MAX FORDHAM

Highgate Cemetery - Landscape

Sustainable Drainage Strategy Report

P02

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ISSUE HISTORY

Issue	Date	Description
P01	9/8/24	Planning
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APPENDICES

1.0 INTRODUCTION

This Drainage Strategy is written to support a planning submission for Highgate Cemetery Masterplan at Highgate Cemetery, at Swain's Lane, London, N6 6PJ, and shall henceforth be referred to as the Application Site.

In total, the development redline boundary occupies a total area of 14.9511ha. Of this area, it is proposed 2.2942ha will become impermeable when the development is completed. When compared to the existing impermeable area of 1.1510ha, this presents an increase of 1.1432ha of impermeable area.

The purpose of this Drainage Strategy is to demonstrate how this impermeable area can be satisfactorily drained without increasing flood risk onsite and elsewhere. The strategy has been developed in full accordance with National and Local standards as well as best practice documentation.

Specifically, this Drainage Strategy demonstrates that the proposed development does not lead to an increase in;

- Peak runoff rate of storm water runoff leaving the site
- Volume of runoff leaving the site
- Pollution to receiving waters from storm water runoff
- Flood risk to nearby or neighbouring sites

2.0 EXISTING SITE

2.1 Site Location

The Application Site is located at Ordnance Survey grid reference 528491mE, 187152mN, and the redline boundary includes an area of 14.95ha, as indicated on Figure 1.

The address of the site is Highgate Cemetery, at Swain's Lane, London, N6 6PJ.

The Application Site is currently a Cemetery (Sui Generis).

Figure 1 Site Location Plan

2.2 Site Hydrology

According to the Camden Local Plan, the River Fleet, an Ordinary Watercourse, is located approximately 100m south of the site (see Figure 2). A spring potentially feeding the River Fleet has been observed at the southwest corner of the west side of the site.

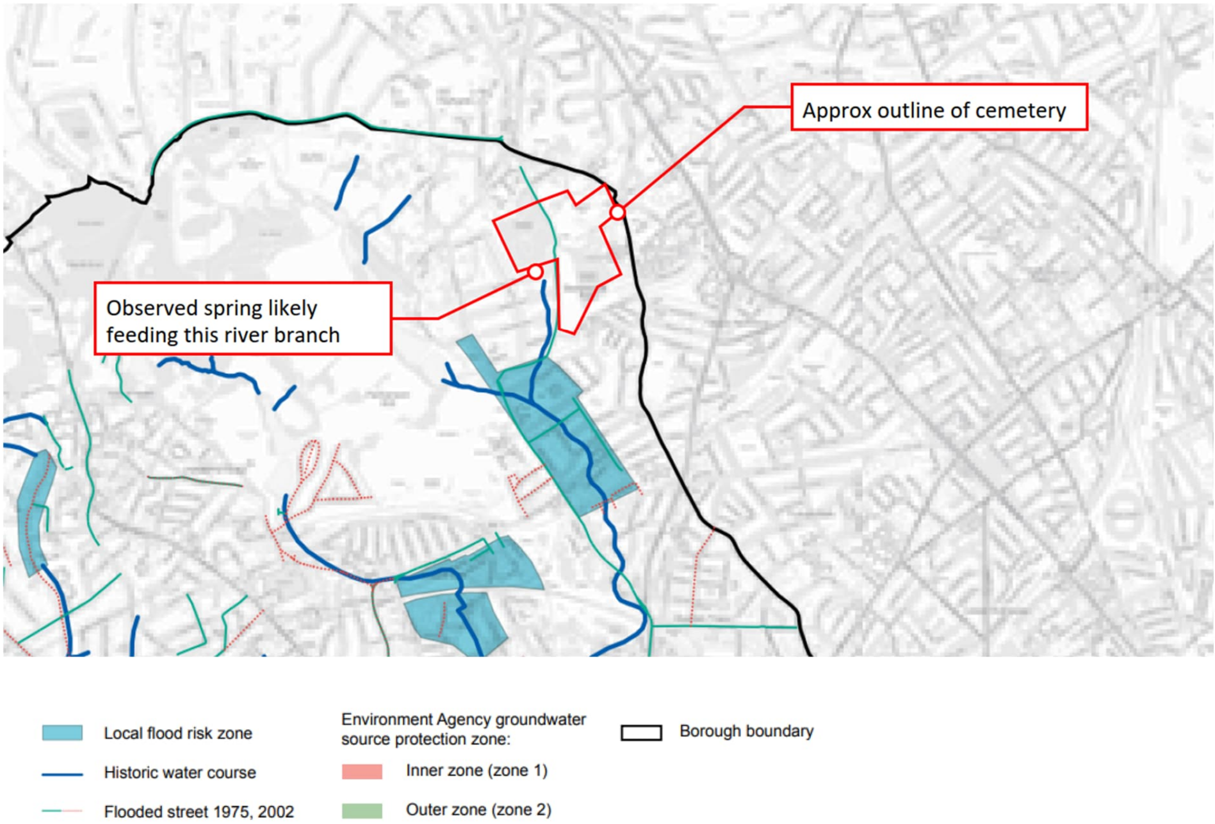

Figure 2 Ordinary Watercourse (Source: Camden Local Plan)

Based on Thames Water asset mapping and a CCTV Survey conducted by UKDN Waterflow (dated 3rd December 2013), combined water sewers are serving east and west side of the cemetery on Swain's Lane and Chester Road. Details can be referred to Appendix A: Thames Water Asset Map and Appendix B: CCTV Survey.

Based on the extent of the existing surface water run off assumed to drain from the impermeable area of existing site (East: 0.3328ha; West: 0.8182ha; Total: 2.2942ha), a theoretical flow rate of the 1, 30 and 100 years storm return periods can be calculated as shown in Table 1. Calculations are based on the Modified Rational Method assuming a runoff coefficient of 0.8 and duration of 60 minutes. Catchment area being drained is assumed the existing paths equipped with surface water discharge points, such as gullies and drainage channels, and all footprint covered by buildings.

A plan showing existing site drainage regime is shown in Appendix C: Drainage Survey Report and Appendix D: Drainage Survey Drawings. Drainage survey was conducted in March 2024.

Table 1 Existing site runoff rates for the 1, 20 and 100 year storm event

Storm Event (Annual Exceedance Probability)	Predicted Rainfall Intensity (mm/hr)	Existing Discharge Rate (l/s)		
		East Side	West Side	Total
1 in 1 year	12.4	9.38	22.61	31.98
1 in 20 year	28.8	21.78	52.52	74.30
1 in 100 year	39	29.49	71.12	100.61

2.3 Site Topography

A topographic survey was prepared by Atlantic Geomatics (dated November 2020) determined ground levels within the application site. The west side ranges from 122.58 mAOD at its highest point to 88.78 mAOD at its lowest. The east side varies between 86.45 mAOD and 60.35 mAOD. While the site is generally upslope, the predominantly permeable landscape of the cemetery is not anticipated to significantly increase surface water runoff. Topographic survey drawings can be found in Appendix E: Site Topology Survey.

2.4 Site Geology

An intrusive Ground Investigation was undertaken by Sub Surface in May 2024. A summary of the test pits records are shown below;

- Test Pit TP1 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP2 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP3 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP4: identifies 0.4m MADE GROUND on top of 0.6m CLAY. No Groundwater was encountered.
- Test Pit TP5: identifies 0.2m MADE GROUND on top of 0.8m CLAY. No Groundwater was encountered.
- Test Pit TP6: identifies 0.4m MADE GROUND on top of 0.6m CLAY. No Groundwater was encountered.
- Test Pit TP7 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP8 identifies 0.95m MADE GROUND. Groundwater was encountered at 0.8m.
- Test Pit TP9 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP10 identifies 1.0m MADE GROUND. No Groundwater was encountered.
- Test Pit TP11: identifies 0.4m MADE GROUND on top of 0.6m CLAY. No Groundwater was encountered.
- Test Pit TP12: identifies 0.65m MADE GROUND on top of 0.35m CLAY. No Groundwater was encountered.

Infiltration rate of test pits are summarised in Table 2.

Table 2 Soil Infiltration Test Result

Test Pit Reference	Soil Infiltration Rate (m/sec)
TP1	4.89E-06
TP2	4.48E-05
TP3	Failed
TP4	1.26E-05
TP5	7.01E-07
TP6	Failed
TP7	Failed
TP8	Failed
TP9	2.40E-06
TP10	1.13E-06
TP11	1.13E-06
TP12	1.13E-06

Full ground investigation is provided in Appendix F: Soil Infiltration Test Result.

2.5 Existing surface water drainage

A detailed drainage survey was carried out in March 2024 to find out details of existing drainage system in the Application Site (see Appendix C: Drainage Survey Report and Appendix D: Drainage Survey Drawings). Detailed information on the existing surface water drainage can also be found in Appendix A: Thames Water Asset Map and Appendix H: Site Utilities and Drainage Survey.

The site's surface water drainage is managed through an underground piped system that collects runoff from the main paths, buildings, and surrounding landscape. This water is typically conveyed to the Thames Water sewage network or an unidentified underground stream.

Landscape Drainage
Surface water from the landscape where graves are located infiltrates directly into the ground.

The main paths on both the east and west sides are equipped with gullies and drainage channels to collect surface water and direct it into the underground system.

However, not all paths have adequate outlets, increasing the risk of surface water runoff.

Underground Drainage System
The system is a combined network of underground pipes carrying both sewage and surface water.

Pipes are primarily made of aged materials such as clay, brick, or concrete, and are located beneath the paths with accessible manholes.

A CCTV inspection has identified defects in certain sections of the system.

Sewer Connection
On the west side, surface water is collected in Thames Water manhole 5901 and discharged into the combined sewer in Swain's Lane. Additionally, some water appears to enter an unidentified underground stream via another manhole.

On the east side, surface water flows into the Thames Water combined sewer in Chester Road, though the exact connection point is unknown due to limited data.

3.0 DEVELOPMENT PROPOSAL

The development proposal includes restoration, demolition and replacement of buildings in East Side and West Side of Highgate Cemetery, including Cemetery wide landscaping, drainage, public realm and access works and repair of tombs and monuments to support the function of a working cemetery and community uses.

East Side includes the demolition and replacement of gardener's compound with a community education building, removal of ticket booth and replacement with sentry at Swain's Lane and erection of additional sentry at Chester Road, and the erection of a two-storey gardener's building, for office, workshop, staff welfare and storage use, plus alterations to the boundary wall.

West Side includes erection of a two-storey visitor and operations building, demolition and replacement of visitor toilets building with a utility store, restoration of Dissenters' Chapel and Anglican Chapel for community and funeral uses, and restoration of South Lodge for visitor toilets and North Lodge for staff welfare.

In summary, development proposals consist of the following:

- Proposed impermeable area (including building and impermeable pavement): 2.2942ha
- Proposed permeable area: 12.6569ha

Total impermeable area generated from development proposal is 1.1432ha.

Development proposals are provided in Appendix G: Development Proposals.

4.0 SURFACE WATER DRAINAGE STRATEGY (SUDS)

4.1 Relevant Standard and Guidance

Surface water drainage systems are designed in accordance with the standard and guidance set out in the below documents:

- Water Industry Act (1999)
- Building Regulation Part H (2015)
- British Standards, Drain and sewer systems outside buildings (BS EN 752:2017)
- CiRIA SuDS Manual (C753, 2015)
- CiRIA Report 156 – Infiltration drainage – Manual of good practice (1996)
- The London Plan – published 2021 and available at: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf
- Camden Local Plan – published 2017 and available at: https://www.camden.gov.uk/documents/20142/4820180/Local+Plan.pdf/ce6e992a-91f9-3a60-720c-70290fab78a6
- Rainfall runoff management for developments report (R. Kellagher, 2013), available at https://assets.publishing.service.gov.uk/media/602e7158d3bf7f7220fe109d/_Rainfall_Runoff_Management_for_Developments_-_Revision_E.pdf

4.2 Surface Water Drainage Hierarchy

CiRIA SuDS Manual and London Plan outline surface water drainage hierarchy as of below.

1. Rainwater use as a resource (e.g. rainwater harvesting, blue roofs for irrigation)
2. Rainwater infiltration to ground at or close to source
3. Rainwater attenuation in green infrastructure features for gradual release (e.g. green roofs, rain gardens)
4. Rainwater discharge direct to a watercourse
5. Controlled rainwater discharge to a surface water sewer or drain
6. Controlled rainwater discharge to a combined sewer.

Each drainage mechanism in turn has been reviewed in context of the development site;

Rainwater use as a resource
Rainwater harvesting is deemed a suitable approach in the new buildings where rainwater is collected from roofs and stored in the storage tanks to be filtered and reused for irrigation and WC flushing. Surface water will be use as a resource where applicable, considering limitations such as location and space available.

An active attenuation system is proposed for the east side to capture and store surface water for subsequent irrigation. This system will incorporate rainwater harvesting and controlled release mechanisms to manage stormwater runoff effectively. By filtering and reusing captured water during non-storm periods, water resource utilisation can be maximised and reduce reliance on the public water supply.

Infiltration to ground
Intrusive ground investigations were conducted to assess soil infiltration rates (see section 2.4). A general benchmark of $1x10^{-6}$ is typically required to maintain a 24-hour half drawdown time, essential for successful infiltration systems.

Results from the west side indicate satisfactory infiltration rates, with most test pits exceeding the benchmark. Consequently, infiltration systems are deemed suitable for this area.

However, a significant number of test pits on the east side failed to meet the infiltration rate criteria. As a result, infiltration systems are considered unsuitable for the east side.

Rainwater attenuation for gradual release
In landscape area French drain is proposed to area where soakaway is infeasible. French drain is consisted of permeable paved surface and porous Type 3 subbase to provide attenuation storage. At the bottom a porous drainage pipe will convey the surface water to sewer at a controlled flow rate.

Watercourse Disposal
An ordinary watercourse is located approximately 100 meters southwest of the west side (see section 2.2). Based on the findings of the drainage surveys (see Appendix C: Drainage Survey Report, Appendix D: Drainage Survey Drawings and Appendix H: Site Utilities and Drainage Survey), it is believed that certain underground drainage connections may discharge into an unidentified stream or watercourse within this vicinity. Given the proximity of the watercourse and the existing drainage connections, it is considered suitable to retain and maintain these connections for the disposal of surface water.

Surface Water Sewer Disposal
Given no dedicated surface water sewer available in vicinity of the Application Site (see Appendix A: Thames Water Asset Map), disposing surface water to surface water sewer or drain is infeasible.

Combined Water Sewer Connection
Given the site's limited suitability for surface water disposal through infiltration or to watercourses, it is proposed that the remaining surface water be controlled released into the existing Thames Water combined sewer network.

4.3 Surface Water Drainage Proposals

4.3.1 Rainwater Harvesting System

Rainwater harvesting systems are proposed for buildings and nearby paths to collect water from roofs and terraces for irrigation and WC flushing. These systems will be installed at Catacombs Terrace, the Chapel, the new Education and Community Building, and the Chester Road gate on the east side. By capturing and storing rainwater, these systems will conserve water, reduce reliance on municipal supplies, and mitigate the impacts of droughts.

At the Chester Road gate, an active attenuation system is proposed. This innovative approach will share a storage tank for both rainwater harvesting and long-term stormwater storage. A control system linked to weather forecasts will manage water levels and release rates, optimising water use during non-storm periods and effectively managing stormwater runoff.

The rainwater harvesting process involves collecting rainwater from designated surfaces and storing it in a tank. Once the tank reaches capacity, the system gradually releases water at a controlled rate to drainage system. Filtration and overflow protection measures will be incorporated to ensure water quality and prevent flooding.

4.3.2 Soakaway System

West side
A soakaway is a subsurface drainage system designed to allow rainwater to gradually infiltrate the surrounding soil. It consists of a pit or trench filled with coarse gravel or stone that allows rainwater to percolate slowly into the surrounding soil. The primary purpose of a soakaway is to prevent flooding and waterlogging by providing a sustainable way to dispose of excess water.

As section 4.1 suggests infiltration systems is suitable at west side due to its satisfactory infiltration ability. Soakaway systems are proposed at several secondary paths at west side as a result. Soakaway systems location, volume and details can be referred to Appendix G: Development Proposals for information. In summary, the soakaways can provide 117m^3 attenuation storage and retention volume.

Soakaways will be constructed using coarse gravel with a triangular cross-section. This design minimises disturbance to the surrounding environment, including existing graves. For soakaways with a sloping base, strategically placed weirs will be incorporated to regulate water flow. These weirs will optimise the storage capacity within each section, promoting efficient infiltration.

Following the guidance of Building Regulations Part H, CIRIA Report 156, and the CIRIA SuDS Manual, the soakaway is designed to accommodate a 10-year return period rainfall event. Its capacity is assessed by ensuring it can empty from full to half-full within 24 hours, enabling it to manage a subsequent rainfall event.

Issue of ponding has been observed in the southwest corner of the west side. Our investigations suggest that an unidentified shallow underground stream may be elevating the local groundwater table, causing the ponding. To mitigate this issue, a strategically placed soakaway system will be implemented. The system will consist of a trench filled with coarse gravel that extends from the ponded area along the footpath and connects to the main path. This design allows the collected water to be redirected towards a larger infiltration area, facilitating more effective drainage and reducing ponding. Figure 3 and Figure 4 are site photos showing the subjected footpath and ponding issue.

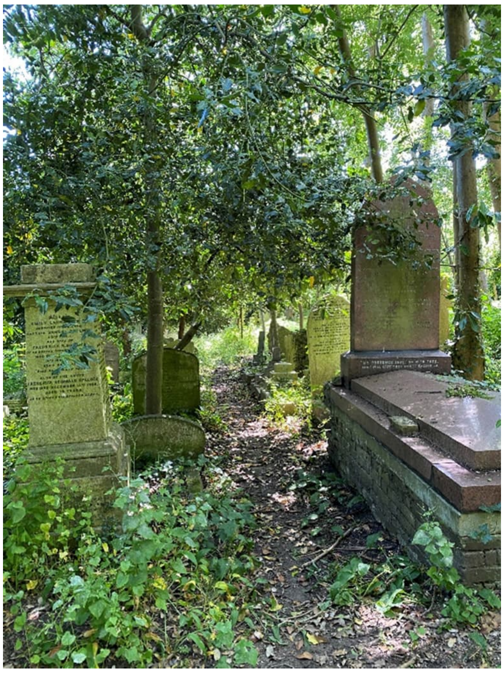

Figure 3 The tertiary footpath leading from the main path to the stream.

Figure 4 Our investigation identified ponding water, covered by vegetation, in the southwest corner of the west side.

East side

Soakaway systems are generally not suitable for the east side of the site. However, due to observed ponding in two low-lying areas, pumped soakaway systems are proposed. These systems will capture and retain surface water from the surrounding area before controlled release via pump chambers.

The proposed solution involves installing an infiltration well and a pump chamber at each low point. Collected water will drain into the infiltration well, allowing for natural infiltration into the ground where possible. A submersible pump within the chamber will then transfer any excess water at a controlled rate to the existing piped drainage network. This multi-stage approach ensures efficient water management and minimises the risk of ponding recurrence in these areas.

4.3.3 Permeable Pavement

Where soakaway systems are infeasible due to tree protection zones, shallow gravel subbase and French drain is planned on the west and east side This strategy facilitates infiltration where feasible and directing excess water towards soakaways or piped drainage systems in a controlled manner.

French drain will be incorporated to secondary and tertiary pavement providing interception storage, slowing down runoff and providing treatment. These linear trenches consist of a perforated pipe wrapped in filter fabric and surrounded by coarse gravel aggregate. The perforated pipe efficiently collects surface water runoff, while the filter fabric prevents soil particles from clogging the system. The surrounding gravel acts as a reservoir, facilitating temporary storage of collected water and reducing the strain on traditional drainage systems. This environmentally friendly approach effectively manages surface water runoff while minimising environmental impact.

4.3.4 Piped Drainage System

A key objective of the drainage strategy for both the west and east sides is to maximise resource utilisation. Wherever possible, the existing underground piped drainage network will be strategically retained and reused. This approach promotes cost-effectiveness and minimises disruption to the existing landscape.

To further enhance surface water management, a system of drainage channels will be installed along all primary paths within both sides. These channels will be designed to efficiently collect surface water runoff from the paths and convey it directly to the existing piped drainage network. This integration ensures the efficient removal of surface water from high-traffic areas, thereby minimising the risk of ponding and potential erosion.

Due to variations in soil conditions, topography, and the existing surface water drainage system between the east and west sides, the piped drainage system has been designed accordingly.

East Side
It is proposed all runoff from the proposed impermeable area in east side (1.4760ha) is attenuated and controlled to 29.49 l/s for all storm event up to and including the critical 100 year plus 40% climate change event. 29.49 l/s discharge has been calculated to simultaneously control flows as close as reasonably practical to pre-development runoff rates whilst also providing safeguard against blockage risk.

In accordance with the CIRIA SuDS Manual and Rainfall run off management for development report (Kellagher, 2013), attenuation storage aims to limit the rate of runoff into the receiving water to similar rates of discharge to that which took place before the site was developed (greenfield runoff rate). Given the site's previous use as a cemetery and the development's objective to restore and enhance the site, a pre-development runoff rate is proposed. To achieve this, long-term storage is the correct tool to access the necessary storage to address the additional volume of runoff caused by the development. By implementing such storage, the project aims to simulate pre-development hydrological conditions.

According to Rainfall runoff management for developments report (Kellagher, 2013), long term storage can be calculated with equation in Figure 5. Required volume to compensate the additional of impermeable surface is 7.97m^3.

$$Vol_{xs} = 10.RD.A\left[\frac{PIMP}{100}(\alpha 0.8)+\left(1-\frac{PIMP}{100}\right)(\beta.SOIL)-SOIL\right] \quad (7.1)$$

Where:

Vol_{XS}	=	the extra runoff volume (m^3) of development runoff over Greenfield runoff
RD	=	the rainfall depth for the 100 year, 6 hour event (mm)
PIMP	=	the impermeable area as a percentage of the total area (values from 0 to 100)
A	=	the area of the site (ha)
SOIL	=	the "SPR" value for the relevant FSR soil type
α	=	the proportion of paved area draining to the network or directly to the river (values from 0 to 1)
β	=	the proportion of pervious area draining to the network or directly to the river (values from 0 to 1)
0.8	=	the runoff factor for contributing paved surfaces

Figure 5 Long term storage equation

Detail calculation can be referred to Appendix I: Surface Water Runoff Calculation.

The proposed development will drain via a piped network to a tanked geo-cellular storage tank located underneath the private permeable pavement, before releasing flows at 29.49 l/s via a hydro-brake flow control to a diverted Thames Water combined water sewer (to an existing Thames Water manhole, however connection is unclear given no clear indication could be found from survey and Thames Water asset map)

As per section 4.3.1 outlined the active attenuation system will incorporate a long-term storage volume. This stored rainwater can be reused for purposes such as irrigation during non-storm periods. The proposed tank volume could provide 53m^3 of capacity, combining the needs of surface water long-term storage and rainwater harvesting.

West Side

As mentioned above existing piped drainage system underneath the main paths are proposed to be retained and replaced, and soakaways system are implemented where possible. Given the proposed development's reduction in the catchment area serviced by the piped drainage system due to the integration of soakaways, the requirement for long-term storage to mimic pre-development runoff conditions is eliminated. Consequently, the piped drainage system will be directly connected to the existing Thames Water sewer or watercourse.

Detail calculation can be referred to Appendix I: Surface Water Runoff Calculation.

4.4 Surface Water Management & Maintenance

To ensure the long-term performance of any surface water drainage system, it is essential to implement a robust maintenance regime. This development's SuDS features will be fully maintained and managed by either in house management team of Highgate Cemetery or a dedicated private management company.

Table 3, Table 4, Table 5, Table 6 and Table 7 outline the specific maintenance activities and their corresponding frequencies for the responsible management body throughout the development's lifespan.

Table 3 Operation and Maintenance Requirements for Rainwater Harvesting Systems

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pump, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional Maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial Actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Table 4 Operation and Maintenance Requirements for Soakaways

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect for sediment and debris in pre-treatment components	Annually
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris from pre-treatment system	As required
Remedial Actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Table 5 Operation and Maintenance Requirements for Pervious Pavements (including Gravel Subbase and French Drain)

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an application rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth –required, take remedial action	Three-monthly, 48 hours after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 6 Operation and Maintenance Requirements for Geo-cellular Tank

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risk to performance)	Monthly
	For system where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and / or internal forebays	Annually, or as required
Remedial Actions	Repair / rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 7 Operation and Maintenance Requirements for Flow Control Device

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Visual inspection and removal of debris / silt. If any siltation or debris is observed, it will be removed by hosing down, manual cleaning (subject to sufficient risk assessment taking place)	Visual inspection to be carried out once every month or after a substantial storm event.
Occasional Maintenance	Remove debris and hose down as a matter of course including clearing of sump chamber	Every 6 months
Remedial Actions	Operation of flow control including testing as required. If operation is compromised in any way, flow control to be replaced.	As required

5.0 PROPOSED FOUL WATER DRAINAGE

All foul wastewater generated by the development will be discharged by gravity to the existing Thames Water combined sewer via the existing connection point.

For the new gardener's building on the east side, foul wastewater will be conveyed through a new underground pipe to the Chester Road gate. At this point, it will combine with the surface water outflow from the attenuation tank before discharging into the Thames Water combined sewer at Chester Road.

The total foul water flow rate from development proposals can be calculated based on guidance given within Flows and Loads 4 Design criteria.

Flows and Loads 4 assumes a flow rate of 10 Litres per Person per Day (l/p/d). Based on this and assuming an operation period of 8 hours per day and a population of 1280 (including staff and visitors), a peak flow rate of 1.34 l/s can be calculated as follows;

- DWF Flow rate = (10 l/p/d x 1280)/ 28,800 = 0.44l/s
- Peak flow rate = 0.44 x 3 = 1.34 l/s

A more detailed calculation of foul water drainage peak load will be undertaken during Stage 4. Nevertheless, the preliminary estimate provides a reasonable approximation of the anticipated peak flow rate.

6.0 CONCLUSION

This Sustainable Drainage Strategy is written to support the planning submission for the Highgate Cemetery Landscape masterplan, which includes restoration, demolition and replacement of buildings in East Side and West Side of Highgate Cemetery, including Cemetery wide landscaping, drainage, public realm and access works and repair of tombs and monuments to support the function of a working cemetery and community uses.

The purpose of this Drainage Strategy is to demonstrate how the site can be satisfactorily drained after development without increasing flood risk onsite and elsewhere. This report has been developed in full accordance with National and Local standards as well as best practice documentation.

Specifically, this Drainage Strategy demonstrates development proposals do not lead to an increase in:

- Peak runoff rate of storm water runoff leaving the site
- Volume of runoff leaving the site
- Pollution to receiving waters from storm water runoff
- Flood risk to nearby or neighbouring sites

This report makes the following key conclusions.

- As part of development proposals 2.2942ha will become impermeable when the development is completed. When compared to the existing impermeable area of 1.1510ha, this presents an increase of 1.1432ha of impermeable area.
- Infiltration systems are only feasible on the west side of the site, as infiltration testing has demonstrated inadequate permeability on the east side. Consequently, a site-specific approach is proposed. The west side will employ a combination of soakaways, shallow French drains, and piped drainage, while the east side will primarily rely on shallow French drains and piped drainage, discharging to the Thames Water surface water sewer at a controlled rate.
- It is proposed that all runoff from the west side of the development be discharged directly to the Thames Water sewage network. For the east side, the discharge rate will be limited to 29.49 l/s. The discharge performance has been assessed for all storm events up to and including the 100-year plus 40% climate change event.
- All foul water will be gravitated to existing Thames Water Foul Water sewers.