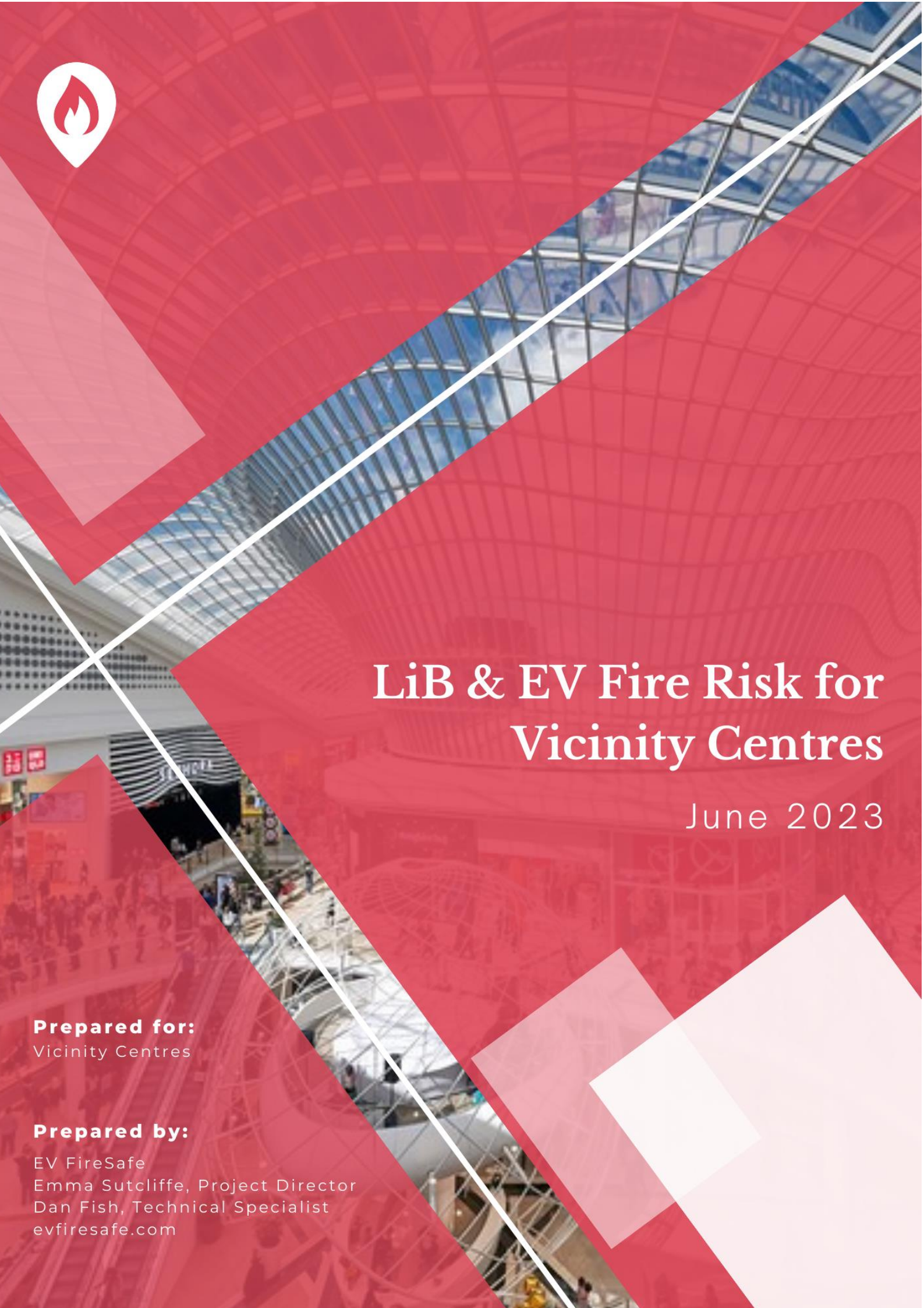

LiB & EV Fire Risk for Vicinity Centres

June 2023

Prepared for:
Vicinity Centres

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1. Executive summary

EV FireSafe is delighted to work with Vicinity Centres, a leading Australian retail property group, to review lithium-ion battery & electric vehicle risks, hazards & mitigations.

Five Vicinity Centre site tours were facilitated by Vicinity Centre's National Security Manager, Marc Klomp, & attended by EV FireSafe Project Director, Emma Sutcliffe & Technical Specialist, Daniel Fish. At each location, Site Managers supplied in-depth knowledge of buildings, tenants, fire control rooms & car parks.

EV FireSafe's aim was to identify, in relation to lithium-ion batteries & electric vehicles:

1. Site-specific risks & hazards
2. Risk-reduction strategies already installed or planned by Vicinity Centres
3. Sensible additional considerations & best practice

Sites visited included nationally renowned luxury retail hubs Chadstone Shopping Centre & the Queen Victoria Building, & highly popular suburban centres, Warriewood Square, Roselands & Bankstown. These chosen to provide indicative examples of the extensive Vicinity Centres national portfolio, in terms of demographics, tenancy & building age.

Overall, we found these sites to have high standards of fire protection, security & layout that enables fast detection, evacuation & incident management in the event of a fire involving a lithium-ion battery or electric vehicle.

We did identify some risks & hazards, primarily relating to the:

- Operation & charging of privately owned light electric vehicles (e-bikes, scooters)
- Use of smaller device batteries by retail tenants
- Charging of site-owned mobility scooters overnight
- Sale of light electric vehicles by retail tenants
- Display of passenger electric vehicles in shopfront & 'kiosk' spaces
- Power isolation of electric vehicle charging units
- Lack of awareness of the risks & hazards by centre staff*

However, we believe these be successfully addressed & mitigated - as far as is possible - through internal policy, & site & retail staff awareness training.

These findings are based on our knowledge as firefighters, experience in researching battery fires & are also benchmarked against global real-world incidents at similar sites, plus ongoing collaboration with an international network of fire & battery experts.

Through our ongoing research we have found **no other** similar business anywhere in the world taking such a proactive stance on battery fire risks, & commend Vicinity Centres for leading this emerging & vital global discussion.

This document sets out our findings & provides a framework for Vicinity Centres to begin to review & update relevant internal policy, & roll out awareness training.

Emma Sutcliffe
Director, EV FireSafe

**Lack of awareness is a global issue, not specific to Vicinity Centres*

2. Introduction

2.1 Brief overview of global electric vehicle battery fire research & testing:

The world of electrified transport moves quickly & the question of *how* emergency incidents involving electric vehicles are managed is still emerging.

Nascent research & testing programs cannot keep pace with EV deployment & there is no 'silver bullet' to solve the new risks & challenges lithium-ion battery fires pose to emergency response.

The unstable exothermic chemical reaction known as 'thermal runaway' causes EV battery fires to behave differently to traditional vehicle fires, with jet-like flames, higher temperatures, long duration burn times & the need for increased resources, including personnel & firefighting water.

However, passenger EV battery fires are currently very rare. EV FireSafe's incident database is one of a small handful of programs focused on providing data-driven learnings to the global emergency response community.

To answer the multiple in-depth questions regarding EV battery fire risks to life & property safety, EV FireSafe is partnered with emerging large & small scale testing programs running over the next 12-18 months, including:

- Fire Rescue NSWs Safety of Alternative & Renewable Energy Technology (SARET)
- Fire Protection Research Foundation at NFPA (USA)
- LASH at RI.SE (Sweden)
- Extinguishing & nail penetration tests by Newcastle University (UK)
- Small scale testing by EV FireSafe & various other organisations

2.2 About EV FireSafe:

EV FireSafe is an Australian company funded by the Department of Defence to research electric vehicle lithium-ion traction battery (EV LiB) fires & emergency response, particularly where the vehicle was connected to energised charging.

Since launching an online knowledge hub in November 2021, our work has been mentored by global electrochemistry expert Professor Paul Christensen, & referenced by multiple fire agencies & peak bodies, including the Australian Fire Agencies Council (AFAC), Comité Technique International de Prevention et D'extinction de Feu (CTIF) & the National Fire Chief's Council UK (NFCC).

EV FireSafe has also presented to & collaborates with EV manufacturers Tesla, Ford & Hyundai. Additionally, we are an invited Technical Panel member of the Fire Research Protection Foundation's (USA) two year testing program investigating emergency response to lithium-ion & electric vehicle battery fires.

This document has been prepared by EV FireSafe Director Emma Sutcliffe & Technical Specialist Daniel Fish, with support from Research Lead Ciara Kruger.

Questions regarding this document may be directed to Emma Sutcliffe on emma@evfiresafe.com or 0409 040 499. Further information about EV FireSafe can be found at evfiresafe.com

2.3 Assumptions:

There are a range of new & familiar risks & challenges associated with lithium-ion batteries & electric vehicles that EV FireSafe has identified in collaboration with a global network of battery & fire experts.

Rather than distract from the purpose of this report, we have assumed understanding of the following concepts & identified risks in relation to EV LiB incidents. An emergency-focused presentation of these concepts can delivered upon request, virtually or via an in-person demonstration.

Hyperlinks to explainer pages at evfiresafe.com are provided here, however it should be noted these relate primarily to passenger electric vehicles:

- Definition of a battery electric vehicle & plug-in hybrid electric vehicle
- How an EV HV traction battery is constructed
- Basics of how EV charging works
- RCM Tick for electrical compliance & AS 3000 App P for EV charging installation
- Overall risks of EV LiB fires vs ICEV fires, including risk of electrocution
- How thermal runaway in an EV battery pack occurs
- Early signs of thermal runaway for emergency responders
- EV LiB suppression challenges & methods
- Low risk of vapour cloud explosion
- Secondary ignition risk

We also highlight the 'FAQ' page for supporting evidence to our own findings that passenger EV LiB fires & vapour cloud explosions are very rare.

2.4 Glossary:

Acronyms used throughout this document are provided with a full explanation when first written, however a list is provided here for easy reference.

LiB	Lithium-ion battery (eg, a HV traction battery in an EV)
ICEV	Internal combustion engine vehicle
EV	Electric Vehicle
BEB	Battery Electric Bus
BET	Battery Electric Truck
BESS	Battery Energy Storage System
LEV	Light Electric Vehicle (eg, e-scooter, e-bike, hover board)
EVSE	Electric Vehicle Supply Equipment (charging infrastructure)
CPO	Charge Point Operator
NMC	Lithium Nickel Manganese Cobalt Oxide
OEM	Original Equipment Manufacturer
HV	High Voltage (>60V DC for automotive)
LV	Low Voltage (<60V DC for automotive)
AC	Alternating Current

DC	Direct Current
BMS	Battery Management System
ERG	Emergency Response Guide (long version)
ERC	Emergency Rescue Card (short version)
ESIP	Emergency Services Information Package
SOP	Standard Operating Procedure
SOG	Standard Operating Guideline
GPO	General Power Outlet – Power point
FRNSW	Fire and Rescue NSW
RFS	Rural Fire Service
FRV	Fire Rescue Victoria
CFA	Country Fire Authority
Permanent	Full-time career firefighter – @ station or with fire appliance
Retained/On-call	Casual Firefighter – may be at primary employment etc
Volunteer	Casual Firefighter – may be at primary employment etc
AFA	Automatic Fire Alarm
VESDA	Very Early Smoke Detection Apparatus
EWIS	Emergency warning intercom system

The terminology of **high voltage (HV)** used throughout this document relates to the Society of Automotive Engineers classification of high voltage as anything over 60V DC in an electric vehicle.

2.5 Disclaimer:

This document has been prepared for the use of **Vicinity Centres**. Other agencies, departments or companies can apply to use the information or resources contained within by contacting our Director, Emma Sutcliffe at emma@evfiresafe.com, & only following permission by our client.

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3. Fast explainers

3.1 Categorisation:

Globally, no categorisation of LiB application for emergency response has been put forward, that we are aware of.

To highlight a) the vast array of LiB uses & b) the differing emergency management required depending on application, we have categorised LiBs to better assist in building incident standard operating procedures & awareness:

Small devices: Personal electronic devices like phones, tablets, gaming consoles & laptops, vapes & cordless power tools

Light electric vehicles (LEV): Electric bikes, scooters, skateboards & hoverboards, privately owned or pay for use

Electric vehicles (EV): Road registered electric vehicles such as motor scooters, cars, buses, trucks & delivery vans

Battery energy storage systems (BESS): Static units, including portable, fixed residential, commercial or grid-scale

3.2 Causes of battery fire:

Possible causes of thermal runaway (battery fire) include, but are not limited to:

Cause	**Potential scenario**
Mechanical abuse - most likely	• Collision with other vehicle/s, structure, debris • Tyre blow-out impacting pack • Roll-over • Extended submersion in water (particularly salt water)

	• Impact with floor/ramp/hump/median due to ramp-over angle and clearance of vehicles
Electrical abuse – unlikely due to inbuilt safety systems & BMS	• Compromised HV cabling leading to electrical short, impacting battery • Dendrite growth • Overcharge • Over discharge • Short circuit
Thermal abuse – very unlikely due to inbuilt safety systems & BMS	• External heat, such as extreme environmental temperatures or fire of structure or neighbouring vehicle

3.3 Risk profiles of LiB fires by category:

***Passenger EV LiB fires*:** Are very rare, with 375 verified incidents globally since 2010 at the time of writing.

Electric bus/truck LiB fires: Are likewise rare, with 24 globally since 2011 & only three electric truck LiB fires.

Light EVs: A high rate of death, injury & property loss is caused by light EVs; electric bikes, scooters, skateboards & hoverboards. These micromobility devices are either bought for private use or rented out by the hour by companies moving into cities or large campuses, including universities & hospitals.

3.4 Comparison of fire dynamics

Emergency responders already understand ICEV fires & have well-rehearsed & established SOPs to manage such incidents. EVs, on the other hand, pose a mix of similar & new risks & challenges.

To provide a starting point, we have developed operational comparisons from an emergency response perspective, which we outline on our website at '[Risks EV traction battery fire]'.

A further comparison in relation to incident management relevant to EVs & charging in structures is provided below; created in collaboration with Professor Paul Christensen.

	ICEV	EV LiB
Cause of fire	Electrical, fuel tank	Thermal runaway
Exposure to toxic gas	Burnt plastics, fuel, metal	Mix of hydrogens, plastics, metal

Explosion	Running fuel fire, vapour cloud explosion (fumes)	Vapour cloud explosion
Temperature	Approx. 800-1000 ˚c	Potential for up to 1000-1200˚c
Duration	Typically 1-2 hours	No average known, upwards of 3-5 hours typical
Secondary ignition	Only if not fully extinguished	Occurs in approx. 10% of incidents
Electrocution	Very low	Very low
Fire spread	Believed to be similar – testing to confirm	
Heat release rate	Believed to be similar – testing to confirm	
Fuel load	Believed to be similar – testing to confirm	

Initial testing & research from global organisations indicate similar heat release rate, fuel load & fire spread in ICEV versus EV; this work is emerging & requires corroboration with further testing & research.

However, the fire dynamics also need to be considered; for example, overall heat release rate may be similar, but is delivered differently & potentially for longer & in one direction with an EV, when compared to ICEV.

3.5 Main & secondary hazards

There are three primary hazards with lithium-ion batteries & electric vehicles:

- Off-gassing: toxic, flammable vapour clouds
- Ignition: vapour cloud ignites, creating a ‘jet-like’ flame
- Explosion: vapour cloud deflagrates, followed by ignition

Additionally, secondary hazards include:

- Chemical exposure: The amount of electrolyte in LiBs is very small & unlikely to form a pool of liquid if a cell has been penetrated. However, it is toxic & may cause serious injury if ingested, or comes into contact with skin or eyes.

- Electrocution: Electrocution risk from EVs & LiBs is very low, but is still a risk. In the case of single LiB cells that have been damaged, it's best to use a shovel & metal bucket for removal. In damaged EVs, the nature of the DC (direct current) high voltage systems means there is little to no risk of becoming the 'earth', or suffering an electric shock. All personnel should avoid orange cables, be aware of arc flash in severely damaged or ignited EVs.

- Projectiles: Single LiBs cells may become projectile (fly around the immediate area) when in thermal runaway. In EV incidents, cell & other pieces of debris may also be projected from

underneath the vehicle.

- Uncontrolled movement: EVs typically move silently & with instant torque. Personnel should avoid being in the forward & rear path of the vehicle in case it moves without warning.

- Air quality: There are two hazards to be aware of:
    - **Vapour cloud** - as we've seen, the gases vented from LiBs are toxic & flammable, & can cause respiratory distress.
    - **Smoke** - additionally, if an EV or LiB is on fire, the normal products of combustion (plastics etc) are toxic to humans

- Water quality: If fire water has been used, either in a hose stream or by submerging smaller LiB packs in a bucket of water, there is a high likelihood of contamination. Water should be retained where possible & not allowed to enter natural waterways. Seek advice from appropriate authority.

- Secondary ignition: If an LiB pack has gone into thermal runaway with ignition, but not all cells have been destroyed, we're left with 'stranded energy'. This poses a risk of a secondary ignition hours, days or even weeks after the initial fire.

4. Site visits – aim & purpose

At each Vicinity Centres site visited, we considered the following in relation to current or future storage, sale, use, operation & charging of lithium-ion batteries & electric vehicles:

- Site-specific risks & hazards
- Risk-reduction strategies already installed or planned
- Additional sensible considerations & best practice

Please note, that for ease of reading, we refer to the following acronyms:

- EV – passenger electric vehicles, such as Tesla, Polestar etc
- LEV – light electric vehicles, such as e-bikes, e-scooters & e-skateboards
- LiB – other smaller devices, such as power tools
- BESS – battery energy storage systems

4.1 Site considerations

On each site visit, we considered the following questions:

Overall site considerations of LiBs & EVs within buildings by:	
Site owner	EVs in carparks or at charging hubs BESS
Tenants	EVs on display or within retail stores LEVs for sale or hire (incl mobility scooters) LEVs charged within tenancies
Contractors	Smaller devices used by building / cleaning contractors
Private & customers	Private use LEVs ie. food delivery drivers LEVs brought into sites by customers Private LEVs charged on site

Detailed site considerations include:	
Heritage or high iconic value?	Legacy construction materials
Existing fire protection systems	Fire control room Smoke detectors Fire hydrants Sprinklers Ventilation / air handling system Rate of rise detectors Hose reels Extinguishers Fire exit stairs Fire exit signage CCTV

	Lighting
Public use	How are customers using the site?
EV charging hubs	Proximity to existing fire protection systems Are charging units compliant & installed to standard? Emergency exits/fire stairs Entry/exit to building Natural waterways Natural bushland/grassland Schools, hospitals, aged care, residential buildings Flooding risk Separation of EVs from ICEs Additional space around charging bay for egress (people living with disability) Can emergency vehicles reach charging site? Can tow recovery vehicles reach charging site? Carpark considerations Is carpark accessible 24/7? What level is charging is on? Internet connection/cell reception
Do EVs include those owned or operated by:	Staff Customers Deliveries/logistics Public transport
LEVs – retail & private	Are LEVs for sale or hire? Are retail & site staff aware of risks? How are those units charged? Are they charged overnight/unsupervised? How are damaged or returned retail units managed?
Past incidents	Have you experienced past EV or LiB incidents?
Fire Service awareness & capability	Services available Approximate response capacity Approximate response time

5. Summary of findings

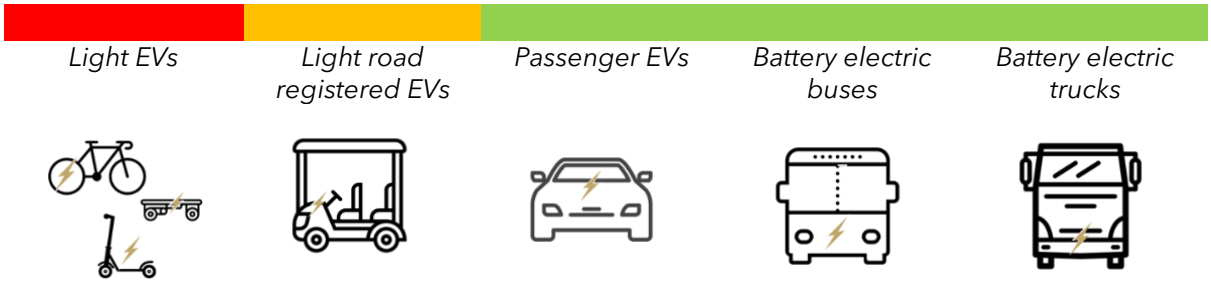
For ease, we provide here a summary of findings applicable to each of the sites visited, & which can be expanded with the aim of turning best practice into policy across the entire Vicinity Centres portfolio.

Detailed explanations follow in sections 6 to 10, specific to each site visited.

5.1 All sites - Site specific risks & hazards

Overall, there is a low risk to Vicinity Centres with road-registered electric vehicles (passenger, bus, truck), but a higher risk of battery fire due to light EVs (LEVs).

Current global thinking regarding risk profiles is shown below:



The risk of vapour cloud explosion is increased (but still rare) where the electrified vehicle goes into thermal runaway (battery fire) in an enclosed space.

EVs around the site	At all Vicinity Centres visited we noted passenger electric vehicles being operated, parked or charged by customers &/or tenants; ie. Tesla, with a dedicated charging point at Chadstone. Some sites have retail stores or 'kiosk' style spaces leased to EV manufacturers.
EV charging	All sites have EV charging installed or planned, & our additional considerations & best practice will further enhance safety at those sites.
LEV hire, sale, use & charging	Mobility scooters are available for hire at some sites for the use of customers. Many sites have LEVs for sale via retail outlets like JB HiFi, Kmart etc. All sites have tenants selling LEVs & food delivery drivers using electric bikes near or within food court areas. Privately owned LEVs are not allowed to be ridden or charged within centres; enforced by security staff. However, rapid uptake means more will be present. Eg. We found a public listing on PlugShare for e-bike owners to charge at a powerpoint adjacent to an exit at Roselands SC.

BESS	No Vicinity Centres site has battery energy storage systems installed at this stage, however design considerations for emergency response should be incorporated into future planning.
Contractors	The operation & charging of smaller device batteries (such as in power tools) & small vehicles (such as electrified cleaning 'golf buggies') is already occurring & will grow in future.

As the push to decarbonised transport accelerates, over coming years Vicinity Centres can expect to see:

- A greater proportion of private EVs being parked & charged at sites
- A greater proportion of their internal fleet transitioned to EVs
- Electrified public transport buses (battery electric buses or BEBs)
- Electric last mile delivery trucks & vans
- Increased use of smaller electrified vehicles by contractors, such as 'golf cart' style buggies used to transport cleaning products
- A dramatic increase in the stocking, sale & return of light EVs by their tenants
- A dramatic increase in the use of private light EVs by food delivery drivers & customers within sites

Following our site visits, we could not identify any major risks or hazards that are unable to be somewhat mitigated through design or awareness measures.

5.2 All sites - Risk reduction strategies already installed or planned

All Vicinity Centres visited had a high level of risk awareness, fire protection systems & well-run centre management & security teams.

All sites had fully operational fire control rooms & well lit, secured & marked carparks.

With respect to the design, placement & installation of EV charging infrastructure, the Warriewood Shopping Centre has excellent consideration for emergency response, including early detection systems, & an open sided carpark with charging located at a distance from the centre entry/exit point. It should be considered a best practice model for other sites in these early days of EV charging take up.

We have no doubt the sensible considerations outlined in this document will be implementable to Vicinity Centre's current policies & procedures, as a forward thinking, proactive & safety focused organisation.

5.3 All sites - Additional sensible considerations & best practice

Across all Vicinity Centre sites, we put forward the following best practice considerations.

These considerations are in addition to site-specific suggestions, which can be viewed in sections 6 to 10.

It's important to note all considerations, best practices & suggestions are based on our battery fire research, experience as firefighters & collaboration with a global network of

fire & battery experts. They are advisory only & should not be considered regulatory or essential in nature.

EV charging (EVSE) design & positioning	

EV charging	In an emergency involving an EV & charging unit, there is an increased risk to site staff & emergency responders from electrocution
	
	Across all sites, all EV charging equipment should have RCM Tick electrical compliance & be installed to ASNZ3000 App P wiring rules.
	
	• We additionally propose:
	  ○ All EV charging units should have isolation switches within 2 metres of the unit itself (as per ASNZ3000)
	  ○ A second isolation point/e-stop at distribution board/s should be installed, providing the ability to shut down power to multiple chargers at once*
	  ○ Isolation/e-stops should be accessible & identifiable, with suitable signage*
	  ○ Wall stickers or suitable signage is installed to point responders to distribution board/s, fire hydrants & to point to nearest exits
	  ○ Those in public spaces can be secured with a '003' key
	  ○ Those in secure spaces should not be locked
	  ○ An EVFSB Charging Hub Fire Safety sign is installed at each site for the information of EV drivers
	  ○ All charging units are protected with bollards & wheel stops
	  ○ Site staff undertake online awareness training for EV charging hub & LiB fires
	
	*Refer to Australian Standards for guidance on the installation height of isolation/e-stop switches & the colour of switches & signage so there is contrast for easy identification

Signage may include	• Safety Signage at Charging Hubs with Early Signs of Thermal Runaway w/ site contact details • To nearest Emergency Exits • To Isolation Points/DB points • To Fire Control Room and AFA Panels
Clear marking of any impact hazards	• Review of speed hump design & positioning to ensure not likely to cause EV HV pack damage (height and length, combined with any other angles such as drainage or guttering) • Installation of markers &/or bollards at any irregular kerbing or median that may cause EV HV pack damage
EV charging – emergency response guidance	With the rollout of the new technology of EV charging supply equipment, it is vital that emergency services are given suitable, supplier/manufacturer supplied information outlining safe operation & shut-down procedures for charging units.

	An easily identifiable document labelled “Emergency Responder Guide – EV Charging” or similar, should be established for each site, printed & in a digital format. A laminated copy of any technical information should be prominently displayed in any or all of the following locations: • Security Office • Fire Control Room (A3 sized copy) • Electrical isolation/distribution room or cabinet relevant to EVSE shut-down • Cabinet adjacent to EVSE installation, secured with a “003” key • Any other location relevant deemed relevant A digital copy should also be forwarded to the local emergency agency that should be attached to electronic pre-incident plans. If the site has an ESIP (see below), this information can also be contained within the ESIP documentation.

ESIP – Emergency Services Information Package	ESIPs are developed in collaboration with local emergency agencies to provide important response information.
	
	Although an ESIP would usually be considered for properties classed as special hazards, it may be prudent to ensure this information is readily available.
	• Information included in an ESIP should include, but not be limited to;
	  ○ Emergency Contacts
	  ○ Evacuation Overview
	  ○ Tactical Checklists
	  ○ Hazardous chemicals or procedures
	  ○ Building Performance Solutions
	  ○ Tactical Fire Plans
	
	For Vicinity Centre sites that already have an ESIP, this should be updated to reflect EVSE information.
	
	For sites that do not have an ESIP, consideration should be given to developing such material to aid in the appropriate response of emergency services.

Familiarisation sessions for local emergency services (optional)	As EV charging infrastructure is rolled out, Vicinity Centres should consider inviting local fire stations to the site for an organised 60 minute tour of charging hubs, including location of distribution board/s & fire control room. These sessions assist agencies to respond with more confidence, therefore potentially reducing response time.
Opportunistic charging (EV & LEV at powerpoints)	Opportunistic charging of EVs does not automatically create a risk or carry additional hazards. However, unsafe practices are possible and will undermine management strategies of charging hub locations, emergency shut-downs of EVSE.

	Vicinity Centres should consider: • Installation of signage that EV charging is only permissible at charging hubs using dedicated hard-wired EVSE, not GPOs, or; • Establish a dedicated BYO charger area where electrical circuits have been tested and are fitted with emergency stops and AFA stop when AFA system is tripped • Conduct a car park audit of all GPOs and ensure they are either switched off and locked, or the circuit is isolated at the distribution board • Schedule a regular review of public charging information (such as PlugShare app) to ensure no opportunistic charging is located within sites • Ban the charging of LEVs at any powerpoint across all sites
EVSE ongoing maintenance	• A fortnightly inspection by onsite staff or each EVSE to look for wear & tear should be scheduled • A 6 monthly test & inspection by a qualified person should be scheduled; testing to be conducted using an EV or diagnostic tool that simulates an EV • Any damaged EVSE should be taken offline & replaced (in full or part) with electrically compliant 'like for like' units • Any portable extinguishers installed near EVSE are inspected for location and serviceability as part of regular fire protection checks* *While currently available portable extinguishers are not suitable for lithium ion battery fires, they can be used on EVs where burning combustibles are present (ie. no battery involvement) **For consideration:** **If it is noted that a detection or suppression system covering a charging hub location will be offline for servicing, maintenance or a fault, it would be advisable to take any EVSE offline for the same duration, especially in below-ground, enclosed or semi-enclosed locations. Local signage & website information should inform the public of this.*** *Although there are currently no formal obligations for such practices, it would be predictable that such expectations will be held by fire response agencies if asked. It should be considered normal practice to engage the EVSE Charge Point Operator (CPO) to put these systems online or offline and update EV charging app data. For non-smart systems, this may be required to be completed by Vicinity site staff.
EV charging – Display EVs within retail stores	Where floor-mounted power outlets are fitted in areas with sprinkler systems, electrical circuits should have readily accessible isolation, fitted with appropriate earth leakage detection & circuit breaker. They should additionally be regularly inspected & tested.

LEVs for sale by retail tenants

	• Develop & implement policies & practices that encourage safe storage, handling & disposal or return of warranty products by retail tenants. This may include retail tenants:
	  ○ Requiring LEV OEM fire safety information prior to stocking their products*
	  ○ Requiring LEV OEM to ship products at a low state of charge (this may reduce violence of fire behaviour)
	  ○ Minimising stock held in one area within stores
	  ○ Ensuring a quarantine area (clear, non-combustible) is available for 'risky' damaged battery packs, either new or returned
	  ○ Ensuring appropriate warranty return procedure is arranged with OEM
	  ○ Ensuring damaged packs are disposed of through certified & established recycling/waste channels
	  ○ Ensure they are NOT disposed of in general waste
	  ○ Ensuring staff can identify 'risky' battery packs & do not do anything to cause further damage
	  ○ Ensure LiB products sold in stores are certified, with no modified products available
	
	*This should also include information supplied to the buyer for the lifecycle of the product
	
	For consideration:
	Vicinity Centres would be well-positioned to establish a centre-wide battery management program in collaboration with an organisation like B-Cycle or the Battery Stewardship Council, that includes safe disposal. This may be cheaper than ad-hoc store-by-store arrangements and increase the likelihood that stores participate in correct practices. These could be established/piloted at sites with less combustible construction & cladding, avoiding sites with high iconic value (eg. QVB, Sydney)

Private & delivery rider LEV operation & charging	
	Privately owned LEVs are: • Banned from entering or being ridden at all sites ○ This includes those owned by site & tenant staff • Banned from being charged at any site, in any location Delivery rider LEVs are: • Banned from entering or being ridden at all sites* **For consideration:** **Vicinity Centres may consider creating a nearby outdoor 'secure' space for delivery riders to leave their LEV while collecting food.**

Smaller devices & light 'golf buggy' EVs

	The policy for the procurement, use & charging of smaller devices & vehicles supplied by contractors should be established &/or reviewed by Vicinity Centres.
	
	This may include:
	• Procurement of smaller devices & vehicles from a reputable supplier that can:
	  ○ Provide electrical compliance & quality standards information
	  ○ Provide an emergency response guide (vehicles only)
	  ○ Provide battery details, such as chemistry & form type
	  ○ Guarantee a local support & maintenance team
	  ○ Guarantee replacement of parts & charging equipment to a high standard & with quick turnaround (preferably with locally held parts)

'Lite' online training – site & retail staff	
	• General LiB & EV awareness training delivered in a fast, visual online format

Full online training – centre security & management	
	• As the personnel involved in the daily operation of the centres on the ground, roles in incident response & management, and heavily relied on by any emergency agency during an emergency incident, it is vitally important that site security staff & managers receive full training in LiB and EV hazards, risks & response.

In-person training – centre security & management	
	As determined by National Security Manager, training provided to those taking on the roles involved in Hazard & Risk Identification & Management, Emergency Response Plan Development, and contingency planning, these staff are faced with the WHS legislated requirement that they "*must identify reasonably foreseeable hazards that could give rise to risks to health and safety.*"

6. Chadstone Shopping Centre, Victoria

The Chadstone Shopping Centre is a modern multi-level site located in the eastern suburb of Melbourne and known for its luxury brands & eateries, & is known nationally as 'the fashion capital'.

Premium guest services including valet parking, hands free shopping, personal styling, butler service & parcel concierge are offered at this location.

The overall site includes head offices for the Vicinity Group, high-end hotel, multi-level carpark and a large modern shopping centre.

There is also a local bus interchange where Battery Electric Buses (BEB) are known to be operated, and hydrogen fuel cell buses can be expected soon.

Due to its prominent location & iconic value, this centre is frequented by a significant population daily.

Major tenants retailing lithium-ion batteries include David Jones, Myer, Apple, Tesla, Polestar & JB HiFi.

6.1 Chadstone – Site specific risks & hazards

Chadstone is an above-ground, reinforced concrete shopping centre, however, car parks are built up to multiple levels on several sides. This means that when exiting the main building from some parts, you will still be in an enclosed space, and/or multiple levels of the carpark feed into the main building.

There are several EV charging locations around the centre, however, EV FireSafe only viewed the Tesla Destination Chargers located adjacent to Mulberry & Ralph Lauren.

During our site visit, we noted the following:

	Passenger electric vehicles (EV)		
	EVs around the site	• Customer EV's were present in various numbers throughout the public car park. • It is likely that Vicinity Centres will start to note the use of Battery Electric Trucks (BET's) for the delivery of stock/product & waste removal services. BET's would likely enter the adjoining below-ground and enclosed loading dock area for loading & unloading & potential charging activities. • It is known that the public bus network is already operating Battery Electric Buses (BEB's) that will increase in numbers and frequency near the property, however not entering any structure and remaining in the open air.	
	EVs on display (kiosk)	• BYD – (Atto 3) single new vehicle on display in common space in the open part of the centre with extremely high ceiling space.	

		○ Sprinklers are installed on the ceiling but may experience a retarded triggering due to the height. ○ Smoke detectors are also believed to be functional in this zone. ○ The vehicle was unlocked and shopping centre patrons welcome to open all doors etc. ○ The vehicle did not have any immobilisation or isolation devices visible. ○ No key fob or RFID card was located in the car – likely with staff ○ An incident involving this vehicle will likely be difficult to contain and may impede centre evacuations due to the walkway location, however it is unknown where this vehicle is positioned in relation to fire/smoke doors or compartmentation. ○ State of Charge - 76%	
		• Cupra – 2x new vehicles on display (2x Petrol ICE, not EV) ○ Sprinklers are installed on the ceiling but may experience a retarded triggering due to the height ○ Smoke detectors are believed to be functional in this zone ○ The vehicle was unlocked and shopping centre patrons welcome to open all doors etc. ○ The vehicle did not have any immobilisation or isolation devices visible. ○ No key fob or RFID card was located in the car – keys likely with staff	
	EVs within retail stores	• Polestar – 2x "Polestar 2" new vehicles on display, ○ Secured overnight within store. ○ The vehicles unlocked and shopping centre patrons welcome to open all doors etc. ○ Vehicles are immobilised with a plug-in device that is connected to the vehicles diagnostic port and additional charge & control module under the front of the vehicle attached to a floor mounted 240v power outlet (Show mode) ○ Sprinklers are mounted in the ceiling of the store at normal height and should be expected to operate as designed and expected. ○ Smoke detectors are installed and believed to be functional in this zone ○ There would be potential to isolate any incident of these vehicles by containing to the store, however a significant incident would likely extend beyond the store – vapour/smoke travel ○ Given the contained space presented by the store if secured, there may be a potential to experience a vapour cloud explosion where there is thermal runaway without a flame.	

		○ State of Charge - 82% / 73%	
		• Tesla – 1x Model 'Y', 1x Model '3' vehicles on display, ○ Secured overnight within store. ○ The vehicle was unlocked and shopping centre patrons welcome to open all doors etc ○ Park brake applied. ○ To start or move the vehicles require a 'valet' RFID card held by Tesla staff. ○ The vehicles will likely be charged as required using the 2x tesla wall chargers mounted inside the store (240v mode 3) ○ Sprinklers are mounted in the ceiling of the store at normal height and should be expected to operate as designed and expected. ○ Smoke detectors are installed and believed to be functional in this zone ○ There would be potential to isolate any incident of these vehicles by containing to the store, however a significant incident would likely extend beyond the store – vapour/smoke travel ○ Given the contained space presented by the store if secured, there may be a potential to experience a vapour cloud explosion where there is thermal runaway without a flame. ○ State of Charge - Unknown / 81%	

	EV charging hubs		
	EV charging & carparks	• A search on the Chadstone vicinity website returned no information for EV charging (https://www.chadstone.com.au/) Terms searched included; Electric Car Charging, EV Charging, Charging	
		• Car Park A / David Jones chargers were not viewed during EV FireSafe site visit ○ Unable to comment on electrical isolation ○ *Plugshare* App Notes – Site 1, David Jones, Car Park A "Description – Located near the David Jones entrance against the wall. (5) AC charging bays (Jet Charge), Chargefox app or RFID card. BYO cable Type 2 to Type 2 cable. Plug your car in, then walk into David Jones to activate the charging" 2 chargers, 22kW (62x non-positive comments out of 181+ – rating 3.1) Common comments- ▪ No mobile reception – need mobile phone to activate charging ▪ ICE'd – spots occupied by ICE vehicles ▪ Spaces occupied by EVs not charging	

		• Car Park B / Tesla Destination Chargers (x5) – Not viewed during EV FireSafe site visit ○ Unable to comment on electrical isolation ○ *Plugshare* App Notes – Site 3, Car Park B "Description Top level of car park B(Target car park), level P3 blue. 2 Tesla bays. 6 of 9 Bays NOT for public use. 9 chargers (61x comments out of 173 – rating 8.1) Common comments – ▪ Both bays occupied, need more chargers ▪ ICE'd – spots occupied by ICE vehicles ▪ Spaces occupied by EVs either not on charge, or charging completed ▪ Right charger not functional	
		• Car Park F / Tesla Destination Chargers (x2) ○ Unable to locate isolation point for chargers Follow-up advice is isolation is located in secured area rear of charger install location against building ○ The mode 3 destination chargers are located close to automatic doors leading into the centre's ground floor. The space where the chargers are installed is in a very high ceiling space (approx. 6m), however this is only a very small portion of this car park – the majority of the carpark is 2 levels in mezzanine style (using same ceiling - mezzanine ceiling height approx. 2.2m). ○ Any vapour/smoke will likely build up at a very high rate until the air handling system is fully operational for an incident in fire mode. ○ Fire mode was not tested at this location to ascertain the direction of air travel or effectiveness, but this would be recommended with simulated controlled conditions out of centre operational hours. (Centre building should auto-activate positive pressure ventilation) ○ *Plugshare* App Notes – Site 2, "Description - Parking Block F (Red), Level P1 (lowest level), Row 2. (2) Tesla Destination chargers available. Follow signs to Parking Block F (Pink). Turn left after entry into the parking structure and head down the ramp to level P1. Head to Row 2. The charging spots are against the wall next to the lifts and the shopping complex entrance facing General Pants Co store." 2 Chargers, 10kW (122 non-positive comments out of 420 – rating 7.4) Common comments ▪ Charger closest to door faulty ▪ Both chargers used, need more chargers	

		▪ Difficult to locate in car park	
		• Does carpark have internet connection? o EV FireSafe did not complete a full site visit, and as such this was not fully checked. o Comments from PlugShare app suggest there is insufficient phone coverage in some areas	
		• Power points in carpark? o EV FireSafe did not complete a full site visit, and as such this was not fully checked but anticipate there are likely to be GPO's accessible	
		• Carparks are closed overnight, except for hotel parking	
		• Susceptible to flooding? o Extremely low flooding risk from natural causes o Marginal flooding risk from water main rupture etc	

	LEV for hire by site	
	• EV FireSafe did not complete a full site visit, and as such this was not checked • Potentially mobility scooters available for hire • No ride-share LEVs available	

	LEVs used for food delivery	
	• EV FireSafe did not complete a full site visit, and as such this was not checked • The LEV's are expected to leave their devices outside, however, it is likely commonplace for these to be brought into the centre with the operator.	

	LEVs used by private customers	
	• It was noted that there are numerous points of entry to the centre that include street-level public entry points that will likely facilitate public entry on or with a LEV	

	LEVs charging	
	• No charging noticed on-site during our visit, however any GPO may be opportunistically used if power is available	

	BESS	

		• EV FireSafe did not complete a full site visit, and as such this was not checked	

	Cleaning contractors		
		• The use of robotic, battery powered cleaning 'machines' was noted in a conversation with Marco Klomp, but not inspected on site • These are supplied by the cleaning contractor & charged & operational (autonomously) overnight • A procurement & maintenance policy of cleaning machines using LiBs should be reviewed & updated, requiring information on quality standards, electrical compliance & provision of emergency response guides	

	Maintenance & other contractors		
		• Smaller devices such as power tools are regularly operated at the site by contractors, but this was not confirmed during the site tour	

	Any relevant past incidents?		
		• ICEV fire in enclosed car park on 20th December 2018, damaging 11 other vehicles	

6.2 Chadstone – Risk-reduction strategies already installed or planned

	Fire control room & protection systems		

		• EV FireSafe did not complete a full site visit, and as such this was not viewed, however confident relevant fire control room layout & protection systems are in place to standard
		• There is a normal level of susceptibility to contents & furnishings fire
		• A very low level of susceptibility to structural elements fire (non-combustible construction)
		• There appears to be all currently required detection and suppression systems installed and maintained. This includes, but not limited to;
		  ○ Fire hose reels
		  ○ Detection system
		  ○ Automatic Fire Alarm System (AFA)
		  ○ Sprinkler system in visited areas of the property	

		○ Internal firefighting hydrants in visited areas of the property ○ Emergency Warning Intercom System (EWIS) ○ Automatic Fire Doors and compartmentation	

	On site security		
		• Well prepared with handheld radios, torches etc • Well trained with a 'Stand back, Observe, Report' system in place	

	Fire Service Considerations (included for information only)		
		Chadstone is aided by general proximity to multiple Fire Rescue Victoria fire stations (Permanent) with 24hr coverage of standard pumpers, rescue & aerial appliances. If an automatic fire alarm (AFA) occurred, at least 2 fire appliances would likely be dispatched and on-scene within 5 to 12 minutes, regardless of the time of day, or day of the week. The number of appliances would likely be increased if the AFA was reinforced with a '000' call from the site confirming a fire or emergency. Although the stations are a relatively short distance away, there will normally be extremely heavy traffic in this location for fire appliances to negotiate. If a significant incident occurred at the Chadstone shopping centre site it would likely be isolated to the site and smoke impact to local residential areas. Some traffic impact would be likely with the potential for local closures and diversion.	

Distance to closest Fire Station (Fire Rescue Victoria)	
Oakleigh	2.6kms – 5 minutes
Glen Iris	4.5kms – 9 minutes
Burwood	4.4kms – 9minutes
Glen Waverly	8.6kms – 12 minutes
Caulfield South	6.8kms – 14 minutes
Closest Aerial Appliance – Oakleigh	2.6kms – 5 minutes

6.3 Chadstone – Additional sensible considerations & best practice

In addition to the information outlined in '**5.3 All sites - Additional sensible considerations & best practice**' that is applicable to all Vicinity Centre sites, we put forward these site-specific suggestions:

	Mobile phone coverage		

		• Phone coverage has been identified as being 'patchy' for the general operation of EV charging in some areas. Acknowledging this hinders patrons from easily activating charging, it is anticipated this may also be the same regarding calls to centre management & emergency services if there were an incident or emergency.
		• This may negatively impact the raising of an alarm at early stages of an emergency incident, prior installed systems being triggered. This may also impact on patron general safety.
		• A lack of phone coverage has the potential to negatively impact incident communications and management via;
		  ○ Customer to centre management
		  ○ Customer to emergency services
		  ○ Centre management to emergency services
		  ○ Emergency services personnel to incident management
		• It would be advisable to conduct phone coverage mapping across the full site and explore systems to improve phone coverage in areas with insufficient coverage.	

	Emergency Services radio coverage		
		• Given the size and construction of the Chadstone shopping centre, it would be advisable to liaise with emergency services to ascertain if they are experiencing communications problems at the site using handheld radios or cellular-based devices, especially from the fire control room to the car parks. • Emergency services should be able to recommend a suitable communications repeater system compatible with their equipment if there are concerns.	

7. Warriewood Shopping Centre, NSW

The Warriewood Shopping Centre was built in the early 1980's. Located on Sydney's Northern Beaches, it is a modern single-level site (with small second level space) that has also recently undergone a refurbishment & is the second largest shopping centre in the area.

The Centre is located at the southern end of a peninsular with somewhat restricted patronage of mostly local residents.

Major retailers include Kmart, Aldi, Coles, Woolworths, Cotton On, JB Hi-fi, & Rebel.

7.1 Warriewood - Overall site considerations

Warriewood is predominantly single level, reinforced concrete shopping centre, with a separate multi-level car park built on the eastern side.

There are several EV chargers planned in one location of the mentioned car park.

During our site visit to the Warriewood Shopping Centre, we noted the following potential hazard & risk points:

	Passenger electric vehicles (EV)		
	EVs around the site	• EV's were present in various numbers throughout the public car park. • It is likely that Vicinity Centres will start to note the use of Battery Electric Trucks (BET's) for the delivery of stock/product & waste removal services. • It is highly probable that the public bus network is already operating Battery Electric Buses (BEB's) that will increase in numbers and frequency in close proximity to the property along Jacksons Rd.	
	EVs on display (kiosk)	• No EVs were noted on display	
	EVs within retail stores	• No EVs were noted on in retail stores	

	EV charging hubs		
	EV charging & carparks	• A search on the Warriewood vicinity website returned the no information for EV charging (https://www.warriewoodsquare.com.au) Terms searched included; Electric Car Charging, EV Charging, Charging	

		• Planned location – North end of multi-story car park on level 2 (Green) of 3.
		Area has;
		  ○ fire detection (rate of rise)
		  ○ video surveillance
		  ○ hose reel
		  ○ firefighting attack hydrant in proximity
		  ○ provision for AFA trip – run off adjacent plant room
		  ○ provision for emergency stop
		  ○ suitable ventilation – located on the outside edge of open car park
		  ○ large area available - should be used to increase vehicle bay spaces
		• The area does not have;
		  ○ Sprinkler system (correct as per ABCB NCC requirements)
		
		• Carpark has internet connection
		  ○ It is believed that the car park has full phone coverage, however, this was not specifically measured.
		
		• Power points in carpark
		  ○ It was noted there are GPO's in the car park space that may already allow opportunistic charging practices by patrons or staff
		
		• Carpark closed overnight? – Closes at 11pm
		Terms searched included; Electric Car Charging, EV Charging, Charging	

	LEVs for hire by centre – Mobility Scooters	

	• It was noted there are mobililty scooters available for hire/loan from customer services.
	  ○ It is believed these devices are lead-acid battery powered.
	  ○ These devices are located at the customer service booth
	  ○ These devices are charged at this location, potentially overnight.	

	LEVs for hire by centre – Mobility Scooters	
	• It was noted there are mobililty scooters available for hire/loan from customer services. ○ It is believed these devices are lead-acid battery powered.	

		○ These devices are located at the customer service booth ○ These devices are charged at this location, potentially overnight.	

	LEVs used for food delivery		
		• The LEV's are expected to leave their devices outside, however, it is likely commonplace for these to be brought into the centre with the operator. This was not witnessed during the site visit.	

	LEVs used by private customers		
		• It was noted that there are numerous points of entry to the centre that include street-level public entry points that will all likely facilitate public entry on or with a LEV device.	

	LEVs charging		
		• No charging noticed on-site during our visit, however any GPO may be opportunistically used if power is available	

	BESS		
		• EV FireSafe did not complete a full site visit, and as such this was not checked	

	Cleaning contractors		
		• It is not believed that cleaners use any LiB devices during their duties	

	Any past incidents		
		• Fire in trash compactor system	

7.2 Warriewood - Risk-reduction strategies already installed or planned

	Fire control room & protection systems		
		• Appropriate fire control room with AFA panel & EWIS, site maps etc	

		• There is a normal level of susceptibility to contents & furnishings fire
		• A very low level of susceptibility to structural elements fire (non-combustible construction)
		• There appears to be all currently required detection and suppression systems installed and maintained. This includes, but not limited to;
		  ○ Fire hose reels
		  ○ Detection system
		  ○ Automatic Fire Alarm System (AFA)
		  ○ Sprinkler system in visited areas of the property
		  ○ Internal firefighting hydrants in visited areas of the property
		  ○ Emergency Warning Intercom System (EWIS)
		  ○ Automatic Fire Doors and compartmentation	

	On site security	
	• Well prepared with handheld radios, torches etc • Well trained with a 'Stand back, Observe, Report' system in place	

	Contractors on site?	
	• Yes, with power tools.	

	Flooding on site?	
	• Marginal flooding risk from natural causes due to storm water and drainage issues of local creek system into ocean. • Marginal flooding risk from water main rupture etc	

	Fire Service Considerations (included for information only)	
	The Warriewood location in on the northern beaches of Sydney is covered by general proximity to multiple Fire and Rescue NSW fire stations (Permanent) with 24hr coverage of standard pumpers, rescue & aerial appliances. There are various volunteer fire brigades of the RFS that may also be called on to attend and support firefighting operations, however there is no guarantee of service provided and these are not full-time staffed, and usually not trained or equipped for large structure fires.	

If an automatic fire alarm (AFA) occurred, at least 2 fire appliances would likely be dispatched and on-scene within 7 to 14 minutes, regardless of the time of day, or day of the week.
The number of appliances would likely be increased if the AFA was reinforced with a '000' call from the site confirming a fire or emergency.
Although the stations are a relatively short distance away, there will normally be extremely heavy traffic in this location for fire appliances to negotiate.

If a significant emergency incident occurred at the Warriewood shopping centre site, it would likely be isolated to just the site with smoke impact to local residential properties.
Some traffic impact would be likely with the potential for local closures and diversion.

Distance to closest Fire Station (Fire and Rescue NSW)	
Mona Vale	3.6kms – 7 minutes
Narrabeen	3.7kms – 9 minutes
Deewhy	7.8kms – 14minutes
Forestville	13.6kms – 16 minutes
Avalon	11.5kms – 18 minutes
Closest Aerial Appliance - Manly	20.2kms – 25 minutes

7.3 Warriewood – Additional sensible considerations & best practice

There are no additional considerations other than those outlined in '**5.3 All sites - Additional sensible considerations & best practice**'.

8. Bankstown Shopping Centre, NSW

The Bankstown Shopping Centre is located not far from the geographic centre of the Sydney region and hosts an extremely high ethnic diversity.
A somewhat unique feature of the Bankstown Shopping Centre is that the site is split by a roadway.

Major retail stores include Myer, Big W, Kmart, Woolworths, Coles & Rebel

There is a local bus route in the local area, but it is not known if this may impact the centre. There is also a major rail corridor located directly to the south.

8.1 Bankstown - Overall site considerations

Bankstown is a multi-level above-ground, reinforced concrete shopping centre that has been extended and added to over time which has led to it sprawling over two blocks.

This separation adds both opportunity and hazard, where an incident at this location may be confined by the isolation of building elements, but also lead to possible delays and confusion.

An incident involving a vehicle fire could include several different car parks, open deck, multi-level or open.

During our site visit to the Bankstown Shopping Centre, we noted the following potential hazard & risk points:

	Passenger electric vehicles (EV)		
	EVs around the site	• EV's were present in various numbers throughout the public car park. • It is likely that Vicinity Centres will start to note the use of Battery Electric Trucks (BET's) for the delivery of stock/product & waste removal services. BET's would likely enter the adjoining below-ground and enclosed loading dock area for loading & unloading & potential charging activities. • It is highly probable that the public bus network is already operating Battery Electric Buses (BEB's) that will increase in numbers and frequency, although the bus terminus and routes should not impact the centre operation during an incident.	
	EVs on display (kiosk)	• No EVs were noted on display, however, it would be possible that the building layout would facilitate such activities.	

	EVs within retail stores	• No EVs were noted on display, however, it would be possible that the building layout would facilitate such activities.	

	EV charging hubs		

	EV charging & carparks	• EV Charging is not currently installed at Bankstown Shopping Centre, however two primary sites were discussed as options.
		These locations were influenced by the proximity to an electrical control room to be able to supply to required power for DC charging.
		
		• Open deck car park (near Star Car Wash, Level 3) (Preference 1)
		  ○ This area is in a high traffic area and benefits from a direct entry and exit to the major road on the perimeter of the centre.
		  ○ Given the amount of vehicles that were parked in this area of the car park at the time of the visit, it would be hoped that ICE vehicles would not be a significant issue blocking EV charging bays.
		  ○ There is opportunity for the installation of a combination of solar PV panels with or without battery energy storage.
		  ○ This area could easily be utilised for large scale EV charging, taking into account disabled access charging bays, drive-thru bays, and combination of multiple slower AC units combined with faster DC units.
		  ▪ The combination of multiple AC and DC chargers provides charging solutions to meet the needs of longer dwellers without needing to move their vehicle before they finish their experience, or fast DC options for those that are after a quick pit-stop of charging and back on the road.
		
		• Below-ground enclosed car park (Near Woolworths, Level 2)(Preference 2)
		  ○ This area is in very close proximity to the entry to the shopping centre from the enclosed car park
		  ○ There is a large amount of parked vehicles & traffic in this area and it would be predicted there will be significant issues of any EV charging spots being occupied by ICE vehicles – this could be managed with signage and engagement from security staff, but would detract from normal	

		operations and add additional workload to security operations. This could also be a potential for confrontation between members of the public, or public & security staff. o There is an emergency exit that may be located extremely close the any EV charging bays – this may impact the use of the emergency exit in the event of any vehicle fire due to messy charger leads etc. o There are services run along the ceiling of this enclosed car park that were not identified. It would be advisable to identify these and avoid the installation of EV charging below these if they include gas plumbing. • Carpark has internet connection? o EV FireSafe did not complete a full site visit, and as such this was not fully checked. • A search on the Roselands vicinity website returned the no information for EV charging (www.bankstowncentral.com.au/) Terms searched included; Electric Car Charging, EV Charging, Charging o Given there are parts of the car park that are enclosed it is highly likely there may be phone coverage issues unless this has already been addressed with technological solutions. • Power points in carpark? o EV FireSafe did not complete a full site visit, and as such this was not fully checked but it is anticipated there would likely be GPO's accessible • Carpark closed overnight? – To follow up	

	LEVs for hire by centre – Mobility Scooters		
		• It was noted there are mobililty scooters available for hire/loan from below the admin offices of the centre. o It is believed these devices are lead-acid battery powered. o These devices are located at the customer service booth o These devices are charged at this location, potentially overnight.	

	LEVs used for food delivery		
		• The LEV's are expected to leave their devices outside, however, it is likely commonplace for these to be brought into the centre with the operator.	

	LEVs used by private customers		
		• Several members of the public were witnessed to be walking through the shopping centre with e-scooters. • It was noted that there are numerous points of entry to the centre that include street-level public entry points that will all likely facilitate public entry on or with a LEV device.	

	LEVs charging		
		• No specific charging noticed on-site during our visit, however any GPO may be opportunistically used if power is available • It was noted that there are GPOs provided in the food court that will no doubt be used by public for opportunistic charging of LEVs, however, this is not currently displayed on the *PlugShare* app at this time. • This location is very central within the building, usually heavily occupied, and could lead to an event of significance due to the large space and very high ceilings that may potentially impact both smoke detection and sprinkler system operations. • Sprinkler systems may not activate due to the highly localised heat output from a LiB related event, until such time as other material is ignited in large enough quantities, while "smoke" (LiB vapour cloud) may stratify and not necessarily rise to the ceiling. • To manage the potential for opportunistic LEV charging, it is advisable to review the installation of standard 240v GPO outlets. It would be recommended to continue the installation of inductive charging pads and USB-type sockets that are currently provided within the food court area. • If the centre wishes to allow LEV charging, it would be recommended to have a designated external area that provides facilities to secure a personal LEV, monitored by CCTV, smoke detectors and protected by sprinklers. This area should be away from any entry/exit point of the building and as per other EV FireSafe guidance.	

	BESS		
		• It is believed there is no BESS currently at this location.	

	Cleaning contractors		
		• It is not believed that cleaners use any LiB devices during their duties	

	Any past incidents		
		• Unknown	

8.2 Bankstown - Risk-reduction strategies already installed or planned

	Fire control room & protection systems		
		• The fire control room is located below ground level and accessible from both the street and via the enclosed car park area.	

	On site security		
		• Well prepared with handheld radios, torches etc • Well trained with a 'Stand back, Observe, Report' system in place	

	Contractors on site?		
		• Yes, with power tools.	

	Flooding on site?		
		• Marginal flooding risk from natural causes due to storm water and drainage issues of local creek system into ocean. • Marginal flooding risk from water main rupture etc	

	Fire Service Considerations (included for information only)	
	The Bankstown location in the western suburbs of Sydney is aided by general proximity to multiple Fire and Rescue NSW fire stations (Permanent) with 24hr coverage of standard pumpers, rescue & aerial appliances.	

If an automatic fire alarm (AFA) occurred, at least 2 fire appliances would likely be dispatched and on-scene within 4 to 13 minutes, regardless of the time of day, or day of the week.
The number of appliances would likely be increased if the AFA was reinforced with a '000' call from the site confirming a fire or emergency.
Although the stations are a relatively short distance away, there will normally be extremely heavy traffic in this location for fire appliances to negotiate.

If a significant emergency incident occurred at the Chadstone shopping centre site, it would likely be isolated to just the side.
Some traffic impact would be likely with the potential for local closures and diversion.

Distance to closest Fire Station (Fire and Rescue NSW)	
Bankstown	1.5kms – 4 minutes
Revesby	5.4kms – 10 minutes
Lakemba	5.2kms – 13minutes
Riverwood	6.9kms – 13minutes
Chester Hill	7.6kms – 14 minutes
Closest Aerial Appliance Revesby	5.4kms – 10 minutes

8.3 Bankstown – Additional sensible considerations & best practice

There are no additional considerations other than those outlined in '**5.3 All sites - Additional sensible considerations & best practice**'.

9. Roselands, NSW

The Roselands Shopping Centre is a mid 1960's era suburban facility that, at its time, was the largest shopping centre in the Southern Hemisphere.
Servicing the local community as a central hub, there is significant patronage from the local multi-cultural demographics.

Major retailers include Kmart, Aldi, Coles, Woolworths, Cotton On, JB Hi-fi.

9.1 Roselands - Overall site considerations

Roselands is an above-ground, reinforced concrete shopping centre, however, car parks are built up to multiple levels on the western side. This means that when exiting the main building from some parts, you will still be in a partially enclosed space, and/or multiple levels of the carpark feed into the main building.

There are currently NO charging installed at the centre, however, EV Charging is planned for the Red level of the multi-level carpark.
It is noted that *PlugShare* has two charging options pinned for the site.

During our site visit to the Roselands Shopping Centre, we noted the following potential hazard & risk points:

	Passenger electric vehicles (EV)		
	EVs around the site	• EV's were present in various numbers throughout the public car park. • It is likely that Vicinity Centres will start to note the use of Battery Electric Trucks (BET's) for the delivery of stock/product & waste removal services. BET's would likely enter the adjoining below-ground and enclosed loading dock area for loading & unloading & potential charging activities.	
	EVs on display (kiosk)	• No EVs were noted on display within the centre	
	EVs within retail stores	• No EVs were noted on display, however, it would be possible that the building layout would facilitate such activities.	

	EV charging hubs		
	EV charging & carparks	• A search on the Roselands vicinity website returned the no information for EV charging (https://www.roselands.com.au/ Terms searched included; Electric Car Charging, EV Charging, Charging	

- EV Charging is not currently installed at Roselands Shopping Centre, however one primary site was discussed.
  This location was influenced by the proximity to an electrical control room to be able to supply to required power for DC charging.

- Level 3, Row H – Red, Western Multi-level car park
  Although this location is assisted by the proximity to the required electrical supply infrastructure, there are some non-positive considerations with this being the site for the EV charger installation.
    - The position is directly adjacent to the emergency exit and fire stairs that may potentially impact emergency egress from the general location with consideration to a vehicle fire, or the additional trip hazards posed by cables between vehicles and across the ground
    - The level is identified "red" by colouring all columns and walls – this acts to camouflage the fire hydrant system and will make it extremely difficult for firefighters responding to a vehicle fire and attempting to locate and connect to a fire attack hydrant in reduced visibility.
    - Steps should be taken to rectify this camouflage of fire hydrants at any site with "red" levels. Colours should be contrasting to installed firefighting equipment, whether charging goes ahead here or not.
    - The location displays as a high-traffic area with current spots already allocated as short-stay parking. This will likely lead to problems with ICE'ing of EV charging bays either through not identifying the difference or through convenience.
      This will lead to frustration of EV drivers and undermine the proactive step of Vicinity installing EV charging
    - There would be great benefit in increasing the size of the EV charging bays to reflect that of disabled vehicle bays to ensure access and operation by all shopping centre patrons.
      *both disabled driver and/or passenger
    - Given that various makes and models of EV will be using the site, there is little standardisation around the location of the vehicle charge port – this means that vehicles will be required to park in any manner of ways to facilitate vehicle charging. The high traffic area with somewhat tight parking spaces may lead to an increase of vehicle accidents and may include EVSE.

		• *PlugShare* Info*
		  ○ Roselands – Blue Level Parking
		  "Description – Poster has not confirmed if permission was given for its use. Wall plugs row Blue O"
		  Image 1 – Shows GPO adjacent to Elevator & automatic door
		  Image 2 – Shows 240v & 415V outlets on a concrete column
		  Comments
		  - Wall plugs available for e-bike chargers
		
		• Carpark has internet connection?
		  ○ Carpark seems to have decent phone coverage, however this was not thoroughly investigated or measured.
		
		• Power points in carpark?
		  ○ EV FireSafe notes, as per PlugShare app, there are several outlets that would provide opportunistic charging or both EVs & LEVs
		
		• Carpark closed overnight? – To follow up	

	LEVs for hire by centre – Mobility Scooters	
	○ None noted	

	LEVs used for food delivery	
	• The LEV's are expected to leave their devices outside, however, it is likely commonplace for these to be brought into the centre with the operator.	

	LEVs used by private customers	
	• It was noted that there are numerous points of entry to the centre that include street-level public entry points that will all likely facilitate public entry on or with a LEV device. • As per PlugShare app, it is noted that patrons may be using their LEVs in the centre	

	LEVs charging	
	• As per PlugShare app, it is noted that patrons may be charging their LEVs in the centre & carpark	

BESS		
	• It is believed there is no BESS currently at this location.	

Any past incidents		
	• Unknown	

9.2 Roselands - Emergency Response Assistance Considerations

Fire control room & protection systems		
	• One large Fire Control Room located on the eastern side of the centre with internal and external access.	

On site security		
	• Well prepared with handheld radios, torches etc • Well trained with a 'Stand back, Observe, Report' system in place	

Contractors on site?		
	• Yes, with power tools.	

Flooding on site?		
	• Marginal flooding risk from natural causes due to storm water and drainage issues of local creek system into ocean. • Marginal flooding risk from water main rupture etc	

Fire Service Considerations (included for information only)	
The Roselands location in the inner western suburb of Sydney is aided by general proximity to multiple Fire and Rescue NSW fire stations (Permanent) with 24hr coverage of standard pumpers, rescue & aerial appliances. If an automatic fire alarm (AFA) occurred, at least 2 fire appliances would likely be dispatched and on-scene within 7 to 9 minutes, regardless of the time of day, or day of the week. The number of appliances would likely be increased if the AFA was reinforced with a '000' call from the site confirming a fire or emergency.	

As the fire stations are spaces further apart in this area, there would likely be a longer response time compared to some other centres. The response in this location can be aided by the proximity to the M5 motorway and King Georges Rd.

If a significant emergency incident occurred at the Roselands shopping centre site, it would likely be isolated to just the site and local residential areas. Some traffic impact would be likely with the potential for local closures and diversion.

Distance to closest Fire Station (Fire and Rescue NSW)	
Lakemba	3.3kms – 7 minutes
Revesby	6.9kms – 8 minutes
Riverwood	4.5kms – 9 minutes
Hurstville	4.8kms – 10minutes
Bankstown	7.5kms – 15 minutes
Closest Aerial Appliance - Revesby	6.9kms – 8 minutes

9.3 Roselands – Additional sensible considerations & best practice

There are no additional considerations other than those outlined in '**5.3 All sites - Additional sensible considerations & best practice**'.

10. QVB, NSW

The Queen Victoria Building, or QVB, is a multi-level heritage-listed site with combustible frame construction & high iconic value dating back to the 1890's. It is primarily tenanted by luxury brands & eateries, all popular with 'Instagram influencers' due to its exclusive surrounds, large stained-glass windows & brand appeal.

Due to its prominent location & iconic value, this centre is frequented by a significant population daily.

Major retailers include R.M. Williams, Oroton, KENZO, Polo, Ralph Lauren, Hugo Boss, & Jimmy Choo.

QVB has one below ground level of shopping, & several underground levels of car parking. Tesla destination chargers (AC) are at the valet parking section (x2), with others in planning.

On our tour we noted multiple electric vehicles (not charging) on all levels of the underground carpark

During our site visit to the QVB, we noted the following potential hazard & risk points:

10.1 QVB, Overall site considerations

	Passenger electric vehicles (EV)		
	EVs around the site	• EV's were present in various numbers throughout the public car park. • It is likely that Vicinity Centres will start to note the use of Battery Electric Trucks (BET's) for the delivery of stock/product & waste removal services. BET's would likely enter the adjoining below-ground and enclosed loading dock area for loading & unloading & potential charging activities. • It is highly probable that the public bus network is already operating Battery Electric Buses (BEB's) that will increase in numbers and frequency in close proximity to the property, however not entering any structure and remaining in the open air. It is noted that there is approx. 4m between the main QVB structure and the roadway area used as the bus stop or terminal area.	
	EVs on display (kiosk)	• Not probable due to the historic layout of the building and difficult access	

	EVs within retail stores	• Not probably due to the historic layout of the building and access, however, many LEV devices were noted in retail stores for sale and are likely to increase in numbers	

	EV charging hubs		
	EV charging & carparks	• A search on the QVB vicinity website returned the **NO information** for EV charging (https://www.qvb.com.au/) Terms searched included; Electric Car Charging, EV Charging • A search on the QVB vicinity website returned the below information for EV charging (https://www.qvb.com.au/directions/valet-parking Terms searched included; Charging **TESLA CHARGING STATIONS** Recharge your Tesla while you shop with Charging Bays available at the QVB. Available exclusively to valet patrons, simply drive into the QVB car park and enjoy valet parking to recharge. How's that for city convenience? • 2 x Tesla destination chargers (managed by valet parking - Wilson) o The mode 3 destination chargers are located in close proximity to an automatic door leading into the lower ground/basement floor of the centre. The ceiling height in this area is approx. 1.95metres o Any vapour/smoke will likely build up at a very high rate until the air handling system is fully operational for an incident in fire mode. o Fire mode was not tested at this location to ascertain the direction of air travel or effectiveness, but this would be recommended with simulated controlled conditions out of centre operational hours. (Centre should auto-activate positive pressure ventilation) o *Plugshare* App Notes "Description – Located on level 3 at valet parking, a few spots past the valet booth. These are for the valet parking customers, but you can ask nicely to self park if they are not busy. Managed by Wilson Parking." Tesla Destination – 2 Stations, 22kW (7x non-positive comments out of 51 – rating 8.0) • Carpark has internet connection	

		○ This was not fully inspected, but think largely OK – mostly covered by centre wifi • Powerpoints in carpark? Yes – possible for drivers to charge opportunistically. • Carpark closed overnight – closes at 1am	

	LEVs for hire by centre – Mobility Scooters		
		• It was noted that QVB does not have LEVs for hire at this location. This may be deliberate due to the historic design of the property combined with the large number of persons usually within the property.	

	LEVs used for food delivery		
		• Food delivery services were seen to access the QVB food outlets during the visit but were primarily seen on the lower ground floor with the food outlets. • The LEV's are expected to leave their devices outside, however, it is commonplace for these to be brought into the centre with the operator..	

	LEVs used by private customers		
		• It was noted that there are numerous points of entry to the centre that include street-level public entry points to below ground connected to the rail network (Town Hall Train Station) that will all likely facilitate public entry on or with a LEV device.	

	LEVs charging		
		• No charging noticed on-site during our visit, however any GPO may be opportunistically used if power is available	

	BESS		
		• UPS next to CCTVs • No BESS storage	

	Any past incidents		
		• Electrical fire due to contractor overloading.	

10.2 QVB - Emergency Response Assistance Considerations

	Fire control room & protection systems		
		• Fire control room is accessible from a stairway within the centre. • It is assumed that multiple entry/exit points are able to access the fire control room.	

	Cleaning contractors		
		• Did have small buggy with lead acid, inoperative but may be replaced *Currently located in the carpark adjacent to valet parking	

	On site security		
		• Well prepared with handheld radios, torches etc • Well trained with a 'Stand back, Observe, Report' system in place	

	Contractors on site?		
		• Yes, with power tools.	

	Flooding on site?		
		• regular ground water & storm water entry into underground carparks, down walls which are sandstone – normal and suitably addressed • very low flooding risk from natural causes • marginal flooding risk from water main rupture etc	

	Fire Service Considerations (included for information only)
	The QVB location in the center of the Sydney CBD is aided by close proximity to multiple Fire and Rescue NSW fire stations (Permanent) with 24hr coverage of standard pumpers, rescue & aerial appliances. If an automatic fire alarm (AFA) occurred, at least 2 fire appliances would likely be dispatched and on-scene within 5 to 7 minutes, regardless of the time of day, or day of the week.

The number of appliances would likely be increased if the AFA was reinforced with a '000' call from the site confirming a fire or emergency. Although the stations are a relatively short distance away, there will normally be extremely heavy traffic in this location for fire appliances to negotiate.

If a significant emergency incident occurred with either the QVB or Town Hall train station (joined via tunnel system), this could have dire flow-on impacts for both properties & the entire CBD traffic flow (both road and rail networks)

Distance to closest Fire Station (Fire and Rescue NSW)	
City of Sydney	1.1kms – 5 minutes
The Rocks	1.2kms – 5 minutes
Pyrmont	1.8kms – 6minutes
Darlinghurst	1.8kms – 6 minutes
Glebe	3.1kms – 7 minutes
Nearest Aerial (44m) City of Sydney	1.1kms – 5 minutes

10.3 QVB – Additional sensible considerations & best practice

There are no additional considerations other than those outlined in '**5.3 All sites - Additional sensible considerations & best practice**'.

10. Conclusion

Overall, the Vicinity Centres sites visited by EV FireSafe had high level of fire protection & site supervision, with well trained staff alert to risks. When considering LiB fire risks, we collate those identified from high to low:

Highest: Light electric vehicles are deemed the highest risk of a lithium-ion battery fire for Vicinity Centres, particularly privately owned LEVs that are used by staff or brought to a site by a food delivery rider or customer. Our recommendations & planned awareness training will mitigate significant risk in this regard. This level is based on our global research & the number of incidents occurring on a daily basis. LEVs typically use a lower quality battery cell, with lower in-built safety protections.

We also need to consider the risk – albeit lower – of new LEVs being sold by tenants & provide some level of awareness to their staff.

Low: Smaller devices, such as phones, laptops, power tools & other equipment that is for sale, or used by staff or contractors to Vicinity Centres, pose a lower risk of battery fire as they typically use a higher quality battery cell.

It should be noted there have been two incidents involving nail salon equipment, however it is yet to be confirmed these contained lithium-ion batteries.

It raises the important point that we will see a greater number of mass produced smaller devices in tenancy's, & this situation should be monitored as it progresses.

Very low: We consider the electric vehicle charging sites to be very low risk, & the implementation of the recommendations outlined in this document (& by extension, those put forward by the Australian Building Code Board Advisory Notice that was informed by our 2022 report commissioned by their team) will enable earlier detection & reduced risk for bystanders, staff & emergency responders should an incident occur.

Likewise, the display of electric vehicles inside tenancies or in 'kiosk' style areas, carries a very low risk. However, in all cases, basic awareness training for staff across all areas is advisable as it may assist in early detection & enhanced safety.

Finally, we would like to commend Vicinity Centres for their proactive stance on lithium-ion battery safety at their sites. When researching similar businesses globally, we were unable to find anyone taking this forward-thinking step.

We have no doubt Vicinity Centres will be used as a case study in best practice globally & look forward to sharing these learnings with others.

Emma Sutcliffe, EV FireSafe Director
June 2023