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Report

Grahamvale BESS Stormwater Management Strategy

AE BESS 3 Pty Ltd

2 June 2026

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
V01	Draft	G. Chandrasena	G. Chandrasena	15/01/2025
V02	Draft	G. Chandrasena	G. Chandrasena	25/03/2026
V03	Report	A. Vendargon	A. Vendargon	02/06/2026

Project Details

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Document Number	26010102_Shepparton_BESS_R01V03.docx

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

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1 INTRODUCTION

This report sets out the stormwater management strategy (SWMS) for the proposed Grahamvale Battery Energy Storage System (BESS) development (the Subject Site) at 221 Grahamvale Road and 305 Verney Road, Grahamvale (Figure 1-1). The Subject Site is approximately 10.83ha, the proposed development layout plan can be seen in Figure 1-2.

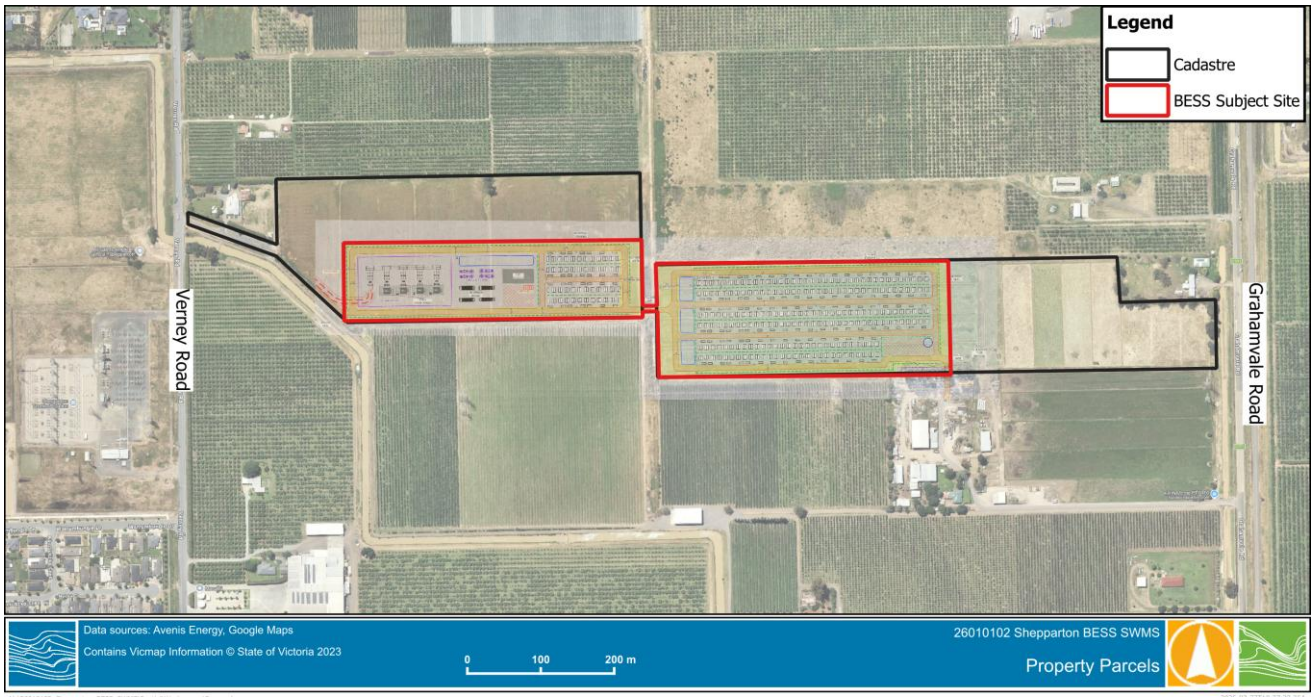

Figure 1-1 Subject Site

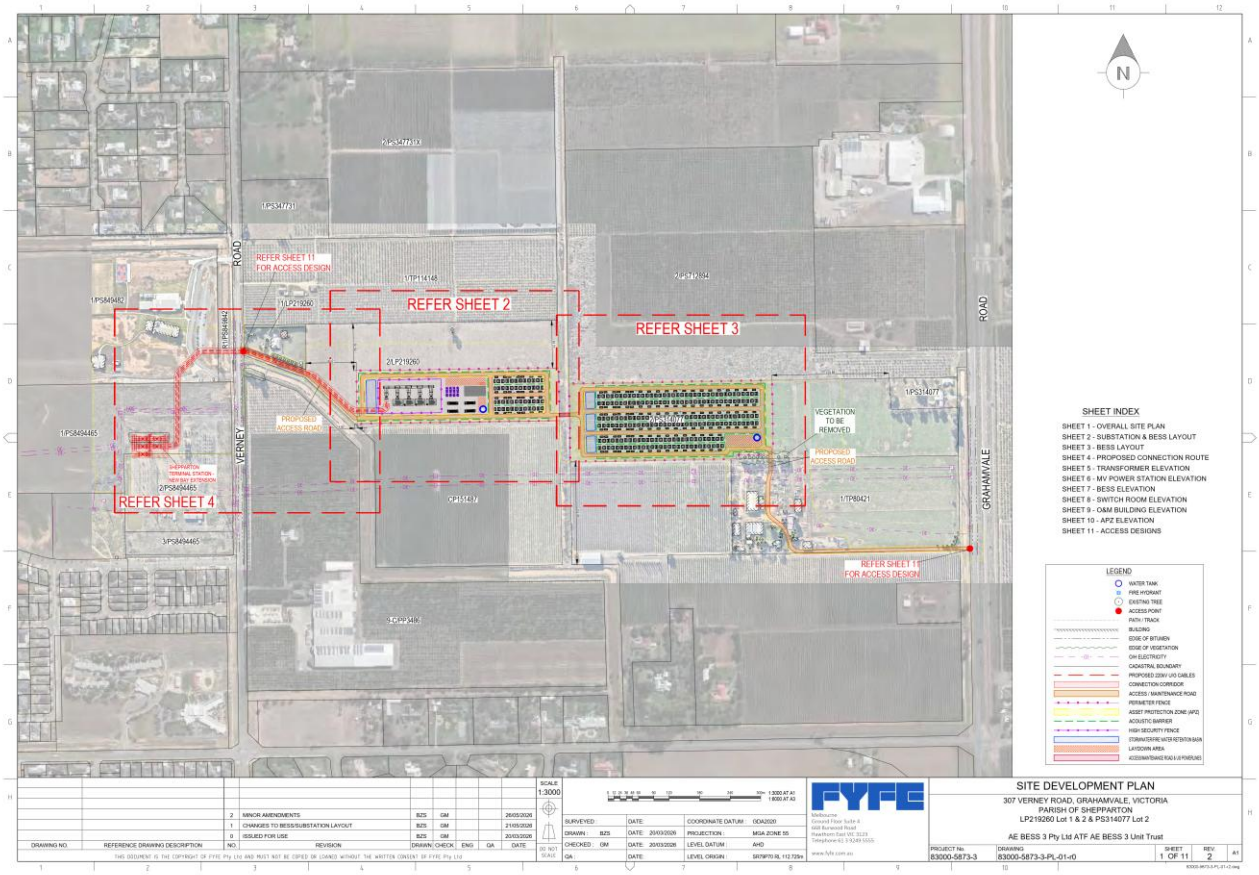

Figure 1-2 Grahamvale BESS Preliminary Layout (Avenis Energy, March 2026)

1.1 Background

As seen in Figure 1-3, the Subject Site is very flat, with a high point at the eastern boundary of approximately 112.4 mAHD, sloping to a low point along the western boundary at approximately 111.6 mAHD. The average slope across the site was approximately 0.1%. Only the flows generated from the development within the Subject Site were considered in this SWMS, with external flows presumed to bypass the site.

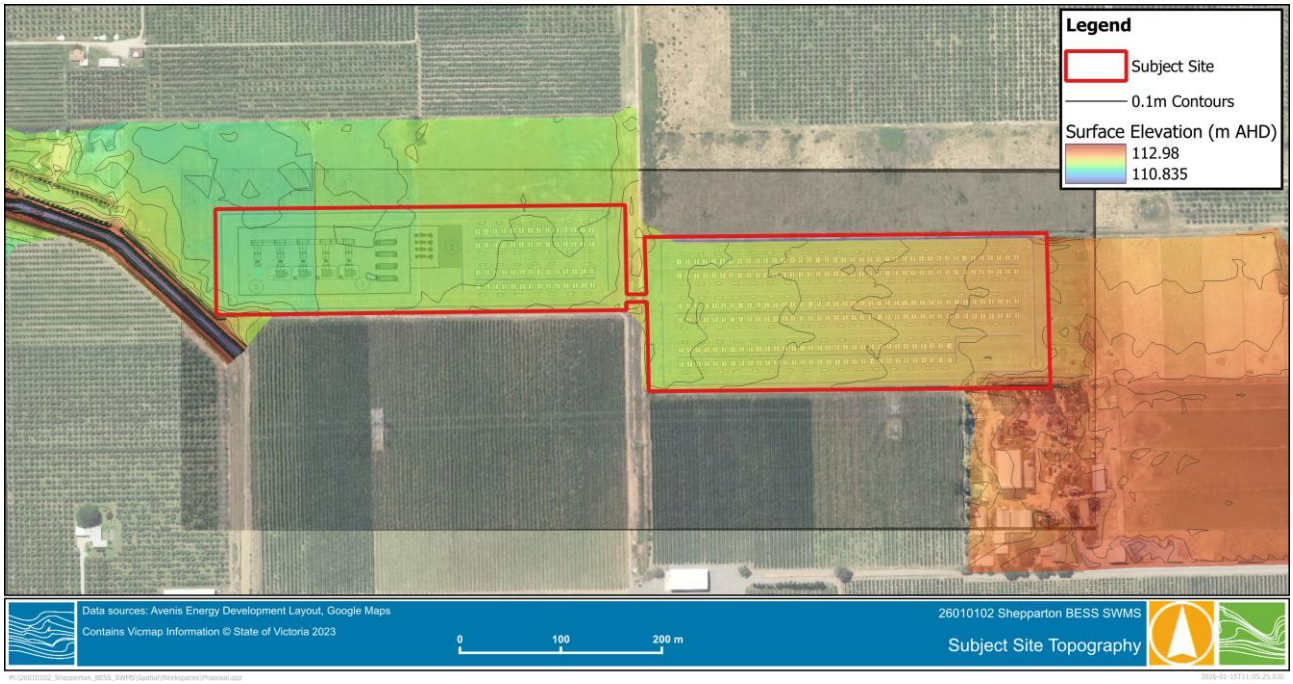

Figure 1-3 Subject Site Topography

1.2 Objectives

The main objectives of this SWMS are to satisfy the requirements of Greater Shepparton City Council, including;

- Achieve full retention of flows up to the 10% AEP event through onsite detention; and
- Controlling the rate of stormwater runoff for the post-development peak flows to pre-development level up to and including 1% AEP event through on-site detention.

2 STORMWATER QUANTITY MANAGEMENT

This section details the behaviour and conveyance of stormwater runoff generated at the site, as well as the characteristics of any stormwater detention assets that are to be installed as part of the proposed development. The intent is to guide drainage design in a manner that comply with Council requirements (Section 1.2).

The proposed stormwater management strategy consists of conveying flows from the hardstand surface areas towards two detention basins servicing the (1) eastern catchment and (2) western catchment of the proposed BESS site (Figure 2-2).

2.1 Legal Stormwater Discharge Point

Council's Legal Stormwater Discharge Point (LSDP) requirements set each parcel were:

- Stormwater runoff will be wholly contained within the site under typical design conditions, including minor storm events 10% AEP.
- For major storm events, specifically the 1% AEP (1 in 100-year ARI), overland flow may exceed the capacity of the internal drainage system. In such cases, the excess flow will be directed to the open channels:
  - Properly designed overland flow paths
  - No adverse impact on downstream infrastructure or properties

Therefore, stormwater quantity management were set to:

- Retain all minor stormwater events up to 10% AEP wholly
- Maintain 1% AEP flow rates at or below pre-development rates and enable overland flow discharge for events above 10% AEP.
- Ensure overland flow path has sufficient capacity to convey mitigated 1% AEP flows

2.2 Site-specific Constraints and Arrangements

Due to the extremely low gradient of the site, runoff is proposed to be to be routed to the detention basins via swales for minor and major flow events in the post developed conditions and routed out of the basins via existing overland flow paths where possible.

Since all flows up to the 10% AEP event are to be fully retained on site, the required storage volume can be provided below ground, with the 10% AEP flood level set at existing ground level. This configuration allows flows from events rarer than 10% AEP to be safely conveyed via the overland flow path. A conceptual sketch of potential basin arrangement with inlet and outlet arrangements are shown in Figure 2-1

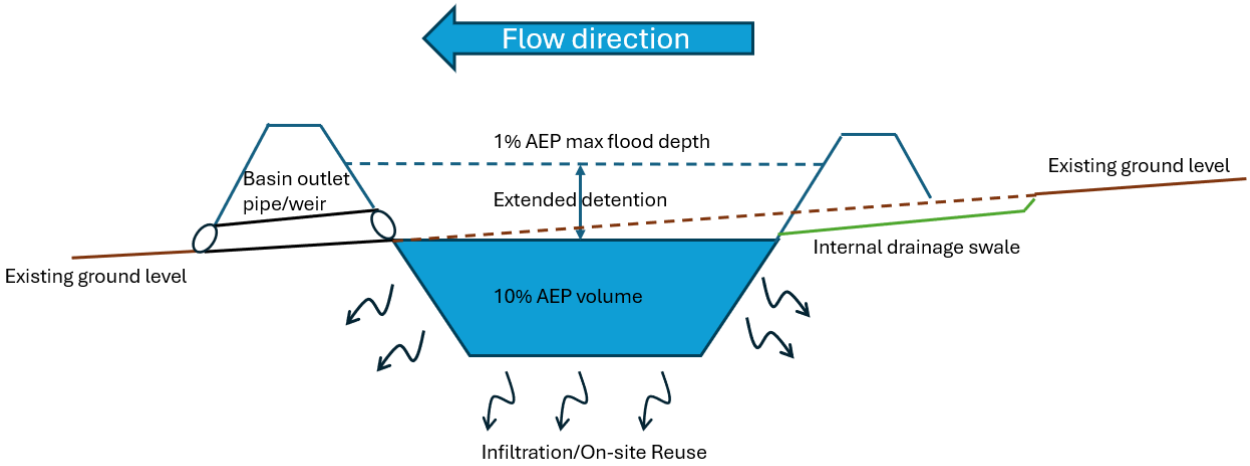

Figure 2-1 Conceptual Storage Basin Arrangement

Because there is no outfall for events up to the 10% AEP, a mechanism is required to ensure that sufficient storage is available between rainfall events to allow full containment of subsequent storms. Under current Australian practice, detention storage for the 10% AEP event must be emptied within 48 hours[1].

This requirement can be met either through infiltration to the surrounding soils or by actively pumping out stored water for on-site reuse. A geotechnical investigation will be required to confirm whether infiltration is feasible and at what rate it can be relied upon as an emptying mechanism. If infiltration capacity is insufficient, a hybrid approach combining infiltration with pumped reuse (e.g. for landscape irrigation or other non-potable uses) may be adopted. The preferred emptying strategy will be confirmed during subsequent design phases.

2.3 Catchment Delineation

The Subject Site was split into land parcels/catchments based on the two proposed detention basin locations and local topography. The Eastern Catchment has a contributing area of 6.06 ha and the Western Catchment has a contributing area of 4.32 ha. Only the hardstand BESS development areas were considered in the assessment, with any external contributing catchments and the remaining undeveloped land within the property parcels excluded from further analysis. Refer to Figure 2-2 for the contributing catchment area. The catchment characteristics are summarised in Table 2-1.

[1] John R Argue and David Pezzaniti, Chapter 11 – Infiltration Systems, Australian Runoff Quality – A Guide to Water Sensitive Urban Design (2006)

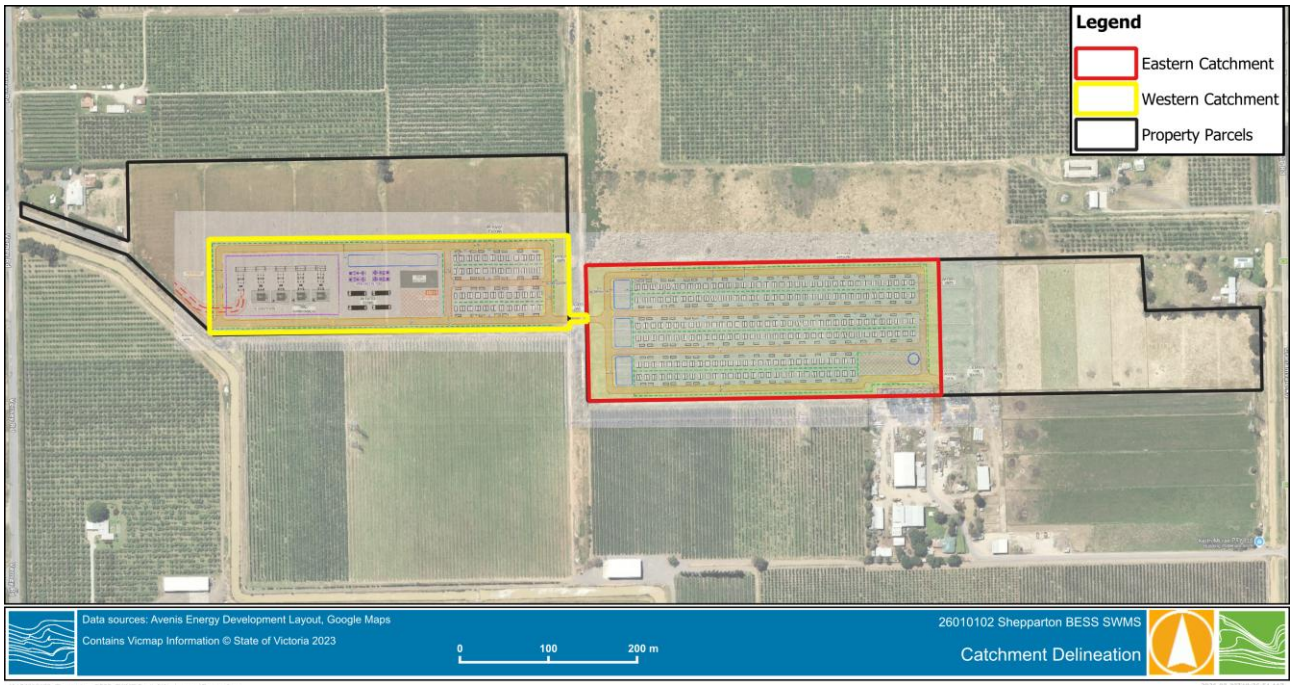

Figure 2-2 Contributing Catchment Area

Table 2-1 Catchment Characteristics

	Eastern Catchment	Western Catchment
Catchment Area (ha)	6.06	4.32
Fraction Impervious	0.0 (pre-development) 0.6 (post-development)	0.0 (pre-development) 0.6 (post-development)
Time of Concentration (minutes)	16	14

2.4 DRAINS Model

Hydrological analysis of the site was undertaken using DRAINS modelling. DRAINS was used to determine the pre-development and post-development peak flow rates and onsite detention storage requirements.

A DRAINS model was set up using ARR2019 procedures. Minor design storm was set to 10% AEP and Major design stormwater was set to 1% AEP. Lumped catchment nodes were used to represent the Eastern and Western Catchments.

Initial Loss/Continuous Loss (IL/CL) method was used as the hydrological modelling method. The pervious area losses were obtained from the ARR Datahub online portal. BoM IFD rainfall depths and temporal patterns for Subject Site location (-36.3412, 145.4216) was used for the modelling. As per ARR2019 guidelines, 75th percentile pre-burst rainfall (in lieu of the median value) in combination with unmodified Data Hub values of initial and continuing loss were used. The adopted IL/CL parameters are shown in Table 2-2 below.

Table 2-2 Model IL/CL Parameters

Parameter	Selected value
Impervious Area Initial Loss	1 mm
Impervious Area Continuing Loss	0 mm/hr

Parameter	Selected value
Pervious Area Initial Loss	24 mm
Pervious Area Continuing Loss	4.6 mm/hr

2.5 On-Site Detention

It is anticipated that two detention basins will be required to capture all the runoff up to the 10% AEP event and detain the 1% AEP event flows discharging from the site back to pre-development levels. The onsite detention basins were modelled as regular trapezoidal basins. The basins are proposed to be positioned (1) downstream of the eastern lot and (2) downstream of the western lot, as shown in Figure 2-3 and Figure 2-4 respectively. It is noted that the basin footprint displayed in Figure 2-3 and Figure 2-4 is an approximation only, and is subject to change in the detailed design stage to suit the final drainage and development arrangements.

Table 2-3 provides details regarding the detention basin minimum flood storage volume required for the 1% and 10% AEP events. As seen in Table 2-4, the detention basins successfully retarded the 1% AEP flow rate to below pre-development levels. Figure 2-3 and Figure 2-4 indicate the prospective detention basin layout proposed for the catchments.

Table 2-3 Detention Basin Storage Volume Requirements

	Eastern Catchment Basin	Western Catchement Basin
Peak 1% AEP Event Storage Volume*	3,000 m^3	2,200 m^3
Peak 10% AEP Event Storage Volume	2,300 m^3	1,650 m^3

*assuming an empty basin at the start of 1% AEP event

Table 2-4 1% AEP Flow Rate Assessment

	Eastern Catchment (m^3/s)	Western Catchment (m^3/s)
Pre-Dev Flow Rate (Permissible Site Discharge)	0.803	0.621
Post-Dev Flow Rate (Unmitigated)	1.07	0.816
Post-Dev Flow Rate (Mitigated)*	0.176	0.128

*assuming an empty basin at the start of 1% AEP event

2.5.1 Fire Fighting Requirements

The proposed BESS will be required to have a sufficient supply of water in the event of fire. This investigation involved a review of the CFA design guidelines for Renewable energy facilities[2] which details the following requirements:

- For planning applications, the following documents are required to be prepared in consultation with the CFA (beyond the scope of this investigation):
  - Risk management plan.

[2] https://www.cfa.vic.gov.au/plan-prepare/building-planning-regulations/renewable-energy-fire-safety

- Fire management plan.
- Emergency plan.

As this is a high-level assessment, this investigation is limited to providing an estimation of the storage volume required for firefighting purposes. It is expected that the above plans will be developed by other consultants.

- The minimum static water storage where no reticulated water is available is to be no less than 288,000L or as per the provisions of AS2419.1-2021: Fire hydrant installations, Table 2.2.5(D). Based upon these standards the following information is relevant:
  - Table 2.2.5 (D) – specifies the number of hydrants required for yard areas. The site has the following areas:
    - Eastern Catchment –Yard area of approximately 47,200 m^2 including buffering.
    - Western Catchment – This area consists of a single yard with an area of approximately 11,710 m^2 including buffering.
  - Table 2.2.6 (A) – specifies that a minimum pumping rate of 10 L/s is to be assumed.
  - Table 4.2.8 (A) – specifies that the static water supply is have sufficient volume for 4 hours of fighting.
- Infrastructure is provided for the contaminated fire-water runoff, the capacity should be the equivalent of the volume required for fire-fighting purposes.

It is recommended that during the development of the required response plans that the storage volume required on-site is confirmed. This investigation has assumed that the total volume required is based the equation below.

$$Volume\ (KL) = No.Hydrants\ x\ Pumping\ Rate\ x\ Duration$$

The parameters and sizing of the storage volume and therefore required basin volume for run-off is provided in Table 2-5. A point to clarify during future design work is whether the required volume of water is dependent on the number of yards, as shown in the equation below. If so the volume of water required on site and run-off basin would be significantly larger.

$$Volume\ (KL) = No.Hydrants\ x\ Pumping\ Rate\ x\ Duration\ x\ Number\ of\ Yards$$

Table 2-5 Firefighting Volume

Item	Eastern Catchment	Western Catchment
Total Yard Area (m^2)	47,200	11,710
Number of Hydrants Required*	4	3
Pumping Rate	10 L/s	
Duration	4 hrs	
Static Volume Required	576 KL	432 KL
Run-off Basin Volume	> 576 KL	> 432 KL

*Based total yard area from Table 2.2.5 (D)

Due to site space constraints, a combined basin has been proposed to provide both stormwater detention and firewater retention functions. This approach optimises the available footprint while satisfying the required storage volumes for both flood mitigation and firewater containment. It is acknowledged that, in the unlikely event of a fire emergency occurring concurrently with a storm event, measures will be required to prevent

potentially contaminated firewater runoff from discharging to the downstream drainage network. Accordingly, the detailed design will incorporate an isolation mechanism (e.g. shut-off valve or equivalent control structure) at the basin outlet to enable containment of firewater runoff within the system during emergency conditions. The final configuration and operational requirements of this isolation arrangement will be confirmed during the detailed design phase. The combined detention basin and firefighting storage size is summarised in Table 2-6.

Table 2-6 Combined Detention and Fire Fighting Storage Capacity

	Eastern Catchment Basin	Western Catchement Basin
Peak 1% AEP Event Storage Volume* + Fire Fighting Storage Volume	3,576 m^3	2,632 m^3
Peak 10% AEP Event Storage Volume + Fire fighting Storage Volume	2,876 m^3	2,082 m^3

*assuming an empty basin at the start of 1% AEP event

2.6 Open Channel Capacity

As discussed in Section 2.2, swales are nominated for flow conveyance throughout the Subject Site. Figure 2-3 and Figure 2-4 illustrate the preliminary detention basin and swale layout for the Eastern and Western Catchments respectively.

Due to the topography and consistent east to west slope of the Eastern Catchment, it is suggested that 3 parallel swales are utilised to convey the flows through the BESS hardstand areas, to then be conveyed by a catch drain/swale to the detention basin (Figure 2-3). As illustrated in Figure 2-4, the Western Catchment slopes more north-west and as such can be largely serviced by a swale along the northern parcel boundary, which will outfall into the proposed detention basin.

The Manning's Calculation was used to produce appropriate preliminary swale sizing to ensure there is sufficient capacity to convey the unmitigated post-development 1% AEP flows (Table 2-4) towards the detention basin, and the mitigated flows to the discharge point. The preliminary swale sizing can be seen in Table 2-7. It is noted that this sizing is an estimate only and is to be finalised during the subsequent detailed design stage, post development approval.

Table 2-7 Preliminary Swale Sizing

Parameter	Eastern Upstream Swale (x3)	Eastern Catchment Downstream Swale	Western Catchment Upstream Swale	Western Catchment Downstream Swale
Length (m)	340	5	371	118
Slope (%)	0.06	0.06	0.04	0.04
Base Width (m)	1	1	5	1

Parameter	Eastern Upstream Swale (x3)	Eastern Catchment Downstream Swale	Western Catchment Upstream Swale	Western Catchment Downstream Swale
Top Width (m)	6	7	12	6
Depth (m)	0.5	0.3	0.5	0.3
side slope (1 in x)	5	10	7	8
Mannings n	0.05	0.05	0.05	0.05
Flow Capacity (m^3/s)	0.37*	0.18	0.85**	0.13

*Each of the three upstream swales needs to have capacity for one third of the unmitigated post-development flow rate ($1.07m^3/s$)

**The upstream swale needs to have capacity for the whole unmitigated post-development flow rate ($0.816m^3/s$)

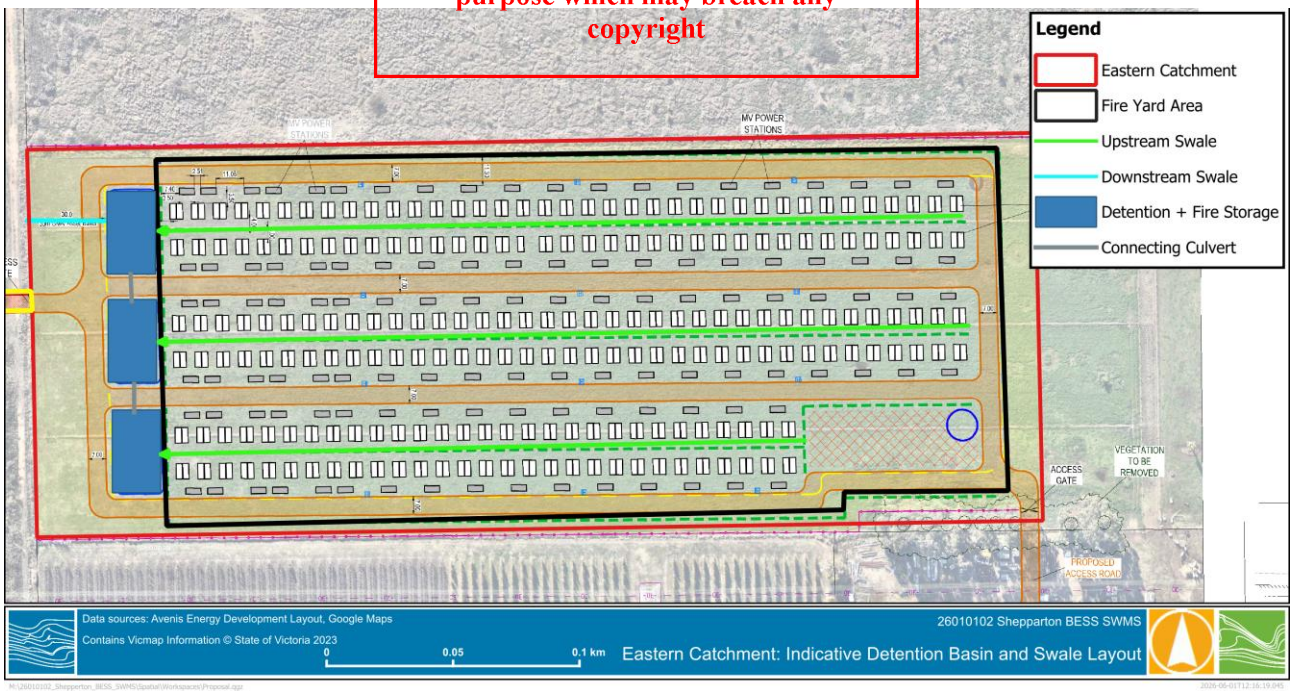

Figure 2-3 Eastern Catchment Preliminary Detention Basin and Swale Layout

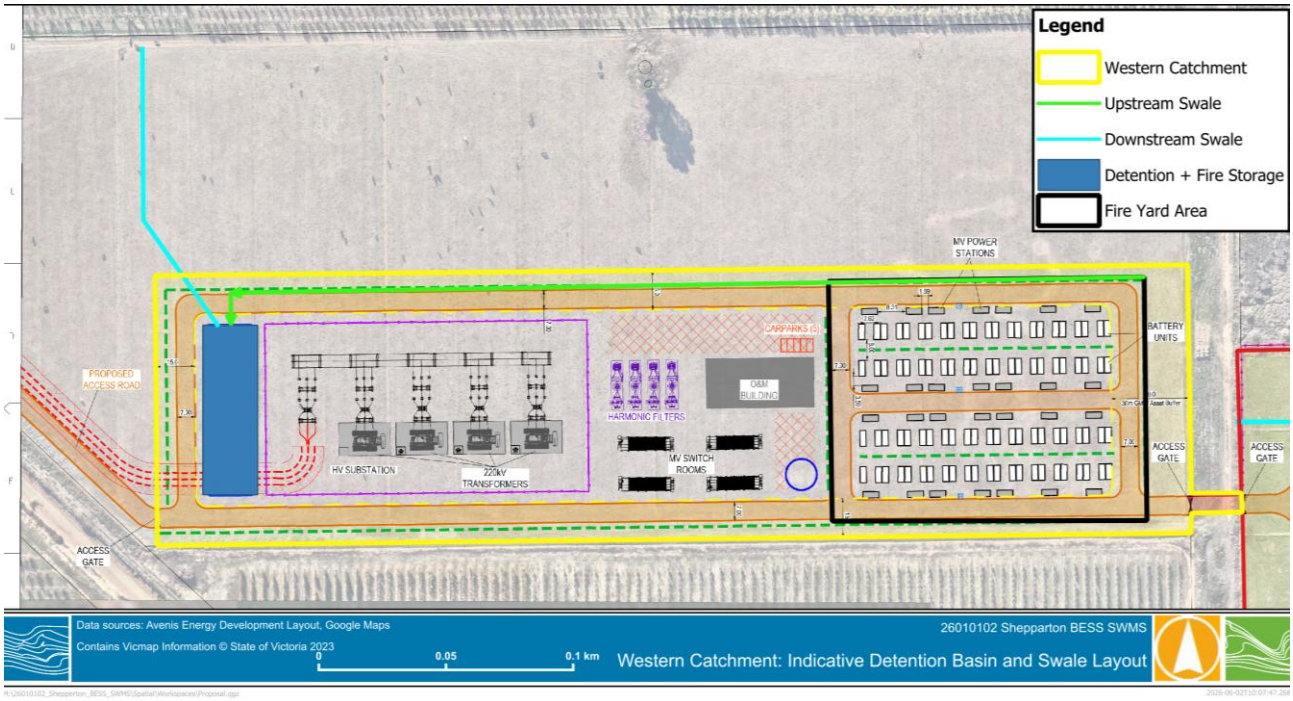

Figure 2-4 Western Catchment Preliminary Detention Basin and Swale Layout

3 SUMMARY

This report sets out the SWMS for the proposed BESS Grahamvale development. The stormwater management strategy for the Subject Site demonstrates that:

- Two flood storage basins downstream of the development outfalls are required to retain flows up to the 10% AEP event and detain the 1% flows back to pre-development levels
  - The conceptual OSD is ~2,200m^3 for the Western Catchment and ~3,000m^3 for the Eastern Catchment. It is proposed that this is provided in an online detention basin with flows to be conveyed from the subject site through a swale.
  - The combined conceptual OSD and fire fighting storage required is ~2,650m^3 for the Western catchment and ~3600m^3 for the Eastern Catchment.
  - The details of the OSD design including the final detention volume and outlet configuration can be finalised at the functional/detail design stage with the drainage design.
  - External flows east of the Subject Site will need to be bypassed around the internal drainage system.

The strategy outlined in this SWMS will ensure that the development meets flow management objectives (flows up to the 10% AEP event are detained onsite, and that the 1% flow rates do not exceed pre-development rates). The site-specific constraints such as insufficient gradient across the site and maintaining sufficient storage capacity between storm events up to 10% AEP need to be considered as the design progress.

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