Flood Risk Assessment and Surface Water Drainage Strategy for Planning

Prepared for:
Hartmires Investment Ltd

August 2020

Location:
Proposed Crematorium,
Land north of Turners Hill Road,
Turners Hill
RH10 4PB

Our reference:
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Document Issue Record

Location:	Proposed Crematorium, Land north of Turners Hill Road, Turners Hill, West Sussex RH10 4PB				
Application:	Outline planning application for a single 'chapel' crematorium with abated cremator and natural burial site with associated access, car parking, landscaping and drainage				
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Title:	Flood Risk Assessment and Surface Water Drainage Strategy for Planning				
Project No.:	89699	**Date:**	3rd August 2020	**Issue No.:**	2.0
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1. Introduction

1.1. This Flood Risk Assessment and Surface Water Drainage Strategy has been prepared by Unda Consulting Limited on behalf of Hartmires Investment Ltd, in support of a planning application for *Construction of a crematorium facility*. The development is proposed at Land to the north of Turners Hill Road, Turners Hill, West Sussex RH10 4PB. This report assesses flood risk and surface water drainage for the proposed development.

1.2. The proposed planning application is for *Outline planning application for a single 'chapel' crematorium with abated cremator and natural burial site with associated access, car parking, landscaping and drainage*. Post development the total roof area of the new crematorium building will cover approximately 888m².

1.3. In order to mitigate flood risk posed by post development runoff, adequate control measures will be required within the site. This will ensure that surface water runoff is dealt with at source and the flood risk off site is not increased.

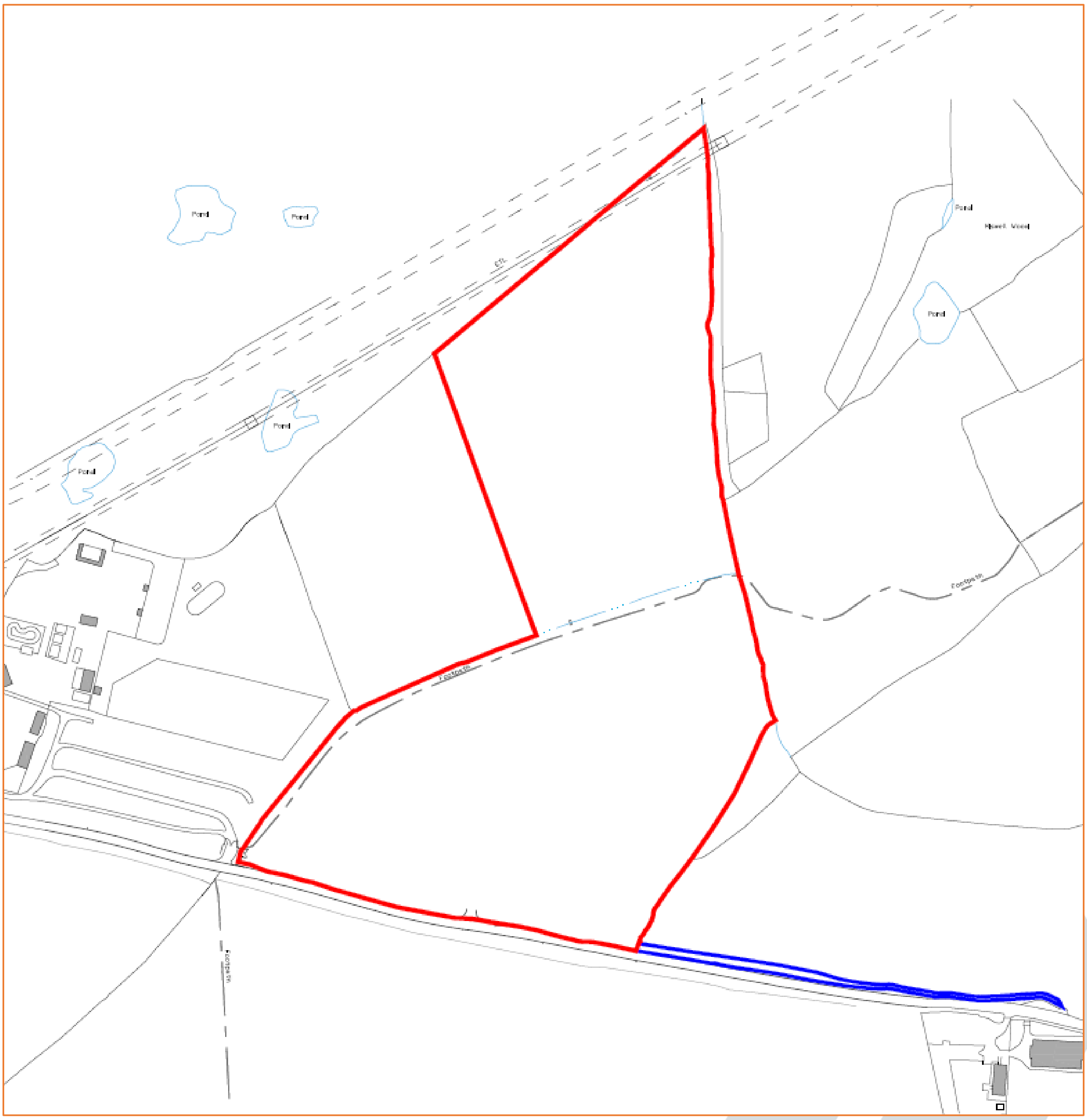


Figure 1: Site Location Plan (Source: Hartmires Investments Ltd)

2. Existing Site:

2.1. The site is currently occupied by two fields with a car park in the south, underlain by MOT type one gravel. According to plans provided by the client a public footpath transects the centre of the site along with two drainage ditches. Following a site reconnaissance, the application boundary was found to be largely underlain by grassland with the site sloping steeply towards the north east.

2.2. The site is approximately 68253m^2 in size and accessed from the south via gravel junction, off Turners Hill Road. Information provided by the client, and noted during the site walkover, indicates that the current site is underlain by MOT type one gravel and soft landscaping. As such the existing site is considered to be formed of entirely permeable coverage.

2.3. The surrounding area is predominantly characterised by agricultural land similar to that of the existing site. The south of the site is bound by Turners Hill Road with Butcher's Wood adjacent east. According to Google imagery the site is approximately 260m north west of St. Leonard's C of E Church and 600m west of Turners Hill crossroads.

Figure 2: Site Location (Source: Google)

Figure 3: View of the Site from Turners Hill Road (Source: Google)

Site Topography:

2.4. A topographical contour map has been provided by the client for inclusion within the report. This shows that levels within the southern field, proposed to be developed, range between 150.00mAOD, relating to land along the north eastern boundary, and 169.00mAOD in the south east, associated with land adjacent to Turner Hill Road.

2.5. A site reconnaissance confirmed that the site slopes steeply from south eastern corner towards north eastern periphery.

2.6. The area of land proposed to be developed in the centre of the site is recorded as having an approximate elevation of 164.00mAOD (refer to report appendix).

Existing Ground Conditions:

2.7. The 1:50,000 BGS map shows the site to be located directly upon the bedrock geology of Ardingly Sandstone Formation - Sandstone. This strata was formed during the Valanginian Age.

2.8. According to BGS mapping the site is not underlain by superficial geological deposits.

2.9. The soil type taken from the UK soils website shows deep intermediate Sandstone with a Sand to Sandy Loam texture.

2.10. There are no nearby BGS borehole logs.

2.11. Published Environment Agency Groundwater Vulnerability mapping shows that the site is not located within an area classified as a Groundwater Source Protection Zone.

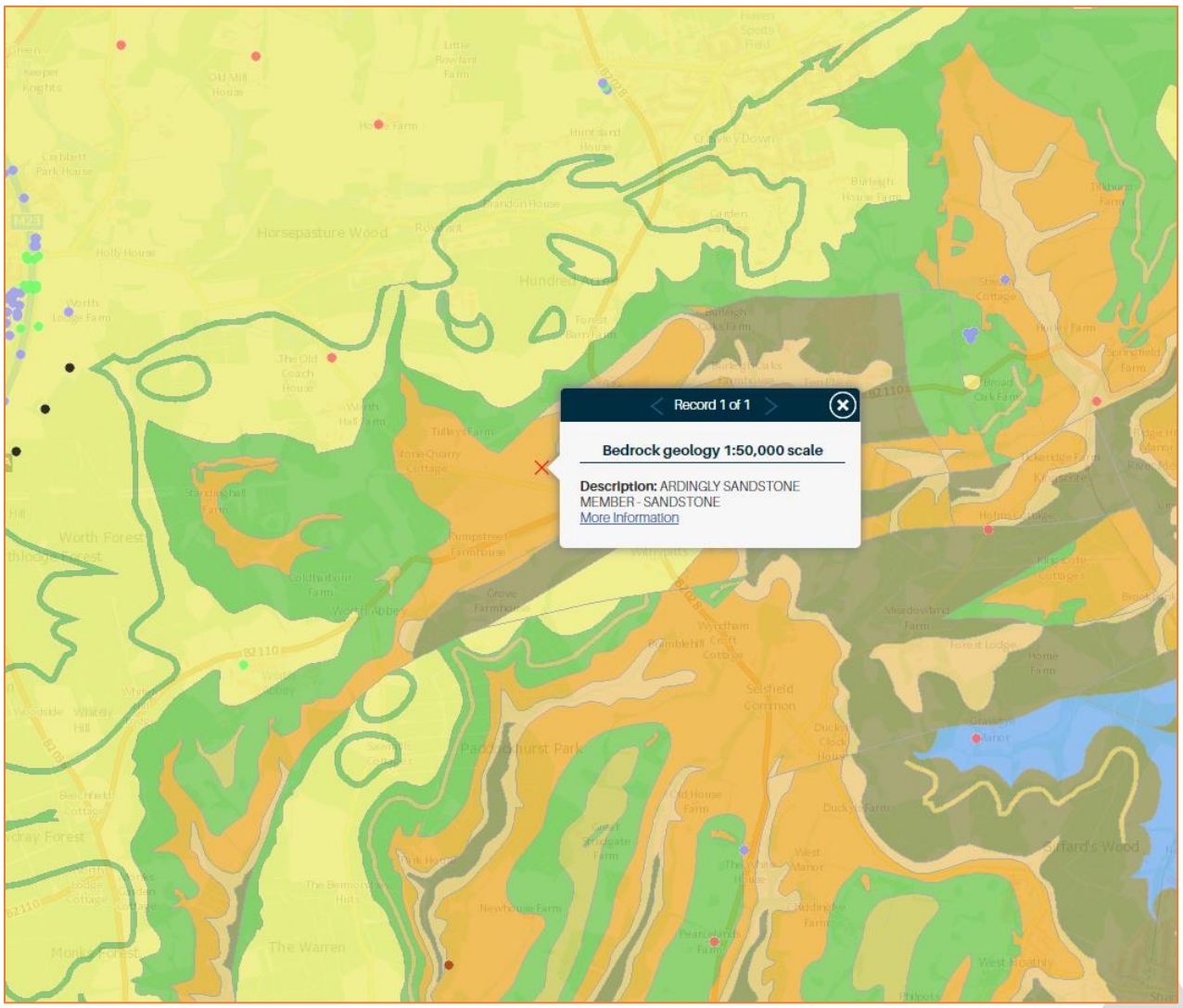


Figure 4: BGS Bedrock Geology (Source: BGS)

Figure 5: Soil Map (Source: UK Soils, BGS)

Nearby Watercourses / Drainage Features:

2.12. The client has confirmed that two drainage ditches are located within the red outline application boundary.

2.13. Both ditches reportedly flow from west to east transecting the centre north and north of the site. Given that both ditches are located within the red outline boundary they are considered within the client's ownership. Therefore it is possible to discharge to these features without third party permissions.

2.14. Following a site reconnaissance, it is considered most appropriate to discharge any post development runoff to the western section of the drainage ditch which transects the centre north of the site. Channel dimensions have not been measured however, given the topography of the site gravity connection is considered feasible.

Figure 6: Photos of the Downstream Section of the Centre North Drainage Ditch (Source: Unda Consulting Ltd)

Existing Drainage:

2.15. Given the current use of the site, and the information provided by the client, it can confidently be assumed that there are no formal surface water connections to Thames Water assets from within the red application boundary.

2.16. Surface water generated within the existing site boundary is considered likely to currently discharge at an uncontrolled rate to ground, and via overland/subsurface flow into the two aforementioned drainage ditches.

3. Development Proposals:

Proposed Development:

3.1. The proposed planning application is for *Outline planning application for a single 'chapel' crematorium with abated cremator and natural burial site with associated access, car parking, landscaping and drainage*.

3.2. Post development the total area of newly introduced impermeable surfacing will amount to approximately 6279m^2. This comprises the crematorium roof area (888m^2), 112 space car park and access road (4481m^2) and, paved areas (910m^2).

3.3. In light of this, SuDS sizing within the strategy has been based on all newly introduced impermeable surfacing (6279m^2) comprising post development built footprint, car park, access road and footpath.

Figure 7: Proposed Development Plan (Source: Indigo Landscape Architects Limited)

Vulnerability to flooding:

3.4. The NPPF classifies property usage by vulnerability to flooding.

3.5. The site is currently occupied by vacant land.

3.6. Post development the site will be utilised as a crematorium. Although crematoria are not specifically identified within Table 2: Flood risk vulnerability classification of the guidance to NPPF, it is considered that the development could be described as a non–residential institution not included in "more vulnerable", or an assembly use, both of which are classed as "Less Vulnerable", and are considered appropriate in Flood Zone 1.

4. Flood Risk Assessment:

Flood Zones:

4.1. Within planning, Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's website.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Table 1: Environment Agency Flood Map for Planning (Rivers and Sea) (Source: EA)

4.2. The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

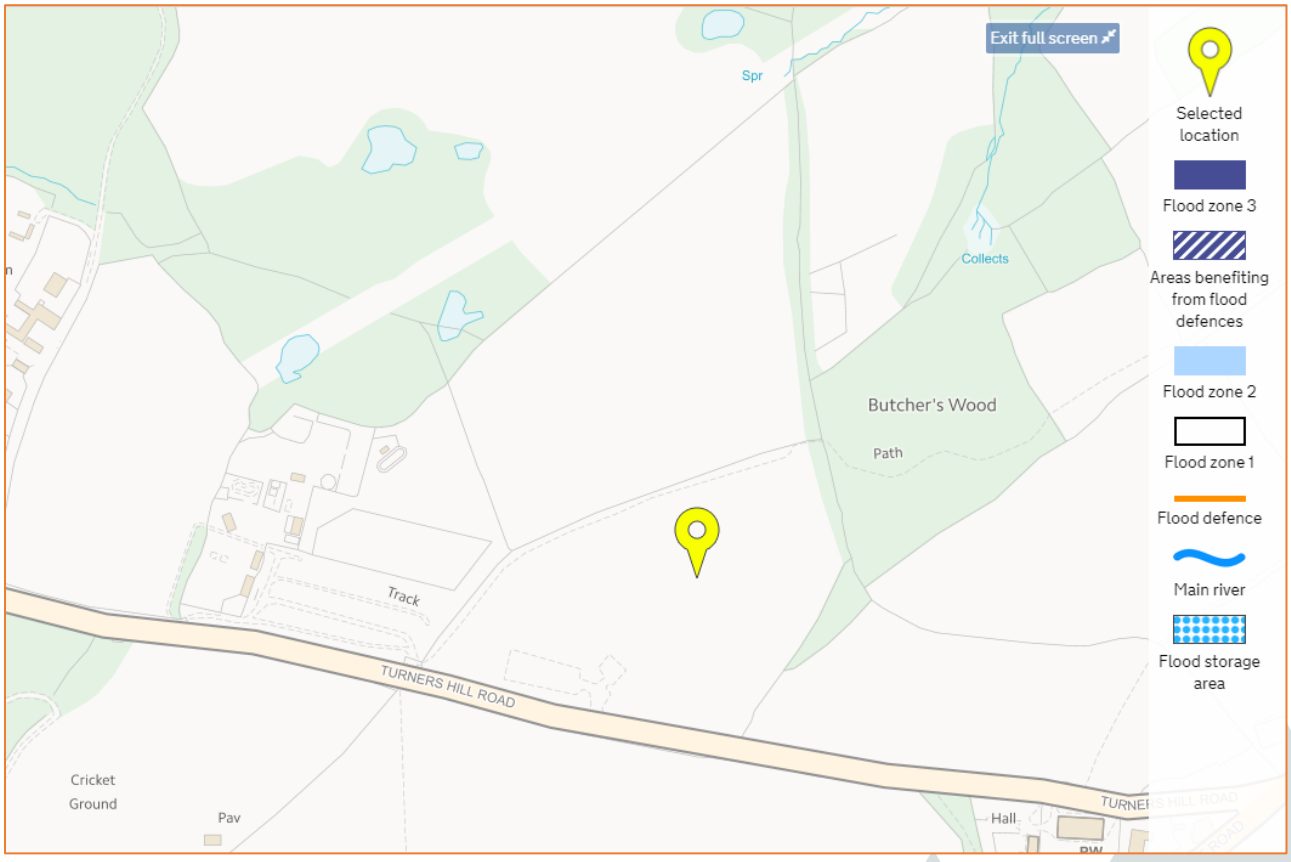


Figure 8: Environment Agency Flood Map for Planning (Rivers and Sea) (Source: EA)

4.3. The site and surrounding area are located entirely within Flood Zone 1 (Low Probability), defined as land having less than a 1:1000 annual probability of fluvial or tidal flooding.

Fluvial:

4.4. In light of the above, the site is considered to be at very low risk of river flooding.

Tidal:

4.5. Due to the site topography and distance to the nearest coast/ tidal watercourse, the risk of tidal flooding is considered to be very low.

Pluvial:

4.6. Pluvial (surface water) flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

4.7. In 2013 the EA, working with Lead Local Flood Authorities (LLFAs), produced an updated Flood Map for Surface Water. It is considered to represent a significant improvement on the previous surface water flood maps available, both in terms of method and representation of the risk of flooding. The modelling techniques and data used are considerably improved, and also incorporated locally produced mapping where this is available to represent features best modelled at a local scale.

4.8. The Flood Map for Surface Water assesses flooding scenarios as a result of rainfall with the following chance of occurring in any given year (annual probability of flooding is shown in brackets):

- 1:30 (3.3%)
- 1:100 (1%)
- 1:1000 (0.1%)

4.9. The mapping below shows the Risk of Flooding from Surface Water centred on the site. Please note that the EA do not consider this information suitable to be used to identify the risk to individual properties or sites. It is useful to raise awareness in areas which may be at risk and may require additional investigation.

4.10. The EA Risk of Flooding from Surface Water Map suggests that the majority of the site, including the proposed crematorium building, lies within an area of "Very Low" risk of flooding from surface water.

4.11. However, the Environment Agency have modelled two swathes of "Low" to "High" risk surface water pooling along the eastern and northern site boundary. Comparison of modelled extents with the topographic contour map indicates that the areas of risk correlate with the lowest lying land; approximately 10m lower than the proposed crematorium ground elevation.

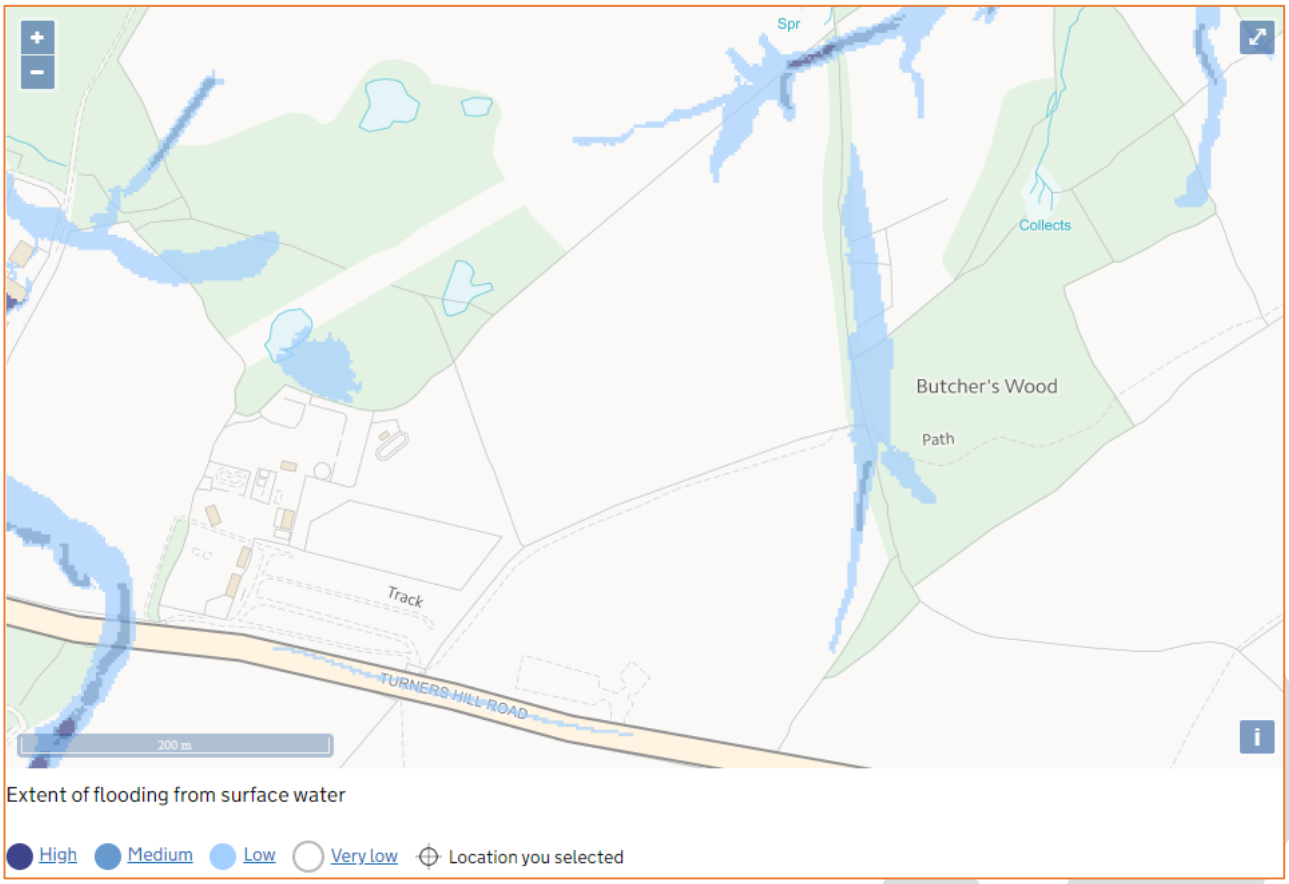


Figure 9: Extract from Environment Agency RoFSW map (Source: EA)

Groundwater:

4.12. Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

4.13. Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

4.14. No information has been provided which indicates that the site is at risk of groundwater flooding.

Sewer:

4.15. Sewer flooding occurs when the sewer network cannot cope with the volume of water that is entering it. It is often experienced during times of heavy rainfall when large amounts of surface water overwhelm the sewer network causing flooding. Temporary problems such as blockages, siltation, collapses and equipment or operational failures can also result in sewer flooding.

4.16. All Water Companies have a statutory obligation to maintain a register of properties/areas which have reported records of flooding from the public sewerage system, and this is shown on the DG5 Flood Register. This includes records of flooding from foul sewers, combined sewers and surface water sewers which are deemed to be public and therefore maintained by the Water Company. The DG5 register records of flood incidents resulting in both internal property flooding and external flooding incidents. Once a property is identified on the DG5 register, water companies can typically put funding in place to address the issues and hence enable the property to be removed from the register. It should be noted that flooding from land drainage, highway drainage, rivers/watercourses and private sewers is not recorded within the register.

4.17. Having reviewed Local Authority documentation there is no indication that the site has ever been subject to sewer surcharge flooding.

Other Sources:

4.18. The EA Risk of Flooding from Reservoirs Map suggests that the site does not lie within the "Maximum extent of flooding" from reservoir failure. Despite this, the EA advise on their website that reservoir flooding is extremely unlikely. All major reservoirs have to be inspected by specialist dam and reservoir Engineers. These inspections are monitored and enforced by the EA themselves. The risk to the site from reservoir flooding is therefore minimal and is far lower than that relating to the potential for fluvial flooding to occur.

4.19. No further information has been provided to suggest the site is susceptible to from the failure of reservoirs, canals or other artificial infrastructure from the risk of flooding.

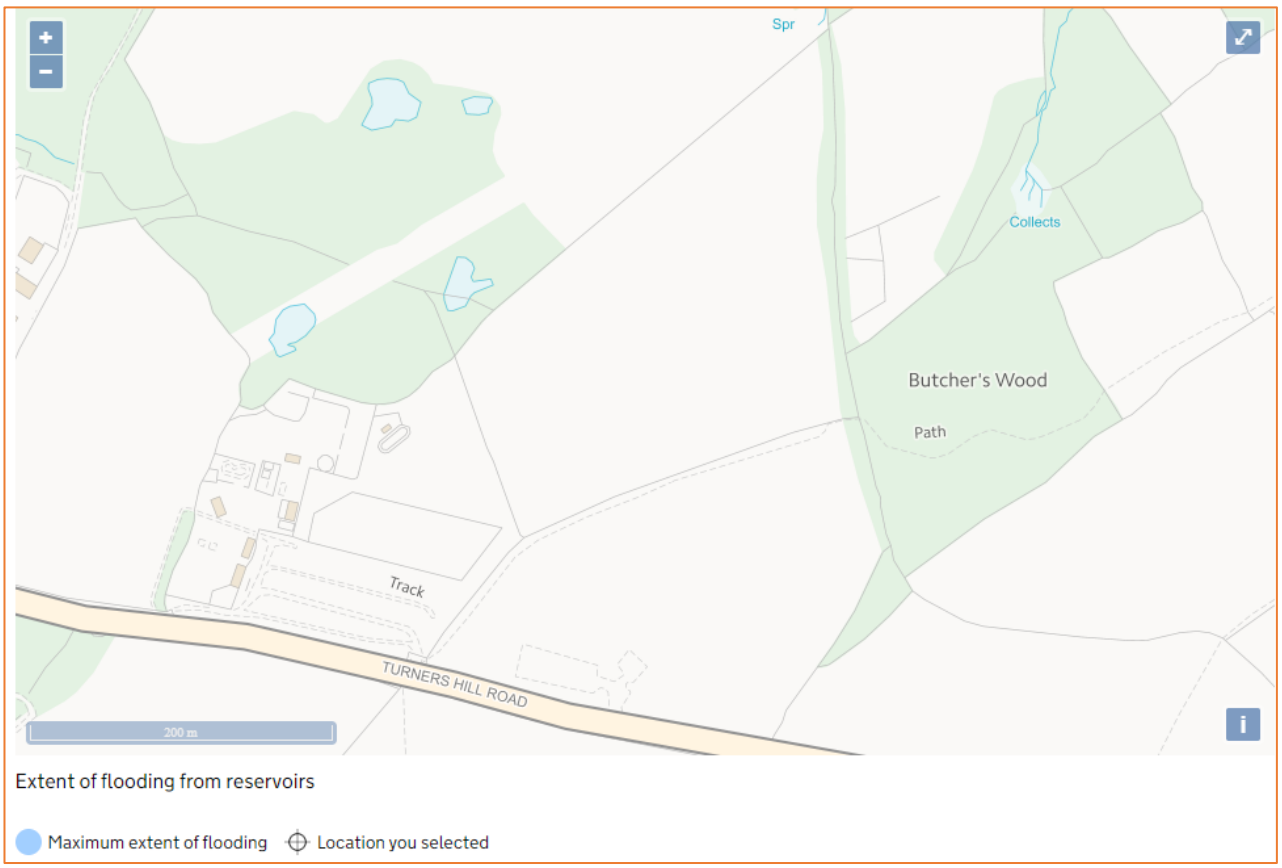


Figure 10: Environment Agency Reservoir Flood Map (Source: EA)

5. Surface Water Drainage Strategy:

5.1. In order to mitigate flood risk posed by post development runoff, adequate control measures will need to be considered within the site. This will ensure that surface water runoff is dealt with at source and flood risk is not increased elsewhere.

Drainage Hierarchy:

5.2. The drainage strategy for the site has been prepared according to the drainage discharge hierarchy from *CIRIA C753 The Suds Manual*, as follows:

- Infiltration to the maximum extent that is practical;
- Discharge to surface waters;
- Discharge to surface water sewer.

Infiltration Potential:

5.3. The 1:50,000 BGS map shows the site to be located directly upon the bedrock geology of Ardingly Sandstone Formation.

5.4. Despite being located directly upon Ardingly Sandstone Formation, the site is proposed to be utilised as a crematorium and burial ground.

5.5. Due to the existing permitted and proposed usage as a burial site infiltration to ground is not considered suitable.

5.6. In light of the above, an attenuation based strategy is proposed.

Proposed Discharge Rate:

5.7. Existing greenfield runoff rates for the southern field (3.939ha) have been calculated as 19.1 l/s for the 1:1 annual runoff event, 50.9 l/s for the 1:30 year event and 71.7 l/s for the 1:100 year event. Refer to enclosed calculations.

5.8. It is proposed that runoff from all SuDS features will be gradually discharged to the existing drainage ditch some 55m north of the proposed crematorium, via a new outfall connection (refer to proposed drainage layout in the report appendix).

5.9. Outflow from the proposed SuDS systems to the drainage ditch will be limited to greenfield runoff rate.

5.10. The greenfield runoff rates calculated for the southern field (refer to 5.6) are relatively high. Therefore, it is proposed to limit post development discharge to the greenfield runoff rate for all newly introduced impermeable areas (6279m^2).

5.11. Existing greenfield runoff rates for the newly introduced impermeable areas (6279m^2) have been calculated as 3.0 l/s for the 1:1 annual runoff event, 8.1 l/s for the 1:30 year event and 11.4 l/s for the 1:100 year event. Refer to enclosed calculations.

5.12. As such, discharge from the site will be limited to 3.0 l/s for all storms up to, and including, the 1:100 year + 40% climate change event via a hydrobrake. The hydrobrake will be installed in an inspection chamber within the site.

Areas of Focus:

5.13. The proposed SuDS features will be of sufficient size to ensure attenuation of all post development surface water runoff generated during the 1 in 100 year plus climate change event.

5.14. Key stakeholders would like to incorporate a pond within the proposed scheme to offer both amenity and biodiversity benefits. Given the preferred location of the pond, it is proposed that all post development roof runoff from the crematorium building will be directed and stored within a pond.

5.15. Post development surface water runoff generated from the car park, access road and paved areas will be managed via tanked permeable paving SuDS system located beneath the access road and car park.

5.16. The following section details the surface water attenuation volumes required to ensure that no flooding occurs at the site during the 1 in 100 year plus (40%) climate change event.

Proposed SuDS

Tanked Permeable Paving:

5.17. The proposed car park and access road will be surfaced in tanked permeable pavement amounting to approximately 4481m^2.

5.18. Runoff from these areas will be collected and stored within a 0.4m gravel sub-base beneath the Tanked Permeable Paving surface. Check dams will be utilised within the subbase where the topography is on a gradient, so as to maximise storage potential. Water within the gravel sub-base will be discharged to the existing drainage ditch some 55m north of the crematorium via Hydro-Brake flow control device.

5.19. Surface water runoff from paved areas (910m^2) will also be directed to the area of Tanked Permeable Paving.

5.20. Preliminary calculations indicate that tanked permeable pavement with dimensions of 4481m^2 x 0.4m deep x 0.3 (voids) will be sufficient to accommodate all runoff from 5391m^2 of impermeable areas arising from the critical 1:100 year + 40% climate change event. Refer to enclosed calculations and Plan 89699-01 [*Proposed Drainage Layout*].

5.21. Preliminary calculations indicated that some 409.6m^3 of storage is required to attenuate the runoff for all storms up to and including the 1:100 year + 40% climate change event.

5.22. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

Attenuation Basin:

5.23. Runoff from the proposed crematorium roof area (888m^2) will be directed into an attenuation basin Sustainable Urban Drainage System (SUDS) situated to the south of the proposed building. The main purpose of the pond will be to attenuate all surface water generated from roof runoff; however it will also provide ecological and aesthetic benefits.

5.24. Runoff from proposed roof area (888m^2) will be connected directly to an attenuation basin located to the south of the building.

5.25. Attenuated water within the pond will be discharged to the existing drainage ditch some 55m north of the crematorium via Hydro-Brake flow control device.

5.26. Preliminary calculations indicate that an attenuation basin with dimensions of 331m^2 x 1.4m deep will be sufficient to accommodate all runoff from 888m^2 of impermeable surfacing arising from the critical 1:100 year + 40% Climate Change event.

5.27. The pond will provide an attenuation volume of 65.5m^3 for surface water runoff from the development. The maximum attenuated water depth within the pond will be 0.337m.

5.28. The basin will retain a permanent water level at a depth of 0.5m; this can be utilised to provide biodiversity enhancement as part of the development and contribute towards the POS of natural and semi natural greenspace provision. All attenuation required for management of runoff from the catchment draining to the pond will be located above the permanent water volume but below the required 0.5m freeboard.

5.29. The basin design includes 0.563m of freeboard, above the maximum water level. This will mitigate residual flood risk from blockage or exceedance storm events.

5.30. Refer to enclosed calculations and Plan 89699-01 [*Proposed Drainage Layout*].

5.31. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

Water Quality:

5.32. Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 The SuDS Manual:

Step 1 – Allocate suitable pollution hazard indices for the proposed land use.
Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

5.33. The highest pollution hazard level for the proposed land use is Low (residential car parks and low trafficked roads). The pollution hazard indices for this land use are shown in Table 2 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.5	0.4	0.4

Table 2: Pollution Hazard Indices for the proposed site (from Table 26.2 of CIRIA C753 The SuDS Manual)

5.34. All SuDS components are assessed for their effectiveness in pollutant removal prior to discharge to sewer in Table 26.3 in CIRIA C753 The SuDS Manual. The pollution mitigation indices for permeable pavements are show in Table 3 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.7	0.6	0.7

Table 3: Pollution Mitigation Indices for permeable pavements (from Table 26.3 of CIRIA C753 The SuDS Manual)

5.35. The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. Therefore, permeable pavements will provide sufficient water quality treatment prior to discharge to ground.

5.36. Runoff from roof areas is considered to be uncontaminated and does not warrant any form of treatment process to improve water quality. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

Design Exceedance:

5.37. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

Adoption and Maintenance:

5.38. All proposed SuDS features will be maintained privately by the future land owner.

5.39. A draft Maintenance Schedule is outlined in the Table below.

Tanked Permeable Paving

5.40. Permeable surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capability. A brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper, should be used and the sweeping regime should be as follows:

1. End of winter (April) – to collect winter debris.
2. Mid-summer (July/August) – to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

5.41. If reconstruction is necessary, the following procedure should be followed:

1. Lift surface layer and laying course.
2. Remove any geotextile filter layer.
3. Inspect sub-base and remove, wash and replace if required.
4. Renew any geotextile layer.
5. Renew laying course, jointing material and concrete block paving.

5.42. Materials removed from the voids or the layers below the surface of the paving may contain hazardous substances such as heavy metals and hydrocarbons which may need to be disposed of as controlled waste.

Attenuation Basin

5.43. It is not anticipated that the attenuation basin will require a rigorous maintenance regime as long as silt is removed on a regular basis. A suitable maintenance regime for the attenuation basin would be as follows:

1. Monthly – removal of litter, mowing grass & check outlet for blockages.
2. Annually – sediment removal and tidy dead plant growth.
3. As required – repair inlets and outlets and reinstate design levels. Refer to Table 5, below

Pipework and Catchpits

5.44. It is not envisaged that silt build up within the pipework systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits on a regular basis. Notwithstanding this, a suitable maintenance regime for the systems will comprise of routine inspection (every three months) and silt removal (as necessary).

Drainage Element	Maintenance Requirement	Frequency
Gutters & downpipes	▪ Inspect and remove silt/ debris	▪ To be inspected every three months and silt/ debris removed as necessary.
Inspection Chambers and Catch Pits and Flow Controls	▪ Inspect and remove silt	▪ To be inspected every three months and silt/ debris removed as necessary. Flow control to be checked for blockages.
Tanked Permeable Paving	▪ Sweeping/vacuuming to remove build-up of silt or other sediments	▪ Three times a year or as necessary
	▪ Removal of weeds ▪ Replacement of cracked paving blocks ▪ Remedial work to cracks and depressions	▪ As required

Table 4: Suggested Maintenance Regime for Elements of the Drainage Infrastructure

Note: In addition to the above maintenance requirements, it is recommended that all drainage elements are inspected:

- Following the first storm event;
- Monthly for the first 3 months following commissioning.

Maintenance Schedule	Required Actions	Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – landscaped areas and access routes	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly, at start, then as requested
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	Annually or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Repair or rehabilitate inlets and outlets	As required
Monitoring	Inspect inlets, outlets and overflows for blockages and clear if required.	Monthly
	Inspect bank slopes, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems of silt accumulation; establish appropriate silt removal frequencies	Half Yearly

Table 5: Attenuation Basin Maintenance Requirements

6. Flood Risk Mitigation:

Physical Design Measures:

6.1. The NPPF requires residential finished floor levels to be 300mm above the modelled 1:100 year flood level with allowance for Climate Change.

6.2. The proposed development is for commercial use and the site lies entirely within Flood Zone 1 according to the EA Flood Map for planning (Rivers and the Sea), thus completely outside Flood Zone 2 and Flood Zone 3 extents.

6.3. Additionally, according to Environment Agency mapping, the main area of the site has been identified at "Very Low" Risk of Flooding from Surface Water.

6.4. Despite this, it is recommended that the finished internal floor level of the proposed crematorium is set to standard building thresholds.

Safe Escape:

6.5. The NPPF requires a route of safe escape for all residents and users to be provided from residential properties in Flood Zone 3. Safe escape is usually defined as being though slow moving flood water no deeper than 25cm.

6.6. The entire development site, and surrounding area, are located wholly within Flood Zone 1 therefore in accordance with NPPF guidance a route of safe escape is not required.

Flood Warning:

6.7. The EA is responsible for issuing flood warnings. Flood warnings are issued to the emergency services and local authorities. Both private individuals and organisations can sign-up to receive warnings via phone, text or email. This system of receiving warnings is currently voluntary.

6.8. Advice regarding severe flood warnings will generally be given during weather forecasts on local radio and TV. In the case of extreme events, warnings can also be disseminated via door to door visits by the police or locally appointed flood wardens.

6.9. The EA issue flood warnings to specific areas when flooding is expected. It is recommended that the applicant registers online with the free Environment Agency Floodline Warnings/Alert Direct service at https://fwd.environment-agency.gov.uk/app/olr/register to receive flood warnings by phone, text or email.

6.10. The flood warning service has three types of warnings that will help you prepare for flooding and take action:

Flood Warning	Flood Alert	Flood Warning	Severe Flood Warning
			
What it means?	Flooding is possible. Be prepared.	Flooding is expected. Immediate action required.	Severe flooding. Danger to life.
When it's used?	Two hours to two days in advance of flooding.	Half an hour to one day in advance of flooding.	When flooding poses a significant threat to life.
What to do?	Be prepared to act on your flood plan. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast on our website.	Move family, pets and valuables to a safe place. Turn off gas, electricity and water supplies if safe to do so. Put flood protection equipment in place.	Stay in a safe place with a means of escape. Be ready should you need to evacuate from your home. Co-operate with the emergency services. Call 999 if you are in immediate danger.

Table 6: Flood Warnings

Flood Plan:

6.11. It is recommended that the applicant and future owners and occupiers of the property prepare a flood plan to protect life and property during a flood event:

Before a flood:

- Find out if you are at risk of flooding.
- Find out if you can receive flood warnings.
- Prepare and keep a list of all your important contacts to hand or save them on your mobile phone.
- Think about what items you can move now and what you would want to move to safety during a flood such as cars, furniture, and electrical equipment.
- Know how to turn off gas, electricity and water supplies.
- Prepare a flood kit of essential items and keep it handy. It can include copies of important documents, a torch, a battery-powered or wind-up radio, blankets and warm clothing, waterproofs, rubber gloves and a first aid kit including all essential medication.
- Consider buying flood protection products such as flood boards and airbrick covers to help reduce flood water getting into your property.

During a flood:

- Tune into your local radio station on a battery or wind-up radio.
- Grab your flood kit - if you have prepared one.
- Collect blankets, torch, first aid kit, medication and food.
- Move important documents, personal items, valuables, and lightweight belongings upstairs or to high shelves.
- Raise large items of furniture, or put them in large bags if you have them.
- Move people, outdoor belongings and cars to higher ground.
- Switch off water, gas and electricity at mains when water is about to enter the property. Do not touch sources of electricity when standing in water.
- Fit flood protection products, if you have them, for example flood boards, airbrick covers, sandbags.
- Put plugs in sinks. Weigh them down with a pillowcase or plastic bag filled with soil.
- If you do not have non-return valves fitted, plug water inlet pipes with towels or cloths.
- Move site users to a high place with a means of escape.
- Listen to the advice of the emergency service and evacuate if told to do so.
- Avoid walking or driving through flood water. Six inches of fast-flowing water can knock over an adult and two feet of water can move a car.

After a flood:

- If you have flooded, contact your insurance company as soon as possible.
- Take photographs and videos of your damaged property as a record for your insurance company.
- If you don't have insurance, contact your local authority for information on grants and charities that may help you.
- Flood water can contain sewage, chemicals and animal waste. Always wear waterproof outerwear, including gloves, wellington boots and a face mask.
- Have your electrics, central heating and water checked by qualified engineers before switching them back on.

Fluvial floodplain storage:

6.12. The NPPF requires that where development is proposed in undefended areas of floodplain, which lie outside of the functional floodplain, the implications of ground raising operations for flood risk elsewhere needs to be considered. Raising existing ground levels may reduce the capacity of the floodplain to accommodate floodwater and increase the risk of flooding by either increasing the depth of flooding to existing properties at risk or by extending the floodplain to cover properties normally outside of the floodplain. Flood storage capacity can be maintained by lowering ground levels either within the curtilage of the development or elsewhere in the floodplain, in order to maintain at least the same volume of flood storage capacity within the floodplain.

6.13. In undefended tidal areas, raising ground levels is unlikely to impact on maximum tidal levels so the provision of compensatory storage should not be necessary.

6.14. For development in a defended flood risk area, the impact on residual flood risk to other properties needs to be considered. New development behind flood defences can increase the residual risk of flooding if the flood defences are breached or overtopped by changing the conveyance of the flow paths or by displacing flood water elsewhere. If the potential impact on residual risk is unacceptable then mitigation should be provided.

6.15. The proposed development is situated entirely within Flood Zone 1 when using the Environment Agency Flood Map for Planning (Rivers and Sea). No fluvial floodwater would be displaced by the proposed development.

7. Discussion and Conclusions:

7.1. This Flood Risk Assessment and Surface Water Drainage Strategy has been prepared by Unda Consulting Limited on behalf of Hartmires Investment Ltd, in support of a planning application for *Outline planning application for a single 'chapel' crematorium with abated cremator and natural burial site with associated access, car parking, landscaping and drainage*. The development is proposed at Land to the north of Turners Hill Road, Turners Hill, West Sussex RH10 4PB. This report assesses flood risk and surface water drainage for the proposed development.

7.2. The site is currently occupied by two fields with a car park in the south, underlain by MOT type one gravel. According to plans provided by the client a public footpath transects the centre of the site along with two drainage ditches. Following a site reconnaissance, the application boundary was found to be largely underlain by grassland with the site sloping steeply towards the north east.

7.3. The site is approximately 68253m^2 in size and accessed from the south via gravel junction, off Turners Hill Road. Information provided by the client, and noted during the site walkover, indicates that part of the current site is underlain by MOT type one gravel and soft landscaping. As such the existing site is considered to be formed of entirely permeable coverage.

7.4. A topographical contour map has been provided by the client for inclusion within the report. This shows that levels within the southern field, proposed to be developed, range between 150.00mAOD, relating to land along the north eastern boundary, and 169.00mAOD in the south east, associated with land adjacent to Turner Hill Road.

7.5. A site reconnaissance confirmed that the site slopes steeply from south eastern corner towards north eastern periphery.

7.6. The area of land proposed to be developed in the centre of the site is recorded as having an approximate elevation of 164.00mAOD (refer to report appendix).

7.7. The proposed planning application is for *Outline planning application for a single 'chapel' crematorium with abated cremator and natural burial site with associated access, car parking, landscaping and drainage*.

7.8. Post development the total area of newly introduced impermeable surfacing will amount to approximately 6279m^2. This comprises the crematorium roof area (888m^2), 112 space car park and access road (4481m^2) and, paved areas (910m^2).

7.9. The 1:50,000 BGS map shows the site to be located directly upon the bedrock geology of Ardingly Sandstone Formation - Sandstone. The soil type taken from the UK soils website shows deep intermediate Sandstone with a Sand to Sandy Loam texture.

7.10. There are no nearby BGS borehole logs.

7.11. Published Environment Agency Groundwater Vulnerability mapping shows that the site is not located within an area classified as a Groundwater Source Protection Zone.

7.12. Given the current use of the site, and the information provided by the client, it can confidently be assumed that there are no formal surface water connections to Thames Water assets from within the red application boundary.

7.13. Surface water generated within the existing site boundary is considered likely to currently discharge at an uncontrolled rate to ground, and via overland/subsurface flow into the two aforementioned drainage ditches.

Flood Risk Discussion

7.14. The site and surrounding area are located entirely within Flood Zone 1 (Low Probability), defined as land having less than a 1:1000 annual probability of fluvial or tidal flooding. In light of this, the site is considered to be at very low risk of both river and tidal flooding.

7.15. The EA Risk of Flooding from Surface Water Map suggests that the majority of the site, including the proposed crematorium building, lies within an area of "Very Low" risk of flooding from surface water.

7.16. Despite the site being located entirely in Flood Zone 1 and at low risk of surface water flooding, it is recommended that the finished internal floor level of the proposed crematorium is set to standard building thresholds.

7.17. No information has been provided which indicates that the site is at risk of groundwater or sewer surcharge flooding.

Surface Water Drainage Discussion

7.18. Despite being located directly upon Ardingly Sandstone Formation, the site is proposed to be utilised as a crematorium and burial ground.

7.19. Due to the existing permitted and proposed usage as a burial site infiltration to ground is not considered suitable.

7.20. In light of the above, an attenuation based strategy is proposed.

7.21. Existing greenfield runoff rates for the newly introduced impermeable areas (6279m^2) have been calculated as 3.0 l/s for the 1:1 annual runoff event, 8.1 l/s for the 1:30 year event and 11.4 l/s for the 1:100 year event. Refer to enclosed calculations.

7.22. It is proposed that runoff from all SuDS features will be gradually discharged to the existing drainage ditch some 55m north of the proposed crematorium, via a new outfall connection (refer to proposed drainage layout in the report appendix).

7.23. Outflow from the proposed SuDS systems to the drainage ditch will be limited to greenfield runoff rate.

7.24. Discharge from the site will be limited to 3.0 l/s for all storms up to, and including, the 1:100 year + 40% climate change event via a hydrobrake. The hydrobrake will be installed in an inspection chamber within the site.

7.25. The proposed SuDS features will be of sufficient size to ensure attenuation of all post development surface water runoff generated during the 1 in 100 year plus climate change event.

7.26. Key stakeholders would like to incorporate a pond within the proposed scheme to offer both amenity and biodiversity benefits. Given the preferred location of the pond, it is proposed that all post development roof runoff from the crematorium building will be directed and stored within a pond.

7.27. Post development surface water runoff generated from the car park, access road and paved areas will be managed via tanked permeable paving SuDS system located beneath the access road and car park.

7.28. The following section details the surface water attenuation volumes required to ensure that no flooding occurs at the site during the 1 in 100 year plus (40%) climate change event.

Tanked Permeable Paving

7.29. The proposed car park and access road will be surfaced in tanked permeable pavement amounting to approximately 4481m^2.

7.30. Runoff from these areas will be collected and stored within a 0.4m gravel sub-base beneath the Tanked Permeable Paving surface. Check dams will be utilised within the subbase where the topography is on a gradient, so as to maximise storage potential. Water within the gravel sub-base will be discharged to the existing drainage ditch some 55m north of the crematorium via Hydro-Brake flow control device.

7.31. Surface water runoff from paved areas (910m^2) will also be directed to the area of Tanked Permeable Paving.

7.32. Preliminary calculations indicate that tanked permeable pavement with dimensions of 4481m^2 x 0.4m deep x 0.3 (voids) will be sufficient to accommodate all runoff from 5391m^2 of impermeable areas arising from the critical 1:100 year + 40% climate change event. Refer to enclosed calculations and Plan 89699-01 [*Proposed Drainage Layout*].

7.33. Preliminary calculations indicated that some 409.6m^3 of storage is required to attenuate the runoff for all storms up to and including the 1:100 year + 40% climate change event.

Attenuation Basin

7.34. Runoff from the proposed crematorium roof area (888m^2) will be directed into an attenuation basin Sustainable Urban Drainage System (SUDS) situated to the south of the proposed building. The main purpose of the pond will be to attenuate all surface water generated from roof runoff; however it will also provide ecological and aesthetic benefits.

7.35. Runoff from proposed roof area (888m^2) will be connected directly to an attenuation basin located to the south of the building.

7.36. Attenuated water within the pond will be discharged to the existing drainage ditch some 55m north of the crematorium via Hydro-Brake flow control device.

7.37. Preliminary calculations indicate that an attenuation basin with dimensions of 331m^2 x 1.4m deep will be sufficient to accommodate all runoff from 888m^2 of impermeable surfacing arising from the critical 1:100 year + 40% Climate Change event.

7.38. The pond will provide an attenuation volume of 65.5m^3 for surface water runoff from the development. The maximum attenuated water depth within the pond will be 0.337m.

7.39. The basin will retain a permanent water level at a depth of 0.5m; this can be utilised to provide biodiversity enhancement as part of the development and contribute towards the POS of natural and semi natural greenspace provision. All attenuation required for management of runoff from the catchment draining to the pond will be located above the permanent water volume but below the required 0.5m freeboard.

7.40. The basin design includes 0.563m of freeboard, above the maximum water level. This will mitigate residual flood risk from blockage or exceedance storm events.

7.41. The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. Therefore, permeable pavements will provide sufficient water quality treatment prior to discharge to ground.

7.42. Runoff from roof areas is considered to be uncontaminated and does not warrant any form of treatment process to improve water quality. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

7.43. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

7.44. It is proposed that all SuDS facilities will be maintained privately by the end user. A draft Maintenance Schedule is outlined within the report.

7.45. This drainage strategy has been undertaken in accordance with the principles set out in NPPF. We can conclude that providing the development adheres to the conditions advised above, the said development proposals can be accommodated without increasing flood risk within the locality in accordance with objectives set by Central Government and the EA.

Unda Consulting Limited

August 2020

8. Appendix

A - Plans by others:

- Location Plan – Indigo Landscape Architects Limited;
- Proposed Development Layout Plan with Contour Mapping – Indigo Landscape Architects Limited.

B - MicroDrainage Calculations:

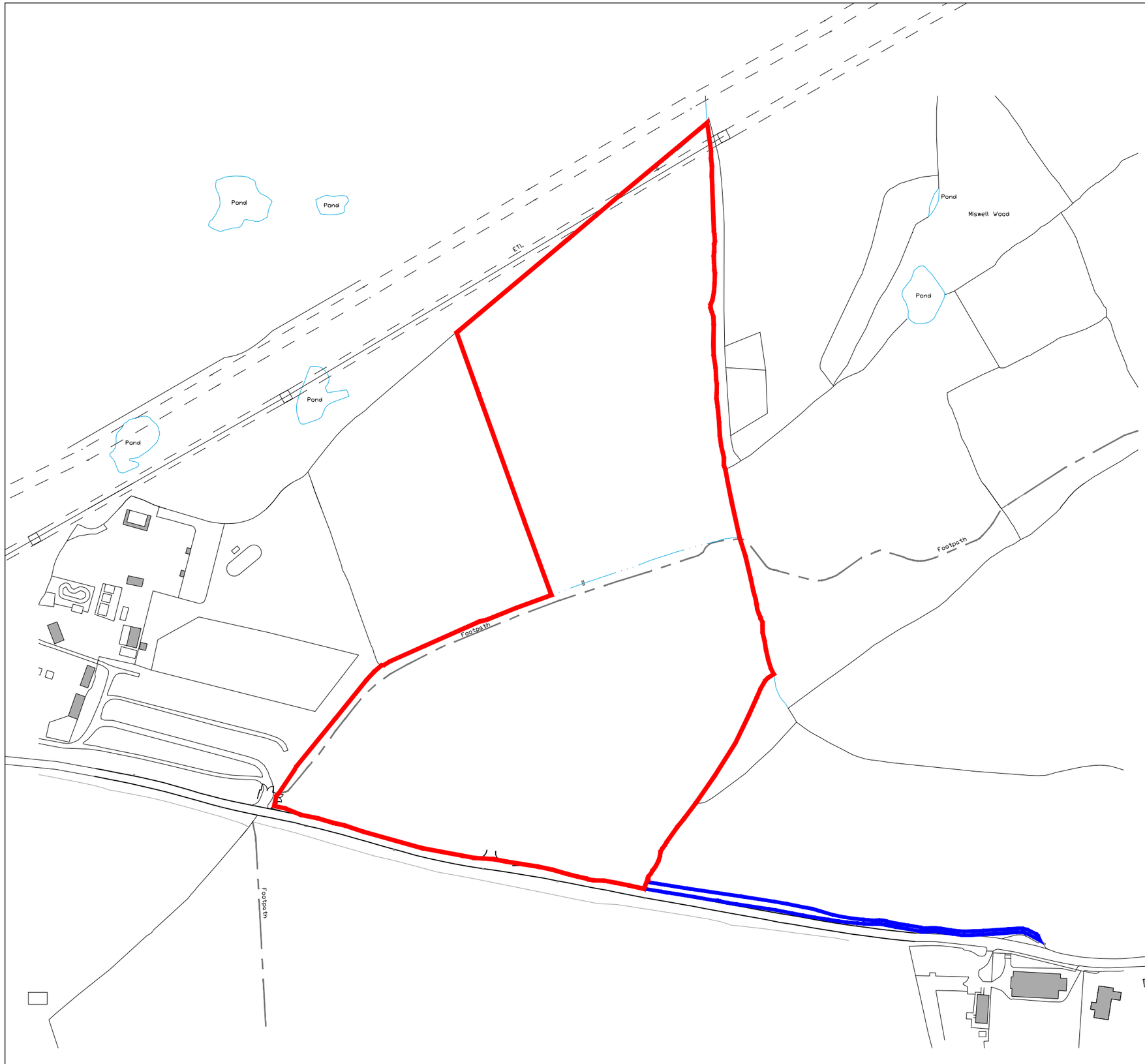
- ICP SUDS Rural Runoff Calculations – Southern Field;
- ICP SUDS Rural Runoff Calculations – Newly Introduced Impermeable Areas Only (6279m^2);
- Tanked Permeable Paving Calculations;
- Attenuation Basin (Pond) Calculations.

C - Plans:

- 1:500 Scale Proposed Drainage Layout [89699-01].

Appendix A

INDIGO



0 20 50 100m

Metres Scale 1:2500

NORTH

rev	description	date	by	chk
-	FIRST ISSUE	2020-06-29	MH	MG

project
TURNERS HILL CREMATORIUM

client
HARTMIRES INVESTMENTS LTD

drawing title
LOCATION PLAN

drawing number	revision	status	scale
917-GA-03	-	PLANNING	1:2500@A3

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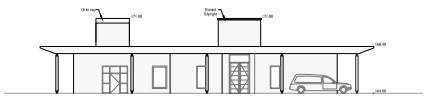
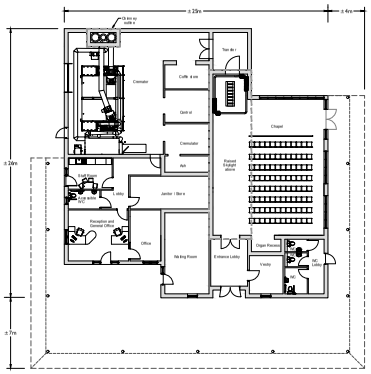
INDIGO LANDSCAPE ARCHITECTS LIMITED



South (Front) Elevation - Illustrative
Scale 1:250@A1

West (Side) Elevation - Illustrative
Scale 1:250@A1



Proposed Ground Floor - Illustrative
Scale 1:250@A1

GENERAL NOTES:
Layout is for illustrative purposes only.

INDIGO

KEY

- Application boundary
- Other land owned by the applicant
- Ex Footpath
- Ex Drainage ditch
- Existing contours (1m)

Setbacks

- 15m standoff to ancient woodland (Butcher's Wood)
- 45.72m (50yd) standoff to highways (Crematoria Act 1902)
- Natural burial 10m from drainage ditches (per DM/15/1035)

Proposed

- Woodland Planting
- Tree
- Hedge
- Informal footpath
- Reinforced grass track
- Scenic Views
- Visibility Splay

Maximum Height Parameters

Crematorium
Raised Skylights / Chimney: ±171.0 AOD
Roof line: ±168.5 AOD

SCALE 1:500@A1
0 5 10 20 30

NORTH

Layout is for illustrative purposes only.

rev	description	date	by	chk
G	Minor revisions	2020-06-29	MH	MG
F	Circulation adjusted	2020-06-17	ZH	MG
E	Notations / dimensions added	2020-06-08	ZH	MG
D	Minor revisions	2020-06-04	ZH	MG
C	Layout revised per team comments	2020-06-03	ZH	MG
B	Layout revised per team comments	2020-06-01	ZH	MG
A	General revisions	2020-05-27	ZH	MG

project
CREMATORIUM - LAND NORTH OF TURNERS HILL RD

client
HARTMIRES INVESTMENTS LTD

drawing title
ILLUSTRATIVE LAYOUT PLAN

drawing number	revision	status	scale
917-SK-01	G	INFORMATION	1:500@A1

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INDIGO LANDSCAPE ARCHITECTS LIMITED

ILLUSTRATIVE PLAN ONLY

Appendix B

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	3.939	Urban	0.000
SAAR (mm)	875	Region Number	Region 6

Results l/s

QBAR Rural	22.5
QBAR Urban	22.5
Q100 years	71.7
Q1 year	19.1
Q30 years	50.9
Q100 years	71.7

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.628	Urban	0.000
SAAR (mm)	875	Region Number	Region 6

Results l/s

QBAR Rural	3.6
QBAR Urban	3.6
Q100 years	11.4
Q1 year	3.0
Q30 years	8.1
Q100 years	11.4

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1379 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	163.552	0.082	0.0	2.1	2.1	109.7	O K
30 min Summer	163.584	0.114	0.0	2.5	2.5	153.9	Flood Risk
60 min Summer	163.620	0.150	0.0	2.5	2.5	201.3	Flood Risk
120 min Summer	163.655	0.185	0.0	2.5	2.5	249.3	Flood Risk
180 min Summer	163.675	0.205	0.0	2.5	2.5	275.5	Flood Risk
240 min Summer	163.687	0.217	0.0	2.5	2.5	292.3	Flood Risk
360 min Summer	163.705	0.235	0.0	2.5	2.5	315.7	Flood Risk
480 min Summer	163.716	0.246	0.0	2.5	2.5	330.2	Flood Risk
600 min Summer	163.723	0.253	0.0	2.5	2.5	339.8	Flood Risk
720 min Summer	163.727	0.257	0.0	2.5	2.5	346.0	Flood Risk
960 min Summer	163.732	0.262	0.0	2.5	2.5	351.8	Flood Risk
1440 min Summer	163.732	0.262	0.0	2.5	2.5	352.4	Flood Risk
2160 min Summer	163.728	0.258	0.0	2.5	2.5	347.0	Flood Risk
2880 min Summer	163.721	0.251	0.0	2.5	2.5	337.2	Flood Risk
4320 min Summer	163.701	0.231	0.0	2.5	2.5	311.1	Flood Risk
5760 min Summer	163.680	0.210	0.0	2.5	2.5	282.5	Flood Risk
7200 min Summer	163.660	0.190	0.0	2.5	2.5	255.1	Flood Risk
8640 min Summer	163.641	0.171	0.0	2.5	2.5	229.8	Flood Risk
10080 min Summer	163.624	0.154	0.0	2.5	2.5	207.0	Flood Risk
15 min Winter	163.563	0.093	0.0	2.3	2.3	125.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	76.6	19
30 min Summer	88.566	0.0	114.9	34
60 min Summer	56.713	0.0	182.4	64
120 min Summer	35.004	0.0	231.3	124
180 min Summer	25.973	0.0	259.3	182
240 min Summer	20.877	0.0	278.2	242
360 min Summer	15.365	0.0	305.9	362
480 min Summer	12.341	0.0	324.5	482
600 min Summer	10.402	0.0	337.5	602
720 min Summer	9.042	0.0	346.2	720
960 min Summer	7.241	0.0	353.8	960
1440 min Summer	5.284	0.0	339.8	1210
2160 min Summer	3.848	0.0	493.1	1576
2880 min Summer	3.068	0.0	516.6	1964
4320 min Summer	2.226	0.0	538.8	2768
5760 min Summer	1.771	0.0	601.5	3576
7200 min Summer	1.483	0.0	618.9	4328
8640 min Summer	1.284	0.0	630.6	5096
10080 min Summer	1.137	0.0	636.2	5840
15 min Winter	131.851	0.0	90.2	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	163.600	0.130	0.0	2.5	2.5	175.3	Flood Risk
60 min Winter	163.640	0.170	0.0	2.5	2.5	228.6	Flood Risk
120 min Winter	163.680	0.210	0.0	2.5	2.5	282.9	Flood Risk
180 min Winter	163.703	0.233	0.0	2.5	2.5	312.8	Flood Risk
240 min Winter	163.717	0.247	0.0	2.5	2.5	332.1	Flood Risk
360 min Winter	163.737	0.267	0.0	2.5	2.5	359.4	Flood Risk
480 min Winter	163.750	0.280	0.0	2.5	2.5	377.0	Flood Risk
600 min Winter	163.760	0.290	0.0	2.5	2.5	389.2	Flood Risk
720 min Winter	163.766	0.296	0.0	2.5	2.5	397.7	Flood Risk
960 min Winter	163.773	0.303	0.0	2.5	2.5	407.3	Flood Risk
1440 min Winter	163.775	0.305	0.0	2.5	2.5	409.6	Flood Risk
2160 min Winter	163.765	0.295	0.0	2.5	2.5	396.9	Flood Risk
2880 min Winter	163.753	0.283	0.0	2.5	2.5	380.5	Flood Risk
4320 min Winter	163.721	0.251	0.0	2.5	2.5	337.9	Flood Risk
5760 min Winter	163.688	0.218	0.0	2.5	2.5	292.6	Flood Risk
7200 min Winter	163.656	0.186	0.0	2.5	2.5	249.9	Flood Risk
8640 min Winter	163.628	0.158	0.0	2.5	2.5	211.9	Flood Risk
10080 min Winter	163.604	0.134	0.0	2.5	2.5	179.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	88.566	0.0	132.3	33
60 min Winter	56.713	0.0	208.0	62
120 min Winter	35.004	0.0	262.0	122
180 min Winter	25.973	0.0	292.4	180
240 min Winter	20.877	0.0	312.6	240
360 min Winter	15.365	0.0	340.9	356
480 min Winter	12.341	0.0	357.9	474
600 min Winter	10.402	0.0	367.3	590
720 min Winter	9.042	0.0	370.5	704
960 min Winter	7.241	0.0	364.2	932
1440 min Winter	5.284	0.0	338.1	1368
2160 min Winter	3.848	0.0	555.1	1728
2880 min Winter	3.068	0.0	580.6	2164
4320 min Winter	2.226	0.0	600.5	3028
5760 min Winter	1.771	0.0	684.0	3864
7200 min Winter	1.483	0.0	705.8	4616
8640 min Winter	1.284	0.0	721.2	5360
10080 min Winter	1.137	0.0	730.1	6048

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.539

Time (mins) From:	To:	Area (ha)
0	4	0.539

Model Details

Storage is Online Cover Level (m) 163.870

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	448.1
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	1244.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	163.470	Cap Volume Depth (m)	0.400

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0084-2500-0400-2500
Design Head (m)	0.400
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	84
Invert Level (m)	163.470
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	2.5
Flush-Flo™	0.133	2.5
Kick-Flo®	0.293	2.2
Mean Flow over Head Range	-	2.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	1.200	4.1	3.000	6.4	7.000	9.6
0.200	2.4	1.400	4.4	3.500	6.8	7.500	9.9
0.300	2.2	1.600	4.7	4.000	7.3	8.000	10.3
0.400	2.5	1.800	5.0	4.500	7.7	8.500	10.6
0.500	2.8	2.000	5.3	5.000	8.1	9.000	10.9
0.600	3.0	2.200	5.5	5.500	8.5	9.500	11.2
0.800	3.4	2.400	5.7	6.000	8.9		
1.000	3.8	2.600	5.9	6.500	9.3		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	163.221	0.121	0.5	21.7	Flood Risk
30 min Summer	163.259	0.159	0.5	28.9	Flood Risk
60 min Summer	163.299	0.199	0.5	36.6	Flood Risk
120 min Summer	163.336	0.236	0.5	44.2	Flood Risk
180 min Summer	163.356	0.256	0.5	48.2	Flood Risk
240 min Summer	163.368	0.268	0.5	50.7	Flood Risk
360 min Summer	163.383	0.283	0.5	54.0	Flood Risk
480 min Summer	163.392	0.292	0.5	55.7	Flood Risk
600 min Summer	163.396	0.296	0.5	56.7	Flood Risk
720 min Summer	163.398	0.298	0.5	57.1	Flood Risk
960 min Summer	163.397	0.297	0.5	56.8	Flood Risk
1440 min Summer	163.389	0.289	0.5	55.3	Flood Risk
2160 min Summer	163.376	0.276	0.5	52.3	Flood Risk
2880 min Summer	163.359	0.259	0.5	48.8	Flood Risk
4320 min Summer	163.326	0.226	0.5	42.1	Flood Risk
5760 min Summer	163.296	0.196	0.5	36.0	Flood Risk
7200 min Summer	163.269	0.169	0.5	30.7	Flood Risk
8640 min Summer	163.245	0.145	0.5	26.1	Flood Risk
10080 min Summer	163.225	0.125	0.5	22.3	Flood Risk
15 min Winter	163.235	0.135	0.5	24.3	Flood Risk
30 min Winter	163.278	0.178	0.5	32.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	20.6	19
30 min Summer	88.566	0.0	27.6	34
60 min Summer	56.713	0.0	37.1	64
120 min Summer	35.004	0.0	45.8	124
180 min Summer	25.973	0.0	50.9	182
240 min Summer	20.877	0.0	54.5	242
360 min Summer	15.365	0.0	60.0	362
480 min Summer	12.341	0.0	64.0	482
600 min Summer	10.402	0.0	67.1	602
720 min Summer	9.042	0.0	69.5	720
960 min Summer	7.241	0.0	72.5	952
1440 min Summer	5.284	0.0	71.6	1168
2160 min Summer	3.848	0.0	91.8	1556
2880 min Summer	3.068	0.0	97.6	1956
4320 min Summer	2.226	0.0	105.8	2724
5760 min Summer	1.771	0.0	113.2	3512
7200 min Summer	1.483	0.0	118.5	4248
8640 min Summer	1.284	0.0	123.0	4936
10080 min Summer	1.137	0.0	126.8	5648
15 min Winter	131.851	0.0	23.1	19
30 min Winter	88.566	0.0	30.8	33

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	163.321	0.221	0.5	41.1	Flood Risk
120 min Winter	163.363	0.263	0.5	49.8	Flood Risk
180 min Winter	163.386	0.286	0.5	54.4	Flood Risk
240 min Winter	163.399	0.299	0.5	57.3	Flood Risk
360 min Winter	163.417	0.317	0.5	61.1	Flood Risk
480 min Winter	163.427	0.327	0.5	63.3	Flood Risk
600 min Winter	163.433	0.333	0.5	64.6	Flood Risk
720 min Winter	163.436	0.336	0.5	65.3	Flood Risk
960 min Winter	163.437	0.337	0.5	65.5	Flood Risk
1440 min Winter	163.428	0.328	0.5	63.6	Flood Risk
2160 min Winter	163.411	0.311	0.5	59.9	Flood Risk
2880 min Winter	163.391	0.291	0.5	55.5	Flood Risk
4320 min Winter	163.341	0.241	0.5	45.1	Flood Risk
5760 min Winter	163.294	0.194	0.5	35.6	Flood Risk
7200 min Winter	163.253	0.153	0.5	27.6	Flood Risk
8640 min Winter	163.219	0.119	0.5	21.2	Flood Risk
10080 min Winter	163.193	0.093	0.5	16.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	56.713	0.0	41.6	62
120 min Winter	35.004	0.0	51.3	122
180 min Winter	25.973	0.0	57.0	180
240 min Winter	20.877	0.0	60.9	240
360 min Winter	15.365	0.0	66.8	356
480 min Winter	12.341	0.0	71.0	472
600 min Winter	10.402	0.0	73.8	586
720 min Winter	9.042	0.0	75.4	700
960 min Winter	7.241	0.0	75.7	922
1440 min Winter	5.284	0.0	72.5	1328
2160 min Winter	3.848	0.0	102.8	1664
2880 min Winter	3.068	0.0	109.2	2132
4320 min Winter	2.226	0.0	118.3	2984
5760 min Winter	1.771	0.0	126.8	3752
7200 min Winter	1.483	0.0	132.8	4472
8640 min Winter	1.284	0.0	137.9	5184
10080 min Winter	1.137	0.0	142.1	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.089

Time (mins) From:	To:	Area (ha)
0	4	0.089

Model Details

Storage is Online Cover Level (m) 163.500

Tank or Pond Structure

Invert Level (m) 163.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	170.0	0.400	230.0	0.401	242.0	0.900	331.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0039-5000-0400-5000
Design Head (m)	0.400
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	39
Invert Level (m)	163.100
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	0.5
Flush-Flo™	0.123	0.5
Kick-Flo®	0.269	0.4
Mean Flow over Head Range	-	0.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	1.200	0.8	3.000	1.2	7.000	1.8
0.200	0.5	1.400	0.9	3.500	1.3	7.500	1.9
0.300	0.4	1.600	0.9	4.000	1.4	8.000	2.0
0.400	0.5	1.800	1.0	4.500	1.5	8.500	2.0
0.500	0.6	2.000	1.0	5.000	1.6	9.000	2.1
0.600	0.6	2.200	1.1	5.500	1.6	9.500	2.1
0.800	0.7	2.400	1.1	6.000	1.7		
1.000	0.7	2.600	1.1	6.500	1.8		

Appendix C

Proposed Hydro Brake flow control device to limit discharge from the tanked permeable paving to a maximum of 2.5l/s
IL: 163.47

Proposed Hydro Brake flow control device to limit discharge from the pond to a maximum of 0.5l/s
IL: 163.10

Footpath

Parkland

Staff Parking
4 Spaces

Service Yard

Crematorium

Floral Tribute

Garden of Remembrance

Chapel
DM/18/0677

Barn / Workshop
DM/19/5100

Reception
DM/15/1035

Overflow Car Park
±25 Spaces

Main Car Park
±80 Spaces

1:20

6.0m

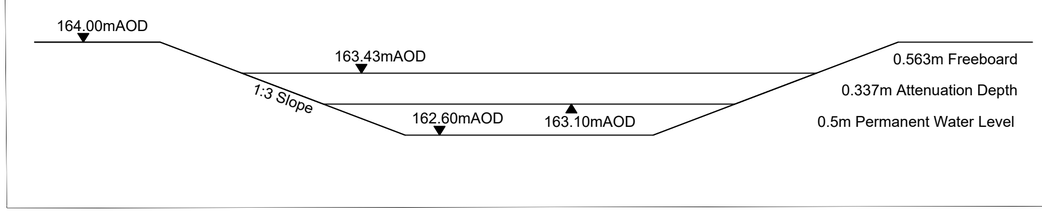
4.2m

5.5m

Visibility Splay

Turners Hill Rd

Attenuation Pond Schematic



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Key

- Site Boundary
- Proposed Crematorium Roof Area
- Proposed Tanked Permeable Paving
- Proposed Impermeable Paved Areas
- Proposed Pond (Attenuation Basin)
- Proposed Hydro-Brake
- Proposed Downpipes
- Proposed Surface Water Pipework
- Proposed Inspection Chambers
- Existing Drainage Ditch
- Proposed Outfall
- 156 Topographic Site Contour
- Design Exceedance Route

Notes:

Discharge of post development surface water runoff will be managed via combination of tanked permeable paving and pond/attenuation basin.

Tanked Permeable Paving:
Preliminary calculations indicate that tanked permeable pavement with dimensions of 481m^2 x 0.4m deep x 0.3 (voids) will be sufficient to accommodate all runoff from 5391m^2 of impermeable areas arising from the critical 1:100 year + 40% climate change event

Pond/Attenuation Basin:
Preliminary calculations indicate that an attenuation basin with dimensions of 331m^2 x 1.4m deep will be sufficient to accommodate all runoff from 888m^2 of impermeable surfacing arising from the critical 1:100 year + 40% Climate Change event.

All levels are in metres above ordnance datum.

Client:
Hartmiras Investment Ltd

Site Address:
Proposed Crematorium,
Land north of Turners Hill Road,
Turners Hill,
West Sussex
RH10 4PB

Job Reference:	Date:
89699-190520-Muntham-TurnersHill	30-Jul-20
Drawing Number:	**Revision:**
89699-01	v1.0

Designed by:	Drawn by:	Checked by:
TS	TS	EB

Scale:
1:500@A2

Disclaimer:
The drawings provided are for planning purposes only.

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Gatwick
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