



Penistone Grammar Phase 2,  
Penistone,  
Sheffield

Drainage Strategy Report

**Project number:** 3317

**Date:** September 2018

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## Document Control Sheet

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## Executive Summary

This report details the drainage strategy for a proposed two-storey extension to Penistone Grammar School.

The proposed extension is located on greenfield land, as such greenfield runoff rates will apply. A minimum discharge rate of 5l/s will be utilised to reduce the risk of blockages. Intrusive investigations revealed the underlying geology to be variable depths of Made Ground, overlying the Pennine Lower Coal Measures Formation. Therefore, given the cohesive nature of the underlying geology infiltration is not a viable SuDS technique.

The existing School surface water drainage discharges, via existing flow controls, to the south of the site before ultimately outfalling into the nearby Scout Dike and ultimately the River Don. Therefore, surface water runoff from the proposed extension will discharge, at a restricted rate, into the local watercourses via the existing private surface water drainage on site. The restricted discharge rate will generate surface water attenuation which will be contained within oversized pipes prior to connection.

There is no residual flood risk from the development site to the surrounding district due to the mimicking of existing storm water flow rates. Therefore, the development does not increase the risk of flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100-year plus climate change event may occur within the development site and is classed as exceedance flows. Flood water from this event will be contained within the development site and directed away from the building to the external hard and soft landscaped areas.

Foul water generated by the development will be discharged into the existing private foul drains on site prior to discharging into the existing 150mm diameter Yorkshire Water Combined Sewer in Huddersfield Road to the west. The foul discharge does not present an increased flood risk to the surrounding district.

## 1.0 Introduction

- 1.1 Scott Hughes Design (SHD) has been appointed by Penistone Grammar School to prepare this Drainage Strategy Report to support the planning application for the proposed two storey extension to the existing School. The assessment has been undertaken in line with the new 'National Planning Policy Framework' (NPPF) Technical Guidance on Flood Risk.
- 1.2 This report has been commissioned by Penistone Grammar School and is specific to their interests in the Penistone Grammar Phase 2 development proposals as described by the Architectural plan in Appendix A.
- 1.3 The report has been commissioned to identify any drainage related issues associated with the proposed development and which are subsequently addressed within this report;
  - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
  - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
  - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
  - Devise an appropriate outline foul water drainage strategy.
  - Consider the recommendations of the Barnsley Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA).
  - Assess mitigation measures & off-site impacts and define any residual risks.

## 2.0 Development Description and Location

### 2.1 Site Location

The site is referenced in Table 1, and a site location map is provided in Appendix A.

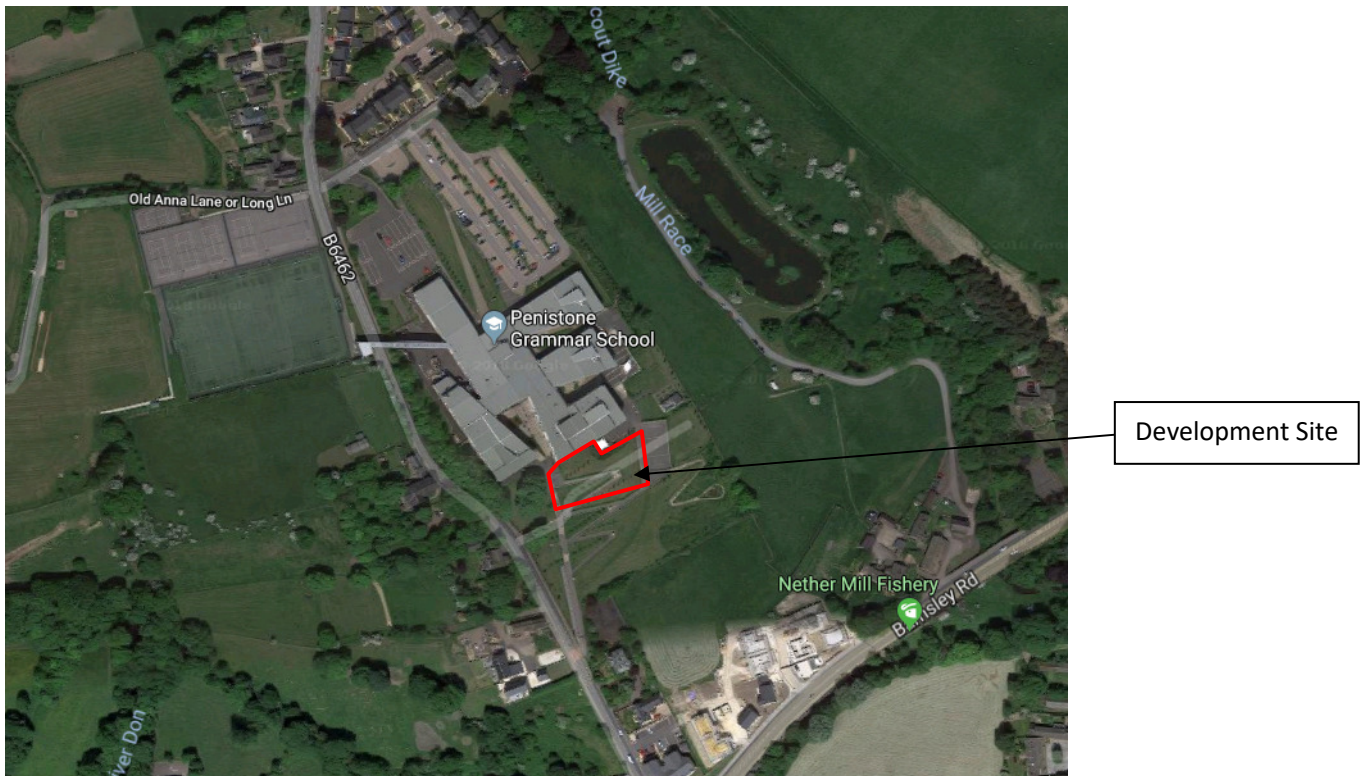
**Table 1: Site Referencing Information**

Item	Brief Description
Site name	Penistone Grammar Phase 2
Site address and location	Penistone Grammar School, Huddersfield Road, Penistone, Sheffield, S36 7BX
Council Area	Barnsley Metropolitan Borough Council
Approximate Grid Reference	OS: 424348, 403957
General Locality	The site is located some 1.3km to the northwest of Penistone Town Centre.

### 2.2 Existing Site Description

- 2.2.1 Penistone Grammar School is comprised an irregularly shaped School building, cark parking, hardstanding sports pitches and landscaped areas.
- 2.2.2 Penistone Grammar School is bordered to the north by residential properties. Huddersfield Road borders the site to the west. Undeveloped agricultural land borders the site to the east and south, beyond which lies Scout Dike and farm buildings respectively. The proposed extension is situated to the south of the existing School building on an area of soft landscaping.
- 2.2.3 Figure 1 (from Google Maps) below identifies the overall site location details.

**Figure 1 - Site Location Plan**



## 2.3 Development Proposals

- 2.3.1 As discussed in the earlier sections, the report is prepared to support a planning application for a proposed extension to Penistone Grammar School.
- 2.3.2 The proposed development area is approximately 0.25ha.
- 2.3.3 The current outline Architectural Master Plan in Appendix A provides an indication of the proposals of the site.

### **3.0 Planning Policy and Consultation**

#### **3.1 Strategic Flood Risk Assessment (SFRA)**

3.1.1 SFRA's assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area; how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that Regional Planning Bodies (RPB's) or Local Planning Authorities (LPA's) should prepare SFRA's in consultation with the EA.

3.2.2 JBA Consulting were commissioned by Barnsley Metropolitan Borough Council (MBC) to undertake a review and update of the existing Strategic Flood Risk Assessment (SFRA); the revised report was published in September 2010. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.3 A summary of the main elements from the SFRA associated with the development site is detailed below. The full report can be found on the Barnsley Metropolitan Borough Council website.

- SFRA provides a detailed understanding of flood risks across the borough from all sources.
- Penistone is not listed as an area that is susceptible to groundwater flooding.
- The site is not shown as being at risk of flood from fluvial or surface water sources.
- The sit is not within an Internal Drainage Board boundary.
- Development should aim to deliver greenfield runoff rates on greenfield sites up to a 1 in 100 year storm event, considering climate change.
- Development should be designed so that there is no flooding to the development in a 1 in 30 year event and so that there is no property flooding in a 1 in 100 year plus climate change event.
- For all sites, development proposals should look at opportunities to incorporate SuDS to reduce the risk of surface water flooding.

## 4.0 Outline Drainage Strategy

### 4.1 Existing Surface Water Runoff

- 4.1.1 The proposed extension is situated on an existing soft landscaped area, where much of the existing runoff will infiltrate into the ground.
- 4.1.2 As the existing site is soft landscaping, greenfield runoff rates will apply as shown in table 2 below. These rates have been calculated using the IH124 method in MicroDrainage Source Control software.

**Table 2 – Existing Runoff Rates**

	Permeable Area (m <sup>2</sup> )	1 Year (l/s)	Qbar (l/s)	30 Year (l/s)	100 year (l/s)
Soft Landscaping	2500	0.6	0.7	1.3	1.7

### 4.2 Statutory Authority Correspondence

- 4.2.1 The SFRA for Barnsley Metropolitan Borough Council states that developments should aim to deliver greenfield runoff rates on greenfield sites up to a 1 in 100 year storm event, considering climate change.

### 4.3 Geology

- 4.3.1 The site is underlain by between 1.0m and 2.25m of Made Ground. The Pennine Lower Coal Measures Formation was encountered in all trial pits, generally comprising weak yellow/brown mudstone, recovered as fine to coarse sub-granular sandy gravel of mudstone.
- 4.3.1 The Pennine Lower Coal Measure Formation is classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- 4.3.2 Based on the cohesive nature of the underlying geology, soakaways are not a viable SuDS technique.

### 4.4 Sustainable Drainage Systems

#### 4.4.1 SuDS Objectives:

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts

from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

#### 4.4.2 SuDS's Design Themes

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individuals plot structure, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area of land.

#### 4.4.3 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

#### 4.4.4 SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- **Land Use Characteristics:** The size and type of the development plot restricts the range of source control and site control SuDS devices to potentially be considered both above and below ground.
- **Site Characteristics:** The cohesive underlying geology means infiltration is not a viable SuDS technique.
- **Catchment Characteristics:** The site is currently greenfield; the proposed discharge rate will be a minimum 5l/s to avoid blockages.
- **Environmental and Amenity Performance:** The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. Safety to all

future occupiers is paramount and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

#### 4.4.5 SuDS Methods

Tables 3 and 4, below, provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the development.

**Table 3: Surface SuDS Methods**

Method	Comment	Suitability for Development
Green Roofs	<ul style="list-style-type: none"> <li>Can be used on suitable low rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.</li> </ul>	<p><i>Suitable:</i></p> <ul style="list-style-type: none"> <li>Architectural proposals for the development deem this suitable.</li> </ul>
Water Butts	<ul style="list-style-type: none"> <li>Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.</li> </ul>	<p><i>Not suitable:</i></p> <ul style="list-style-type: none"> <li>Not suited to school developments due to health and safety concerns.</li> </ul>
Rainwater Harvesting	<ul style="list-style-type: none"> <li>Rainwater harvesting reduces the total runoff volume from the developed site, and reduces treated water consumption.</li> </ul>	<p><i>Not Suitable:</i></p> <ul style="list-style-type: none"> <li>Additional costs of installation would have severe effect on viability of the development.</li> <li>Running and maintenance costs would not be acceptable to our client and future occupiers.</li> <li>The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs.</li> </ul>
Infiltration Options	<ul style="list-style-type: none"> <li>Reduces total run off volume from the development.</li> </ul>	<p><i>Not Suitable:</i></p> <ul style="list-style-type: none"> <li>Cohesive underlying geology means infiltration is not viable.</li> </ul>

Method	Comment	Suitability for Development
Permeable Surfacing (Infiltration)	<ul style="list-style-type: none"> <li>Reduces total run off volume from the development.</li> <li>Can be used to enhance water quality.</li> </ul>	<p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>Cohesive underlying geology means infiltration is not viable.</li> </ul>
Permeable Surfacing (Standard)	<ul style="list-style-type: none"> <li>Can be used to enhance quality of runoff water.</li> <li>Sub-base provides 'source' storage and reduces the volume of storage downstream.</li> <li>The storage can be created with selection of the stone fill or use of plastic box stems.</li> <li>Impermeable membrane at base of construction to prevent impact on pavement stability.</li> </ul>	<p><u>Not Suitable:</u></p> <ul style="list-style-type: none"> <li>Cohesive underlying geology means infiltration is not viable.</li> </ul>
Swales, basins and ponds	<ul style="list-style-type: none"> <li>Provide areas for above ground surface runoff storage.</li> <li>Swales also allow filtering of particulate matter, improving water quality</li> </ul>	<p><u>Not suitable:</u></p> <ul style="list-style-type: none"> <li>Space constraints on site do not permit large above ground areas for surface water storage.</li> <li>No scope to reduce development area due to site viability.</li> </ul>
Bio-Retention	<ul style="list-style-type: none"> <li>Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.</li> </ul>	<p><u>Not suitable:</u></p> <ul style="list-style-type: none"> <li>Space constraints on site do not permit large above ground areas for surface water storage.</li> <li>No scope to reduce development area due to site viability.</li> </ul>

**Table 4: Sub-Surface SuDS Methods**

Method	Comment	Suitability for Development
Geocellular Storage	<ul style="list-style-type: none"> <li>Suitable for sites with insufficient space for basins etc.</li> <li>Suitable for sites where topography prevents the use of open basins etc.</li> <li>Can be very effective infiltration devices subject to ground conditions.</li> </ul>	<p><i>Suitable:</i></p> <ul style="list-style-type: none"> <li>The use of geocellular attenuation may be possible to retain excess storm water.</li> </ul>
Large Diameter Pipes, Culverts or Tanks	<ul style="list-style-type: none"> <li>Suitable for sites with insufficient space for basins etc.</li> <li>Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning.</li> <li>Generally be suitable for adoption by the statutory water company (e.g. United Utilities).</li> </ul>	<p><i>Suitable:</i></p> <ul style="list-style-type: none"> <li>The use of oversized pipes may be possible to retain excess storm water.</li> </ul>

4.4.6 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 3 and 4, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

**Table 5: SuDS Hierarchal Approach**

Method	Suitability	Suitability for Development
Infiltration to Ground	No	Cohesive underlying geology indicates infiltration is not a viable technique.
Connection to Watercourse	Yes	All existing surface water drainage discharges into Scout Dike to the east and ultimately the River Don.
Connection to Surface Water Sewer	No	There are other suitable options that would take precedent.
Connection to a Combined Sewer	No	There are other suitable options that would take precedent.

#### 4.4.7 SuDS Design Philosophy

The SuDS assessment and hierarchical approach discussed in Tables 3, 4 and 5 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of Prevention, Source Control and Site Control techniques with discharge rates to be restricted to greenfield rates, to reduce the risk of both site and downstream flooding.

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the ground.
- Discharge into the surface water sewer network on the site, which ultimately outfalls into the nearby watercourses.
- Site control in the form of oversized pipes with restricted outflow.
- Aim to limit where possible the impermeable fraction of development.

### 4.5 **Surface Water Drainage Strategy**

4.5.1 The outline strategy is to collect runoff from the roof and direct it to new below ground surface water drainage runs that will discharge into the existing School drainage and ultimately the surrounding watercourses. The surface water runoff will be restricted to a minimum 5l/s, to ensure that flow control devices are not at risk of blockage. In turn, this will generate surface water attenuation which will be contained in oversized pipes.

4.5.2 The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100 year return period including a 20% increase to account for climate change to confirm that there is no flood risk to the building.

4.5.3 Flooding can occur on a local scale beyond the 30-year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Sewers for Adoption (SfA) 7<sup>th</sup> Edition (WRC, 2006) states that developments should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.

4.5.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Sewers for Adoption guidance. Using storage within the external areas would be achievable and would direct flood water away from the proposed school building with flows directed back into the sewers as the water levels recede.

4.5.5 Table 6 below defines the outline post-development attenuation volumes associated with the site (further details can be found on drawing PGEW-SHD-00-ZZ-DR-C-0100 in Appendix B). The volumes identified below are preliminary for this outline assessment and are likely to alter at detailed design stage.

4.5.6 Any future drainage calculations carried out as part of a site-wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate Change allowances.

**Table 6: Outline Attenuation Volumes**

	<b>New Impermeable Area (m<sup>2</sup>)</b>	<b>Proposed Discharge Rate (l/s)</b>	<b>1 in 30 year attenuation (m<sup>3</sup>)</b>	<b>1 in 100 year attenuation + 20% Climate Change Allowance (m<sup>3</sup>) (extra over from 30yr retained on the surface)</b>
School Extension	600	5.0	5.0	12

#### 4.6 Pollution Control

4.6.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, french drains with silt traps or by the use of Sustainable Drainage techniques. If appropriate, oil separators in line with Pollution Prevention Guidance 3 (PPG 3) criteria will be provided (it is acknowledged that PPG 3 has been withdrawn, however as no replacement has been released it is still best practice guidance).

#### 4.7 Foul Water Strategy

4.7.1 The outline foul water drainage strategy is to connect into the existing foul network on the site, this then conveys foul water into the 150mm diameter Yorkshire Water Combined Sewer in Huddersfield Road to the west.

## **5.0 Management Measures, Off Site Impacts and Residual Risk**

### **5.1 Flood Risk Management Measures**

- 5.1.1 The surface water drainage strategy will restrict surface water runoff to greenfield runoff rates, with a minimum of 5l/s. Attenuation has been proposed in the form of oversized pipes. The new surface water networks will be designed in line with current British Standard and Sewers for Adoption Guidance up to the 100-year storm return period including an allowance for climate change.
- 5.1.2 The use of SuDS in the form of Prevention and Site Control measures, with controlled (restricted) outflow, will help to minimise the flood risk impact to the surrounding sewer network.
- 5.1.3 The long-term maintenance of the new drainage infrastructure will be included within the Schools existing maintenance regime detailed in the existing OM manual. Annual inspections will need to be carried out and clearing of drainage channels undertaken. There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains and drainage facilities such as the channels, gullies, pipes, manholes and all SUDS facilities. The School will be responsible for site cleanliness, gully emptying and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.
- 5.1.4 Should any flooding occur from the new sewers and drains it will be directed away from the School units to the external areas.

### **5.2 Off Site Impacts**

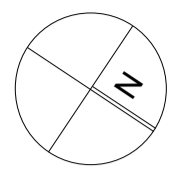
- 5.2.1 Up to and including the 100-year plus increase in rainfall allowance due to climate change (CC) event, the report has justified that there is no risk of flooding.
- 5.2.2 Surface water runoff does not increase from the pre-development regime and utilises SuDS solutions to satisfy the site constraints.
- 5.2.3 As all surface water will be discharged on site there will be no impact on the surrounding drainage network.
- 5.2.4 As there is no flood displacement or increased rate of runoff as part of this proposal into the adjacent sewers, the proposed development will therefore not increase flood risk onto its locality.

### **5.3 Residual Risk**

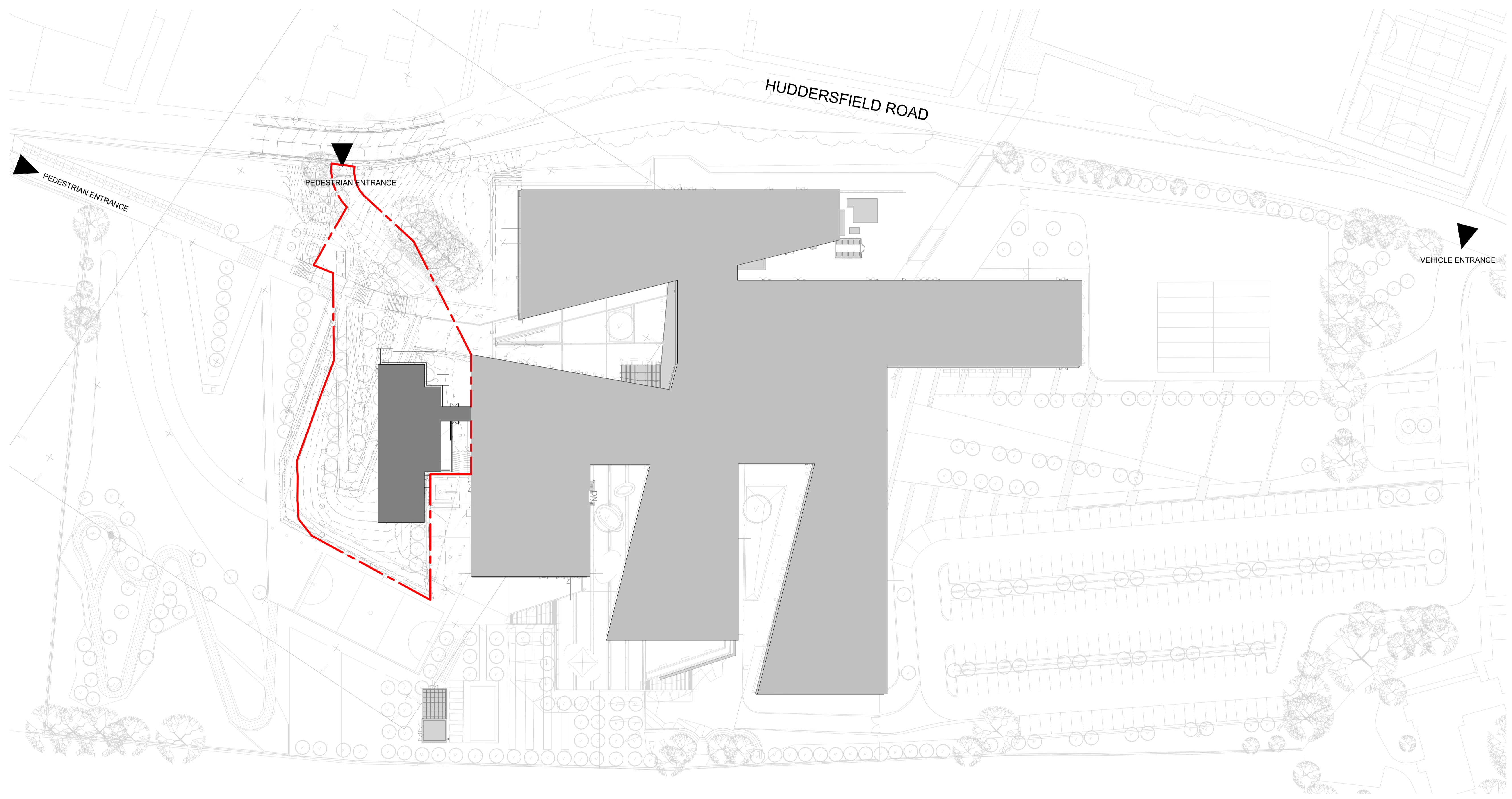
- 5.3.1 With careful design of the drainage elements as described above there will be no residual flood-related risks that will remain after the development has been completed.
- 5.3.2 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. The only known flood related risk that will remain will be the risk of out of manhole flooding within both the existing private and public sewer network beyond the 30 year design criterion. Should exceedance occur, out of chamber flood water will be directed to the external hard standing areas and roads but will not be a flood risk generator.

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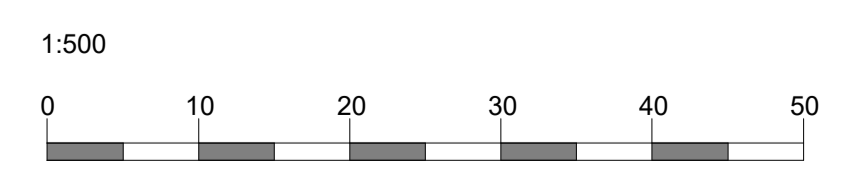
## Appendix A – Architectural Site Layout



EXISTING BUILDING  
NEW BUILDING

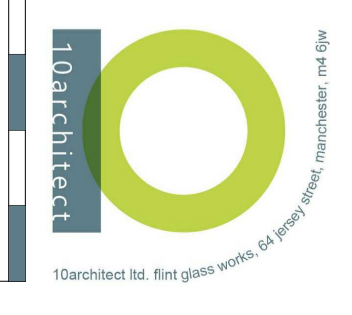


1 Site Plan  
1 : 500  
Ref Sheet: 0301



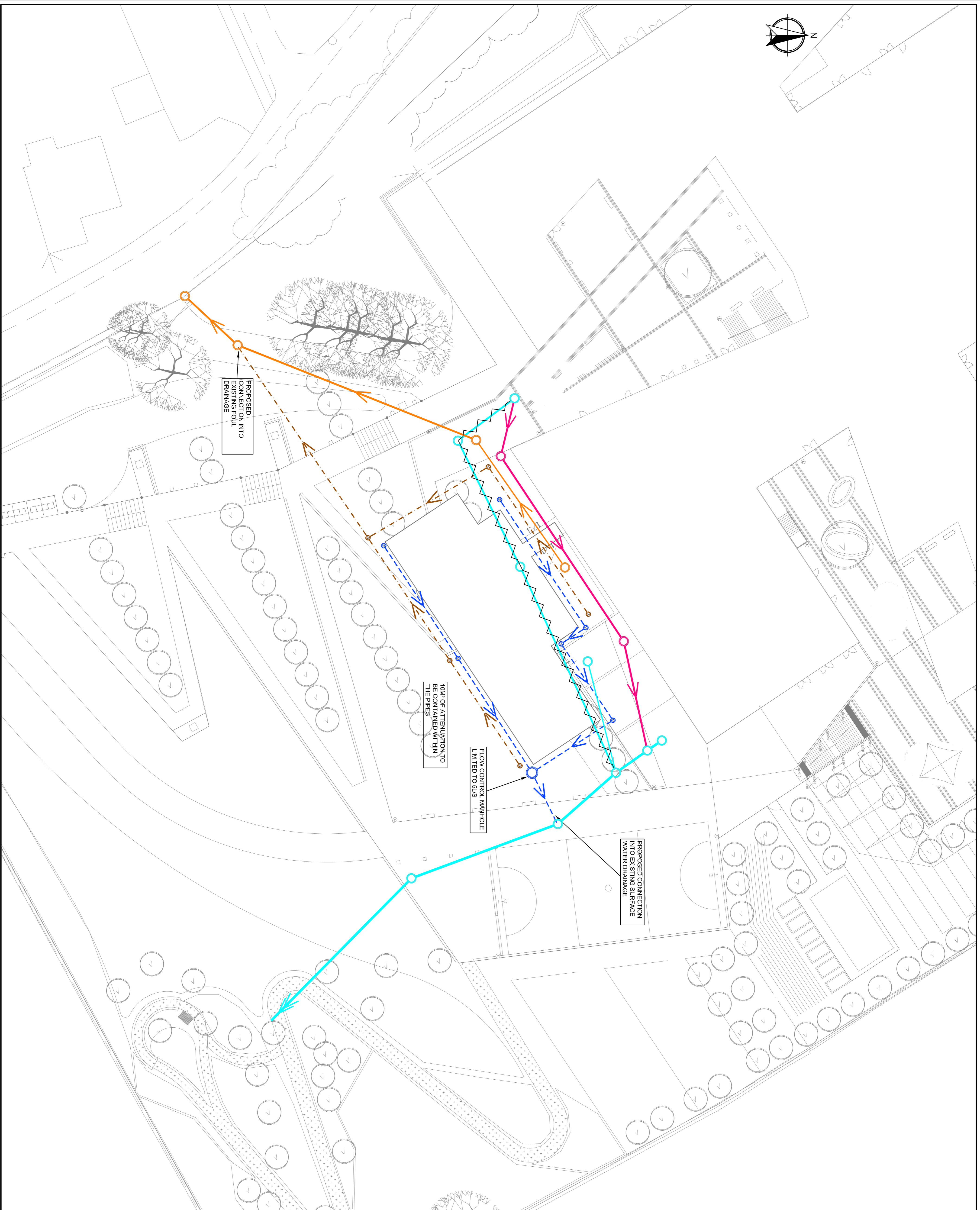
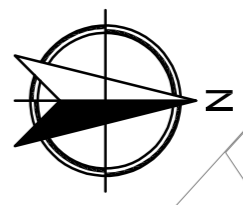
Client: Penistone Grammar School  
Project: Penistone Phase 2  
Job No.: 1080  
Date: 07/09/2018  
BIM Model:  
QA: ACM DWD  
Scale: As indicated@A1  
Drawing: Proposed Site Plan  
Rev notes: 108 - Drawing for review prior to Planning Submission

PGEW-10A- VD- ZZ- DR- A- 0100- P3



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## Appendix B – Drainage Layout



**GENERAL NOTES**

1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, INCLUDING APPROVED BUILDERS WORK SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING. WORK TO DIMENSIONS OR CO-ORDINATES PROVIDED. ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS, SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY.

**DRAINAGE KEY**

- EXISTING SW DRAIN
- EXISTING FW DRAIN
- PROPOSED FW DRAIN
- PROPOSED FW MANHOLE
- PROPOSED SW DRAIN
- PROPOSED SW MANHOLE
- PROPOSED DIVERSION
- DRAINAGE TO BE ABANDONED

NO	DATE	DRAWN	REVISED	AMENDMENT

**S2 FOR INFORMATION**

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CLIENT  
**PENISTONE GRAMMAR**

PROJECT  
**PENISTONE GRAMMAR SCHOOL**

DRAWN BY  
EJD

ENGINEER  
PG

TITLE  
**DRAINAGE STRATEGY PLAN**

SCALE	1:250	SHEET	A1	DRAWING NO	3317-SHD-00-ZZ-DR-C-0101	REV	P2
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## Appendix C – Outline Surface Water Attenuation Calculations

The Flint Glass Works  
64 Jersey Street  
Manchester M4 6JW

Penistone Grammar School



Date 17/09/2018  
File

Designed by EJD  
Checked by PG

Micro Drainage

Source Control 2018.1

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 983 Urban 0.000  
Area (ha) 0.250 Soil 0.300 Region Number Region 4

**Results 1/s**

QBAR Rural 0.7  
QBAR Urban 0.7

Q1 year 0.6

Q1 year 0.6  
Q30 years 1.3  
Q100 years 1.7

The Flint Glass Works  
64 Jersey Street  
Manchester M4 6JW

Penistone Grammar Phase 2  
Penistone



Date 20/09/2018  
File 30YR.SRCX

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Micro Drainage

Source Control 2018.1

Summary of Results for 30 year Return Period

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	203.261	0.261	0.0	5.0	5.0	3.7	O K
30 min Summer	203.322	0.322	0.0	5.0	5.0	4.6	O K
60 min Summer	203.315	0.315	0.0	5.0	5.0	4.5	O K
120 min Summer	203.239	0.239	0.0	5.0	5.0	3.4	O K
180 min Summer	203.173	0.173	0.0	4.9	4.9	2.5	O K
240 min Summer	203.132	0.132	0.0	4.7	4.7	1.9	O K
360 min Summer	203.103	0.103	0.0	3.9	3.9	1.5	O K
480 min Summer	203.089	0.089	0.0	3.2	3.2	1.3	O K
600 min Summer	203.080	0.080	0.0	2.8	2.8	1.1	O K
720 min Summer	203.074	0.074	0.0	2.5	2.5	1.1	O K
960 min Summer	203.065	0.065	0.0	2.0	2.0	0.9	O K
1440 min Summer	203.055	0.055	0.0	1.5	1.5	0.8	O K
2160 min Summer	203.047	0.047	0.0	1.1	1.1	0.7	O K
2880 min Summer	203.041	0.041	0.0	0.9	0.9	0.6	O K
4320 min Summer	203.035	0.035	0.0	0.7	0.7	0.5	O K
5760 min Summer	203.031	0.031	0.0	0.5	0.5	0.4	O K
7200 min Summer	203.029	0.029	0.0	0.5	0.5	0.4	O K
8640 min Summer	203.027	0.027	0.0	0.4	0.4	0.4	O K
10080 min Summer	203.025	0.025	0.0	0.4	0.4	0.4	O K
15 min Winter	203.308	0.308	0.0	5.0	5.0	4.4	O K
30 min Winter	203.373	0.373	0.0	5.0	5.0	5.3	O K
60 min Winter	203.337	0.337	0.0	5.0	5.0	4.8	O K
120 min Winter	203.201	0.201	0.0	5.0	5.0	2.9	O K
180 min Winter	203.125	0.125	0.0	4.7	4.7	1.8	O K
240 min Winter	203.104	0.104	0.0	3.9	3.9	1.5	O K
360 min Winter	203.083	0.083	0.0	3.0	3.0	1.2	O K
480 min Winter	203.073	0.073	0.0	2.4	2.4	1.0	O K
600 min Winter	203.066	0.066	0.0	2.1	2.1	0.9	O K
720 min Winter	203.061	0.061	0.0	1.8	1.8	0.9	O K
960 min Winter	203.054	0.054	0.0	1.5	1.5	0.8	O K
1440 min Winter	203.046	0.046	0.0	1.1	1.1	0.6	O K
2160 min Winter	203.039	0.039	0.0	0.8	0.8	0.6	O K
2880 min Winter	203.035	0.035	0.0	0.7	0.7	0.5	O K
4320 min Winter	203.030	0.030	0.0	0.5	0.5	0.4	O K
5760 min Winter	203.027	0.027	0.0	0.4	0.4	0.4	O K
7200 min Winter	203.024	0.024	0.0	0.3	0.3	0.3	O K
8640 min Winter	203.023	0.023	0.0	0.3	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	66.941	0.0	7.5	20
30 min Summer	45.292	0.0	10.2	28
60 min Summer	29.395	0.0	13.2	44
120 min Summer	18.513	0.0	16.7	74
180 min Summer	13.951	0.0	18.8	104
240 min Summer	11.347	0.0	20.4	132
360 min Summer	8.487	0.0	22.9	190
480 min Summer	6.895	0.0	24.8	250
600 min Summer	5.865	0.0	26.4	310
720 min Summer	5.136	0.0	27.7	370
960 min Summer	4.163	0.0	30.0	490
1440 min Summer	3.091	0.0	33.4	732
2160 min Summer	2.292	0.0	37.1	1092
2880 min Summer	1.851	0.0	40.0	1468
4320 min Summer	1.369	0.0	44.3	2196
5760 min Summer	1.105	0.0	47.7	2936
7200 min Summer	0.936	0.0	50.5	3584
8640 min Summer	0.817	0.0	53.0	4296
10080 min Summer	0.729	0.0	55.1	5120
15 min Winter	66.941	0.0	8.4	20
30 min Winter	45.292	0.0	11.4	29
60 min Winter	29.395	0.0	14.8	46
120 min Winter	18.513	0.0	18.7	76
180 min Winter	13.951	0.0	21.1	102
240 min Winter	11.347	0.0	22.9	132
360 min Winter	8.487	0.0	25.7	192
480 min Winter	6.895	0.0	27.8	252
600 min Winter	5.865	0.0	29.6	312
720 min Winter	5.136	0.0	31.1	372
960 min Winter	4.163	0.0	33.6	490
1440 min Winter	3.091	0.0	37.4	734
2160 min Winter	2.292	0.0	41.6	1104
2880 min Winter	1.851	0.0	44.8	1468
4320 min Winter	1.369	0.0	49.7	2224
5760 min Winter	1.105	0.0	53.4	2864
7200 min Winter	0.936	0.0	56.6	3592
8640 min Winter	0.817	0.0	59.3	4312

The Flint Glass Works  
64 Jersey Street  
Manchester M4 6JW

Penistone Grammar Phase 2  
Penistone



Date 20/09/2018  
File 30YR.SRCX

Designed by EJD  
Checked by PG

Micro Drainage

Source Control 2018.1

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	203.021	0.021	0.0	0.3	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.729	0.0	61.7	5024

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Penistone Grammar Phase 2  
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Micro Drainage

Source Control 2018.1

Rainfall Details

Rainfall Model	FSR	Ratio R 0.317	Cv (Winter) 0.840
Return Period (years)	30	Summer Storms Yes	Shortest Storm (mins) 15
Region	England and Wales	Winter Storms Yes	Longest Storm (mins) 10080
M5-60 (mm)	19.100	Cv (Summer) 0.750	Climate Change % +0

Time Area Diagram

Total Area (ha) 0.060

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
From:	To:	From:	To:	From:	To:
0	4	4	8	8	12
	0.020		0.020		0.020



Model Details

Storage is Online Cover Level (m) 205.000

Cellular Storage Structure

Invert Level (m) 203.000 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	15.0	15.0	2.800	0.0	30.5	5.600	0.0	30.5	8.400	0.0	30.5
0.400	15.0	21.2	3.200	0.0	30.5	6.000	0.0	30.5	8.800	0.0	30.5
0.800	15.0	27.4	3.600	0.0	30.5	6.400	0.0	30.5	9.200	0.0	30.5
1.200	0.0	30.5	4.000	0.0	30.5	6.800	0.0	30.5	9.600	0.0	30.5
1.600	0.0	30.5	4.400	0.0	30.5	7.200	0.0	30.5	10.000	0.0	30.5
2.000	0.0	30.5	4.800	0.0	30.5	7.600	0.0	30.5			
2.400	0.0	30.5	5.200	0.0	30.5	8.000	0.0	30.5			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-5000-0800-5000	Sump Available	Yes
Design Head (m)	0.800	Diameter (mm)	109
Design Flow (l/s)	5.0	Invert Level (m)	203.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0	Kick-Flo®	0.537	4.2
Flush-Flo™	0.241	5.0	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.600	4.4	1.600	6.9	2.600	8.7	5.000	11.8	7.500	14.4
0.200	5.0	0.800	5.0	1.800	7.3	3.000	9.3	5.500	12.4	8.000	14.8
0.300	5.0	1.000	5.5	2.000	7.7	3.500	10.0	6.000	12.9	8.500	15.2
0.400	4.8	1.200	6.0	2.200	8.0	4.000	10.6	6.500	13.4	9.000	15.7
0.500	4.5	1.400	6.5	2.400	8.4	4.500	11.3	7.000	13.9	9.500	16.1

The Flint Glass Works  
64 Jersey Street  
Manchester M4 6JW

Penistone Grammar Phase 2  
Penistone



Date 20/09/2018  
File 100YR + CC.SRCX

Designed by EJD  
Checked by PG

Micro Drainage

Source Control 2018.1

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 20 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	203.516	0.516	0.0	5.0	5.0	7.3	O K
30 min Summer	203.660	0.660	0.0	5.0	5.0	9.4	O K
60 min Summer	203.691	0.691	0.0	5.0	5.0	9.8	O K
120 min Summer	203.621	0.621	0.0	5.0	5.0	8.8	O K
180 min Summer	203.492	0.492	0.0	5.0	5.0	7.0	O K
240 min Summer	203.366	0.366	0.0	5.0	5.0	5.2	O K
360 min Summer	203.209	0.209	0.0	5.0	5.0	3.0	O K
480 min Summer	203.137	0.137	0.0	4.7	4.7	2.0	O K
600 min Summer	203.114	0.114	0.0	4.3	4.3	1.6	O K
720 min Summer	203.101	0.101	0.0	3.8	3.8	1.4	O K
960 min Summer	203.086	0.086	0.0	3.1	3.1	1.2	O K
1440 min Summer	203.070	0.070	0.0	2.3	2.3	1.0	O K
2160 min Summer	203.058	0.058	0.0	1.7	1.7	0.8	O K
2880 min Summer	203.051	0.051	0.0	1.3	1.3	0.7	O K
4320 min Summer	203.043	0.043	0.0	1.0	1.0	0.6	O K
5760 min Summer	203.038	0.038	0.0	0.8	0.8	0.5	O K
7200 min Summer	203.035	0.035	0.0	0.7	0.7	0.5	O K
8640 min Summer	203.032	0.032	0.0	0.6	0.6	0.5	O K
10080 min Summer	203.031	0.031	0.0	0.5	0.5	0.4	O K
15 min Winter	203.603	0.603	0.0	5.0	5.0	8.6	O K
30 min Winter	203.762	0.762	0.0	5.0	5.0	10.9	O K
60 min Winter	203.782	0.782	0.0	5.0	5.0	11.1	O K
120 min Winter	203.649	0.649	0.0	5.0	5.0	9.3	O K
180 min Winter	203.430	0.430	0.0	5.0	5.0	6.1	O K
240 min Winter	203.257	0.257	0.0	5.0	5.0	3.7	O K
360 min Winter	203.123	0.123	0.0	4.6	4.6	1.7	O K
480 min Winter	203.100	0.100	0.0	3.7	3.7	1.4	O K
600 min Winter	203.088	0.088	0.0	3.2	3.2	1.2	O K
720 min Winter	203.080	0.080	0.0	2.8	2.8	1.1	O K
960 min Winter	203.069	0.069	0.0	2.2	2.2	1.0	O K
1440 min Winter	203.058	0.058	0.0	1.6	1.6	0.8	O K
2160 min Winter	203.049	0.049	0.0	1.2	1.2	0.7	O K
2880 min Winter	203.043	0.043	0.0	1.0	1.0	0.6	O K
4320 min Winter	203.036	0.036	0.0	0.7	0.7	0.5	O K
5760 min Winter	203.032	0.032	0.0	0.6	0.6	0.5	O K
7200 min Winter	203.029	0.029	0.0	0.5	0.5	0.4	O K
8640 min Winter	203.027	0.027	0.0	0.4	0.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.784	0.0	11.7	21
30 min Summer	70.952	0.0	16.0	31
60 min Summer	46.349	0.0	20.8	48
120 min Summer	29.196	0.0	26.3	82
180 min Summer	21.908	0.0	29.6	114
240 min Summer	17.715	0.0	31.9	142
360 min Summer	13.161	0.0	35.5	198
480 min Summer	10.637	0.0	38.3	254
600 min Summer	9.008	0.0	40.5	312
720 min Summer	7.860	0.0	42.4	370
960 min Summer	6.331	0.0	45.6	490
1440 min Summer	4.657	0.0	50.3	730
2160 min Summer	3.417	0.0	55.3	1100
2880 min Summer	2.738	0.0	59.1	1468
4320 min Summer	2.000	0.0	64.8	2176
5760 min Summer	1.601	0.0	69.2	2880
7200 min Summer	1.348	0.0	72.8	3672
8640 min Summer	1.172	0.0	75.9	4400
10080 min Summer	1.041	0.0	78.7	5088
15 min Winter	103.784	0.0	13.1	21
30 min Winter	70.952	0.0	17.9	32
60 min Winter	46.349	0.0	23.4	50
120 min Winter	29.196	0.0	29.4	88
180 min Winter	21.908	0.0	33.1	120
240 min Winter	17.715	0.0	35.7	146
360 min Winter	13.161	0.0	39.8	192
480 min Winter	10.637	0.0	42.9	250
600 min Winter	9.008	0.0	45.4	308
720 min Winter	7.860	0.0	47.5	370
960 min Winter	6.331	0.0	51.0	494
1440 min Winter	4.657	0.0	56.3	720
2160 min Winter	3.417	0.0	62.0	1088
2880 min Winter	2.738	0.0	66.2	1456
4320 min Winter	2.000	0.0	72.6	2148
5760 min Winter	1.601	0.0	77.5	2872
7200 min Winter	1.348	0.0	81.5	3672
8640 min Winter	1.172	0.0	85.0	4296

The Flint Glass Works  
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Penistone Grammar Phase 2  
Penistone



Date 20/09/2018  
File 100YR + CC.SRCX

Designed by EJD  
Checked by PG

Micro Drainage

Source Control 2018.1

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	203.026	0.026	0.0	0.4	0.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.041	0.0	88.1	5096

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Micro Drainage

Source Control 2018.1

Rainfall Details

Rainfall Model FSR Ratio R 0.317 Cv (Winter) 0.840  
 Return Period (years) 100 Summer Storms Yes Shortest Storm (mins) 15  
 Region England and Wales Winter Storms Yes Longest Storm (mins) 10080  
 M5-60 (mm) 19.100 Cv (Summer) 0.750 Climate Change % +20

Time Area Diagram

Total Area (ha) 0.060

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
From:	To:	From:	To:	From:	To:
0	4	4	8	8	12
	0.020		0.020		0.020



Model Details

Storage is Online Cover Level (m) 205.000

Cellular Storage Structure

Invert Level (m) 203.000 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	15.0	15.0	2.800	0.0	30.5	5.600	0.0	30.5	8.400	0.0	30.5
0.400	15.0	21.2	3.200	0.0	30.5	6.000	0.0	30.5	8.800	0.0	30.5
0.800	15.0	27.4	3.600	0.0	30.5	6.400	0.0	30.5	9.200	0.0	30.5
1.200	0.0	30.5	4.000	0.0	30.5	6.800	0.0	30.5	9.600	0.0	30.5
1.600	0.0	30.5	4.400	0.0	30.5	7.200	0.0	30.5	10.000	0.0	30.5
2.000	0.0	30.5	4.800	0.0	30.5	7.600	0.0	30.5			
2.400	0.0	30.5	5.200	0.0	30.5	8.000	0.0	30.5			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-5000-0800-5000	Sump Available	Yes
Design Head (m)	0.800	Diameter (mm)	109
Design Flow (l/s)	5.0	Invert Level (m)	203.000
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0	Kick-Flo®	0.537	4.2
Flush-Flo™	0.241	5.0	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.600	4.4	1.600	6.9	2.600	8.7	5.000	11.8	7.500	14.4
0.200	5.0	0.800	5.0	1.800	7.3	3.000	9.3	5.500	12.4	8.000	14.8
0.300	5.0	1.000	5.5	2.000	7.7	3.500	10.0	6.000	12.9	8.500	15.2
0.400	4.8	1.200	6.0	2.200	8.0	4.000	10.6	6.500	13.4	9.000	15.7
0.500	4.5	1.400	6.5	2.400	8.4	4.500	11.3	7.000	13.9	9.500	16.1