LE-020

King James' School Expansion

for

Farrell and Clark Architects

Flood Risk Assessment and Surface Water Management Report

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Contents

Appendices

1. Introduction

CCS Consulting Ltd have prepared a Flood Risk Assessment and Surface Water Management report, for the expansion of King James' School, Huddersfield, HD4 6SG.

This report will assess the current flood risks to the development site and will demonstrate that the surface water run-off rate and volume for the new development site is managed so it adheres to current regulations, and local authority requirements.

In particular, this flood risk statement and surface water management (SuDS) report has been prepared to the requirements of the:

- National Planning Policy Framework (NPPF) 2019 Paragraphs 149-150 and 155-165;
- National Planning Practice Guidance (NPPG);
- Principles of Sustainable drainage systems (SuDS) set out by DEFRA (2011);
- Ciria SuDS Manual C753 (2015);
- Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015);
- Kirklees Council Surface Water Management Plan (February 2011);
- Kirklees Council Flood Risk Management Strategy (February 2013);
- Kirklees Local Plan Strategy and Policies (Adopted 27 February 2019).

Kirklees Council Lead Local Flood Authority (LLFA) need to be satisfied that the design and drainage principles of the proposed development will address the risk of flooding to the development site, and that the proposals will not in turn increase the risk of flooding to neighbouring land and property.

This flood risk assessment and surface water management report has therefore been prepared to identify and evaluate the various possible sources of flood risk to which the proposed site might be subjected to; to identify any mitigation, protection or compensation measures deemed necessary or feasible; ad to manage the surface water so it sustainable, and does not increase the probability of flooding within, or near the site.

2. National / Local Policies and Water Management Guidance

2.1. National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG)

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. This document is used to form this flood risk statement, with particular attention to Paragraphs 149 to 154 Planning for Climate Change, and Paragraphs 155 to 165 Planning for Flood Risk.

NPPG, Paragraph 030, outlines that the objectives of this FRA is to establish whether a proposed development is likely to be affected by current or future flooding from any source; whether it will increase flood risk elsewhere; whether the measures proposed to deal with these effects and risks are appropriate; whether the evidence for the local planning authority to apply (if necessary) the Sequential Test; and whether the development will be safe and pass the Exception Test, if applicable.

NPPG, Paragraph 051 states that sustainable drainage systems (SuDS) are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible, where they provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban run-off at source; and to combine water management with green space with benefits for amenity, recreation and wildlife

Further to this NPPG, Paragraph 080 states that the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable which (in order) are into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain, or another drainage system; to a combined sewer.

2.2. Flood and Water Management Act

The Flood and Water Management Act takes forward some of the proposals from three previous strategy documents published by the UK Government - Future Water (2008), Making Space for Water (2008) and the UK Government's response to the Sir Michael Pitt's Review of the summer 2007 floods. In doing so it gives the EA a strategic overview role for flood risk and gives local authorities responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

2.3. Kirklees Local Plan Strategy and Policies (Adopted 27 February 2019)

Kirklees Local Plan Strategy and Policies - Policy LP28 states that: *'The presumption is that Sustainable Drainage Systems (SuDS) will be used to assist in achieving the following on each site:*

a. for proposals on greenfield sites, typical greenfield run-off rates should not be exceeded.

b. for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions;

c. No negative impact on local water quality and improvements in water quality where practicable;

d. Consider whether proposed open spaces and green infrastructure within sites can contribute to the sustainable drainage of the site.

Local conditions including the existence of critical drainage areas may require a lower run-off rate to be agreed to reflect volume control, local surface water risks, water course capacity and flood risk further downstream. There will be a general presumption against pumping surface water. It must also be demonstrated that the surface water management solution is designed to meet requirements over the lifetime of the development *including evidence that management and maintenance arrangements have been secured to cover that period. This includes ensuring proposals to store water meet national standards and latest best practice. Flow paths accommodating water from outside the site or due to an exceedance event should be designed to avoid buildings and curtilages. Development will only be permitted if it can be demonstrated that the water supply and waste water infrastructure required is available or can be coordinated to meet the demand generated by the new development'.*

3. Site Setting and Description

3.1. Development Site Location

As detailed in Appendix A, The existing school is in a rural / residential area of Almondsbury, which is approximately 3km south east of Huddersfield town centre and train station, with the full address being King James School, St Helens Gate, Almondsbury, Huddersfield, and the nearest postcode being HD4 6SG.

The areas of the school to be expanded is to the west of the existing school building and access road, with the co-ordinates of the development site being Easting: 417085, Northing: 414775.

3.2. Existing Use and Topography

As detailed on the topographical survey in Appendix B, the area of the school to be developed currently consists of two temporary buildings to the north and east; hard-standing 'tarmac' car parking arras to the south, and grassed / overgrown vegetation for the remaining areas.

In terms of topography, the areas of the school being developed has a general fall from west to east with the high point along the western boundary being approximately 127.49m AOD, and the low-point along the eastern boundary being approximately 123.10m AOD.

3.3. Proposed Development

The proposed development plans are shown in Appendix C, with a full description of the development site being stated by the Architect.

In brief, and in relation to this flood risk assessment and surface water management report, the proposal is to expand the school by demolishing the temporary buildings and to build a new a new 2-storey permeant school building with 9 class rooms, and leaning resource areas. The external areas (previously occupied by parking bays and temporary building) will be formed with new permeable / impermeable car park and pedestrian areas.

3.4. Ground Conditions

Ground conditions can be sourced from the British Geological Survey (BGS) website, which identifies the ground at the site to have no superficial deposits, and bedrock layer of sandstone.

The BGS data also shows public record borehole logs, with the nearest logs being approximately 500m north of the school at Southfield Road and Somerset Road. The borehole records are shown in Appendix D, which show that the ground at each borehole location to the north predominantly consists of silty clay.

A full Phase 2 ground investigation and infiltration tests have been undertaken on the site. These confirm that the underlying ground conditions generally comprise made ground consisting of gravelly clay, over mudstone and sandstone. Infiltration tests have confirmed that these have very low to no infiltration value, and therefore it is confirmed that discharging the surface water run-off from the new development area of the school, to ground, is not feasible.

3.5. Waterbodies

There are no known waterbodies near to the school site, with the nearest main waterbodies being Rushfield Dike approximately 150m to the south east, and Fenay Beck approximately 650m to the east.

3.6. Existing Drainage

As detailed on the utilities survey drawing in Appendix E, there is an existing 100mm diameter surface water drainage network running below the access road to the east of the development area, and existing foul / combined water systems running between the existing school buildings to the east of the development area.

The utilities plan shows a pipe connection from one of the temporary buildings to the surface water network, therefore it is deemed that the surface water run-off from this building will discharge to the existing surface water drainage system.

It is also assumed that due to the topography of the ground (falling from west to east) the surface water run-off from the existing car parking areas and other temporary building will also discharge onto the access road, and into the existing surface water drainage system.

3.7. Development Areas

The overall area of the school that is to be developed is approximately 1127m² / **0.113 ha**.

The surface water run-off from the temporary buildings and car parking areas is believed to discharge to the existing surface water network, which equates to approximately 370m² / 0.037 ha.

For the purpose of the pre-development surface water run-off rates and volume calculations, the area is to be 0.037 ha, and for the purpose of the greenfield run-off rates and volume calculations, the urban factor of the development area is deemed to be **0.33** (0.037 / 0.113).

The post development area will consist of the new 2-storey building and permeable / impermeable car park and pedestrian areas. For the purpose of the post development surface water run-off rates and volume calculations, all of the development area is to be taken into consideration. Therefore, the post development surface water management area is based on an area of **0.113 ha**.

In summary:

Overall Development Area	-	0.113 ha
Pre-Development SW Run-Off Area	-	0.037 ha
Greenfield Urban Factor	-	0.33
Post Development SW Run-Off Area	-	0.113 ha

4. Potential Sources of Existing Flooding

The potential sources of exiting flooding for the site, that are to be assessed, are as follows:

4.1. Fluvial Flooding

Fluvial flooding is resulted from watercourses / rivers surcharging and flooding the surrounding areas.

4.2. Pluvial Flooding

'Pluvial' flooding is that which results from rainfall generated overland flow before the run-off enters any watercourse, drain or sewer. It is more often linked to high intensity rainfall events (typically more than 30mm per hour). However, it can also result from lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or has low permeability. This results in overland flow and ponding in depressions in the topography. In urban areas 'pluvial' flows are likely to follow the routes of highways and other surface connectivity to low spots where flooding can occur. In some cases, it can deviate from this route into adjacent developments via dropped kerbs (either for access to driveways or disability access).

4.3. Groundwater Flooding

Groundwater flooding is caused by the emergence of water from sub-surface permeable strata. Fluctuations in the groundwater table can cause flooding should the table rise above the existing ground level. Groundwater flooding events tend to have long durations, lasting days or weeks.

4.4. Flooding from Drains and Sewers

Flooding from drains and sewers is caused when the capacity of the drains and sewers is exceeded, and will result in flooding from the manholes.

4.5. Canals, Reservoirs and Other Artificial Sources

Flooding from canals, reservoirs and artificial sources is caused when the capacity of the sources is exceeded, or if there is an infrastructure failure.

5. Probability of Flooding

5.1. Fluvial Flooding

The Environment Agency (EA) fluvial flood map shown in Figure 1, indicates that the development site is within Flood Zone 1 – low probability (Land having a less than 1 in 1,000 annual probability of river or sea flooding).

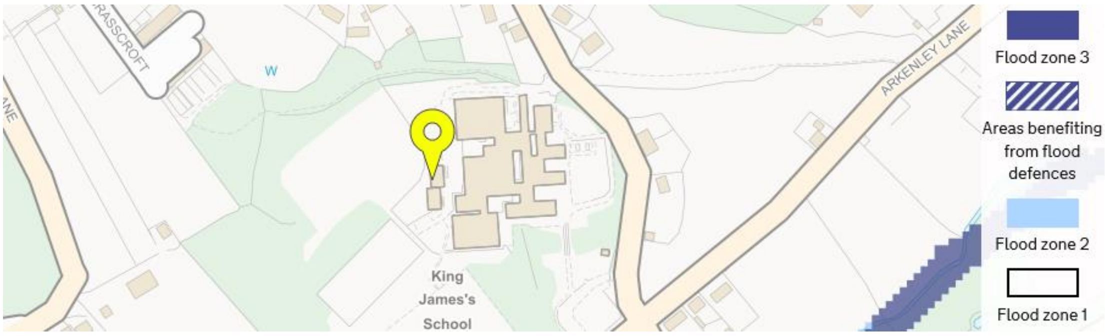


Figure 1 – EA Flood Zone Map

The EA fluvial flood map shown in Figure 2, indicates that the development site has a less than very low probability of flooding rivers or the sea. Therefore, the probability of fluvial flooding is deemed to be low.

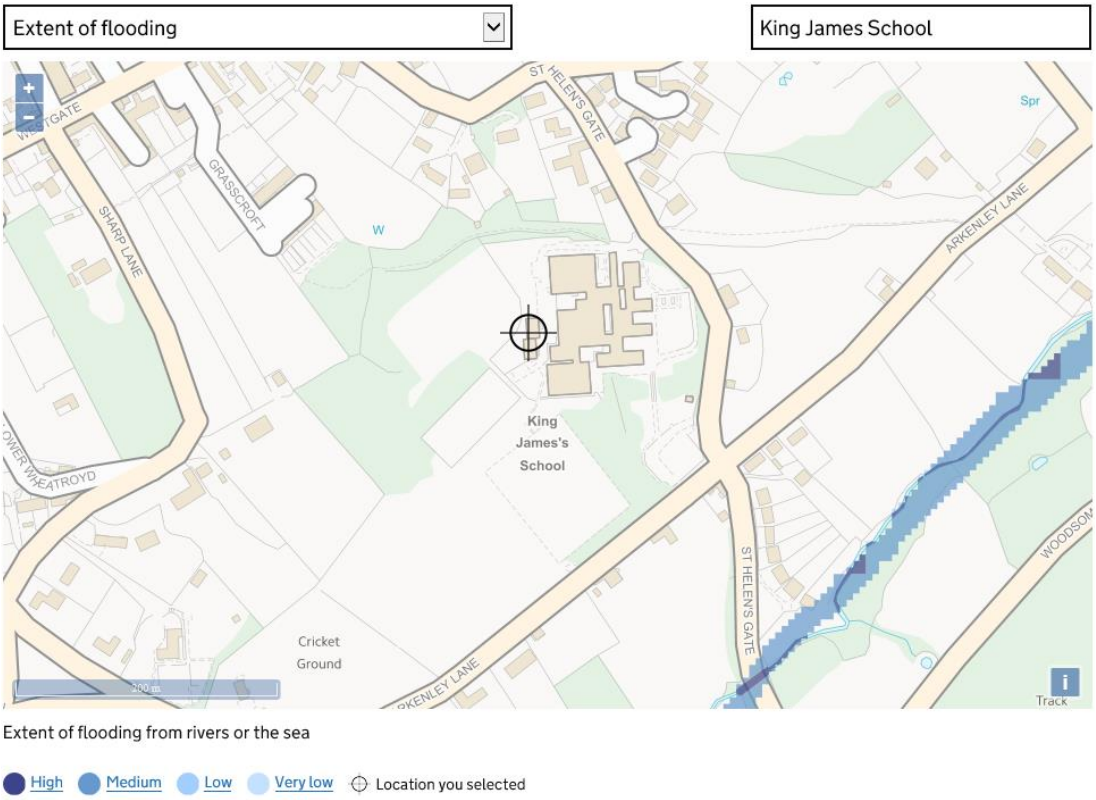


Figure 2 – EA Fluvial Flood Map

5.2. Pluvial Flooding

The EA pluvial flood map shown in Figure 3, indicates that there is better than a very low flood probability from surface water / pluvial source for the area of the school being developed site, with a low probability of pluvial flooding to the north east within the access road, and a medium probability around the existing buildings to the east. As no pluvial flooding is shown within the development area, the probability of surface water/ pluvial flooding is deemed to be low.

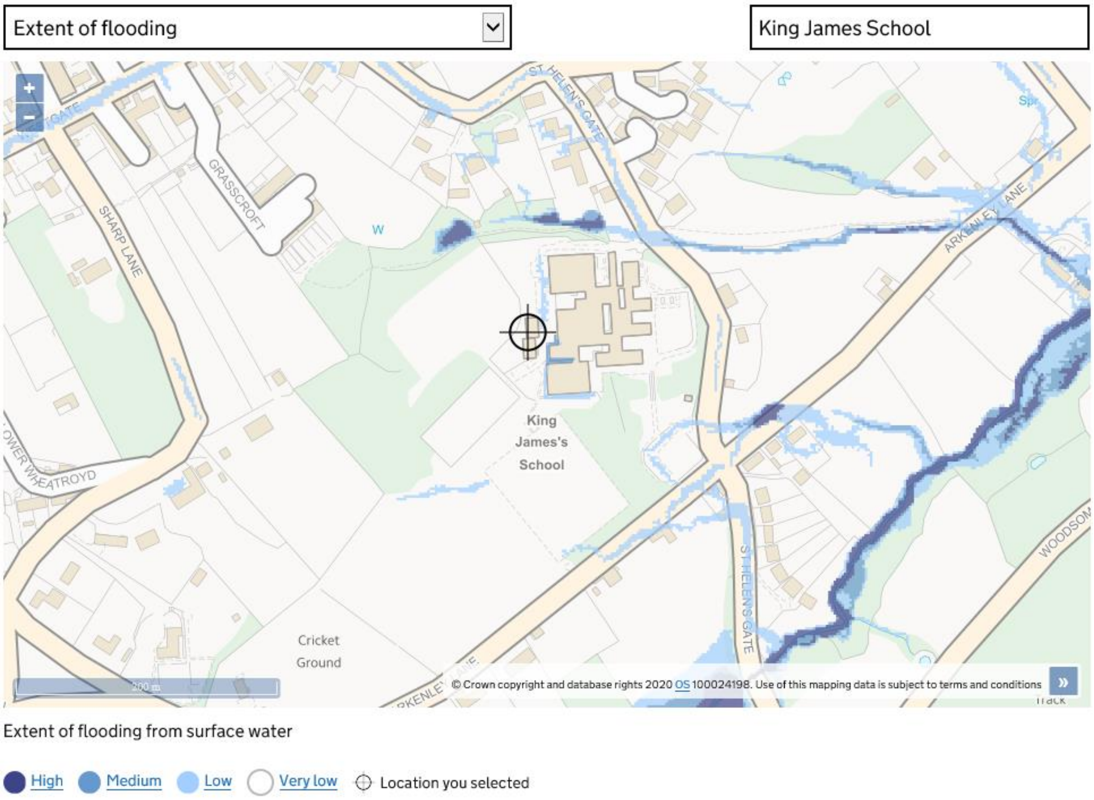


Figure 3 – EA Pluvial Flood Map

5.3. Ground Water Flooding

The BGS data, and the Phase 2 Ground Investigation, identify the ground to predominantly consist of silty clay over sandstone. Clay and sandstone is to have little or no percolation value, and there ground water is unlikely to be conveyed through these strata's to surface. Therefore, as the ground is likely to be impermeable, the probability of ground water flooding is deemed to be low.

5.4. Flooding from Drains and Sewers

The nearest drains / sewers to the area of the school being developed are within the access road and between the buildings to the east. The cover and invert levels of the existing drainage networks are lower than the proposed development levels, and therefore if any flooding form the existing network were to occur, it will flow away from the area being development. The probability of flooding from drains and sewers is therefore deemed to be low.

5.5. Canals, Reservoirs and Other Artificial Sources

There are no canals, reservoirs or other artificial water sources in direct vicinity or at a higher level to the development site, and therefore the probability of flooding from any of these sources is deemed to be low.

6. Flood Risk and Vulnerability

The NPPG Paragraphs 065 to 067 sets out the flood risk for a site by assessing the flood zones, flood risk vulnerability classification, and flood risk vulnerability and flood zone 'compatibility'.

6.1. Flood Zones

NPPG Paragraph 065, Table 1 indicates that the flood zones are:

Flood Zones	
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)

The EA flood map data has identified that the development site is in Flood Zone 1, which has a low probability of flooding

6.2. Flood Risk Vulnerability Classification

NPPG Paragraph 066, Table 2 stated the flood risk vulnerability classifications as:

Flood Risk Vulnerability Classification
Essential Infrastructure Essential transport infrastructure (including mass evacuation routes) which should cross the area at risk; Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood; Wind turbines.
Highly Vulnerable Police and ambulance stations; fire stations and command centers; telecommunications installations required to be operational during flooding; Emergency dispersal points; Basement dwellings; Caravans, mobile homes and park homes intended for permanent residential use; Installations requiring hazardous substances consent.

More Vulnerable
Hospitals; Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels; Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels; Non–residential uses for health services, nurseries and **educational establishments**; Landfill* and sites used for waste management facilities for hazardous waste; Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable
Police, ambulance and fire stations which are not required to be operational during flooding; Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure; Land and buildings used for agriculture and forestry; Waste treatment (except landfill* and hazardous waste facilities); Minerals working and processing (except for sand and gravel working); Water treatment works which do not need to remain operational during times of flood.
Water-Compatible Development
Flood control infrastructure; Water transmission infrastructure and pumping stations; Sewage transmission infrastructure and pumping stations; Sand and gravel working; Docks, marinas and wharves; Navigation facilities.

This development is classed as a 'More Vulnerable' as the development is to be used for an educational establishment.

6.3. Flood Risk Vulnerability and Flood Zone 'Compatibility'

NPPG Paragraph 067 Table 3, gives guidance on flood risk vulnerability compared with flood zone, to determine the compatibility.

Flood Risk Vulnerability and Flood Zone 'Compatibility'					
Flood Zones	**Flood Risk Vulnerability Classification**				
	Essential Infrastructure	Highly Vulnerable	**More Vulnerable**	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	† Exception Test required	✗	Exception Test required	✓	✓
Zone 3b*	* Exception Test required	✗	✗	✗	✓*

In accordance with Table 3 of the NPPF if the site is in Flood Zone 1, is classed as 'More Vulnerable', the development is appropriate.

7. The Sequential Test and Exception Test

7.1. Sequential and Exception Test Guidance

Paragraph 101 of the NPPG states that: *The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding.*

Paragraph 102 of the NPPG states that: *If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:*

- *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*
- *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

7.2. Sequential and Exception Test Requirement for Development

The development site has passed the sequential and exception test as it is in Flood Zone 1, and in accordance with NPPF guidelines is classed as 'More Vulnerable', and therefore is an appropriate development.

8. Surface Water Management Principles

The surface water for the development site is to be managed so that it adheres to the current regulations, and local authority requirements, as detailed in previous sections of this report.

8.1. Run-Off Destination

Surface water run-off is to discharge to one or more of the following in the order of priority shown:

- Discharge into the ground (infiltration);
- Discharge to a surface water body;
- Discharge to a surface water sewer, highway drain or other drain;
- Discharge to combined sewer.

8.2. The Management Train

A concept fundamental to implementing a successful SuDS scheme is the management train. This is a sequence of SuDS components that serve to reduce run-off rates and volumes and reduce pollution. The hierarchy of techniques that are to be used for the surface water management of the development are:

- Prevention - Prevention of run-off by good site design and reduction of impermeable areas;
- Source Control - Dealing with water where and when it falls (e.g. infiltration techniques);
- Site Control - Management of water in the local area (e.g. swales, detention basins);
- Regional Control - Management of run-off from sites (e.g. balancing ponds, wetlands).

8.3. Design Principles

The design principles for the surface water management of the development will be to:

- Ensure that people, property and critical infrastructure are protected from flooding;
- Ensure that the development does not increase flood risk off site;
- Ensure that SuDS can be economically maintained for the development.

8.4. Peak Surface Water Flow

Kirklees Local Plan Strategy and Policies - Policy LP28 states that:

'for proposals on greenfield sites, typical greenfield run-off rates should not be exceeded., and for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions'.

The area of the school being developed is deemed to be a brownfield site, and therefore, based to the guidance, the surface water will be restricted to as low as possible with the aim to achieve the equivalent greenfield rates, and a maximum rate of 30% betterment of the pre-development rates.

8.5. Volume Control

The aim is to ensure that the run-off volume from the developed site for the 1 in 100-year 6-hour rainfall does not exceed the pre-development run-off volume for the same event.

Should infiltration methods not be suitable, and it is not possible to achieve pre-development runoff volume, then it will be demonstrated that the increased volume will not increase flood risk on or off site.

8.6. Flood Risk

The drainage system will be designed so that, unless an area is designed to hold and/or convey water, flooding does not occur on any part of the site for a 1 in 30-year rainfall event.

The drainage system will also be designed so that, unless an area is designed to hold and/or convey water, flooding does not occur during a 1 in 100-year rainfall event in any part of a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

The design of the site will ensure that flows resulting from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that avoid risk to people and property both on and off site.

8.7. Pollution

The SuDS design for the development site will ensure that the quality of any receiving water body is not adversely affected and preferably enhanced in accordance with Ciria SuDS Manual C753, Chapter 4.

8.8. Designing for Exceedance

The development site design will be such that when SuDS features fail or are exceeded, exceedance flows do not cause flooding of properties on or off site. This will be achieved by designing suitable ground exceedance or flood pathways, and run-off will be completely contained within the drainage system (including areas designed to hold or convey water) for all events up to a 1 in 30-year event. The design of the site ensures that flows from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that avoid risk to people and property both on and off site.

9. Surface Water Run-Off Destination

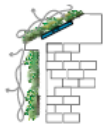
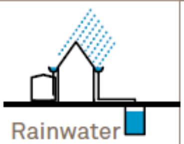
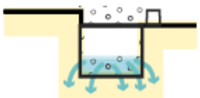
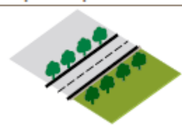
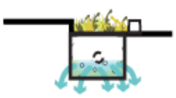
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

Run-Off Destination	Feasible	Description
Discharge to Ground	No	The BGS data identifies that the ground at the varied borehole locations (within 500m of development) predominantly consists of silty clay, with a bedrock layer of sandstone. Phase 2 Ground Investigations and infiltration tests have confirmed that the ground is underlain with Clay and Sandstone which have a very low to no infiltration value, and therefore it is deemed that discharging the surface water run-off from the new development area of the school to ground is not feasible.
Discharge to Surface Water Body	No	There are no known waterbodies near the area of the school being development, and therefore discharge to a waterbody is not a feasible destination.
Discharge to Surface Water Sewer	**Yes**	As surface water cannot discharge to ground due to the presence of silty clay and sandstone, and there are no known water bodies near the development area of the school, the only alternative will be to discharge the surface water from the post development to the existing surface water drainage network to the east. This surface water discharge destination will 'mimic' the pre-development surface water discharge destination.
Discharge to Highway Drain or Other	No	There are no known highway or other drains near the area of the school being development, and therefore discharge to a waterbody is not a feasible destination.
Discharge to Combined Water Sewer	No	There are no known combined sewers near the area of the school being development, and therefore discharge to a waterbody is not a feasible destination.

10. SuDS Feasibility

To reduce the surface water run-off to the greenfield rate or 50% betterment of the pre-development rate, SuDS methods are to be introduced to the post development design.

SuDS methods as per the Sustainable Drainage System (SuDS) hierarchy, and the Non-Statutory Technical Standards for Sustainable Drainage Systems – March 2015, that can be used are detailed below:

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	 Building	Building integrated.
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	 Building	Water storage (underground or above ground).
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	 Open space	Dependant on runoff volumes and soils.
 Filter Strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	 Open space	Minimum length 5 metres.
Permeable paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	 Street/open space	Can typically drain double its area.
 Bioretention area	A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	 Street/open space	Typically surface area is 5-10% of drained area with storage below.

	Description	Setting	Required area
Swale	Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	Street/open space	Account for width to allow safe maintenancce typically 2-3 metres wide.
Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Open space	Could be above or below ground and sized to storage need.
Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open space	Dependant on runoff volumes and soils.
Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open space	Typically 5-15% of drainage area to provide good treatment.
Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	Open space	Dependant on runoff volumes and soils.

The feasibility of the above SuDS methods for the post developed site are summarised in the table below:

SuDS Method	**Feasible Use**	**Description**
Green Roof	No	The proposed school building is not structurally designed for green roofs, and therefore this is not a feasible SuDS method.
Rainwater Harvesting	**Yes**	The water demand for the new school building will not match the potential yield of water. Therefore, due to the low demand the use of rainwater harvesting for use in the building is not feasible. However, water butts could be installed at some rainwater pipe locations to the rear of the building, where the water will be stored and used for future irrigation of the landscape / garden areas.
Soakaway	No	As stated in Section 9, the BGS data identifies that the ground at the varied borehole locations (within 500m of development) predominantly consists of silty clay, with a bedrock layer of sandstone. A Phase 2 Ground Investigation and infiltration tests have

		been undertaken on the site which have confirmed that the ground is underlain with Clay and Sandstone which have a very low to no infiltration value, and therefore it is deemed that the use of soakaways to discharge the surface water to ground is not feasible.
Filter Strips	No	There are limited areas in the areas of the school being developed for a filter drain, due to the area consisting of the building and permeable / impermeable external areas only. Therefore, due to the lack of suitable soft landscape areas, there will the use of this SuDS method is not feasible.
Permeable Paving	**Yes**	There is potential to have a permeable paving for the external development areas. The permeable paving will NOT be used as a soakaway, but will convey the water to the main network (via ap perforated pipe in the sub-base), reduce the surface water discharge rate and volume, attenuate restricted surface water, and act as a pollutant control.
Bioretention Area	No	There are limited areas in the areas of the school being developed for a filter drain, due to the area consisting of the building and permeable / impermeable external areas only. Therefore, due to the lack of suitable soft landscape areas, there will the use of this SuDS method is not feasible.
Swale	No	There are limited areas in the areas of the school being developed for a filter drain, due to the area consisting of the building and permeable / impermeable external areas only. Therefore, due to the lack of suitable soft landscape areas, there will the use of this SuDS method is not feasible.
Pond / Basin	No	There are limited areas in the areas of the school being developed for a filter drain, due to the area consisting of the building and permeable / impermeable external areas only. Therefore, due to the lack of suitable soft landscape areas, there will the use of this SuDS method is not feasible.
Underground Storage	**Yes**	The surface water run-off from the development site will be restricted to as low as possible with the aim to achieve the equivalent greenfield run-off rate, or at least a 30% betterment of the pre-development rates. Therefore, there will be a requirement to have underground storage for storm events up to 1 in 30-year; and to suitable sized so that the volume of water during the 1 in 100-year storm event is kept a minimum at surface level, where it can be contained on site.

11. Development Greenfield Run-Off Rate and Volumes

To minimise the surface water run-off from the new development areas of the school, it is preferred that the post development surface water run-off be restricted to the equivalent greenfield run-off rates and volume.

11.1. Greenfield Run-Off Rate

The Flood Estimation Handbook (FEH) is often used for the calculation of the greenfield run-off rate, however, relevant documents state that to calculate the greenfield run-off rates on small catchments less than 25km², the IH 124 QBAR equation (and the equation for the instantaneous time to peak for the unit hydrograph approach) is to be used.

The IH method is based on the Flood Studies Report (FSR) approach and is developed for use on catchments less than 25km². It yields the Mean Annual Maximum Flood (QBAR). This reference also recommends the use Ciria C753 Table 24.2 to generate Growth Factors. These are used to convert QBAR to different return periods for different regions in the UK.

The input variables to establish QBAR are:

Return Period (years)	Results based on a range of return periods and the specified RP;
Area	Catchment Area (ha) which is adjusted to km2 for use in the equation;
SAAR	Average annual rainfall in mm (1941-1970) from FSR figure II.3.1;
Soil	Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively;
Urban	Proportion of area urbanised expressed as a decimal;
Region Number	Region number of the catchment based on FSR Figure I.2.4.

QBAR(l/s)

The output variables to establish QBAR are calculated using the following formula (equation yields m³/s):

$$\textbf{QBAR} = \mathbf{0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}}$$

The IH 124 Variables (taken from FSR) that are specific to this site are as follows:

Area	=	50.00 ha
SAAR	=	948
Soil	=	0.300
Urban Factor	=	0.33
Region Number	=	10

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix F), the QBAR for a 50.00ha catchment area is:

QBAR	=	218.8 l/s

This figure is for the catchment area of 50.00 ha, and is to be reduced to reflect the surface water run-off area (0.113 ha) of the development site. Therefore, the QBAR (greenfield run-off) for development area has been calculated to be:

QBAR = **0.49 l/s (4.38 l/s/ha)**

Ciria C753 Table 24.2 identifies the growth factors for each of the storm events, based on the known QBAR figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 10.

Based on the figures shown in the table, the growth factors and the existing greenfield run-off rates for each of the storm events for the development areas of the site are as follows:

Storm Event	QBAR	Growth Factor (C753 Table 24.2)	Greenfield Run-off Rate
Q_1	0.49 l/s	0.87	**0.43 l/s**
Q_{30}	0.49 l/s	1.70	**0.83 l/s**
Q_{100}	0.49 l/s	2.08	**1.01 l/s**

11.2. Greenfield Run-Off Volume

The greenfield run-off volume for the 100-year, 6-hour storm event has also been calculated in the MicroDrainage software using the data from the Flood Estimation Handbook (FEH), with the results shown in Appendix E.

The FEH data and variables used to calculate the greenfield run-off volume at the development site locations are as follows:

Site Location = GB 417200 414500 SE 17200 14500

C (1km) = -0.026

D1 (1km) = 0.397

D2(1km) = 0.421

D3 (1km) = 0.308

E (1km) = 0.308

F (1km) = 2.388

Areal Reduction Factor = 1.000

Area = 365.500 ha

SAAR = 884

CWI = 121.412

SPR Host = 21.940

URBTEXT = 0.33

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix F), the greenfield run-off volume for the overall catchment area at the site location is:

Q100 (6-Hour) = 94,994.979m³

This figure is for the catchment area of 365.500 ha, and is to be reduced to reflect the surface water catchment area of the development site which is 0.113 ha. Therefore, the greenfield run-off volume for the development site area has been calculated to be:

Q100 (6-Hour) = **29.37m³ (259.90m³/ha)**

12. Pre-Development Surface Water Run-Off Rates and Volume

The pre-development surface water run-off rates and volumes are to be calculated, so that the post development rates are at least a 30% betterment.

The calculations to determine the pre-development surface water run-off rates and volumes are based on the pre-development surface water run-off area of 0.037 ha, and the data given by the Flood Estimation Handbook (FEH).

The pre-development surface water run-off rates and volume have also been simulated in the MicroDrainage software (Appendix G), where the variables used (FEH data) to calculate the surface water run-off rates and volumes are as follows:

Pre-Development Area = 0.037 ha

Site Location = GB 417200 414500 SE 17200 14500

C (1km) = -0.026

D1 (1km) = 0.397

D2(1km) = 0.421

D3 (1km) = 0.308

E (1km) = 0.308

F (1km) = 2.388

Time of Entry = 5 minutes

Based on the above variables and computer software results, the pre-development surface water run-off rates will be as follows:

Q_1 = 4.00 l/s (15-minute storm duration*)

Q_{30} = 13.40 l/s (15-minute storm duration*)

Q_{100} = 20.40 l/s (15-minute storm duration*)

*The critical storm duration for each of the return period is 15 minutes.

Based on the above variables for the surface water run-off from the pre-development impermeable area, it has been calculated that the pre-development surface water discharge volume for the pre-development site (at 6-hour storm events) are as follows:

Q_{100} = $20.52m^3$ (360-minute storm duration)

13. Below Ground Drainage Network and Surface Water Management Calculation

13.1. Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The recommended allowances are taken from the Environment Agency guidance (Table 2) summarised in Table 4 below.

Applies across all of England	**Total change anticipated for the 2020's**	**Total change anticipated for the 2050's**	**Total change anticipated for the 2080's**
Upper End	10%	20%	**40%**
Central	5%	10%	20%

The baseline year is 1961 to 1990. It is anticipated the life span of the proposed school building will be between 50 - 80 years, and therefore will fall at least into the 2080's and will have rainfall intensity increase of 40%. This increase in rainfall is to be taken into consideration for the surface water management of the proposed development site, to ensure that the probability of flooding remains low.

13.2. Surface Water Network Calculations

The FEH data and variables used to calculate the required below ground attenuation network and attenuation volumes at the development site are as follows:

SW Management Area	=	0.113 ha
Site Location	=	GB 417200 414500 SE 17200 14500
C (1km)	=	-0.026
D1 (1km)	=	0.397
D2(1km)	=	0.421
D3 (1km)	=	0.308
E (1km)	=	0.308
F (1km)	=	2.388
Time of Entry	=	5 minutes

13.3. Surface Water Drainage Network and Management

As shown on the below ground drainage layout drawing in Appendix H, the proposed surface water network will consist of 100mm and 300mm diameter pipes; 100mm perforated pipes, 450mm diameter silt trap chambers; a 1200mm diameter flow control chamber containing a hydro-brake; permeable paving systems and a below ground attenuation tank.

The surface water run-off from the roof areas will discharge to the main network via rainwater pipes (location to be confirmed); and the surface water run-off from the external areas will discharge to the main network via the permeable paving system.

The network will flow around the perimeter of the new building, where the surface water will discharge through the flow control chamber, prior to discharge / connection to the existing 100mm surface water drainage network. An attenuation tank is to be built within the network, where surface water will surcharge the network, once restricted, and fill the tank to prevent flooding.

13.4. Surface Water Run-Off Rate

For the surface water run-off from the development area of the school to be at the greenfield run-off rate, they are to be restricted to 0.43 l/s for the 1 in 1-year storm event; 0.83 l/s for the 1 in 30-year storm event, and 1.01 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase (climate change).

For the surface water run-off to be a 30% betterment of the pre-development rates, the surface water run-off from the post development site is to be restricted to at least 2.80 l/s for the 1 in 1-year storm event (pre-development 4.00 l/s); 114.2 l/s for the 1 in 30-year storm event 9.38 l/s (pre-development 13.40 l/s); and 14.28 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase (pre-development 20.40 l/s).

An assessment of the suitable flow control opening and subsequent surface water discharge also needs to assessed, where Ciria document C753 – The SuDS Manual states that: *'the flow controls / orifice design should be designed so that it has simplicity on operation, and has resistance to clogging, blocking or mechanical failure'.*

For this development, and based on the guidance, greenfield rates and pre-development rates the suitable / minimum size of the flow control opening (hydro-brake opening) is deemed to be 75mm, with a design flow of **3.00 l/s**. The design flow of 3.00 l/s will restrict the surface water discharge at least a 30% betterment of the pre-development surface water run-off for the 1-year storm event.

As shown in the network / output calculation from the MicroDrainage computer software in Appendix I, if the hydro-brake opening is set at 75mm, the design flow at 3.00 l/s, with a design head of 1.500m, the maximum surface water run-off rates for each storm event will be as follows:

Strom	**-**	**Rate**	**-**	**Critical Storm Event**
Q_1	-	2.30 l/s	-	15-minute winter storm duration
Q_{30}	-	2.50 l/s	-	15-minute winter storm duration
Q_{100}	-	3.00 l/s	-	240-minute winter storm duration

A summary of the post development surface water run-off rates compared to the greenfield and pre-development rates are as follows:

Greenfield Rate to Post Development Rate

Strom	**-**	**Greenfield**	**-**	**Post Dev**	**-**	**Difference**
Q_1	-	0.43 l/s	-	2.30 l/s	-	5.35 x Greenfield
Q_{30}	-	0.83 l/s	-	2.50 l/s	-	3.01 x Greenfield
Q_{100}	-	1.01 l/s	-	3.00 l/s	-	2.97 x Greenfield

Pre-Development Rate to Post Development Rate

Strom	**-**	**Pre-Dev**	**-**	**Post Dev**	**-**	**Difference**
Q_1	-	4.00 l/s	-	2.30 l/s	-	43% Betterment

Q_{30}	-	13.40 l/s	-	2.50 l/s	-	81% Betterment
Q_{100}	-	20.40 l/s	-	3.00 l/s	-	85% Betterment

The surface water run-off rates are greater than the equivalent greenfield rates, however, are between 43% to 87% betterment of the pre-development run-off rates, and therefor adhere to the local authority minimum requirements, without increasing the flood risk to the existing drainage network and school site. .

13.5. Surface Water Run-Off Volume

The surface water run-off volume for the post development site, when restricted to 3.00 l/s have also been calculated for 1 in 100-Year the 6-hour duration (Inc. 40% RII), and are detailed in the MircroDrainage calculations on Appendix I, the results of which are:

Q_{100} (6hour) - **95.42m³**

A summary of the post development run-off volumes compared to the greenfield and pre-development volumes are as follows:

Greenfield Volume to Post Development Volume

Strom	**-**	**Greenfield**	**-**	**Post Dev**	**-**	**Difference**
Q_{100}	-	29.37m³	-	85.72m³	-	2.92 x Greenfield

Pre-Development Volume to Post Development Volume

Strom	**-**	**Pre-Dev**	**-**	**Post Dev**	**-**	**Difference**
Q_{100}	-	20.52m³	-	85.72m³-	-	4.18 x Pre-Development

The surface water run-off volume for the post development exceeds the greenfield and pre-development run-off volume, however as the rate at which the volume will discharge to the existing network will be reduced by 85% the additional volume will not result in flooding to the existing drainage network and school. Therefore, the surface water discharge volume is deemed to be acceptable.

13.6. Surface Water Attenuation Calculations

As stated above, if the post development run-off rates were restricted there will be a requirement for surface water attenuation to prevent flooding. The attenuation volume is achieved within the attenuation tank in the form of cellular units, and the sub-base of the permeable paving system, which have been designed / sized in accordance with:

Ciria SuDS Manual 2015, Paragraph 10.2.4 which states that: *'Exceedance flows (i.e. flows in excess of those for which the system is designed) should be managed safely in above-ground space such that risks to people and property are acceptable'.* And PPS25 Practice Guidance Paragraph 5.51 which previously stated that: *'For events with a return-period in excess of 30 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property, and avoid creating hazards to access and egress routes. No flooding of property should occur as a result of a one i*n 100-year storm event (including an appropriate allowance for climate change)'.

As detailed in the surface water management calculations in Appendix I, and demonstrated on the surface water management layout in Appendix H, the attenuation for each SuDS feature ARE

Cellular Units			**Permeable Paving**		
Area	-	45.00m²	Area	-	470m²
Depth	-	0.80m	Sub-Base Depth	-	0.300m
Porosity	-	0.95	Porosity	-	0.30
Cellular Unit Volume	-	**36.00m³**	Max. Paving Volume*	-	**42.30m³**

**excluding gradient of permeable paving that reduces volume*

The calculations (Appendix I) show that with the cellular units, no flooding occurs form any part of the network for all storms up to and including the 100-year + climate change event. This ensures that all the surface water up this storm event is contained within the development area of the school.

14. Maintenance Requirements

The extent of the drainage network and SuDS features for the development site are shown on the surface water management layout and detail drawings in Appendix I. The drainage networks and SuDS methods are to be maintained and managed to ensure that the systems are working affectively, and subsequently reducing the risk of flooding on the site, and surrounding land.

The management and maintenance of the surface water drainage networks and SuDS features will be by the caretakers of the exiting school, where the additional features will form part of the overall school maintenance and management. Details of the requirements are as follows:

14.1. Drainage Networks

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from manholes (where may cause risk performance)	Monthly
Where rainfall into network from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Repair/check all inlets, outlets and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

14.2. Attenuation Tank and Flow Control Chamber

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from tank and flow control chamber (where may cause risk performance)	Monthly
Where rainfall into tank and flow control manhole from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least twice a year
Remove sediment from upstream surface water network by jetting.	Annually or as required
Repair/check all inlets, outlets and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

14.3. Permeable Paving

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from on surface of permeable paving (where may cause risk performance)	Monthly
Where rainfall infiltration into [permeable paving and filter drain structure, lengths and ensure working effectively.	As required, but at least twice a year

14.4. Linked to Further Maintenance and Maintenance Activities

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance plan for the commercial and residential building. A log of all maintenance activities is to be kept and made available to the local planning authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.

15. Surface Water Design Exceedance

In the unlikely event of a storm exceeding the design 100-year + 40% climate change storm event, or blockage in the system due to poor management and maintenance, surface water may flow form the surface water network.

Surface water to follow the topography of the existing / proposed ground and flow in a southerly direction towards the school playing fields. Surface water to flow away from the proposed existing school buildings and will be contained within the grassed playing fields.

Therefore, an exceedance event will not increase the flood risk to any building within the development site, or prosperities / building near the development.

16. Water Quality / Pollutants

The source of any potential pollutants will be from the surface water run-off from the school building roof areas and external permeable paving areas.

The pollutants from the roof are deemed to be very low, and therefore no pollutant control measures will be required. The surface water run-off from the external areas will discharge through the permeable paving system, where the granular material will act as a pollutant control.

17. Development Management and Construction Phase

Any existing drainage within the site, is to be maintained during the construction of the new buildings and external hard standing areas. The flow control chamber and below ground attenuation tank are to be the first parts of the drainage network to be built. This will ensure that the surface water discharge from any phase of the network will be restricted to the required run-off rates.

18. Conclusion / Summary

18.1. Existing Flood Probability

All potential sources of flooding to the development site have assessed, and it is deemed that the probability of flooding from all existing sources is low

18.2. SuDS Principles and Surface Water Discharge Destination

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being rainwater harvesting butts (location to be confirmed); permeable paving system, an attenuation tank in the form of cellular units; and a flow control chamber. The surface water run-off destination from the post development area will be to the existing surface water network within the access road of the school. The surface water run-off destination will replicate that of the pre-development.

18.3. Peak Flow Control

The surface water run-off has been restricted to as low as possible to prevent blockage and subsequent flooding, The flow control diameter is to be 75mm, which equates to a maximum surface water run-off rate of between 2.30 l/s for the 1-year storm event, and 3.00 l/s for up to the 1 in 100-year + 40% climate change storm event.

The surface water run-off rates are greater than the equivalent greenfield rates, however, are between 43% to 85% betterment of the pre-development run-off rates, and therefor adhere to the local authority minimum requirements, without increasing the flood risk to the existing drainage network and school site. .

18.4. Volume Control

The surface water run-off volume has been restricted to 85.72m² for the 100-year, 6-hour storm event. The surface water run-off volume for the post development exceeds the greenfield and pre-development run-off volume, however as the rate at which the volume will discharge to the existing network will be reduced by 85% the additional volume will not result in flooding to the existing drainage network and school. Therefore, the surface water discharge volume is deemed to be acceptable.

18.5. Flood Risk within the Development

The below ground attenuation tank has been suitably sized / designed so that no flooding occurs within the network during the 1 in 1-year; 1 in 30-year; and 1 in 100-year storm event + 40% climate change.

18.6. Management and Maintenance

The management and maintenance of the surface water drainage networks and SuDS features will be by the caretakers of the exiting school, where the additional features will form part of the overall school maintenance and management

18.7. Network Exceedance Event

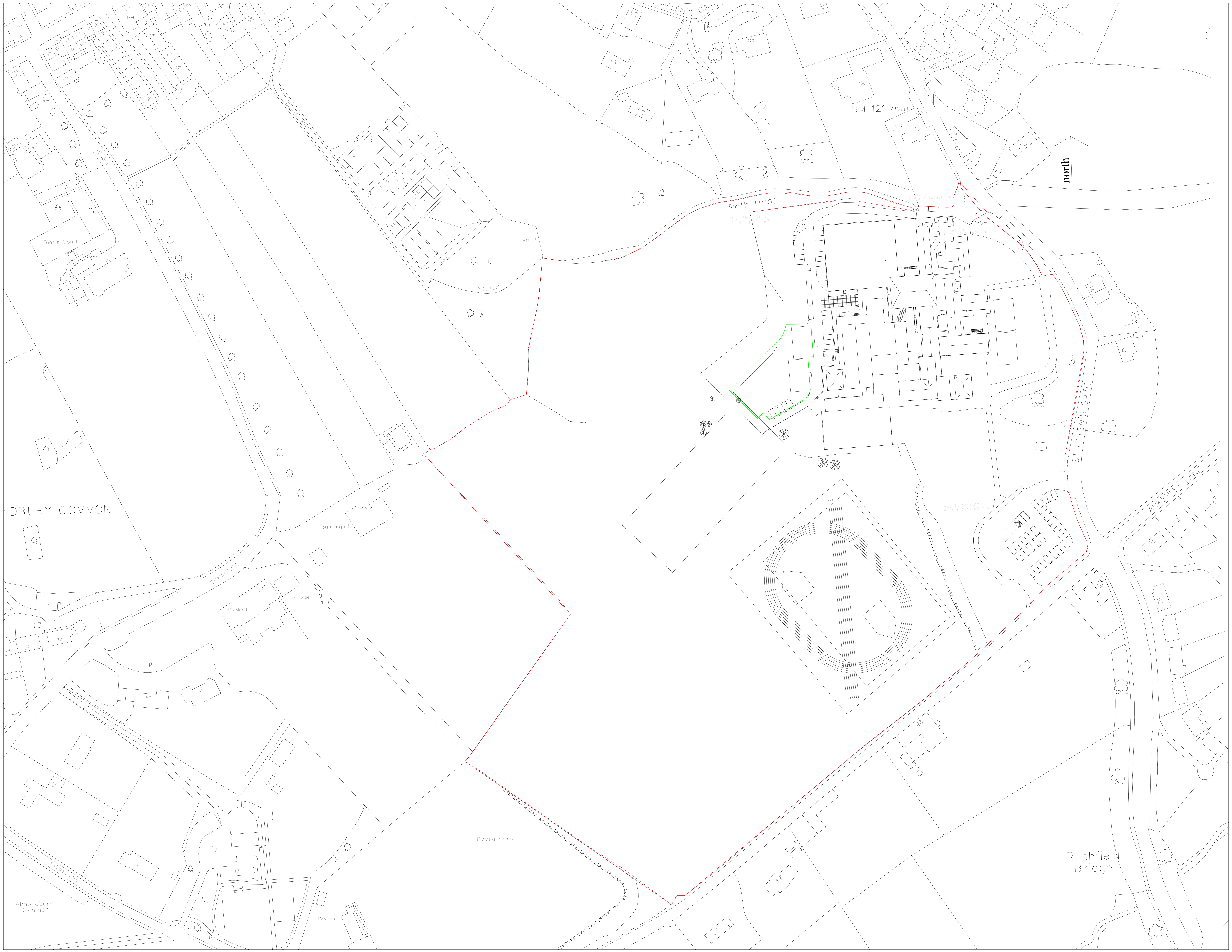
In the unlikely network exceedance event, Surface water to follow the topography of the existing / proposed ground and flow in a southerly direction towards the school playing fields. Surface water to flow away from the proposed existing school buildings, and will be contained within the grassed playing fields. Therefore, an exceedance event will not increase the flood risk to any building within the development site, or prosperities / building near the development.

18.8. Water Quality

The source of any potential pollutants will be from the surface water run-off from the school building roof areas and external permeable paving areas. The pollutants from the roof are deemed to be very low, and therefore no pollutant control measures will be required. The surface water run-off from the external areas will discharge through the permeable paving system, where the granular material will act as a pollutant control.

Appendix A Site Location Plan

Rev.	Description	Date	By
1	Pre-app submission review.	24/04/20	RAS



Location plan

1 : 1250

NOTE:
-Notional road level +123.19 indicated as Level 00 or Ground level for purpose of pre-application.
-Massing form shown only. Layout(s) subject to change.
-Existing and Proposed levels of site under development.

site boundary

land ownership

0 12.5 25 37.5 50 62.5m

Scale 1:1250

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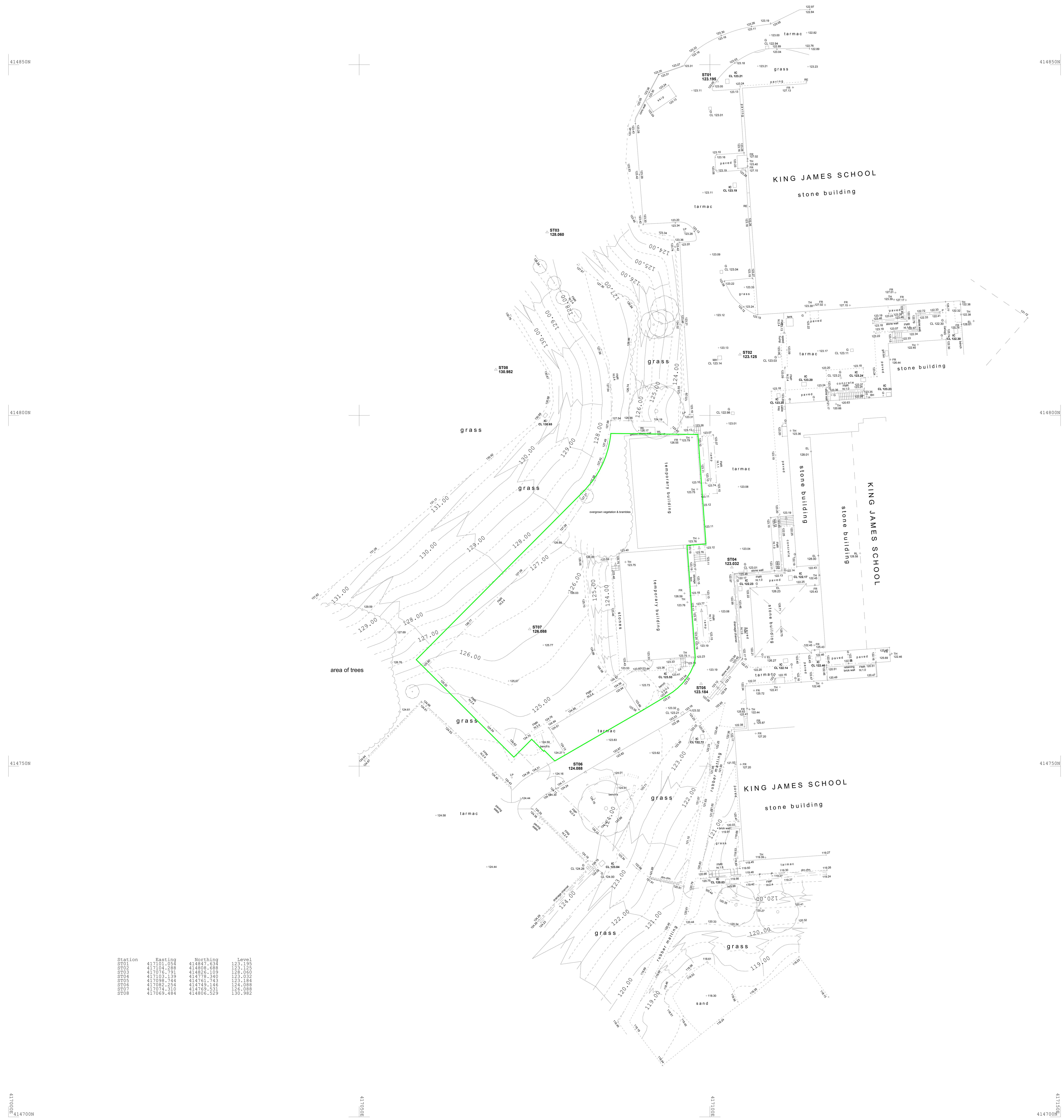
Status: PLANNING PRE-APP	S0
Client: Kirklees Council	
Project: King James's School Expansion	
Title: Location Plan	
Drawn: AZ	Date: Apr' 2020
Check: RAS	Scale: As indicated @A2
Drawing No.: PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER 303_020-FC-01-ZZ-DR-A-0700	Rev: 1

Appendix B Topographical Survey



Station	Easting	Northing	Level
ST01	417101.054	414847.634	123.195
ST02	417104.288	414808.688	123.125
ST03	417076.791	414826.109	128.060
ST04	417103.139	414778.340	123.032
ST05	417098.744	414761.743	123.184
ST06	417082.254	414749.146	124.088
ST07	417074.310	414769.531	126.088
ST08	417069.484	414806.529	130.982

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ABBREVIATIONS

AR	ASSUMED ROUTE	OSA	OUTSIDE SURVEY AREA
AV	AIR VALVE	P	POST / POLE
B	BOLLARD	RL	RIDGE LEVEL
BH	BOREHOILE	RE	RODDING EYE
BT	BRITISH TELECOM CHAMBER	RS	ROAD SIGN
CATV	CABLE TV	RWP	RAINWATER PIPE
CP	CABLE PIT	S	STAY
CL	COVER LEVEL	SC	STOP COCK
CR	CABLE RISER	ST	STOP TAP
DP	DOWN PIPE	SV	STOP VALVE
EL	EAVES LEVEL	SVP	SOIL VENT PIPE
EP	ELECTRICITY POLE	TC	TRAFFIC CONTROL
ER	EARTH ROD	TCB	TELEPHONE CALL BOX
FH	FIRE HYDRANT	TFR	TAKEN FROM RECORDS
FL	FLOOR LEVEL or FENCE LEVEL	TH	THRESHOLD LEVEL
FR	FLAT ROOF LEVEL	TL	TRAFFIC LIGHTS
G	GULLY	TP	TELEGRAPH POLE
GPR	TRACED BY G.P.R.	UTGA	UNABLE TO GAIN ACCESS
GV	GAS VALVE	UTL	UNABLE TO LOCATE
IC	INSPECTION CHAMBER	UTR	UNABLE TO RAISE
IL	INVERT LEVEL	UTS	UNABLE TO SURVEY
JB	JUNCTION BOX	UTT	UNABLE TO TRACE
KW	KERB WIER	WL	WATER LEVEL or WALL LEVEL
LB	LITTER BIN or LETTER BOX	VP	VENT PIPE
LP	LAMP POST	WM	WATER METER
MH	MANHOLE	WO	WASH OUT VALVE
NL	NOT LOCATED	WP	WATER PIPE
NT	NO TRACE		

b	BEAM HEIGHT
c	CILL HEIGHT
cht	CEILING HEIGHT
dht	DOOR HEIGHT
fcht	FALSE CEILING HEIGHT
+10.26	FLOOR LEVEL
+[10.26]	BEAM/OVERHEAD LEVEL
h	HEAD HEIGHT
p	PURLIN HEIGHT
r	RIDGE BOARD HEIGHT
sp	SPRING POINT
←	STEPS / STAIRS UP

FENCE LINETYPES

GENERAL FENCE
IRON RAILING FENCE
POST & RAIL FENCE
BARBED WIRE FENCE
CLOSE BOARDED FENCE
TIMBER PALISADE FENCE
POST & MESH FENCE
POST & RAIL FENCE
POST & WIRE FENCE
TIMBER PANEL FENCE
CONCRETE PANEL FENCE
METAL PALISADE FENCE
METAL RAILING FENCE

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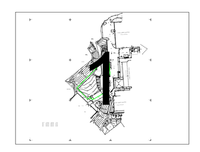
SURVEY NOTES:
The survey is fitted to National Grid and Datum using GPS, and has been drawn at a scale factor of 1.000
Due to the scale factor any setting out or design works should strictly use the control co-ordinates as shown on the drawing.

SURVEY REVISIONS

PREVIOUS DWG NO:	-
REVISION NO:	-
ORIGINAL SURVEY DATE:	-

REVISION NOTES:

LAYOUT VIEWS



CLIENT:
Farrell & Clark Architects

PROJECT TITLE:
King James School, 42A St Helens Gate, Huddersfield, HD4 6SG

DRAWING NUMBER:
4687AJB/1

INDICATIVE

SCALE: 1:200 @ A0	SURVEY DATE: October 2019	
LEVEL DATUM: OSGB by GPS	GRID DATUM: OSGB fixed at ST01	
BENCH MARK USED: Nail at ST01 surveyed by GPS	BM VALUE: 123.195m	SHEET NUMBER: 1 of 1

Appendix C Proposed Site Plans

Department Legend

- Circulation
- basic teaching
- learning resource areas
- staff and administration
- storage
- toilets (and personal care)
- sub-total non-net

OPT A - LEVEL 00 - PROPOSED
1 : 200

AREA ASSESSMENT:

OPTION A GIFA

LEVEL 00 = 555 sq.m.
LEVEL 01 = 525 sq.m.
TOTAL = 1080 sq.m.

0 2 4 6 8 10m
Scale 1:200

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Do not scale from this drawing

Rev.	Description	Date	By
1	Issued for design review	02/04/20	RAS

Farrell & Clark Architects

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Status: SKETCH S1
Client: Kirklees Council
Project: King James's School Expansion
Title: Level 00 GA Layout Proposed OPTION A
Drawn: AZ | Date: Apr' 2020
Check: RAS | Scale: 1 : 200 @A2
Drawing No.: PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER
303_020-FC-03-00-DR-A-0201A | Rev: 1

Department Legend

- Circulation
- basic teaching
- learning resource areas
- staff and administration
- storage
- toilets (and personal care)
- sub-total non-net

OPT A - LEVEL 01 - PROPOSED
1 : 200

AREA ASSESSMENT:

OPTION A GIFA

LEVEL 00 = 555 sq.m.
LEVEL 01 = 525 sq.m.
TOTAL = 1080 sq.m.

0 2 4 6 8 10m
Scale 1:200

Rev.	Description	Date	By
1	Issued for design review	02/04/20	RAS

Farrell & Clark Architects

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Status: SKETCH S1

Client: Kirklees Council

Project: King James's School Expansion

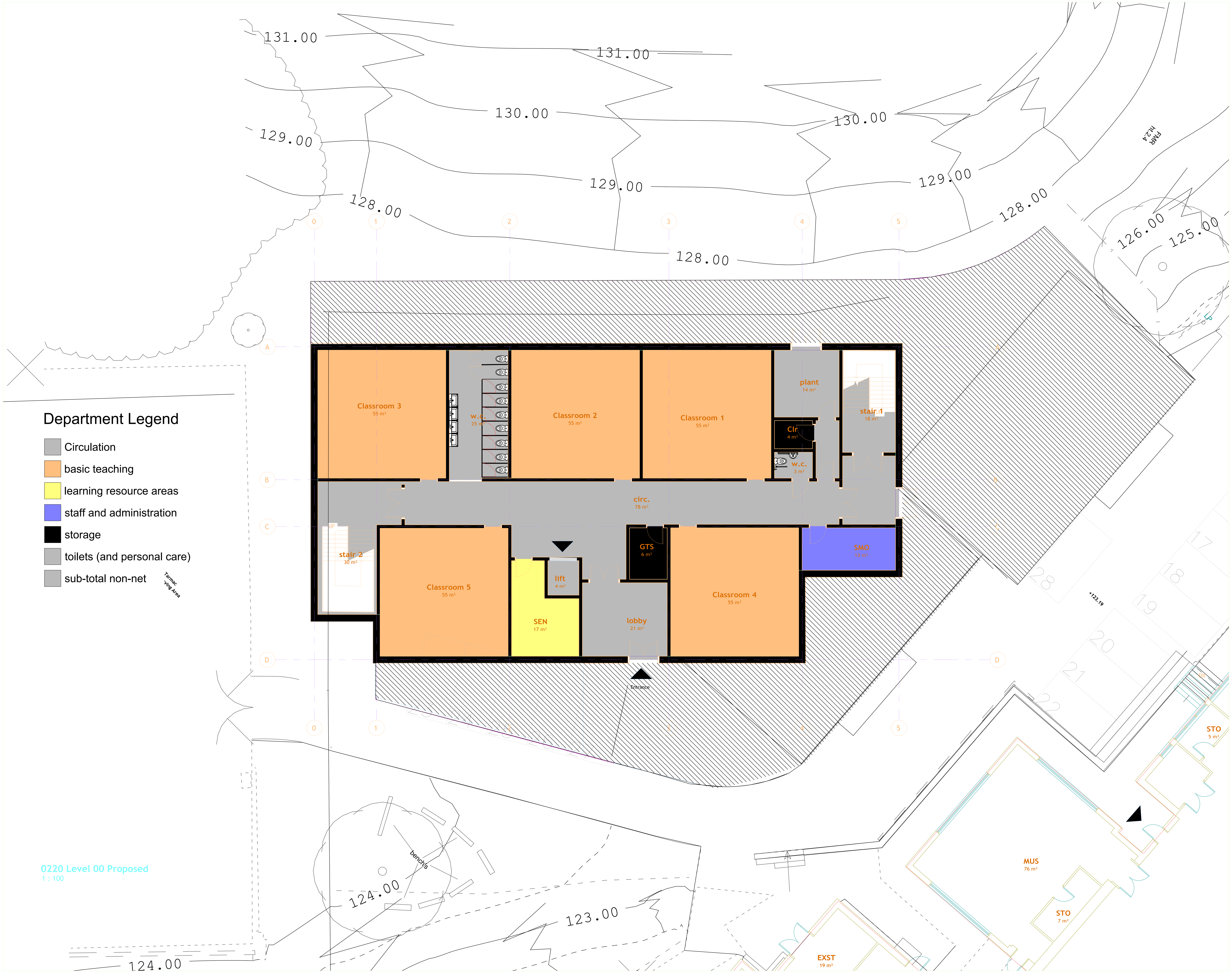
Title: Level 01 GA Layout Proposed OPTION A

Drawn: AZ Date: Apr' 2020

Check: RAS Scale: 1 : 200 @A2

Drawing No.: PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER
303_020-FC-03-01-DR-A-0202A

Rev: 1



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Rev.	Description	Date	By

Scale 1:100

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Status: PRELIMINARY		S0
Client: Kirklees Council		
Project: King James's School Expansion		
Title: Level 00 GA - Proposed		
Drawn: RAS	Date: Apr' 2020	
Check: NJC	Scale: 1 : 100	@A1
Drawing No.: PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER 303_020-FC-03-00-DR-A-0220	Rev:	

Appendix D British Geological Survey Data

BOREHOLE RECORD

Contract No. 14224/96

Client WILLIAM TURNBULL ASSOCIATES

Ground Level

Location SOUTHFIELD ROAD, ALMONDBURY, HUDDERSFIELD 416791

BOREHOLE No. 3

Date APRIL, 1996 415367

Depth	Thick-ness	Legend	Description of Strata	Type of Sample	C kN/m2	M %	Ø	Density kg/m3	N
1.500	1.500		Firm grey brown mottled silty clay	1.000 u	68.6	21		1925	
2.250	0.750		Very stiff grey brown mudstone shale	2.000 p	For 55mm. penetration				50

Water Struck at 1.500m. Standing Water Level

Undisturbed Sample	U
Disturbed Sample	O
Penetration Test	P
Cohesion	C
Angle of Internal Friction	Ø
Moisture Content %	M
Standard Penetration Value	N

J. T. HYMAS (Site Investigation) LTD.

12 Yarm Road, Stockton-on-Tees,
Cleveland TS18 3NE
Tel. 01642 607083 Fax.01642 612355

BOREHOLE RECORD

Contract No. 14224/96 | Client WILLIAM TURNBULL ASSOCIATES

Ground Level | Location SOUTHFIELD ROAD, ALMONDBRY, HUDDERSFIELD 416798 415402

BOREHOLE No. 2 | Date APRIL 1996

Depth	Thick-ness	Legend	Description of Strata	Type of Sample	C kN/m2	M %	Ø	Density kg/m3	N
0.800	0.800		Made up ground - topsoil with occasional brick fill						
				1.000 u	63.5	36		1795	
2.000	1.200		Firm grey brown mottled silty clay						
				2.000 p					34
2.900	0.900		Very compact grey brown weathered sandstone						
3.200	0.300		Very compact light brown sandstone	3.000 p	for 170mm. penetration				50

Water Struck at | Standing Water Level

Undisturbed Sample	U
Disturbed Sample	O
Penetration Test	P
Cohesion	C
Angle of Internal Friction	Ø
Moisture Content %	M
Standard Penetration Value	N

J. T. HYMAS (Site Investigation) LTD.

12 Yarm Road, Stockton-on-Tees,
Cleveland TS18 3NE
Tel. 01642 607083 Fax.01642 612355

BOREHOLE RECORD

Dunelm GEOTECHNICAL • ENVIRONMENTAL

BH No.	R2
	Sheet 1 of 1
Site:	Somerset Road, Huddersfield
Contract No:	Q1119
Client:	JCT 600 (Properties) Ltd
Dates:	29/03/2003
Method:	Rotary openhole boring.
Scale	1:100
Driller:	Drilltec
Logged By:	DB

SAMPLE DETAILS / STRATA RECORD

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (FI)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							Possible MADE GROUND: Brown sandy CLAY.				
							Grey MUDSTONE with bands of grey siltstone noted.	3.50			
						▽ 15					

End of Borehole at 20.00 m

Remarks and Water Observations

1. Groundwater encountered at 15.0m depth.
2. No evidence of broken ground or loss of flush returns.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.

R 2

BOREHOLE RECORD

GEOTECHNICAL • ENVIRONMENTAL

BH No.	R3 Sheet 1 of 1
Site:	Somerset Road, Huddersfield
Contract No:	Q1119
Client:	JCT 600 (Properties) Ltd
Dates:	29/03/2003
Method:	Rotary openhole boring.
Scale	1:100
Driller:	Drilltec
Logged By:	DB

SAMPLE DETAILS / STRATA RECORD

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (FI)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: Black and grey CLAY, SAND and GRAVEL. Gravel includes brick and sandstone. Sand includes ash.	5.20			
							Brown sandy gravelly CLAY.	6.00			
						▽ 12	Grey MUDSTONE with bands of grey siltstone noted.				

End of Borehole at 20.00 m

Remarks and Water Observations

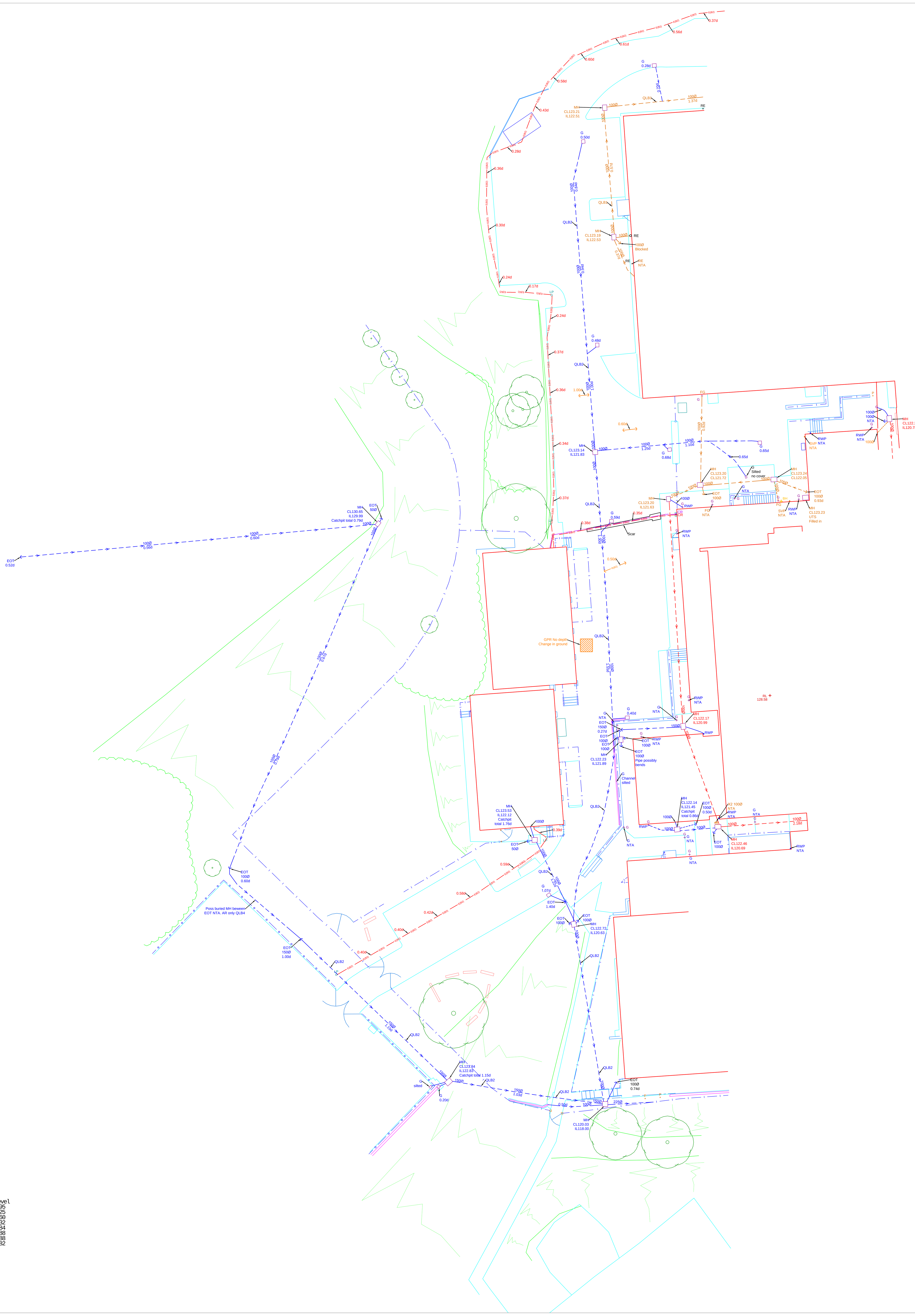
1. Groundwater encountered at 12.0m depth.
2. No evidence of broken ground or loss of flush returns.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.

R 3

Appendix E Existing Drainage Details



Station	Easting	Northing	Level
ST01	417101.054	414847.634	123.195
ST02	417104.288	414808.688	123.125
ST03	417076.791	414826.109	128.060
ST04	417103.139	414778.340	123.032
ST05	417098.744	414761.743	123.184
ST06	417082.254	414749.146	124.088
ST07	417074.310	414769.531	126.088
ST08	417069.484	414806.529	130.982

Topographical Survey -

CT Surveys
Topographic & Building Surveys

THE OLD MILL, HIGHFIELD, TINGLEY
WAKEFIELD WF3 1LA
TEL: 0113 259 7023
MOB: 07949 195764
EMAIL: mail@ct-surveys.com
WEBSITE: www.ct-surveys.com

Disclaimer

The location of under ground services shown on this drawing has been determined using electro-magnetic and GPR radar techniques and visual observations. No guarantee can be given that all services have been shown on the drawing. The relevant service drawings should be obtained from the appropriate service providers company and used in conjunction with this drawing. No guarantee can be given to the accuracy and completeness of any service provider record information shown in this drawing and no liability will be accepted for any losses that arise due to a lack of accuracy in any service providers record information. Reference should also be made to historical plans and as built drawings. Excavations in the vicinity of services should be carried out with due diligence ref: HSG47 document. Location accuracy is determined by referring to manufacturers guidelines for the systems deployed. Reference should be made to the latest version of Discovery Surveys Ltd site procedures document for utility location surveys.

ABBREVIATIONS

AR	ASSUMED ROUTE	NFI	NO FURTHER INFORMATION
BD	BACKDROP	NTA	NO TRANSMITTER ACCESS
BTIC	BRITISH TELECOM CHAMBER	OSA	OUTSIDE SURVEY AREA
CI	CAST IRON	PE	POLYETHALINE
CL	COVER LEVEL	PR	PIPE RISER
CO	CONCRETE	PVC	POLYVINYL CHLORIDE
CP	CABLE PIT	RE	RODDING EYE
CR	CABLE RISER	RWP	RAINWATER PIPE
d	DEPTH IN METRES	SV	STOP VALVE
EM	EARTH MAT	SVP	SOIL VENT PIPE
EP	ELECTRICITY POLE	TFR	TAKEN FROM RECORDS
EOT	END OF TRACE	TP	TELEGRAPH POLE
FE	FENCE EARTH POINT	UDI	UNRELIABLE DEPTH INFO'
FH	FIRE HYDRANT	UTL	UNABLE TO LOCATE
G	GULLY	UTR	UNABLE TO RAISE
GPR	TRACED BY G.P.R.	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GR	GAS RISER	WL	WATER LEVEL
IC	INSPECTION CHAMBER	WR	WATER RISER
IL	INVERT LEVEL	VP	VENT PIPE
LP	LAMP POST	VR	VAPOUR RECOVERY
MH	MANHOLE	WM	WATER METER
MCW	MAINS COLD WATER	WO	WASH OUT VALVE
ND	NO DEPTH (Unable to acquire depth)	WWP	WASTE WATER PIPE

LEGEND

BSI PAS 128 Quality Levels (displayed in linetype)

(A) = Verified by inspection-trial pit, vacuum excavation, inspection chamber/manhole.
(B1) = Detected with GPR & EML - High confidence position and depth.
(B2) = Detected with either GPR or EML - Medium confidence position and depth.
(B3) = Detected with either GPR or EML - No depth - poor signal.
(B4) = Assumed route - not detected - interpreted route.
(C) = Record data located to street furniture - not detected.
(D) = Record data not located- not detected. Taken from records only.
N.B. QL(A) is inferred at all MHs ICs etc unless otherwise stated.

CATV(B2)	CABLE TELEVISION
CCTV(B1)	CLOSED CIRCUIT TELEVISION
COM(B2)	COMMUNICATIONS CABLE
A(B1)	COMPRESSED AIR
D(B2)	DUCTING
E(B1)	ELECTRIC CABLE
EA(B2)	EARTH CABLE
	FOUL WATER SEWER
	COMBINED WATER SEWER
	SURFACE WATER SEWER
F(B2)	FUEL PIPE
G(B1)	GAS PIPE
GL(B2)	GAUGE LINE
H(B1)	HEATING
O(B2)	OFFSET FILL PIPE
R(B2)	RADAR TRACE
T(B1)	TELECOMS CABLE
TL(B2)	TRAFFIC LIGHT CABLE
U(B2)	UNIDENTIFIED SERVICE
VR(B2)	VAPOUR RECOVERY
V(B3)	VENT PIPE
W(B3)	WATER PIPE
	SURVEY BOUNDARY
	END OF TRACE (Signal lost, unless stated otherwise)

N

No.	Revision/Issue	By	Date
-	-	-	-

Discovery Surveys Ltd
Winning Post Centre
MoorendsThorne
Doncaster
DN8 4PB

Project Name and Address

King James School
42a St Helens Gate
Huddersfied
HD4 6SG

06-11-2019

Discovery Surveys Drawing No: CTS 311019 129	Sheet: 1of1
CT Surveys Drawing No: 4687AJB/1	
Scale: 1:200@A0	

Client	Drawn	Approved
Farrell & Clark Architects	JH	SR

Appendix F Greenfield Run-Off Rate and Volume Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	50.000	Urban	0.330
SAAR (mm)	948	Region Number	Region 10

Results	**l/s**
QBAR Rural	129.9
QBAR Urban	218.1
Q1 year	189.8
Q1 year	189.8
Q2 years	212.4
Q5 years	263.0
Q10 years	296.4
Q20 years	327.2
Q25 years	336.0
Q30 years	341.8
Q50 years	360.2
Q100 years	391.4
Q200 years	430.6
Q250 years	442.9
Q1000 years	520.9

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Areal Reduction Factor	1.00
Area (ha)	365.500
SAAR (mm)	884
CWI	121.412
SPR Host	21.940
URBEXT (USER)	0.3300

Results

Percentage Runoff (%)	35.20
Greenfield Runoff Volume (m^3)	94992.979

Appendix G Pre-Development Run-Off Rate and Volume Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.030	4-8	0.007

Total Area Contributing (ha) = 0.037

Total Pipe Volume (m³) = 0.237

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	9.950	1.490	6.7	0.030	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	20.240	2.630	7.7	0.007	0.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.06	122.120	0.030	0.0	0.0	0.0	3.01	23.7	4.1
1.001	50.00	5.18	120.630	0.037	0.0	0.0	0.0	2.80	22.0	5.0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					122.146
1.001	2	15 Winter	1	+0%					120.660

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.074	0.000	0.15		3.4	OK	
1.001	2	-0.070	0.000	0.19		4.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					122.170
1.001	2	15 Winter	30	+0%					120.689

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.050	0.000	0.49		10.8	OK	
1.001	2	-0.041	0.000	0.63		13.4	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+0%					122.185
1.001	2	15 Winter	100	+0%					120.709

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.035	0.000	0.75		16.5	OK	
1.001	2	-0.021	0.000	0.96		20.4	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308

Synthetic Rainfall Details

F (1km)	2.388
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

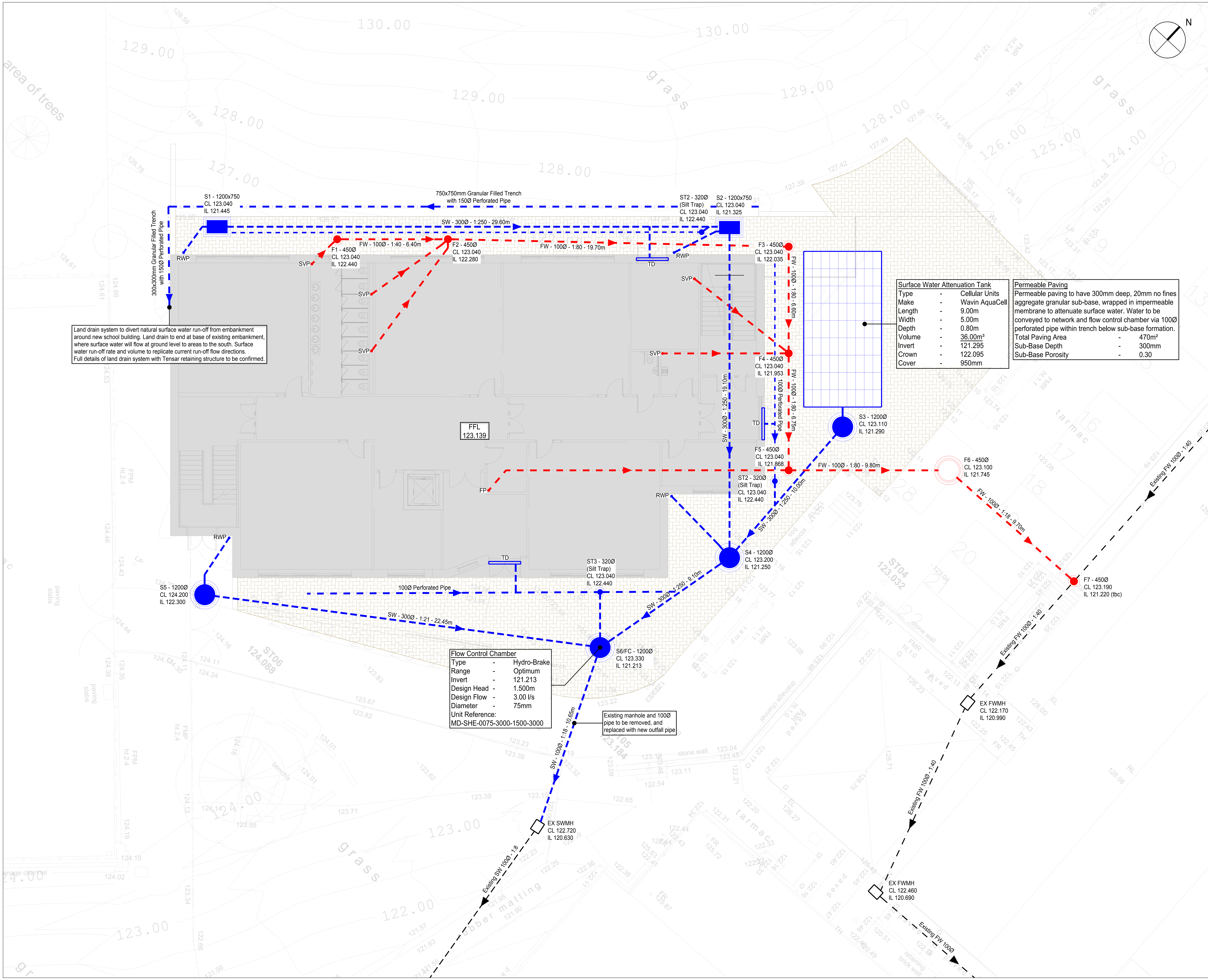
Margin for Flood Risk Warning (mm)	450.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	360
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Summer I+0%	123.530	122.144	-0.076	0.000	0.13
1.001	2	360 minute 100 year Summer I+0%	122.720	120.658	-0.072	0.000	0.17

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1		16.618	2.9	OK
1.001	2		20.517	3.6	OK

Appendix H Surface Water Management Layout and Details



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3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS

Legend

- Proposed Surface Water Drainage
- Perforated Pipe in Paving System
- Existing Surface Water Drainage
- Existing Foul Water Drainage
- Permeable Paving
- Development Extents Boundary

Site Specific Drainage Notes:

Rainwater pipe and internal foul locations to be confirmed by Architect. Discrepancies to be brought to CCS Consulting attention prior to the commencement of drainage works.

Final external levels to be confirmed. Levels currently based on topographical survey levels and finished floor level. Manhole and inspection cover levels subject to change once final external levels are known.

Existing land drainage (to which the proposed is connecting / discharging) location and depth to be confirmed prior to the commencement of any drainage works.

All foul water pipes to be 100Ø, and all surface water pipes to be 150Ø unless shown otherwise.

Foul water down pipes to have rest bend invert of 450mm below finished floor level, unless stated otherwise.

Rainwater pipe to have rest bend invert of 600mm below finished floor level unless stated otherwise.

Drainage Specifications

Foul water pipes to be Polypipe to BS EN 1401-1 or similar.

Surface water pipes to be Polypipe Ridgidrain or similar.

Threshold Drain to be ACO DoorWay Drain or similar

Inspection chambers to be WAVIN OSMA Universal IC or similar.

Manholes by FP McCann or similar.

Attenuation tank to be WAVIN AquaCell Prime or similar.

Silt trap chambers to be Polypipe Mini Silt Trap or similar

Flow control to be a Hydro-Brake by Hydro International or similar

rev	amendments	by	date
T3	Flow Control Details Amended	MDS	21.10.20
T2	SW Network Amended	MDS	14.08.20
T1	Issued for Tender	MDS	31.07.20
P1	Issued for Planning	MDS	30.09.19

ccs consulting

Client:
King James School

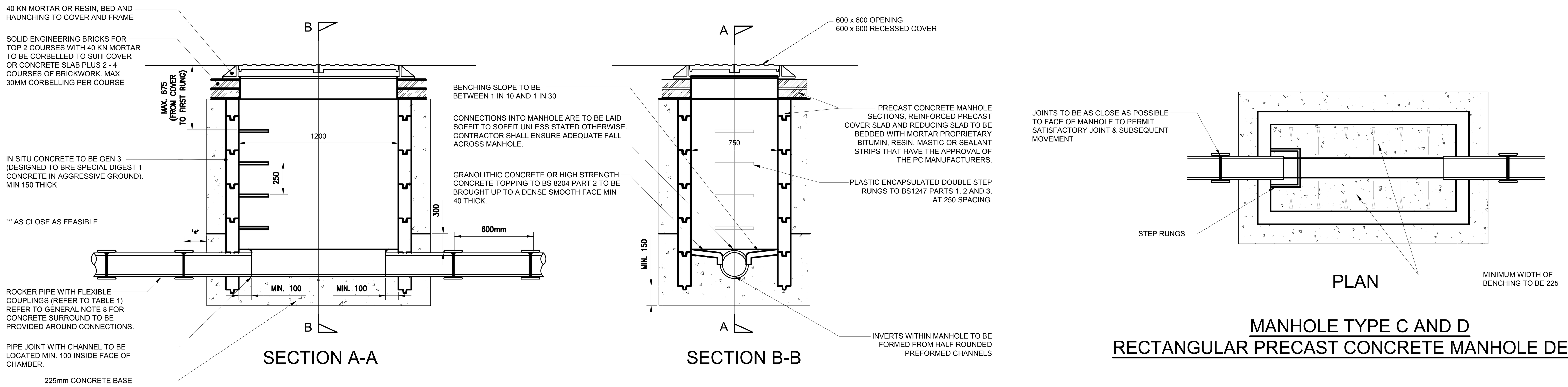
Project:
King James School Extension

Title:
Surface Water Management Layout

Drawing Status:	Date Created:	Drawing Scale:
Tender	Apr '20	1:100@A1

LE-020 / A1 / 100 T3

Project Leader:	Drawn By:	Initial Review:
LB	MS	LB

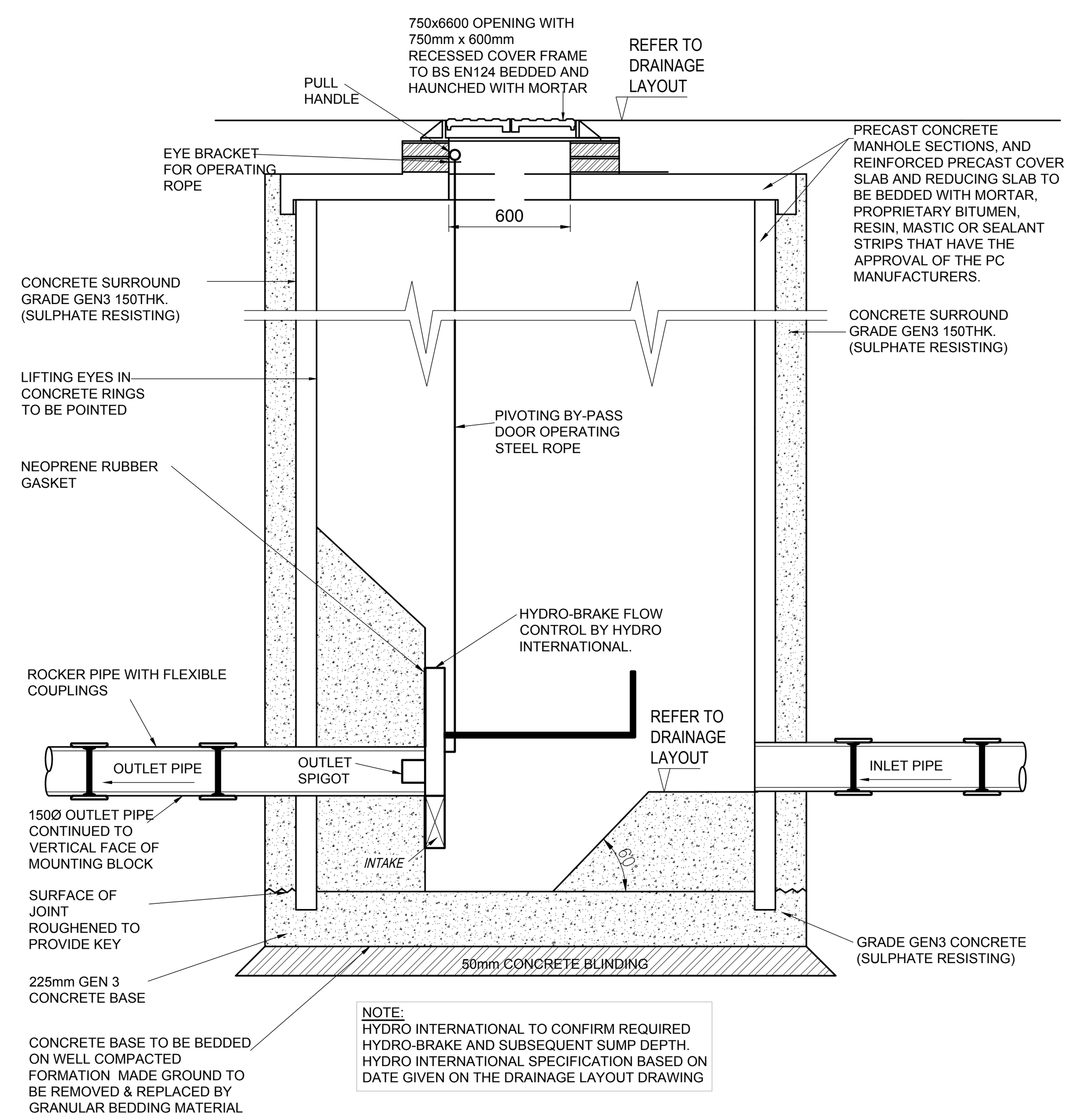


SECTION A-A

SECTION B-B

PLAN

MANHOLE TYPE C AND D
RECTANGULAR PRECAST CONCRETE MANHOLE DETAIL



FLOW CONTROL MANHOLE DETAIL

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CONTROL MANHOLE NOTES

ALL DIMENSION ARE IN MILLIMETERS

PRECAST CONCRETE UNITS TO BE BS5911 PART 200 AND TO BE CONSTRUCTED WITH A MINIMUM CLASS 3 SULPHATE RISISTING CEMENT.

ALL INSITU CONCRETE TO BE CLASS STANDARD MIX ST4 (GRADE C20) IN ACCORDANCE WITH SECTION 4 OF BS5328 PART 2.

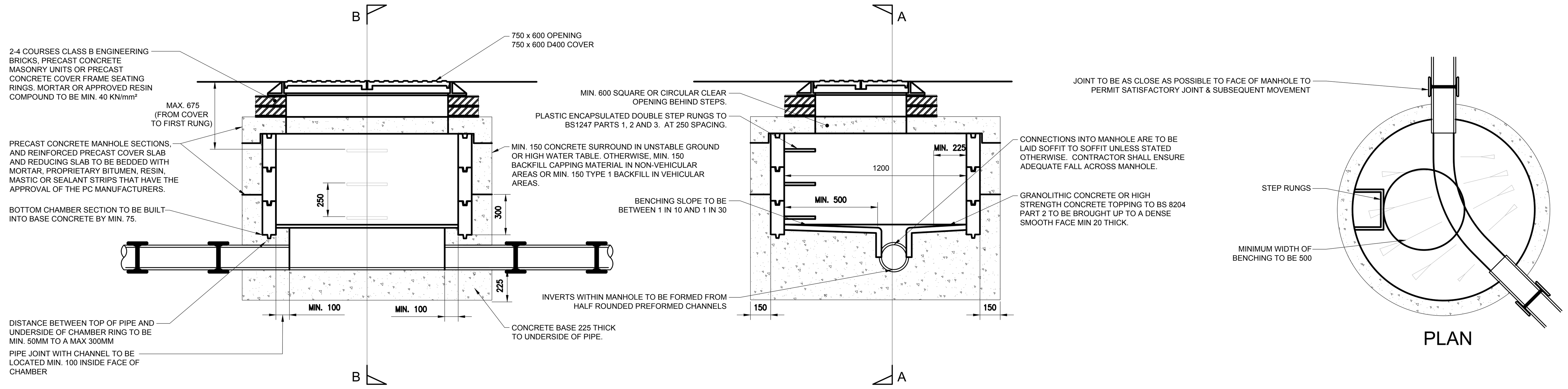
MATERIALS FOR JOINTING MANHOLE RINGS TO BE A RUBBER BITUMEN COMPOUND OF APPROVED MANUFACTURER 'TOKSTRIP' OR SIMILAR.

ALL BRICKWORK TO BE CLASS B ENGINEERING -2 COURSES MIN:4 COURSES MAX; 225mm THICK - BS5628 PART 3.

20mm THICK GRANOLITHIC CONCRETE BENCHING TO BE BROUGHT UP TO A DENSE SMOOTH FACE NEATLY SHAPED AND FINISHED TO ALL BRANCH CONNECTIONS. WHERE BENCHING IS LESS THAN 450mm WIDE, SLOPE TO BE 1:10; MORE THAN 450mm, 1:30

PIPES ENTERING MANHOLES TO HAVE A FLEXIBLE JOINT AS CLOSE AS FEASIBLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH THE PIPE IS BUILT IN ORDER TO FACILITATE MOVEMENT OF THE JOINT.

THE LENGTH OF THE NEXT PIPE (ROCKER PIPELINES, BEDDING, LAYING AND JOINTING OF PIPES AND BACKFILLING OF TRENCHES SHALL BE IN ACCORDANCE WITH THE W.S.A.SPEC 'SEWERS FOR ADOPTION' - 6TH EDITION TOGETHER WITH ANY LOCAL AUTHORITY REQUIREMENTS.

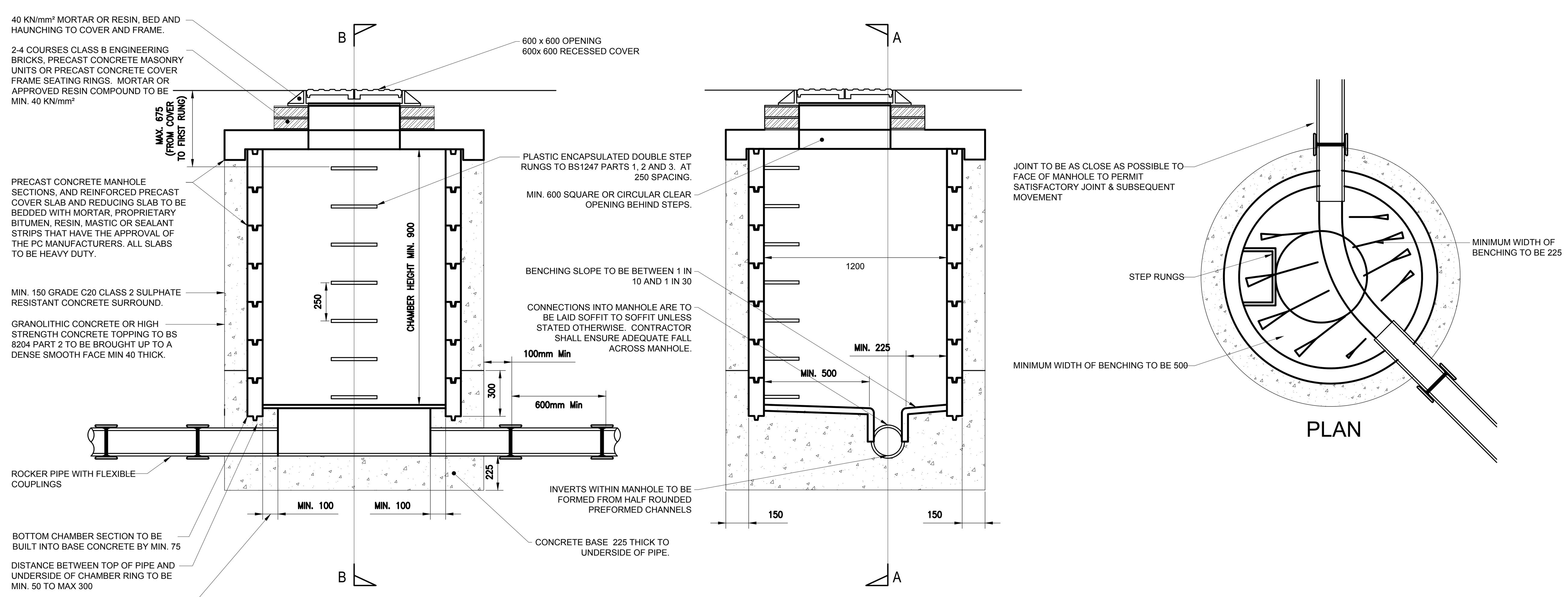


SECTION A-A

SECTION B-B

PLAN

MANHOLE TYPE E AND F
CIRCULAR PRECAST CONCRETE MANHOLE DETAIL

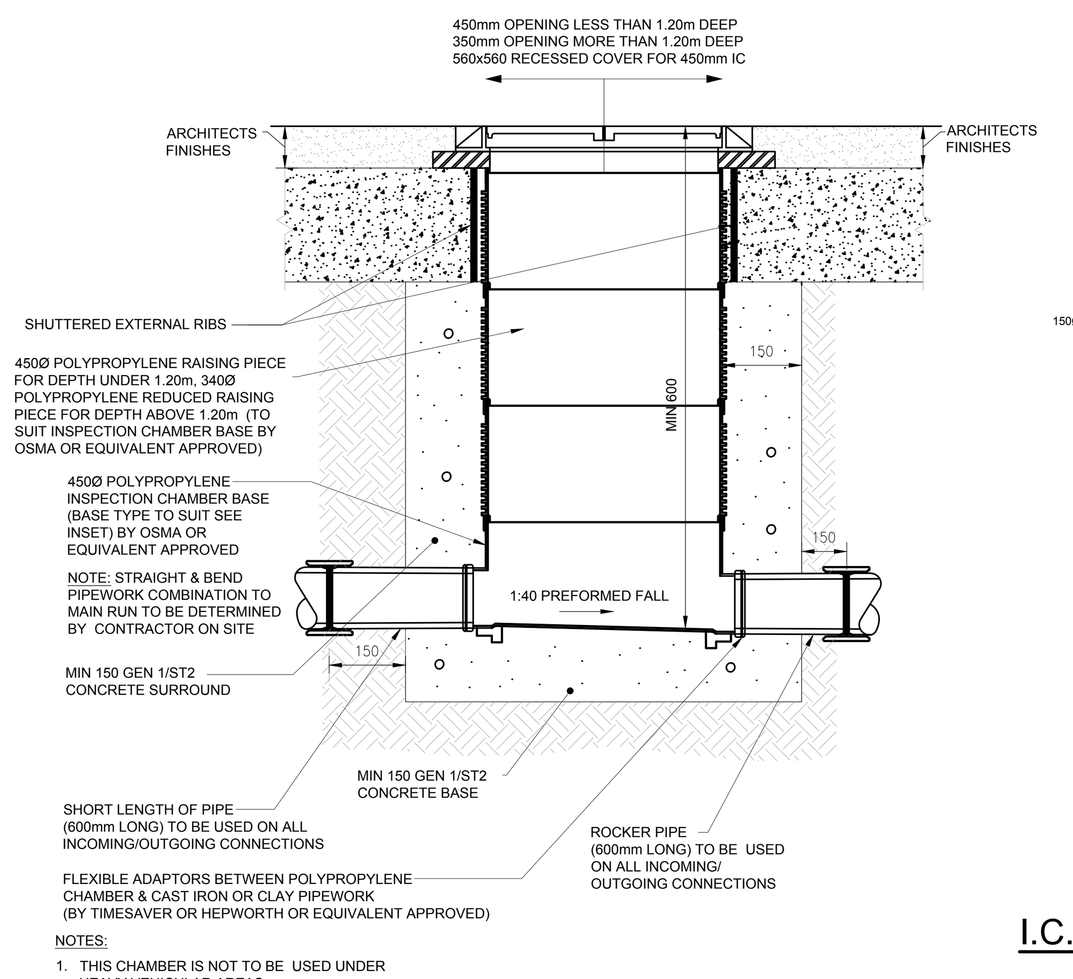


SECTION A-A

SECTION B-B

PLAN

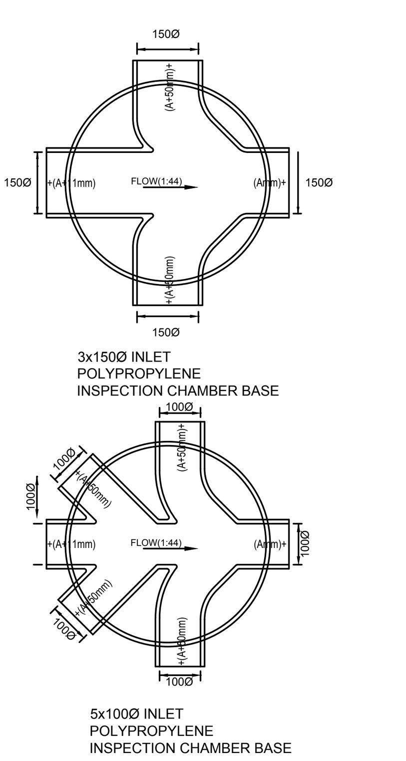
MANHOLE TYPE B
CIRCULAR PRECAST CONCRETE MANHOLE DETAIL



NOTES:
1. THIS CHAMBER IS NOT TO BE USED UNDER HEAVY VEHICULAR AREAS.
2. MAXIMUM INCOMING/OUTGOING PIPE DIAMETER SHALL BE 100 OR 150Ø.

PPIC
POLYPROPYLENE INSPECTION CHAMBER

NOTE:
COVERS TO BE ORIENTATED BY CONTRACTOR ON SITE TO SUIT PAVEMENT FINISHES.
COVERS SHOULD NOT STRADDLE TWO PAVEMENT FINISHES.



I.C. TYPE 2 BASE TYPES

T1	Issued for Tender	MDS	31.07.20
rev	amendments	by	date

consulting

Client:
King James School

Project:
King James School Extension

Title:
Drainage Details Sheet 1

Drawing Status:	Date Created:	Drawing Scale:
Tender	July '20	N.T.S

LE-020 / A1 / 102 T1

Project Leader:	Drawn By:	Initial Review:
LB	MS	LB

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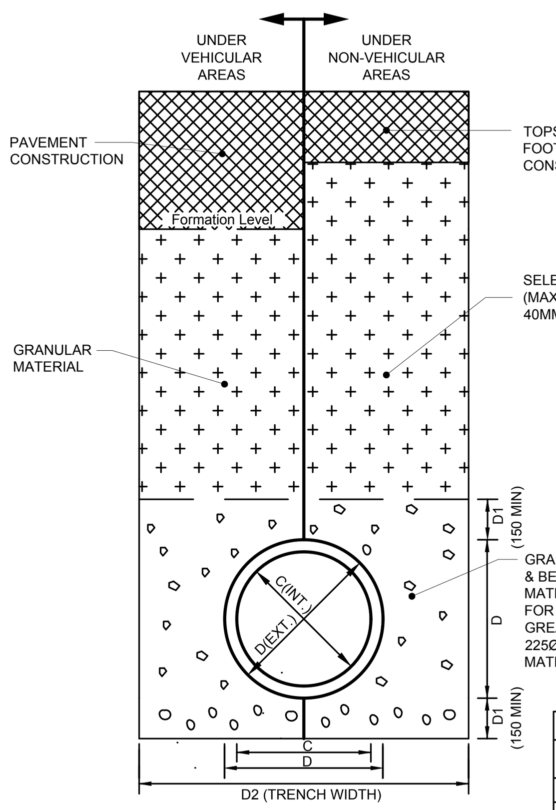


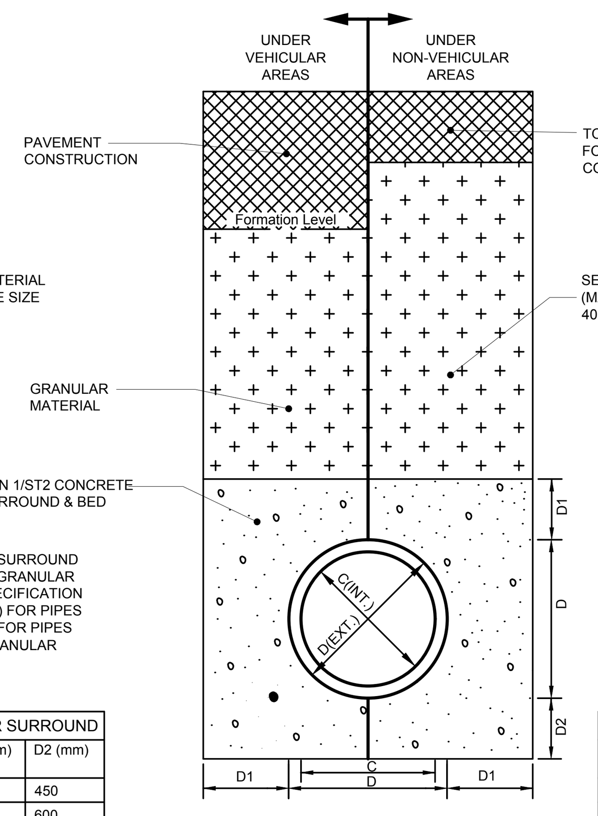
TO BE USED UNDER:

1. VEHICULAR AREAS WHERE COVER TO PIPE SOFFIT IS GREATER THAN 900mm.
2. ALL NON-VEHICULAR AREAS WHERE COVER TO PIPE SOFFIT IS GREATER THAN 600mm.

NOTE:
ALL PIPEWORK SHALL HAVE FLEXIBLE COUPLINGS

MIN. GRANULAR SURROUND		
PIPE Ø (C) (mm)	D1 (mm)	D2 (mm)
100	150	450
150	150	600
225	150	700
300	150	850
375	200	1050
450	200	1150
525	200	1200
600	200	1350
675	200	1450
750	200	1500

CLASS S PIPE BEDDING & SURROUND
(TO BE USED FOR PLASTIC, VITRIFIED CLAY & CONCRETE PIPEWORK)



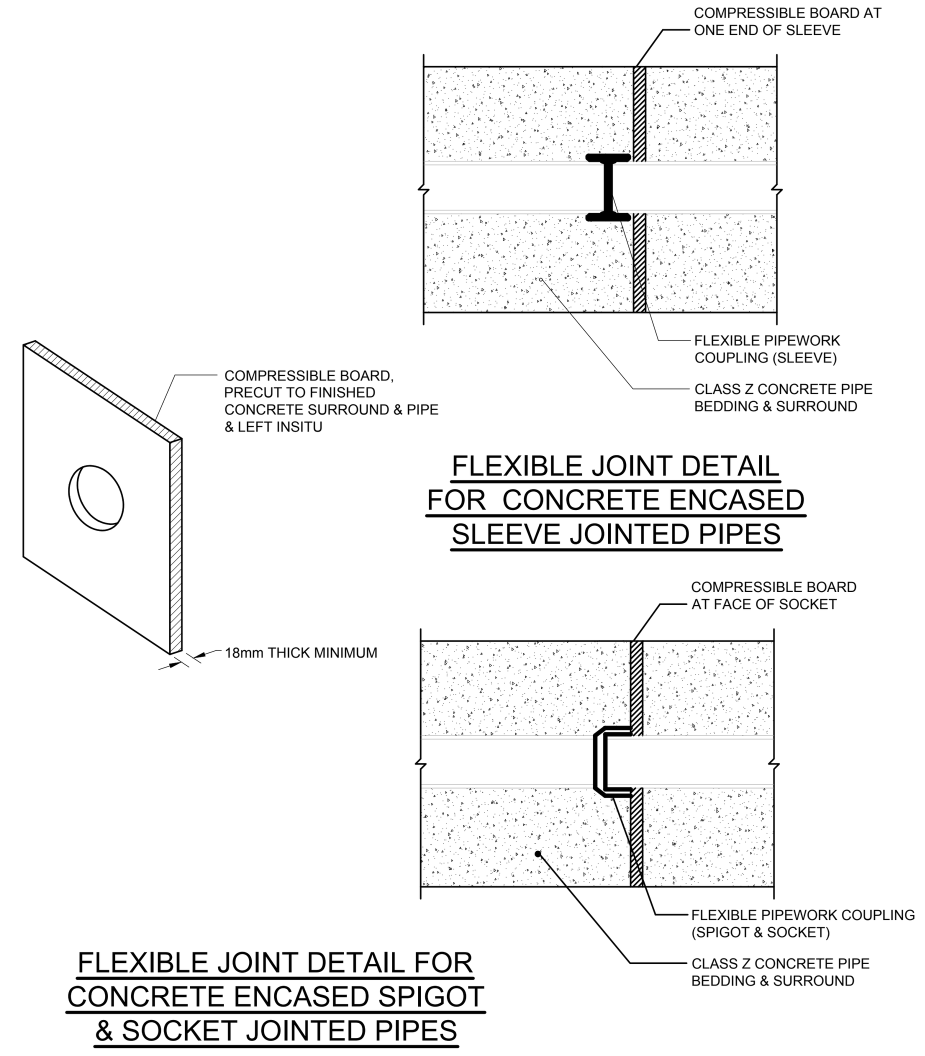
TO BE USED UNDER:

1. VEHICULAR AREAS WHERE COVER TO PIPE SOFFIT IS EQUAL TO OR LESS THAN 900mm.
2. ALL NON-VEHICULAR AREAS WHERE COVER TO PIPE SOFFIT IS EQUAL TO OR LESS THAN 600mm.

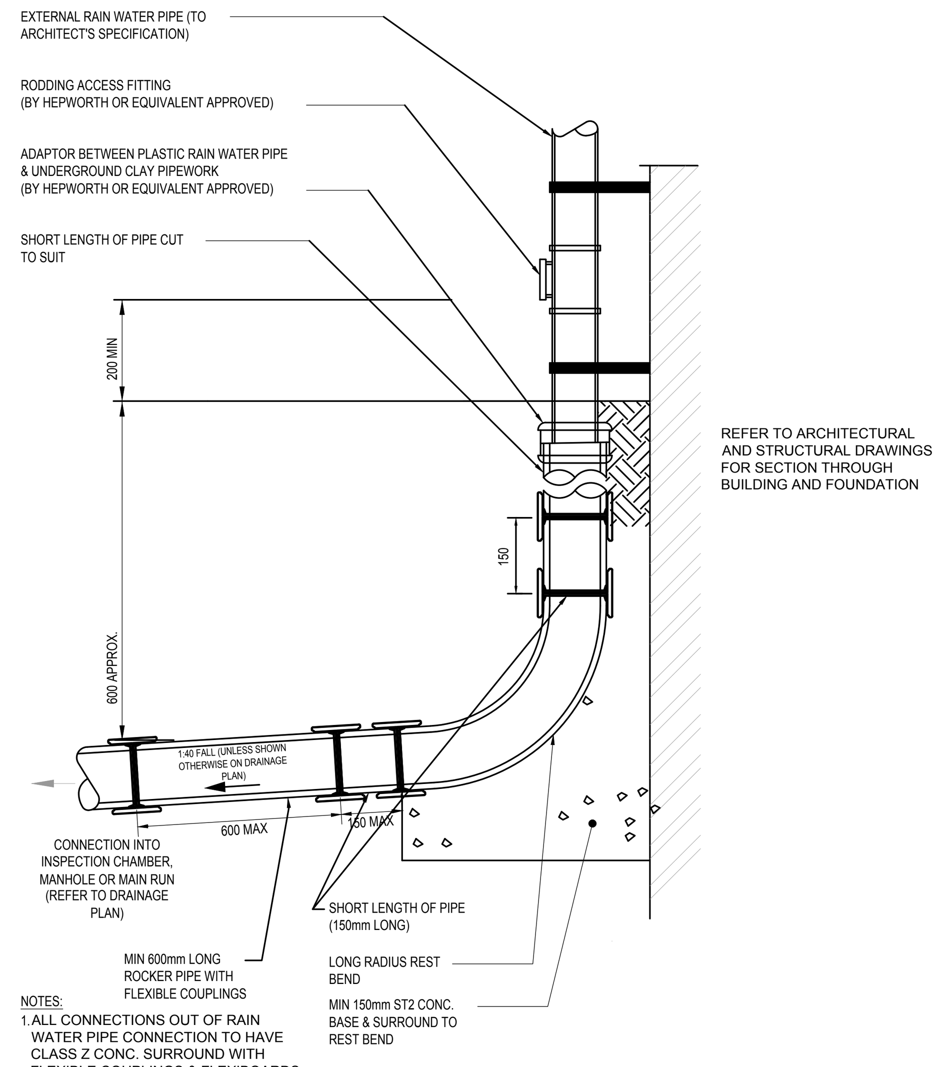
NOTE:
ALL PIPEWORK WITH CLASS Z (GEN 3/ST4) CONCRETE SURROUND SHALL HAVE FLEXIBLE COUPLINGS WITH FLEXI-BOARDS ON ALL JOINTS (REFER TO DETAIL D8)

MIN. CONCRETE ENCASEMENT		
PIPE Ø (C) (mm)	D1 (mm)	D2 (mm)
100-600	150	150
675	150	170
750	150	190
825	150	210
900	150	225
975	150	250
1050	150	270
1200	170	300
1350	180	350
1500	200	375
1650	220	420

CLASS Z PIPE BEDDING & SURROUND
(TO BE USED FOR PLASTIC, VITRIFIED CLAY & CONCRETE PIPEWORK)

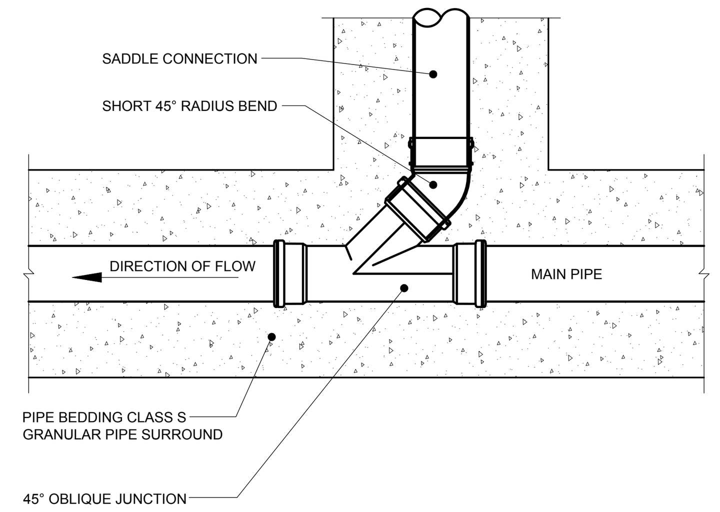


FLEXIBLE JOINT DETAIL FOR CONCRETE ENCASED PIPES
(TO B.S. 1142)

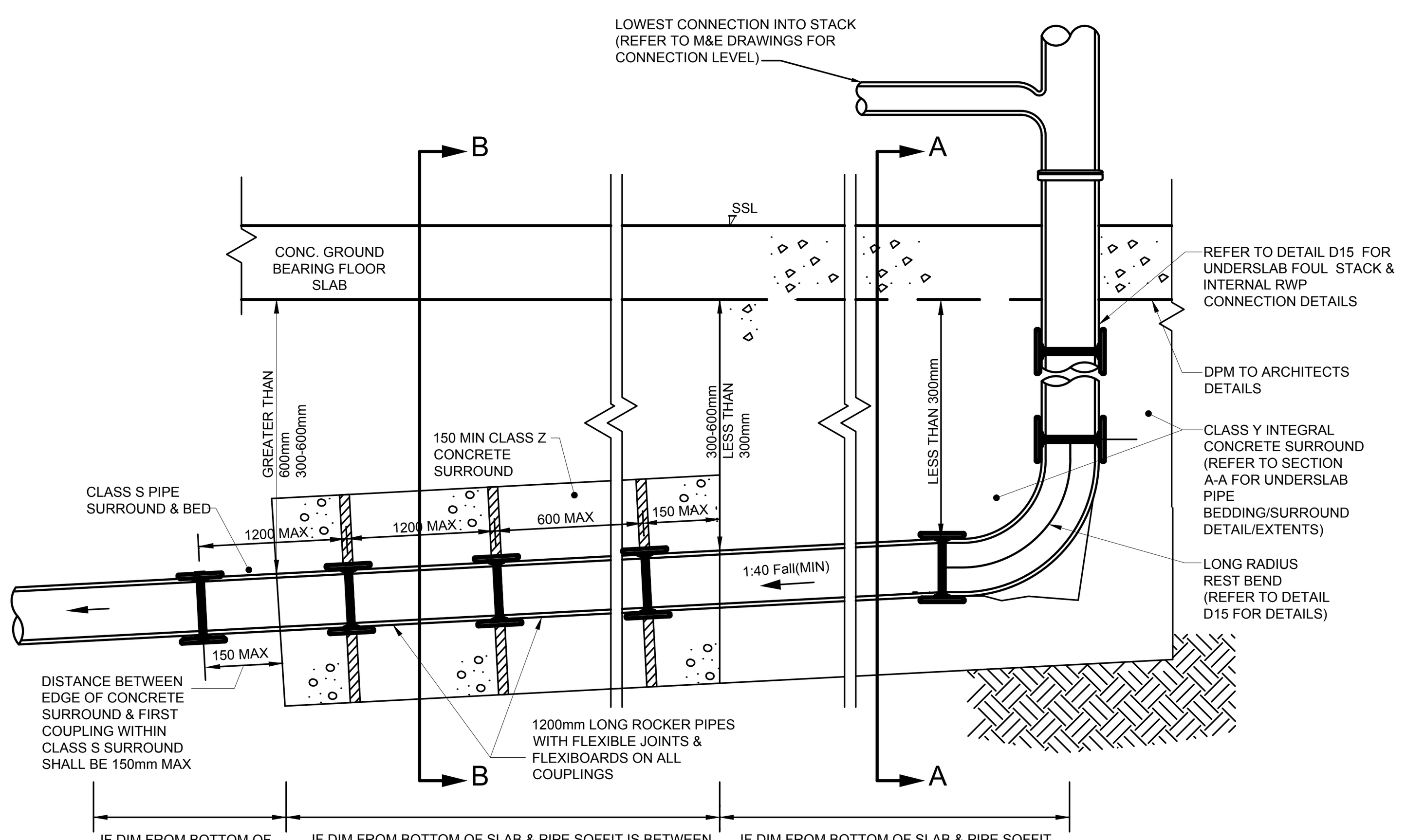


NOTES:
1. ALL CONNECTIONS OUT OF RAIN WATER PIPE CONNECTION TO HAVE CLASS Z CONC. SURROUND WITH FLEXIBLE COUPLINGS & FLEXIBOARDS ON ALL COUPLINGS WHERE COVER TO PIPE SOFFIT IS EQUAL TO OR LESS THAN 900mm UNDER MEDIUM/LIGHT VEHICULAR AREAS & EQUAL TO OR LESS THAN 600mm UNDER NON-VEHICULAR AREAS.

TYPICAL RODDABLE
RAIN WATER PIPE CONNECTION



TYPICAL 45° PIPE JUNCTION CONNECTION DETAIL



IF DIM FROM BOTTOM OF SLAB & PIPE SOFFIT IS GREATER THAN 600mm CLASS S SURROUND & BED SHALL BE USED

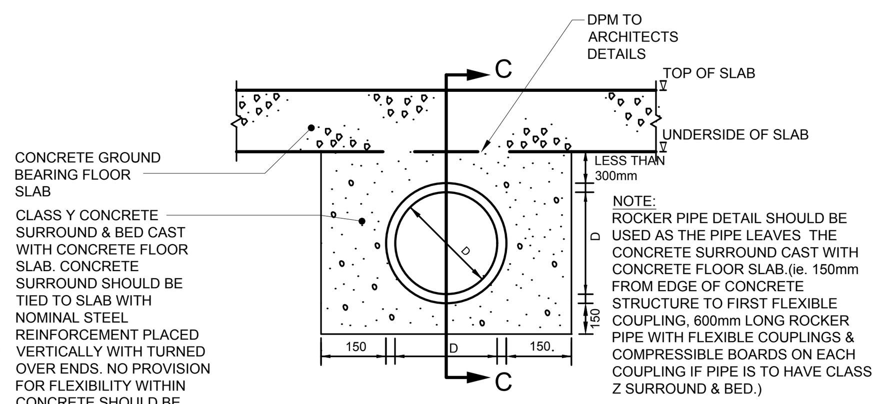
IF DIM FROM BOTTOM OF SLAB & PIPE SOFFIT IS BETWEEN 300-600mm PIPEWORK SHALL BE SURROUNDED IN 150 MIN CLASS Z CONCRETE WITH FLEXIBLE JOINTS & FLEXIBOARDS ON ALL COUPLINGS (REFER TO SECTION B-B FOR DETAILS)

IF DIM FROM BOTTOM OF SLAB & PIPE SOFFIT IS LESS THAN 300mm PIPEWORK SHALL BE CAST IN 150 MIN CLASS Y CONCRETE SURROUND CAST & INTEGRAL WITH REINFORCED GROUND SLAB (REFER TO SECTION A-A FOR DETAILS)

SECTION C-C

NOTES:
1. THIS DETAIL SHALL ONLY BE USED UNDER AREAS OF GROUND BEARING SLAB WHERE UNDER SLAB PIPEWORK CAN BE SUPPORTED BY UNDER SLAB FILL MATERIAL.
2. CONNECTION INTO INTERNAL MANHOLE OR MAIN UNDER SLAB RUN OR EXIT THROUGH FOUNDATION EDGE DETAIL AS PER DETAIL D (REFER TO DRAINAGE PLAN)

TYPICAL UNDERSLAB PIPE BEDDING DETAILS FOR PIPEWORK UNDER GROUND BEARING SLAB
(FOR ALL UNDER SLAB PIPE DEPTHS)

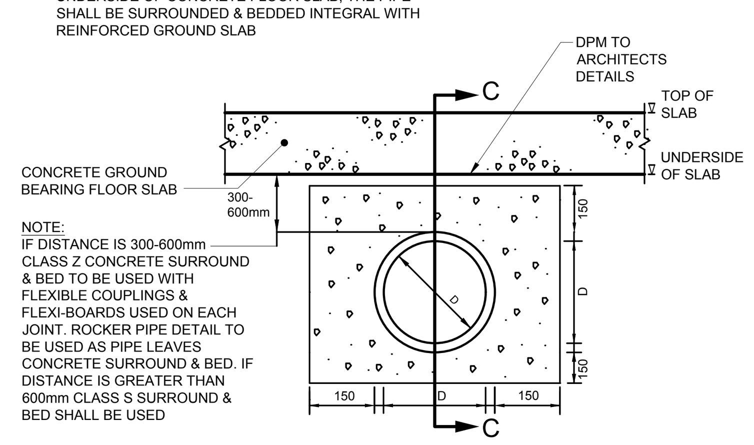


CLASS Y CONCRETE SURROUND & BED CAST WITH CONCRETE FLOOR SLAB. CONCRETE SURROUND SHOULD BE TIED TO SLAB WITH NOMINAL STEEL REINFORCEMENT PLACED VERTICALLY WITH TURNED OVER ENDS. NO PROVISION FOR FLEXIBILITY WITHIN CONCRETE SHOULD BE MADE.

NOTE:
ROCKER PIPE DETAIL SHOULD BE USED AS THE PIPE LEAVES THE CONCRETE SURROUND CAST WITH CONCRETE FLOOR SLAB.(ie. 150mm FROM EDGE OF CONCRETE STRUCTURE TO FIRST FLEXIBLE COUPLING. 600mm LONG ROCKER PIPE WITH FLEXIBLE COUPLINGS & COMPRESSIBLE BOARDS ON EACH COUPLING IF PIPE IS TO HAVE CLASS Z SURROUND & BED.)

SECTION A-A
WHERE DISTANCE BETWEEN PIPE SOFFIT & UNDERSIDE OF CONCRETE GROUND BEARING FLOOR SLAB/GROUND BEAM IS LESS THAN 300mm

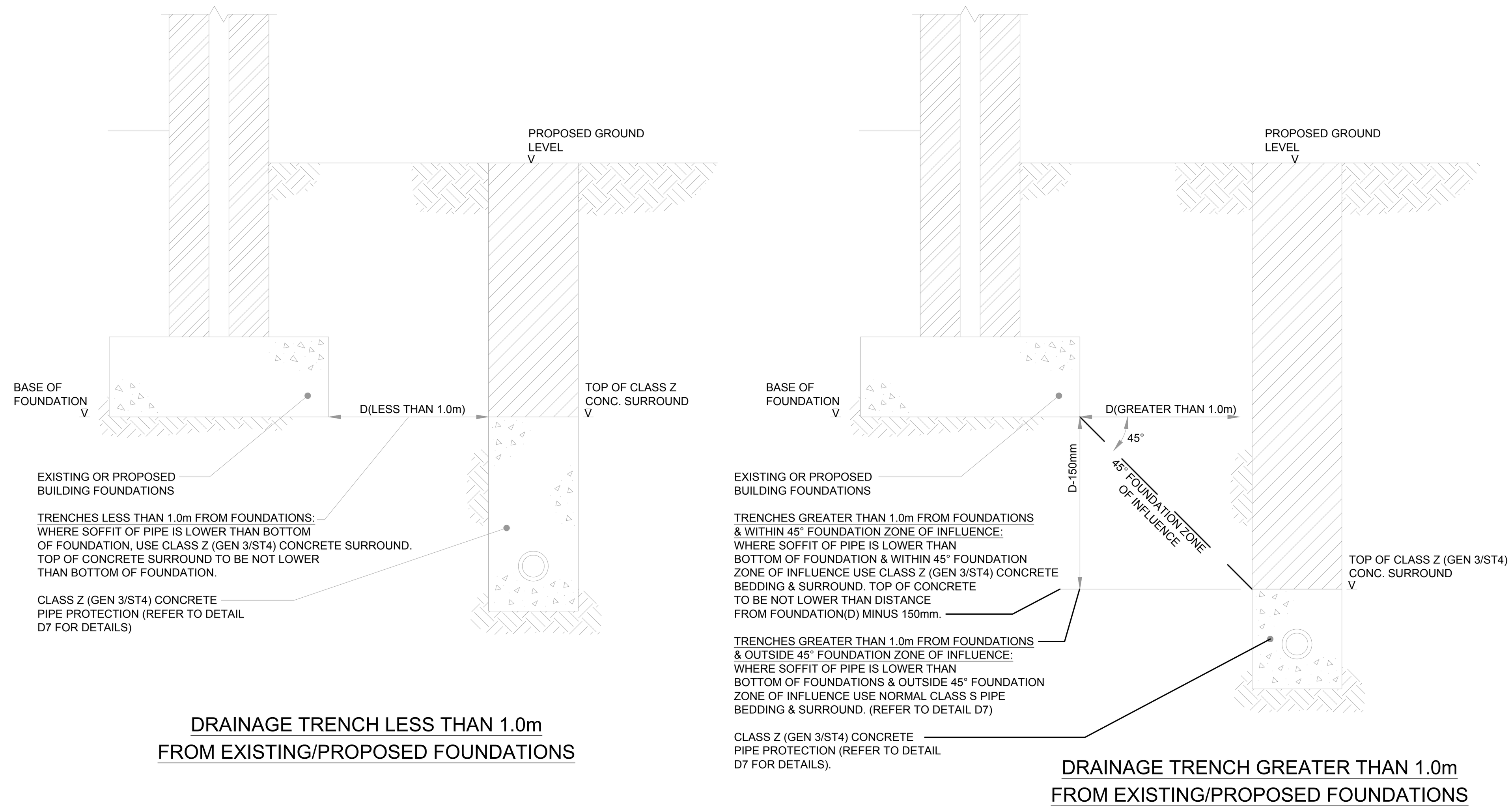
WHERE SOFFIT OF PIPE IS WITHIN 300mm OF UNDERSIDE OF CONCRETE FLOOR SLAB, THE PIPE SHALL BE SURROUNDED & BEDDED INTEGRAL WITH REINFORCED GROUND SLAB



NOTE:
IF DISTANCE IS 300-600mm CLASS Z CONCRETE SURROUND & BED TO BE USED WITH FLEXIBLE COUPLINGS & FLEXI-BOARDS USED ON EACH JOINT. ROCKER PIPE DETAIL TO BE USED AS PIPE LEAVES CONCRETE SURROUND & BED. IF DISTANCE IS GREATER THAN 600mm CLASS S SURROUND & BED SHALL BE USED

WHERE SOFFIT OF PIPE IS BETWEEN 300 & 600mm FROM UNDERSIDE OF CONCRETE FLOOR SLAB, THE PIPE SHALL BE SURROUNDED & BEDDED IN ST4 CONCRETE. WHERE THIS DISTANCE EXCEEDS 600mm THE PIPE SHALL BE SURROUNDED & BEDDED IN GRANULAR MATERIAL

SECTION B-B
WHERE DISTANCE BETWEEN PIPE SOFFIT & UNDERSIDE OF CONCRETE GROUND BEARING FLOOR SLAB/GROUND BEAM IS GREATER THAN 300mm



PIPE PROTECTION ADJACENT TO EXISTING/PROPOSED FOUNDATIONS

T1	Issued for Tender	MDS	31.07.20
rev	amendments	by	date

ccs consulting

Client:
King James School

Project:
King James School Extension

Title:
Drainage Details Sheet 2

Drawing Status:	Date Created:	Drawing Scale:
Tender	July '20	N.T.S

LE-020 / A1 / 103 T1

Project Leader:	Drawn By:	Initial Review:
LB	MS	LB

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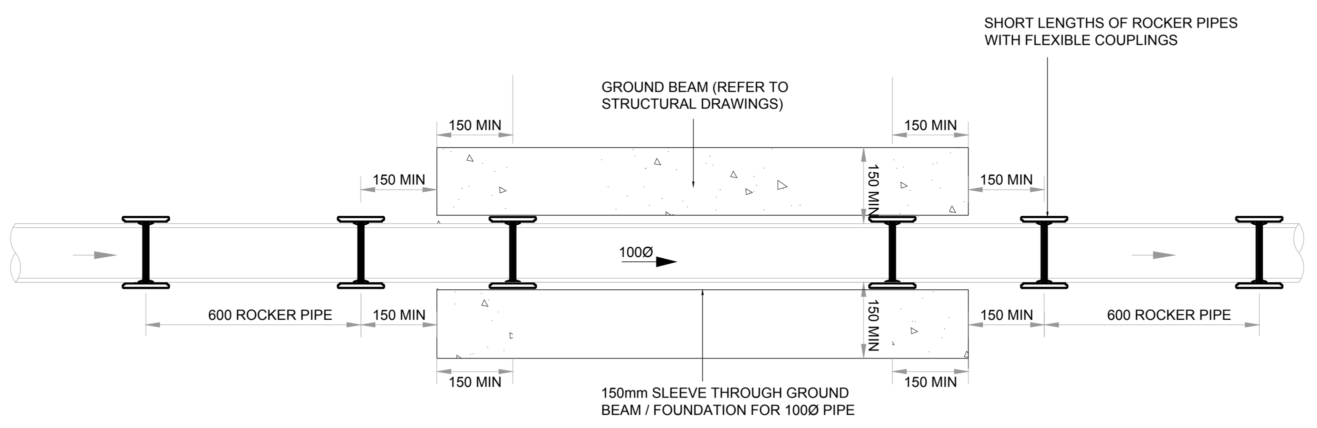
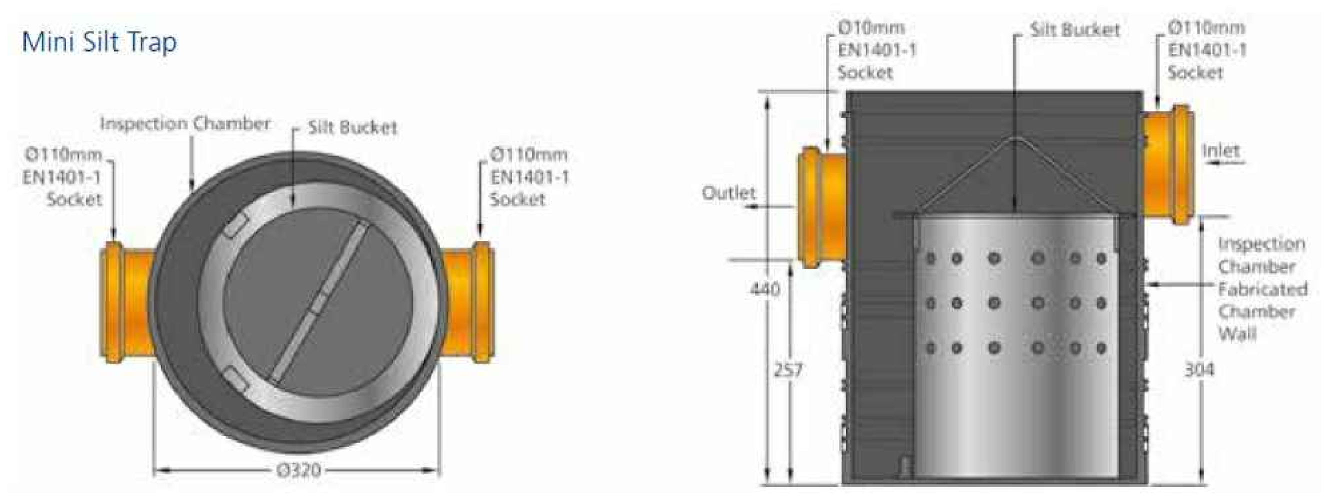
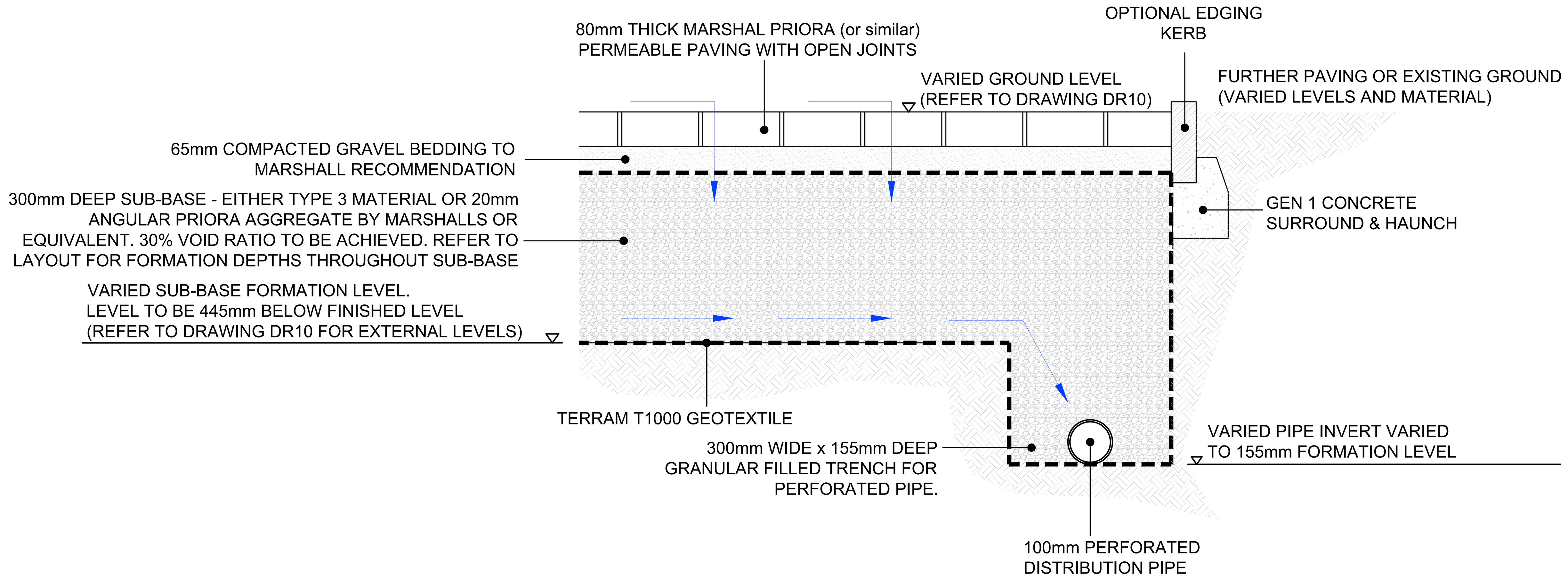
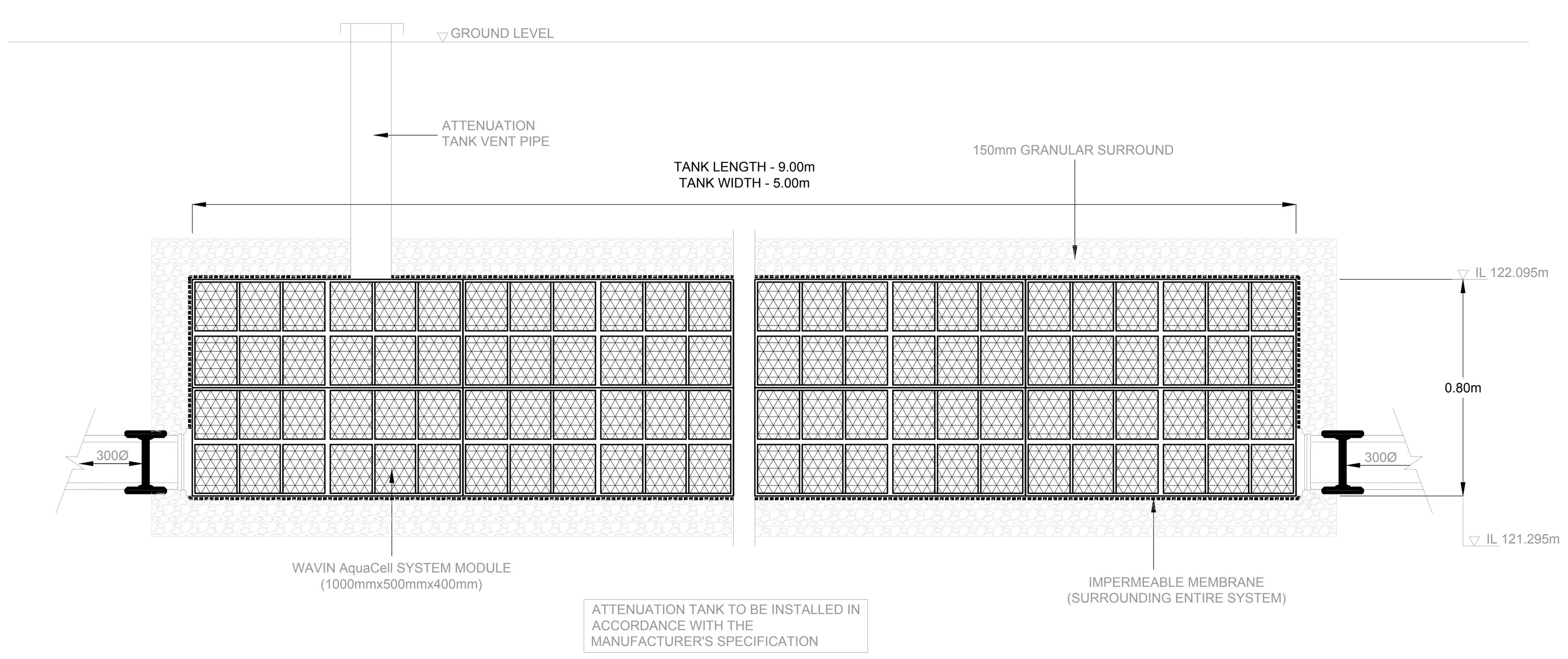


TYPICAL PIPE THROUGH GROUND BEAM / FOUNDATION DETAIL

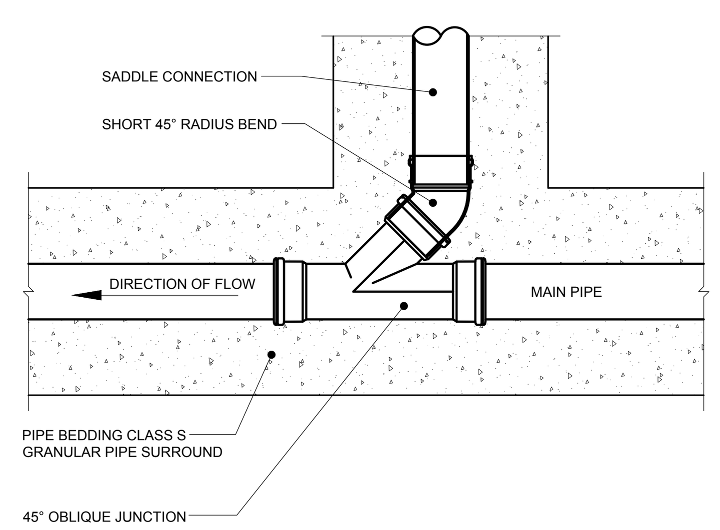




PERMEABLE PAVING DRAINAGE DETAIL



ATTENUATION TANK DETAIL



TYPICAL 45° PIPE JUNCTION CONNECTION DETAIL

T1	Issued for Tender	MDS	31.07.20
rev	amendments	by	date

ccs consulting

Client:
King James School

Project:
King James School Extension

Title:
Drainage Details Sheet 3

Drawing Status:	Date Created:	Drawing Scale:
Tender	July '20	N.T.S

LE-020 / A1 / 104 T1

Project Leader:	Drawn By:	Initial Review:
LB	MS	LB

Appendix I Surface Water Network / Management Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	40
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.063	4-8	0.018

Total Area Contributing (ha) = 0.081

Total Pipe Volume (m³) = 7.132

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	29.600	0.120	246.7	0.022	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	19.100	0.075	254.7	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	10.000	0.040	250.0	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	9.100	0.037	245.9	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	22.450	1.087	20.7	0.027	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	10.650	0.583	18.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.50	121.445	0.022	0.0	0.0	1.2	1.00	70.4	4.2
1.001	50.00	5.82	121.325	0.038	0.0	0.0	2.1	0.98	69.3	7.2
2.000	50.00	5.17	121.290	0.000	0.0	0.0	0.0	0.99	70.0	0.0
1.002	50.00	5.97	121.250	0.054	0.0	0.0	2.9	1.00	70.5	10.2
3.000	50.00	5.11	122.300	0.027	0.0	0.0	1.5	3.48	245.6	5.1
1.003	50.00	6.02	121.213	0.081	0.0	0.0	4.4	3.70	261.2	15.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	123.040	1.595	Open Manhole	1200 x 750	1.000	121.445	300				
S2	123.040	1.715	Open Manhole	1200 x 750	1.001	121.325	300	1.000	121.325	300	
S3	123.110	1.820	Open Manhole	1200	2.000	121.290	300				
S4	123.200	1.950	Open Manhole	1200	1.002	121.250	300	1.001	121.250	300	
								2.000	121.250	300	
S5	124.200	1.900	Open Manhole	450	3.000	122.300	300				
S6/FC	123.330	2.117	Open Manhole	1200	1.003	121.213	300	1.002	121.213	300	
								3.000	121.213	300	
EX SWMH	123.530	2.900	Open Manhole	0		OUTFALL		1.003	120.630	300	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	S1	123.040	121.445	1.295	Open Manhole	1200 x 750
1.001	o	300	S2	123.040	121.325	1.415	Open Manhole	1200 x 750
2.000	o	300	S3	123.110	121.290	1.520	Open Manhole	1200
1.002	o	300	S4	123.200	121.250	1.650	Open Manhole	1200
3.000	o	300	S5	124.200	122.300	1.600	Open Manhole	450
1.003	o	300	S6/FC	123.330	121.213	1.817	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	29.600	246.7	S2	123.040	121.325	1.415	Open Manhole	1200 x 750
1.001	19.100	254.7	S4	123.200	121.250	1.650	Open Manhole	1200
2.000	10.000	250.0	S4	123.200	121.250	1.650	Open Manhole	1200
1.002	9.100	245.9	S6/FC	123.330	121.213	1.817	Open Manhole	1200
3.000	22.450	20.7	S6/FC	123.330	121.213	1.817	Open Manhole	1200
1.003	10.650	18.3	EX SWMH	123.530	120.630	2.600	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	EX SWMH	123.530	120.630	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	4

Simulation Criteria for Storm

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6/FC, DS/PN: 1.003, Volume (m^3): 4.5

Unit Reference	MD-SHE-0075-3000-1500-3000
Design Head (m)	1.500
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	121.213
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.500	3.0
Flush-Flo™	0.329	2.6
Kick-Flo®	0.671	2.1
Mean Flow over Head Range	-	2.4

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.5
Max Percolation (l/s)	20.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	122.640	Cap Volume Depth (m)	0.300

Cellular Storage Manhole: S3, DS/PN: 2.000

Invert Level (m)	121.295	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	45.0	0.0	2.600	0.0	0.0
0.200	45.0	0.0	2.800	0.0	0.0
0.400	45.0	0.0	3.000	0.0	0.0
0.600	45.0	0.0	3.200	0.0	0.0
0.800	45.0	0.0	3.400	0.0	0.0
1.000	0.0	0.0	3.600	0.0	0.0
1.200	0.0	0.0	3.800	0.0	0.0
1.400	0.0	0.0	4.000	0.0	0.0
1.600	0.0	0.0	4.200	0.0	0.0
1.800	0.0	0.0	4.400	0.0	0.0
2.000	0.0	0.0	4.600	0.0	0.0
2.200	0.0	0.0	4.800	0.0	0.0
2.400	0.0	0.0	5.000	0.0	0.0

Porous Car Park Manhole: S4, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	27.5
Max Percolation (l/s)	76.4	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	122.800	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: S6/FC, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	33.3	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	122.930	Cap Volume Depth (m)	0.300

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	1	+0%	100/15 Summer				121.490
1.001	S2	15 Winter	1	+0%	30/15 Summer				121.412
2.000	S3	60 Winter	1	+0%	30/60 Winter				121.340
1.002	S4	15 Winter	1	+0%	30/15 Summer				121.405
3.000	S5	15 Winter	1	+0%	100/120 Winter				122.328
1.003	S6/FC	15 Winter	1	+0%	30/15 Summer				121.405

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.255	0.000	0.05		3.4	OK	
1.001	S2	-0.213	0.000	0.08		4.7	OK	
2.000	S3	-0.250	0.000	0.02		1.1	OK	
1.002	S4	-0.145	0.000	0.03		1.8	OK	
3.000	S5	-0.272	0.000	0.02		4.3	OK	
1.003	S6/FC	-0.108	0.000	0.01		2.3	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	30	+0%	100/15 Summer				121.649
1.001	S2	15 Winter	30	+0%	30/15 Summer				121.636
2.000	S3	120 Winter	30	+0%	30/60 Winter				121.618
1.002	S4	15 Winter	30	+0%	30/15 Summer				121.619
3.000	S5	15 Winter	30	+0%	100/120 Winter				122.349
1.003	S6/FC	15 Winter	30	+0%	30/15 Summer				121.636

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.096	0.000	0.16		10.2	OK	
1.001	S2	0.011	0.000	0.28		16.8	SURCHARGED	
2.000	S3	0.028	0.000	0.04		2.0	SURCHARGED	
1.002	S4	0.069	0.000	0.04		2.3	SURCHARGED	
3.000	S5	-0.251	0.000	0.06		13.7	OK	
1.003	S6/FC	0.123	0.000	0.01		2.5	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	240 Winter	100	+40%	100/15 Summer				122.752
1.001	S2	240 Winter	100	+40%	30/15 Summer				122.751
2.000	S3	240 Winter	100	+40%	30/60 Winter				122.752
1.002	S4	240 Winter	100	+40%	30/15 Summer				122.752
3.000	S5	240 Winter	100	+40%	100/120 Winter				122.752
1.003	S6/FC	240 Winter	100	+40%	30/15 Summer				122.751

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	1.007	0.000	0.06		3.9	FLOOD RISK	
1.001	S2	1.126	0.000	0.11		6.7	FLOOD RISK	
2.000	S3	1.162	0.000	0.05		2.5	FLOOD RISK	
1.002	S4	1.202	0.000	0.05		2.8	FLOOD RISK	
3.000	S5	0.152	0.000	0.02		5.1	SURCHARGED	
1.003	S6/FC	1.238	0.000	0.02		3.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	40
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308

Synthetic Rainfall Details

F (1km)	2.388
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 417200 414500 SE 17200 14500
C (1km)	-0.026
D1 (1km)	0.397
D2 (1km)	0.421
D3 (1km)	0.308
E (1km)	0.308
F (1km)	2.388
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	360
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	360 minute 100 year Winter I+40%	123.040	122.716	0.971	0.000	0.05
1.001	S2	360 minute 100 year Winter I+40%	123.040	122.715	1.090	0.000	0.08
2.000	S3	360 minute 100 year Winter I+40%	123.110	122.716	1.126	0.000	0.04
1.002	S4	360 minute 100 year Winter I+40%	123.200	122.716	1.166	0.000	0.05
3.000	S5	360 minute 100 year Winter I+40%	124.200	122.716	0.116	0.000	0.02
1.003	S6/FC	360 minute 100 year Winter I+40%	123.330	122.715	1.202	0.000	0.02

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m^3)	Pipe Flow (l/s)	Status
1.000	S1		26.745	3.0	FLOOD RISK
1.001	S2		45.622	5.0	FLOOD RISK
2.000	S3		0.090	2.5	FLOOD RISK
1.002	S4		63.253	2.7	SURCHARGED
3.000	S5		32.822	3.8	SURCHARGED
1.003	S6/FC		95.977	3.0	SURCHARGED