



RIDGE

**SANDY BROW
BATTERY ENERGY STORAGE
SYSTEM FACILITY**

BALANCE POWER

**FLOOD RISK ASSESSMENT AND
SURFACE WATER DRAINAGE
STRATEGY**

23rd June 2025

**SANDY BROW
BATTERY ENERGY STORAGE SYSTEM FACILITY**

BALANCE POWER

5022617-RDG-XX-XX-RP-C-0501

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EXECUTIVE SUMMARY

Ridge and Partners LLP have been commissioned by Balance Power to prepare a Flood Risk Assessment and Surface Water Drainage Strategy in support of a planning application for the construction of a Battery Energy Storage System (BESS) facility at Perimeter Road, Knowsley, Liverpool, L33 3AE.

The Environment Agency Flood Map for Planning indicates that the proposed site lies within Flood Zone 1, and is therefore at 'Very Low' risk of fluvial and tidal flooding (less than 1 in 1000 probability of flooding in any given year). An ordinary watercourse lies to the south of the site which is within Flood Zones 2 and 3. Environment Agency surface water flood risk mapping indicates that isolated parts of the site are at 1 in 30 (3.3%), 1 in 100 (1%) and 1 in 1000 (0.1%) risk of surface water flooding each year. The Environment Agency flood risk service also states that flooding from groundwater and reservoirs is unlikely in this area. No flood risk sources are considered to pose an unmanageable risk to the development, and therefore the proposed BESS facility is considered suitable in this location.

The proposed surface water drainage system incorporates open SuDS in the form of swales and an attenuation basin. A series of filter drains are positioned around the perimeter of the BESS platform to capture surface water runoff before discharging to the southern swale. A flow control chamber is located downstream of the attenuation basin with the outflow rate restricted to the 1 in 1 year greenfield runoff rate for the site. A new headwall/ outfall will be constructed within the existing watercourse.

The site has historically been utilised as landfill, and the site investigation undertaken by Ridge and Partners LLP in January 2024 identified a significant thickness of Made Ground across the site. Given these findings, it was not possible to undertake soakage testing across the site, and surface water should be prevented from percolating into the landfill. As such, soakaways are therefore not a viable means of surface water disposal at the Sandy Brow site. Surface water drainage systems will be lined with impermeable membranes (including below the granular compound areas) to prevent surface water infiltrating to ground. Installing impermeable membranes will also guard against used/ contaminated firewater infiltrating to ground and potentially contaminating groundwater sources in the event of a battery fire at the site. A penstock shutoff valve will be provided on the flow control chamber downstream of the proposed attenuation basin, which can be utilised to prevent used/ contaminated firewater discharging into the downstream watercourse, and provide a contained firewater supply for reuse (if required) during a fire incident.

A new mains water supply and hydrant connection is currently being explored, which is the preferred means of providing a water supply to the Sandy Brow BESS site. A firewater holding tank is proposed as an alternative to a new hydrant connection (on the north-eastern side of the site) but would only be progressed if a new mains supply is not feasible.

1. INTRODUCTION

Ridge and Partners LLP have been commissioned by Balance Power to prepare a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy in support of a planning application for the construction of a Battery Energy Storage System (BESS) facility at Perimeter Road, Knowsley, Liverpool, L33 3AE.

Whilst the existing site is brownfield (former landfill use), greenfield (pre-development) run off rates have been calculated and utilised for establishing the allowable peak post-development runoff rates from the site.

The total development area associated with this planning application covers an approximate area of 3.06 ha, of which approximately 1.22 ha is new hard landscaped area (access roads, granular compounds, concrete bases etc). The remaining area will remain as soft landscaping.

The NPPF and Environment Agency (EA) provide guidance for where a site-specific FRA is required, which applies to the following:

- For sites of 1 hectare or greater in Flood Zone 1;
- All new development (including minor development and change of use to a more vulnerable class e.g. commercial to residential) in Flood Zones 2 and 3;
- For sites within Flood Zone 1 which have critical drainage problems (as notified by the Environment Agency); and
- Where proposed development (including change of use to a more vulnerable class e.g. commercial to residential) may be subject to other sources of flooding.

Furthermore, all planning applications which are classified as 'Major Development' must be submitted with a Surface Water Management Strategy. 'Major Development' is considered either:

- 10 or more dwellings, or a site of 0.5 hectares or more for residential applications; or
- Floorspace of 1000m² or more, or a site of 1 hectare or more.

As the proposed BESS facility site is larger than 1 hectare, a Flood Risk Assessment and Surface Water Management Strategy is required.

This FRA and Drainage Strategy assesses the existing flood risk associated with the proposed site (including managing any potential increase in flood risk as a result of the new development), whilst setting out the surface water drainage design for the development to manage flood risk (both on and off the site) in the post-development scenario. The report considers the risk of flooding from all sources, including fluvial (watercourse), pluvial (surface water), groundwater, reservoir, sewer flooding and flooding from artificial sources.

2. SITE DESCRIPTION

2.1. Site Location

Site Name: Sandy Brow BESS

Site Address: Perimeter Road, Knowsley, Liverpool, L33 3AE

Site Location: Easting: 344229, Northing: 398323

National Grid Reference: SJ 4423 9832

Site Area: Approx. 3.06 ha

The site is accessed from Perimeter Road (public highway) via a gravel track which joins the site from the west. A public footpath runs adjacent to the northern side of the gravel access track, which continues in an easterly direction until it meets a public bridleway approximately 500m further east. An area of scrubland runs adjacent to the southern and eastern boundaries of the site. An unnamed ordinary watercourse is located adjacent to the south-western boundary of the site, and this drains in a westerly direction to Knowsley Industrial Park. The land ownership boundary for the site extends to the centreline of the existing watercourse.

132kV and 275kV overhead powerlines cross the site, running north to south, with a 275kV pylon located at the south-west boundary of the site.

The operational design life of the BESS development is 40 years, and the anticipated connection date is April 2028. Construction is likely to commence in early/ mid 2027.

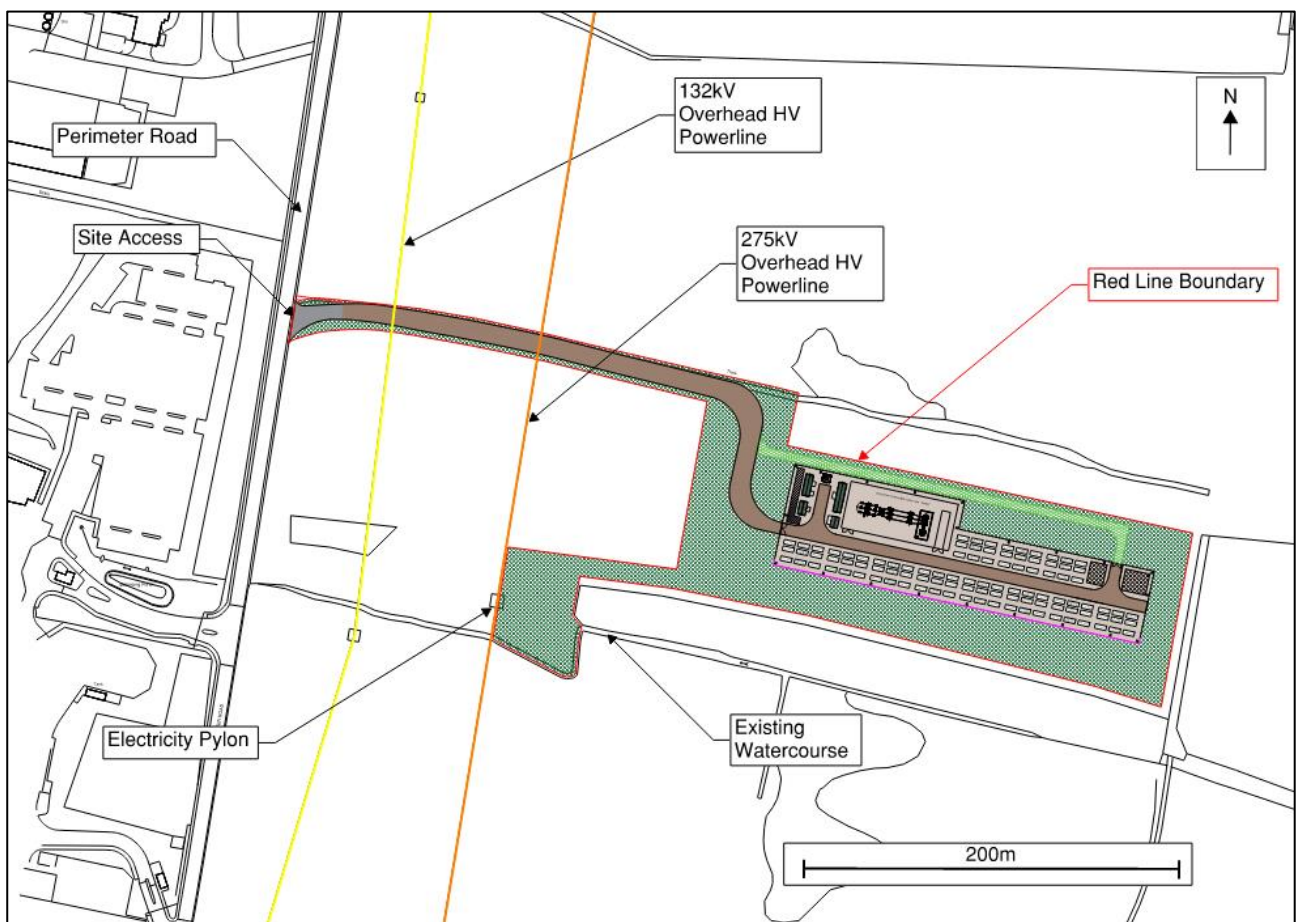


Figure 1 – Sandy Brow Development Site Layout (Balance Power, 2025)

2.2. Land use and Topography

The site comprises rough open grassland with densely vegetated field boundaries, and barbed wire fencing is visible within the vegetation along the boundary lines. A number of mounds of concrete/ brick rubble (including other grassed mounds) across the west of the site. Intrusive site investigation has been undertaken (discussed in Section 2.7 of this report) which identified a significant thickness of Made Ground, which remains from the sites former landfill use.

The main site where the proposed BESS platform is located generally falls in a southerly direction towards an existing watercourse. The highest point is along the north-eastern boundary of the site (approx. 52.50mAOD) and the lowest in the south-western corner of the site (approx. 49.30mAOD). There is therefore an approximate maximum level difference of 3m across the site. The levels along the existing gravel access track (which connects Perimeter Road to the proposed BESS platform) varies between existing levels of 47.50mAOD at Perimeter Road, to 51.30mAOD at the eastern end of the access track.

The topographical survey drawing has been provided in Appendix A – Topographic and Existing Utilities Survey.

2.3. Site Constraints and Risks

The following site constraints and risks have been identified:

- **Overhead power lines and pylon** – 132kV and 275kV overhead powerlines cross the access road for the site. Power lines of 132kV and lower are owned by the DNO (Distribution Network Operator. For the case of Sandy Brow, the DNO is Scottish Power (SP) Energy Networks. National Grid own the larger pylons (275kV and 400kV), which includes the pylon located at the south-western corner of the site. A 30m exclusion zone from the base of this National Grid pylon for proposed works has been utilised. Any proposed works which are planned below the overhead power lines e.g. along the access track, should be discussed with SP Energy Networks and National Grid.
- **Ground Conditions** – The Sandy Brow site is a former landfill site, and there is a significant thickness of Made Ground across the site. An earthworks remediation strategy is presently being developed.
- **Site Access** – An existing vehicular access track is available to the site from Perimeter Road. It is anticipated the existing access will be widened to accommodate construction traffic, and formalised as a surfaced bell mouth access, with a Section 278 agreement required with Knowsley Council. The speed limit outside the site entrance on Perimeter Road is 40mph, however there is a change in speed limit (from 40mph to 50mph) close to the site entrance which will need to be considered in the design of any permanent vehicular access e.g. visibility splay requirements.
- **Public Right of Way** – Maintaining access to the public footpath which follows the northern edge of the existing access track will need to be considered when planning works to the site, to ensure the safety of footpath users is protected.
- **Vegetation** – The thick vegetation around the boundary of the site, particularly in the south-west corner (where a new swale and connection to the existing watercourse is required to be formed) will require clearance. Any ecological impacts and mitigation should be confirmed prior to any works in this area.

2.4. Hydrology

The site falls within the Alt and Crossens Management Catchment area, and the site drains towards an ordinary watercourse at the south-western corner of the site.

The FEH hydrological catchment for the site is shown below in Figure 2:

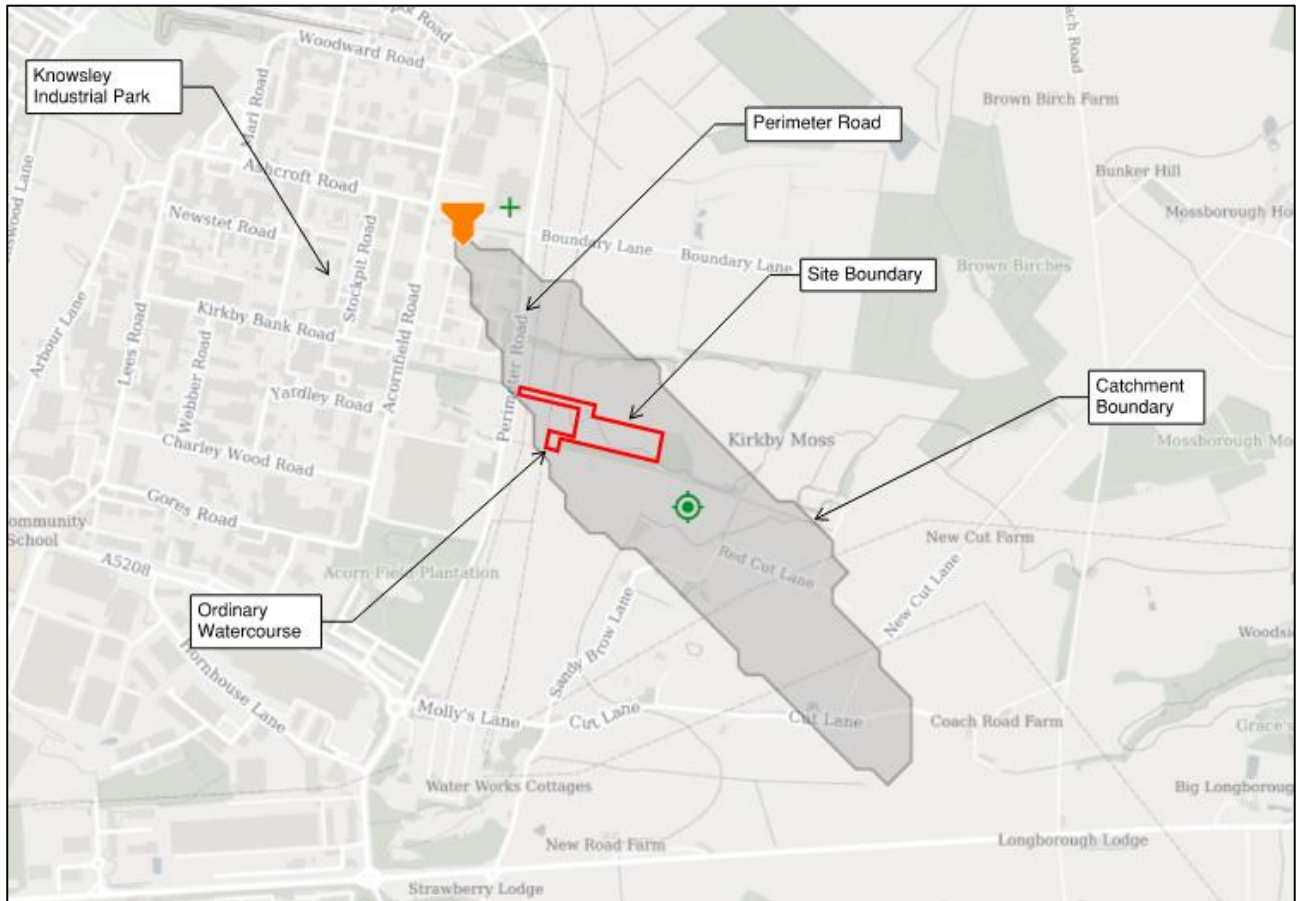


Figure 2 – Hydrological Catchment (FEH Online Web Service, 2025)

2.5. Geological Records

The BGS geological mapping records pertaining to the site are illustrated in Figures 3 and 4 below:

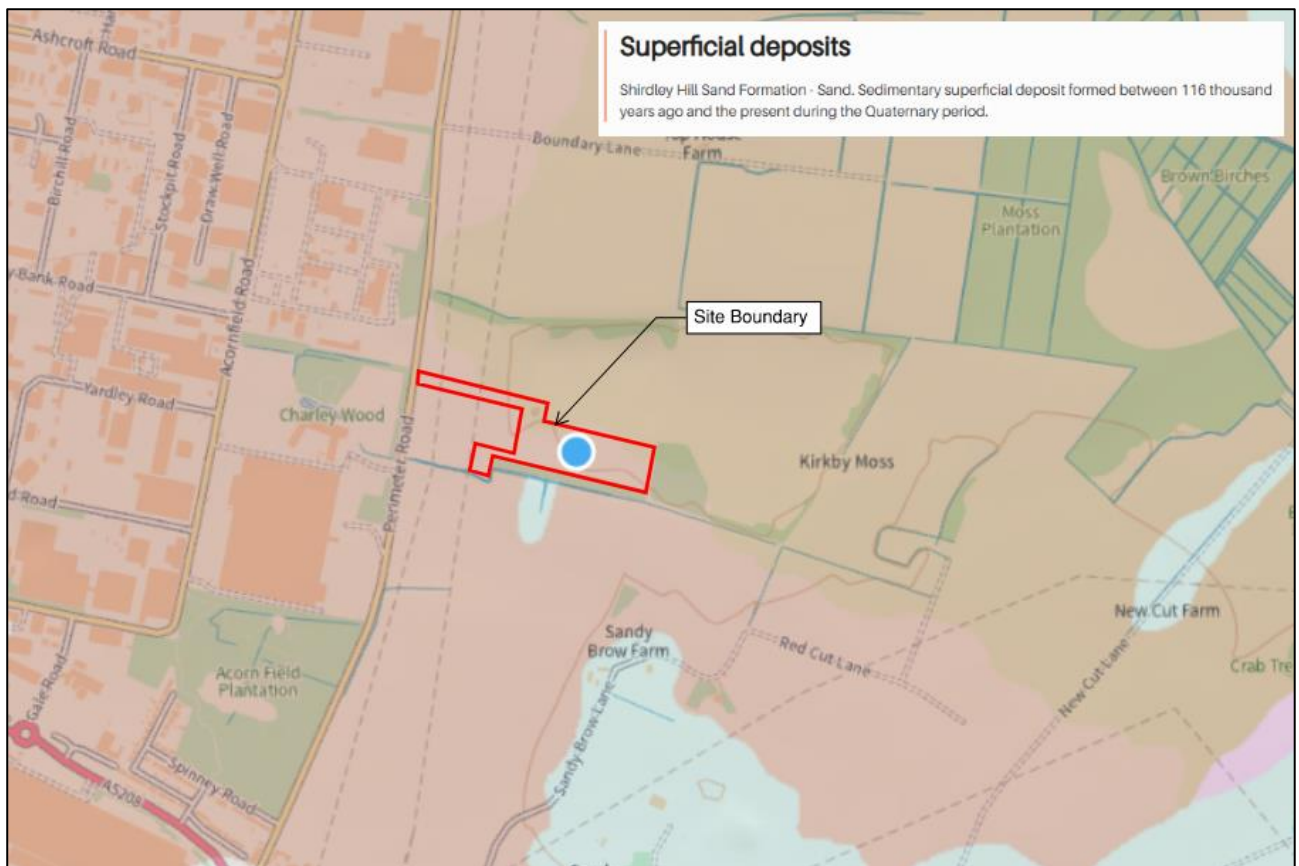


Figure 3 – Superficial deposits at the site (British Geological Survey, 2025)

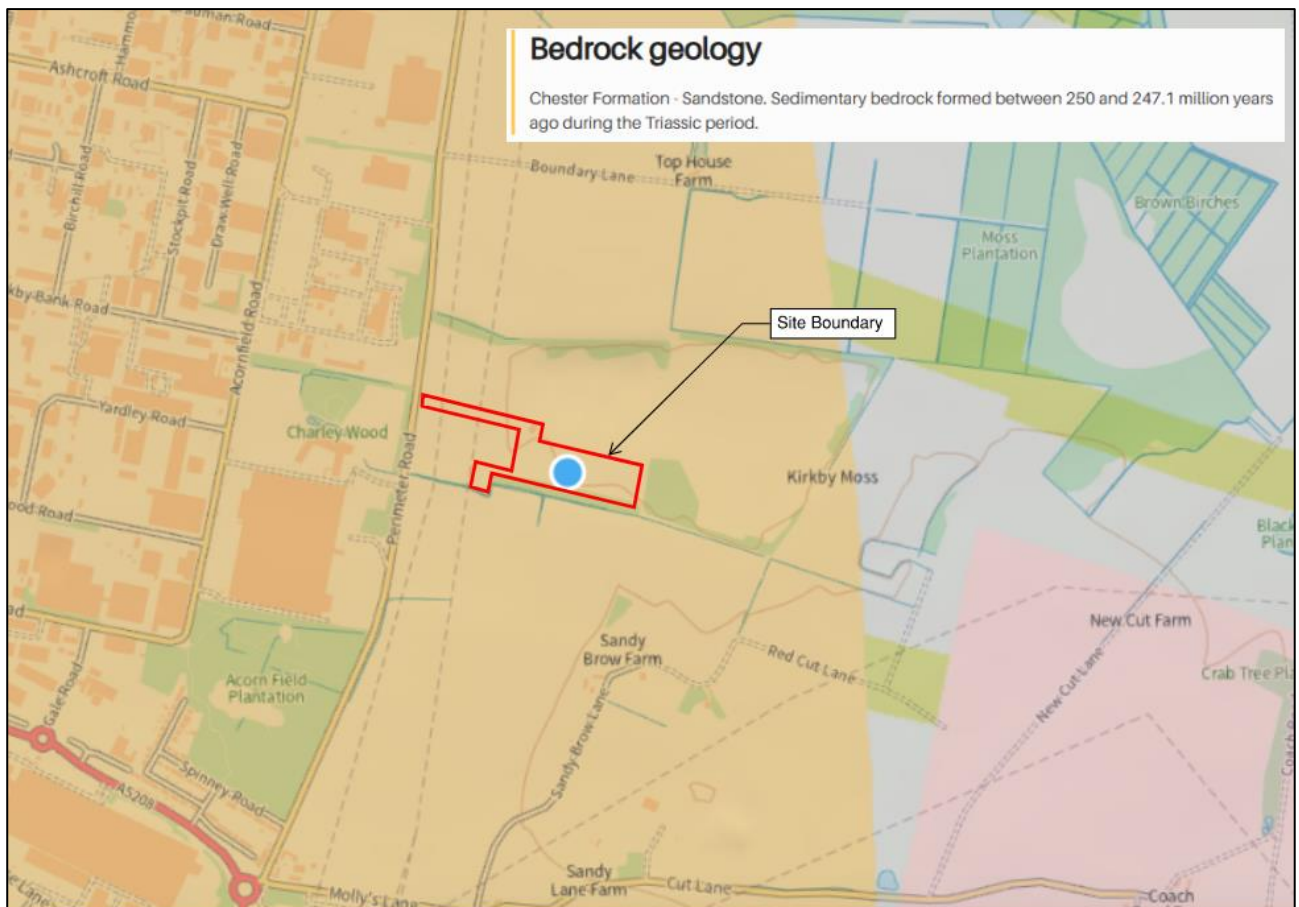


Figure 4 – Bedrock deposits at the site (British Geological Survey, 2025)

No historic borehole records are available for the site, however there are several borehole logs locally including:

- **Ref. SJ49NE50** (700m east of the site) – Indicates a layer of peat above silty sand, sandy clay, and a sandstone bedrock.
- **Ref. SJ49NW1024** (300m north-west of the site) – Indicates made ground, silty sandy clay, and a sandstone bedrock.

The borehole records broadly accord with the BGS geology mapping which is illustrated in Figures 3 and 4 above. Historic borehole information can be viewed on the BGS borehole records website¹. However, site specific ground investigation is always recommended to confirm the in-situ ground conditions. The findings of the site investigation at Sandy Brow site are discussed in Section 2.7.

Soilscapes² mapping indicates the soil is likely to be raised bog peat soils/ very acid sandy and loamy soils (naturally wet).

2.6. Hydrogeology

The site is located within a principal aquifer (sandstone bedrock). Sandstone has high permeability and porosity which enables large volumes of groundwater to be stored and transmitted, making them important sources for water supply.

The site also sits within a Zone III (Total Catchment) Source Protection Zone (SPZ). This is the area around a supply source within which all the groundwater ends up at the abstraction point. This could extend some distance from the source point.

The site is located within an area classified as 'Low' groundwater vulnerability.

Groundwater vulnerability can be summarised as follows:

- **High:** areas that can easily transmit pollution to groundwater. They are characterised by high-leaching soils and the absence of low-permeability superficial deposits.
- **Medium:** areas that offer some groundwater protection. Intermediate between high and low vulnerability.
- **Low:** areas that provide the greatest protection to groundwater from pollution. They are likely to be characterised by low-leaching soils and/or the presence of low-permeability superficial deposits.
- **Unproductive:** areas comprised of rocks that have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.

The above information indicates that the groundwater quality could potentially be compromised if surface water was discharged to ground by infiltration e.g. if existing pollutants from former land-use were mobilised, although given the anticipated low permeability of the superficial deposits at the site, this would offer some protection to groundwater supplies. This would however likely preclude the use of soakaways at the site.

¹ [Borehole records - British Geological Survey \(bgs.ac.uk\)](https://www.bgs.ac.uk/borehole-records/)

² [LandIS - Land Information System - Soilscapes soil types viewer](#)
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2.7. Desktop Study and Ground Investigation

A desktop study was undertaken by Ridge & Partners LLP in August 2023 for the proposed site. The findings of the study can be found in the report titled '5022617-RDG-XX-ST-DOC-C-00DTS01' which is included in Appendix G of this report.

Ground investigation was undertaken at the site in January 2024 by Ridge & Partners LLP which is summarised in report titled 5022617-RDG-XX-ST-DOC-C-00SIR01 (report provided as part of the planning application supporting documents).

The ground investigation trial holes comprised the following:

- 18 machine excavated trial pits;
- 30 dynamic probes;
- 11 dynamic cone penetrometer (DCP) tests; and
- 8 windowless sample boreholes.

The findings from the site investigation can generally be summarised as follows:

- **Topsoil** – Topsoil was identified in all locations to an average depth of 0.31mbgl (and a maximum depth of 0.80mbgl). Topsoil generally comprised brown slightly gravelly sandy silt.
- **Made Ground** – Made Ground was identified in all locations to an average depth of 2.69mbgl, although the majority of boreholes and trial pits were terminated in Made Ground. The anthropogenic materials encountered in the layers of made ground included metal, glass, plastic, clinker, concrete, brick, paper, fabric, wire, timber, sponge, cardboard. It should be noted that the entire site is classified as Made Ground due to its historical landfilling history.
- **Peat** – Organic peat was identified in 2 no. windowless sample trial holes only, typically between depths of between 4.0 – 5.0mbgl.
- **Sand** – Brown fine to coarse sand (considered natural deposits) was identified in 3 no. windowless samples and 1 no. trial pit. Depths where the sand was encountered vary between 1.10mbgl up to 5.00mbgl.

Groundwater strikes were observed in numerous trial pits and boreholes, with groundwater levels recorded between 0.40mbgl and 3.50mbgl during the site investigation. Groundwater monitoring has also been undertaken at the site between January – April 2024, which identified an average continuous groundwater level of 3.02mbgl. This is discussed in further detail in ground investigation report 5022617-RDG-XX-ST-DOC-C-00SIR01. It is likely that the shallow groundwater strikes identified during the site investigation relate to shallow or perched water (rather than the continuous groundwater table) as a result of low permeability superficial deposits at the site.

It should be noted that a strong hydrocarbon and sulphur odour was observed in 7 no. of the windowless sample trial holes, both during the site investigation and during return visits to site. Further information on contamination testing is discussed in report 5022617-RDG-XX-ST-DOC-C-00SIR01.

A further site investigation has concluded and is being analysed to inform an earthworks remediation strategy (currently in development).

2.8. Infiltration Testing

No soakage testing was undertaken at the site, as surface water should be prevented from percolating into the made ground which remains from historic landfill use. The site is also located within a principal aquifer, and with the risk of pollutants either being mobilised in the layers of made ground, or the risk of contaminated firefighting water being discharged to groundwater, this represents an unacceptable risk to groundwater quality. As such, soakaways are not a viable means of surface water disposal at the Sandy Brow site. The surface water drainage systems for the BESS facility at Sandy Brow are required to be lined (e.g. using impermeable membranes) with a control penstock upstream of the proposed outfall to the watercourse. The drainage strategy is discussed further in Section 6 of this report.

3. DEVELOPMENT PROPOSALS

The existing site is greenfield and is approximately 3.06ha, of which around 1.22 ha will become impermeable area post-development. The proposed development is comprised of the following:

- MOT Type 1 granular fill for construction of access roads through the site, excluding the future tarmac surface at the site entrance to Perimeter Road;
- MOT Type 1 (or other granular material/ gravel) for the remainder of the compound areas;
- New infrastructure associated with the new BESS facility, including 2 no. substations, control room and welfare, DNO room, transformer, storage room, battery containers and inverters;
- Concrete bases/ plinths for the new containers or buildings;
- Concrete hardstanding for the areas of proposed battery containers;
- Grasscrete or cellular ground reinforcement grids for emergency access track (fire tender access);
- 1 no. attenuation basin (with deeper area for permanent water to support biodiversity and ecology);
- 2 no. swales connected to the attenuation basin;
- Filter strips and filter drains with outfalls to the swales;
- Ditch/ swale along southern side of access road. Check dams could potentially be integrated in the ditch/ swale to maximise surface water storage along the length of the ditch;
- Pumping station and rising main on access road to connect back to main drainage network;
- Below-ground cellular storage adjacent to the pumping station;
- Impermeable liners e.g. butyl to be installed below the attenuation basin, filter strips, filter drains, swales, ditches and granular areas e.g. access tracks within the battery container compound to prevent any pollutants from entering the ground or contaminants entering the system;
- 1 no. vortex flow control (downstream of attenuation basin); and
- Outfall ditch to connect the vortex flow control to existing watercourse.

A proposed site layout plan is provided in Appendix B.

4. FLOOD RISK POLICY

4.1. National Flood Risk Policy

Under Section 14 'Meeting the challenge of climate change, flooding and coastal change' of the **National Planning Policy Framework (NPPF)**³, the 'Planning and flood risk' section provides high-level guidance to local planning authorities to ensure the effective implementation of flood risk planning policy. This includes overarching statements relating to inappropriate development (in areas at risk of flooding) and flood risk vulnerability classifications, seeking advice from flood risk management authorities, a sequential based approach to siting of new development, the importance of not increasing flood risk off-site, and requirements for minor and major development (such as the incorporation of sustainable drainage systems).

The **Technical Guidance to the National Planning Policy Framework**⁴ provides supplementary information to the NPPF specific to Flood Risk and Minerals Policy. This document provides more specific information on The Sequential and Exception Tests, definition of Flood Zones 1, 2 and 3, types of development across the flood risk vulnerability classifications and flood zone compatibility, site-specific and Strategic Flood Risk Assessments (SFRAs), managing residual risk on sites, and accounting for climate change when assessing flood risk.

The NPPF and Environment Agency (EA) provide guidance for where a site-specific FRA is required to be submitted with a planning application, which applies to the following:

- For sites of 1 hectare or greater in Flood Zone 1;
- All new development (including minor development and change of use to a more vulnerable class e.g. commercial to residential) in Flood Zones 2 and 3;
- For sites within Flood Zone 1 which have critical drainage problems (as notified by the Environment Agency); and
- Where proposed development (including change of use to a more vulnerable class e.g. commercial to residential) may be subject to other sources of flooding.

Furthermore, all planning applications which are classified as 'Major Development' must be submitted with a Surface Water Management Strategy. 'Major Development' is considered either:

- 10 or more dwellings, or a site of 0.5 hectares or more for residential applications; or
- Floorspace of 1000m² or more, or a site of 1 hectare or more.

DEFRA (Department for Environment, Flood and Rural Affairs) have also produced a document titled '**Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems**'⁵. These technical standards for SuDS provide a high-level overview for managing peak flows from a new development, controlling surface water runoff volumes, managing flood risk within the development, construction of SuDS, and key maintenance considerations for SuDS.

The national guidance described in this section has been utilised to inform the development of this Flood Risk Assessment and Drainage Strategy.

³ [National Planning Policy Framework \(publishing.service.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/432424/nppf-2019.pdf)

⁴ [Technical Guidance to the National Planning Policy Framework \(publishing.service.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/432424/technical-guidance-to-the-national-planning-policy-framework.pdf)

⁵ [Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems \(publishing.service.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/432424/sustainable-drainage-systems-non-statutory-technical-standards-for-sustainable-drainage-systems.pdf)

4.1.1. Knowsley Council Sustainable Drainage & Surface Water Management – Technical Guidance for Developers⁶

This document provides technical guidance for developers with regards to the management of surface water drainage. It also sets out some key technical requirements that an FRA/Surface Water Drainage Strategy must demonstrate, which are outlined below.

SuDS

The SuDS hierarchy provided should be followed, with any obstacles justified as to why they prevent the most desirable SuDS method being implemented.

Peak Flow and Volume Control

Whilst the site is considered brownfield due to its former use for landfill, it is currently scrubland/ grassed and is therefore being treated as a greenfield site. There are also no existing below ground drainage systems which have been identified. For greenfield sites, discharge rates are to be limited to the equivalent pre-development greenfield runoff rates for all events (up to and including the 1 in 100-year event plus climate change allowance). The post-development runoff volume for a 1 in 100-year, 6-hour rainfall event should not exceed the greenfield runoff volume for the same event.

Storage Volumes

Calculations should be provided for the following storm events; 1 in 1 year, QBAR (1 in 2.2 year), 1 in 30 year, 1 in 100 year, and 1 in 100 year + climate change. The drainage system should be designed so that flows up to the 1 in 30 critical rainfall event are contained in the surface water drainage system (no flooding). For the 1 in 100-year critical event (with an allowance for climate change), the drainage system must be designed so that, unless an area is designated to hold and/ or convey water as part of the design, flooding does not occur in any part of a building or in any utility plant susceptible to water.

Residual Risk

Any excess flows and volumes of water resulting from rainfall in excess of a 1 in 100 year critical rainfall event are to be safely managed in exceedance routes which minimise risks to people and property, and must be retained within the curtilage of the site. This should be demonstrated with an overland flow routing plan.

Climate change allowances

Whilst Section 3.4 of the Technical Guidance document states a maximum climate change allowance of 40% for the 2070 to 2115 epoch, these climate change allowances have now been superseded by updated management catchment peak rainfall allowances.

The upper end climate change allowance for the Alt and Crossens Management Catchment for the higher epoch (2070's) is 45%⁷. This has been utilised for surface water calculations to develop the drainage strategy for the Sandy Brow site.

The Drainage Strategy information checklist (provided by Knowsley Council LLFA) is provided in Appendix H of this document.

⁶<https://www.knowsley.gov.uk/sites/default/files/2023-11/Sustainable%20Drainage%20and%20Surface%20Water%20Management%20Technical%20Guidance%20document.pdf>

⁷ <https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=30025022617-RDG-XX-XX-RP-C-0501>

4.2. Flood Risk Management Authorities

Below is a summary of flood risk management authorities pertinent to the site:

Lead Local Flood Authority (LLFA) - Knowsley Council are the LLFA who are responsible for managing local flood risk (surface water, groundwater and ordinary watercourses). This includes leading on cooperation and coordination between Risk Management Authorities in the area.

Local Planning Authorities (LPAs) – Knowsley Council are the local planning authority. LPAs have a duty to cooperate and share information to reduce flood risk, and have powers to carry out flood risk management works on minor watercourses (outside IDB areas).

Environment Agency (EA) - The Environment Agency have a strategic overview of all sources of flooding and coastal erosion. In particular, the EA are responsible for regulating Main Rivers, managing flood risk and activities for those watercourses which are designated as Main Rivers. The Environment Agency also oversee the protection of groundwater and risks of groundwater pollution, and will require evidence of how proposed activities at the site will be managed to demonstrate the risks to groundwater are acceptable e.g. containment of contaminated firewater.

Internal Drainage Boards (IDBs) - IDBs manage water levels in areas where there is a special need for drainage. The site is not located within an IDB area.

5. SOURCES OF FLOOD RISK

An overview of flood risk sources in relation to the site is presented below in Table 1 and discussed further in Sections 5.1 - 5.6.

Table 1 - Summary of Flood Risk Sources

Flood Risk Source	Possibility at Site
Rivers or the Sea (Fluvial)	Proposed site lies within Flood Zone 1, and is therefore at 'Very Low' risk of fluvial and tidal flooding (less than 1 in 1000 probability, or 0.1%, of flooding in any given year).
Surface Water (Pluvial)	Isolated parts of the site are at 'High' (more than 1 in 30 probability, or 3.3%, of flooding each year) and 'Medium' (between 1 in 100, or 1%, and 1 in 30, or 3.3%, probability of flooding each year) risk of surface water flooding.
Groundwater	Environment Agency flood risk services states that flooding from groundwater is unlikely in this area. However site specific conditions and results from groundwater monitoring should be considered.
Artificial Sources e.g. reservoirs, canals, ponds	Environment Agency flood risk services states that flooding from reservoirs is unlikely in this area. No other artificial water features have been identified which could present a risk to the proposed development.
Sewers or Drains	Considered unlikely given no sewers or drains have been identified across the site.
Historical Flood Events	No historical flood events have been identified in the vicinity of the site.

5.1. Flooding from Rivers or the Sea (Fluvial/Tidal Flood Risk)

The Environment Agency (EA) Flood Map for Planning (extract provided below in Figure 5) indicates the site is located within Flood Zone 1 (Very Low risk of fluvial flooding). Very Low fluvial flood risk is a probability of less than 1 in 1000 year, or an annual probability of less than 0.1%. Given the fluvial flood mapping, the site is not considered to be at risk of fluvial flooding.



Figure 5 - Extract of Flood Map for Planning (Environment Agency, 2025)

5.2. Surface Water (Pluvial) Flood Risk

Extracts from the Environment Agency's surface water flood risk mapping are presented in Figures 6 - 8 below:

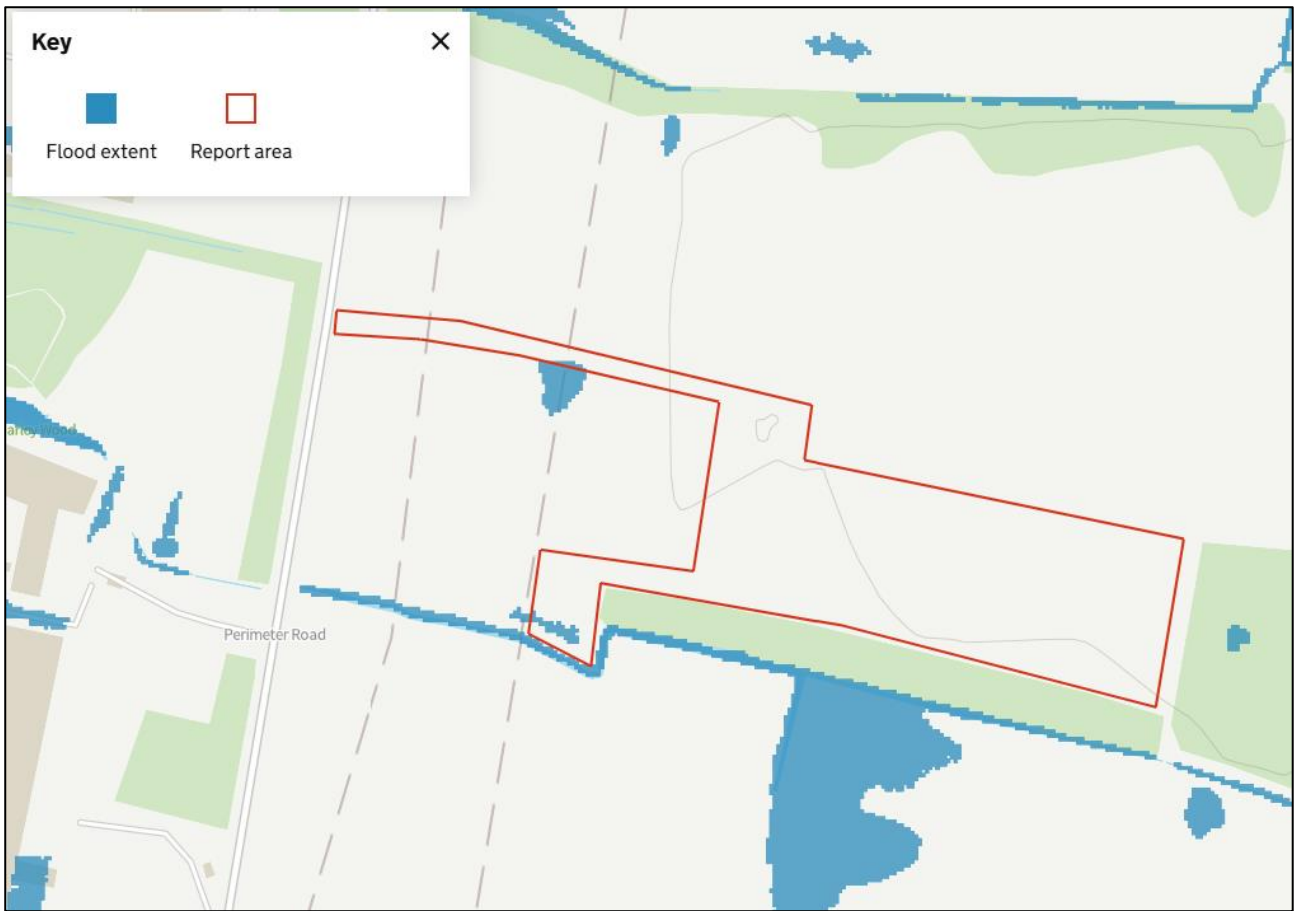


Figure 6 - Extract of 1 in 30 (3.3%) Risk of Surface Water Flood Mapping (Environment Agency, 2025)

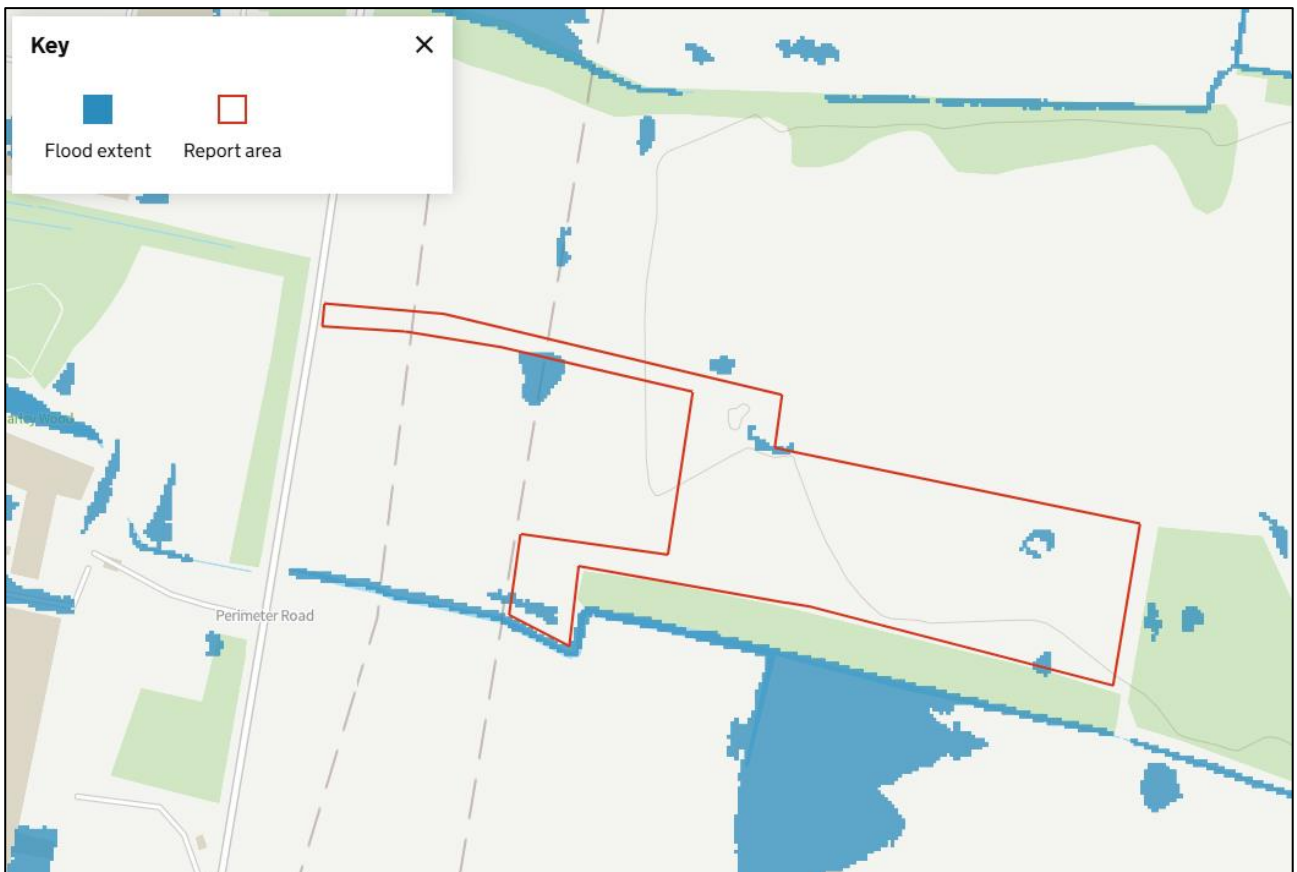


Figure 7 - Extract of 1 in 100 (1%) Risk of Surface Water Flood Mapping (Environment Agency, 2025)

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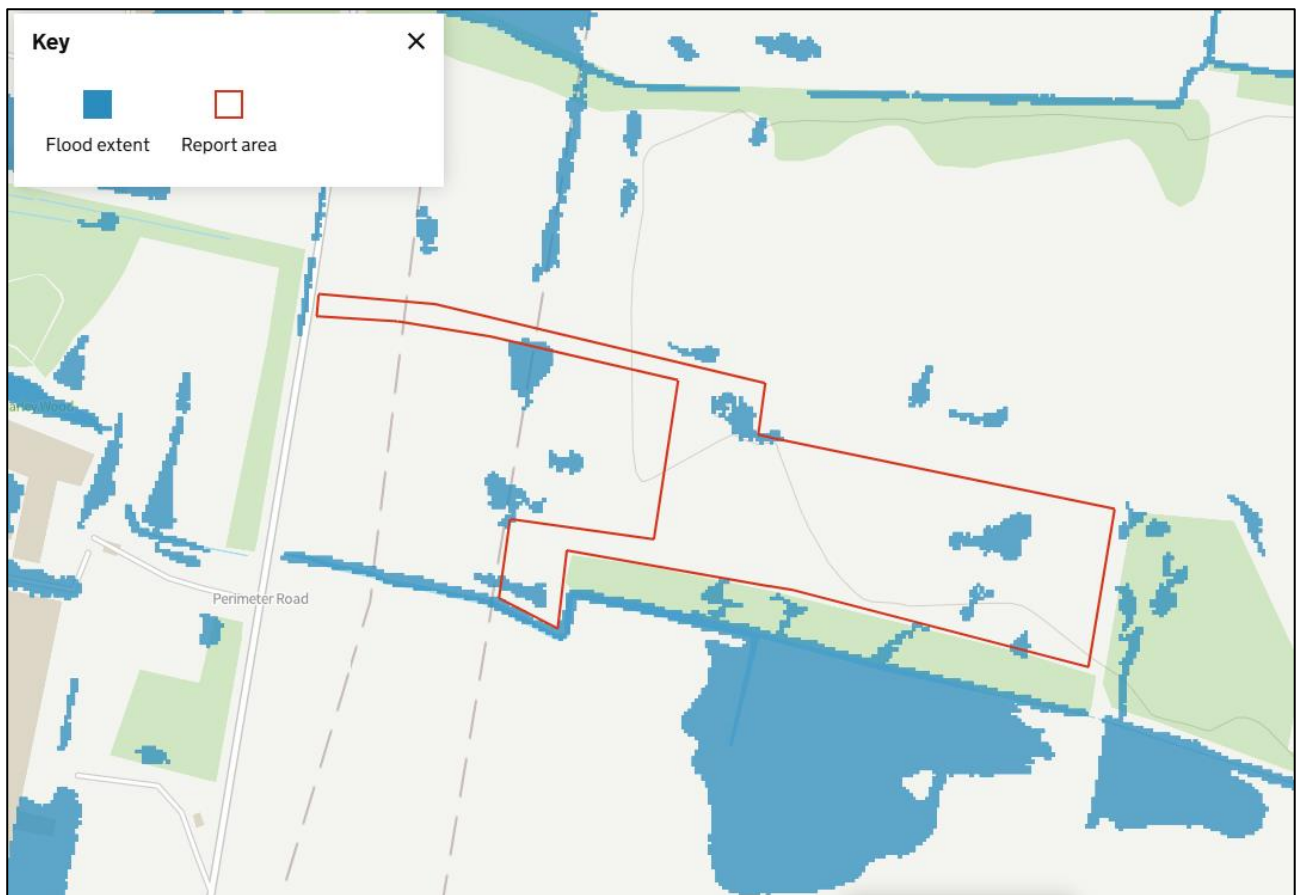


Figure 8 - Extract of 1 in 1000 (0.1%) Risk of Surface Water Flood Mapping (Environment Agency, 2025)

The extracts above indicate a number of isolated spots of predicted surface water flooding across the site, which are most evident in the 1 in 1000 (0.1%) storm event. None of these predicted surface water flooding locations appear to be connected to an overland flow route. The site levels will be reprofiled as part of the works, predominantly across the area of the BESS platform in the central/ eastern areas of the site. The proposed surface water drainage systems are designed to capture and manage surface water from the development and attenuate surface water within the sustainable drainage features e.g. swales and attenuation basin. As such, the baseline surface water flood risk illustrated in the extracts above is not considered to pose a risk to the proposed BESS development.

5.3. Flooding from Groundwater

The Environment Agency flood risk services states that flooding from groundwater is unlikely in this area. Groundwater monitoring was also undertaken at the site between January – April 2024, which identified an average groundwater level of 3.02mbgl. This depth indicates the continuous groundwater table is significantly below ground level (even during the winter and spring months where groundwater level maximums are typically observed) and therefore the risk of groundwater emergence is unlikely.

5.4. Flooding from Artificial Sources

Environment Agency flood risk services states that flooding from reservoirs is unlikely in this area. No other artificial water features have been identified which could present a risk to the proposed development.

5.5. Flooding from Sewers or Drains

No sewers or drains have been identified across the site. As such, the risk of the site flooding from sewers or drains is considered unlikely. The sewer records pertaining to the site are included in Appendix I of this report.

5.6. Historical Flood Events

The Environment Agency historic flood map⁸ has been reviewed which does not indicate any recorded fluvial flood outlines in the vicinity of the site. The Preliminary Flood Risk Assessment⁹ report (2011) for Knowsley Council has also been reviewed, which does not indicate any recorded surface water flooding incidents in the vicinity of the site.

5.7. Sequential Test

Paragraph 167 of the National Planning Policy Framework (NPPF)¹⁰ requires all proposed development to apply a sequential, risk-based approach to the location of the development, taking into account all sources of flood risk, and the current and future impacts of climate change. Essentially, the purpose of the sequential test is to steer new development to areas with the lowest risk of flooding from any source, before higher risk locations are considered.

The National Flood Risk Standing Advice for Local Planning Authorities states a sequential test is required if any part of a proposed development will be:

- In Flood Zones 2 or 3;
- In Flood Zone 1 and the local SFRA shows it will be at increased risk of flooding during its lifetime; or
- Subject to sources of flooding other than rivers or the sea.

If it is not possible for development to be located in an area with a lower risk of flooding, the exception test may have to be applied. To pass the exception test, it should be demonstrated that:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

As isolated parts of the Sandy Brow BESS development are at risk of surface water flooding, the sequential test has been considered to demonstrate why this particular site has been selected. A new BESS development must typically be within 2km from an available point of connection (POC) to be financially viable. The only available POC within the distribution network for Knowsley and Merseyside is the Kirkby Supergrid (GSP) substation, which is located approximately 1km south of the Sandy Brow site. Other factors have been considered in site selection, such as size of plot to support a BESS development, proximity to highway for access, greenbelt status or other environmental considerations (e.g. nature reserves, conservation areas) and available brownfield sites. It was concluded that the Sandy Brow site is the most feasible location for a new BESS facility.

The proposed site layout has also been arranged to locate the BESS platform away from the existing ordinary watercourse, which is part of Flood Zone 2 and 3.

⁸ [Historic Flood Map](#)

⁹ [Microsoft Word - PFRA FINAL REPORT 2011](#)

¹⁰ [National Planning Policy Framework \(publishing.service.gov.uk\)](#)

Table 2 of the NPPF classifies the 'Flood risk vulnerability classification' of proposed development. As the proposed development is to be used for electrical energy storage, it shall be classed as **Essential Infrastructure**. The extract from Annex 3: Flood Risk Vulnerability Classification of the NPPF is shown in Figure 9 below.

Essential infrastructure	
- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. - Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. - Wind turbines. - Solar farms.	

Figure 9 - Flood Risk Vulnerability Classification (Extract from Annex 3, NPPF)

Whilst the Sandy Brow site is not located within floodplain, the vulnerability classification can be checked against Table 3 of the NPPF 'Flood risk vulnerability and flood zone compatibility' to confirm whether the development is appropriate, and whether an exception test is required. As the site lies in Flood Zone 1, there is no requirement to apply the exception test.

Table 2 - Flood Risk Vulnerability and Flood Zone Compatibility (Table 3, NPPF Practice Guide)

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓ *
Key:					
✓ Exception test is not required					
X Development should not be permitted					

6. SURFACE WATER DRAINAGE PROPOSALS

6.1. Overview

The proposed surface water drainage strategy for the site comprises the following:

- 1 no. attenuation basin (with deeper area for permanent water to support biodiversity and ecology);
- 2 no. swales connected to the attenuation basin;
- Filter strips and filter drains with outfalls to the swales;
- Ditch/ swale along southern side of access road. Check dams could potentially be integrated in the ditch/ swale to maximise surface water storage along the length of the ditch;
- Pumping station and rising main on access road to connect back to main drainage network;
- Below-ground cellular storage adjacent to the pumping station;
- Impermeable liners e.g. butyl to be installed below the attenuation basin, filter strips, filter drains, swales, ditches and granular areas e.g. access tracks within the battery container compound to prevent any pollutants from entering the ground or contaminants entering the system;
- 1 no. vortex flow control (downstream of attenuation basin);
- Outfall ditch to connect the vortex flow control to existing watercourse.

The system shall discharge to the existing watercourse in the southwest corner of the site (which bounds the southern side of the site) at a maximum restricted rate of 2.5 l/s, which matches the 1-year greenfield runoff rate (calculated based on the proposed impermeable area).

6.2. Greenfield Runoff Estimates

The greenfield runoff rates were calculated using FEH and FSR data using the latest InfoDrainage design software (released by Innovyze) which has superseded MicroDrainage.

The greenfield runoff rates for the catchment area of 1.22ha have been summarised in Table 3 below and an extract from InfoDrainage has been included in Figure 10 below.

Table 3 - Greenfield Runoff Rate Summary (InfoDrainage, 2025)

RETURN PERIOD	GREENFIELD RUNOFF RATE (L/S)
1 in 1	2.5
1 in 30	4.9
1 in 100	6.0

Method ☒ ICP SUDS ☐ IH 124

Area (ha)

SAAR (mm)

Soil

Region

Additional Options

Urban

Return Period (years)

Growth Curve

Results					
Region	QBAR Rural (L/s)	QBAR Urban (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 10	2.9	2.9	2.5	4.9	6.0

Figure 10 - Greenfield Runoff Rate (InfoDrainage, 2025)

6.3. Proposed SuDS Strategy

For the proposed surface water drainage strategy, the SuDS hierarchy has been followed (as stipulated in Knowsley Council's Sustainable Drainage & Surface Water Management – Technical Guidance for Developers document), with the discharge of surface water to be as high up the discharge hierarchy as reasonably practicable.

The surface water drainage hierarchy is set out below in order of most to least sustainable:

- **Infiltration:** Discharging runoff into the ground is the most preferred option, as it replenishes groundwater and reduces downstream flood risk.
- **Surface Water Body:** Discharging to a river, stream, or lake is the next preferred option, as it allows the runoff to be managed in a natural system.
- **Surface Water Sewer/Highway Drain/Other Drainage System:** Discharging to a separate drainage system designed for surface water is the next option, ensuring that the runoff doesn't enter a combined sewer.
- **Combined Sewer:** Discharging to a combined sewer (which carries both surface water and sewage) is the least preferred option, as it can overload the sewer and lead to sewage overflows.

Given the site constraints discussed in Sections 2.7 and 2.8 of this report with regards to former landfill use, and the risk of groundwater pollution, infiltration is not a viable means of surface water disposal. The drainage system is to be fully lined with impermeable membranes to prevent infiltration of surface water to ground.

The majority of attenuation storage volume is provided within the attenuation basin and connected swales (to the south and west of the proposed BESS platform). The proposed surface water drainage strategy includes an attenuated gravity discharge (with a new outfall to the existing watercourse) limited to the 1-year greenfield runoff rate of 2.5l/s. This will provide a benefit for the higher return period storm events e.g. 30 year, 100 year, as the 2.5l/s post-development runoff rate is lower than the greenfield runoff rates for these higher intensity rainfall events. Therefore, the second discharge option of the SuDS hierarchy (surface water body) is the preferred means of discharge.

The four pillars of SuDS (water quality, water quantity, amenity and biodiversity) are considered to have been achieved by the following means:

- **Water quality** – Surface SuDS features have been proposed, with an assessment of the pollution hazard indices, mitigation indices, and treatment trains to ensure a suitable level of treatment is provided. This is discussed in Section 6.5 of this report. The site is located on a former landfill site, so impermeable membranes are proposed to prevent infiltration of surface water to ground and any risk of contaminants entering the drainage system.
- **Water quantity** – 1 no. attenuation basin has been proposed with connected swales to convey the surface water from the development, with a vortex flow control chamber prior to the outfall to the existing watercourse to restrict post-development runoff to the existing 1-year greenfield runoff rate.
- **Amenity** – Although the surface SuDS features will not be utilised by the general public, the attenuation basin and swales will provide pleasant, landscaped areas for users of the site, and facilitate maintenance of the surface water systems.

- **Biodiversity** – The new attenuation basin and swales have been designed to support and enhance local biodiversity, by incorporating permanent water features. Due to the gradient of the access road, check dams could be incorporated in the swale/ ditch feature to the southern side of the access track to maximise surface water storage volume along the length of the swale/ ditch.

6.4. Design of Surface Water Drainage and InfoDrainage Modelling

The proposed surface water drainage system has been modelled using InfoDrainage. The output results include all the data that is typically presented in MicroDrainage outputs, plus greater visibility of proposed SuDS features and graphical representation. Innovyze has worked extensively with approving authorities to ensure the output from InfoDrainage facilitates a more streamlined review. InfoDrainage design software has been utilised to design the surface water drainage system; results are provided in Appendix E of this report.

The site lies within the Alt and Crossens Management Catchment. Refer to Table 4 below for the latest peak rainfall climate change allowances for the Alt and Crossens Management Catchment:

Table 4 - Ouse Upper and Bedford Management Catchment Peak Rainfall Allowances (Environment Agency, 2025)

1% annual exceedance rainfall event		
Epoch		
	Central allowance	Upper end allowance
2050s	25%	40%
2070s	30%	45%
*Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.		

The upper end climate change allowance for the 2070s epoch (to be utilised for development with a lifetime between 2061 and 2125) is 45%. As such, a 45% uplift to the design rainfall has been utilised for the design of the surface water drainage in the InfoDrainage software.

The surface water drainage system has been designed to attenuate up to the 1 in 100 year+ 45% climate change storm event.

Table 5 – SuDS Design Summary

SUDS FEATURE	DEPTH (M)	AREA/ LENGTH	VOLUME (M ³)	OUTFLOW CONTROL
Attenuation basin	1.15	1000m ²	690	Free discharge to vortex flow control chamber FC01
Swales	0.5 - 1.1	430m	1340	N/A
Cellular Storage	1.2	84m ²	100	Pump
Filter Drains	0.65 - 0.85	450m	40	N/A

Note that the volume of storage is based on 300mm freeboard; the maximum design water level in the attenuation basin and connected swales is designed to be 50.05mAOD (for the 1in100+45% climate change storm event) with the top of basin/swales set at 50.35mAOD.

Prior to the connection with the existing watercourse (via. the new outfall ditch), a vortex flow control in chamber FC01 is utilised to restrict the outflow. The peak discharge rate from the downstream attenuation basin has been limited to the 1-year greenfield runoff rate of 2.5 l/s.

The proposed peak discharge rates for the 1in1, 1in2, 1in30 and 1in100+45% climate change storm events are summarised in Table 6 below:

Table 6 – Post-Development Peak Discharge Rates

CRITICAL STORM BY RETURN PERIOD	FC01 PEAK DISCHARGE RATE (l/s)
1in1	2.5
1in2	2.5
1in30	2.5
1 in 100	2.5
1in100+45%	2.5

The proposed levels and surface water drainage layouts are provided in Appendix C and Appendix D respectively. Overland flow routing plans are presented in Appendix F.

6.5. Water Quality

In accordance with Table 4.3 in Chapter 4 of the SuDS manual (C753) a water quality assessment has been undertaken using the Simple Index Approach. This approach is set out in Section 26.7.1 of the SuDS Manual.

For the purposes of the water quality assessment for the BESS facility at Sandy Brow, the land-use has been classified as 'Commercial Yard and Delivery Areas' in accordance with Table 26.2 of the SuDS Manual. The pollution hazard indices are noted as follows in Table 7:

Table 7 - Pollution Hazard Indices

LAND USE	POLLUTION HAZARD LEVEL	TOTAL SUSPENDED SOLIDS (TSS)	METALS	HYDROCARBONS
Commercial yards and delivery areas	Medium	0.7	0.6	0.7

To provide sufficient treatment, the selected SuDS components should have a total mitigation index that equals or exceeds the pollution hazard index.

Total SuDS Mitigation $\geq$ Pollution Hazard Index

Where multiple SuDS components are proposed, the following calculation shall be applied:

Total SuDS Mitigation Index of the primary SuDS component + 0.5 * Mitigation indices of secondary SuDS components

The site utilises a treatment train of filter strips, filter drains and detention basins to mitigate the pollution hazard.

The indicative SuDS mitigation indices for filter strips, filter drains, and detention basins are as follows:

Table 8 - Pollution Mitigation Indices

	MITIGATION INDICES		
TYPE OF SUDS COMPONENT	TSS	METALS	HYDROCARBONS
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6

The total mitigation indices of the treatment trains have been calculated as follows:

Table 9 - Treatment Trains

TREATMENT TRAIN		MITIGATION INDICES			
TREATMENT REFERENCE	TRAIN	SUDS COMPONENTS	TSS	METALS	HYDROCARBONS
Treatment Train 1 (Access Road)	Ditch/ Swale > Swale > Basin		1.00	1.10	1.20
Treatment Train 2 (Battery Storage)	Filter Strip > Filter Drain > Swale > Basin		1.15	1.20	1.35

As highlighted in Table 9, all three treatment trains provide sufficient pollution mitigation for TSS, Metals and Hydrocarbons.

The scenario provided above is for the site operating as normal. For management of contaminated firewater runoff in the event of a fire, please refer to Section 8 of this report.

6.6. Management of Surface Water Runoff during Construction

Before the permanent surface water drainage system is operational, the contractor will ensure that surface water runoff from the site is managed using some/ all of the following measures to control the quality of surface water runoff from the site:

- Constructing the proposed surface water drainage system from downstream to upstream, to facilitate the provision of suitable settlement/ control points e.g. attenuation basin, outfall chamber before discharging runoff to the outfall ditch, construction of headwall outfall to existing watercourse before discharging runoff to the outfall ditch;
- Catchpits across the site (either temporary or permanent locations) to facilitate the capture of silt at the sump locations;
- Silt barrier/s to capture and control the runoff of any sediment from the site;
- Silt sock/s or settlement tank/s to be provided as temporary means of capturing fine sediment and silt before it is discharged to surface water systems; and
- Spill kits to provide a means of containing and mopping up spills of hazardous substances, to protect downstream surface water drainage networks and watercourses.

The contractor's methodology for dewatering of excavations shall ensure that dewatering operations e.g. overpumping does not draw fine material from the ground, to minimise potential ground movement and limit the volume of entrained material which is discharged from excavations.

6.7. Flood Resistance and Resilience Measures

Whilst the site is not located in fluvial floodplain, it is recommended that the proposed BESS equipment and buildings are raised by a minimum of 150mm from external ground levels to protect against the potential ingress of surface water. This will be coordinated at detailed design with other parties e.g. structural designers, Distribution Network Operator.

The levels may be further raised where required by the earthworks remediation strategy.

7. FOUL WATER DRAINAGE

No proposed foul drainage systems are required to be installed at the site, such as a new connection to a foul public sewer or sewage treatment plant/ septic tank. The control room and welfare unit will be provided with a toilet, however this will be a contained system which will be emptied periodically and taken away from site for disposal.

8. CONTAMINATED WATER DRAINAGE STRATEGY

In the unlikely event of a battery fire at the site, adequate provision needs to be in place both for firewater supply, and containment of contaminated surface water runoff from firefighting activities.

For BESS sites, the National Fire Chiefs Council recommends a minimum flow rate of no less than 1,900 litres per minute for at least 2 hours, or 31.7 litres/sec. A new mains water supply and hydrant connection is currently being progressed for the Sandy Brow site, which if viable, would mean a firewater supply/ holding tank would not be required. A potential location for a large below-ground firewater supply tank (228,000 litre capacity) has been indicated in the north-eastern area of the site (adjacent to the emergency access track). This holding tank option would only be pursued if the new hydrant connection was not feasible.

In the event of a battery fire (or other fire at the site), the penstock shutoff valve would be activated in chamber FC01. This would prevent potentially contaminated firewater being released into the downstream watercourse system and contain used firewater within the proposed drainage network on site. Firewater would build up in the network, backing up into access chambers which could be utilised as pumping points for firewater reuse (if required) by the fire service.

Following any fire incident, the firewater would be tested for contaminants and tankered away as necessary from the site, including any cleaning required of the attenuation basins or wider surface water network. The proposed surface water drainage layout is provided in Appendix D.

9. MAINTENANCE PLAN

The construction, operation, and maintenance requirements of all SuDS components has been considered as part of the proposed drainage strategy. It is important for the performance of the surface water systems that they are maintained on a regular basis.

The Balance Power site management/ facilities team will be responsible for the operation and maintenance of the proposed surface water drainage systems, and will therefore become the maintaining body for the drainage systems in perpetuity.

A summary of the recommended management and maintenance requirements is provided below:

Pipes

It is recommended that all drainage runs are inspected a minimum of once per year. High-pressure jet washing/ rodding of surface water pipes shall be undertaken if necessary to remove detritus and reduce the likelihood of blockages obstructing flow through the pipes. A full CCTV condition survey of the surface water network is recommended once per ten years as a minimum.

Manholes/Catchpits

All manholes and catchpits shall be inspected regularly (minimum once per 3 months recommended initially for the first 12 months) and cleared as necessary e.g., using high-pressure jetting. A visual inspection shall be undertaken by lifting the catchpit/ manhole cover, to check the chamber is free flowing and for any evidence of blockage. The frequency of inspection can be reduced after the first 12 months to either annual or half yearly inspections if appropriate.

Vortex Flow Control

Flow control chambers shall be inspected on a regular basis (minimum once per 3 months recommended) to check for potential blockages, accumulations of silt, etc. and cleared as required. This is particularly important in advance of forecasted storm events since the available attenuation capacity is dependent on the downstream vortex flow control being free from obstructions and operating efficiently.

Attenuation Basin and Swales

The attenuation basin and swales should be inspected on a regular basis (typically monthly or quarterly as a minimum) and any build-up of litter (including leaf litter in the autumn), debris and litter should be removed as required. Routine maintenance, including cutting/ mowing of grass and any aquatic vegetation will also be required on a regular basis particularly during the growing season. This includes maintenance routes, embankments/ side slopes, areas around headwalls (to reduce the risk of blockages/ obstruction and to facilitate visual inspections) and across the main storage area. Slope areas that have become bare should be re-vegetated, and any eroded areas should be regraded before replanting. Silt removal should be undertaken, as required, to ensure the effective operation of the pond and to maintain aesthetic appearance of the site. Invasive silt and vegetation removal should only be carried out to limited areas at a time (25% of the basin on one occasion each year) to minimise the impact on biodiversity.

An excerpt from Table 23.1 from the CIRIA SuDS Manual has been included below:

TABLE 23.1 Operation and maintenance requirements for ponds and wetlands			
	Maintenance schedule	Required action	Typical frequency
Regular maintenance		Remove litter and debris	Monthly (or as required)
		Cut the grass – public areas	Monthly (during growing season)
		Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
		Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
		Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
		Inspect water body for signs of poor water quality	Monthly (May – October)
		Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
		Check any mechanical devices, eg penstocks	Half yearly
		Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
		Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
		Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
		Remove sediment from any forebay.	Every 1–5 years, or as required
		Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
	Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
	Remedial actions	Repair erosion or other damage	As required
		Replant, where necessary	As required
		Aerate pond when signs of eutrophication are detected	As required
		Realign rip-rap or repair other damage	As required
		Repair / rehabilitate inlets, outlets and overflows.	As required

Figure 17 - Recommended Pond/ Basin Maintenance Activities and Frequency (CIRIA SuDS Manual, 2015)

Geocellular Storage Tanks

A visual inspection should be undertaken on the cellular storage tank after every major flood event to ensure the tank is working effectively. If jetting of the cellular storage tank is required, this must be done following jet vacuum clearance of sump manholes. This should be completed twice yearly, or more frequently if determined by visual inspection.

Debris should be removed from the surface finish above the tank to prevent any litter, organic material or sediment potentially risking the performance of the cellular storage tanks. The filtration membrane at the soffit of the tank should also be checked for sediment or algae to ensure it providing appropriate infiltration.

Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Figure 18 - Recommended Operation and Maintenance for Cellular Storage (CIRIA SuDS Manual, 2015)

Filter Drains

The treatment performance of filter drains is dependent on maintenance, and it is important that adequate access is provided for inspection. Filter drains are sometimes used in conjunction with filter strips, which help limit the volume of silt draining into the filter drain. Routine maintenance typically involves removing debris and litter from the surface and cutting back vegetation, whereas more extensive works may involve cleaning or replacing the surface gravel periodically.

An excerpt from Table 16.1 from the CIRIA SuDS Manual has been included below:

TABLE 16.1 Operation and maintenance requirements for filter drains			
	Maintenance schedule	Required action	Typical frequency
Regular maintenance		Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
		Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
		Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
		Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance		Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
		At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
		Clear perforated pipework of blockages	As required

Figure 19 - Recommended Filter Drain Maintenance Activities and Frequency (CIRIA SuDS Manual, 2015)

Filter Strips

The most significant maintenance requirement for filter strips is mowing. Access for mowers should always be available. Grass lengths at the site should ideally be kept between 75-150mm, which assists in filtering pollutants and sediment retention. Litter and debris removal should also be undertaken regularly.

An excerpt from Table 15.1 from the CIRIA SuDS Manual has been included below:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (eg oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Figure 20 - Recommended Filter Strip Maintenance Activities and Frequency (CIRIA SuDS Manual, 2015)

Pumping Station

Inspection and servicing requirements for the pumping station should be undertaken in accordance with the manufacturer/ supplier specification.

Typically, a pumping station should be serviced every 6 months, and every 12 months as a minimum. Maintenance activities can often include the following:

- Visual inspection and condition check of the sump, internal pipework and cabling.
- Inspection of float switches, including high level alarm float.
- Pumping station pumped down to check overall pump performance.
- Valve operation to be checked.
- Test operation of high-level alarm (if applicable). Check battery and mains supply.
- Test operation of battery back-up (if applicable). Ensure it goes into backup mode correctly.
- Test operation of control panel (if applicable). Ensure auto changeover (dual).
- Basic clean of floats, pumps and chamber walls.
- Visual inspection of pump/s and impeller.

- Adjustment of floats and pumps within the pump station (if required) to ensure correct activation.
- Test all pumps to ensure operation (automatic or manual).

10. CONCLUSION

Ridge and Partners LLP have been commissioned by Balance Power to prepare a Flood Risk Assessment and Surface Water Drainage Strategy in support of a planning application for the construction of a Battery Energy Storage System (BESS) facility at Sandy Brow, Knowsley, Liverpool, L33 3AE.

The Environment Agency Flood Map for Planning indicates that the proposed site lies within Flood Zone 1, and is therefore at 'Very Low' risk of fluvial and tidal flooding (less than 1 in 1000 probability of flooding in any given year). An ordinary watercourse lies to the south of the site which is within Flood Zones 2 and 3. Environment Agency surface water flood risk mapping indicates that isolated parts of the site are at 1 in 30 (3.3%), 1 in 100 (1%) and 1 in 1000 (0.1%) risk of surface water flooding each year. The Environment Agency flood risk service also states that flooding from groundwater and reservoirs is unlikely in this area. No flood risk sources are considered to pose an unmanageable risk to the development, and therefore the proposed BESS facility is considered suitable in this location.

The proposed surface water drainage system incorporates open SuDS in the form of swales and an attenuation basin. A series of filter drains are positioned around the perimeter of the BESS platform to capture surface water runoff before discharging to the southern swale. A flow control chamber is located downstream of the attenuation basin with the outflow rate restricted to the 1 in 1 year greenfield runoff rate for the site. A new headwall/ outfall will be constructed within the existing watercourse.

The site has historically been utilised as landfill, and the site investigation undertaken by Ridge and Partners LLP in January 2024 identified a significant thickness of Made Ground across the site. Given these findings, it was not possible to undertake soakage testing across the site, and surface water should be prevented from percolating into the landfill. As such, soakaways are therefore not a viable means of surface water disposal at the Sandy Brow site. Surface water drainage systems will be lined with impermeable membranes (including below the granular compound areas) to prevent surface water infiltrating to ground. Installing impermeable membranes will also guard against used/ contaminated firewater infiltrating to ground and potentially contaminating groundwater sources in the event of a battery fire at the site. A penstock shutoff valve will be provided on the flow control chamber downstream of the proposed attenuation basin, which can be utilised to prevent used/ contaminated firewater discharging into the downstream watercourse, and provide a contained firewater supply for reuse (if required) during a fire incident.

A new mains water supply and hydrant connection is currently being explored, which is the preferred means of providing a water supply to the Sandy Brow BESS site. A firewater holding tank is proposed as an alternative to a new hydrant connection (on the north-eastern side of the site) but would only be progressed if a new mains supply is not feasible.

10.1. Recommendations

The following recommendations are provided for further works:

- Prepare and apply for Land Drainage Consent with Knowsley Council;
- Review any earthworks remediation proposals to confirm no impact on the proposed drainage strategy;
- Engage with National Grid and Scottish Power Energy Networks regarding the proposed works in proximity to/ below the existing overhead power lines and pylons to discuss how works can be safely undertaken; and
- Confirm viability of new mains water supply and hydrant to serve the site for fire suppression purposes.

APPENDIX A - TOPOGRAPHICAL SURVEY (LANDMARK SURVEYS, 2023)

APPENDIX B - PROPOSED SITE LAYOUT PLAN (BALANCE POWER, 2025)

APPENDIX C – PROPOSED LEVELS LAYOUT (RIDGE, 2025)

APPENDIX D – PROPOSED SURFACE WATER DRAINAGE LAYOUT (RIDGE, 2025)

APPENDIX E - INFODRAINAGE RESULTS AND OUTPUTS (RIDGE, 2025)

APPENDIX F - OVERLAND FLOW ROUTING PLAN (RIDGE, 2025)

APPENDIX G – GROUND INVESTIGATION DESKTOP STUDY (RIDGE, 2023)

**APPENDIX H – KNOWSLEY COUNCIL LLFA INFORMATION CHECKLIST
(KNOWSLEY COUNCIL, 2025)**

APPENDIX I – SEWER RECORDS (UNITED UTILITIES, 2025)



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