
Highgate School Science Building, North Road

Flood Risk Assessment and Surface Water Drainage Strategy Report

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Job Number: **26574**

Date	Revision	Notes/Amendments/Issue Purpose
July, 2022	3	For Planning

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Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
M&E	Mechanical and Electrical
P&M	Price and Myers
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TW	Thames Water

1 Introduction

Price & Myers (P&M) are working on behalf of Highgate School to produce a Flood Risk Assessment (FRA) for the extension of the science building. The report also covers the landscaped areas of the Science Quad and Garner Quad.

This FRA has been carried out in accordance with the National Planning Policy Framework and the accompanying Planning Practice Guidance (PPG) "Flood Risk and Coastal Change". This FRA also incorporates advice and guidance from the Environment Agency (EA, Haringey Strategic Flood Risk Assessment (SFRA), CIRIA documents and Non-statutory Technical Standards (NSTS).

The NPPF states that an appropriate FRA will be required for all development proposals of 1 ha or greater in Flood Zone 1 and for any development within Flood Zones 2 or 3.

The EA's indicative floodplain map shows that the site is located in Flood Zone 1. This report will outline the proposed drainage strategy for the site including a detailed SuDS assessment.

2 Site Description and Location

The site is located within Highgate Schools' campus between North Road and Southwood Lane; refer to Figure 2.1 below.



Site Location

Figure 2.1: Site Location. Source: Google Maps

2.1 Existing Drainage

Surface water is drained from the existing science block using a network of rainwater down pipes and gullies which discharge to Thames Water sewer east of the site on Southwood Lane. Science Quad is drained via a network of shallow gullies before discharging into the public sewer east of the site on Southwood Lane. Garner Quad is drained via a network of shallow gullies before discharging into the public sewer the west of the site on North Road. Refer to the CCTV surveys in appendix A and Thames Water Sewer maps in Appendix B.

3 Development Proposal

The development proposal is to refurbish the existing Science and Administrative buildings on the North Road campus. An extension in the Science Quad to the west side of the East Science Wing is proposed, comprising a 4-storey building with a basement, and an extension in Garner Quad to the north side of the Science centre block, comprising a 2-storey building with an open colonnade at ground level. The Garner Quad extension is an extension of the upper levels only, increasing the size of the 1st floor and 2nd-floor science laboratories. Both Garner and Science Quads are proposed to be re-landscaped as part of the works.

4 Flood Risk Assessment

4.1 Flood Risk from Watercourses

The EA's indicative floodplain map shows that the site is located in Flood Zone 1 and is not at risk of fluvial and/or tidal flooding. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

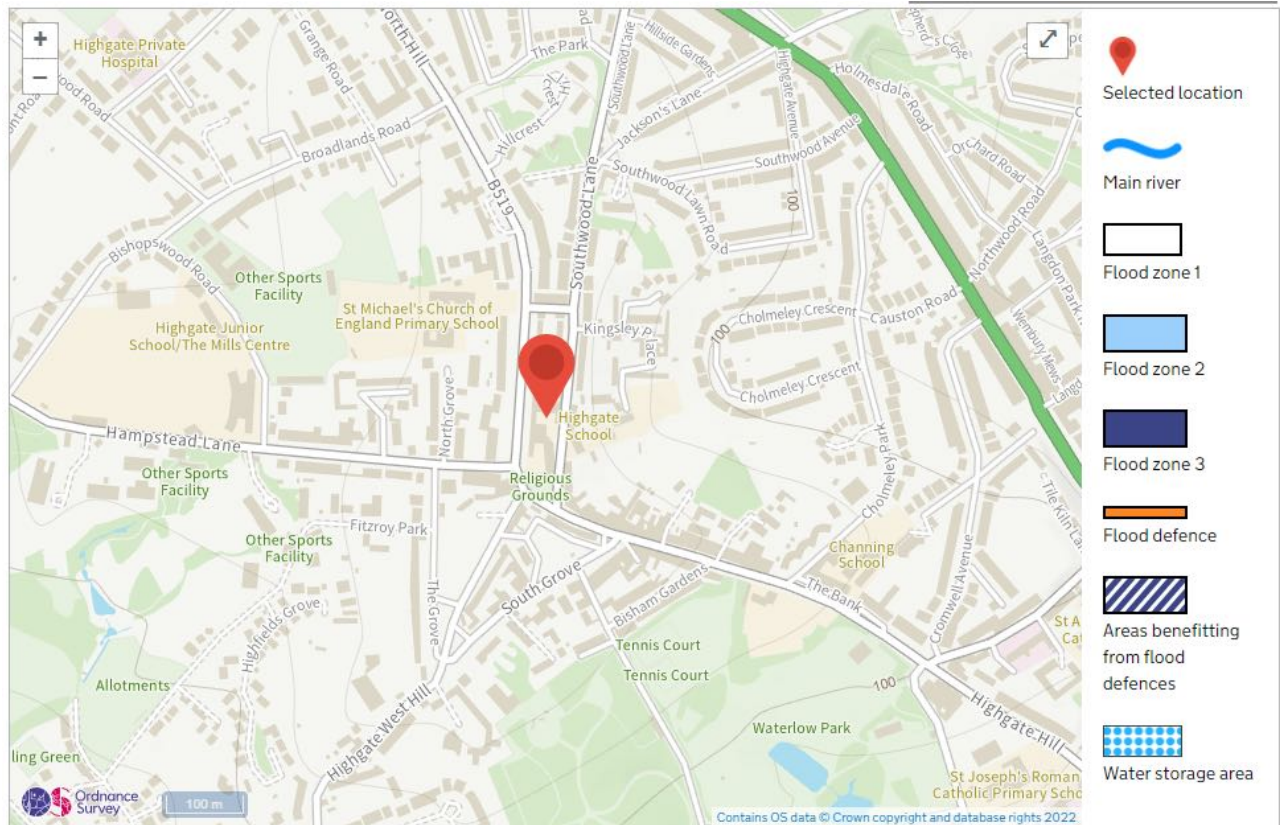
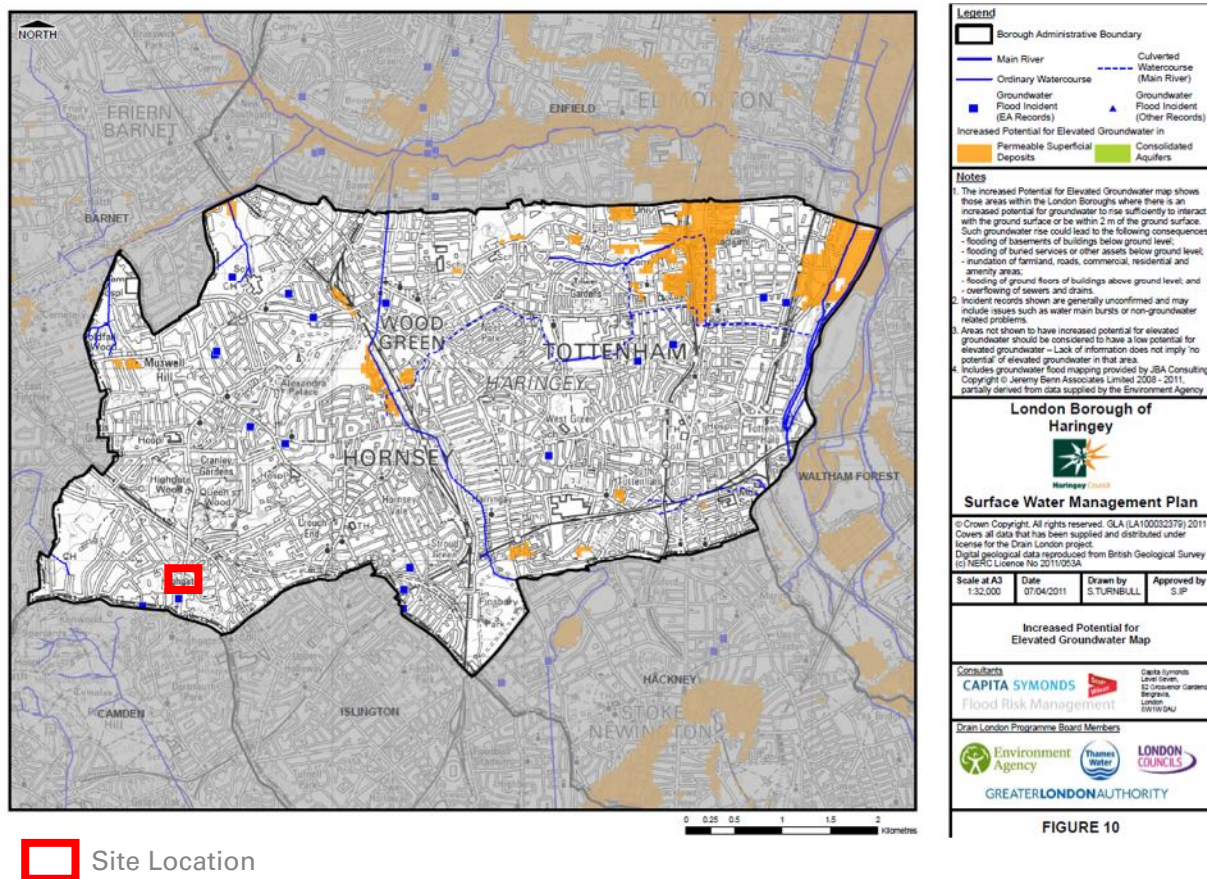


Figure 4.1: Flood risk zone from EA Flood Map for Planning

4.2 Flood Risk from Groundwater

Groundwater flooding occurs when water originating from sub-surface permeable strata emerges from the ground, typically after prolonged rainfall.

The “Increased Potential for Elevated Groundwater” map in Haringey Council's SWMP indicates that the proposed site is in an area with no recorded historic groundwater flooding and is not susceptible to elevated groundwater levels. An extract from the map is included in Figure 4.2 below.



 Site Location

Figure 4.2: Increased Potential for Elevated Groundwater Map (Extract from SWMP)

The British Geological Survey (BGS) map for this area shows that the site is underlain by Bagshot Formation – Sand, as shown in Figure 4.3 below.

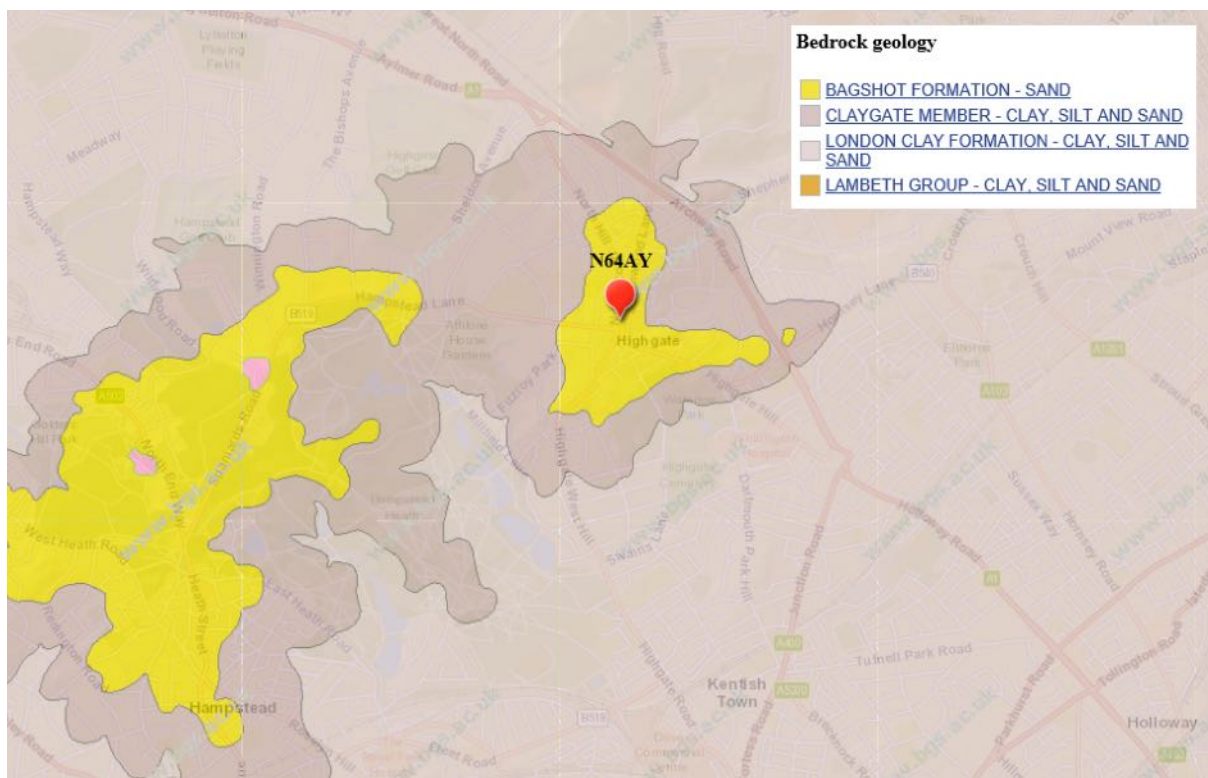


Figure 4.3: Local Geology (Map data British Geological Survey © NERC 2019)

The North London SFRA concludes that "groundwater flooding was found to be a relatively low risk. However, the local geology does increase the risk of groundwater flooding and these risk zones were highlighted" for Haringey.

Listers Geo have carried out a geotechnical site investigation and prepared an accompanying report (reference no: 18.07.019) The investigation revealed that a layer of engineered fill and Made Ground is above Bagshot Formation, extending to depths of 11.50m bgl, over the Claygate Member to a full depth of 15.1m.

Groundwater was encountered during intrusive works between 8.0m and 12.5m bgl and Claygate Member between 2.5m and 11.5m proven a maximum depth of 15.1m bgl. Although groundwater was found to be deep and is likely to be below the base of the basement excavation, the proposed basements will be designed to be fully waterproof for the lifetime of the development, further reducing the residual risk of groundwater flooding.

The EA have defined Source Protection Zones (SPZ) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. The closer the activity, the greater the risk. The EA maps confirm that the site is not located within any groundwater SPZ, as shown in the Figure 4.4. Therefore, it can be concluded that the groundwater flood risk to the site is low.



 Site Location

Figure 4.4: Source Protection Zones (Map data © 2019 OS 100022861)

The underlying Bagshot Formation is classified as a Secondary A aquifer, corresponding with the information shown in Figure 4.5 below. The Claygate Member is classified as Unproductive Strata. According to the site investigation, no significantly elevated concentrations of contaminants were detected in soils at this site, it is considered unlikely that significant contamination will migrate from

soils into the groundwater of the Secondary A aquifer. Subsequent migration of contamination to surface water is also considered unlikely, particularly given their proximity from the site.

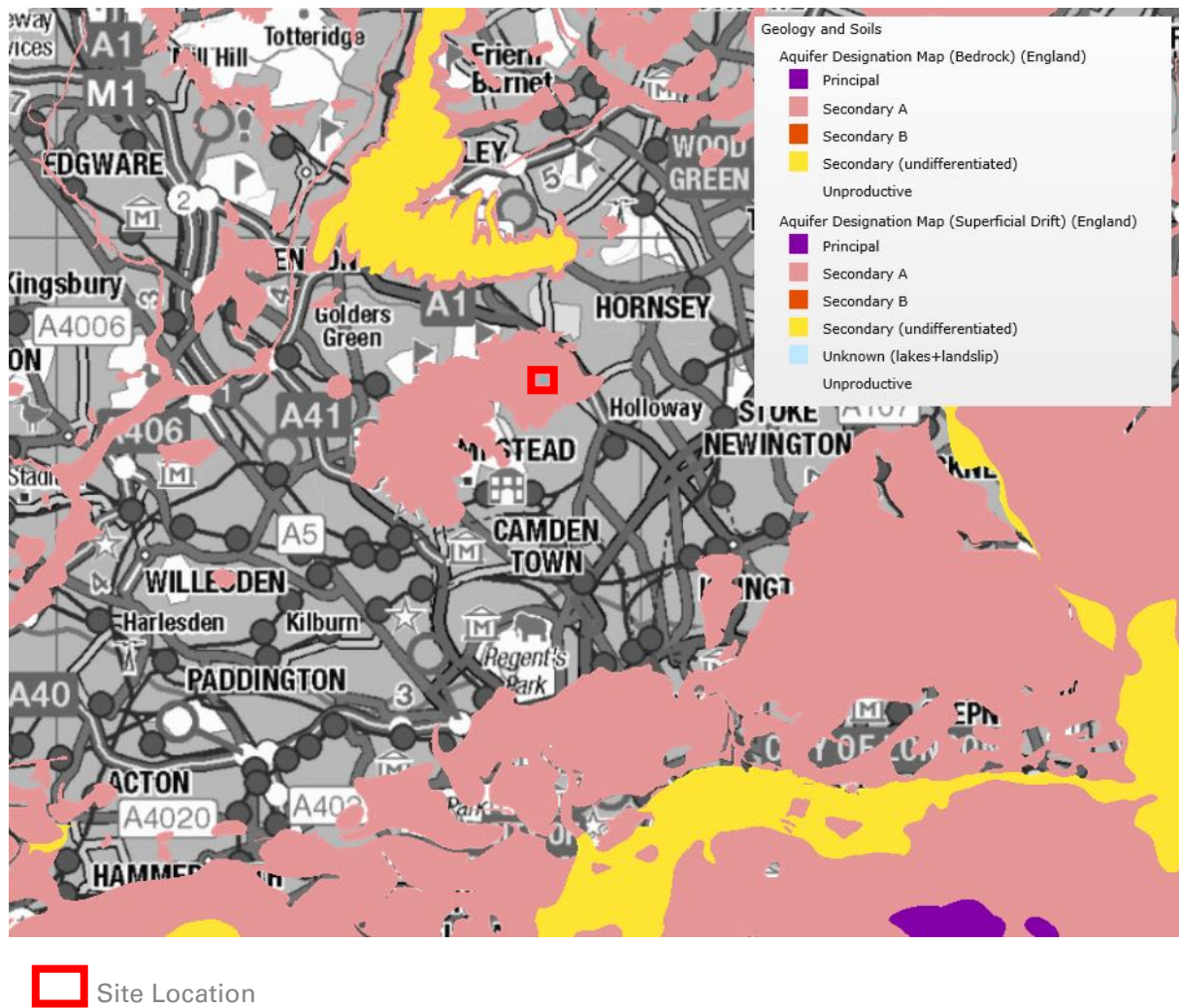
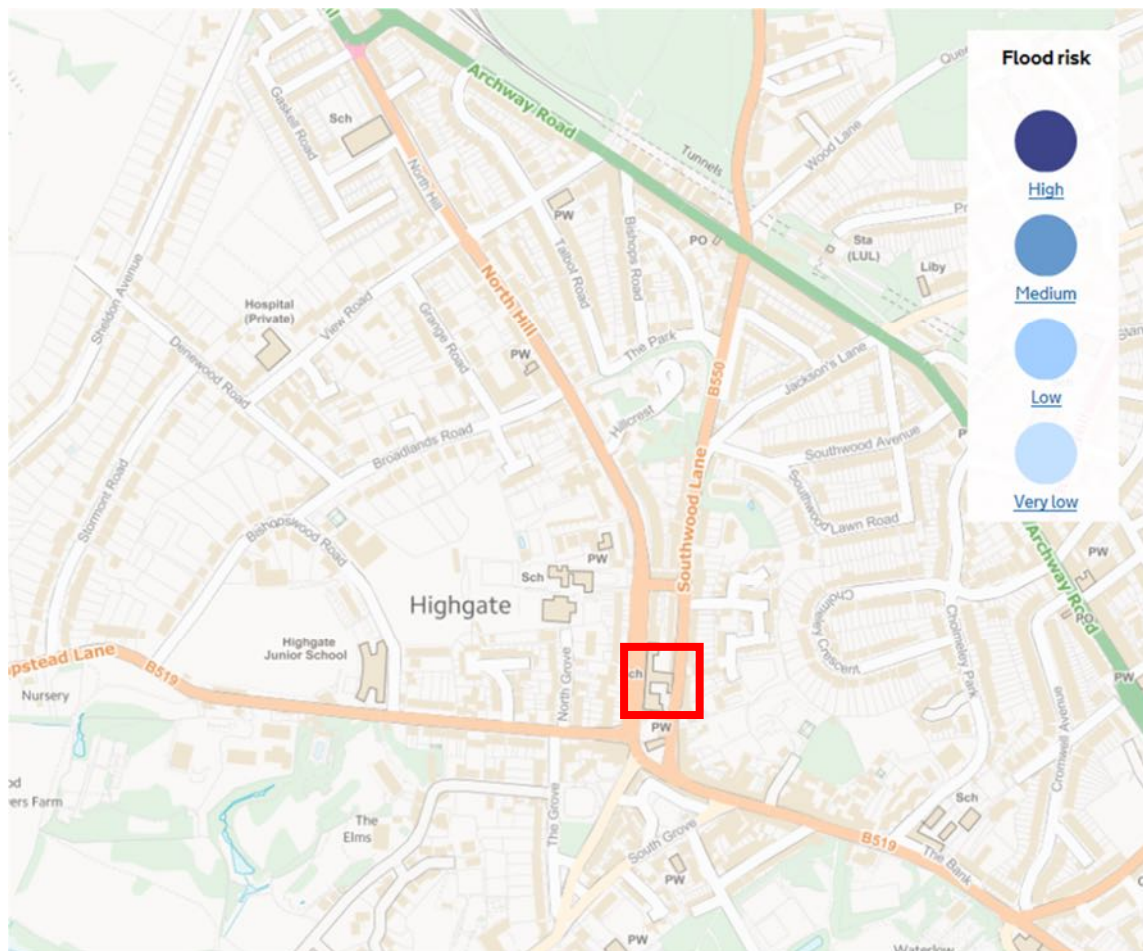


Figure 4.5: Aquifer Designation Map (Map data © 2019 OS 100022861)

4.3 Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

The EA's indicative Surface Water Flooding Map, Figure 4.6, shows that the site is at very low risk of surface water flooding.



 Site Location

Figure 4.6 Environment Agency Surface Water Flood Risk Map (Map data © 2019 OS 100022861)

The site is located in a Critical Drainage Area (CDA) Group4_062, however, the site is at low risk of surface water flooding. The surface water flood risk identified in this CDA refers to Milton Park and Causton Road, which are located 500m + away from the site location.

Therefore, the flood risk from surface water and overland flows is considered low.

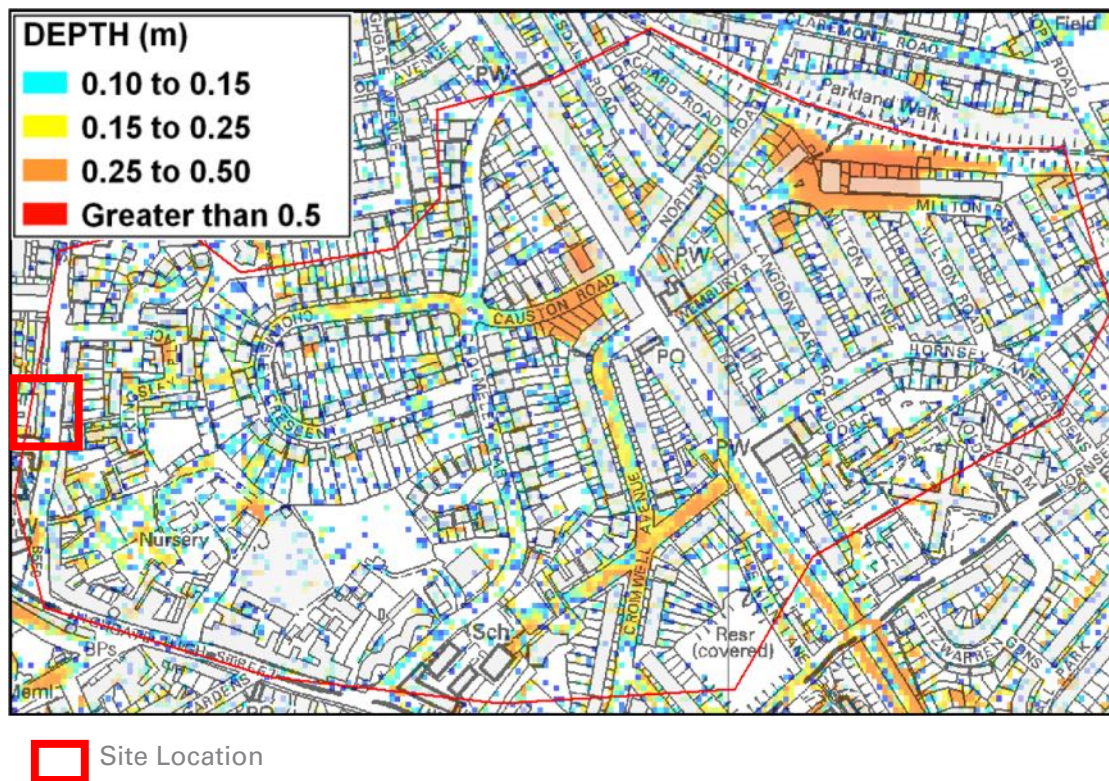


Figure 4.7 Critical Drainage Areas (Extract from SWMP)

4.4 Flood Risk from Reservoirs

The EA provides information on flood risk from reservoirs. The figure below shows that the site is not at risk of reservoir flooding.

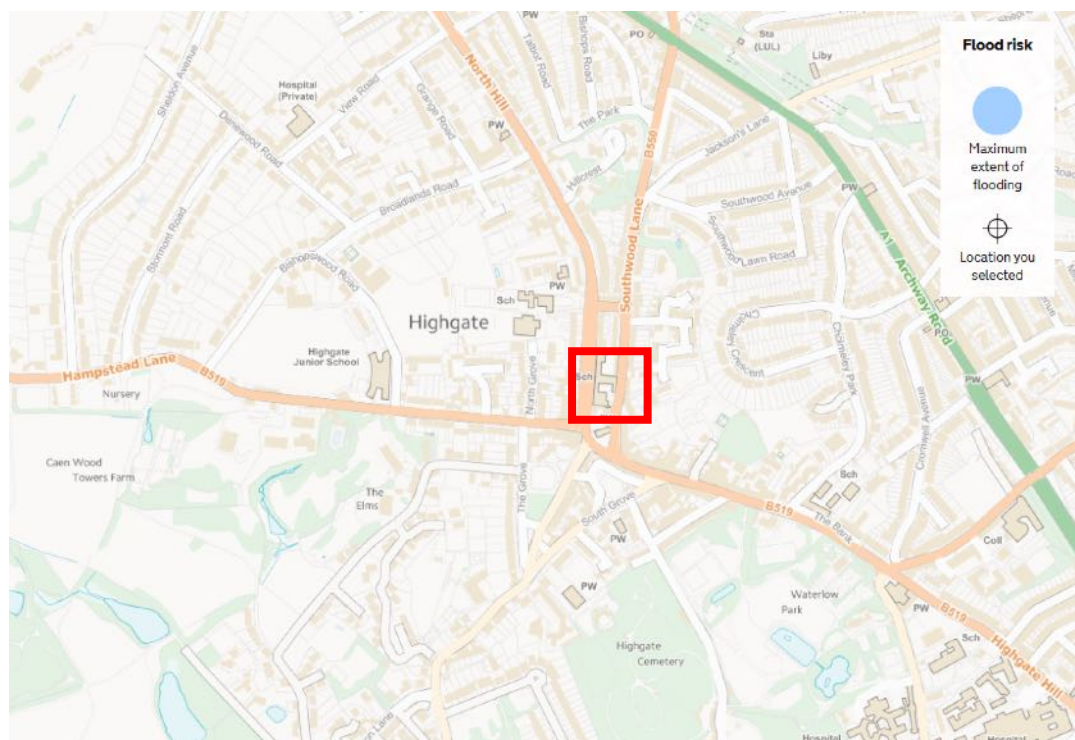


Figure 4.8 Environment Agency Risk of Reservoir Flooding Map (Map data © 2019 OS 100022861)

The EA's information states that reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Reservoir Act of 1975 ensures that reservoirs are inspected regularly, and essential safety work is carried out.

5 Surface Water Run-off Assessment

5.1 Existing Run-off

Science Building and Science Quad

The total existing site area is approximately 371m² or 0.037 ha, of which 342m² or 0.034ha is impermeable. The existing run-off rate for the design storm events was calculated using the modified rational method as shown below:

$$Q_x = 2.78 \times i \times A$$

Where 'x' is the return period in years, 'A' is the catchment area in ha and 'i' is the rainfall intensity in mm/hr as estimated from Microdrainage software, using the Flood Studies Report method.

$$\begin{aligned} Q_1 &= 2.78 \times 29.190 \times 0.034 = 2.75 \text{ l/s} \\ Q_{30} &= 2.78 \times 96.449 \times 0.034 = 9.12 \text{ l/s} \\ Q_{100} &= 2.78 \times 127.795 \times 0.034 = 12.08 \text{ l/s} \end{aligned}$$

Garner Quad

The total existing site area is approximately 745m² or 0.075 ha, of which 70m² or 0.067ha is impermeable. The existing run-off rate for the design storm events was calculated using the modified rational method as shown below:

$$\begin{aligned} Q_1 &= 2.78 \times 29.190 \times 0.067 = 5.44 \text{ l/s} \\ Q_{30} &= 2.78 \times 96.449 \times 0.067 = 17.96 \text{ l/s} \\ Q_{100} &= 2.78 \times 127.795 \times 0.067 = 23.80 \text{ l/s} \end{aligned}$$

5.2 Proposed Run-off

Science Building and Science Quad

This is proposed to discharge at 7.1l/s for storm events up to the 1 in 100 year plus 40% climate change. This is the minimum possible flow rate achievable with a 75mm orifice plate, in line with part H of the Building Regulations. This is further explained in section 6.3 of this report.

Garner Quad

Garner Quad is currently drained via a network of shallow gullies. This is proposed to discharge as existing due to the impracticality of rebuilding the existing drainage network.

6 SuDS Assessment

In accordance with the EA guidelines, the SFRA, SWMP and CIRIA documents, surface water run-off should be managed as close to its source as possible. The guidelines states that all new developments should aim to reduce run-off to greenfield rates "*utilising SUDS unless there are practical reasons for not doing so*".

The possibility of implementing SuDS at the site was assessed using a hierarchy of preferred surface water management methods. The following paragraphs discuss the various methods in order of that hierarchy and evaluate the site's suitability for each method.

6.1 Store Rainwater for Later Use

Rainwater harvesting promotes the storage and re-use of rainwater collected from roofs and hard-surfaced areas. This type of system contributes to the reduction of runoff rates and volumes within a development.

Storing rainwater for later use is not feasible on the site due to the impracticality of rebuilding the existing network to allow for storage and later use. It is important to note that rainwater harvesting systems ability to attenuate rainwater depends on the amount of water use. If there is no use of the rainwater and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, the rainwater harvester will provide no attenuation and therefore cannot be used in any attenuation calculations.

6.2 Infiltration

Infiltration testing at four locations approximately 100m east of the site was conducted by Listers Geo consultants in 2018 to BRE 365 standards. Three of the locations failed the infiltration test with only one passing. The only successful test completed was tested in the made ground layer of the ground profile. The results suggest that on average, the ground is not suitably permeable. The layout of the science quad is also such that it is impossible to locate an infiltration system 5m away from foundations. Also, it is not feasible to infiltrate in the Garner Quad due to the impracticality of rebuilding the existing network to allow for infiltration. It is concluded that infiltration is not feasible in this case.

6.3 Attenuation

Attenuation in Garner Quad is not feasible on the site due to the impracticality of rebuilding the existing network to allow for storage and later use. Attenuation for just the science block extension proved to be redundant due to the minimum achievable discharge rate achievable from a 75mm orifice in line with Building Regulation Part H and the existing runoff rate being very similar. In order to improve the existing condition and provide betterment in the discharge rates, attenuation is provided for the Science Quad and extension. The size of attenuation tank and depth is restricted by the site levels, space and minimum orifice size. A 13m³ attenuation tank with an orifice plate restricting discharge to 7.1l/s for storm events up to 1 in 100 year plus 40% climate change is

proposed. This this provides a betterment of 43% compared to existing for the Science quad and extension catchment areas.

7 Surface Water Maintenance

The successful implementation and operation of a SuDS system depends on a robust and clear maintenance strategy being implemented. The following measures should form part of the site's proposed management plan.

The SuDS will be maintained by Highgate School and will form part of the overall maintenance regime for the site.

SUDS Element	Maintenance		
	Activity	Required Action	Typical Frequency
Attenuation Tank		Pump repairs	
	Monitoring / Inspections	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are working as they should	Annually or after severe storms
		Inspect and identify any elements that are not operating correctly.	Monthly for three months, then half yearly or as required.
	Regular Maintenance	Remove sediments / debris from catch pits / gullies and control structures	Annually, after severe storms or as required
	Remedial Actions	Repair inlets, outlets, vents, overflows and control structures.	As required
		Realignment of rip-rap	
		Repair/rehabilitation of inlets, outlets and overflows	
		Relevel uneven surfaces and reinstate design levels	
		Replant, where necessary	
		Aerate pond when signs of eutrophication are detected	
		Realign rip-rap or repair other damage	
		Repair / rehabilitate inlets, outlets and overflows.	

8 Foul Water Assessment

The developed design includes two extensions and refurbishment of the existing facilities. The Garner Quad extension is an extension of the upper levels only, increasing the size of the 1st floor and 2nd-floor science laboratories. The Science Quad extension will accommodate a lift and stairs. At basement level, an additional sink, toilet and four showers are proposed.

Foul water appliances in the basement will require pumping due to the proposed levels relative to the sewer, pumping minimises the potential flood risk from a surcharged sewer.

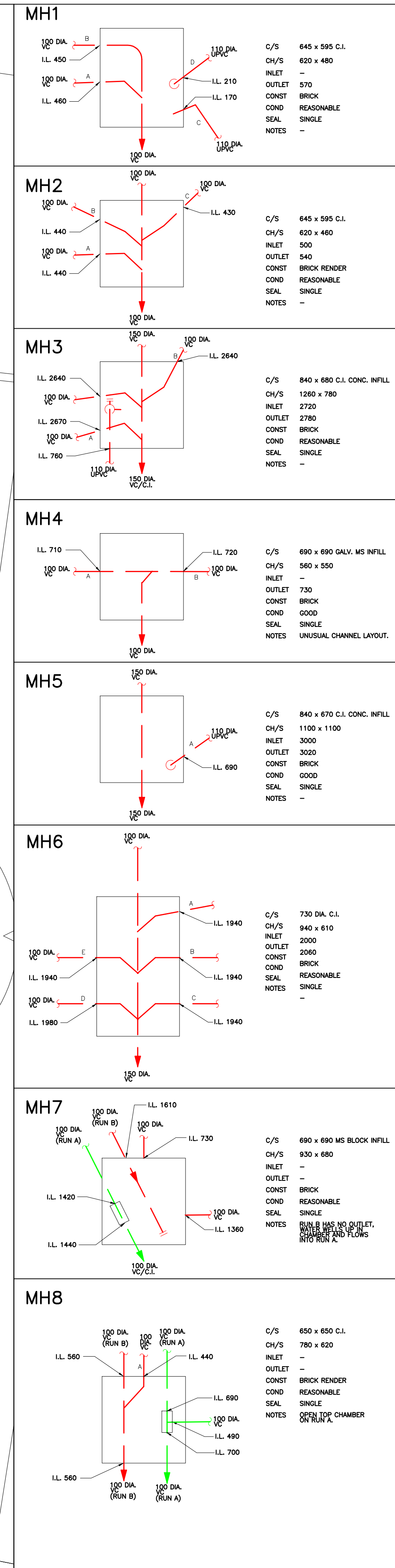
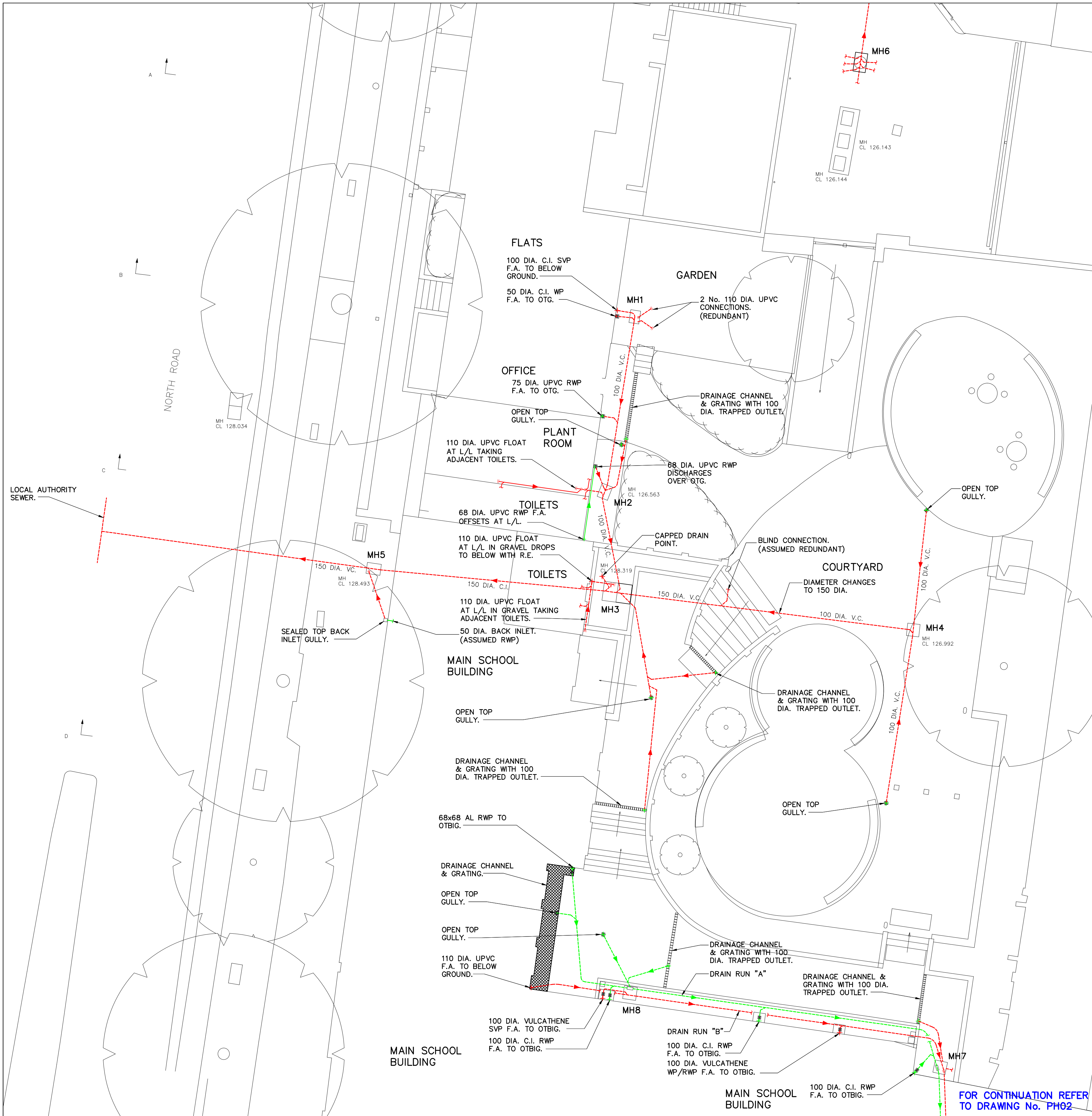
The number of pupils and staff post-development will remain as existing. Therefore, it is proposed to reuse the existing drainage connections where feasible, including the existing connections to the Thames Water public sewers.

9 Conclusions

- This Flood Risk Assessment and surface water strategy report have been produced to accompany the Basement Impact Assessment for Highgate School, North Road, Highgate, London, N6 4AY.
- The site falls within Flood Zone 1 “areas with little or no potential risk of flooding” from watercourses.
- The site is located within a CDA (Group 4_062); however, the site is at low risk of flooding from all sources, including surface water, groundwater, public sewers or reservoirs.
- Therefore, the proposed development has an acceptable flood risk within the terms and requirements of the NPPF.

Appendix A

CCTV Surveys



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE SPAFLOW (UTILITIES) LTD REPORT DATED APRIL 2010.

LEGEND:

- BELOW GROUND (SURFACE WATER)
- BELOW GROUND (FOUL WATER)
- ABOVE GROUND (SURFACE WATER)
- ABOVE GROUND (FOUL WATER)

Abbreviations:

FH	FIRE HYDRANT	F.A.	FROM ABOVE
IV	ISOLATION VALVE	T.A.	TO ABOVE
WMT	WATER METER	T.B.	TO BELOW
GMT	GAS METER	RWP	RAINWATER PIPE
WM	WATER MAIN	G	GULLY
GM	RISING GAS MAIN	RG	ROAD GULLY
GT	GREASE TRAP	OTG	OPEN TOP GULLY
CBP	CABLE PIT	L/L	LOW LEVEL
RE	RODDING EYE	MH	MANHOLE
SVP	SOIL VENT PIPE	FWP	FOUL WATER PIPE
RED.	REDUNDANT	BIG.	BACK INLET GULLY
WHB	WASH HAND BASIN	VP	VENT PIPE
CP	CATCHPIT	C.I.	CAST IRON

REV.	DATE	DESCRIPTION	BY	APP.
A.	13.4.12	CONTINUATION NOTE ADDED, LINE STYLES REVISED.	SWW	DWH

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CLIENT:
HEYNE TILLET STEEL
on behalf of
HIGHGATE SCHOOL

PROJECT:
HIGHGATE SCHOOL
HIGHGATE

TITLE:
RECORD OF CCTV SURVEY
OF DRAINAGE

PROJECT REF:	REV:
DRAWN: SWW	DATE: APR 10
CHECKED: DWH	APPROVED: DWH
CLIENT DRG. No:	CAD. Q.A.:
MICROFILM REF:	SHEET:
	ORG. No: PH01

Appendix B

Thames Water Asset Location Map

Asset Location Search Sewer Map - ALS/ALS Standard/2015 2989764



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 528436,187538
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

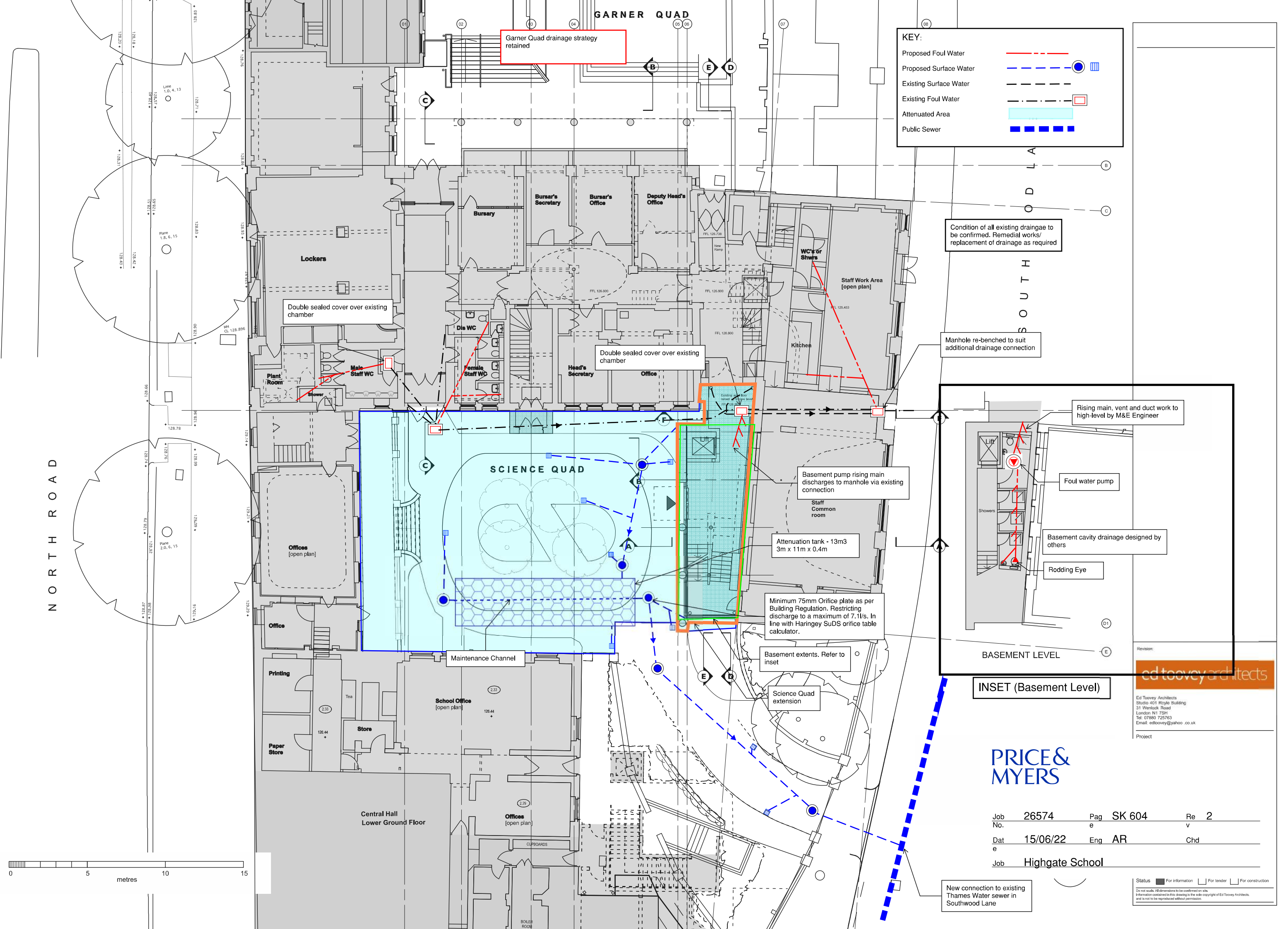
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Appendix C

GPR Surveys

Appendix D

Proposed Drainage Strategy



Garner Quad drainage strategy retained

KEY:

- Proposed Foul Water
- Proposed Surface Water
- Existing Surface Water
- Existing Foul Water
- Attenuated Area
- Public Sewer

Condition of all existing drainage to be confirmed. Remedial works/ replacement of drainage as required

Manhole re-benched to suit additional drainage connection

Rising main, vent and duct work to high-level by M&E Engineer

Foul water pump

Basement cavity drainage designed by others

Rodding Eye

BASEMENT LEVEL

INSET (Basement Level)

Basement pump rising main discharges to manhole via existing connection

Attenuation tank - 13m³
3m x 11m x 0.4m

Minimum 75mm Orifice plate as per Building Regulation. Restricting discharge to a maximum of 7.1l/s. In line with Haringey SuDS orifice table calculator.

Basement extents. Refer to inset

Science Quad extension

Maintenance Channel

School Office [open plan]

Central Hall Lower Ground Floor

PRICE & MYERS

Job No. 26574
Pag e SK 604
Re v 2
Dat e 15/06/22
Eng AR
Chd
Job Highgate School

Status ☒ For information ☐ For tender ☐ For construction
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