Our Ref: 240085
Council Ref: DA2021/00007

3 June 2021

City of Newcastle
PO Box 489
Newcastle NSW 2300

ATTENTION: DAMIAN JAEGER

RE: LOT 12 DP 280089 DA2021/00007
27D RIVERSIDE DRIVE, MAYFIELD WEST – PROPOSED BATTERY STORAGE FACILITY

Dear Damian,

Thank you for your letter dated 22 April 2021 providing City of Newcastle's request for additional information in relation to the above application following further assessment. Please accept this submission as our formal response to the matters raised. City of Newcastle is requesting for the following information to be provided:

Comments
PHA/Risk Analysis: *Sufficient details regarding the containerized option have been submitted for the proposal. Conversely, a similar level of analysis was not adopted to analyse separation distance between battery modules (i.e. Tesla Megapacks) and there is insufficient information at this stage to allow support of this option. You would need to confirm if you intend further pursue both battery options as part of the application.* *If the 'Tesla Megapack' option is being pursued, further Preliminary Hazard Analysis (PHA) reporting will need to be provided demonstrating the basis on which the risks of this option are acceptable (i.e. which has direct ramifications on the number of batteries and the proposed layout/separations across the site). The extract provided below (as emailed 31 March 2021) from the Department of Planning's hazard assessment may assist addressing these issues.* *"the Applicant has taken an appropriate approach in preparing a PHA (SEE Appendix G) to assess BESS-related risks and consulted with FRNSW in preparing this PHA.* *In reviewing the PHA, we consider the approach adopted by the Applicant to be appropriate for this development, provided that battery containers are adopted as the final design.*

Principally, the Applicant has verified that the proposed BESS capacity can fit within the site boundary accounting for separation distances between battery containers, and that these separation distances would prevent a fire from one battery container spreading to neighbouring battery containers.

However, a similar level of analysis was not adopted to analyse separation distance between battery modules (i.e. Tesla Megapacks), instead relying on a 2016 US NFPA fire-test on such systems to deduce the separation distances in PHA Section 4.1.1. The Department is aware of significant developments in research and standards for BESS which may run in contrary with 155 mm separation distance in PHA Section 4.1.1. Such research and standards include (not exhaustive):

- *NFPA 855;*
- *AS 5139;*
- *IEC 62897;*
- *UL 9540;*
- *UL 9540A;*
- *FM Global DS 5-33; and*
- *FM Global's Development of Sprinkler Protection Guidance for Lithium Ion Based Energy Storage Systems.*

Given the above and in noting the proposed BESS capacity not exceeding 30 MW, we consider the PHA to be prepared in accordance with the Department's HIPAP 6, showing that the development can comply with the Department's HIPAP 4 land use safety risk criteria if:

- *battery containers are adopted as the final design; and*
- *a post-approval FHA is prepared to support battery modules as the final design."*

Response

City of Newcastle have provided an extract from the Department of Planning's hazard assessment. The Department has confirmed that sufficient detail regarding the containerised option has been provided and further analysis is required for the modular battery configuration.

An updated Preliminary Hazard Analysis (PHA) has been prepared by ARUP for the proposed development and is enclosed as **Appendix E.** The amended PHA gives further consideration to the modular battery configuration. An additional site plan has also been prepared to show the configuration of the Modula Batteries. A copy of this plan is enclosed as **Appendix A**.

The PHA prepared by ARUP has been prepared in accordance with the relevant guidelines from NSW DPIE's *Multi-level Risk Assessment* [1] and Hazardous Industry Planning Advisory Papers (HIPAPs) No. 4 – *Risk Criteria for Land Use Safety Planning* [2] and No. 6 – *Hazard Analysis* [3].

The applicant intends to progress with two (2) proposed battery options as per the original development application (shown on the plans provided within **Appendix A**), being:

- Modular cubical cabinets (similar to the Megapack system) that are installed in an array around an inverter pack; and
- Containerised modules (containerised system) that have been preassembled in modified shipping containers prior to transport to site.

Two (2) hazards were identified as having the potential to cause offsite impacts, namely a battery fire and battery explosion. A quantitative consequence analysis was undertaken for these hazards. The findings of the analysis as they relate to the modular battery configuration are reproduced below:

Battery Fire

Modular Battery Configuration

For a fire in a modular/cabinet unit, in order to have a received radiant heat flux of less than 4.7kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and site boundary = 2.25m; and
- Side modular/cabinet unit wall and site boundary = 9m.

Similarly, in order to have a received radiant heat flux of less than 12.6kW/m^2 on the adjacent modular/cabinet units, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and adjacent modular/cabinet unit = 1m; and
- Side modular/cabinet unit wall and adjacent modular/cabinet unit = 5m.

Until the modular supplier has been confirmed as a conservative measure, it is recommended that the separation distances are as follows:

- Between the long sides of the modular/cabinet units shall not be less than 5m;
- Between the ends of the modular/cabinet units shall not be less than 2m; and
- The distance from the site boundary shall not be less than 10m.

In the event the project does procure modular cabinets from Tesla the specific recommendations provided in Section 5 of the PHA and summarised on page 4 below will apply, which is based on fire testing performed using the UL UL9540A fire test method which ARUP have been able to obtain from Tesla. A copy of this test data is provided in A copy of the Test Report is provided within **Appendix G**.

An additional site plan has been included within the amended Development Plans provided within **Appendix A,** which details the proposed configuration of the Modular Battery system option. As demonstrated on the plans provided, the Modular Battery configuration can be accommodated within the identified development footprint and will achieve the recommended separation distances as outlined in the PHA.

The Modular Batter configuration will result in a slightly smaller footprint when compared with the containerised option, with vehicle manoeuvring remaining to be accommodated throughout the site.

Battery Explosion

For an explosion in a battery unit, a vapour cloud explosion of vented gas was modelled. An overpressure of 7kPa – the accepted minimum for injury or fatality – was found to extend to a distance of 24m, and an overpressure of 35 kPa – corresponding to significant damage of structures – was found to extend to a distance of 7.5m.

Recommendations

The following recommendations are made to ensure that the residual risks for the identified hazards will be reduced so far as reasonably possible:

- Separate Battery Energy Storage System 24 m from the site boundary unless the following are met:

    1. Battery Energy Storage Systems shall have a means to safely vent or prevent an explosion designed to NFPA 68, NFPA 69, or an international equivalent to reduce this risk as far as reasonably possible;
    2. In the absence of more specific test data, containerised Battery Energy Storage Systems shall be separated from one another by not less than 3.25 m end to end and not less than 3 m side to side, and separated from the site boundary by not less than 10 m; and
    3. In the absence of more specific test data, modular/cabinet BESSs shall be separated from one another by not less than 2 m end to end and not less than 5 m side to side, and separated from the site boundary by not less than10 m.

    If specific test data exist, the recommended separation distances between units provided for (from the battery supplier/integrator) can be used in preference to the distances listed here. For example, the Tesla Megapack can be separated by 6 inches (155 mm) side-to-side or back-to-back (i.e. the sides of the unit without doors) as demonstrated by fire testing performed using the UL9504A Test Method, and as shown in Figure 11 in Section 4.1.3. A copy of the Test Report is provided within **Appendix G**.

- Ensure the Battery Energy Storage System manufacturer supplies the UL9540A fire test report for further refinement of separation distances; and
- Ensure Battery Energy Storage Systems have a fire suppression system, if they are to be entered for maintenance. Additionally:

    1. It is preferred for the fire suppression system to not rely on shutdown of the battery cooling system; and
    2. The fire suppression system design should also consider the explosion hazard.

Comments

CPTED (CCTV/Lighting):
The submitted SEE indicates that the proposal will have a SCADA system for 24/7 monitoring and associated alarms but this appears to be an operational monitoring system of the 'batteries' themselves and provides little assistance in terms of Crime Prevention Through Environmental Design (CPTED) principles and is not a surveillance system. It is recommended that a CCTV and lighting system should be provided in terms of security and surveillance for the site considering that there will be limited personnel associated with the operation of the development. Incorporation motion detection alarms and lighting may also be appropriate. A lux diagram for any lighting system proposed is to be submitted demonstrating the lighting impacts on neighbouring future properties and the nearby roadways (including the future access road) is limited and acceptable.

Response

The applicant proposes to incorporate both lighting and CCTV monitoring into the design of the proposed development to achieve CPTED principles.

An Obtrusive Lighting Report has been prepared by Power Solutions for the subject site and is enclosed as **Appendix F**.

The lighting design incorporates six (6) x 6.5m high light poles with 2m outreach. The luminaries proposed are Aidridge 17W LED RRW with Giara Shields fitted to reduce light spill. The light locations are shown in Section 3.2 of the Obtrusive Lighting Report provided within **Appendix F**. The proposed lighting was found to be compliant with AS4282. All lighting will be installed and maintained in accordance with relevant Australian Standards, codes and policies. The obtrusive light assessment has demonstrated that the proposed light design will not result in unacceptable lighting impacts on neighbouring future properties and the nearby roadways. The lighting proposed is considered to be acceptable and appropriate in this instance.

Continuously operating CCTV is integrated with the lighting design and provides surveillance to key areas within the site. CCTV cameras will be situated on each of the proposed light poles. The CCTV system will provide a back to base monitoring system. The CCTV will be monitored by an appropriately certified security company.

The intent of the proposed lighting and CCTV is to decrease opportunities for crime to occur and improve surveillance.

Comments ***Proposed and existing levels:*** *It is necessary to provide the existing and proposed levels of the site at the 'lot scale'. The existing levels have been provided at the 'whole subdivision estate' scale and are not helpful in the assessment of this application. Existing levels could be provided as contours or spot levels as long there are sufficient details provided to clearly understand the proposed change in levels in context of the proposed lot from existing to proposed.*

Response

To provide clarity around the existing and proposed site levels a copy of the approved earthworks plan for the Subdivision Works Certificate Plans issued for Lots 1101 to 1103 within Stage 11 of the Steel River Business Estate has been provided within **Appendix D**. The plans show the approved finished earthworks levels of the site (Lot 1102).

Amended Concept Engineering Plans for the proposed development are enclosed within **Appendix C**. These plans now include the finished levels following completion Stage 11. There are minimal proposed changes in finished ground level required to facilitate the proposed battery facialilty as shown on the Development Plans and Concept Engineering Plans provided within **Appendix A** and **C**.

The proposed Battery Storage Facility does not rely on amending other approvals related to the broader subdivision. The site is currently approved for further subdivision (DA2006/2076.02 as most recently amended) and is situated within approved Lot 1102, part of future Stage 11 Steel River Estate.

Comments ***Visual Appearance Impacts:*** *Significant concern was raised regarding visual appearance and mitigation during the Pre-DA application. While the submitted application has included elements to assist with the visual mitigation (lower landscaping towards Maitland Rd), concern is raised that it is not sufficient in this respect. The partial reliance on future development to limit the visual impacts and existing trees towards Maitland Road is problematic. More so, many of these trees are either on a separate site or appear to be removed as part of the future subdivision works (e.g. new access road to Maitland Rd and associated works).* *As previously indicated, a combination of visual appearance mitigation methods may be appropriate considering the possible fire risks, hazards and the present of high voltage power lines. One approach taken with electrical substations, which have some similar risk constraints, is the inclusion of faux walls/screens in combination with landscaping.*

Response

A Visual Impact Assessment prepared by Terras Landscape Architects is enclosed as **Appendix E**.

The Visual Impact Assessment prepared by Terras has considered the proposal from two (2) potential viewpoints located along Maitland Road. Due to local topography, existing vegetation and existing road alignment the proposal would only have visual effect upon those areas within or immediately adjacent to the site, and only experienced by road users for a very short period of time as they drive south-east along Maitland Road.

<u>Viewpoint – Maitland Road</u>

The impact on road users travelling south-east along Maitland Road is minimal due to the following:

- Visual access into the site is minimal due to the limited extent and short exposure of the site;
- The site is part of a larger industrial subdivision which has been partially developed with large warehouses, workshops and office buildings. When considering the scale of the existing development this proposal presents as a non-intrusive, low scale development in keeping with the industrial precinct; and
- While there are some limitations to the amount of screening vegetation provided, a number of trees have been proposed along the southern and eastern boundaries to effectively screen where possible.

The below photomontages are taken from the visual impact assessment provided to give an indication of the what the proposed development will look like when viewed from Maitland Road.

Figure 1 – Viewpoint 1 of the Proposed Development with accurate colour scheme and mature planting when viewed heading south-east along Maitland Road.

Figure 2 – Viewpoint 2 of the Proposed Development with accurate colour scheme and mature planting when viewed heading south-east along Maitland Road from Rail Bridge.

It should be noted that the site will not be as readily viewed by motorists travelling north west due to the topography of Maitland Road and major transmission towers located along Maitland Road.

It is noted that the subject site is located central to a developing industrial area and is not considered to be a highly sensitive visual location. Notwithstanding this, the landscaping proposed is commensurate with the emerging industrial nature of the subject site and surrounding area.

Viewpoint – Riverside Drive

Visually the project will present from street level as a modern, low scale development, enabling the surrounding landscaping to further add to the quality of the Steel River Estate.

The surrounding buildings in Steel River includes a variety of energy-based businesses such as CSIRO Energy Research, Line Gas, Yanmar Diesel amongst others, which will complement the character of the proposed project.

The impact on users within the subdivision will be limited due to the relatively low scale of development when comparing it to the existing development. New landscaping in the form of trees and groundcovers will be provided along the Riverside Drive frontage, providing a significant buffer between the proposed development and the street. The proposed security gates will be setback from Riverside Drive with one of the entrance gates partially screened by landscaping, particularly for vehicles travelling north along Riverside Drive.

Figure 3 – Landscape screening when viewed from Riverside Drive.

Based on the photomontages provided as part of the Visual Impact Assessment, it is considered the physical separation of the proposed facility from key viewpoints along with the proposed Landscaping will contribute to achieving suitable visual mitigation of the proposal. It is not considered that the inclusion of faux walls/screens as suggested by Council is warranted in this instance to act as a physical visual screen.

Comments

Landscape Area/Easements/Lot Features:

The rear of the proposed lot appears to be in conflict with existing features and easements towards the rear/northern corner. It is necessary to clarify how these features impact the proposal and are resolved. Based on the information available, the submitted plans do not reflect these impacts and show these areas as landscaped and contributing to compliance with the landscaped area percentage (20%) under the SIAS. It is considered that none of these areas would be available for the landscape area where the conflicting features remain and the plans need to be modified to reflect these features/easements and landscape area proposed re-calculated. Additionally, the plans should be amended to include any easements which affect the proposed lot and may have ramifications for how the proposal is assessed.

Response

As requested by Council, an amended landscape design for the proposed development has been prepared by Terras Landscape Architects is enclosed as **Appendix B**. The revised scheme has removed where necessary areas of proposed landscaping which may conflict with the existing easements which extend along the rear of the site.

The rear of the site is burdened by the following easements:

1. Easement for Sewer Mains – Hunter Water (A);
2. Easement for Access & Maintenance – BHP (M);
3. Right of Access – Hunter Water (T); and
4. Easement for Effluent Pipeline – Kooragang Water (B).

A dechlorination facility is also located within easements (A), (M) & (T). In order to reduce any potential conflict with the dechlorination facility and access to the facility the extent of landscaping has been reduced to easement (B) for effluent pipeline only. The proposed landscaping within the the easement (B) for effluent pipeline at the rear of this lot is proposed to include a hydroseed mix consisting of shallow rooted native grasses and ground covers noting that this selection of landscaping will allow for the continued access to the easement and will not impact upon the pipeline.

Although none of the easement terms that burden the lot actually restricts the landowner from installing any trafficable landscaping on the land, Steel River West Pty Ltd did seek confirmation that the benefited party of easement (B), Kooragang Water Pty Ltd, have no objection to the proposed landscaping. A copy of this correspondence has been provided within **Appendix H**.

The proposed battery storage facility has been sited on approved Lot 1102 to be clear of the easements which extend through the rear of the allotment.

A revised landscape area calculation has been provided to reflect the revised landscaping proposed. The Landscaped areas of the site comprise approximately 20% of the site area and will remain to provide screening and visual relief along the southern and eastern boundaries.

The landscaping proposed remains to be consistent with the recommendations of the Preliminary Hazard Assessment, with all proposed landscaping being setback 10m from the proposed batteries. Landscaping along the rear setback has also been restricted due to a number of easements extending along the rear of the site along which has limited available area for landscaping outside the 10m setback requirement. Sandstone spallings are to be provided along the rear of the site, which is also consistent with the findings of the Preliminary Hazard Assessment.

Comments

Unregistered Proposed Allotment

The subject site is within a proposed lot of an approved, yet unregistered subdivision. The Construction Certificate for these works does not appear to be lodged as yet and/or approved and, as such the completion of the subdivision works, finalisation of levels, provision of services and infrastructure and final registration of the subdivision would all be many months from completion. It is noted that this stage of the subdivision is dependent on approvals from Transport for NSW for the construction of a new road access from Maitland Road and land contamination certification.

Response

Noted.

Comments

Similar Developments:

The RPP enquired as to any other similar developments have been approved in NSW and the details in this respect.

Response

As requested by the Regional Planning Panel, the following is a list of similar developments recently approved in NSW:

Name	Application	Capacity	LGA	Approval Date
Hume Battery Energy Storage System	SSD-10460	20MW / 40 MWh	Albury City Council	21/01/2021
Wallgrove Battery energy Storage System	See Link to TransGrid and ARENA	50 MW / 75MWh	Western Sydney Regional Organisation of Councils	2020
Sapphire WF Battery Energy Storage System	SSD-8643	50 MW / 100 MWh	Inverell Shire Council	16/08/2018
Hay SF Battery Energy Storage System	SSD-8113-Mod-2	29 MW / 29 MWh	Hay Shire Council	03/05/2021
Culcairn SF Battery Energy Storage System	SSD-10288	100 MW / 200 MWh	Greater Hume Shire Council	25/03/2021
Quorn Park SF Battery Energy Storage System	SSD-9097	20MW / 20 MWh	Parkes Council	16/07/2020
New England SF Battery Energy Storage System	SSD-9255	200 MW / 400 MWh	Uralla Shire Council	09/05/2020
Tamworth SF Battery Energy Storage System	SSD-9264	19 MW / 19 MWh	Tamworth Regional Council	30/11/2020
Wellington SF Battery Energy Storage System	SSD-8573	25 MW / 100 MWh	Dubbo Regional Council	03/03/2020
Jindera SF Battery Energy Storage System	SSD-9549	30 MW / 60 MWh	Greater Hume Shire Council	22/12/2020

It should be noted that the Hume Battery and Wallgrove Battery Energy Storage Systems are the only two 'standalone' utility-scale batteries that have been approved in NSW to date. The design of these batteries is similar to the proposed Steel River Battery. There is a number of other similar battery projects that have been approved and are co-located with either wind or solar farms. Some of these are also listed above.

As part of Council's Assessment of the application they could refer to these applications and development consents for relevant details as needed.

The below provides examples of similar battery developments currently in operation throughout Australia:

1. Gannawarra Energy Storage System (VIC).
    a. Design - Tesla, modular battery enclosure
    b. [Developed by Edify Energy]

2. Ballarat Energy Storage System (VIC).
    a. Design - Fluence, containerised enclosure
    b. [Developed by Spotless and AusNet]

3. Hornsdale Power Reserve (SA).
    a. Design - Tesla, modular battery enclosure
    b. [Developed by Neoen]

Comments

KML File:
To assist with assessed of the proposal the provision of a KML file showing the combination of i) proposed lot in context of the adjacent road and approved lots and ii) the proposed development within the proposed lot.

Response

Please see the requested KMZ file has been provided to Council as part of this response.

CONCLUSION

We trust that the additional information provided is satisfactory and allows Council to finalise its assessment of the proposed development.

The proponent and its consultant team are available to meet with Council staff to discuss any of the items that form part of this submission. The proponent seeks to work with Council staff to achieve a recommendation for approval following completion of Council's assessment.

The following information is attached to accompany this submission:

- **Appendix A** – Amended Development Plans;
- **Appendix B** – Amended Landscape Plans;
- **Appendix C** – Amended Concept Civil Engineering Plan;
- **Appendix D** – Approved Stage 11 Earthworks Plan;
- **Appendix E** – Visual Impact Assessment;
- **Appendix F** – Obtrusive Lighting Report;
- **Appendix G** – Updated Preliminary Hazard Assessment; and
- **Appendix H** – Email from Kooragang Water Approving Landscaping in Easement.

Should you have any questions in relation to the contents of this submission or would like to arrange a meeting to discuss any of the above matters further, please do not hesitate to contact the undersigned on (02) 4978 5100 or via email at zacs@adwjohnson.com.au.

Yours sincerely,

ZAC SMURTHWAITE
SENIOR PLANNER
ADW JOHNSON PTY LTD
HUNTER OFFICE

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Appendix A

AMENDED DEVELOPMENT PLANS

DEVELOPMENT APPLICATION
PROPOSED BATTERY STORAGE FACILITY
RIVERSIDE DRIVE MAYFIELD WEST

PROPOSED LOT 1102

SUBDIVISION OF LOT 12 DP 280089

DRAWING SCHEDULE

PROJECT	SHEET	TITLE	REVISION
20269A	DA01	SITE PLAN	8
20269A	DA02	PERSPECTIVE VIEWS	8
20269A	DA03	VEHICLE MOVEMENT PLAN	8
20269A	DA04	VEHICLE MOVEMENT PLAN	8
20269A	DA05	VEHICLE MOVEMENT PLAN	8
20269A	DA06	BATTERY MODULE OPTION	8

LOCALITY PLAN

NOT TO SCALE

Council

NEWCASTLE CITY COUNCIL

Client

STEEL RIVER WEST PTY LTD

STEEL RIVER BUSINESS PARK

GCA ENGINEERING SOLUTIONS

GCA Engineering Solutions
1 Hartley Drive (PO Box 3337),
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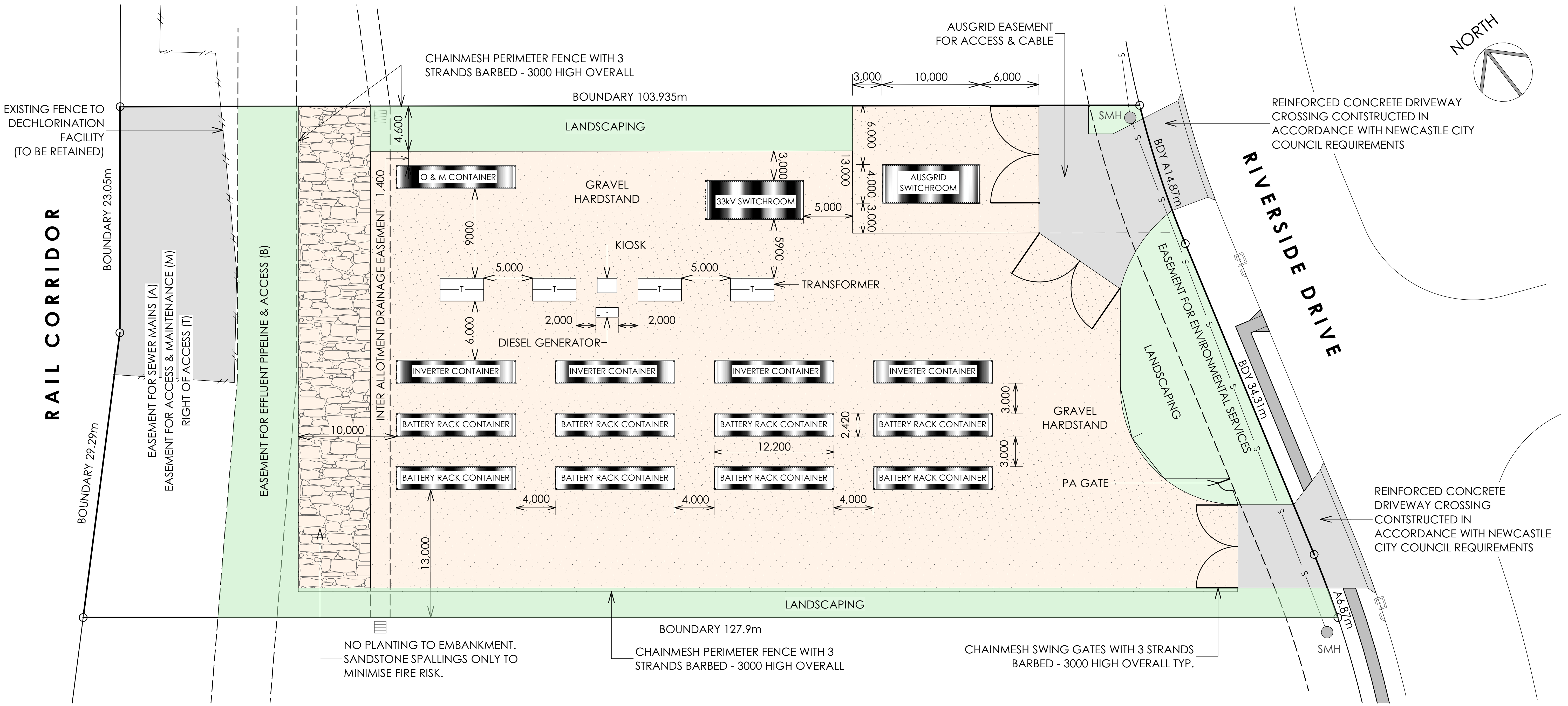

SITE PLAN

Scale 1:400

LEGEND

SMH	SEWER MAN HOLE
S	SEWER MAIN
	EXISTING KERB INLET PIT
	EXISTING STORMWATER PIT

Scale 1:400 — 5 0 5 10 15 20 25m

NOTES

FENCE WILL BE BUILT IN ACCORDANCE WITH:
- *T0057 NEG EP09 [INTRUDER RESISTANT FENCES FOR ZONE & SUBTRANSMISSION SUBSTATIONS]*; AND *ENA DOC-15* [NATIONAL GUIDELINE FOR PREVENTION OF UNAUTHORISED ACCESS TO ELECTRICITY INFRASTRUCTURE].

- *ALL SUBSTATION BUILDING AND FENCING LOCKS SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF NEG EP07 NETWORK ACCESS AND SECURITY - LOCKS AND KEYS."*

NOTE

- ALL LOT BOUNDARIES, EASEMENTS, DIMENSIONS AND AREAS TO BE CONFIRMED WITH THE REGISTERED DEPOSITED PLAN & ARE SUBJECT TO FINAL SURVEY.
- LOCATIONS OF SERVICES TO BE CONFIRMED.

REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

20269A DAr8.pln Last saved on 28/05/2021 by Bernie

STEEL RIVER BUSINESS PARK

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Client
STEEL RIVER WEST PTY LTD

Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

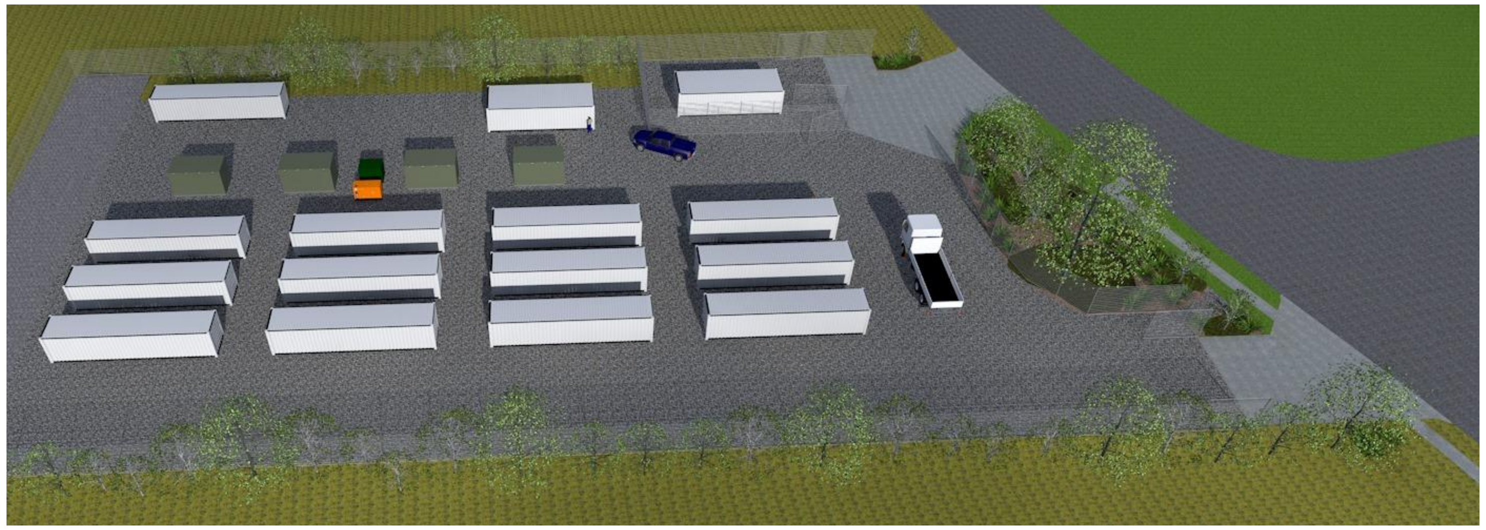
Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
SITE PLAN

Project No.
20269A

Revision
8

Drawing No.
DA01



REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

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Client
STEEL RIVER WEST PTY LTD

Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

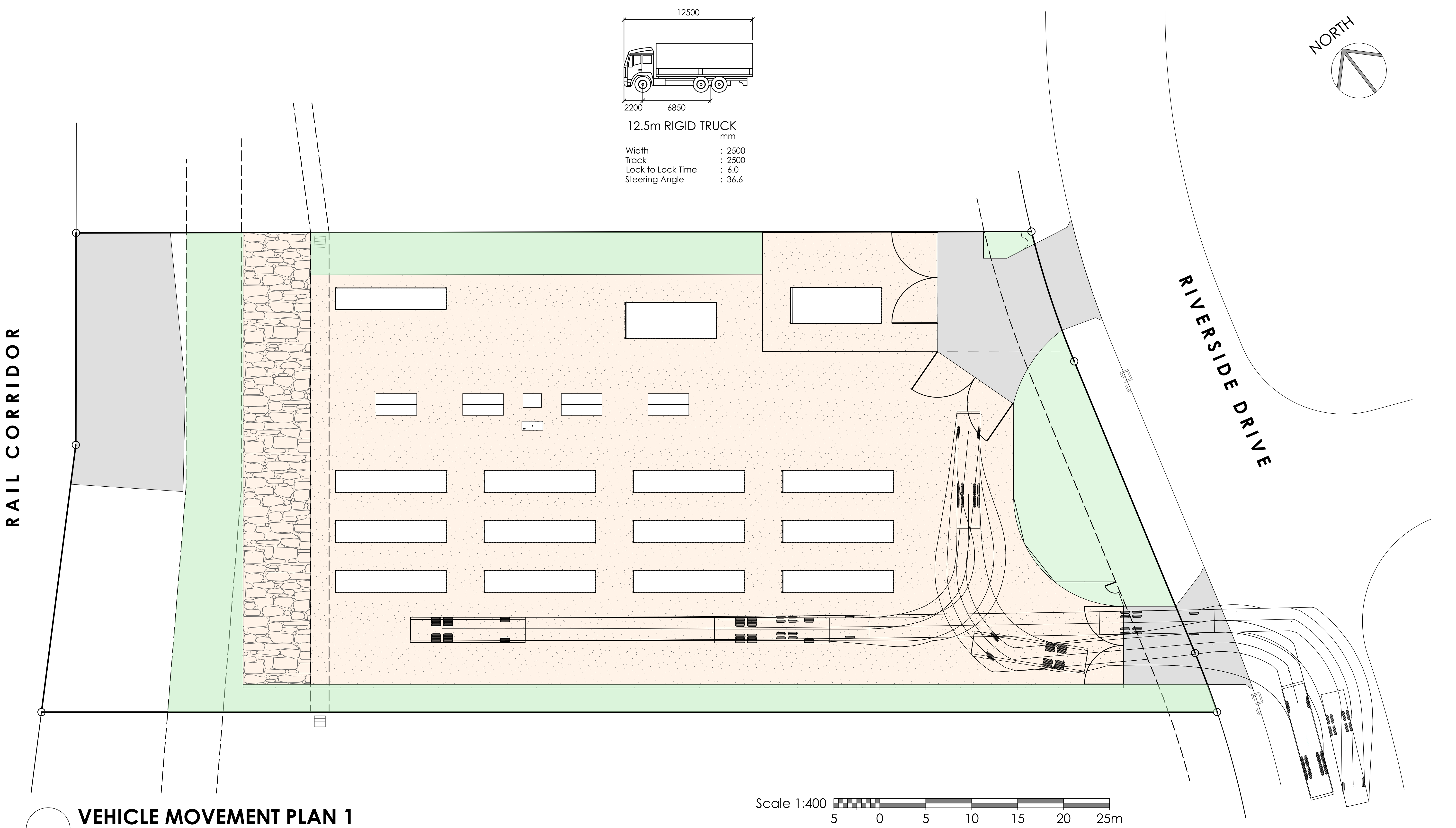
Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
PERSPECTIVE VIEWS

Project No.
20269A

Revision
8

Drawing No.
DA02



VEHICLE MOVEMENT PLAN 1

Scale 1:400

REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

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Client
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Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

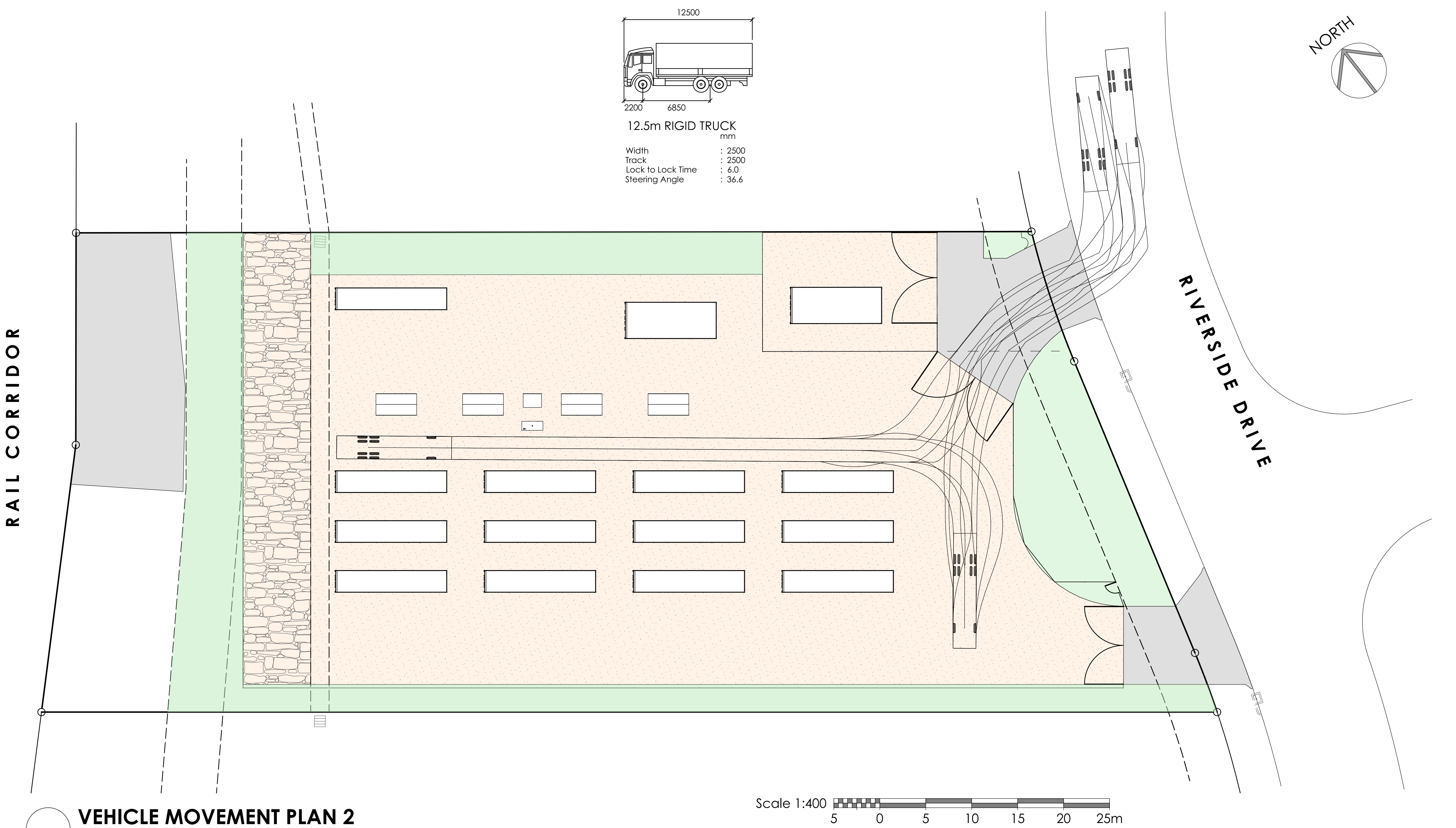
Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
VEHICLE MOVEMENT PLAN

Project No.
20269A

Revision
8

Drawing No.
DA03



VEHICLE MOVEMENT PLAN 2

Scale 1:400

REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

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STEEL RIVER BUSINESS PARK

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Client
STEEL RIVER WEST PTY LTD

Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

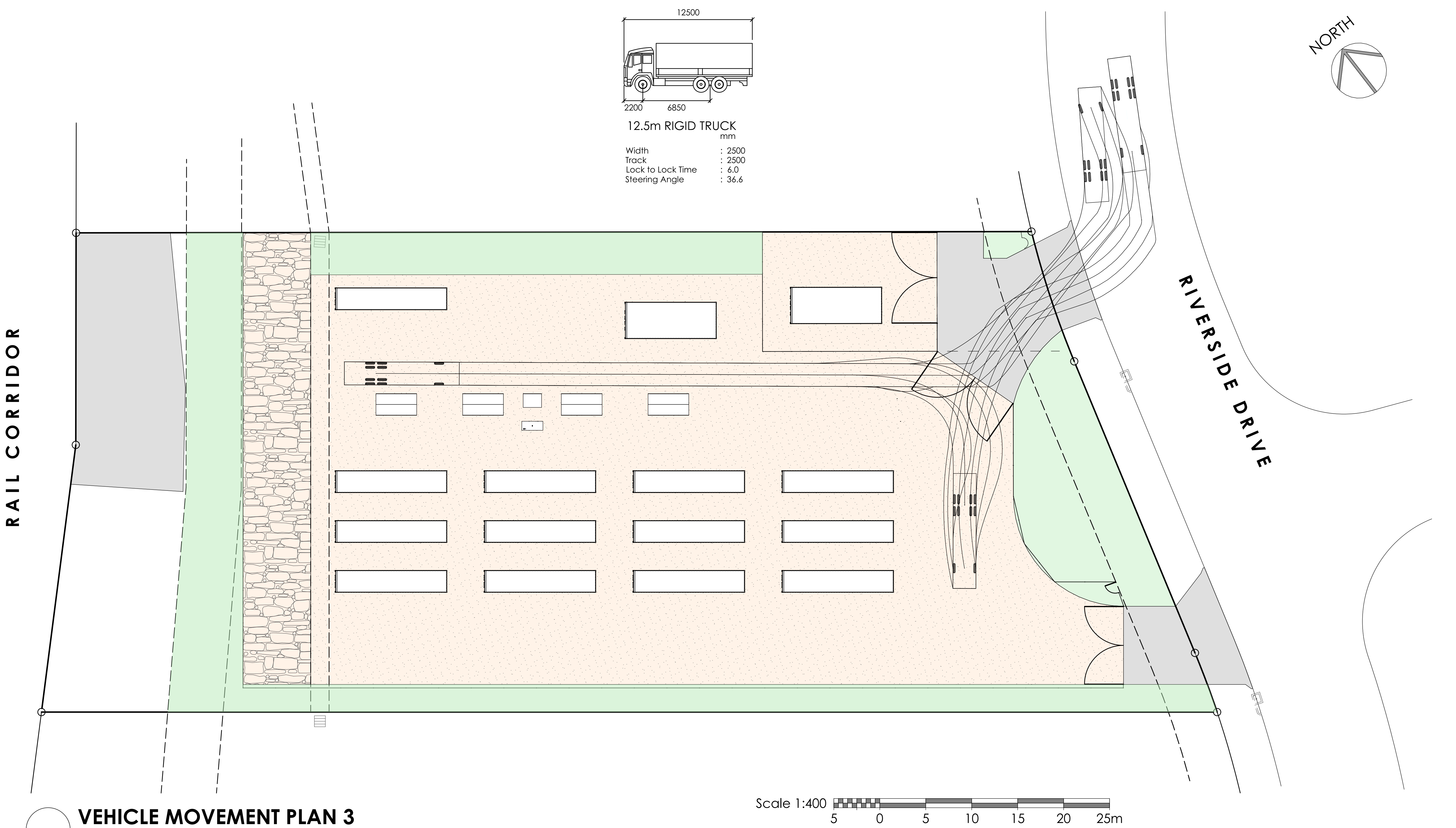
Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
VEHICLE MOVEMENT PLAN

Project No.
20269A

Revision
8

Drawing No.
DA04



VEHICLE MOVEMENT PLAN 3
Scale 1:400

REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

20269A DAr8.pln Last saved on 28/05/2021 by Bernie

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Client
STEEL RIVER WEST PTY LTD

Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

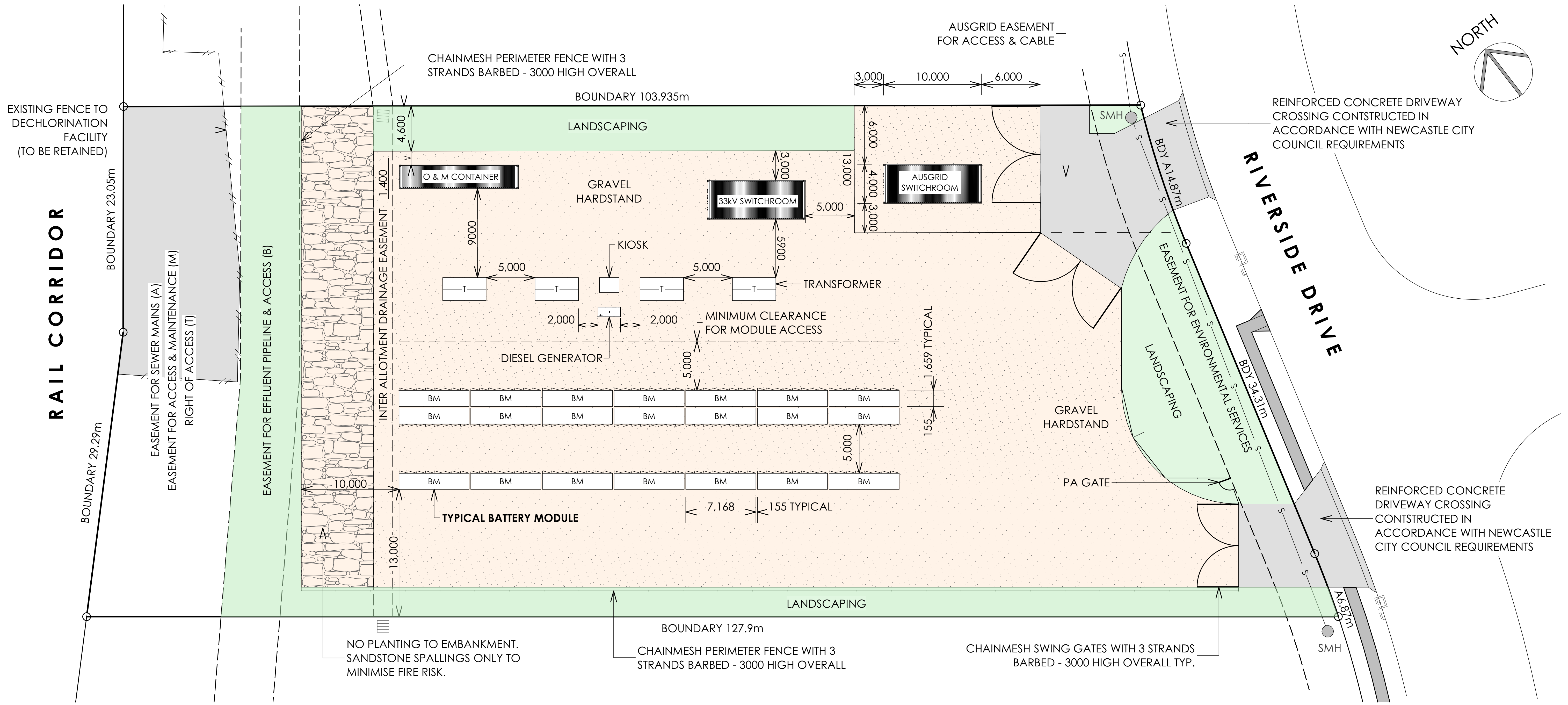
Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
VEHICLE MOVEMENT PLAN

Project No.
20269A

Revision
8

Drawing No.
DA05



SITE PLAN

Scale 1:400

LEGEND

SMH	SEWER MAN HOLE
S	SEWER MAIN
	EXISTING KERB INLET PIT
	EXISTING STORMWATER PIT

Scale 1:400 — 5 0 5 10 15 20 25m

NOTES

FENCE WILL BE BUILT IN ACCORDANCE WITH:
- *T0057 NEG EP09 [INTRUDER RESISTANT FENCES FOR ZONE & SUBTRANSMISSION SUBSTATIONS]*; AND *ENA DOC-15* [NATIONAL GUIDELINE FOR PREVENTION OF UNAUTHORISED ACCESS TO ELECTRICITY INFRASTRUCTURE].

- ALL SUBSTATION BUILDING AND FENCING LOCKS SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF NEG EP07 NETWORK ACCESS AND SECURITY - LOCKS AND KEYS."

NOTE

- ALL LOT BOUNDARIES, EASEMENTS, DIMENSIONS AND AREAS TO BE CONFIRMED WITH THE REGISTERED DEPOSITED PLAN & ARE SUBJECT TO FINAL SURVEY.
- LOCATIONS OF SERVICES TO BE CONFIRMED.

REV.	DATE	DESCRIPTION	DRAWN
8	28.05.21	GENERAL REVISIONS	BB

20269A DAr8.pln Last saved on 28/05/2021 by Bernie

STEEL RIVER BUSINESS PARK

GCA ENGINEERING SOLUTIONS
GCA Engineering Solutions
1 Hartley Drive (PO Box 3337),
Thornton NSW 2322
Ph 02 4964 1811 www.gca.net.au

Client
STEEL RIVER WEST PTY LTD

Project Status
DEVELOPMENT APPLICATION

Drawings scaled to an A3 sheet

Project Title
PROPOSED BATTERY STORAGE FACILITY

Project Address
RIVERSIDE DRIVE MAYFIELD WEST

Drawing Title
BATTERY MODULE OPTION

Project No.
20269A

Revision
8

Drawing No.
DA06

Appendix B

AMENDED LANDSCAPE PLANS

landscape development application

EDIFY ENERGY PTY LTD & PRECINCT GROUP

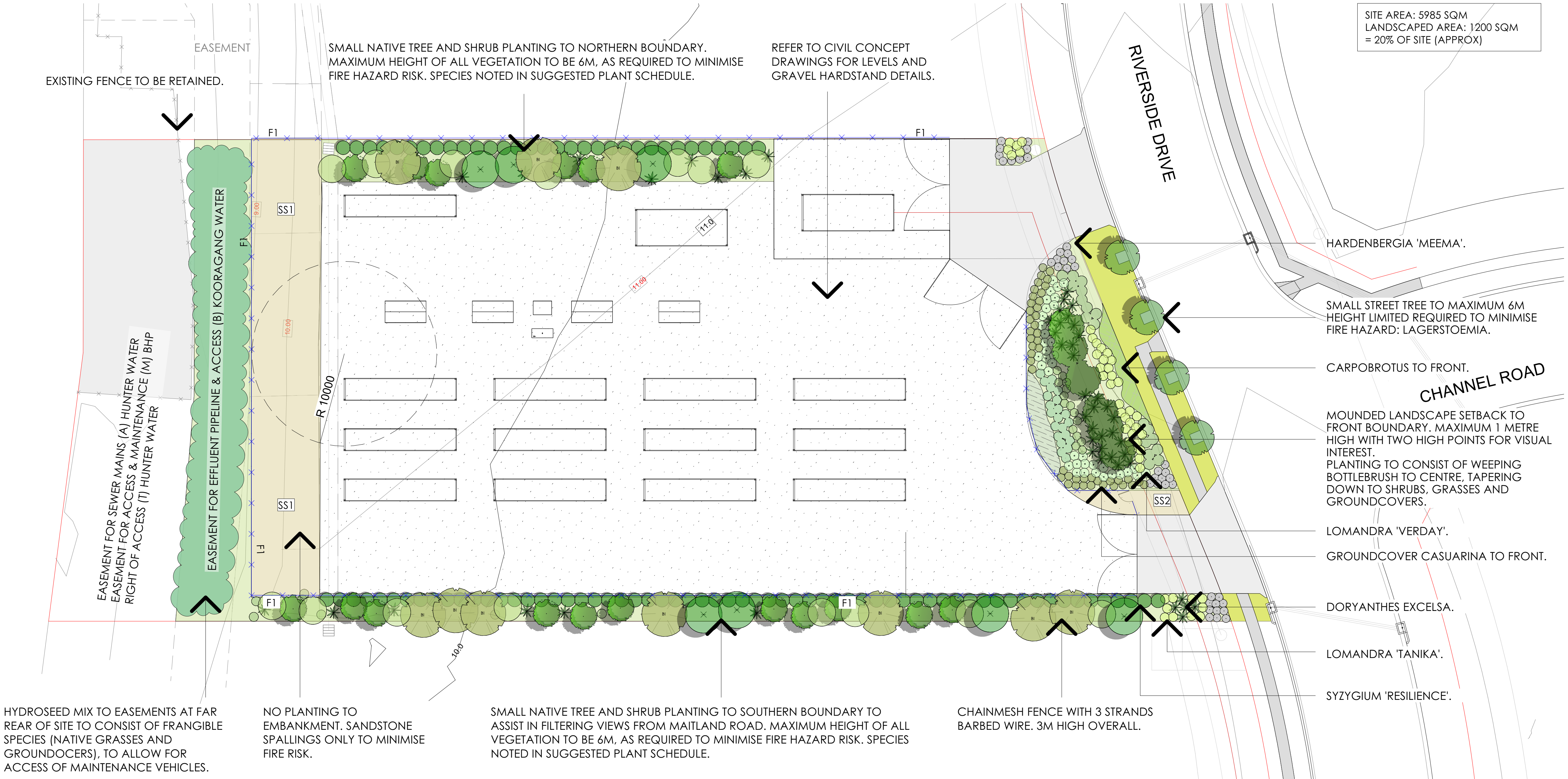
STEEL RIVER BATTERY STORAGE FACILITY

Lot 12 DP 280089, 27D RIVERSIDE DRIVE, MAYFIELD WEST.

terras
landscape architects

LANDSCAPE CONCEPT PLAN | L101

STEEL RIVER BATTERY STORAGE FACILITY



LEGEND

- SMALL STREET TREE: LAGERSTROEMIA INDICA.
- NEW SMALL TREES: AS SCHEDULED.
- SCREEN PLANTING: AS NOTED ON PLAN.
- ACCENT PLANTS: DORYANTHES.
- MASS PLANTING: AS NOTED ON PLAN.
- GROUNDCOVER PLANTING: AS NOTED ON PLAN.
- HYDROSEEDING TO EASEMENTS.
- NEW TURF
- F1 CHAINMESH FENCE WITH 3 STRANDS BARBED WIRE. 3M HIGH TOTAL.
- SS1 SANDSTONE SPALLINGS: 50-150MM DIAMETER
- SS2 SANDSTONE MULCH TO PATH: 10-20MM DIAMETER

north

REV	DATE	COMMENTS
H	27/5/21	FOR APPROVAL
G	26/5/21	FOR APPROVAL
F	24/5/21	FOR APPROVAL
E	19/5/21	FOR APPROVAL
D	16/12/20	FOR APPROVAL
C	26/11/20	FOR APPROVAL
B	19/11/20	CLIENT REVIEW
A	13/11/20	PRELIMINARY FOR REVIEW

PROJECT:
STEEL RIVER BATTERY STORAGE FACILITY

SITE:
Lot 12 DP 280089, 27D RIVERSIDE DRIVE, MAYFIELD WEST.

CLIENT:
EDIFY ENERGY PTY LTD & PRECINCT GROUP

13360.5-SRBSF-DA-REV H.vwx 27/5/21

DRAWN: KM/ GF | DATE: 13.11.2020 | SCALE: 1:500@A3

JOB NUMBER: PHASE: DWG No: REV:
13360.5 DA L101 H

terras landscape architects
412 KING STREET NEWCASTLE NSW AUSTRALIA 2300
TERRAS.COM.AU PH: 49 294 926 FAX: 49 263 069

HYDROSEED MIX	KG/HA
CYNODON DACTYLON	3.0
DIANELLA LONGIFOLIA	0.5
IMPERATA CYLINDRICA	0.5
LOMANDRA CONFERTIFOLIA	0.5
LOMANDRA FILIFORMIS	0.5
LOMANDRA LONGIFOLIA	0.5
LOMANDRA MULTIFLORA	0.5
POA LABILLARDEIEREI	1.0
THEMEDA AUSTRALIS	1.0
GOODENIA ROTUNDIFOLIA	0.2
HARDENBERGIA VIOLACEA	0.2
HIBBERTIA ASPERA	0.1
KENNEDIA RUBICUNDA	0.1

PLANT PALETTE | L102

STEEL RIVER BATTERY STORAGE FACILITY


Lagerstroemia 'Natchez'


Callistemon 'Dawson River Weeper'


Banksia integrifolia


Syzygium 'Resilience'


Casuarina 'Cousin It'


Doryanthes excelsa


Lomandra 'Tanika'


Westringia 'Zena'


Hardenbergia 'Meema'


Myoporum parvifolium


Carpobrotus glaucescens

PLANT SCHEDULE

ID	COMMON NAME	BOTANICAL NAME	POT SIZE
Trees			
Bi	Coastal Banksia	Banksia integrifolia	25 Litre
CA	Black Wattle	Callicoma serratifolia	25 Litre
CD	Weeping Bottlebrush	Callistemon 'Dawson River Weeper'	75 Litre
LN	Crepe Myrtle	Lagerstroemia 'Natchez'	100 Litre
Shrubs			
Ba	Wallum Banksia	Banksia aemulea	25 Litre
Bo	Breynia	Breynia oblongifolia	5 Litre
Cb	Better John	Callistemon 'Better John'	5 Litre
Cs	Bottlebrush	Callistemon salignus	25 litre
De	Gymea Lily	Doryanthes excelsa	45 Litre
Sp	Pinnacle	Syzygium 'Pinnacle'	25 Litre
Sr	Resilience	Syzygium 'Resilience'	5 Litre
Wz	Dwarf Coastal Rosemary	Westringia 'Zena'	5 Litre
Ground Covers			
Cg	Pigface	Carpobrotus glaucescens	2.5 Litre
Cc	Cousin It	Casuarina 'Cousin It'	2.5 Litre
Hm	Meema	Hardenbergia 'Meema'	2.5 Litre
Mp	Spreading Myoporum	Myoporum parvifolium 'Fine Leaf Form'	2.5 Litre
Wm	Groundcover Coastal Rosemary	Westringia 'Mundi'	2.5 Litre
Grasses			
Lt	Dwarf Mat Rush	Lomandra 'Tanika'	2.5 Litre
Lv	Verday	Lomandra 'Verday'	2.5 litre

REV	DATE	COMMENTS
H	27/5/21	FOR APPROVAL
G	26/5/21	FOR APPROVAL
F	24/5/21	FOR APPROVAL
E	19/5/21	FOR APPROVAL
D	16/12/20	FOR APPROVAL
C	26/11/20	FOR APPROVAL
B	19/11/20	CLIENT REVIEW
A	13/11/20	PRELIMINARY FOR REVIEW

PROJECT:
STEEL RIVER BATTERY STORAGE FACILITY

SITE:
Lot 12 DP 280089, 27D RIVERSIDE DRIVE, MAYFIELD WEST.

CLIENT:
EDIFY ENERGY PTY LTD & PRECINCT GROUP

13360.5-SRBSF-DA-REV H.vwx 27/5/21

DRAWN: KM/ GF DATE: 13.11.2020 SCALE: @A3

JOB NUMBER: PHASE: DWG No: REV:
13360.5 DA L102 H

terras landscape architects

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TERRAS.COM.AU PH: 49 294 926 FAX: 49 263 069

Appendix C

AMENDED CONCEPT CIVIL ENGINEERING PLANS

PROPOSED BATTERY ENERGY STORAGE FACILITY

PROPOSED LOT 1102 RIVER SIDE DRIVE MAYFIELD WEST

CONCEPT CIVIL ENGINEERING FOR DA

PRECINCT CAPITAL PTY LTD

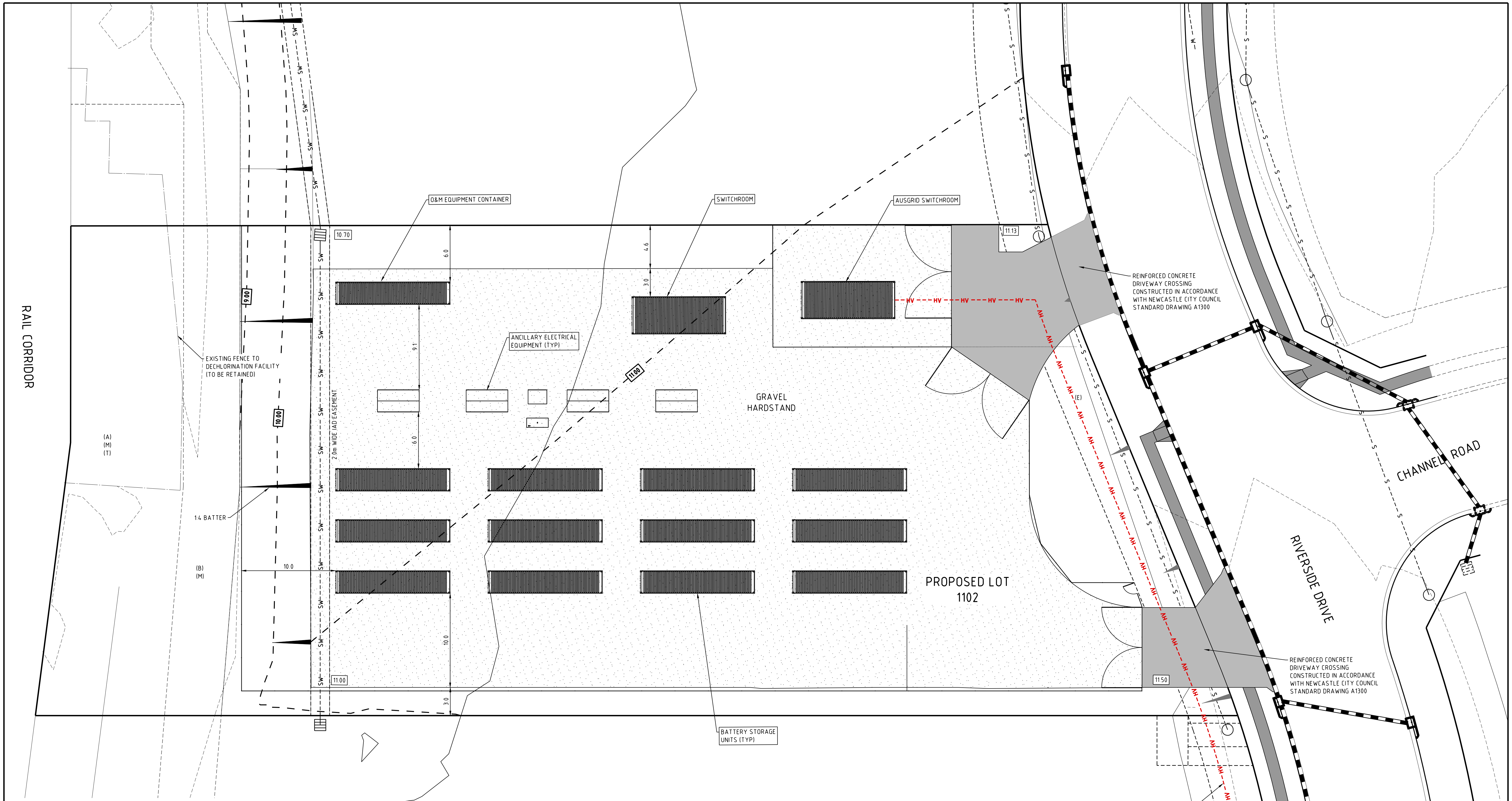
NEWCASTLE CITY COUNCIL

DRAWING SCHEDULE   PROJECT No. 20269C

DWG No.	SHEET TITLE	REV
C00	COVER SHEET	3
C01	PLAN SHEET	3
C02	EROSION AND SEDIMENT CONTROL PLAN	3

GCA ENGINEERING SOLUTIONS
A.B.N. 92 086 017 745
1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION



NOTE:
SITE LEVELS AND BATTERS HAVE BEEN ADOPTED FROM THE CIVIL DESIGN FOR THE PARENT SUBDIVISION WORKS CERTIFICATE CREATING LOT 1102. ONLY MINOR EARTHWORKS TO CREATE LEVEL PADS FOR EACH INFRASTRUCTURE ITEM OR TO ACCOMMODATE DRIVEWAYS IS PROPOSED WITH THE DEVELOPMENT

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

(A) EASEMENT FOR SEWER MAINS 8.5, 12 AND VARIABLE WIDTH (AA995559)
(B) EASEMENT FOR EFFLUENT PIPELINE 6 WIDE (DP270249) (DOC 3)
(E) EASEMENT FOR ENVIRONMENTAL SERVICES (5 WIDE)
(M) EASEMENT FOR ACCESS AND MAINTENANCE VARIABLE WIDTH (DP270249) (DOC 1)
(T) RIGHT OF ACCESS VARIABLE WIDTH (DP270249) (DOC 13)

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
3	GRAVEL AND SWITCHROOM ADJUSTED	A.S.	A.S.	20.05.21
2	EXISTING FENCE ADDED	D.B.	A.S.	04.05.20
1	ORIGINAL ISSUE	D.B.	A.S.	17.12.20

North

Scale
0 4 8 12 16m
1:200 (A1) 1:400 (A3)

Designed: A.M.
Cad Reference: 20269C C01 r3
Scale: 1:200
A1 SHEET
Project Approval
IAN HILL (B.E)
Consulting Civil Engineer

Client

GCA
ENGINEERING SOLUTIONS
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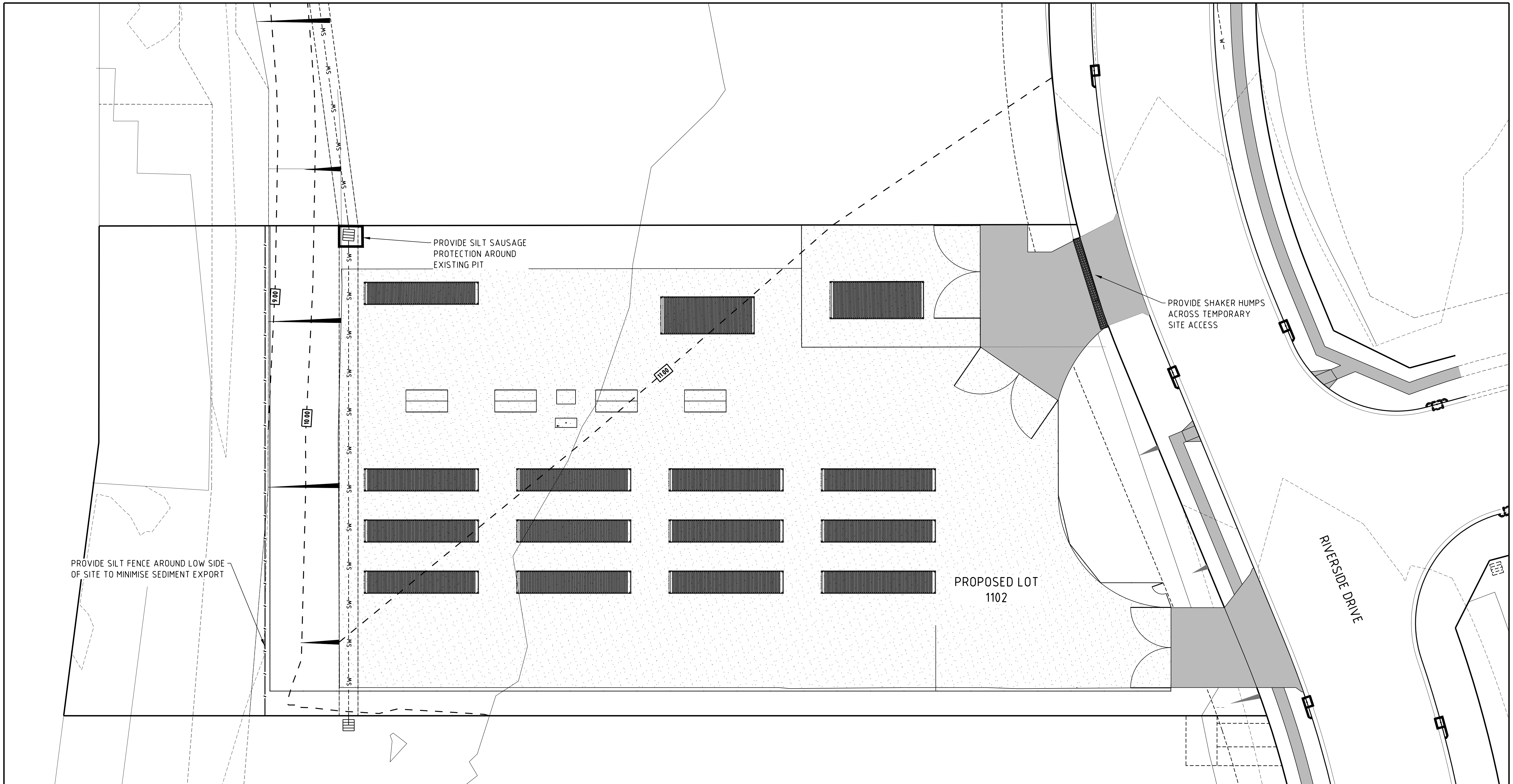
1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811

PROPOSED BATTERY ENERGY STORAGE FACILITY
RIVER SIDE DRIVE MAYFIELD WEST
PROPOSED LOT 1102
PLAN SHEET

Project No: 20269C
Drawing No: C01
Revision: 3

PLOT DATE: 20/05/2021 7:34:44 PM CAD FILE: Q:\20\20269 Lot 1101, Riverside Drive, Mayfield (Battery Storage)\02_CAD\AutoCAD\Civil\20269C C01 r3.dwg



LEGEND:

—·—·—	SEDIMENT FENCE
▒	SHAKER HUMPS

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

NOTES:

1. NO MANOEUVRING OF VEHICLES OR STOCKPILING OF MATERIALS OUTSIDE THE CONSTRUCTION SITE.
2. ALL SEDIMENT CONTROL STRUCTURES TO BE INSPECTED AND MAINTAINED BY SITE MANAGER DAILY.
3. ALL SEDIMENT RETAINING STRUCTURES TO BE CLEANED ON REACHING 50% STORAGE CAPACITY.
4. ALL EXISTING VEGETATION WILL BE RETAINED OUTSIDE THE CONSTRUCTION SITE.
5. DRAINAGE IS TO BE CONNECTED TO STORMWATER SYSTEM IMMEDIATELY ON COMPLETION OF WORKS.
6. CONSTRUCTION SITE STABILISATION TO COMMENCE IMMEDIATELY ON COMPLETION OF WORKS.
7. TEMPORARY LIP DRAINS WITHIN SITE WORKS TO BE REMOVED/RELOCATED AS REQUIRED DURING CONSTRUCTION

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
3	GRAVEL AND SWITCHROOM ADJUSTED	A.S.	A.S.	20.05.21
2	EXISTING FENCE ADDED	D.B.	A.S.	04.05.21
1	ORIGINAL ISSUE	D.B.	A.S.	17.12.20

North

Scale
0 4 8 12 16m
1:200 (A1) 1:400 (A3)

Designed	Cad Reference
A.M.	20269C C02 r3
Scale	
1:200	A1 SHEET

Project Approval
IAN HILL (B.E)
Consulting Civil Engineer

Client

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PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811

PROPOSED BATTERY ENERGY STORAGE FACILITY
RIVER SIDE DRIVE MAYFIELD WEST
PROPOSED LOT 1102
EROSION AND SEDIMENT CONTROL PLAN

Project No	
20269	
Drawing No	Revision
C02	3

PLOT DATE: 20/05/2021 7:34:46 PM CAD FILE: Q:\20\20269 Lot 1101, Riverside Drive, Mayfield (Battery Storage)\02_CAD\AutoCAD\Civil\20269C C02 r3.dwg

Appendix D

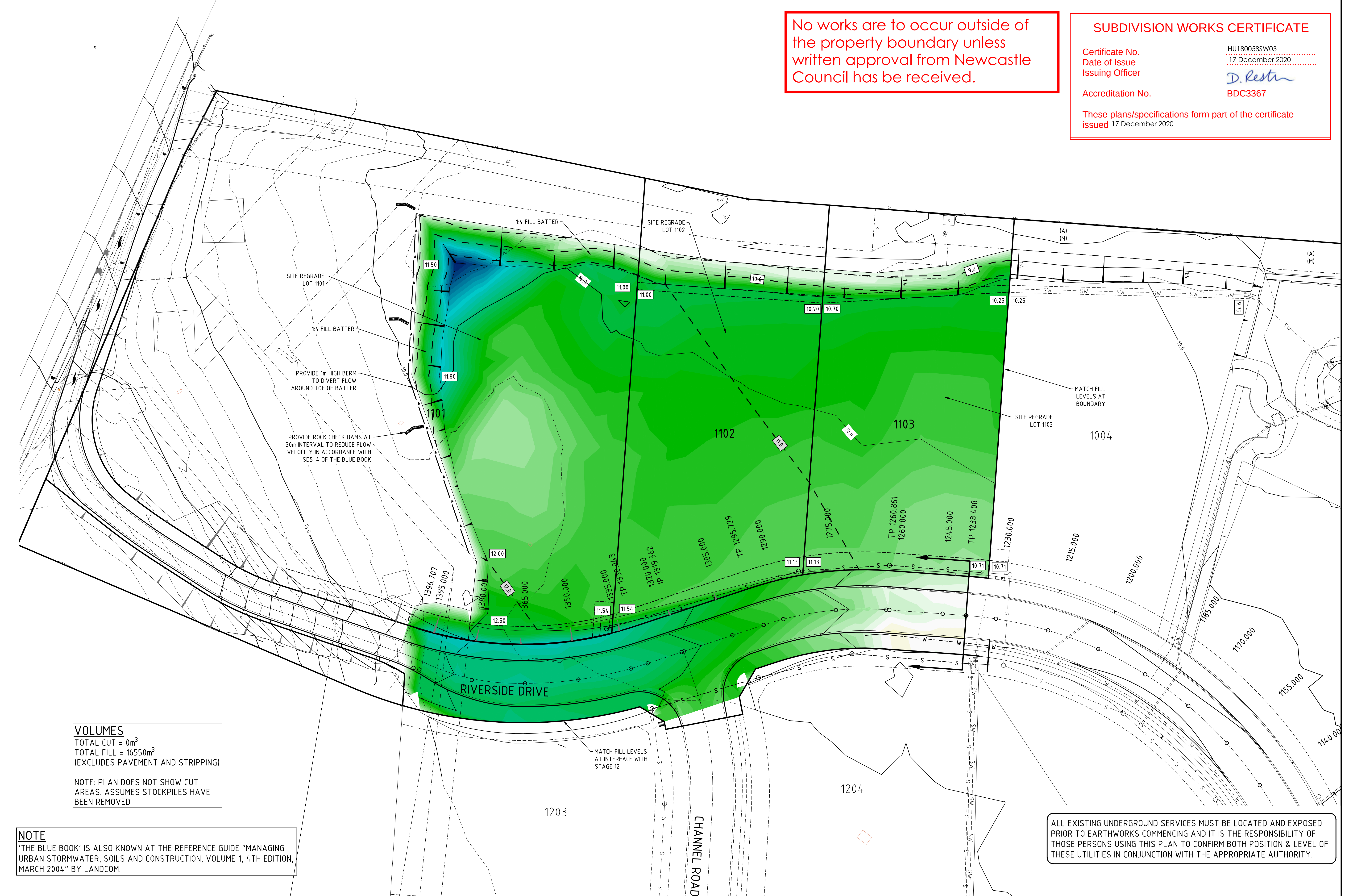
APPROVED STAGE 11 EARTHWORKS PLAN

No works are to occur outside of the property boundary unless written approval from Newcastle Council has be received.

SUBDIVISION WORKS CERTIFICATE

Certificate No. HU180058SW03
Date of Issue 17 December 2020
Issuing Officer D. Reston
Accreditation No. BDC3367

These plans/specifications form part of the certificate issued 17 December 2020



CUT/FILL DEPTH

>	-2.90 m
-2.90	to -2.80 m
-2.80	to -2.70 m
-2.70	to -2.60 m
-2.60	to -2.50 m
-2.50	to -2.40 m
-2.40	to -2.30 m
-2.30	to -2.20 m
-2.20	to -2.10 m
-2.10	to -2.00 m
-2.00	to -1.90 m
-1.90	to -1.80 m
-1.80	to -1.70 m
-1.70	to -1.60 m
-1.60	to -1.50 m
-1.50	to -1.40 m
-1.40	to -1.30 m
-1.30	to -1.20 m
-1.20	to -1.10 m
-1.10	to -1.00 m
-1.00	to -0.90 m
-0.90	to -0.80 m
-0.80	to -0.70 m
-0.70	to -0.60 m
-0.60	to -0.50 m
-0.50	to -0.40 m
-0.40	to -0.30 m
-0.30	to -0.20 m
-0.20	to -0.10 m
-0.10	to 0.00 m
0.00	to 0.10 m
0.10	to 0.20 m
0.20	to 0.30 m
0.30	to 0.40 m
0.40	to 0.50 m
0.50	to 0.60 m
0.60	to 0.70 m
0.70	to 0.80 m
0.80	to 0.90 m
0.90	to 1.00 m
1.00	to 1.10 m
1.10	to 1.20 m
1.20	to 1.30 m
1.30	to 1.40 m
1.40	to 1.50 m
1.50	to 1.60 m
1.60	to 1.70 m
1.70	to 1.80 m
1.80	to 1.90 m
1.90	to 2.00 m
2.00	to 2.10 m
2.10	to 2.20 m
2.20	to 2.30 m
2.30	to 2.40 m
2.40	to 2.50 m
2.50	to 2.60 m
2.60	to 2.70 m
2.70	to 2.80 m
2.80	to 2.90 m
2.90	<

VOLUMES
TOTAL CUT = 0m^3
TOTAL FILL = 16550m^3
(EXCLUDES PAVEMENT AND STRIPPING)

NOTE: PLAN DOES NOT SHOW CUT AREAS. ASSUMES STOCKPILES HAVE BEEN REMOVED

NOTE
'THE BLUE BOOK' IS ALSO KNOWN AT THE REFERENCE GUIDE "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION, VOLUME 1, 4TH EDITION, MARCH 2004" BY LANDCOM.

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

Amendment	Description	Drawn	App'd	Date
3	BRS FEEDBACK	D.B.	A.S.	10.20.20
2	GENERAL AMENDMENTS	A.M	I.H	01.12.20
1	ORIGINAL ISSUE	A.M	A.S	10.11.20

North

Scale 0 10 20 30 40m 1:500 (A1) 1:1000 (A3)

Designed A.M
Cad Reference 17007C dBE4001 r3
Scale 1:500
A1 SHEET
Project Approval
IAN HILL (B.E)
Consulting Civil Engineer

Client STEEL RIVER ESTATE

GCA ENGINEERING SOLUTIONS
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1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811 FAX: (02) 4964 1822

INDUSTRIAL SUBDIVISION
RIVER SIDE DRIVE, MAYFIELD WEST
STEEL RIVER ESTATE
STAGE 11 BULK EARTHWORKS PLAN

Project No 17007C
Drawing No BE4001
Revision 3

PLOT DATE: 10/12/2020 12:37:54 PM CAD FILE: Q:\17\17007 Steel River - West End\02_CAD\AutoCAD\Civil\400 Stage 11\BE Stage 11-13\17007C dBE4001 r3.dwg

Appendix E

VISUAL IMPACT ASSESSMENT

terras
landscape architects
412 King Street Newcastle NSW 2305. ABN 67129348842 0249294926

PHOTO MONTAGES - STEEL RIVER BATTERY STORAGE FACILITY

prepared for:

EDIFY ENERGY & PRECINCT CAPITAL

Rev 03 - 25.05.2021

Methodology

Visual impact assessment is concerned with changes to the physical landscape in terms of features/ elements that may give rise to changes in character. Visual appraisal is concerned with the changes that arise in the composition of available views as a result of changes to the landscape, people's responses to the changes and to the overall effects on visual amenity. Changes may result in adverse (negative) or beneficial (positive) effects.

The nature of landscape and visual assessment requires both objective analysis and subjective professional judgement. Accordingly, the following assessment is based on the best practice guidance listed above, information and data analysis techniques, uses subjective professional judgement.

A number of potential viewpoints were assessed for inclusion. Due to local topography, existing vegetation and existing road alignment the proposal would only have visual effect upon those areas within or immediately adjacent to the site, and only experienced by road users for a very short period of time as they drive south east along Maitland Rd.

Viewpoint – Maitland Rd

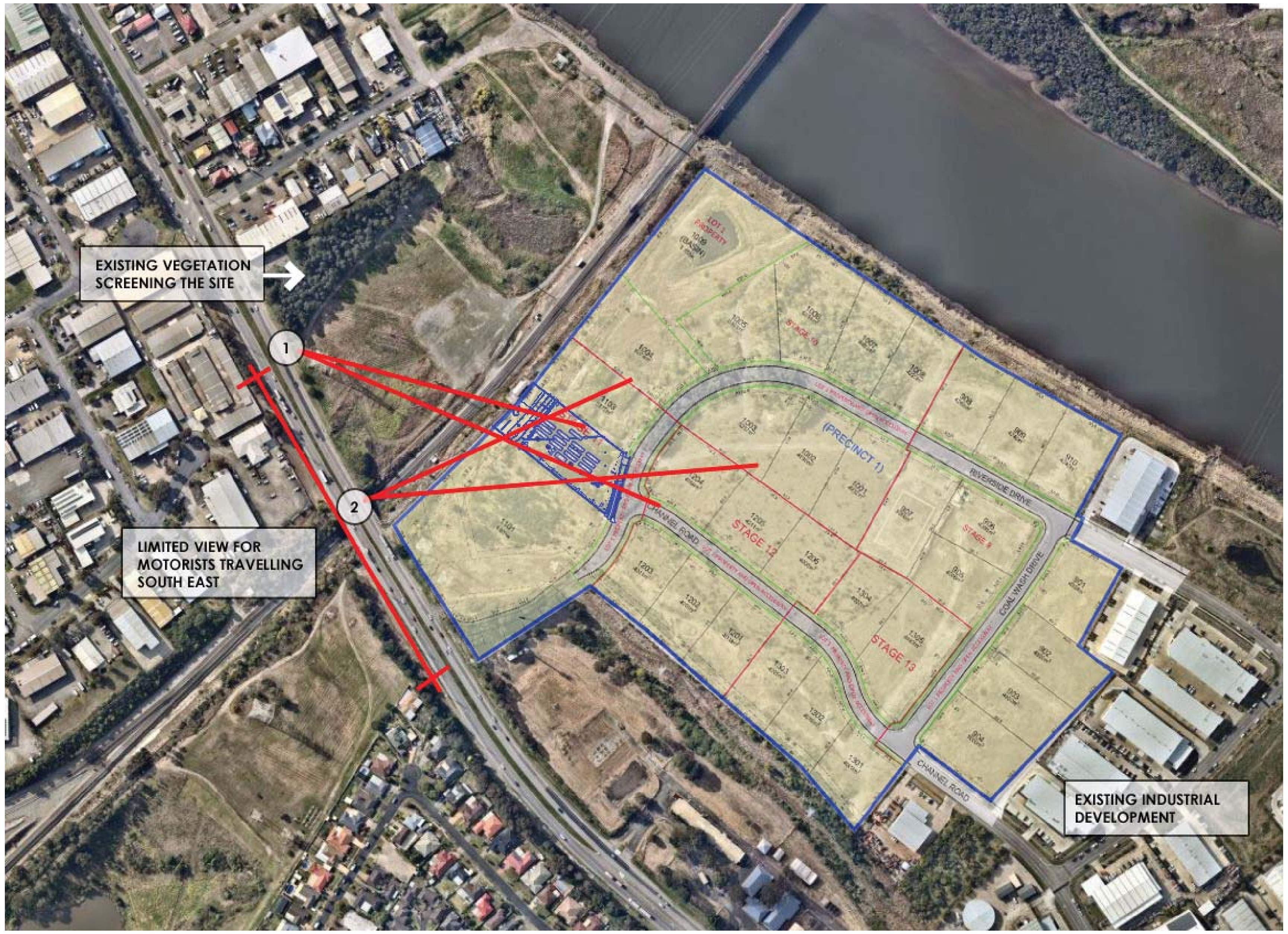
The impact on road users travelling south east on Maitland Rd is minimal due to the following:

- Visual access into the site is minimal due to the limited extent and short exposure of the site
- The site is part of a larger industrial subdivision which has been partially developed with large warehouses, workshops and office buildings. When considering the scale of the existing development this proposal presents as a non intrusive, low scale development in keeping with the industrial precinct.
- While there are some limitations to the amount of screening vegetation provided due to a fire safety risk assessment, a number of trees have been proposed along the southern and eastern boundaries to effectively screen where possible.

NOTE:
The site will not be visible to motorists travelling north west due to the topography of Maitland Rd and major transmission towers frosting Maitland Rd.

Viewpoint – Riverside Drive (Within development)

The impact on users within the subdivision will be limited due to the relatively low scale of development when comparing it to the existing development. Refer to perspective views prepared by GCA as part of their DA submission.



VIEWPOINT 1 - Highlighted in red to identify the extent of the proposed development with no visual screening

VIEWPOINT 1 - Proposed development with accurate colour scheme and new planting

N

VIEWPOINT 1 - Proposed development with accurate colour scheme and mature planting

VIEWPOINT 2 - Highlighted in red to idntify the extent of the proposed development with no visual screening

VIEWPOINT 2 - Proposed development with accurate colour scheme and new planting

VIEWPOINT 2 - Proposed development with accurate colour scheme and mature planting

Appendix F

OBTRUSIVE LIGHTING REPORT

Precinct Capital

Steel River BESS
Obtrusive Lighting Report

18th May 2021

power solutions

C106/215 Pacific Hwy CHARLESTOWN NSW
810 Pacific Hwy GORDON NSW
PO BOX 278 CHARLESTOWN NSW 2290
t: 1300 732 293 f: (02) 4923 8199
e: office@powersol.com.au

Document Control

Version	Date	Author	Reviewer	Revision Details
A	18/05/2021	Steve Goman	Scott Clothier	Initial Issue

Contents

1 EXECUTIVE SUMMARY

Power Solutions was commissioned by Precinct Capital to assess the proposed lighting for the Steel River BESS and the surrounding area against the Australian lighting standard AS4282: Control of the obtrusive effects of outdoor lighting.

The proposed lighting layout for the Steel River BESS was found to be **compliant** with Australian Standard AS4282.

2 APPLICABLE STANDARDS

2.1 Australian Lighting Standard – Environmental Zone

Table 3.1 of AS2482 specifies the lighting environmental for the area:

TABLE 3.1

ENVIRONMENTAL ZONES

Zones	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve. IDA Dark Sky Parks. Major optical observatories No road lighting -unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting - unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sports stadium during TV broadcasts
V	Residences near traffic routes	Refer AS/NZS1158.1.1
R1	Residences near local roads with significant setback	Refer AS/NZS 1158.3.1
R2	Residences near local roads	Refer AS/NZS 1158.3.1
R3	Residences near a roundabout or local area traffic management device	Refer AS/NZS 1158.3.1
RX	Residences near a pedestrian crossing	Refer AS/NZS 1158.4

NOTE: Recreational areas are not considered commercial.

Based on the table above and the surrounding area, **zone 'A3'** has been used for this study.

Following on, Table 3.2 and 3.3 provide the maximum lighting values for the environmental zone:

TABLE 3.2

MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS

Zones	Vertical illuminance levels (E_v) lx		Threshold increment (TI)		Sky glow
	Non-curfew	Curfew	%	Default adaptation level (L_{ad})	Upward light ratio
A0	See Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08
V	N/A	4	Note 2	Note 2	Note 2
R1	N/A	1	20%	0.1	Note 3
R2	N/A	2	20%	0.1	Note 3
R3	N/A	4	20%	0.1	Note 3
RX	N/A	4	20%	5	Note 4

NOTES:

1 For A0, E_v shall be as close to zero as practicable without impacting safety considerations.

2 Refer to AS/NZS 1158.1.1.

3 Refer to AS/NZS 1158.3.1.

4 Refer to AS/NZS 1158.4.

5 N/A means 'Not Applicable'.

6 For an internally illuminated sign in an A2 zone, $L_{ad} \leq 0.25$ cd/m^2.

TABLE 3.3

MAXIMUM LUMINOUS INTENSITIES PER LUMINAIRE

Zone	Luminous intensity (I), cd		
	Non-curfew L1	Non-curfew L2	Curfew
A0	See Note	See Note	0
A1	2 500	5 000	500
A2	7 500	12 500	1 000
A3	12 500	25 000	2 500
A4	25 000	50 000	2 500
TV	100 000	150 000	0

NOTE: For A0, I shall be as close to zero as practicable without impacting safety considerations.

3 OBTRUSIVE LIGHTING MODEL

3.1 Australian Lighting Standard – Illuminance Calculation

Section 3.3.1.2 and 3.3.1.4 state the requirements for the illuminance calculation:

3.3.1.2 *Calculation of illuminance in a vertical plane (E_v)*

Limiting values are for the direct component of illuminance only. The illuminance calculations shall be made for a grid of points in the relevant vertical plane as described in Clause 3.3.1.3. The points shall be spaced at not more than 5 m horizontally, and 1 m vertically, unless there is a luminaire/s within 20 m of the vertical plane, then the points shall be spaced at not more than 2 m horizontally, and 1 m vertically.

3.3.1.4 *Height of the vertical calculation points*

The height of the points in the vertical plane shall be as follows (see Figure 3.2):

(a) Where the calculation plane is along a building line of an existing building, the highest calculation points shall be taken to be the top of the highest window of the habitable rooms. The lowest calculation points shall be taken to be the bottom of the lowest window of the habitable rooms.

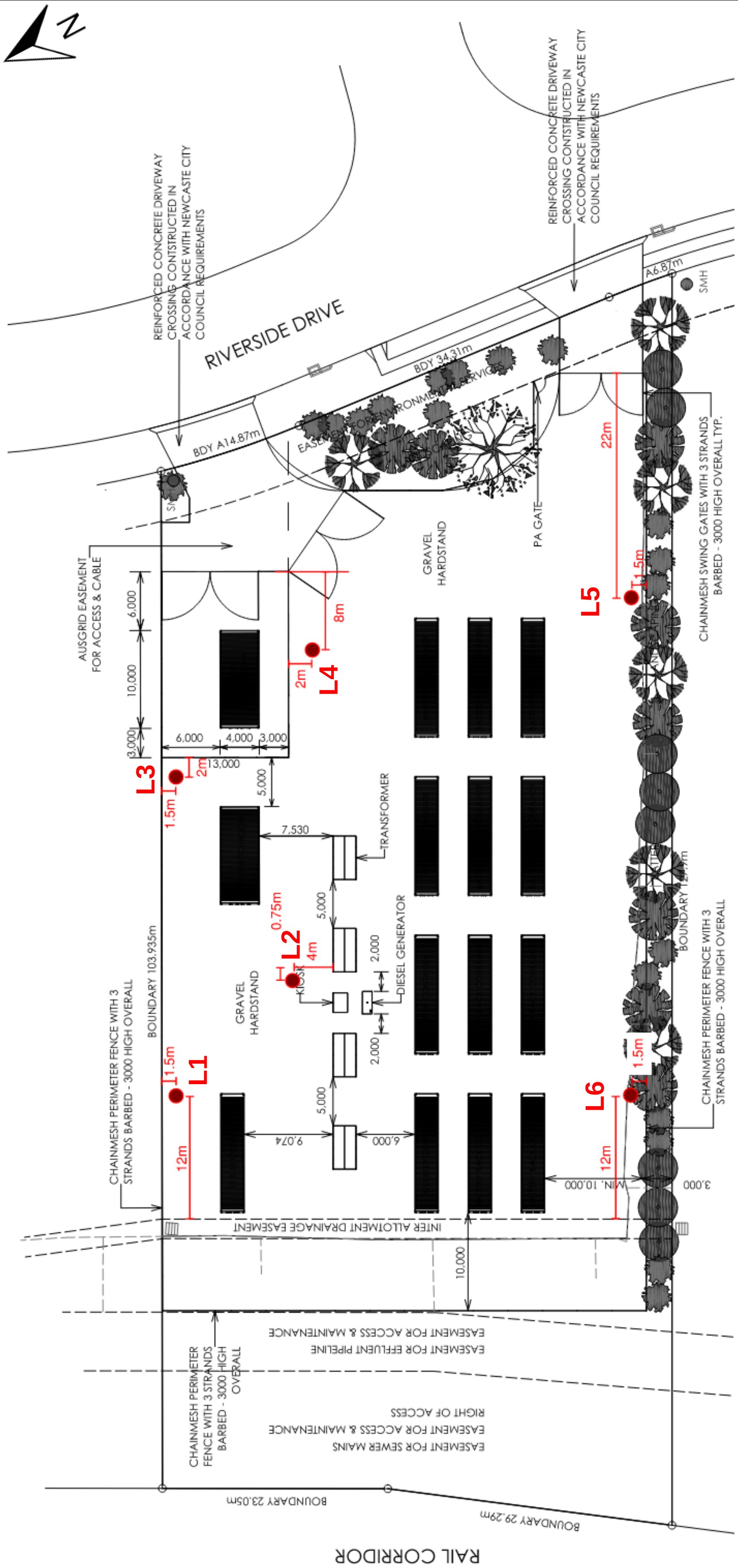
(b) Where the calculation plane is along a boundary with a minimum dwelling or other setback, the highest calculation points shall be taken to be the maximum building height permitted by the land use zoning provisions. The lowest calculation point shall be 1.5 m or less above ground level. Where there is no maximum building height in the zoning the highest calculation point shall be equal to the height of the highest luminaire subject to analysis.

As there is no existing properties around the development, a setback of 6m (the closest any future building can be built) was used for the lighting assessment. The proposed luminaires are 6.5m high and there are no existing buildings around the site. To account for any future developments in the area, a vertical height of 10m was assumed for the calculation grid.

3.2 Luminaires Used

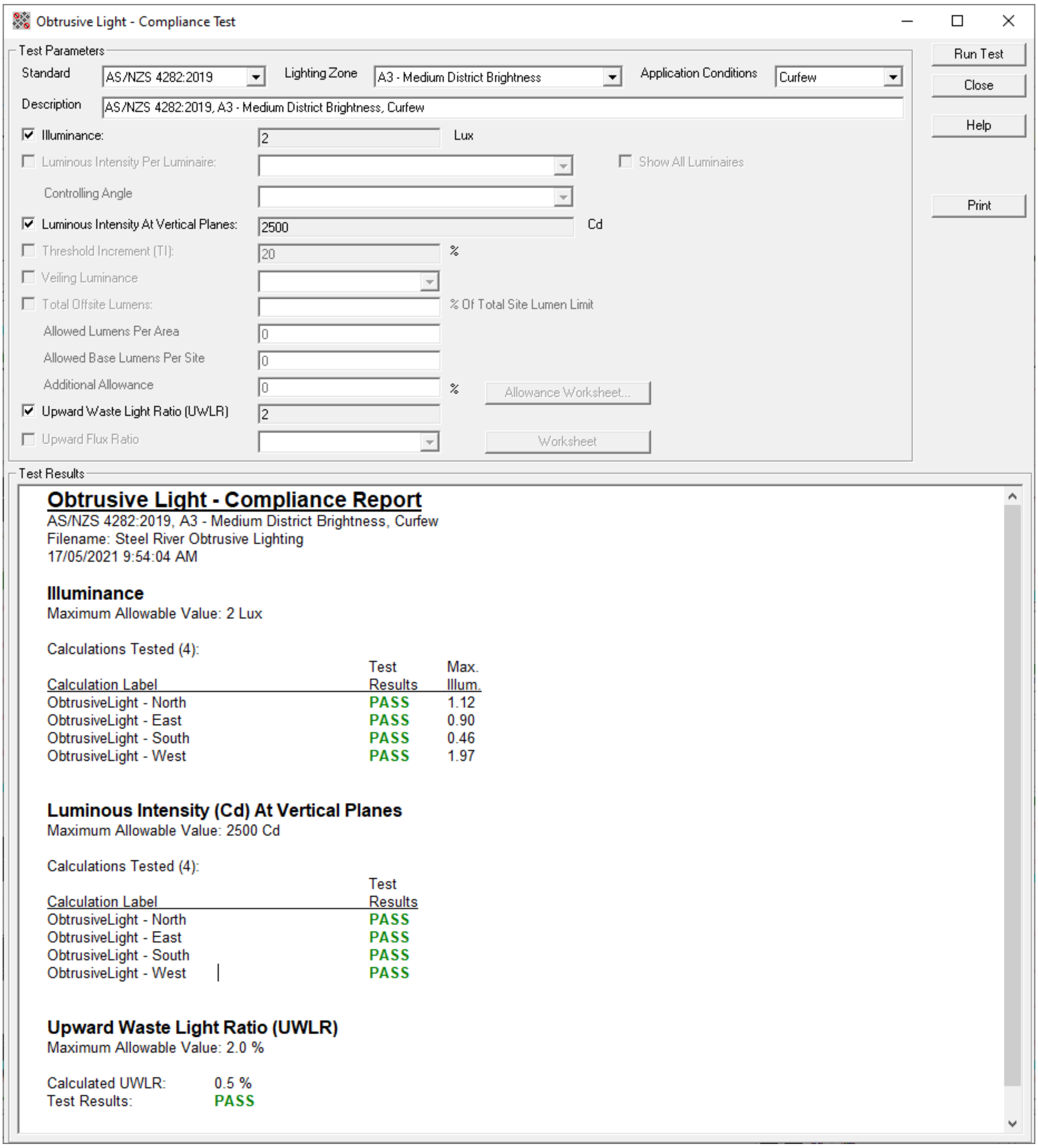
For this site, steel columns with a 6.5m height and 2m outreach were used (Ausgrid standard component – Stockcode 100115). The luminaires were Aldridge 17W LED RRW with Glare Shields fitted to reduce light spill (Ausgrid standard component – Stockcode 185760).

Luminaires were placed at the following locations:


RIVERSIDE DRIVE
REINFORCED CONCRETE DRIVEWAY CROSSING CONTSTRUCTED IN ACCORDANCE WITH NEWCASTE CITY COUNCIL REQUIREMENTS
BDY A14.87m
BDY 34.31m
A6.87m
SMH
AUSGRID EASEMENT FOR ACCESS & CABLE
GRAVEL HARDSTAND
PA GATE
CHAINMESH SWING GATES WITH 3 STRANDS BARBED - 3000 HIGH OVERALL TYP.
TRANSFORMER
KIOSK
DIESEL GENERATOR
BOUNDARY 103.935m
CHAINMESH PERIMETER FENCE WITH 3 STRANDS BARBED - 3000 HIGH OVERALL
INTER ALLOTMENT DRAINAGE EASEMENT
EASEMENT FOR ACCESS & MAINTENANCE
EASEMENT FOR EFFLUENT PIPELINE
RIGHT OF ACCESS
EASEMENT FOR SEWER MAINS
BOUNDARY 23.05m
BOUNDARY 29.29m
RAIL CORRIDOR
L1
L2
L3
L4
L5
L6
22m
12m
8m
2m
1.5m
0.75m
4m

4 CALCULATION RESULTS

From AGi32, the lighting arrangement was found to be in compliance with AS 4282 for environmental zone A3:



5 CONCLUSIONS

From AGi32, the lighting arrangement was found to be in compliance with AS4282 for environmental **zone A3** and no changes to the lighting arrangement are required.

Appendix G

UPDATED PRELIMINARY HAZARD ASSESSMENT

Edify Energy

Steel River Battery Farm

Preliminary Hazard Analysis

Issue 5 | 3 June 2021

Job number 278292-00

Arup Australia Pty Ltd ABN 76 625 912 665

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ARUP

Document verification

ARUP

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		Signature			
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		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
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			Prepared by	Checked by	Approved by
		Name			
		Signature			

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Executive Summary

Background

Edify Energy Pty Ltd and Precinct Group are jointly developing a 28 MW advanced lithium ion battery energy storage facility known as the Steel River Battery, at the Steel River Industrial Park located in Mayfield, New South Wales.

The Project will connect to the local Ausgrid 33 kV electrical distribution network and will provide benefits to the local electricity network as well as network services to the wider New South Wales grid.

Project details are summarised in Table 1.

Table 1: Summary of project details

Project Detail	Description
Project Type	Stand-alone large scale battery storage connected to the National Electricity Market.
Electrical Connection	Ausgrid 33kV distribution network.
Battery Technology	Lithium ion battery system.
Battery Capacity	Up to 28MW
Battery Storage Duration	Up to 2 hours
Battery Configuration	Outdoor modular battery units or containerised battery system with ancillary balance of plant equipment.
Project Location	Proposed lots 1101 - 1102 Riverside Drive, Mayfield West. Part of future Stage 11 of Steel River Estate (Zoned IN1 General Industrial)

Methodology

This Preliminary Hazard Analysis (PHA) has been prepared in accordance with the relevant guidelines from NSW DPIE's *Multi-level Risk Assessment* [1] and Hazardous Industry Planning Advisory Papers (HIPAPs) No. 4 – *Risk Criteria for Land Use Safety Planning* [2] and No. 6 – *Hazard Analysis* [3].

During the analysis of the identified risks, reference was made to the relevant general principles as defined by HIPAP 4 [2] Section 2.4.1:

- The avoidance of all *avoidable* risks;
- The risk from a major hazard should be reduced wherever practicable, even where the likelihood of exposure is low; and
- The effects of significant risks should, wherever possible be contained within the site boundary.

Recommendations have been made against each of the identified risks to ensure that the residual risks will be reduced So Far as is Reasonably Practicable (SFAIRP).

Hazards and Consequences

The hazards assessed to be 'medium' risk or higher in the hazard identification study (HAZID), or where offsite consequences were anticipated have been carried forward for qualitative assessment. The following hazards have been assessed:

- Security breach leading to injury;
- Electrocution from an electrical facility;
- Injury to construction or operations personnel;
- Exposure to dangerous goods during a site emergency;
- Battery fire; and
- Battery explosion.

The two hazards that were identified as having the potential to cause offsite impacts, namely a battery fire and battery explosion, were carried forward for quantitative consequence analysis.

As the final battery technology has not yet been chosen for the site, these hazards were considered for both modular/cabinet and containerised solutions.

For a fire in a modular/cabinet unit, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and site boundary = 2.25 m; and
- Side modular/cabinet unit wall and site boundary = 9 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent modular/cabinet units, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and adjacent modular/cabinet unit = 1 m; and
- Side modular/cabinet unit wall and adjacent modular/cabinet unit = 5 m.

For a fire in a container, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the container and site boundary = 5.5 m; and
- Side container wall and site boundary = 5.25 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent containers, the required minimum separation distance between the:

- Front/end of the container and adjacent container = 3.25 m; and
- Side container wall and adjacent container = 2.0 m.

For an explosion in a battery unit, a vapour cloud explosion of vented gas was modelled. An overpressure of 7 kPa – the accepted minimum for injury or fatality – was found to extend to a distance of 24 m, and an overpressure of 35 kPa – corresponding to significant damage of structures – was found to extend to a distance of 7.5 m.

Recommendations

Arup makes the following recommendations to ensure that the residual risks for the identified hazards will be reduced SFAIRP:

- Separate BESS 24 m from the site boundary unless the following are met:

  1. BESSs shall have a means to safely vent or prevent an explosion designed to NFPA 68, NFPA 69, or an international equivalent to reduce this risk SFAIRP.
  2. In the absence of more specific test data, containerised BESSs shall be separated from one another by not less than 3.25 m end to end and not less than 3 m side to side, and separated from the site boundary by not less than 10 m.
  3. In the absence of more specific test data, modular/cabinet BESSs shall be separated from one another by not less than 2 m end to end and not less than 5 m side to side, and separated from the site boundary by not less than 10 m.

  If specific test data exist, the recommended separation distances between units provided for in those data can be used in preference to the distances listed here. For example, the Tesla Megapack can be separated be 6 inches (155 mm) side-to-side or back-to-back (i.e. the sides of the unit without doors) as demonstrated by fire testing performed using the UL9504A Test Method, and as shown in Figure 11 in Section 4.1.3.

- Ensure the BESS manufacturer supplies the UL9540A fire test report for further refinement of separation distances.
- Ensure BESSs have a fire suppression system, if they are to be entered for maintenance. Additionally:

  1. It is preferred for the fire suppression system to not rely on shutdown of the battery cooling system.

The fire suppression system design should also consider the explosion hazard.

1 Introduction

1.1 Site Description and Surrounding Land Use

The subject site has a property description of Lot 12 DP 280089 with a street address of 27D Riverside Drive, Mayfield West. The site is currently approved for further earthworks and is situated within approved Lot 1102, part of future Stage 11 Steel River Business Park. The subject site has a combined total area of approximately 2.44 ha. The site is currently vacant IN1 General Industrial zone land.

1.2 Operational Process

The proposed Battery Energy Storage System (BESS) is expected to operate in conjunction with the electrical grid to provide the following functions:

- Charging and discharging of energy from the electrical grid for shifting of energy to peak consumption periods when electricity is needed the most; and
- Participate in the electricity market to provide ancillary services which help contribute to the stability and functionality of the electrical grid.

The primary modes of operation of the BESS are:

- Charging of the battery from the external electrical grid; or
- Discharging of the battery to the external electrical grid.

It should be noted that during regular operations of the proposed facility, no dangerous goods will be consistently used.

Two battery solutions are currently being considered for the site:

- Modular cubical cabinets (similar to the Tesla Megapack system, for example) that are installed in an array around an inverter pack as illustrated in Figure 1; and
- Containerised modules (containerised system) that have been preassembled in modified shipping containers prior to transport to site as illustrated in Figure 2

Both proposed battery technologies will consist of lithium ion battery technology. The system is expected to be highly modular and based on individual smaller power blocks to achieve the required system size. Each battery pack is comprised of multiple smaller lithium ion cells which are fully enclosed and connected to form an integrated system. The BESS will be required to conform with the following safety standards:

- UL 1642: *Standard for Lithium Batteries*
- UL 9540: *Standard for Energy Storage Systems and Equipment*

Figure 1 Indicative Tesla Megapack (example modular/cabinet unit)

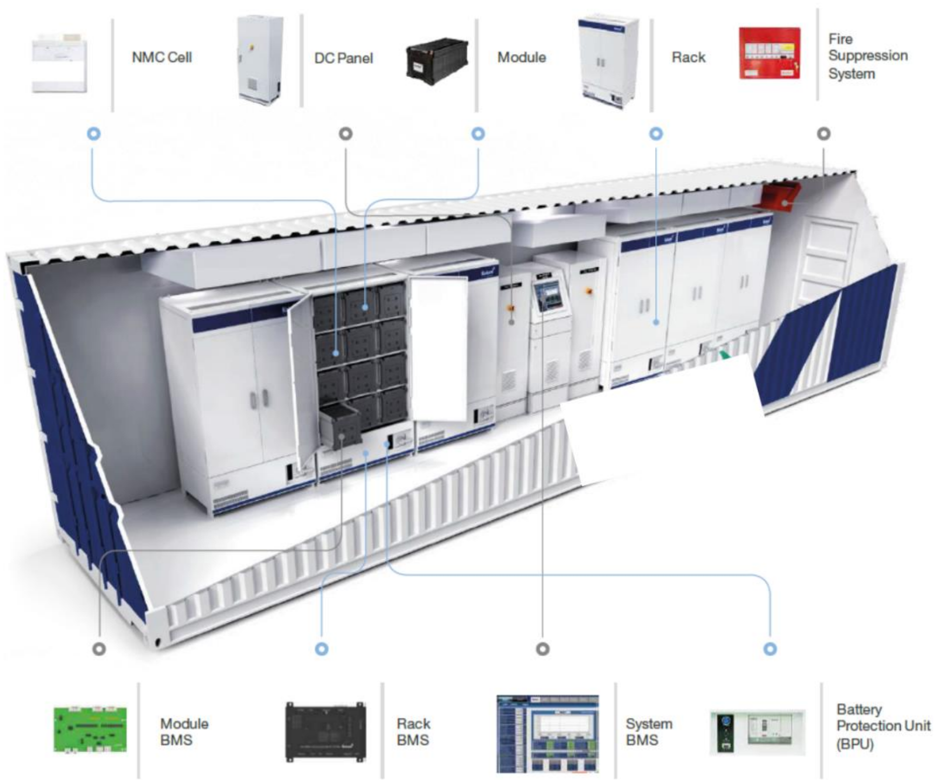


Figure 2 Indicative arrangement of containerised module

2 Applicability of SEPP 33

2.1 Dangerous Goods Used and Stored at the Facility

The list of dangerous goods to be used and stored at the facility has been based on the Darlington Point Solar Farm (DPSF) BESS dangerous goods storage. Table 22 below contains the estimated quantities of chemicals stored onsite.

Table 2: List of potentially hazardous goods used and stored at the facility

Item	UN No.	Dangerous Goods Class	Total Storage Onsite	Description
Lithium Ion Batteries	3481	9	~ 800 units	Installed as part of the battery units as solid material inside cells
Refrigerant (R 134a)	3159	2.2	~ 350 kg	Installed as part of the cooling system of some battery technologies (including the Tesla Megapack)
Miscellaneous Minor Chemicals Store	N/A	2.2, 3, 5.1, 8	< 1 t	Onsite storage for maintenance
Ethylene Glycol solution	3082	N/A, not a dangerous good	~ 3 t	Installed as part of the cooling system of some battery technologies (including the Tesla Megapack)
Transformer Oil	N/A, not a dangerous good		~ 45 t	Possibly in transformers

2.2 SEPP 33 Screening

It has been assumed that the goods stored onsite are stored in similar locations and so have been screened against SEPP 33 thresholds together, as per NSW Department of Planning, Industry and Environment's (DPIE's) *Applying SEPP 33* [4]. The screening can be found in Table 3 below.

Table 3: Screening against SEPP 33 thresholds

Dangerous Goods Class	Quantity	Threshold	Threshold Exceeded?
3	< 1 t	5 t	No
5.1	< 1 t	5 t	No
8 PGII	< 1 t	25 t	No

Note that Dangerous Goods Classes 2.2 and 9 are excluded from the risk screening. It should also be noted that no dangerous goods are expected to be transported (beyond the needs of minor maintenance) to or from the site on a regular basis and so no transportation screening has been undertaken.

As all the dangerous goods screened above do not exceed the SEPP 33 threshold, a PHA is not required for the development by SEPP 33. It should be noted that by taking a conservative approach to land use planning, a PHA has been prepared to address the potential risks that may arise from this development.

2.3 Relevant Guidance

This PHA has been prepared in accordance with the relevant guidelines from NSW DPIE's *Multi-level Risk Assessment* [1] and Hazardous Industry Planning Advisory Papers (HIPAPs) No. 4 – *Risk Criteria for Land Use Safety Planning* [2] and No. 6 – *Hazard Analysis* [3].

During the analysis of the identified risks, reference was made to the relevant general principles as defined by HIPAP 4 [2] Section 2.4.1:

- The avoidance of all *avoidable* risks;
- The risk from a major hazard should be reduced wherever practicable, even where the likelihood of exposure is low; and
- The effects of significant risks should, wherever possible be contained within the site boundary.

Recommendations have been made against each of the identified risks to ensure that the residual risks will be reduced So Far as is Reasonably Practicable (SFAIRP).

3 Hazard Identification

A hazard identification study (HAZID) was conducted for the site. This HAZID was conducted by personnel with relevant experience of grid scale BESS units.

The identified hazards and their qualitative likelihood and consequence scores can be found in Appendix A. The hazards assessed to be ‘medium’ risk or higher in the HAZID, or where offsite consequences were anticipated have been carried forward for qualitative assessment. The following hazards have been assessed:

- Security breach leading to injury;
- Electrocution from an electrical facility;
- Injury to construction or operations personnel;
- Exposure to dangerous goods during a site emergency;
- Release of firewater runoff;
- Battery fire; and
- Battery explosion.

These hazards have been discussed in more detail in Section 3.1 below.

3.1 Hazard Details

3.1.1 Security Breach

A security breach of the facility could credibly lead to theft of equipment or injury to personnel and individuals. This event is not considered likely to cause offsite impacts. Arup makes the following recommendations:

- Security fencing around the facility and separately around critical and hazardous assets should be installed;
- A CCTV security system should be installed; and
- Regular O&M inspections to monitor breaches should be undertaken.

As there is no potential for offsite impacts, the above recommendations are considered sufficient to mitigate the risk of this event.

3.1.2 Electrocution from Electrical Facility

Electrocution occurring in the BESS is a credible scenario that could lead to the injury or death of a maintenance worker. Arup makes the following recommendations:

- Electrical assets shall be installed in accordance with AS 3000: *Electrical Installations*; and
- Appropriately qualified maintenance personnel are to be used.

As there is no potential for offsite impacts, the above recommendations are considered sufficient to mitigate this risk.

3.1.3 Injury to Construction or Operations Personnel

During the construction and operation of the facility, there is a credible hazard associated with the injury of construction and operations personnel, respectively. This event is not considered likely to cause offsite impacts. Arup makes the following recommendations:

- The development of a Work, Health and Safety plan; and
- Detailed Safety in Design processes are to be carried out.

As there is no potential for offsite impacts, the above recommendations are considered sufficient to mitigate this risk.

3.1.4 Exposure to Dangerous Goods During Site Emergency

In the event of an emergency at the site, personnel may be exposed to dangerous goods and suffer injury. This event is not considered likely to cause offsite impacts. Arup makes the following recommendations:

- The development of a site-specific Emergency Response Plan;
- Appropriate signage and labelling to identify site-specific hazards are to be installed; and
- Emergency response workers are to be made aware of the response requirements.

As there is no potential for offsite impacts, the above recommendations are considered sufficient to mitigate this risk.

3.1.5 Release of Firewater Runoff

Following a fire event that requires extinguishing, the firewater used for extinguishment has the potential to be released into the environment without being controlled. This firewater is likely to be contaminated and will be required to be contained.

Broadly speaking, the contaminated firewater may be contained in one of two ways:

- Permanent containment system: the civil design of the site can be scoped such that it is possible to contain all runoff in a designated catchment area (e.g. a bund or some form of holding basin).
- Temporary containment: the site can be designed such that, in the event of a fire brigade response that may lead to contaminated runoff, drainage can be thoroughly sealed, and firewater contained on-site. In essence, this is a temporary bund.

The most appropriate approach is determined as a function of the choice of battery technology, the “acceptable loss” strategy (i.e. whether the response to a fire is to suppress and extinguish, or to allow the unit to burn while protecting adjacent units), the design and budget implications on the broader site development, and fire brigade input to all of the above. This is therefore a decision that is made as the project develops.

3.1.6 Battery Fire

As the final battery technology has not yet been chosen for the Site, this hazard has been considered for both modular/cabinet and containerised solutions.

A fire could credibly form in a lithium ion battery system as a result of a thermal runaway in one or more cells or from an external source such as a fire at the facility. The potential for this to have offsite impacts means it has been carried forward for consequence analysis in Section 4.1.

3.1.7 Battery Explosion

Flammable vapours may accumulate in the battery unit. This could result in a confined vapour cloud explosion (VCE) occurring. The potential for this to have offsite impacts means it has been carried forward for consequence analysis in Section 4.2.

4 Consequence Analysis

The two hazards that were identified as having the potential to cause offsite impacts, namely a battery fire and battery explosion, have been carried forward for quantitative consequence analysis.

4.1 Battery Fire

As the final battery technology has not yet been chosen for the site, this hazard has been considered for both modular/cabinet and containerised solutions.

4.1.1 Modular/Cabinet

A fire event in a battery container was modelled to assess the impact on its surroundings. The modelling assumed that the battery management system and other safety features are unable to control thermal runaway, leading to a fire in the container. Additionally, it is assumed that the fire suppression system is not functional as a worst-case scenario.

The dimensions of the Tesla Megapack were used as an indicative size for a modular/cabinet unit – approx. 7.14 m (L) x 1.60 m (W) x 2.36 m (H). Figure 3 shows a Tesla Megapack as an example of the modular/cabinet technology options.

Figure 3: Tesla Megapack (example modular/cabinet unit)

Key Assumptions and Fire Scenarios

The basis of the modelling is radiative heat transfer using the Stefan-Boltzmann Law and view factor method. Further description of this methodology and all equations used are presented in Appendix B.

The worst credible fire scenario has been considered in which all of the doors along the side of the modular/cabinet unit are left open.

- The temperature of the open side is set at 840 °C (flame temperature). This is representative of an emitting heat flux of 84 kW/m² which is used for fire spread design between buildings such as offices (Approved Document B) (HMCLG, 2010). While the units do contain batteries, which would have combustible contents and some plastic materials, the overall structure of the modular/cabinet unit and insulation is to be non-combustible and the majority of racking within the space is constructed of non-combustible metal. This results in a comparable fuel load. 840 °C is also within the flame temperature range recommended for use for fires based on the Fire Engineering Design Guide. While adiabatic flame temperature is based on the chemistry of a flame, within a compartment the overall compartment dynamics and air ratio influence the temperature of a flame.
- The radiating panel shall be 7.14 m x 2.36 m (at full door height and width) with 840 °C;
- The emissivity of the door opening is taken to be 0.9. This represents a conservative emissivity for a severe fire and a good radiator;
- The temperature of the end walls was set at 600 °C, which is generally the temperature at which flashover begins in a compartment as per the SFPE Handbook and CIBSE Guide E. This represents a severe fully developed fire throughout the modular/cabinet unit.
- It is assumed that the radiating panel shall be based on the full height and length of the modular/cabinet unit end wall with the dimension of 1.60 m (W) x 2.36 m (H) at 600 °C;
- The emissivity of the modular/cabinet unit end wall is taken to be 0.7. This represents the maximum steel emissivity that could be reached at high temperature (flashover temperature) based on research conducted by VTT [5];
- The heat flux from the emitting surface was assumed to be uniform; and
- No heat loss was assumed to intermediate media (i.e. to air or smoke).
- The basis of the fire modelling is to consider the worst-case conditions. It is a consequence-based assessment. In this context historical wind data does not affect the consequence assessment. Further as detailed above the fire modelling ignores that integrity and insulation rating of the unit, providing further conservativeness.

The fire scenario is represented pictorially in Figure 4.

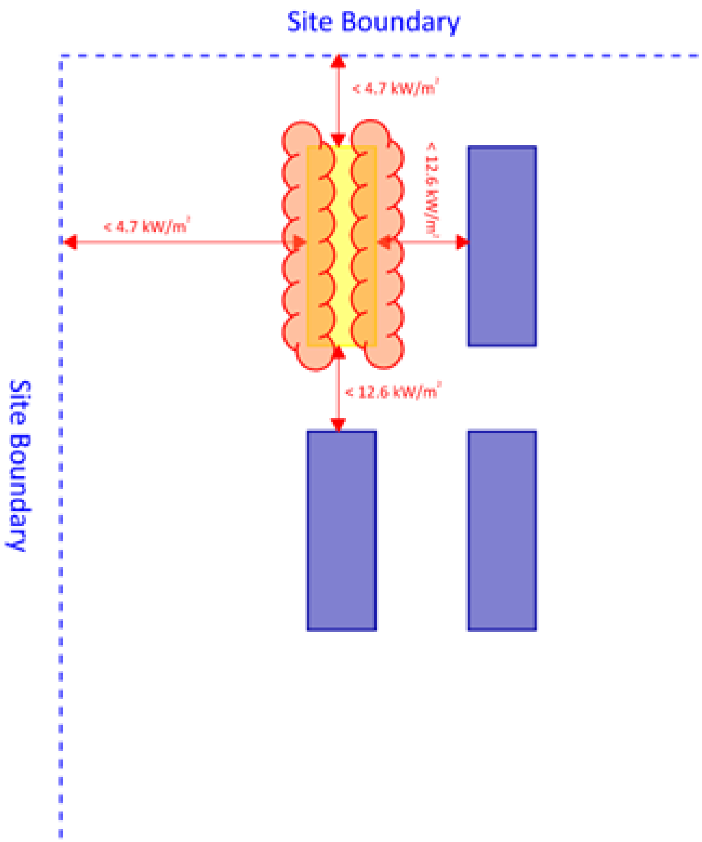


Figure 4 Pictorial representation of the fire modelling scenario

Acceptance Criteria

According to HIPAP 4 [2], a radiation intensity of 4.7 kW/m^2 will cause pain and burn injuries to humans. At 12.6 kW/m^2, it is known that:

- The temperature of wood can rise to a point where it can be ignited by a naked flame after long exposure;
- Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure;
- There is a significant chance of fatality with extended exposure and a high chance of injury.

Therefore, sufficient separation distance must be provided such that:

- The heat radiation received at the site boundary is less than 4.7kW/m^2; and
- The heat radiation on the adjacent modular/cabinet unit is less than 12.6kW/m^2.

Results

The results of the modelling are presented in Figure 5.

As shown in Figure 5, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and site boundary = 2.25 m; and
- Side modular/cabinet unit wall and site boundary = 9 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent modular/container units, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and adjacent modular/cabinet unit = 1 m; and
- Side modular/cabinet unit wall and adjacent modular/cabinet unit = 5 m.

This is represented pictorially in Figure 10. However, as a conservative measure, it is recommended that the separation distances are as follows:

- Between the long sides of the modular/cabinet units shall not be less than 5 m;
- Between the ends of the modular/cabinet units shall not be less than 2 m; and
- The distance from the site boundary shall not be less than 10 m.

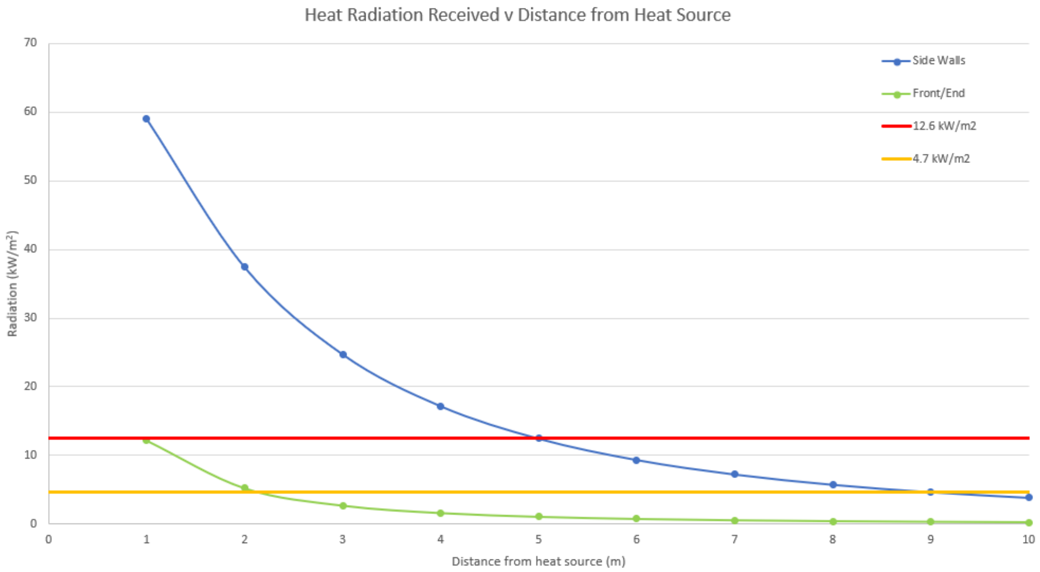


Figure 5 The results of the fire modelling, showing heat flux radiation plotted against the separation distance. The red line is set at 12.6 kW/m^2 while the orange line is set at 4.7 kW/m^2

4.1.2 Containerised

A fire event in a battery container was modelled to assess the impact on its surroundings. The modelling assumed that the battery management system and other safety features are unable to control thermal runaway, leading to a fire in the container. Additionally, it is assumed that the fire suppression system is not functional as a worst-case scenario.

It is understood from the Memo provided by Edify, the supplied battery container is a modified standard 40 ft shipping container - approx. 12.2 m (L) x 2.35 m (W) x 2.39 m (H). Figure 6 shows a typical modified shipping container of this type and Figure 7 shows the dimensions of the container. It will house battery cells and associated electrical infrastructure and be typically installed at ground level or slightly elevated on structure.

Figure 6 Typical 40 ft modified shipping container for battery energy storage (extracted from Edify Memo)

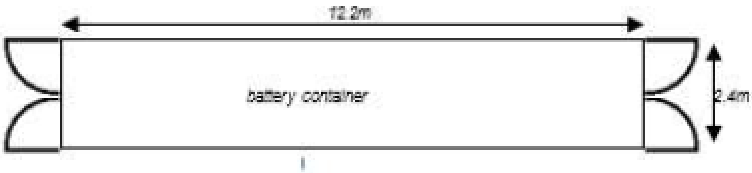


Figure 7 Containerised battery container layout illustrating the double-leaf door at both ends of the containers (extracted from Edify Memo)

Key Assumptions and Fire Scenarios

The basis of the modelling is radiative heat transfer using the Stefan-Boltzmann Law and view factor method. Further description of this methodology and all equations used are presented in Appendix B.

The worst credible fire scenario has been considered in which the double-leaf doors are left open at both ends of the container.

- The temperature of the open door is set at 840 °C (flame temperature). This is representative of an emitting heat flux of 84 kW/m² which is used for fire spread design between buildings such as offices (Approved Document B) (HMCLG, 2010). While the units do contain batteries, which would have combustible contents and some plastic materials, the overall structure of the container and insulation is to be non-combustible and the majority of racking within the space is constructed of non-combustible metal. This results in a comparable fuel load. 840 °C is also within the flame temperature range recommended for use for fires based on the Fire Engineering Design Guide. While adiabatic flame temperature is based on the chemistry of a flame, within a compartment the overall compartment dynamics and air ratio influence the temperature of a flame.

- It is assumed that the open double-leaf door is the full height and width of the container (see Figure 7), i.e. 2.4 m (W) x 2.4 m (H). The radiating panel shall be 2.4 m x 2.4 m (at full door height and width) with 840 °C;
- The emissivity of the door opening is taken to be 0.9. This represents a conservative emissivity for a severe fire and a good radiator;
- The temperature of the perimeter container walls was set at 600 °C, which is generally the temperature at which flashover begins in a compartment as per the SFPE Handbook and CIBSE Guide E. This represents a severe fully developed fire throughout the container.
- It is assumed that the radiating panel shall be based on the full height and length of the container side wall with the dimension of 12.2 m (L) x 2.4 m (H) at 600 °C;
- The emissivity of the container side wall is taken to be 0.7. This represents the maximum steel emissivity that could be reached at high temperature (flashover temperature) based on research conducted by VTT [5];
- The heat flux from the emitting surface was assumed to be uniform; and
- No heat loss was assumed to intermediate media (i.e. to air or smoke).
- The basis of the fire modelling is to consider the worst-case conditions. It is a consequence-based assessment. In this context historical wind data does not affect the consequence assessment. Further as detailed above the fire modelling ignores that integrity and insulation rating of the containers, providing further conservativeness.

The fire scenario is represented pictorially in Figure 8.

Acceptance Criteria

According to HIPAP 4 [2], a radiation intensity of 4.7 kW/m^2 will cause pain and burn injuries to humans. At 12.6 kW/m^2, it is known that:

- The temperature of wood can rise to a point where it can be ignited by a naked flame after long exposure;
- Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure;
- There is a significant chance of fatality with extended exposure and a high chance of injury.

Therefore, sufficient separation distance must be provided such that:

- The heat radiation received at the site boundary is less than 4.7kW/m^2; and
- The heat radiation on the adjacent container is less than 12.6kW/m^2.

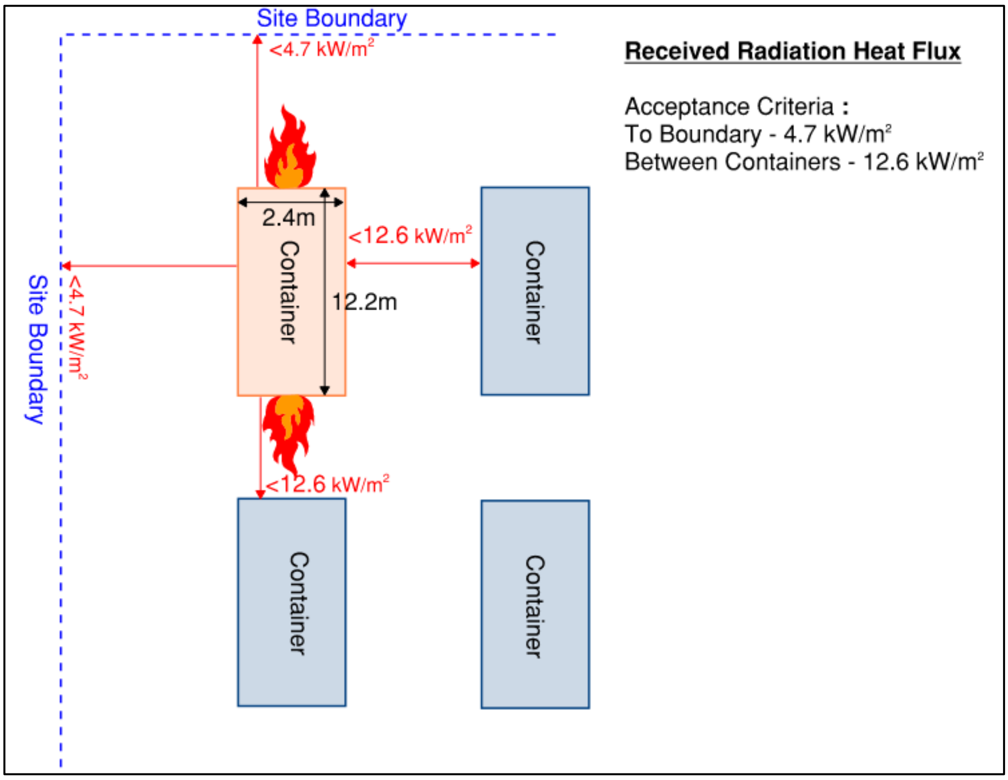


Figure 8 Pictorial representation of the fire modelling scenario.

Results

The results of the modelling are presented in Figure 9.

As shown in Figure 9, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the container and site boundary = 5.5 m; and
- Side container wall and site boundary = 5.25 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent containers, the required minimum separation distance between the:

- Front/end of the container and adjacent container = 3.25 m; and
- Side container wall and adjacent container = 2.0 m.

This is represented pictorially in Figure 10. However, as a conservative measure, it is recommended that the separation distances are as follows:

- Between the long ends of the containers shall not be less than 3.25 m;
- Between the sides of the containers shall not be less than 3 m; and
- The distance from the site boundary shall not be less than 10m.

There is the potential for these values to be further refined upon review of the UL9540A fire test report that should be furnished by the BESS manufacturer.

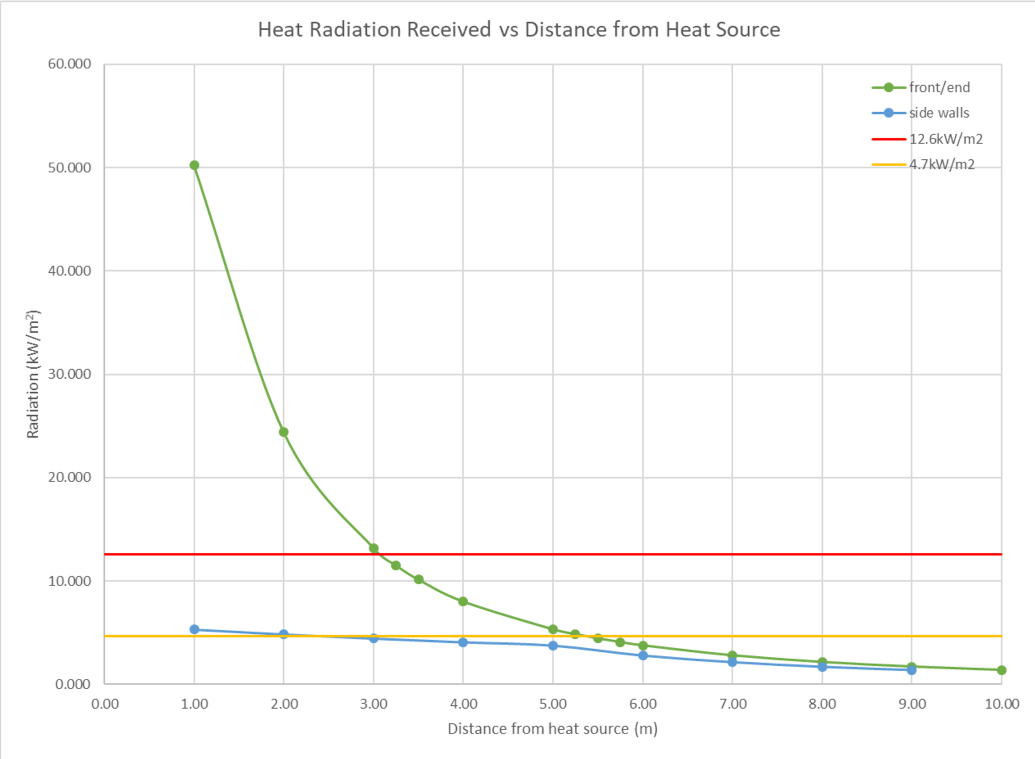


Figure 9 The results of the fire modelling, showing heat flux radiation plotted against the separation distance. The red line is set at 12.6 kW/m^2 while the orange line is set at 4.7 kW/m^2.

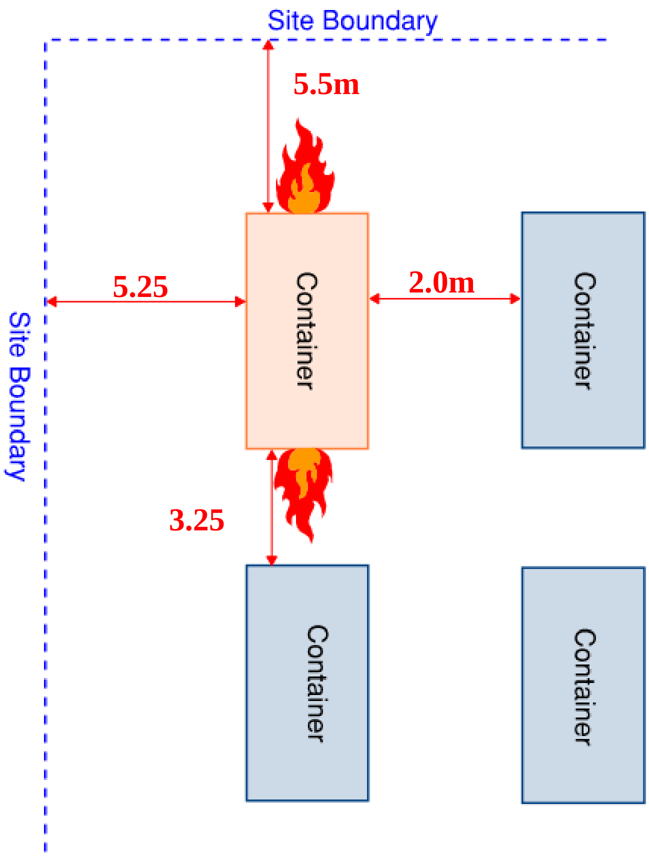


Figure 10 Pictorial representation of the fire modelling results.

Additionally, it is recommended that a containerised BESS, requiring entry for maintenance, have a fire suppression system. It is preferred for the fire suppression system to not rely on shutdown of the battery cooling system. The fire suppression system design should also consider the explosion hazard presented by offgassing, as discussed further in Section 4.2. These recommendations are considered sufficient to mitigate the offsite impact of this event SFAIRP.

4.1.3 Fire Tests

The analyses performed above are independent of the details of specific technology options; this is a conservative approach which allows for greater flexibility in the final selection of technology options as the project progresses.

However, in the course of performing this more conservative analysis, design and safety features are not taken into consideration. It is appropriate to consider these features if a more specific analysis has been performed. Typically, this analysis takes the form of a fire test performed to appropriate standards, such as those specified by the NFPA.

For example, the Tesla Megapack underwent fire testing using the UL9540A Test Method. The results of that testing, published in 2019, indicated that a separation distance of 6 inches (155 mm) between the sides and backs of Megapack units was acceptable to prevent fire spread from unit to unit. This is demonstrated in Figure 11.

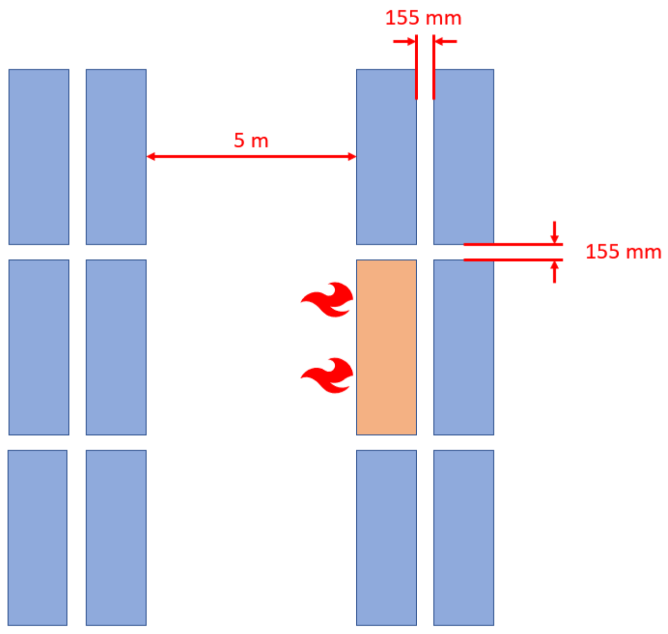


Figure 11: Acceptable spacing between Tesla Megapacks based on UL9540A testing results. (Note: 5 m separation is based on the analysis performed in this report.)

Should the Tesla Megapack be the technology option selected, the separation distances between units outlined in that 2019 fire test would be an appropriate basis for the BESS layout. Similarly, an equivalent fire test report for an alternative technology option would be applicable if that technology is ultimately used.

Arup recommends that the 10 m setback distance between the edge of the outermost battery unit in the BESS and the site boundary be maintained irrespective of the results of the fire tests.

4.2 Battery Explosion

As the final battery technology has not yet been chosen for the Site, this hazard has been considered for all technology options.

Due to the variety in BESS unit design options, a confined VCE was modelled for a vapour release scenario inside a battery container. Based on Arup's previous work, it is known that at high temperatures (100 °C or more), cells are designed to vent, to release internal gas pressure [6]. It is also known that for 20 ft containers, in a worst-case scenario, 400 L of hot gas will be released. This has been conservatively adjusted to be 800 L for the 40 ft containers being considered at the site. Teng et al. (2015) [7] give the compositions of gas generated by different electrolyte combinations at different charge levels. For 1:2 mixture of ethylene carbonate (EC) and diethyl carbonate (DEC), the composition of the released gas was derived from Teng et al.'s (2015) [7] testing and is shown in Table 4.

Table 4: Gas composition of a standard $LiPF_6$-EC-DEC electrolyte during a high temperature event

Material	Gas composition by mass (%)
Carbon Monoxide	34.8
Carbon Dioxide	0.2
Methane	0.3
Ethane	0.7
Ethylene	63.9

The scenario upon which the VCE model was based is an 800 L cloud of the released gas forming within the container. The indicative size of the container has been assumed to be 12.2 m (L) x 2.35 m (W) x 2.39 m (H), giving a volume of 68.5 m^3. Assuming that the batteries and other equipment inside the container take up 50% of the available space, 34.25 m^3 was available for the gas mixture to accumulate Modelling was performed using DNV GL's modelling software *Phast v8.22*.

Using the ideal gas law $pV = nRT$, where $p = 101325\ Pa$, $V = 0.8\ m^3$, $R = 8.314\ m^3 PaK^{-1} mol^{-1}$, and $T = 373.15\ K$ gives 26.1 moles of the gas mixture and air. The molecular weight of the released gas has been calculated to be 28 g/mol which gives 732 g of fuel at 100 °C and 1 atm.

The Multi-Energy method was used to model the explosion behaviour. One of the parameters used in this method is the 'explosion strength', which is a number between 1 and 10, and is used to define the equation used in the calculations. Due to the highly confined nature of the scenario, an explosion strength of 7 was deemed most appropriate for the situation.

The inputs for the model are given in Table 5 below.

Table 5: Input parameters for the VCE model

Parameter	Value
Material	$LiPF_6$-EC-DEC mixture
Flammable mass in cloud (kg)	0.732
Volume of confined source (m^3)	34.25
Strength of explosion	7

The results are presented in Figure 12 and Table 6 below.

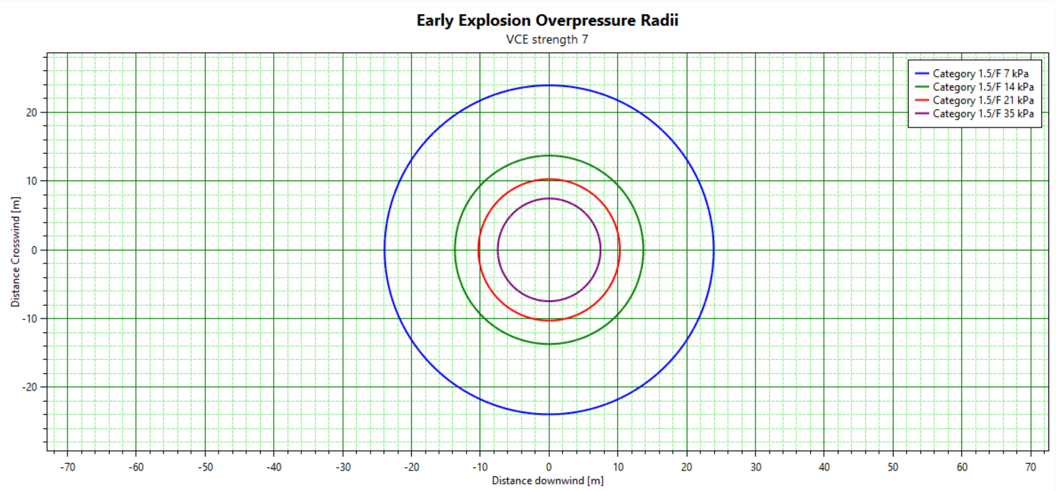


Figure 12 Overpressure contours for the VCE model

Table 6: Distances to overpressures of interest for VCE model

Overpressure (kPa)	Distance from blast centre (m)
7	24
14	14
21	10
35	7.5

HIPAP 4 [2] suggests that 7 kPa is an appropriate cut-off for risk criteria for offsite impacts. As such, it is recommended that a container without any explosion prevention or venting be at least 24 m from the site boundary to reduce the consequence of this risk. Alternatively, to reduce the likelihood and consequence of this event occurring, Arup makes the following recommendation:

- Procure a containerised BESS with explosion venting or an explosion prevention system designed to NFPA 68, NFPA 69, or an international equivalent.

The explosion venting or prevention system described above is considered sufficient mitigation to allow for the separation distances to the:

- Front/end of the container and adjacent container = 3.25 m
- Side container wall and adjacent container = 2.0 m

These recommendations are considered sufficient to mitigate the offsite impact of this event SFAIRP.

5 Findings and Recommendations

The two hazards that were identified as having the potential to cause offsite impacts, namely a battery fire and battery explosion, were carried forward for quantitative consequence analysis.

As the final battery technology has not yet been chosen for the site, these hazards were considered for both modular/cabinet and containerised solutions.

For a fire in a modular/cabinet unit, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and site boundary = 2.25 m; and
- Side modular/cabinet unit wall and site boundary = 9 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent modular/cabinet units, the required minimum separation distance between the:

- Front/end of the modular/cabinet unit and adjacent modular/cabinet unit = 1 m; and
- Side modular/cabinet unit wall and adjacent modular/cabinet unit = 5 m.

For a fire in a container, in order to have a received radiant heat flux of less than 4.7 kW/m^2 at the site boundary, the required minimum separation distance between the:

- Front/end of the container and site boundary = 5.5 m; and
- Side container wall and site boundary = 5.25 m.

Similarly, in order to have a received radiant heat flux of less than 12.6 kW/m^2 on the adjacent containers, the required minimum separation distance between the:

- Front/end of the container and adjacent container = 3.25 m; and
- Side container wall and adjacent container = 2.0 m.

For an explosion in the unit, a vapour cloud explosion of vented gas was modelled. An overpressure of 7 kPa – the accepted minimum for injury or fatality – was found to extend to a distance of 24 m, and an overpressure of 35 kPa – corresponding to significant damage of structures – was found to extend to a distance of 7.5 m.

Arup makes the following recommendations to ensure that the residual risks for the identified hazards will be reduced SFAIRP:

- Separate the BESS 24 m from the site boundary unless the following are met:
    1. BESSs shall have a means to safely vent or prevent an explosion designed to NFPA 68, NFPA 69, or an international equivalent to reduce this risk SFAIRP.

2. In the absence of more specific test data, containerised BESSs shall be separated from one another by not less than 3.25 m end to end and not less than 3 m side to side, and separated from the site boundary by not less than 10 m.

3. In the absence of more specific test data, modular/cabinet BESSs shall be separated from one another by not less than 2 m end to end and not less than 5 m side to side, and separated from the site boundary by not less than 10 m.

   If specific test data exist, the recommended separation distances between units provided for in those data can be used in preference to the distances listed here. For example, the Tesla Megapack can be separated be 6 inches (155 mm) side-to-side or back-to-back as demonstrated by fire testing performed using the UL9504A Test Method.

- Ensure the BESS manufacturer supplies the UL9540A fire test report for further refinement of separation distances.
- Ensure BESSs have a fire suppression system, if they are to be entered for maintenance. Additionally:

  1. It is preferred for the fire suppression system to not rely on shutdown of the battery cooling system.

The fire suppression system design should also consider the explosion hazard.

Bibliography

[1] NSW Department of Planning, Industry and Environment (DPIE), *Multi-level Risk Assessment*, 2011.

[2] NSW Department of Planning, Industry and Environment (DPIE), *HIPAP No. 4 - Risk Criteria for Land Use Safety Planning*, 2011.

[3] NSW Department of Planning, Industry and Environment (DPIE), *HIPAP No. 6 - Guidelines for Hazard Analysis*, 2011.

[4] NSW Department of Planning, Industry and Environment (DPIE), *Applying SEPP 33*, 2011.

[5] T. P. a. L. Liedquist, *Steel Emissivity at High Temperature,* VTT Research Notes 2299, 2005.

[6] Arup, "Preliminary Hazards Assessment for Sapphire Solar Farm and Battery Installation," 2017.

[7] Xin Teng et al., "In Situ Analysis of Gas Generation in Lithium-Ion Batteries with Different Carbonate-Based Electrlytes," Beijing Key Laboratory of Environment Science and Engineering, School of Materials Science and Engineering, Beijing Institute of Technology, Beijing, 2015.

[8] National Transport Commission Australia, *Australian Code for the Transport of Dangerous Goods by Road & Rail, Edition 7.6,* 2018.

[9] US National Fire Protection Association, *Fire Hazard Assessment of Lithium Ion Battery Energy Storage Systems*, 2016.

Appendix A

HAZID Risk Register

A1 Risk Register

Facility/Event	Cause/Comment	Possible Results/Consequences	Risk (considering current and proposed controls)			
			Existing Controls	Likelihood	Consequence	Risk
Lithium Ion Cell Leakage	Damage to cells caused by external event	Leakage of battery materials requiring clean-up	Lithium batteries do not contain free liquid electrolytes Individual cells are used which minimises extent of release	Rare	Minor	Low
Damage to batteries from vehicle collision	Light vehicle strike to batteries	Damage to battery cells Electrical risks	Use of perimeter fence around battery facility Use of internal access roads with appropriate turning circles Limit of speed limit within fenced facility Earthing system installed as per normal electrical facilities	Rare	Moderate	Low
Transformer Oil Leakage	Corrosion of tank base or leakage of oil tank	Leakage of transformer oil to environment	Use of fully bunded oil storage for transformers in accordance with AS1940 Regular tank inspections included in O&M contract inspection requirements	Unlikely	Minor	Low
Overhead Line Failure	Collapse or fall of overhead electricity line onto battery storage facility	Falling of overhead line near facility	Location of all equipment outside TransGrid easements for overhead lines Normal electricity industry practice for plant shutdown Adherence to AS7000 for overhead lines	Rare	Minor	Low
Security Breach	Security breach into battery storage facility for theft of components	Theft of equipment or risk to personnel	Installation of security fencing around entire facility and also battery facility separately Installation of CCTV security system to monitor key areas O&M inspections to monitor for security breaches	Unlikely	Moderate	Medium
Fire Spreading Internally from Battery Packs	Spread of fire across battery facility between battery packs	Localised fire causing damage by spreading to facility	Separation distances between battery packs in accordance with manufacturer recommendations Adherence to bushfire management plan Coordination with local fire authorities Use of thermal CCTV security cameras to identify fires remotely	Rare	Moderate	Low

Facility/Event	Cause/Comment	Possible Results/Consequences	Risk (considering current and proposed controls)			
			Existing Controls	Likelihood	Consequence	Risk
Coolant leakage causing eye irritation	Minor spray in eye if working on battery coolant system	Minor leakage of coolant (typical of normal engine coolant) during minor maintenance activities at site	Use of appropriately qualified maintenance personnel Use of portable eye wash (squeeze bottle) for work on battery cooling system	Possible	Minor	Low
Electrocution from electrical facility	Electrocution due to electrical fault	Electrical fault causing personnel injury	Normal electrical standards including AS3000 and installation of appropriate earthing system Use of appropriately qualified maintenance personnel	Rare	Major	Medium
Damage due to lightning strike	Lightning striking facility and causing damage	Lightning strike causing damage to facility or personnel	Completion of a lightning risk assessment in accordance with AS1768 Include lightning protection measures if deemed necessary	Unlikely	Minor	Low
Flooding of facility causing damage	High rainfall and flooding to site	Damage to electrical equipment Restricted access to site	Undertake a site-specific flooding/hydrology study to determine site flood risk and Q100 flood levels Install all electrical equipment to be above the Q100 flood level with some freeboard Ensure suitable site access and egress at different locations	Rare	Moderate	Low
Miscellaneous and Small Stores of Dangerous Goods Being Spilled	Improper handling or storage of dangerous goods	Injury to personnel Minot spill to environment	Use an appropriately rated dangerous goods cabinet for small stores in accordance with Australian Standards Use appropriate bunding for chemicals stored in IBCs Provide all MSDSs on site and only use appropriately qualified personnel for handling Comply with appropriate transport requirements according to the Australian Dangerous Goods Code.	Possible	Low	Low
Explosion of Battery Cells	Explosion of cells from physical impact causing damage to equipment and personnel	Damage to surrounding equipment and injury to personnel	Liaise with battery OEM for relevant clearance distances And understand failure mechanics for battery explosion if relevant Use of perimeter fence around battery facility Use of internal access roads with appropriate turning circles Limit of speed limit within fenced facility	Rare	Moderate	Low

Facility/Event	Cause/Comment	Possible Results/Consequences	Risk (considering current and proposed controls)			
			Existing Controls	Likelihood	Consequence	Risk
Construction risks	General miscellaneous construction risks	Injuries to construction personnel	Develop a WHS plan Conduct detailed Safety in Design processes during project execution	Unlikely	Moderate	Medium
O&M risks	General miscellaneous O&M risks	Injuries to operations personnel	Develop a WHS plan Conduct detailed Safety in Design processes during project execution	Unlikely	Moderate	Medium
High wind events and seismic events	High wind or seismic events causing structural damage to equipment or battery packs	Damage to equipment and injury to personnel	Design in accordance with AS1170 considering appropriate wind speed and seismic design requirements	Rare	Minor	Low
Transport and delivery (manual handling)	Personnel injury through manual handling of equipment during operations	Personnel injury through inappropriate handling or spillage of handled equipment	Ensure a traffic management plan is in place during construction Adhere to requirements of a WHS plan and the ADG code Ensure site specific handling equipment of a ‘trolley’ is used for handling of battery equipment, including portable facilities for handling where appropriate	Unlikely	Minor	Low
Exposure to dangerous goods during site emergency	Site emergency event causing personnel injury through exposure to dangerous materials during site emergency	Site emergency event causing personnel injury through exposure to dangerous materials during site emergency	Have a site-specific Emergency Response Plan (ERP) for the facility Installation of appropriate signage and labelling to identify site specific hazards for different areas Liaise with emergency response workers for site specific response requirements	Rare	Major	Medium
Offsite impacts	Fire in or explosion of BESS with impacts extending past the site boundary	Societal and individual injuries and/or fatalities	Appropriate separation distances from the site boundary Ensure the BESS has a fire suppression system Containerised BESSs should have explosion venting or explosion prevention system	Rare	Major	Medium

Appendix B

Heat Radiation Calculations

B1 Heat Radiation Calculations

A fire event in a battery unit was modelled. In order to assess the worst credible case off-site risk, it was assumed that all fire prevention measures have failed and a unit has caught fire. One fire configuration was considered in which double doors at both ends of a container are open. Another fire configuration had doors along the long side of a modular/cabinet unit open.

The radiative heat flux emitted from the surface of the unit was calculated using the Stefan-Boltzmann Law:

$$j^*_{emitter} = \varepsilon \sigma T^4$$

where j^* is the radiant emittance, ε is the emissivity of the unit/smoke, σ is the Stefan-Boltzmann constant and T is the surface temperature. The heat flux received was calculated using the view factor method:

$$j^*_{receiver} = 4 \cdot \emptyset \cdot j^*_{emitter}$$

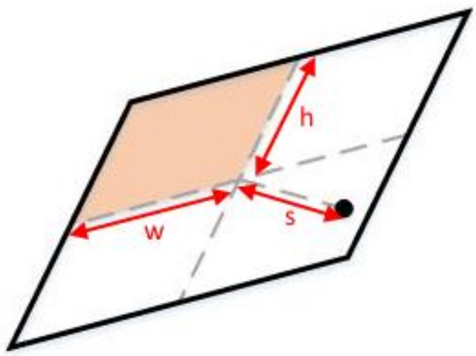
The view factor, $\emptyset$, is given by the equation

$$\emptyset = \frac{1}{2\pi}\left[\frac{a}{(1+a^2)^{1/2}}\tan^{-1}\frac{b}{(1+a^2)^{1/2}} + \frac{b}{(1+b^2)^{1/2}}\tan^{-1}\frac{a}{(1+b^2)^{1/2}}\right]$$

The parameters a and b are given by the following equations, where h is half the height of the surface, w is half the width of the surface and s is the perpendicular distance from the surface to the point of interest:

$$a = \frac{h}{s}\,;\, b = \frac{w}{s}$$

This is represented graphically as follows:



The radiative heat flux emitted was calculated using the Stefan-Boltzmann Law:

$$j^*_{emitter} = \varepsilon \sigma T^4$$

TEST REPORT

ANSI/CAN/UL 9540A:2019
Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Report Number............................. :	32072059.002
Date of issue .... :	Dec. 01, 2020
Total number of pages .... :	27
Name of Testing Laboratory preparing the Report .... :	**TÜV Rheinland of North America, Inc.** 1279 Quarry Lane, Suite A, Pleasanton, CA 94566
Applicant's name .... :	**Tesla, Inc.**
Address .... :	3500 Deer Creek Road, Palo Alto, CA 94304
Test specification:	
Standard .... :	ANSI/CAN/UL 9540A:2019
Test procedure.............................. :	Report
Non-standard test method........... :	N/A
Test Report Form No. .... :	N/A
Test Report Form(s) Originator.... :	N/A
Master TRF .... :	Dated 2019-01-17

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the CB, responsible for this Test Report.

Test item description ....:	Battery Energy Storage System
Trade Mark ....:	Tesla
Manufacturer....................................:	Tesla, Inc, (new # 1210368) 3500 Deer Creek Rd, Palo Alto, CA 94304
Model/Type reference ....:	1462965-XX-Y Megapack XX – can be any number from 00 to 99. XX – represents style codes used for different variants of the same part, having no impact on the safety and functionality of the entire product. Y – can be any upper case letter from A to Z. Y – represents pedigree and is used for tracking changes to parts that have already been released to suppliers or production, having no impact on the safety and functionality of the entire product
Ratings ....:	1) 480Vac, 1573 kVA 2) 505Vac, 1654.9 kVA (3 phase 3 wire or 3 phase 4 wire) Nominal Battery Power: 2 hr: 1341kW; 4 hr: 770.1kW Battery capacity 4hr: 3080.4kWh Battery capacity 2hr: 2682kWh

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒ **Testing Laboratory:**	**TÜV Rheinland of North America, Inc.** 1279 Quarry Lane, Suite A, Pleasanton, CA 94566	
Testing location/ address .... :		
Tested by (name, function, signature) .... :		
Approved by (name, function, signature) .. :		
☒ **Testing procedure: CTF Stage 1/TMP:**	**Tesla, Inc.**	
Testing location/ address .... :	3500 Deer Creek Road, Palo Alto, CA 94304	
Tested by (name, function, signature) .... :	Justin Goh/ Himanshu Vaidya	
Approved by (name, function, signature) .. :	Howard Liu	
☐ **Testing procedure: CTF Stage 2/WMT:**		
Testing location/ address .... :		
Tested by (name + signature) .... :		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) .. :		
☐ **Testing procedure: CTF Stage 3/SMT:**		
☐ **Testing procedure: CTF Stage 4:**		
Testing location/ address .... :		
Tested by (name, function, signature) .... :		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) .. :		

Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment):

1. Test package with testing equipment list
2. Photo documentation

Summary of testing:

Tests performed (name of test and test clause):	Testing location:
9540A cl 9 – Unit Level	Tesla, Inc. Tesla Battery Test Facility Fernley, Nevada

Summary of compliance with National Differences (List of countries addressed): N/A

☐ **The product fulfils the requirements of _________ (insert standard number and edition and delete the text in parenthesis, leave it blank or delete the whole sentence, if not applicable)**

Possible test case verdicts:	
- test case does not apply to the test object....:	N/A
- test object does meet the requirement...........:	P (Pass)
- test object does not meet the requirement....:	F (Fail)
Testing:	
Date of receipt of test item ....:	May 10, 2020
Date (s) of performance of tests ....:	May 13, 2020
General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
Name and address of factory (ies) .... :	
Copy of marking plate: Use – "Only for use with Tesla Products" "The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCB' s that own these marks"	
General product information and other remarks:	

ANSI/CAN/UL 9540A:2019			
Clause	Requirement – Test	Result – Remark	Verdict

CONSTRUCTION			--
5	**General**		--
5.1	**Cell**		P
5.1.1	The cells associated with the BESS that were tested shall be documented in the test report	Panasonic Model NCR2170D LiNiCoAlO2 Cylindrical Lithium ion battery Rated capacity (Ah): 3930mAh Nominal voltage (V): 3.6V Upper limit charging voltage (V) : 4.2V Nominal mass (g): 70.6g or less (68.1g typ) External dimensions (mm): 21+/-0.12mm diameter, 70+/-0.25mm height LG Model INR21700M48F (Note: Refer to A2.2.2. Its cell level testing was completed and evaluated to a baseline fire performance data.)	P
5.1.2	The cell documentation included in the test report shall indicate if the cells associated with the BESS comply with UL 1973	Battery module is compliant with UL 1973. Cell is compliant with UL 1642.	P
5.1.3	Refer to 7.6.1 for further details	See 7.6.1	N/A
5.2	**Module**		P

ANSI/CAN/UL 9540A:2019			
Clause	Requirement – Test	Result – Remark	Verdict
5.2.1	The modules associated with the BESS that were tested shall be documented in the test report	Battery module (12 modules in series): Rated Voltage MV (before DCDC converter) nominal voltage: 400V MV max. charge voltage: 470 V(operational) (460 V full power) MV min. discharge voltage: 216 V (operational) (324 V full power) Rated Current Max. HV charge/discharge current: 116 A (2 hr), 58 A (4 hr) Max. MV charge/discharge current: 280.8 A (2 hr), 143.8 A (4 hr) Max. HV charge and discharge power: 125 kW (2 hr), 52 kW (4 hr) Battery module: Nominal voltage: 33.3 V Max charge voltage: 38.75 V(operational) (37.75 V full power) Min. discharge voltage: 18 V (operational) (27 V full power)	P
5.2.2	The module documentation included in the test report shall indicate if the modules associated with the BESS comply with UL 1973	Battery module is compliant with UL 1973	P
5.2.3	Refer to 8.3 for further details	See 8.3	N/A
5.3	**Battery energy storage system unit**		P
5.3.1	The BESS unit documentation included in the test report shall indicate the units that comply with UL 9540	UL 9540 compliant	P
5.3.2	For BESS units for which UL 9540 compliance cannot be determined,	See above	N/A
5.3.3	If applicable, the details of any fire detection and suppression systems that are an integral part of the BESS shall be noted in the test report	No fire detection and suppression systems used	N/A
5.3.4	Refer to 9.7, 10.4 and 10.7 for further details	See 9.7	P
5.4	**Flow Batteries**		N/A
5.4.1	For flow batteries, the report will cover the chemistry, as well as the electrical rating in capacity and nominal voltage of the cell stack	Not flow batteries	N/A
5.4.2	The flow battery documentation included in the test report shall indicate if the flow battery system complies with UL 1973		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
5.4.3	See 7.6.2 for further details		N/A
PERFORMANCE			--
6	**General**		N/A
6.1	The tests in this standard are extreme abuse conditions conducted on electrochemical energy storage devices that can result in fires		N/A
6.2	At the conclusion of testing, samples shall be discharged in accordance with the manufacturer's specifications		N/A
9	**Unit Level**		--
9.1	**Sample and test configuration**		--
9.1.1	The unit level test shall be conducted with BESS units installed as described in the manufacturer's instructions and this section. Test configurations include the following:		P
	a) Indoor floor mounted non-residential use BESS; b) Indoor floor mounted residential use BESS; c) Outdoor ground mounted non-residential use BESS; d) Outdoor ground mounted residential use BESS; e) Indoor wall mounted non-residential use BESS; f) Indoor wall mounted residential use BESS; g) Outdoor wall mounted non-residential use BESS; h) Outdoor wall mounted residential use BESS; and i) Rooftop and open garage non-residential use BESS installations.	Outdoor ground mounted non-residential use BESS	P
9.1.2	The unit level test requires one initiating BESS unit in which an internal fire condition in accordance with the module level test is initiated and target adjacent BESS units representative of an installation	One initiating BESS and two target adjacent BESS	P
	Exception: Testing can be conducted outdoors for outdoor only installations if there are the following controls and environmental conditions in place:	Testing can be conducted outdoors for outdoor only installations See Figure 1	P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) Wind screens are utilized with a maximum wind speed maintained at ≤ 12 mph; b) The temperature range is within 10°C to 40°C (50°F to 104°F); c) The humidity is < 90% RH; d) There is sufficient light to observe the testing; e) There is no precipitation during the testing; f) There is control of vegetation and combustibles in the test area to prevent any impact on the testing and to prevent inadvertent fire spread from the test area; and g) There are protection mechanisms in place to prevent inadvertent access by unauthorized persons in the test area and to prevent exposure of persons to any hazards as a result of testing.	This was an outdoor installation test. The ambient temperature was varied between 10°C and 27°C and humidity less than 90% RH, and wind was under 12 mph.	P
9.1.3	Depending upon the configuration and design of the BESS (e.g. the BESS is composed of multiple separate parts within separate enclosures), this testing to determine fire characterization can be done at the battery system level	Testing performed at BESS level	N/A
9.1.4	The initiating BESS unit shall contain components representative of a BESS unit in a complete installation.	Complete unit in the testing	P
9.1.5	Target BESS units shall include the outer cabinet (if part of the design), racking, module enclosures, and components		P
9.1.6	The initiating BESS unit shall be at the maximum operating state of charge (MOSOC),	100% SOC	P
9.1.7	If a BESS unit includes an integral fire suppression system, there is an option of providing this with the DUT	No integral fire suppression system	N/A
9.1.8	Electronics and software controls such as the battery management system (BMS) in the BESS are not relied upon for this testing.		P
9.2	**Test method – Indoor floor mounted BESS units**	Outdoor ground mounted units. Used the test method described in the Section 9.2 except conflicted with Section 9.3.	--
9.2.1	Samples and test configurations are in accordance with 9.1.	Testing conducted outdoor	N/A
9.2.2	Any access door(s) or panels on the initiating BESS unit and adjacent target BESS units shall be closed,	Doors closed	P
9.2.3	The initiating BESS unit shall be positioned adjacent to two instrumented wall sections	No instrumented wall sections	N/A
9.2.4	Instrumented wall sections shall extend not less than 0.49 m (1.6 ft) horizontally beyond the exterior of the target BESS units.	No instrumented wall sections	N/A
9.2.5	Instrumented wall sections shall be at least 0.61-m (2-ft) taller than the BESS unit height	No instrumented wall sections	N/A
9.2.6	The surface of the instrumented wall sections shall be covered with 16-mm (5/8-in) gypsum wall board and painted flat black	No instrumented wall sections	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
9.2.7	The initiating BESS unit shall be centered underneath an appropriately sized smoke collection hood of an oxygen consumption calorimeter	Testing conducted outdoor	N/A
9.2.8	The light transmission in the calorimeter's exhaust duct shall be measured using a white light source and photo detector for the duration of the test	Testing conducted outdoor	N/A
9.2.9	The chemical and convective heat release rates shall be measured for the duration of the test, using the methodologies specified in 8.2.11 and 9.2.12, respectively	Testing conducted outdoor	N/A
9.2.10	With reference to 9.2.9, the heat release rate measurement system shall be calibrated	Testing conducted outdoor	N/A
9.2.11	With reference to 9.2.9, the convective heat release rate shall be measured using thermopile	Testing conducted outdoor	N/A
9.2.12	With reference to 9.2.9, the convective heat release rate shall be calculated using the following equation: $HRR_c = V_e A \frac{353.22}{T_e} \int_{T_o}^{T} C_p dT$	Testing conducted outdoor	N/A
9.2.13	The physical spacing between BESS units (both initiating and target) and adjacent walls shall be representative of the intended installation	No instrumented wall sections	N/A
9.2.14	Separation distances shall be specified by the manufacturer for distance between:		P
	a) The BESS units and the instrumented wall sections; and b) Adjacent BESS units.	a) No wall b) 6 inches from ISO knuckle of Initiating unit to Target unit. 4 inches from surface of initiating unit to target unit surface.	P
9.2.15	Wall surface temperature measurements shall be collected for BESS intended for installation in locations with combustible construction.	No instrumented wall sections	N/A
9.2.16	Wall surface temperatures shall be measured in vertical array(s) at 152-mm (6-in) intervals for the full height of the instrumented wall sections using No. 24-gauge or smaller,	No instrumented wall sections	N/A
9.2.17	Thermocouples shall be secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires	No instrumented wall sections	N/A
9.2.18	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter gauges at the surface of each instrumented wall:	No instrumented wall sections	N/A
	a) Both are collinear with the vertical thermocouple array;		N/A
	b) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module; and		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	c) One is positioned at the elevation estimated to receive the greatest heat flux during potential propagation of thermal runaway within the initiating BESS unit.		N/A
9.2.19	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit:	No target facing the initiating BESS	N/A
	a) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module within the initiating BESS; and		N/A
	b) One is positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.		N/A
9.2.20	For non-residential use BESS, heat flux shall be measured with the sensing element of at least one water-cooled Schmidt-Boelter gauge	Testing conducted outdoor	N/A
9.2.21	No. 24-gauge or smaller, Type-K exposed junction thermocouples shall be installed to measure the temperature of the surface	No. 24-gauge, Type-K used	P
9.2.22	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth	Non-residential	N/A
9.2.23	An internal fire condition in accordance with the module level test shall be created within a single module in the initiating BESS unit:	See Figure 2 Megapack can consist up to 17 Battery Module assemblies. Each module assembly contains 6 trays of 2 Modules each which is a total of 204 modules. The module that was set to initiate was located at location 72 and on Tray III. Two sections of heaters with 29 and 27 heater were setup to force thermal runaway.	P
	a) The position of the module shall be selected to present the greatest thermal exposure		P
	b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module shall be the same as that used to initiate and propagate thermal runaway within the module level test		P
9.2.24	The composition, velocity and temperature of the initiating BESS unit vent gases shall be measured within the calorimeter's exhaust duct	Testing conducted outdoor	N/A
9.2.25	The hydrocarbon content of the vent gas shall be measured using flame ionization detection	Testing conducted outdoor	N/A
9.2.26	The test shall be terminated if:		P
	a) Temperatures measured inside each module within the initiating BESS unit return to ambient temperature;	Appilcable	P
	b) The fire propagates to adjacent units or to adjacent walls; or		N/A
	c) A condition hazardous to test staff or the test facility requires mitigation		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
9.2.27	For residential use systems, the gas collection data gathered in 9.2 shall be compared to the smallest room installation	Non-residential	N/A
9.3	**Test method – Outdoor ground mounted units**		--
9.3.1	Outdoor ground mounted non-residential use BESS being evaluated for installation in close proximity to buildings shall use the test method described in Section 9.2	See 9.2	P
9.3.2	except as noted in 9.3.3 and 9.3.4. Heat flux measurements for the accessible means of egress shall be measured in accordance with 9.2.20.	See 9.2	P
9.3.3	Test samples shall be installed as shown in Figure 9.2 in proximity to an instrumented wall section that is 3.66-m (12-ft) tall with a 0.3-m (1-ft) wide horizontal soffit	No instrumented wall sections	N/A
	Exception: If the manufacturer requires installation against non-flammable material, the test setup may include manufacturer recommended backing material between the unit and plywood wall		N/A
9.3.4	Target BESS shall be installed on each side of the initiating BESS in accordance with the manufacturer's installation specifications	No target unit on the front side	N/A
9.4	**Test Method – Indoor wall mounted units**	Testing conducted outdoor	N/A
9.4.1	Testing of indoor wall mounted BESS shall be in accordance with Section 9.2, except as modified in this section. See Figure 9.3.		N/A
9.4.2	The test shall be conducted in a standard NFPA 286 fire test room, 3.66 × 2.44 × 2.44-m (12 × 8 × 8-ft) high, with a 0.76 × 2.13-m (2-1/2 × 7-ft) high opening.		N/A
9.4.3	The initiating BESS unit shall be positioned on the wall opposite of the door opening		N/A
9.4.4	Target BESS shall be installed on the wall on each side of the initiating BESS		N/A
9.4.5	The wall on which the initiating and target BESS units are mounted shall be instrumented in accordance with Section 9.2.		N/A
9.4.6	The gas collection methods shall be in accordance with 9.2		N/A
9.4.7	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator.		N/A
9.5	**Test Method – Outdoor wall mounted units**	Testing conducted outdoor, ground mounted	N/A
9.5.1	Testing of outdoor wall mounted BESS shall be in accordance with Section 9.2, except as modified in this section. See Figure 9.4.		N/A
9.5.2	Test samples shall be mounted on an instrumented wall section that is 3.66-m (12-ft) tall with a 0.3-m (1-ft) wide horizontal soffit (undersurface of the eave shown in Figure 9.4).		N/A

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Clause	Requirement – Test	Result – Remark	Verdict

9.5.3	The initiating BESS unit shall be positioned on the instrumented wall, with its center located 1.22-m (4-ft) above the floor,		N/A
9.5.4	Target BESS shall be installed on the wall on each side of the initiating BESS, at the same height		N/A
9.5.5	The wall on which the initiating and target BESS units are mounted shall be instrumented in accordance with Section 9.2.		N/A
9.5.6	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth		N/A
9.6	**Rooftop and open garage installations**	Testing conducted outdoor, ground mounted	N/A
9.6.1	Testing of BESS intended for non-residential use rooftop or open garage installations shall be in accordance with 9.2.		N/A
9.6.2	If intended for rooftop and open garage use only installations, the smoke release rate, the convective and chemical heat release rate and content, velocity and temperature of the released vent gases need not be measured		N/A
9.7	**Unit level test report**		--
9.7.1	The report on the unit level testing shall identify the type of installation being tested, as follows:		P
	a) Indoor floor mounted non-residential use BESS; b) Indoor floor mounted residential use BESS; c) Outdoor ground mounted non-residential use BESS; d) Outdoor ground mounted residential use BESS; e) Indoor wall mounted non-residential use BESS f) Indoor wall mounted residential use BESS; g) Outdoor wall mounted non-residential use BESS; h) Outdoor wall mounted residential use BESS; i) Rooftop installed non-residential use BESS; or j) Open garage installed non-residential use BESS.	Outdoor ground mounted non-residential use BESS;	P
9.7.2	With reference to 9.7.1, if testing is intended to represent more than one installation type, this shall be noted in the report	One installation type	N/A
9.7.3	The report shall include the following, as applicable:	See Table 1	P

	a) Unit manufacturer name and model number (and whether UL 9540 compliant); b) Number of modules in the initiating BESS unit; c) The construction of the initiating BESS unit per 5.3; d) Fire protection features/detection/suppression systems within unit; e) Module voltage(s) corresponding to the tested SOC; f) The thermal runaway initiation method used; g) Location of the initiating module within the BESS unit; h) Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, and soffits; i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension; j) Chemical and convective heat release rate versus time data; k) Separation distances from the initiating BESS unit to target walls (e. g. distances A and C in Figure 9.1); l) Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and H in Figure 9.1); m) The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple; n) The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple; o) The maximum incident heat flux on target wall surfaces and target BESS units; p) The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test; q) Gas generation and composition data; r) Peak smoke release rate and total smoke release data; at which activation occurred; t) Observation of flying debris or explosive discharge of gases; u) Observation of re-ignition(s) from thermal runaway events; v) Observation(s) of sparks, electrical arcs, or other electrical events; w) Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units;		

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Clause	Requirement – Test	Result – Remark	Verdict
	3) Adjacent walls, ceilings, or soffits; and x) Photos and video of the test.		
9.8	**Performance at unit level testing**		--
9.8.1	Installation level testing in Section 10 is not required if the following performance conditions outlined in Table 9.1 are met during the unit level test.	a) Peak flame extension was observed to be at about 10-12 ft upwards and 8-10 ft in front of the unit. b) Surface temperatures of the modules within the target BESS remained below 140.2C (cell vent temperature). Maximum temperature measured was 44.5C. c) Not intended for installation near exposures, no measurements taken to walls. d) No explosion hazards observed (no deflagration, detonation, or accumulation of battery vent gases) e) Maximum incident heat flux was 17.5kW/m^2 at 3 ft from the left of the initiating cabinet enclosure (Note: Megapack is not designed to be installed near accessible means of egress. Refer to Figure 10. Heat Flux results for more information on heat flux around the product).	--
10	**Installation Level**	Unit level testing only	N/A
10.1	General		N/A
10.1.1	The installation level test method assesses the effectiveness of the fire and explosion mitigation methods for the BESS in its intended installation		N/A
	a) Test Method 1 – "Effectiveness of sprinklers" is used		N/A
	b) Test Method 2 – "Effectiveness of fire protection plan" is used		N/A
10.1.2	Installation level testing is not appropriate for units only intended for outdoor use or residential use.	Outdoor use only	P
10.2	Sample		N/A
10.2.1	The samples (initiating BESS and target BESS) and their preparation for testing		N/A
10.2.2	A flame indicator consisting of a cable tray with fire rated cables that complies with UL 1685 and representative of the installation per the anufacturer's specifications		N/A
10.3	Test method 1 – Effectiveness of sprinklers		N/A
10.3.1	For BESS units with a height of 2.44 m (8 ft) or less, the test shall be conducted in a 6.10 × 6.10 × 3.05-m (20 × 20 × 10-ft) high test room		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
10.3.2	The test room shall be fitted with four sprinklers at 3.05-m (10-ft) spacing in the center		N/A
10.3.3	Walls shall be constructed with 16-mm (5/8-in) gypsum wall board		N/A
10.3.4	The initiating BESS unit shall be positioned at manufacturer specified distances		N/A
10.3.5	Temperature measurements at the ceiling locations directly above the initiating and target BESS unit shall be collected by an array of thermocouples		N/A
10.3.6	Instrumented wall surface temperature measurements shall be collected in a vertical array at 152-mm (6-in) intervals		N/A
10.3.7	Thermocouples for wall surface temperature measurements shall be secured to gypsum surfaces by the use of staples		N/A
10.3.8	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter gauges at the surface of each instrumented wall:		N/A
	a) Both are collinear with the vertical thermocouple array;		N/A
	b) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module; and		N/A
	c) One is positioned at the elevation estimated to receive the greatest heat flux during potential propagation of thermal runaway within the initiating BESS unit.		N/A
10.3.9	Heat flux shall be measured with at least two sensing water-cooled Schmidt-Boelter gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit:		N/A
	a) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module within the initiating BESS; and		N/A
	b) One is positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.		N/A
10.3.10	The heat flux shall be measured with the sensing element of at least one water-cooled Schmidt-Boelter gauge		N/A
10.3.11	No. 24-gauge or smaller Type-K exposed junction thermocouples shall be installed		N/A
10.3.12	An internal fire condition in accordance with the module level test shall be created		N/A
	a) The position of the module shall be selected to present the greatest thermal exposure		N/A
	b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module shall be the same		N/A
10.3.13	The composition of BESS unit vent gases shall be measured		N/A
10.3.14	The test shall be terminated if:		N/A

Clause	Requirement – Test	Result – Remark	Verdict
	a) Temperatures measured inside each module of the initiating BESS return to below the cell vent temperature;		N/A
	b) The fire propagates to adjacent units or to adjacent walls; or		N/A
	c) A condition hazardous to test staff or the test facility requires mitigation.		N/A
10.3.15	The initiating unit shall be under observation for 24 h after conclusion of the installation test		N/A
10.4	Installation level test report – Test method 1 – Effectiveness of sprinklers		N/A
10.4.1	The report on installation level testing shall include the following:		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	a) Unit manufacturer name and model number (and whether compliant with UL 9540); b) Number of modules in the initiating BESS unit; c) The construction of the initiating BESS unit per 5.3; d) Module voltage(s) of initiating BESS corresponding to the tested SOC; e) The thermal runaway initiation method used; f) Diagram and dimensions of the test setup including location of the initiating and target BESS units, and the locations of walls and ceilings; g) Location of initiating module within the BESS unit; h) Separation distances from the initiating BESS unit to (e.g. distances A and C in Figure 10.1); i) Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and E in Figure 10.1); j) Distances of the flame indicator (if used) with respect to the BESS (e. g. distances A and B in Figure 10.2); k) Maximum temperature at the ceiling; l) Distance of fire spread within the flame indicator; m) The maximum wall surface and target BESS unit temperatures achieved during the test and the location of the measuring thermocouple; n) The maximum incident heat flux on target wall surfaces and target BESS units; o) Voltages of initiating BESS; p) Total number of sprinklers that operated and length of time the sprinklers operated during the test; q) Gas generation and composition data, if measured; r) Observation of flaming outside of the test room s) Observation of flying debris or explosive discharge of gases; t) Observation of re-ignition(s) from thermal runaway events; u) Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; and 3) Adjacent walls; v) Photos and video of the test; w) Fire protection features/detection/suppression systems within unit; and x) Sprinkler K-factor, RTI, manufacturer and model, number of sprinklers and layout		N/A
10.5	Performance – Test method 1 – Effectiveness of sprinklers		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
10.5.1	For BESS units intended for installation in locations with combustible construction, surface temperature measurements along instrumented wall surfaces shall not exceed a temperature rise of 97°C		N/A
10.5.2	The surface temperature of modules within the BESS units adjacent to the initiating BESS unit shall not exceed the temperature at which thermally initiated cell venting occurs		N/A
10.5.3	The fire spread on the cables in the flame indicator shall not extend horizontally beyond the initiating BESS enclosure dimensions		N/A
10.5.4	There shall be no flaming outside the test room.		N/A
10.5.5	There is no observation of detonation.		N/A
10.5.6	Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		N/A
10.5.7	There shall be no observation of re-ignition within the initiating unit after the installation test		N/A
10.5.8	An installation level test that does not meet the applicable performance criteria noted above is considered noncompliant and would need to be revised and retested		N/A
10.6	Test method 2 – Effectiveness of fire protection plan		N/A
10.6.1	The test method 2 test set-up and test procedures are identical to that in 10.3, except instead of the sprinkler system set up of 10.3.2, the room shall be fitted with the specified fire protection		N/A
10.7	Installation level test report – Test method 2 – Effectiveness of fire protection plan		N/A
10.7.1	The report on installation level testing shall include the following:		N/A
	a) The report information in 10.4.1 items (a) – (u), and (v) if applicable; b) Fire protection features/detection/suppression systems within installation; and c) Length of time of operation of the clean agent, or other suppression system in addition to any sprinklers used.		N/A
10.8	Performance – Test method 2 – Effectiveness of fire protection plan		N/A
10.8.1	See 10.5 for performance criteria		N/A

ANNEX A	**Test Concepts And Application Of Test Results To Installations**	INFORMATIVE	
A2.1	General		N/A
A2.2	Cell level testing		N/A

A2.2.2	Cell level testing performed on the cells used within a BESS module establishes a base line fire test performance that can be evaluated against the fire performance of other battery cells the BESS manufacturer may choose to use within the unit's modules.	Panasonic NCR2170D cell provides a baseline fire test performance (Report 32082976.001). LG INR21700M48F cell has been tested (Report 32073357.001) and evaluated to the baseline fire performance data (Reference table below)	P

Parameter	**Panasonic NCR2170D**	**LG INR21700M48F**
Type	Li ion	Li ion
Form factor	Cylindrical	Cylindrical
Diameter	21+/-0.12mm	21.16mm
Height	70+/-0.25mm	70.15mm
Rated Capacity	3930mAh	4600mAh
Nominal Voltage	3.6V	3.67V
Upper Limit charging voltage	4.2V	4.2V
Cell vent temperature	138.9C	207.5C
Thermal runaway temperature	242.7C	324.4C
LFL by vol%	6.04%	11%
Burning velocity	63.528cm/s	9.758cm/s
Pmax	5.71bar	6.01bar

ANNEX B	**Safety Recommendations for Testing**	INFORMATIVE	

Figure 1. Site layout

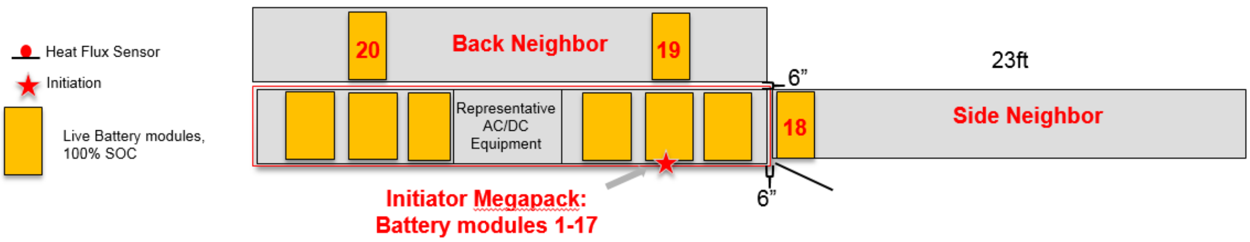


Figure 2. Test enclosure layout

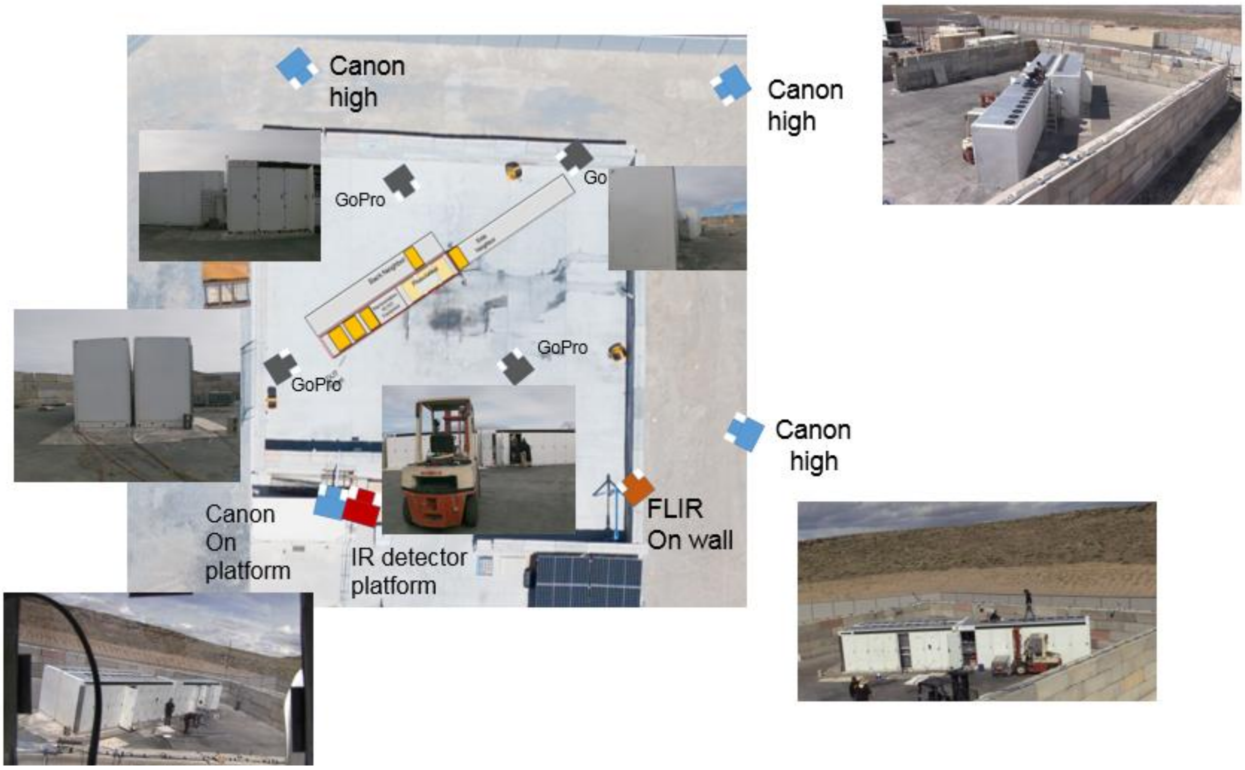
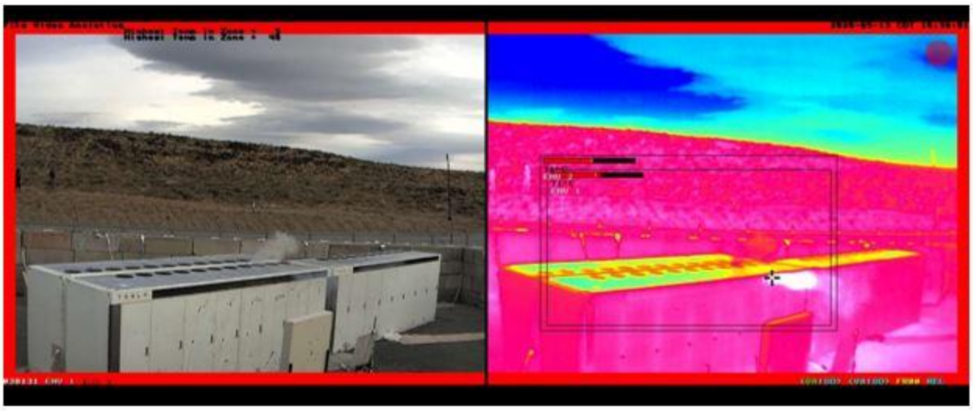
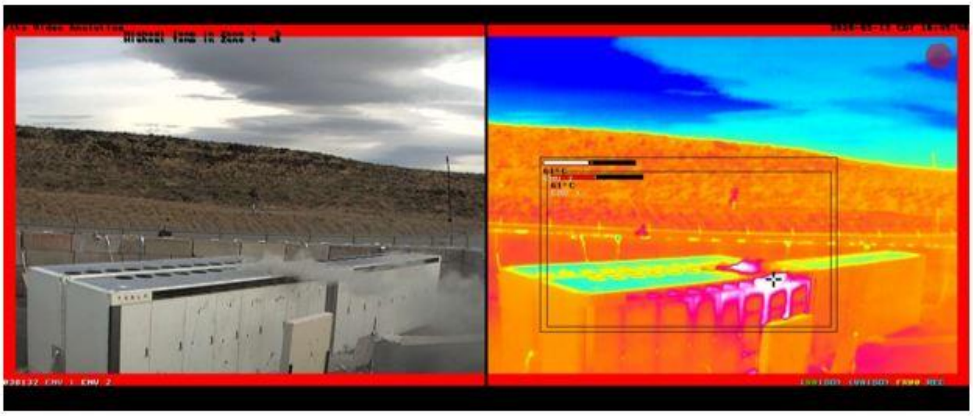


Figure 3. Camera and IR detector layout and view

Figure 4. White smoke indication



First alarm - 60 C trigger 38 seconds after first runaway



Second alarm - 60 C trigger 7 minutes 47 seconds after first alarm

Figure 5. IR detector alarm


Figure 6. Peak reaction rate site photo


Figure 7. End of test site photo

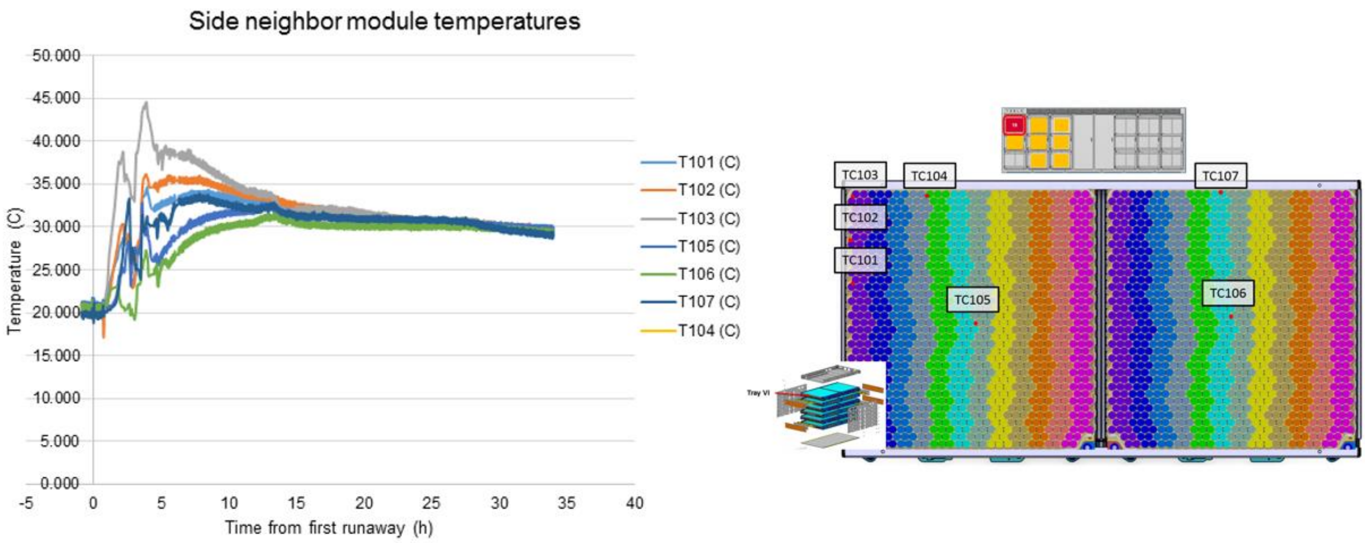


Figure 8. Side neighbor temperature result

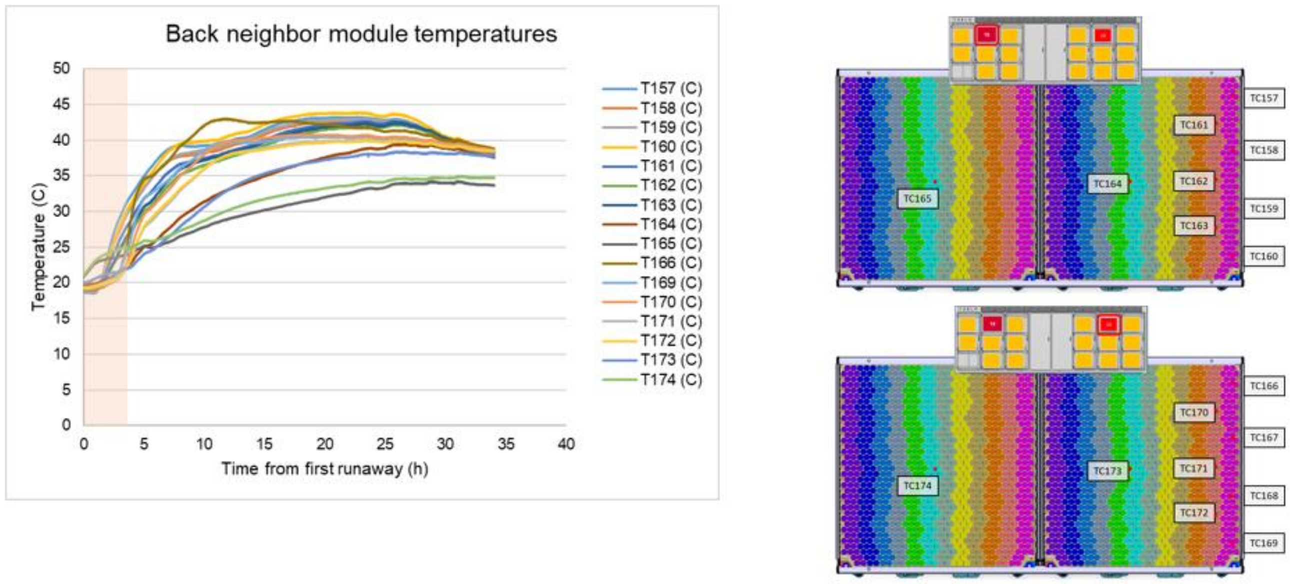


Figure 9. Back neighbor temperature result

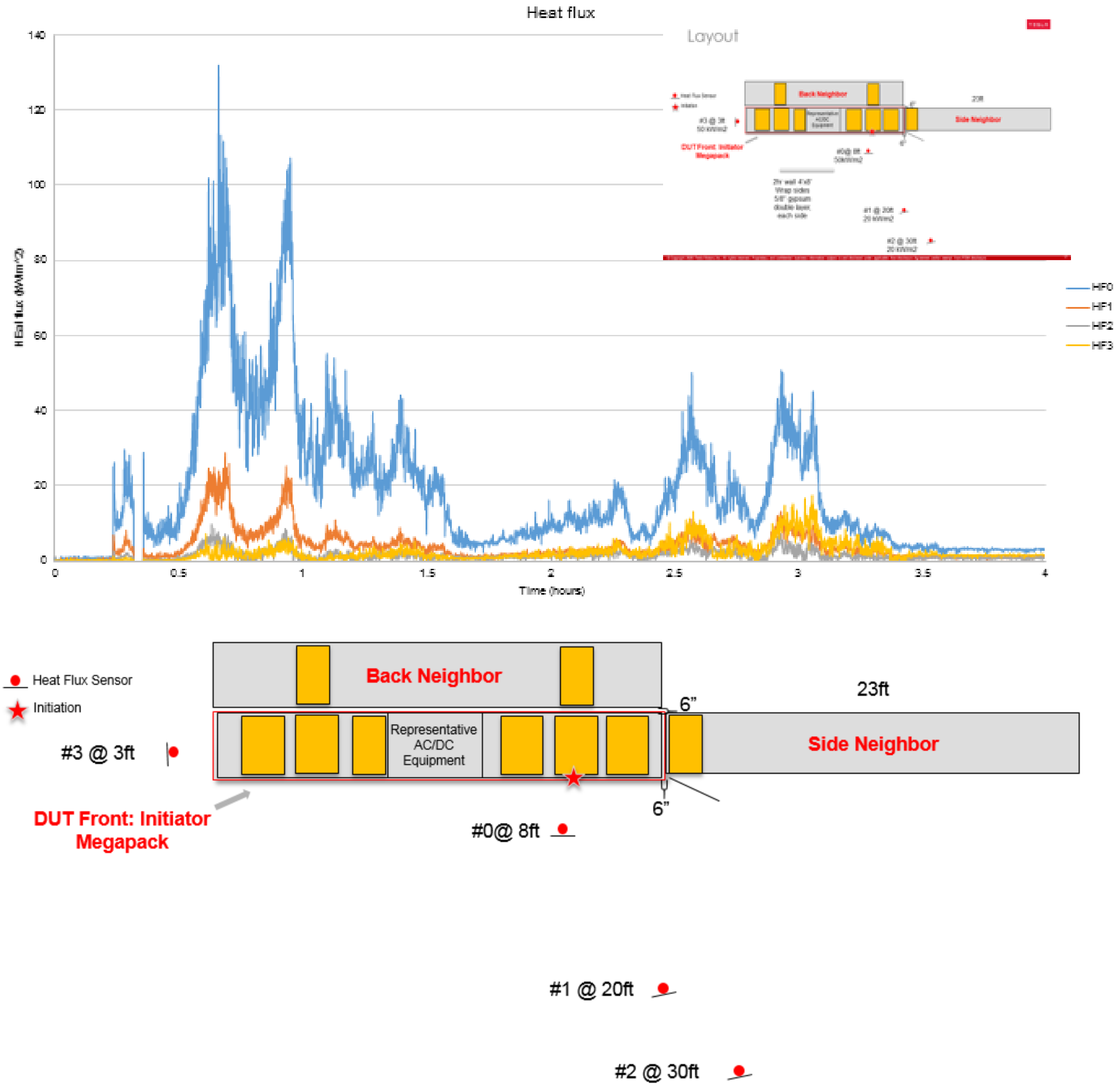


Figure 10. Heat flux results

Table 1. Test results per Clause 9.7

#	Items	Description
a)	Unit manufacturer name and model number (and whether UL 9540 compliant);	Tesla Megapack - 1462965
b)	Number of modules in the initiating BESS unit;	12 modules in a Battery assembly. Maximum 17 Battery assemblies in Megapack. 12 X 17 = 204
c)	The critical construction of the initiating BESS unit per 5.3;	UL 9540 compliant. Refer to TUV certificate CU 72200868
d)	Fire protection features/detection/suppression systems within unit;	Optional signal
e)	Module voltage(s) corresponding to the tested SOC;	100% SOC measured 4.1 V per brick (parallel connection of cells). 9 bricks in series in a module. 9 X 4.1V = 36.9V
f)	The thermal runaway initiation method used;	Heating of 27 cells simultaneously.
g)	Location of the initiating module within the BESS unit;	Initiator Megapack Battery assembly 72
h)	Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, and soffits;	6 inches from ISO knuckle of Initiating unit to Target unit. 4 inches from surface of initiating unit to target unit surface; wall – N/A
i)	Observation of any flaming outside the initiating BESS enclosure;	Yes. 10-12 ft upwards and 8-10 ft in front of the unit.
j)	Chemical and convective heat release rate versus time data;	N/A
k)	Separation distances from the initiating BESS unit to target walls (e.g. distances A and C in Figure 9.1);	N/A
l)	Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and H in Figure 9.1);	6 inches from ISO knuckle of Initiating unit to Target unit. 4 inches from surface of initiating unit to target unit surface
m)	The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple;	Back neighbor Module: 43.9 C at location 19 Side neighbor module:44.5 C at location 18 Wall surface: N/A
n)	The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple;	N/A
o)	The maximum incident heat flux on target wall surfaces and target BESS units;	17.5 kW/m^2 at 3 ft to left
p)	The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test;	N/A
q)	Gas generation and composition data;	N/A
r)	Peak smoke release rate and total smoke release data;	N/A
s)	Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred;	N/A
t)	Observation of flying debris or explosive discharge of gases;	None observed

u)	Observation of re-ignition(s) from thermal runaway events;	None observed
v)	Observation(s) of sparks, electrical arcs, or other electrical events;	None observed
w)	Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; and 3) Adjacent walls	1. Initiator internally fully consumed. All damage contained within the enclosure. 2. Back neighbor had some signs of fans and paint degradation. Side neighbor had some aesthetic degradation on the top left corner. 3. N/A
x)	Photos and video of the test	Attached

- End of Report -

Appendix H

KOORAGANG WATER APPROVAL OF LANDSCAPING IN EASEMENT

From:	Bradley Rea <BRea@wua.com.au>
Sent:	Tuesday, 27 April 2021 5:01 PM
To:	James Allison
Cc:	kiwsnotification
Subject:	RE: Easement DP270249 - Lot 1102 Mayfield West

Hi James,

Thank you for sending details regarding the landscaping on lot 1102 that has been submitted in a development application to the Newcastle City Council. Kooragang Water Pty Ltd has no objections to your proposal to landscape the effluent pipeline easement location at the rear of this lot with a hydroseed mix consisting of shallow rooted native grasses and ground covers noting that this selection of landscaping will allow for the continued access to the easement and will not impact upon the pipeline.

Kind regards,

Brad Rea
Risk & Compliance Officer and Company Secretary | Water Utilities Australia

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Mail Suite 1005, 147 Pirie Street, Adelaide SA 5000 | **ABN** 48 129 876 213
Email brea@wua.com.au | **Website** www.wua.com.au

From: James Allison <james@precinctgroup.com.au>
Sent: 27 April 2021 15:41
To: Bradley Rea <BRea@wua.com.au>
Subject: Easement DP270249 - Lot 1102 Mayfield West

Hi Brad,

As discussed we recently submitted a development application to Newcastle City Council for a battery storage facility on proposed lot 1102 in stage 11.

In designing the lot layout we have given careful consideration to the easements at the rear of the site so to ensure that full access for maintenance is maintained in accordance with the easement terms. There have been no proposed changes to existing levels within the easements.

We have proposed to landscape this area with a hydroseed mix consisting of native grasses and ground covers. The proposed shallow rooted vegetation will not impact accessibility for maintenance.

Although landscaping generally isn't considered an improvement as such, I thought it prudent to seek your consent for this in accordance with the easement terms.

To assist with providing such consent I have enclosed the following for your reference:

1. Proposed landscape plan (lot 1102)
2. Approved DA subdivision plan
3. Draft DP with location of landscaping marked up

Let me know if you require anything else.

Regards,

James Allison
Precinct Capital Pty Ltd

PRECINCT

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