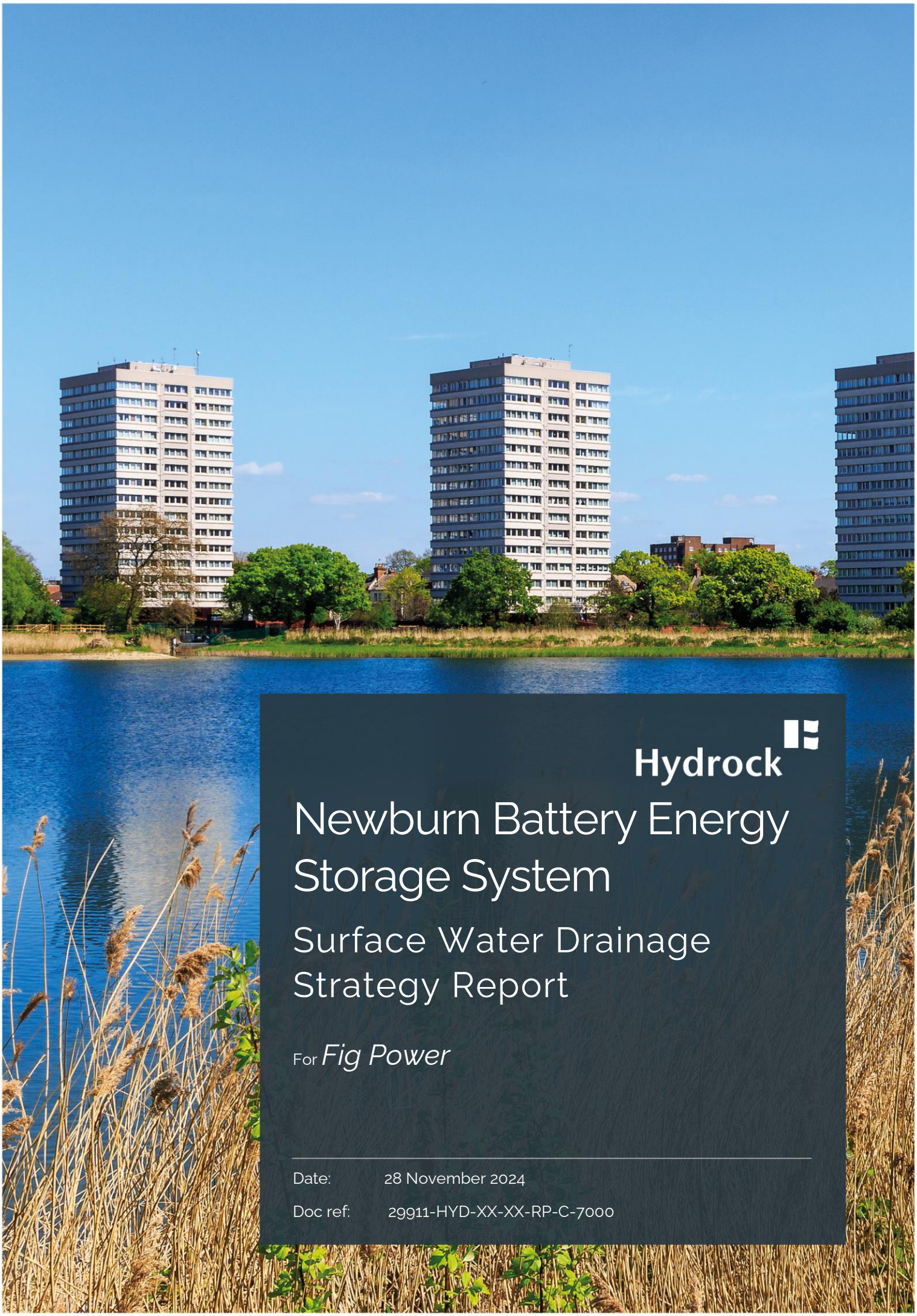

Hydrock

Newburn Battery Energy Storage System

Surface Water Drainage Strategy Report

For *Fig Power*

Date: 28 November 2024

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1. Introduction

1.1 Scope of The Report

Hydrock have been appointed by Fig Power to provide a Drainage Strategy report for the approval of Newcastle Council Lead Local Flood Authority.

The proposed drainage strategy will be in accordance with national guidelines and will incorporate a 'best practise' approach in reducing the impact of the flooding caused by the new development.

The report is based upon sewer asset information provided by the sewerage undertakers Northumbrian Water in relation to assets within the vicinity of the development site.

The report highlights the key stakeholders in terms of ownership and maintenance to ensure the drainage system is kept well maintained and reduce the risk of failure. Should the network fail at any point, clearly defined ownership liabilities will ensure that problems can quickly be rectified thereby reducing the impact of potential damaged caused by flooding.

1.2 Limitations of The Report

This report has been prepared in connection with the scope as described above and considers the instructions and requirements of the client's needs. It is not intended for and should not be relied upon by any third party.

The information received is summarised within this report. In the event that the information is relied upon and is subsequently found to be incorrect, Hydrock Consultants accepts no responsibility for any direct and/or consequential loss that may occur as a result.

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1.3 References / Design Codes

- BS EN 752 - Drain and Sewer Systems Outside Buildings.
- Building Regulations Approved Document Part H - Drainage and waste disposals.
- Sewers for Adoption (where applicable).
- Local Authority Guidance.
- CIRIA C753 - SuDS Manual.
- National Planning Policy Framework (NPPF).
- DEFRA Non-Statutory Technical Standards for Sustainable Drainage.

2. Site Information

2.1 Site Location

The site is located within the Newburn area of Newcastle Upon Tyne, England. The site is approximately 8 km east of the city centre of Newcastle Upon Tyne. The site is split into two separate areas defined by their own red line boundaries. The northern site is larger, while the southern site is smaller and constrained by the A6085 and Walbottle Road.

The site is bound:

- To the north by residential development;
- To the east by Walbottle Road, beyond which lies a council recycling centre;
- To the south by the A6085 and builder yard;
- To the west by commercial properties.

Access to the site is via a junction from the A6085 at the far south of the site.

Table 2.1: Site Referencing Information

Site Address	
Address	Stewart Court, Lemington, Newburn, Newcastle upon Tyne, North of Tyne, England, United Kingdom
Postcode	NE15 8HH
National Grid Reference	NZ 17032 65310 417032 565310

Figure 1: Site Location with Approximate Red Line Boundaries

2.2 Site Topography

No topographical survey is available at the time of writing; however, topographic levels have been derived from a 2 m resolution EA composite Light Detecting and Ranging (LiDAR) DTM. This data suggests the existing land within the northern site falls in a western direction from highs of 22m AOD down to 15m AOD. The southern site is much flatter and falls from 14m in the east towards the A6085 at around 13m. There is a bank along the eastern boundary which reaches around 19m AOD along Walbottle Road, increasing to the north.

See **Appendix A** for LIDAR drawing

2.3 Geology

No Ground investigation has been undertaken at the time of writing; however, according to British Geological Society data the geology of the site is attributed to the Pennine Lower Coal Measures Formation. This formation is characterised by a diverse sequence of sedimentary rocks, including mudstones, siltstones, sandstones, and coal seams.

The permeability of the Pennine Lower Coal Measures Formation exhibits variability contingent on the specific lithology of the rocks within the formation. Typically, coal seams demonstrate low permeability owing to their compact nature, while the surrounding mudstones, siltstones, and sandstones may display differing but generally limited permeability. Undertaking a comprehensive site-wide ground investigation becomes imperative to ascertain and provide more accurate details about the overall low permeability characteristics of the site. Due to this uncertainty utilising infiltration has been discounted as an unfeasible option.

2.4 Fluvial Flood Risk

Fluvial flood risk is the risk of flooding from the overbank flow of rivers and watercourses.

Within England, the risk of fluvial flooding is defined by Flood Zones (FZs) which indicate the potential extent of flooding for a given Annual Exceedance Probability (i.e., the potential for of an occurrence within any one year (AEP)) without considering the benefits from flood defences, other manmade structures, or channel improvement works.

The EA Flood Map for Planning indicates that the site is located within Flood Zone 1 and is therefore considered to be at low risk of fluvial flooding.

Figure 2: EA Flood Map for Fluvial Flooding

Table 2.2: Flood Zones Probability of Flooding

NPPF - Flood Zones		
Flood Zone 1	Low Probability	Less than 1 in 1000 (< 0.1%) chance of flooding occurring each year
Flood Zone 2	Medium Probability	Between 1 in 100 and 1 in 1000 (1% - 0.1%) chance of flooding occurring each year
Flood Zone 3a	High Probability	Greater than 1 in 100 (> 1%) chance of flooding occurring each year
Flood Zone 3b	Functional Floodplain	Land where water *has* to be stored in times of flood

2.5 Proposed Development

The proposed development will consist of the construction a Battery Storage facility. The entire facility would be located within a compound. See **Appendix B** for the Proposed Site Layout.

3. Pre-Development Surface Water Management Strategy

3.1 Existing Surface Water Drainage Network

3.1.1 Existing Public Drainage

Review of Northumbrian Water's (NWL) sewer asset maps confirm that there is a culverted watercourse that flows along the western edge of the northern site. A NWL combined sewer runs along the A6085 that looks to collect foul and surface water from the existing properties on the southern plot.

For the purpose of this report the drainage has been taken from the sewer asset map information only. It is recommended a full drainage CCTV survey is undertaken to determine accurate routes of the existing drainage so the proposed network can be suitably coordinated.

See **Appendix C** for the Sewer Asset Map.

3.2 Pre-Development Surface Water Catchment Areas

Below is an indication of the pre-development catchment type area. The site is currently comprised of land for commercial use. **Total area = 5378**

Table 3.1: Pre-Development Catchment Areas

Catchment	**Northern Area** (sqm)	**Southern Area** (sqm)
Impermeable		
Building / Roof	0	691
Roads / Hardstanding	3440	767
Permeable		
Soft Landscaping	0	480
Permeable Surfacing	0	0
Total Area	**3440**	**1938**

See **Appendix D** for Pre-Development Catchment Plans.

3.3 Pre-Development Surface Water Run-Off Rates

In order to determine the post-development surface water flows, an assessment has been carried out on the pre-development to ensure that the run-off from the new development will not adversely affect flood risk either within the site boundary, offsite adjacent properties, or the downstream network. This run-off will be limited by the existing greenfield or brownfield run-off rates, as explained below:

3.3.1 Greenfield Run-Off Rates

In line with the Non-Statutory Technical Standard for Sustainable Drainage S2 (Peak Flow Control) it is a requirement that on new developments, consideration be given to limit discharge as close as reasonably practical to the equivalent 'Greenfield' rate for the corresponding storm event. Below considers what the maximum surface water discharge from the site would be if the site was 'Greenfield' i.e., not developed:

Table 3.2: Pre-Development Greenfield Run-Off Rates

Storm Event	Maximum Run-Off Rate (l/s) Greenfield Northern Area	Maximum Run-Off Rate (l/s) Greenfield Southern Area
Q1 Year (1 in 1 Year)	1.33	0.75
Q30 Year (1 in 30 Year)	2.70	1.52
Q100 Year (1 in 100 Year)	3.21	1.81
Qbar	1.54	0.87

See **Appendix E** for Calculations.

3.3.2 Brownfield Run-Off Rates

In line with the Non-Statutory Technical Standard for Sustainable Drainage S3 (Peak Flow Control), should the site not be suitable to discharge as close as reasonably practical to the equivalent 'Greenfield' rate, Brownfield should be considered with a % betterment on the flow. The following considers what the maximum surface water discharge from the site would be if the site was 'Brownfield' i.e., developed:

following parameters were used to calculate the Brownfield Run-Off from the site:

Qp (l/s) = 2.78CiA.

Where:

Qp = discharge rate

C = Coefficient where C = Cv x Cr (Cv = volumetric coefficient & Cr = routing coefficient) C = 0.9 x 1.3

i = mean rainfall intensity (mm/hr)

A = Area (ha) drained hard surfaces (see Table 3.1)

Below summaries the calculated Brownfield Run-Off Rates for the site for the 1 in 1year, 1 in 30year, 1 in 100year and 1 in 100year + 45% Climate Change events for the 15min storm:

Table 3.3: Pre-Development Brownfield Run-Off Rates

Storm Event	Mean Rainfall Intensity (mm/hr) 15min Storm	Brownfield Run-Off Rate (l/s) Northern Area	Brownfield Run-Off Rate (l/s) Southern Area
Q1 Year (1 in 1 Year)	27.292	32.23	13.68
Q30 Year (1 in 30 Year)	66.853	78.96	33.51
Q100 Year (1 in 100 Year)	86.368	102.01	43.29
Q100 + 45% Climate Change	120.915	142.81	60.61

3.4 Pre-Development Flood Exceedance

Through LIDAR survey information, it is determined that pre-development surface water overland flows follow the site topography and are directed towards the western site boundary.

4. Surface Water Management and SuDs Assessment

4.1 Run-off Destinations

An appraisal should be undertaken to confirm the most suitable and sustainable method for managing surface water runoff from the development in accordance with the following hierarchy as highlighted in Part H of Building Regulations and the National Planning Policy Framework (NPPF):

1. Infiltration to the ground using a sustainable drainage system.
2. If this is not feasible, discharge to a watercourse or river; generally, at a controlled rate unless it does not affect flood risk e.g., if to the sea or an estuary.
3. Discharge at a controlled rate to a surface water sewer or drain.
4. Discharge at a controlled rate to a combined sewer system, with the approval from the Water Authority.
5. Only if the above have all been investigated and it has been proved that none of these options are suitable will discharge at a controlled rate to a foul sewer system, with the approval from the Water Authority.

The discharge of surface water run-off has been considered in accordance with the hierarchical approach:

Table 4.1: Review of the Drainage Hierarchy

Method	Reasoning	Suitability
Interception / Reuse	Considered unsuitable for a Battery Facility.	X
Infiltration	Considered unsuitable due to sites geological formation	X
Surface Water Body	A culverted watercourse flows along the western boundary of the site. To be used for northern site discharge.	✓
Surface Water Sewer	No surface water sewers in vicinity of site. Surface water sewer discharges to far side of watercourse 120m from site boundary.	X
Combined Sewer	Combined sewer beneath A6085 along site boundary. Existing connection from site assumed and planned for reuse.	✓
Foul Water Sewer	N/A due to sites use.	X

4.2 SuDs Assessment

4.2.1 Overview of SuDS

The design of the surface water drainage system should seek to implement and maximise the use of Sustainable Drainage Systems (SuDS) where possible.

The primary purpose of a SuDS system is to manage surface water run-off within a development via mimicking natural methods, attenuating additional water volume generated by the introduction of impermeable areas whilst providing a degree of water treatment to run-off alongside amenity and biodiversity benefits to the local community.

The suitability and benefits of the various potential SuDS systems for the proposed development should be considered, which will aim to maximise the 4 pillars of SuDS:

- Water Quantity (Controlling runoff);
- Water Quality (Managing quality of runoff);
- Amenity (Create and sustain better places for people);
- Biodiversity (Create and sustain better places for nature).

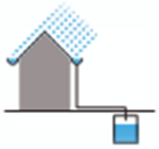
The implementation of SuDS can be divided into the management of sources and of the wider site and even region, with preference given to source control.

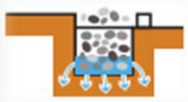
4.2.2 Suitability of SuDS Elements

The drainage design should adopt the principles of SuDS where appropriate taking into consideration the site context and location. The principals of SuDS are that they should be designed to maximise the opportunities and benefits that can be secured surface water run-off management in terms of quality, quantity, flood risk, and amenity. The implementation and selection of SuDS techniques is largely dependent on the site layout and context. Some SuDS techniques may be more appropriate than others.

The suitability of SuDS components has been assessed as follows:

Table 4.2: Suitability of SuDS Components

Hierarchy	System	Description	Suitability
Source Control	Green Roofs 	A planted soil layer on the roof of a building: stores water in the soil layer to be absorbed by vegetation. Reduces runoff and treats pollutants.	No. Unsuitable for a battery storage facility.
	Rainwater Harvesting 	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an over ground or underground tank for treatment and reuse locally.	No. Unsuitable for a battery storage facility.
	Permeable Surfaces 	Surfaces that allow water to penetrate into underlying layers to be stored, collected or made to infiltrate to groundwater.	Yes permeable surfacing in the form of open graded crushed rock will be utilised
	Bioretention Area 	A vegetated area with gravel and sand layers below designated to channel, filter and cleanse water vertically, to then be stored, collected or made to infiltrate to groundwater.	No. Limited green space within site boundary available to

			accommodate this approach.
Hierarchy	**System**	**Description**	**Suitability**
	Filter Strip 	Grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	No. Limited green space within site boundary available to accommodate this storage approach.
	Soakaway 	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	No. The site does not have viable infiltration characteristics, soakaways will not be considered.
Site and Regional Control	Swale 	Shallow depressions to convey and filter water. May be 'wet' with above ground attenuation or 'dry' with a gravel layer. Can be made to infiltrate to groundwater.	No. Limited green space within site boundary available to accommodate this storage approach.
	Hardscape Storage 	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	No. Unsuitable for a battery storage facility.
	Pond / Basin 	Store and treat water. Ponds have a level of standing water whereas basins are generally dry. Can be made to infiltrate to groundwater.	No. Limited green space within site boundary available to accommodate this storage approach.

Wetland 	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	No. Limited green space within site boundary available to accommodate this storage approach.
Underground Storage 	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	No. As the sites strategy is to use an attenuating sub-base, this approach has not been considered.

4.2.3 *Interception Storage*

Interception can be defined as the capture and retention on site of the first 5mm of the majority of all rainfall events. Interception mechanisms have been assessed to show the site is compliant for zero run-off from the first 5mm for 80% of events during the summer and 50% in winter. (Ciria)

Table 4.3: Interception Storage Systems

System	Reasoning	
Green Roofs	All surfaces that have green / blue roofs	X
Rainwater Harvesting	All surfaces drained to RWH systems designed whether for surface water management or just water supply, provided the RWH system design is based on regular daily demand for non-potable water	X
Soakaways / Infiltration	Due to sites geological formation infiltration would not be suitable.	X
Permeable Pavements	All permeable pavements surfacing (for this site being in the form of open graded crushed rock), can be assumed to comply, provided there is no extra area drained to the permeable pavement.	✓
Filter Strips / Swales	Roads drained by filters strips / swales, where the longitudinal gradient of the vegetated area is less than 1:100, are suitable for interception delivery for impermeable areas up to 5 times the base of the vegetated surface area receiving the runoff.	X
Infiltration Trenches	Roads drained by infiltration trenches can be considered to provide interception	X
Detention Basins	Areas of the site drainage to detention basin with a flat base can be assumed to comply. The area of the basin that is assumed to contribute to interception of run-off should be below the outlet of the basin.	X
Bioretention / Rain Gardens	Areas of the site drainage to unlined bioretention components can be assume to comply where the impermeable area is less than 5 times the vegetated surface area receiving run-off/ They can be designed to deliver interception for larger areas, where suitable infiltration capacity is available.	X
Ponds	Areas drained by ponds (with a permanent water pool that is effectively maintained by the outlet structure) are not assumed to deliver interception	X

5. Post-Development Surface Water Management Strategy

5.1 Proposed Surface Water Drainage Strategy

The proposed surface drainage strategy aims to effectively manage surface runoff across both the northern and southern areas of the site. Runoff will be collected and stored, then released at a controlled rate using a flow control device. This control will be regulated to match the greenfield runoff rates specific to each area—1.54 l/s for the northern area of site and 1 l/s for the southern area of the site. From there, the flow will be directed toward a culverted watercourse along the western boundary for the northern area and a combined sewer for the southern area. Please refer to Appendix G for the Drainage Strategy Layout.

For both areas of the site, the surface water will fall from the battery platforms and the surrounding area and percolate through a 150mm layer of compacted clean stone into the site's attenuating sub-base. The attenuating sub-base will be made up of 400 - 450mm compacted open graded crushed rock with 30% voids. This layer provides storage for a 1 in 100-year storm return period. This water will then be conveyed through the crushed rock storage layer and collected via the use of a network of perforated pipes. The water will then flow into a flow control manhole and be discharged off site. Due to the natural topography of the land, the drainage network will be a gravity system without the need for pumping.

Where applicable, the surface water management strategy has incorporated the recommendations of the 'Non-Technical Standards for Sustainable Drainage' and general 'good practice' in terms of providing a Sustainable Drainage System (SuDS) that does not adversely impact flood risk either within the site or beyond the development boundary.

See **Appendix G** for the Drainage Strategy Layout.

5.2 Post-Development Surface Water Catchment Areas

Below is an indication of the post-development catchment type area.

Table 5.1: Pre vs Post-Development Catchment Areas

Catchment	**Northern Area** (sqm)	**Southern Area** (sqm)
Impermeable		
Building / Roof	0	0
Roads / Hardstanding	0	0
Permeable		
Soft Landscaping	0	84
Permeable Gravel Surfacing	3440	1853
Total Area	**3440**	**1937**

5.3 Post-Development Surface Water Run-Off Rates

In order to determine the post-development surface water flows an assessment has been carried out to ensure that the flows from the new development will not adversely affect flood risk either within the site boundary, offsite adjacent properties, or the downstream network:

5.3.1 Greenfield Run-Off Rates

In line with the Non-Statutory Technical Standard for Sustainable Drainage S2 Cont. Peak Flow Control), due to the nature of the existing development and its current arrangement, it has been determined that the

post-development surface water flow rates can been restricted to the sites greenfield run-off rate of 1.54l/s with the use of site wide sub-base attenuation and flow control system.

5.3.2 *Post-Development Surface Water Storage*

In line with the Non-Statutory Technical Standard for Sustainable Drainage S7 & S8 (Flood Risk), all storm events up to and including the 1 in 30 AEP storm event will be retained within the proposed surface water drainage network and exceedance volumes from all other storm events up to and including the 1 in 100 AEP plus 45% allowance for climate change will be retained within the site and manged to minimise the risk to people and property.

Attenuation flood storage will be distributed across the development with the sites 400mm deep sub-base storage system, attenuating at source. In the event that one part of the system fails through blockage the remainder of the system will still be able to function effectively.

Expected attenuation requirements are shown below:

Table 5.2: Attenuation Requirements

Impermeable Area* (ha)	Maximum Discharge Rate (l/s)	Total Attenuation Provided (m3)
Northern Area - 3440	1.54	460
Southern Area - 1937	1.0	225

See **Appendix E** for Calculations.

For the southern area QBar has been calculated as 0,87 l/s. To reduce problems caused by overly small aperture sizes in flow control units it is proposed that flows be restricted to 1.0 l/s. This still provides a 93% betterment to brownfield flows from site in the 1 in 1 year rainfall event and considerably more in higher rainfall events.

Please note that the 150mm layer of clean stone will provide additional storage on top of the storage provided in the table above, although this volume has not been calculated.

5.4 Urban Creep

Urban Creep Factor (UCF) is defined as any increase in the impervious area that is drained to an existing drainage system without planning permission being required, such as the construction of patios, small extensions, etc.

As the footprint of the Battery Facility takes up the entire site boundary no urban creep has been factored.

5.5 Post-Development Flood Exceedance

In the event that flows from rainfall exceed the 1 in 100-year rainfall event or system failure through lack of maintenance, surface water run-off will be directed via exceedance routes away buildings and/or critical infrastructure.

See **Appendix F** for Overland Flow Routes

5.6 Summary of Post-Development Flows

It has been determined that the post-development surface water flow rates have been restricted to greenfield runoff rate in accordance with national guidelines and non-statutory technical standards so as to not adversely impact downstream flooding of the site as a result of the new development.

See **Appendix G** for the Drainage Strategy Layout.

5.7 Water Quality

Consideration must be given both during construction and post-development to ensure that water quality is not negatively impacted.

Table 26.2 of The SuDS Manual identifies the overall pollution hazard indices from the site to be medium, as shown below.

Table 5.3: Pollution Hazards

Land Use	Hazard Level	TSS	Metal	Hydro-carbons	
Residential roofs	Very Low	0.2	0.2	0.05	X
Other roofs (typically commercial / industrial roofs)	Low	0.3	0.2-0.8	0.05	X
Individual property driveways, residential car parks, low traffic roads (e.g., cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g., schools, offices) i.e., <300 traffic movements/day	Low	0.5	0.4	0.4	✓
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low traffic roads and trunk roads / motorways	Medium	0.7	0.6	0.7	X
Sites with heavy pollution (e.g., haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9	X

Table 26.3 of The SuDS Manual provides various mitigation indices for discharge to surface waters. The mitigation indices for SuDS elements that are included within the proposed development are shown below.

Table 5.4: Pollution Mitigation

Indicative SuDS mitigation indices for discharge of surface water			
	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
Bioretention system	0.8	0.8	0.8
Permeable pavement (in the form of open graded crushed rock)	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately 1 in 1 year return period event, for inflow concentration relevant to the contributing drainage area		

Refer to below table for a summary comparing the mitigation and pollution indices for the identified land usage classification. The site has been classified as having the pollution characteristics of a residential car park.

Residential Carpark	TSS	Metals	Hydrocarbons
Pollution Index	0.5	0.4	0.4
Mitigation Index (Permeable Paving)	0.7	0.6	0.7
Net Pollution	0	0	0
Comments	The utilisation of an open graded crushed rock surface type. effectively mitigates the pollution risk from the residential car park.		

Based on the above table the water quality criteria of document Ciria C753 - The SuDS Manual is satisfied.

Although potential SuDS options have been stated, alternative options may be considered provided that the management train meets or exceeds the water quality requirements.

Provided that the mitigation indices of the various treatment trains meet or exceed the requirements of each pollutant, it is expected that there will be no reduction in the quality of water being discharged into the public sewer network.

5.7.1 Quality of Surface Water Run-off: Post-Development

In line with the SuDS suitability, the design should seek to provide an appropriate level of water treatment to effectively mitigate the pollution risk associated with the site and not affect the quality of water downstream.

The proposed layout has **1** primary driver of pollutant risks to the discharge point. The sources, pollutants and mitigations are as follows:

Vehicle parking/ movement across the site

Because the site will be primarily unmanned it is considered low risk in terms of pollutants. As shown in table 5.4 the proposed permeable surface satisfactorily mitigates expected pollutants from a site such as this.

5.7.2 Quality of Surface Water Run-off: During Construction

It is anticipated that the during construction adequate provisions will be put in place to ensure the existing drainage is protected to prevent material which could have a negative impact on water quality entering the system.

Some pollution mitigation techniques that are to be considered include:

- Monitoring and managing disposal of site waste. Make sure all waste is correctly dealt with to stop it from spreading.
- Keeping materials such as sand and cement secure. Materials should be located where there isn't risk of them being washed into the drainage system.
- Covering up all drains to prevent waste from ending up in the system.
- Keep the road and paths to the site clean at all times. This will prevent silt and other pollutants from running off into any bodies of water.
- Properly collect and treat any wastewater that is produced.
- Temporary installation of screens within manholes to capture any debris.

5.8 Design Standards for Surface Water Drainage

The surface water drainage strategy for the new development should aim to deliver a safe, functional, cost effective and, as far as possible, sustainable drainage system (SuDS) which considers the following design principles to ensure:

- That natural drainage features are protected;
- That public health and safety risks are taken into account and managed;
- The constructability of the surface water system;
- The maintainability of the surface water system;
- The long-term economic viability of the system;
- That sustainability issues are taken into account;
- That the information requirements of stakeholders are adequately addressed;
- That the potential value of the surface water system, in enhancing the rural and urban environment is recognized and optimized.

In accordance with best practice storm drainage will be designed to the following performance criteria:

1 in 2-year storm return period:	Pipes running under full conditions with no surcharge.
1 in 30-year storm return period:	No flooding.
1 in 100-year storm:	Extreme flooding to be retained on site.

6. Ownership and Maintenance

The key elements of the surface water drainage system will require periodic maintenance to prevent failure of the system and/or a reduction in capacity of the networks as a whole and the following matrix therefore sets out the various drainage items to be maintained, identifies who is responsible and the frequency of maintenance.

The proposed SuDS features will require maintenance including litter and debris removal, sediment removal, vegetation maintenance and remediation to any damaged structures.

The maintenance requirements will be the responsibility of a private maintenance company. All inspection and maintenance works should take into consideration the implications of 'lone working'. An assessment should be carried out and the risks mitigated accordingly.

Table 6.1: Proposed Schedule of Maintenance for Below Ground Drainage

Permeable Paving (in the form of OGCR) - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
Maintenance Schedule	**Required Action**	**Frequency**
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
	Remedial work to any depressions/ rutting considered detrimental to the structural performance or a hazard to users. To be made level.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).
Monitoring	Initial inspection.	Monthly for three months after installation.

	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48 h after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Reference should be made to the manufacturer recommendations where applicable

The following information should be passed to the development operator to ensure that future maintenance is carried out in a safe and proper manner.

A formal review of the risks should be undertaken on an annual basis:

Table 6.2: Proposed Operational Schedule for Below Ground Drainage

Operation	Risks	Mitigating Measures
Access to manholes for Inspection and Maintenance.	1. Confined spaces	1. Entry to confined space to be minimised and, where unavoidable, to be carried out by appropriately trained personnel
Removal of silt from outfall	1. Risk to members of the public 2. Open Water	1. Access to hazardous areas by members of the public to be prohibited. 2. To be carried out by appropriately trained personnel

Provided that the surface strategy set out in this report, is implemented, it is expected that the primary residual failure would be as a result of some form of failure of the site drainage system during the life of the development. Therefore, regular, ongoing maintenance as set out in the Operations and Maintenance Manual, will be required to ensure that the capacity of the system is maintained as designed.

7. Consent / Planning

Summary of expected consents required:

- Sewerage Undertaker Consent – Confirmation required for surface water discharge rates to combined sewer
- Section 104 / 106 Drainage Adoption - Not required
- Build Over / Build Near - Not required
- Ordinary Watercourse Consent – Agreement with Lead Local Flood Authority (LLFA) for connection to culverted water course. Dialog to be opened with LLFA to discuss suitability of works in vicinity of culverted watercourse.

It is anticipated that details of the drainage scheme will need to be approved by Newcastle City Council Lead Local Flood Authority (LLFA) through a formal planning application. Any connection into the local watercourse will also require EA approval.

8. Conclusions

This report concludes that the surface water drainage strategy for the development will be designed in accordance with both national and local standards and best practice. The following key items have been summarised below:

- The surface water drainage system for the new development will be designed to accommodate the required flows for the lifetime of the development.
- It has been determined that the post-development surface water flow rates can be restricted to the greenfield run-off rate of 1.54l/s for the northern area of the site and 1 l/s for the southern area of the site in accordance with national guidelines and non-statutory technical standards, so as to not adversely impact downstream flooding of the site as a result of the new development.
- All surface water run-off from storm events up to and including the 100-year plus 45% climate change will be retained within the overall site.
- Attenuation provided 'at source' by way of an open graded crushed rock sub-base prior to discharging via a flow control into a culverted watercourse for the northern area of the site and to a combined sewer for the southern site, to meet the required flow rates for the whole site.
- In the event that flows from rainfall exceed the 1 in 100-year rainfall event or system failure through lack of maintenance, surface water run-off will be directed via exceedance routes away buildings and/or critical infrastructure.
- The use of sub-base attenuation for rainwater run-off mitigation, satisfies the water quality criteria of document Ciria C753 - The SuDS Manual.
- Ownership and maintenance liabilities for the surface water drainage system will be clearly defined so that in the event of failure the drainage system appropriate action can be taken to ensure that the drainage system continues to work efficiently.

Appendix A LIDAR Survey Data

Data from https://environment.data.gov.uk/survey

LIDAR DATA SOURCED FROM:
https://environment.data.gov.uk/survey

KEY PLAN

NOTES

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3. All levels are shown in metres above Ordnance Datum (m AOD).

REV						
P04	UPDATED TO SUIT REVISED SITE PLAN					
	H.MILLER	13/11/24	J.MAGEE	13/11/24		
P03	UPDATED TO SUIT REVISED SITE PLAN					
	H.MILLER	28/02/24	J.MAGEE	28/02/24		
P02	UPDATED TO SUIT REVISED SITE PLAN					
	H.MILLER	09/02/24	J.MAGEE	09/02/24		
P01	PRELIMINARY ISSUE					
	H.MILLER	07/12/23	J.MAGEE	07/12/23		
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT
FIG ENERGY

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
LIDAR DATA

HYDROCK PROJECT NO.	SCALE @ A1
C-29911-C	1:250

STATUS DESCRIPTION	STATUS
FOR INFORMATION	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
29911-HYD-00-ZZ-SK-C-7790	P04

Appendix B Proposed Site Layout

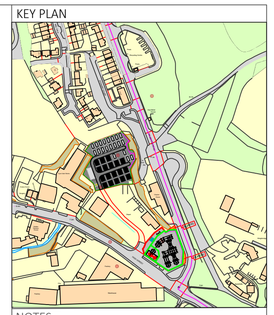
29911-FIG-DR -0006

N

MILLFIELD CLOSE
MILLFIELD LANE
9 to 25
22
24
25
18
12
14
15
16
STEWART COURT
35
25
1 to 6
Posts
Recycling Centre
Posts
32.3m
Gas Meter House
WALBOTTLE ROAD
25.3m
El Sub Sta
18 to 23
26 to 31
24
25
32
33
11
CLARKS HILL WALK
22 to 27
16 to 21
10 to 15
CHURCH ROAD
1
7
12
Tyne Vale Works
Dukes House
East House
Surgery
Clayton House
HIGH S
Newburn House
49
54
The Old Cottage
6.4m
7.3m
Depot
Public Path
PLANTING
PLANTING
Weighbridge
The Chare
1
Walker Davison House
Azure Business Centre
New Burn
Vicarage
HIGH STREET
Factory
Chy
Warehouse
Factory
Path
Sandhills
SM
Dismantled Railway
Dismantled Railway
SHELLEY ROAD

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

KEY PLAN



NOTES

Any equipment shown is indicative of dimensions and general appearance and may be subject to minor amendments by the manufacturer or supplier

LEGEND

- BATTERY
- TRANSFORMER
- PCS AND TRANSFORMER
- CONCRETE PLINTHS
- TYPE I- SURFACE(CRUSHED LIMESTONE)
- PROPOSED NEW LOCATION OF NORTHERN POWER GRID SUBSTATION
- 3 m SECURITY FENCE
- COAL-MINESHAFT
- ON SITE SUBSTATION
- RETAINING WALL

REVISIONS

REV	REVISION NOTES/COMMENTS	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
P04	UPDATED VERSION - SUBSTATION/RETAINING WALL	SS	17/10/24	XX	XX	XX	XX
P03	UPDATED VERSION - SUBSTATION/MINESHAFT	SS	11/09/24	XX	XX	XX	XX
P02	UPDATED VERSION	CL	24/07/24	XX	XX	XX	XX
P01	INITIAL VERSION	CL	22/01/24	XX	XX	XX	XX

fig power
firm, flexible energy

CLIENT
FIG POWER

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
SITE LAYOUT
FOR OPERATION- ALIGNMENT WITH TOPO

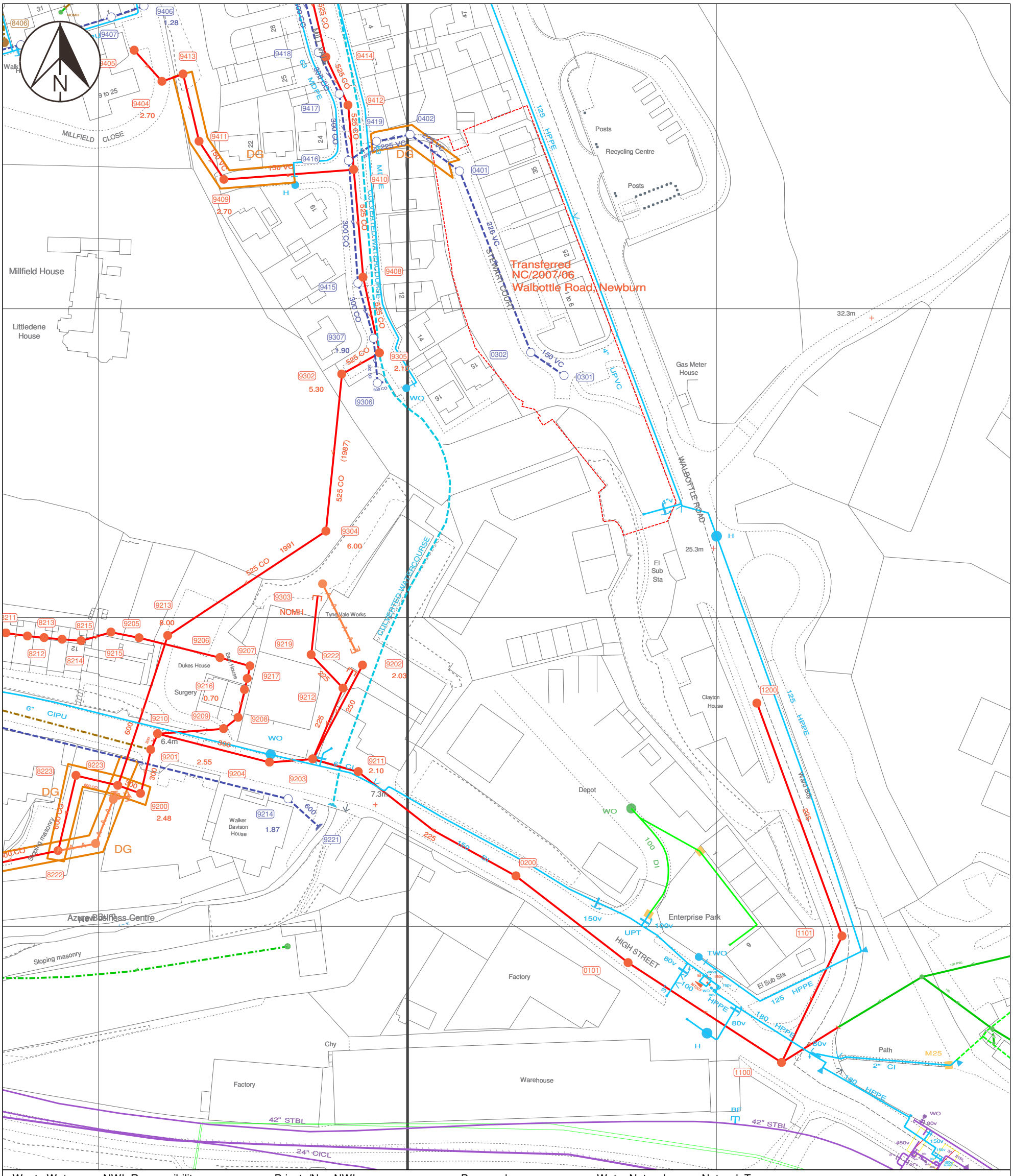
FIG PROJECT NO.	SCALE @ A1	PAGE NO.
29911	1:500	X:XXX

STATUS DESCRIPTION	STATUS
FOR INFORMATION	S2

DRAWING NO. (PROJECT CODE-ORIGINATOR ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
2991-FIG-DR-0006	P04

Appendix C Sewer Asset Map

Sheet Reference: NZ1765SW



Waste Water - NWL Responsibility

Combined	
Foul	
Surface	
Treated Eff	
Untreated Eff	
Overflow	

Private/Non NWL

Combined	
Foul	
Surface	
Treated Eff	
Trade Eff	
Watercourse	

Proposed

Combined	
Foul	
Surface	

Water Network - Network Types

Distribution	
Treated	
Raw	
Fire	
Supply	
Private	

AB Asbestos	
Abandoned	
Out of Comm	
Proposed	

NORTHUMBRIAN WATER living water

User : BOWMS

Title :

Centre Point : 417032,565310

Date : 04/12/2023 12:43:09

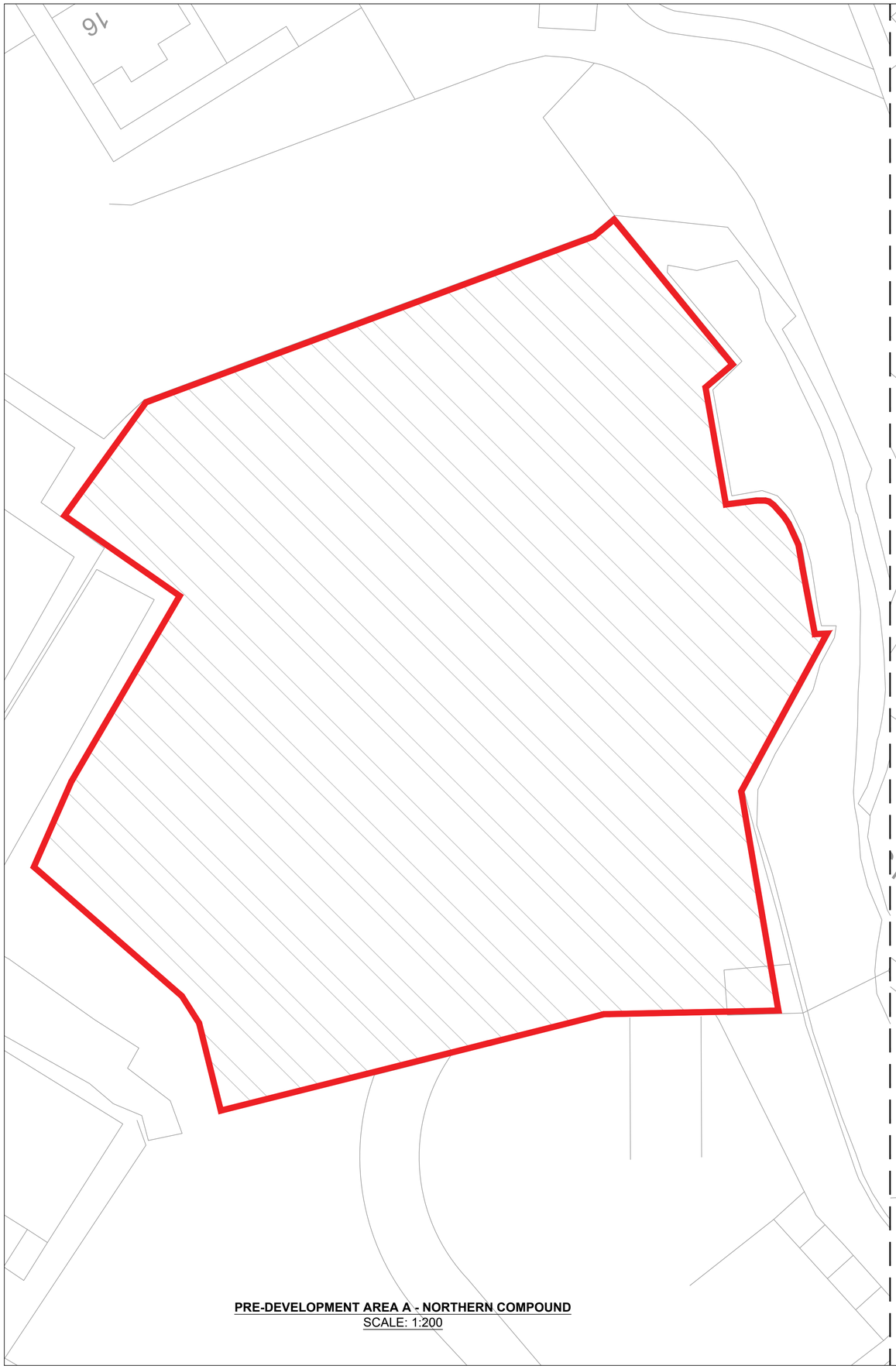
Map Sheet : NZ1765SW

Paper / Scale : A3@1:1250

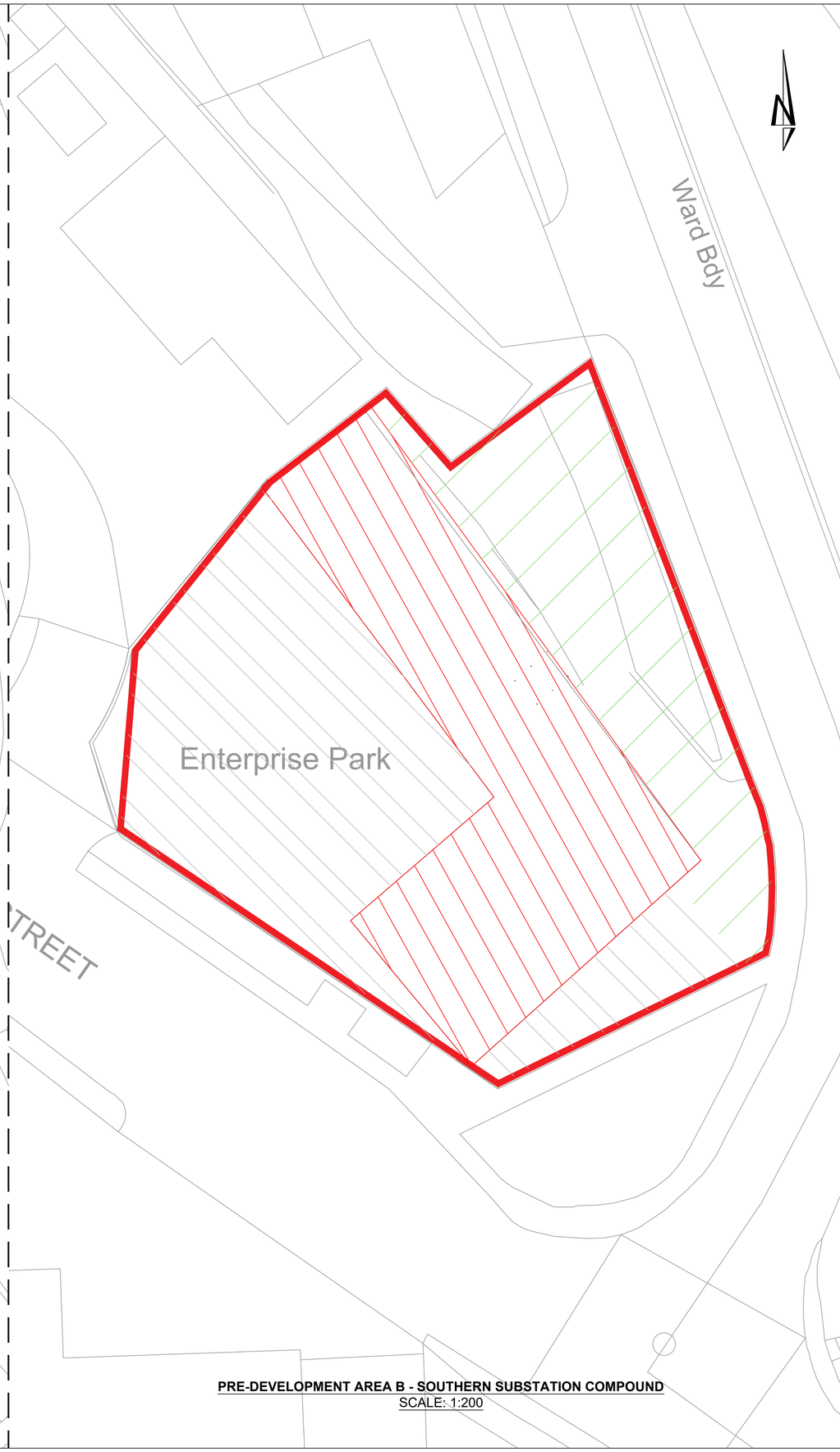
10 m

Appendix D Pre / Post Development Catchments

29911 -HYD-00-ZZ-SK-C-7710 & 7720

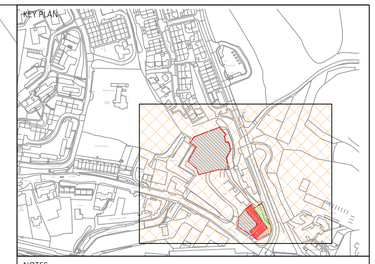


PRE-DEVELOPMENT AREA A - NORTHERN COMPOUND
SCALE: 1:200



PRE-DEVELOPMENT AREA B - SOUTHERN SUBSTATION COMPOUND
SCALE: 1:200

KEY PLAN



NOTES

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4. All levels are shown in metres above Ordnance Datum (m AOD).

LEGEND AREA A - NORTHERN COMPOUND

BUILDING / ROOF	= 0m^2
HARDSTANDING	= 3440m^2
SOFT LANDSCAPING	= 0m^2
TOTAL	= 3440m^2

LEGEND AREA B - SOUTHERN SUBSTATION COMPOUND

BUILDING / ROOF	= 691m^2
HARDSTANDING	= 767m^2
SOFT LANDSCAPING	= 480m^2
TOTAL	= 1938m^2

REV						
P04	UPDATED SITE LAYOUT					
	H.MILLER	13/11/24	A.TODD	13/11/24	J.MAGEE	13/11/24
P03	UPDATED SITE LAYOUT					
	C.HOPKINSON	27/02/24	H.MILLER	27/02/24	J.MAGEE	27/02/24
P02	UPDATED SITE LAYOUT					
	C.HOPKINSON	30/01/24	H.MILLER	30/01/24	J.MAGEE	30/01/24
P01	PRELIMINARY ISSUE					
	C.HOPKINSON	08/12/23	H.MILLER	08/12/23	J.MAGEE	08/12/23
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT
FIG POWER

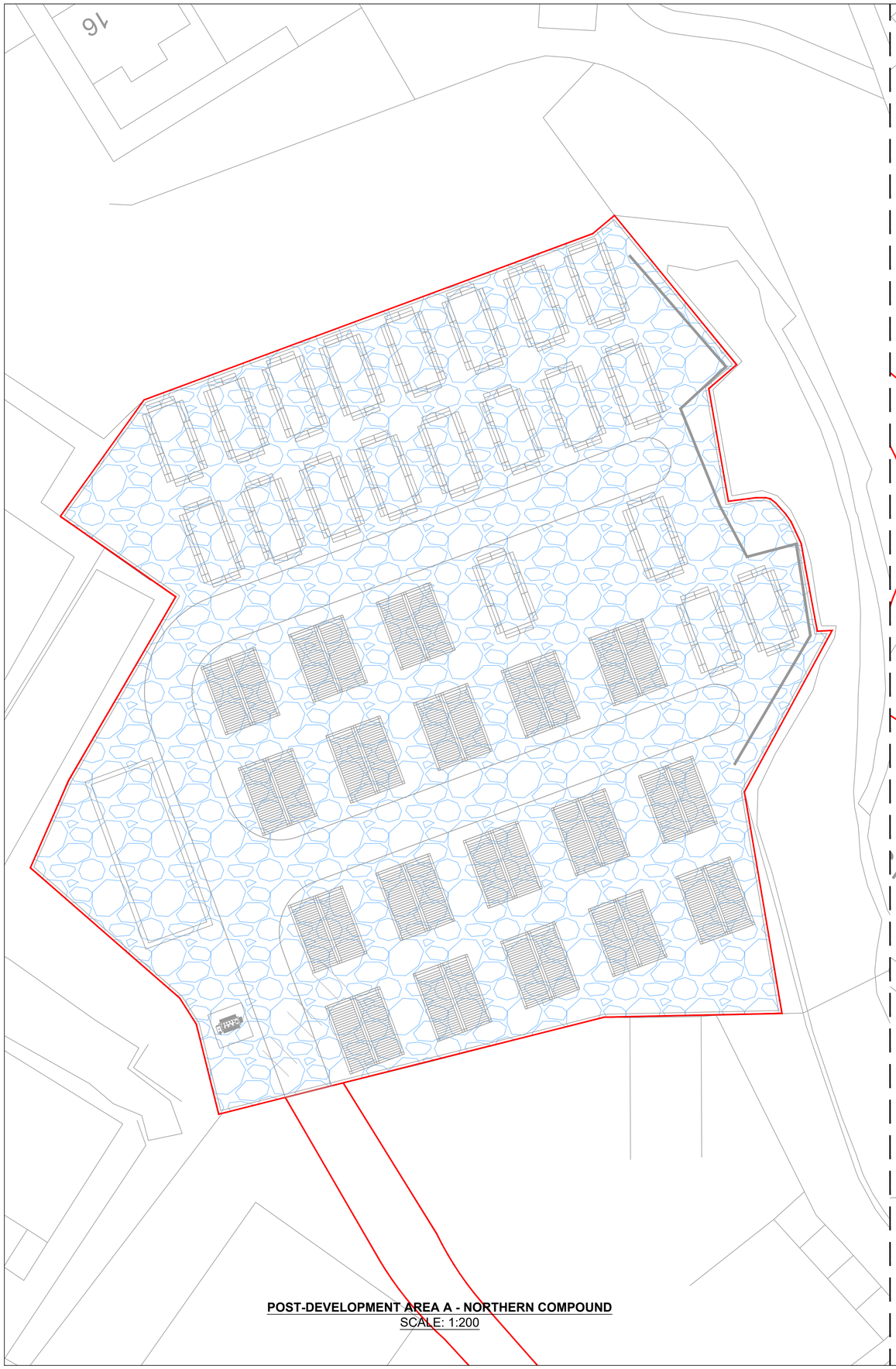
PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
PRE-DEVELOPMENT CATCHMENT PLAN

HYDROCK PROJECT NO.	SCALE @ A1
29911	1:200

STATUS DESCRIPTION	STATUS
FOR PLANNING	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
29911-HYD-00-ZZ-SK-C-7710	P04



POST-DEVELOPMENT AREA A - NORTHERN COMPOUND
SCALE: 1:200

POST-DEVELOPMENT AREA B - SOUTHERN SUBSTATION COMPOUND
SCALE: 1:200

KEY PLAN

NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
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4. All levels are shown in metres above Ordnance Datum (m AOD).

LEGEND AREA A - NORTHERN COMPOUND

PERMEABLE GRAVEL SURFACING	= 3440m^2
HARDSTANDING	= 0m^2
BUILDING / ROOF	= 0m^2
LANDSCAPING	= 0m^2
TOTAL	= 3440m^2

LEGEND AREA B - SOUTHERN SUBSTATION COMPOUND

PERMEABLE GRAVEL SURFACING	= 1853m^2
HARDSTANDING	= 0m^2
BUILDING / ROOF	= 0m^2
LANDSCAPING	= 84m^2
TOTAL	= 1937m^2

REV						
P04	UPDATED SITE LAYOUT					
	H.MILLER	13/11/24	A.TODD	13/11/24	J.MAGEE	13/11/24
P03	UPDATED SITE LAYOUT					
	C.HOPKINSON	27/02/24	H.MILLER	27/02/24	J.MAGEE	27/02/24
P02	UPDATED SITE LAYOUT					
	C.HOPKINSON	08/02/24	H.MILLER	08/02/24	J.MAGEE	08/02/24
P01	PRELIMINARY ISSUE					
	C.HOPKINSON	08/12/23	H.MILLER	08/12/23	J.MAGEE	08/12/23
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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FIG ENERGY

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
POST-DEVELOPMENT CATCHMENT PLAN

HYDROCK PROJECT NO.	SCALE @ A1
C-29911-C	1:250

STATUS DESCRIPTION	STATUS
FOR PLANNING	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
29911-HYD-00-ZZ-SK-C-7720	P04

Appendix E Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Henry Miller
Site name:	Newburn BESS
Site location:	Area A

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	54.98195° N
Longitude:	1.73512° W
Reference:	1327662715
Date:	Nov 13 2024 15:25

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.344

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	658	658
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	1.54	1.54
1 in 1 year (l/s):	1.33	1.33
1 in 30 years (l/s):	2.7	2.7
1 in 100 year (l/s):	3.21	3.21
1 in 200 years (l/s):	3.66	3.66

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Henry Miller
Site name:	Newburn BESS
Site location:	Area B

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	54.98195° N
Longitude:	1.73512° W
Reference:	1477281966
Date:	Nov 13 2024 15:27

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.194

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	658	658
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	0.87	0.87
1 in 1 year (l/s):	0.75	0.75
1 in 30 years (l/s):	1.52	1.52
1 in 100 year (l/s):	1.81	1.81
1 in 200 years (l/s):	2.06	2.06

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address:		

Catchment Area A North

Type : Catchment Area

Area (ha)	0.344

Preliminary Sizing

Volumetric Runoff Coefficient	0.950
Percentage Impervious (%)	100
Time of Concentration (mins)	5

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.950
Winter Volumetric Runoff	0.950
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Attenuating Sub-base North Area A

Type : Porous Paving

Dimensions

Exceedance Level (m)	16.000
Depth (m)	0.600
Base Level (m)	15.400
Paving Layer Depth (mm)	150
Membrane Percolation (m/hr)	50.0
Porosity (%)	30
Length (m)	82.416
Long. Slope (1:X)	200.00
Width (m)	41.287
Total Volume (m³)	459.368

Inlets

Inlet

Inlet Type	Lateral Inflow
Incoming Item(s)	Catchment Area A North
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	Pipe
Outlet Type	Free Discharge

Advanced

Conductivity (m/hr)	500.0

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area A North	FSR: 1 years: +0 %: 15 mins: Summer	0.34	51.6	22.910

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area A North	FSR: 30 years: +40 %: 15 mins: Summer	0.34	180.0	79.223

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area A North	FSR: 100 years: +45 %: 15 mins: Summer	0.34	234.0	106.077

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area A	FSR: 1 years: +0 %: 180 mins: Summer	16.000	14.000	15.423	1.423	3.1	1.610	0.000	1.4	16.995	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area A	FSR: 30 years: +40 %: 2160 mins: Summer	16.000	14.000	15.712	1.712	2.1	1.936	0.000	1.5	321.976	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area A	FSR: 100 years: +45 %: 2160 mins: Summer	16.000	14.000	15.830	1.830	2.1	2.070	0.000	1.5	339.766	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base North Area A	FSR: 1 years: +0 %: 2160 mins: Summer	15.856	15.412	0.044	0.012	3.8	63.512	0.000	0.000	1.3	123.858	505	86.174

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Status
OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base North Area A	FSR: 30 years: +40 %: 1440 mins: Summer	15.967	15.707	0.155	0.307	14.3	223.017	0.000	0.000	2.1	220.418	1077	51.451

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Status
OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base North Area A	FSR: 100 years: +45 %: 1440 mins: Winter	16.016	15.824	0.203	0.424	12.1	311.915	0.000	0.000	2.2	233.227	1457	32.099

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Status
OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address:		

Catchment Area B Southern Compound

Type : Catchment Area

Area (ha)	0.185

Preliminary Sizing

Volumetric Runoff Coefficient	0.950
Percentage Impervious (%)	100
Time of Concentration (mins)	5

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.950
Winter Volumetric Runoff	0.950
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address:		

Attenuating Sub-base Area B

Type : Porous Paving

Dimensions

Exceedance Level (m)	14.000
Depth (m)	0.550
Base Level (m)	13.450
Paving Layer Depth (mm)	150
Membrane Percolation (m/hr)	50.0
Porosity (%)	30
Length (m)	55.375
Long. Slope (1:X)	10000.00
Width (m)	33.829
Total Volume (m^3)	224.796

Inlets

Inlet

Inlet Type	Lateral Inflow
Incoming Item(s)	Catchment Area B Southern Compound
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	Pipe
Outlet Type	Free Discharge

Advanced

Conductivity (m/hr)	500.0

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area B Southern Compound	FSR: 1 years: +0 %: 15 mins: Summer	0.19	28.0	12.331

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area B Southern Compound	FSR: 30 years: +40 %: 15 mins: Summer	0.19	97.2	42.658

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m^3)
Catchment Area B Southern Compound	FSR: 100 years: +45 %: 15 mins: Summer	0.19	126.8	57.160

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area B	FSR: 1 years: +0 %: 120 mins: Summer	14.000	13.000	13.471	0.471	1.8	0.533	0.000	0.8	5.821	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area B	FSR: 30 years: +40 %: 2160 mins: Summer	14.000	13.000	13.617	0.617	1.1	0.697	0.000	0.9	148.547	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Flow Control Manhole Area B	FSR: 100 years: +45 %: 1440 mins: Summer	14.000	13.000	13.710	0.710	1.2	0.802	0.000	0.9	130.613	OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base Area B	FSR: 1 years: +0 %: 7200 mins: Summer	13.566	13.458	0.111	0.008	0.9	44.397	0.000	0.000	0.4	88.835	1285	80.250

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Status
OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 30 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base Area B	FSR: 30 years: +40 %: 2160 mins: Summer	13.703	13.616	0.247	0.166	5.7	121.544	0.000	0.000	1.1	147.639	1062	45.931

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

Status
OK

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

FSR: 100 years: Increase Rainfall (%): +45: Critical Storm Per Item: Rank By: Max. Avg. Depth

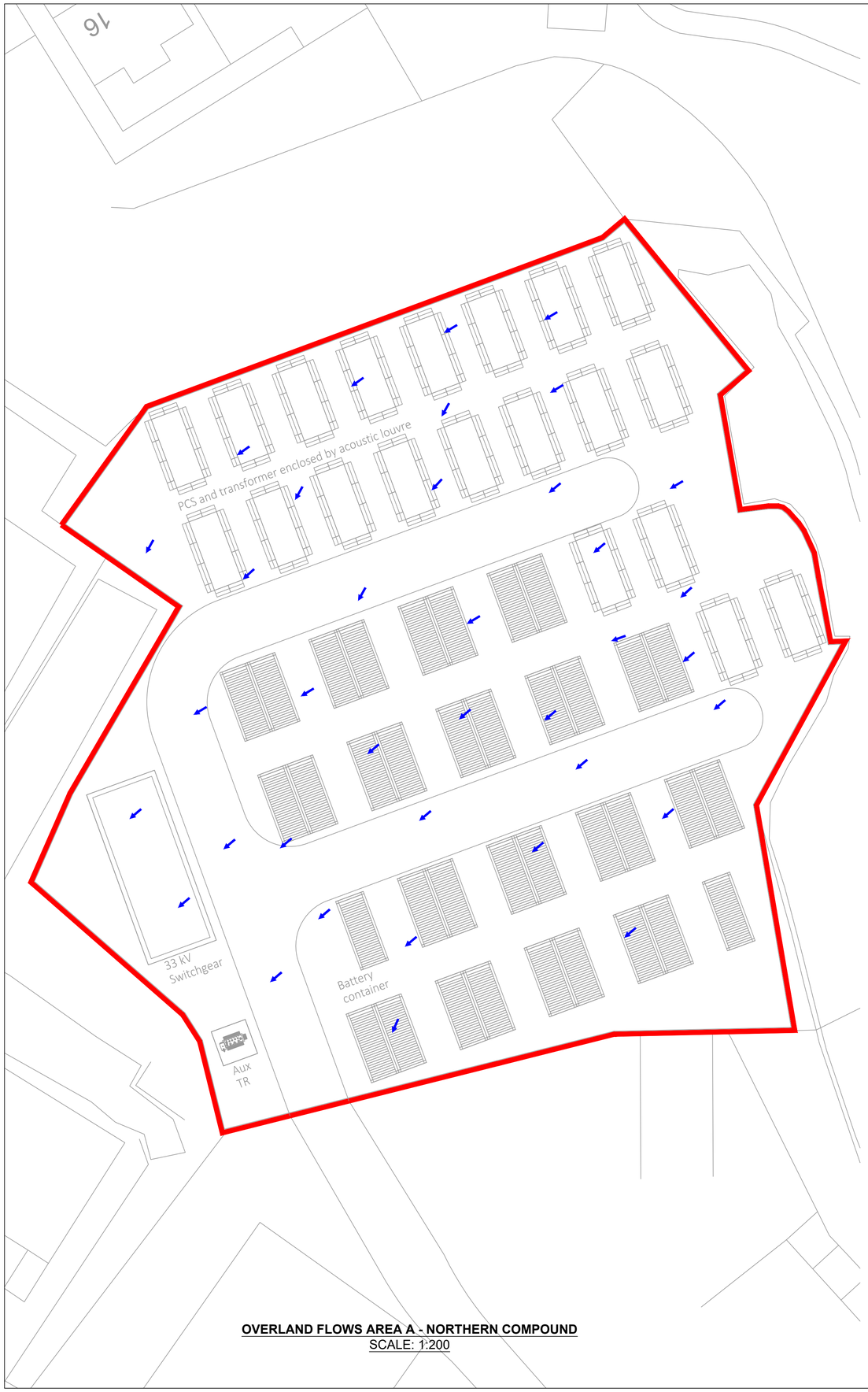
Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Attenuating Sub-base Area B	FSR: 100 years: +45 %: 2160 mins: Summer	13.773	13.709	0.318	0.259	7.3	165.860	0.000	0.000	1.1	187.099	1460	26.218

Project:	Date: 13/11/2024		
	Designed by: HenryMiller	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address:		

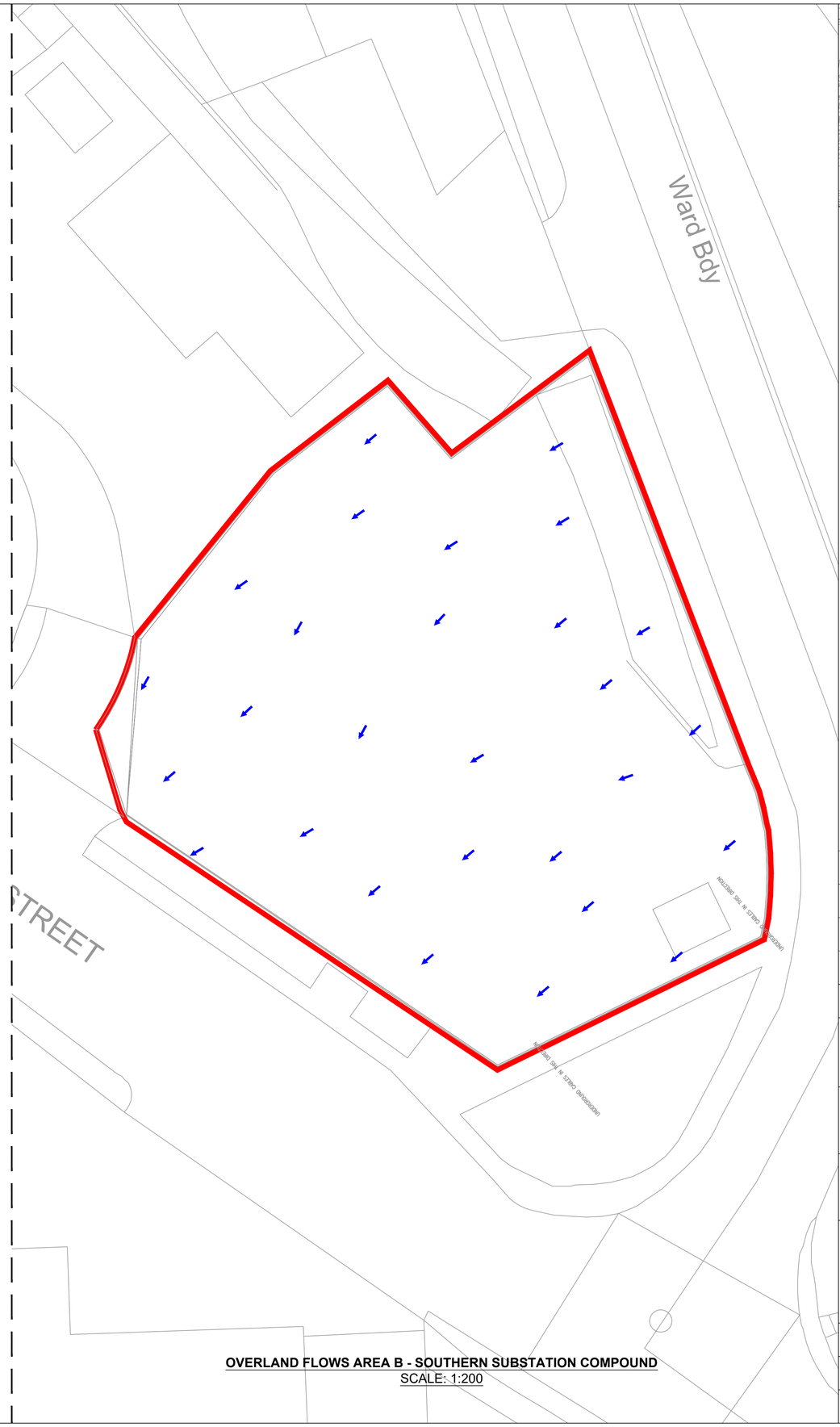
Status
OK

Appendix F Overland Flow Routes

29911 -HYD-00-ZZ-SK-C-7730

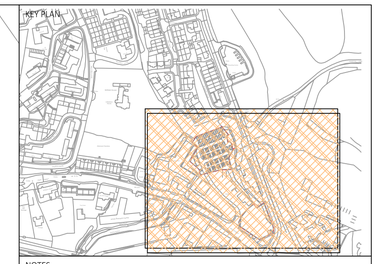


OVERLAND FLOWS AREA A - NORTHERN COMPOUND
SCALE: 1:200



OVERLAND FLOWS AREA B - SOUTHERN SUBSTATION COMPOUND
SCALE: 1:200

KEY PLAN



NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. The DWG file is issued for the purposes of coordination only and do not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets.
3. Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Hydrock immediately.
4. All levels are shown in metres above Ordnance Datum (m AOD).

LEGEND

OVERLAND FLOW ROUTE

REV						
P04	UPDATED SITE LAYOUT					
	H.MILLER	13/11/24	A.TODD	13/11/24	J.MAGEE	13/11/24
P03	UPDATED SITE LAYOUT					
	C.HOPKINSON	27/02/24	H.MILLER	27/02/24	J.MAGEE	27/02/24
P02	UPDATED TO SUIT REVISED SITE LAYOUT					
	C.HOPKINSON	08/02/24	H.MILLER	08/02/24	J.MAGEE	08/02/24
P01	PRELIMINARY ISSUE					
	H.MILLER	08/12/23	H.MILLER	08/12/23	J.MAGEE	08/12/23
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT
FIG POWER

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
OVERLAND FLOW ROUTE

HYDROCK PROJECT NO.	SCALE @ A1
29911	1:200
STATUS DESCRIPTION: FOR PLANNING	STATUS: S2
DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER): 29911-HYD-00-ZZ-SK-C-7730	REVISION: P04

Appendix G Proposed Drainage Strategy Layout

29911 -HYD-00-ZZ-DR-C-7000

NOTES

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4. All levels are shown in metres above Ordnance Datum (m AOD).
5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. Drainage pipework routes under building footprint will require Co-ordination with foundations.
7. Surface water drainage RWP locations to be confirmed by Architect.
8. External levels shown on this drawing relating to the civils, drainage works etc are to be confirmed on receipt of final external levels drawing (by others).

REV						
P04	UPDATED TO SUIT REVISED SITE PLAN					
	A.TODD	14/11/24	H.MILLER	14/11/24	J.MAGEE	14/11/24
P03	UPDATED TO SUIT REVISED SITE PLAN					
	H.MILLER	29/02/24	J.MAGEE	29/02/24	J.MAGEE	29/02/24
P02	UPDATED TO SUIT REVISED SITE PLAN					
	H.MILLER	09/02/24	J.MAGEE	09/02/24	J.MAGEE	09/02/24
P01	PRELIMINARY ISSUE					
	H.MILLER	07/12/23	J.MAGEE	08/12/23	J.MAGEE	08/12/23
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT
FIG POWER

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
DRAINAGE STRATEGY
NORTHERN AREA

HYDROCK PROJECT NO.	SCALE @ A1
C-29911-C	1:250
STATUS DESCRIPTION: FOR PLANNING	STATUS: S2
DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER): 29911-HYD-00-ZZ-DR-C-7000	REVISION: P04

PERFORATED PIPE 150Ø

PERFORATED PIPE TO CONVEY STORM WATER FROM SUB-BASE TO DISCHARGE POINT

ACCESS TRACK OUTSIDE REDLINE BOUNDARY TO DRAIN LOCALLY

Clayton House

Depot

3m

ATTENUATING SUB-BASE
TO BE LOCATED BENEATH BATTERY FACILITY.
DRAINED AREA = 1938m²
SRP = 1 IN 100 YR + 40% CLIMATE CHANGE.
STORAGE PROVIDED IN OPEN GRADED CRUSHED ROCK (OGCR) TYPE 3 OR SIMILAR WITH MIN 30% VOIDS.
1853m² x 400mm DEEP.
MAX STORAGE VOLUME = 225m³

PERFORATED PIPE 150Ø

PERFORATED PIPE TO CONVEY STORM WATER FROM SUB-BASE TO DISCHARGE POINT

EXISTING CONNECTION TO PUBLIC SEWER TO BE SURVEYED AND CONFIRMED SUITABLE FOR REUSE

FLOW CONTROL MANHOLE
HYDRO-BRAKE FLOW CONTROL
DISCHARGE LIMITED TO **1.00 l/s**
D400 CVR
CL: 14.000
IL: 13.000

HIGH ST

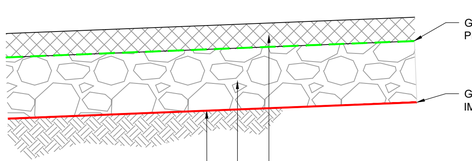
CONNECTION TO PUBLIC COMBINED WATER SEWER - EXISTING CONNECTION TO BE CONFIRMED. NEW CONNECTION MAY BE REQUIRED

EXCW-01
CL: 13.990
IL: TBC

PERFORATED PIPE 150Ø

PERFORATED PIPE 150Ø

PAVEMENT BUILD-UPS ARE SUBJECT TO IN-SITU CBR TESTS AT SUB-GRADE LEVEL



ATTENUATING SUB-BASE STORAGE - SOUTH

GRAVEL ROAD CONSTRUCTION
(Frequent HGV and Commercial Vehicles)

SCALE 1:20

PROPOSED DRAINAGE - STORM

150Ø@1:100

- STORM WATER DRAIN
- STORM WATER MANHOLE
- STORM WATER INSPECTION CHAMBER
- CULVERTED WATERCOURSE
- PERFORATED PIPE IN GRAVEL TRENCH

LEGEND - SURFACE TYPES

- **ATTENUATING SURFACE:** OGCR SUB BASE
- FREQUENT HGV AND COMMERCIAL VEHICLES

NOTE: DRAINAGE HAS ONLY BEEN SHOWN INDICATIVELY TO DEMONSTRATE THE PRINCIPLES OF THE DRAINAGE STRATEGY AND SHOULD NOT BE USED FOR PRICING

KEY PLAN

NOTES

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4. All levels are shown in metres above Ordnance Datum (m AOD).
5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. Drainage pipework routes under building footprint will require Co-ordination with foundations.
7. Surface water drainage RWP locations to be confirmed by Architect.
8. External levels shown on this drawing relating to the civils, drainage works etc are to be confirmed on receipt of final external levels drawing (by others).

REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
P01	UPDATED TO SUIT REVISED SITE PLAN					
	A.TODD	14/11/24	H.MILLER	14/11/24	J.MAGEE	14/11/24

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e: bristolcentral@hydrock.com

CLIENT
FIG POWER

PROJECT
NEWBURN
BATTERY ENERGY STORAGE SYSTEM

TITLE
DRAINAGE STRATEGY
SOUTHERN AREA

HYDROCK PROJECT NO.	SCALE @ A1
C-29911-C	1:250

STATUS DESCRIPTION	STATUS
FOR PLANNING	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
29911-HYD-00-ZZ-DR-C-7001	P01