APPENDIX 10.1
CAMBRIDGE NORTH DEVELOPMENT FLOOD RISK ASSESSMENT AND DRAINAGE

Brookgate Land Limited

Cambridge North Development

Flood Risk Assessment and Drainage Strategy

June 2022

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PJA
The Aquarium
King Street
Reading
RG1 2AN
pja.co.uk

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Purpose

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The conclusions and recommendations contained herein are limited by the availability of background information and the planned use for the Site.

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CDM

The revised Construction (Design and Management) Regulations 2015 (CDM Regulations) came into force in April 2015 to update certain duties on all parties involved in a construction project, including those promoting the development. One of the designer's responsibilities under clause 9 (1) is to ensure that the client organisation, in this instance Brookgate Land Limited, is made aware of their duties under the CDM Regulations.

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Appendices

1 Executive Summary

1.1.1 PJA has been commissioned by Brookgate Land Limited to prepare Flood Risk Assessment (FRA) and Surface Water Drainage Strategy to support a mixed use redevelopment of land at Cambridge North. The proposed development is a hybrid planning application comprising an outline application for up to 425 homes and two commercial buildings and a detailed application for three commercial buildings and a Multi-Storey Car park.

1.1.2 The planning strategy upon which this scope of works was based comprising a detailed application for:

- S4 (Office: GIA approx. 17,326m^2 including basement)
- S5 (Multistorey Car Park: GIA approx. 20,584m^2 including basement)
- S6 (Laboratory: GIA approx. 29,457m^2 including basement)
- S7 (Laboratory: GIA approx. 11,345m^2)
- S8 (Office: GIA approx. 13,056m^2 including basement
- S9 (Laboratory: GIA approx. 24,099m^2 including basement. and
- A total of 425 residential units proposed within Buildings S12 to S21.

1.1.3 The commercial and residential accommodation schedule is included in Appendix A of this report.

1.1.4 A summary of the site can be seen in Table 1-1: Executive Summary Table

Table 1-1: Executive Summary Table

Overview	
Site Location	Milton Avenue, Barnwell, Milton, Cambridge, Cambridgeshire, East of England, England, CB4 0AE, United Kingdom
Development Proposal	Hybrid
Environment Agency Flood Zone(s)	Flood Zone 1
Vulnerability Classifications(s)	More Vulnerable
Fluvial Flood Risk	Low
Surface Water Flood Risk	Very low/low
Groundwater Flood Risk	Low
Sewer Flood Risk	Low
Artificial Flood Risk	Low

2 Introduction

2.1 Terms of Reference

2.1.1 PJA were commissioned by Brookgate Land Limited to prepare a Flood Risk Assessment (FRA) and Drainage Strategy for a proposed commercial development adjacent to North Cambridge station (herein referred to as 'the site').

2.2 Scope of works

Flood Risk Assessment

2.2.1 This FRA provides information on the nature of the identified potential flood risk at the site and follows government guidance with regard to development and flood risk in line with the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance (PPG).

Drainage Strategy

2.2.2 The surface water drainage strategy aims to sustainably manage surface water from the site and has been developed in accordance with current sustainable development best practices and the specific requirements of Cambridgeshire County Council as the Lead Local Flood Authority (LLFA).

2.3 Information Sources

2.3.1 This report comprises a review of readily available public information and other relevant information obtained from the following sources:

- Environment Agency (EA);
- British Geological Survey (BGS);
- Cranfield Soil and Agrifood Institute Soilscapes;
- DEFRA Magic Mapping;
- Cambridge City Council (CCiC) Planning Documents;
- Cambridgeshire Flood and Water Supplementary Planning Document
- Cambridgeshire County Council (CCoC) Surface Water Planning Guidance
- CIRIA Guidelines; and
- Design and Construction Guidelines (2020)

3 Site Details

3.1 Site Description

3.1.1 The site forms part of the wider Cambridge North redevelopment, the first phase of which has been completed and comprises Cambridge North Railway Station, a new hotel and a new commercial building (also known as building S3). The site is located on previously developed land to the north of the first phase of the Cambridge North redevelopment.

3.1.2 The existing site is occupied by a mixture of unused, unmade ground; vegetated areas comprising dense trees and hedges; a surface-level car park that serves Cambridge North Railway Station; and access roads connecting the first phase of the Cambridge North development to the wider highway network in Cambridge to the north-west. The site was previously occupied by railway sidings.

3.1.3 Cowley Road runs through the middle of the site in a north/south direction. It is proposed in the future that the section of Cowley Road that runs within the application site will be known as Milton Avenue. A cycleway runs adjacent to Cowley Road. Milton Avenue separates two parts of the site, to the north-west of the station and hotel, and runs in an east/west direction. Cambridgeshire Guided Busway runs along the western edge of the site in a north/south direction.

3.1.4 North-west of the site is Cambridge Business Park and an industrial park, and further to the north lies the Cambridge Water Recycling Centre (WRC). North of the site boundary is an aggregates railhead. The Nuffield Road Allotment lies to the southwest of the site within a small, wooded area. The eastern edge of the site is bordered by the Fen Line, a railway line connecting Cambridge and King's Lynn.

3.1.5 The site is relatively flat with fluctuations in elevation between 6m and 7m Above Ordnance Datum (AOD).

3.1.6 The site's OS national grid reference is X (Eastings) 547419, Y (Northings) 260815.

3.1.7 The red line boundary for the site is included in Appendix B and also indicatively shown on Figure 3-1 .

3.1.8 The nearest Main River is the River Cam located between 400 and 630m east of the site.

3.1.9 An ordinary watercourse called the First Public Drain (FPD) is located to the north-west of the site. The watercourse is an open channel running adjacent to Cowley Road outside of the site extents. The watercourse enters a culvert near the junction of Cowley Road and the access road to the aggregates railhead. The culverted watercourse passes under the northern extent of the site beneath the access road to Cambridge North car park and flows eastwards under the railway.

3.1.10 A site location plan and summary are available in Figure 3-1 and Table 3-1 respectively below.

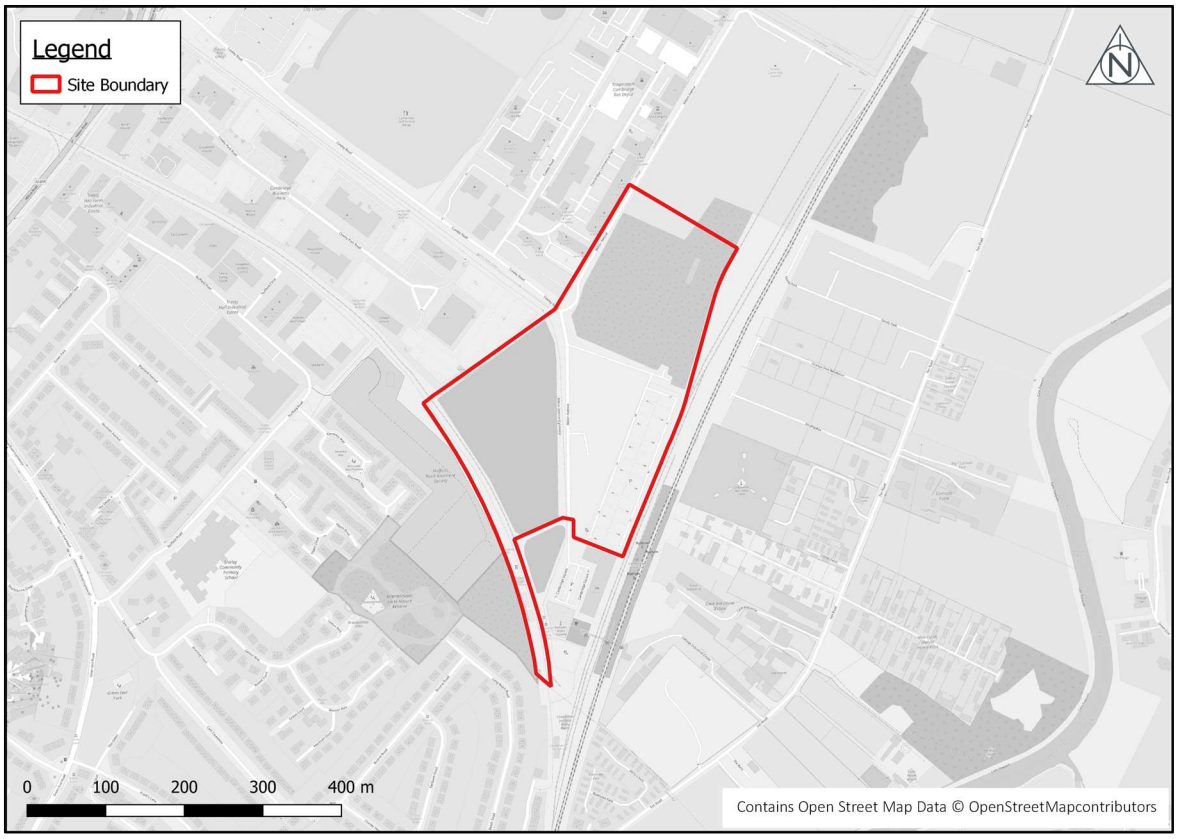

Figure 3-1: Site Location Plan

Table 3-1: Site Summary

Site Address	Milton Avenue, Barnwell, Milton, Cambridge, Cambridgeshire, East of England, England, CB4 0AE, United Kingdom
Existing Land use	Mixed land use – commercial, car parking, rail infrastructure and vacant
Proposed Development Type	Mixed proposed development – Residential Units, Offices, Laboratories and Car Parking
Site Area	8.1ha
OS grid reference	547446, 260823
County	Cambridgeshire
Local Planning Authority	Cambridge City Council
Lead Local Flood Authority	Cambridgeshire County Council
Local Water Authority	Anglian Water

3.2 Site Topography

3.2.1 The site is predominantly brownfield with commercial, car parking, rail infrastructure and vacant hardstanding areas. There are some green spaces with trees and dense vegetation present on the site.

3.2.2 From a review of publicly available 1m Digital Terrain Model (DTM) LiDAR data and site topographic surveys, the site's topography is shown to be relatively flat with fluctuations in elevation between 6m and 7m AOD.

3.2.3 Cowley Road falls in a north to south direction. The topographic survey for the site is included as Appendix C to this report.

3.2.4 Figure 3-2 illustrates the topography of the site based on the publicly available 1m DTM LiDAR data, respectively.

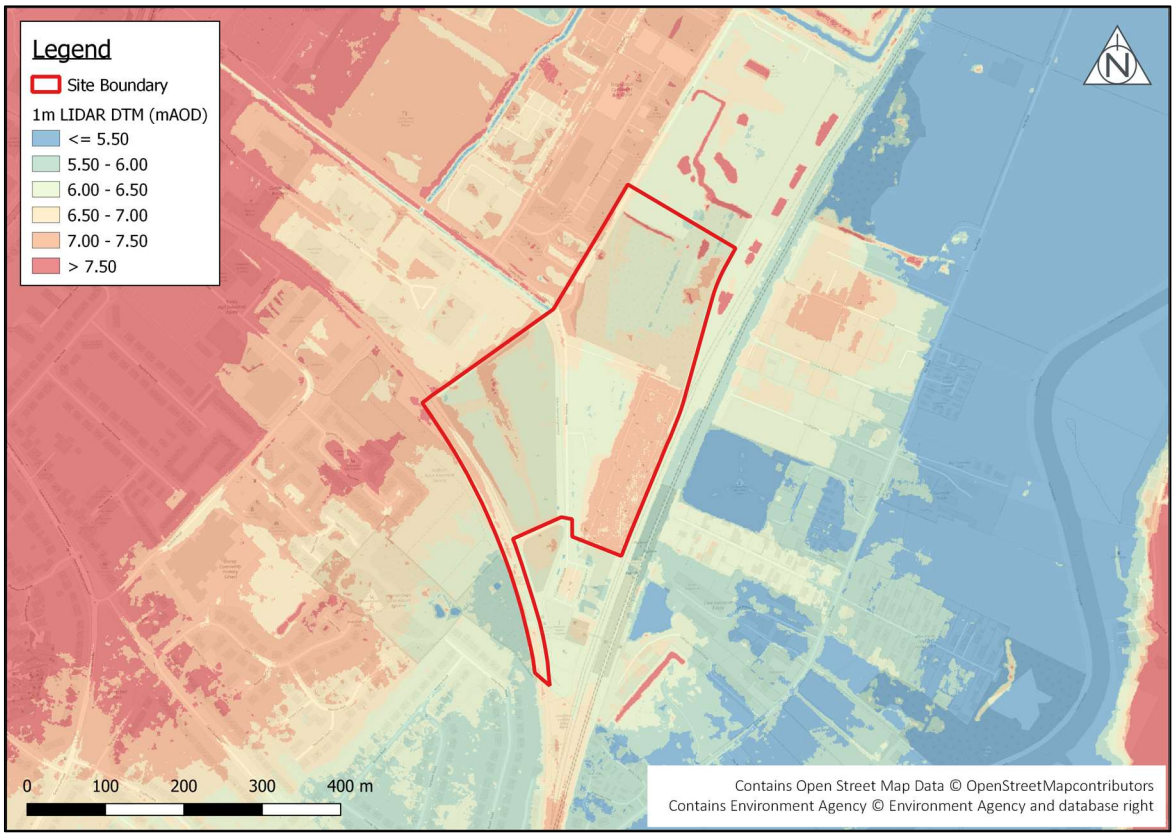

Figure 3-2: Existing Site Topography

3.3 Site Soils and Geology

3.3.1 The BGS Geology of Britain viewer[1] was reviewed to identify the local geological conditions. This identified that the overlying superficial deposits are comprised of River Terrace Deposits including

[1]British Geological Survey. Geology of Britain Viewer.
https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

Sands and Gravels. The underlying bedrock formation is identified as part of the Gault Formation which is typically comprised of Mudstone.

3.3.2 The Cranfield University Soilscape viewer[2] suggests that the majority of the site contains soils that are comprised of loam and sand with naturally high groundwater and a peaty surface. The remainder of the site contains soils that are comprised of freely draining lime-rich loamy soils.

3.4 Hydrogeology

3.4.1 From a review of the publicly available DEFRA Magic Mapping[3], Aquifer Designation Map (Superficial Drift) the site is underlain by a Secondary A aquifer that comprises permeable layers that can support local water supplies and may form an important source of base flow to rivers. The Aquifer Designation Map (Bedrock) does not identify an underlying aquifer.

3.4.2 The site is not underlain by a Groundwater Source Protection Zone.

3.4.3 More information on groundwater can be found in Section 3.5.

3.5 Site-Specific Ground Investigation

3.5.1 A "factual report on ground investigation" for the site was produced by Socotec[4] in November 2017. The factual report provides results for exploratory holes and in situ testing carried out on site in addition to groundwater monitoring. Figure A2 from the report is included as Appendix D to this report and shows recorded groundwater levels below ground level along the proposed 'Station Row' which runs south to north through the centre of the proposed site.

3.5.2 From a surface water drainage perspective, the geology of the site is relatively consistent. Upper strata tend to be comprised of Made Ground up to a depth of around 1-3m below ground level (bgl). Underlying geology is broadly comprised of stiff clay. The depth of clay is found immediately below Made Ground deposits at 1-3bgl and extends to the bottom of exploratory holes (some in excess of 20m bgl).

3.5.3 Groundwater depths across the site were recorded between 2.83 to 0.82m bgl. Results were recorded between the start of September and start of October 2017.

3.5.4 According to the Met Office[5] the average recorded rainfall for Cambridge between 1981 and 2010 in September and October was 53.5mm and 59.0mm respectively. September and October are, on average, the two wettest months of the year. Rainfall data for East Anglia suggests that September

[2]Cranfield Soil and Agrifood Institute. Soilscape Viewer. http://www.landis.org.uk/soilscapes/
[3] DEFRA Magic Map https://magic.defra.gov.uk/MagicMap.aspx
[4] Socotec, Cambridge North Development, Factual Report on Ground Investigation, Report No E7030, November 2017
[5] Rainfall Data observed here: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/u1214qgj0

2017 was slightly wetter than average with 58mm rainfall recorded following a very wet summer (rainfall exceeding 60mm in the previous 4 months). The groundwater depths recorded should therefore give a robust representation of average groundwater levels across the site during wetter periods.

3.5.5 Deeper groundwater levels (>2m bgl) are recorded across the west of the site, whereas shallower groundwater levels (<1m bgl) are found to the east.

3.5.6 Based on the 2017 Ground Investigation report initial geological conditions and groundwater levels, surface water drainage via infiltration is not viable as a method of surface water disposal. This is due to the extensive presence of Made Ground and high groundwater levels.

3.6 Existing Drainage Assets

3.6.1 The existing site is a brownfield, developed site with green vegetated areas.

3.6.2 Much of the site has been redeveloped in the last decade with the creation of North Cambridge Station and the associated "Novotel" hotel. Existing Surface Water Drainage across the site is privately owned and maintained.

3.6.3 As part of the existing development of the site two surface water drainage networks have been identified. A larger network collects runoff from the majority of the site, whilst a second smaller network drains the access road to existing North Cambridge Station temporary car park and a small section of Cowley Road. The existing drainage networks serve catchments 5 and 6 on the Surface Water Drainage Strategy drawing included as Appendix I to this report.

3.6.4 A description of the larger existing network is contained below:

(1) The larger network accepts runoff from the Cambridgeshire Guided Busway, Cowley Road, Cambridge North Station, the hotel and the associated car parks.

(2) The network includes collection methods comprising gullies, combined kerb drains, slot drains, filter drains and rain gardens.

(3) Most of the site discharges surface water into a branch of the network that flows via gravity to a pumping station west of the hotel. The pumping station limits discharge to approximately 170l/s and attenuation is provided via extensive 900mm diameter pipes immediately upstream of the pumping station.

(4) Water leaves the pumping station via a surface water rising main which flows northeast towards North Cambridge Station temporary car park.

(5) At North Cambridge Station temporary car park, the rising main connects into a chamber that disperses flow into an attenuation tank.

(6) The outlet from the tank discharges flow northwards via a filter drain which collects runoff from the car park.

(7) The filter drain discharges flow into a flow control chamber which limits the outgoing flow to a rate of approximately 6.6l/s.

(8) From the flow control there is a single outfall into the FPD Overflow Culvert which is located under the access road to North Cambridge Station temporary car park.

3.6.5 A description of the smaller existing network is contained below:

(1) Water is collected from the gullies along the access road to North Cambridge Station temporary car park and the nearby junction with Cowley Road.

(2) The gullies connect into a carrier pipe system that flows into a vortex flow control chamber limiting discharge rates to 12.3l/s.

(3) From the flow control chamber water is discharged into the FPD Overflow Culvert.

3.6.6 A review of the previously submitted drainage strategies for the development of North Cambridge station and the Novotel state that discharge rates from the site have historically been limited to 2l/s/ha. The final discharge into the FPD Overflow Culvert from the main network at 6.6l/s is based on a total impermeable area for the site comprised of access roads, disabled car park, roofs, plaza and platforms, 450 space porous car park with impervious liner. The discharge rate from the second smaller network (12.3l/s) was previously agreed with CCiC in 2017 during a previous planning application.

3.7 First Public Drain

3.7.1 The FPD is an ordinary watercourse that is located to the north-west of the site. The FPD is an open watercourse running adjacent to Cowley Road outside of the site extents.

3.7.2 The culverted overflow pipe from the FPD is currently sited below the access road to Cambridge North Station temporary car park. The culvert was redirected previously as part of the development of North Cambridge Station.

3.7.3 The FPD overflow culvert is under riparian ownership. However, as part of the new diversion proposed as part of this strategy an Ordinary Watercourse Consent should be obtained from CCoC before work on the FPD commences.

3.8 Site Proposals

3.8.1 The application site forms part of the Major Development Site allocation within the adopted South Cambridgeshire Local Plan (2018), under Policy SS/4: Cambridge Northern Fringe East and Cambridge North railway station. The application site also falls within the emerging North East Cambridge Area Action Plan (NEC AAP) area.

3.8.2 The Architect and Landscape Architects Masterplans are included in Appendix E and an extract can be seen below in Figure 3-3. The individual building uses are as listed in Section 1.1.2.

Figure 3-3: Masterplan Extract (239-ACME-PLA-S00-0013 Rev -)

4 Planning Context

4.1 National Planning Policy Framework

4.1.1 The revised NPPF was published by the Ministry of Housing, Communities and Local Government in July 2018 and was updated in 2021. The NPPF's Planning Practice Guidance (PPG) supports the Framework and is an online resource that is frequently updated.

4.1.2 Paragraph 167 of the National Planning Policy Framework (NPPF) advises that when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere and that where appropriate, applications should be supported by a site-specific FRA. The NPPF also states that developments should incorporate Sustainable Drainage Systems (SuDS) unless there is clear evidence that this would be inappropriate.

4.1.3 This FRA & SWDS has been prepared in line with the guidelines of the NPPF, accompanying Planning Policy Guidance for Flood Risk & Coastal Change (PPG-FRCC) and local standards to provide sufficient evidence to inform the design and decision-making process for the proposed development.

4.1.4 The principle aims of this FRA & surface water drainage strategy are:

- To assess potential sources of flooding at the site and consider whether there is an associated flood risk present both to and arising from redevelopment of the site;
- To take the impacts of climate change into account and ensure that the development remains safe from flood risk during its lifetime as reasonably practicable as possible;
- To consider the vulnerability and safety of occupants relative to flood risk;
- To identify any opportunity for flood risk reduction and subsequently identify whether residual risk management should be considered;
- To consider existing and proposed methods of surface water runoff management and in turn establish a sustainable strategy for drainage of the development.

4.1.5 Paragraphs 159 and 162 of the NPPF sets out the principle aim to avoid inappropriate development in areas at risk of flooding, to steer new development to areas with the lowest risk of flooding from any source and that development should be made safe for its lifetime without increasing flood risk elsewhere.

4.1.6 According to Table 2 of the Planning Practice Guidance - Flood Risk & Climate Change (PPG-FRCC), the primary proposed land use (residential development) falls within the category of 'More Vulnerable'. Table 3 of the same guidance indicates that development with this vulnerability of use within Flood Zone 1 would be appropriate.

4.1.7 Paragraph 18 of the PPG-FRCC advises that 'according to the information available, other forms of flooding should be treated consistently with river flooding in mapping probability and assessing vulnerability to apply the sequential approach across all flood zones'.

4.1.8 Paragraph 50 of the PPG-FRCC directs developers to 'seek opportunities to reduce the overall level of flood risk in the area and beyond'. It advises that 'this can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of Sustainable Drainage Systems' (SuDS). A surface water drainage strategy is considered later in this report to accord with best practice drainage design to suit the constraints of the site (i.e., topography, ground conditions, location and level of existing drainage), development density and proposed layout.

4.2 Local Policy

Local Plan (South Cambridgeshire District Council)

4.2.1 The South Cambridgeshire Local Plan was adopted in 2018 and sets out the planning policies and land allocations to guide the future development of the district up to 2031 (SCDC, 2018). It includes policies on a wide range of topics such as housing, employment, services and facilities, and the natural environment.

4.2.2 The application site forms part of the Major Development Site allocation within the South Cambridgeshire Local Plan (2018) under Policy SS/4: Cambridge Northern Fringe East and Cambridge North railway station. Policy SS/4 confirms that the area is allocated for “high quality mixed-use development, primarily for employment within Use Classes B1, B2 and B8 as well as a range of supporting uses, commercial, retail, leisure and residential uses (subject to acceptable environmental conditions).”

4.2.3 Pertinent to this report are policies CC/8 (Sustainable Drainage Systems) and CC/9 (Managing Flood Risk).

4.2.4 Policy CC/8 promotes current industry best practice in the provision of Sustainable Drainage Systems (SuDS), noting that schemes should comply with the non-statutory technical standards for SuDS (Defra, 2015) and the Cambridgeshire Flood and Water Supplementary Planning Document (CCC, 2016).

4.2.5 Policy CC/9 sets out requirements for development proposals to meet the Sequential Test and (where necessary) the Exception Test, in accordance with the NPPF. The policy sets out flood protection measures that should be incorporated into development design, such as raising of floor levels. The policy also specifies the need for development proposals to be supported by a site-specific Flood Risk Assessment (FRA); requires that proposals do not increase flood risk elsewhere; and requires the destination of surface water discharge to obey the following priority order:

(1) firstly, to the ground via infiltration;

(2) then, to a water body;

(3) then, to a surface water sewer;

(4) discharge to a foul water or combined sewer is unacceptable.

Emerging Greater Cambridge Local Plan

4.2.6 Cambridge City Council and South Cambridgeshire District Council are working together to create a new joint Local Plan for the two areas – referred to as Greater Cambridge.

4.2.7 In November and December 2021, the Councils undertook the 'First Proposals' consultation, also known as Regulation 18 Preferred Options consultation. This sought views on the emerging development strategy, the direction of travel for policies and issues the Council should be considering as policies are prepared.

4.2.8 In the 'First Proposals' consultation document, a new Policy (Policy S/NEC: North East Cambridge) is proposed to cover the whole of the AAP area and to set out the placemaking vision for and the scale and scope of development at North East Cambridge.

4.2.9 The Emerging Greater Cambridge Local Plan, when adopted, will replace the South Cambridgeshire Local Plan and Cambridge Local Plan. However, given the early stage of preparation it carries little weight in the decision-making process

Draft North East Cambridge Area Action Plan (NEC AAP)

4.2.10 South Cambridgeshire District Council and Cambridge City Council are jointly preparing an Area Action Plan (AAP) for North East Cambridge. Once adopted the Area Action Plan would form part of the statutory development plan for both Councils. It will set out a series of site specific policies and the mix and quantum of development for the Area Action Plan.

4.2.11 The Proposed Submission version of the emerging NEC AAP (Regulation 19) was reported to the respective decision-making committees of the Councils over December 2021 to January 2022 and was approved for public consultation. However, the Proposed Submission Plan is not able to progress to public consultation until the Development Consent Order (DCO) process for the relocation of the Cambridge Waste Water Treatment Plant has concluded.

4.2.12 In light of the above, the NEC AAP remains at an early stage in its preparation and can only be afforded negligible weight in the determination of planning applications.

4.2.13 However, the evidence based studies that are informing the emerging NEC AAP form material considerations and the Surface Water Drainage Core Principles document is of relevance.

4.2.14 The NECAAP Surface Water Drainage Core Principals state the following:

- The Councils will require outfalls to be gravity designed unless certain site conditions apply as contained within the Sustainable Design and Construction SPD (2020) and Anglian Water Design and Construction Guidance (DCG 2020). A pumped solution will only be considered acceptable if it can be clearly demonstrated that all other options are unfeasible.
- Development proposals will be required to demonstrate that the peak rate of run-off over the lifetime of the development achieves greenfield run-off rates. If this cannot be technically achieved, then the limiting discharge should be 2 litres per second per hectare for all events up to and including the 100-year return period event, including an allowance for climate change.
- Between 10-15% of each development parcel should be allocated towards SuDS attenuation and conveyance. Land used for SuDS will not be included in formal open space calculations. This is to ensure the functionality of the SuDS system does not reduce the amount of useable formal open space provided on-site.

Level 1 and 2 Strategic Flood Risk Assessment (SFRA)

4.2.15 A level 1 SFRA was completed in September 2010 and published by South Cambridgeshire District Council and Cambridge City Council.

4.2.16 The published date of the SFRA precedes current planning guidance and requirements. The contents of the SFRA are focused primarily on fluvial flooding across the region including the nearby River Cam. No mention is given to the ordinary watercourse referred to as the First Public Drain.

4.2.17 Appendix D of the document contains Flood Zone mapping which differs slightly from EA flood risk maps. The drawing “FLOOD RISK CONSTRAINTS 1402 - D - 1.2” in the appendix shows that the extent of the Flood Zones does not encroach on the site.

4.2.18 There is no specific mention of the site or immediate surrounding area being at risk of flooding in the level 1 SFRA and the Level 2 SFRA does not apply to the area which the site is located in.

Local Flood Risk Management Strategy (LFRMS)

4.2.19 The Local Flood Risk Management Strategy 2015-2020 was published in September 2015. The revised Strategy 2021-2027 is currently under consultation.

4.2.20 The Strategy explains the different organisations, authorities and individuals involved in flood risk management in Cambridgeshire. There is a reference guide for some of the main flood related

issues that may be experienced. The principal management organisations are also discussed setting out what their roles and responsibilities are.

4.2.21 The organisations are defined by the Flood and Water Management Act 2010 as 'risk management authorities' (RMAs) with responsibilities relating to the LFRMS. All RMAs must also act in a manner which is consistent with the National Strategy and guidance.

Cambridgeshire Culvert Policy

4.2.22 Cambridgeshire Culvert Policy was published in 2013. The culvert policy aims to:

4.2.23 CCoC is generally opposed to the culverting of watercourses due to the adverse ecological, flood risk, human safety and aesthetic impacts. Each application to culvert a watercourse will only be approved if there is no reasonably practicable alternative or if the detrimental effects would be so minor that a more costly alternative would not be justified.

4.2.24 The Policy is written to:

- Clarify CCoC's approach to assessing permissions for culverts;
- Ensure a consistent approach to culverting approvals; and
- Demonstrate how CCoC will take action to protect the continuity and integrity of watercourses within the county.

Water Resources East (WRE) Emerging Water Resources Plan for Eastern England

4.2.25 One of the focuses of the regional plan is defined as the recovery, enhancement and protection of the natural water environment through an overarching water resources related environment vision for the region.

4.3 Consultation (LLFA / Environment Agency)

Meetings were held with the Drainage Officers from the CCoC LLFA Harry Pickford on the 13th of December 2021 and with Luisa Nunes from CCiC on the 13th of December 2021 and 9th February 2022. The minutes of these meetings are included as Appendix F to this report.

5 Assessment of Flood Risk

5.1.1 The flood risk to and from the site has been assessed based on a review of publicly available information (e.g., Environment Agency flood data). A summary of the flood risk at the site is provided in Table 5-1 and discussed in more detail in the chapters below.

Table 5-1: Potential Sources of Flood Risk

Source of Flooding	On Site Presence
Fluvial	×
Tidal	×
Surface Water	✓ *(section 5.4)*
Reservoirs	×
Groundwater	×
Sewers	×

5.2 Historic Flooding

5.2.1 The EA were contacted to provide a better understanding of flood risk at the site. EA flood data is included as Appendix G to this report.

5.2.2 EA Mapping showing historic flooding shows that a portion of the north of the site flooded in 1947 but not during more recent flooding in 2001. The 1947 floods were deduced to be caused by the backing up of flood water from the River Cam into the open channel section of the FPD which then over topped its banks to flood the existing railway depot, largely in the area North of Cowley Road (NoCR). The absence of any flooding in the 2001 event is assumed to be due to the introduction of the overflow culvert to the FPD, better flow control at the FPD/River Cam interface north of the A14 Highway (i.e., a weir) and/or changes to flow pathways and land uses in the intervening years.

5.3 Fluvial Flooding

5.3.1 The EA, through the publicly available Flood Map for Planning, categorises potential fluvial flood risk into Flood Zones, assuming no flood defences, which provides the basis for the assessment of flood risk and development suitability under the NPPF.

5.3.2 The proposed development site is identified in the publicly available Flood Map for Planning as located wholly within Flood Zone 1, demonstrating that the fluvial flood risk is considered to have <0.1% Annual Exceedance Probability (AEP). The 0.1% AEP floodplain is included within Appendix G to this report and is shown not to extend from the River Cam to any areas west of the railway lines including the site.

5.3.3 An extract of the Flood Map for Planning is contained in Figure 5-1.

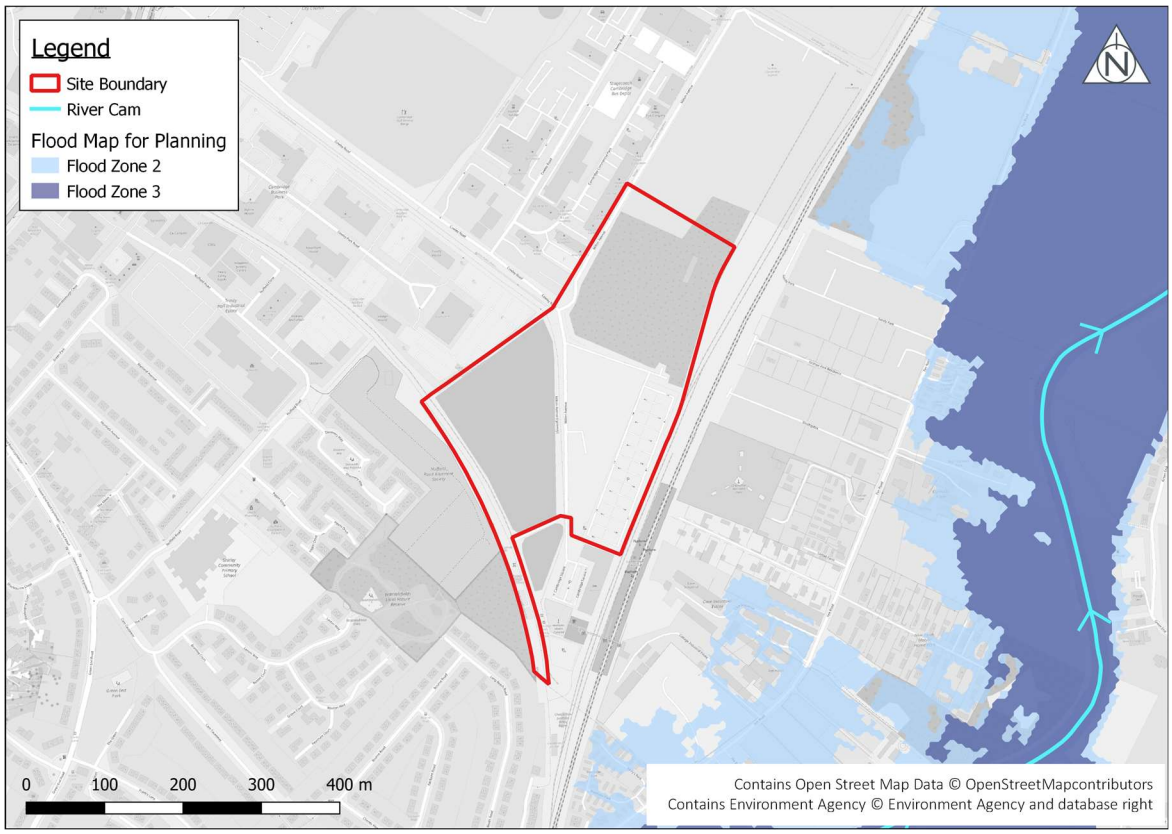

Figure 5-1: EA Flood Map for Planning Extract

5.3.4 Figure 5-1 is an extract of the publicly available Flood Map for Planning and identifies that the site lies wholly within Flood Zone 1 and that the risk of flooding from fluvial and tidal sources to the site is very low. Areas located within Flood Zone 1 have less than a 0.1% chance of flooding in any given year. The risk of fluvial flooding affecting the site is assessed as very low.

Vulnerability Classification

5.3.5 Table 2 of the NPPF summarises the flood risk vulnerability classification for different types of development. The proposed residential development at the site is classified as More Vulnerable development, with the commercial development proposed classified as Less Vulnerable whilst the amenity open space classified as water-compatible development. Some of the buildings include basement provisions and there are proposed to be laboratories on site which could at times contain hazardous substances, these buildings would be classified as Highly Vulnerable development.

5.3.6 In accordance with the NPPF, all vulnerability classifications are appropriate for development within Flood Zone 1. The proposed development meets the requirements of the Sequential Test and there is no requirement to apply the Exception Test in the context of fluvial flood risk.

5.4 Surface Water Flooding

5.4.1 The EA Flood Risk from Surface Water Map identifies the site to be in an area with very low (each year this area has a chance of flooding of less than 0.1%) to low (each year this area has a chance of flooding of between 0.1% and 1%) surface water flood risk. The mapping shows this surface water to flow in a south easterly direction along the route of the FPD adjacent to Cowley Lane. Some of this surface water follows the route of the FPD in a north easterly direction whilst a nominal amount leaves the extents of the FPD channel and continues along Milton Avenue to disperse within the Site. The mapping shows that flood water leaves the confines of the FPD channel during the 0.1% to 1% Annual Exceedance Probability (AEP) event and as such is regarded as an extreme event and beyond the requirements of a design event. An extract of this mapping is provided in Figure 5-2.

5.4.2 As part of the site drainage and landscape design, measures will be implemented to ensure there is no increase in surface water flood risk both on- and off-site and to ensure that any such exceedance flows will be directed away from buildings. This is discussed in Section 6.9 in further detail.

5.4.3 Flood risk from surface water sources is therefore considered to be low.

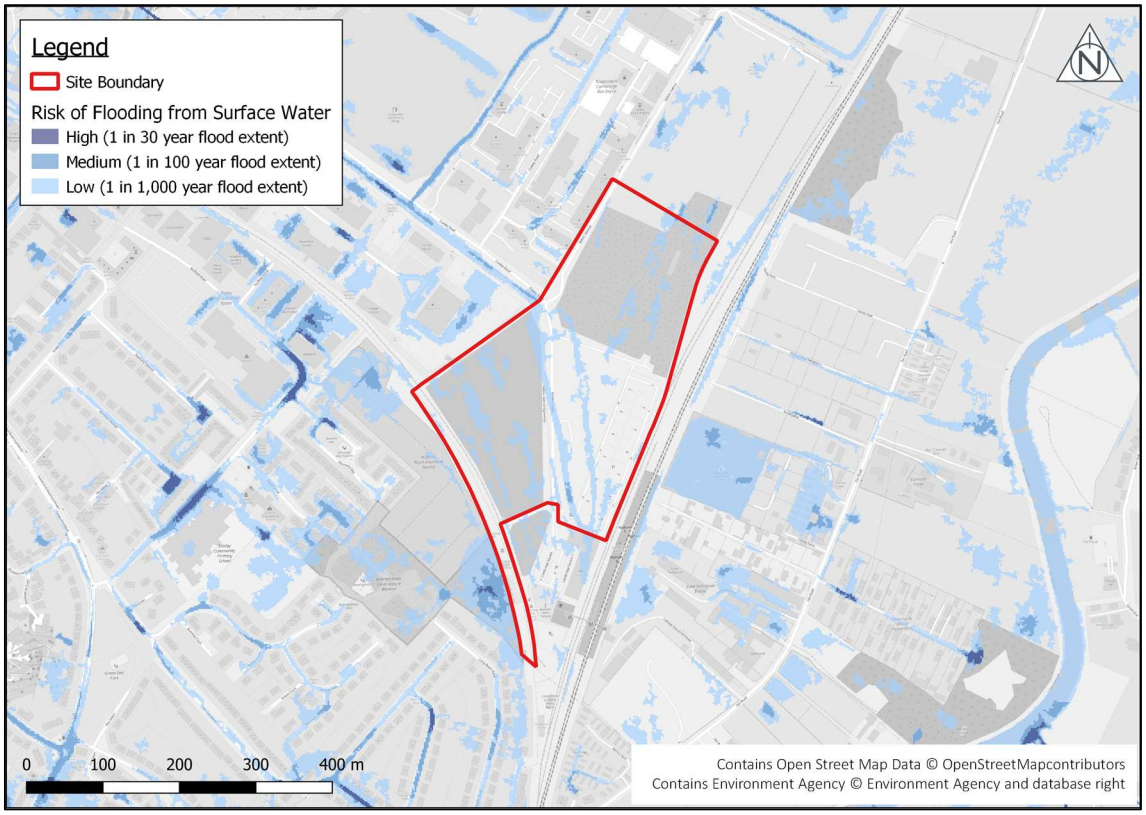

Figure 5-2: EA Surface Water Flood Mapping Extract

5.5 Groundwater

5.5.1 Groundwater flooding is typically caused by high groundwater levels. It occurs where excess water emerges at the ground surface via springs or within manmade structures such as basements. The risk of groundwater flooding depends upon the nature of the geological strata underlying the site, as well as on the local topography.

5.5.2 The Greater Cambridge Integrated Water Management Study plan '' Susceptibility to Groundwater Flooding'' shows the site located in an area where groundwater has the potential to occur at the ground surface. This plan is included as Appendix H to this report.

5.5.3 A review of published British Geological Survey (BGS) mapping shows that Made Ground is not recorded at the site. However, Made Ground may be present associated with the site's historical use. Published geological mapping indicates the majority of the site is underlain by River Terrace Deposits described as 'sand and gravel, locally with lenses of silt, clay or peat'. Superficial Deposits are indicated to be absent from the northern and eastern extents of the site. Bedrock of the Gault Formation underlies the entirety of the site.

5.5.4 The Socotec ground investigation report provides results for exploratory holes and in situ testing carried out on site in addition to groundwater monitoring. Groundwater depths across the site were recorded between 2.83 to 0.82m bgl. Results were recorded between the start of September and start of October 2017. The groundwater depths recorded give a good representation of average groundwater levels across the site during wetter periods.

5.5.5 Deeper groundwater levels (>2m bgl) are recorded across the west of the site, whereas shallower groundwater levels (<1m bgl) are found to the east.

5.5.6 Groundwater flood risk is hence assessed to be medium to high.

5.5.7 The site is not located within a groundwater Source Protection Zone. The principal aquifer in the locality with its associated abstraction boreholes is predominantly located to the east of Cambridge City.

5.6 Sewer Flood Risk

5.6.1 The Greater Cambridge Integrated Water Management Study plan ''Historic Sewer Flooding'' shows the site located in an area where few sewer flooding incidences have been recorded. This plan is included as Appendix H to this report.

5.6.2 The Historic Sewer Flooding map uses the DG5 register provided by the sewerage company, Anglian Water, which is a record of all reported sewer flooding incidents. The incidents are recorded on a postcode basis; therefore, each coloured area represents the total number of reported incidents,

both internal and external, within that postcode. Between two and five flooding incidents were recorded in the postcode local to the site.

5.6.3 The site is considered to be at low risk of sewer flooding based upon the Anglian Water DG5 list.

5.7 Reservoir Failure

5.7.1 The publicly available EA Flood Risk from Reservoirs Mapping identifies that the site lies outside the maximum extent of flooding from reservoirs.

5.7.2 Flood risk from reservoirs may be considered to be very low.

5.8 Canal

5.8.1 Flooding from canals is a much less common occurrence than fluvial flooding due to the managed nature of water levels within the artificial waterways.

5.8.2 There are no canals within the vicinity of the site. Flood risk from canals is considered to be very low.

5.9 Summary

5.9.1 The existing risk of groundwater flooding is assessed as medium. The risk of surface water and sewer flooding is assessed as low. The risk of fluvial, reservoir or canal flooding is assessed as very low.

5.9.2 Mitigation for the groundwater flood risk will be explored under the surface water drainage strategy section of this report.

5.9.3 The consultations undertaken with third parties are listed below

Table 5-2: Summary of Consultation

Source of Flooding	Date Response Received	Comments
Environment Agency	30th September 2021	EA Product 4 Flood Data
Cambridgeshire County Council Lead Local Flood Authority	December 2021 to January 2022	Meeting December 13th, 2021, and Telecon 12th January 2022 with Harry Pickford
Anglian Water	20th October and 4th November 2021 1st December 2021	Asset Plans received including extended locality Foul water assessment including connection manhole

6 Surface Water Drainage Strategy

6.1.1 A Surface Water Drainage Strategy outlining the means of surface water management and disposal from the proposed development site has been produced largely in line with the latest guidance as follows:

- CIRIA C753 "The SuDS Manual", November 2015;
- CIRIA document C522 Sustainable Drainage Systems – design manual for England and Wales;
- CIRIA document C635 Designing for exceedance in urban drainage;
- Rainfall Runoff Management for Developments – SC030219 (Environment Agency, 2013);
- Environment Agency's pollution prevention guidelines (PPGs); and
- Sewerage Sector Guidance – Design & Construction Guidance Approved Version 2.1 (May 2021)

6.1.2 The proposed Surface Water Drainage Strategy aims to sustainably manage surface water runoff without increasing flood risk to on- or off-site areas, nor adversely impacting on water quality through the use of Sustainable Drainage Systems (SuDS).

6.1.3 SuDS aim to mimic the natural processes of surface water drainage by allowing water to flow along natural flow routes ensuring that runoff rates and volumes during storm events are not increased above the greenfield values. SuDS also aim to provide water treatment, biodiversity and amenity benefits within blue and green corridors.

6.1.4 There are typically three design storm events which should be considered when designing the SuDS system and managing flows and volumes:

- 1 in 1 year storm event, on sloping sites without basements, where surcharging above soffits of any surface water drainage pipework is not permitted.
- 1 in 30 year storm event, where surface water flooding of the site does not occur at this frequency.
- 1 in 100 year storm event with allowances for future climate change, where runoff from the site should be controlled to the greenfield rate using SuDS attenuation features to manage flows and volumes within the extents of the development site.

6.1.5 Further to this, dedicated overland flow routes should be identified through the development to convey any exceedance flows in events greater than the 1 in 100-year plus climate change event or in the event of system failure.

6.2 Existing Surface Water Drainage Features

6.2.1 The site was formerly a railyard depot. Existing drainage is assumed to have been achieved by infiltration despite the high groundwater levels recorded on the site. No existing drainage connections to surface water sewers or watercourses have been identified from the former use.

6.2.2 The site masterplan and landscape masterplan are included within Appendix E to this report.

6.2.3 The southern end of the site has been developed under previous planning permissions to enable the development of Cambridge North Railway Station and an adjacent hotel. The station and hotel development along with Plot S3 (currently under construction) drain to an existing surface water pumping station at the southern end of the site on the hard shoulder of the Cambridgeshire Guided Busway. From here the water is pumped via a rising main to a granular storage reservoir located under the temporary car park on the east of the site (the location of proposed structures S5, S6 and S7). The granular storage reservoir drains by gravity to the FPD overflow culvert which then discharges underneath the railway lines to the east, ultimately outfalling to the River Cam.

6.3 Discharge Hierarchy

6.3.1 In accordance with SuDS guidance, surface water should be sustainably managed and designed in accordance with the discharge hierarchy; collect for re-use; infiltrate to ground; discharge to watercourse; discharge to surface water sewer, highway drain or another drainage system; and lastly discharge to a combined sewer.

Table 6-1: Drainage Hierarchy

Discharge Location	Suitability	Comments
Collect for Re-Use	✓	The potential to incorporate rainwater harvesting and re-use measures may be assessed further during the detailed design stage.
Infiltration	×	The high groundwater levels recorded during the ground investigation have led to infiltration being discounted as an option.
Watercourse	✓	The overflow culvert to the FPD is classed as an ordinary watercourse and is the proposed outfall for surface water discharge from the site.
Surface Water Sewer	×	There are no existing surface water sewers in the locality of the site.
Combined Sewer	×	There are no existing combined water sewers in the locality of the site.

6.3.2 In accordance with the above sequential approach to the disposal of surface water, it is proposed that surface water runoff is predominantly discharged to the overflow culvert to the FPD.

6.4 Pre-development Surface Water Run-off rates

6.4.1 The pumping station serving the existing station and hotel development discharges at 170 l/s. The receiving granular storage reservoir discharges into the FPD overflow culvert at a maximum rate of 9.3 l/s equating to a design flow of 3.3 l/s/ha for this catchment. This is Catchment 5 on the proposed Surface Water Drainage Strategy drawing (refer to Appendix I) with a drainage area 2.806 ha

6.4.2 An area of Cowley Road at the north of the site discharges directly to the FPD overflow culvert via a petrol interceptor and a flow control limited to 12.3 l/s. This is Catchment 6 on the proposed drainage strategy with a drainage area 0.323 ha.

6.4.3 Discharge from these two catchments is proposed to remain unchanged under this development with the pumped discharge rate remaining at 170 l/s.

6.5 Climate Change Impact

6.5.1 In line with the climate change allowances recommended by the EA in their February 2016 guidance the impact of climate change on the peak rainfall intensities in urban drainage designs should be assessed by increasing them by 20% and 40% (central and upper end respectively) when designing for the '2080s' scenario (2070 to 2115).

6.5.2 The proposed development and associated surface water drainage scheme has been designed to sustainably manage the run-off from the critical 1 in 100 year storm event with a 40% allowance for climate change.

6.6 Proposed Surface Water Drainage Strategy

6.6.1 The surface water drainage strategy plan is included as Appendix I to this report. The development has been divided into the catchments shown in Table 6-4 for ease of assessment and to link to the construction programme.

Table 6-2: Summary of Surface Water Drainage Catchments

Proposed Drainage Catchment	Description
1	Commercial Building S4 and Residential Blocks S13-S14
2	Residential Blocks S11-S12 and S14-S21
3	Laboratory Buildings S8 and S9/S10 including Station Row and Chesterton Square
4	Laboratory Buildings S6-S7 and Railside Highway
5	Existing catchment comprising Cambridge North Station, Hotel, Building S3 (under construction), Cowley Road and Milton Avenue
6	Existing catchment comprising the highway extension to Cowley Road connecting to the temporary car park
7	MSCP Building S5

6.6.2 In accordance with local planning policy flow rates from new drainage catchments will be capped at 2 l/s/ha maximum discharge rate.

6.6.3 The proposed new discharge to the FPD overflow culvert locations will be split into four locations as follows:

- Discharge from proposed residential development Catchment 2, flow control 3.3 l/s
- Discharge from existing Catchment 5 to include proposed Catchment 1 (flow control 1.4l/s), pumped discharge then flow control limited to 11.1 l/s (includes Temporary Logistics Area)
- Discharge from proposed commercial/retail/laboratory/multi-storey car park (MSCP) development Catchments 3 and 7, flow control 3.4 l/s
- Discharge from proposed commercial/retail/laboratory development Catchment 4, flow control 1.6 l/s

6.6.4 The proposed Surface Water Drainage Strategy implements SuDS in the form of basin/swale/green and brown roofs and cellular storage tanks. A summary of the selection of SuDS features has been provided in Table 6-1.

Table 6-3: Summary of SuDS Feature Selection

Feature	Description	Selection
Green and Brown Roofs	Green and brown roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	✓ Green and Brown roofs are proposed for all surfaces not occupied by plant on Buildings S4, S6, S7, S8 and S9.
Filter Strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	✓ Filter strips have been provided adjacent to Cowley Road to drain the highway and pavement. These are located within existing catchment 5.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.	× The available footprint for permeable paving after all other uses and drivers were taken into account was limited therefore other SuDs methods are preferred.
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff and can infiltrate the water into the ground (if ground conditions allow).	✓ A 205m length swale is incorporated within the surface water drainage strategy to convey water to the FPD overflow culvert. The proposed swale drains buildings S5, S8 and S9 within catchments 3 and 7.
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value, particularly relevant to the golf course.	× The high groundwater levels on site have ruled out the use of infiltration as a SuDs method.
Basins / Ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.	✓ An attenuation basin is proposed for use on site. This is to attenuate surface water pumped from the existing pumping station (Catchment 5) and replaces the granular storage reservoir currently located under catchments 4 and 7. The basin will also serve the adjacent Temporary Logistics Area.
Underground Attenuation	Cellular storage crates lined and buried to provide surface water storage volumes dictated by downstream flow controls.	✓ Underground attenuation is proposed for use within catchments 2, 3 and 4 where other SuDs methods cannot be applied.

6.6.5 To ensure maximum peak discharge from the development is maintained at greenfield runoff rates, on-site attenuation will be required. The required storage volumes for the attenuation have been calculated from the 100 years return period event plus 20% climate change allowance. This is in accordance with the design life for the commercial, retail and laboratory uses. For the residential catchments additional storage to the 100 year plus 40% climate change event will be stored in sunken areas on the ground surface within the central courtyard.

6.6.6 Impermeable surfacing has been calculated from the masterplan; the estimated contributing areas and proposed SuDs are shown together with their required capacity on the Drainage Strategy drawing in Appendix I. A summary table for the proposed attenuation is provided in Table 6-4 which also identifies the impermeable areas per catchment.

Table 6-4: Attenuation Summary

Assumed Catchment	Proposed Discharge Rate (l/s/ha)	Proposed Impermeable Area [ha]	Proposed Attenuation Volume Required [m^3]
1	2.0	0.713	625
2	2.0	1.625	1420
3	2.0	1.154	1570
4	2.0	0.817	650
5	3.3	2.806	2700
6	As Existing	0.323	As Existing
7	2.0	0.584	Included within Catchment 3

6.6.7 Vortex flow controls, such as a Hydrobrakes, will restrict the rate of discharge downstream to the surface water attenuation to the required rates at the discharge points.

6.6.8 The proposed SuDS features have been sized in MicroDrainage to ensure that the proposed system will be capable of conveying run-off from the design storm event without flooding. Refer to Appendix J for the MicroDrainage model output.

6.6.9 The design calculations confirm that the proposed surface water drainage system is capable of attenuating, and discharging in a controlled manner, the run-off from the design 1 in 100 year storm with climate change allowance without flooding of the development.

6.7 Designing for Exceedance

6.7.1 During a rainfall event with a return period well in excess of that for which the surface water drainage system was designed (in this case a 1 in 100 year plus climate change allowance), or in the event of a blockage, the capacity of the surface water drainage system may be exceeded, resulting in localised flooding in the areas affected. This is considered to be a residual risk.

6.7.2 However, the layout and landscaping of the proposed development should be designed and will be developed to ensure that exceedance flood flow paths are routed away from vulnerable development and toward landscaped areas, areas of open attenuation or surrounding green infrastructure.

6.7.3 In line with Building Regulations the finished floor levels of the properties will be set at least 150mm above the surrounding ground levels to prevent surface water ingress through doorways. Location of buildings in ground depressions will be avoided to prevent water ponding around dwellings.

6.7.4 Minor modifications to topography, the profile of the roads, footpaths or kerbs and strategically placed green infrastructure will be developed to ensure that exceedance flood flows are managed and there is little or no risk of property flooding or unacceptable ponding within the highway.

6.8 Mitigation for Groundwater Flood Risk

6.8.1 Basements are proposed for many of the structures on the site including S4, S6, S7 and an extensive underground car park beneath buildings S8 and S9/S10.

6.8.2 The Socotec 'Factual Report on Ground Investigation' shows that the shallow groundwater levels will rise above the level of the basements. To protect the proposed basements from groundwater ingress an impermeable geo-membrane is prescribed to surround and coat the below ground concrete structure. The proposed basements will be waterproofed to the appropriate standard specified within BS 8102:2009.

6.8.3 To mitigate the effects of blocking established flow paths for groundwater, granular corridors will be provided underneath and around the basements to facilitate the flow of water from one side of the basement to the others.

6.8.4 The SuDS on site in the form of buried tanks, the swale and the attenuation basin will all be lined with impermeable membranes and pinned down to prevent the ingress of groundwater.

7 Foul Water Drainage Strategy

7.1.1 This document provides a summary of the existing foul drainage infrastructure in and around the site, sets out the estimated foul water flows generated by the proposed development, and identifies a suitable solution for the disposal of these foul water flows.

7.2 Information Sources

7.2.1 This report comprises a review of readily available public information and other relevant information obtained from the following sources:

- Anglian Water Asset Plans (Appendix K);
- Anglian Water Pre-Planning Assessment Report (Appendix L);
- Mott MacDonald Technical Note – Foul Pump Station CB4 – upgraded pumps flow and pressure verification (document. ref 3183-5-MEC-03 Rev 4 dated 19/08/2021);
- Multi Utility Trench as-built drawing (prepared by SurvaTec Limited and dated 28/01/2020);
- CIRIA C657 Water key performance indicators and benchmarks for offices and hotels (2006);
- Sewerage Sector Guidance – Design & Construction Guidance v2 (Water UK, March 2020);

7.3 Existing Foul Water Drainage

7.3.1 The below summary of existing foul drainage infrastructure on and around the site is based on a review of Anglian Water asset plans; topographical and utilities survey data; and as-built drainage drawings prepared by Atkins and Mott MacDonald. The Anglian Water asset plans are included as Appendix K to this report.

7.3.2 Anglian Water asset plans show that there are existing foul sewers in Cowley Road to the north-west of the site. This sewer serves the industrial park to the north and flows north-west along Cowley Road to reach an adopted sewage pumping station to the north side of Cowley Road (grid ref. TL 47290 61150).

7.3.3 The nearby Cambridge Business Park is drained by a separate foul sewer, which runs north-west along the central road (Cowley Park) to connect to a large foul sewer that runs from south-west to north-east, crossing the business park. The principal dimension of the receiving sewer is recorded as 2120mm, and the utilities survey indicates that this sewer is over 8m deep.

7.3.4 As part of the previous phase 1 works to the south of the site, new foul drainage was installed to convey foul water from the new Cambridge North Railway Station development. This foul drainage network conveys flows west via gravity to a pumping station constructed on the western side of the Cambridgeshire Guided Busway (grid ref. TL 47415 60620), near the western boundary of the site. The rising main leaves the pumping station on the east side, passing beneath the busway

before heading north in the western verge of Cowley Road. The rising main continues along Cowley Road to discharge into the Anglian Water foul sewer network described at 7.3.2 above.

7.3.5 The pumping station was originally designed for foul water flows from the Cambridge North Railway Station only, comprising a pumped flow of 3.8l/s. The pumping station has since been upgraded to accommodate the foul water flows from the new hotel and commercial development (building S3) to the south of the site. The upgraded pumping station a pumped flow of 6.5l/s and an online storage structure providing 35m³ storage volume. Part of the original foul rising main was diverted to re-route it around the proposed footprint of building S3.

7.3.6 In 2020, two new rising mains (one 160mmØ and one 225mmØ) were laid in the footway that runs parallel to Cowley Road (to the south of the First Public Drain). These rising mains were laid at the same time as a new multi-utility trench was constructed. The rising mains begin at a valve chamber near the eastern end of Cowley Road (grid ref. 547397, 261030) and run north-west along the footway, falling for approx. 180m before reaching a washout chamber. From the washout chamber the rising main continues north-west for another 240m, terminating at a break chamber (grid ref. 547060, 261279) near the route of the large and deep Anglian Water foul sewer (refer to Section 7.3.3).

7.4 Proposed Foul Water Drainage

Proposed Development Foul Flows

7.4.1 The proposed development comprises multiple commercial buildings (offices and laboratories S4 and S6-S9/S10) and the MSCP (Building S5). The laboratories S6-S7 and MSCP S5 will occupy the land used for the existing surface level car park in the south-western corner of the site, which serves the hotel and railway station.

7.4.2 The parcel of undeveloped land to the north-west of the site (bordered by Cowley Road, Milton Avenue, Cambridgeshire Guided Busway and Cambridge Business Park) will be developed to provide residential dwellings. A total of 425 units have been proposed within Buildings S12 to S21.

7.4.3 The proposed gross internal areas (GIAs) areas for each of the buildings throughout the proposed development are set out in Table 7-1 below. The proposed masterplan, accommodation schedule and areas schedule are included within Appendices A and E to this report.

Table 7-1: Summary of Proposed Foul Water Generating Development

	Type	GIA (m^2)	No. Units
Building S4	Offices	17,326	-
Building S6	Labs	29,457	-
Building S7	Labs	11,345	-
Building S8	Offices	13,056	-
Building S9/S10	Offices	24,099	-
Residential S11 to S21	Dwellings	-	425

7.4.4 For the purposes of estimating foul flows from the proposed development, an average flow rate of 2.4l/m^2/day has been used for both the offices and labs, based on the values set out in CIRIA C657 'Water key performance indicators and benchmarks for offices and hotels (CIRIA, 2006). Flow rates for residential dwellings is based on an average water use of 125 litres per person per day and an average occupancy of 2.35 persons per dwelling and 25% infiltration allowance in accordance with Anglian Water design guide advice.

7.4.5 The extent of proposed development generates a flow that is beyond the capacity of the existing rising main. Therefore, upgrading the existing foul water pumping station has been discarded as an option.

7.4.6 A new foul water pumping station is proposed, adjacent and to the south of the existing foul water pumping station, on the hard shoulder of the Cambridgeshire Guided Busway.

7.4.7 To determine the peak design flow rate for proposed foul water drainage, the dry weather flows (DWFs) calculated above have been multiplied by the following factors:

- Offices and Labs: 3x DWF
- Residential: 6x DWF

7.4.8 For the new pumping station design flow rate, a peak factor of 4xDWF has been calculated in accordance with Anglian Water design guide advice.

7.4.9 Table 7-2 below provides a summary of the estimated average daily and design foul flows from the proposed development and future residential development.

Table 7-2: Summary of proposed foul water flows

Development	GIA (m²) / No. Units	Base Flow 1DWF (l/s)	Sewer Design Flow 6/3DWF (l/s)	Pumped Design Flow 4DWF (l/s)
Building S4	17,326	0.49	1.47	1.96
Building S6	29,457	0.83	2.48	3.32
Building S7	11,345	0.32	0.96	1.28
Building S8	13,056	0.36	1.09	1.45
Building S9/S10	24,099	0.67	2.00	2.68
Total (excl. residential)		**2.67**	**8.01**	**10.68**
Residential	425 units	1.81	10.86	7.22
Total (incl. residential)		**4.48**	**18.87**	**17.90**

7.5 Foul Water Discharge Outfall

7.5.1 The proposed development will drain via gravity to the proposed pumping station to the south, where it will be pumped to the Anglian Water foul sewer network in Cowley Road. The existing pumping station serving phase 1 will be maintained adjacent to the new pumping station.

7.5.2 Anglian Water have been consulted through the pre-planning enquiry process, to identify a suitable point of connection to the Anglian Water foul sewer network for discharge of the foul flows from the proposed development.

7.5.3 The Anglian Water Foul Water Pre-Planning Assessment Report is included as Appendix L to this report. The connection manhole identified was manhole reference 0200 in Cowley Park however the downstream chamber reference 0300 off Cowley Road has been deemed more appropriate as the existing rising main pipes under the Cowley Road cycle path can be used to convey the flow.

7.5.4 Therefore, it is proposed that an adoptable pumping station at Cambridgeshire Guided Busway be constructed to drain foul water from the proposed phase 2 development. The pumped foul water at 17.90 l/s rate to the agreed point of connection at manhole reference 0300 (subject to S106/S104/Anglian Water approval). A minimum of 55 m^3 storage to be provided via a tank connected to the adoptable pumping station in accordance with Anglian Water design guide advice.

7.6 Trade Effluent Licences

7.6.1 Trade effluent licences from Anglian Water will be applied for the laboratory buildings S6, S7, S8 and S9/S10. Although foul flow from these buildings will drain to the proposed foul water pumping station serving the rest of the site, dedicated internal foul drainage within the structures and external sampling chambers will be provided to enable chemical testing to be undertaken in isolation from the remainder of the foul water network on site. This will enable the facility to ensure compliancy with any trade effluent consent parameters.

8 Adoption & Management

8.1 Surface Water Drainage System

8.1.1 The proposed infrastructure will be designed and constructed according to Sewerage Sector Guidance – Design & Construction Guidance v2 (Water UK, March 2020).

8.1.2 The SuDS features will be operated and maintained by a third-party private maintenance company. Such a company can be established to maintain the features in perpetuity. An adoption agreement between the site developer and the maintenance company can be largely based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

8.1.3 Drainage serving new roads to be offered for adoption by the Local Highway Authority will become highway drains, adopted as part of Section 38 agreements (Highways Act 1980).

8.1.4 A typical maintenance schedule of the attenuation basin, swale, attenuation tanks and flow control devices proposed on site are shown in Table 8-1.

Table 8-1: SuDs Indicative Maintenance Schedule

Frequency	Action
Monthly	• Inspect and identify any areas that are not operating correctly. If required, take remedial action (for three months following installation)
Six Monthly	• Inspect and identify any areas that are not operating correctly. If required, take remedial action. • Remove sediment from pre-treatment structures
Annually	• N/A
Following significant events	• Inspect and carry out essential recovery works to return the feature to full working order.

8.1.5 The proposed maintenance regimes for the SuDs and flow controls should be in accordance with The SuDS Manual (CIRIA C753) and other best practice guidelines and in accordance with manufacturer's recommendations. This will ensure the design performance, structural integrity and where applicable- appearance of each feature is maintained throughout its lifetime.

8.1.6 Further details will be provided on the maintenance requirements of the proposed SuDS components across the development as the detailed design is developed. The details of the party responsible for maintenance of each feature will be confirmed prior to occupation of the proposed development.

8.2 Foul Water Drainage System

8.2.1 It is anticipated that the proposed foul sewer network will be offered to Anglian Water for adoption under Section 104 of the Water Industry Act 1991. To meet the requirements for adoption, the proposed infrastructure must be designed and constructed according to Sewerage Sector Guidance – Design & Construction Guidance v2 (Water UK, March 2020).

9 Conclusion & Recommendations

9.1 Conclusion

9.1.1 PJA has been commissioned by Brookgate Land Limited to prepare a Flood Risk Assessment and Drainage Strategy for the proposed mixed-use development at the allocated site *'Cambridge North'*.

9.1.2 This Flood Risk Assessment has been undertaken in accordance with current national and local food risk policy requirements. This report assesses the existing and future flood risk at the site, including an assessment of the potential effects of the proposed development on flood risk on- and off-site.

9.1.3 The site is located within EA Flood Zone 1. According to the NPPF, the site is considered appropriate for all types of development subject to an assessment of flood risk from other sources. The assessment concludes that the site is considered at either very low or low risk of flooding from all sources assessed (fluvial, tidal, reservoirs, canals, surface water, and sewers) with the exception of groundwater. The high groundwater levels will be mitigated through construction to ensure all basements are protected to a sufficient standard and groundwater flow paths across the development are maintained.

9.1.4 In addition to the NPPF, the proposed surface water drainage strategy complies with local policy and site-specific requirements.

9.1.5 A Drainage Strategy has been prepared to demonstrate that a sustainable drainage solution can be provided for the proposed development. The Drainage Strategy has been designed in accordance with current sustainable development best practice and meets the requirements of Cambridgeshire County Council (as the LLFA).

9.1.6 The proposed surface water drainage systems discharge run-off to the existing overflow culvert to the First Public Drain watercourse present on-site. Discharge from each proposed catchment will be controlled to the equivalent rate of 2.0 l/s/ha (3.3 l/s/ha for existing catchments) by vortex flow control devices. Attenuation storage will be provided in the form of open SuDS features such as an attenuation basin, a swale and green and brown roofs.

9.1.7 SuDS Management Trains will provide suitable treatment of run-off by removing pollutants prior to discharge.

9.1.8 Foul flows from the proposed development will discharge via a new pumped connection to the existing Anglian Water foul sewer off Cowley Road, north-west of the site. The connection location has been confirmed with the utility company.

9.1.9 Safe access and egress will be available to and from the site for events up to and including the 1 in 100 year plus climate change (40%) rainfall events.

9.1.10 The responsibility for the operation and maintenance of each SuDS feature will be confirmed prior to the commencement of construction. The SuDS used on site will be maintained in accordance with manufacturer's recommendations and current best practice and guidelines to ensure routine operation.

9.1.11 This report demonstrates that the proposed development may be undertaken in a sustainable manner without increasing the flood risk either at the site or to any third-party land in line with NPPF requirements.

Appendix A Accommodation Schedule

CAMBRIDGE NORTH SOUTHERN PLOT
COMMERCIAL BUILDINGS AREA SCHEDULE

acme

24.05.2022

Level		S04						S06						S07					
		GEA		GIA		NIA		GEA		GIA		NIA		GEA		GIA		NIA	
		m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²
Above Ground Only	07	229	2,465	198	2,131	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06	1,517	16,329	1,428	15,371	1,091	11,743	-	-	-	-	-	-	-	-	-	-	-	-
	05	1,721	18,525	1,620	17,438	1,283	13,810	-	-	-	-	-	-	-	-	-	-	-	-
	04	2,383	25,650	2,228	23,982	1,881	20,247	428	4,607	385	4,144	-	-	429	4,618	382	4,112	-	-
	03	2,383	25,650	2,228	23,982	1,881	20,247	2,566	27,620	2,396	25,790	2,011	21,646	2,677	28,815	2,501	26,921	2,117	22,787
	02	2,383	25,650	2,228	23,982	1,881	20,247	2,898	31,194	2,736	29,450	2,352	25,317	3,082	33,174	2,914	31,366	2,530	27,233
	01	2,175	23,411	2,011	21,646	1,664	17,911	2,898	31,194	2,736	29,450	2,352	25,317	3,082	33,174	2,914	31,366	2,530	27,233
	GF	2,175	23,411	2,011	21,646	1,051	11,313	2,617	28,169	2,467	26,555	1,504	16,189	2,791	30,042	2,634	28,352	1,450	15,608
	Total	**14,966**	**161,093**	**13,952**	**150,178**	**10,732**	**115,518**	**11,407**	**122,784**	**10,720**	**115,389**	**8,219**	**88,468**	**12,061**	**129,823**	**11,345**	**122,116**	**8,627**	**92,860**
Incl. Basement	B1	3,609	38,847	3,374	36,317	-	-	7,796	83,915	7,392	79,567	-	-						
	Total	**18,575**	**199,939**	**17,326**	**186,495**	**10,732**	**115,518**	**31,264**	**336,523**	**29,457**	**317,072**	**16,846**	**181,329**						

* Single basement consolidated figures for S6 & S7

Typical Floor Efficiency	84%	86%	87%
Overall Floor Efficiency	77%	77%	76%

Level		S05 – Mobility Hub						S08 (Outline Planning)						S09 (Outline Planning)					
		GEA		GIA		NIA		GEA		GIA		NIA		GEA		GIA		NIA	
		m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²	m²	ft²
Above Ground Only	05	-	-	-	-	-	-	63	678	50	538	-	-	133	1,432	114	1,227	-	-
	04	3,510	37,781	3,480	37,458	3,340	35,951	2,310	24,865	2,195	23,627	1,856	19,978	3,910	42,087	3,740	40,257	3,260	35,090
	03	3,510	37,781	3,480	37,458	3,340	35,951	2,310	24,865	2,195	23,627	1,856	19,978	3,910	42,087	3,740	40,257	3,260	35,090
	02	3,510	37,781	3,480	37,458	3,340	35,951	2,310	24,865	2,195	23,627	1,856	19,978	3,910	42,087	3,740	40,257	3,260	35,090
	01	3,510	37,781	3,480	37,458	3,340	35,951	2,310	24,865	2,195	23,627	1,856	19,978	3,910	42,087	3,740	40,257	3,260	35,090
	GF	3,510	37,781	3,447	37,103	3,291	35,424	2,122	22,841	2,008	21,614	1,180	12,701	3,910	42,087	3,740	40,257	2,260	24,326
	Total	**17,550**	**188,906**	**17,367**	**186,937**	**16,651**	**179,230**	**11,425**	**122,978**	**10,838**	**116,659**	**8,604**	**92,613**	**19,683**	**211,866**	**18,814**	**202,512**	**15,300**	**164,688**
Incl. Basement	B1	3,423	36,845	3,217	34,627	3,094	33,304	2,328	25,058	2,218	23,874	-	-	5,450	58,663	5,285	56,887	-	-
	Total	**20,973**	**225,751**	**20,584**	**221,564**	**19,745**	**212,533**	**13,753**	**148,036**	**13,056**	**140,533**	**8,604**	**92,613**	**25,133**	**270,529**	**24,099**	**259,399**	**15,300**	**164,688**

Typical Floor Efficiency	-	85%	87%
Overall Floor Efficiency	-	79%	81%

SOUTHERN PLOTS (Units mix)

Block	Unit Size					
	studio	1b/2p	2b/4p	3b/6p	TOTAL	
	39m²	50m²	70m²	95m²		
Build to Rent						
S11	0	14	26	0	40	BTR
S12	0	18	20	0	38	BTR
S17	0	15	14	4	33	BTR
S18	0	20	9	5	34	BTR
S19	7	21	20	0	48	BTR
S20	0	14	26	0	40	BTR
S21	0	18	19	0	37	BTR
Total (units)	7	120	134	9	270	BTR
Percentage (%)	3%	44%	50%	3%		
Brookgate Target Total	**6**	**119**	**146**	**22**	**293**	BTR
Target Unit mix	**2%**	**41%**	**50%**	**8%**		
Difference (absolute)	1	1	-12	-13	-23	
Difference (Percentage)						
Private / Affordable / Shared Ownership						
S13	5	28	26	2	61	Affordable/Shared
S14	0	5	17	7	29	Private
S15	0	9	18	5	32	Private
S16	0	15	18	0	33	Private
Total (units)	5	57	79	14	155	Private/Affordable/Shared
Percentage (%)	3%	37%	51%	9%		
Affordable/Shared Analysis of S13						
Affordable	4	21	20	0	45	
Shared Ownership	1	7	6	2	16	
Total (units)	5	28	26	2	61	
Percentage (%)	8%	46%	43%	3%		
Housing Officer Brief						
Affordable	3	17	17	5	42	
Shared Ownership	0	4	14	0	18	
Total (units)	3	21	31	5	60	
Percentage (%)	5%	35%	52%	8%		
Private Analysis S14-S16						
Private for Sale	0	29	53	12	94	
Total (units)	0	29	53	12	94	
Percentage (%)	0%	31%	56%	13%		
Brookgate Brief						
Private for Sale	0	30	53	7	90	
Total (units)	0	30	53	7	90	
Percentage (%)	0%	33%	59%	8%		
Difference (absolute)	0	-1	0	5	4	
Combined Proposal						
Total (units)	12	177	213	23	425	Private/Affordable Shared
Percentage (%)	3%	42%	50%	5%		
Combined Brief						
Total (units)	9	170	230	34	443	Private/Affordable Shared
Percentage (%)	2%	38%	52%	8%		
Difference (absolute)	3	7	-17	-11	-18	

*Areas subject to design development

*Areas are approximate and allowance should be made for wall thicknesses, columns and other building components

Affordable/Shared Analysis of S13 - Shared on bottom two floors

Tenure	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
Affordable	4	21	20	0	45
Shared Ownership	1	7	6	2	16
Total (units)	5	28	26	2	61
Percentage (%)	8%	46%	43%	3%	

Affordable/Shared Analysis of S13 - Shared on top two floors

Tenure	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
Affordable	3	19	16	2	40
Shared Ownership	2	9	10	0	21
Total (units)	5	28	26	2	61
Percentage (%)	8%	46%	43%	3%	

Affordable/Shared Analysis of S13 - Previously Shared with Planning Officer for comment

Tenure	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
Affordable	4	16	24	0	44
Shared Ownership	0	4	9	3	16
Total (units)	4	20	33	3	60
Percentage (%)	7%	33%	55%	5%	

Housing Officer Brief

Tenure	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
Affordable	3	17	17	5	42
Shared Ownership	0	4	14	0	18
Total (units)	3	21	31	5	60
Percentage (%)	5%	35%	52%	8%	

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LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	1	3	5	-	9
L04	1	6	5		12
L03	1	6	5	-	12
L02	1	6	5	-	12
L01	1	4	1	-	6
GF	-	3	5	2	10
TOTAL (UNITS)	5	28	26	2	61
UNIT MIX	8%	46%	43%	3%	100%

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LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	1	3	5	-	9
L04	1	6	5		12
L03	1	6	5	-	12
L02	1	6	5	-	12
L01	1	4	1	-	6
GF	-	3	5	2	10
TOTAL (UNITS)	5	28	26	2	61
UNIT MIX	8%	46%	43%	3%	100%

	S14				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
	-	-	-	-	0
	-	-	-	-	0
	-	2	3	-	5
	-	-	3	1	4
	-	1	3	2	6
	-	1	3	2	6
	-	-	1	-	1
	-	1	4	2	7
	0	5	17	7	29
	-	17%	59%	24%	100%

	S15				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
	-	-	-	-	0
	-	-	-	-	0
	-	2	3	-	5
	-	2	3	-	5
	-	2	4	1	7
	-	2	4	1	7
	-	-	-	1	1
	-	1	4	2	7
	0	9	18	5	32
	-	28%	56%	16%	100%

	S16				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
	-	-	-	-	0
	-	-	-	-	0
	-	2	3	-	5
	-	2	3	-	5
	-	3	4	-	7
	-	3	4	-	7
	-	3	2	-	5
	-	2	2	0	4
	0	15	18	0	33
	-	45%	55%	0%	100%

OVERALL S13 – S16					
UNIT TYPE	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
OVERALL TOTAL (UNITS)	5	57	79	14	155
OVERALL UNIT MIX	3%	37%	51%	9%	

WASTE STORAGE

BLOCK	S13	S14	S15	S16
REQUIRED WASTE STORAGE CAPACITY (L)	8,200	5,070	5,160	4,560
REQUIRED NO. OF 1,100L BINS	7.5	4.6	4.7	4.1

ST / 1B	2B	3B
100	170	240

CYCLE STORAGE

BLOCK	S13	S14	S15	S16
REQUIRED CYCLE SPACE (TOTAL BEDROOMS)	91	60	60	51

1 CYCLE SPACE PER BEDROOM

	75% DS / 25% SF		
	S15 + S16	S14	S13
DS	83	45	68
SF	28	15	23

OPTION 1

LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	1	6	3	-	10
L04	2	7	3	1	13
L03	1	5	6	-	12
L02	1	5	6	-	12
L01	-	1	4	-	5
GF	-	3	6	2	11
TOTAL (UNITS)	5	27	28	3	63
UNIT MIX	8%	43%	44%	5%	100%

OPTION 2

LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	-		5	-	5
L04	1	5	5	1	12
L03	1	5	6	-	12
L02	1	5	6	-	12
L01	-	1	4	-	5
GF	-	3	6	2	11
TOTAL (UNITS)	3	19	32	3	57
UNIT MIX	5%	33%	56%	5%	100%

OPTION 3

LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	0	4	5	-	9
L04	1	5	5	1	12
L03	1	5	6	-	12
L02	1	5	6	-	12
L01	-	1	4	-	5
GF	-	1	7	2	10
TOTAL (UNITS)	3	21	33	3	60
UNIT MIX	5%	35%	55%	5%	100%

OPTION 4

LEVEL	S13				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0
L06	-	-	-	-	0
L05	0	4	5	-	9
L04	1	5	5	1	12
L03	1	5	6	-	12
L02	1	5	6	-	12
L01	-	2	3	-	5
GF	-	3	6	2	11
TOTAL (UNITS)	3	24	31	3	61
UNIT MIX	5%	39%	51%	5%	100%

LEVEL	S11					S12				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0	-	-	-	-	0
L06	-	1	3	-	4	-	-	-	-	0
L05	-	1	3		4	-	2	4	-	6
L04	-	3	5	-	8	-	4	4	-	8
L03	-	3	5	-	8	-	4	4	-	8
L02	-	3	5	-	8	-	4	4	-	8
L01	-	3	5	-	8	-	4	4	-	8
GF	-	-	-	-	0	-	-	-	-	0
TOTAL (UNITS)	0	14	26	0	40	0	18	20	0	38
UNIT MIX	0%	35%	65%	0%	100%	-	47%	53%	0%	100%

OVERALL S11 – S12					
UNIT TYPE	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
OVERALL TOTAL (UNITS)	0	32	46	0	78
OVERALL UNIT MIX	0%	41%	59%	0%	

WASTE STORAGE

BLOCK	S11	S12
REQUIRED WASTE STORAGE CAPACITY (L)	5,820	5,200
REQUIRED NO. OF 1,100L BINS	5.3	4.7

ST / 1B	2B	3B
100	170	240

CYCLE STORAGE

BLOCK	S11	S12
REQUIRED CYCLE SPACE (TOTAL BEDROOMS)	66	58

1 CYCLE SPACE PER BEDROOM

LEVEL	S17					S18					S19					S20					S21				
	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
L07	-	-	-	-	0	-	-	-	-	0	1	2	3	-	6	-	2	3	0	5	-	-	-	-	0
L06	-	-	-	-	0	-	3	1	-	4	1	2	3	-	6	-	2	3	0	5	-	3	1	-	4
L05	-	3	1	-	4	-	3	1	1	5	1	3	3	-	7	-	2	4	0	6	-	3	2	-	5
L04	-	3	1	1	5	-	4	1	1	6	1	3	3	-	7	-	2	4	0	6	-	3	4	-	7
L03	-	3	3	1	7	-	4	1	1	6	1	3	3	-	7	-	2	4	0	6	-	3	4	-	7
L02	-	3	3	1	7	-	4	1	1	6	1	3	3	-	7	-	2	4	0	6	-	3	4	-	7
L01	-	-	-	1	1	-	1	-	1	2	1	3	2	-	6	-	2	4	0	6	-	3	4	-	7
GF	-	3	6	-	9	-	1	4	-	5	-	2	0	-	2	-	-	-	-	0	-	-	-	-	0
TOTAL (UNITS)	0	15	14	4	33	0	20	9	5	34	7	21	20	0	48	0	14	26	0	40	0	18	19	0	37
UNIT MIX	0%	45%	42%	12%	100%	-	59%	26%	15%	100%	15%	44%	42%	0%	100%	-	35%	65%	0%	100%	-	49%	51%	0%	100%

OVERALL S17 – S21					
UNIT TYPE	ST.2P	1B.2P	2B.4P	3B.6P	TOTAL
OVERALL TOTAL (UNITS)	7	88	88	9	192
OVERALL UNIT MIX	4%	46%	46%	5%	

WASTE STORAGE

BLOCK	S17	S18	S19	S20	S21
REQUIRED WASTE STORAGE CAPACITY (L)	4,840	4,730	6,200	5,820	5,030
REQUIRED NO. OF 1,100L BINS	4.4	4.3	5.6	5.3	4.6

ST / 1B	2B	3B
100	170	240

CYCLE STORAGE

BLOCK	S17	S18	S19	S20	S21
REQUIRED CYCLE SPACE (TOTAL BEDROOMS)	55	53	68	66	56

1 CYCLE SPACE PER BEDROOM

CAMBRIDGE NORTH
RESIDENTIAL AREA SCHEDULE

REV Q

acme

23.03.2022

Level		S11 GEA m²	S11 GEA ft²	S11 GIA m²	S11 GIA ft²	S11 NSA m²	S11 NSA ft²
Above Ground Only	06	482	5,188	435	4,682	276	2,971
	05	482	5,188	435	4,682	276	2,971
	04	818	8,805	729	7,847	550	5,920
	03	818	8,805	729	7,847	550	5,920
	02	818	8,805	729	7,847	550	5,920
	01	818	8,805	729	7,847	550	5,920
	GF	818	8,805	761	8,191	0	0
	Total	**5,054**	**54,401**	**4,547**	**48,943**	**2,752**	**29,622**
Incl. Amenities and Retail	GF	818	8,805	758	8,159	371	3,993
	Total					**3,123**	**33,616**
Incl. Basement	B1	513	5,522	482	5,188	-	-
	Total	**5,567**	**59,923**	**5,029**	**54,132**	**3,123**	**33,616**
Incl. Plant Area	Roof	144	1,550	130	1,399	-	-
	Total	**5,711**	**61,473**	**5,159**	**55,531**	**3,123**	**33,616**

Level		S12 GEA m²	S12 GEA ft²	S12 GIA m²	S12 GIA ft²	S12 NSA m²	S12 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	636	6,846	565	6,082	404	4,349
	04	780	8,396	689	7,416	515	5,543
	03	780	8,396	689	7,416	515	5,543
	02	780	8,396	689	7,416	515	5,543
	01	780	8,396	689	7,416	515	5,543
	GF	780	8,396	725	7,804	0	0
	Total	**4,536**	**48,825**	**4,046**	**43,551**	**2,464**	**26,522**
Incl. Amenities and Retail	GF	780	8,396	722	7,772	330	3,552
	Total					**2,794**	**30,074**
Incl. Basement	B1						
	Total						
Incl. Plant Area	Roof	144	1,550	130	1,399	-	-
	Total	**4,680**	**50,375**	**4,176**	**44,950**	**2,794**	**30,074**

* Single basement consolidated figures for S11 & S12

CURRENT RESIDENTIAL GRAND TOTAL

GEA m²	GEA ft²	GIA m²	GIA ft²	NSA m²	NSA ft²
50,609	**544,750**	**45,352**	**488,164**	**29,383**	**316,276**

GRAND TOTAL INCLUDING BASEMENT

GEA m²	GEA ft²	GIA m²	GIA ft²	NSA m²	NSA ft²
52,574	**563,393**	**47,176**	**507,798**	**29,383**	**316,276**

INCLUDING RETAIL AND AMENITIES

GEA m²	GEA ft²	GIA m²	GIA ft²	NSA m²	NSA ft²
52,574	**563,393**	**47,176**	**507,798**	**31,515**	**339,224**

* not including communal area of 53.16 sqm at every other level of S19/S20
For a total of 212.6 sqm

INCLUDING RETAIL, AMENITIES AND PLANT AREA

GEA m²	GEA ft²	GIA m²	GIA ft²	NSA m²	NSA ft²
54,533	**586,988**	**48,960**	**527,001**	**31,515**	**339,224**

Level		S13 GEA m²	S13 GEA ft²	S13 GIA m²	S13 GIA ft²	S13 NSA m²	S13 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	843	9,074	743	7,998	561	6,039
	04	1,047	11,270	927	9,978	711	7,653
	03	1,047	11,270	927	9,978	711	7,653
	02	1,047	11,270	927	9,978	711	7,653
	01	1,047	11,270	950	10,226	739	7,955
	GF	1,047	11,270	962	10,355	468	5,038
	Total	**6,078**	**65,423**	**5,436**	**58,513**	**3,901**	**41,990**
Incl. Amenities and Retail	GF	1,046	11,259	958	10,312	125	1,345
	Total					**4,026**	**43,335**
Incl. Basement	B1	203	2,185	186	2,002	-	-
	Total	**6,281**	**67,608**	**5,622**	**60,515**	**4,026**	**43,335**
Incl. Plant Area	Roof	340	3,660	316	3,401	-	-
	Total	**6,621**	**71,268**	**5,938**	**63,916**	**4,026**	**43,335**

Level		S14 GEA m²	S14 GEA ft²	S14 GIA m²	S14 GIA ft²	S14 NSA m²	S14 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	528	5,683	465	5,005	329	3,541
	04	524	5,640	466	5,016	339	3,649
	03	726	7,815	637	6,857	488	5,253
	02	726	7,815	637	6,857	488	5,253
	01	726	7,815	659	7,093	463	4,984
	GF	727	7,825	671	7,223	328	3,531
	Total	**3,957**	**42,593**	**3,535**	**38,050**	**2,435**	**26,210**
Incl. Amenities and Retail	GF	727	7,825	668	7,190	0	0
	Total					**2,435**	**26,210**
Incl. Basement	B1	233	2,508	214	2,303	-	-
	Total	**4,190**	**45,101**	**3,749**	**40,354**	**2,435**	**26,210**
Incl. Plant Area	Roof	155	1,668	140	1,507	-	-
	Total	**4,345**	**46,769**	**3,889**	**41,861**	**2,435**	**26,210**

Level		S15 GEA m²	S15 GEA ft²	S15 GIA m²	S15 GIA ft²	S15 NSA m²	S15 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	543	5,845	477	5,134	320	3,444
	04	543	5,845	477	5,134	320	3,444
	03	743	7,998	660	7,104	492	5,296
	02	743	7,998	660	7,104	492	5,296
	01	743	7,998	676	7,276	465	5,005
	GF	743	7,998	685	7,373	322	3,466
	Total	**4,058**	**43,680**	**3,635**	**39,127**	**2,411**	**25,952**
Incl. Amenities and Retail	GF	743	7,998	681	7,330	0	0
	Total					**2,411**	**25,952**
Incl. Basement	B1						
	Total						
Incl. Plant Area	Roof	155	1,668	140	1,507	-	-
	Total	**4,213**	**45,348**	**3,775**	**40,634**	**2,411**	**25,952**

* Single basement consolidated figures for S15 & S16

Level		S16 GEA m²	S16 GEA ft²	S16 GIA m²	S16 GIA ft²	S16 NSA m²	S16 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	541	5,823	473	5,091	331	3,563
	04	541	5,823	473	5,091	331	3,563
	03	707	7,610	619	6,663	453	4,876
	02	707	7,610	619	6,663	453	4,876
	01	707	7,610	633	6,814	475	5,113
	GF	794	8,547	735	7,911	166	1,787
	Total	**3,997**	**43,023**	**3,552**	**38,233**	**2,209**	**23,777**
Incl. Amenities and Retail	GF	794	8,547	733	7,890	281	3,025
	Total					**2,490**	**26,802**
Incl. Basement	B1	330	3,552	306	3,294	-	-
	Total	**8,385**	**90,255**	**7,493**	**80,654**	**4,901**	**52,754**
Incl. Plant Area	Roof	130	1,399	116	1,249	-	-
	Total	**8,515**	**91,655**	**7,609**	**81,903**	**4,901**	**52,754**

Level		S17 GEA m²	S17 GEA ft²	S17 GIA m²	S17 GIA ft²	S17 NSA m²	S17 NSA ft²
Above Ground Only	06	-	-	-	-	-	-
	05	437	4,704	377	4,058	241	2,594
	04	546	5,877	487	5,242	343	3,692
	03	717	7,718	650	6,997	497	5,350
	02	717	7,718	650	6,997	497	5,350
	01	717	7,718	667	7,180	505	5,436
	GF	780	8,396	725	7,804	372	4,004
	Total	**3,914**	**42,130**	**3,556**	**38,276**	**2,455**	**26,425**
Incl. Amenities and Retail	GF	780	8,396	723	7,782	0	0
	Total					**2,455**	**26,425**
Incl. Basement	B1	355	3,821	327	3,520	-	-
	Total	**8,267**	**88,985**	**7,516**	**80,901**	**4,865**	**52,366**
Incl. Plant Area	Roof	153	1,647	139	1,496	-	-
	Total	**8,420**	**90,632**	**7,655**	**82,398**	**4,865**	**52,366**

Level		S18 GEA m²	S18 GEA ft²	S18 GIA m²	S18 GIA ft²	S18 NSA m²	S18 NSA ft²
Above Ground Only	06	437	4,704	377	4,058	241	2,594
	05	546	5,877	487	5,242	343	3,692
	04	603	6,491	547	5,888	397	4,273
	03	603	6,491	547	5,888	397	4,273
	02	603	6,491	547	5,888	397	4,273
	01	603	6,491	564	6,071	411	4,424
	GF	603	6,491	564	6,071	224	2,411
	Total	**3,998**	**43,034**	**3,633**	**39,105**	**2,410**	**25,941**
Incl. Amenities and Retail	GF	606	6,523	560	6,028	0	0
	Total					**2,410**	**25,941**
Incl. Basement	B1						
	Total						
Incl. Plant Area	Roof	153	1,647	139	1,496	-	-
	Total	**4,151**	**44,681**	**3,772**	**40,601**	**2,410**	**25,941**

* Single basement consolidated figures for S17 & S18

Level		S19 GEA m²	S19 GEA ft²	S19 GIA m²	S19 GIA ft²	S19 NSA m²	S19 NSA ft²
Above Ground Only	07	626	6,738	559	6,017	386	4,155
	06	626	6,738	531	5,716	386	4,155
	05	683	7,352	620	6,674	439	4,725
	04	683	7,352	591	6,361	439	4,725
	03	683	7,352	620	6,674	439	4,725
	02	683	7,352	591	6,361	439	4,725
	01	683	7,352	629	6,770	445	4,790
	GF	662	7,126	633	6,814	79	850
	Total	**5,329**	**57,361**	**4,774**	**51,387**	**3,052**	**32,851**
Incl. Amenities and Retail	GF	624	6,717	582	6,265	188	2,024
	Total					**3,240**	**34,875**
Incl. Basement	B1	331	3,563	309	3,326	-	-
	Total	**10,814**	**116,401**	**9,665**	**104,033**	**6,456**	**69,492**
Incl. Plant Area	Roof	212	2,282	194	2,088	-	-
	Total	**11,026**	**118,683**	**9,859**	**106,121**	**6,456**	**69,492**

Level		S20 GEA m²	S20 GEA ft²	S20 GIA m²	S20 GIA ft²	S20 NSA m²	S20 NSA ft²
Above Ground Only	07	580	6,243	515	5,543	344	3,703
	06	580	6,243	482	5,188	344	3,703
	05	660	7,104	598	6,437	419	4,510
	04	660	7,104	565	6,082	419	4,510
	03	660	7,104	598	6,437	419	4,510
	02	660	7,104	565	6,082	419	4,510
	01	660	7,104	598	6,437	419	4,510
	GF	694	7,470	661	7,115	0	0
	Total	**5,154**	**55,477**	**4,582**	**49,320**	**2,783**	**29,956**
Incl. Amenities and Retail	GF					433	4,661
	Total					**3,216**	**34,617**
Incl. Basement	B1						
	Total						
Incl. Plant Area	Roof	220	2,368	202	2,174	-	-
	Total	**5,374**	**57,845**	**4,784**	**51,494**	**3,216**	**34,617**

Level		S21 GEA m²	S21 GEA ft²	S21 GIA m²	S21 GIA ft²	S21 NSA m²	S21 NSA ft²
Above Ground Only	07	-	-	-	-	-	-
	06	458	4,930	389	4,187	254	2,734
	05	537	5,780	472	5,081	329	3,541
	04	708	7,621	634	6,824	482	5,188
	03	708	7,621	634	6,824	482	5,188
	02	708	7,621	634	6,824	482	5,188
	01	708	7,621	634	6,824	482	5,188
	GF	707	7,610	659	7,093	0	0
	Total	**4,534**	**48,804**	**4,056**	**43,658**	**2,511**	**27,028**
Incl. Amenities and Retail	GF					404	4,349
	Total					**2,915**	**31,377**
Incl. Basement	B1						
	Total						
Incl. Plant Area	Roof	153	1,647	138	1,485	-	-
	Total	**4,687**	**50,450**	**4,194**	**45,144**	**2,915**	**31,377**

* Single basement consolidated figures for S19 & S20

Appendix B Red Line Boundary

KEY

OUTLINE PLANNING AREA

RED LINE BOUNDARY

rev no	date	issue description	drawn checked
-	27.05.22	Planning Submission	TS / LH

revisions

notes

Dimensions govern. Do not scale drawings.
All dimensions are in millimeters unless noted otherwise.
All dimensions shall be verified on site before proceeding.
All discrepancies to be notified in writing to ACME.
This drawing is to be read in conjunction with all relevant architectural and engineers information.

Area measurements must not be taken to represent contractual documentation.

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architect
acme
76 Tabernacle Street, London, EC2A 4EA
T: +44 20 7251 5122
M: mail@acme.ac W: www.acme.ac

client
BROOKGATE
Two Station Place, Cambridge CB1 2FP
T: +44 1223 465760
M: info@brookgate.eu

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checked by	LH
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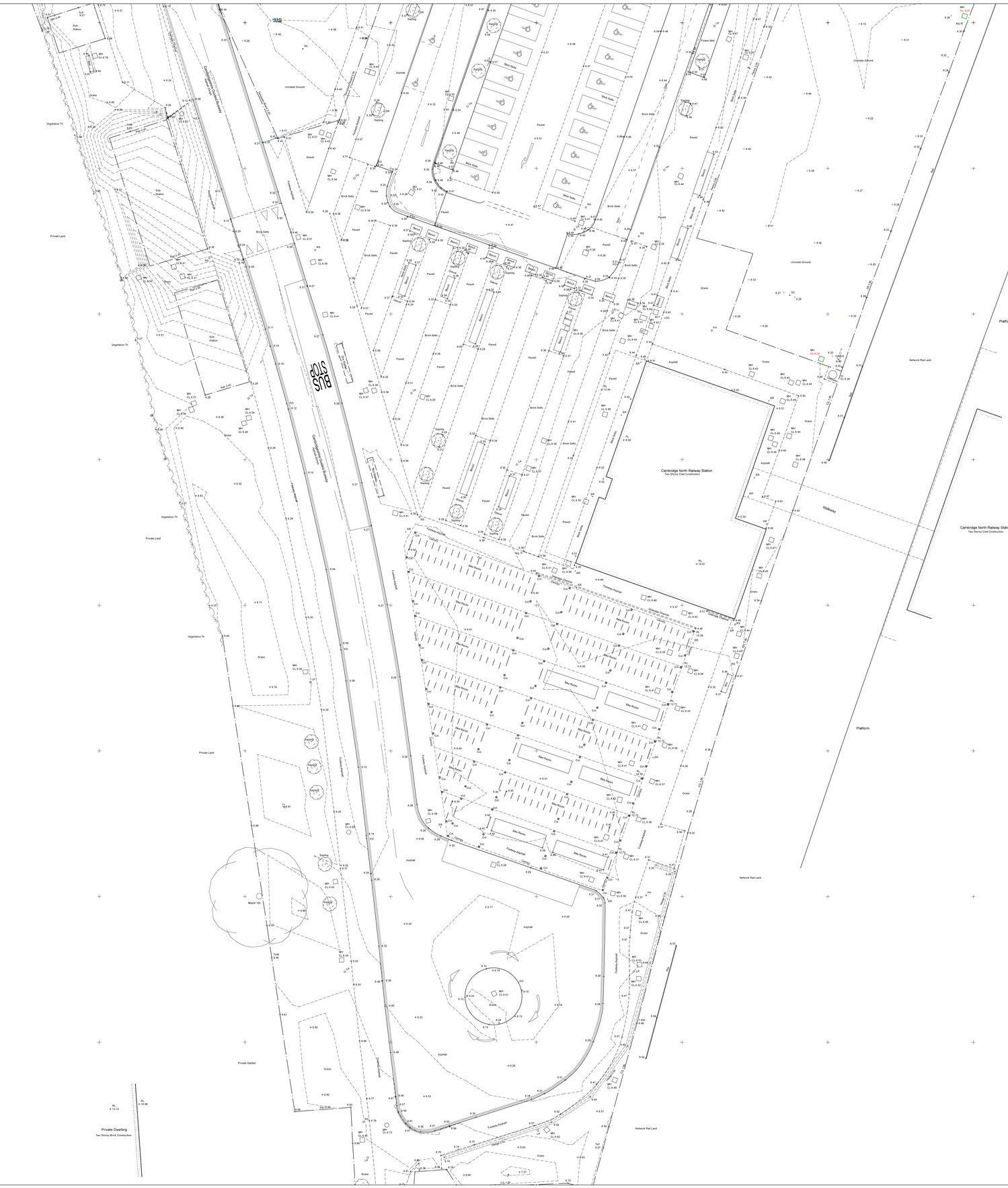
rev no	

N

Appendix C Topographic Survey



TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

ABBREVIATIONS & SYMBOLS

AH	Arch Head Height	FH	Fire Hydrant	RSJ	Rolled Steel Joist
AR	Assumed Route	FBD	Floor Board Direction	SI	Sign Post
AV	Air Valve	FH	Fire Hydrant	SP	Arch Spring Point Height
BB	Belisha Beacon	FL	Floor Level	SV	Stop Valve
BH	Bore Hole	FP	Flag Pole	SW	Surface Water
BL	Bed Level	FW	Foul Water	SY	Stay
BO	Bollard	GG	Gully Grate	Tac	Tactile Paving
B/P	Brace Post	GV	Gas Valve	TC	Telecom Cover
BS	Bus Stop	HH	Head Height	TH	Trial Pit
BU	Bush	IC	Inspection Cover	THL	Threshold Level
B/W	Barbed Wire Fence	IL	Invert Level	TL	Traffic Light
BX	Box (Utilities)	I/R	Iron Railings	ToW	Top of Wall
C/B	Close Board Fence	KO	Kerb Outlet	TP	Telegraph Pole
CH	Cill Height	LP	Lamp Post	TV	Cable TV Cover
CL	Cover Level	MH	Manhole	UB	Universal Beam
CL	Chain Link Fence	MP	Marker Post	UC	Unknown Cover
C-Lev	Crown Level	NB	Notice Board	UC	Universal Column
Col	Column	OHL	Overhead Line (approx)	USB	Under Side Beam
C/P	Chestnut Paling Fence	Pan	Panel Fence	UTL	Unable To Lift
C/R	Cable Riser	PB	Post Box	VP	Vent Pipe
DC	Drainage Channel	PM	Parking Meter	WB	Waste Bin
DH	Door Head Height	PO	Post	WH	Weep Holes
DP	Down Pipe	P/R	Post & Rail Fence	WL	Water Level
DR	Drain	P/W	Post & Wire Fence	WM	Water Meter
EL	Eaves Level	P/Wall	Partition Wall	WO	Weeth Out
EP	Electric Pole	RE	Rodding Eye		Floor to Ceiling Height
ER	Earth Rod	RL	Ridge Level		F/C Floor to False Ceiling Ht
ET	EP+Transformer	RP	Reflector Post		Survey Control Station
FB	Flower Bed	RS	Road Sign		
FBD	Floor Board Direction	RSD	Roller Shutter Door		

DRAWING NOTE

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including; sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

Do not scale from this drawing.

Sheet Template

CONTROL CO-ORDINATES

STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
ST01	547462.466	260998.996	7.136	PK Nail
ST02	547472.995	260896.091	6.360	PK Nail
ST03	547473.721	260771.093	6.079	PK Nail
ST04	547470.937	260692.892	6.387	PK Nail
ST05	547369.349	261065.042	7.408	PK Nail
ST07	547575.210	260914.597	7.012	PK Nail
ST08	547556.883	260922.683	7.018	PK Nail

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to grid north with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey (OS) using GPS Smartnet.

To avoid discrepancies any coordinated data used in conjunction with this survey must be derived directly from this control data.

REV	DESCRIPTION	DRAWN	APPR	DATE
A	EXTRA SURVEY WORK AND CONTOURS ADDED	RDS	JIA	19/01/2018

SURVEY SOLUTIONS

Ipswich Coventry Yeovil Norwich Perth Nottingham Brentwood

Tel No: 0845 0405 969 Fax No: 0845 0405 970
www.survey-solutions.co.uk enquiries@survey-solutions.co.uk

LAND SURVEYING BUILDING SURVEYING UNDERGROUND SURVEYING

PROJECT TITLE: COWLEY ROAD, CAMBRIDGE, CB4 0WZ.				
DRAWING DETAIL: TOPOGRAPHICAL SURVEY Sheet 2 of 14				
CLIENT: BROOKGATE LAND LTD				SCALE: 1:200
SURVEYOR: RDS	SURVEY DATE: 12/12/2017	CHECKED BY: KJS	APPROVED BY: JIA	DWG STATUS: FINAL
DRAWING NUMBER: 20852ea-02			REVISION: A	ISSUE DATE: 05/01/2018

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