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Flood Risk Assessment and Drainage Strategy

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1.0 INTRODUCTION

Conisbee have been appointed by The London Borough of Camden to undertake a Flood Risk Assessment (FRA) and Drainage Strategy for the proposed Maria Fidelis Lower School development on North Gower Street, London Borough of Camden. The site is located in Flood Zone 1 of the Environment Agency Flood Map for Planning.

The purpose of this flood risk assessment is to demonstrate compliance with relevant national and local planning requirements.

2.0 BACKGROUND

This flood risk assessment and drainage strategy refers to the following documents:

2.1 National Legislation and Documentation

2.1.1 National Planning Policy Framework (TSO, July 2018) & Planning Practice Guidance - Flood Risk and Coastal Change (CLG, March 2014)

The NPPF sets out government policy on development and flood risk. The aim is to ensure that flood risk is taken into account at all stages of the planning process and that inappropriate development is not undertaken within areas of flood risk.

2.1.2 Flood and Water Management Act (2010)

The Act sets out the responsibilities for statutory authorities involved in Flood Risk Management. The Act requires that the relevant Lead Local Flood Authority (LLFA) be responsible for co-ordinating surface water flood risk in the area. The LLFA is a statutory consultee in planning for all major development in relation to the management of surface water drainage.

2.1.3 Non-statutory technical standards for sustainable drainage systems

The Flood and Water Management Act sets out that the government shall publish national standards, for the consideration of the approving body. The current national standards are "Non-statutory technical standards for sustainable drainage systems", 2015.

2.2 Local planning policy

2.2.1 The London Plan Sustainable Design and Construction - Supplementary Planning Guidance (Mayor of London, April 2014)

This SPG document provides detailed guidance for local authorities and developers on how to meet the objectives of the London Plan Policies relating to sustainable design and construction. This includes 5.12 – Flood Risk Management and 5.13 – Sustainable Drainage.

2.2.2 Camden Local Plan (Camden, 2017)

The relevant policy CC3 states the council's requirements for flood and water management for new developments. This policy aims to reduce the risk of flooding where possible.

2.3 Relevant Local Flood Risk information

2.3.1 Sustainable Urban Drainage System in Camden

London Borough of Camden has produced a document which sets out the technical requirements they require in the assessment of proposed drainage for relevant planning applications.

2.3.2 London Borough of Camden Strategic Flood Risk Assessment (SFRA)

The Strategic Flood Risk Assessment provides a summary of the flood risk in the Borough from various sources (eg fluvial, tidal, reservoirs) and provides policy recommendations and guidance for the preparation of site specific Flood Risk Assessments (FRAs). The SFRA also presents the requirements for developments located in zones of flood risk such as floor levels, evacuation routes, and flood resilient construction.

2.4 Site Specific Documents

The following documents should be referred to as part of this report:

- **Appendix A:** Topographic and CCTV Survey
- **Appendix B:** Landscape Proposal
- **Appendix C:** Thames Water Records
- **Appendix D:** Ground Investigation Borehole Logs
- **Appendix E:** Critical Drainage Area Extract
- **Appendix F:** Proposed Drainage Strategy Plans
- **Appendix G:** Drainage Calculations
- **Appendix H:** SuDS Maintenance Strategy
- **Appendix I:** Thames Water Pre-development Enquiry Response

3.0 EXISTING SITE

3.1 Site Location

The proposed redevelopment is located Maria Fidelis School, North Gower Street, London NW1 2HR, OS grid reference 529287, 182631. The approximately triangular shaped site has an overall area of 6,290m^2 and it is bound by St James Garden to the north, North Gower Street to the West and Starcross street to the South East. The new HS2 Euston Station is also being constructed to the north of the site.

A site location plan is shown in the figure below.

Figure 3.1 Site location plan

3.2 Existing Site and Topography

There are a number of existing buildings on the site at present. The main school building which is 2-3 storeys high and a single storey double height extension which is used as a gym. There is also a 2 storey building to the north west of the main building and a long single storey building to the east, these are currently being used as classrooms but will be demolished as part of the development.

There are also a number of small single storey plant rooms on the site.

The total site area is approximately 6,290m2. The existing impermeable area is 5,937m^2 which is 94% of the total site area, which positively drains. Based on the topographical survey (refer to *Appendix A*), the site is generally level at an approximately elevation of 25.00m AOD on ground that falls gently to the north-east, towards the culverted River Fleet, which flows south-eastwards some 0.8km to the north-east.

Topographic drawings can be found in *Appendix A*.

3.3 Historical Use of site

Historically the school site was used for housing until the main school building was developed between 1949-1953. The site extended to the southeast in the late 1950's.

3.4 Geology

An intrusive geotechnical and ground investigation was produced for the site by Ground Engineering Limited in December 2018, with the site visit in late October 2018. The report indicates that the made ground was underlain by the expected solid geology of the London Clay Formation.

Groundwater was not encountered in any boreholes during excavation. A 7.00m deep standpipe installed within BH 1 and it was recorded as dry during the three return monitoring visits in November 2018.

Chemical testing confirmed that the made ground contained elevated concentrations of lead, benzo[a]pyrene and asbestos containing material. The benzo[a]pyrene results also statistically exceeded the soil screening criteria for the intended commercial/industrial end use. The report recommends that in areas of soft landscaping the made ground should be removed and replaced with a surface covering of at least 0.60m of certified 'clean' topsoil.

Infiltration methods of disposing of rainwater have been considered not feasible for the site due to urban character and ground condition, London Clay underlying the site.

The indicated Site Investigation Borehole Records are presented in *Appendix D*.

3.5 Hydrogeology

Aquifer geology maps published by the EA show the site is within the limits of a Secondary Aquifer A at greater depth. These are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers; which give the site low groundwater vulnerability.

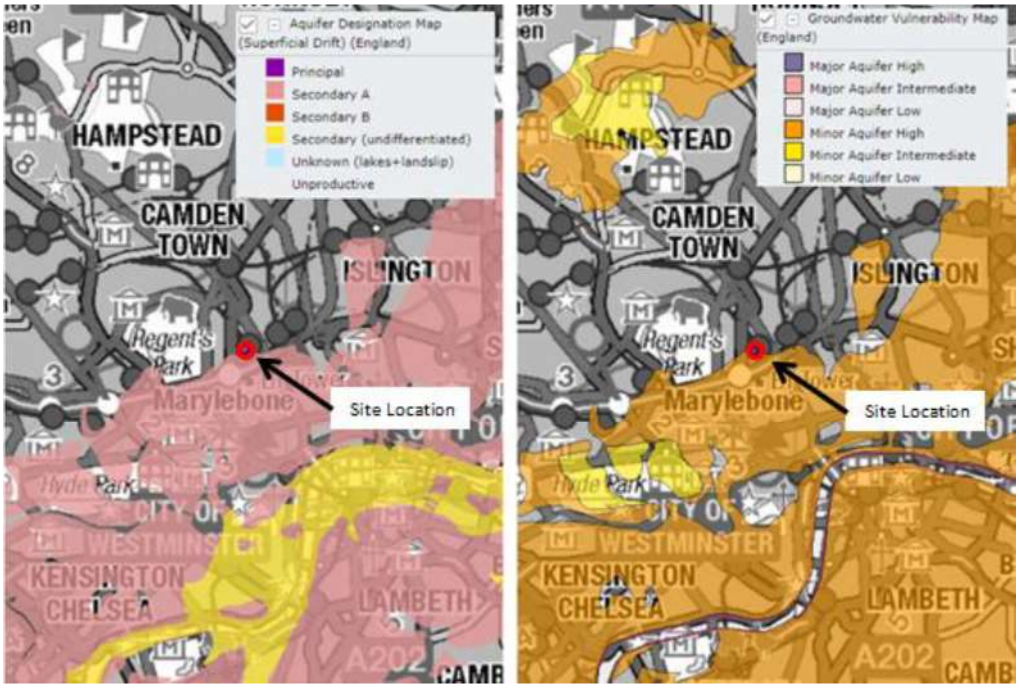

Figure 3.2 Aquifer Designation and Groundwater Vulnerability Maps

Based on the Environment Agency map shown below, the site is not located within a Source Protection Zone.

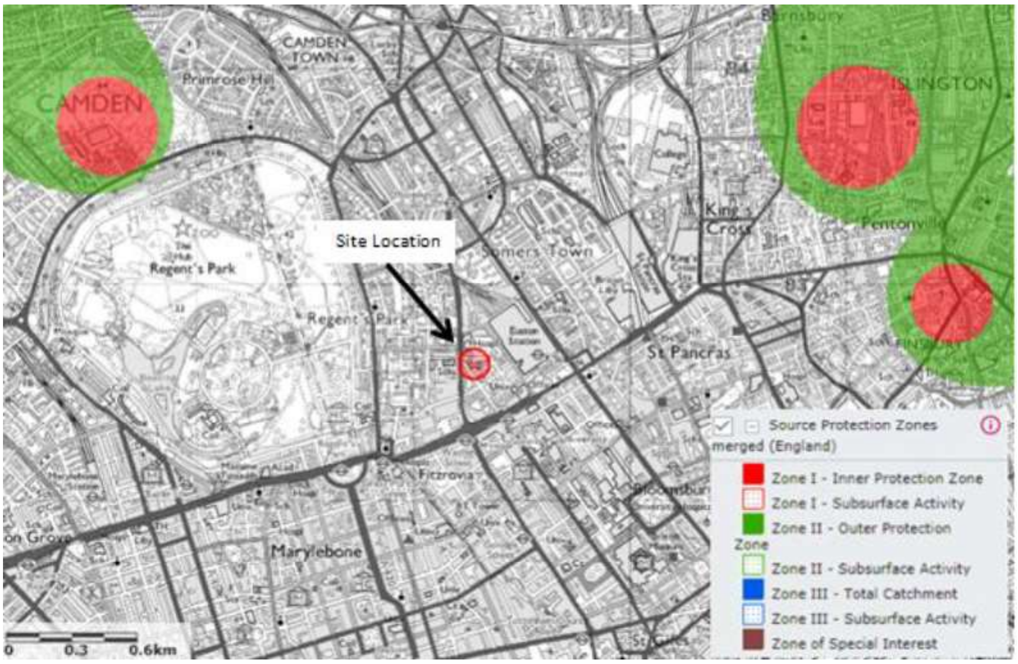

Figure 3.3 Groundwater Source Protection Zones

3.6 Groundwater

Groundwater was not encountered during the ground investigation.

3.7 Existing Site Drainage

A topographic survey of the existing site was carried out by EDI Surveys Ltd in July 2018 and a CCTV survey of the drainage system was carried out by InSewer Surveys on 22nd October 2018. Both are included in *Appendix A*.

These surveys indicate that surface and foul water from the site is collected by a private combined drainage system with several gullies located along the hard paved areas. The drainage discharges into three local combined sewers: one in the north of the site flowing west, one to the south in Starcross Street and one to the west of the site in North Gower Street flowing south.

The Thames Water sewer record plan has been received for the development, and is included in *Appendix C*. They show that there is an elliptical 1168x787 mm brick combined sewer crossing the site at a depth of approximately 4m deep, at 20.5 m AOD.

Consultations have been held with Thames Water regarding the Build Over Agreement required for the construction of the Construction Skills Centre. A class 3 Build Over is required as the sewer is over 375mm in diameter.

An additional CCTV and drainage survey was carried out by Flowline Ltd, in December 2018 and is included in *Appendix A*. This has confirmed the depth and size of the public combined water sewer crossing the site indicated in the Thames Water records.

The site directly north of Maria Fidelis School is being developed as part of HS2. Due to the groundwork within the HS2 site an agreement has been made between HS2 and Thames Water to re line sections of existing Thames Water sewer throughout the Maria Fidelis site.

Following discussions with HS2, Thames water and the design team it has been made clear that these works are likely to affect the CSC building construction programme, as HS2 will need to temporarily take possession of the site. Additionally the placement of any new manholes that HS2 build within 7m of the footprint of the CSC building will require a build over agreement from Thames water. We are at present trying to coordinate with HS2 so that these manholes are positioned in locations which will not require further agreements with Thames water.

The current foul drainage strategy is based on connecting into the existing manhole on site which flows into the existing Thames water Sewer. The strategy does not take into account the HS2 proposals to re line the sewer, as their final design has not been provided to the team yet, however it is unlikely that these works will affect the proposed drainage strategy.

3.8 Existing Site Characteristics

The existing hydrological characteristics for the site are as follows:

- M5_60min=20
- Ratio r=0.4
- IH 124 Soil Type: 4
- Total Site Area = 6,287m²
- Total Existing Impermeable Area = 5,937m²
- Percentage Impermeable (PIMP) = 94%
- Peak Foul Flow = 30.31 l/s

Table 3.1 Existing Peak Runoff Rates, Greenfield Rates and Discharge Volumes

Return period	Existing peak run off rate [1]	Greenfield run off rate [2]	Existing Discharge volume [3]
	[l/s]	[l/s]	[m^3]
1 in 1 year	33.1	2.08	107.8
1 in 30 years	81.2	5.64	236.9
1 in 100 years	106.0	7.82	307.8
1 in 100 years (+30%)	N/A	N/A	N/A

[1] The existing run off rates were determined by the Wallingford Rational Method with a rainstorm of 30 minutes duration; Volumetric run-off coefficient = 1 for impermeable areas, and 0 for permeable areas.

[2] Calculated based on IH 124 and 'Rainfall runoff management for developments'

[3] Based on BS 8582 section 9.8

3.9 Existing overland flow paths

The existing overland flows routes for flows generated within the site follow the general falls of the site into existing drainage serving the site, as shown in the topographic survey in *Appendix A* and as described in section 3.2.

The land surrounding the site is generally flat, shown by the standing water in the local area on EA Risk of Surface Water Flooding Map as described in Section 6. These do however show surface water streaming to the north along Hampstead Road to the west of the site.

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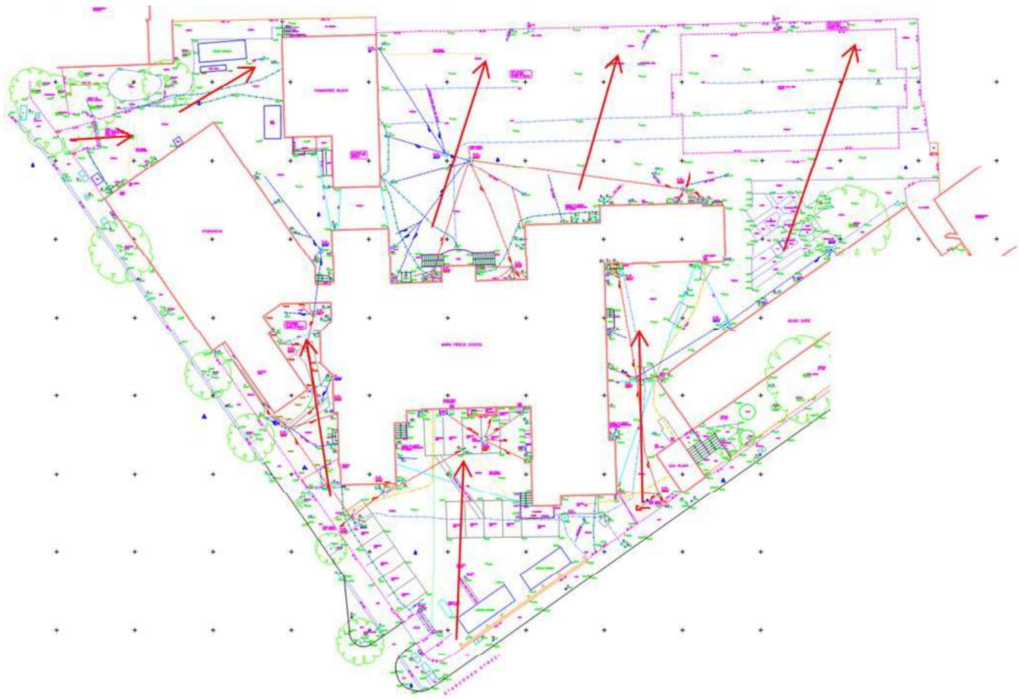

Figure 3.4 Existing Overland Flow Paths

4.0 PROPOSED DEVELOPMENT AND DRAINAGE STRATEGY

4.1 Description

The proposed development comprises the provision of temporary open space, conversion of the main school building into offices and the construction of a new two storey building which is to be used as education facility for teaching construction skills.

4.2 Proposed Drainage

In accordance with the NPPF, London Plan, and Camden Local Plan, the new development will incorporate a Sustainable Drainage System (SuDS) to manage rainfall on site and ensure that runoff is not increased elsewhere. Drawings showing the proposed drainage strategy are presented in *Appendix F*.

The proposed site has been split into two main catchments: Catchment 1 will convey foul water from the entire site and surface water from the existing buildings and the open area in the west of the site. Catchment 2 will convey surface water runoff only from the proposed new building, surrounding impermeable area and proposed open area in the southeast of the site. The extent of Catchment 2 is shown on the Proposed Drainage Strategy drawing (in *Appendix F*) and Catchment 1 includes all other areas.

The majority of drainage in Catchment 1 will be retained existing drainage. Pipes in poor condition will be repaired/replaced and manholes/RWP/SVPs moved where necessary into more suitable locations. Drainage which is made redundant by the proposed development will be abandoned. The three existing combined connections to local Thames Water sewers will be retained as existing.

Catchment 2 will be drained by an entirely new drainage network designed to modern standards.

In Catchment 2 surface water runoff from the proposed new building and landscaped area and a small area of existing building will be discharged at a controlled rate into the local combined sewer to the southeast of the site, with attenuation provided in crate system storage and permeable paving.

This report does not contain a generic assessment of advantages and disadvantages of different SuDS measures as it is assumed that the reader can obtain this from the SuDS Manual.

The surface water runoff from Catchment 2 will be discharged at 1.0 l/s (closest achievable controlled rate to QBAR greenfield runoff rate) into the Thames Water combined sewer to the southeast of the site. A total of 1,733m2 of impermeable area will be served by the new drainage system and 112m^3 of attenuation volume is provided, designed with capacity for a 1 in 100 +30% storm event.

The proposed strategy drawing provides notes on attenuation volumes and is included in *Appendix F*.

The proposed drainage system includes catch pits to catch sediment within the system and utilises permeable paving improving surface water quality.

The proposed runoff characteristics are as follows:

- Proposed Impermeable Area (includes lined permeable pavement) = 4,809m^2
- Percentage Impermeable (PIMP) = 75%
- Net reduction of impermeable area after development = 1,128m^2
- Existing Greenfield runoff rate (QBAR) of Catchment 2 = 0.72 l/s
- Proposed runoff rate for Catchment 2 = 1.0 l/s

Table 4.1 Proposed Peak Runoff Rates from Catchment 1 and 2

Return period	Proposed peak run off rate [1] from Catchment 1	Proposed peak run off rate [3] from Catchment 2	Proposed Discharge volume [4] from Catchment 1	Proposed Discharge volume [3] from Catchment 2
	[l/s]	[l/s]	[m^3]	[m^3]
1 in 1 year	19.0	1.0	89.5	22.3
1 in 30 years	46.5	1.0	196.6	31.1
1 in 100 years	60.8	1.0	255.4	43.4
1 in 100 years (+30%)	79.0	1.0	332.1	46.7

Table 4.2 Proposed Peak Runoff Rate and Discharge Volume from the Whole Site

Return period	*Existing peak run off rate* [1]	*Greenfield run off rate* [2] *from catchment 2*	Proposed peak run off rate from whole site	*Existing Discharge volume* [4]	Proposed Discharge volume from whole site [4]
	[l/s]	*[l/s]*	[l/s]	*[m^3]*	[m^3]
1 in 1 year	*33.1*	*0.61*	20.0 l/s	*107.8*	99.6
1 in 30 years	*81.2*	*1.65*	47.5 l/s	*236.9*	219.0
1 in 100 years	*106.0*	*2.29*	61.8 l/s	*307.8*	284.0
1 in 100 years (+30%)	*N/A*	*N/A*	80.0 l/s	*N/A*	369.9

[1] The existing run off rates were determined by the Wallingford Rational Method with a rainstorm of 30 minutes duration; Volumetric run-off coefficient = 1 for impermeable areas, and 0 for permeable areas.
[2] Calculated based on IH 124 and 'Rainfall runoff management for developments' by the EA
[3] From a Source Control Model
[4] Based on BS 8582 section 9.8

4.3 Water disposal hierarchy

The LLFA, Thames Water, the SuDS Manual and the Building Regulations recommend a hierarchy of methods of disposal of surface water. In order, these are re-use, disposal by infiltration, discharge to watercourses and if neither of these options are reasonably practical then discharge to a public surface water sewer and finally discharge to a combined sewer. The objective is for surface water discharged from urban development's to replicate the predevelopment response of the site as far as possible.

Table 4.3 Surface Water Disposal Hierarchy Discussion

Disposal Method	Comments
Re-use water at source	No demand for harvested rainwater on site
Infiltration	Geology unsuitable
Watercourse	None located nearby
Surface water sewer	None located nearby
Combined Sewer	Chosen option

4.4 Peak Flow and Volume Control

The existing discharge rate of surface water from the whole site into Thames Water sewers for a 1 in 30 year event is 81.2 l/s.

The proposed discharge of surface water from the whole site into Thames Water sewer for a 1 in 30 year event is 47.5 l/s, a significant reduction in discharge rate. The total volume of discharge will also be reduced, due to the reduction of impermeable area.

The proposed discharge rate of surface water from Catchment 2 is 1.0 l/s. The QBAR greenfield runoff rate from the same area has been calculated using the IH124 method to be 0.72 l/s. This discharge rate is not feasible so the lowest feasible controlled discharge rate of 1.0 l/s has been used.

4.5 Water quality

The proposed uses of the sites along with the SuDS elements proposed will ensure that water leaving the site to the sewer would be of good quality. The permeable paving will allow settlement and catch pits will reduce the silt content.

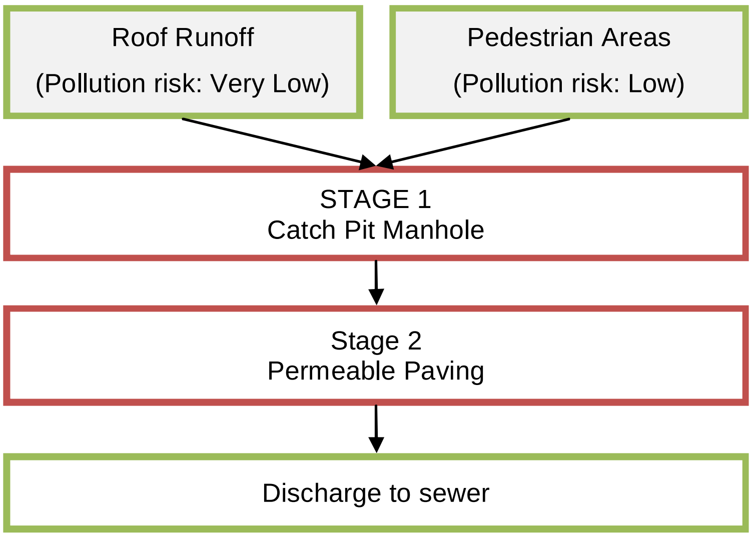

Figure 4.1: Proposed Treatment Train

4.6 Design and modelling criteria, assumptions, and simplifications

The drainage has been designed with an allowance for a 30% increase in rainfall intensity due to climate change for 100 year storms. This complies with the “Upper Limit” in DEFRA guidance.

The Drainage Calculations produced using the source control module within Microdrainage results (included in *Appendix G*) demonstrate that all water for a 1 in 100 year storm plus 30% climate change is contained within the proposed drainage system.

A volumetric coefficient (PAF) of 1 has been applied to all proposed impermeable areas and a PAF of 0 applied to all permeable areas in line with the latest guidance from CIRIA and Sewers for Adoption. Overall catchment factors (Cv) of 1 have been used for both winter and summer storms.

The proposed areas to be surfaced in permeable resin bound gravel and porous safety rubber may have additional storage in gravel below (like permeable paving) but this has not been included in the calculations.

4.7 Exceedance Flows

In an event where the capacity of the surface water system is exceeded, water will leave the site via overland flow. For the site this is to the northeast, as shown in the figure below. The overland flow arrows only relate to exceedance flows generated from within the site boundary. In addition, the proposed drainage strategy results in exceedance volumes generated by the site being reduced.

The proposed floor level of the proposed new building will be raised above external levels so surface water will flow away from building entrances.

The exceedance flow routes will remain generally as existing although the proposed landscaping buffer in the southeast of the site will reduce flows in addition to the proposed drainage improvements.

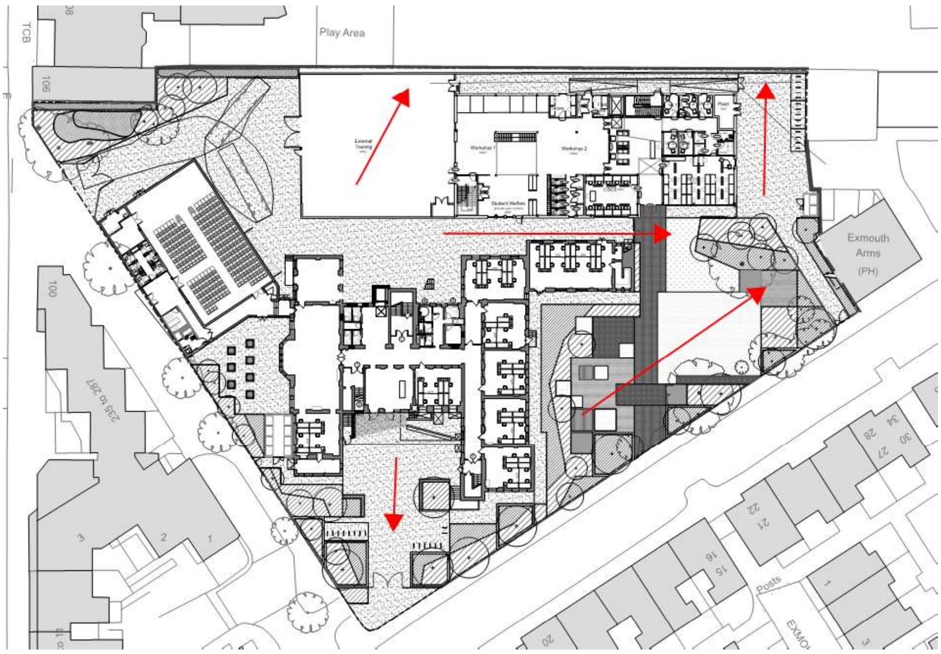

Figure 4.1 Exceedance Flow Route

4.8 Maintenance Strategy

All proposed SuDS and drainage are to be maintained for the duration of the development by the client.

A proposed maintenance strategy, in line with the CIRIA SuDS Manual, is included in *Appendix H*.

4.9 Proposed Foul Drainage

The existing foul drainage for the main building and building in the west of the site will be retained. The system will have minor improvements, relocated manholes where necessary and the pipes will be repaired/replaced if necessary. The proposed foul drainage strategy for new proposed northern building will be to convey flows to the west then connect into an existing manhole which then flows into the Thames Water foul water sewer in the north of the site. At this stage the exact arrangement of the network inside the site boundary has not been established.

Based on the development to offices and training centre, the estimated peak foul flow rate is 3.37 l/s for 275 office workers and 100 students.

Table 4.4 Proposed Peak Foul Flow Rate

Useage	No. of people	Foul water flow	Foul water base flow	Peaking Factor	Foul Water peak flow
	-	l/day	l/s	-	l/s
School Pupils	100	10000	0.12	6	0.69
Office	275	27500	0.32	6	1.91
Industrial	0	0	0.00	6	0.00
				Total	**2.60**

The existing peak foul flow rate of 2.26 l/s is based on 485 students at the existing school.

Table 4.5 Existing Peak Foul Flow Rate

Useage	No. of people	Foul water flow	Foul water base flow	Peaking Factor	Foul Water peak flow
	-	l/day	l/s	-	l/s
School Pupils	485	48500	0.56	6	3.37
Office	0	0	0.00	6	0.00
Industrial	0	0	0.00	6	0.00
				Total	3.37

4.10 Public Sewer Capacity

Thames Water has been contacted to confirm there is capacity for the increased foul flows via a pre-development enquiry. Thames Water has confirmed that there is sufficient capacity within the sewers, with the response included in *Appendix I*. The receiving sewer is 1168 x 787mm.

Although foul flows from the site will increase due to the proposed development, the provision of a SuDS system and reduction in impermeable area reduces combined flows overall.

Table 4.6 Existing and Proposed Combined Flow Rates

Return period	Existing combined flow rate	Proposed combined flow rate
	[l/s]	[l/s]
1 in 1 year	36.47	22.60
1 in 30 years	84.57	50.10
1 in 100 years	109.37	64.40
1 in 100 years (+30%)	N/A	82.60

5.0 FLOOD ZONE, SEQUENTIAL AND EXCEPTION TEST

5.1 Flood Zone

The EA Flood Map for Planning shows the site to be in Flood Zone 1, at low probability of flooding (less than 1 in 1,000 annual probability).

Figure 5.1 – "Flood Map for Planning" from Environment Agency

5.2 Vulnerability Classification

According to ["Table 2: Flood Risk Vulnerability Classification"] in the NPPF Practice Guidance (Flood Risk and Coastal Change) the intended use as commercial has a Vulnerability Classification of 'Less Vulnerable'.

5.3 Sequential Test

As the site is located in Flood Zone 1, according to Table 3 of the NPPF Practice Guidance, the exception test is not required.

Table 5.1 Flood Risk Vulnerability Classification (after Table 3 NPPF Practice Guide Flood Risk and Coastal Change)

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓ *

As the site is located in Flood Zone 1 it is not required to pass the Sequential Test.

6.0 DEFINITION OF THE FLOOD HAZARD

6.1 Sources of Flooding

The London Borough of Camden Strategic Flood Risk Assessment summarises the risk of flooding from the following sources;

- Fluvial
- Tidal
- Surface Water / Overland Flow
- Sewers
- Groundwater
- Artificial Sources

These sources of flooding, and how they relate to the site, are discussed below:

6.1.1 Fluvial Flooding

The EA flood maps confirmed that the site is located within Flood Zone 1, at low risk of flooding.

Reference has also been made to the London Borough of Camden SFRA. This document indicates the lack of main rivers within the area as all main rivers historically located within the borough are now culverted and incorporated into the Thames Water sewer network.

The Environment Agency's Historic Flood Map shows that no flooding has occurred within the borough from fluvial or tidal sources.

As been shown previously in Figure 4.1 the Environmental Agency Flood Risk Map indicates that the proposed development site is located in Flood Zone 1 (low risk of flooding from rivers and see) and more than 2,500m away from the nearest instance of Environment Agency Flood Zones 2 & 3 to the south, where River Thames is located.

It is concluded that the site is not at risk of flooding from fluvial sources.

6.1.2 Surface Water and Overland Flooding

Surface water flooding occurs when high intensity rainfall overwhelms man made drainage systems or surface water cannot soak into the ground. Man-made drainage systems can fail for a number of reasons, such as when the rainfall event exceeds the capacity of the drainage system, the drainage system (including surface level drainage) become blocked by debris or sediment, or because the system surcharges due to high water levels in receiving (downstream) watercourses.

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The Environment Agency publishes and maintains the national Risk of Flooding from Surface Water Flood Map (RoFSW). This aims to represent flooding caused by surface runoff from precipitation and is based on a high resolution ground model and simulated rainfall for return periods up to the 1 in 1000 year event. The model picks up depressions in the surface where flooding would occur and indentifies the overland flood flow paths.

The Environment Agency model, shown in Figure 6.1, indicates that the site is located within an area where the flood risk from surface water is very low. This means that each year this area has a chance of flooding of less than 0.1%. The southeast of the site is at low risk of surface water flooding, but the proposed development will improve the drainage of this area reducing the flood risk.

The site is considered to be at a very low risk of flooding from surface water or overland flows.

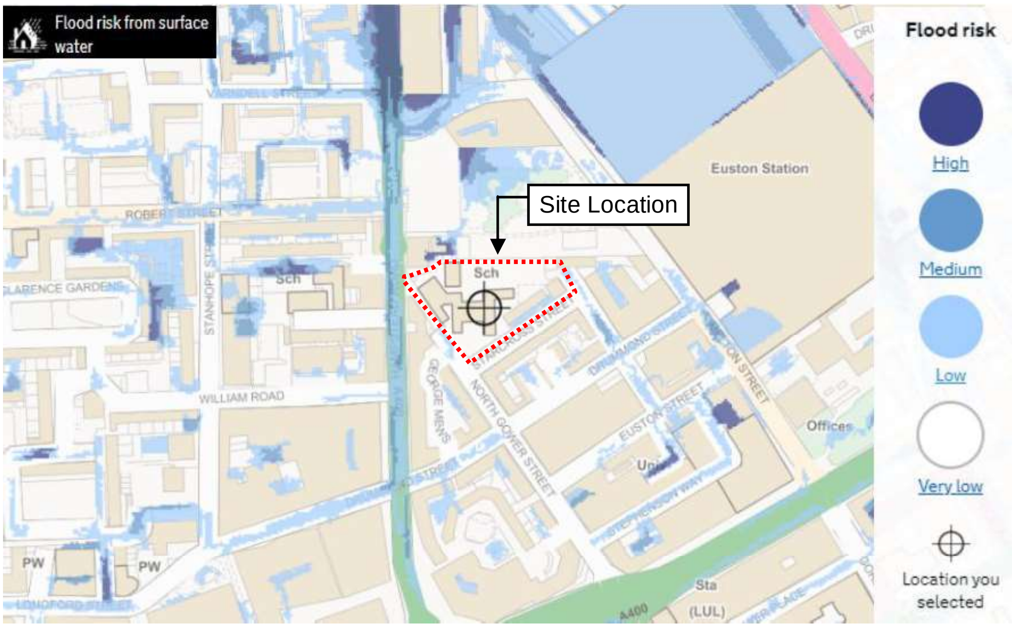


Figure 6.1 EA RoFSW "Extent of Flooding" Map

6.1.3 Sewer Flooding

Since the late 1970s, and with the publication of Sewers for Adoption in 1980, sewer networks are designed to cope with storm events up to and including the 1 in 30 year storm event. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in a given year).

London Borough of Camden SFRA shows there was no historical incident of sewer flooding close to the site.

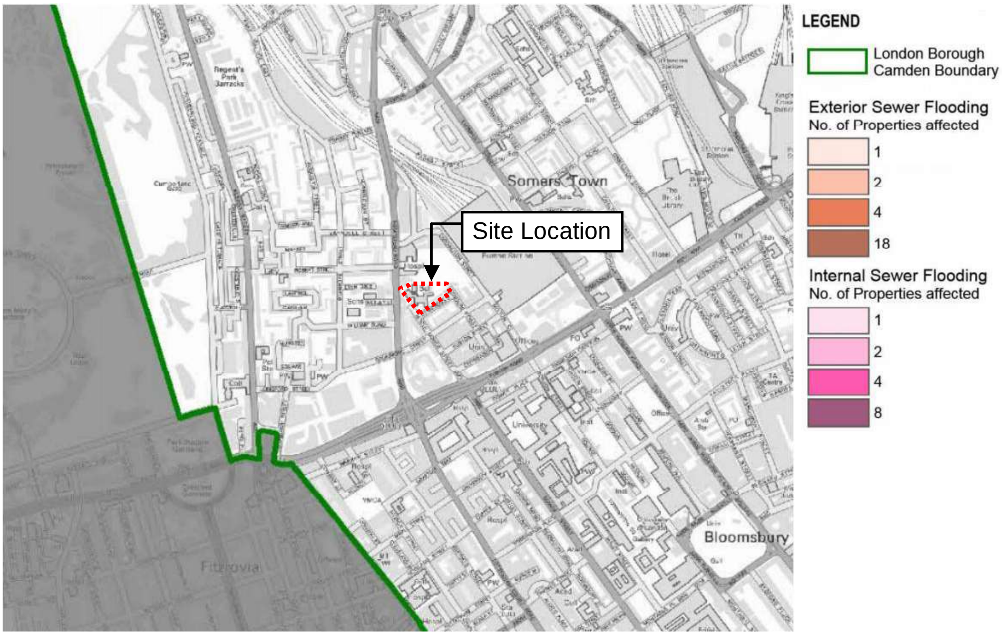


Figure 6.2 – Historical Sewer Flooding Incidents from London Borough of Camden SFRA

The new drainage system seeks to intercept as much runoff as possible and reduce the peak flow from the site through the use of Sustainable Drainage Systems (SuDS). This should reduce the risk of the external drainage system being overloaded and therefore reduces flood risk elsewhere.

The site is considered to be at a very low risk from sewer flooding, and the proposed development reduces flood risk elsewhere.

6.1.4 Groundwater Flooding

Groundwater flooding occurs when the water table rises above ground level and flows over land. It can also occur where building floors, such as basements, are lower than the surrounding ground.

Reference has been made to the London Borough of Camden SFRA which indicates that the south part of the site is identified as in an area where there is increased potential for groundwater levels to rise within 2m of the ground surface following periods of higher than average recharge.

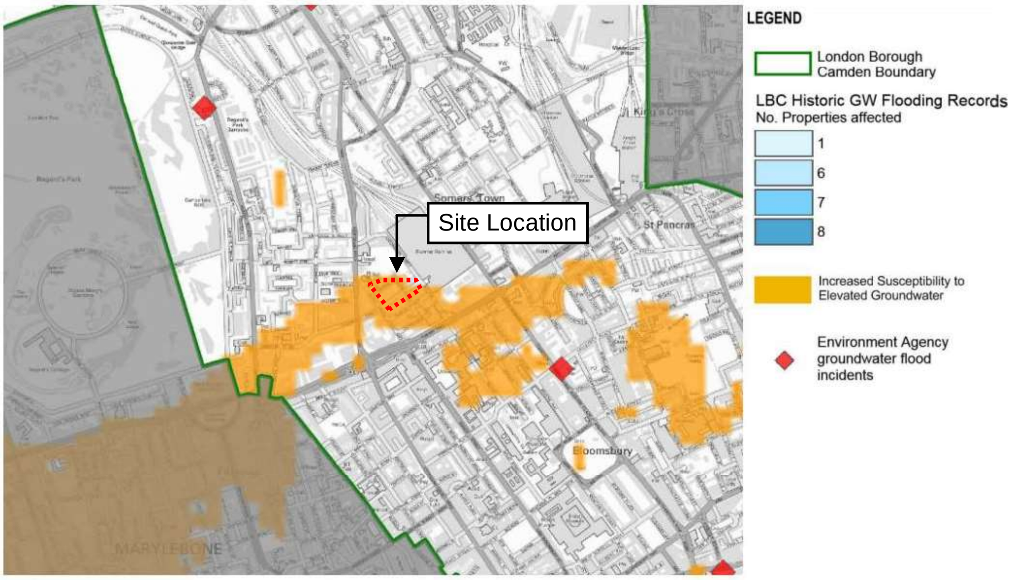


Figure 6.3 – Increased Potential for Elevated Groundwater from London Borough of Camden SFRA

Groundwater flooding is often relatively small scale and site-specific, this can be related to isolated perched water within sandy layers of the London Clay that underlie the site. The perched water tables are identified to be a slope stability, rather than flood risk, issue within Camden and should be assessed as such in any Basement Impact Assessment.

There are no basements proposed and the site investigation indicates that there is no risk of elevated ground water levels at the site.

The proposed attenuation storage crate system is proposed at 1.8m deep, kept shallow to avoid groundwater levels.

The site is considered to be at a very low risk of flooding from groundwater.

6.1.5 Flooding from Artificial Sources

Artificial water bodies, such as reservoirs, canals, etc. could pose a flood risk in the event of a structural failure such as a breached reservoir dam.

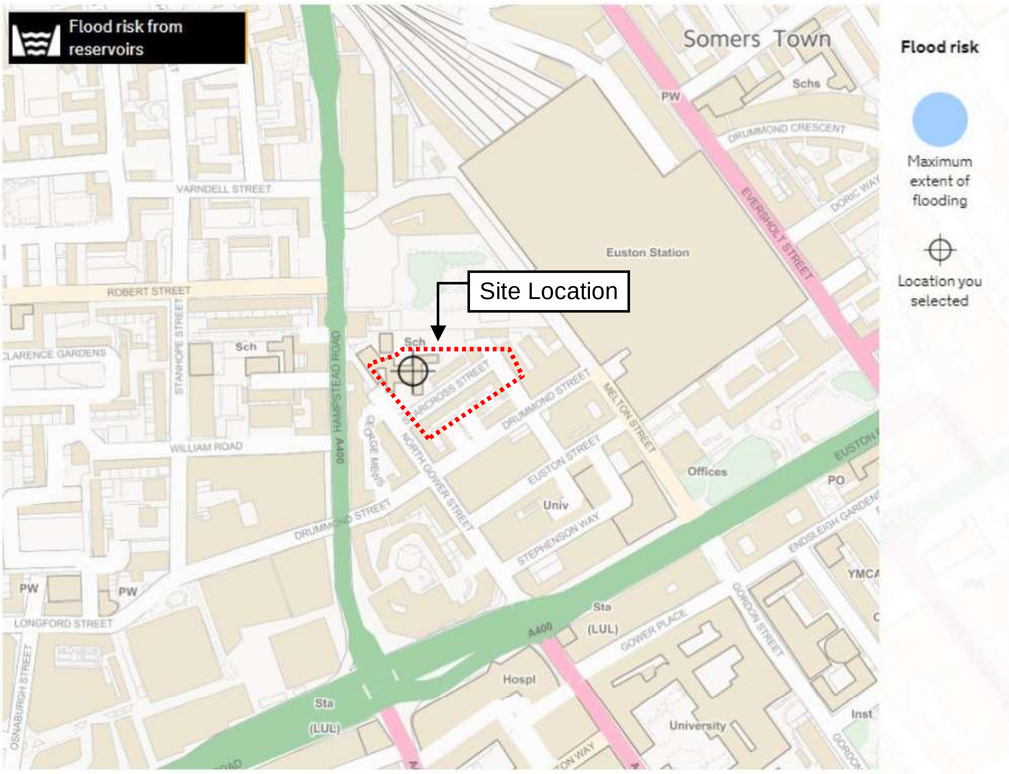


Figure 5.4 – EA Map of Risk of flooding from artificial sources.

The Environment Agency Flood Risk from Reservoirs Map shows that the site is located 2.5 km away from any extent of flooding from reservoirs.

The site is not considered to be at risk of flooding from artificial sources.

6.1.6 Tidal Flooding

There are no tidal watercourses nearby the site. The nearest tidal water course is the River Thames, as discussed previously this is located 2.5 km to the south. Whilst the Thames poses a potential risk of flooding to properties within the borough, all property within the borough is currently protected from combined tidal and fluvial flooding by the River Thames Tidal Defences (TTD) up to the 1 in 1000 year event.

It is concluded that the site is not at risk of flooding from tidal sources.

6.2 Critical Drainage Area

London Borough of Camden has coordinated a Surface Water Management Plan for the borough. This considers flooding from sewers, drains, groundwater, runoff from land, small water courses and ditches that occurs as a result of heavy rainfall.

Areas where the flood risk is considered to be most significant are identified with the SWMP as Critical Drainage Areas. Reference has been also made to this document and it has been found that the site is located within the Critical Drainage Area, CDA Group3_003. An extract of this document showing the location of the site in relation with the CDA can be found in *Appendix E*.

As can be seen from these maps the site is located outside of the existing 1 in 100 year depth and hazard results area. As indicated previously the proposed development will result in a decrease in impermeable areas (See section 4.2). Furthermore design measures such as permeable pavements and attenuation tanks along with a flow control will be put in place. This will ensure that the peak surface will decrease over the current calculated peak flows as well as significantly increase the time of entry to the public sewer.

Therefore, after the construction of the proposed development surface water strategy the site will reduce the risk of flooding within the site and the surrounding sites located within the Critical Drainage Area.

6.3 Probability of Flooding

Overall the probability of the site flooding from the sources described above is very low.

6.4 Flood Risk due to Climate Change

The effect of climate change will be to increase the intensity and duration of rainfall events, thus increasing the likelihood of localised flooding. In accordance with the National Planning Policy Framework (NPPF) practice guidance an additional 30% has been added to rainfall profiles during design to accommodate future increases due to Climate Change.

6.5 Residual Risks

The residual risk is thought to be very low providing that the drainage systems are adequately maintained.

6.6 Off Site Impacts

As discussed in Section 4, every effort has been made to ensure the runoff from site is as low as possible using sustainable drainage techniques. The development is not thought to impact existing flood flow paths or groundwater flows. Overall the proposals have a slightly positive impact on flood risk elsewhere.

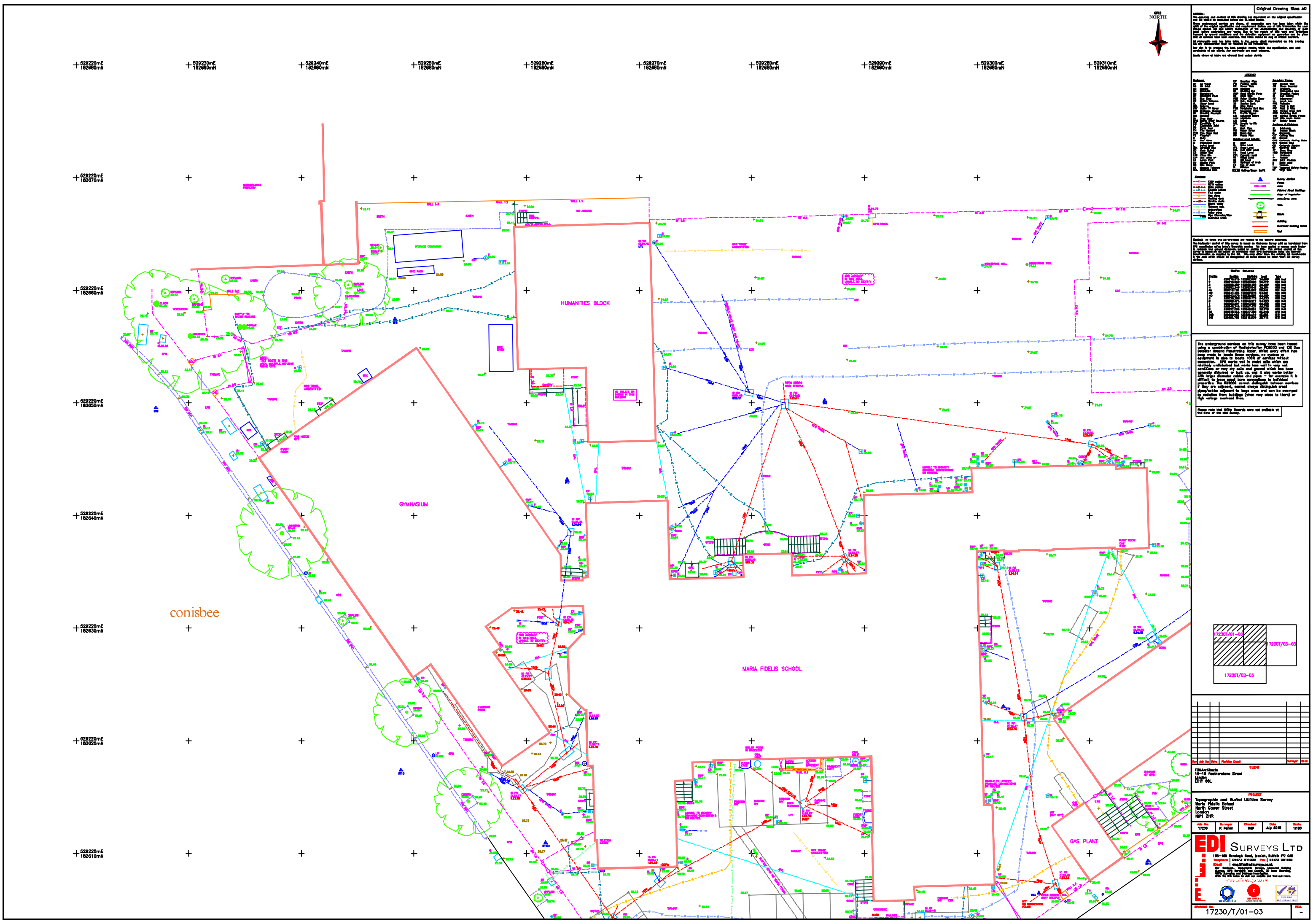
7.0 CONCLUSIONS

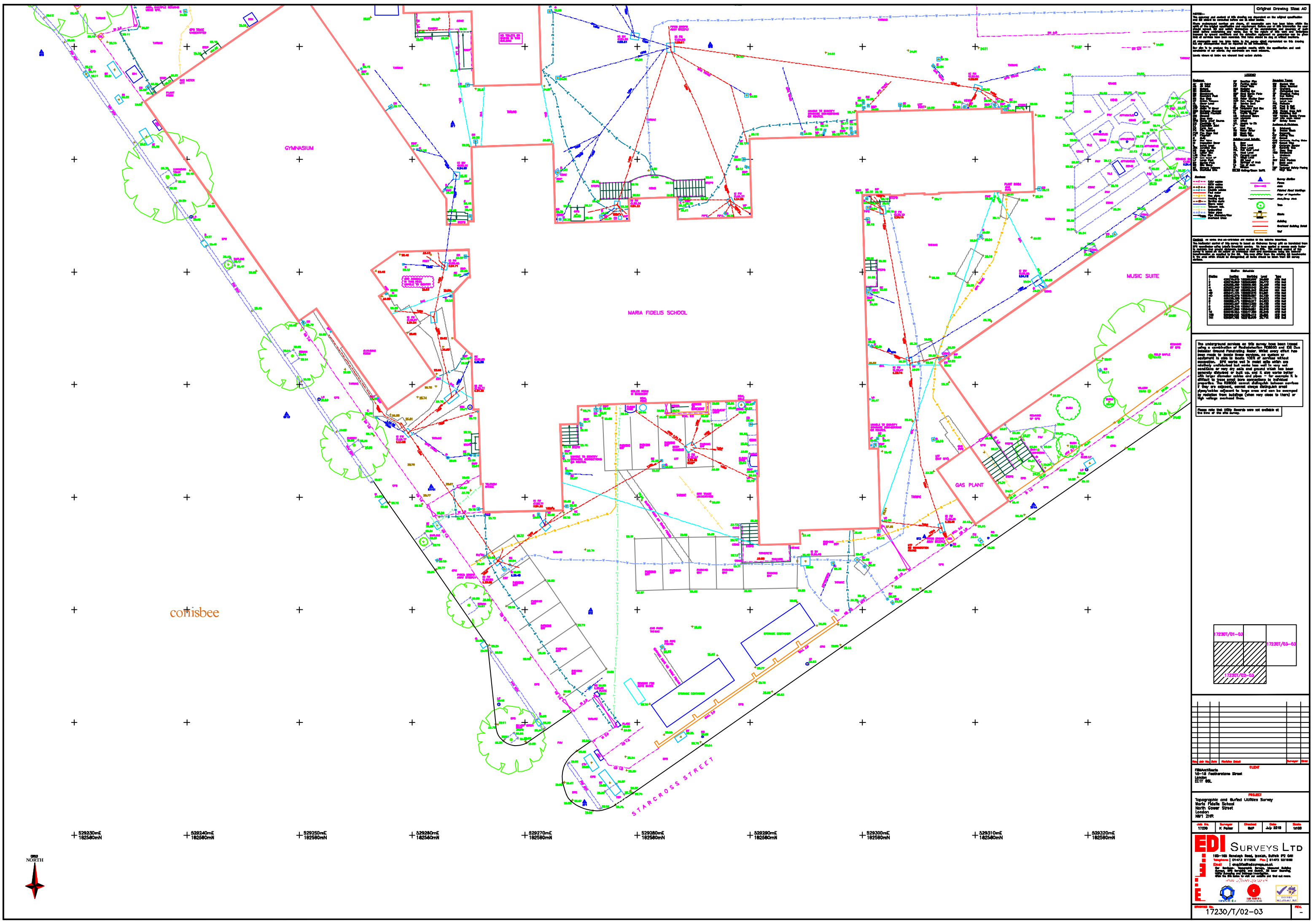
The site is located in Flood Zone 1 and there is a low risk of flooding from other sources such as ground water, sewers and overland flows.

Surface water runoff from the development is managed through the use of sustainable drainage systems (SuDS) to ensure there is a significant reduction in flows leaving the site. The design accounts for an increase in rainfall volumes due to climate change.

It is considered that the development will reduce flood risk elsewhere because of the proposed SuDS system.

APPENDIX A: TOPOGRAPHIC AND CCTV SURVEY


HUMANITIES BLOCK
GYMNASIUM
MARIA FIDELIS SCHOOL
GAS PLANT
conisbee
Original Drawing Size: A0
CLIENT
FBMArchitects
16-18 Featherstone Street
London
EC1Y 8SL
PROJECT
Topographic and Buried Utilities Survey
Maria Fidelis School
North Gower Street
London
NW1 2HR
Job No.
17230
Surveyor
K Parker
Date
July 2018
Scale
1:100
EDI SURVEYS LTD
DRAWING No.
17230/T/01-03
REV.
-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MUSIC SUITE
GAS PLANT
STARCROSS STREET
cornisbee
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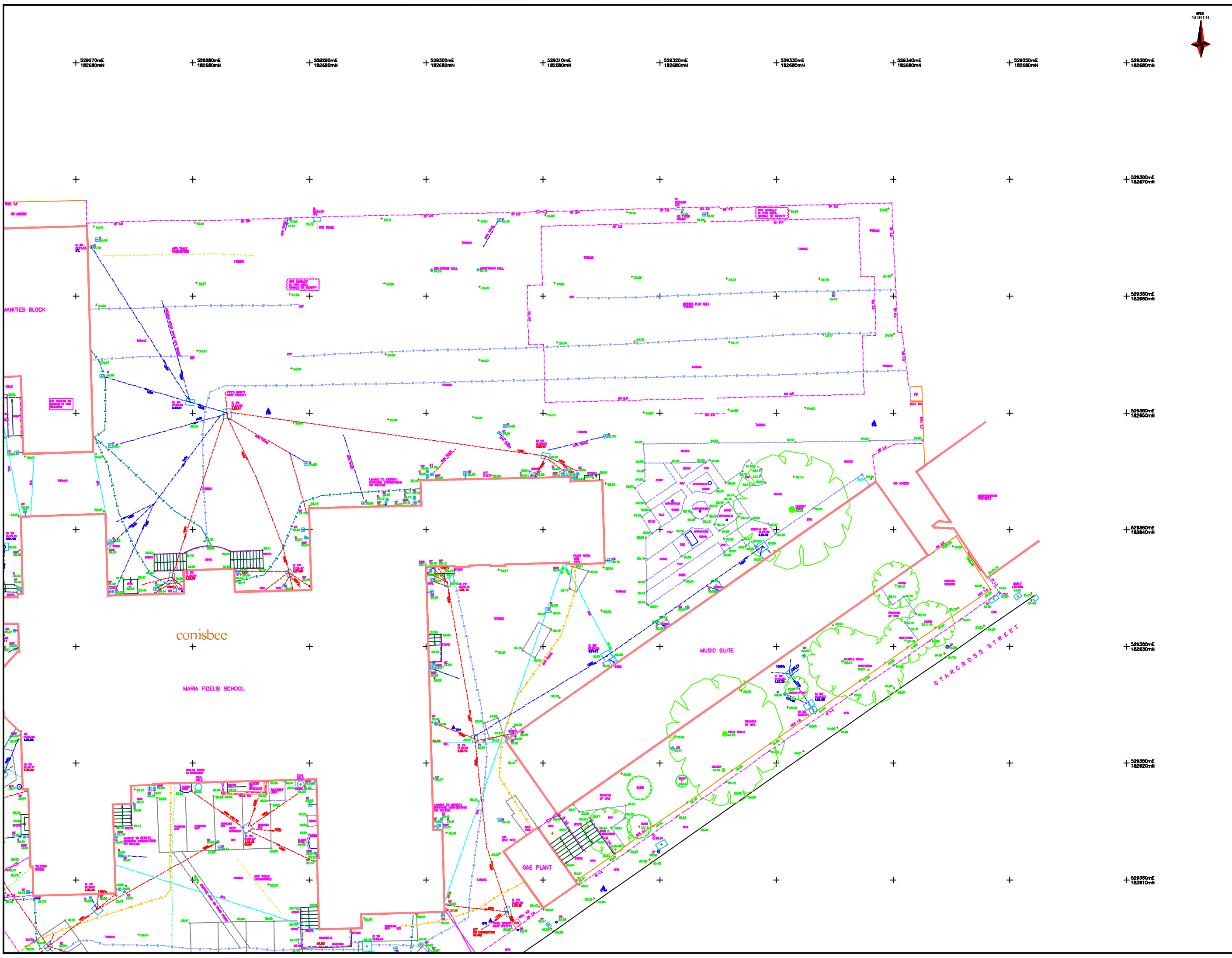
17230/T/02-03
REV.
-



Original Drawing Sheet A0

17230T/01-03		17230T/03-03
17230T/02-03		

Rev.	Job No.	Date	Revision Detail	Surveyor	Chkd

CLIENT
FBMArchitects
10-18 Featherstone Street
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EC1Y 8SL

PROJECT
Topographic and Buried Utilities Survey
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North Gower Street
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NW1 2HR

Job No.	Surveyor	Checked	Date	Scale
17230	K Parker	GMP	July 2018	1:100

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163-165 Ranelagh Road, Ipswich, Suffolk IP2 0AH
Telephone | 01473 211232 Fax | 01473 231880
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Our Services- Topographic Surveys, Measured Building Surveys, GPS Surveying and Control, 3D laser Scanning, Utility Surveying and Drainage Investigation.

DRAWING No. 17230/T/03-03
REV. -

Sewer Inspection,
Cleaning and Repair

Project ref:TV181034

22nd – 24th OCT 2018

CCTV Survey Report

CLIENT: Conisbee

SITE: Maria Fidelis School

North Gower Street

Camden

NW1 2HR

www.insewer.co.uk
Tel : 01634 861 768

InSewer Surveys
16a Revenge Road
Lordwood Industrial Estate
Tel: 01634 861 768
Fax: 01634 201 376
Email: liam@insewer.co.uk

Project-information

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Town:	**London**
County:	**N1 1DH**
Telephone:	**0207 6977 248**
Fax:	
Mobile:	
E-mail:	

Site:	
Contact Name:	**Rosana or Emanoel**
Department:	**Maria Fidelis School**
Road:	**North Gower School**
Town:	**Camden**
County:	**NW1 2HR**
Telephone:	
Fax:	
Mobile:	
E-mail:	

Contractor	**InSewer Surveys**
Contact Name:	**Liam Sellar**
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Telephone:	**01634 861 768**
Fax:	**01634 201 376**
Mobile:	**07802 660 752**
E-mail:	**liam@insewer.co.uk**

Sewer Inspection,

Cleaning and Repair

Site Plan

www.insewer.co.uk

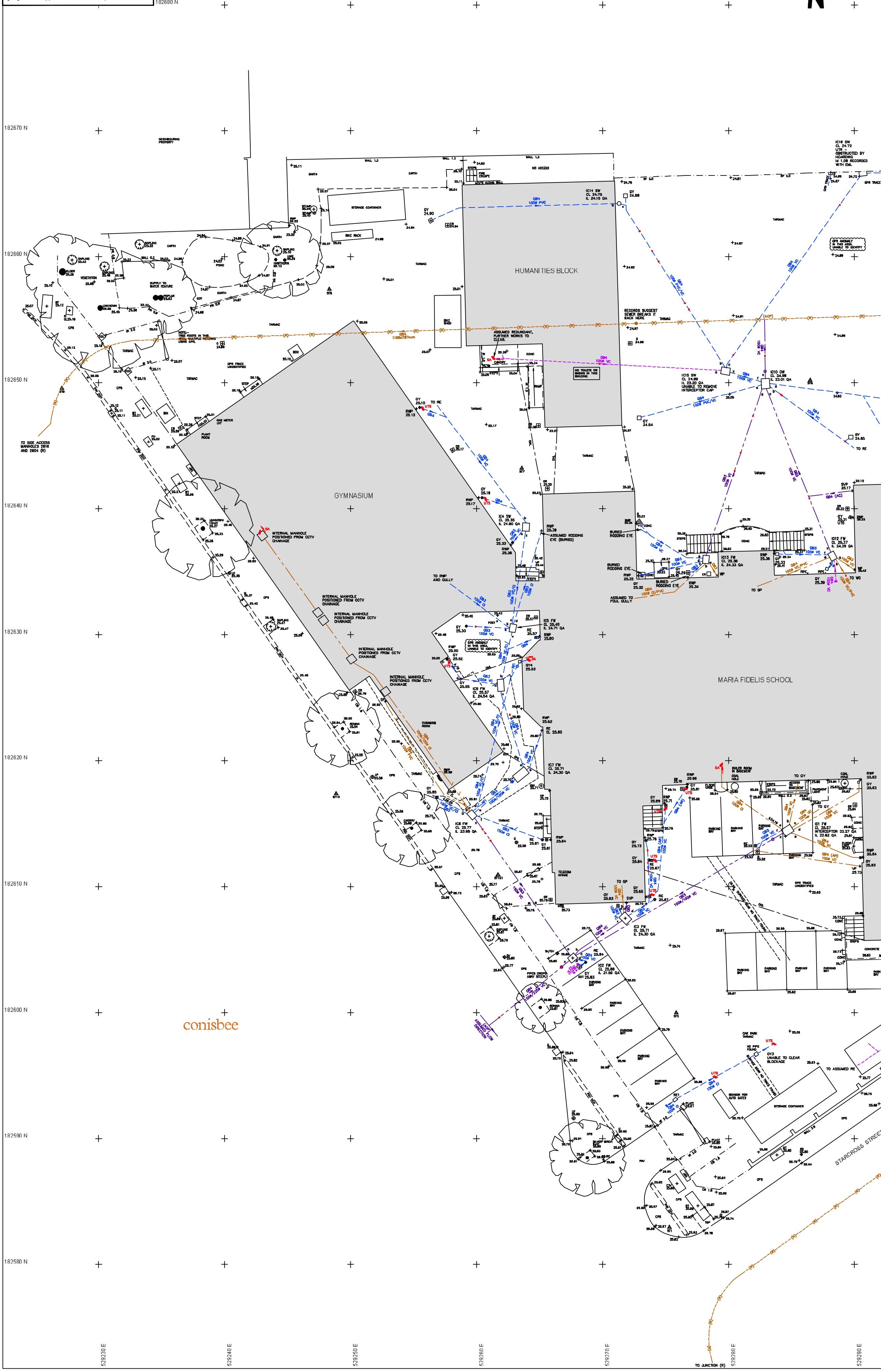
Tel : 01634 861 768

DETECTION SURVEY REPORT

CONNECTIVITY SURVEY
All drainage connectivity was carried out in accordance with PAS 128:2014 (Publicly Available Specification from BSI). Quality levels are determined by the detection methodology. Please refer to PAS 128:2014 Quality Level Guide for details.

CCTV SURVEY
All drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. Where a saddle connection is present the position has been achieved by CCTV chainage unless stated as an assumed connection (ACP). Drains / sewers between manholes are assumed to be straight. If the drain / sewer has been CCTV surveyed, saddle connections and line deviations are indicative and not positioned via Ground penetrating radar (GPR) or Electromagnetic locator (EML). Internal Manholes / Inspection covers are positioned indicatively from CCTV Chainage. All sub surface drainage positions should be cross checked in critical areas by EML, GPR survey or hand dug trial holes.
Attempts have been made to carry out CCTV surveys of all sewers across the entire drainage system at Maria Fidelis School. Jetting has taken place, though some surveys may have been abandoned due to a build up of silt/debris and any other obstruction/obstacle. In other cases structural defects within the system may prevent completion of CCTV surveys between assets.

Information regarding the drainage system has been added to the drawing. For all information regarding the CCTV survey, please refer to TV181034 CCTV Report



Notes:
1. DRAINAGE INFORMATION ADDED TO TOPOGRAPHICAL SURVEY PRODUCED BY EDI SURVEYS LTD. JOB No. 17230/T/01 DATE JULY 2018. NO SITE VERIFICATION CARRIED OUT BY INSEWER UNLESS SPECIFIC TO DRAINAGE.
2. DRAINAGE INFORMATION HAS BEEN DETERMINED WITHOUT MAN ENTRY INTO CHAMBERS AND WHILST EVERY EFFORT HAS BEEN MADE TO CORRECTLY IDENTIFY THIS INFORMATION, IT SHOULD ALWAYS BE CHECKED IN AREAS THAT ARE CRITICAL TO THE FUTURE PROPOSAL.
3. ALL SEWERS ARE PRESUMED TO BE STRAIGHT BETWEEN CHAMBERS, WITH ROUTES / CONNECTIVITY OBTAINED USING ACOUSTIC METHODS ONLY. THESE ARE TO BE CONSIDERED ASSUMED AND SHOULD BE INVESTIGATED FURTHER IN CRITICAL AREAS. KINKS AND DEVIATIONS ARE INDICATIVE AND UNLESS SPECIFIED HAVE NOT BEEN ACCURATELY POSITIONED VIA ELECTROMAGNETIC LOCATOR (EML), GROUND PENETRATING RADAR (GPR). ALL SUB SURFACE DRAINAGE POSITIONS SHOULD BE CROSS CHECKED IN CRITICAL AREAS BY EML OR GPR SURVEY OR HAND DIG TRIAL HOLES.
4. CONNECTIONS FROM RAIN WATER PIPES, GULLIES, KERB OUTLETS, SOIL PIPES ETC SHOULD BE TREATED AS ASSUMED ONLY, UNLESS PROVEN WITH A CCTV SURVEY.
5. SURVEY TO BE READ IN CONJUNCTION WITH TV181034 CCTV REPORT.

DRAINAGE KEY

ABBREVIATIONS

(ACP)	ASSUMED CONNECTION POINT	MH	MANHOLE
(AC)	ASSUMED CONNECTION	NPV	NO PIPES VISIBLE
(AG)	ABOVE GROUND	OL	OUTLET
(AR)	ASSUMED ROUTE	OU	OUTFALL
BD	BACKDROP LEVEL	PF	PITCH FIBRE
BD	BASE DEPTH	PP	POLYPROPYLENE
BK	BRICK	POW	PIPE ON WALL
BL	BASE LEVEL	PT	P-TRAP
CI	CAST IRON	PTG	PIPE TO GROUND
CL	COVER LEVEL	PTS	PIPE TO SURFACE
CO	CONCRETE	PVC	POLYVINYL CHLORIDE
CU	CULVERT	PVC-U	ULTRA RIB (PVC)

LEGEND

PAS 128:2014 Quality Level Guide

SHEET LAYOUT (not to scale):

1 2

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conisbee

Maria Fidelis Convent School
North Gower Street
Kings Cross
London

Drainage and CCTV Survey

Scale:	Sheet Size:	Sheet Number:	Date:
1:100	A0	1	November 2018
Project Number: 26282	Rev: -	Surveyed By: InSewer	Approved By: MPW

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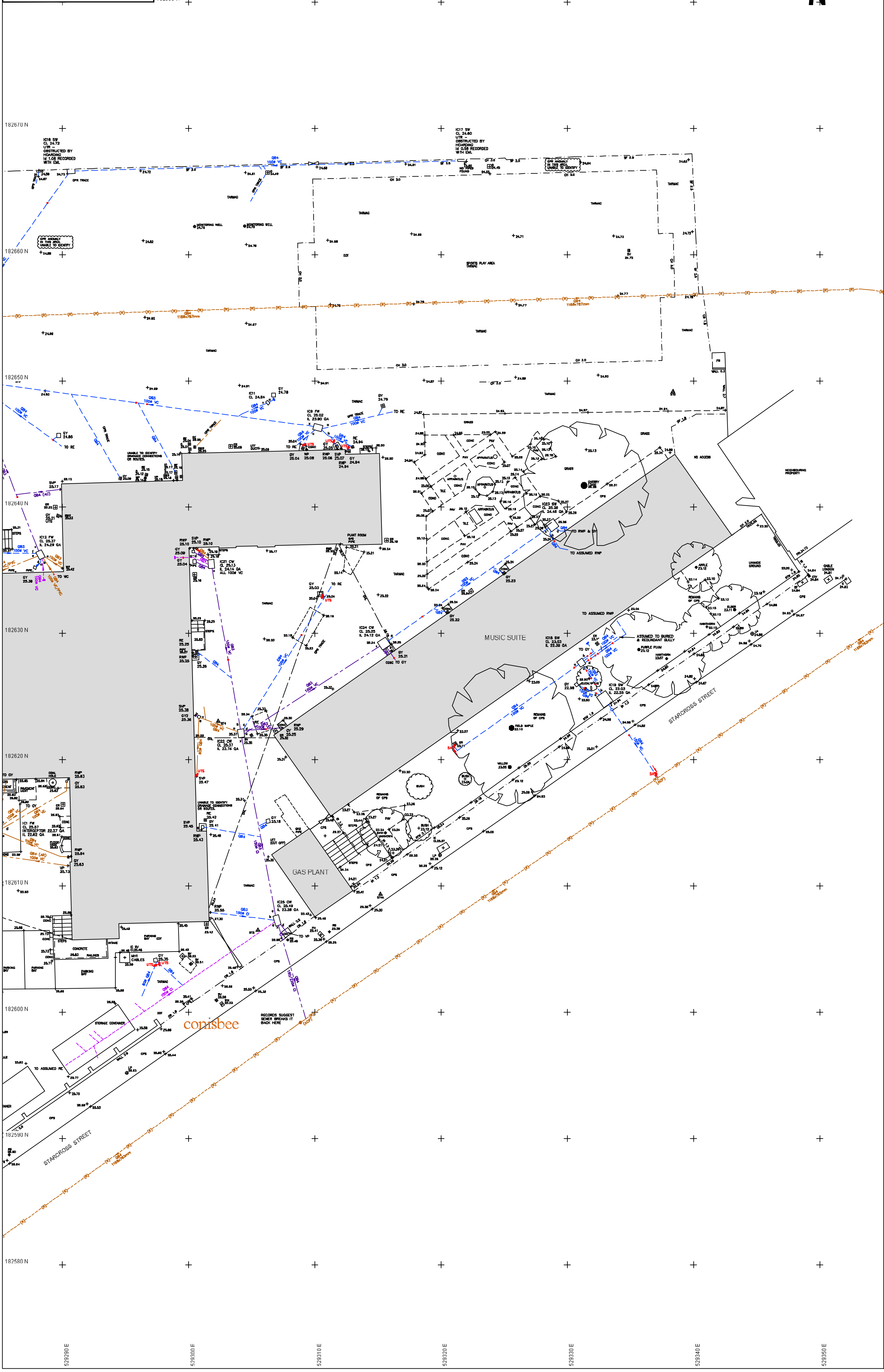

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LEGEND

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1 2

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1:100	A0	2	November 2018
Project Number: 26282	Rev: -	Surveyed By: InSewer	Approved By: MPW

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APPENDIX B: LANDSCAPE PROPOSAL