Flood Risk Assessment & Drainage Strategy

Title	Graven Hill, Bicester
Client	LNT Construction
Location	Land off Graven Hill, Bicester, Oxfordshire, OX26 6HG
Project number	24-0303
BIM reference	GHBO-BSP-XX-XX-T-W-0001-P05_Flood_Risk_Assessment
Date	03 FEB 2025

Authorisation Sheet & Revisions Record

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Project Title:	Graven Hill, Bicester
Client:	LNT Construction
Location:	Land off Graven Hill, Bicester, Oxfordshire, OX26 6HG
Document Reference:	GHBO-BSP-XX-XX-T-W-0001-P04_Flood_Risk_Assessment
Office Address:	BSP Consulting, 12 Oxford Street, Nottingham, NG1 5BG
Telephone No:	0345 413 4000

Rev:	Issue Date:	Description:	Prepared:	Checked:	Authorised:
P01	17/07/2024	Initial issue	MG	TH	TG
P02	18/07/2024	Minor amendments following client comments	MG	TH	TG
P03	01/08/2024	Inclusion of the updated ground investigation	MG	TH	TG
P04	11/10/2024	Drainage strategy amendments	TH	TG	TG
P05	03/02/2025	Update to surface water drainage strategy	MG	TH	TG

MG	Matthew Genn BSc (Hons) MSc	m.genn@bsp-consulting.co.uk Senior Flood Risk Engineer
TH	Thomas Hall MA (Hons) MSc	t.hall@bsp-consulting.co.uk Flood Risk Engineer
TG	Tony Goddard BEng (Hons) CEng MICE	t.goddard@bsp-consulting.co.uk Director

Contents

Executive Summary

Introduction	BSP Consulting has been commissioned by LNT Construction to undertake a Flood Risk Assessment and Drainage Strategy for a proposed residential care home on land off Graven Hill in Bicester, Oxfordshire. This Flood Risk Assessment has been prepared in accordance with the Technical Guidance to the National Planning Policy Framework.
Existing Site Conditions	The site is currently a vacant development plot that is primarily an open grassland area, with a compound to store excess spoil for the construction of earlier phases of the wider Graven Hill development site. An updated topographical survey of the site was undertaken in March 2024, following archaeological survey work which removed the topsoil from across the site, and the construction of a new site access road in the south-west corner. Levels are shown to fall from the south-west corner at approximately 68.80m AOD, down a level of 67.30m AOD in the north-east site corner.
Development Description	The development proposals are for a 66-bed residential care home with associated car parking, soft landscaping, with access provided from the newly constructed access road in the south-west corner.
Definition of Flood Hazard	The only source of fluvial flooding locally is the Langford Brook, an EA Main River located approximately 250m to the north. Given its relative distance from the site, it is not deemed to pose a significant flooding risk. There is also an unnamed watercourse which runs adjacent to the western site boundary, but this also does not pose any risk to the proposed development.
Probability (Rivers/fluvial)	The EA Risk of Flooding from Rivers and Sea mapping indicates that the proposed development site has less than a 1 in 1,000 annual probability of flooding from rivers or the sea (Flood Zone 1).
Climate Change	The implications of climate change for future rainfall intensity have been considered in this assessment. Based on the Environment Agency datasets, the peak rainfall intensity is anticipated to increase by up to 40% by the 2070s epoch. The appropriate mitigation measures have been incorporated within the proposed drainage design.
Planning Context	The technical guidance to the NPPF states that developments of a more vulnerable category such as the proposed residential care home are deemed to be appropriate within Flood Zone 1, without being subject to the application of the Sequential Test.
Off-Site Impacts	Any increase in surface water runoff generated by the development will be discharged offsite at the agreed discharge rate via the use of below ground attenuation and a flow

	control device on-site. Therefore, the development will not increase flooding adjacent to or downstream of the site for the lifetime of the development.
Residual Risks	The investigations conducted as part of this flood risk assessment and flood risk management measures proposed have demonstrated that the development will be safe, without increasing flood risk elsewhere.
Recommendations	• The finished floor level (FFL) of the proposed care home, and external ground levels will be set at a level of **68.00m AOD.** This is to allow for a reasonable volume of fill to restore ground levels on-site, whilst also allowing a gravity discharge into the unnamed watercourse adjacent to the western boundary. • The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings. • Based on the renewed soakaway test results, the use of soakaway or other infiltration features are not deemed to be viable on-site. • It is proposed to restrict surface water runoff to the equivalent discharge rates for the 1 in 2 year, 1 in 30 year and 1 in 100 year storm events including an allowance for future climate change, based on the proposed impermeable surface area from the development. A pumped discharge shall look to be made into the unnamed ordinary watercourse along the western site boundary. This is in accordance with the initial discussions undertaken with the LLFA to reach agreement on the proposed offsite discharge rates. • On-site attenuation will be provided by a combination of a below ground tank, and permeable paving with sub-base storage in the car parking area. This will provide a total storage volume of **253m^3**. • Surface water treatment will be provided by the use of permeable paving and filter drains along the perimeter of the proposed care home building. • Foul flows are to be discharged offsite via an existing connection into an adopted 300mm foul sewer that runs along the western site boundary. It is understood that a Section 106 agreement was reached with Thames Water (TW) for the previous development proposals, and it is advised that further discussions are undertaken with them to confirm the proposed foul connection strategy.

1.0 Introduction

1.1 Terms of Reference

1.1.1 BSP Consulting has been commissioned by LNT Construction to undertake a Flood Risk Assessment and Drainage Strategy for a residential care home development on land at Graven Hill in Bicester, Oxfordshire.

1.1.2 This Flood Risk Assessment has been prepared in accordance with the Department for Communities and Local Government (DCLG) Planning Practice Guidance website section on 'Flood Risk and Coastal Change' and the Site-Specific Flood Risk Assessment Checklist.

1.1.3 This report has been produced on behalf of the Client, LNT Construction, and no responsibility is accepted to any third party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of BSP Consulting. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

1.2 Legislation & Guidance

National Planning Policy Framework

1.2.1 The National Planning Policy Framework (NPPF) was published on 27 March 2012, with the latest update published in December 2023.

1.2.2 Planning Practice Guidance to the NPPF regarding Flood Risk and Coastal Change has been published and this site-specific Flood Risk Assessment is written in compliance with this guidance.

1.2.3 The NPPF, and supporting technical guidance, can be downloaded free of charge from the internet at the following link:

http://www.communities.gov.uk/publications/planningandbuilding/nppf

Flood & Water Management Act

1.2.4 The Flood & Water Management Act (F&WMA) was passed in 2010 and aims to reduce the flood risk associated with extreme weather, compounded by climate change. This act established the EA as responsible for flood risk related to Main Rivers. In this instance, Oxfordshire County Council (OCC) as Lead Local Flood Authority (LLFA), are responsible for local sources of flood risk (that being from ordinary watercourses, surface water run-off and groundwater). As Local Planning Authority, Cherwell District Council (CDC) as due regard for drainage and flood risk in accordance with local and national guidance and responses from statutory consultees.

2.0 Background Information

2.1 Site Details

2.1.1 Figure 2.1 below indicates the location of the development site. A range of sources have been used to assess the local topography, local watercourses, and current site use.

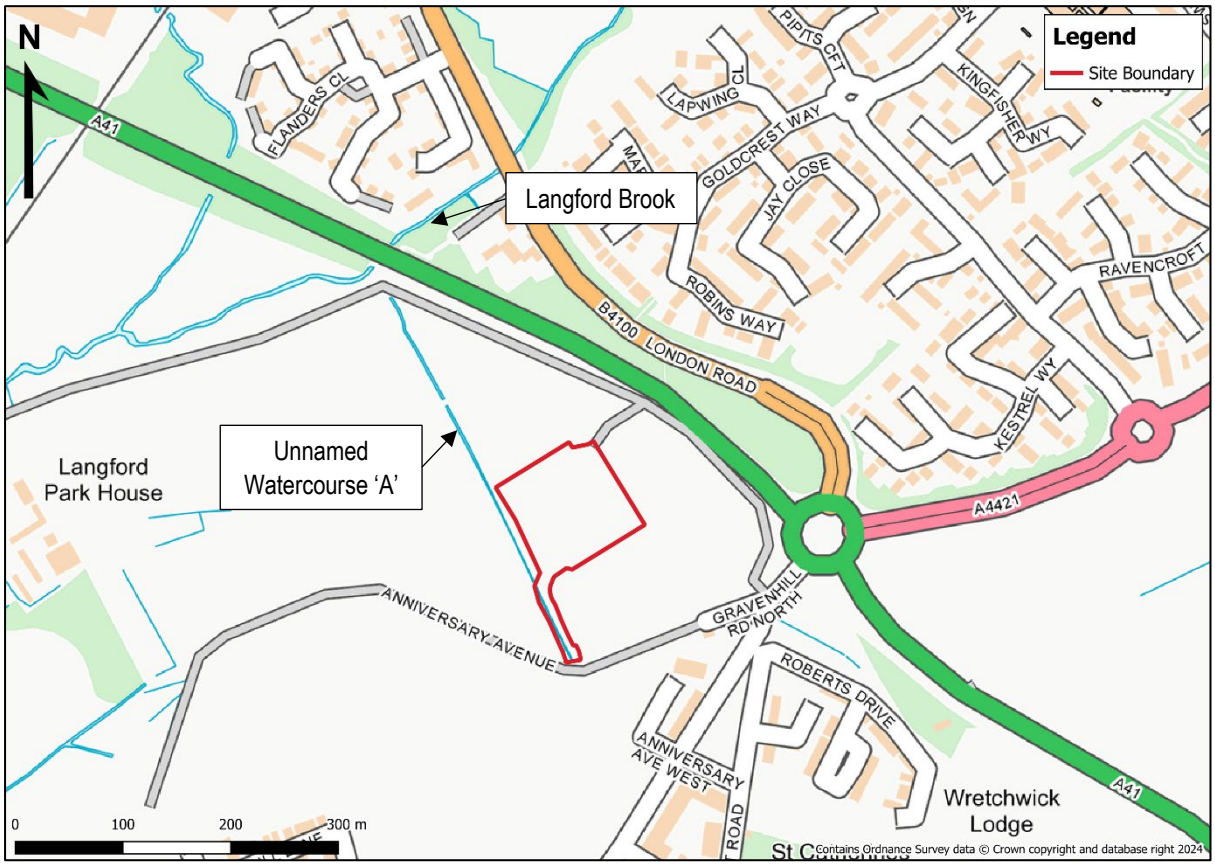

Figure 2.1 Graven Hill, Bicester – Site Location Plan

2.1.2 The proposed development site is located at the northern edge of the Graven Hill village development adjacent to the A41, south of Bicester. The site is centred on OSNGR 458886E, 221246N, and occupies an area of approximately 1.05ha.

2.1.3 The site is bound by greenfield land to the north, Graven Hill and the A41 to the north-east and east, a large detention feature that serves the ongoing development to the south and recently constructed commercial and industrial units off Anniversary Avenue to the west.

2.1.4 A site walkover survey was undertaken by Calabrian in July 2024, in which it was observed that the site is a vacant development parcel that is devoid of vegetation and other surface coverings, with the exception of a thin strip of asphalt along the eastern site boundary, and a low brick wall in the south-

central area of the site. A heavily vegetated open watercourse was also observed on the western boundary.

2.1.5 A topographical survey of the wider Graven Hill was originally undertaken by MK Surveys in May 2015. The survey showed that in the area of the site, there is a slight fall from the access off Anniversary Road in the southwest at approximately 68.90 m AOD down to the north-east corner at 67.30m AOD. There is also a slight fall towards the north-west corner, near to an existing land drain which runs along the western site boundary.

2.1.6 Since the 2015 survey was undertaken, archaeological survey work was undertaken on-site in which the topsoil was removed across the site, with on-site elevations being lowered by up to 700mm in comparison to original surface level, leaving bare ground across the site with raised sewer manhole features. A renewed topo survey was conducted by MK Surveys in March 2024, which show that levels continue to fall from the newly constructed access road in the south-west down at 68.80m AOD, down to the north-east corner at 66.85m AOD.

2.1.7 A copy of the updated topographical survey is provided in **Appendix A** for reference.

Table 2.1: Overall Catchment Context and Local Watercourse Classifications

Classification	Name	Description
Main Rivers	Langford Brook	An EA Main River located approximately 250m to the north of the site that drains Bicester and the surrounding area and continues to the south where it joins the River Ray near Merton.
Ordinary Watercourses	Unnamed Watercourse 'A'	There is an unnamed watercourse which flows adjacent to the western site boundary, and is a tributary of the Langford Brook.
Manmade Watercourses	N/A	There are no manmade watercourses within the vicinity of the site.

2.1.8 The locations of the above watercourses are indicated on Figure 2.1 above.

2.2 Approach to the Assessment

2.2.1 This study has been supplemented by information from the Environment Agency (EA), Thames Water (TW) and additional information contained on the British Geological Society (BGS) website, the DEFRA MagicMap website and the Cranfield Soil and Agrifood Institute Soilscapes website.

2.2.2 This assessment seeks to draw together the relevant data information from these sources and to collate this with the findings of our investigations and discussions to assess the flood risk and drainage strategy for this site.

3.0 Flood Risk Assessment

3.1 Development Description and Planning Context

3.1.1 The development proposals are for a residential care home with sixty-six beds, and associated car parking, access from the new constructed access road in the south-west, landscaping, and all other associated infrastructure. The proposed site plan is included in **Appendix B**.

3.1.2 The local area benefits from a local Strategic Flood Risk Assessment. This assessment is the Cherwell Level 1 SFRA, which was updated in May 2017, and includes mapping of the fluvial flooding risk across Cherwell. The accompanying mapping notes the site to fall within Flood Zone 1.

3.1.3 In accordance with the NPPF, the proposed residential care home use falls under the **more vulnerable** category in terms of flood risk.

3.2 Sequential and Exception Tests

3.2.1 The Sequential Test is designed to steer development towards areas of lower flood risk and is required to be completed for development within Flood Zone 2 and 3. As the site is located within Flood Zone 1 the Sequential Test is not required.

3.2.2 The Exception Test is designed to require evidence of how flood risk will be managed on the proposed development site, ensuring that it is safe for its lifetime and will not increase flood risk elsewhere. Table 3.1 below indicates whether developments, based on their vulnerability classification, are permitted within each Flood Zone and whether the Exception Test is required. The NPPF states that developments of the more vulnerable category are suitable within Flood Zone 1, and so does not require either the Sequential or the Exception Test.

Table 3.1: Flood Risk Vulnerability and Flood Zone Compatibility (Source: NPPF)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b Functional Floodplain	Exception Test Required	✓	✗	✗	✗

3.3 Definition of Flood Hazard

The potential sources of flooding in the vicinity of the site are as detailed below:

Historic Flooding

3.3.1 The Environment Agency's Historic Flood Map indicates that the development site has not flooded previously. The dataset shows the maximum extent of all individual recorded flood outlines that have occurred as a result of flooding from rivers, the sea and groundwater sources since records began 1946. The dataset does not account for flooding from other sources, such as sewer flooding or surface water flooding, nor is it exhaustive as it may not include all previous flooding incidents and does not provide information regarding event dates. However, the dataset does provide an insight into the potential for flooding from nearby sources.

Fluvial Flood Risk

3.3.2 The EA Risk of Flooding from Rivers and Sea mapping indicates that the proposed development site has less than a 1 in 1,000 annual probability of flooding from Rivers and Sea. This map shows the indicative extent of the natural floodplain, if there were no flood defences or certain other manmade structures, such as surface water sewers, and channel improvements.

3.3.3 The only source of fluvial flooding locally is the Langford Brook, an EA Main River, which is located approximately 250m to the north of the site. Given the relative distance from the site, the Langford Brook does not present a risk of flooding to the site.

Tidal Flood Risk

3.3.4 The site is not located within a tidally influenced area, therefore, the residual risk to the site is deemed to be minimal.

Surface Water Flood Risk

3.3.5 The EA publish mapping which shows the route of surface water runoff across the ground surface following an intense rainfall event. Figure 3.1 below shows an extract of the Risk of Flooding from Surface Water mapping and indicates that most of the site has a very low risk (<0.1% AEP) of surface water flooding. The exception being a small area of 'low' risk flooding in the north of the site, which corresponds to a localised topographic low point.

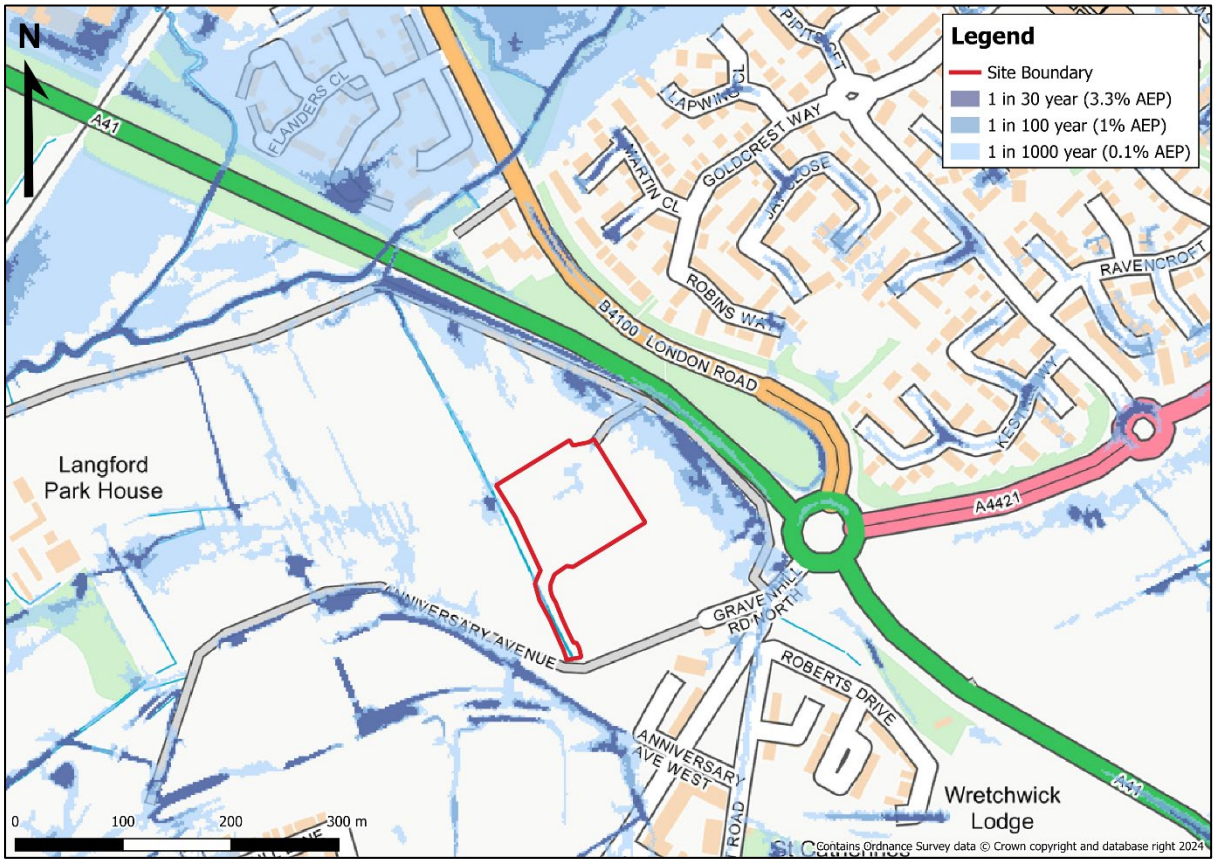

Figure 3.1 Graven Hill, Bicester – Risk of Flooding from Surface Water (Source: EA)

3.3.6 The site walkover observed that there was ponding of runoff within the northern portion of the site. This is attributed to the lowering of on-site levels, which has created a topographic low point, and allowed for runoff to collect in that part of the site. This is further exacerbated by the poor drainage conditions in the underlying soils, and no existing outfall into the watercourse on the western boundary.

3.3.7 The overall risk of surface water flooding to the site is considered to be low, given that the indicated surface water flood risk appears to originate within and be contained within the site. It is anticipated that this can be adequately mitigated by the raising of ground levels, and the provision of a surface water drainage system for the development that would capture and sufficiently drain any surface water runoff generated on-site without issue. This is discussed in further detail in the sections of the report below.

Flood Risk from Ground Water

3.3.8 The British Geological Survey's Geology of Britain mapping indicates that the site is situated upon bedrock geology consisting of Peterborough Member – Mudstone, with no and superficial deposits recorded. Mudstones are classed as nonproductive aquifer, with minimal groundwater present.

3.3.9 The local SFRA includes mapping of Cherwell, which shows areas that are deemed to be susceptible to groundwater flooding on a 1km^2 grid scale. This mapping indicates that the site falls within an area that has a low (>=25% <50%) susceptibility to groundwater flooding. It should be noted that the mapping is indicative in nature and only shows the relative proportion of each grid square where groundwater may emerge at the surface. This can be influenced by the presence of local watercourses and potentially suggest a heightened rate of risk of groundwater flooding.

3.3.10 As part of the recent site investigation, six exploratory boreholes were excavated across the site, and it was noted that no significant inflows of groundwater were encountered during the survey works.

3.3.11 Based on the information from the above sources, the site is considered to have a low risk of flooding from groundwater sources.

Flood Risk from Sewers and Infrastructure

3.3.12 The local sewers are operated and maintained by Thames Water (TW). A commercial drainage and water enquiry was conducted in December 2022 to confirm the presence of any adopted water or sewer assets either within or close to the site. The available records show a 225mm foul sewer which runs along the western site boundary before it crosses the unnamed watercourse to manhole 8201 and continues to the north. A copy of the sewer record plan is provided as part of the enquiry response is included in **Appendix C**.

3.3.13 Murphy Geospatial undertook a utilities and CCTV survey in April 2024, a copy of which is provided in **Appendix D**. The survey found that the Thames Water foul sewer is actually a 300mm diameter pipe. In addition to evidence of existing foul and surface water drainage within the site, although there is limited detail of where these networks drain to.

3.3.14 The survey also recorded two surface water manhole features in the north-west site corner, although it is understood that the manholes are actually foul in nature and have a separate connection to the Thames Water sewer at manhole 8201.

3.3.15 TW have not raised any concerns regarding existing sewer flooding issues or capacity problems with the adopted foul sewer.

3.3.16 The EA's Flood Risk from Reservoir mapping indicates that the site lies outside of the predicted maximum flood extents in the unlikely event that all upstream large, raised reservoirs and dams simultaneously fail and release the water they hold; both on a 'dry day', if reservoir flooding were to occur when river levels are at normal levels, and on a 'wet day', should reservoir breach occur if a river is already experiencing an extreme natural flood. As such, the site is not considered to be at risk of flooding from reservoirs.

3.3.17 The site is also not in close proximity to any Manmade Watercourses such as canals, reservoirs or wet process industry works.

3.3.18 The sewers and infrastructure flood risk source can therefore be discounted as a significant source of flood risk to the site.

3.4 Climate Change

3.4.1 Climate change is recognised as a factor for consideration in terms of its effects on flood risk. In line with the latest update to the planning practice guidance in the NPPF on Flood Risk and Coastal Change, it has been assumed that the proposed development will have a minimum lifetime of 100 years. As such, to assess the effects of climate change, the 2070s epoch has been assessed for peak rainfall intensity.

3.4.2 The implications of climate change should be considered in relation to surface water drainage. Guidance from the EA advises that the upper end allowances for both the 1 in 30-year (3.3% AEP) and 1 in 100-year (1% AEP) events should be assessed. The development should be designed to ensure that there is no increase in flood risk elsewhere and the development will be safe from surface water flooding during the 1 in 100-year event when the upper end allowance for climate change is applied. In this instance, peak rainfall intensity for more vulnerable development uses, such as the proposed care home, within the Cherwell and Ray Management Catchment are estimated to increase by 35% for the 3.3% AEP event and 40% for the 1% AEP event. Therefore, it is recommended that the upper end allowance of 40% is applied to design rainfall intensity to allow for the potential implications of climate change.

3.5 Detailed Development Proposals

3.5.1 The proposed development and vulnerability classification are discussed in Section 3.1 above.

3.5.2 The technical guidance to the NPPF states that developments of a more vulnerable category such as the proposed care home use are appropriate within Flood Zone 1, without being subject to the application of the Sequential Test.

4.0 Flood Risk Management & Drainage Strategy

4.1 Surface Water Flood Risk Mitigation

4.1.1 The development proposals are for the construction of a residential care home, together with associated car parking, landscaping, and access from the newly constructed access road in the south-west site corner.

4.1.2 As part of the development design, it is proposed to set finished floor levels (FFLs) of the care home building, and the external levels of the car parking area, to an elevation of **68.00m AOD**. This is to allow for the ground levels on-site to be restored to an acceptable level in terms of the volume of fill required. In addition to allowing for a gravity discharge into the unnamed watercourse to be achieved, this removes the need for surface water pumping on-site.

4.1.3 The design of the on-site levels also ensures that any surface water flow paths generated by the hardstanding surfaces on-site are conveyed away from the proposed care home building and towards the watercourse, while ensuring that the surface water flood risk is not increased elsewhere.

4.2 Surface Water Drainage

Sustainable Drainage Systems

4.2.1 Part H of the Building Regulations 2010 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

a) an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable.

b) a watercourse, or, where that is not reasonably practicable.

c) a sewer.

4.2.2 It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

Infiltration Based Systems

4.2.3 The British Geological Survey's Geology of Britain mapping indicates that the site is situated upon bedrock geology consisting of Peterborough Member – Mudstone, with no superficial deposits recorded.

4.2.4 The Cranfield Soil and Agrifood Institute's Soilscapes mapping indicates the majority of the site to be situated on soils categorised as Soilscape 18: slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils.

4.2.5 Based on the desktop review, it is deemed unlikely that permeable ground conditions are present at the site. On-site soakaway testing was conducted by Harrison Geotechincal Engineering in April 2021, in which six soakaway pits (SA01 – SA06) were excavated to depths of 2.1m below ground level (bgl) to assess permeability across the soil strata. The testing found very poor infiltration charactertisics across the site, with only one pit (SA06) being able to complete all three required tests that resulted in a poor infiltration rate of 4.88×10^{-7}m/s. An extract of the soakaway testing is provided in **Appendix E**.

4.2.6 Calabrian undertook renewed soakaway testing in accordance with BRE 365 at two of the exploratory boreholes (TP105 and TP106). It was observed after a period of four hours that the water level within each borehole had not fallen, and so it was not considered suitable to calculate an infiltration rate.

4.2.7 Based off both the desktop review and renewed soakway testing, the use of infiltration-based systems such as soakaways has been ruled out as the preferred method for surface water disposal from the proposed development.

Open Watercourses

4.2.8 Unnamed Watercourse 'A' along the western site boundary is suitably located to receive a direct surface water discharge from the site and as such, is the proposed surface water outfall from the site.

Sewers

4.2.9 As it is proposed to discharge surface water runoff to Unnamed Watercourse 'A,' it will not be necessary to discharge surface water to a sewer.

SuDS Option Feasibility

4.2.10 A range of SuDS options have been considered for use within the context of the proposed development site, in-line with CIRIA guidance. Table 4.1 provides a summary of the options considered for this site.

Table 4.1: Sustainable Urban Drainage Systems Options

SuDS Category	SuDS Technique	Viability	Explanation
Infiltration	Infiltration Trenches	✗	Due to the underlying ground conditions, as shown by the on-site soakaway testing, infiltration features are not deemed to be suitable.
	Infiltration Basins	✗	
	Soakaways	✗	
	Bioretention/Filter Strips	✗	
Filtration	Bioretention/Rain Gardens	✗	Due the existing levels in part of the site, it is proposed to use filter drains around the perimeter of the care home building to help capture and convey runoff. This will also provide a further element of surface water treatment.
	Filter Strips	✓	
Source Control	Green Roofs	✗	The development proposals include a pitched roof for the care home building, which is not conducive for the use of a green roof.
	Rainwater Harvesting	✗	Due to nature of the proposed development, the scope for rainwater harvesting is limited. As such, other SuDS options are more favourable than rainwater harvesting.
	Pervious Pavements	✓	Pervious paving with sub-base storage is proposed for the car parking spaces. This will provide an initial stage of treatment and attenuation of runoff from the car park area.
Conveyance	Swales	✗	There is limited available space on-site to accommodate these features within the drainage design.
	Filter Drains	✗	
	Channels/Rills	✗	
Retention/ Detention	Detention Basin	✗	Due to the on-site levels and spatial constraints, the preferred solution is to use below ground geo-cellular storage located beneath the soft landscaping area to the west of the proposed care home building. A restricted discharge shall be made into the unnamed watercourse along the western boundary. All surface water runoff should drain via a suitable SuDS feature prior to the tank.
	Retention Pond	✗	
	Subsurface Storage	✓	
	Wetlands	✗	

Runoff Assessment

4.2.11 The ICP SUDS and IH124 (Flood Studies Report) methods have been used to calculate the equivalent greenfield runoff rate ($QBAR_{RURAL}$), which are detailed overleaf.

$QBAR_{RURAL} = 0.00108 \times (0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$

Where
AREA = Area (ha)
SAAR = Standard Average Annual Rainfall (mm, 1941-1970)
SPR = Standard Percentage Runoff Coefficient

4.2.12 With a total site area of 1.05ha and using Flood Studies Report values for SAAR (675mm) and SPR (0.450), this results in a **$QBAR_{RURAL}$** rate of **4.4l/s** and discharge rates for the following return periods:

Rainfall Event	Runoff Rate (l/s)
1 in 1-year	3.8
1 in 30-year	10.0
1 in 30-year + 35% Climate Change	13.5
1 in 100-year	14.1
1 in 100-year + 40% Climate Change	19.7

4.2.13 A copy of the Greenfield runoff calculations is provided in **Appendix F**.

Return Period Design

4.2.14 The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings.

Discharge Rate

4.2.15 In accordance with DEFRA guidance, the peak surface water runoff rate for greenfield development sites should look to be restricted to the pre-development site where reasonably practicable. A previous agreement between the LLFA and EA for the wider Graven Hill site, in which the allowed discharge rate is set at 11l/s/ha, as outlined in the 2015 Sitewide Drainage Strategy. This agreement has been included in **Appendix G**, which allows for a restricted runoff rate of 2l/s/ha for the 1 in 1-year storm event and 11l/s/ha for the 1 in 100-year event. The EA confirmed that these rates would be acceptable on a pro-rata basis for the new catchment areas, which includes the site in this report. The discharge rate of

11l/s/ha for up to the 1 in 100-year plus 40% has therefore already been accounted for in the initial site-wide drainage strategy.

4.2.16 Further discussions have been undertaken with OCC, in its role as Lead Local Flood Authority, to reach agreement on the proposed discharge rate and surface water drainage strategy. In their consultation response (see **Appendix H**), it was stated that the discharge rate should be based on the proposed impermeable surface area of 0.296ha, rather than the total site area of 1.05ha. The revised runoff calculations are also provided in Appendix F for reference.

4.2.17 OCC also specified that the discharge rates for the site must not exceed the greenfield rate for the equivalent storm event and should include a range of storm events including the 1 in 100 year plus climate change event. This would mitigate against any potential flooding risk downstream, as well as adhering to the required local policy.

4.2.18 To achieve the revised discharge rates would result in a significant increase in the onsite attenuation volume required. The site also has constraints from a landscaping and BNG perspective, which limits the available space onsite to accommodate a below ground geocelluar tank. Therefore, it is proposed to pump surface water runoff into the ordinary watercourse on the western site boundary at the equivalent greenfield rates for the 1 in 2 year, 1 in 30 year and 1 in 100 year plus climate change events, respectively.

Drainage Proposals – Main Strategy

4.2.19 The required surface water attenuation volume is to be primarily provided by below ground attenuation in the form of geo-cellular crates located to the west of the main care home building. This will be supplemented by sub-base attenuation beneath permeable paved surfaces within the car parking area.

4.2.20 The tank has been provisionally sized to the required design standard of the 1 in 100 year plus 40% climate change storm event, with a shallow depth of 1.2m and a gradient of 1 in 500. The approximate attenuation volume provided by the tank is **226m^3**.

4.2.21 At the downstream end of the tank feature, there will be a private surface water pumping station that will pump surface water runoff offsite into the unnamed watercourse at the proposed discharge rates.

4.2.22 As discussed, there will be permeable paving beneath the car parking area which has been designed to provide an additional **27m^3** of surface water storage for runoff generated by the car park and access road, in addition to providing an initial stage of surface water treatment prior to the below ground attenuation tank.

4.2.23 Filter drains at appropriate locations around the main building and car parking area have also been incorporated into the drainage design to provide an additional treatment train for runoff generated by these areas.

4.2.24 An initial surface water drainage network has been constructed in Info Drainage to initially size the below ground tank, filter drain and permeable paving features, to assess the performance of the proposed on-site network and verify the required attenuation volume. The model was simulated for a range of return periods and storm durations, including the required future climate change allowances.

4.2.25 The results showed that the drainage network performed well across all simulated storm events, with no significant flooding observed across the network. It is anticipated that as the detailed drainage design progresses, then the modelled surface water drainage network will be further refined, and any modelled flooding issues will be resolved.

4.2.26 Full details of the InfoDrainage surface water drainage network including the proposed attenuation and SuDS features is provided in **Appendix F**.

4.2.27 A drainage layout plan which shows the layout of the proposed drainage networks, the location of the below ground attenuation tank and permeable paving areas, as well as the respective outfall locations for surface water runoff and foul flows has been prepared, a copy of which is also provided in **Appendix F**.

4.3 Water Quality

Simple Index Approach

4.3.1 In order to determine whether the proposed SuDS features for the development will be sufficient at removing pollutants from surface water runoff, the CIRIA SuDS Manual (2015) Simple Index Approach has been applied. This approach provides pollution hazard levels and indices to relevant pollutants based upon contributing hardstanding surfaces.

4.3.2 Table 4.2 overleaf provides an extract of the land use types and pollutant indices from the CIRIA SuDS Manual which are relevant to the proposed development.

Table 4.2: Pollution hazard indices for different land use classifications (Source: CIRIA SuDS Manual 2015)

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.2
Low traffic roads and non-residential car parking with infrequent change	Low	0.5	0.4	0.4

4.3.3 Based upon the above, the worst-case indices for the development are 0.5 (Total Suspended Solids), 0.4 (Metals) and 0.4 (Hydrocarbons). Table 4.3 below indicates the mitigation indices for different types of SuDS components, with only those relevant to the development included. Under the Simple Index Approach, in order to suitably mitigate surface water pollutants, the total combined indices for any SuDS components will need to be greater than the worst-case indices above. Where multiple SuDS components are proposed, the primary component is given its full indices, while subsequent component indices are applied with a factor of 50%.

Table 4.3: Indicative SuDS mitigation indices for discharges to surface water (Source: CIRIA SuDS Manual 2015)

Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Permeable Pavement	0.7	0.6	0.7
Filter Drain	0.2	0.2	0.2

4.3.5 Based upon the above, the permeable paving areas have mitigation indices of 0.7 (Total Suspended Solids), 0.6 (Metals) and 0.7 (Hydrocarbons), demonstrating that this component alone will be sufficient in mitigating surface water runoff pollution from the proposed development. Where further SuDS components are included in the development proposals these will offer even greater mitigation against surface water runoff pollution.

4.4 Maintenance

4.4.1 The proposed surface water drainage system will require routine maintenance to ensure it remains fully operational and effective. The on-site drainage including the respective pipe networks, below ground tank, permeable paving and filter drains will be maintained by a site management company. These features and should be inspected and maintained in accordance with the proposed maintenance schedule included in **Appendix F**.

4.5 Foul Water Drainage

4.5.1 A foul sewer connection will need to be sought for the proposed development, preferably using any existing connection points. The available sewer plans provided by Thames Water (see **Appendix C**), and utilities survey, show that there is a 300mm foul sewer that runs along the western site boundary. As discussed, it is understood that there is an existing connection between the surveyed foul drainage in the north-west site corner and the Thames Water sewer at manhole 8201.

4.5.2 As part of the previous development proposals, a Section 106 application was made to, and subsequently approved by, Thames Water for a proposed connection to be made into the adopted foul sewer at manhole 8201. It is advised that renewed discussions are undertaken with Thames Water to verify whether the agreed connection can continue to be used for the proposed care home site.

5.0 Off-Site Impacts

5.1.1 The proposed development will look to discharge surface water runoff at the agreed discharge rate, in line with the wider site drainage strategy. This is in comparison to the existing conditions in which it is assumed that runoff discharges into the unnamed watercourse at an unrestricted rate.

5.1.2 On-site attenuation in the form of a below ground tank and permeable paving is proposed to temporarily store runoff generated by the impermeable surfaces before it is discharged offsite. In addition, the inclusion of permeable paving and filter drains within the drainage design will provide a suitable surface water treatment train. Therefore, the development will bring about improvements to the surface water regime in the area and hence will not increase flooding adjacent to or downstream of the site for the lifetime of the development.

6.0 Overland Flow & Flood Routing Considerations

6.1.1 The routing of potential surface water runoff, should the capacity of the proposed drainage system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

6.1.2 Careful attention will need to be paid to the proposed site levels to ensure that overland flow routes are maintained, and localised low spots are not created.

7.0 Residual Risks

7.1.1 The investigations conducted as part of this flood risk assessment and flood risk management measures proposed have demonstrated that the development will be safe, without increasing flood risk elsewhere.

8.0 Recommendations

The following recommendations are made to ensure flood risk at this site is minimised:

- The finished floor level (FFL) of the proposed care home, and external ground levels will be set at a level of **68.00m AOD.** This is to allow for a reasonable volume of fill to restore ground levels on-site, whilst also allowing a gravity discharge into the unnamed watercourse adjacent to the western boundary.
- The proposed surface water drainage system should be designed to accommodate the 1 in 30-year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100-year plus climate change (40%) storm event on site without flooding any buildings.
- Based on the renewed soakaway testing results, the use of soakaways or other infiltration features are deemed not to be viable on-site.
- It is proposed to restrict surface water runoff to the equivalent discharge rates for the 1 in 2 year, 1 in 30 year and 1 in 100 year storm events including an allowance for future climate change, based on the proposed impermeable surface area from the development. A pumped discharge shall look to be made into the unnamed ordinary watercourse along the western site boundary. This is in accordance with the initial discussions undertaken with the LLFA to reach agreement on the proposed offsite discharge rates.
- On-site attenuation will be provided by a combination of a below ground tank, and permeable paving with sub-base storage in the car parking area. This will provide a total storage volume of **253m^3**.
- Surface water treatment will be provided by the use of permeable paving and filter drains along the perimeter of the proposed care home building.
- Foul flows are to be discharged offsite via an existing connection into an adopted 300mm foul sewer that runs along the western site boundary. It is understood that a Section 106 agreement was reached with Thames Water (TW) for the previous development proposals, and it is advised that further discussions are undertaken with them to confirm the proposed foul connection strategy.

Disclaimer

We would note that all comments made in this report are based on the sources stated in Section 1.1. This report and its recommendations are intended for the use of LNT Construction Ltd for the above site only.

Appendix A

Topographical Survey

Notes:

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR 0.999964 APPLIED.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.

Coordinate Table

Station	Description	Easting	Northing	Level
S1	Road Nail	458906.033	221302.860	67.501
S2	Road Nail	458927.971	221267.301	67.826
S3	Peg	458905.288	221206.432	68.188
S4	Peg	458865.073	221231.668	67.464
S5	Road Nail	458949.265	221343.581	67.243
S10	Peg	458870.476	221164.527	68.700
S11	Hilti Nail	458889.185	221097.122	69.668

TOPOGRAPHICAL KEY

GENERAL ABBREVIATIONS

SURVEY STATION
BANKING (TOP / BOTTOM)
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UPWARDS
TREES (SPREAD & GIRTH SHOWN TO SCALE)
GATE
KERB CHANNEL
ROAD UNKERBED
FOOTPATH
CHANGE IN SURFACE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
FOUL SEWER
SURFACE SEWER
BACK DROP (EXTERNAL)
BACK DROP (INTERNAL)
BUILDING
OPEN SIDED BUILDING
OVERHANG / CANOPY
GLASSHOUSE
CONTOUR
SPOT LEVEL
SONAR LEVEL
BORE HOLE
TRIAL HOLE

AIR CONDITIONING UNIT	ACU
AIR VALVE	AV
AVERAGE	Av.
BACK DROP	BD
BASE LEVEL	BL
BEACON / BEACON	BO
BOLLARD	BOL
BOLLARD LIGHT	BK
BRICK	BS
BUS STOP	CATV
CABLE TV COVER	CTG
CABLES TO GROUND	CP
CATCH PIT	CB
CONTROL BOX	CL
COVER LEVEL	CCB
CROSSING CONTROL BUTTON	CC
CYCLE PARKING HOUSE	DCH
DRAINAGE CHANNEL	DK
DROP KERB	EP
ELECTRICITY POLE	ER
EARTH ROD	FH
FLOWER PLANT	FL
FLOOR LEVEL	FW
FOOTPATH	GR
FOUL WATER	GV
GAS RISER	GY
GAS VALVE	GT
GULLY	IC
GRASS BED	IL
INSPECTION COVER	KO
INVERT LEVEL	LP
KERB OUTLET	MH
LAMP POST	MP
MANHOLE	NPV
MARKER POST	OBBM
NO HYPES VISIBLE	PT
ORDNANCE SURVEY BENCH MARK	PO
P-TRAP	PBOX
POST	RE
POST BOX	RIS
RODDING EYE	RWP
ROAD SIGN	RW
RAIN WATER PIPE	SB
RETAINING WALL	SG
SOFT BED	SWP
STOP COCK	SV
STOP COCK NAME PLATE	SP
STOP VALVE	SVP
SOIL PIPE	SW
SOIL VENT PIPE	TAC
SURFACE WATER	TP
TACTILE PAVING	TEL
TELECOM POLE	TCB
TELECOM INSPECTION COVER	TM
TELEPHONE CALL BOX	TOW
TICKET MACHINE	TL
TOP OF WALL	TWC
TRAFFIC LIGHT	THL
TRAFFIC LIGHT COVER	UTL
TIMES TABLE LEVEL	UTR
UNABLE TO LOCATE	UTS
UNABLE TO RAISE	VP
UNABLE TO SURVEY	WL
VENT PIPE	WM
WATER LEVEL	WO
WATER METER	WR
WASH OUT	WT
WATER RISER	
WATER TAP	

FENCE ABBREVIATIONS

BARBED WIRE FENCE	BWF
CLOSE BOARDED FENCE	CJB
CONCRETE PANEL FENCE	CPL
CORRUGATED IRON FENCE	CI
CHAIN LINK FENCE	CL
CHESTNUT PALING	CNP
IRON RAILINGS	IR
LARCH LAP FENCE	LJL
POST AND RAIL FENCE	PJR
POST AND WIRE FENCE	PJW
WIRE MESH FENCE	WM

Sheet Layout: (Not to Scale)

Revision	Description	Surv. by	Check. by	Appr. by	Date
1.	New access road added	SB	AG	JS	April 2024

0m 2 4 6 8 10 12 14 16 18 20 22

Topographical Survey

Client:

LNT Care Developments

Care Home Site
Graven Hill
Bicester
Oxfordshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:200	A0	1	March 2024

Project Number:	Rev:	Surveyed by:	Checked by:	Approved by:
33902	1	SB	AG	JS

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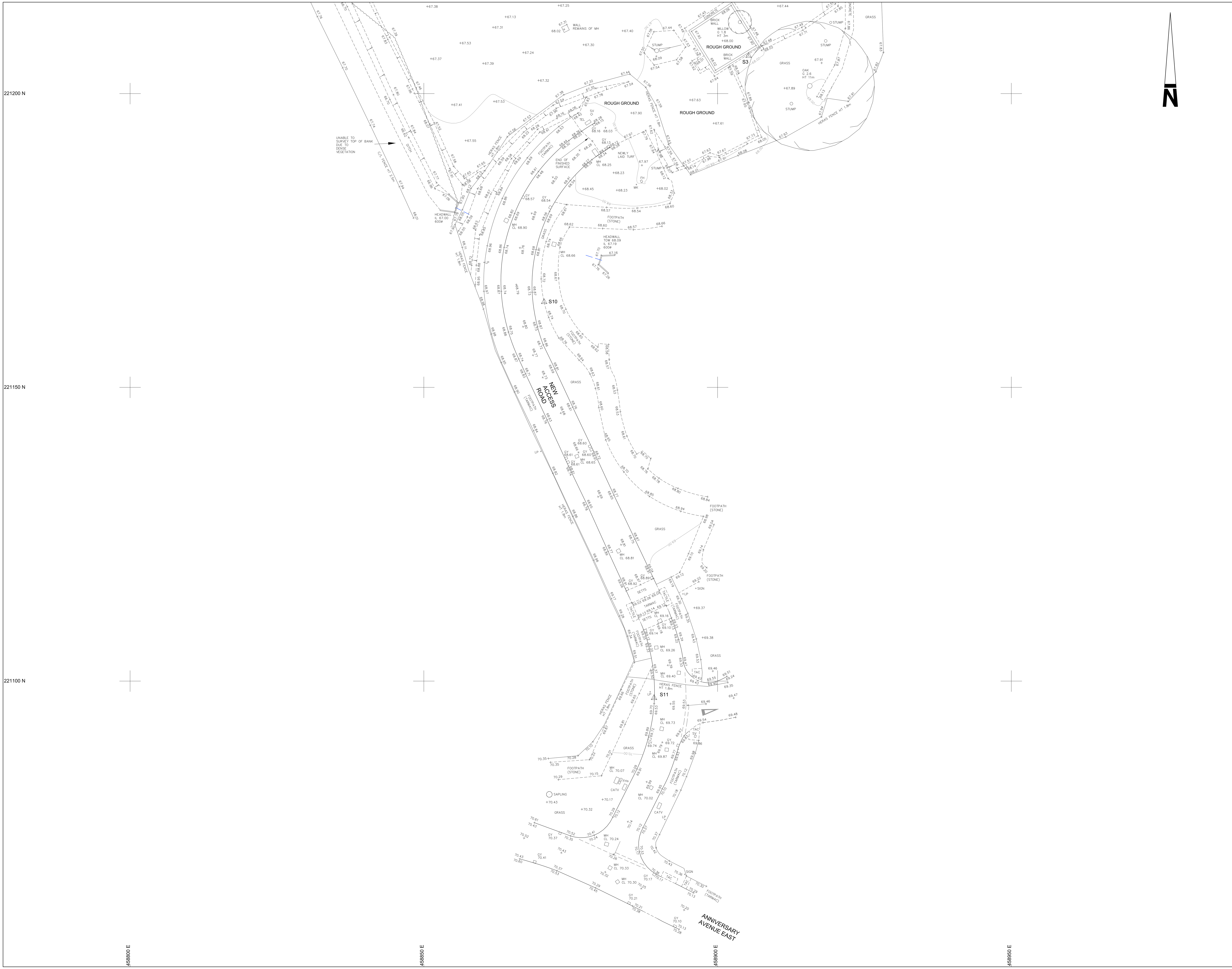

Notes:

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S10	Peg	458870.476	221164.527	68.700
S11	Hilti Nail	458889.185	221097.122	69.668

TOPOGRAPHICAL KEY

SURVEY STATION 5
BANKING (TOP / BOTTOM)
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UPWARDS
TREES (SPREAD & GIRTH SHOWN TO SCALE)
GATE
KERB CHANNEL
ROAD UNKERBED
FOOTPATH
CHANGE IN SURFACE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
FOUL SEWER
SURFACE SEWER
P-TRAP
BACK DROP (EXTERNAL)
BACK DROP (INTERNAL)
BUILDING
OPEN SIDED BUILDING
OVERHANG / CANOPY
GLASSHOUSE
CONTOUR 25.50
SPOT LEVEL + 127.13
SONAR LEVEL ○ 127.13
BORE HOLE BH
TRIAL HOLE TH

GENERAL ABBREVIATIONS

AIR CONDITIONING UNIT	ACU
AIR VALVE	AV
AVERAGE	Av.
BACK DROP	BD
BASE LEVEL	BL
BELISHA BEACON	BB
BOLLARD	BO
BOLLARD LIGHT	BOL
BRICK	BK
BUS STOP	BS
CABLE RISER	CR
CABLE TV COVER	CATV
CABLES TO GROUND	CTG
CATCH PIT	CP
CONTROL BOX	CB
COVER LEVEL	CL
CROSSING CONTROL BUTTON	CCB
DAMP PROOF COURSE	DPC
DRAINAGE CHANNEL	DCH
DROP KERB	DK
ELECTRICITY POLE	EP
EARTH ROD	ER
FIRE HYDRANT	FH
FLOOR LEVEL	FL
FOOTPATH	FP
FOUL WATER	FW
GAS RISER	GR
GAS VALVE	GV
GULLY	GY
HARD BED	HB
INSPECTION COVER	IC
INVERT LEVEL	IL
KERB OUTLET	KO
LAMP POST	LP
MANHOLE	MH
MARKER POST	MK
METER	MT
NO PIPES VISIBLE	NPV
ORDNANCE SURVEY BENCH MARK	OSBM
P-TRAP	PT
POST	PO
POST BOX	P.BOX
RODDING EYE	RE
ROAD SIGN	RS
RAIN WATER PIPE	RWP
RETAINING WALL	RW
SOFT BED	SB
STOP COCK	SC
STREET NAME PLATE	SNP
STOP VALVE	SV
SOIL PIPE	SP
SOIL VENT PIPE	SVP
SURFACE WATER	SW
TACTILE PAVING	TAC
TELECOM POLE	TP
TELECOM INSPECTION COVER	TEL
TELEPHONE CALL BOX	TCB
TICKET MACHINE	TM
TOP OF WALL	TOW
TRAFFIC LIGHT	TL
TRAFFIC LIGHT COVER	TLC
THRESHOLD LEVEL	THL
UNABLE TO LOCATE	UTL
UNABLE TO RAISE	UTR
UNABLE TO SURVEY	UTS
VENT PIPE	VP
WATER LEVEL	WL
WATER METER	WM
WASH OUT	WO
WATER RISER	WR
WATER TAP	WT

FENCE ABBREVIATIONS

BARBED WIRE FENCE	B/W	IRON RAILINGS	I/R
CLOSE BOARDED FENCE	C/B	LARCH LAP FENCE	L/L
CONCRETE PANEL FENCE	CPL	POST AND RAIL FENCE	P/R
CORRUGATED IRON FENCE	C/I	POST AND WIRE FENCE	P/W
CHAIN LINK FENCE	C/L	WIRE MESH FENCE	W/M
CHESTNUT PALING	CNP		

Sheet Layout: (Not to Scale)

1

2

Revision	Description	Surv. by	Check. by	Appr. by	Date
1	New access road added	SB	AG	JS	April 2024

0m 2 4 6 8 10 12 14 16 18 20 22

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Client:

LNT Care Developments

Care Home Site
Graven Hill
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Oxfordshire

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33902	1	SB	AG	JS

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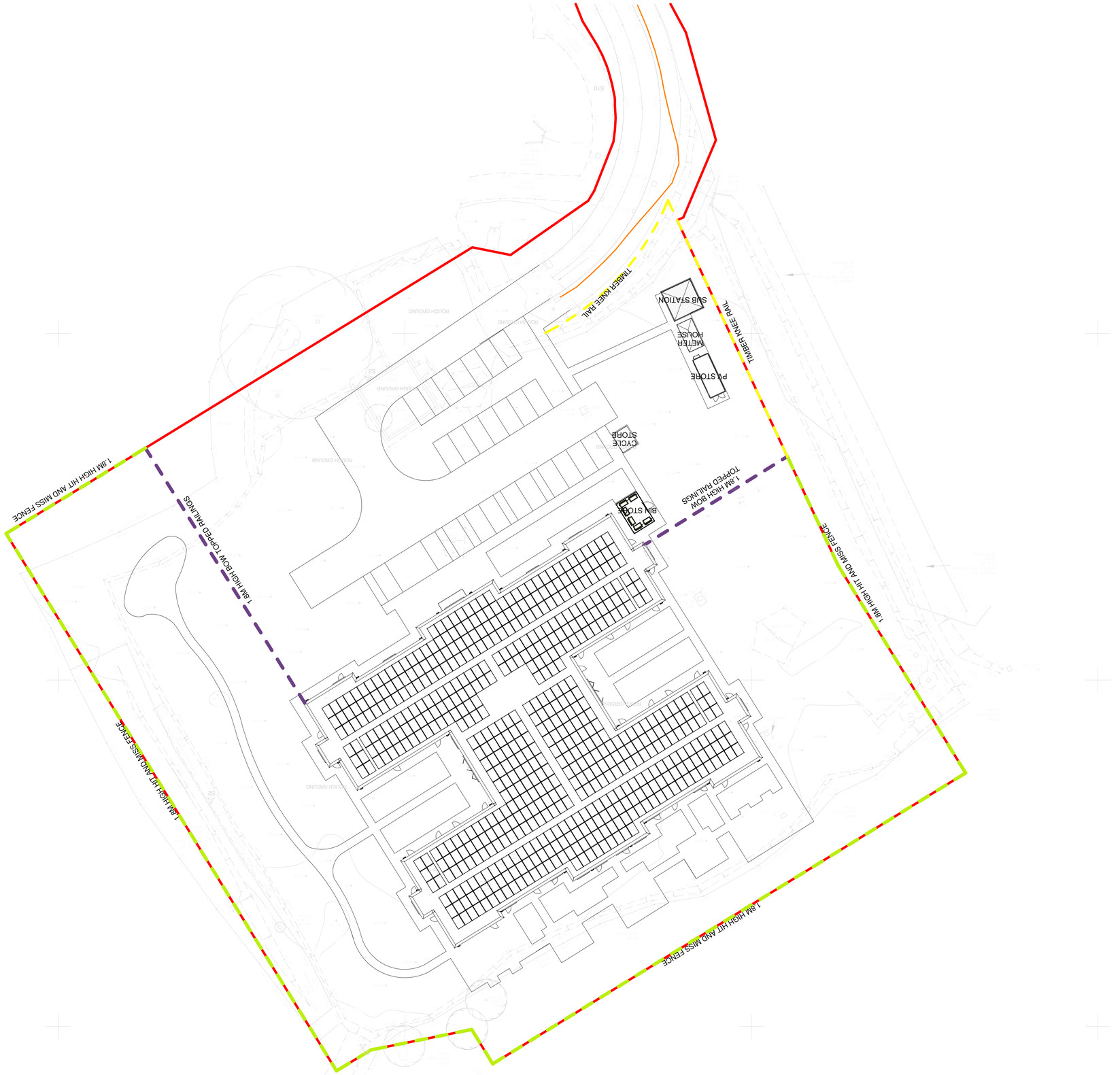
Appendix B

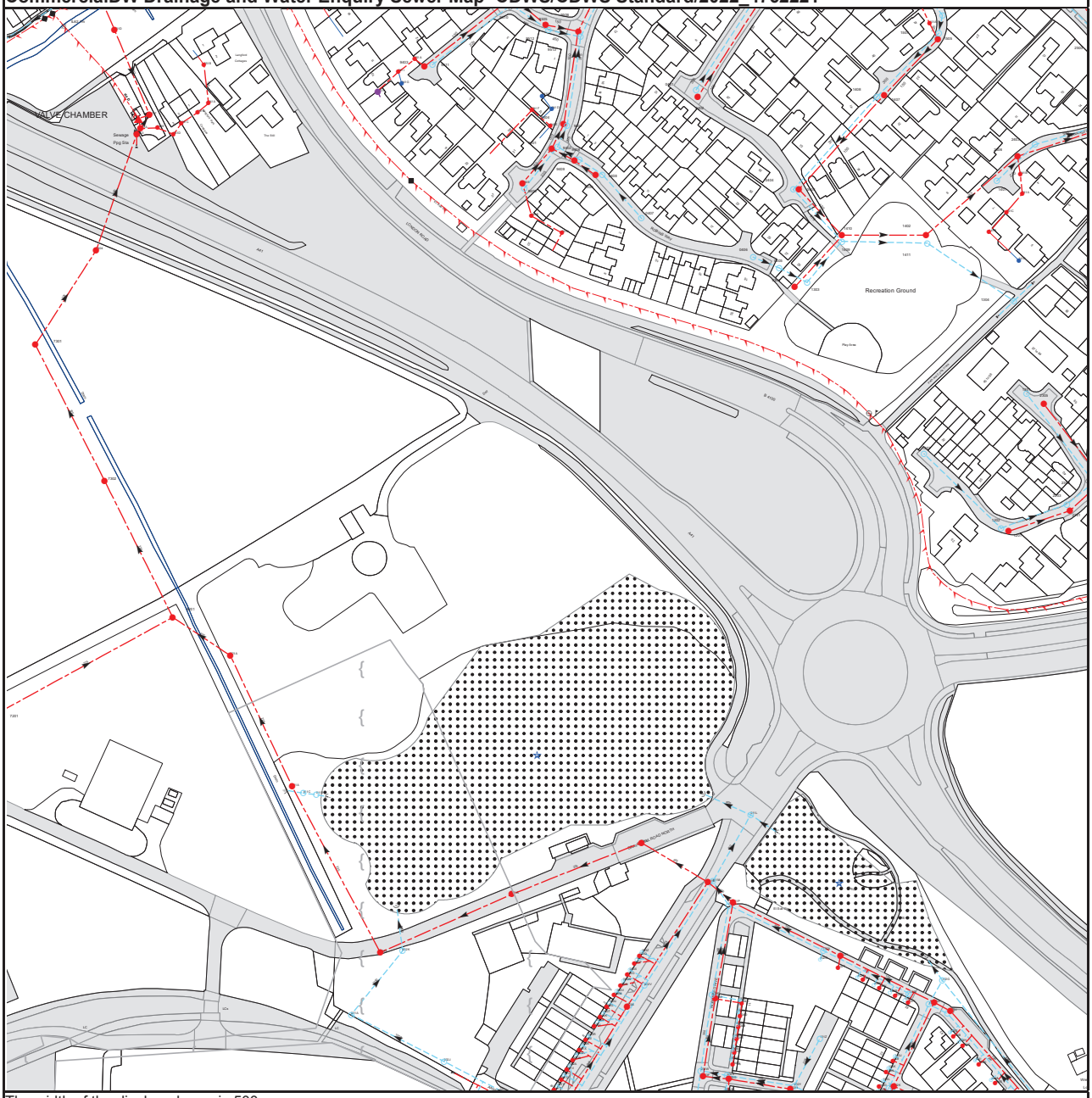
Proposed Site Plan


1.8M HIGH HIT AND MISS FENCE
1.8M HIGH BOW TOPPED RAILINGS
TIMBER KNEE RAIL
SUB STATION
METER HOUSE
PV STORE
CYCLE STORE
BIN STORE
TIMBER KNEE RAIL
1.8M HIGH BOW TOPPED RAILINGS
1.8M HIGH HIT AND MISS FENCE
1.8M HIGH HIT AND MISS FENCE
1.8M HIGH HIT AND MISS FENCE

Appendix C

Thames Water Sewer Records

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2022_4762221



The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no survey information is available.

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0301	n/a	n/a
811A	67.95	65.19
811C	68.7	67.09
811B	68.7	67.16

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Con29DW Commercial Drainage and Water Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Inlet
- Outfall
- Undefined End

Other Symbols

Symbols used on maps which do not fall under other general categories.

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement — Ducts may contain high voltage cables. Please check with Thames Water.
- Conduit Bridge
- Subway
- Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement.

If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Thames Water Utilities Ltd, Property Searches, PO Box 3189, Slough SL1 4W, DX 151280 Slough 13
T 0800 009 4540 **E** searches@thameswater.co.uk **I** www.thameswater-propertysearches.co.uk

Appendix D

On-site Utilities Survey

N

W E

S

Approximate North

PLEASE NOTE:

Utility Asset Records provided by Client.

PLEASE NOTE:

Topographical plan supplied by client

LEGEND

Utility Survey Point Features

AV	Air Valve	GR	Gully Round	MH	MH - Round
BB	Belisha Beacon	IC	IC	MH	MH - Surface Water
CP	CCTV Camera Pole	ICC	IC - Comms	MK 12.24	Marker Post
CR	Cable Riser	ICE	IC - Electric	PR	Pipe Riser
DP	Down Pipe	ICR	IC - Round	RL	Recessed Light
DPG	Down Pipe To Ground	ICT	IC - Telecom	RE	Rodding Eye
EP	Electrical Pole	ICTC	IC - TCSU/TFL	SC	Stop Cock
ER	Earth Rod	ICTV	IC - CATV	TL	Traffic Light
	Fire Hydrant	LP	Lamp Post	TP	Telegraph Pole
GM	Gas Meter	MH	MH	V	Valve General
GV	Gas Valve	MH	MH - District Heat	WM	Water Meter
G	Gully	MH	MH - Foul	WV	Water Valve

Utility Survey Linework Features

Communications
- BT — British Telecom
- CATV — Cable TV
- CCTV — Closed Circuit TV
- COMMS — Communications
- FOL — Fibre Optic Line
- FOLC — Fibre Optic Line - Colt
- FOLE — Fibre Optic Line - Energis
- FOLF — Fibre Optic Line - Fibernet
- FOLL — Fibre Optic Line - Level 3
- FOLM — Fibre Optic Line - Mercury
- FOLMF — Fibre Optic Line - MFSC
- FOLT — Fibre Optic Line - Tanet
- FOLV — Fibre Optic Line - Virgin
- FOLVF — Fibre Optic Line - Vodafone
- FOLVN — Fibre Optic Line - Verizon
- FOLW — Fibre Optic Line - WCOM
- TS — Telecom Service

Drainage
- CW — Combined Water
- FW — Foul Water
- SW — Surface Water
- RM — Rising Main

Water
- FRW — Fire Water
- WM — Water Main
- WS — Water Service

Electrical
- E — Electrical Service
- EE — Electrical Earth
- P — Electrical Pilot Cable
- EHV — Electrical - Extra High Voltage
- HV — Electrical - High Voltage
- LV — Electrical - Low Voltage
- TFL — Electrical - TFL
- SL — Street Lighting
- TCSU — Traffic Control System Unit

Gas
- G — Gas Service
- GLP — Gas Low Pressure
- GIP — Gas Intermediate Pressure
- GMP — Gas Medium Pressure
- GHP — Gas High Pressure

GPR + Unknown
- ED — Empty Duct
- GPR — GPR Anomaly
- UA — Unknown Asset
- UAPS — UA Passive Sweep
- UCL — Unknown Cable
- GPR Slab
- GPR Survey Area
- GPR buried structure
- GPR Reinforced Slab
- GPR interface layer (change in material)

Other
- DH — District Heat
- FU — Fuel Pipe
- XX — Decommissioned/Abandoned
- Manhole Chamber
- Manhole ID
- PEO — Pot End
- Scope of Works

PAS128 Quality Levels

(Consult document 'PAS128:2014.pdf' for full details)

- XX - A — Quality Level A
- XX - B1 — Quality Level B1
- XX - B1P — Quality Level B1P
- XX - B2 — Quality Level B2
- XX - B2P — Quality Level B2P
- XX - B3 — Quality Level B3
- XX - B3P — Quality Level B3P
- XX - B4 — Quality Level B4
- XX - C — Quality Level C
- XX - D — Quality Level D

Special Survey Features

ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Survey Station

ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Scan Target

Utility Survey Abbreviations

AB	Abandoned	CSER	Confined Space Entry Required
AR	Assumed Route	MH	Manhole
BI	Illuminated Bollard	NVO	Not Visible Outlet
BLD	Blocked	OE	Overhead Electric
CPD	Capped	OT	Overhead Telecom
CL	Cover Level	SOF	Soffit Level
CPD	Capped	TFR	Taken From Records
CUT	Disconnected Utility	TVM	Ticket Vending Machine
EOCCTV	End of CCTV Survey	UTO	Unable to Open
EOG	End of GPR Signal	UTS	Unable to Survey
EOT	End of Trace	UTT	Unable to Trace
EOS	End of Survey	UKN	Unknown
IC	Inspection Cover	WL	Water Level
IL	Invert Level	XXd	Service Depth

Utility Material Abbreviations

AC	Asbestos Cement	CO	Concrete	SI	Spun Iron
BC	Brick Chamber	DI	Ductile Iro	ST	Steel
CI	Cast Iron	PE	Polyethylene	WTR	Water

Level Measured For Ducts/Pipes At Pits Is To Top of The Service — 0.80d

Level Measured For Drainage At Pits Is To Invert Level Of The Service — 0.80d

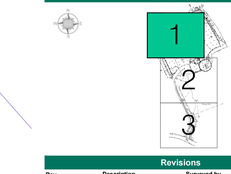
Murphy Geospatial Disclaimer

All reasonable endeavours have been used to capture the required data in the survey to the agreed standards of accuracy. Where features have been obstructed due to a lack of access, the areas will be annotated as **UTS** (Unable To Survey). The Company shall not be liable for any damages or consequential losses arising from the reliance on survey information beyond its specified scale and accuracy, or survey information used for purposes other than that stated in the Contract of Works.

Any concerns with the survey should be raised with Murphy Geospatial, who will endeavour to promptly provide a remedy. The Client shall not seek recourse through any third party until such time as Murphy Geospatial have had the opportunity to redress any concerns raised.

For full terms and conditions visit **Terms and Conditions** www.murphygs.com

Location Plan



Revisions

Rev	Description	Surveyed by	Drawn by	Checked by
A	First Issue	LL - 26/03/24	CS - 03/04/24	ER - 05/04/24
B	CCTV data added	LL - 23/04/24	CN - 26/04/24	ER - 26/04/24
C	Utility data added	DA - 17/05/24	CS - 21/05/24	ER - 21/05/24
D	Comments added	DA - 17/05/24	CS - 21/05/24	ER - 22/05/24

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UK Head Office
9 Millfield Croxley Park
Woodshots Meadow
Watford
WD18 8YX
Phone: (+44) 0192 362 4800
Email: info@murphygs.com

London Manchester Birmingham Glasgow Belfast Cork Kildare

Client	LNT
Project	Graven Hill
Site Address	Graven Hill Road Bicester OX25 2BF
Description	Underground Utility Survey(PAS128)
Survey Grid	Localised OSGB36(15) - Scale Factor 1.0
Survey Datum	GNSS - Ordnance Datum Newlyn (ODN)
RICS Band	Band E
Drawing Scale	1:100 @A0
Drawing Number	MGS57126-U-RevD-01

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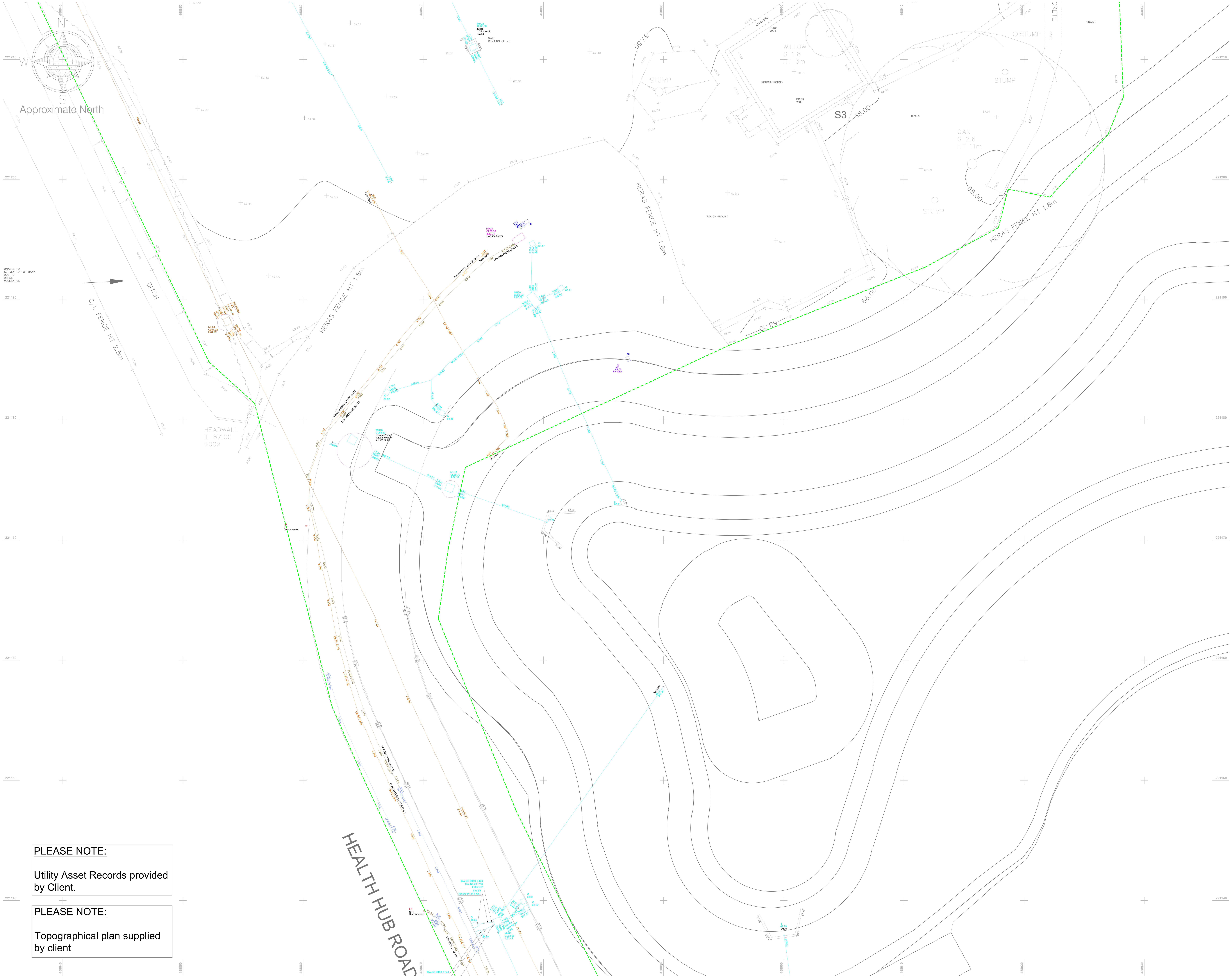

PLEASE NOTE:

Utility Asset Records provided by Client.

PLEASE NOTE:

Topographical plan supplied by client

LEGEND
Utility Survey Point Features

AV	Air Valve	G	Gully Round	MH	MH - Round
BB	Belisha Beacon	IC	IC	MH	MH - Surface Water
CP	CCTV Camera Pole	ICC	IC - Comms	MK 12.24	Marker Post
CR	Cable Riser	ICE	IC - Electric	PR	Pipe Riser
DP	Down Pipe	ICR	IC - Round	RL	Recessed Light
DPG	Down Pipe To Ground	ICT	IC - Telecom	RE	Rodding Eye
EP	Electrical Pole	ICTC	IC - TCSU/TFL	SC	Stop Cock
ER	Earth Rod	ICTV	IC - CATV	TL	Traffic Light
	Fire Hydrant	LP	Lamp Post	TP	Telegraph Pole
GM	Gas Meter	MH	MH	V	Valve General
GV	Gas Valve	MH	MH - District Heat	WM	Water Meter
G	Gully	MH	MH - Foul	WV	Water Valve

Utility Survey Linework Features

	Communications		**Electrical**
BT	British Telecom	EHV	Electrical - Extra High Voltage
CATV	Cable TV	HV	Electrical - High Voltage
CCTV	Closed Circuit TV	LV	Electrical - Low Voltage
COMMS	Communications	TFL	Electrical - TFL
FOL	Fibre Optic Line	SL	Street Lighting
FOLC	Fibre Optic Line - Colt	TCSU	Traffic Control System Unit
FOLE	Fibre Optic Line - Energis		**Gas**
FOLF	Fibre Optic Line - Fibernet	G	Gas Service
FOLL	Fibre Optic Line - Level 3	GLP	Gas Low Pressure
FOLM	Fibre Optic Line - Mercury	GIP	Gas Intermediate Pressure
FOLMF	Fibre Optic Line - MFSC	GMP	Gas Medium Pressure
FOLT	Fibre Optic Line - Tanet	GHP	Gas High Pressure
FOLV	Fibre Optic Line - Virgin		**GPR + Unknown**
FOLVF	Fibre Optic Line - Vodafone	ED	Empty Duct
FOLVN	Fibre Optic Line - Verizon	GPR	GPR Anomaly
FOLW	Fibre Optic Line - WCOM	UA	Unknown Asset
TS	Telecom Service	UAPS	UA Passive Sweep
		UCL	Unknown Cable
	Drainage		GPR Slab
CW	Combined Water		GPR Survey Area
FW	Foul Water		GPR buried structure
SW	Surface Water		GPR Reinforced Slab
RM	Rising Main		GPR interface layer (change in material)
	Water		**Other**
FRW	Fire Water	DH	District Heat
WM	Water Main	FU	Fuel Pipe
WS	Water Service	XX	Decommissioned/Abandoned
			Manhole Chamber
	Electrical		Manhole ID
E	Electrical Service	PE	Pot End
EE	Electrical Earth		Scope of Works
P	Electrical Pilot Cable		

PAS128 Quality Levels
(Consult document 'PAS128:2014.pdf' for full details)

XX - A	Quality Level A	XX - B3	Quality Level B3
XX - B1	Quality Level B1	XX - B3P	Quality Level B3P
XX - B1P	Quality Level B1P	XX - B4	Quality Level B4
XX - B2	Quality Level B2	XX - C	Quality Level C
XX - B2P	Quality Level B2P	XX - D	Quality Level D

Special Survey Features

ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Survey Station

ID E=XXXX.XXX N=YYYY.YYY H=ZZZ.ZZZ Scan Target

Utility Survey Abbreviations

AB	Abandoned	CSER	Confined Space Entry Required
AR	Assumed Route	MH	Manhole
BI	Illuminated Bollard	NVO	Not Visible Outlet
BLD	Blocked	OE	Overhead Electric
CPD	Capped	OT	Overhead Telecom
CL	Cover Level	SOF	Soffit Level
CPD	Capped	TFR	Taken From Records
CUT	Disconnected Utility	TVM	Ticket Vending Machine
EOCCTV	End of CCTV Survey	UTO	Unable to Open
EOG	End of GPR Signal	UTS	Unable to Survey
EOT	End of Trace	UTT	Unable to Trace
EOS	End of Survey	UKN	Unknown
IC	Inspection Cover	WL	Water Level
IL	Invert Level	XXd	Service Depth

Utility Material Abbreviations

AC	Asbestos Cement	CO	Concret	SI	Spun Iron
BC	Brick Chamber	DI	Ductile Iro	ST	Steel
CI	Cast Iron	PE	Polyethylene	WTR	Water

Level Measured For Ducts/Pipes At Pits Is To Top of The Service 0.80d

Level Measured For Drainage At Pits Is To Invert Level Of The Service 0.80d

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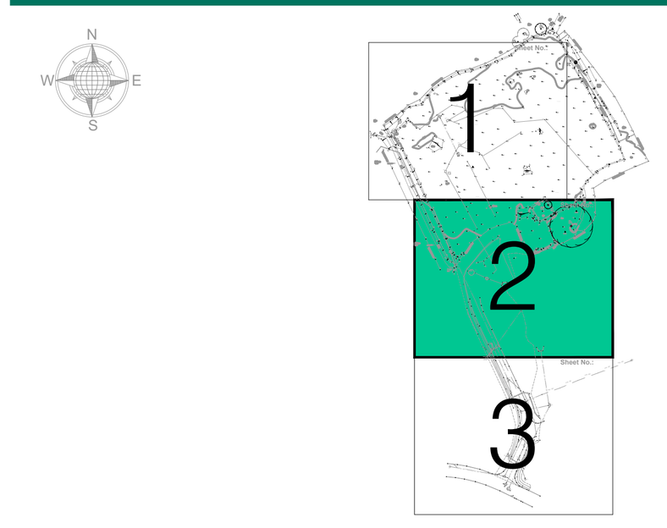
Location Plan



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9 Millfield Croxley Park
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ISO 19650 Building Information Modelling · ices Approved Development Partner · RICS · ISO 9001 Quality Management · ISO 14001 Environmental Management · ISO 45001 Health & Safety Management

London Manchester Birmingham Glasgow Belfast Cork Kildare

Client	LNT
Project	Graven Hill
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Description	Underground Utility Survey(PAS128)
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RICS Band	Band E
Drawing Scale	1:100 @A0
Drawing Number	MGS57126-U-RevD-02

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N

W E

S

Approximate North

WESTERN SPINE ROAD

PLEASE NOTE:

Utility Asset Records provided by Client.

PLEASE NOTE:

Topographical plan supplied by client

LEGEND

Utility Survey Point Features

AV Air Valve
BB Belisha Beacon
CP CCTV Camera Pole
CR Cable Riser
DP Down Pipe
DPG Down Pipe To Ground
EP Electrical Pole
ER Earth Rod
Fire Hydrant
GM Gas Meter
GV Gas Valve
G Gully
GG Gully Round
IC IC
ICC IC - Comms
ICE IC - Electric
ICR IC - Round
ICT IC - Telecom
ICTC IC - TCSU/TFL
ICTV IC - CATV
LP Lamp Post
MH MH
MH DH MH - District Heat
MH F MH - Foul
MH MH - Round
MH MH - Surface Water
MK Marker Post
PR Pipe Riser
RL Recessed Light
RE Rodding Eye
SC Stop Cock
TL Traffic Light
TP Telegraph Pole
V Valve General
WM Water Meter
WV Water Valve

Utility Survey Linework Features

Communications
BT British Telecom
CATV Cable TV
CCTV Closed Circuit TV
COMMS Communications
FOL Fibre Optic Line
FOLC Fibre Optic Line - Colt
FOLE Fibre Optic Line - Energis
FOLF Fibre Optic Line - Fibernet
FOLL Fibre Optic Line - Level 3
FOLM Fibre Optic Line - Mercury
FOLMF Fibre Optic Line - MFSC
FOLT Fibre Optic Line - Tanet
FOLV Fibre Optic Line - Virgin
FOLVF Fibre Optic Line - Vodafone
FOLVN Fibre Optic Line - Verizon
FOLW Fibre Optic Line - WCOM
TS Telecom Service

Drainage
CW Combined Water
FW Foul Water
SW Surface Water
RM Rising Main

Water
FRW Fire Water
WM Water Main
WS Water Service

Electrical
E Electrical Service
EE Electrical Earth
P Electrical Pilot Cable

Electrical
EHV Electrical - Extra High Voltage
HV Electrical - High Voltage
LV Electrical - Low Voltage
TFL Electrical - TFL
SL Street Lighting
TCSU Traffic Control System Unit

Gas
G Gas Service
GLP Gas Low Pressure
GIP Gas Intermediate Pressure
GMP Gas Medium Pressure
GHP Gas High Pressure

GPR + Unknown
ED Empty Duct
GPR GPR Anomaly
UA Unknown Asset
UAPS UA Passive Sweep
UCL Unknown Cable
GPR Slab
GPR Survey Area
GPR buried structure
GPR Reinforced Slab
GPR interface layer (change in material)

Other
DH District Heat
FU Fuel Pipe
XX Decommissioned/Abandoned
Manhole Chamber
Manhole ID
PEO Pot End
Scope of Works

PAS128 Quality Levels

(Consult document 'PAS128:2014.pdf' for full details)

XX - A Quality Level A
XX - B1 Quality Level B1
XX - B1P Quality Level B1P
XX - B2 Quality Level B2
XX - B2P Quality Level B2P
XX - B3 Quality Level B3
XX - B3P Quality Level B3P
XX - B4 Quality Level B4
XX - C Quality Level C
XX - D Quality Level D

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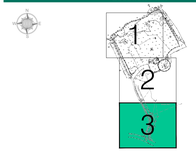
Location Plan



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RICS Band	Band E
Drawing Scale	1:100 @A0
Drawing Number	MGS57126-U-RevD-03

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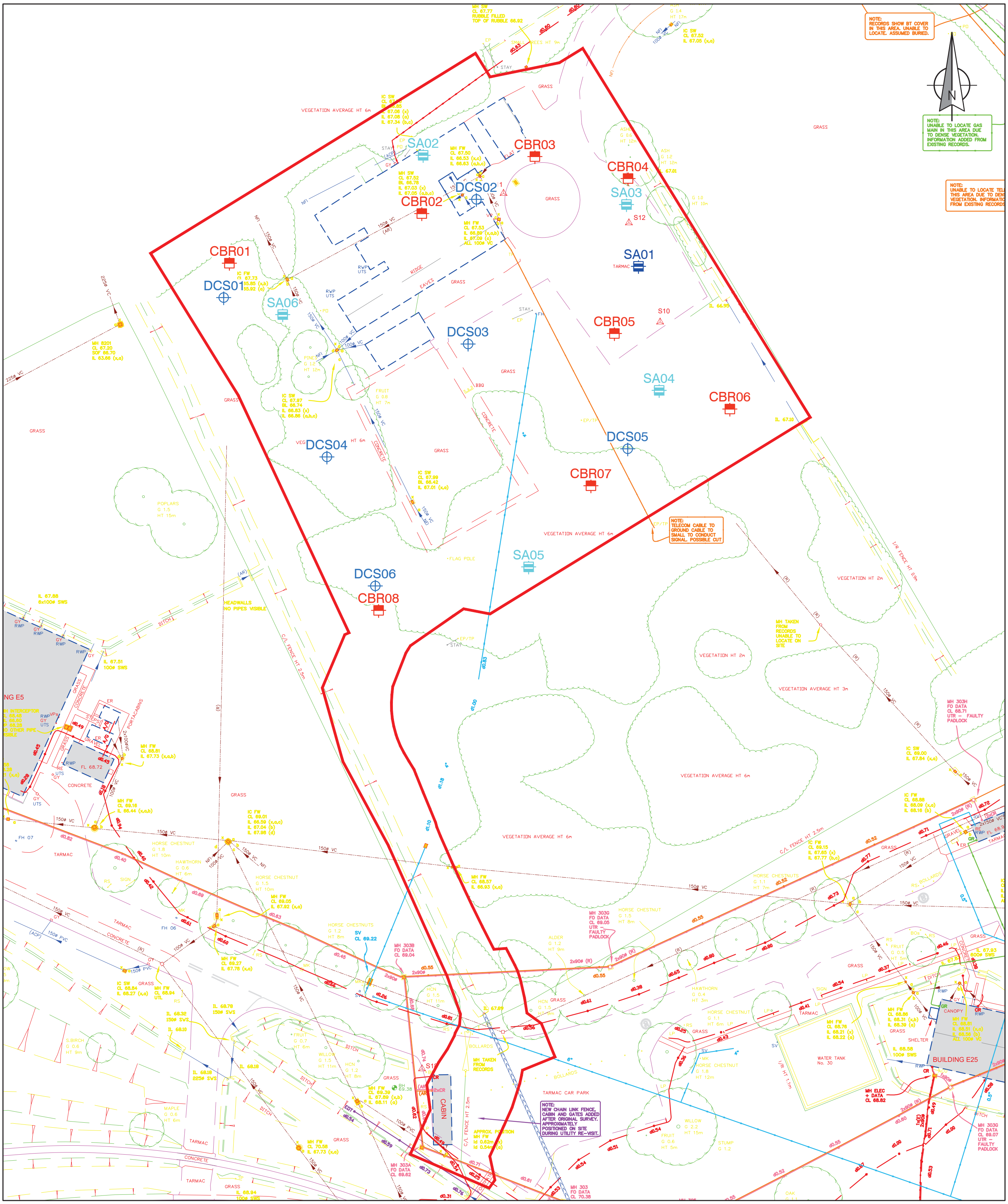
Appendix E

On-site Soakaway Testing

FM-Hn-D-103 Rev B M:\Cambridge Projects\Jobs 23000\23300\GC23319 Bicester Health Care Hub\Drawings\CAD files\GC23319 - DR002.dwg



Rossi Long Consulting

Client : Rossi Long Consulting Ltd

Project : Bicester Health Care Hub

Job No : GC23319 Date : April 2021

Drawing Title : Fieldwork Location Plan

Drawing No : GC23319 - DR002

Scale : 1:750 @ A3

Drawn by : RW Checked by : CN

Eastings : 458890 Northings : 221240

Revision history

Rev	Date	Revision Data
.01	May 2021	122447_Topographical Survey_EXTRACT added

Key :

- Site Boundary
- Historic Buildings
- DCS01 Dynamic Continuous Sampling Borehole
- CBR01 California Bearing Ratio Test
- SA01 Machine Excavated Trial Pit with Soakaway Test - Deep
- SA02 Machine Excavated Trial Pit with Soakaway Test - Shallow

Notes :

Norwich: 01603 613111 London: 020 7537 9233
Cambridge: 01223 781585 Laboratory: 01603 416333

Email: info@harrisongroupuk.com
Website: www.harrisongroupuk.com

ISOQAR REGISTERED UKAS MANAGEMENT SYSTEMS 0026 UKAS TESTING

Certificate Number 5933
ISO 9001, ISO 14001

4031

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Test Location	Test no.	Test depth (m)	Strata	Infiltration rate (max) (m/s)	Recommended infiltration rate (m/s)
SA01	1	2.10	Peterborough Member (clay)	N/A	N/A
SA02	1	1.20	Peterborough Member (clay)	N/A	N/A
SA03	1	1.00	Peterborough Member (clay)	N/A	N/A
SA04	1	1.05	Peterborough Member (clay)	N/A	N/A
SA05	1	0.70	Peterborough Member (clay)	N/A	N/A
SA06	1	0.75	Peterborough Member (clay)	5.59×10^{-7}	4.88×10^{-7}
	2			5.14×10^{-7}	
	3			4.88×10^{-7}	

Summary of Onsite Soakaway Test Results – Source: Harrison Geotechnical Engineering (2021) – GC23319_SI

Appendix F

Proposed Drainage Strategy Plan, Supporting Calculations & Maintenance Records

SW Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 675 Urban 0.000
Area (ha) 1.050 Soil 0.450 Region Number Region 6

Results l/s

QBAR Rural 4.4
QBAR Urban 4.4

Q100 years 14.1

Q1 year 3.8
Q30 years 10.0
Q100 years 14.1

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ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 675 Urban 0.000
Area (ha) 0.297 Soil 0.450 Region Number Region 6

Results l/s

QBAR Rural 1.3
QBAR Urban 1.3

Q100 years 4.0

Q1 year 1.1
Q30 years 2.8
Q100 years 4.0

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SW Network Outputs

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Junctions Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Name	Junction Type	Easting (m)	Northing (m)	Cover Level (m)	Depth (m)	Invert Level (m)	Chamber Shape	Diameter (m)
S11	Manhole	458864.051	221218.658	67.700	0.873	66.827	Circular	0.600
S04	Manhole	458904.456	221275.926	68.000	0.815	67.185	Circular	0.600
S02	Manhole	458908.549	221269.301	68.000	0.662	67.338	Circular	0.600
S05	Manhole	458894.095	221292.704	68.000	0.932	67.068	Circular	0.450
S06	Manhole	458845.314	221262.559	68.000	1.123	66.877	Circular	0.600
S12	Manhole	458872.695	221246.557	68.000	0.500	67.500	Circular	0.600
S03	Manhole	458890.542	221267.328	68.000	0.500	67.500	Circular	0.600
S01	Manhole	458894.734	221260.763	68.000	0.500	67.500	Circular	0.600
S17	Manhole	458825.239	221247.457	67.500	0.810	66.690	Circular	0.450
S14	Manhole	458868.223	221254.123	68.000	0.500	67.500	Circular	0.600
S15	Manhole	458854.000	221245.334	68.000	0.611	67.389	Circular	0.600
S13	Manhole	458858.474	221237.769	68.000	0.611	67.389	Circular	0.600
S16	Manhole	458834.599	221252.347	67.600	1.578	66.022	Circular	1.050
S08	Manhole	458900.307	221217.187	67.900	0.770	67.130	Circular	0.600
S07	Manhole	458910.978	221223.893	67.900	0.685	67.215	Circular	0.600
S09	Manhole	458893.743	221213.128	68.105	1.026	67.079	Circular	0.600
S10	Manhole	458871.674	221206.184	68.000	1.076	66.924	Circular	0.600

Name	Lock
S11	None
S04	None
S02	None
S05	None
S06	None
S12	None
S03	None
S01	None
S17	None
S14	None
S15	None
S13	None
S16	None
S08	None
S07	None
S09	None
S10	None

Surface Water Network::	Date:		
Site: Graven Hill, Bicester	30/01/2025		
Project: 24-0303	Designed by:	Checked by:	Approved By:
Client: LNT Construction Ltd	FE	MG	TG
Report Details:	BSP Consulting Ltd::		
Type: Junctions	Title: Surface Water Calculations		
Storm Phase: Phase	Purpose: Preliminary		
	GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
S11	Outlet	PN 3.004	Free Discharge
S04	Outlet	PN 1.002	Free Discharge
S02	Outlet	PN 1.001	Free Discharge
S05	Outlet	LINK 1.1	Free Discharge
S06	Outlet	PN 1.003	Free Discharge
S12	Outlet	PN 4.000	Free Discharge
S03	Outlet	PN 2.000	Free Discharge
S01	Outlet	PN 1.000	Free Discharge
S14	Outlet	PN 5.000	Free Discharge
S15	Outlet	PN 5.001	Free Discharge
S13	Outlet	PN 4.001	Free Discharge
S16	Outlet	PN 1.005	Pump
	Invert Level (m)	66.022	

Depth (m)	Outflow (L/s)
0.200	0.59
0.400	0.59
0.600	1.30
0.800	1.30
0.855	1.30
0.856	3.20
1.000	3.20
1.200	3.20

S08	Outlet	PN 3.001	Free Discharge
S07	Outlet	PN 3.000	Free Discharge
S09	Outlet	PN 3.002	Free Discharge
S10	Outlet	PN 3.003	Free Discharge

Tank

Type : Tank

Dimensions

Exceedance Level (m)	67.740
Depth (m)	1.700
Base Level (m)	66.040
Freeboard (mm)	500
Initial Depth (m)	0.000
Porosity (%)	95
Average Slope (1:X)	0.00
Total Volume (m³)	225.720

Depth (m)	Area (m²)	Volume (m³)
0.000	198.00	0.000
1.200	198.00	225.720

Advanced

Perimeter	Circular
Length (m)	33.000

Porous Paving 1

Type : Porous Paving

Dimensions

Exceedance Level (m)	67.835
Depth (m)	0.600
Base Level (m)	67.235
Paving Layer Depth (mm)	60
Membrane Percolation (m/hr)	250.0
Porosity (%)	30
Length (m)	5.000
Long. Slope (1:X)	60.00
Width (m)	49.500
Total Volume (m³)	40.098

Advanced

Conductivity (m/hr)	250.0

Porous Paving 2

Type : Porous Paving

Dimensions

Exceedance Level (m)	67.780
Depth (m)	0.550
Base Level (m)	67.230
Paving Layer Depth (mm)	60
Membrane Percolation (m/hr)	250.0
Porosity (%)	30
Length (m)	5.000
Long. Slope (1:X)	60.00
Width (m)	25.000
Total Volume (m³)	18.375

Advanced

Conductivity (m/hr)	250.0

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Stormwater Controls Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Filter Trench 1

Type : Infiltration Trench

Dimensions

Exceedance Level (m)	68.000
Depth (m)	1.123
Base Level (m)	66.877
Freeboard (mm)	400
Porosity (%)	30
Length (m)	54.974
Long. Slope (1:X)	300.00
Width (m)	0.600
Total Volume (m³)	8.684

Under Drain

Height Above Base (m)	0.000
Diameter (mm)	225
No. of Barrels	1
Release Height (m)	0.000
Friction Scheme	Manning's n
n	0.015

Advanced

Conductivity (m/hr)	250.0

Filter Trench 2

Type : Infiltration Trench

Dimensions

Exceedance Level (m)	68.000
Depth (m)	1.038
Base Level (m)	66.962
Freeboard (mm)	300
Porosity (%)	30
Length (m)	56.561
Long. Slope (1:X)	300.00
Width (m)	0.600
Total Volume (m³)	8.213

Under Drain

Height Above Base (m)	0.000
Diameter (mm)	150
No. of Barrels	1
Release Height (m)	0.000
Friction Scheme	Manning's n
n	0.015

Advanced

Conductivity (m/hr)	250.0

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd		Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Stormwater Controls Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Filter Trench 3

Type : Infiltration Trench

Dimensions

Exceedance Level (m)	68.105
Depth (m)	1.005
Base Level (m)	67.100
Freeboard (mm)	300
Porosity (%)	30
Length (m)	10.575
Long. Slope (1:X)	300.00
Width (m)	0.600
Total Volume (m³)	1.473

Under Drain

Height Above Base (m)	0.000
Diameter (mm)	150
No. of Barrels	1
Release Height (m)	0.000
Friction Scheme	Manning's n
n	0.015

Advanced

Conductivity (m/hr)	250.0

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Inflow Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	S10		Time of Concentration	0.002	100	0	100	0.002
Catchment Area (1)	S10		Time of Concentration	0.001	100	0	100	0.001
Catchment Area (2)	S10		Time of Concentration	0.002	100	0	100	0.002
Catchment Area (3)	Filter Trench 3		Time of Concentration	0.019	100	0	100	0.019
Catchment Area (4)	S14		Time of Concentration	0.024	100	0	100	0.024
Catchment Area (5)	Filter Trench 1		Time of Concentration	0.039	100	0	100	0.039
Catchment Area (6)	S04		Time of Concentration	0.006	100	0	100	0.006
Catchment Area (7)	S03		Time of Concentration	0.021	100	0	100	0.021
Catchment Area (9)	S12		Time of Concentration	0.025	100	0	100	0.025
Catchment Area (10)	Filter Trench 2		Time of Concentration	0.041	100	0	100	0.041
Catchment Area (11)	S01		Time of Concentration	0.025	100	0	100	0.025
Catchment Area (12)	Porous Paving 1		Time of Concentration	0.078	100	0	100	0.078
Catchment Area (13)	Porous Paving 2		Time of Concentration	0.013	100	0	100	0.013
TOTAL		**0.0**		**0.296**				**0.296**

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd		Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Outfall Details Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Outfalls

Outfall	Outfall Type	Fixed Surcharged Level (m)	Level Curve
S17	Free Discharge		

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by: FE	Checked by: MG	Approved By: TG
Report Title: Rainfall Analysis Criteria	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Shortest
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FEH

Type: FEH

Site Location	GB 458844 221216 SP 58844 21216
Rainfall Version	2022
Summer	☐
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
2.0	0.000
30.0	35.000
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by:	Checked by:	Approved By:
	FE	MG	TG
Report Details: Type: Junctions Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

FEH: 2 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
S11	FEH: 2 years: +0 %: 30 mins: Winter	67.700	66.827	66.930	0.103	10.9	0.029	0.000	10.8	11.977	OK
S04	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.185	67.251	0.066	7.7	0.019	0.000	7.5	3.723	OK
S02	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.338	67.386	0.048	3.8	0.014	0.000	3.6	1.780	OK
S05	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.068	67.162	0.094	7.5	0.015	0.000	7.1	3.712	OK
S06	FEH: 2 years: +0 %: 15 mins: Winter	68.000	66.877	66.960	0.083	10.7	0.023	0.000	10.4	6.330	OK
S12	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.500	67.556	0.056	3.9	0.016	0.000	3.8	1.795	OK
S03	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.500	67.540	0.040	3.3	0.011	0.000	3.2	1.526	OK
S01	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.500	67.549	0.049	3.9	0.014	0.000	3.8	1.783	OK
S17	FEH: 2 years: +0 %: 15 mins: Winter	67.500	66.690	66.690	0.000	0.3	0.000	0.000	0.3	0.334	OK
S14	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.500	67.555	0.055	3.8	0.016	0.000	3.7	1.744	OK
S15	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.389	67.416	0.027	3.7	0.008	0.000	3.6	1.743	OK
S13	FEH: 2 years: +0 %: 15 mins: Winter	68.000	67.389	67.416	0.027	3.8	0.008	0.000	3.7	1.794	OK
S16	FEH: 2 years: +0 %: 720 mins: Winter	67.600	66.022	66.358	0.336	0.6	0.291	0.000	0.6	42.013	Surcharged
S08	FEH: 2 years: +0 %: 15 mins: Winter	67.900	67.130	67.152	0.022	0.6	0.006	0.000	0.7	0.492	OK
S07	FEH: 2 years: +0 %: 15 mins: Winter	67.900	67.215	67.226	0.012	0.2	0.003	0.000	0.2	0.132	OK
S09	FEH: 2 years: +0 %: 15 mins: Winter	68.105	67.079	67.125	0.046	3.1	0.013	0.000	2.8	1.860	OK
S10	FEH: 2 years: +0 %: 15 mins: Winter	68.000	66.924	66.973	0.048	3.6	0.014	0.000	3.3	2.192	OK

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by:	Checked by:	Approved By:
	FE	MG	TG
Report Details: Type: Junctions Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

FEH: 30 years: Increase Rainfall (%): +35: 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
S11	FEH: 30 years: +35 %: 15 mins: Winter	67.700	66.827	67.121	0.294	21.5	0.083	0.000	21.8	23.092	Surcharged
S04	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.185	67.358	0.173	24.2	0.049	0.000	20.2	11.626	OK
S02	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.338	67.435	0.097	11.8	0.027	0.000	11.2	5.539	OK
S05	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.068	67.333	0.265	20.2	0.042	0.000	19.0	11.611	Surcharged
S06	FEH: 30 years: +35 %: 15 mins: Winter	68.000	66.877	67.028	0.151	28.4	0.043	0.000	28.0	20.061	OK
S12	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.500	67.608	0.108	12.1	0.030	0.000	11.9	5.601	OK
S03	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.500	67.576	0.076	10.3	0.021	0.000	10.2	4.717	OK
S01	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.500	67.596	0.096	12.1	0.027	0.000	11.8	5.568	OK
S17	FEH: 30 years: +35 %: 15 mins: Winter	67.500	66.690	66.690	0.000	0.6	0.000	0.000	0.6	0.703	OK
S14	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.500	67.605	0.105	11.8	0.030	0.000	11.5	5.433	OK
S15	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.389	67.439	0.050	11.5	0.014	0.000	11.4	5.431	OK
S13	FEH: 30 years: +35 %: 15 mins: Winter	68.000	67.389	67.440	0.051	11.9	0.014	0.000	11.7	5.599	OK
S16	FEH: 30 years: +35 %: 720 mins: Winter	67.600	66.022	66.872	0.850	1.4	0.737	0.000	1.3	90.031	Surcharged
S08	FEH: 30 years: +35 %: 15 mins: Winter	67.900	67.130	67.218	0.088	2.4	0.025	0.000	2.9	1.757	OK
S07	FEH: 30 years: +35 %: 15 mins: Winter	67.900	67.215	67.235	0.020	0.6	0.006	0.000	0.6	0.406	OK
S09	FEH: 30 years: +35 %: 15 mins: Winter	68.105	67.079	67.213	0.135	9.0	0.038	0.000	8.0	6.050	OK
S10	FEH: 30 years: +35 %: 15 mins: Winter	68.000	66.924	67.166	0.241	10.2	0.068	0.000	9.5	7.109	Surcharged

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd	30/01/2025		
	Designed by:	Checked by:	Approved By:
	FE	MG	TG
Report Details: Type: Junctions Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

FEH: 100 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
S11	FEH: 100 years: +40 %: 15 mins: Winter	67.700	66.827	67.175	0.348	23.4	0.098	0.000	23.7	27.696	Surcharged
S04	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.185	67.528	0.343	26.9	0.097	0.000	25.0	15.494	Surcharged
S02	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.338	67.568	0.230	12.9	0.065	0.000	11.0	7.375	Surcharged
S05	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.068	67.485	0.417	25.0	0.066	0.000	23.1	15.478	Surcharged
S06	FEH: 100 years: +40 %: 720 mins: Winter	68.000	66.877	67.074	0.197	4.6	0.056	0.000	4.6	104.779	OK
S12	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.500	67.635	0.135	16.2	0.038	0.000	15.7	7.472	OK
S03	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.500	67.600	0.100	13.7	0.028	0.000	12.1	6.289	OK
S01	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.500	67.667	0.167	16.1	0.047	0.000	12.9	7.411	Surcharged
S17	FEH: 100 years: +40 %: 15 mins: Winter	67.500	66.690	66.690	0.000	0.6	0.000	0.000	0.6	0.738	OK
S14	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.500	67.631	0.131	15.7	0.037	0.000	15.3	7.250	OK
S15	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.389	67.448	0.059	15.3	0.017	0.000	15.1	7.249	OK
S13	FEH: 100 years: +40 %: 15 mins: Winter	68.000	67.389	67.449	0.060	15.7	0.017	0.000	15.5	7.471	OK
S16	FEH: 100 years: +40 %: 720 mins: Winter	67.600	66.022	67.073	1.051	3.3	0.911	0.000	3.2	158.814	Surcharged
S08	FEH: 100 years: +40 %: 15 mins: Winter	67.900	67.130	67.296	0.166	4.0	0.047	0.000	4.1	2.932	Surcharged
S07	FEH: 100 years: +40 %: 15 mins: Winter	67.900	67.215	67.296	0.082	1.3	0.023	0.000	1.0	0.636	OK
S09	FEH: 100 years: +40 %: 15 mins: Winter	68.105	67.079	67.289	0.210	9.3	0.059	0.000	8.7	8.421	Surcharged
S10	FEH: 100 years: +40 %: 15 mins: Winter	68.000	66.924	67.227	0.303	11.7	0.086	0.000	10.7	9.567	Surcharged

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd		Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

FEH: 2 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)	Percentage Available (%)
Tank	FEH: 2 years: +0 %: 720 mins: Winter	66.358	66.358	0.318	0.318	4.4	59.762	0.000	0.000	0.6	42.252	73.524
Filter Trench 1	FEH: 2 years: +0 %: 15 mins: Winter	67.153	67.012	0.092	0.135	13.0	1.067	0.000	0.000	10.9	6.362	87.711
Filter Trench 2	FEH: 2 years: +0 %: 30 mins: Winter	67.240	67.083	0.090	0.121	8.4	1.098	0.000	0.000	8.0	9.019	86.628
Porous Paving 1	FEH: 2 years: +0 %: 30 mins: Winter	67.386	67.265	0.067	0.030	7.8	3.466	0.000	0.000	4.4	5.578	91.356
Porous Paving 2	FEH: 2 years: +0 %: 120 mins: Winter	67.337	67.239	0.024	0.009	0.7	0.604	0.000	0.000	0.4	1.841	96.713
Filter Trench 3	FEH: 2 years: +0 %: 15 mins: Winter	67.200	67.166	0.065	0.066	3.0	0.124	0.000	0.000	2.8	1.385	91.589

FEH: 30 years: Increase Rainfall (%): +35: 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)	Percentage Available (%)
Tank	FEH: 30 years: +35 %: 720 mins: Winter	66.873	66.873	0.833	0.833	11.1	156.601	0.000	0.000	1.4	90.687	30.621
Filter Trench 1	FEH: 30 years: +35 %: 15 mins: Winter	67.325	67.135	0.265	0.258	37.6	2.654	0.000	0.000	28.7	20.095	69.437
Filter Trench 2	FEH: 30 years: +35 %: 15 mins: Winter	67.436	67.219	0.286	0.257	19.8	2.956	0.000	0.000	12.2	16.376	64.011
Porous Paving 1	FEH: 30 years: +35 %: 30 mins: Winter	67.530	67.458	0.212	0.223	24.5	16.162	0.000	0.000	9.2	18.851	59.693
Porous Paving 2	FEH: 30 years: +35 %: 60 mins: Winter	67.383	67.248	0.069	0.018	2.9	1.589	0.000	0.000	1.8	4.073	91.353
Filter Trench 3	FEH: 30 years: +35 %: 15 mins: Winter	67.284	67.242	0.149	0.142	9.4	0.276	0.000	0.000	8.5	4.327	81.271

Surface Water Network::	Date:		
Site: Graven Hill, Bicester Project: 24-0303 Client: LNT Construction Ltd		Designed by: FE	Checked by: MG	Approved By: TG
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	BSP Consulting Ltd:: Title: Surface Water Calculations Purpose: Preliminary GHBO-BSP-ZZ-XX-CA-C-0001-P04		

FEH: 100 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)	Percentage Available (%)
Tank	FEH: 100 years: +40 %: 720 mins: Winter	67.074	67.074	1.034	1.034	14.9	194.440	0.000	0.000	3.3	159.603	13.858
Filter Trench 1	FEH: 100 years: +40 %: 15 mins: Winter	67.479	67.207	0.418	0.330	47.9	3.865	0.000	0.000	35.0	26.829	55.496
Filter Trench 2	FEH: 100 years: +40 %: 30 mins: Winter	67.575	67.298	0.424	0.336	18.3	4.049	0.000	0.000	14.0	36.615	50.705
Porous Paving 1	FEH: 100 years: +40 %: 30 mins: Winter	67.629	67.576	0.310	0.341	33.0	24.195	0.000	0.000	10.5	22.377	39.659
Porous Paving 2	FEH: 100 years: +40 %: 15 mins: Winter	67.391	67.297	0.078	0.067	8.1	2.721	0.000	0.000	3.8	2.648	85.193
Filter Trench 3	FEH: 100 years: +40 %: 15 mins: Winter	67.385	67.314	0.250	0.214	12.5	0.437	0.000	0.000	9.7	5.771	70.300

Proposed Drainage Layout Plan

Drawing - GHBO-BSP-ZZ-XX-D-C-0240-P05

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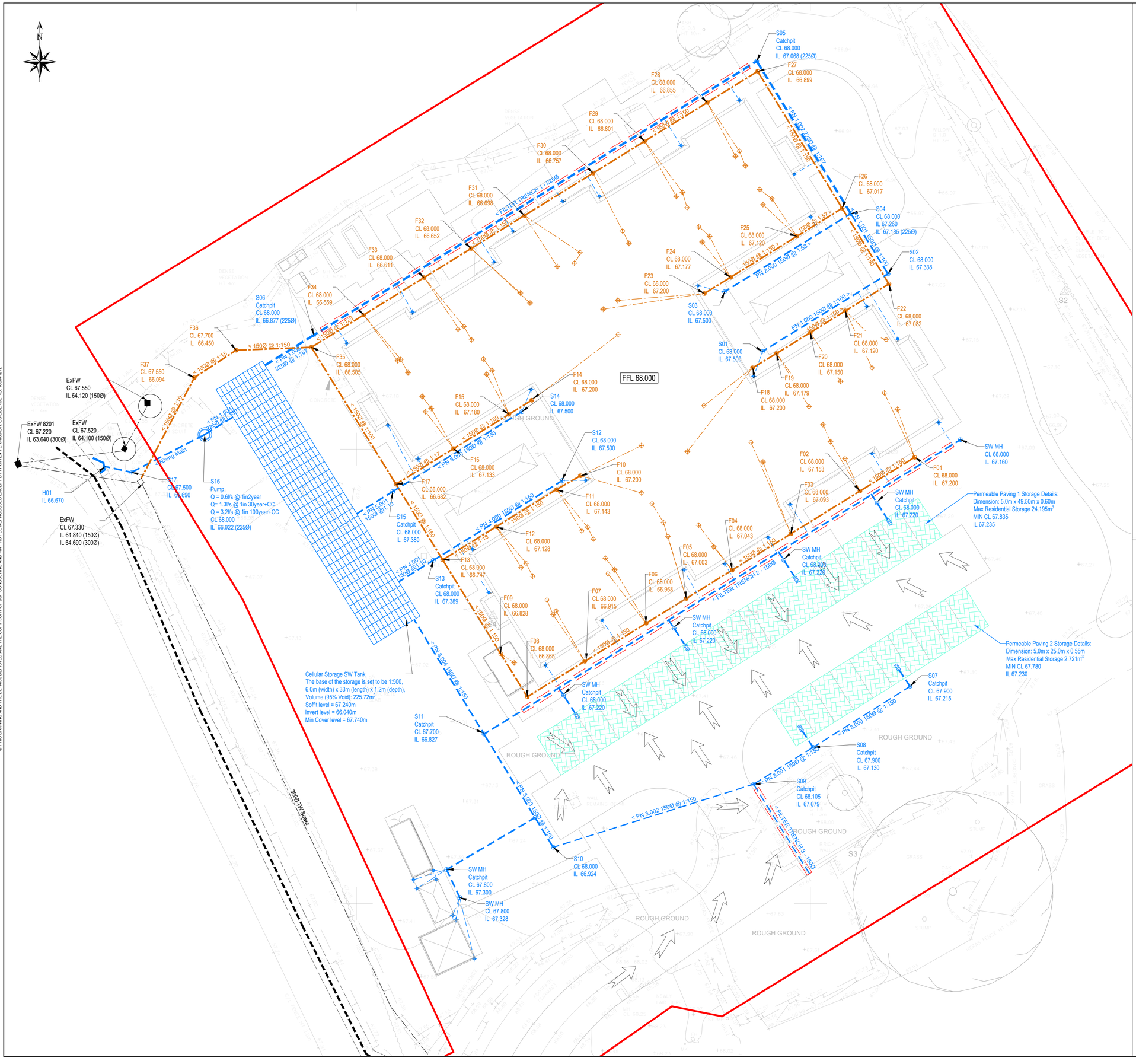

Key

- Proposed finished floor level — FFL 105.660
- Proposed Private Surface Water Drain (PPIC with 150Ø main runs& PCCIC) — PPIC150 PCCIC
- Proposed Private Foul Water Drain (PPIC with 150Ø main runs) — PPIC150s
- Proposed private surface water drain (pipe size @ gradient) — 150Ø @ 1:100
- Proposed private foul water drain (pipe size @ gradient) — 150Ø @ 1:100
- Proposed private permeable block paving
- Proposed private foul drain point
- Proposed private surface water drain point
- Proposed private attenuation tank
- Existing sewer
- Proposed overland flood flow route
- Proposed diffuser block
- Proposed Filter Trench with Perforated Pipe
- Existing Ditch
- Proposed private headwall
- Site Boundary

Drainage Strategy Notes:

1. Proposed net impermeable area 0.296 ha
2. The design has followed the drainage hierarchy. As infiltration is not a viable option of discharge for this site, the surface water is to be discharged to the neighbouring watercourse.
3. Surface water from the site is to be restricted to a discharge rate of 11l/s/ha for the 1in100 +CC storm event and a discharge rate of 2l/s/ha for the 1 in 2 year storm event , into the existing ditch to the west of the site. Due to the nature of this requirement from the LLFA, and due to other site complexities, a pump with a variable discharge rate will be utilised.
4. Surface water is to be discharged to the offsite existing ditch,via pumping, through a 150mm dia. pipe at an invert level of 66.670m. Connection to offsite ditch with agreement with relevant parties.
5. Climate Change Allowance of the development (building design life is expected to be 100 years) are 35% and 40% for 1 in 30-year and 1 in 100-year rainfall events, respectively.
6. SuDS feature to improve water quality via permeable paving parking, filter trench and catchpits to be implemented. Permavoid or similar devices to be installed at the low point of the parking spacing. Permeable Paving provides an additional max resident volume of 26.916m³.
7. The foul water from the development is proposed to discharge to the existing offsite chamber via gravity connection. Discharge level to the chamber is 64.840m. Connection to offsite sewer with agreement with relevant parties.
8. All foul water and surface water sewers are 150Ø dia. Unless stated otherwise.
9. Existing sewer cover and invert levels have been provided by LNT
10. All downpipes connected directly to a filter trench to have a gully/catchpit.

KEY PLAN

Construction Risks	Maintenance/cleaning Risks	Demolition/adaptation Risks

In addition to the hazard/risks normally associated with the type of works detailed on this drawing take note of the above.
It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION BOX

NOTES

1. DO NOT SCALE.
2. Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.
3. Until technical approval has been obtained from the relevant Authority, it should be understood that all drawings issued are Preliminary and NOT for construction. Should the contractor commence site work prior to such approval being given, it is entirely at his own risk.
4. All dimensions are in metres unless otherwise stated.
5. The BSP Hazard Identification and Risk Assessment information for this project must be reviewed and understood by the contractor PRIOR to the commencement of any works on site.

REV	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
P05	Amendment to tank and pump					
	FE	03/02/25	MG	03/02/25	TG	03/02/25
P04	Amendment to place tank under parking spaces					
	FE	24/01/25	MG	24/01/25	TG	24/01/25
P03	Amendment due to LLFA comments					
	FE	12/12/24	MG	12/12/24	TG	12/12/24
P02	Amendment to foul water outfall					
	FE	31/07/24	MG	31/07/24	TG	31/07/24
P01	First Issue					
	FE	15/07/24	TG	15/07/24	TG	15/07/24

SCALE @ A1	ISSUING OFFICE	PROJECT NUMBER
1:200	NOTTINGHAM	24-0303

CLIENT APPROVAL

- A - APPROVED
- B - APPROVED WITH COMMENTS
- C - DO NOT USE

STATUS	PURPOSE OF ISSUE
S1	PRELIMINARY

• CIVIL • STRUCTURAL • TRANSPORTATION • GEOTECHNICAL • ENVIRONMENTAL
bsp CONSULTING
12 Oxford Street
Nottingham, NG1 5BG
Tel: 0345 413 4000
e-mail: info@bsp-consulting.co.uk
Also offices in Derby, Leicester and Sheffield
BIM Design and Construction KITEMARK™
KM 718353
BS EN ISO 19650

PROJECT

Graven Hill, Bicester, Oxfordshire

TITLE

Drainage Strategy

CLIENT

LNT Construction Ltd.

PROJECT	ORIGINATOR	FUNCTIONAL	SPATIAL	FORM	DISCIPLINE	NUMBER	REV
GHBO	BSP	ZZ	XX	DR	C	SK240	P05

Maintenance Schedules

SUDS Maintenance Manual Data Sheet

Reference: MM-GS-02
V1 – Nov 2016

Element:
Gullies

Function Served:
Drainage pots with grating cover located at the lower side of the road to collect surface rainwater, and allows the rainwater flow into the main drainage network.

Features:
Internal diameter of 450mm with a sump to trap rainwater and rubbish.

Owned:
Operation Company

Location:
Refer to drawing FRY-BSP-ZZ-00-DRC-SK240-P03

General Notes:
Maintenance strategy should be reviewed on a regular basis and performance of the maintenance activities assessed.

Reference should be made to recognised industry standards in undertaking maintenance.

Where activities are required outside ownership permission must be sought from relevant party.

Part A: Routine Maintenance (typically monthly):

Maintenance Activity	Comments	Frequency
Litter and debris removal to prevent blockage		Monthly
Inspect structure for evidence of poor operation		Monthly
Inspect cover for any sign of damage		Monthly

Where Part A activities do not address deficient performance refer to Part B, see General Notes.

Part B: Occasional Maintenance (typically 6 monthly):

Maintenance Activity	Comments	Frequency
Carry out gully maintenance by sucking and cleaning the gully pot		6 monthly
Visual inspection of gullies, linking pipework etc for evidence of physical damage	Visual inspection from surface only, CCTV survey required if evidence present of structural issues.	6 monthly

Annual Activities:

Maintenance Activity	Comments	Frequency
Carry out gully maintenance by emptying and cleaning the gully pot	Employing gully emptiers vehicle to empty the gullies.	Once every year

Infrequent/Corrective Activities:

Maintenance Activity	Comments	Frequency
Repair/replace cover		As required
Rehabilitate/replacement of the gully	Required when all mechanical elements checked and performance remains inadequate.	As required
Jetting linking pipework	Where CCTV survey shows blockage of the linked pipework	As required

SUDS Maintenance Manual Data Sheet

bsp

Reference: MM-PP-01
V2 – June 2015

SUDS Element:
Permeable Paved Driveway

Function Served:
Permeable paving acting as drainage, conveyance, allowing infiltration and functioning as attenuation.

Features:
60mm permeable block paviour, bedding material over 30% voided stone. Including perforated pipework and catch pits for drain down and conveyance.

Owned:
Private Property Owner

Location:
Refer to drawing 14203/2171.

Associated with plots 152,153,154,155,156,168,169, 194 and 195

General Notes:
As a private owner scope of maintenance requirements are limited to what can reasonably be expected under routine maintenance of property. i.e. Part A.

Where normal maintenance is not sufficient items from Part B. of the schedule should be undertaken by a suitably experienced body

Part A: Routine Maintenance (typically monthly):

Maintenance Activity	Comments	Frequency
Litter and debris removal		Monthly
Inspect structures for evidence of poor operation		Monthly

Occasional Maintenance (typically every 6 months):

Maintenance Activity	Comments	Frequency
Brushing of pavement surface	Joints in paving become silted over time. Inspect visually. Undertake maintenance where joints are greater than 50% silted.	6 monthly or more frequently if required
Filling joints between paving blocks with suitable material	Following brushing joints may need to be topped up with suitable material. Specification as follows: *"Jointing material: 2/6.3mm clean crushed stone (no fines) to BS RN 13242:2002 or BS EN 12620"*	6 monthly as required following brushing

Where Part A activities do not address deficient performance refer to Part B, see General Notes.

Part B: Occasional Maintenance (typically every 6 months):

Maintenance Activity	Comments	Frequency
Inspect inlet catch pit and pre-treatment components for silt accumulation	Includes visual inspection of inlet chamber, forebay and inspection of flow control.	Half yearly
Visual inspection catch-pits, linking pipework etc. for evidence of physical damage	Visual inspection from surface only, CCTV survey required if evidence present of structural issues.	Half yearly

Annual Activities:

Maintenance Activity	Comments	Frequency
Remove sediment from catch-pits	Remove accumulated silt with suction tanker when 50% full.	Annual/as required

Infrequent/Corrective Activities:

Maintenance Activity	Comments	Frequency
Repair damage to paving	Damage may include rutting or local failure of structure	As required
Repair/rehabilitation of inlets and outlets.		As required
Rehabilitation following a pollution event	Pollution includes potential sealants of joints	As required
Repair/replace geotextile base.	If evidence from CCTV suggests a direct source of silt is present intrusive works will be required to the geotextile	As required
Rehabilitate sub-base	If, following brushing, the structure continues to perform below standard structural overhaul may be required. Stone may require reprocessing to reinstate original void ratio.	As required Evidence of similar structures installed around the country suggests rebuilding of the structures may be required typically every 25 years.

SUDS Maintenance Manual Data Sheet

bsp

Reference: MM-FT-01
V1 – March 2021

SUDS Element:

Filter Trench

Function Served:

Cleanses surface water runoff and facilitates filtration.

Features:

Stone-filled trench.

Owned:

Site Management

Location:

Refer to drawing 14203/2171.

General Notes:

Maintenance strategy should be reviewed on a regular basis and performance of the maintenance activities assessed.

Reference should be made to recognised industry standards in undertaking maintenance.

Where activities are required outside ownership permission must be sought from relevant party.

Refer to section 22 of CIRIA C697 for discussion on maintenance techniques.

Requirement for reporting of inspections to be confirmed by responsible party. May be required as evidence of activities to prove activity as part of funding arrangements.

Routine Maintenance (typically monthly):

Maintenance Activity	Comments	Frequency
Litter and debris removal	Litter and debris (removed prior to any grass cutting activity) to minimise risk of shredding litter	Monthly
Grass cutting of landscaped areas	All cuttings to be removed from SUDS components	Monthly (during growing season) or as required
Remove nuisance plants	Invasive species should be removed in accordance with best practice	Monthly (at implementation) then as required.
Inspect any inlet and outlet structures for evidence of poor operation		Monthly
Safety signage and safety equipment inspection	Generally limited to knee-rail fencing	Monthly

Occasional Maintenance (typically 6 monthly):

Maintenance Activity	Comments	Frequency
Inspect inlet catch pit and pre-treatment components for silt accumulation	Includes visual inspection of inlet chamber, forebay and inspection of flow control.	6 monthly
Visual inspection catch-pits, linking pipework etc for evidence of physical damage	Visual inspection from surface only, CCTV survey required if evidence present of structural issues.	6 monthly

Annual Activities:

Maintenance Activity	Comments	Frequency
Tidy all dead growth before start of growing season		Annually
Prune and trim nearby trees and remove cuttings	Where vegetation is planted as a barrier management of upward growth to encourage outward growth is necessary (after shrub seedlings are established).	As required
Remove sediment from catch-pit	Remove accumulated silt with suction tanker when 50% full.	As required

Infrequent/Corrective Activities:

Maintenance Activity	Comments	Frequency
Remove dead vegetation from trench edges		As required
Repair erosion or other damage	Required to maintain the bed at original design level	As required
Repair/rehabilitation of any inlets and outlets.		As required
Rehabilitation following a pollution event		As required
Rehabilitate/replace filter medium	Required when all mechanical elements checked and performance remains inadequate.	As required
Jetting of any linking pipework	Where CCTV survey shows siltation of pipework has occurred	As required

SUDS Maintenance Manual Data Sheet

Reference: MM-AT-01
V1 – Nov 2016

SUDS Element:
Attenuation Tanks

Function Served:
Acting as attenuation tank

Features:
Crate storage with maintenance access tunnel with catch-pits above and below

Owned:
Management Company

Location:
Refer to drawing 16205/240.

Parking courtyards are associated with the buildings.

General Notes:
Maintenance strategy should be reviewed on a regular basis and performance of the maintenance activities assessed.

Reference should be made to recognised industry standards in undertaking maintenance.

Where activities are required outside ownership permission must be sought from relevant party.

Refer to section 22 of CIRIA C697 for discussion on maintenance techniques.

Requirement for reporting of inspections to be confirmed by responsible party. May be required as evidence of activities to prove activity as part of funding arrangements.

Routine Maintenance (typically monthly):

Maintenance Activity	Comments	Frequency
Litter and debris removal		Monthly
Inspect structures for evidence of poor operation		Monthly

Occasional Maintenance (typically every 6 months):

Maintenance Activity	Comments	Frequency
Inspect inlet catch pit and pre-treatment components for silt accumulation	Includes visual inspection of inlet chamber, forebay and inspection of flow control.	6 monthly
Visual inspection catch-pits, linking pipework etc for evidence of physical damage	Visual inspection from surface only, CCTV survey required if evidence present of structural issues.	6 monthly
Check mechanical devices within control chambers	Includes inspection of orifice plate for signs of damage	6 monthly

Annual Activities:

Maintenance Activity	Comments	Frequency
Remove sediment from catch-pits	Remove accumulated silt with suction tanker when 50% full.	Annual/as required

Infrequent/Corrective Activities:

Maintenance Activity	Comments	Frequency
Repair/rehabilitation of inlets and outlets.		As required
Jetting and vacuuming inspection tunnel	Remove accumulated silt with suction tanker when 20% section loss (or 100mm whichever the lesser).	As required

Note;

Attenuation crate manufacturers have suppliers maintenance guidance. This should be obtained from the supplier and appended to this data-sheet and any recommended actions above and beyond stated here should be included in the maintenance regime.

Appendix G

Wider-Site Discharge Rate Agreement Notes

Minutes of Meeting Held
Graven Hill Surface Water Drainage Meeting
10am - Wednesday 23rd October 2013
Environment Agency, Wallingford

Attendees: **Peter Johnson (PJ) – Waterman (WM)**
Jack Moeran (JM) – Environment Agency (EA)
Nick Read (NR) – Environment Agency (EA)
Gordon Hunt (GH) - Oxfordshire County Council (OCC)

Apologies: **David Neale (DN) – Waterman (WM)**

Action

Background to the scheme

1.0 PJ presented AMEC Drawings Figure 45 'Graven Hill Strategic Masterplan' & Figure 46 'Graven Hill Detailed Masterplan' showing the previous masterplan for Site. This masterplan currently has draft planning conditions. JM asked for masterplan drawings to be provided electronically to the EA. **PJ**

1.1 It is Cherwell District Councils (CDC) intention to develop the Site. It is CDC intention for residential areas to be self-build. A revised masterplan is being worked up which will be similar to the current masterplan but needs to be updated to account for the phasing of handover of land from the MOD.

1.2 CDC intention is to develop the Site in phases, with phase 1 likely to be circa 350 dwellings. All required infrastructure (Drainage, SuDs, Highways, Service's etc.) will be installed in advance of each phase.

Outfalls & Allowable Discharge Rates

2.0 PJ presented AMEC Drawing Figure 'Graven Hill Site and Surroundings Hydrological Features'. PJ confirmed it was WM intention to re-use outfalls SW1-SW5 identified on this drawing.

2.1 PJ presented WM Drawing No: CIV15119-C-SA-92-001, which showed proposed catchments. Catchments have been altered from the AMEC Drainage Strategy to account for phasing of the development. PJ proposed that discharges from the Site would be limited to 2l/s/ha during a 1 in 1 year storm event and 11l/s/ha during a 1 in 100 year plus climate change storm event. NR confirmed that these discharge rates would be acceptable on a pro-rata basis for the new catchment areas.

SuDs & Attenuation

3.0 PJ proposed that attenuation would be provided for up to the 1 in 100 year (+30% for climate change) event and provided using swales and ponds.

3.1 GH commented that OCC would like to see over the edge road drainage and porous paving were slopes/road hierarchy allow it. PJ suggested that due to underlying clay soil, porous paving could not be relied on for infiltration and would require an outfall to a swale / sewer.

3.2 GH suggested that the school wouldn't like open water features but swales would be acceptable along the boundary of the school.

DRAFT

3.3	NR & GH would like to see exceedance routes during more extreme storms (up to a 1 in 500 year event) identified at the site. The site should be designed such that flooding is routed away from buildings to green space and road corridors.	
3.4	EA & OCC have concerns about who will maintain proposed SuDs on self- build plots. If SuDs are to be adopted by the OCC under the Floods & Water Management Act (to be implemented 6th April 2014), then CDC should be made aware of potential maintenance costs on themselves or home owners. WM to make CDC aware of this. EA & OCC to arrange a meeting with CDC to discuss this and other infrastructure adoption / maintenance.	**WM** **EA & OCC**
3.5	EA & OCC have concerns on how pollution of watercourses would be prevented during construction of self-build plots. JM confirmed that this couldn't be policed by planning conditions. PJ suggested that this could be incorporated into a design code for developers. NR commented that this is likely to be too high level for the control of pollution during construction. PJ suggested that CDC may need to produce a detailed developer pack which contains info on how to prevent pollution of watercourses.	
	Flood modelling, finished floor levels & watercourse diversions	
4.0	NR was aware of recent flood modelling of Langford Brook to the west of by Network Rail as part of the Bicester Core scheme. NR to check availability of this model. NR suggested that if this model wasn't available existing flood levels for the Langford Brook could be used and there was no need for WM to re-model for a 3rd time.	**NR**
4.1	For ordinary watercourses NR suggested that for outline planning, a simple assessment to determine buffer zones around ordinary watercourses to protect the development from flooding would be sufficient.	
4.2	NR confirmed that the previous allowance in the AMEC FRA of setting finished floor levels of buildings 300mm above the 1 in 100 year (+20% for climate change) flood level would be sufficient.	
4.3	PJ commented that a watercourse in the west of the Site would need to be diverted as part of the development. NR & GH would prefer this watercourse to remain in open channel and access for future maintenance allowed for in the design.	
	Planning	
5.0	JM confirmed that the EA would accept a to change the draft planning conditions so that relevant information is submitted to the LPA prior to each phase rather than the development as a whole. It was agreed though that an addendum report to the AMEC FRA and Drainage Strategy would be worthwhile as it could be referenced in the planning conditions and would give CDC comfort that planning has been gained for a feasible development.	
5.1	PJ asked whether water quality and flood level data in the AMEC reports is still current. PJ to provide to the EA who will confirm whether it is still relevant	**PJ** **EA**
	Approvals & consents post planning	
6.0	GH confirmed that for diversions / culverting of ordinary watercourses on the site a land drainage consent would be required from OCC as the Lead Local Flood Authority (LLFA)	

DRAFT

6.1 Post 6th April 2014, any SuDs will need to be approved by OCC as the SuDs Approving Body (SAB). GH confirmed arrangements for this still need to be confirmed.

Distribution: All attendees + DN

DRAFT

Appendix H

LLFA correspondence

From:	Callaway, Thomas - Oxfordshire County Council
To:	Matthew Genn
Subject:	RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query
Date:	20 December 2024 12:09:08
Attachments:	image001.png

Hi Matthew

Yes the discharge rates of 2 l/s/ha and 11 l/s/ha are to apply to the respective storm events for the developable area rather than the whole site area.

Regards

Tom Callaway
Team Leader – SuDS & Surface Water
Oxfordshire County Council

thomas.callaway@oxfordshire.gov.uk

Did you know that we have a new pre-application service available for Lead Local Flood Authority advice? Find out more here.

From: Matthew Genn <m.genn@bsp-consulting.co.uk>
Sent: 20 December 2024 11:37
To: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Subject: RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query

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Morning Tom,

Thank you for coming back to me so quickly on Tuesday.

Noted about the pumped solution and what would be required to justify pursuing this option over a gravity outfall.

Just so I can be clear with my client on a gravity outfall from the site, you would expect that runoff is limited to 2l/s/ha and 11l/s/ha based on the developable site area rather than total site area. As discussed previously, to achieve this we would have to accept a larger onsite attenuation volume to get this option to work.

I look forward to your response.

Kind Regards,

Matthew

Matthew Genn
BSc (Hons) MSc
Senior Flood Risk Engineer
BSP Consulting
Office: 0345 413 4000
Direct: 0345 413 4018
e: m.genn@bsp-consulting.co.uk

Advance Notice:

From: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Sent: 17 December 2024 12:40
To: Matthew Genn <m.genn@bsp-consulting.co.uk>
Cc: Tony Goddard <T.Goddard@bsp-consulting.co.uk>; Finlay East <f.east@bsp-consulting.co.uk>
Subject: RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query

Hi Matthew

While we would prefer to see a gravity outfall, a pumped solution can be acceptable. You would need to submit further information to justify the reasoning for having a pumped outfall, and for the use of a tank rather than SuDS. Finally, you would need to provide enhanced maintenance information for the pumped outfall and

consider the provision of duty/standby pumping arrangements etc.

Regards

Tom Callaway
Team Leader – SuDS & Surface Water
Oxfordshire County Council

thomas.callaway@oxfordshire.gov.uk

Did you know that we have a new pre-application service available for Lead Local Flood Authority advice? Find out more here.

From: Matthew Genn <m.genn@bsp-consulting.co.uk>
Sent: 17 December 2024 12:06
To: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Cc: Tony Goddard <T.Goddard@bsp-consulting.co.uk>; Finlay East <f.east@bsp-consulting.co.uk>
Subject: RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query

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Afternoon Tom,

Thank you for coming back to me on this, much appreciated.

The site is constrained in terms of available space and levels, hence why the drainage strategy has evolved towards a below ground tank with a gravity discharge into the watercourse on the western boundary. The strategy had previously considered a pumped solution, but in working with our client we were hoping to achieve a gravity outfall. However, it seems now to achieve an overall strategy that reduces the plan area of the below ground attenuation, whilst also respecting the lower discharge rates, then it seems we will need to move back to a pumped solution?

I am happy to have a quick Teams call to discuss this through, as I am wanting for us to reach a strategy that would acceptable to all.

Kind Regards,

Matthew

Matthew Genn
BSc (Hons) MSc
Senior Flood Risk Engineer
BSP Consulting
Office: 0345 413 4000
Direct: 0345 413 4018
e: m.genn@bsp-consulting.co.uk

Advance Notice:

From: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Sent: 17 December 2024 09:51
To: Matthew Genn <m.genn@bsp-consulting.co.uk>
Cc: Tony Goddard <T.Goddard@bsp-consulting.co.uk>; Finlay East <f.east@bsp-consulting.co.uk>
Subject: RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query

Matthew

Are there any opportunities for SuDS such as attenuation basins? This could potentially be incorporated into landscaping and BNG requirements if the relevant consultees agree.

A pumped discharge can be considered as a last resort, however would this not require a large tank still? The discharge rates being considered are the ones that have previously been agreed I believe.

Regards

Tom Callaway

Team Leader – SuDS & Surface Water
Oxfordshire County Council

thomas.callaway@oxfordshire.gov.uk

Did you know that we have a new pre-application service available for Lead Local Flood Authority advice? Find out more here.

From: Matthew Genn <m.genn@bsp-consulting.co.uk>
Sent: 16 December 2024 14:50
To: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Cc: Tony Goddard <T.Goddard@bsp-consulting.co.uk>; Finlay East <f.east@bsp-consulting.co.uk>
Subject: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire - Pumped Discharge Query
Importance: High

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Afternoon Thomas,

Apologies for throwing another question on this scheme back at you.

However, since Finlay's email last week, we have amended our drainage layout plan and accompanying calculations to include for a complex flow control devices that limits runoff to the 1 in 1 year, 1 in 30 year and 1 in 100-year storm events for the developable site area. As expected, this has resulted in the area of the proposed below ground attenuation tank significantly increasing compared to our previous design iteration.

We have presented the amended drainage design to our client, who has raised concerns regarding the increased cost of the larger tank, as well as potential implications on landscaping and BNG. They are keen that we try to find a drainage solution that reduces the overall footprint of the below tank. One suggestion that they have put forward is whether we could look at a pumped discharge into the ordinary watercourse along the western site boundary. Can I ask whether this would be acceptable in principle as an alternative solution?

We would look to discuss with an appropriate manufacturer about whether there a suitable product that would allow for the variable discharge rates to be maintained.

Finally, I assume that from the previous email correspondence that there would be no opportunity to discuss a higher discharge rate that would allow us to maintain a gravity outfall into the watercourse?

Kind Regards,

Matthew

Matthew Genn
BSc (Hons) MSc
Senior Flood Risk Engineer
BSP Consulting
Office: 0345 413 4000
Direct: 0345 413 4018
e: m.genn@bsp-consulting.co.uk

Advance Notice:

From: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Sent: 10 December 2024 10:07
To: Finlay East <f.east@bsp-consulting.co.uk>
Cc: Matthew Genn <m.genn@bsp-consulting.co.uk>; Tony Goddard <T.Goddard@bsp-consulting.co.uk>
Subject: RE: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire

Finlay

Apologies, it is a little while since I looked at it, but I believe there were two possible issues.

The allowable discharge rate must be based on the developable area, not including areas left undeveloped. So not the whole site area.

The discharge rate for the developed site must also not exceed greenfield runoff rates for the equivalent storm event. I believe only the 1 in 2 year and 1 in 100 year events were referenced, but this should also apply to storm events within that range. E.g. discharging the runoff from the 1 in 30 year storm event at the rate of the 1 in 100 year storm event would increase the risk of flooding downstream, which would be against policy and best practice standards.

Regards

Tom Callaway
Team Leader – SuDS & Surface Water
Oxfordshire County Council

thomas.callaway@oxfordshire.gov.uk

Did you know that we have a new pre-application service available for Lead Local Flood Authority advice? Find out more here.

From: Finlay East <f.east@bsp-consulting.co.uk>
Sent: 06 December 2024 15:12
To: Callaway, Thomas - Oxfordshire County Council <Thomas.Callaway@Oxfordshire.gov.uk>
Cc: Matthew Genn <m.genn@bsp-consulting.co.uk>; Tony Goddard <T.Goddard@bsp-consulting.co.uk>
Subject: 24-0303 - GHBO - Graven Hill Bicester Oxfordshire

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Good afternoon Thomas,

Regarding your comments below:

> We want to see that the restricted discharge rate is applied for the impermeable/developable area only.
>
> The discharge rate should not exceed 2 l/s/ha for the 1 in 1 year event, and 11 l/s/ha for the 1 in 100 year event.
>
> All events up to the 1 in 100 year event can be restricted to Qbar or the 1 in 2 year event if that works for you. Alternatively, the site could discharge at greenfield rates for each storm event with a complex flow control. The first option would be simpler though.

Through the use of a complex control chamber, we have been able to limit the 1in2 year to not exceed 2l/s/ha and for the 1 in 100 year +45%CC we have been able to limit to 11 l/s/ha. My only question is whether you require restrictions for the rainfall events between 1in2 year and 1 in 100 year.
Currently we have a vortex control limiting discharge to 2 l/s/ha for the 1in2year, and then another vortex control chamber above the max 1in2year water level that is restricted to 11 l/s/ha. Is this correct?

If this isn't correct, please contact me to talk through what the LLFA requires.

Kind Regards,

Finlay East
Civil Engineer
MEng (Hons)

BSP Consulting (Nottingham)
Office: 0345 413 4000
Direct: 0345 413 4095
Email: f.east@bsp-consulting.co.uk

www.bsp-consulting.co.uk

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bsp CONSULTING

Nottingham

12 Oxford Street
Nottingham
NG1 5BG

0345 413 4000

Derby

5 Pride Point Drive
Pride Park
Derby
DE24 8BX

0345 413 4000

Leicester

Floor 4
24 De Montfort St
Leicester
LE1 7GB

0345 413 4000

Sheffield

Smithy Wood House
Smithy Wood Cres
Sheffield
S8 0NU

0345 413 4000

www.bsp-consulting.co.uk

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