

Project

**Extension of
Wardle Academy, Rochdale**

Title

Surface Water Management Report

Project No

C14570

Date

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Revision

A

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Preliminary Note

This report has been produced by Mark Symonds who has over 20 years' experience in infrastructure engineering (in particular surface water management design) and has qualifications including: BSc (Hons) Civil Engineering (2003); HND Civil Engineering Studies (2002); and OND Construction Studies (2000).

1. Introduction

Northern Structural Services have prepared this surface water management report for a proposed extension of Wardle Academy, Birch Road, Rochdale, OL12 9RD (hereafter referred to as 'the Site').

The report describes and demonstrates how the surface water run-off rate and volume from the post development site will be managed to adhere to National planning policies, regulations, and relevant design guidance, which include:

- National Planning Policy Framework (NPPF), July 2021, Paragraphs 153-158 and 159-169;
- National Planning Practice Guidance (NPPG) ('Flood Risk and Coastal Change' section), released in March 2014 and updated in August 2022;
- National Standards for Sustainable Drainage Systems (SuDS) set out by the Department for Environment, Food & Rural Affairs (DEFRA) (2011);
- CIRIA (2010) Planning for SuDS – Making it Happen C687;
- CIRIA SuDS Manual C753 (2015).

And local policies including:

- Bury, Rochdale and Oldham, Strategic Flood Risk Assessment – Level 2 SFRA (November 2009);
- Greater Manchester Surface Water Management Plan – Stage 1 (January 2012);
- Greater Manchester Strategic Flood Risk Assessment Framework (September 2018);
- Rochdale Borough's Strategy for Flood Risk Management 2014-2024;
- Rochdale Adopted Core Strategy (October 2016);

Subsequently, Rochdale Metropolitan Borough Council, acting as Lead Local Flood Authority (LLFA), need to be satisfied that the design and drainage principles of the proposed development:

- will address the surface water management and risk of flooding within the site;
- will ensure that the drainage is managed and maintained for its lifetime to prevent flooding;
- and will ensure that the development will not increase the risk of flooding to neighbouring land and property.

2. National Policies and Water Management Guidance

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

The NPPF (July 2021) 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 surface water management report, with particular attention to Paragraphs 153 to 158 Planning for Climate Change, and Paragraphs 159 to 169 Planning for Flood Risk.

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 (FWMA) received royal assent in April 2010, aiming to create a simpler and more effective means of managing flood risk and coastal erosion. The FWMA incorporates and implements some of the recommendations from the Pitt Review (2008), following the severe flooding that affected a large area of the UK in 2007. The FWMA also places several new duties and responsibilities on LLFAs regarding the management of local flood risk, to:

- Develop, maintain, apply, and monitor a Local Flood Risk Management Strategy.
- Approve, adopt, and maintain Sustainable Drainage Systems (SuDS) (yet to be implemented).
- Establish and maintain a flood risk Asset Register.
- Investigate incidents of flooding (where appropriate) and publish the findings in a report.
- Ensure delivery of effective and joined up management of flood risk.

3. Site Setting and Description

3.1. Site Location

The Site is part of Wardle Academy, which is approximately 1.5km north-west of Smithy Bridge Station, approximately 5km north-east of Rochdale town centre, and as shown on the site location plan in Appendix A, is bound by existing academy buildings to the north and east; Green Meadow to the south; and playing fields to the west.

The address of the Site is Wardle Academy, Birch Road, Rochdale, OL12 9RD, with the co-ordinates to the centre of the site being: Easting: 391625, Northing: 3416080.

3.2. Existing Site and Topography

The existing plans in Appendix A show that the Site (area of Wardle Academy being developed) currently consists of hard-standing car park, with a hard-standing footpaths to the north, an access road to the east, and area of soft-landscaping / grassed areas to the east and west. Most of the existing areas are developed and is therefore classed as a 'Brownfield Site.'

In terms of levels, the Site has a general fall towards the south, with the levels ranging from approximately 170.88m along the northern development boundary adjacent to existing school building), to approximately 170.06m AOD along the southern development boundary.

3.3. Proposed Development

The Site plans are shown in Appendix C, with a full description of the Site being stated by the Architect. In brief, and in relation to this report, the proposal is to build an extension of the existing Wardle Academy building over the existing car park area, and to create a new access road to the east and south of the extension building, a new footpath around the extension perimeter, and new grassed areas along the western boundaries.

3.4. Ground Conditions

A Phase 2 Geo-Environmental Investigation Report was produced by IGE Consulting in May 2023, which describes the ground conditions and infiltration rates of the soils at the site.

The borehole logs (see Appendix D) show the ground to consist of made ground over a Glacial Till (clay).

'In terms of infiltration testing, the report states: Soil infiltration tests were undertaken in DS01 and DS02 via falling head method in accordance with the methodology defined in BS5930 (2015) +A1 (2020). It should be noted that only one run was attempted in each location due to the slow infiltration rate within the cohesive Glacial Till.'

Based on the rates of infiltration obtained during the tests and the site-wide presence of cohesive Glacial Till, however, given the small size of the site and the potential feasibility of utilising solely large-scale soakaway drainage, it is not considered feasible to utilise soakaway drainage across the site.'

Results of the infiltration tests can be found in Appendix D.

3.5. Waterbodies

There are no known waterbodies in the direct vicinity of the Site, with the nearest being Ash Brook, approximately 200m to the west (adjacent to Wardle Academy playing fields).

3.6. Existing Drainage / Sewers

The United Utilities asset plan in Appendix E shows there to be a 225mm diameter surface water sewer in Green Meadow (east of the Site), with a drainage survey (Appendix E) showing the surface water run-off from the existing car park discharging to a gully and into a 150mm pipe that connects / discharges to the 225mm diameter surface water sewer system. Therefore, the pre-development surface water run-off discharges to a surface water sewer.

3.7. Development Areas

The Site area is for the new extension building and access roads only, with the remaining school areas remaining as existing. The Site area therefore equates to 630m² / **0.063 ha**.

The existing car park, footpaths and access road equates to approximately 560m² / 0.056 ha, with the demolished existing soft-landscaping / grassed areas equating to approximately 70m² / 0.007 ha.

The surface water run-off from the car park, footpath and access road to discharges to the existing drainage network and subsequently surface water sewer, with the surface water run-off from the soft-landscaping / grassed areas discharging off the site at a natural / greenfield rate.

Therefore, in terms of the greenfield run-off rate calculations, the Site has an urban factor of **0.89** (0.056 ha / 0.063 ha), and in terms of pre-development surface water run-off calculations the area of **0.056 ha** is to be used.

The post development site will consist of the new extension building, footpaths and access road which equates to approximately 510m² / 0.051 ha, with the remaining soft-landscaping / grassed areas equating to approximately 120m² / 0.012 ha.

The surface water run-off from the new extension building, footpaths and access road areas will discharge to a below ground drainage network, with the surface water run-off from the remaining soft-landscaped areas continuing to discharge off the Site at a natural / greenfield rate.

Therefore, in terms of post development surface water run-off management calculations the area of **0.051 ha** is to be used.

In summary:

The Site Area	-	0.063 ha
Development Greenfield Urban Factor	-	0.89
Pre-Development Surface Water Run-Off Area	-	0.056 ha
Post Development Surface Water Run-Off Area	-	0.051 ha

4. Surface Water Management Principles

The surface water for the development site is to be managed so that it adheres to the current national regulations and local authority requirements.

4.1. 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.

4.2. 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).

4.3. 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.

4.4. Peak Surface Water Flow

DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems states:

‘S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event’

4.5. Volume Control

DEFRA Non-statutory technical standards for sustainable drainage systems states:

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk’.

4.6. Flood Risk within Development

DEFRA Non-statutory technical standards for sustainable drainage systems states:

S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year rainfall event.

S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, 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.

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property'.

4.7. Pollution / Water Quality

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.

4.8. 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 is achieved by completely containing the surface water 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.

5. Surface Water Run-Off Destination

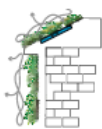
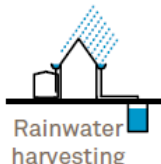
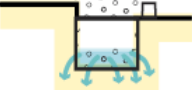
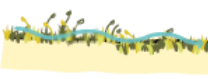
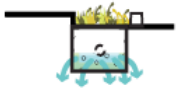
The destination of the surface water run-off from the development areas of the site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

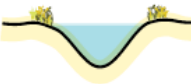
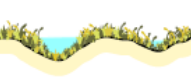
Run-Off Destination	Feasible	Description
Discharge to Ground	No	A Phase 2 Geo-Environmental Investigation Report was produced by IGE Consulting in May 2023, which describes the ground conditions and infiltration rates of the soils at the site. Borehole logs show the ground to consist of made ground over a Glacial Till (clay). Soil infiltration tests via falling head method in accordance with the methodology defined in BS5930 (2015) +A1 (2020). Only one run was attempted in each location due to the slow infiltration rate within the cohesive Glacial Till. Based on the rates of infiltration obtained during the tests and the site-wide presence of cohesive Glacial Till, it is not considered feasible to utilise soakaway drainage across the site. And therefore, not feasible to discharge the surface water to ground.
Discharge to Surface Water Body	No	There are no waterbodies in the direct vicinity to the Site, with the nearest being Ash Brook, approximately 200m to the west. To discharge to this waterbody new drainage network will have to cross existing playing fields which are to remain as existing in the temporary construction and permanent state. Therefore, discharge of the surface water to a waterbody is not feasible.
Discharge to Surface Water Sewer	Yes	As the ground is unsuitable for infiltration and discharge to a waterbody is not feasible, the alternative is to discharge the surface water to the existing 225mm surface water sewer in Green Meadow (east of site). This will replicate the pre-development surface water run-off destination.
Discharge to Highway Drain or Other	No	There is no requirement to discharge the surface water to a highway or other drain, as discharge to a surface water sewer is feasible.
Discharge to Combined Water Sewer	No	There is no requirement to discharge the surface water to a combined water sewer, as discharge to a surface water sewer is feasible.

6. SuDS Feasibility

To reduce the surface water run-off to as low as possible, 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 maintenance 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 development areas of the site are summarised in the table below:

SuDS Method	Feasible / Used?	Description
Living Roofs	Yes	The new extension building will have a living roof, which an area of approximately 80m ² . The living roof will reduce the surface water run-off rate and volume, act as a pollutant control, and add biodiversity to the development.
Rainwater Harvesting	No	Rainwater harvesting for water re-use has not been considered for the development due to the cost of a dual pipe network, and that water supply for the existing will be linked to the existing Wardle Academy buildings.
Soakaway / Infiltration Structure	No	As stated in Section 5, Borehole logs show the ground to consist of made ground over a Glacial Till (clay). Soil infiltration tests via falling head method in accordance with the methodology defined in BS5930 (2015) +A1 (2020). Only one run was attempted in each location due to the slow infiltration rate within the cohesive Glacial Till. Based on the rates of infiltration obtained during the tests and the site-wide presence of cohesive Glacial Till, it is not considered feasible to utilise soakaway drainage across the site.

Permeable Surfacing	Yes	Permeable surfacing can be formed in the footpath areas around the perimeter of the new extension building. The permeable surfacing will be formed over a 300mm deep sub-base costing of 20mm no fines aggregate, which houses a perforated pipe to convey the surface water to the infiltration structure. The permeable surfacing system will reduce the surface water run-off rates, and act as a pollutant control.
Filter Drains	Yes	A filter drain can be formed along the access road to the south of the Site, where the surface water run-off from the access can discharge to the filter drain prior to discharge to main draiange network. The filter drain will be formed of a 300x300mm deep trench filled with 20mm no fines aggregate and wrapped in a permeable membrane. The trach will house a perforated pipe which will convey the surface water to the main network. The filter drain system will reduce the surface water run-off rates, and act as a pollutant control.
Hardscape Storage	No	There are no suitable developed external areas within the Site that are suitable for hardscape storage without permeable surfacing being used. Therefore, this is not a feasible SuDS method.
Swales / Pond	No	Due to the Site being part of the Wardle Academy, and near to the pedestrian access routes to the playing fields to the pupils, the use of open water systems for surface water attenuation is not recommended on health and safety grounds. Therefore, due to the proximity of the pupils, the use of swales or ponds is not feasible.
Underground Storage	Yes	The surface water run-off from the development site will be restricted. The restricted rate will be lower than the surface water run-off rate, therefore there will be a requirement to have further underground storage in the form of cellular units.

7. Development Greenfield Run-Off Rates and Volume

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

7.1. Greenfield Run-Off Rate

The Flood Estimation Handbook (FEH 2013) 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 km ² 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):

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

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

Area	=	50.00 ha (required area for calculation)
SAAR	=	1200
Soil	=	0.450
Urban Factor	=	0.75 (actual 0.89, but 0.75 highest for calculation)
Region Number	=	10

The calculations in Appendix F, show the rate for 50.00ha is 947.2 l/s, but is to be reduced to reflect the surface water management area (0.051 ha) of the development site. Therefore, the QBAR (greenfield run-off) for development area has been calculated to be:

$$\text{QBAR} = 1.0 \text{ l/s (18.94 l/s/ha)}$$

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 ₂	1.0 l/s	0.93	1.0 l/s
Q ₃₀	1.0 l/s	1.70	1.7 l/s
Q ₁₀₀	1.0 l/s	2.08	2.1 l/s

7.2. 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 FEH 2013, with the results shown in Appendix F.

The FEH data and variables used to calculate the greenfield run-off volume at the Site location area as follows:

Site Location	=	GB 391627 416081 SD 91627 16081
Area	=	0.051 ha
SAAR	=	1255
CWI	=	123.937
SPR Host	=	47.000
URBTEXT	=	0.50 (actual 0.89, but 0.50 highest for calculation)

Based on these calculation results (Appendix F), the greenfield run-off volume for the surface water management area of the Site is:

Q ₁₀₀ (6-Hour)	=	20.11m ³ (394.27m ³ /ha)
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8. Pre-Development Surface Water Run-Off Rates and Volume

The pre-development surface water run-off rates and volume from the existing car park, footpaths and access roads areas (which discharge to a drainage network) are to be calculated, to ensure there is no exceedance from the post development surface water run-off rates and volume.

The calculations to determine the pre-development surface water run-off rates and volume are based on the pre-development surface water run-off area of 0.056 ha, the rainfall data given by the FEH 2013, and simulation / calculations in the MicroDrainage computer software (see Appendix G).

Based on the FEH 2013 data and computer software results, the pre-development surface water run-off rates are as follows:

Q ₂	=	6.9 l/s (15-minute storm duration)
Q ₃₀	=	16.8 l/s (15-minute storm duration)
Q ₁₀₀	=	21.4 l/s (15-minute storm duration)

The surface water run-off volumes for the pre-development site have also been calculated for 1 in 100-Year the 6-hour duration within the MicroDrainage computer software (Appendix F), where:

Q ₁₀₀ (6-hour)	=	32.44m ³
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9. Climate Change Allowance

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 summarised in Figure 1 below.

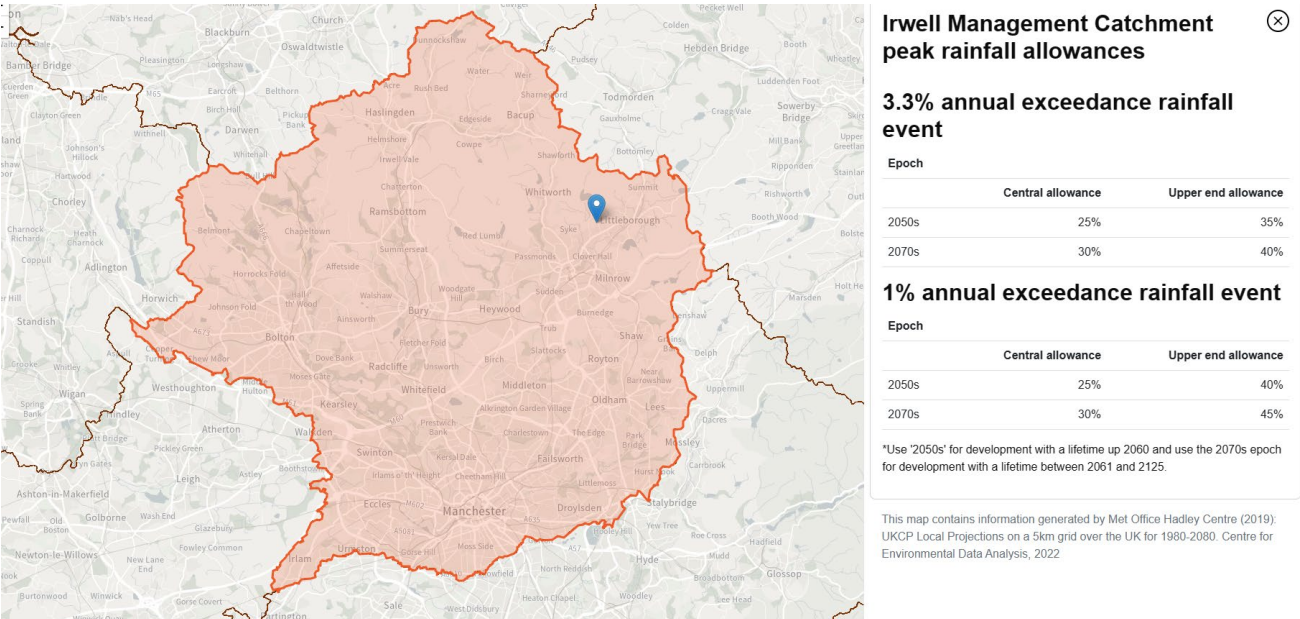


Figure 1 - DEFRA – Climate Change Allowances

The lifetime of the residential building is likely to be beyond 2061, and therefore the Epoch 2070's is to be used with Upper End Allowance. Therefore, the climate change allowance for the surface water run-off will be 40% for the 30-Year Storm, and 45% for the 100-Year Storm.

10. Drainage Networks and Surface Water Management Calculation

10.1. Surface Water Network Calculations

The calculations to determine the post development surface water run-off rates and required infiltration structure volume, are based on the post development surface water run-off area of 0.051 ha, and the rainfall data given by the FEH 2013.

10.2. Surface Water Drainage Network

As shown on the below ground drainage layout drawing in Appendix H, the proposed surface water network will consist of 150mm diameter pipes, 150mm perforated pipes, 460mm inspection and silt trap chambers, 1200mm to diameter manholes; permeable paving; filter drains; a 1200mm diameter flow control chamber containing a hydro-brake; and an attenuation tank in the form of cellular units.

The surface water run-off from the new roof areas will discharge to the main network via living roofs and the permeable paving system, the surface water run-off from the access road will discharge to the main drainage via filter drains, and the surface water run-off from the footpaths will discharge to the main drainage via the permeable paving system.

The surface water network will flow towards the north-east boundary of the Site, and will discharge through the flow control chamber prior to connection / discharge to the existing 150mm diameter surface water pipe and subsequently the 225mm diameter United Utilities surface water sewer in Green Meadow.

The surface water will surcharge the drainage network when being restricted, and will back discharge into cellular units where the water will be stored to prevent flooding.

10.3. Surface Water Run-Off Rates

For the surface water run-off from the Site to be at the greenfield run-off rate, they are to be restricted to 1.0 l/s for the 1 in 2-year storm event; 1.7 l/s for the 1 in 30-year storm event including 40% allowance, and 2.1 l/s for the 1 in 100-year storm event including 50% allowance.

For the surface water run-off to be a reduction of the pre-development rates, the surface water run-off from the Site is to be restricted to less than 6.9 l/s for the 1 in 2-year storm event; 16.8 l/s for the 1 in 30-year storm event including 40% allowance; and 21.4 l/s for the 1 in 100-year storm event including 50% allowance.

For the surface water run-off volume to be a betterment of the pre-development volume as a minimum (100-year, 6-hour storm event), the surface water discharge rates need to be a maximum of 1.5 l/s ($32.44\text{m}^3 \times 1000 / 60 \times 60 \times 6$).

For this development, and based on the greenfield rates, pre-development rates, and greenfield volume the suitable / minimum size of the flow control opening (hydro-brake opening) is deemed to be 55mm, with a design rate of 1.5 l/s.

As shown in the output calculation from the MicroDrainage computer software in Appendix I, if the hydro-brake opening is set at 55mm, the design flow at 1.5 l/s, with a design head of 1.2m, the maximum surface water run-off rates for each storm event will be as follows:

Storm	-	Rate	-	Critical Storm Event
Q ₂	-	1.2 l/s	-	60-minute winter storm duration
Q _{30 + 40%}	-	1.2 l/s	-	480-minute winter storm duration
Q _{100 + 45%}	-	1.5 l/s	-	120-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

Storm	-	Greenfield	-	Post Dev	-	Difference
Q ₂	-	1.0 l/s	-	1.2 l/s	-	20% Increase
Q _{30 + 40%}	-	1.7 l/s	-	1.2 l/s	-	30% Reduction
Q _{100 + 45%}	-	2.1 l/s	-	1.5 l/s	-	29% Reduction

Pre-Development Rate to Post Development Rate

Storm	-	Pre-Dev	-	Post Dev	-	Difference
Q ₂	-	6.9 l/s	-	1.2 l/s	-	83% Reduction
Q _{30 + 40%}	-	16.8 l/s	-	1.2 l/s	-	93% Reduction
Q _{100 + 45%}	-	21.4 l/s	-	1.5 l/s	-	93% Reduction

The calculations show that the surface water run-off rates exceed the 2-year greenfield rate, but are an 18% to 29% reduction of the 30-year and 100-year greenfield rate, respectively, and between an 83% to 93% reduction of pre-development rates. Therefore, they adhere to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems – S3 (see Section 4.4), where the rates are as close to greenfield rates as possible and are a reduction of the pre-development rates.

10.4. Surface Water Run-Off Volume

The post development surface water run-off volume for the Site has also been calculated for 1 in 100-Year the 6-hour duration (Inc. 45% allowance) based on the peak discharge rate (Appendix I), where:

$$Q_{100 \text{ (6-hour)}} - 1.5 \text{ l/s} \times (60 \times 60 \times 6) - 32,400 \text{ litres} - 32.40\text{m}^3$$

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

Greenfield Volume to Post Development Volume

Storm	-	Greenfield	-	Post Dev	-	Difference
Q ₁₀₀	-	20.11m ³	-	32.40m ³	-	61% Increase

Pre-Development Volume to Post Development Volume

Storm	-	Pre-Dev	-	Post Dev	-	Difference
Q ₁₀₀	-	32.44m ³	-	32.40m ³	-	Equivalent

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield run-off volume but is equivalent to the pre-development run-off volume.

The rate at which the volume of water discharges off the site is also a 29% reduction of the greenfield rate, and a 93% reduction of the pre-development rate. Therefore, the volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems – S6 (see Section 4.5), where the volume of water is discharged at a rate that does not adversely affect flood risk.

10.5. Surface Water Attenuation Calculations

As stated above, the post development run-off rates are restricted, there will be a requirement for surface water attenuation.

Ciria SuDS Manual 2015, Paragraph 10.2.4 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'*.

Attenuation structure formed of below ground attenuation tank in the form of cellular units.

As detailed in the MicroDrainage calculations (Appendix I) and demonstrated on the surface water management layout (Appendix H), the attenuation volume and details for the SuDS method are as follows:

Cellular Units

Attenuation Tank Length	-	10.00m
Attenuation Tank Width	-	4.00m
Attenuation Tank Area	-	40.00m ²
Attenuation Tank Depth	-	0.40m
Attenuation Tank Volume	-	16.00m ³

The MicroDrainage calculations (Appendix I) show that with this SuDS method and volume, no flooding will occur for all storms up to and including the 100-year + 45% storm event.

11. Maintenance Requirements

The management and maintenance of the surface water drainage networks and SuDS features will be by estate management / caretakers of the Wardle Academy site, where the maintenance of the drainage and SuDS will form part of the overall site management / landscaping / gardening. The details of the management and maintenance to be carried out is as follows:

11.1. Drainage Network, Flow Control and Cellular Units

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

11.2. Permeable Paving and Filter Drains

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 filter drain and permeable paving or near system (where may cause risk performance)	Monthly
Rainfall infiltration into permeable paving and / or filter drain is ensured working effectively.	As required, but at least twice a year

11.3. Linked and Further Maintenance Activities

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance Wardle Academy. A log of all maintenance activities is to be kept and made available to the local planning authority.

12. Surface Water Design Exceedance

In the unlikely event of an extreme storm greater than 100-year + 45% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur. Surface water flow paths to follow existing and proposed ground topography, where water will flow across the existing playing fields and into Ash Brook (west of site). Flood water will flow away from the proposed and existing buildings, and will not flow directly towards existing dwellings / properties outside the development boundary prior to discharge to Ash Brook. Therefore, no flood risk increase in the exceedance event.

13. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment.

13.1. External and Roof Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level = Low

C753 Table 26.2 Pollution Hazard Index:

Total Suspended Solid (TSS)	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.40
Pollution Hazard Index	=	1.30

13.2. External Areas Pollutant Mitigation

Mitigation Measures: **Green Roofs, Permeable Paving and Filter Drains**

The lowest of the Pollutant Mitigation Indices:

Total Suspended Solid (TSS)	=	0.7
Metals	=	0.6
Hydrocarbons	=	0.7
SuDS Mitigation Indices	=	2.00

The mitigation indices are greater than the pollution hazard index, and therefore suitable water quality is achieved.

14. Development Management and Construction Phase

14.1. Construction Environment Management Plan

The construction environment management plan (CEMP) is based on the requirements of CIRIA 753 – The SuDS Manual – Chapter 31. The chosen contractor to for the development will adhere to the following procedures:

14.2. Construction Access

The main construction traffic will access the Site from the north-east (Green Meadow).

14.3. Sediments and Traps

Sediment basins and traps are to be installed before any major site earthworks take place, with further sediment traps and silt fences being installed as the earthworks progresses. This will keep sediment contained on site at appropriate locations.

14.4. Run-Off Control Measures

Run-off control measures are to be used in conjunction with sediment traps to divert water around planned earthworks areas to remove silt. Any surface water upstream of the site is to be diverted around the development areas.

14.5. Main Surface Water Run-Off Systems

The flow control chamber and attenuation structure in the form of cellular units, are to be built prior to any phase of construction of site. Surface water from each of the phased areas are to discharge to the new drainage network, where the water is adequately controlled, and water quality maintained before discharging to existing drainage network. Temporary inlet and outlet protection measures and appropriate silt traps are to be installed to prevent silt ingress into the main drainage network.

14.6. Clearing and Earthworks

Clearing and earthworks will only start when adequate erosion and sediment control measures are in place. Once the development areas are cleared, earthworks will follow immediately to ensure that the ground cover can be re-established quickly. Adjacent land to that being developed will be left undisturbed for as long as possible.

14.7. Surface Stabilisation Measures

Surface stabilisation measures will be applied to completed areas, channels ditches and other disturbed areas after the land is cleared and profiled. Permanent stabilisation measures will be installed as soon as possible after final profiling.

14.8. Construction of Filter Drain

Construction of permeable surfacing system is to be left to the later stages of construction. Unsuitable sediment is to be removed from surfacing prior to installation of clean gravel.

15. Conclusion / Summary

15.1. SuDS Principles and Discharge Destination

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being living roofs, permeable paving, filter drains, cellular units and a flow control chamber, and the surface water destination being to a surface water sewer via an existing drainage network.

15.2. Peak Flow Control

The surface water run-off rates exceed the 2-year greenfield rate, but are an 18% to 29% reduction of the 30-year and 100-year greenfield rate, respectively, and between an 83% to 93% reduction of pre-development rates. Therefore, the adhere to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems – S3 (see Section 4.4), where the rates are as close to greenfield rates as possible and are a reduction of the pre-development rates.

15.3. Volume Control

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield run-off volume but is equivalent to the pre-development run-off volume. The rate at which the volume of water discharges off the site is also a 29% reduction of the greenfield rate, and a 93% reduction of the pre-development rate. Therefore, the volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems – S6 (see Section 4.5), where the volume of water is discharged at a rate that does not adversely affect flood risk.

15.4. Flood Risk within the Development

The MicroDrainage calculations show that with this SuDS method and volume, no flooding will occur for all storms up to and including the 100-year + 45% storm event.

15.5. Maintenance

The management and maintenance of the surface water drainage networks and SuDS features will be by estate management / caretakers of the Wardle Academy site, where the maintenance of the drainage and SuDS will form part of the overall site management / landscaping / gardening.

15.6. Surface Water Design Exceedance

In the unlikely event of an extreme storm greater than 100-year + 45% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur. Surface water flow paths to follow existing and proposed ground topography, where water will flow across the existing playing fields and into Ash Brook (west of site). Flood water will flow away from the proposed and existing buildings, and will not flow directly towards existing dwellings / properties outside the development boundary prior to discharge to Ash Brook. Therefore, no flood risk increase in the exceedance event.

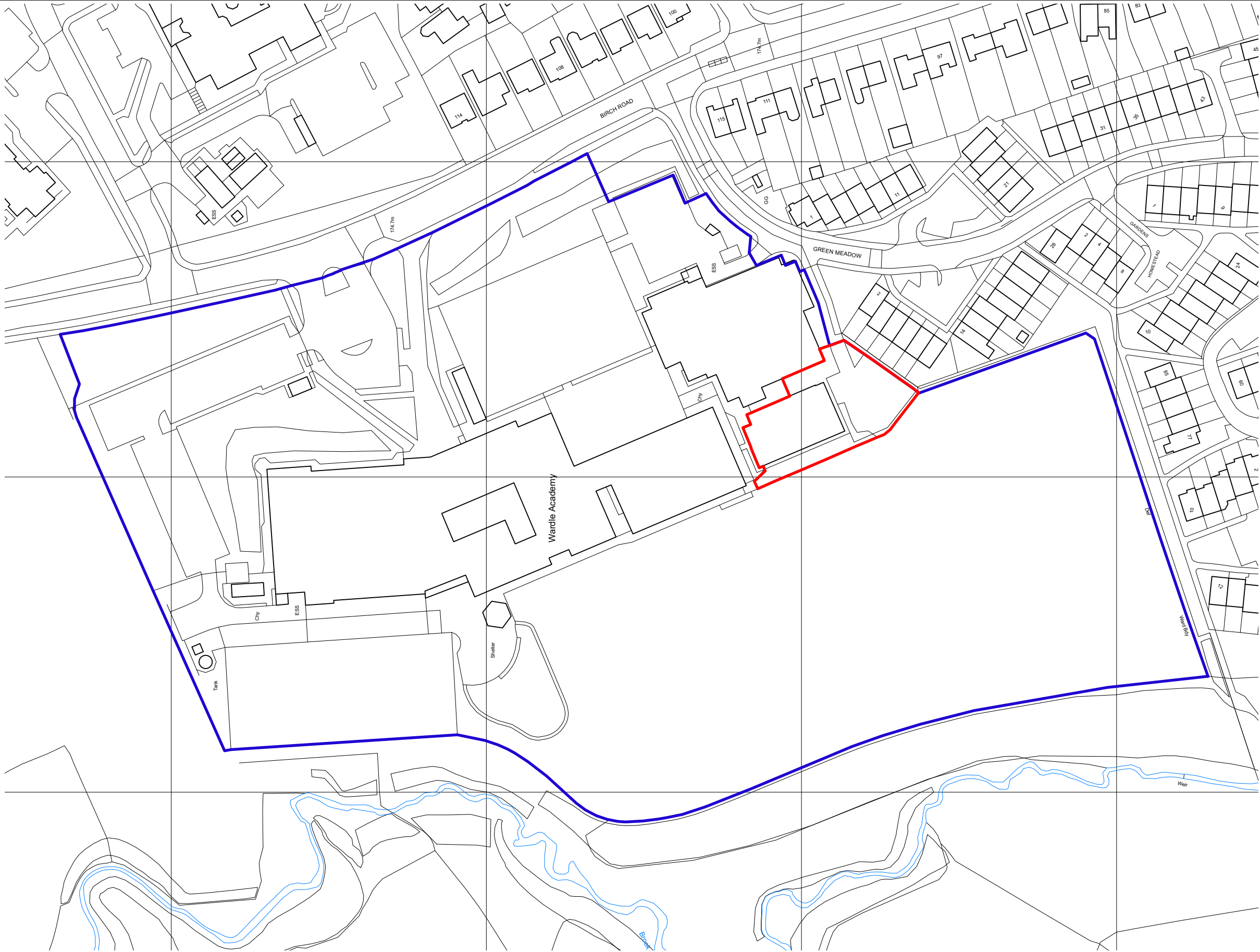
15.7. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment. The mitigation indices are greater than the pollution hazard index, and therefore suitable water quality is achieved.

15.8. Development Management and Construction Phase

The construction environment management plan (CEMP) is based on the requirements of CIRIA 753 – The SuDS Manual – Chapter 31. The flow control chamber and attenuation structure in the form of cellular units, are to be built prior to any phase of construction of site. Surface water from each of the phased areas are to discharge to the new drainage network, where the water is adequately controlled, and water quality maintained before discharging to the existing drainage network.

Appendix A Site Location Plan



A3

1:1250 @ A3

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25 M

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NOTES:

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All dimensions to be checked on site.

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The Contractor's attention is drawn to the Health & Safety matters identified in the Health & Safety plan as being potentially hazardous.

These items should not be considered as a full and final list.

The Work Package Contractor's normal Health & Safety obligations still apply when undertaking constructional operations both on and off site.

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Site of proposed development

Boundary of Wardle Academy

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define /

REV

T01

T02

DATE

24/01/2023

02/02/2023

NOTES

ISSUED FOR BUILDING REGS PLAN CHECK

ISSUED FOR TENDER

DRAWN BY

AM

CHECKED BY

GW

JOB NO.

052

STATUS

TENDER

PROJECT

Wardle Academy - Anderson Suite Extension

DRAWING TITLE

Site Location Plan

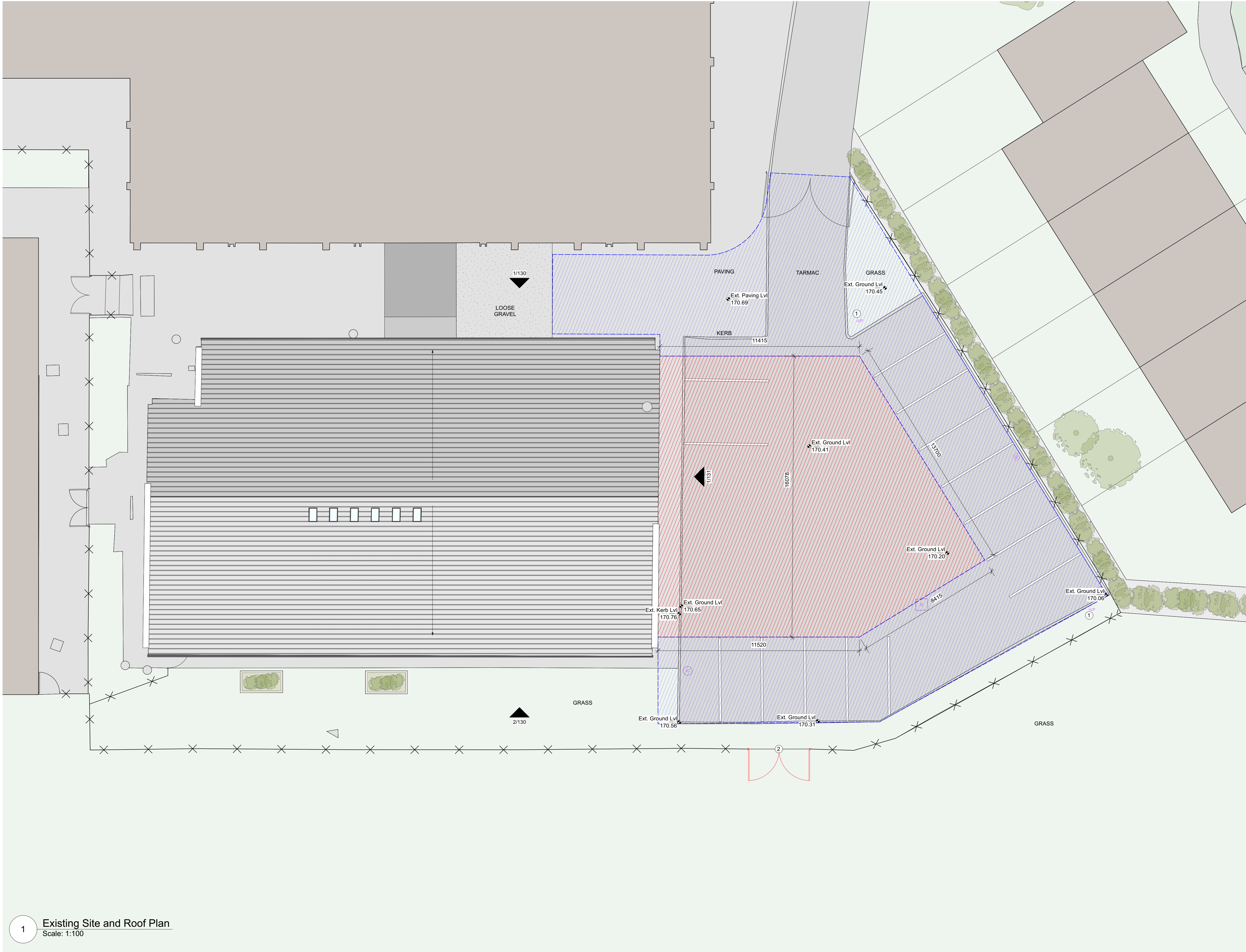
DRAWING NO.

052_GAD_090

REV

T02

Appendix B Existing Site Plans

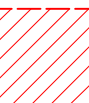
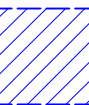


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Notes

1. Lamp post to be relocated to allow for proposed road layout.
Refer to M&E consultant information for proposed location.
2. Vehicular gate to be relocated

-  Demolition area for proposed extension
-  Area of existing hard-landscaping to be stripped back and altered for new road access/layout

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PROJECT

Wardle Academy - Anderson Suite Extension

DRAWING TITLE

Existing Site and Roof Plan

REV	DATE	NOTES
T01	24/01/2023	ISSUED FOR BUILDING REGS PLAN CHECK
T02	02/02/2023	ISSUED FOR TENDER

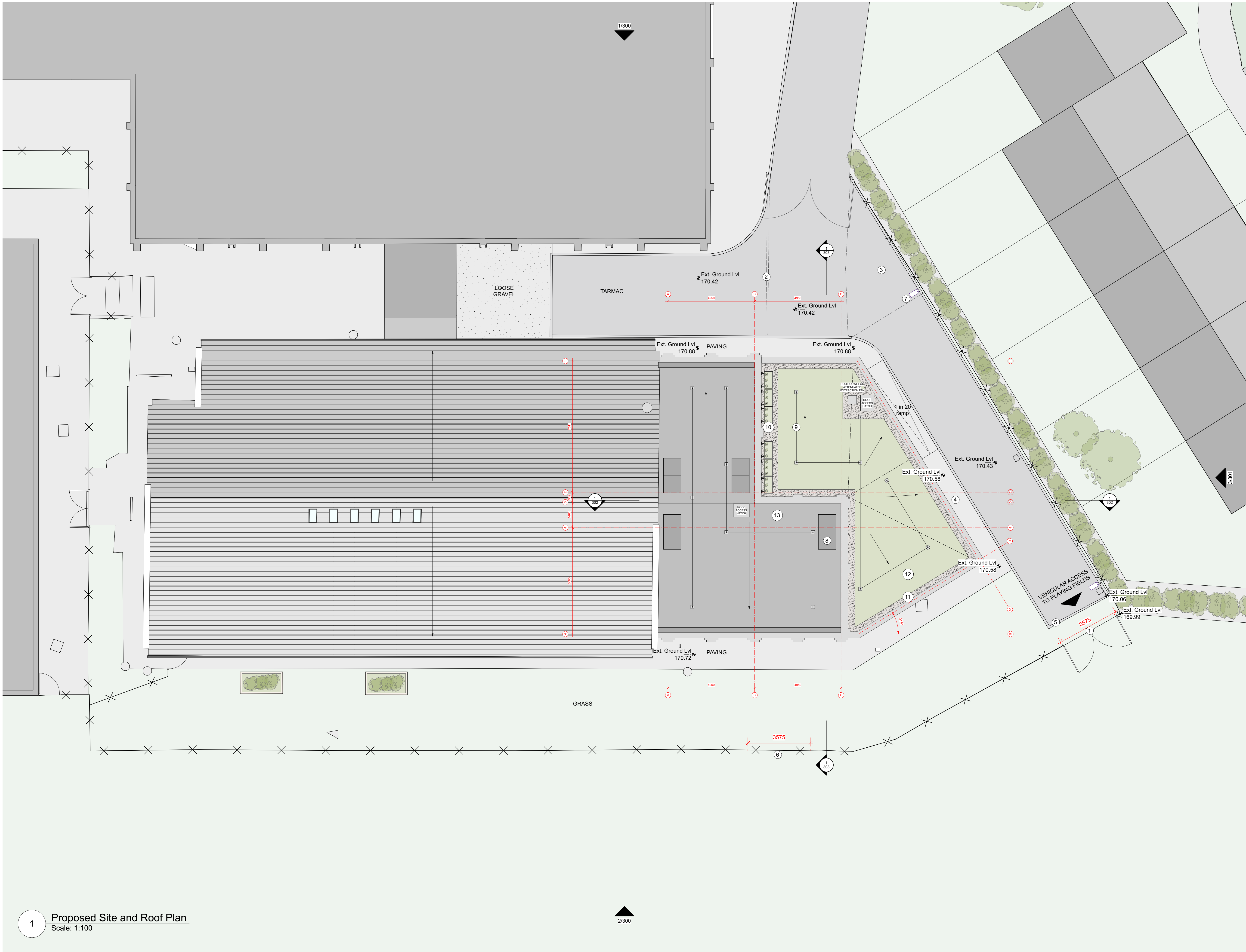
DRAWN BY	CHECKED BY
EP	GW

JOB NO.	STATUS
052	TENDER

DRAWING NO.	REV
052_GAD_100	T02

Appendix C Proposed Site Plans





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01234M

1:100 @ A1

A1

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Notes

1. Vehicular gate relocated

2. Kerb lowered to road level

3. New tarmac

4. New paving

5. Dropped kerb to allow for vehicular access to playing field.

6. Area of new fencing to match existing to replace relocated gates.

7. New lamp post

8. Roof cowls providing natural ventilation to classrooms

9. Mansafe system to installer's design

10. Planters fixed to wall with tensile wires for climbing plants

11. Loose round pebble maintenance strip

12. Sedum roof

13. Bituminous Flat Roof System to 1 in 40 Falls

NOTE: Number and positions of roof cowls assumed. TBC by M&E Engineer.

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Wardle Academy - Anderson Suite Extension

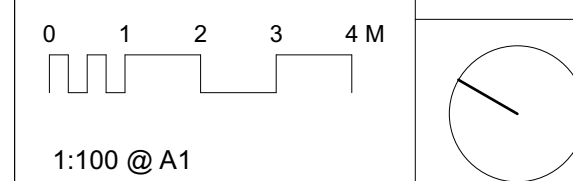
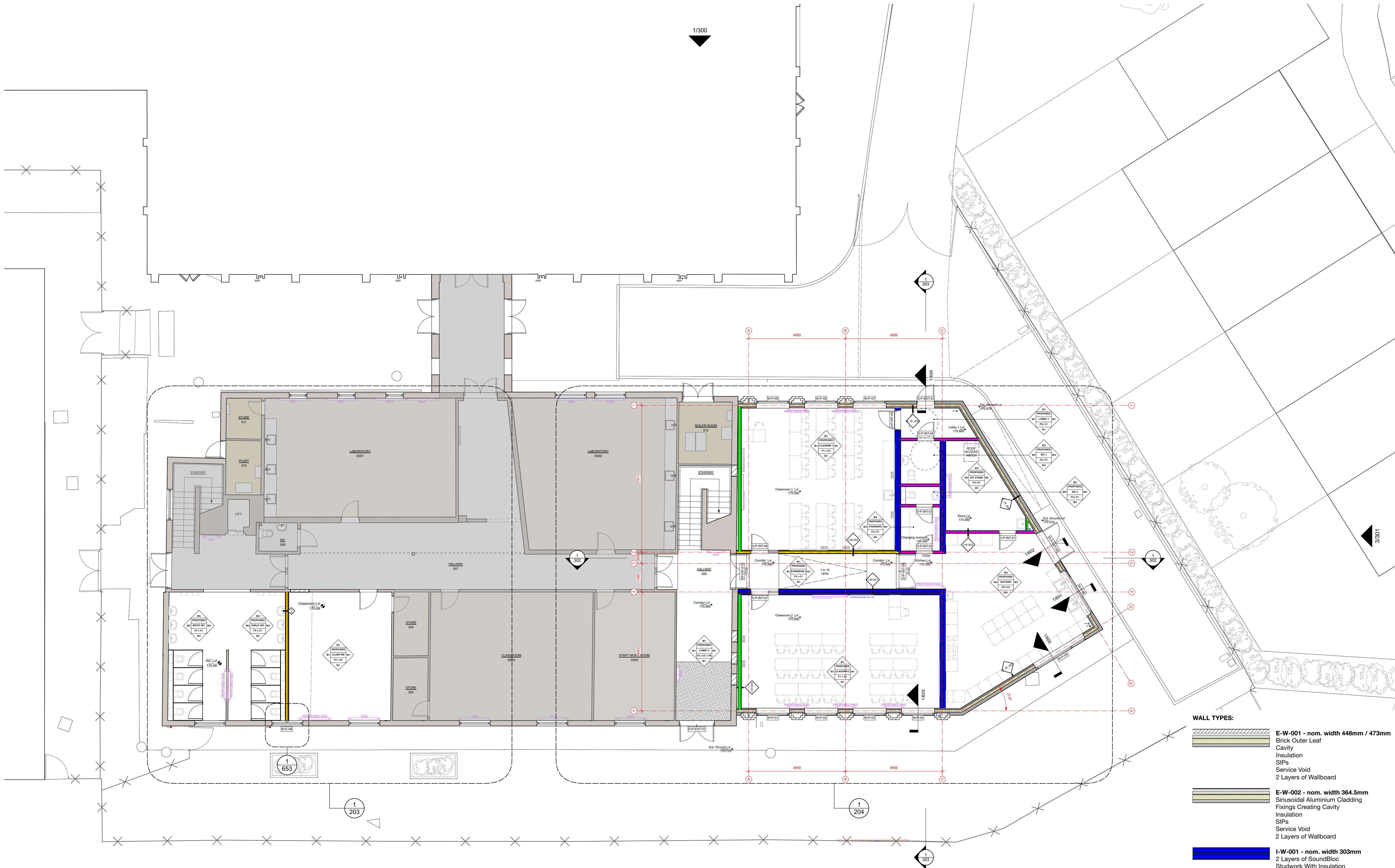
DRAWING TITLE

Proposed Site and Roof Plan

REV	DATE	NOTES
T01	24/01/2023	ISSUED FOR BUILDING REGS PLAN CHECK
T02	02/02/2023	ISSUED FOR TENDER
T03	04/05/2023	STEP-BACK ADDED AND PITCHED ROOF AMENDED TO FLAT ROOF IN-LINE WITH LBC COMMENTS. PLANTERS ADDED.
T04	12/05/2023	MANSAFE SYSTEM AND ACCESS HATCH ADDED TO UPPER FLAT ROOF

DRAWN BY AM	CHECKED BY GW
JOB NO. 052	STATUS TENDER

DRAWING NO. 052_GAD_200	REV T04
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Area outside of scope of works

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PROJECT
Wardle Academy - Anderson Suite Extension

DRAWING TITLE
Proposed Ground Floor Plan

REV	DATE	NOTES
T01	24/01/2023	ISSUED FOR BUILDING REGS PLAN CHECK
T02	02/02/2023	ISSUED FOR TENDER
T03	04/05/2023	WALL ON GL-C REPOSITIONED IN-LINE WITH WALL ABOVE. 2 NO. BRICK PIERS OMITTED ON GL-1.

DRAWN BY
AM

CHECKED BY
GW

JOB NO.
052

STATUS
TENDER

DRAWING NO.
052_GAD_201

REV
T03

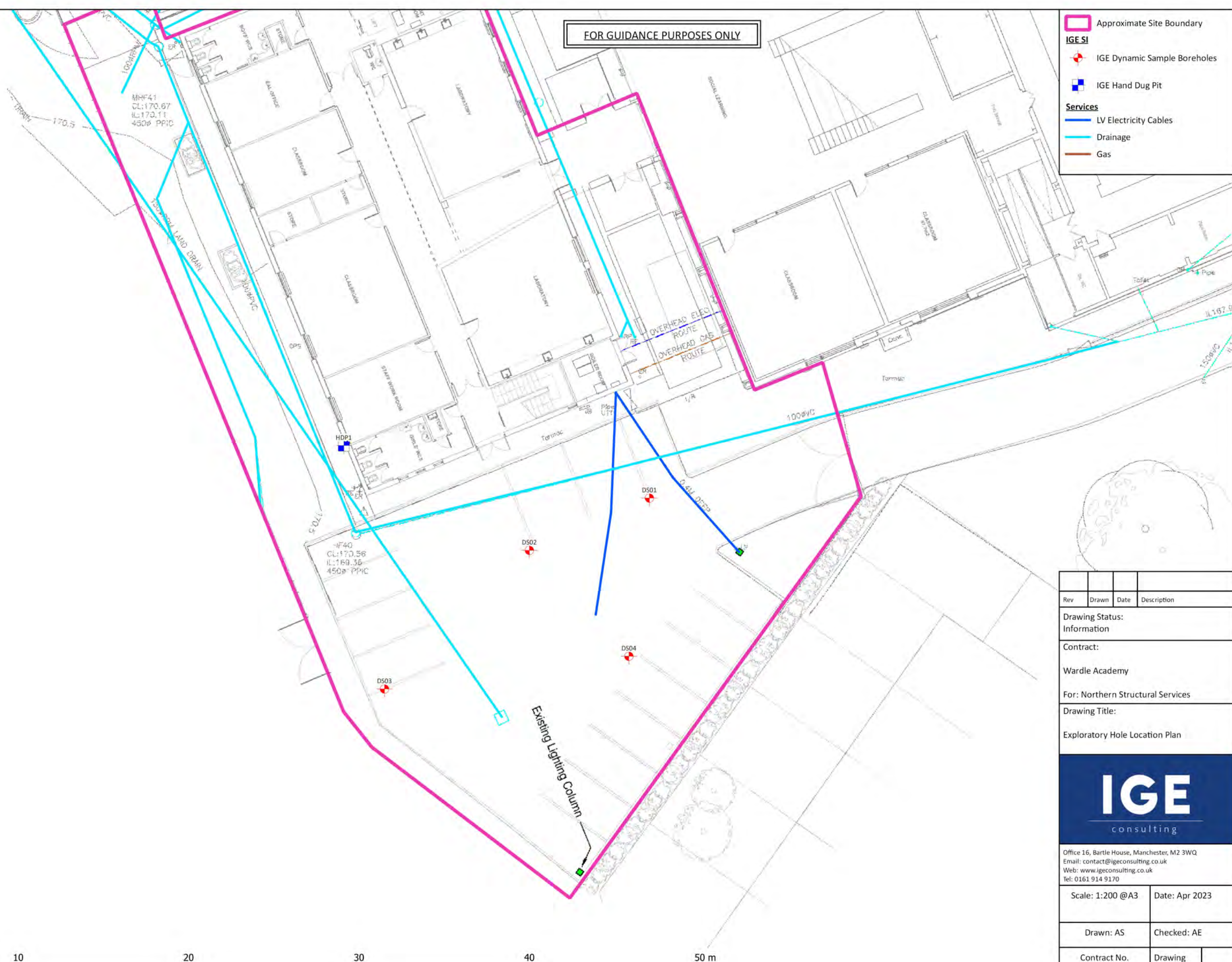
Appendix D

Ground Investigation Data

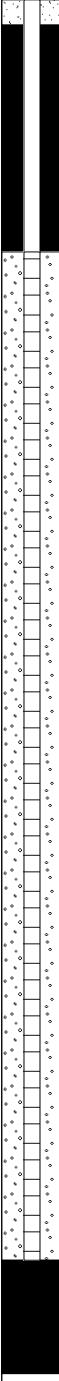


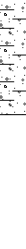
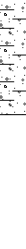
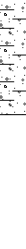
FOR GUIDANCE PURPOSES ONLY

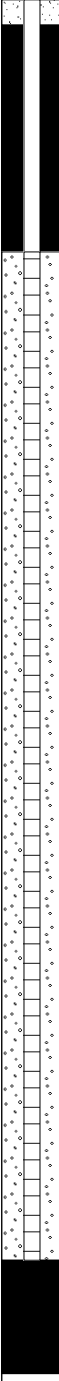
- Approximate Site Boundary**
- IGE SI**
- IGE Dynamic Sample Boreholes
 - IGE Hand Dug Pit
- Services**
- LV Electricity Cables
 - Drainage
 - Gas



Rev	Drawn	Date	Description
Drawing Status: Information			
Contract:			
Wardle Academy			
For: Northern Structural Services			
Drawing Title:			
Exploratory Hole Location Plan			
IGE consulting			
Office 16, Bartle House, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:200 @A3		Date: Apr 2023	
Drawn: AS		Checked: AE	
Contract No.		Drawing No.	
3940		SI - 05	P1

Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Dynamic Sample Borehole Log ver. 1.5				Dynamic Sample No. DS01 Sheet 1 of 1						
Project Name: Wardle Academy						Co-ords: 391632E - 416088N		Project No. 3940						
Location: Wardle						Level (m AOD): 170.50		Logged By AS						
Client: Northern Structural Services Ltd.						Date: 13/04/2023		Checked By LM						
Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)		Stratum Description						
		Depth(m)	Type	Results										
		0.20	ES		0.05	170.45		ASPHALT. MADE GROUND Dark brown, mottled black, very gravelly, slightly clayey, fine to coarse SAND. Gravel is angular to subangular, fine to coarse of asphalt (60%), concrete (30%) and ceramic (10%). MADE GROUND Firm, dark greyish brown, mottled black, slightly gravelly, sandy CLAY with occasional decaying plant fragments. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and coal (30%). REWORKED NATURAL DEPOSITS. MADE GROUND						
		0.80 0.80	B ES			0.30		170.20						
		1.20 - 1.65 1.20 - 2.00 1.20	D B SPT	N=11 (1,2/2,3,3,3)		1.00		169.50	Firm, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY with frequent gravel sized pockets of brown, silty, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and mudstone (30%). GLACIAL TILL					
		1.50	ES											
		2.00 - 2.45 2.00 - 3.00 2.00	D B SPT	N=14 (3,2/2,3,4,5)										
		2.60	ES											
		3.00 - 3.45 3.00 - 4.00 3.00	D B SPT	N=29 (5,5/5,9,8,7)										
		3.50	ES											
		4.00 - 4.45 4.00	D SPT	N=15 (3,3/4,3,3,5)										
		5.00 - 5.45 5.00	D SPT	N=12 (2,2/2,3,3,4)										
						5.45		165.05	Dynamic Sample terminated at 5.45m.					
		Remarks:						Water Strike		Casing Details		Sample Sleeve Runs		
Dynamic Sample Borehole terminated at 5.45m bgl at target depth.						Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)		
						2.00				1.20	2.00	87 90%		
										2.00	3.00	77 80%		
										3.00	4.00	67 80%		
										4.00	5.00	67 80%		

IGE consulting		Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170		Dynamic Sample Borehole Log ver. 1.5				Dynamic Sample No. DS02 Sheet 1 of 1																																																																																																																																																																																																																																										
Project Name: Wardle Academy				Co-ords: 391625E - 416085N		Project No. 3940																																																																																																																																																																																																																																												
Location: Wardle				Level (m AOD): 170.54		Logged By AS																																																																																																																																																																																																																																												
Client: Northern Structural Services Ltd.				Date: 13/04/2023		Checked By LM																																																																																																																																																																																																																																												
Weather: Rain																																																																																																																																																																																																																																																		
<table><tr><td rowspan="2">Well / Backfill</td><td rowspan="2">Water Strikes</td><td colspan="3">Sample and In Situ Testing</td><td rowspan="2">Depth (m)</td><td rowspan="2">Level (m AOD)</td><td rowspan="2"></td><td rowspan="2">Stratum Description</td><td rowspan="2"></td></tr><tr><td>Depth(m)</td><td>Type</td><td>Results</td></tr><tr><td rowspan="15"></td><td rowspan="15"></td><td>0.20</td><td>ES</td><td rowspan="5">N=9 (3,2/2,2,2,3)</td><td>0.05</td><td>170.49</td><td rowspan="5"></td><td>ASPHALT. MADE GROUND</td><td rowspan="5">1</td></tr><tr><td></td><td></td><td>0.20</td><td>170.34</td><td>Dark greyish brown, mottled black, very sandy, angular to subangular, fine to coarse GRAVEL of asphalt (60%) and concrete (40%). MADE GROUND</td></tr><tr><td></td><td></td><td>0.50</td><td>170.04</td><td>Reddish brown, very gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of red brick (80%) and concrete (20%). MADE GROUND</td></tr><tr><td></td><td></td><td></td><td></td><td>Firm, dark greyish brown, mottled black, slightly gravelly, sandy CLAY with occasional decaying plant fragments. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and coal (30%). REWORKED NATURAL DEPOSITS. MADE GROUND</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>1.00</td><td>B</td><td rowspan="5">N=15 (2,3/4,4,3,4)</td><td>1.00</td><td>169.54</td><td rowspan="5"></td><td>Firm, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY with frequent gravel sized pockets of brown, silty, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and mudstone (30%). GLACIAL TILL</td><td rowspan="5">2</td></tr><tr><td></td><td></td><td>1.00</td><td>ES</td><td></td><td></td></tr><tr><td></td><td></td><td>1.20 - 1.65</td><td>D</td><td></td><td></td></tr><tr><td></td><td></td><td>1.20</td><td>SPT</td><td></td><td></td></tr><tr><td></td><td></td><td>1.50 - 2.00</td><td>B</td><td></td><td></td></tr><tr><td></td><td></td><td>1.80</td><td>ES</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>2.00 - 2.45</td><td>D</td><td rowspan="5">N=20 (4,4/4,5,5,6)</td><td>2.00</td><td>168.54</td><td rowspan="5"></td><td>Firm to stiff, brown, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone (60%) and mudstone (40%). GLACIAL TILL</td><td rowspan="5">3</td></tr><tr><td></td><td></td><td>2.00 - 3.00</td><td>B</td><td></td><td></td></tr><tr><td></td><td></td><td>2.00</td><td>SPT</td><td></td><td></td></tr><tr><td></td><td></td><td>2.50</td><td>ES</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>3.00 - 3.45</td><td>D</td><td rowspan="5">N=13 (2,2/3,3,3,4)</td><td></td><td></td><td rowspan="5"></td><td></td><td rowspan="5">4</td></tr><tr><td></td><td></td><td>3.00 - 4.00</td><td>B</td><td></td><td></td></tr><tr><td></td><td></td><td>3.00</td><td>SPT</td><td></td><td></td></tr><tr><td></td><td></td><td>4.00 - 4.45</td><td>D</td><td></td><td></td></tr><tr><td></td><td></td><td>4.00 - 5.00</td><td>B</td><td></td><td></td></tr><tr><td></td><td></td><td>4.00</td><td>SPT</td><td rowspan="5">N=17 (3,3/3,4,4,6)</td><td></td><td></td><td rowspan="5"></td><td></td><td rowspan="5">5</td></tr><tr><td></td><td></td><td>4.50</td><td>ES</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>5.00 - 5.45</td><td>D</td><td rowspan="5"></td><td></td><td></td><td rowspan="5"></td><td></td><td rowspan="5">6</td></tr><tr><td></td><td></td><td>5.00</td><td>SPT</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td colspan="4"></td><td>5.45</td><td>165.09</td><td colspan="4">Dynamic Sample terminated at 5.45m.</td></tr></table>										Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)		Stratum Description		Depth(m)	Type	Results			0.20	ES	N=9 (3,2/2,2,2,3)	0.05	170.49		ASPHALT. MADE GROUND	1			0.20	170.34	Dark greyish brown, mottled black, very sandy, angular to subangular, fine to coarse GRAVEL of asphalt (60%) and concrete (40%). MADE GROUND			0.50	170.04	Reddish brown, very gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of red brick (80%) and concrete (20%). MADE GROUND					Firm, dark greyish brown, mottled black, slightly gravelly, sandy CLAY with occasional decaying plant fragments. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and coal (30%). REWORKED NATURAL DEPOSITS. MADE GROUND								1.00	B	N=15 (2,3/4,4,3,4)	1.00	169.54		Firm, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY with frequent gravel sized pockets of brown, silty, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and mudstone (30%). GLACIAL TILL	2			1.00	ES					1.20 - 1.65	D					1.20	SPT					1.50 - 2.00	B					1.80	ES									2.00 - 2.45	D	N=20 (4,4/4,5,5,6)	2.00	168.54		Firm to stiff, brown, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone (60%) and mudstone (40%). GLACIAL TILL	3			2.00 - 3.00	B					2.00	SPT					2.50	ES											3.00 - 3.45	D	N=13 (2,2/3,3,3,4)					4			3.00 - 4.00	B					3.00	SPT					4.00 - 4.45	D					4.00 - 5.00	B					4.00	SPT	N=17 (3,3/3,4,4,6)					5			4.50	ES																							5.00 - 5.45	D						6			5.00	SPT																									5.45	165.09	Dynamic Sample terminated at 5.45m.			
Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)		Stratum Description																																																																																																																																																																																																																																										
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Remarks:				Water Strike		Casing Details		Sample Sleeve Runs																																																																																																																																																																																																																																										
Dynamic Sample Borehole terminated at 5.45m bgl at target depth.				Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)																																																																																																																																																																																																																																								
					No strike.			1.20	2.00	87 90%																																																																																																																																																																																																																																								
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IGE consulting		Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170		Dynamic Sample Borehole Log		Dynamic Sample No. DS04 Sheet 1 of 1				
Project Name: Wardle Academy				Co-ords: 391630E - 416079N		Project No. 3940				
Location: Wardle				Level (m AOD): 170.30		Logged By AS				
Client: Northern Structural Services Ltd.				Date: 13/04/2023		Checked By LM				
Well / Backfill		Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m AOD)	Stratum Description			
			Depth(m)	Type	Results					
			0.20	ES	N=15 (1,1/2,5,4,4)	0.05	170.25	ASPHALT. MADE GROUND Dark greyish brown, mottled black, very sandy, angular to subangular, fine to coarse GRAVEL of asphalt (60%) and concrete (40%). MADE GROUND Firm, dark greyish brown, mottled black, slightly gravelly, sandy CLAY with occasional decaying plant fragments. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and coal (30%). REWORKED NATURAL DEPOSITS. MADE GROUND Firm, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY with frequent gravel sized pockets of brown, silty, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and mudstone (30%). GLACIAL TILL		
			0.50	B		0.20	170.10			
			0.50	ES		0.60	169.70			
			0.90	B		1.60	168.70			
			0.90	ES						
			1.20 - 1.65	D						
			1.20	SPT						
			1.40	B		HVP=96 HVP=102				
			1.40	ES						
			1.70							
			1.80							
			2.00 - 2.45	D		N=15 (2,3/3,3,4,5)				
			2.00 - 3.00	B						
			2.00	SPT						
			3.00 - 3.45	D					N=18 (2,4/4,4,4,6)	
3.00 - 4.00	B									
3.00	SPT									
3.50	ES									
4.00 - 4.45	D	N=15 (2,3/3,4,4,4)								
4.00 - 5.00	B									
4.00	SPT									
5.00 - 5.45	D			N=12 (0,1/2,3,3,4)						
5.00	SPT									
			5.45	164.85	Dynamic Sample terminated at 5.45m.					
Remarks:										
Dynamic Sample Borehole terminated at 5.45m bgl at target depth.				Water Strike		Casing Details		Sample Sleeve Runs		
				Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)
				3.00				1.20	2.00	87 90%
								2.00	3.00	77 100%
								3.00	4.00	67 80%
								4.00	5.00	67 90%



Trial Pit No.

HDP01

Sheet 1 of 2

ver. 1.0

Project Name: Wardle Academy

**Level
(mAOD):**

170.74

Date:

13/04/2023

Project No.

AS

Client: Northern Structural Services Ltd.

Co-ords:

391614E - 416092N

Checked By
LM

1

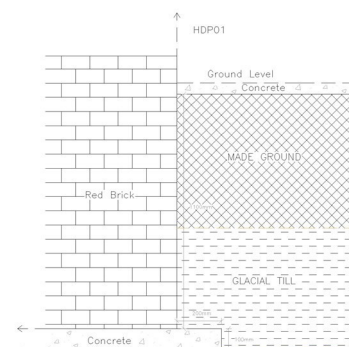
Water Strike

Stability:	
Frequent moderate collapses.	

Stability:	Frequent moderate collapses.

Remarks:

Hand Dug Pit terminated at 1.20m bgl at target depth.



IGEconsulting Office 11, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Hand Dug Pit Log ver. 1.0				Trial Pit No. HDP01 Sheet 2 of 2			
Project Name: Wardle Academy					Level (mAOD): 170.74		Date: 13/04/2023		Project No. 3940		
Location: Wardle					Weather: Rain				Logged By AS		
Client: Northern Structural Services Ltd.					Co-ords: 391614E - 416092N				Checked By LM		
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description				
	Depth (m)	Type	Results								
				1.20	169.54		Firm, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY with frequent gravel sized pockets of brown, silty, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone (70%) and mudstone (30%). GLACIAL TILL				
							Trial Pit terminated at 1.20m.				
2											
Water Strike											
Depth Strike (mbgl)		Remarks									
1.00											
Stability: Frequent moderate collapses.											
Remarks: Hand Dug Pit terminated at 1.20m bgl at target depth.											

DS01

Dynamic Sample Hole Falling Head Test

FIELD MEASUREMENTS	Time (min)	Water Depth (m below top of casing)	Head (from water level) (m)	INPUT PARAMETERS	Borehole Depth	5.450	m
	0.50	0.180	2.170		Casing Depth	0.000	m
	1.00	0.300	2.050		Difference in Length between bottom of casing/boreholes, L	5.450	m
	1.50	0.320	2.030		Water Depth	2.350	m
	2.00	0.320	2.030		Casing Diameter, D	0.051	m
	2.50	0.320	2.030		Cross Sectional area of casing, A	0.002	m ²
	3.00	0.330	2.020		Height of casing above ground level	0.000	m
	3.50	0.330	2.020		Approximate long term water table (or base of BH see rules)	2.350	m
	4.00	0.330	2.020		Borehole End Condition (important to get right)	d	
	4.50	0.330	2.020		a= Soil flush with bottom at impervious boundary	0.102	
	5.00	0.340	2.010		b= Soil flush with bottom in uniform soil	0.140	
	6.00	0.340	2.010		c= Well point or hole extended at impervious boundary	6.150	
	7.00	0.340	2.010		d= Well point or hole extended in uniform soil	0.340	
	8.00	0.340	2.010		e= Soil in casing with bottom at impervious boundary	0.000	
	9.00	0.340	2.010		f= Soil in casing with bottom in uniform soil	0.000	
	10.00	0.340	2.010		Intake factor, F (Select correct end condition)	0.340	
	15.00	0.350	2.000		Variable Head, H ¹	2.170	m
	30.00	0.350	2.000		Time, T ¹	0.500	min
	41.00	0.350	2.000		Variable Head, H ²	1.970	m
	87.00	0.370	1.980		Time, T ²	159.000	min
	116.00	0.370	1.980	K unsat (m/s)	3.67E-06		
	159.00	0.380	1.970				
				RULES	1. A borehole location MUST be entered to generate <i>k</i> .		
					2. Enter all values in shaded cells: A, F, L and k are calculated automatically in the spreadsheet.		
					3. Head is measured to the base of the BH, or use WL if higher.		
					4. End conditions referenced in BS 5930 see notes. Usually d. <u>Formula for uncased hole</u> .		
					5. If groundwater level is below test, k is not true permeability, but indicative only.		
					6. Usually T ¹ =0 and T ² =60 or at H ¹ =25% and H ² =75% of effective depth, input H at these times.		
					7. Where 25% and 75% of effective depth cannot be calculated, an extrapolated value can be produced.		

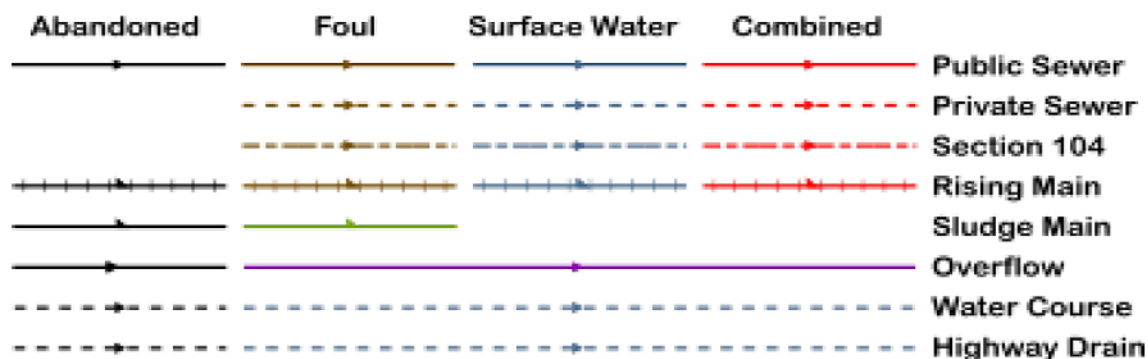
DS02

Dynamic Sample Hole Falling Head Test

FIELD MEASUREMENTS	Time (min)	Water Depth (m below top of casing)	Head (from water level) (m)	INPUT PARAMETERS	Borehole Depth	5.450	m
	0.50	0.600	2.000		Casing Depth	0.000	m
	1.00	0.610	1.990		Difference in Length between bottom of casing/boreholes, L	5.450	m
	1.50	0.630	1.970		Water Depth	2.600	m
	2.00	0.640	1.960		Casing Diameter, D	0.051	m
	2.50	0.640	1.960		Cross Sectional area of casing, A	0.002	m ²
	3.00	0.640	1.960		Height of casing above ground level	0.000	m
	3.50	0.640	1.960		Approximate long term water table (or base of BH see rules)	2.600	m
	4.00	0.640	1.960		Borehole End Condition (important to get right)	d	
	4.50	0.640	1.960		a= Soil flush with bottom at impervious boundary	0.102	
	5.00	0.640	1.960		b= Soil flush with bottom in uniform soil	0.140	
	6.00	0.640	1.960		c= Well point or hole extended at impervious boundary	6.150	
	7.00	0.640	1.960		d= Well point or hole extended in uniform soil	0.340	
	8.00	0.640	1.960		e= Soil in casing with bottom at impervious boundary	0.000	
	9.00	0.640	1.960		f= Soil in casing with bottom in uniform soil	0.000	
	10.00	0.650	1.950		Intake factor, F (Select correct end condition)	0.340	
	22.00	0.650	1.950		Variable Head, H ¹	2.000	m
	45.00	0.650	1.950		Time, T ¹	0.500	min
				K unsat (m/s)	Variable Head, H ²	1.950	m
					Time, T ²	45.000	min
				RULES	3.42E-06		
					1. A borehole location MUST be entered to generate <i>k</i> .		
					2. Enter all values in shaded cells: A, F, L and k are calculated automatically in the spreadsheet.		
					3. Head is measured to the base of the BH, or use WL if higher.		
					4. End conditions referenced in BS 5930 see notes. Usually d. <u>Formula for uncased hole.</u>		
					5. If groundwater level is below test, k is not true permeability, but indicative only.		
					6. Usually T ¹ =0 and T ² =60 or at H ¹ =25% and H ² =75% of effective depth, input H at these times.		
					7. Where 25% and 75% of effective depth cannot be calculated, an extrapolated value can be produced.		

Appendix E Existing Drainage Plans

Wastewater Symbolology



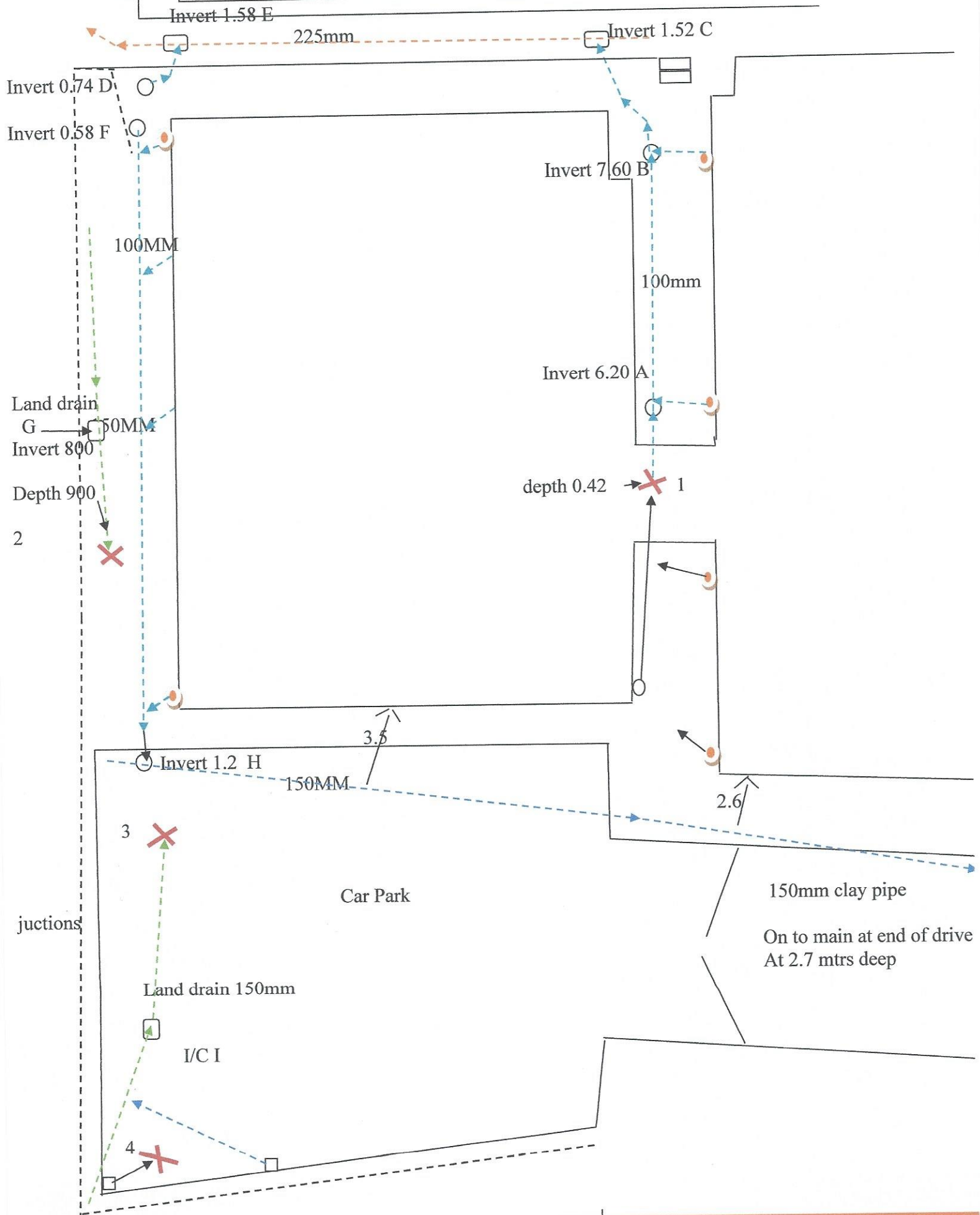
All point assets follow the standard colour convention: **red** – combined **brown** - foul
blue – surface water **purple** - overflow

Manhole	Side Entry Manhole
Head of System	Outfall
Extent of Survey	Screen Chamber
Rodding Eye	Inspection Chamber
Inlet	Bifurcation Chamber
Discharge Point	Lamp Hole
Vortex	T Junction / Saddle
Penstock	Catchpit
Washout Chamber	Valve Chamber
Valve	Vent Column
Air Valve	Vortex Chamber
Non Return Valve	Penstock Chamber
Soakaway	Network Storage Tank
Gully	Sewer Overflow
Cascade	Ww Treatment Works
Flow Meter	Ww Pumping Station
Hatch Box	Septic Tank
Oil Interceptor	Control Kiosk
Summit	
Drop Shaft	Change of Characteristic
Orifice Plate	



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CSS LTD SITE PLAN ONLY NOT TO SCALE
ROCHDALE WARDLE HIGH SCHOOL



Notes Faults

CCTV up stream line from m/c A as per plan 100mm clay pipe at approx 4.2 mtrs inside walkway Collapsed pipe see photo 1

CCTV down stream from m/c G 150mm land drain at approx 8.7 mtrs pipe through land drain can not pass See photo 2

CCTV down stream from m/c I 150MM land drain in car park area at approx 12.2 damaged pipe can not pass See photo 3

CCTV down stream from road gulley in car park debris jammed in pipe See photo 4

Keys	100mm		225mm pipe	
	150mm			
	150mm land drain			
	S/W Gulleys			
	M/C	 		
	Faults on line			

Appendix F Greenfield Run-Off Calculations

Flo Consult UK Ltd		Page 1
4 Market Square	Wardle Academy	
Old Amersham	Greenfield Run-Off	
Buckinghamshire, HP7 0DQ	Rate Calculations	
Date 19/05/2023	Designed by MDS	
File	Checked by MDS	
Innovyze		Source Control 2020.1.3
<u>IH 124 Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.450 Area (ha) 50.000 Urban 0.750 SAAR (mm) 1200 Region Number Region 10 Results l/s QBAR Rural 412.7 QBAR Urban 947.2 Q1 year 824.0 Q1 year 824.0 Q2 years 967.6 Q5 years 1161.2 Q10 years 1251.4 Q20 years 1333.6 Q25 years 1354.8 Q30 years 1371.6 Q50 years 1415.3 Q100 years 1492.7 Q200 years 1600.4 Q250 years 1633.1 Q1000 years 1839.4		
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Flo Consult UK Ltd		Page 1																										
4 Market Square	Wardle Academy																											
Old Amersham	Greenfield Run-Off																											
Buckinghamshire, HP7 0DQ	Volume Calculations																											
Date 19/03/2023	Designed by MDS																											
File	Checked by MDS																											
Innovyze	Source Control 2020.1.3																											
<u>Greenfield Runoff Volume</u> FEH Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>2013</td> </tr> <tr> <td>Site Location</td> <td>GB 391627 416081 SD 91627 16081</td> </tr> <tr> <td>Data Type</td> <td>Point</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>0.051</td> </tr> <tr> <td>SAAR (mm)</td> <td>1255</td> </tr> <tr> <td>CWI</td> <td>123.936</td> </tr> <tr> <td>SPR Host</td> <td>47.000</td> </tr> <tr> <td>URBEXT (USER)</td> <td>0.5000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>57.18</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>20.108</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	FEH Rainfall Version	2013	Site Location	GB 391627 416081 SD 91627 16081	Data Type	Point	Areal Reduction Factor	1.00	Area (ha)	0.051	SAAR (mm)	1255	CWI	123.936	SPR Host	47.000	URBEXT (USER)	0.5000	Percentage Runoff (%)	57.18	Greenfield Runoff Volume (m³)	20.108
Return Period (years)	100																											
Storm Duration (mins)	360																											
FEH Rainfall Version	2013																											
Site Location	GB 391627 416081 SD 91627 16081																											
Data Type	Point																											
Areal Reduction Factor	1.00																											
Area (ha)	0.051																											
SAAR (mm)	1255																											
CWI	123.936																											
SPR Host	47.000																											
URBEXT (USER)	0.5000																											
Percentage Runoff (%)	57.18																											
Greenfield Runoff Volume (m³)	20.108																											
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Appendix G

Pre-Development Run-Off Calculations

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4 Market Square	Wardle Academy	
Old Amersham	Surface Water	
Buckinghamshire, HP7 0DQ	Run-Off Calculations	
Date 19/05/2023	Designed by MDS	
File	Checked by MDS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 391627 416081 SD 91627 16081
Data Type	Point
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 * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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 Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 391627 416081 SD 91627 16081
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Run-Off Calculations	
Date 19/05/2023	Designed by MDS	
File	Checked by MDS	
Innovyze	Network 2020.1.3	
Synthetic Rainfall Details Storm Duration (mins) 30		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ		Wardle Academy Surface Water Run-Off Calculations	
Date 19/05/2023		Designed by MDS	
File		Checked by MDS	
Innovyze		Network 2020.1.3	

2 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 Coefficient 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 Offline Controls 0

Number of Time/Area Diagrams 0

Number of Online Controls 0

Number of Storage Structures 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH

FEH Rainfall Version 2013

Site Location GB 391627 416081 SD 91627 16081

Data Type Point

Cv (Summer) 0.750

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

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) 2, 30, 100

Climate Change (%) 0, 0, 0

								Water	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	15 Winter	2	+0%	100/15 Summer				10.056
1.001	2	15 Winter	2	+0%	30/15 Summer				9.970

Surcharged Flooded

US/MH Depth Volume Flow / Overflow

PN Name (m) (m³) Cap. (l/s)

1.000 1 -0.094 0.000 0.30

1.001 2 -0.080 0.000 0.44

Half Drain Pipe

Time Flow Level

(mins) (l/s) Status Exceeded

4.7 OK

6.9 OK

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ				Wardle Academy Surface Water Run-Off Calculations									
Date 19/05/2023				Designed by MDS									
File				Checked by MDS									
Innovyze				Network 2020.1.3									
<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>													
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 Coefficient		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 Offline Controls		0							
Number of Online Controls		0		Number of Storage Structures		0							
				Number of Time/Area Diagrams		0							
				Number of Real Time Controls		0							
Synthetic Rainfall Details													
Rainfall Model				FEH									
FEH Rainfall Version				2013									
Site Location				GB 391627 416081 SD 91627 16081									
Data Type				Point									
Cv (Summer)				0.750									
Cv (Winter)				0.840									
Margin for Flood Risk Warning (mm)				300.0		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)				2, 30, 100									
Climate Change (%)				0, 0, 0									
Water													
US/MH		Return Climate		First (X)		First (Y)		First (Z)		Overflow		Level	
PN Name Storm		Period Change		Surcharge		Flood		Overflow		Act.		(m)	
1.000		1 15 Winter		30 +0%		100/15 Summer						10.107	
1.001		2 15 Winter		30 +0%		30/15 Summer						10.059	
Surcharged Flooded								Half Drain		Pipe			
US/MH		Depth		Volume		Flow / Overflow		Time		Flow		Level	
PN Name		(m)		(m³)		Cap. (l/s)		(mins)		(l/s)		Status Exceeded	
1.000		1		-0.043		0.000		0.68		10.8		OK	
1.001		2		0.009		0.000		1.06		16.8		SURCHARGED	
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ				Wardle Academy Surface Water Run-Off Calculations			
Date 19/05/2023				Designed by MDS			
File				Checked by MDS			
Innovyze				Network 2020.1.3			
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>							
<u>Simulation Criteria</u>							
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 Coefficient 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 Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0							
<u>Synthetic Rainfall Details</u>							
Rainfall Model				FEH			
FEH Rainfall Version				2013			
Site Location GB 391627 416081 SD 91627 16081							
Data Type				Point			
Cv (Summer)				0.750			
Cv (Winter)				0.840			
Margin for Flood Risk Warning (mm) 300.0 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) 2, 30, 100							
Climate Change (%) 0, 0, 0							

Flo Consult UK Ltd		Page 1
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Run-Off Calculations	
Date 19/05/2023	Designed by MDS	
File	Checked by MDS	
Innovyze	Network 2020.1.3	
<u>Simulation Criteria for Storm</u> 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 Coefficient 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 Time/Area Diagrams 0 Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FEH Return Period (years) 2 FEH Rainfall Version 2013 Site Location GB 391627 416081 SD 91627 16081 Data Type Point Summer Storms Yes Winter Storms Yes Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Run-Off Calculations	
Date 19/05/2023	Designed by MDS	
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Innovyze	Network 2020.1.3	

Summary Wizard of 360 minute 100 year Winter I+0% 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 Coefficient	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 391627 416081 SD 91627 16081
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	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)	2, 30, 100
Climate Change (%)	0, 0, 0

			Water Surcharged Flooded				
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+0%	11.500	10.039	-0.111	0.000	0.15
1.001	2	360 minute 100 year Winter I+0%	11.500	9.950	-0.100	0.000	0.24

			Pipe		
PN	US/MH Name	Overflow Discharge (l/s)	Vol (m³)	Pipe Flow (l/s)	Status
1.000	1	20.852	2.4	OK	
1.001	2	32.442	3.8	OK	

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Appendix H

Surface Water Management Layout and Details

Appendix I Surface Water Network / Management Calculations

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ		Wardle Academy Surface Water Management Calculations										
Date 19/05/2023		Designed by MDS										
File SW Network Calculations.mdx		Checked by MDS										
Innovyze		Network 2020.1.3										
<u>STORM SEWER DESIGN by the Modified Rational Method</u>												
<u>Design Criteria for Storm</u>												
Pipe Sizes STANDARD Manhole Sizes STANDARD												
FEH Rainfall Model												
Return Period (years)		2										
FEH Rainfall Version		2013										
Site Location		GB 391627 416081 SD 91627 16081										
Data Type		Point										
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												
<u>Time Area Diagram for Storm</u>												
Time (mins)	Area (ha)	Time (mins)	Area (ha)									
0-4	0.035	4-8	0.008									
Total Area Contributing (ha) = 0.043												
Total Pipe Volume (m³) = 0.461												
<u>Network Design Table for Storm</u>												
PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow (l/s)	(mm)	SECT	(mm)			Design
<u>Network Results Table</u>												
PN	Rain	T.C.	US/IL	Σ I.Area	Σ Base	Foul	Add Flow	Vel	Cap	Flow		
	(mm/hr)	(mins)	(m)	(ha)	Flow (l/s)	(l/s)	(l/s)	(m/s)	(l/s)	(l/s)		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Management Calculations	
Date 19/05/2023	Designed by MDS	
File SW Network Calculations.mdx	Checked by MDS	
Innovyze		Network 2020.1.3

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	150	1	170.100	169.040	0.910	Open Manhole	1200
1.001	o	150	2	170.420	168.870	1.400	Open Manhole	1200
1.002	o	150	3	170.420	168.800	1.470	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	16.950	99.7	2	170.420	168.870	1.400	Open Manhole	1200
1.001	7.150	102.1	3	170.420	168.800	1.470	Open Manhole	1200
1.002	2.000	100.0	S4	170.420	168.780	1.490	Open Manhole	1200

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)
1.002	S4	170.420	168.780	0.000	1200	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 Coefficient	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 Time/Area Diagrams 1
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 391627 416081 SD 91627 16081
Data Type	Point

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Management Calculations	
Date 19/05/2023	Designed by MDS	
File SW Network Calculations.mdx	Checked by MDS	
Innovyze	Network 2020.1.3	
Synthetic Rainfall Details Summer Storms Yes Winter Storms Yes Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Wardle Academy Surface Water Management Calculations																																																																																																																	
Date 19/05/2023	Designed by MDS																																																																																																																	
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<u>Online Controls for Storm</u> <u>Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 1.9</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0055-1500-1200-1500</td></tr><tr><td>Design Head (m)</td><td>1.200</td></tr><tr><td>Design Flow (l/s)</td><td>1.5</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>55</td></tr><tr><td>Invert Level (m)</td><td>168.800</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>75</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.200</td><td>1.5</td><td>Kick-Flo®</td><td>0.493</td><td>1.0</td></tr><tr><td>Flush-Flo™</td><td>0.242</td><td>1.2</td><td>Mean Flow over Head Range</td><td>-</td><td>1.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>1.1</td><td>1.200</td><td>1.5</td><td>3.000</td><td>2.3</td><td>7.000</td><td>3.4</td></tr><tr><td>0.200</td><td>1.2</td><td>1.400</td><td>1.6</td><td>3.500</td><td>2.4</td><td>7.500</td><td>3.5</td></tr><tr><td>0.300</td><td>1.2</td><td>1.600</td><td>1.7</td><td>4.000</td><td>2.6</td><td>8.000</td><td>3.6</td></tr><tr><td>0.400</td><td>1.2</td><td>1.800</td><td>1.8</td><td>4.500</td><td>2.7</td><td>8.500</td><td>3.7</td></tr><tr><td>0.500</td><td>1.0</td><td>2.000</td><td>1.9</td><td>5.000</td><td>2.9</td><td>9.000</td><td>3.8</td></tr><tr><td>0.600</td><td>1.1</td><td>2.200</td><td>2.0</td><td>5.500</td><td>3.0</td><td>9.500</td><td>3.9</td></tr><tr><td>0.800</td><td>1.2</td><td>2.400</td><td>2.1</td><td>6.000</td><td>3.1</td><td></td><td></td></tr><tr><td>1.000</td><td>1.4</td><td>2.600</td><td>2.1</td><td>6.500</td><td>3.3</td><td></td><td></td></tr></table>			Unit Reference	MD-SHE-0055-1500-1200-1500	Design Head (m)	1.200	Design Flow (l/s)	1.5	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	55	Invert Level (m)	168.800	Minimum Outlet Pipe Diameter (mm)	75	Suggested Manhole Diameter (mm)	1200	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	1.5	Kick-Flo®	0.493	1.0	Flush-Flo™	0.242	1.2	Mean Flow over Head Range	-	1.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	1.1	1.200	1.5	3.000	2.3	7.000	3.4	0.200	1.2	1.400	1.6	3.500	2.4	7.500	3.5	0.300	1.2	1.600	1.7	4.000	2.6	8.000	3.6	0.400	1.2	1.800	1.8	4.500	2.7	8.500	3.7	0.500	1.0	2.000	1.9	5.000	2.9	9.000	3.8	0.600	1.1	2.200	2.0	5.500	3.0	9.500	3.9	0.800	1.2	2.400	2.1	6.000	3.1			1.000	1.4	2.600	2.1	6.500	3.3		
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<u>Storage Structures for Storm</u> <u>Cellular Storage Manhole: 1, DS/PN: 1.000</u> Invert Level (m) 169.100 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>40.0</td><td>0.0</td><td>1.300</td><td>0.0</td><td>0.0</td></tr><tr><td>0.100</td><td>40.0</td><td>0.0</td><td>1.400</td><td>0.0</td><td>0.0</td></tr><tr><td>0.200</td><td>40.0</td><td>0.0</td><td>1.500</td><td>0.0</td><td>0.0</td></tr><tr><td>0.300</td><td>40.0</td><td>0.0</td><td>1.600</td><td>0.0</td><td>0.0</td></tr><tr><td>0.400</td><td>40.0</td><td>0.0</td><td>1.700</td><td>0.0</td><td>0.0</td></tr><tr><td>0.500</td><td>0.0</td><td>0.0</td><td>1.800</td><td>0.0</td><td>0.0</td></tr><tr><td>0.600</td><td>0.0</td><td>0.0</td><td>1.900</td><td>0.0</td><td>0.0</td></tr><tr><td>0.700</td><td>0.0</td><td>0.0</td><td>2.000</td><td>0.0</td><td>0.0</td></tr><tr><td>0.800</td><td>0.0</td><td>0.0</td><td>2.100</td><td>0.0</td><td>0.0</td></tr><tr><td>0.900</td><td>0.0</td><td>0.0</td><td>2.200</td><td>0.0</td><td>0.0</td></tr><tr><td>1.000</td><td>0.0</td><td>0.0</td><td>2.300</td><td>0.0</td><td>0.0</td></tr><tr><td>1.100</td><td>0.0</td><td>0.0</td><td>2.400</td><td>0.0</td><td>0.0</td></tr><tr><td>1.200</td><td>0.0</td><td>0.0</td><td>2.500</td><td>0.0</td><td>0.0</td></tr></table> <u>Time Area Diagram for Green Roof at Pipe Number 1.002 (Storm)</u> Area (m³) 80 Evaporation (mm/day) 3 Depression Storage (mm) 5 Decay Coefficient 0.050 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From:</td><td>To:</td><td>From:</td><td>To:</td><td>From:</td><td>To:</td><td>From:</td><td>To:</td></tr><tr><td>0</td><td>4</td><td>0.001454</td><td>32</td><td>36</td><td>0.000294</td><td>64</td><td>68</td><td>0.000059</td><td>96</td><td>100</td><td>0.000012</td></tr><tr><td>4</td><td>8</td><td>0.001190</td><td>36</td><td>40</td><td>0.000240</td><td>68</td><td>72</td><td>0.000049</td><td>100</td><td>104</td><td>0.000010</td></tr><tr><td>8</td><td>12</td><td>0.000974</td><td>40</td><td>44</td><td>0.000197</td><td>72</td><td>76</td><td>0.000040</td><td>104</td><td>108</td><td>0.000008</td></tr><tr><td>12</td><td>16</td><td>0.000798</td><td>44</td><td>48</td><td>0.000161</td><td>76</td><td>80</td><td>0.000033</td><td>108</td><td>112</td><td>0.000007</td></tr><tr><td>16</td><td>20</td><td>0.000653</td><td>48</td><td>52</td><td>0.000132</td><td>80</td><td>84</td><td>0.000027</td><td>112</td><td>116</td><td>0.000005</td></tr><tr><td>20</td><td>24</td><td>0.000535</td><td>52</td><td>56</td><td>0.000108</td><td>84</td><td>88</td><td>0.000022</td><td>116</td><td>120</td><td>0.000004</td></tr><tr><td>24</td><td>28</td><td>0.000438</td><td>56</td><td>60</td><td>0.000088</td><td>88</td><td>92</td><td>0.000018</td><td></td><td></td><td></td></tr><tr><td>28</td><td>32</td><td>0.000358</td><td>60</td><td>64</td><td>0.000072</td><td>92</td><td>96</td><td>0.000015</td><td></td><td></td><td></td></tr></table>						Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	0.000	40.0	0.0	1.300	0.0	0.0	0.100	40.0	0.0	1.400	0.0	0.0	0.200	40.0	0.0	1.500	0.0	0.0	0.300	40.0	0.0	1.600	0.0	0.0	0.400	40.0	0.0	1.700	0.0	0.0	0.500	0.0	0.0	1.800	0.0	0.0	0.600	0.0	0.0	1.900	0.0	0.0	0.700	0.0	0.0	2.000	0.0	0.0	0.800	0.0	0.0	2.100	0.0	0.0	0.900	0.0	0.0	2.200	0.0	0.0	1.000	0.0	0.0	2.300	0.0	0.0	1.100	0.0	0.0	2.400	0.0	0.0	1.200	0.0	0.0	2.500	0.0	0.0	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From:	To:	From:	To:	From:	To:	From:	To:	0	4	0.001454	32	36	0.000294	64	68	0.000059	96	100	0.000012	4	8	0.001190	36	40	0.000240	68	72	0.000049	100	104	0.000010	8	12	0.000974	40	44	0.000197	72	76	0.000040	104	108	0.000008	12	16	0.000798	44	48	0.000161	76	80	0.000033	108	112	0.000007	16	20	0.000653	48	52	0.000132	80	84	0.000027	112	116	0.000005	20	24	0.000535	52	56	0.000108	84	88	0.000022	116	120	0.000004	24	28	0.000438	56	60	0.000088	88	92	0.000018				28	32	0.000358	60	64	0.000072	92	96	0.000015			
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<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>																																																			
<u>Simulation Criteria</u>																																																			
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 Coefficient 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 Offline Controls 0 Number of Time/Area Diagrams 1																																																			
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0																																																			
<u>Synthetic Rainfall Details</u>																																																			
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FEH Rainfall Version 2013																																																			
Site Location GB 391627 416081 SD 91627 16081																																																			
Data Type Point																																																			
Cv (Summer) 0.750																																																			
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Analysis Timestep Fine Inertia Status OFF																																																			
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Profile(s) Summer and Winter																																																			
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440																																																			
Return Period(s) (years) 2, 30, 100																																																			
Climate Change (%) 0, 40, 45																																																			
WARNING: Half Drain Time has not been calculated as the structure is too full.																																																			
<table><tr><th colspan="2">US/MH</th><th rowspan="2">Storm</th><th rowspan="2">Return Period</th><th rowspan="2">Climate Change</th><th rowspan="2">First (X) Surcharge</th><th rowspan="2">First (Y) Flood</th><th rowspan="2">First (Z) Overflow</th><th rowspan="2">Overflow Act.</th><th>Water Level</th></tr><tr><th>PN</th><th>Name</th><th>(m)</th></tr><tr><td>1.000</td><td>1</td><td>120</td><td>Winter</td><td>100</td><td>+45%</td><td>30/15</td><td>Summer</td><td></td><td>170.096</td></tr><tr><td>1.001</td><td>2</td><td>120</td><td>Winter</td><td>100</td><td>+45%</td><td>2/15</td><td>Summer</td><td></td><td>170.093</td></tr><tr><td>1.002</td><td>3</td><td>120</td><td>Winter</td><td>100</td><td>+45%</td><td>2/15</td><td>Summer</td><td></td><td>170.090</td></tr></table>									US/MH		Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	PN	Name	(m)	1.000	1	120	Winter	100	+45%	30/15	Summer		170.096	1.001	2	120	Winter	100	+45%	2/15	Summer		170.093	1.002	3	120	Winter	100	+45%	2/15	Summer		170.090
US/MH		Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level																																										
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