REPORT

PRELIMINARY HAZARD ANALYSIS

BATTERY ENERGY STORAGE SYSTEM

WINTERBOURNE WIND FARM

PREPARED FOR: **WinterbourneWind Pty Ltd**

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Title: **Report** **Preliminary Hazard Analysis** **Battery Energy Storage System** **Winterbourne Wind Farm**	**QA verified:** S. Ligori **Date:** 04-Apr-2022

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ABBREVIATIONS

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
AC	Alternating Current
AS	Australian Standard
BESS	Battery Energy Storage System
BMS	Battery Management System
CSS	Construction Safety Study
DA	Development Application
DC	Direct Current
DPIE	(NSW) Department of Planning, Industry and Environment
DVC	Decisive Voltage Classification
EIS	Environmental Impact Statement
EMF	Electric and Magnetic Fields
ERM	Environmental Resources Management Australia Pty Ltd
ESRG	Energy Safety Response Group
ESV	Energy Safe Victoria
FEI	Fisher Engineering
FHA	Final Hazard Analysis
FRNSW	Fire and Rescue NSW
HAZID	Hazard Identification
HIPAP	Hazardous Industries Planning Advisory Paper
HVAC	Heating Ventilation Air Conditioning
ICNIRP	International Commission on Non-Ionizing Radiation Protection
kV	kilovolt
LGA	Local Government Area
MLRA	Multi Level Risk Assessment
MV	Medium Voltage
MW	Megawatt
MWh	Megawatt hours
NEM	National Electricity Market
OH&S	Occupational Health & Safety
O&M	Operation and Maintenance
NSW	New South Wales

PCE	Power Conversion Equipment
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
RFS	Rural Fire Service
SDS	Safety Data Sheet
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SSD	State Significant Development
WTG	Wind Turbine Generator
WWF	Winterbourne Wind Farm
WWPL	WinterbourneWind Pty Ltd

TERMINOLOGY

Term	Definition
Winterbourne Wind Farm (WWF)	The construction, operation and decommissioning of a 700 MW (approximate) wind farm generally comprising wind turbine generator, access tracks, underground and above ground cables, on-site substations, large scale battery storage, and associated operational facilities including the construction of a new 330 kV overhead transmission line to new switchyard which would be constructed approximately 7 km south of Uralla, NSW.
Project	Winterbourne Wind Farm proposal.
Proponent	WinterbourneWind Pty Ltd (WWPL)
Project area	The area of land that includes the entirety of all the Lot/DPs for the WWF, access roads, and transmission line (before any subdivisions/ leases/ purchases)
Development footprint	The area of land that is directly impacted and/or used for the construction and operation of the Project. It includes permanent and temporary development footprints. Permanent development footprint is the area of land that will form the operational footprint of the Project, post subdivision of Lot/DPs. Temporary development footprint is the area of land that will be temporarily disturbed during construction of the Project and rehabilitated following construction.
Consequence	Outcome or impact of a hazardous incident, including the potential for escalation
Off-site	Areas extending beyond the development footprint boundary
Risk	The likelihood of a specified undesired event occurring within a specified period or in specified circumstances, It may be either a frequency (the number of specified events occurring in unit time) or a probability (the probability of a specified event following a prior event), depending on the circumstances.

1. INTRODUCTION

1.1. Background

WinterbourneWind Pty Ltd (WWPL) proposes to construct and operate the Winterbourne Wind Farm (WWF), a grid-connected wind powered electricity generation facility located to the north and east of Walcha, NSW. The proposed wind farm is situated approximately 75 kilometres (km) north-east of Tamworth, 40 km south-south-east of Armidale, within both Walcha Shire and Uralla Shire Local Government Areas (LGA) (the Project).

The Project consists of up to 119 wind turbine generator (WTG) locations, internal electricity reticulation network, on-site substations and a new overhead transmission line to enable connection into the existing grid network operated by TransGrid at a new switchyard to be constructed approximately 7 km south of Uralla. The Project will have a combined installed capacity of approximately 700 Megawatts (MW). A large-scale Battery Energy Storage System (BESS) with 100 MW/200 MWh is also proposed to support stabilising the supply of electricity to the National Electricity Market (NEM).

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) and requires an Environmental Impact Statement (EIS) to accompany the Development Application (DA) submission, in accordance with the Environmental Planning and Assessment (EP&A) Regulation.

WWPL has commissioned Environmental Resources Management Australia Pty Ltd (ERM) to prepare an Environmental Impact Statement (EIS) for the Project. ERM has retained Sherpa Consulting Pty Ltd (Sherpa) to undertake a Preliminary Hazard Analysis (PHA) for the proposed BESS for input to the ‘Hazards and Risks’ section of the EIS.

1.2. Objectives

The overall study objective was to address the assessment requirement for the BESS under the ‘Hazards and Risks’ component of the Secretary’s Environmental Assessment Requirements (SEARs), received on 17 September 2020:

- *Battery Storage – include a Preliminary Hazard Analysis (PHA) prepared in accordance with Hazardous Industry Planning Advisory Paper (HIPAP) No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011) demonstrating that the battery energy storage system is suitably located and minimises risks to neighbouring land uses and on-site substations(s).*

The objective of the PHA was to identify the hazards and assess the risks associated with the BESS at the DA stage to determine risk acceptability from land use safety planning perspective. The PHA is based on the operating phase of the BESS and is focused on events that may have off-site impacts (i.e. consequences outside the Project development footprint boundary).

The PHA assumed that the requirement to minimise risks to on-site substations is in the context of minimising potential escalation events from the BESS to the substations that could subsequently result in off-site impacts (as intended in relation to HIPAP No. 6).

This report documents the BESS PHA undertaken for the Project to support the EIS development for submission to the relevant planning authority.

1.3. Scope

The scope of the study was limited to the proposed BESS facility for the Winterbourne Wind Farm.

1.4. Exclusions and assumptions

The study exclusions and assumptions are summarised as follows:

1. State Environmental Planning Policy (SEPP) No. 33 *Hazardous and Offensive Development* risk screening. A risk screening is typically undertaken to determine whether (1) the development is considered as ‘potentially hazardous’ in the context of SEPP 33 and hence (2) requirement for a PHA. The SEARs issued for this development included requirement for a PHA to be carried out for the BESS without first applying the SEPP screening approach.
2. Transport route analysis. The SEARs issued for this development does not include a requirement for a transport route analysis to be carried out.
3. Other *Hazards and Risks* assessment requirements under the SEARs are not included in this study (e.g. *aviation safety, telecommunications, health, bushfire, blade throw, landslide risk*). These are addressed separately in the EIS.
4. Final Hazard Analysis (FHA). An update of this PHA to FHA may be required as per HIPAP requirements and/or conditions of consent for the development. Update of this PHA to FHA (with design information that becomes available as the project progresses) is outside of the study scope.
5. The study identified and assessed credible hazards associated with proposed operations of the BESS, and excluded specific hazards relating to construction, commissioning and decommissioning. This approach is assumed appropriate for EIS assessment at the DA stage aimed to obtain approval for the proposed development.
6. Construction safety study. This study does not constitute a Construction Safety Study (CSS). Requirement for a CSS at a later stage will be subject to the conditions of consent of the DA approval. For more information, refer to the HIPAP No. 7 Construction Safety, Ref [1].

2. PROJECT DESCRIPTION

2.1. Location

The Winterbourne Wind Farm (the Project) is situated approximately 75 km north-east of Tamworth and 40 km south-south-east of Armidale within both Walcha Shire and Uralla Shire LGA. The locations of the Project site and BESS are shown in Figure 2.1 and Figure 2.2, respectively.

The Project is roughly bounded by Thunderbolts Way to the west, the Oxley Highway to the south, the Oxley Wild Rivers National Park to the east, and the Salisbury Plains to the north.

The Project area encompasses an area of approximately 22,285 hectares. The Project area and surroundings are generally used for grazing activities.

2.2. Surrounding land use

The Project site comprises land zoned RU1 – Primary Production, a rural zone intended to promote sustainable primary industry production. The areas surrounding the Project are generally also zoned RU1 – Primary Production, with the exception of the E1 National Parks and Nature Reserve (Oxley Wild Rivers National Park) to the east of the Project site, and a mixture of land uses within the Walcha town centre, approximately 6 km from the closest edge of the Project area.

WWPL will lease land from associated landholders for the construction and operation of the Project.

The nearest town centre to the site is Walcha, located approximately 15 km south-west of the proposed BESS.

The closest involved residential dwelling (associated with the project) is located approximately 2.6 km north-east of the proposed BESS (SR 031). The closest non-involved residential dwelling is located approximately 3.5 km south of the proposed BESS (SR 088).

Figure 2.1: Project site location

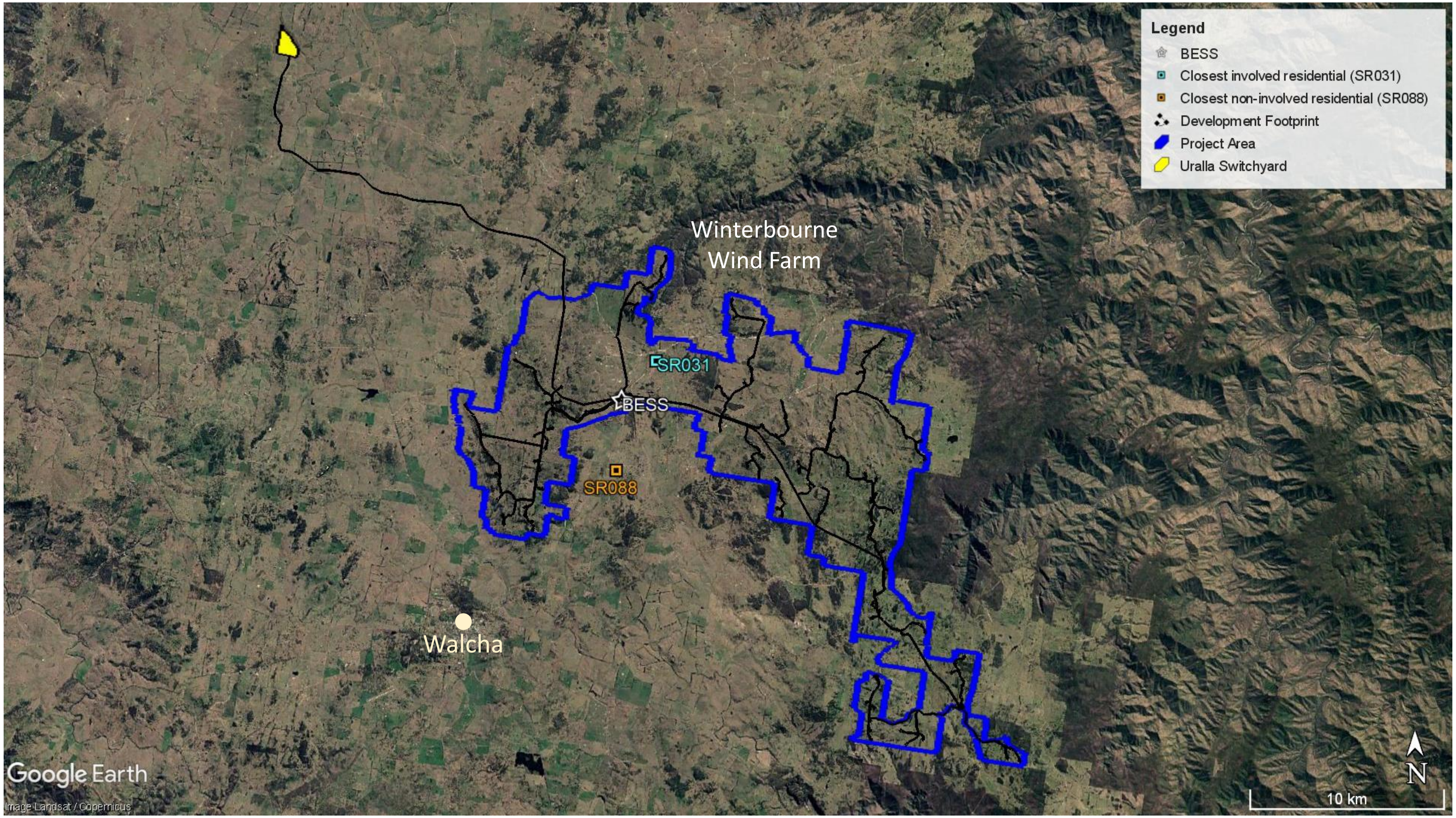
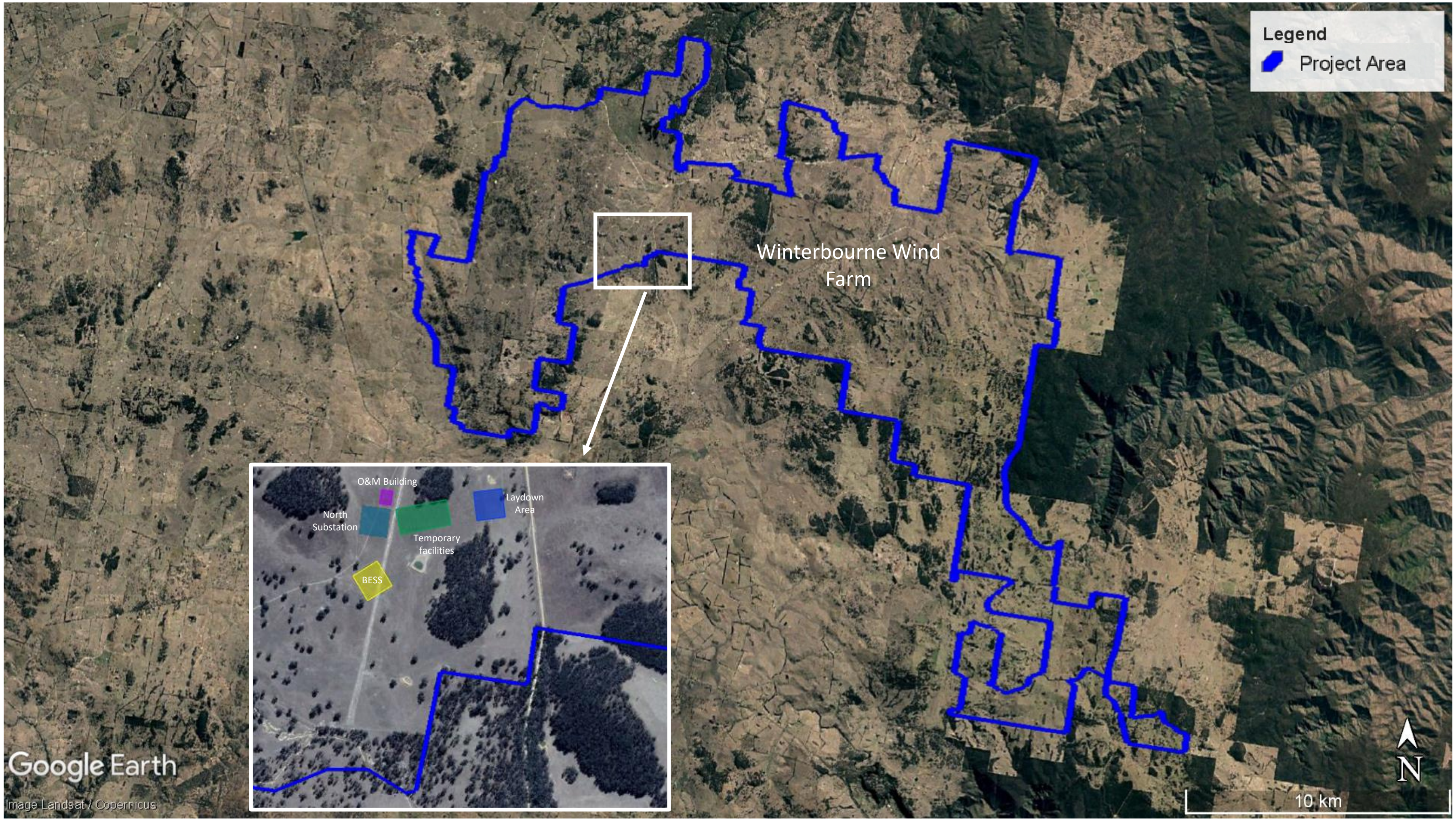


Figure 2.2: BESS location



2.3. Project components

A summary of the indicative Project components and specification is provided in Table 2.1. A more detailed description is provided in the EIS. It should be noted that only the BESS is of relevance in this study.

Table 2.1: Indicative Project component and specification

Component	Feature	Specification
Energy generation	Wind turbine generators	The Project will consist of up to 119 WTGs with a combined installed capacity of approximately 700 MW. The Project will likely utilise the Vestas V162-6.2 MW WTG model. The turbines will have a tip height of 230 m.
Electrical reticulation network	On-site substations	There will be two 33/330 kV electrical substations (i.e. North substation and South substation) to transform the 33 kV received from internal reticulation network to the 330 kV transmission voltage. Each substation will be provided with security fence around the perimeter. A 20 m bushfire Asset Protection Zone (APZ) will surround the substation.
	Internal electrical reticulation network	The Project will include an internal reticulation network connecting the WTGs to the on-site substations which spans approximately 324 km, including both overhead and underground. Where possible the cabling will be located in underground trenches (approximately 600 mm wide and 1 m deep), which run parallel to the access track.
	330 kV overhead transmission lines	The Project will include a new 330 kV overhead transmission line with length of approximately 50 km to connect the Project to the existing grid network operated by TransGrid at a new switchyard. The indicative design of the transmission line will either be: • Single circuit steel lattice towers approximately 40 m high, spaced around 500 m apart within a 60 m wide easement, or • Monopoles approximately 50 m high, spaced around 200 to 250 m apart within a 60 m wide easement.
	Switchyard	The Project will include construction of new switchyard approximately 7 km south of Uralla to connect the Project transmission line to the existing 330 kV TransGrid Tamworth to Armidale transmission line network. A 20 m bushfire APZ will surround the switchyard.

Component	Feature	Specification
Battery storage	BESS	A BESS of 100 MW/200 MWh capacity will be located adjacent to the North Substation. Indicatively, the BESS would utilise lithium-ion technology. Further information on the BESS is provided in Section 2.4.
Access roads	Access to site and turbines	The Project will include: • New internal access tracks with combined length of approximately 113 km connecting the WTGs and other Project infrastructure with the public road network, and • Upgrades to roads and intersections required for the delivery of WTG components, transformers, construction phase materials and vehicular movements.
Operation and Maintenance (O&M) facility	Permanent office and/or building(s)	A permanent site O&M facility will be constructed to provide for all operations and maintenance activities associated with the Project. The O&M compound will be located next to the North Substation, BESS and laydown area. The buildings of the O&M facility will contain the control room, switch room, and storage shed.
Temporary construction facilities	Temporary facilities	Construction of the Project will require a range of temporary buildings and facilities for construction personnel and equipment. These will include: • A construction compound including site offices, car parking, and amenities for the construction work force • Mobile concrete batching plants • Potential rock crushing facilities • Laydown areas • Temporary storage for construction materials and equipment and wind turbine components • Temporary power supply for construction.

2.4. Battery Energy Storage System

The purpose of the BESS will be to provide a dispatchable capability to the Project's energy generation profile and support stabilising the supply of electricity to the National Electricity Market (NEM). Indicatively, the proposed BESS will have a 100 MW/200MWh capacity and make use of lithium-ion technology.

The BESS will likely utilise a pre-assembled and pre-tested, fully integrated system that includes the battery modules, inverters, thermal management system, circuit breakers and other controls. The model and design specification of the BESS will be determined during detailed design. For this study and input to the EIS, the Tesla Megapack battery system was assumed as advised by WWPL.

The Tesla Megapack battery system enclosure will be outdoor rated cabinets mounted on concrete pads and security fence on the perimeter.

The BESS will be located adjacent to the North Substation, occupying an area of approximately 100 m x 100 m (refer to inset on Figure 2.1). A 20 m bushfire APZ will surround the BESS to minimise the risk of fire escaping from the facility and the risk of external fire affecting the facility.

Major components for the BESS include:

- Battery: It is anticipated that 80 Megapacks will be installed to provide the required 100 MW/200 MWh capacity. Each Megapack is rated 1.25 MW/2.5 MWh.
- Battery Management System (BMS): The electronic system that monitors and manages the battery system electric and thermal states enabling it to operate within the safe operating region of the battery (e.g. protection against overcurrent, over-charge, over-discharge, overheating, over-voltage).
- Thermal management system: The system that provides temperature control for the batteries. The Tesla battery system includes a fully enclosed liquid thermal management system with a dual coolant and refrigerant loop system that runs through battery modules and inverters.
- Power Conversion Equipment (PCE) or inverters: These are electrical devices that convert Direct Current (DC) to Alternating Current (AC).
- Fire protection system: The Tesla Megapack does not contain built-in smoke, gas, or fire detection or suppression features. The Tesla Megapack inherent design minimises risk of a fire spreading from one cabinet to another. Validated large-scale fire testing has shown that in the event of a fire, the Megapacks perform in a safe and controlled manner, consuming themselves slowly without explosive bursts, deflagrations, or unexpected hazards, and without propagating to neighbouring enclosure units, Ref [2]. Water spray has been deemed safe as an agent for use on exposed Megapacks and water is considered the preferred agent for suppressing lithium-ion battery fires, Ref [2].

2.5. Operations

The operations stage of the Project is currently planned for September 2025. The expected operating life of the Project is up to 30 years.

Upon commissioning, the Project will be operational 24 hours per day, seven days per week. The BESS will also operate 24 hours per day, seven days per week.

The operations stage is anticipated to require 16 full time employees for ongoing service and maintenance work. An office and staff amenities (e.g. toilet, kitchen, first aid, potable water supply) will be provided at the O&M compound. Permanent parking facilities will be provided adjacent to the O&M compound.

3. METHODOLOGY

3.1. Overview

This study was carried out in accordance with the requirements of HIPAP No. 6 *Hazard Analysis*, Ref [3], and included the following steps:

1. Establish the study context
2. Identification of hazards resulting from the operations of the BESS and events with the potential for off-site impact *(Hazard Identification)*.
3. Analysis of the severity of the consequences for the identified events with off-site impact, e.g. fires and explosions *(Consequence Analysis)*.
4. Determination of the level of analysis and risk assessment criteria.
5. Analysis of the risk of the identified events with off-site impact (*Risk Analysis*).
6. Assessment of the estimated risks from identified events against risk criteria to determine acceptability (*Risk Assessment)*.

The PHA assessed the events associated with proposed operation of the BESS (i.e. excluded construction related events). The development footprint boundary was used to define and determine off-site impact (i.e. impact extending outside of the development footprint boundary).

3.2. Context

A risk screening is typically undertaken to determine whether (1) the development is considered as 'potentially hazardous' in the context of SEPP 33 and hence (2) requirement for a PHA. The SEARs issued for this development included requirement for a PHA to be carried out for the BESS without first applying the SEPP screening approach.

This PHA was prepared by Sherpa for use by WWPL (the Proponent) and ERM (the EIS preparer) to support the EIS development for submission to the relevant planning authority, as part of the Project approval process.

3.3. Level of analysis

The Multi-Level Risk Assessment (MLRA), Ref [4], sets out three levels of risk analysis that may be appropriate for a PHA, as shown in Table 3.1. This guidance document was consulted to determine the level of analysis required for this study.

The outcomes of the *Hazard Identification* and *Consequence Analysis* were used to determine the level of analysis appropriate for the PHA.

Table 3.1: Level of analysis

Level	Analysis type	Appropriate/can be justified if
1	Qualitative	There are no potential events with significant off-site consequences and societal risk is negligible
2	Partially Quantitative	The frequency of occurrence of risk contributors having off-site consequences is low
3	Quantitative	There are significant off-site risk contributors, and a Level 2 analysis is unable to demonstrate that the risk criteria will be met.

3.4. Risk assessment criteria

The risk criteria used for assessment followed the guidance provided in HIPAP No. 4 *Risk Criteria for Land Use Safety Planning*, Ref [5], appropriate for the level of analysis determined (based on guidance outlined in Table 3.1).

4. HAZARD IDENTIFICATION

4.1. Overview

Hazard Identification (HAZID) aims to identify all reasonably foreseeable hazards and associated events that may arise due to the operation of the facilities and defining the relevant controls through a systematic and structured approach.

The HAZID process was completed using the following input:

1. Review of the battery Safety Data Sheet (SDS)/emergency response guide, Ref [2], for potential hazardous events and controls provided.
2. Review of AS/NZS 5139:2019 *Electrical installations – Safety of battery systems for use with power conversion equipment*, Ref [6].
3. Literature research of past incidents involving similar BESS systems.
4. Previous risk assessments for similar BESS systems.
5. Consultation and feedback from WWPL.

4.2. Identified hazards and events

The following factors were considered to identify the hazards:

- BESS component and type of equipment
- Hazardous materials present.
- Proposed operation and maintenance activities.
- External factors (e.g. unauthorised personal access, lightning storm).

Events with the potential to result in significant impacts to people (i.e. injury and/or fatality) were identified. The study excluded hazards related with Occupational Health & Safety (OH&S), e.g. slips, trips and falls.

The identified hazards and events for the Project are presented in Table 4.1.

Table 4.1: Identified hazards and events

Hazard	Event
Electrical	Exposure to voltage
Energy	Release of energy (i.e. arc flash)
Fire	Infrastructure fire
Chemical	Release of hazardous materials
Explosive Gas	Generation of explosive gas
Reaction	Battery thermal runaway
EMF	Exposure to Electric and Magnetic Fields (EMF)
External factors	Unauthorised access/trespasser, bushfire, lightning storm, blade throw, turbine collapse, water ingress (rain and flood)

In this study, bushfire was considered as a cause of fire resulting from encroachment of an off-site bushfire impacting the BESS. A separate bushfire assessment will be completed for input to the EIS, to meet the SEARs.

A summary of the hazard present at/applicable to the BESS is provided in Table 4.2.

Table 4.2: Hazards by BESS component

	BESS Components			
Hazard	**Battery modules**	**Battery Management System (BMS)**	**Thermal Management System/HVAC**	**PCE (e.g. inverters)**
Electrical	✓	✓	-	✓
Energy (arc flash)	✓	✓	-	✓
Fire	✓	✓	✓	✓
Chemical	✓	✓	✓	-
Explosive Gas	✓	-	✓	-
Reaction	✓	-	-	-
EMF	✓	✓	-	✓
External factors	✓	✓	✓	✓

4.3. HAZID register

The HAZID register is provided in Table 4.3. The findings are as follows:

- A total of 15 hazardous events were identified.
- The BESS will be located close to the Project's development footprint boundary. Some hazardous events (i.e. fires) may extend beyond this boundary (i.e. off-site impact in the context of HIPAP No. 6). However, as the BESS will be situated in a rural area and the nearest residential dwelling will be approximately 2.6 km away, no events with potential for significant off-site impact (i.e. serious injury and/or fatality to the public or off-site population) were identified.

Table 4.3: HAZID register - BESS

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
1.	Electrical	Battery modules BMS PCE (e.g. inverters)	Exposure to voltage	<u>Short circuit/electrical connection failure</u> due to: - Faulty equipment - Incorrect installation - Incorrect maintenance - Human error during maintenance - Safety device/circuit compromised - Battery casing/enclosure damage <u>Earth potential rise (exposure to step and touch potentials)</u> - Electrical faults	- Electrocution - Fire - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines. - Decisive Voltage Classification (DVC) followed and equipment marked accordingly. - Warning signs (electrical hazards, arc flash) - Engagement of reputable contractors - Installation and maintenance will be done by trained personnel - Independent certifiers/owner's engineers - Electrical switch-in & switch-out protocol - BMS fault detection and safety shut-off - Earthing as per manufacturer and standards requirements - Emergency Response Plan - External firefighting assistance (FRNSW & RFS) - Use of appropriate PPE - Rescue kits (i.e. insulated hooks)	-	No
2.	Energy	Battery modules BMS PCE (e.g. inverters)	Arc flash	- Incorrect procedure (i.e. installation/ maintenance) - Faulty equipment (e.g. corrosion on conductors) - Faulty design (e.g. incorrect equipment spacing) - Human error during maintenance - Insufficient isolation/insulation to applied voltage - Mechanical damage - Vibration	- Arc blasts and resulting heat, may result in fires and pressure waves - Burns - Exposure to intense light and noise - Injury and/or fatality to on-site employees Localised effects, the effects are not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines - Warning signs (arc flash boundary) - Engagement of reputable contractors - Installation and maintenance will be done by trained personnel as per manufacturer's instruction - Independent certifiers/owner's engineers - Site induction/substation training (i.e. high voltage areas) - Maintenance procedure (e.g. deenergize equipment) - Preventative maintenance (insulation) - Emergency Response Plan - External firefighting assistance (FRNSW & RFS) - Use of appropriate PPE for flash hazard within the arc flash boundary. Conductive items not worn while working on or near energised or live conductive parts (e.g. rings, jewellery).	Arc flash is an electrical explosion or discharge, which occurs between electrified conductors during a fault or short circuit condition, Ref [6]. Arc flash occurs when electrical current passes through the air between electrified conductors when there is insufficient isolation or insulation to withstand the applied voltage. Arc flash may result in rapid rise in temperature and pressure in the air between electrical conductors, causing an explosion known as an arc blast.	No

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
3.	Fire	Battery modules BMS HVAC PCE (e.g. inverters)	BESS fire	- Faulty equipment - Arc flash - Damage or failure of battery case (e.g. overload, insulation breakdown, connection failures) - Battery thermal runaway (e.g. short circuit, overheating, overcharge) - External fire (e.g. substation fire) - Bushfire (e.g. encroachment of off-site bushfire, escalated event due to fire from other Project infrastructure)	- Release of toxic and/or explosive combustion products - Escalation to the entire BESS - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines - Equipment will be procured from reputable supplier - Independent certifiers/owner's engineers - Installation, operations and maintenance by trained personnel (e.g. reputable third party) in accordance with relevant procedures - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - Preventative maintenance (e.g. insulation, replacement of faulty equipment) - The Tesla battery system/cabinet facilities inherent design minimises risk of a fire spreading from one cabinet to another - Emergency Response Plan - Activation of emergency shutdown - Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services) - Inclusion of 20 m APZ buffer surrounding the BESS - External firefighting assistance (FRNSW & RFS)	-	No
4.	Chemical	Battery modules BMS HVAC	Release of electrolyte (liquid/ vented gas) from the battery cell	<u>Mechanical failure/damage</u> - Dropped impact (e.g. during installation/ maintenance) - Damage (e.g. crush/ penetration/puncture) <u>Abnormal heating/elevated temperature</u> - Thermal runaway - Bushfire - External fire (e.g. substation fire)	- Release of flammable liquid electrolyte - Vapourisation of liquid electrolyte - Release of vented gas from cells - Fire and/or explosion in battery enclosure - Release of toxic combustion products - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines - Equipment will be procured from reputable supplier - Independent certifiers/owner's engineers - Engagement of reputable contractors - Installation and maintenance by trained personnel - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - BMS fault detection and shut-off function - Each compartment has the capacity to contain liquid from a large number of cells. - Layers of battery case (pod and external casing) - Spill clean-up using dry absorbent material - Emergency Response Plan - Activation of emergency shutdown - Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services) - Inclusion of 20 m APZ buffer surrounding the BESS - External firefighting assistance (FRNSW & RFS) - Venting and containment requirements of the BESS manufacturer to be followed	Vented gases are early indicator of a thermal runaway reaction	No

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
5.	Chemical	Battery modules BMS HVAC	Coolant leak (Tesla Battery System)	- Mechanical failure/damage - Incorrect maintenance	- Irritation/injury to on-site employee on exposure to leak (e.g. inhalation and skin contact) - Ingress of coolant to battery or other electrical components (battery enclosure) leading to short circuit and fire, resulting in injury and/or fatality to on-site employees. As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have a significant off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines - Equipment will be procured from reputable supplier - Independent certifiers/owner's engineers - Installation, operations and maintenance by trained personnel (including reputable third party) in accordance with relevant procedures - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - Maintenance will be done by trained personnel - BMS fault detection and shut-off function - Layers of battery case (pod and external casing) - PPE and spill clean-up using dry absorbent material - Activation of emergency shutdown - Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services) - Emergency Response Plan - External assistance for firefighting (FRNSW & RFS)	For the Tesla system, the coolant is 50/50 mixture of ethylene glycol and water. The fluid does not emit a strong odour. A Megapack contains about 540 L of coolant.	No
6.	Chemical	Battery modules BMS HVAC	Refrigerant leak (Tesla Battery System)	- Mechanical failure/damage - Incorrect maintenance	Irritation/injury to on-site employees on exposure (skin contact) Localised effects - not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS 5139) and guidelines - Equipment will be procured from reputable supplier - Independent certifiers/owner's engineers - Engagement of reputable contractors - Maintenance will be done by trained personnel - BMS fault detection and shut-off function - Layers of battery case (pod and external casing) - PPE and spill clean-up using dry absorbent material	The Tesla thermal management system is in a sealed system. Mechanical damage could result in a release of the refrigerant. Such a release would appear similar to the emission of smoke.	No

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
7.	Explosive Gas	Battery modules	Generation of explosive gas (e.g. hydrogen) Note: also refer to Item 4 (release of vented gas)	- Thermal runaway - Bushfire - External fire (e.g. substation fire)	- Fire and/or explosion in battery enclosure - Release of toxic combustion products - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Equipment and systems will be designed and tested to comply with the relevant international and Australian standards (e.g. AS 5139) and guidelines - Equipment will be procured from reputable supplier - Independent certifiers/owner's engineers - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - BMS fault detection and shut-off function - Ventilation requirements as per manufacturer's instruction - The Tesla battery system/cabinet facilities inherent design minimises risk of a fire spreading from one cabinet to another - Emergency Response Plan - Activation of emergency shutdown - Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services) - Inclusion of 20 m APZ buffer surrounding the BESS - External firefighting assistance (FRNSW & RFS)	-	No

8.	Reaction	Battery modules	Thermal runaway in battery	Elevated temperature
				- Bushfire
				- External fire (e.g. substation fire)
				
				Electrical failure
				- Short circuit
				- Excessive current/voltage
				- Imbalance charge across cells
				
				Mechanical failure
				- Internal cell defect
				- Damage (crush/ penetration/puncture)
				
				Systems failure
				- BMS failure
				- Thermal management system/HVAC failure
					- Fire and/or explosion in battery enclosure
					- Escalation to the entire BESS
					- Injury and/or fatality to on-site employees
					
					As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.
						- Equipment and systems will be designed and tested to comply with the relevant international and Australian standards (e.g. AS 5139) and guidelines
						- Equipment will be procured from reputable supplier
						- Independent certifiers/owner's engineers
						- Battery Management System (BMS)
						  * Voltage control
						  * Charge-discharge current control
						  * Temperature monitoring
						  * Safety shut-off function
						- Thermal management system
						- Cell chemistry selection (minimise runaway)
						- To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways
						- The Tesla battery system inherent design minimises risk of a fire spreading from one cabinet to another.
						- Emergency Response Plan
						- Activation of emergency shutdown
						- Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services)
						- Inclusion of 20 m APZ buffer surrounding the BESS
						- External firefighting assistance (FRNSW & RFS)
							Thermal runaway refers to a cycle in which excessive heat, initiated from inside/outside the battery cell, keeps generating more heat. Chemical reactions inside the cell in turn generate additional heat until there are no reactive agents left in the cell and eventually lead to destruction of the battery.	No

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
9.	EMF	BESS (overall)	Exposure to electric and magnetic fields	Operations of power generation equipment	- High level exposure (i.e. exceeding the reference limits) may affect function of the nervous system (i.e. direct stimulation of nerve and muscle tissue and the induction of retinal phosphenes) - Injury to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Location siting and selection (i.e. separation distance to sensitive receptors) - Optimising equipment layout and orientation - Reducing conductor spacing - Balancing phases and minimising residual current - Incidental shielding (i.e. BESS enclosure) - Equipment and systems will be designed and tested to comply with international standards and guidelines - Exposure to personnel is short duration in nature (transient) - Warning signs - Studies found that the EMF for commercial power generation facilities comply with ICNIRP occupational exposure limits	Adverse health effects from EMF have not been established based on findings of science reviews conducted by credible authorities, Ref [7]. No established evidence that ELF EMF is associated with long term health effects (ARPANSA).	No
10.	External factors	BESS (overall)	Fire	Water ingress (e.g. rain, flood)	- Electrical fault/short circuit - Fire and/or explosion in battery enclosure - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Location siting (i.e. outside of flood prone area) - BESS will be housed in dedicated enclosure. which will be constructed in accordance to relevant standards. - The Tesla battery system enclosures are outdoor rated. - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - Drainage system - Preventative maintenance (check for leaks) - Emergency Response Plan - Activation of emergency shutdown - Fire Management Plan (e.g. establishing defendable fire-fighting boundary, provision of static water supply of at least 20,000 litres for emergency services) - External firefighting assistance (FRNSW & RFS)	-	No
11.	External factors	BESS (overall)	Vandalism	Unauthorised personnel access Trespassing Sabotage (vehicle impact into BESS area)	- Asset damage - Potential hazard to unauthorised person (e.g. electrocution) - Injury and/or fatality to trespasser Effects to unauthorised person are expected to be localised and not expected to have an off-site impact. The impact is to a member of public but occurs on-site.	- Proposed development is located in rural location - Proposed development infrastructure is located in a secure area and will be fenced - Warning signs (i.e. trespassers and on-site hazards) - Security cameras will be provided at the North Substation and in vicinity of the BESS. - On-site security protocol - Presence of staff during operational hours	-	No

ID	Hazard	BESS component	Event	Cause	Consequence	Controls	Other Comments	Significant Off-site Impact?
12.	External factors	BESS (overall)	Lightning strike	Lightning storm	- Fire - Injury and/or fatality to on-site employees As the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- Lightning protection mast (North Substation) - Earthing as per manufacturer and standards requirements - PPE	-	No
13.	External factors	BESS (overall)	Blade throw	Instantaneous failure of the bearing or hub flange fastening system	- Damage to BESS infrastructure and/or fire - Injury and/or fatality to on-site employees As the BESS will be situated at least 3 km away from the closest WTG (i.e. greater than the calculated blade throw impact distance of 500 m), there is no risk of a blade throw impacting the BESS, Ref [8].	- Early detection of abnormalities (e.g. vibration, imbalance, under power) by WTG control system may prevent progression of instantaneous failure of the bearing or hub flange fastening system. - Separation distance between the BESS and the closest WTG is at least 3 km (i.e. greater than the calculated blade throw impact distance of 500 m).	A blade throw incident can occur when an entire wind turbine blade becomes separated from its hub at the metal to metal root joint.	No
14.	External factors	BESS (overall)	Turbine collapse	Mechanical failure	- Damage to BESS infrastructure and/or fire - Injury and/or fatality to on-site employees As the BESS will be situated at least 3 km away from the closest WTG, risk from a turbine collapse is not expected.	- Separation distance between the BESS and the closest WTG is at least 3 km (i.e. greater than the estimated impact distance of 250 m based on WTG tip height of 230 m).	-	No
15.	Escalation to on-site substation	BESS (overall)	Escalation from the BESS to adjacent on-site substation	BESS fire	Escalation to adjacent substation resulting in potential off-site impacts As the BESS and substation will be situated in a rural area and there is a large separation distance to the nearest residential dwelling, the effects are not expected to have an off-site impact.	- The Tesla cabinet facilities inherent design minimises risk of a fire spreading from one cabinet to another. This will minimise escalation of battery fire to the overall BESS and subsequently the on-site substation. - To minimise escalation between sub-units or other structures, the BESS configurations will follow the specified clearances required by the manufacturer. These will include clearances (1) between the units (2) from combustible objects/structures (3) from means of egress, buildings and public ways - Separation distance between the BESS and substation is at least 85 m (based on existing project information at the time of this study).	Separation distance between the North Substation and the development footprint boundary is at least 15 m. Separation distance between the BESS/North Substation and the South Substation is approximately 15 km.	No

5. LEVEL OF ANALYSIS DETERMINATION

5.1. Level of analysis

The HAZID found that for all identified events the resulting consequences are not expected to have significant off-site impacts. This assessment was determined based on the following:

- The distance between the proposed BESS location and the nearest residential dwelling is approximately 2.6 km (ID SR 031). Hazardous events (e.g. thermal runaway) resulting in potential fire and explosion are expected to be localised with no potential for significant off-site consequences.
- Provision of controls under the Battery Management System (BMS) provides protection against overheating, overcharging and thermal runaway. Design of the battery system may also contain fires within the modular units and prevent escalation, Ref [2] and [9].

Additionally, the identified events are expected to present negligible societal risk impact as:

- The proposed BESS will be located at the North Substation, which is situated in a rural area with the scattered residential dwelling. The nearest dwelling is approximately 2.6 km away (ID SR 031).
- The nearest township of Walcha is about 15 km away.

Based on the above findings and the MLRA guidance to determine the required level of analysis for the PHA (Table 3.1), a fully qualitative approach (i.e. Level 1 analysis) was determined appropriate for this study. The risk analysis is presented in Section 6.

5.2. Qualitative risk criteria

The HIPAP No. 4 *Risk Criteria for Land Use Safety Planning*, Ref [5], recommends that the following qualitative criteria/principles be adopted concerning the land use safety acceptability of a development:

a) *All 'avoidable' risks should be avoided. This necessitates the investigation of alternative locations and alternative technologies, wherever applicable, to ensure that risks are not introduced in an area where feasible alternatives are possible and justified.*

b) *The risk from a major hazard should be reduced wherever practicable, irrespective of the numerical value of the cumulative risk level from the whole installation. In all cases, if the consequences (effects) of an identified hazardous incident are significant to people and the environment, then all feasible measures (including alternative locations) should be adopted so that the likelihood of such an incident occurring is made very low. This necessitates the identification of all contributors to the resultant risk and the consequences of each potentially* *hazardous incident. The assessment process should address the adequacy and relevancy of safeguards (both technical and locational) as they relate to each risk contributor.*

c) *The consequences (effects) of the more likely hazardous events (i.e. those of high probability of occurrence) should, wherever possible, be contained within the boundaries of the installation.*

d) *Where there is an existing high risk from a hazardous installation, additional hazardous developments should not be allowed if they add significantly to that existing risk.*

The risk assessment against HIPAP No. 4 criteria is provided in Section 7.

6. RISK ANALYSIS

6.1. Overview

In this study, risk is defined as the likelihood of a specified undesired event occurring within a specified period or in specified circumstances. It may be either a frequency (the number of specified events occurring in a unit of time) or a probability (the probability of a specified event following a prior event) depending on the circumstances.

For each identified event, the risk was qualitatively determined from the resulting severity and likelihood rating pair using the WWPL company risk matrix, shown in Figure 6.1.

Sherpa noted that the company risk matrix is designed to assess the risk for **employees**. As agreed with WWPL for this study, the acceptance criteria used to assess the risk for off-site population are as follows:

- Very High risk – Unlikely to be tolerable (review if activity should proceed)
- High risk – Tolerable, if as low as reasonably practicable
- Medium risk – Broadly acceptable
- Low risk – Acceptable.

6.2. Severity rating

For each event, the severity rating was qualitatively assigned based on the consequence description identified in the HAZID Register (Table 4.3). Using the category scale shown in Figure 6.1, the severity rating was assigned based on consequence to people (Safety) with respect to off-site impact to off-site population.

Sherpa noted that the company risk matrix is designed to assess impact for employees. For this study, the severity scale was used to assess impact for off-site population. For example, an event with consequence outcome identified as “localised effects” or “effects are not expected to have an off-site impact”, was assigned a ‘Very Low’ rating (i.e. lowest severity scale) to indicate minimal impact to off-site population.

6.3. Likelihood rating

The likelihood of an event was estimated using the category scale shown in Figure 6.1. The likelihood ratings were assigned based on knowledge of historical incidents in the industry and in consultation with WWPL. The likelihood ratings were assigned accounting for the initiating causes, resulting consequences with controls (prevention and mitigation) in place.

Figure 6.1: WWPL qualitative risk matrix

			INCREASING LIKELIHOOD				
			1	2	3	4	5
			<20%	20-40%	40-60%	60-80%	>80%
			Remote	Unlikely	Possible	Likely	Almost Certain
INCREASING CONSEQUENCE	5	Very High	High	High	Very High	Very High	Very High
	4	High	Medium	High	High	Very High	Very High
	3	Medium	Medium	Medium	High	High	Very High
	2	Low	Low	Medium	Medium	High	High
	1	Very Low	Low	Low	Medium	High	High

Consequence impacted areas

	1	2	3	4	5
Safety	First aid assistance to one or more employee		Minor injury to one or more employees		Serious injury to one or more employees
Environment	Brief incident/impact on environment, quick clean up and no long term effect		Minor impact on environment, short term clean-up	Medium impact on environment; medium term clean-up efforts	Major, long term impact on environment; prolonged clean-up efforts
Financial	<20,000 Euro	<50,000 Euro	<0.1m Euro	0.25 -1m Euro	> 1 million Euro
Time	1 day delay	2 days delay	3 days delay	1 week delay	2 weeks + delay
Reputation	No media attention, negative information discussed in industry		Negative information in local media	Negative media broadcasting in national media	Negative media attention one or more regions. Potential loss of valued customer
Regulatory/ compliance		No formal attention from authorities	Warning from authorities Minor fine	Investigation Actions required by authorities for continued operations Moderate fine	Company or individuals facing prosecution Citation Major fine

6.4. Risk results and analysis findings

The qualitative risk results for the identified events are shown in Table 6.1.

The risk analysis findings are as follows:

- **Consequence**: The worst-case consequence for the identified events is a fire and/or explosion event which may result from a variety of causes (e.g. battery thermal runaway, encroachment from off-site bushfire, substation fire). The study found that for all events the impacts are not expected to have off-site impacts. This was assessed based on the proposed controls and separation distance between the proposed BESS and sensitive receptors (i.e. residential dwellings).
- **Likelihood**: The highest likelihood rating for the identified events is Remote.
- **Risk analysis**: A total of 15 hazardous events were identified. The breakdown of these events according to their risk ratings are as follows:
  - High risk event: 1

    This event relates to unauthorised person access to the proposed BESS area resulting in vandalism/asset damage to the infrastructure, with no significant off-site impact expected. Severity rating of 'Very High' was assigned to account for the trespasser potentially injuring themselves in the act. The PHA noted that the controls for this event are well understood and the likelihood was rated as Remote.
  - Low risk events: 14

    Most of these events relate to fire and/or explosion events, with no significant off-site impact expected. The study identified proposed prevention controls to reduce the likelihood of these fire events and mitigation controls to contain the fires to minimise potential for escalated events (e.g. fire management plan). Based on the identified controls, the highest likelihood for these events were rated as Remote.

Table 6.1: Risk results

Hazard	Event	Consequence	Off-site consequence	Significant off-site Impact?	Risk analysis (off-site and public impact)		
					Severity	Likelihood	Risk
Electrical	Exposure to voltage	- Electrocution - Fire - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
Energy	Arc flash	- Arc blasts and resulting heat, may result in fires and pressure waves - Burns - Exposure to intense light and noise - Injury and/or fatality to on-site employees	Localised effects, the effects are not expected to have an off-site impact.	No	Very Low	Remote	Low
Fire	BESS fire	- Release of toxic and/or explosive combustion products - Escalation to the entire BESS - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
Chemical	Release of electrolyte from the battery cell (liquid/vented gas)	- Release of flammable liquid electrolyte - Vapourisation of liquid electrolyte - Release of vented gas from cells - Fire and/or explosion in battery enclosure - Release of toxic combustion products - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
	Coolant leak	Irritation/injury to on-site employees on exposure (inhalation)	Localised effects - not expected to have an off-site impact.	No	Very Low	Remote	Low
	Refrigerant leak	Irritation/injury to on-site employees on exposure (skin contact)	Localised effects - not expected to have an off-site impact.	No	Very Low	Remote	Low
Explosive gas	Generation of explosive gas	- Fire and/or explosion in battery enclosure - Release of toxic combustion products - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low

Hazard	Event	Consequence	Off-site consequence	Significant off-site Impact?	Risk analysis (off-site and public impact)		
					Severity	Likelihood	Risk
Reaction	Thermal runaway in battery	- Fire and/or explosion in battery enclosure - Escalation to the entire BESS - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
EMF	Exposure to EMF	- High level exposure (i.e. exceeding the reference limits) may affect function of the nervous system (i.e. direct stimulation of nerve and muscle tissue and the induction of retinal phosphenes) - Injury to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
External factors	Water ingress	- Electrical fault/short circuit - Fire and/or explosion in battery enclosure - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
	Vandalism due to unauthorised personnel access	- Asset damage - Potential hazard to unauthorised person (e.g. electrocution) - Injury and/or fatality to trespassing person	Effects to unauthorised person are expected to be localised and not expected to have an off-site impact. The impact is to a member of public but occurs on-site.	No	Very High	Remote	High
	Lightning strike	- Fire - Injury and/or fatality to on-site employees	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low
	Blade throw	As the BESS will be situated at least 3 km away from the closest WTG (i.e. greater than the calculated blade throw impact distance of 500 m), there is no risk of a blade throw impacting the BESS, Ref [8].	No off-site impact expected as there is no risk of a blade throw impacting the BESS	No	Very Low	Remote	Low
	Turbine collapse	As the BESS will be situated at least 3 km away from the closest WTG, there is no risk of a turbine collapse throw impacting the BESS	No off-site impact expected as there is no risk of a turbine collapse impacting the BESS	No	Very Low	Remote	Low
Escalation risk	Escalation from the BESS to adjacent on-site substation	- Escalation to adjacent substation resulting in potential off-site impacts	No off-site impact expected as the BESS will be situated in a rural area and there is a large separation distance to the nearest residential dwelling.	No	Very Low	Remote	Low

7. RISK ASSESSMENT

7.1. Assessment against company risk acceptance criteria

Using the company risk matrix, the identified hazardous events were qualitatively risk profiled. Of the 15 events identified, all were rated as Low risk except for one High risk event. This event is related to unauthorised person access to the BESS area resulting in vandalism/asset damage to the infrastructure with the potential for self-injury during the act. The PHA noted that the controls for this event are well understood and will be implemented accordingly. In addition to the rural location, the proposed BESS will be located in a secure area with fencing and cameras, and warning signs will be provided. Mitigation measures would also include on-site security protocol and presence of staff during operational hours. In combination, these prevention and mitigation measures are expected to significantly reduce the likelihood of this event. The likelihood rating for this event was rated as “Remote” (i.e. lowest level within the WWPL risk matrix).

All events are expected to have no significant off-site impact. Based on the acceptance criteria used to assess the risk for off-site population, the risk profile for the Project is considered to be tolerable.

7.2. Assessment against HIPAP 4 criteria

Assessment against the HIPAP 4 qualitative land use planning risk criteria is provided in Table 7.1.

7.3. Conclusion and recommendations

A PHA has been completed for the BESS in accordance with the DPIE HIPAP No. 6 and Multi Level Risk Assessment guidance. A Level 1 PHA (qualitative) was conducted for the BESS.

The PHA concluded that:

- There are no events with the potential for significant off-site impact associated with the operation of the WWF BESS and the BESS meets the HIPAP No.4 qualitative risk criteria.
- The BESS is suitably located and minimises the risk to neighbouring land uses and on-site substation(s).

The following recommendations are identified from the PHA:

1. WWPL to consult with Fire and Rescue NSW (FRNSW) during detailed design of the facility to ensure that the relevant aspects of fire protection measures have been included. These may include: (i) type of firefighting or control medium (ii) demand, storage and containment measures for the medium. The above aspects will form an input to the Fire Safety Study which may be required as part of the development consent conditions, for review and approval by FRNSW.

2. WWPL to review the investigation reports on the Victorian Big Battery Fire (occurred on 31 July 2021) and implement relevant findings for the project. The publicly available investigation reports include:

   - Energy Safe Victoria (ESV): Statement of Technical Findings on fire at the Victorian Big Battery.
   - Fisher Engineering (FEI) and Energy Safety Response Group (ESRG): Report of Technical Findings on Victorian Big Battery Fire.

Table 7.1: Assessment against HIPAP qualitative risk criteria

HIPAP 4 qualitative criteria	Remarks	Complies?
All 'avoidable' risks should be avoided. This necessitates the investigation of alternative locations and alternative technologies, wherever applicable, to ensure that risks are not introduced in an area where feasible alternatives are possible and justified.	The PHA has identified hazardous events and assessed the inherent risks associated with the proposed operations of the BESS. The BESS location is suited for the proposed operation, situated in rural area with considerable separation distance to sensitive receptors to avoid off-site risks.	Yes
The risk from a major hazard should be reduced wherever practicable, irrespective of the numerical value of the cumulative risk level from the whole installation. In all cases, if the consequences (effects) of an identified hazardous incident are significant to people and the environment, then all feasible measures (including alternative locations) should be adopted so that the likelihood of such an incident occurring is made very low. This necessitates the identification of all contributors to the resultant risk and the consequences of each potentially hazardous incident. The assessment process should address the adequacy and relevancy of safeguards (both technical and locational) as they relate to each risk contributor.	Based on the separation distance to sensitive receptors, consequence impacts from the identified hazardous events are not expected to have significant off-site impacts	Yes
The consequences (effects) of the more likely hazardous events (i.e. those of high probability of occurrence) should, wherever possible, be contained within the boundaries of the installation.	This study found that for all events the impacts are expected to be localised and contained within the boundaries of the installation with no significant off-site impacts.	Yes
Where there is an existing high risk from a hazardous installation, additional hazardous developments should not be allowed if they add significantly to that existing risk.	There are no other additional hazardous development in the vicinity.	Yes

8. REFERENCES

[1] NSW Department of Planning, "Hazardous Industry Planning Advisory Paper No 7 - Construction Safety," 2011.

[2] Tesla, "Lithium-Ion Battery Emergency Response Guide For Tesla Energy Products including Powerwall, Powerpack, and Megapack," TS-00004027 Rev 2.1, 2020.

[3] NSW Department of Planning, "HIPAP No.6 - Guidelines for Hazard Analysis," 2011.

[4] NSW Department of Planning, "Assessment Guideline: Multi-Level Risk Assessment," 2011.

[5] NSW Department of Planning, "HIPAP No.4 - Risk Criteria for Land Use Planning," 2011.

[6] Standards Australia and Standards New Zealand, "Electrical installations - Safety of battery systems for use with power conversion unit," AS/NZS 5139:2019, 2019.

[7] Energy Networks Association, "EMF Management Handbook," 2016.

[8] Environmental Resources Management Australia Pty Ltd, "Environmental Impact Statement - Winterbourne Wind Farm," 2022.

[9] Electrek, "Tesla set fire to a Powerpack to test its safety features – the results are impressive," 19 December 2016. [Online]. Available: https://electrek.co/2016/12/19/tesla-fire-powerpack-test-safety/. [Accessed 13 June 2021].