199999999999999 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m ²	13.6 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m ²	20.1 m
		Minimum distance to < 10 kW/m ²	24.3 m

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

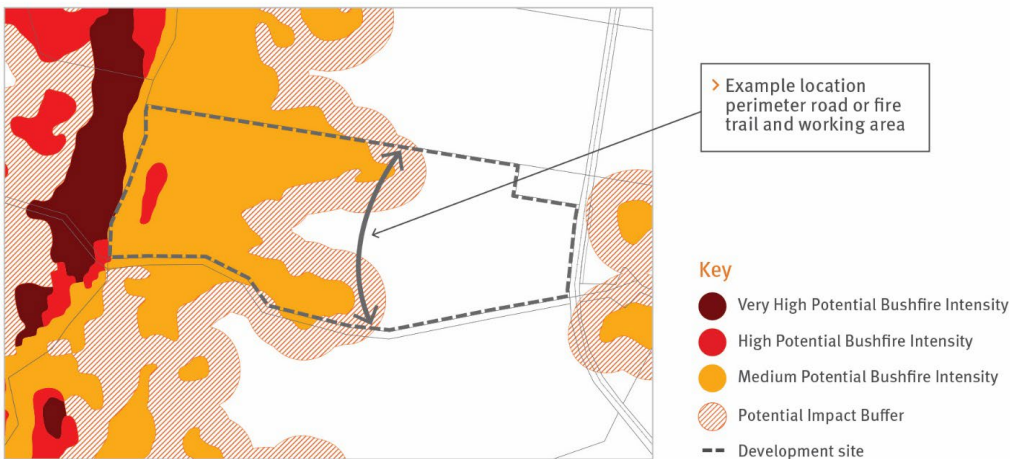
Appendix 5 Bushfire overlay code assessment

Performance outcomes	Acceptable outcomes	Compliance assessment
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 land forms 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 <i>Bushfire resilient communities</i> 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.	Not applicable
	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 <i>Bushfire resilient communities</i> document.	Not applicable
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.	Not applicable
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 land forms that expose people or property to an intolerable risk to life or property; and (b) facilitates emergency access and operational space for	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	Not applicable

Performance outcomes	Acceptable outcomes	Compliance assessment
<p>firefighters in a reduced fuel area between future buildings and structures and hazardous vegetation, that reduce risk to an acceptable or tolerable level.</p> <p>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 <i>QFES Bushfire resilient communities</i> 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.</p>	<p>in Table 5 at all lot boundaries; or :</p> <p>(b) a distance that achieves a radiant heat flux level of 29 kW/m² or less:</p> <p>(i) at the building envelope, if identified at RaL stage; or</p> <p>(ii) where a building envelope is not identified, at all lot boundaries.</p> <p>Note – This separation area is often termed an asset protection zone.</p> <p>Note – The radiant heat flux levels can be established by undertaking a bushfire hazard assessment in accordance with the methodology in the <i>QFES Bushfire resilient communities</i> document.</p> <p>Note – For staged developments, temporary separation areas may be absorbed as part of subsequent stages.</p> <p>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).</p>	
	<p>A03.2</p> <p>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).</p>	Not applicable
Section C		
Reconfiguring a lot (RaL) – where creating more than 20 lots		
<p>PO4</p> <p>The subdivision layout is designed to minimise the length of the development perimeter and number of lots exposed to hazardous vegetation.</p> <p>Note – For example, avoid finger-like subdivision patterns or substantive vegetated corridors between lots.</p>	<p>A04</p> <p>No acceptable outcome is prescribed</p>	Not applicable
<p>PO5</p> <p>The subdivision layout provides for adequate access and egress and safe evacuation routes, to achieve an acceptable or tolerable risk to people.</p>	<p>A05.1</p> <p>The subdivision layout:</p> <p>(a) avoids the creation of bottle-neck points in the movement network within the development (for example, avoids</p>	Not applicable

Performance outcomes	Acceptable outcomes	Compliance assessment
	<p>hourglass patterns); and</p> <p>(b) ensures the road network has sufficient capacity for the evacuating population.</p>	
	<p>A05.2</p> <p>The subdivision layout ensures evacuation routes:</p> <p>(a) direct occupants away from rather than towards or through areas with a greater potential bushfire intensity; and</p> <p>(b) minimise the length of route through bushfire prone areas.</p> <p>Refer Figure 5.</p>	Not applicable
<p>Figure 5 – Subdivision layout and evacuation routes</p>		
<p>PO6</p> <p>The subdivision layout provides adequate buffers between hazardous vegetation and development.</p> <p>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 <i>Bushfire resilient communities</i> 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.</p>	<p>A06.1</p> <p>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.</p>	Not applicable
	<p>A06.2</p> <p>The asset protection zone is comprised of:</p> <p>(a) parks and open spaces; and/or</p> <p>(b) lots greater than 2000 square metres; and/or</p> <p>(c) public roads (termed perimeter roads).</p> <p>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.</p> <p>Note – Portions of lots greater than 2000 square metres may be located within the mapped medium, high and very high potential bushfire intensity areas.</p>	Not applicable

Performance outcomes	Acceptable outcomes	Compliance assessment
	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.	Not applicable
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 <i>Bushfire resilient communities</i> document may assist in demonstrating compliance with this performance outcome.	AO7 Where the asset protection zone includes parks or open spaces, they: <ul style="list-style-type: none"> (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.	Not applicable
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: <ul style="list-style-type: none"> (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). 	Not applicable
	AO8.2 Where the subdivision contains a reticulated water supply, the road network and fire hydrants are designed and installed in accordance with: <ul style="list-style-type: none"> (a) <i>Fire Hydrant and Vehicle Access Guidelines for residential, commercial and industrial lots</i>, Queensland 	Not applicable

Performance outcomes	Acceptable outcomes	Compliance assessment
	<p>Fire and Emergency Services, 2015, unless otherwise specified by the relevant water entity; and</p> <p>(b) the <i>Road Planning and Design Manual 2nd edition</i>, Department of Transport and Main Roads, 2013.</p>	
Section D		
Reconfiguring a lot (RaL) – where creating additional lots for the purpose of residential development and a reticulated water supply is not provided.		
<p>PO9</p> <p>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.</p>	<p>AO9.1</p> <p>The subdivision layout includes:</p> <p>(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</p> <p>(b) a perimeter road designed and constructed in accordance with AO8.1.</p> <p>Refer Figure 6.</p>	<p>Not applicable</p>
 <p>Figure 6 – Siting of fire trail and working area</p>		
Section E		
Material change of use		
<p>PO10</p> <p>Site layout achieve an acceptable or tolerable risk to people. Landscape or open space provided as part of the development:</p>	<p>AO10.1</p> <p>Site layout places the landscape and open spaces within the site between premises and adjacent mapped medium, high or very</p>	<p>Complies with AO10.1</p> <p>Asset protection zones (APZs) will be established and maintained around above ground infrastructure as</p>

Performance outcomes	Acceptable outcomes	Compliance assessment
<p>(a) acts as a buffer between hazardous vegetation and development; and</p> <p>(b) does not create additional bushfire prone areas.</p> <p>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 <i>Bushfire resilient communities</i> 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.</p>	<p>high potential bushfire intensity areas.</p> <p>Refer Figure 7.</p>	<p>specified in Section 6.1 of the Bushfire management plan (BMP).</p>
	<p>AO10.2</p> <p>This landscaping and open space comprises protective landscape treatments that:</p> <p>(a) comprise only low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses and cultivated gardens; or</p> <p>(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.</p> <p>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.</p>	<p>Complies with AO10.2</p> <p>APZs will be cleared of vegetation and established as a gravel hardstand area or grass area. A gravel hardstand area will be maintained free of weeds and grass cover. Where establishing a gravel hardstand area is not practical, a grass area will be established and maintained free of weeds and woody regrowth and with grass cover which has a height of ≤ 30centimetres (cm).</p>

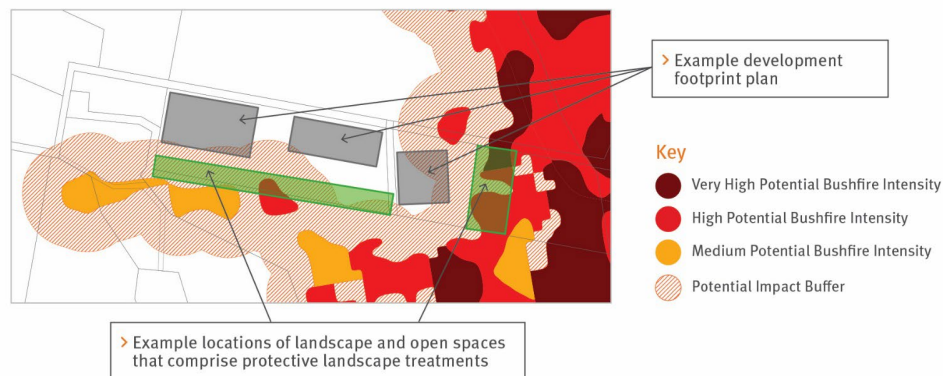


Figure 7 – Siting of protective landscape treatments

<p>PO11</p> <p>The development establishes evacuation areas, to achieve an acceptable or tolerable risk to people.</p>	<p>AO11</p> <p>If in an isolated location, development establishes direct access to a safe assembly/evacuation area.</p> <p>Note – Guidance on identifying safe evacuation areas is contained in the QFES <i>Bushfire resilient communities</i> document.</p>	<p>Complies with AO11</p> <p>Section 6.10.9 of the BMP requires separate emergency response plans to be prepared for the construction and operation phases of the Project.</p> <p>The emergency response plan must identify the location of safe assembly/evacuation areas and the access routes to these areas.</p> <p>Section 6.10.9 of the BMP provides guidance for the construction contractor and the operation contractor to identify safe assembly and evacuation areas. It states that they must have a gravel surface or consist of low cut grass, ie grass</p>
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Performance outcomes	Acceptable outcomes	Compliance assessment
		slashed to a nominal height ≤ 30 cm, and must not be located in areas identified as medium, high and very high potential bushfire intensity in Figures 2.3-2.5 of the BMP.
PO12 If on a lot of over 2,000 m ² , where involving a new premises or an existing premises with an increase in development footprint, development: <ul style="list-style-type: none"> (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.	Complies with PO12 Specifications for the minimum standard of vehicle access tracks within the Project area are provided in Section 6.5 of the BMP and are based on the design specifications for category 1 fire-fighter vehicles by the New South Wales Rural Fire Service (NSW RFS 2016).
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 <i>Bushfire resilient communities</i> document.	AO13 No acceptable outcome is prescribed	Complies with PO13 Upon commencement of the construction phase, fire-fighter water storage tanks will be installed at the operations and maintenance facility. They will remain in place during both the construction and operation phases of the Project. Design specifications for the fire-fighter water storage tanks are based on guidance in <i>Bushfire Resilient Communities Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience - Bushfire'</i> QFES 2019 and are provided in Section 6.6 of the BMP.
PO14 Vulnerable uses listed in Table 7 are not established or intensified within a bushfire prone area unless: <ul style="list-style-type: none"> (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 	AO14.1 No acceptable outcome is prescribed.	Not applicable

Performance outcomes	Acceptable outcomes	Compliance assessment
<p>hazardous vegetation and structures.</p> <p>Note – The preparation of a bushfire management plan in accordance with the methodology in the QFES <i>Bushfire resilient communities</i> document may assist in demonstrating compliance with this performance outcome</p>		
<p>PO15</p> <p>Community infrastructure providing essential services listed in Table 7 are not established within a bushfire prone area unless:</p> <p>(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</p> <p>(b) the infrastructure can function effectively during and immediately after a bushfire event.</p> <p>Note – The preparation of a bushfire management plan in accordance with the methodology in the QFES <i>Bushfire resilient communities</i> document may assist in demonstrating compliance with this performance outcome.</p>	<p>AO15</p> <p>No acceptable outcome is prescribed.</p>	<p>Alternative solution to PO15</p> <p>The substation and switching station could be regarded as community infrastructure providing essential services.</p> <p>In accordance with guidance in Section 9.4 of Bushfire resilient communities, electrical infrastructure at the substation and switching station will have an APZ which is designed to achieve a radiant heat flux level ≤ 10 kilowatts/square metre (kW/m^2) at the electrical infrastructure.</p>
<p>PO16</p> <p>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.</p> <p>Note – The preparation of a bushfire management plan in accordance with the methodology in the QFES <i>Bushfire resilient communities</i> document may assist in demonstrating compliance with this acceptable outcome.</p> <p>Editor's note – In addition to the requirements of this code the <i>Work Health and Safety Act 2011</i> and associated Regulation and Guidelines, the <i>Environmental Protection Act 1994</i> and the relevant building assessment provisions under the <i>Building Act 1975</i> 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-</p>	<p>AO16</p> <p>No acceptable outcome is prescribed.</p>	<p>Complies with PO16</p> <p>Storage or handling of hazardous chemicals during the construction and operations and maintenance phases of the Project must not occur in vegetated areas and must be in accordance with <i>Managing risks of hazardous chemicals in the workplace – Code of Practice</i> (SWA 2023), applicable safety data sheets, and otherwise in accordance with <i>Queensland Work Health and Safety Act 2011</i> and its regulations.</p>

Performance outcomes	Acceptable outcomes	Compliance assessment
<u>management/hazardous-chemicals/storing-transporting.</u>		
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 <i>QFES Bushfire resilient communities</i> 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, for example short-cropped grass to a nominal height of 10 centimetres. OR	Complies with AO17.1 APZs will be cleared of vegetation and established as a gravel hardstand area or grass area. A gravel hardstand area will be maintained free of weeds and grass cover. Where establishing a gravel hardstand area is not practical, a grass area will be established and maintained free of weeds and woody regrowth and with grass cover which has a height of ≤ 30 cm.
	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 <i>QFES Bushfire resilient communities</i> document may assist in demonstrating compliance with this acceptable outcome.	Complies with AO17.2 See response to AO17.1.
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 <i>QFES Bushfire resilient communities</i> 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 <i>QFES Bushfire resilient communities</i> document may assist in demonstrating compliance with acceptable outcome (b).	Not applicable The Project does not involve revegetation or rehabilitation.

Performance outcomes	Acceptable outcomes	Compliance assessment
	<p>AO18.2</p> <p>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.</p> <p>OR</p> <p>Revegetation or rehabilitation of areas located within the mapped potential impact buffer area, revegetate and rehabilitate in a manner that maintains or reduces the existing fuel load.</p> <p>Note – The preparation of a vegetation management plan undertaken in accordance with the methodology in the QFES <i>Bushfire resilient communities</i> document may assist in demonstrating compliance with this acceptable outcome.</p>	<p>Not applicable</p> <p>The Project does not involve revegetation or rehabilitation.</p>

Table 6 – Fire trail and working area design parameters

Parameter	Provisions
Width	<p>Contains a width of at least 20 metres including:</p> <ol style="list-style-type: none"> 1. A trafficable area (cleared and formed); <ol style="list-style-type: none"> a. with a minimum width of 4 metres than can accommodate a rural firefighting vehicle b. with no less than 4.8 metres vertical clearance from canopy vegetation c. with no adjacent inhibiting embankments or retaining walls 2. A working area each side of the trafficable area: <ol style="list-style-type: none"> a. with a minimum width of 3 metres each side b. cleared of all flammable vegetation greater than 10 centimetres in height 3. The balance (i.e. 10 metre width) managed vegetation area: <ol style="list-style-type: none"> a. sited to separate the trafficable area from adjacent mapped medium, high or very high potential bushfire intensity areas managed vegetation b. comprising managed vegetation clear of major surface hazards.
Access	<p>Access is granted in favour of the local government and Queensland Fire and Emergency Services</p> <p>Note – this access is commonly granted in the form of a easement that is to be maintained by the grantor.</p>
Egress	Contains trafficable vehicle routes in to low hazard areas, every 200 metres

Table 7 – Vulnerable uses, community infrastructure for essential services and materials that are hazardous in the context of bushfire hazard

Group	Uses
Vulnerable uses	<i>childcare centre, community care centre, detention facility, educational establishment, hospital, nature-based tourism, relocatable home park, rooming accommodation, residential care facility, resort complex, retirement facility, tourist park</i>
Community infrastructure for essential services	<i>educational establishment, emergency services, hospital</i>
Hazardous materials in the context of bushfire hazard	<p>Hazardous chemicals that are present at the levels or in the quantities that would constitute the use being a hazardous chemical facility</p> <p>Hazardous materials that are present in the quantities in the Work Health and Safety Regulation, schedule 15</p>