Gustafson
Porter +
Bowman

Highgate Cemetery Landscape Masterplan

Design and Access Statement

Volume 2: Landscape Design and Access Statement

Part 2 of 6

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3. Drainage & Materiality

3.1 Existing Drainage

CHALLENGES AND EXISTING CONDITIONS

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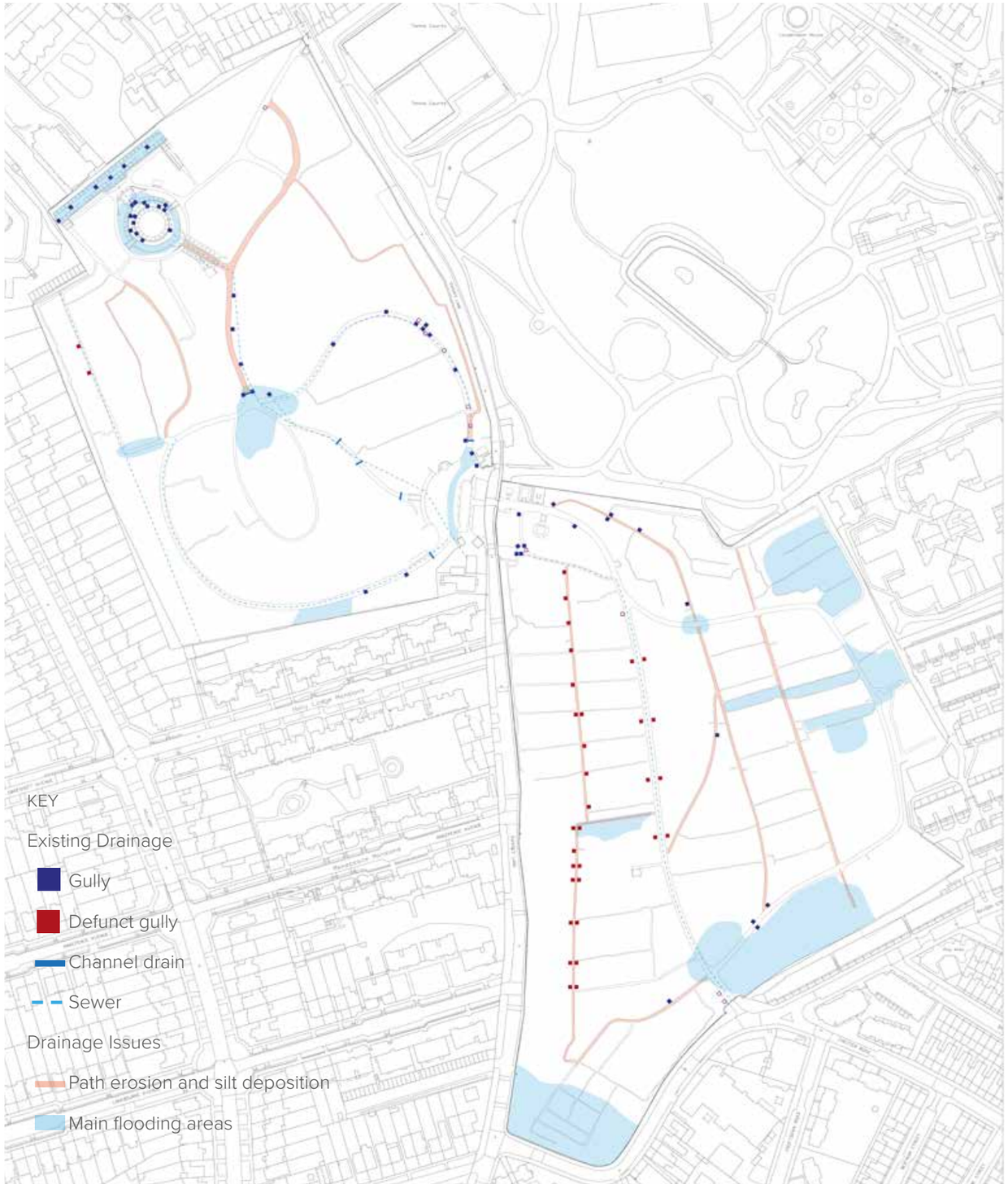
Drainage is a key issue at Highgate Cemetery. This diagram illustrates the existing drainage infrastructure, some of which is not functioning adequately. It also describes areas where path erosion, silt deposition, and flooding are of particular concern. The current condition uses several types of drain including linear drains, and gullies in the middle and sides of paths. Infiltration tests were also conducted to determine the the permeability of soil on boths sides; while the west side soil composition does allow for some infiltration, it is not possible to infiltrate water on the east side, which has informed the proposed drainage strategy.

For more information on existing drainage conditions, please refer to Max Fordham's report.

Existing drainage typologies



3.2 Drainage Strategy

RESTORED PIPED DRAINAGE, SOAKAWAYS, AND ATTENUTATION

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The West side's drainage strategy adopts a multifaceted approach designed for optimised water management and minimal environmental impact. The existing underground piped drainage system will be strategically retained and supplemented by the installation of new channel drains along primary pathways. This ensures efficient surface water collection from high-traffic areas. Secondary pathways will benefit from the implementation of soakaways, promoting natural infiltration of rainwater and replenishing groundwater reserves. Finally, tertiary paths will incorporate shallow French drains. These serve a dual purpose: facilitating infiltration where feasible and directing excess water towards soakaways or piped drainage systems in a controlled manner. This tiered approach maximises the utilisation of existing infrastructure while promoting sustainable water management practices on the West side.

In response to the unsuitable ground conditions identified during infiltration testing, the East side drainage strategy prioritises efficient water management while minimising environmental impact. Given the unpractical use of soakaways, the existing underground piped drainage network, if functional, will be strategically reused to form the backbone of the new system. This will be supplemented by the installation of new channel drains along main pathways for the efficient collection of surface water run-off.

Secondary paths will incorporate French drains. These drains serve a dual purpose:

Attenuation: French drains attenuate surface water run-off by temporarily retaining it before gradually releasing it.

Conveyance: The collected water is then directed towards the piped drainage network for further management.

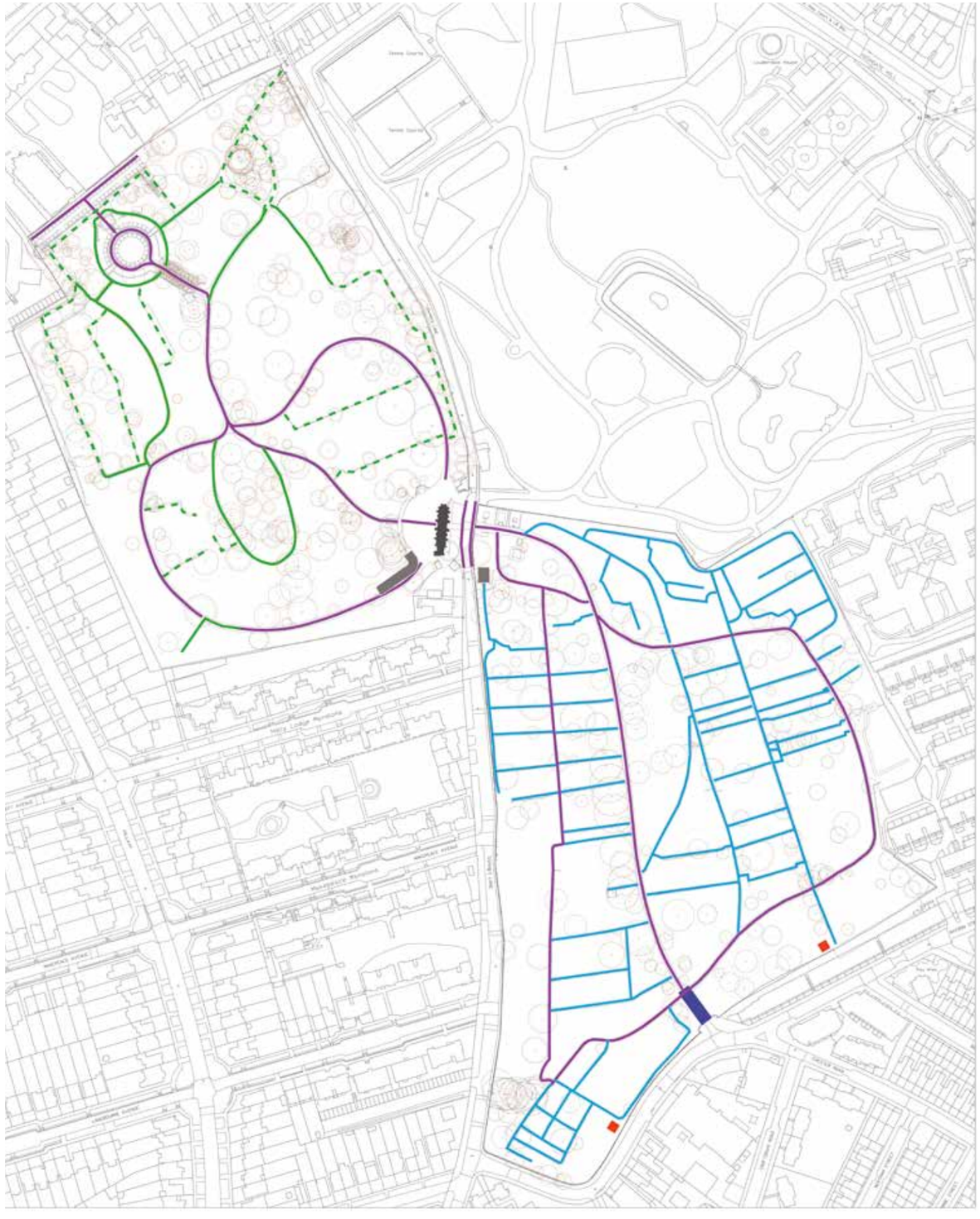
This approach maximises the utilisation of existing infrastructure while promoting a sustainable drainage solution for the East side.

To further ensure effective drainage within the cemetery's east side, the lowest points will have strategically positioned sump pumps. These pumps will assist in the controlled discharge of accumulated water into the piped drainage network. Additionally, an attenuation tank will be incorporated into the design to manage and regulate the overall site runoff. This will serve to mitigate potential downstream flooding impacts.

This multifaceted approach, combining reused piped drainage, strategically placed channel drains, French drains for secondary pathways, strategically positioned sump pumps, and an attenuation tank, ensures comprehensive water management within the East side.

The drainage design incorporates SuDS (Sustainable Drainage Systems) by incorporating attentuation, soakaways, and areas of SuDS planting to reduce water flow.

Please refer to Max Fordham's Drainage Reports for further information and drawings.



- New path soakaway
- New shallow gravel sub-base/ soakaway without impacting tree roots
- Clay pipe drain within sub base of new path build up with linear channel drains; existing piped drainaged to be retained where possible
- Gravel sub-base to attenuate water and direct water to piped drainage.
- Attenuation tank
- Pumped soakaway to infiltrate water collected from lower east side

Drainage Strategy

PRIMARY PATHS

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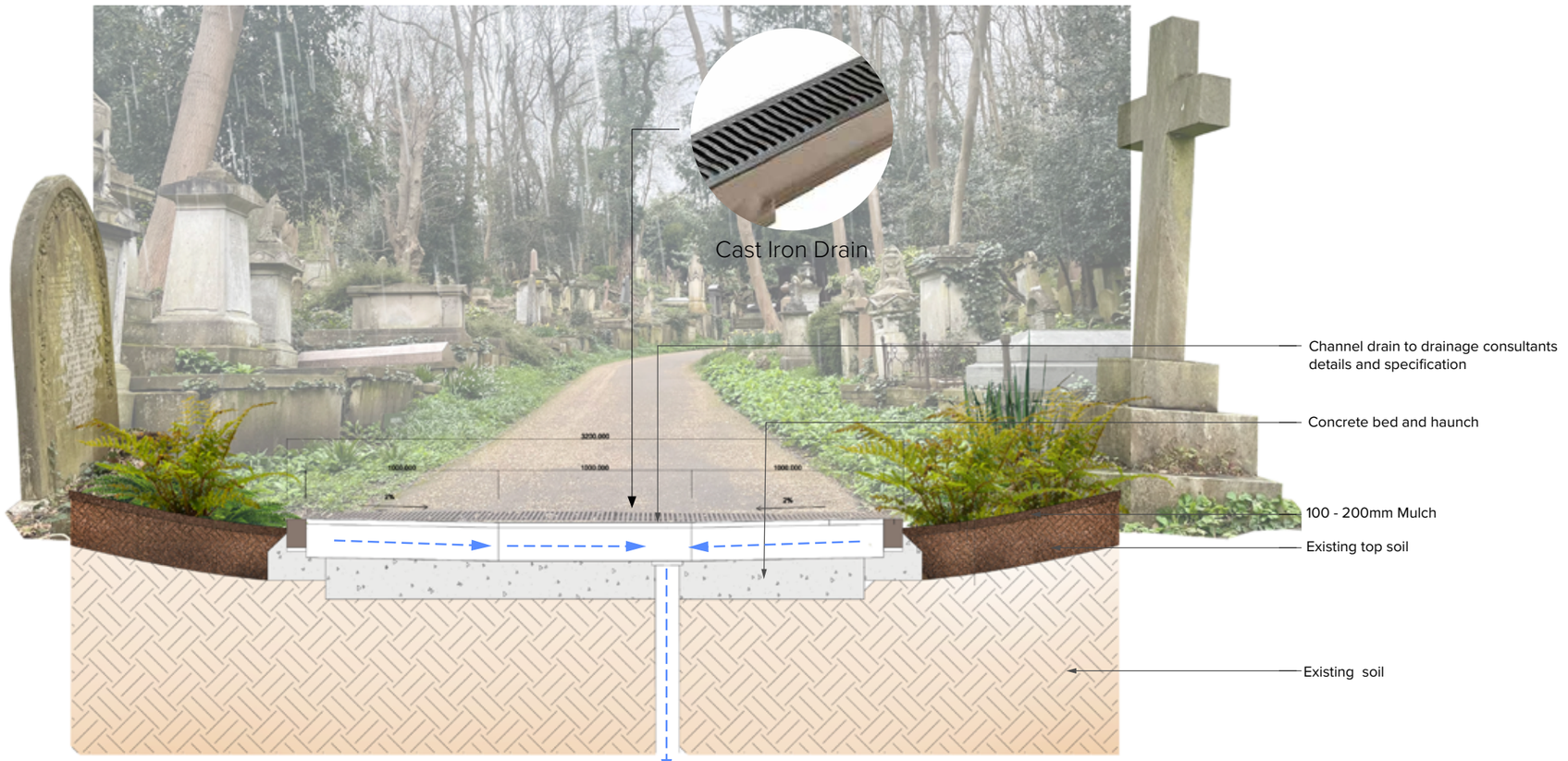
Currently, there are two different existing typologies of drains - gullies and linear cross drains - used in the cemetery which are poorly maintained and work inefficiently. Heavier rainfall necessitates the need for a more robust and efficient drainage system. Please refer back to page 8: Drainage - Existing Challenges for photos of the existing drains.

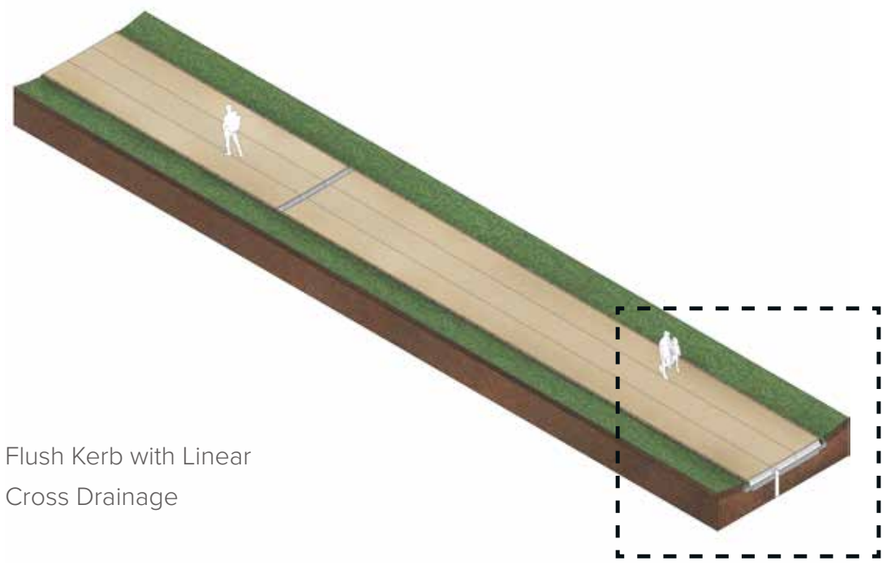
Gullies are typically combined with raised kerbs to effectively direct runoff into the drainage system. The raised kerbs act as barriers that channel the water towards the gullies. This method, while functional, requires careful installation and maintenance to prevent blockages and ensure proper water flow. They would also have to be placed along the path edges with significant frequency as compared to the current condition to accommodate projected water flows. Due to the aesthetic impact, frequency of placement, and the need for raised kerbs, this option has not been pursued.

On the other hand, linear channel drains are designed to work with flush edging; this option allows the surface water to flow directly into the channels without the need for raised kerbs. Historically flush kerbs were also important as raised kerbs are typically associated with vehicular roads. Channel drains are often considered more efficient in certain contexts because they provide a continuous drainage line, which can handle larger volumes of water. This solution will require appropriately graded surfaces to create drainage falls to ensure that the runoff is directed towards the designated collection points, preventing water from ponding. These linear drains will also need to be provided less frequently than gullies, and due to their placement in the path rather than to the side, will reduce the volume of plant material in the drains. Due to these reasons, the linear cross drains as presented in the diagrams to the right are the preferred solution.

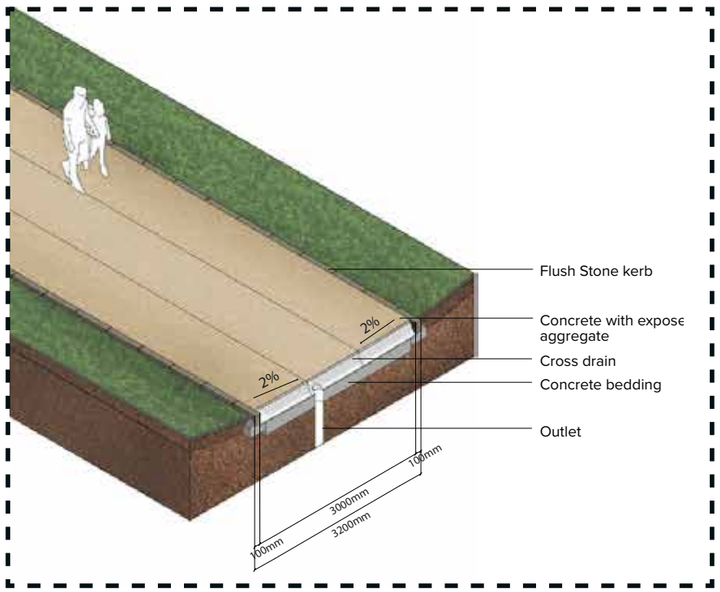
Please refer to Max Fordham's Drainage Reports for further information and placement of drains.



Water flow to piped drainage network



Flush Kerb with Linear Cross Drainage



Drainage Strategy

SECONDARY PATHS

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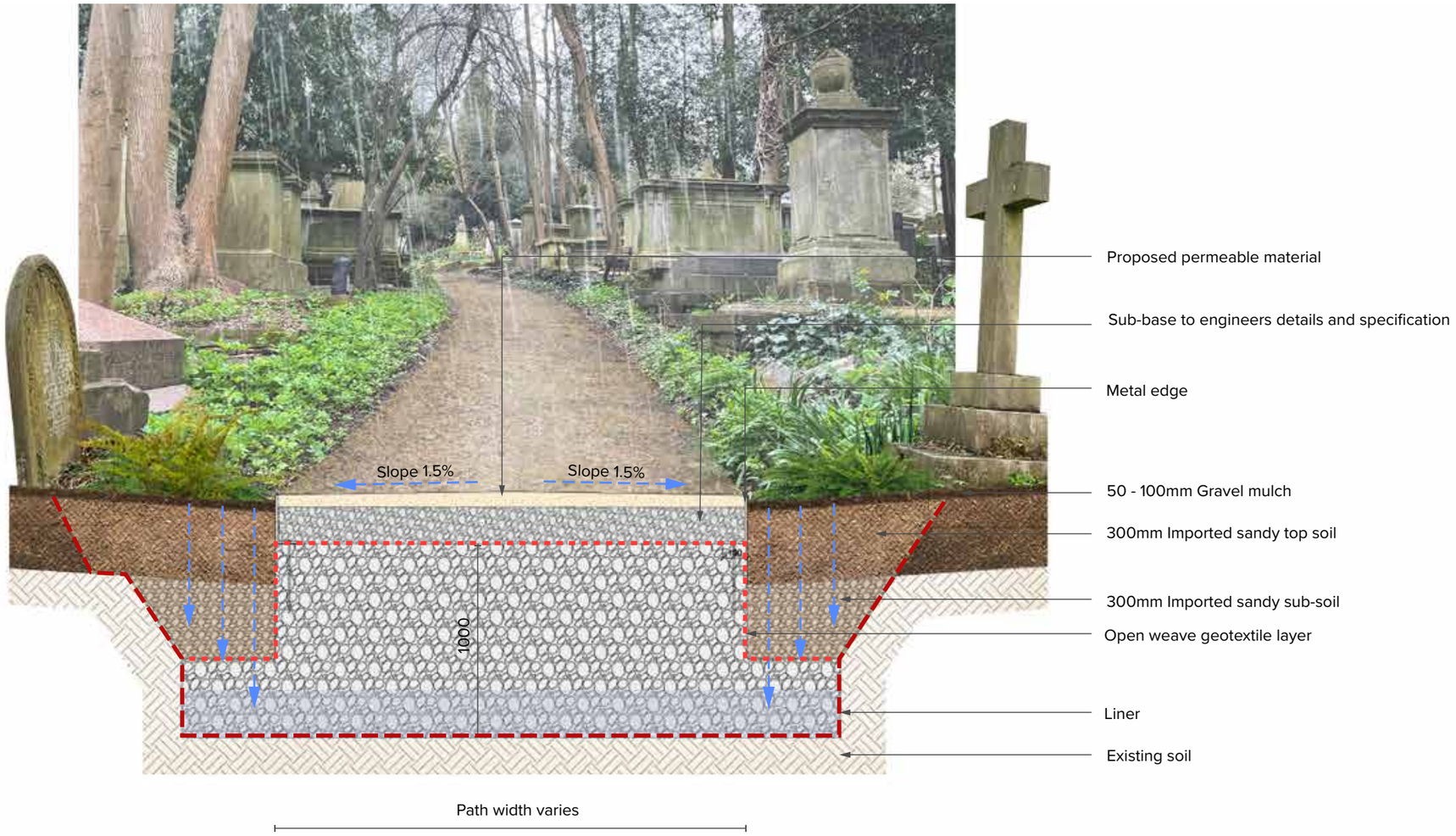
The proposed drainage strategy involves utilizing the sub-base of the secondary paths as soakaways (West) or attenuation areas (East). This approach is designed to manage and mitigate the increased volumes of rainfall, which exceed the capacity of the traditional drainage system. By integrating these features into the landscape, the strategy aims to enhance the cemetery's resilience to heavy rainfall, reducing the risk of flooding and ensuring effective water management.



Drainage Strategy

TERTIARY PATHS

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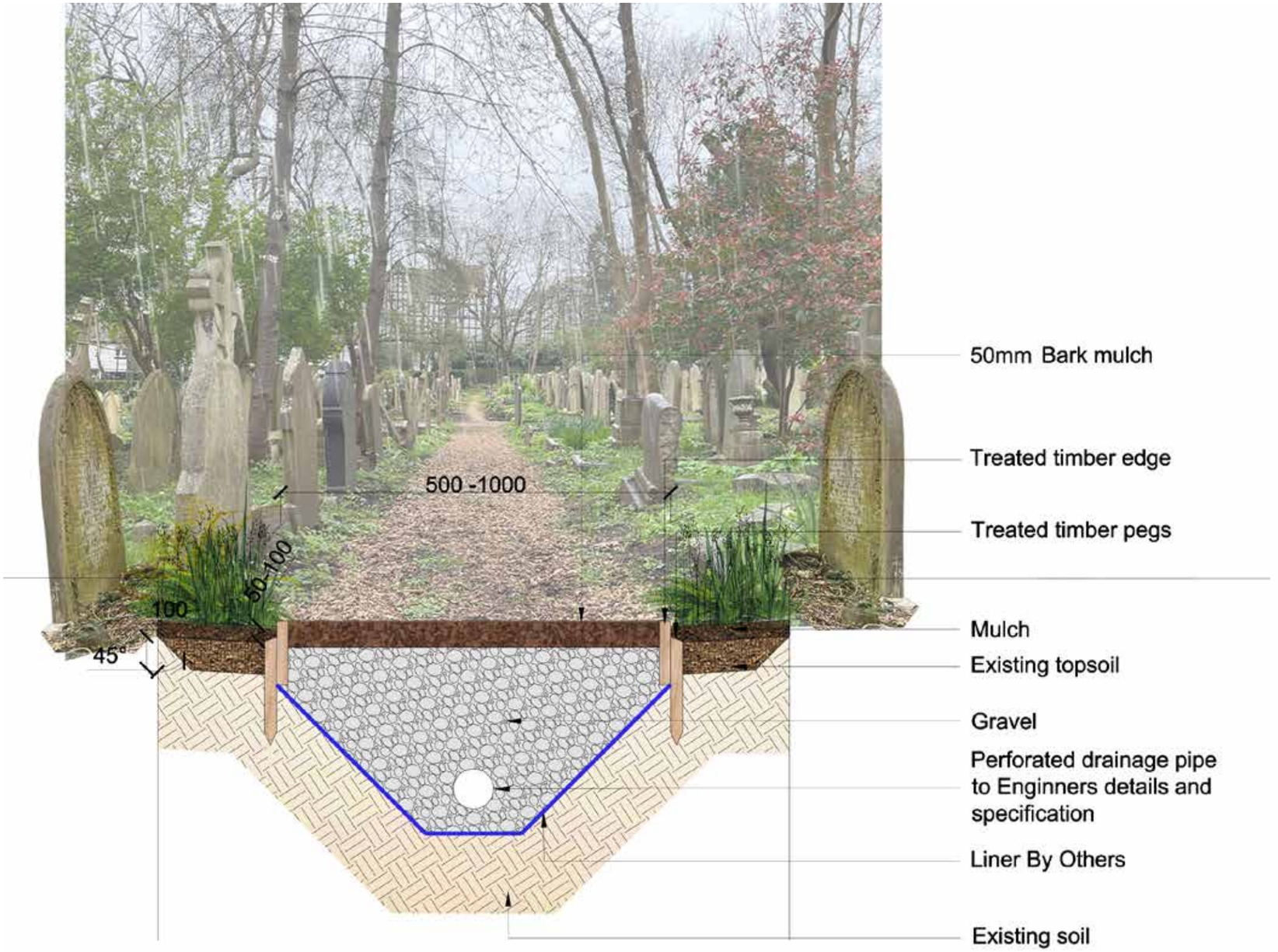
For the tertiary paths, the proposal will adopt a similar approach to that used for the secondary paths, to increase the capacity for storage of water. However, in certain sections of the tertiary paths, specific conditions require the gravel sub-base to be shallower. This adjustment is necessary to minimize the impact of excavation on the root systems of existing trees, preserving their health and stability.



3.3 Water Management

COLLECTION AND IRRIGATION

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Rain Water Harvesting

Rainwater will be captured from the following locations:

Terrace Catacombs - West Side

Courtyard side of the Chapel Roof - West Side

Community & Education Building - East Side

Landscape Paths where feasible - East Side

Rainwater will not be actively harvested from the Cafe & Operations building, and the Gardener's Building, due to the proposed green roofs.

These rainwater tanks will then be used for irrigation, cleaning and washing down, visitor use for watering graves (not potable), and WC flushing, near the entrances, courtyard, and the Circle of Lebanon. Taps further from these tanks will be connected to the water mains, with sustainable usage of water being promoted.

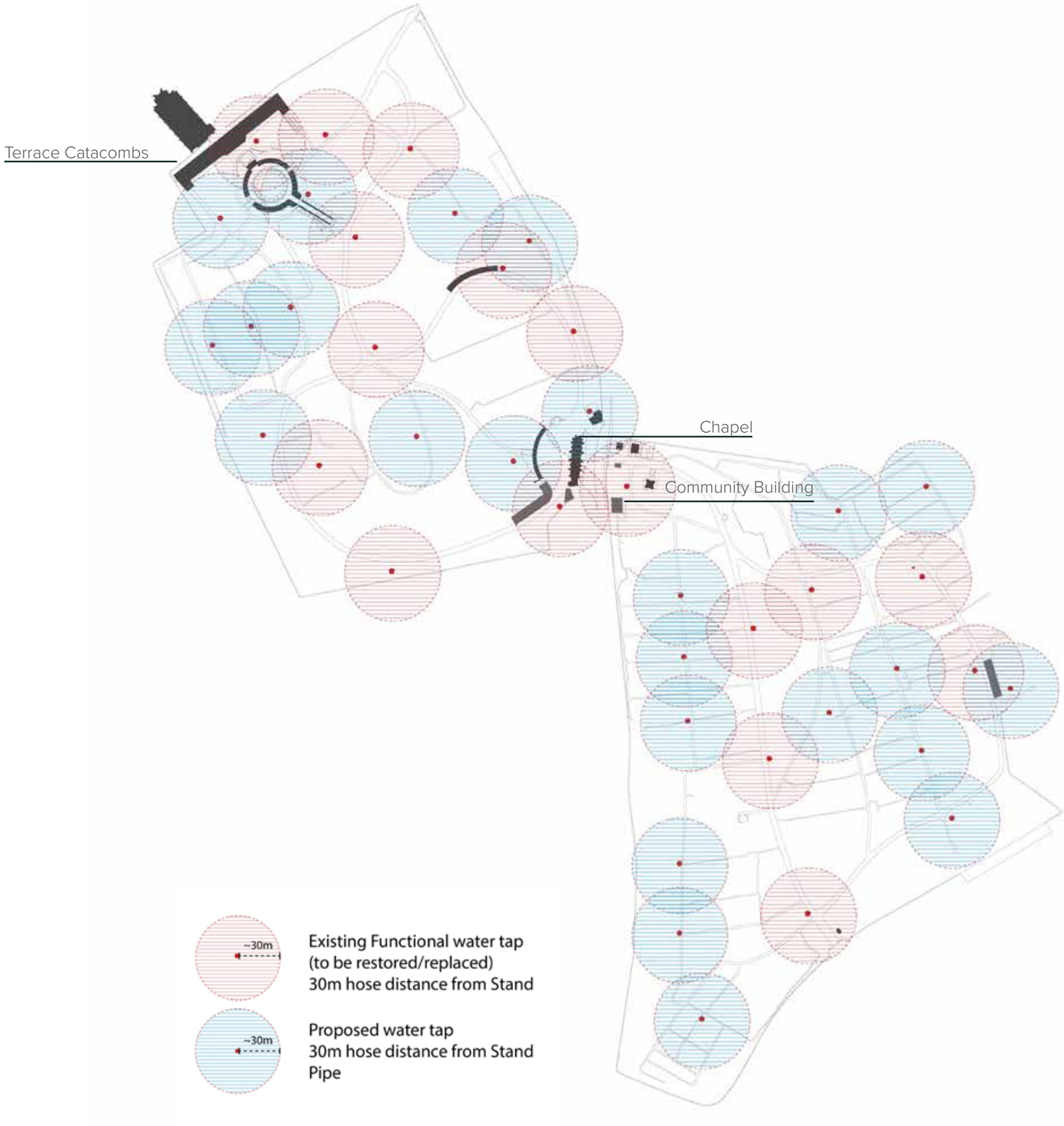
For further information on the harvesting tanks, refer to Max Fordham's strategy.

Irrigation

Irrigation is crucial for the successful establishment of the new plant species, and water points will be strategically placed at frequent intervals throughout the cemetery to facilitate this process. Existing watering points will be restored and replaced, with new watering taps proposed to regularise the frequency and provide ease of access to visitors and staff.

In locations where a hose from a tap cannot reach, a water bowser can be used. For areas that cannot be reached by a hose or plant watering bowser, a backpack water dispenser (10-20L) will be filled at an irrigation point and taken to unreachable areas in need of irrigation.

Due to the proposed strategy of planting more drought resistant plants, once the plants are established harvested water will only be used during severe drought. The tank sizes, irrigation strategy, and frequency of watering during drought periods will be further developed along with the planting proposals in the following stage



3.4 Proposed Hardscape Strategy

WEST SIDE

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The paving materials selected for the cemetery included both those typically used in cemetery de-sign (J C Loudon had advocated the use of gravel for drives and paths and grass for walks) and new materials. The terrace along the top of the Terrace Catacombs was laid out in R T Claridge's Seyssel asphalt (patented in November 1837: patent 7849) and was 'probably the earliest surviving asphalted building in the country having originally been sur-faced by Claridge' (HE Listed Building description). It was resurfaced in the late twentieth century. The early nineteenth century was a period of innova-tive change in road design. Thomas Telford and John Loudon McAdam both stressed the impor-tance of good foundations and drainage to ensure a stable and solid surface

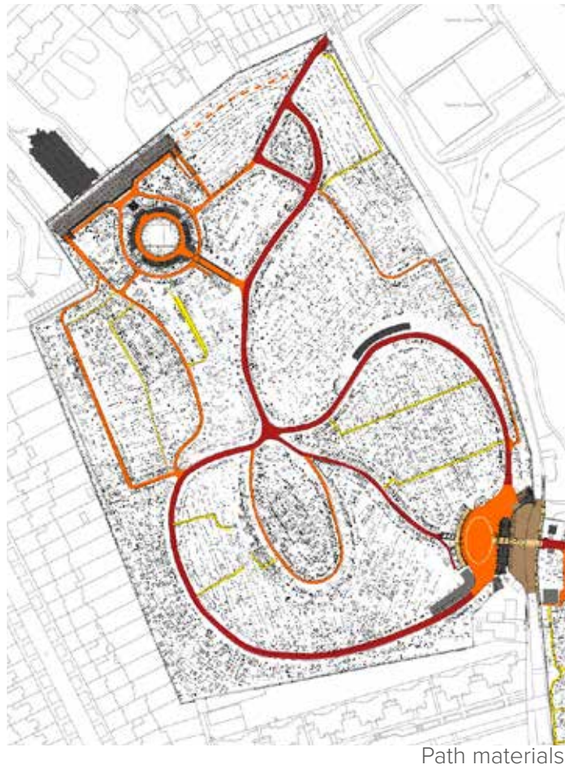
Following historic precedent, a self binding gravel is the material of choice for the secondary paths. Despite its lack of permeability it is softer un-der-foot, giving the feel of being in a landscape, rather than urban road environment. However the steep hillside poses challenges. The best quality Breedon self-binding gravels laid in numerous his-toric settings, is not normally laid on slopes great-er than 6.6%. The majority of Highgate's paths and carriageways are on greater slopes and so its use will require additional details such as granite strips running across the path to stabilise the surface.

For the primary paths, it is proposed to use a fine aggregate concrete that has the appearance of a self-binding gravel, but is far more robust un-der the impact of heavy vehicle movements and rainfall, requiring less maintenance. Sustainability has been considered with an aim to minimise the embodied carbon of the mix.

The Olympic Park provides an interesting prec-edent. All paths during the Olympic period were laid with self-binding gravel regardless of their location on flat or sloped ground. The gravel
on sloped ramped surfaces have since been replaced by exposed aggregate concrete, due to heavy footfall and the increased maintenance burden.

A range of path finishes are being considered for tertiary paths. The most heavily trafficked should remain in self-binding gravel, however on the less well used paths, bark mulch can be used along with compacted soils in a woodland context, or grass where there is enough sunlight to generate healthy growth through all seasons. Both condi-tions would need well drained firm ground to be successful.

Part of the hardscape proposal is the standardisation of path widths corresponding to the hierarchy of primary, secondary, and tertiary use, with the exception of small areas for maintenance access, or where space does not allow. This increases the legibility of the path network and reduces the variation and inconsistency found currently on site.



Path materials

Edging materials

- Primary Paths - Exposed Aggregate Concrete
- Frequent use by landscape maintenance vehicles
- Weekly use by hearse for funerals
- Regular use by pedestrians
- Secondary Paths - Self Binding Gravel
- Occasional use by most landscape maintenance vehicles
- Regular use by pedestrians
- Tertiary Paths - Soil, Grass, Mulch
- Occasional use by some landscape maintenance vehicles
- Occasional use by pedestrians based on recent burials or significant monuments
- Tertiary - new boardwalk path - metal boardwalk with wood edging

- Granite setts - entrance and Swain's lane
- Yorkstone setts - entrance, Swain's lane, & Courtyard
- Stone setts/
- 'L' profile heavy duty steel edge
- Timber edge, flush

Standardising Path Widths - West Side

- 3m wide
- 2m wide
- As existing

Proposed Hardscape Strategy

EAST SIDE

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Generally the primary and secondary paths on the east side are wider than the west side - the masterplan proposes maintaining this width while applying the same hardscape material hierarchy as the west side.

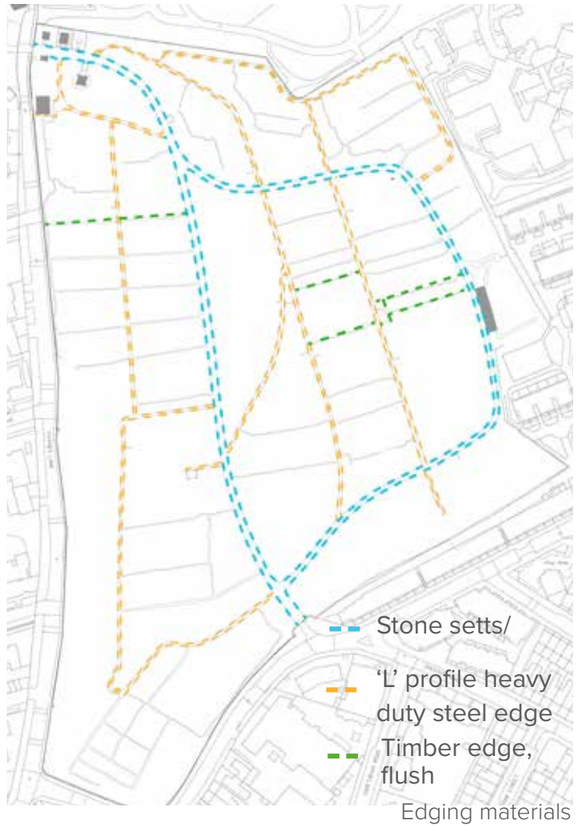
Edging:

Primary Paths are the wider routes for all vehicles to access all areas of the Cemetery using a single course of granite sets on a concrete haunch as a kerb to resist the impact of heavy vehicles. The primary path network also provides the network for pedestrian access.

Secondary Paths are narrower and enable lighter maintenance vehicles to access areas of the Cemetery that are inaccessible to heavy vehicle. A heavy duty steel angle on a concrete haunch can resist the impact of wheels, tools etc.

Tertiary Paths are the narrowest and are generally for pedestrians to access graves in Highgate Cemetery West and East. These would have a timber edge that over time provides a soft edge and combines with the surrounding soils.

Path materials



Edging materials

Primary Paths - Exposed Aggregate Concrete

Frequent use by landscape maintenance vehicles

Weekly use by hearse for funerals

Regular use by pedestrians

Secondary Paths - Self Binding Gravel

Occasional use by most landscape maintenance vehicles

Regular use by pedestrians

Tertiary Paths - Soil, Grass, Mulch

Occasional use by some landscape maintenance vehicles

Occasional use by pedestrians based on recent burials or significant monuments

Tertiary - new boardwalk path - metal boardwalk with wood edging

Granite setts - entrance and Swain's lane

Yorkstone setts - entrance, Swain's lane, & Courtyard

Standardising Path Widths - East Side

3-3.5m wide

1.5-2m wide

As existing

Stone edge - Primary Paths (Concrete)

Metal Edge - Secondary (Gravel)

Timber edge - Tertiary (Lawn or mulch)

3.5 Materials palette

FINE EXPOSED AGGREGATE CONCRETE

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Archive material and the 1839 'View of Highgate and Kentish Town Cemetery', clearly establish that on the west side of the cemetery the carriage drives were finished in gravel (see text on illustration). On such a steep hillside this would have required additional labour to ensure that the finished surface was well maintained and did not erode as a result of heavy rainfall. The sketch also suggests by use of the heavy pencil lines that the curved paths were probably provided with a fine granite kerb, that with well placed gullies, would also have reduced erosion.

As previously stated, contemporary self-binding gravels, such as Breedon do not recommend laying gravel on slopes greater that 6.6%. At Highgate most drives and paths are on slopes greater than 6.5 %. Over time with lack of maintenance this has led to the original drives being eroded, with gravel and silt blocking the drainage gullies. This has led to the use of asphalt as a surfacing material, to take vehicular traffic, but gives the look and feel of an urban street.

The masterplan proposes to use self-binding gravel on the secondary and tertiary pedestrian path networks, with additional details to stop erosion. On the primary vehicular drives we have looked to the City of Paris as a precedent. Here, self-binding gravel paths on the historic boulevards and parks, have come under the same increased pressure from vehicle movement. These have been replaced with hardwearing and accessible, fine aggregate concrete, to a bespoke specification, that uses local materials and manufacturers. We intend to use the same principles to develop a similar product for the London context. Please see the detailed Paris specification in the appendix.

In addition to the aesthetic appearance of the mix, the specification will aim to minimise embodied carbon through aspiring to deliver the following measures:

The final concrete mix design certificate should be accompanied by a specific EPD in accordance with iso 14025, or at a minimum, shall be accompanied by a specific embodied carbon value, with clarity on how it was calculated, including source information on material carbon values.

- The final concrete mix shall have an embodied carbon intensity not greater than 210kgCO2e/m3.
- The concrete should use limestone as part of the cement blend.
- GGBS should not be used in proportions greater than 40% of the total cement content.
- The Contractor shall submit the final mix designs, their embodied carbon intensity and confirm their compliance with the specified embodied carbon intensity target for approval prior to batching

Self binding gravel

Gravel for secondary paths

Concrete with fine aggregates for primary paths & vehicle movement

Blvd Auguste Blanqui - Paris

View of Highgate and Kentish Town Cemetery *Gravel Paths*, (possible source Ramsey), 1839

3.6 Maintenance, Skips, & Storage Areas

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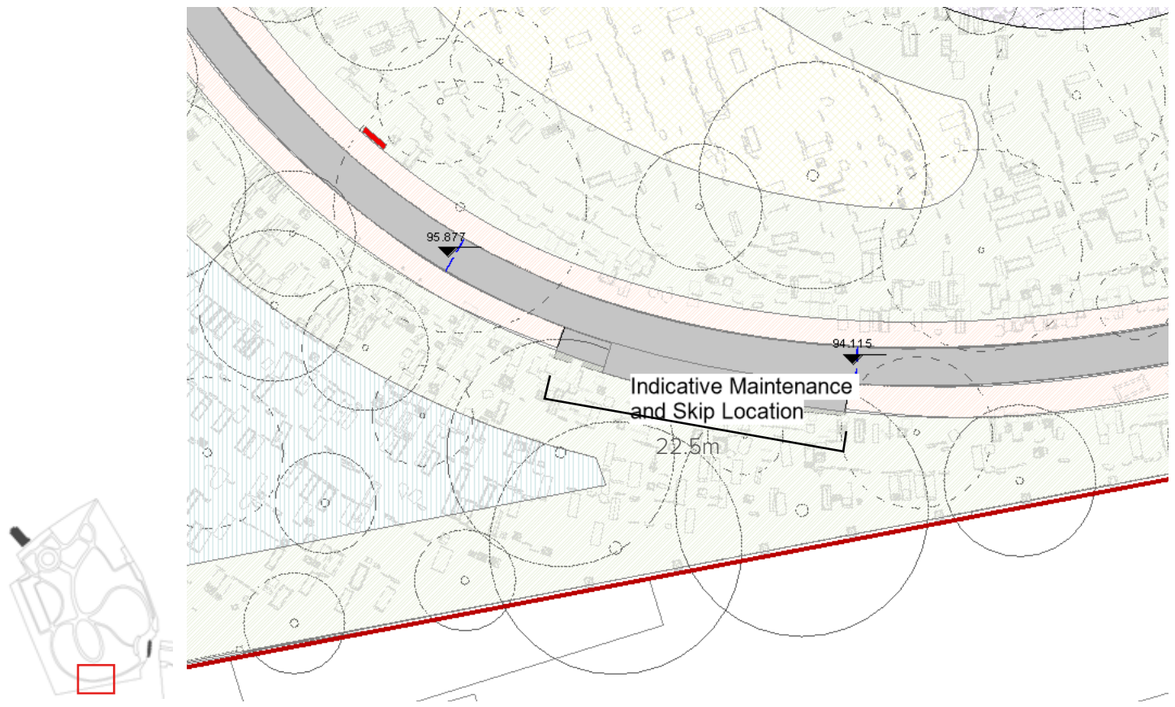
Highgate Cemetery's maintenance team currently use a 3.5 x 45 metre set down area for skips, green waste bags and chipping along the southern edge of the West Carriage Drive. This very necessary activity is the reason the drive and the south-west corner of the Cemetery is closed to visitors. As previously mentioned, the drive is also the most accessible of the three paths that lead up the hillside from the forecourt, with an average slope of around 6% on average. It is proposed to re-open the West Carriage Drive and place set down areas for a skip in both the east and west sides of the Cemetery.

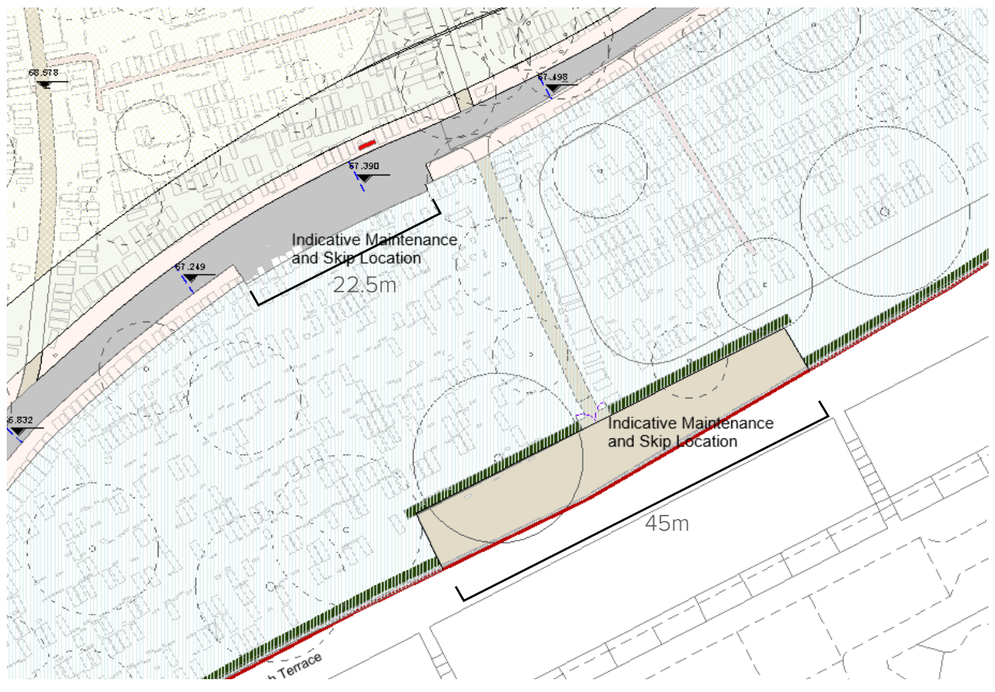
The provision of a space on each side of the Cemetery will help reduce traffic movements between the two and in order to minimise the need for green waste bags, a mobile chipper will bring ready chipped green waste from the location of the maintenance works and place them directly into the skip, avoiding the need for bags to store green waste in the vicinity of each skip. The new skip locations require a locally widened path of 3.5m for vehicle access and a set down area to pick up and deliver the skips of 3.5 x 22.5m.

The hardstanding in the west side is located on the West Carriage Drive as close to the Swain's Lane entrance as is feasible without the need to disturb any burial locations. A similar location has been found on the east side on the south east drive, between the new Gardeners building and the Chester Road gate. The east side hardstanding is located adjacent to the south extension to the Lime tree path, a cul-de-sac route to the only burial free area of the Cemetery adjacent to Stoneleigh Terrace. This 5 x 45m area is to be screened off by a gated fence native species hedge and used for the storage of burial and landscaping materials that are currently located sporadically between burials along the edge of the West Carriage Drive.

Additional information on waste strategy can be found in the Transport Assessment produced by Caneparo Associates.



Outdoor maintenance & Skip location - West side



Outdoor maintenance & Skip location - East side

Hedge along outdoor maintenance area - East side