

**CLEARSTONE
ENERGY**

DARTFORD ENERGY HUB

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

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FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

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1 INTRODUCTION

1.1 General

1.1.1 Wardell Armstrong LLP (WA) has been commissioned by Clearstone Energy to prepare a Flood Risk Assessment (FRA) for a proposed Battery Energy Storage System (BESS) and Substation development located at Station Road, Dartford, Kent.

1.1.2 This report sets out the results of an FRA required by the Local Planning Authority in support of the planning application for this development. The assessment has been carried out in accordance with the guidance set out in the National Planning Policy Framework (NPPF).

1.2 Methodology

1.2.1 The methodology for this FRA has comprised a desktop study and liaison with the Environment Agency (EA) and relevant local authorities.

1.2.2 Reference has been made to relevant plans and documents, including:

- National Planning Policy Framework (2024);
- Kent County Council 'Preliminary Flood Risk Assessment' (2011);
- Dartford Borough Council 'Strategic Flood Risk Assessment' (2021);
- Kent Local Flood Risk Management Strategy 2017-2023;
- Environment Agency flood mapping;
- British Geological Survey mapping; and
- DEFRA 'Magic' mapping.

2 FLOOD RISK AND PLANNING POLICY

2.1 National Planning Policy

2.1.1 The NPPF and the accompanying Planning Practice Guidance (PPG) aim to ensure that flood risk is taken into consideration at all stages of the planning process and advocates the use of a risk-based ‘Sequential Test’ to preferentially locate development in areas with a low risk of flooding. Where development is necessary in high risk areas, the NPPF aims to ensure that the development is safe without increasing flood risk through the application of the Exception Test.

2.1.2 The PPG defines the levels of flood risk within England as follows.

- Flood Zone 1 – Low Probability – Land having less than a 1 in 1,000 annual probability of river or sea flooding.
- Flood Zone 2 – Medium Probability – Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
- Flood Zone 3a – High Probability – Land having a 1 in 100 or greater annual probability of river flooding; or having a 1 in 200 or greater annual probability of sea flooding.
- Flood Zone 3b – Functional Floodplain – Land where water has to flow or be stored in times of flood.

2.1.3 The PPG states that a site-specific FRA is required for all new development proposals located in Flood Zones 2 and 3, and for any proposal of 1 hectare or greater regardless of its flood zone classification. The flood zones as described above are shown on the Environment Agency’s Flood Map for Planning, available online.

2.1.4 Table 2 of the PPG classifies development types based on their vulnerability to flooding, ranging from ‘Essential Infrastructure’ which has to be operational in times of flood, through ‘Highly Vulnerable’ (e.g. emergency service stations), ‘More Vulnerable’ (e.g. residential dwellings and establishments), ‘Less Vulnerable’ (e.g. offices/retail), to ‘Water Compatible’ development (e.g. open space, docks, marinas and wharves).

2.1.5 Based on Table 2 of the PPG, the proposed ESS development is classified as ‘Essential Infrastructure’.

2.1.6 Table 3 of the PPG indicates which ‘vulnerability classes’ are acceptable in each of the Flood Zones, and when the Exception Test should be applied. This is reproduced as Table 1 below.

Table 1: Flood Risk Vulnerability and Flood Zone ‘Compatibility’					
Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1 (>0.1%)	✓	✓	✓	✓	✓
2 (0.1 – 0.5%)	✓	Exception Test	✓	✓	✓
3a (>0.5%)	Exception Test	✗	Exception Test	✓	✓
3b (>5%)	Exception Test	✗	✗	✗	✓

2.2 Application of the Sequential and Exception Test

2.2.1 The Sequential Test, as set out by the PPG, aims to steer developments to areas with the lowest risk of flooding (i.e. Flood Zone 1) where possible. As shown on Figure 1, the Site is located entirely within Flood Zone 1 and it is considered, therefore, that the Sequential Test has been passed.

2.2.2 The Exception Test, detailed in paragraph 159 of the NPPF, should be applied only after the Sequential Test has been applied and when ‘More Vulnerable’ developments and ‘Essential Infrastructure’ cannot be located within Flood Zone 1 or 2, or ‘Highly Vulnerable’ developments cannot be located within Flood Zone 1, it is considered, therefore, that the exception test is not required for this site.



Figure 1. Environment Agency Flood Map for Planning

3 SITE SETTING

3.1 Site Description and Location

3.1.1 A summary of the Site and its characteristics is provided in Table 2.

Table 2: Site Location Summary	
Site Name	Dartford Energy Hub
Site Address	Land adjacent to Station Road, Southfleet, Dartford, Kent, England, DA13 9PA, United Kingdom
Site Area (ha)	9.75ha
National Grid Reference	TQ 61696 72104
Existing Land Use	Agriculture/ Grass land
Proposed Land Use	Battery Energy Storage System
Lead Local Flood Authority	Dartford Borough Council
Local Planning Authority	Kent Council
Sewerage Undertaker	Southern Water

3.1.2 The Site is located on Station Road approximately 1km to the north of the village of Southfleet and approximately 0.4km south of the A2 and the town of Northfleet. The National Grid reference for the Site is TQ 61696 72104 and the nearest postcode is DA13 9PA. A Site Location Plan is included as Drawing No CST010-DF1.0_Rev04 Site Location Plan.

3.1.3 The Site is irregular in shape, occupying two agricultural fields on either side of Station Road. The Site is approximately 9.75ha in total, with the development fields covering an area of approximately 6.27ha across two fields north and south of Station Road.

3.1.4 The Site is predominantly surrounded by further agricultural land. A garden centre is located adjacent to the north-eastern boundary, with a railway line bounding the southern boundary of the Site. The Development Area is bounded by a dismantled railway running on an embankment adjacent to the north-western boundary.

3.1.5 The topographic survey carried out in June 2023 by Solent Surveys Limited is shown on Drawing No. 14650_2D Survey Drawing (Sheet 1-6). Existing levels range from a maximum of 26.0mAOD in the western corner of the Site to minimum of 11.72mAOD at the eastern boundary of the northern parcel defined by a dry pond at this location. Across most of the Site, land generally slopes from the west to the east with an average gradient of approximately 1:22, however, in the western most area of the

southern parcel, the land generally falls from the south to the north with an average gradient of approximately 1:30.

3.2 Existing Watercourses and Waterbodies

3.2.1 There are no watercourses within the vicinity of the Site. The nearest Main River is shown on the EA's Main River map as an unnamed tributary of the River Thames, located approximately 0.3km north of the Site on the adjacent side of the A2 highway and a railway line. The River Thames is located approximately 3km further north of this watercourse.

3.2.2 OS mapping indicates an unnamed drain approximately 0.45km east of the Site adjacent to the roundabout between Station Road and the A2.

3.2.3 A pond is located at the low point of the northern parcel.

3.2.4 There are no other watercourses or waterbodies within the vicinity of the site.

3.3 Ground Conditions

3.3.1 The online British Geological Survey (BGS)¹ 'Geology of Britain Viewer' shows that the Site and its vicinity is underlain predominantly by sand bedrock of the Thanet formation with a band running through the Site underlain by Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formations.

3.3.2 The online DEFRA 'Magic' mapping² classifies the bedrock underlying eastern and western areas of the Site as a Secondary A aquifer, defined as '*comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers*'. The central band is classified as a Principal aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers, lakes and wetlands on a strategic scale. They typically have a high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage*'.

3.3.3 There are no recorded superficial deposits present within the eastern and western areas of the Site. The centre of the Site is underlain by superficial deposits described by the BGS as Head, consisting of clay, silt sand and gravel. This is described as Secondary (Undifferentiated), described as '*aquifers where it is not possible to apply*

¹ BRITISH GEOLOGICAL SURVEY 'Geology of Britain Viewer' Available at: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

² DEFRA 'Magic' Available at: <https://magic.defra.gov.uk/MagicMap.aspx>

either a Secondary A or B definition because of the variable characteristics of the rock type’.

- 3.3.4 ‘Soil Scapes Viewer’ records the soil type underlying the Site as loamy *‘freely draining slightly acid but base rich soils’*.
- 3.3.5 ‘Magic’ mapping (Figure 2) shows that the Site is situated within groundwater Source Protection Zone 2 - Outer Protection. Groundwater Source Protection Zone 1 – ‘Inner Protection Zone’ is located within 100m of the western site boundary. The westernmost corner of the Site is also located within a groundwater drinking water safeguard zone.

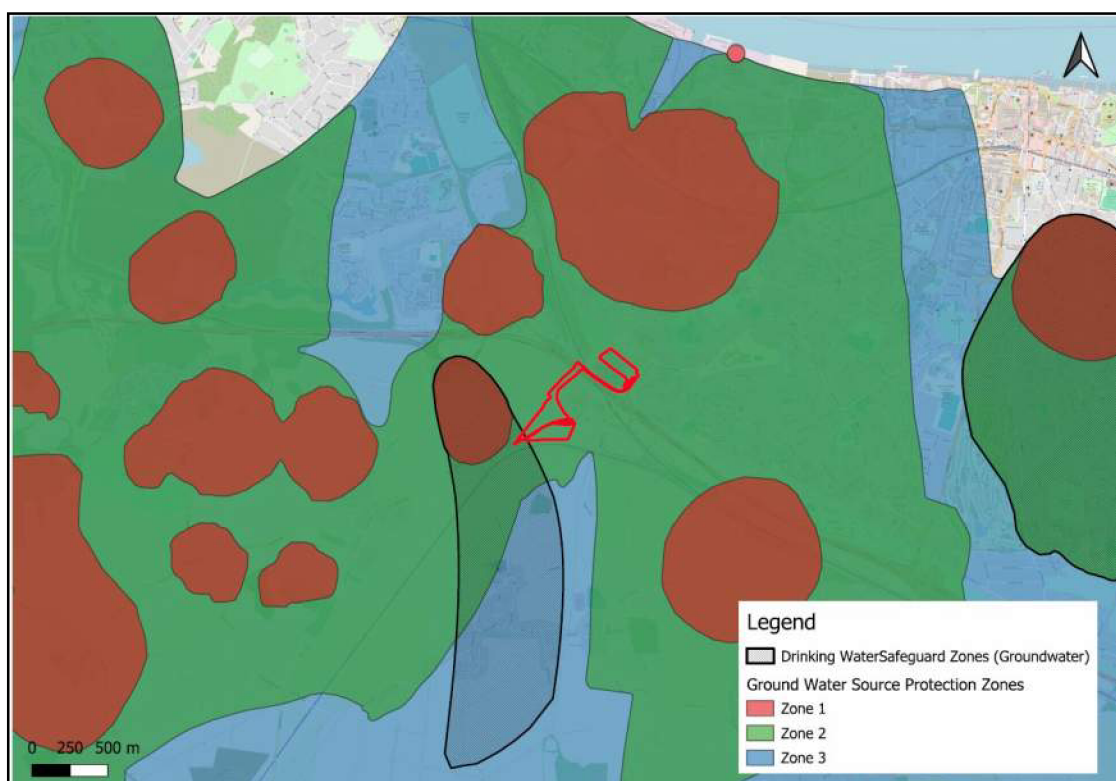


Figure 2. Ground water Source Protection Zones and Drinking Water Safeguard Zones (Groundwater)

- 3.4 Existing Drainage
- 3.4.1 Southern Water sewer plans for the Site have been obtained and are included in Appendix 1. The plans indicate two sewers located within the Site:
- a 200mm diameter public rising main crosses the northern parcel of the Site in a north-west to south-east direction. It crosses Station Road and then runs adjacent to the northern boundary of the southern parcel in a north-easterly direction. This rising main joins a foul gravity sewer close to the eastern site boundary adjacent to Station Road;

- a 300mm diameter public foul sewer enters the southern parcel along its southern boundary and flows north-eastwards towards Station Road.

3.4.2 Highway drainage records, provided by Kent County Council are included as Appendix 2. These records confirm:

- several highway gullies are located at the low point on Station Road adjacent to the pond. These are shown to discharge into a ditch along the southern side of the road;
- adjacent to Station Road in the west of the site, there are several gullies that discharge south-westwards via a highway drain towards an infiltration area located to the east of Dale Road;
- there are soakaways connected to the gullies for Station Road and Dale Road located in the west of the site.

3.4.3 There are no known private sewers within the vicinity of the site.

4 DEVELOPMENT PROPOSALS

4.1 Description of the Proposed Development

- 4.1.1 The proposed development is shown on Drawing No CST010-DF4.0_Rev10 Proposed Site Layout Plan and Drawing No CST010-DF3.0_Rev08 Proposed Development Zone Plan.
- 4.1.2 The development zone will comprise rows of energy storage containers separated by internal access tracks, implemented on five separate development plateaus. A substation will be located on the northernmost plateau.
- 4.1.3 Both the northern and southern development parcels will be accessed from Station Road.
- 4.1.4 The proposed underground cable route will extend north-east from the northern corner of the main development area towards Pepperhill Lane.
- 4.1.5 The cable will be installed using directional drilling, or in a trench which will be infilled back to the existing ground level. There will be no impact on flood risk and therefore, the cable route will not be considered further in this FRA.

5 BASELINE FLOOD RISK ASSESSMENT

5.1 Sources of Flooding

5.1.1 The main sources of flooding identified within the NPPF are rivers, tidal waters and the sea, surface water, groundwater, sewers and drains, and artificial sources such as canals and reservoirs.

5.1.2 The presence of a potential flooding source does not necessarily translate into a high risk of flooding. Table 3 below summarises the potential flood sources and the related flood risk posed to the site.

Table 3: Sources of Flood Risk			
Flood Source	Presence at Site	Potential Risk at Site	Description
Rivers (<i>fluvial flooding</i>)	Y	Low	The entire Site is located within flood zone 1 with no area of flood zone 2 or 3 in close proximity to the site.
Tidal	N	-	-
Surface Water Flooding (<i>pluvial flooding</i>)	Y	Medium	Majority of the Site is at very low risk. A surface water pathway travels northwards through the centre of the site, associated with low lying ground.
Groundwater	Y	Low- Medium	Groundwater monitoring data suggests groundwater level is between 8-13mAOD within the site. Areas within the centre of the Site where the topographic elevations are low are considered to be at risk of flooding from groundwater.
Sewer	Y	Low	Any potential flooding (from foul sewers or highway drains) is considered unlikely and would not affect area of proposed development.
Artificial	Y	Low	The only source of artificial flooding is from the small pond located within the site. The likelihood of this pond exceeding its capacity is considered unlikely.

5.2 Historical Flooding Incidents

5.2.1 EA Historical Flood mapping records no past flood events affecting the Site or the surrounding areas. The closest area to have experienced flooding is approximately 2.5 km north of the Site, at Swanscombe and is associated with the River Thames. Events

occurred in February 1953 and September 1968, were recorded to be a result of the main river exceeding its capacity.

5.2.2 The 2011 Kent County Council Preliminary Flood Risk Assessment (PFRA) and the 2021 Dartford Borough Council Strategic Flood Risk Assessment (SFRA) make no reference to flood events that have affected the Site or surrounding areas.

5.3 Fluvial Flooding

5.3.1 The EA 'Flood Map for Planning' (see Figure 1) shows the whole of the Site is located within Flood Zone 1 with an annual probability of flooding of less than 1 in 1000 years (<0.1% AEP).

5.3.2 As indicated in Figure 1, the closest area of Flood Zone 2 or 3 is a small area associated with the unnamed watercourse located approximately 0.3km north of the site.

5.3.3 Based on the available information, therefore, it is considered that the risk of flooding from fluvial sources is **LOW**.

5.4 Tidal Flooding

5.4.1 The Site is not at risk of flooding from tidal sources due to its inland location. Despite the fact that The River Thames, however, is tidally influenced at the point that the unnamed watercourse close to the Site joins the main river, although this watercourse itself is not tidally influenced. Given that the ground elevation at the banks of the River Thames are significantly lower than at the Site, it is considered that a flood event from tidal sources would be very unlikely.

5.4.2 Based on the available information, therefore, it is considered that the risk of flooding from Tidal sources is **DISCOUNTED**.

5.5 Surface Water Flooding (Pluvial Flooding)

5.5.1 Surface water flooding often occurs during intense rainfall events when water is unable to infiltrate into the ground or enter drainage systems and runs quickly overland resulting in local flooding.

5.5.2 The EA classifies the risk of surface water flooding as follows:

- Very Low – an annual probability of less than 1 in 1,000 years (<0.1%);
- Low – an annual probability of between 1 in 1,000 years and 1 in 100 years (0.1% - 1.0%);
- Medium – an annual probability of between 1 in 100 years and 1 in 30 years (1.0% - 3.3%);

- High – an annual probability of greater than 1 in 30 years (>3.3%).

5.5.3 The EA 'Extent of Flooding from Surface Water' map, included as Figure 3, shows that most of the Site is at a Very Low risk of surface water flooding. There is a surface water flow pathway that travels northwards through the centre of the southern parcel of the Site and through the eastern corner of the northern parcel towards the A2 highway. The medium risk surface water flood depth map (1 in 100 year/ 1%), as shown in Figure 4 indicates that the depth of this flooding is generally below 0.3m across the affected areas of the site.

5.5.4 This surface water flow route is associated with low lying areas of the site. Geological maps shows a network of dry valleys that correspond to the surface water flow routes in the area.

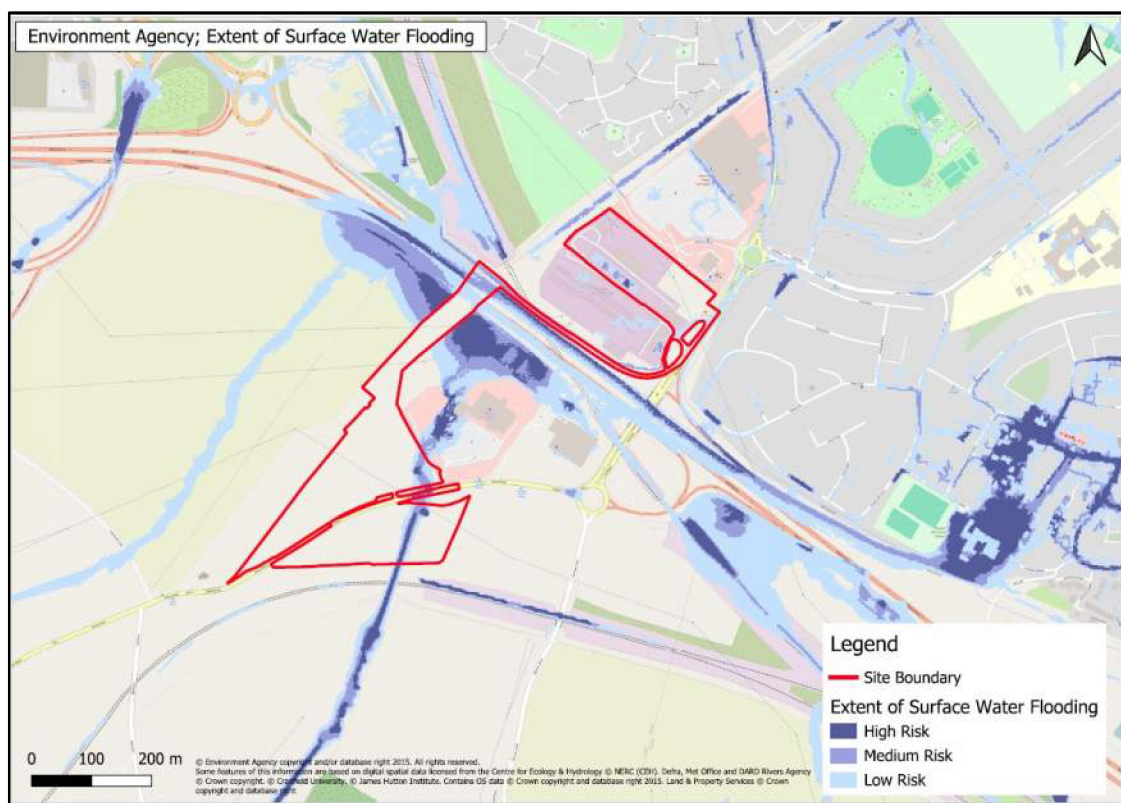


Figure 3. Environment Agency Extent of Surface Water Flooding

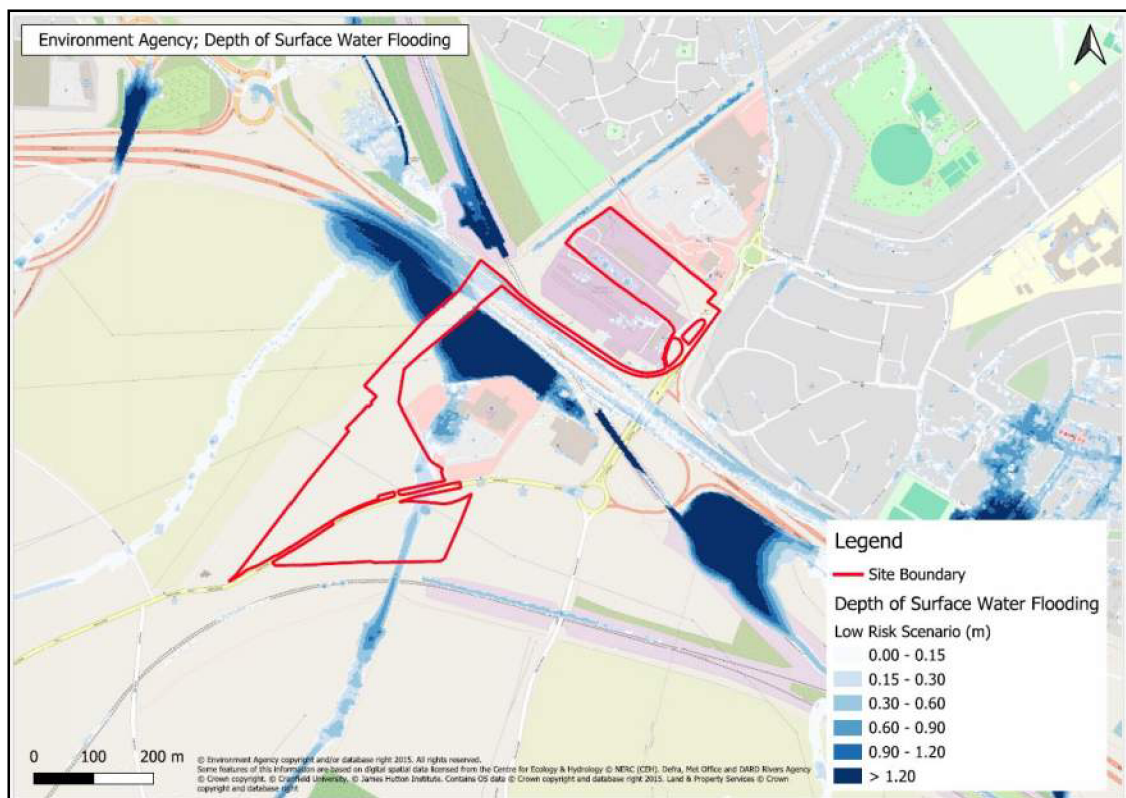


Figure 4. Environment Agency Surface Water Flood Depths (Low Risk Scenario)

- 5.5.5 Based on the available information, it is considered that the Site is at a **MEDIUM** risk of surface water flooding.
- 5.6 Groundwater Flooding
- 5.6.1 Groundwater flooding can occur when prolonged rainfall causes the groundwater table to rise above ground level. Groundwater flooding can occur at the same time as flooding from other sources such as overland flow.
- 5.6.2 BGS 'GeoIndex Onshore' Viewer indicates two borehole records within or in close proximity to the site. These records, however, do not give an indication of the depths to groundwater at the Site location.
- 5.6.3 The BGS Areas Susceptible to Groundwater flooding map, reproduced in Appendix H.2 of the Dartford Borough Council SFRA (see Appendix 3) illustrates that the Site is considered <25% susceptible to groundwater flooding.
- 5.6.4 Infiltration testing carried out by RSK Geosciences in September 2023 (see Appendix 4), reported that groundwater was not encountered during the trial pit completion at a depth of 2.95m below ground level. Given the geology of the Site ('Principal' and 'Secondary A' Aquifers) and the proximity to a Groundwater Source Protection Zone

1, there is the potential that lower-lying areas of the Site may be susceptible to groundwater flooding at certain times of year due to seasonal fluctuation in groundwater levels.

- 5.6.5 The 'Hydrogeological Risk Assessment' produced by Wardell Armstrong (Report Reference 004), further investigates the risk of groundwater flooding at the site. Groundwater monitoring data at a nearby borehole suggests that the groundwater level generally ranged from between 8mAOD and 13mAOD, potentially higher during extreme conditions. The report concludes that the groundwater level of 13mAOD can be assumed to be representative of typical high groundwater levels within the site.
- 5.6.6 Comparing this to the existing topography within the site, there are several areas within the site, most notably in the centre, where the ground elevation is below 13mAOD. These areas are, therefore, considered to be at risk of flooding when ground water levels are high.
- 5.6.7 Based on the available information, the risk of groundwater flooding is considered to be **LOW** with areas of **MEDIUM**.

5.7 Sewer Flooding

- 5.7.1 Flooding can occur from localised, high intensity storms of a relatively short duration that have the potential to exceed the capacity of the local drainage network. Surface water and combined sewers in particular are at risk of exceedance during extreme rainfall events.
- 5.7.2 Sewer records indicate several public foul sewers that flow through the Site and join at the Site boundary, within the southern parcel, adjacent to Station Road. There are three manholes located within the Site boundary which could be a source of potential exceedance flows. These are located in the eastern extent of the southern parcel and away from the main proposed development. The likelihood of this, however, is considered to be low.
- 5.7.3 There is potential that the highway drains that discharge to the ditches at the Site boundary along Station Road may exceed capacity in the event of heavy rainfall causing localised flooding in low lying areas of the site. Notwithstanding this, the proposed development is located away from these areas.
- 5.7.4 Based on the available information flood risk from sewers is considered to be **LOW**.

5.8 Artificial Sources

- 5.8.1 Artificial sources of flooding include reservoirs, canals and any other impounded water body which is elevated above the site. Flooding can occur when the impounding

structures such as dams and embankments fail, when culverts become blocked, or during extreme rainfall events when the waterbodies overflow.

- 5.8.2 The EA's 'Extent of Flooding from Reservoirs' mapping shows that the Site is not located in an area at risk of reservoir flooding, with no surrounding areas considered at risk.
- 5.8.3 The only other potential risk of flooding from artificial sources would be from the small pond located in the eastern corner of the northern parcel. The pond was observed to be completely dry at the time of a site walkover in August 2023. During periods of heavy rainfall there is a chance that the capacity of the pond could be exceeded.
- 5.8.4 In the event of this happening, flood pathways would follow the topography of the land in a northerly direction, dissipating naturally via a combination of infiltration, transpiration, and evaporation. The likelihood of this is, however, considered unlikely.
- 5.8.5 Based on the available information, the risk of flooding from artificial sources is **LOW**.

6 POST-DEVELOPMENT FLOOD RISK ASSESSMENT

6.1.1 New development can pose a risk of flooding to neighbouring properties and areas downstream of the Site, often as a result of an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff. In addition, climate change can be expected to cause an increase in rainfall intensity and surface water runoff over the lifetime of the development.

6.1.2 Flood risk can also be increased as a result of new development if the development reduces the floodplain storage area or alters flood flow paths, ultimately displacing flood water and resulting in an increased risk to the surrounding area.

6.2 Fluvial Flooding

6.2.1 The proposed Site layout is shown on Drawing No CST010-DF4.0_Rev10 Proposed Site Layout Plan. All of the proposed developable areas will be located within Flood Zone 1. There will, therefore, be no loss of floodplain storage or impact on any fluvial flood flow routes as a result of the proposed development.

6.3 Surface Water Flooding (Pluvial Flooding)

6.3.1 Based on surface water flood risk mapping, there is an existing overland flow route through the eastern area of the Site which flows in a northerly direction towards Watling Street.

6.3.2 The easternmost platforms in both the southern and northern parcels of the proposed development are situated within the extent of the surface water flow route. The proposed elevations of the platforms are 15.5mAOD in the northern parcel and 15mAOD in the southern parcel which is 1-3m higher in elevation than the existing ground levels.

6.3.3 The risk of flooding to the development is, therefore, not considered a risk. The construction of the platforms may, however, impede and divert the overland flow route which may cause flooding to areas previously unaffected by pluvial flooding. Mitigation measures will be required, as discussed in Section 7.

6.4 Surface Water Runoff

6.4.1 The existing agricultural land is considered to be wholly permeable, with any surface water runoff dispersing naturally by infiltration, evaporation or uptake by vegetation or flowing overland following the local topography in a westerly direction.

6.4.2 The proposed development will comprise energy storage units and a substation compound, which will be sat on concrete bases. Internal access tracks will be

constructed of impermeable surfacing while the open ground between the structures will comprise an aggregate surfacing with an impermeable membrane beneath to prevent infiltration.

- 6.4.3 There would, therefore, be a significant increase in the rate and volume of surface water runoff generated during storm events. Mitigation measures will, therefore, be required. This is discussed in further detail in Section 8.

6.5 Climate Change

- 6.5.1 It is necessary to account for the anticipated effects of climate change over the lifetime of the development when assessing future flood risk. New climate change guidance was published by the Environment Agency in February 2016, and most recently updated in May 2022³. The guidance provides predictions of anticipated increases in peak rainfall intensity. In assessing surface water runoff from the proposed development, the climate change predictions for peak rainfall intensity for the lifetime of the development should be considered.
- 6.5.2 The proposed development is located within Medway Management Catchment. Using the upper-end allowance and the 2070's epoch, it is considered that an allowance of 35% for the 1 in 30 year storm event and 40% for the 1 in 100 year storm event would be appropriate for this type of development in this location.
- 6.5.3 It is considered, therefore, that the risk of surface water flooding could increase over the lifetime of the development as a result of climate change, and that mitigation measures are required to account for this, see Section 8.

³ GOV.UK (May 2022). Guidance – Flood Risk Assessments: Climate Change Allowances. Available from <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

7 FLOOD RISK MITIGATION MEASURES AND RESIDUAL RISK

7.1 Surface Water Flooding Flow Path

- 7.1.1 It is proposed to divert the existing surface water pathway around the edge of the eastern platforms via a shallow ditch. This will ensure that any overland flow entering the Site from the south, can continue to flow through the Site and not be impeded. The route of the proposed diversion ditch is shown on Drawing No CA12848-007-A Surface Water Management Plan.

7.2 Surface Water Management

- 7.2.1 It is proposed to store the additional surface water runoff generated from the increase in impermeable areas, within the site. Surface water will then discharge via infiltration into the ground via a series of trench soakaways. Sufficient storage will be provided for all storm events up to and including the 1 in 100 year return period including an appropriate allowance for climate change. Storage for firewater runoff will also be provided, see Section 7.4 for further detail.

- 7.2.2 Surface water runoff from BESS units, access tracks and substations will be stored within the aggregate that will surround the BESS units. The aggregate will have a lined membrane to prevent infiltration. Runoff will then be conveyed via a network of pipes to a trench soakaway which will allow disposal of runoff via infiltration.

- 7.2.3 The surface water management proposals are discussed in Section 8. It is considered that the risk of flooding resulting from the proposed development will, therefore, be low with a formal drainage system in place.

7.3 Residual Risk

- 7.3.1 There is always a possibility of a storm event that exceeds the design standards of the proposed flood risk management measures for new developments. Potential risks include the exceedance of the surface water attenuation facilities during extreme storm events.

- 7.3.2 If the capacity of the attenuation features is exceeded by an extreme storm event, exceedance flows will follow the existing topography and will dissipate via a combination of infiltration, transpiration and evaporation with no increased risk to areas previously unaffected by surface water runoff.

7.4 Fire Water Contamination

- 7.4.1 In the unlikely event of a fire, fire water runoff will be stored within the aggregate as usual. The aggregate will be lined with an impermeable membrane and shut-off valves

will be implemented at the outlet to contain the contaminated water and to prevent it entering the soakaway. This will prevent any infiltration of contaminated fire water into the groundwater. After the fire has been managed, contaminated firewater will be tested and either released to the soakaway or removed from the Site for treatment. Further detail on the proposed Firewater Containment Strategy is provided in Section 8.2.

8 DRAINAGE STRATEGY

8.1 Surface Water Drainage Rationale

8.1.1 Surface water runoff from the development will be controlled on Site to ensure that there is no increase in the risk of flooding to areas downstream of the Site and to the development itself.

8.1.2 The PPG stipulates a hierarchy for the disposal of surface water which should be followed as part of any surface water drainage design. This hierarchy is as follows:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain or another drainage system;
4. to a combined sewer.

8.1.3 In accordance with the drainage hierarchy, it is proposed that SuDS features within the main Site are designed to promote infiltration with several soakaways located around the site. Soil Scapes mapping describes the underlying soil as 'freely draining'. The bedrock geology underlying the Site is predominantly sand, with a band of chalk running through the centre of the southern parcel. The chalk bedrock also underlies the sand across the whole Site area, at varying depth.

8.1.4 Permeability testing was carried out in October 2023 by RSK Geosciences (included as Appendix 4) in accordance with BRE 365 standards in order to fully assess the permeability of the underlying ground. The results suggest that infiltration is viable within the Lewes Nodular Chalk bedrock however would not be possible within the Thanet Sand. The infiltrations tests and BGS borehole records give an indication of the depths of the chalk across the site. At soakaway test No.3 (SA03) in the northern corner of the site, chalk is confirmed to be reached at 2.95m. At Trial pit SA04 in the western area of the northern parcel, no chalk was reached with a trial pit depth of 3m. BGS borehole records indicate a depth of chalk in the western area of the Site at between 5.4m and 7.9m+.

8.1.5 Pre-application consultations with the Environment Agency (see Appendix 5) states that they would prefer the use of shallow soakaways and would not permit deep borehole soakaways. It is considered, therefore, that soakaways would not be viable within the western area of the Site.

8.1.6 It is, however, considered feasible to infiltrate within the eastern and central area of the Site. An infiltration rate on 1.6056m/hr (4.46×10^{-4}) will be applied based on the

slowest infiltration rate from the SA03 tests, to provide a conservative estimate of attenuation volumes.

- 8.1.7 As shown on Drawing No CST010-DF4.0_Rev10 'Proposed Site Layout Plan', the proposed development is split over 5 development plateaus with differing elevations. For the purposes of the drainage strategy, each development plateau will be treated as its own catchment area, with the plateau in the north-eastern corner being further divided into two catchment areas, covering the substation and the BESS units.
- 8.1.8 Impermeable areas within the Site will consist of the concrete bases and roof areas of the BESS units and substations structures, internal access tracks and access roads. Aggregate will be implemented between the structures which will have an assumed void ratio of 0.3, although it will be considered 100% impermeable as it will be used to store runoff.
- 8.1.9 The proposed impermeable areas for each area, and the resulting required attenuation for the 1 in 100 year storm event plus a 40% allowance for climate change are summarised in Table 4 below with full calculations included as Appendix 6.

Table 4. Required Attenuation			
Area	Total Impermeable Area (ha)	Required Attenuation (m ³)	
		1in30+35%	1in100+40%
1	0.579	429	565
2	0.442	328	431
3	0.246	182	240
4	0.176	130	172
5	0.412	305	402
6 (Substation)	0.274	203	267
1. Runoff from aggregate assumed to be 100% as aggregate will be used as storage. 2. Attenuation calculations assume no discharge and no infiltration.			

- 8.1.10 It is proposed that surface water runoff will be stored within the void spaces of the aggregate surrounding the BESS units and substation. The attenuation provided has been calculated based on a 0.6m depth of aggregate and a 0.3 void ratio. The depth of aggregate within Areas 2 and 3, however, will be 0.65m to ensure sufficient attenuation in the event of a fire (discussed in further detail in Section 8.2).
- 8.1.11 Perforated pipes will be used to convey surface water within the aggregate, as shown in Drawing No CA1284-007 Surface Water Management Plan.

8.1.12 Surface water will then be conveyed via surface water pipes to the proposed soakaways. Table 5 details the volumes of attenuation stored within the aggregate and the additional attenuation required.

Table 5. Provided Attenuation within Aggregate				
Area	Area of Aggregate (ha)	Required Attenuation for 1in100+40% Event (m ³)	Attenuation Provided within Aggregate (m ³)	Additional Attenuation Required (m ³)
1	0.287	565	517 ¹	48
2	0.176	431	343 ²	88
3	0.091	240	177 ²	63
4	0.076	172	137 ¹	35
5	0.178	402	320 ¹	82
6 (Substation)	0.183	267	329 ¹	0
1. Depth of aggregate is assumed at 0.6m. 2. Depth of Aggregate (for area 2 & 3) 0.65m 3. Attenuation within Aggregate = Area of Aggregate (m2) X Depth X 0.3 (Void Ratio)				

8.1.13 Flow controls (a Hydro-Brake or similar) will be used to maximise storage within the aggregate and restrict the volume of water entering the soakaway. Detailed design works carried out at a later date will confirm the ideal restricted rate of discharge from each area to maximise the storage.

8.1.14 Causeway Flow modelling software has been used to determine the required size of the soakaway up to and including the 1 in 100 year storm event, based on maximum storage within the aggregate, the additional attenuation required, and an infiltration rate of 1.6056m/hr into the Chalk bedrock.

8.1.15 In the northern development area there will be a soakaway located within the available space to the south of Area 1. Due to the various constraints within the Site, Areas 1, 2 and 3 will all drain to this soakaway. Surface water from Area 3 will drain through Area 2 via a surface water pipe. Backdrop manholes will be used to transfer surface water from the higher platforms to the lower platforms.

8.1.16 A second soakaway will be located south of the substation, to drain Area 6 only.

8.1.17 In the southern parcel, Areas 4 and 5 will both drain to a soakaway located within available space to the east of Area 5.

8.1.18 The minimum elevation of the base of the soakaway will be 14mAOD to ensure a 1m unsaturated zone between the design groundwater level at 13mAOD.

8.2 Firewater Runoff

8.2.1 In the unlikely event of a BESS unit catching fire, the water used to manage the fire and cool the units will be contained within the aggregate. Fire water shut of valves are proposed at the outlet of each compartment of aggregate to contain the contaminated water and ensure it does not enter the soakaways and groundwater. Similarly, the aggregate will be lined to prevent infiltration into the ground at this location.

8.2.2 Following the guidance set out by the National Fire Chiefs Council⁴, there should be sufficient storage within the Site to contain 228m³ of firewater runoff. It is proposed that this volume is provided in addition to the attenuation for surface water runoff generated for the 1 in 2 year, 48 hour storm event to account for rainfall already within the system at the time of the fire. As the Site is separated into two development areas either side of Station Road, this will be required for both the northern and southern areas of the development. Similarly, as Areas 1 and 6 and Areas 2 and 3 are drained via separate networks it is necessary to ensure sufficient attenuation is provided within each area individually. As such, the depth of aggregate has been increased to 0.65m for Areas 2 and 3. Table 6 details the total attenuation required to store contaminated fire water runoff for the development areas.

Table 6. Firewater Runoff Attenuation Requirements					
	Required Attenuation 1 in 2y – 48h storm (m ³)	Firewater Containment Requirement (m ³)	Total Storage Required (m ³)	Attenuation Provided within Aggregate (m ³)	Sufficient Attenuation Provided?
Northern Parcel 1	324	228	552	846	Sufficient
Northern Parcel 2	261	228	489	520	Sufficient
Southern Parcel	223	228	451	457	Sufficient
Northern Parcel 1 = Area 1 and 6 Northern Parcel 2 = Area 2 and 3 Southern Parcel = Area 4 and 5					

⁴ National Fire Chiefs Council – Grid Scale Battery Energy Storage System planning – guidance for FRS, V1.0, November 2022.

8.2.3 After the fire has been managed, contaminated firewater will be tested and either released to the soakaway or removed from the Site for treatment.

8.2.4 The system has been designed for the removal of contaminated water by tanker should testing show this is required, with proposed tanker take-off valves located adjacent to access roads for easy access.

8.3 Surface Water Quality

Table 7. Pollution Hazard Indices for Land Use Classifications				
Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Commercial/ industrial roofs	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, non-residential car parks with infrequent change (ie schools, offices), low traffic roads (ie homezones and general access roads) ie less than 300 traffic movements per day	Low	0.5	0.4	0.4
Commercial yard/delivery areas, non-residential car parking with frequent changes (ie retail, hospitals), all roads (except low traffic/trunk roads/motorways).	Medium	0.7	0.6	0.7
Haulage yards, industrial estates, areas, trunk roads, motorways.	High	0.8	0.8	0.9

8.3.1 The Simple Index Approach outlined in the CIRIA SuDS Manual is used to demonstrate that appropriate treatment will be provided within a proposed development to ensure that there is no negative impact on water quality.

8.3.2 The Simple Index Approach assigns 'Pollution Hazard Indices' for suspended solids, metals and hydrocarbons, and an overall 'pollution hazard level' to different types of land use. These are summarised in Table 7 below (based on Table 26.2 of the SuDS Manual).

8.3.3 It is considered that the development would have a 'Low' pollution hazard level. Few vehicles will access the Site and during operation there will be significantly less than 300 traffic movements per day. All access tracks would, therefore, comprise 'low traffic roads'/'general access roads' and areas of parking would comprise 'non-residential car parking with infrequent changes' and roofs will be 'commercial/industrial roofs'. The maximum pollution hazard indices, therefore, would be:

- Total suspended solids: 0.5;
- Metals: 0.4;
- Hydrocarbons: 0.4.

8.3.4 The Simple Index Approach then assigns mitigation indices for suspended solids, metals and hydrocarbons for various SuDS features. To ensure that water quality standards are met, the Pollution Mitigation Indices provided by the sustainable drainage features need to be greater than or equal to the Pollution Hazard Indices for the proposed land use.

8.3.5 The proposed drainage network for the main BESS area will incorporate storage within the aggregate, collected within perforated pipes and conveyed to three soakaways. The aggregate will be lined to prevent infiltration prior to entering the soakaway, allowing for two stages of treatment to the surface water runoff. The mitigation indices for the aggregate are, therefore, is based on Table 26.3 'Indicative SuDS Mitigation indices for discharges to surface waters' of the SuDS Manual.

8.3.6 The soakaways will drain via infiltration with no formal outfall to any watercourses or public sewers. The mitigation indices will, therefore, be based on discharges to groundwater as described in Table 26.4 of the SuDS manual.

8.3.7 In order to account for the reduced performance of secondary SuDS features associated with already reduced inflow concentrations, a factor of 0.5 should be applied to the second stage of treatment within a 'treatment train', following the below formula taken from the CIRIA SuDS manual.

$$\text{Total SuDS mitigation index} = \text{mitigation index} + 0.5 (\text{mitigation index})$$

8.3.8 Table 8 outlines the Simple Index Approach Assessment for the proposed treatment train.

Table 8. CIRIA Simple Index Approach Assessment – BESS Area			
	Total Suspended Solids	Metals	Hydrocarbons
Pollution Hazard Indices – Property Driveways and Low Traffic Roads (Low)	0.5	0.4	0.4
Pollution Mitigation Indices – Aggregate ¹	0.4	0.4	0.4
Pollution Mitigation Indices – Soakaway ²	0.2 (0.4 x 0.5)	0.4 (0.4 x 0.5)	0.4 (0.4 x 0.5)
Total Mitigation Indices ³	0.6	0.6	0.6
Sufficient or Additional Treatment Required	Sufficient	Sufficient	Sufficient
1. Pollution Mitigation Indices for the Aggregate is best defined as a 'Filter drain' from Table 26.3 of the CIRIA SuDS Manual. 2. Pollution Mitigation Indices for the Aggregate is best defined as 'Infiltration trench' (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel) underlain by a soil with good contamination attenuation potential of at least 300mm in depth' from Table 26.4 of the CIRIA SuDS Manual. 3. Treatment indices are halved for the second stage of treatment in a 'treatment train'			

8.3.9 As detailed in Table 8, there will, therefore, be a sufficient level of treatment provided within the proposed drainage features for the proposed development.

8.3.10 It is considered, therefore, that there will be no impact on surface water quality as a result of the proposed development.

9 CONCLUSIONS

- 9.1.1 This report gives details of the Flood Risk Assessment, which has been carried out in accordance with the National Planning Policy Framework.
- 9.1.2 Based on the Environment Agency's Flood Map for Planning, the entire Site area is located within Flood Zone 1 ('Low' risk). The vulnerability class of the proposed development is 'Essential Infrastructure'. Table 3 of the Planning Practice Guidance indicates that such developments are suitable for sites within Flood Zone 1.
- 9.1.3 The risk of flooding from groundwater is considered to be low, with some low lying area considered to be at medium risk. Flooding from surface water is considered to be Medium. Flooding from sewer and artificial sources is considered to be Low. The risk of tidal flooding to the Site is discounted.
- 9.1.4 Flood risk management measures will be implemented to ensure that the risk of flooding to areas downstream of the Site are not increased as a result of the development. This will include a surface water drainage strategy that will mimic greenfield performance for a range of storm events in accordance with the National Planning Policy Framework, Environment Agency requirements and local planning policy.
- 9.1.5 Sustainable Drainage Systems (SuDS) features will be incorporated into the drainage network to provide attenuation for all storm events up to and including the 1 in 100 year storm event, including an appropriate allowance for climate change.
- 9.1.6 Appropriate measures will be implemented to ensure groundwater quality is not impacted due to the development, including from the risk of contamination from firewater runoff.
- 9.1.7 As the risk of flooding to the Site is generally considered to be Low to Medium, and the risk of flooding to surrounding areas will not increase as a result of the proposed development, it is considered that, from a flood risk and drainage perspective, the Site is suitable for the type of development proposed.

APPENDICES

APPENDIX 1

Southern Water Sewer Plans



APPENDIX 2

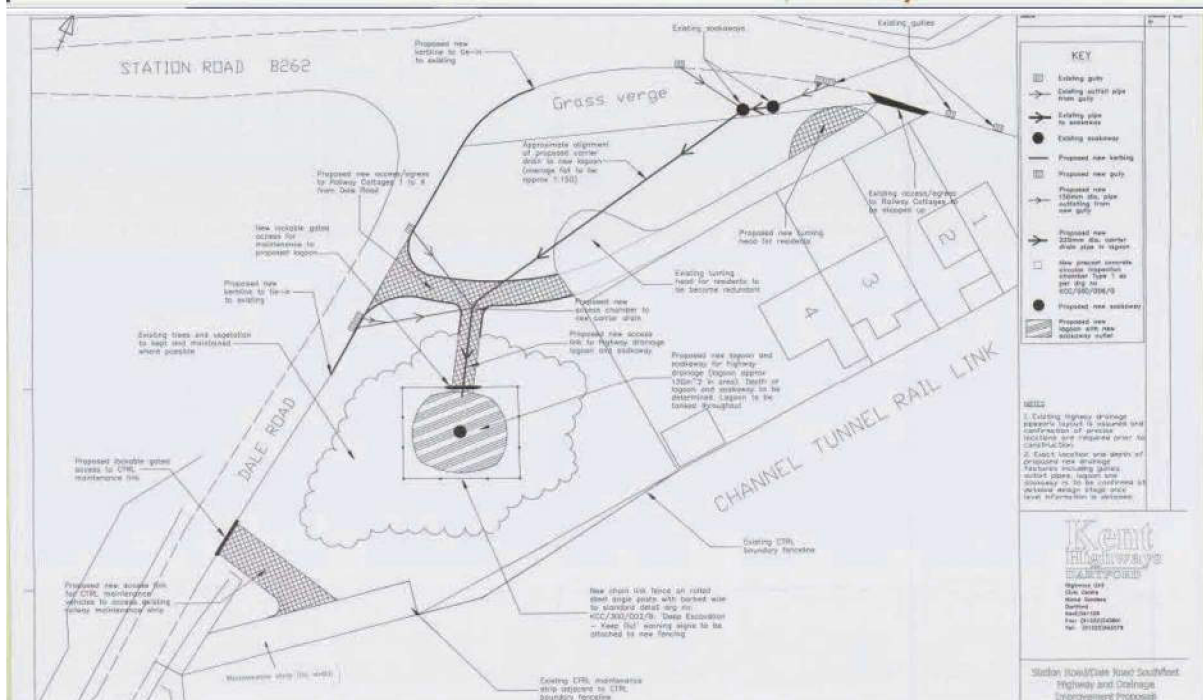
Kent County Council Highway Drainage Records

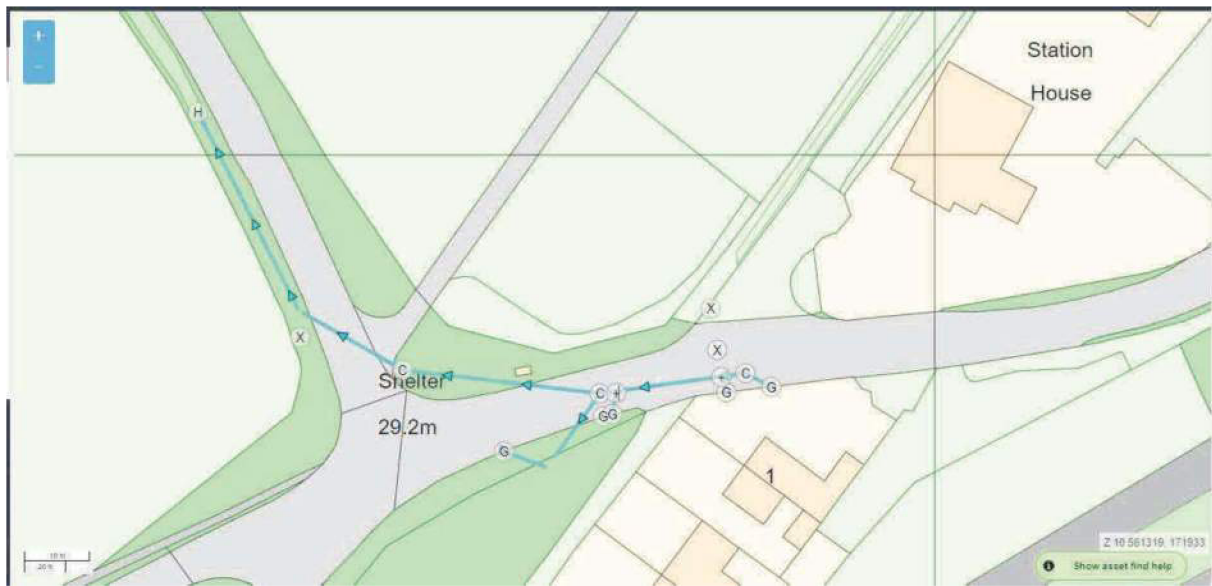
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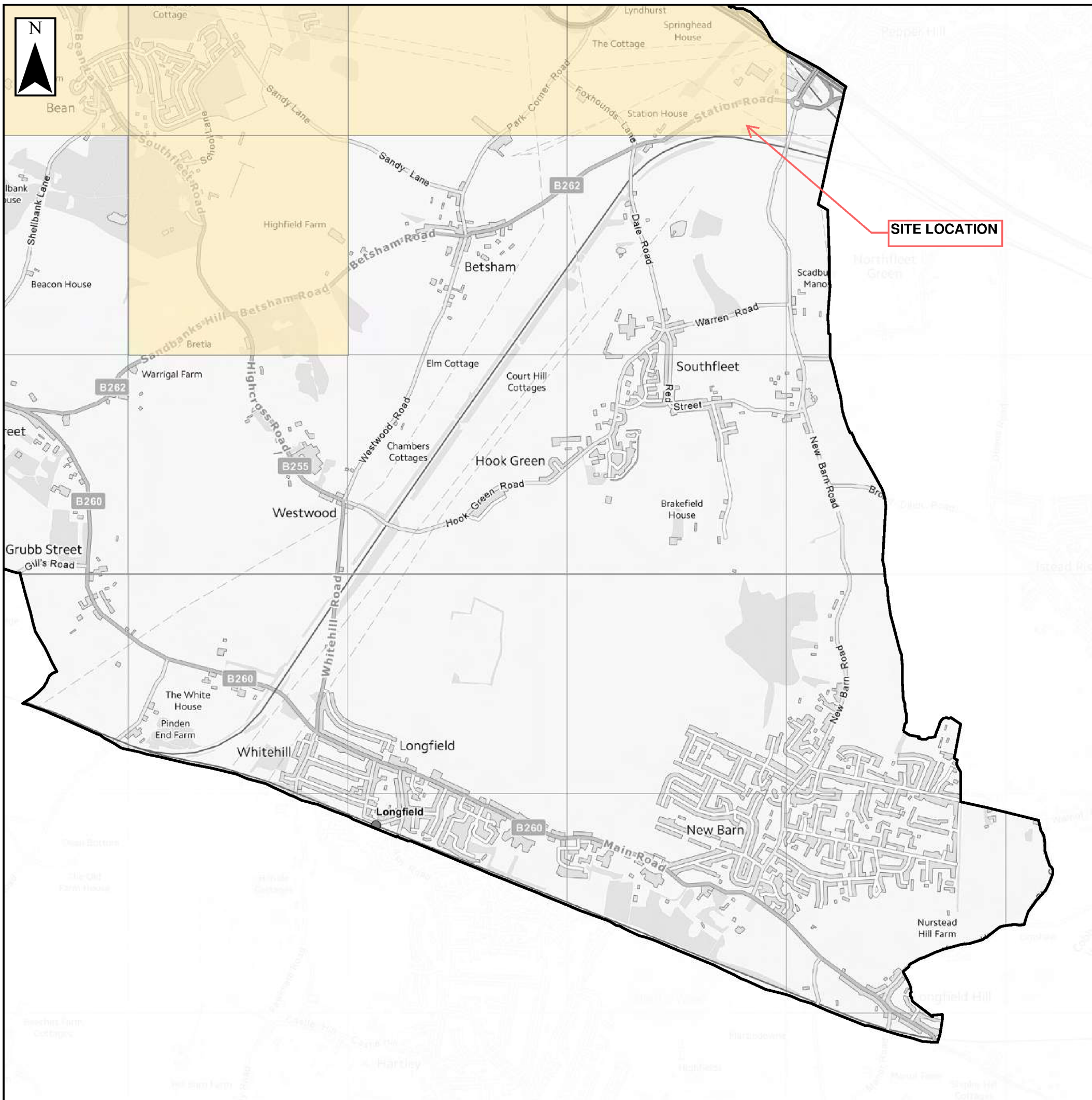




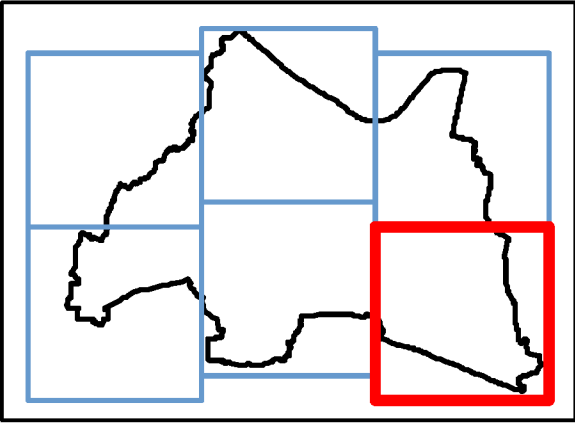


APPENDIX 3

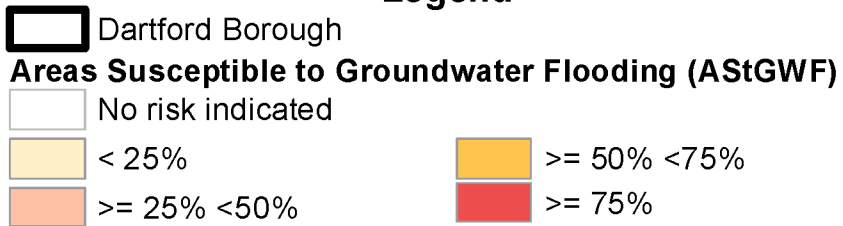
Groundwater Flood Susceptibility map (Dartford Borough Council SFRA; Appendix H.2)



Key Plan

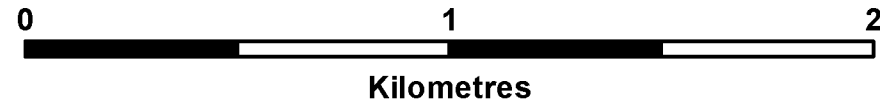


Legend



Notes

The AStGWF is a strategic scale map showing groundwater flood areas on a 1km square grid. This data shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater may emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible areas are actually likely to suffer the consequence of groundwater flooding. The AStGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.



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SFRA: APPENDIX H.2
AREAS SUSCEPTIBLE TO GROUNDWATER
FLOODING

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APPENDIX 4

Infiltration Testing Results (RSK Geosure; October 2023)

Our ref: 52589-L01 (00)
Date: 27th October 2023

Clearstone Energy
8 Devonshire Square
London
EC2M 4PL

For the attention of Mr S Thompson

NORTHFLEET BESS: INFILTRATION TESTING

Dear Sam,

1. INTRODUCTION

RSK have been commissioned by Clearstone Energy to undertake investigation works at the land off Station Road, Northfleet (Northfleet BESS) to investigate the infiltration characteristics of the shallow soils at four (4no.) locations on site.

The works have been conducted as set out in RSK's original email proposal, dated 4th September 2023. This letter report is subject to the RSK service constraints given in **Appendix A**.

2. BACKGROUND

The Site is located to the north and south of Station Road, Northfleet and can be located at National Grid reference TQ616721 as shown in **Figure 1**. An indicative site boundary and current site layout are shown on **Figure 2**.

The site occupies an approximate area of circa 8 hectares and is occupied by open farmland with livestock. The site is formed of two (2no.) irregular shaped fields, to the north and south of Station Road, Northfleet to the west of Millbrook Garden Centre. Both fields are bounded by trees and hedgerows with Station Road separating them to the north / south.

It is understood that the site will be developed as a battery energy storage facility.



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Registered in Scotland No. 115530
www.rskgroup.com

Published records (British Geological Survey) for the area and available historical borehole logs detail that the site is predominantly underlined by the Thanet Sand Formation, with a central outcrop of Head Deposits overlying the Lewes Nodular Chalk Formation. Section 3.1 and 3.2 provide more detailed discussion of the ground conditions encountered on-site.

3. SITE INVESTIGATION

RSK attended site on the 18th October 2023 to conduct soakaway testing at four (4no.) test locations specified by RSK LDE and agreed with the client. The location references are SA01 to SA04, as presented on **Figure 2**.

3.1 Ground conditions

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015. Detailed exploratory hole records are presented within **Appendix B**. The strata encountered during fieldworks are summarised within **Table 1**.

Table 1: Summary of strata encountered during site investigation

Stratum	Exploratory holes encountered	Depth to top of stratum m below ground level (bgl)	Proven thickness (m)
Topsoil	All	Ground Level	0.30
Head Deposits	SA02	0.30	Full thickness not proven
Thanet Sand Formation	SA01, SA03, SA04	0.30	Full thickness not proven
Lewes Nodular Chalk Formation	SA03	2.95	Full thickness not proven

3.2 Soil descriptions

Topsoil was encountered at all locations. It was generally described as vegetation over dark to light brown gravelly sandy SILT with rootlets. Sand is fine to medium. Gravel is rounded to angular fine to medium flint.

Underlying the topsoil, the Thanet Sand Formation encountered at depths between 0.30m to 3.00m bgl in SA01, SA03 and SA04. This strata comprised varying layers of grey to orangish brown gravelly sandy SILT, gravelly silty SAND or clayey GRAVEL. Sand was typically fine. Gravel was typically rounded to angular fine to coarse flint.

Head deposits were observed in SA02 at depths of between 0.30 to 1.50m bgl. This strata comprised organish brown gravelly silty fine SAND. Gravel is rounded to angular fine to medium flint to 1.20m bgl

where it became light brown gravelly sandy SILT. Gravel is angular to subrounded fine to coarse flint and chalk. Sand is fine.

3.3 Groundwater

No groundwater was encountered during the investigation activities.

3.4 Infiltration testing

Infiltration tests were carried out in all four (4no.) trial pit locations to establish the infiltration rate of the shallow geology. The trial pit tests were carried out generally in accordance with the method described in BRE Digest 365 (BRE, 2016).

The results of the infiltration testing are summarised in **Table 2**.

Table 2: Summary of infiltration testing

Location	Testing zone depth (m bgl)	Test number	Infiltration rate (m/s)
SA01	0.50 – 1.50	1	No discernible infiltration rate
SA02	0.50 – 1.50	1	No discernible infiltration rate
SA03	1.90 – 3.00	1	5.88×10^{-4}
SA03	1.90 – 3.00	2	4.46×10^{-4}
SA03	1.90 – 3.00	3	5.48×10^{-4}
SA04	2.00 – 3.00	1	No discernible infiltration rate

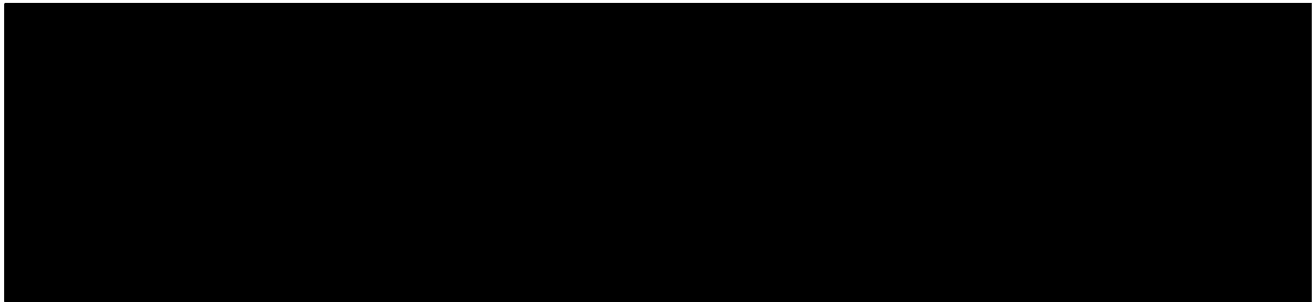
Copies of the testing records are presented within **Appendix C**.

Note that three (3no.) repeat infiltration tests were not permissible within any exploratory positions except for SA03, owing to the comparatively low infiltration rates and the permissible time allocated for this round of exploratory works.

We hope that the information provided within this letter is sufficient for your current requirements, however, if you have any questions, then please contact the undersigned.

Yours sincerely

For RSK Environment Ltd



Geo-Environmental Consultant

Principal Geo-environmental Engineer

Enclosed:

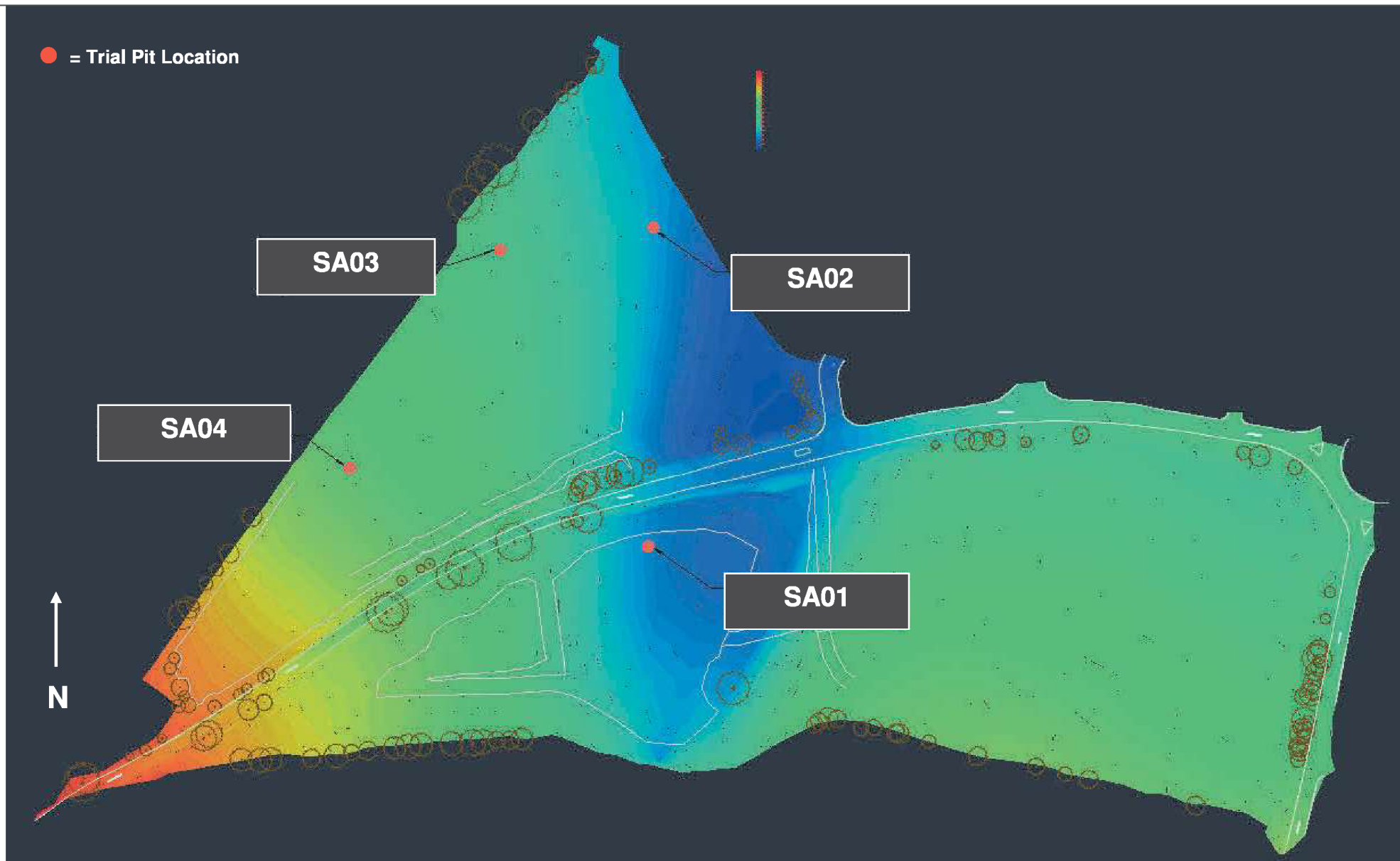
Figures

Figure 1	Site location plan
Figure 2	Exploratory hole location plan

Appendices

Appendix A	Service constraints
Appendix B	Exploratory logs
Appendix C	Infiltration data

FIGURES



APPENDIX A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Clearstone Energy (the "Client") in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] between RSK and the Client. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):
 - a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

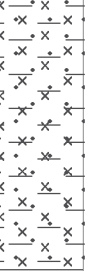
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

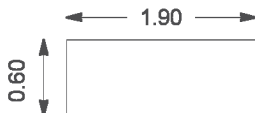
RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

- 8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.
- 9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
- 10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.
- 11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.
- 12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B EXPLORATORY LOGS

Contract: Northfleet BESS		Client: CLEARSTONE ENERGY LIMITED		Trial Pit: SA01
Contract Ref: 52589	Start: 18.10.23 End: 18.10.23	Ground Level: 13.97	National Grid Co-ordinate: E:561723.4 N:172102.1	Sheet: 1 of 1

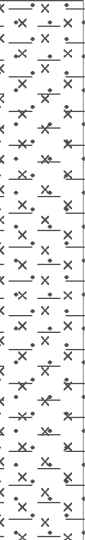
Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						Grass over dark brown gravelly sandy SILT with rootlets. Gravel is rounded to angular fine to medium flint. Sand is fine. (TOPSOIL)	(0.30) 0.30	
						Orangish brown gravelly sandy SILT. Gravel is subangular to subrounded fine to medium chalk and flint. Sand is fine. (THANET FORMATION)	(0.50) 0.80	
						Orangish brown sandy clayey SILT. Sand is fine. (THANET FORMATION)	(0.90) 1.70	

Plan (Not to Scale) 		General Remarks 1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation. 2. Checks for buried ferrous objects carried out during excavation by specialist unexploded ordnance (UXO) officer using magnetometer. 3. Trial pit remained dry and stable during excavation. 4. Trial pit backfilled with arisings upon completion.		
Method Used: Inspection pit + Machine dug Plant Used: 13 Ton Tracked Excavator		All dimensions in metres Scale: 1:25 Logged By: JCurnow Checked By: 		

[illegible]

INGINT_LIBRARY V1.01.GLB LibVersion: v8_07_001 PrjVersion: v8_07 | Log TRIAL PIT LOG - A4P | 525689 NORTHFLEET BESS.GPJ - V10_01.
27/10/23 - 13:32 | JC12

Contract: Northfleet BESS		Client: CLEARSTONE ENERGY LIMITED		Trial Pit: SA03
Contract Ref: 52589	Start: 18.10.23 End: 18.10.23	Ground Level: 18.22	National Grid Co-ordinate: E:561655.8 N:172241.1	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						Grass over light brown gravelly sandy SILT with rootlets. Gravel is rounded to angular fine to medium flint. Sand is fine. (TOPSOIL)	(0.30) 0.30	
						Orangish brown sandy clayey GRAVEL of rounded to angular fine to coarse flint. Sand is fine to coarse. (THANET FORMATION)	(0.90) 1.20	
						Grey to orangish brown sandy clayey SILT. Sand is fine. (THANET FORMATION)	(1.80) 3.00	
						... At 2.95m depth inclusions of structureless CHALK composed of creamy white gravelly SILT. Gravel is weak, low density, white subangular fine to medium chalk.	3.00	

Plan (Not to Scale)



General Remarks

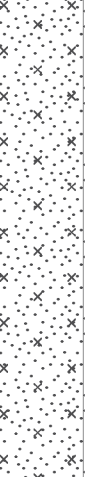
1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Checks for buried ferrous objects carried out during excavation by specialist unexploded ordnance (UXO) officer using magnetometer.
3. Trial pit remained dry and stable during excavation.
4. Trial pit backfilled with arisings upon completion.

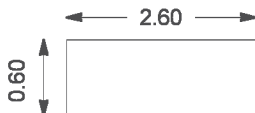
All dimensions in metres

Scale: **1:25**

Method Used: Inspection pit + Machine dug	Plant Used: 13 Ton Tracked Excavator	Logged By: JCurnow	Checked By: AGS
--	---	---------------------------	------------------------

Contract: Northfleet BESS		Client: CLEARSTONE ENERGY LIMITED		Trial Pit: SA04
Contract Ref: 52589	Start: 18.10.23 End: 18.10.23	Ground Level: 21.34	National Grid Co-ordinate: E:561588.6 N:172144.5	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						Grass over light brown gravelly sandy SILT with rootlets. Sand is fine. Gravel is rounded to angular fine to medium flint. (TOPSOIL)	(0.30) 0.30	
						Orangish brown gravelly silty fine SAND. Gravel is rounded to angular fine to coarse flint. (THANET FORMATION)	(1.10) 1.40	
						Oranish brown to light grayish brown silty fine SAND. (THANET FORMATION)	(1.60) 3.00	

Plan (Not to Scale) 		General Remarks 1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation. 2. Checks for buried ferrous objects carried out during excavation by specialist unexploded ordnance (UXO) officer using magnetometer. 3. Trial pit remained dry and stable during excavation. 4. Trial pit backfilled with arisings upon completion.		
Method Used: Inspection pit + Machine dug Plant Used: 13 Ton Tracked Excavator		All dimensions in metres Scale: 1:25 Logged By: JCurnow Checked By: AGS		

APPENDIX C INFILTRATION DATA

FULL SCALE SOAKAWAY TEST

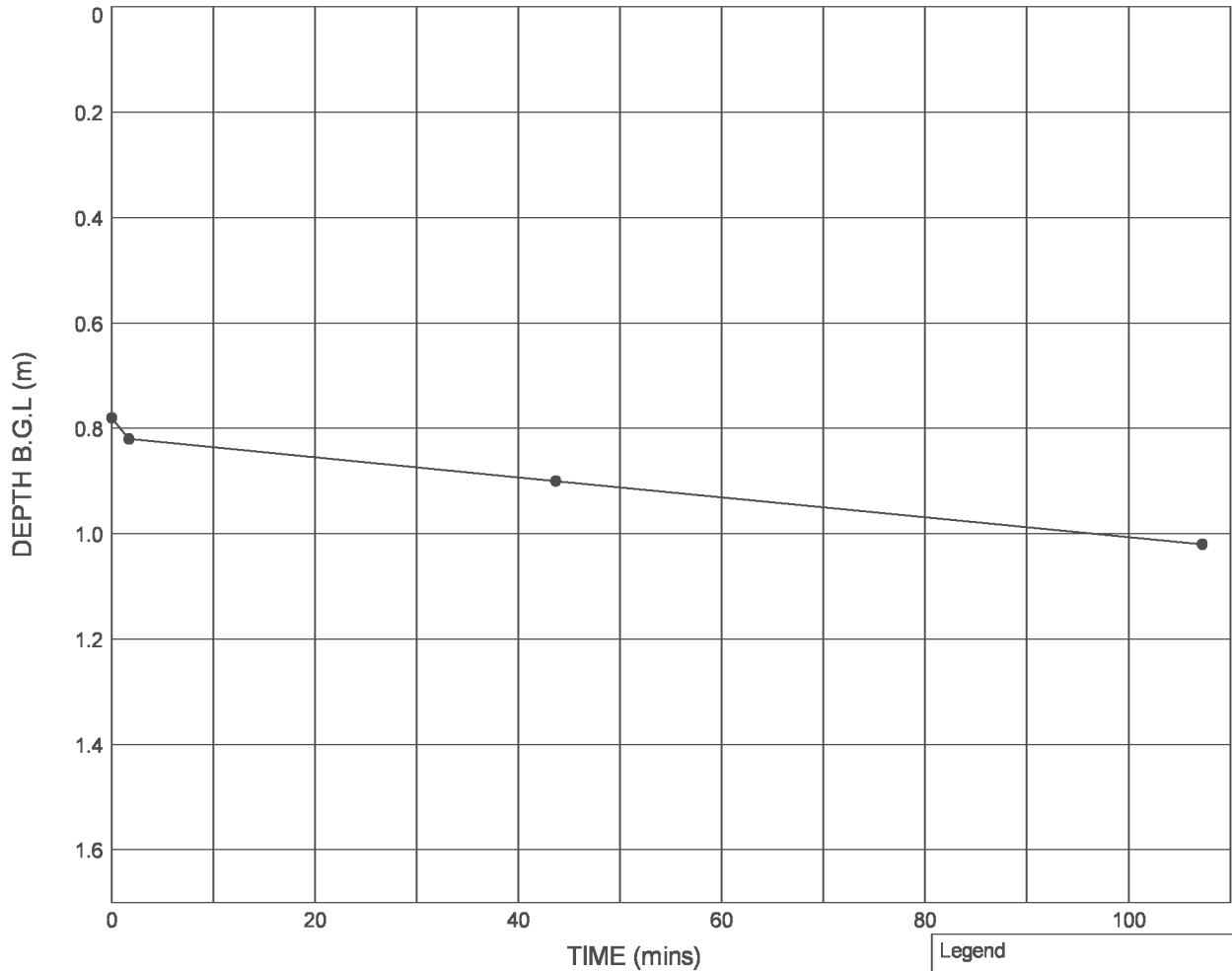
In accordance with BRE Digest 365

Soakaway Test - Position ID : **SA01**

Ground Level: **13.97**

National Grid Co-ordinates: **E:561723.4 N:172102.1**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

Pit start depth: = 1.70 m

Pit final depth: = 1.70 m

Effective depth, D_e = 0.92 m

Effective storage volume, V_{p75-25} = 0.5244 m³

Surface area, a_{s50} = 3.4400 m²

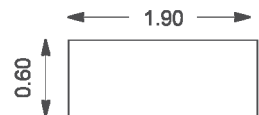
Time, t_{p75-25} = N/A secs

Infiltration rate, f = N/A m/s

Legend

● Test 1 (18.10.23)

Plan (Not to scale)



No Bearing Taken



Compiled By

Date

Checked By

Date

26/10/23

Contract

Northfleet BESS

Contract Ref:

52589

FULL SCALE SOAKAWAY TEST

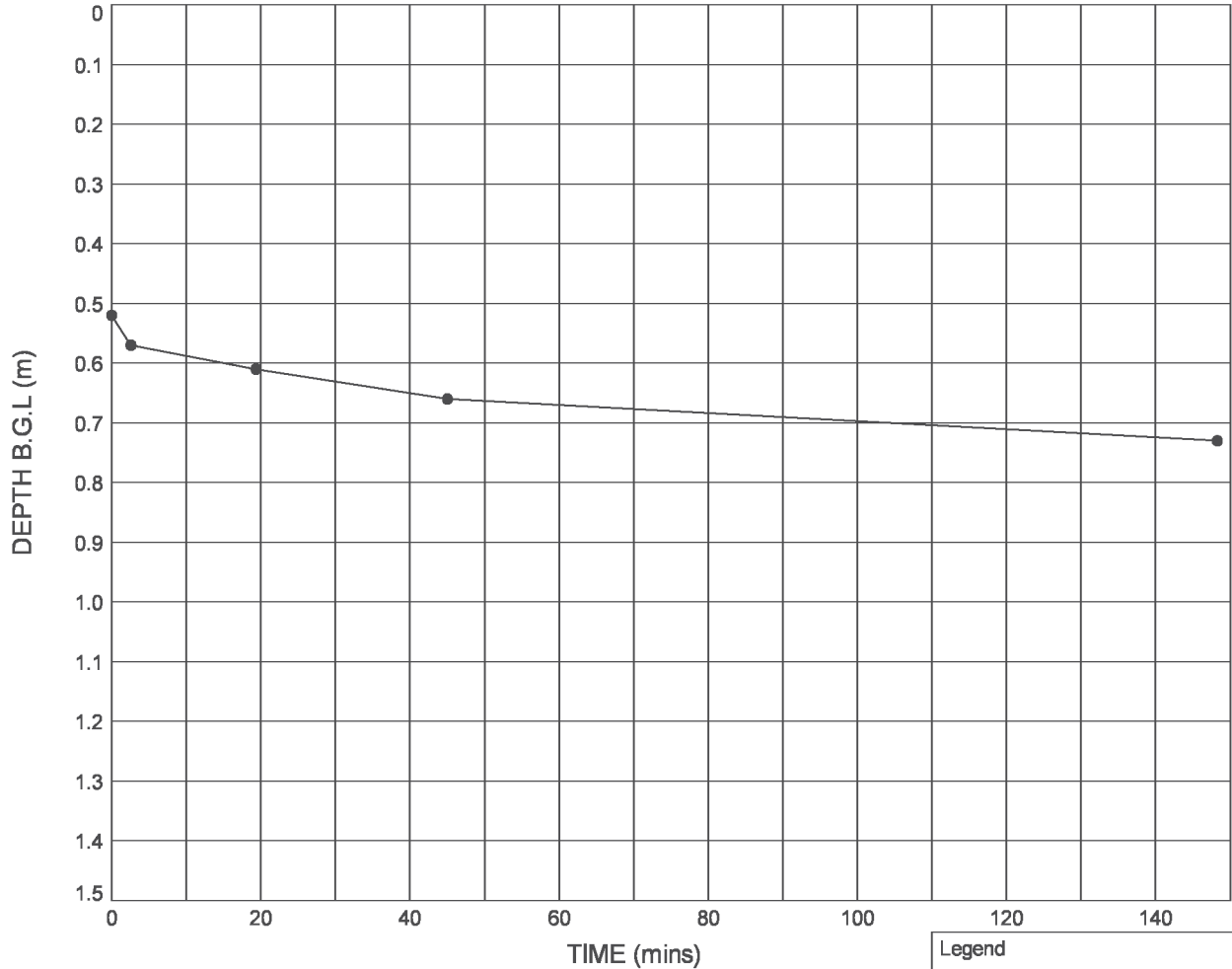
In accordance with BRE Digest 365

Soakaway Test - Position ID : SA02

Ground Level: 14.53

National Grid Co-ordinates: E:561724.2 N:172251.1

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

Pit start depth: = 1.50 m

Pit final depth: = 1.50 m

Effective depth, D_e = 0.98 m

Effective storage volume, V_{p75-25} = 0.6762 m³

Surface area, a_{s50} = 4.2220 m²

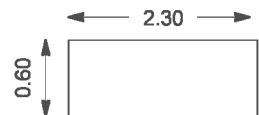
Time, t_{p75-25} = N/A secs

Infiltration rate, f = N/A m/s

Legend

● Test 1 (18.10.23)

Plan (Not to scale)



No Bearing Taken



Compiled By

Date

Checked By

Date

26/10/23

Contract

Northfleet BESS

Contract Ref:

52589

FULL SCALE SOAKAWAY TEST

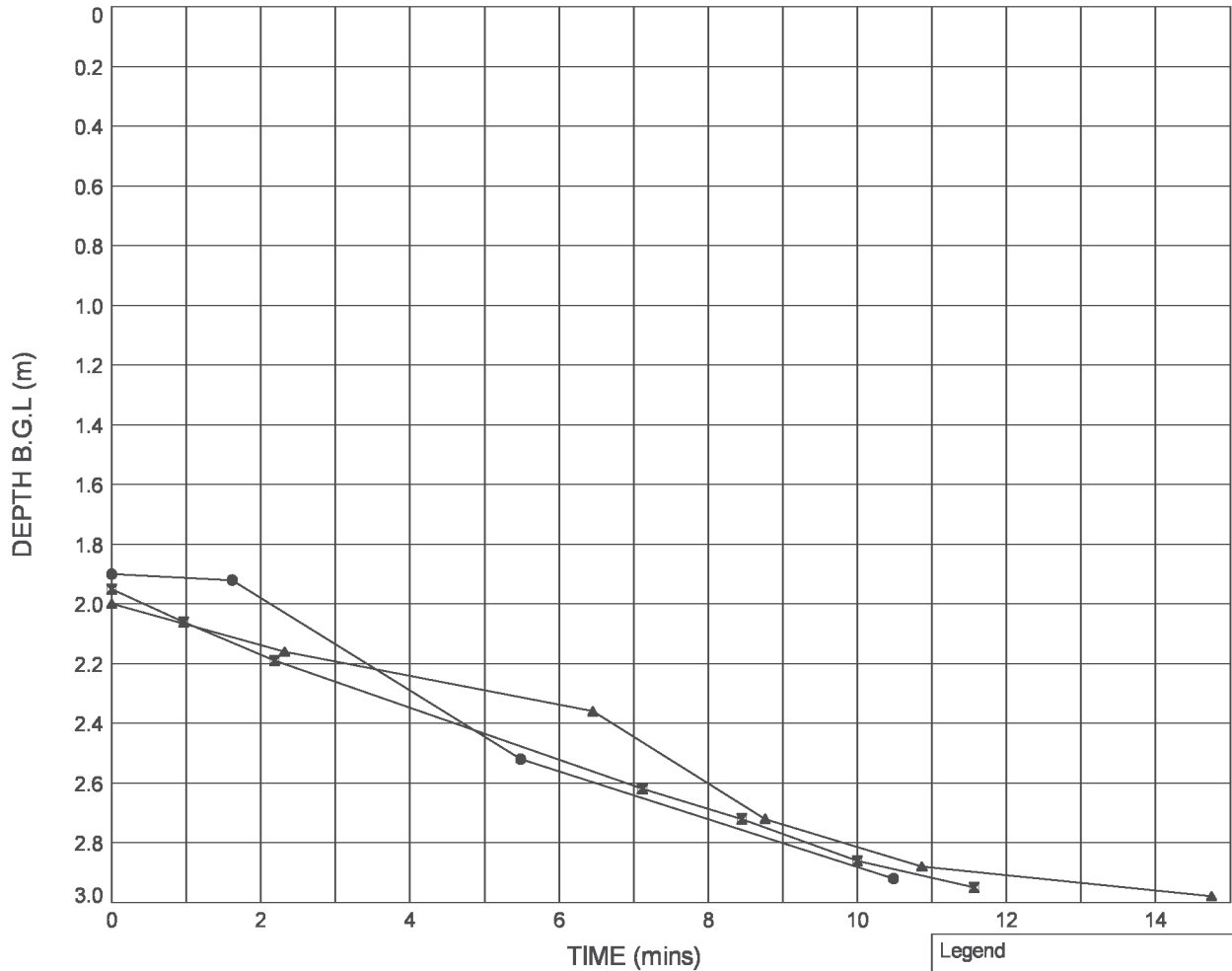
In accordance with BRE Digest 365

Soakaway Test - Position ID : **SA03**

Ground Level: **18.22**

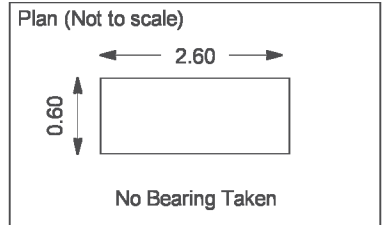
National Grid Co-ordinates: **E:561655.8 N:172241.1**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



	Test 1	Test 2	Test 3	
Pit start depth:	= 3.00	3.00	3.00	m
Pit final depth:	= 3.00	3.00	3.00	m
Effective depth, D_e	= 1.10	1.05	1.00	m
Effective storage volume, V_{p75-25}	= 0.8580	0.8190	0.7800	m^3
Surface area, a_{s50}	= 5.0800	4.9200	4.7600	m^2
Time, t_{p75-25}	= 287.0	373.0	299.0	secs
Infiltration rate, f	= 5.88×10^{-4}	4.46×10^{-4}	5.48×10^{-4}	m/s

Legend		
●	Test 1	(18.10.23)
⊠	Test 2	(18.10.23)
▲	Test 3	(18.10.23)



Compiled By

Date

Checked By

Date

26/10/23

Contract

Contract Ref:

Northfleet BESS

52589

FULL SCALE SOAKAWAY TEST

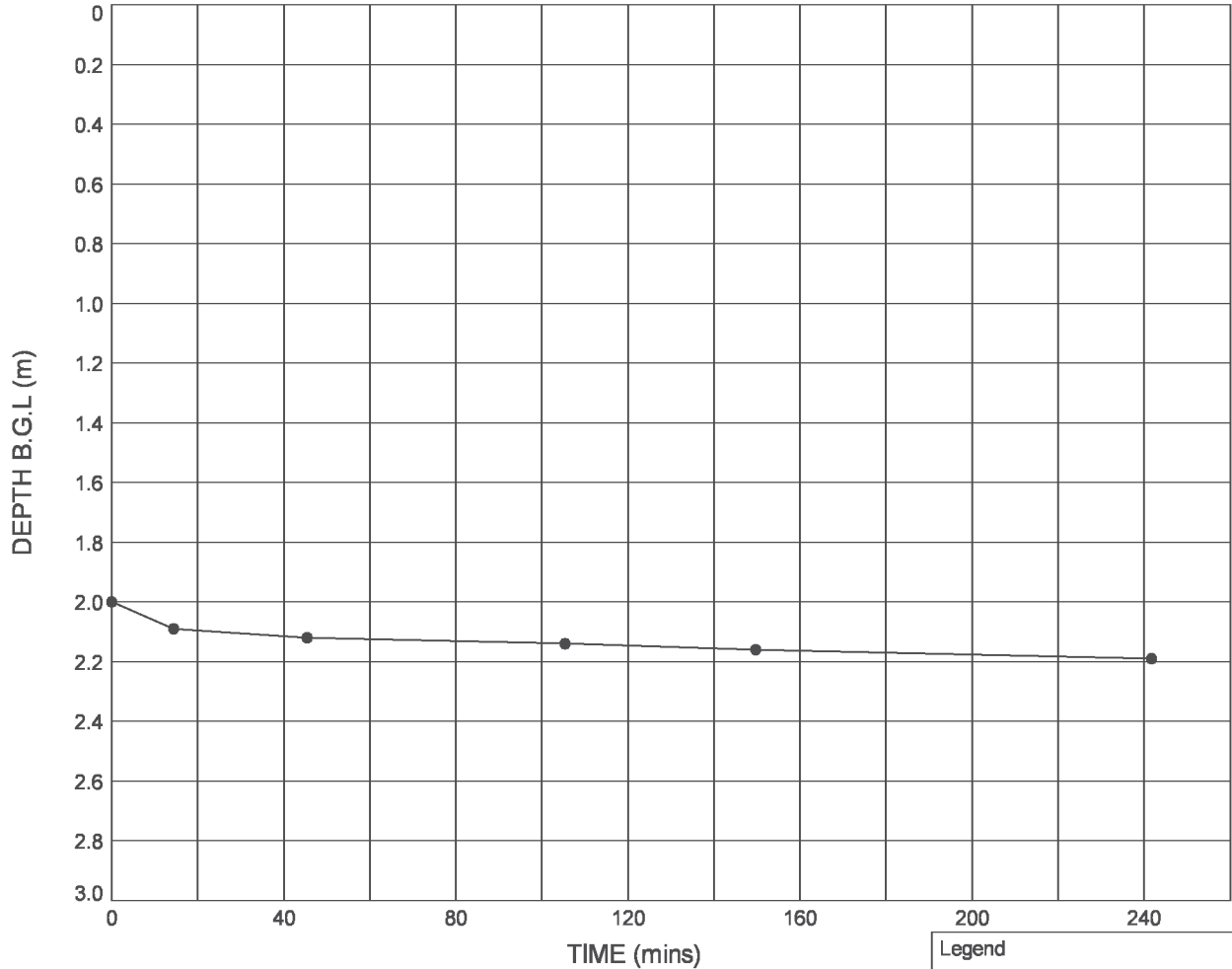
In accordance with BRE Digest 365

Soakaway Test - Position ID : **SA04**

Ground Level: **21.34**

National Grid Co-ordinates: **E:561588.6 N:172144.5**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



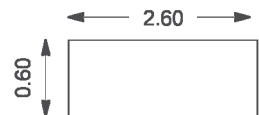
Test 1

Pit start depth: = 3.00 m
Pit final depth: = 3.00 m
Effective depth, D_e = 1.00 m
Effective storage volume, V_{p75-25} = 0.7800 m³
Surface area, a_{s50} = 4.7600 m²
Time, t_{p75-25} = N/A secs
Infiltration rate, f = N/A m/s

Legend

● Test 1 (18.10.23)

Plan (Not to scale)



No Bearing Taken



Compiled By

Date

Checked By

Date

26/10/23

Contract

Northfleet BESS

Contract Ref:

52589

APPENDIX 5

Environment Agency Pre-application Advice

Hannah Wilson
Wardell Armstrong LLP
Sent via email

Our ref: KT/2024/131810/01-L01
Your ref: Northfleet BESS
Date: 12 July 2024

Dear Hannah Wilson

Pre application advice ENVPAC/1/KSL/00759

Battery Energy Storage System, Station Road, Southfleet, Dartford, Kent, DA13 9PA

Thank you for consulting us on the above pre application. Please find to follow our comments.

Environment Agency Position- groundwater and contaminated land

The site is located upon bedrock of Thanet Sands and Chalk Formation overlain in part, by superficial Head Deposits. These are designated as Secondary A, Principal and Secondary Undifferentiated Aquifers respectively. The site is also located within a Source Protection Zone 2 and within 100m of a Source Protection Zone 1. A Safeguard Zone is noted to overlap the southwestern corner of the site, which is designated for elevated nitrates.

Please see our comments to the discussion points provided below:

Infiltration into Groundwater Source Protection Zone 2 (and within 100m of Source Protection Zone 1)

This is considered acceptable in these areas as long as the water is surface water only and no foul water or surface water containing hazardous or non-hazardous contaminants as this may require an environmental permit.

Infiltration into a Groundwater Drinking water safeguard zone:

Same as above, however, should there be the potential for discharge of contaminants associated with those identified within the safeguard zone, we would restrict the discharge of these contaminants to prevent any further increases in this area. The current Safeguard Zone is designated for elevated nitrates and as such would not be considered within this application given that no foul drainage is understood to be proposed as part of this development.

Minimum depth of unsaturated zone between groundwater level and base of any proposed soakaways

There is no specific depth outlined within legislation for the minimum depth of unsaturated zone between groundwater level and the base of any proposed

soakaways other than that any discharge to ground may not be directly to groundwater. We would always recommend that any discharges to ground are as shallow as possible, whilst allowing for suitable discharge rates. This increases the unsaturated zone depth and enables further filtration of the discharged water prior to reaching the groundwater. In areas of very shallow groundwater where a direct discharge could not be prevented, we would object to any direct discharge and recommend that alternative arrangements be sought (i.e. drainage mounds, discharge to surface water).

Type of soakaway that would be preferred

We would prefer the use of shallow soakaways utilising crate or concrete ring systems to reduce the depth of the soakaway and increase the depth of unsaturated zone between the discharge point and groundwater. We would not permit deep borehole soakaways in areas where suitable drainage can be achieved at shallower depths.

Any specific requirements with regards to surface water treatment

We would not recommend any specific treatment with regard to surface water being discharged on a normal day-to-day basis. However, we would recommend that suitable features be implemented to prevent the discharge of any contaminants to groundwater, via surface water drainage, in the event of a fire or an emergency spill from any of the units. This is due to the potential for hazardous substances to be released from the Battery Energy Storage Systems should they catch on fire. Whilst it is considered good practice to allow the systems to burn out and not add water, water may be utilised to cool adjacent battery storage systems. This surface water should be contained within an attenuation feature, which can store sufficient volume to accommodate flows from both rain and fire suppression systems, to enable the treatment and / or removal of contaminated water from site for appropriate disposal.

Suitable mitigation measures to prevent discharge of contaminated surface water to ground can include the inclusion of:

- Automatic shut-off valves at the discharge point of these attenuation features, which shut in the event of a leak or fire;
- Installation of oil and petrol interceptors;
- Installation of trapped gulleys;
- Roof drainage - sealed at ground level.

This enables the storage and recovery of contaminated water prior to any discharges to ground. We would recommend automated systems be utilised to remove potential human error in the event of any emergency.

Further guidance has also been provided by the National Fire Chiefs Council as part of the planning guidance practice for applicants to consider when preparing applications for Battery Energy Storage Systems developments. This guidance can be found at [Renewable and low carbon energy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/renewable-and-low-carbon-energy).

Please do not hesitate to contact us should you require any further information.

Yours sincerely

Ms Laura Edwards
Planning Advisor

Direct e-mail KSLPLANNING@environment-agency.gov.uk

APPENDIX 6

Causeway Flow Attenuation Requirements

Calculation Sheet

CLIENT: Clearstone Energy	PROJECT: Northfleet BESS	JOB NO.: CA12848	CALC. REF.: PAGE: 1 OF 2
CALCULATION Causeway Flow Attenuation Requirments	CALC. BY: (NAME AND SIGNATURE) H Wilson	CHECKED BY: (NAME AND SIGNATURE)	APPROVED BY: (NAME AND SIGNATURE)
	DATE: 09/10/2024	DATE:	DATE:

Design Settings:

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	20.000
Ratio-R	0.400
Summer CV	☒ 0.750
Winter CV	☒ 0.840

Area 1:

1 in 30 +35% CC = 429m3

1 in 100 +40% CC = 565m3

Storage Estimate

Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.579
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	429
to	429

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.579
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	565
to	565

Area 2:

1 in 30 +35% CC = 328m3

1 in 100 +40% CC = 431m3

Storage Estimate

Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.442
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	328
to	328

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.442
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	431
to	431

Area 3:

1 in 30 +35% CC = 182m3

1 in 100 +40% CC = 240m3

Storage Estimate

Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.246
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	182
to	182

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.246
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	240
to	240

Calculation Sheet

CLIENT: Clearstone Energy	PROJECT: Northfleet BESS	JOB NO.: CA12848	CALC. REF.: PAGE: 2 OF 2
CALCULATION Causeway Flow Attenuation Requirments	CALC. BY: (NAME AND SIGNATURE) H Wilson	CHECKED BY: (NAME AND SIGNATURE)	APPROVED BY: (NAME AND SIGNATURE)
	DATE: 09/10/2024	DATE:	DATE:

Area 4:

1 in 30 +35% CC = 130m3

Storage Estimate

Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.176
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	130
to	130

1 in 100 +40% CC = 172m3

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.176
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	172
to	172

Area 5:

1 in 30 +35% CC = 305m3

Storage Estimate

Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.412
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	305
to	305

1 in 100 +40% CC = 402m3

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.412
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	402
to	402

Area 6:

1 in 30 +35% CC = 203m3

Storage Estimate

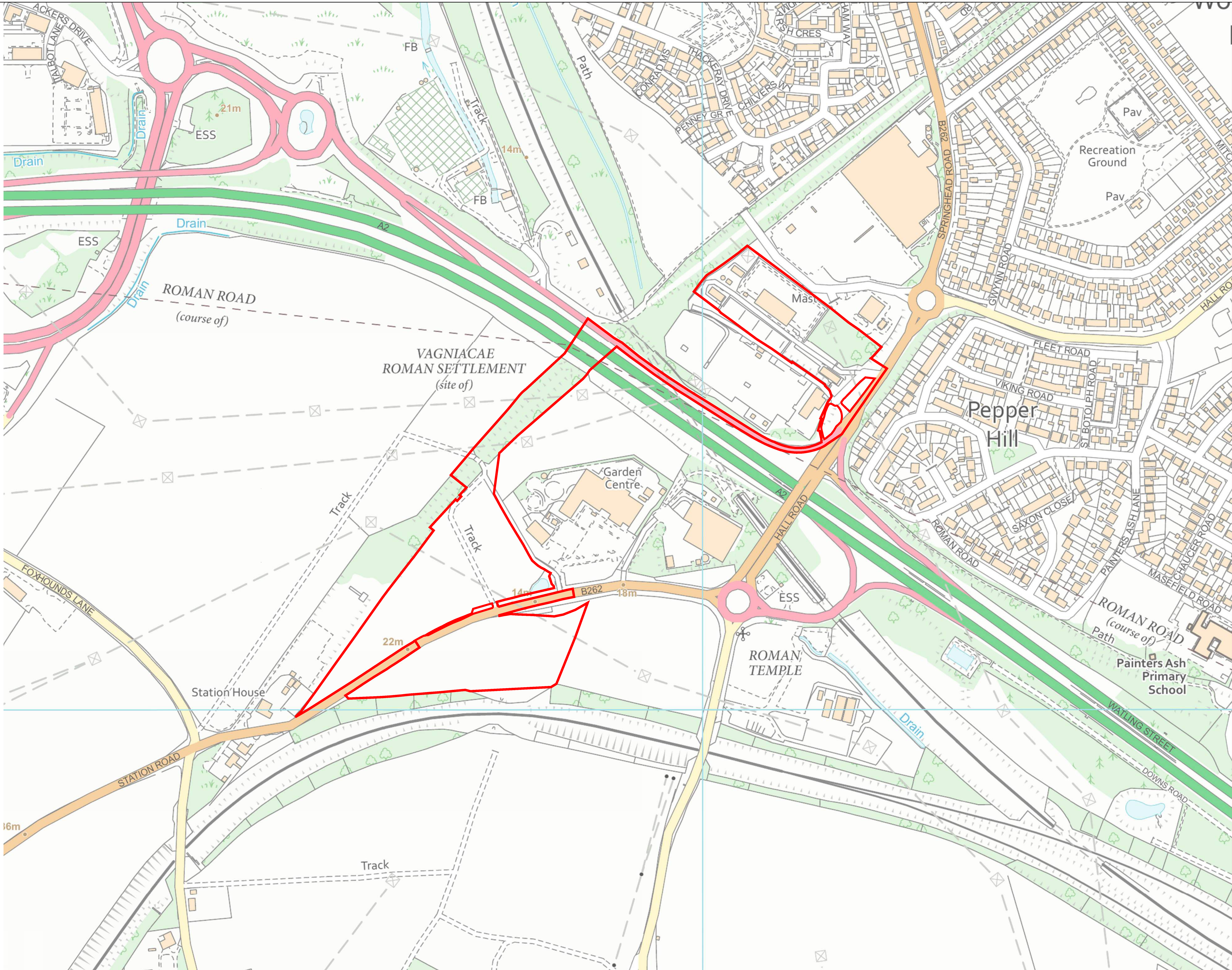
Return Period (years)	30
Climate Change (%)	35
Impermeable Area (ha)	0.274
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	203
to	203

1 in 100 +40% CC = 267m3

Storage Estimate

Return Period (years)	100
Climate Change (%)	40
Impermeable Area (ha)	0.274
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc.
from	267
to	267

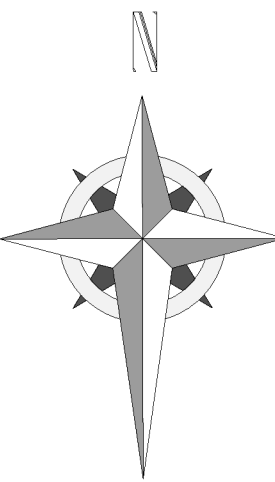
DRAWINGS



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Revisions:					
Revision	Date	Revision Notes	Drawn	Inspected	
01	18.12.23	First Issue	JM	DW	
02	19.01.24	Revised	JM	DW	
03	06.07.24	Cable Route Added to RLB	JM	ST	
04	26.11.24	Via Splay Added to RLB	OS	ST	

LEGEND:
 PROPOSED SITE



Project: **Dartford BESS**

Developer:



**CLEARSTONE
ENERGY**

CLEARSTONE ENERGY Limited
8 Devonshire Square, London
United Kingdom, EC2M 4PL
www.clearstoneenergy.com/

Drawn by:



CADmando
2D, 3D CAD & BIM SERVICES

CADmando Design & Drafting Solutions Ltd
The Long Barn, The Courtyard, Severn Drive, Tewkesbury
Business Park, GL20 8GD
Tel: +44 (0) 1684 850019
Mob: +44 (0) 7814436910

Status: **FOR INFORMATION**

Drawing Title: **Dartford BESS
Site Location Plan**

Drawn: JM	Checked: DW	First Issued: 18.12.2023
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Project Code: **CST010- DF1.0**

Sheet Size: A1	Scale: 1:2500	Revision: 04
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Revisions:

Revision	Date	Revision Notes	Drawn	Inspected
01	07.11.23	First Issue	JM	DW
02	18.12.23	Revised	JM	DW
03	19.01.24	Revised	JM	DW
04	08.07.24	Amendments to Site Technology and Layout	JM	ST
05	30.08.24	Amendments to Layout, Substation relocated	JM	ST
06	10.09.24	Technology and Duration revised	JM	ST
07	28.10.24	Overhead HV Lines Added	GM	ST
08	28.11.24	Amended as per Comments	OB	ST
09	29.11.24	Amended as per Comments	OB	ST
10	06.12.24	Amended as per Comments	OB	ST

LEGEND:

	PLANNING APPLICATION BOUNDARY
	SITE ACCESS
	INTERNAL SITE ROADS
	EMERGENCY/FIRE ACCESS
	DNO ACCESS
	BESS SECURITY FENCE
	EXISTING UNDERGROUND POWER LINES
	EXISTING OVERHEAD POWER LINES
	EXISTING THOROUGHFARE
	FOOT ACCESS
	EXISTING VEGETATION

SITE INFRASTRUCTURE

	SECURITY GATE		BATTERY UNIT
	PEDESTRIAN GATE		PCSK INVERTER
	CUSTOMER SUBSTATION		MV SKID
	FIRE HYDRANT		AC/DCC PANEL
	120,000L WATER TANK		FIRST RESPONDER PANEL
	FIRST RESPONDER REPEATER PANEL		CCTV COLUMN

Project:

Dartford Energy Hub

Developer:



CLEARSTONE ENERGY Limited
8 Devonshire Square, London
United Kingdom, EC2M 4PL
www.clearstoneenergy.com/

Drawn by:



Status:

FOR PLANNING

Drawing Title:

Dartford Energy Hub
Proposed Site Layout Plan

Drawn: JM	Checked: DW	First Issued: 07.11.2023
Project Code: CST010- DF4.0	Drawing Number:	
Sheet Size: A1	Scale: 1:1250	Revision: 10