



Requirement 10 – Surface Water Drainage

National Grid Electricity Transmission

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NORTH LONDON REINFORCEMENT PROJECT

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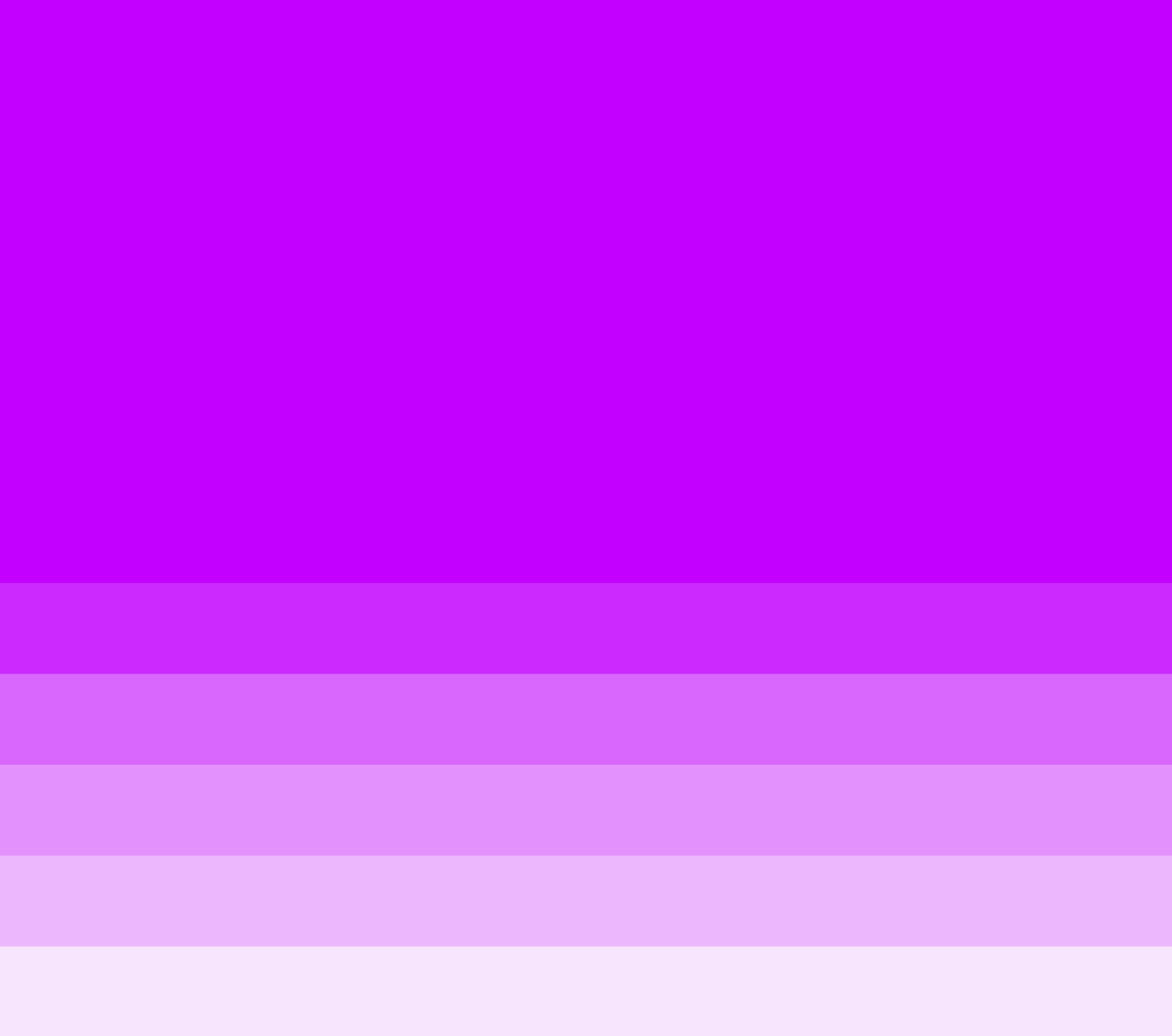
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Acronyms

Acronym	Definition
BGS	British Geological Survey
DCO	Development Consent Order
EA	Environment Agency
FRA	Flood Risk Assessment
GIS	Gas Insulated Switchgear
kV	kilovolt
LBH	London Borough of Haringey
LPA	Local Planning Authority
LVRP	Lee Valley Regional Park
LVRPA	Lee Valley Regional Park Authority
NGET	National Grid Electricity Transmission
NLRP	North London Reinforcement Project
NPPF	National Planning Policy Framework
NPPG	National Planning Policy Guidance
NSIP	Nationally Significant Infrastructure Project
OHL	Overhead Line
Q_{bar}	Greenfield Runoff Rate
SIA	Simple Index Approach
TW	Thames Water

Executive Summary

AtkinsRéalis has been commissioned by National Grid Electricity Transmissions (NGET) to provide services to support for the discharge of requirements for the demolition of the existing building merchant, former bus depot building to facilitate the expansion of the Tottenham sub-station and cable sealed end compound. Stage 3A Requirement 10 covers the surface water drainage design to support the site under temporary requirements, i.e. for the demolition phase, with the understanding that a final drainage solution will be developed and submitted under Stage 3B, with the proposed drainage system likely to be removed.

This report covers the basis of design, drainage strategy and assets, and key risks and assumptions.

The Site has an area of 1.2ha and is located within the administrative area of London Borough of Haringey (LBH). Based on the available data, the surface water within the Site is understood to naturally drain north and east, with the existing site surface water drainage discharging towards the north into the existing Thames Water (TW) surface water sewer network, which flows into Pymmes Brook towards the east.

Following consultation with LBH, the drainage strategy proposed is to contain surface water within the site for up to a 1-in-100-year storm plus 20% climate change allowance (allowance figure derived based on assessment), and to discharge into the existing site manhole, with flow limited to greenfield runoff rate. As the client NGET does not require the site to be dry during the demolition phase, the drainage has been designed to no surcharge for a 1-in-1-year storm. The proposed measures include the use of swales, pipes and manholes, bunds and speed hump, headwalls, flow controls, and vortex interceptor, designed as per LBH and SuDS Manual standards. Moreover, the design encourages the reuse of soil on site and prioritises SuDS where appropriate.

Key risks and assumptions to manage in the subsequent design and construction phases include inconsistent or shallow slopes on site preventing the required flow of water, inability to discharge into the existing surveyed manhole and TW sewer network, drainage infrastructure will remain unaffected and clear during the demolition phase, and concrete base of existing structures not completely excavated as part of the demolition.



1. Introduction

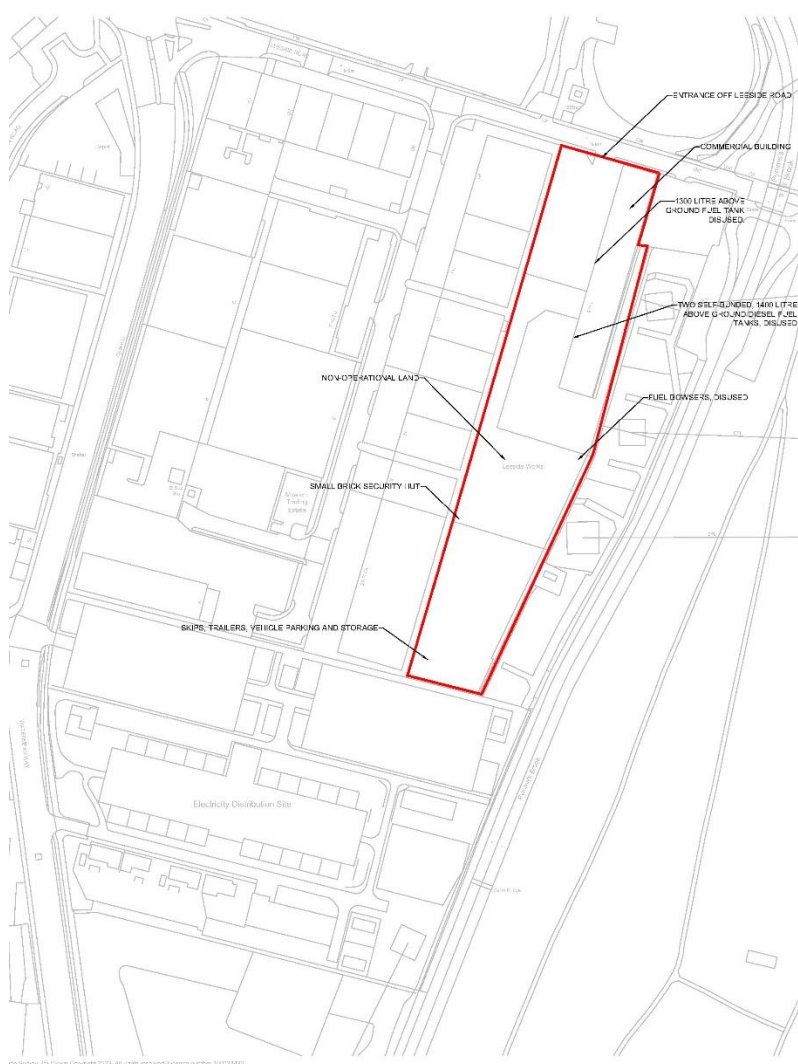
AtkinsRéalis has been commissioned by National Grid (NG) to produce a surface water drainage report for the discharge of Requirement 10 associated with Stage 3A of the North London Reinforcement Project Development Consent Order (DCO). This is in accordance with Requirements 3 of the DCO, a written scheme setting out all stages of development, approved in 2023 under application reference HGY/2023/0953.

The Site is located within the administrative area of London Borough of Haringey (LBH). Part of the works sits within the Lee Valley Regional Park (LVRP), who will be consulted prior to the submission of Requirements 13. This report has been prepared as part of the discharge of Requirement 10 Surface Water Drainage, and covers the basis of design, drainage strategy and assets, and key risks and assumptions.

1.1 The Site

The extent of the Site to which this report covers is shown by the blue line boundary in Figure 1 below. The Site is located along Leaside Road (postcode N17 0QJ), approximately 475 metres north-west of the Walthamstow Reservoirs – a Site of Special Scientific Interest.

Figure 1 - Site Boundary



1.2 Overview of the Wider Project

A DCO was authorised for the wider North London Reinforcement project by the Secretary of State for Energy and Climate Change on 16 April 2014 and came into force on 7 May 2014. The DCO provide powers to the Client (National Grid) to carry out the North London Reinforcement project, which comprises the replacement of existing 275kV overhead lines with an uprated 400 kV overhead line. The DCO also contains powers to carry out associated works to the substations along the route of the uprating, including the Tottenham Substation.

The wider Project falls within the administrative boundaries of Epping Forest District Council, Enfield Council, the London Borough of Waltham Forest and the London Borough of Haringey. The Local Planning Authority for this stage of the works at Tottenham, Stage 3A, is the London Borough of Haringey.

Early enabling works have already been successfully completed at Tottenham Substation under Stage 1 of the DCO, involving the construction of a set of foundations located to the south east of Tottenham Substation approximately 140 m south of the Stage 3A area.

1.3 The Development Consent Order

A Drainage Strategy is required by Schedule 2 Requirement 10 of The National Grid North London Reinforcement Project DCO.

Requirement of the DCO states as follows:

- (1) No stage of the authorised development shall commence until for that stage, written details of the surface and foul water drainage system (including means of pollution control) have, after consultation with the sewerage and drainage authority, been submitted to and approved by the relevant planning authority.*
- (2) The surface and foul water drainage system must be constructed in general accordance with the details approved in accordance with requirement 10(1) unless otherwise agreed with the relevant planning authority.*

1.4 The Proposed Development

The proposed works are in relation to Stage 3A of the schedule of developments, including the preparatory works to facilitate the construction of the Tottenham Substation as a part of the wider Development Consent Order (DCO) for the NLRP. Stage 3A is a substage of Stage 3, which is set to initiate in Q1 2024 and is planned to be completed in Q2 2028.

1.4.1 Stage 3A

Stage 3A of the project primarily involves preparatory and temporary works for the bypass of Tottenham substation prior to main work commencing. Such works includes the remediation of contaminated land to the north of the existing substation compound, and demolition of the former bus depot building on Leaside Road. As accepted by LBH, the approach for Requirement 10 Surface Water Drainage design will only support the Site under temporary requirements, i.e. during demolition and remediation, with the understanding that a final drainage solution will be developed and submitted under Stage 3B, with the current drainage system likely to be removed. Furthermore, access for this stage will primarily be via existing access points, without the need for new access construction. Temporary road enhancements will be applied as needed for efficient access, accompanied by thorough traffic management measures to ensure safety and effective coordination with local road users.

2. Basis of Design

2.1 Summary

Table 1 summarises the source and date accessed of information used as basis of the surface water drainage design.

Table 1 - Basis of Design Summary and Information Source

	Source	Date Accessed
<i>Site Boundary</i>	Drawing “Figure 2: Tottenham (Site Code 3506) – Site Layout Plan”, Google Earth	22 December 2023
<i>Topography</i>	Open-Source LiDAR data	16 October 2023
<i>Infiltration</i>	BGS GeoIndex Maps Borehole and Soil data	19 October 2023
<i>Flood Risk</i>	Environmental Agency Flood Map for Planning	24 October 2023
	GOV.UK ‘long term flood risk check’ service and maps: - Extent of Flooding from Surface Water - Extent of Flooding from Rivers or the Sea - Maximum Extent of Flooding from Reservoirs	22 January 2024
<i>Climate Change Allowance</i>	London Management Catchment peak rainfall allowances	24 October 2023
	Annex 3: Flood risk vulnerability classification	24 October 2023
<i>Existing Drainage System</i>	Thames Water Asset Search: ALS/ALS Standard/2023_4886756	20 September 2023
	Drawing “ADP-LEEDSIDE ROAD TOPO”	24 October 2023
<i>Design Parameters</i>	LBH Local SuDS Standards (2016)	25 October 2023
	SuDS Manual CIRIA C753	15 May 2023
<i>Other</i>	Confirmation from LBH via Pre-Application Advice Note PRE/2023/0197 meeting	6 December 2023
	Confirmation from client NGET Document 5.3 (Flood Risk Assessment) of the Developer’s Application	26 September 2023

2.2 Topography

The Site is relatively flat, with an overall longfall of 1:370 (sloping down towards the north) and a crossfall ranging from 1:100 to 1:300 (sloping down towards the east). Based on open-source surface contours, the ground elevations on site range from 9.94mAOD (by site entrance) to 10.90mAOD (southwest corner).

2.3 Soil Conditions

Based on the geology classifications from the BGS GeoIndex Maps, the Site consists of predominantly clay – Alluvium and London Clay Formation on the superficial and bedrock layers respectively. It has been assumed that the concrete base will be part of the excavation, therefore, only soil will be left on site during the demolition phase.

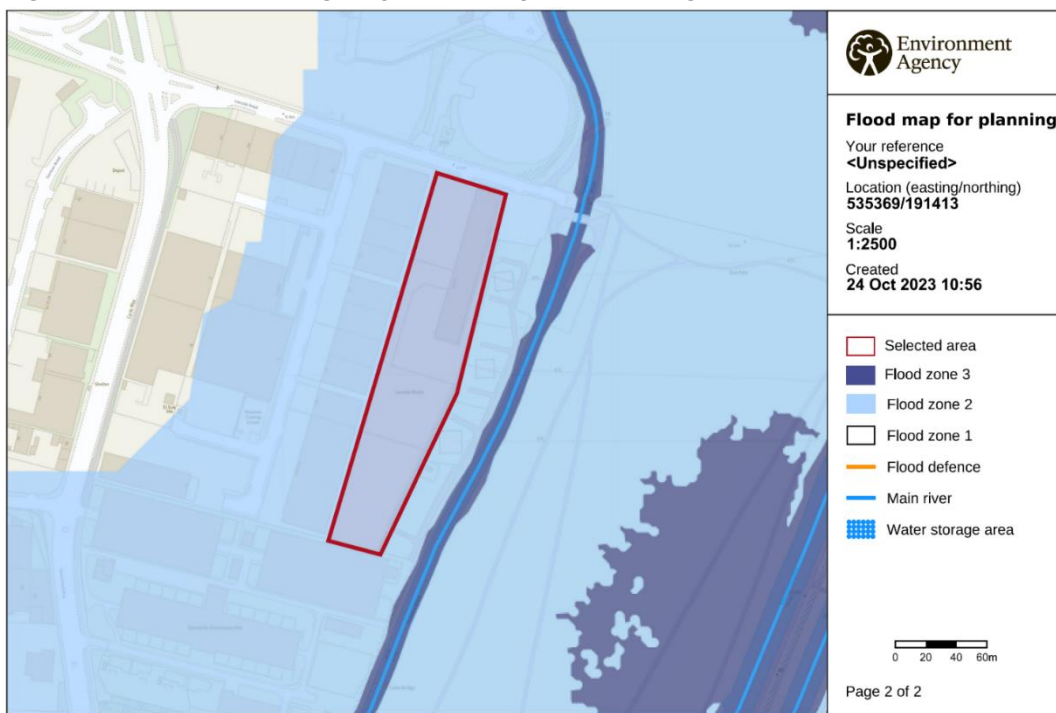
2.4 Infiltration

Soil and borehole data from BGS GeoIndex maps suggest that the Site has low infiltration potential. Additionally, the nearest available borehole, BH TQ39SE838, has a high groundwater table at 2.9mbgl (9.04mOD). No field test data for is available to confirm this. Therefore, for the proposed surface water drainage design, it has been assumed that soakaway or infiltration-based solutions are not appropriate.

2.5 Flood Risk

The Site is located approximately 50m west of Pymmes Brook. Based on the Environment Agency (EA) flood map for planning in Figure 2, the Site is located within Flood Zone 2.

Figure 2 - Environment Agency Flood Map for Planning¹



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Based on the 'long term flood risk check' service provided by GOV.UK, supported by flood risk maps below, the Site has the following risk levels from different sources of flooding:

- Surface water – very low risk (Figure 3);
- Rivers and the sea – low risk (Figure 4);
- Reservoir – risk (Figure 5); and
- Groundwater – unlikely.

¹ Source: <https://flood-map-for-planning.service.gov.uk/> (24 October 2023).

Figure 3 - GOV.UK 'long term flood risk check' Map – Extent of Flooding from Surface Water²

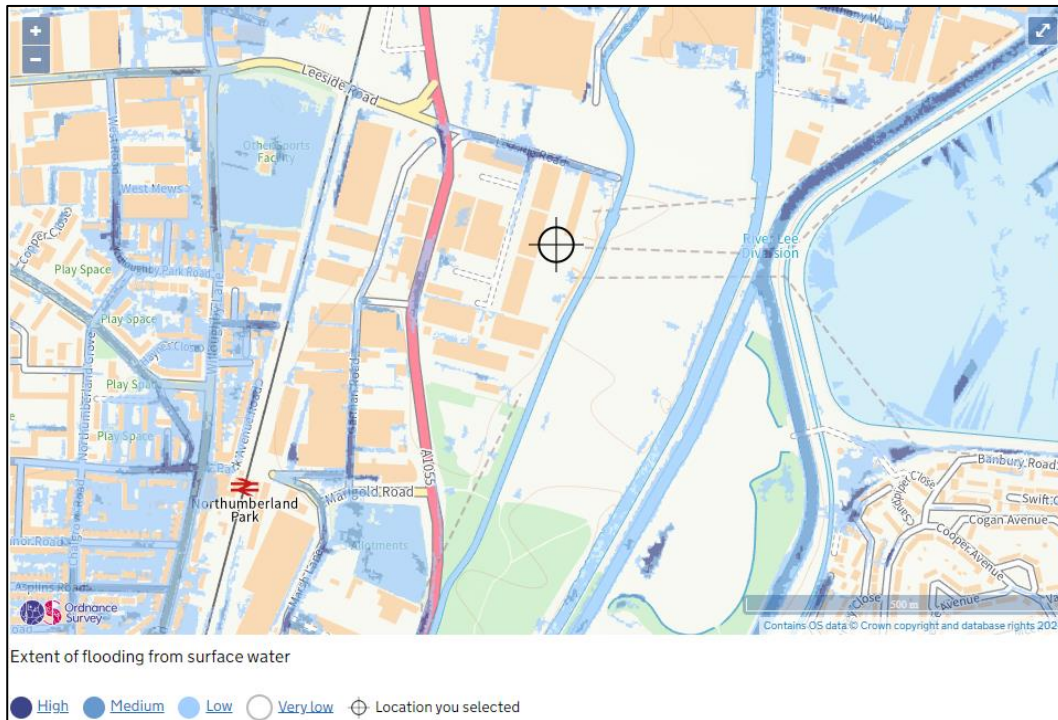
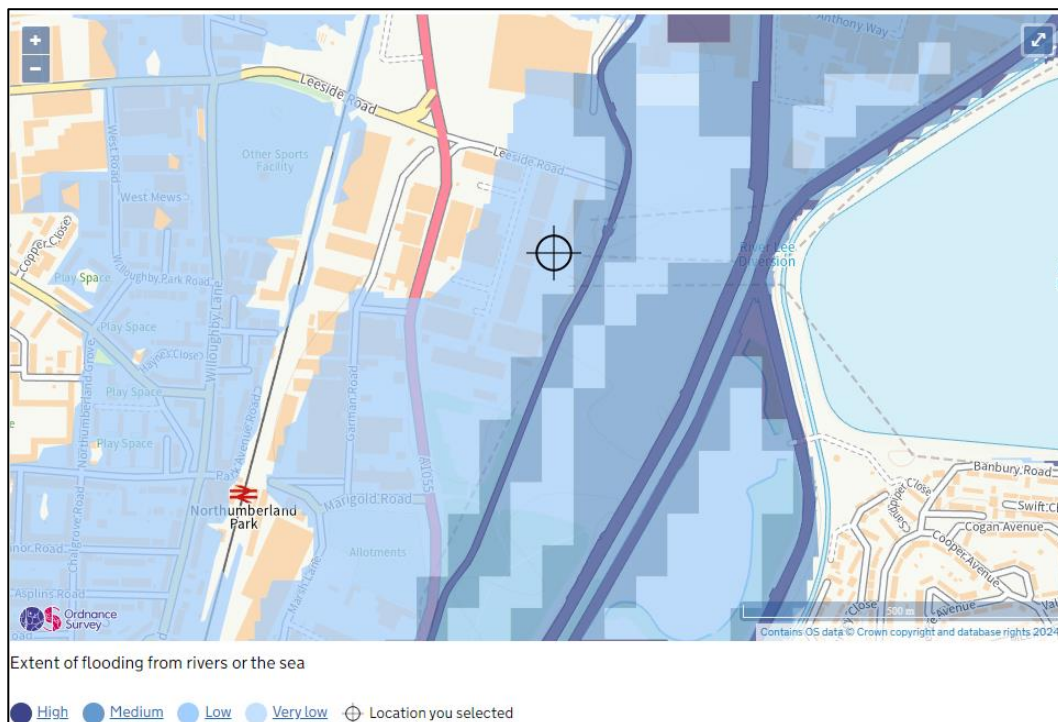


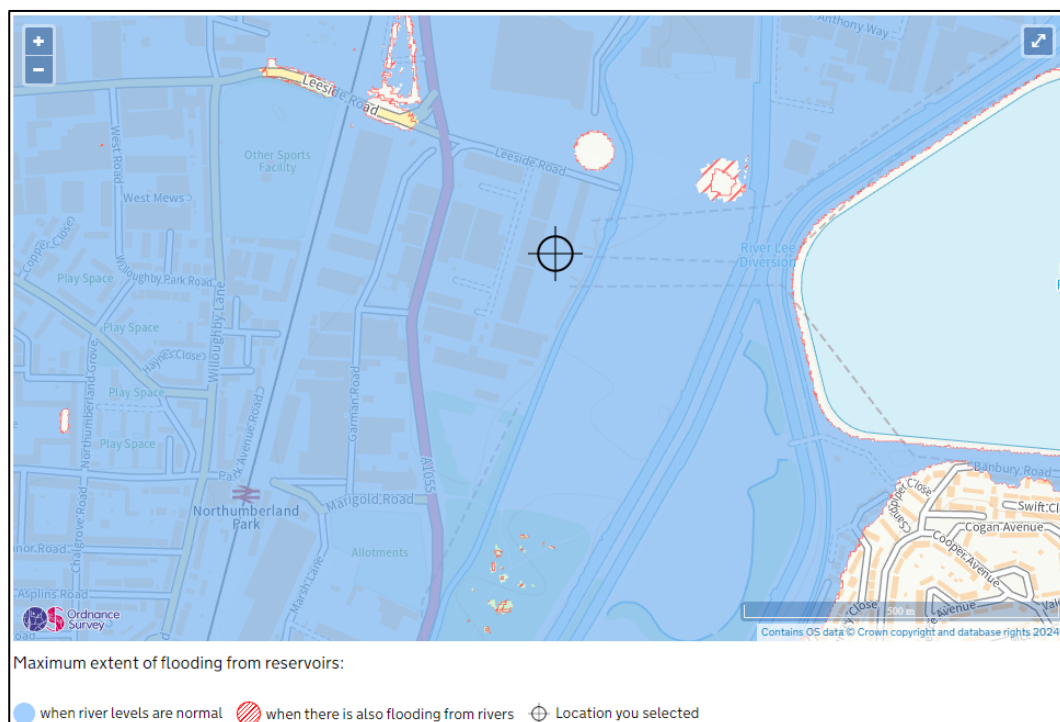
Figure 4 - GOV.UK 'long term flood risk check' Map – Extent of Flooding from Rivers or the Sea³



² Source: <https://check-long-term-flood-risk.service.gov.uk/map?easting=535368&northing=191415&map=SurfaceWater> (22 January 2024).

³ Source: <https://check-long-term-flood-risk.service.gov.uk/map?easting=535368&northing=191415&map=SurfaceWater> (22 January 2024).

Figure 5 - GOV.UK 'long term flood risk check' Map – Maximum Extent of Flooding from Reservoirs⁴



It is to be noted that the wider DCO for the NLRP has covered aspects of a planning application, including a Flood Risk Assessment (FRA) (Document 5.3. of the Developer's Application). The Site covered by this report is adjacent to the Tottenham Substation and covered as part of Section 7 in the FRA. Therefore, the discharge of requirements in this report has been confirmed to be based on an already approved application.

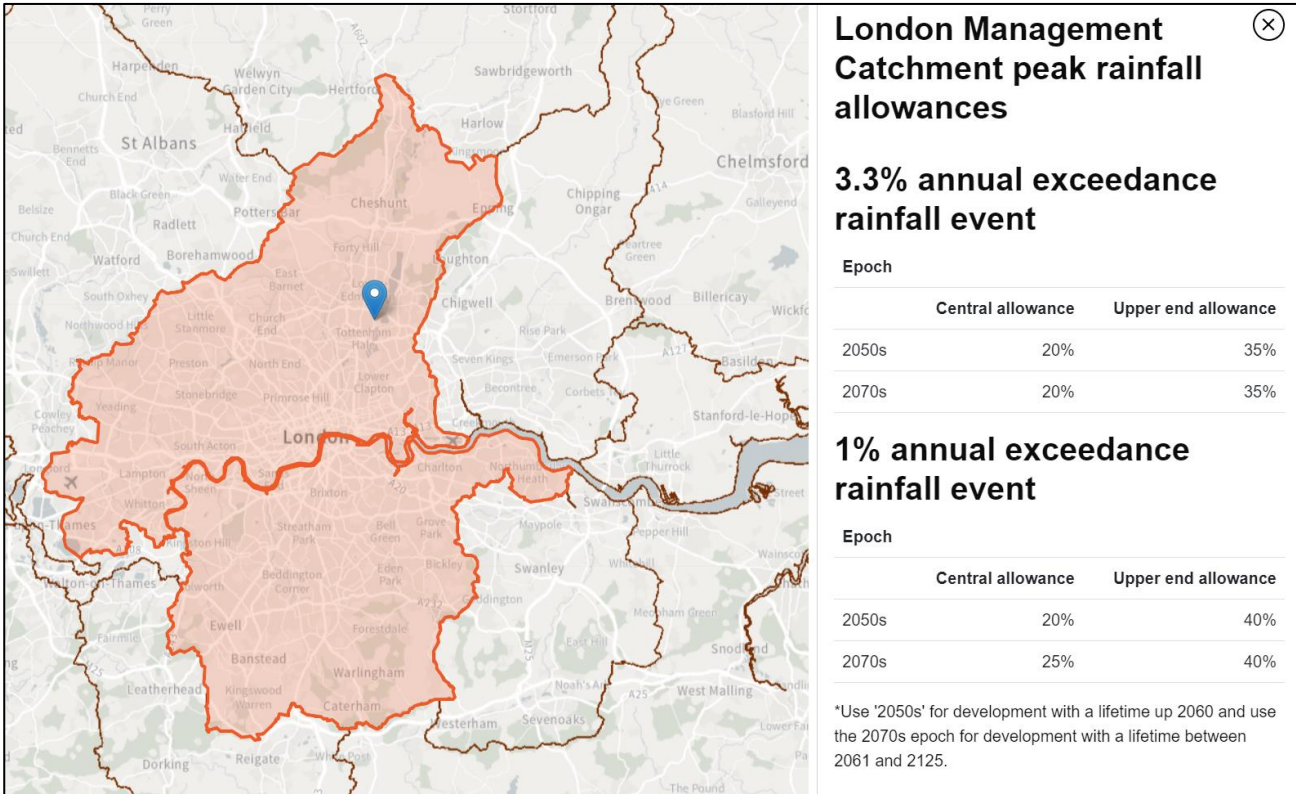
2.6 Climate Change Allowance

The climate change allowance for the Site is 20%. This has been derived from the following site information:

- Site is in Flood Zone 2, as shown in Figure 2;
- Site can be classified as 'Essential Infrastructure' based on GOV.UK's "Annex 3: Flood risk vulnerability classification";
- Site design life (for demolition phase) has been assumed to be up to 2060;
- Based on GOV.UK's guidance on "Flood risk assessments: climate change allowances",
 - Table 2 confirms that 'Essential Infrastructure' in Flood Zone 2 does not require an exception test,
 - Section 'Using peak rainfall intensity allowances to assess surface water flood risk' confirms that for development with a lifetime up to 2060, flood risk assessments assess the central allowance for the 2050s epoch (2022-2060), for both the 1% and 3.3% annual exceedance probability events;
- Site is considered a small catchment (<5km²) or urbanised drainage catchments, which allow use of the peak rainfall allowance map. The London Management Catchment Peak Rainfall Allowances is displayed in Figure 6. For the 2050s epoch, the central allowance is 20%.

⁴ Source: <https://check-long-term-flood-risk.service.gov.uk/map?easting=535368&northing=191415&map=SurfaceWater> (22 January 2024).

Figure 6 - Defra Data Services Platform – London Management Catchment peak rainfall allowances⁵



2.7 Existing Drainage System

Information from asset location search (stats plan) and GPR utility survey evidenced the location of existing drainage systems within and around the Site. The stats plan in Figure 7 show the Thames Water surface water sewer network in close proximity to the Site, which then discharges flow into Pymmes Brook. Moreover, evident from the GPR undertaken in Figure 8, there are existing private surface water pipe serving the Site, which has been assumed to connect into the above-stated sewers, conveying water from the Site to the Thames Water sewers.

⁵ Source: <https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3049> (24 October 2023).

Figure 7 - Screenshot (north-east of site) of Thames Water Asset Location Search Sewer Map⁶

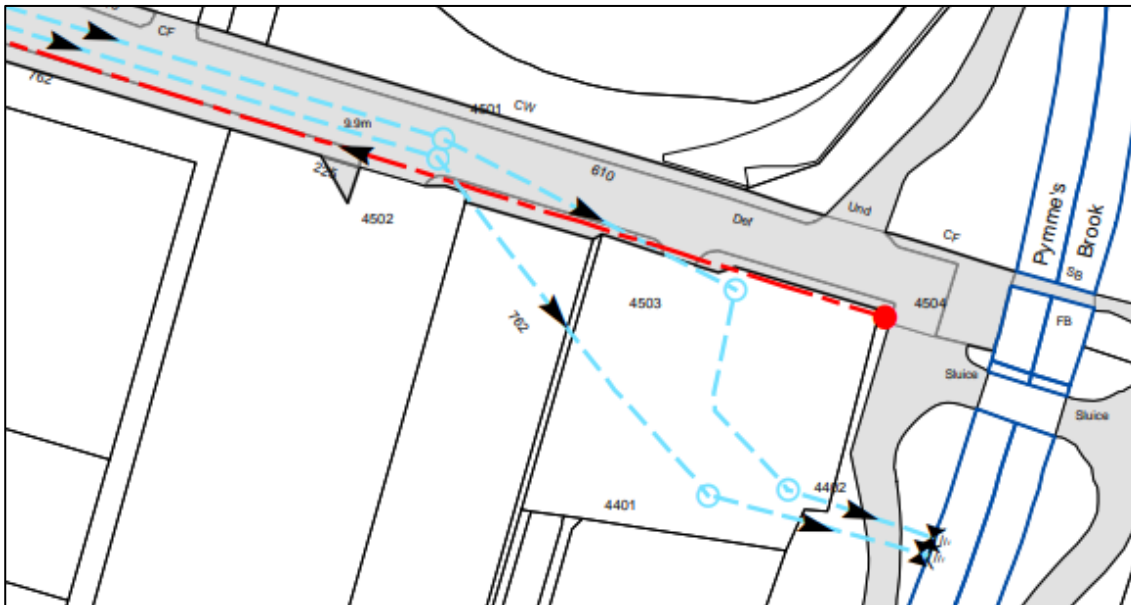
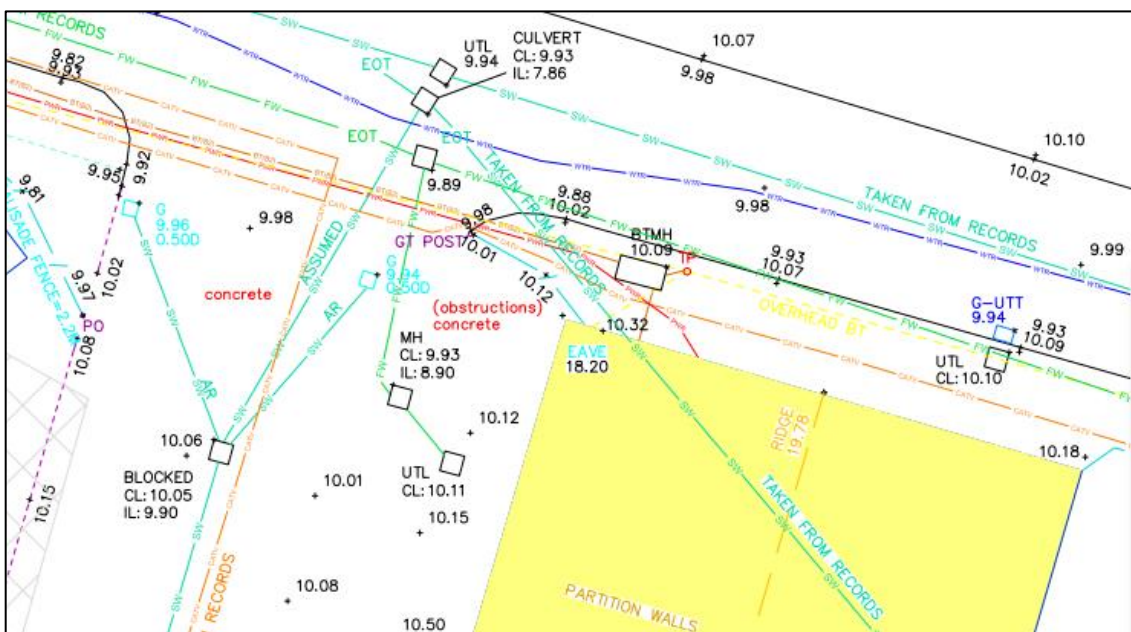


Figure 8 - Screenshot (north-east of site) of the Topographical and Utility Survey⁷



The GPR utility survey in Figure 8 displays the locations of existing gullies, manholes, and sewer near the site entrance. The survey confirms that there is an existing manhole on site (CL: 10.05), which has been proposed to use as a point of connection into the TW surface water sewer system. The proposed surface water discharge location is covered in more detail in Section 3.3.

⁶ Source: ALS/ALS Standard/2023_4886756 (September 2023)

⁷ Source: Drawing 'ADP-LEEDSIDE ROAD TOPO' (October 2023)

3. Surface Water Drainage Design

As part of the Developer’s Application for the NLRP, the Flood Risk Assessment (Document 5.3, Section 7.7.4) recommended french drains and a soakaway to fulfil attenuation requirements for the Tottenham Substation, and gravel surfacing for the exposed areas. A drainage plan included as part of the FRA has been included in Appendix A.1. Whilst the drainage design was not specified for the bus depot demolition site specifically, the overall concept of using soakaways were not appropriate due to the Site’s low infiltration potential.

Therefore, for the proposed drainage design, we have considered the temporary nature of the demolition phase and the client NGET not requiring the Site to be dry, which is reflected in the proposed drainage system. Additionally, following LBH council guidance, we have also prioritised SuDS for sustainability.

The proposed design features on Site include:

- Swale – for collection, conveyance/ attenuation, storage, and treatment of surface water flow. Swale dimensions designed to no surcharge for a 1-in-1-year storm;
- Soil bunds – for keeping flood volumes, up to a 1-in-100-year storm plus 20% climate change allowance, on site. Additionally, to maximise utilisation of Swale storage in the southern (upstream) end of the drainage system, an intermediary bund has also been proposed;
- Speed hump – to allow vehicular access onto the Site via the existing entrance and to ensure continuity of the soil bund in keeping the required flood volumes on site;
- Flow controls – for controlling the Site’s discharge flow to greenfield runoff rate, and to control flow through the Swale at the location of the intermediary bund;
- Consideration of sustainability benefits from the chosen return period criteria for no surcharge, from the reuse of soil excavated from the swale for use to construct the bund, and the use of intermediary bund to maximise upstream storage and reduce swale and bund dimensions across the Site; and
- Pollution mitigation has been considered based on the Simple Index Approach (SIA), as per SuDS Manual C753.

A plan drawing of the proposed drainage system is presented in Appendix A.2.

3.1 Drainage Strategy

The drainage strategy has been developed for the Site during the demolition phase, to:

- Effectively remove water from the Site;
- Ensure that any surface water surcharge is contained on site, for storms up to a 100-year return period plus 20% climate change allowance (Section 2.6);
- Ensure that flows discharged from the Site are attenuated to greenfield runoff rate (Section 3.2); and
- Control pollution risk to acceptable levels using the Simple Index Approach (Section 3.4).

Table 2 below summarises the drainage design parameters for the Site.

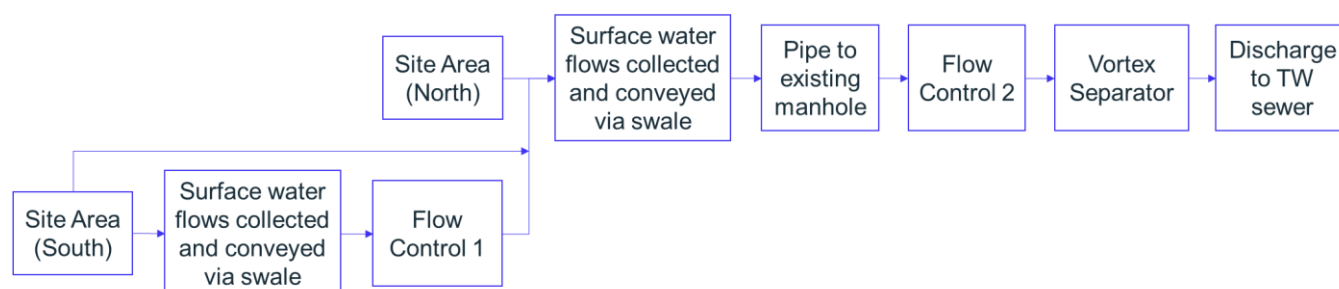
Table 2 - Drainage Design Parameters

<i>Parameters</i>	<i>Assumed Value</i>
Area	1.2ha

Q_{BAR} (for 1.2ha site)	4.4l/s
Return period (for no surcharge)	1 year
Return period (for containing flooding on site)	100 years
Climate Change Allowance	+20%
Infiltration	Low

Considering the above design parameters, the proposed configuration for the drainage system during demolition phase is shown in Figure 9.

Figure 9 - Configuration of the Proposed Drainage System for the NLRP Demolition Phase



In addition to the assets included in the flowchart in Figure 9, a soil bund around the low elevations of the site boundary and a speed hump to allow vehicular access onto the Site have been proposed to contain any surface water surcharge, for events including and up to the 1-in-100-year storm plus 20% climate change allowance, within the Site. From ground conditions available on the BGS GeoIndex maps, parts of the soil excavated to form the swale may be considered for use to construct the bund.

3.2 Greenfield Runoff Rate

In line with the EA SC030219 report “Rainfall runoff management for developments” and LBH Local SuDS Standards, the site discharge is to be controlled to the greenfield runoff rate. This rate can be calculated using the ICP SUDS Methodology, applicable for areas under 50ha. For a site area of 1.2 ha, the calculated greenfield runoff rate (Q_{bar}) is 4.4l/s.

3.3 Surface Water Discharge Location

Based on open-source topography, the Site drains towards the north and east of the Site. As shown in the GPR utility survey in Figure 8, there are existing manholes and gullies on site. Therefore, as the flows are attenuated to greenfield runoff in the design, it is proposed that the attenuated runoff is discharged into the existing surface water manhole located towards the northern end of the Site, by the site entrance, with a labelled cover level of 10.05 in Figure 8. This existing manhole has been included in the Drainage Concept Design Layout Drawing (Appendix A.2) as manhole SW6.

This proposed discharge point (manhole SW6) has been assumed to connect via MH 4502 (Figure 7) into the TW surface water sewer system, and into Pymmes Brook. TW manhole MH 4502 has been included in the Drainage Concept Design Layout Drawing (Appendix A.2) as manhole TW1.

3.4 Simple Index Approach

For water quality risk management, the Simple Index Approach (SIA) is one of the design method outlined in Table 26.1 of the SuDS Manual C753 that characterises pollution hazards using indices based on land use and mitigation indices based on the drainage approach. To deliver adequate treatment, the pollution mitigation components chosen should have a total index equivalent or exceeds the pollution hazard index.

The demolition phase of the Site can be classed as 'sites with heavy pollution' land use as per definitions from Table 26.2 of the SuDS Manual C753, with 'high' pollution hazard level, and the pollution hazard indices have been summarised in Table 3 below. Following the drainage strategy above, the SIA mitigation indices have been summarised in Table 4 below.

Table 3 - Drainage Simple Index Approach Pollution Hazard Indices

Land Use	TSS	Metals	Hydrocarbons
<i>Sites with heavy pollution (eg 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</i>	0.8	0.8	0.9
Total Pollution Index	0.8	0.8	0.9

Table 4 - Drainage Simple Index Approach Mitigation Indices

Component	TSS	Metals	Hydrocarbons
<i>Swale</i>	0.5	0.6	0.6
<i>Proprietary treatment system*</i>	0.8	0.6	0.99
Total Mitigation Index	0.9	0.9	1

Note: *SIA values for SPEL ESR Puraceptor (or equivalent)

3.5 Drainage Assets

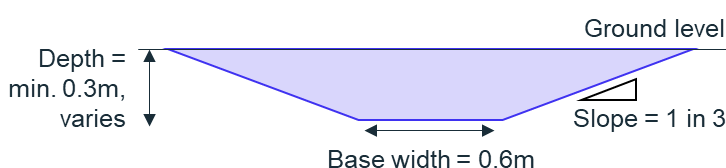
The location of the drainage assets detailed below can be found in the Drainage Concept Design Layout Drawing (Appendix A.2).

3.5.1 Assets for Collection, Conveyance, and Storage

3.5.1.1 Swale

Swales are proposed to intercept and collect flows that naturally drains in their direction, based on the slopes. Based on design criteria in SuDS Manual C753 Chapter 17, Figure 10 shows an initial swale dimension.

Figure 10 - Schematic of Proposed Swale Dimensions



3.5.1.2 Pipes and Manholes

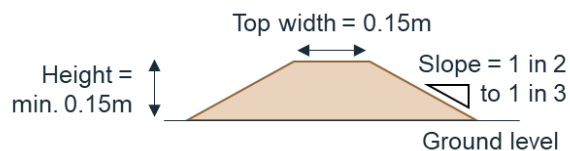
New pipes are proposed to:

1. Connect the downstream end of the swale to the existing manhole where a discharge flow control is proposed; and
2. Connect this existing manhole to a new manhole to locate the vortex separator, before discharge into the existing TW surface water sewer.

3.5.1.3 Bunds

Soil bunds are proposed to hold back surface water runoff and avoid flooding areas beyond the site boundary, for events up to 1-in-100-year storm plus 20% climate change allowance. The bunds help store water during storm events, before slowly being released through the controlled outflow. Based on the “RP9: Earth Banks and Soil Bunds” guidance from GOV.UK, Figure 11 proposes an initial bund dimension. Additionally, to promote more sustainable use of soils on the construction site, it is recommended to consider constructing the bund using materials excavated for the swale on site.

Figure 11 - Schematic of Proposed Bund Dimensions



To reduce the design height of the bund and speed hump, an intermediary bund has been proposed to hold water for the upstream site areas (South). This design aims to attenuate flows from the upstream areas and maximise utilisation of the swale and bund storage in the southern end of the drainage network.

3.5.1.4 Speed Hump

To allow vehicular access into the Site during the demolition phase, a speed hump has been proposed to be located near the site entrance, moved slightly south to allow gates to fully open. A typical speed hump is specified to 0.1m height. Additionally, the speed hump is proposed to connect to the adjacent bunds, to ensure that no water leaks out of site for the design return period. Furthermore, the soil bund has been proposed to be constructed higher than the speed hump, so in the event of exceedance, the flow route is north towards the road, and not east to neighbouring lands in the direction of Pymmes Brook.

3.5.1.5 Headwall

Two headwalls have been proposed to be located:

3. By the intermediary bund, where the first flow control is to be located (see Section 3.5.2.1); and
4. By the swale/ pipe interface, towards the north of the Site.

3.5.2 Assets for Flow Control

3.5.2.1 Orifice

The first flow control is proposed to be a plate orifice, or equivalent, with a proposed flow rate of 20l/s.

3.5.2.2 Hydrobrake

The second flow control is to be a hydrobrake, or equivalent, to allow larger outlet size for low flows, and reduce risks of blockage. The proposed flow rate is 4.4l/s, equivalent to the greenfield runoff rate of the Site.

3.5.3 Assets for Treatment

3.5.3.1 Vortex Interceptor

A SPEL ESR Purceptor (or equivalent vortex interceptor) has been proposed to provide treatment for the site runoff pollution. In combination with the swale upstream, the total pollution mitigation index is higher than the total pollution hazard index, as demonstrated by Table 4 and Table 3 respectively. The vortex interceptor is to be located downstream of the second flow control, to minimise silt from entering and to have a controlled input flow.

4. Conclusion

This report supports Stage 3A Requirement 10 Surface Water Drainage for the NLRP, during the demolition phase. Following consultation with LBH, the drainage strategy proposed is to contain surface water within the Site for up to a 1-in-100-year storm plus 20% climate change allowance, and to limit discharge flow to the greenfield runoff rate. Having reviewed options of techniques for surface water management for the 1.2ha site, the proposed measures include the use of swales, pipes and manholes, bunds and speed hump, headwalls, flow controls, and vortex interceptor. The flow and pollution mitigation measures are as per design standards, and the design also encourages the reuse of soil on site and prioritises SuDS where appropriate.

5. Key Risks and Assumptions

The following risks and assumptions are highlighted to consider in the following stages of design:

- The surface water drainage design in this report was based on open-source topography. There is a risk that slopes present on site are not consistent or steep enough to convey water, and will need to be investigated in the detailed design stage. Potentially, some light surfacing grading may be required to ensure the design is compliant with existing elevations on site.
- The proposed discharge connection point is based on the utility survey undertaken in October 2023, and the associated drawings that indicate the existing manhole on site connects into the existing manhole located on the road.
- The assumption that the drainage infrastructure will remain unaffected and clear during the demolition phase was accepted by LBH. However, it is noted that it is the responsibility of the Contractor to ensure drainage continues to function as required during the works.
- The drainage proposed in this report has been assumed to only support the Site under the temporary requirements, i.e. during demolition and remediation, with the understanding that a final drainage solution will be developed and submitted under Stage 3B, with the current drainage system likely to be removed. This approach has been accepted by LBH.
- The proposed design assumes that the client does not need the Site to stay dry during the demolition phase, and as such, the on-site surface water drainage has been designed to no surcharge for a 1-in-1 year storm.
- The concrete base of existing structures on site has been assumed to be excavated as part of the demolition, thus only soil will remain on site.

APPENDICES

Appendix A. Drawings

A.1 Drainage Plan for ODSE Compound 1 Tottenham (PN/CSED/8172)

Source: Appendix B.3, Page 4 of Document 5.3: Flood Risk Assessment – National Grid (North London Reinforcement Project) Order. Application Reference: EN020009. (2012).



A.2 Drainage Concept Design Layout (5224802-ATRL-HDG-XX-SK-CD-000001)









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- Surface Water Drainage
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