

Far Field Playing Field Renovation, Highgate
School, North Road, Highgate, London N6

Flood Risk, Surface Water
and Foul Drainage Strategy

Reference CWC089

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Quality assurance record

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Limitation of liability and use

The work described in this report was undertaken for the party or parties stated; for the purpose or purposes stated; to the time and budget constraints stated. No liability is accepted for use by other parties or for other purposes, or unreasonably beyond the terms and parameters of its commission and its delivery to normal professional standards.

1. Introduction

1.1 Purpose of this Report

This report presents a Flood Risk Assessment (FRA), Surface Water Management Plan (SWMP) and Foul Water Drainage Strategy (FDS) for the renovation of the Far Field Playing Field, Highgate School, North Road, Highgate, London N6 4LP. The existing pavilion that includes changing rooms and toilet facilities is retained unchanged in size and location, but as part of the renovation scheme there are some upgrading works.

1.2 Background

The National Planning Policy Framework (NPPF) was published on 27 March 2012 and has subsequently been updated several times, most recently in 2021. The document sets out the Government's planning policies for England and how these are expected to be applied. Flooding is addressed, principally in Section 14 'Meeting the challenge of climate change, flooding and coastal change' paragraphs 152 to 173 of the NPPF. These seek to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

The NPPF Planning Practice Guidance (PPG) was released in March 2014 ('Flood Risk and Coastal Change' section) and updated in February 2016 to incorporate the EA 'Flood Risk Assessments: Climate Change Allowances' guidance.

A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

A site-specific flood risk assessment must demonstrate the following:

- that the development will be safe for its lifetime taking account of the vulnerability of its users;
- it should not increase flood risk elsewhere
- it should if possible, reduce flood risk overall.

This site is greater than 1ha in area and is in Flood Zone 1, therefore a flood risk assessment is required. A surface water and foul drainage strategy are also required.

1.2.1 Sources of Information and Consultation

This Report has been informed by the following:

- Location and site plans by Hemstock Design;
- The National Planning Policy Framework (NPPF);
- DEFRA's non-statutory technical standards for SuDS;
- The London Plan;
- Haringey Council Flood Risk and SuDS Guidance;
- The Building Regulations Part H;
- CIRIA 'SuDS Manual' C753;
- Government published flood data
- Previous FRA dated July 2019.

1.3 Structure of this Report

The Report has been structured in order to deal with key flood, surface water and foul drainage related issues, and also relate to the NPPF Practice Guide. The structure of the report is as follows:

- Section 1 presents the purpose and structure of the report.
- Section 2 refers to spatial planning considerations by reference to the proposed land use and flood zoning.
- Section 3 details the existing drainage arrangements and catchment descriptors at the proposed development.
- Section 4 presents the proposed redevelopment plans and the SWMP for the site.
- Section 5 describes foul water management strategy.
- Section 6 provides a summary of findings.
- Section 7 details the documents referenced.

Additional Appendices are provided that deal with the following.

- Appendix A – Hydrology
- Appendix B – Haringey LLFA Technical Assessment Proforma
- Appendix C – Drainage Design outputs

2. Spatial Planning Considerations

2.1 Location and Background

The proposals are for a synthetic turf pitch (STP) sports field development to overcome currently waterlogged conditions in the wetter parts of the year. The proposals cover the same site area as currently, this includes:

Total Site Area (Ownership Boundary) 22,337 sq.m

Playing Surface (Proposed STP) 13,940 sq.m

Embankments 2,812 sq.m

Plateau 19,525 sq.m

Non-STP Margin 5,585 sq.m

Pavilion – includes changing and toilets 56 sq.m

The site is located at Far Field Playing Field, Highgate School, North Road, Highgate, London N6 4LP. The development location plan is shown in Figure 1, with an aerial view in Figure 2.



Figure 1: Development location plan and redline boundary.

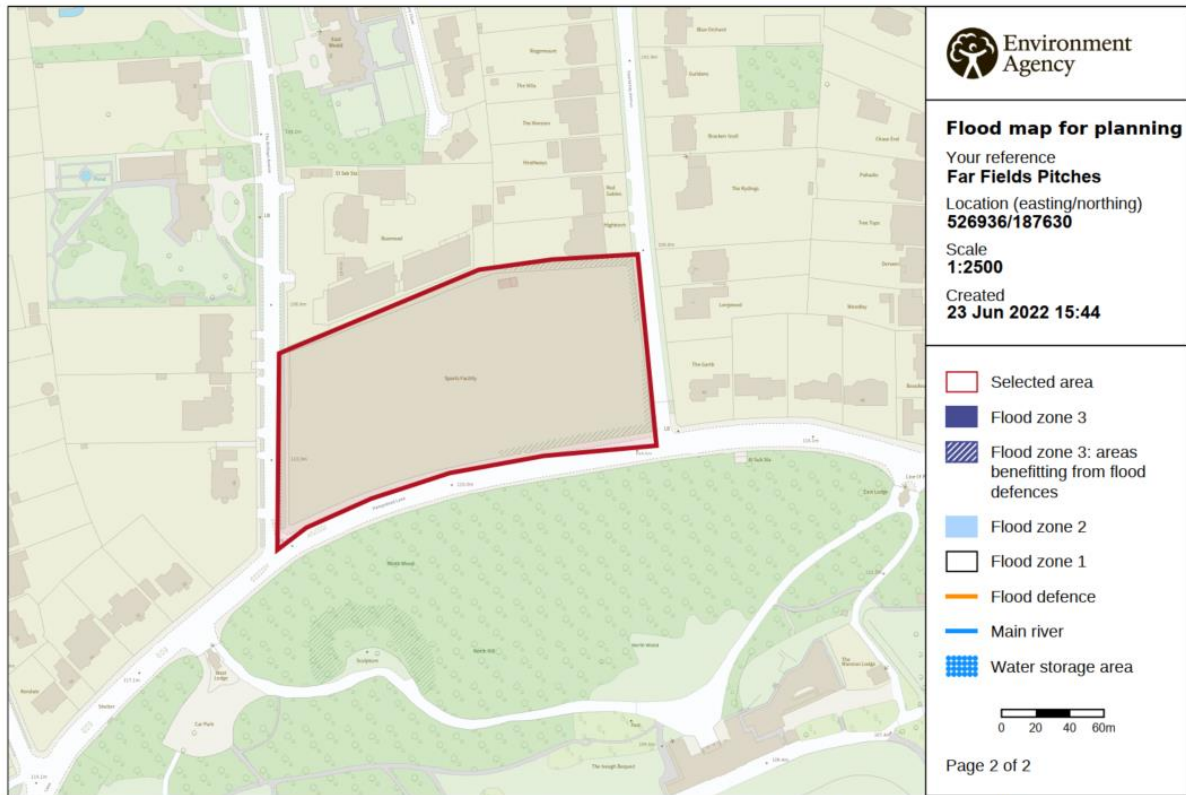


Figure 2: Site location plan (Aerial View)

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation. Source: Bing Maps

2.2 Environment Agency Flood Extents (Fluvial and Surface Water)

The Government and Environment Agency Flood Map for Planning is shown in Figure 3. The site is shown to lie entirely within Flood Zone 1, with an annual exceedance probability (AEP) of flooding lower than 0.1% (1 in 1,000). Fluvial flood risk impacting the site is thus not considered any further in this assessment.



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Figure 3: Flood Map for Planning

Assessing surface water flood risk by utilising the Government Long Term Flood Risk service the site is shown to be at no surface water flood risk for the Medium Risk which is equivalent to a 1 in 100 year or planning threshold event. The Low Risk Depth map or the 1 in 1000 year event is shown in Figure 4 and shows a very small area of flood risk on the eastern site boundary.

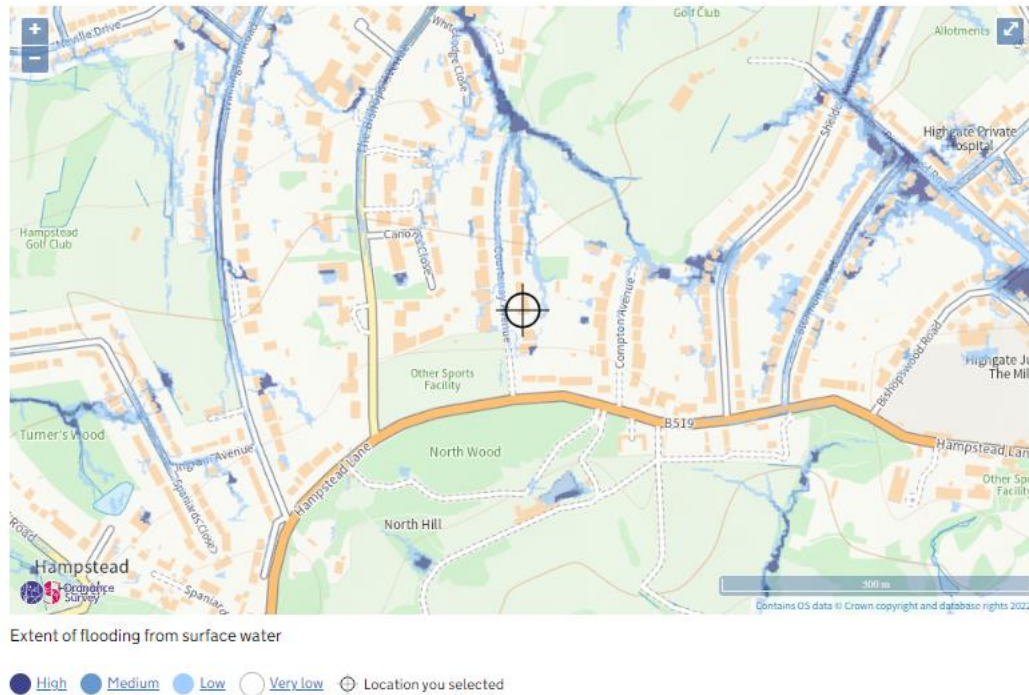


Figure 4: Extract from the Environment Agency's Long-Term flood risk map

3. Existing Arrangements

3.1 Catchment characteristics and Existing Drainage

In terms of foul drainage the pavilion is drained off to Courtenay Avenue by a separate dedicated sewer. This will remain unchanged.

The existing site is totally greenfield apart from the small pavilion with a roof area of 56m². In terms of surface water drainage arrangements, there are historical existing open channels at the northern side of the site. There may have been other land drainage but as the pitches currently become waterlogged after periods of heavy rain this arrangement is not effective.

All surface water flow is drained off site to the east via a 150mm drain into a chamber in Courtenay Avenue. An extensive investigation including CCTV was required to determine the location plus extent of the existing site drainage, including finding buried chamber – which is indicative of a lack of maintenance over the years.

A detailed drainage inspection including CCTV survey of the below ground pipework has been undertaken. Within the Design and Access Statement there are details of the CCTV and existing land drainage. The connection from the pitches off site to the east has also been located and confirmed as a 150mm pipe connecting into the surface water system of Courtenay Avenue, see Figure 5.

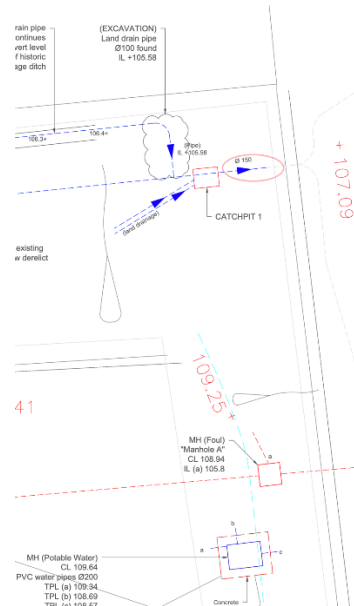


Figure 5 – Existing Drainage Located – Catchpit 1 and 150mm off site

Within the Design and Access Statement there are details of the existing land drainage and offsite networks comprising:

- a stone-block lined ditch,
- a lateral pipe that used to enter the ditch – now blocked by tree roots;
- a buried final drainage chamber – being the last chamber in the playing fields, see D&AS Figure 15;
- a 225mm diameter surface water drain in Courtenay Avenue, see D&AS Figure 16.

For ease of reference the key drainage features are shown in Figure 6 to Figure 8.



Fig. 13: The remains of the stone-block lined ditch, later brick wall and concrete bed.



Fig. 14: One of the lateral pipe spillways into the ditch, blocked by tree roots

Figure 6 Existing Drainage – Left Exposed buried lined channel. Right Pipe blocked by tree roots



Figure 7 – Existing Drainage Located – Left Catchpit 1 on site. Middle & Right Courtenay Avenue

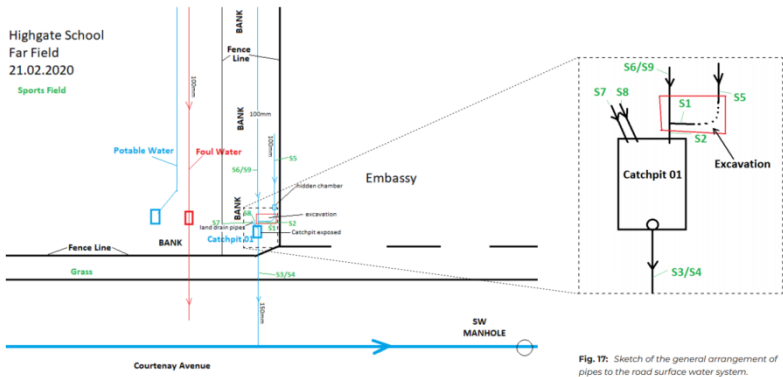


Figure 8 – Overview of Existing Drainage Layout

For estimating the runoff, the rainfall runoff modelling approach of FEH has been used. The adopted catchment descriptors may be found in Table 1. This peak greenfield runoff estimation method is recommended in the CIRIA SuDS Manual C753 and by Haringey Council.

Table 1 – Selected catchment characteristics

	Location:	Far Fields, Highgate
	NGR:	TQ 26650 88550
AREA	Catchment area (km2)	0.57
BFIHOST	Base flow index	0.454
DPLBAR	Mean drainage path length (km)	0.78
DPSBAR	Mean drainage path slope	40.1
FARL	Flood Attenuation by Reservoirs and Lakes	1
LDP	Longest drainage path (km)	1.49
PROPWET	Proportion of time soil is wet	0.29
RMED-1H	Median 1 hour rainfall (mm)	11.2
RMED-1D	Median 1 day rainfall (mm)	33.5
RMED-2D	Median 2 day rainfall (mm)	43.7
SAAR	Average annual rainfall (mm)	682
SAAR4170	Ditto for 1941-1970 (mm)	680
SPRHOST	Percentage runoff	37.91

Source: FEH web service

The Haringey Council publication SuDS Design Requirements dated May 2016 provides typical Greenfield Runoff rates for the area within Table 2: Runoff Rates of that publication, see a copy in Figure 9.

The following table provides a guide to anticipated runoff rates for Haringey based on a clay soil using FEH methodology. Where soils are free draining and there are no constraints on infiltration, then it is anticipated that drainage scheme will be designed to infiltrate.

Table 2: Runoff rates

Return period	Greenfield sites – allowable discharge rate (l/s/ha)	PDL sites – 3 times Greenfield runoff (l/s/ha)	**PDL sites 50% Betterment allowable discharge rate (l/s/ha)
1 in 1 year	3.4	10.2	8
1 in 2.year (Qmed)	4.0	12.0	20
1 in 30 year	9.3	27.9	63
1 in 100 year	12.9	38.7	63

Figure 9 – Haringey SuDS Design Requirements

Pre-development discharge

Site Makeup

Greenfield Method

Positively Drained Area (ha)

SAAR (mm)

Host

BFIHost

Region

QBar/QMed conversion factor

Betterment (%)

QMed (l/s)

QBar (l/s)

Return Period (years)	Growth Factor	Q (l/s)
2	0.88	6.9
30	1.95	15.4
100	2.48	19.5

Figure 10 – FEH Greenfield Runoff – Source Causeway Flow

For this site of 2.234 ha the Greenfield Rates of Runoff have been determined from a number of sources that are compared below.

Table 2 Greenfield runoff rates and volumes

Annual Exceedance Probability	Return period	Greenfield runoff rate (l/s)	
		Haringey	FEH via Causeway Flow
50%	2 year	8.9	6.9
3.3%	30 year	20.8	15.4
1%	100 year	28.8	19.5

The Causeway Flow software utilising FEH rainfall, catchment details and the site area of 2.234ha has determined the pre-development runoff as 786m³ for the 100 year 6 hour storm, which compares well to the previous FRA pre-development volume of 764m³. The variance is due to updated FEH parameters provided by the FEH webservice.

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	2.234
Soil Index	4
SPR	0.38
Catchment Wetness Index	102.222
Return Period (years)	100
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
	Calc
PR	0.392
Runoff Volume (m ³)	784

The site is greenfield pre- and post-development, but will be affected by climate change and has limited infiltration capacity, so the options to mitigate for the additional volume of runoff are to retain the additional rainfall on site during the storm and release it later.

As the site is Greenfield plus contains a large volume of voided stone a minimum Interception Loss of 5mm of rainfall will occur. However given the 5m centre to centre spacing of the perforated drainage below the stone sub-base it is likely that the Interception Storage will be higher as the stone will be coated in moisture and the stone between the perforated pipes is unlikely to fully drain leading to infiltration and evaporation.

At 5mm across the entire 2.234 ha site this amounts to 112m³. Assuming 10mm of Interception Storage within the 1.39ha of Synthetic Pitch sub-base and 5mm across the remainder of the site this volume of storage is 181m³.

3.2 Soil Data

British Geological Survey maps show the site lies on Bagshot Sands over the more impermeable Claygate Beds with London Clay below and with no drift deposits in the local area. There are 2 publicly available BGS boreholes nearby, to the north at Courtney Avenue and Barons Court (Table 4.1).

Table 3 – BGS Borehole Records

Reference	Name	Length (m)	Easting	Northing
TQ28NE238	COURTENAY AVENUE N6 BH1	15.0	527010	187860
TQ28NE3	BARONS COURT EAST FINCHLEY	173.73	526750	187870

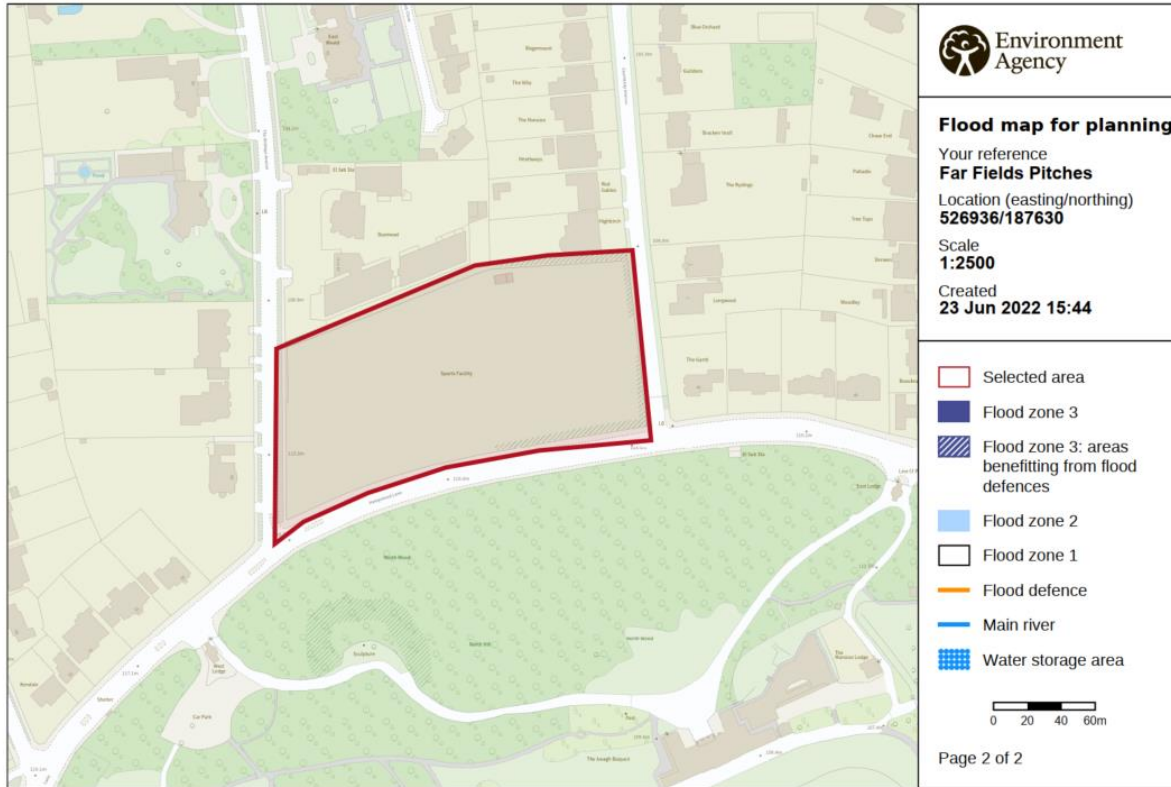
The borehole at Barons Court is 174m deep and the borehole log shows this lies directly on the London Clay. The borehole at Courtney Avenue is 15m deep and the log shows 8m of sandy clay (the Claygate Beds) with London Clay below. The BGS maps suggest the site may have a covering of the more permeable Bagshot sands over the Claygate Beds but this is likely to be insufficient for use for soakaways.

The site is not located within a Groundwater Inner Source Protection Zone.

Soakaway tests were carried out on Far field, indicating a very low infiltration potential into the subsoil, typical of a clay soil profile. The design thus includes a low potential rate of infiltration from the pitches of 0.003 m/hr or 8×10^{-7} m/s, which is low but not typical of clay however it is assumed to be a conservative rate of infiltration. This is based on the fact that the pitches do not become waterlogged at all times of the year, plus the SPR Host runoff coefficient from the FEH Webservice is only 37.91% showing that for this catchment almost two thirds of the rainfall is predicted to enter the soil.

3.3 Sources of flood risk

Government and Environment Agency's surface water flood maps show no significant flood risk at the site. The site is within Flood Zone 1 and therefore there is very low risk of flooding from rivers and watercourses.



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Table 4 - Sources of flood risk

Key sources of flooding	Possibility at Site
Fluvial (Rivers)	<i>Very Low (Flood Zone 1)</i>
Tidal	<i>N/A</i>
Surface water	<i>Very Low – Lower than a 0.1% AEP</i>
Groundwater	<i>No groundwater flooding recorded in the SFRA. No indication of any groundwater.</i>
Sewers	<i>None known to cross the site. Some highway drainage issues – but the council are resolving these.</i>
Infrastructure failure	<i>None that may affect the site</i>

Surface Water Flooding

The planning threshold for flooding assessments is the 100 year plus climate change allowance event. As shown in Figure 11 there is a very small amount of 'Very low risk' mapped surface water flood risk on the eastern boundary – close to the path to Courtenay Avenue and this is likely associated with the current poor drainage of the site. 'Very low risk' means that each year this area has a chance of flooding of less than 0.1% from surface water, equivalent to a 1 in 1000-year Return Period.

As this entire area of the site is to be regraded and covered with voided stone sub-base this surface water flood issue will cease.



4. SURFACE WATER MANAGEMENT PLAN

4.1 Development proposals

The development comprises:

- the regrading of the playing fields over an area of 13,940m² to create a better playing arrangement with a new Synthetic Turf Pitch created at the surface;
- retained changing rooms and toilets pavilion (56m²) but with a green roof added;
- retention of areas around the pitches that will be used for spectator areas (5,585m²).

The development includes:

- Total Site Area (Ownership Boundary) 22,337 sq.m
- Playing Surface (Proposed STP) 13,940 sq.m
- Embankments 2,812 sq.m
- Plateau 19,525 sq.m
- Non-STP Margin 5,585 sq.m

The local topography shown by the Ordnance Survey show that there is a considerable fall between the Southwest and the Northeast corners of the site. The earthworks to create the new pitches area includes a 4,520m² area of cut at the south and west parts of the site, combined with an almost equal 3,970m² of fill in the north and east of the site, shown on Hemstock Design drawing entitled Site Plan Proposed Site Regrading Works, see Figure 12 for an extract.

To protect the trees around the perimeter of the site the earthworks are offset leaving unchanged margins around the new pitches. These margins either slope towards the new pitches or in the case of the northern one are level with the pitches. The southern area slopes down to the pitches level and a land drain has been included as a slope toe drain. This discharges into the proposed flow control chamber located on the north east corner of the pitches. Only the very north eastern part of the site falls away from the pitches.

The proposed new pitch area is a synthetic playing surface underlain by a stone sub-base. To ensure the sub-base drains between rainfall events there are land drainage style perforated pipes laid in stone filled trenches at 5m centre to centre spacing below the sub-base. These are parallel and laid South to North all discharging into a 150mm drain along the northern edge of the pitches. This 150mm drain carries the under-drainage flows to the flow control chamber.

All of the pitch playing surface area slopes from the south to the north. To ensure that the stone sub-base acts as Source Control and slowly releases the rainfall, sections of the pitch will be separated by impermeable barriers and each will have an orifice flow control. As the rainfall flows first pass through a voided stone sub-base this arrangement is not considered a risk. To show that the drainage network can accommodate the rainfall some small overflow weirs have been included in the drainage model to keep the runoff within the system.

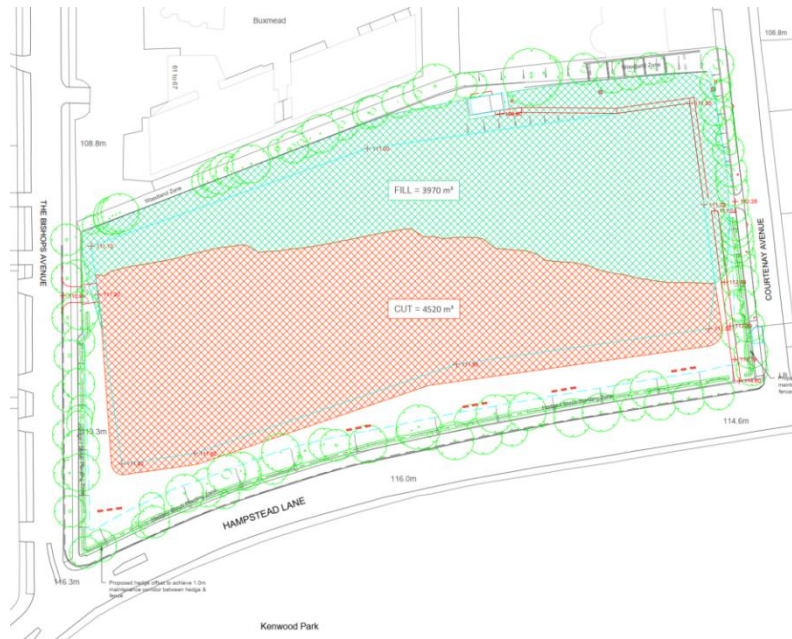


Figure 12 – Regrading of the Site to Create Improved Pitches

The proposed STP includes a permeable stone layer below the playing surface which is drained by perforated land drainage at a 5m centre to centre spacing. This will allow the stone layer to drain down after heavy rainfall and will allow the surface to remain in use during periods of adverse weather. A typical STP cross section is shown in Figure 13.



Figure 13 – Typical Synthetic Pitch Cross Section

The proposed site drainage is shown in Hemstock Design drawing entitled Site Plan Proposed STP Pitch Drainage System, see Figure 14.



Figure 14 – Proposed Pitches and Embankment Drainage

4.2 Mitigation of Off-Site Impacts (Surface Water Management Plan)

According to the National Planning Policy Framework, surface water drainage from new developments should be discharged in the following order of priority:

- Into the ground (infiltration);
- To a surface water body;
- To a surface water sewer, highway drain, or other drainage system;

The drainage design philosophy is that the green areas around the edge of the playing fields remain unchanged in drainage terms and as they all fall towards the pitches any overland flow will enter the sub-base attenuation and be controlled. Runoff from these greenfield areas has been assessed at a the FEH web-service value of SPR Host coefficient of volume Cv value of 37.9% in a similar manner to the previous FRA and the Haringey LLFA Technical Assessment Proforma.

To manage all rainfall landing on the pitches the new STP area has storage in the stone sub-base that is required below the playing surface. As all of the stone is under-drained the STP will be drier than the undisturbed adjacent soil when a rainfall event commences, plus as they are under drained the majority of the rainfall will leave the site eventually so standard coefficient of volume C_v values multiplied by a 1.3 Coefficient of Runoff (C_r) have been used in the analysis. As the pitch is under-drained it collects all rainfall landing across the surface and ultimately drains it slowly off site. In this respect it behaves as an impermeable surface and the hydraulic model includes 1.7 ha to represent the pitches plus surrounding areas draining directly into the networks, e.g. the southern embankments.

The storage includes the stone sub-base under the STP plus 245m³ of geo-cellular storage below the northern non-STP area around the pavilion. Alternative arrangements to the geo-cellular storage, that

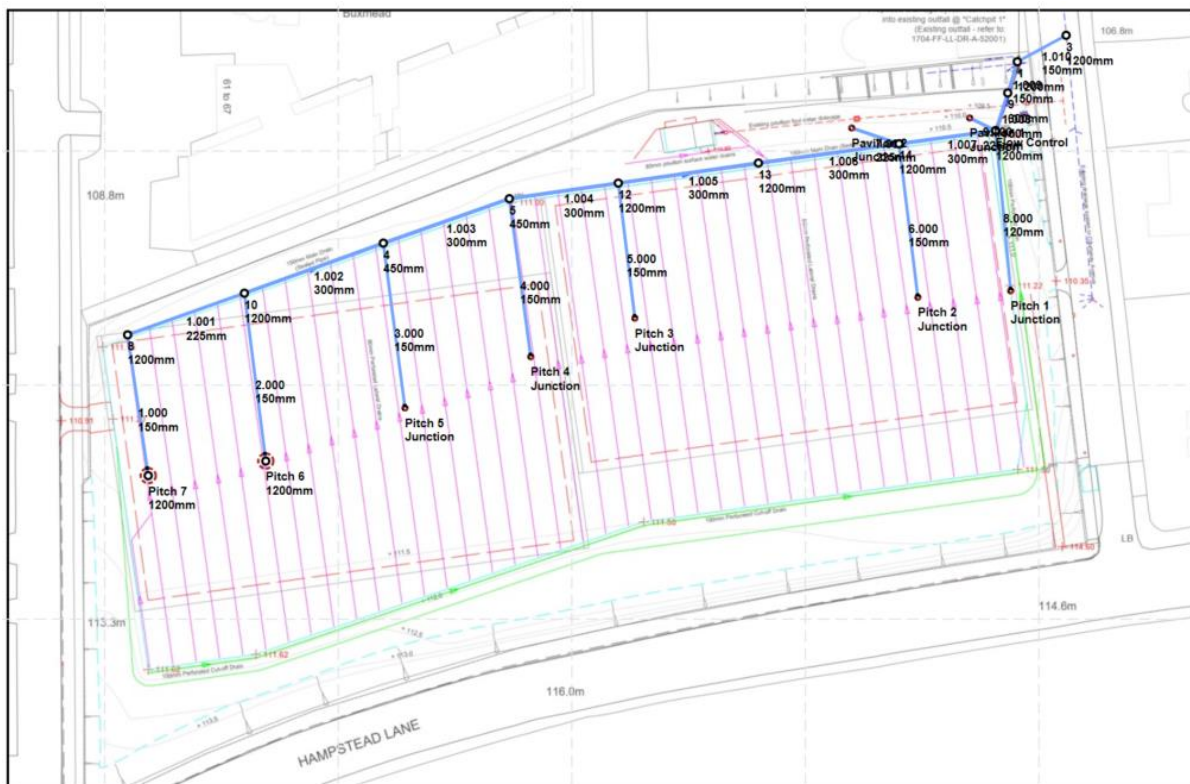
will be assessed prior to construction, are an additional depth of stone sub-base below the pitches or a large shallow dry basin along the northern margin as this area is generally flat being along the 110.5mAOD contour and covers up to 2000m². If this shallow dry basin option is utilised it will need to be elevated just below the playing surface of the pitches and will be the last SuDS element to be utilised for storage. To ensure the access route in the northern margin remains usable even after heavy rain it should be graded slightly towards the pitch edge drainage pipe, or even have under some under-drainage

As with all soakaway designs a factor of safety has been allowed, in this case as the impact will be limited the FoS is 2.0. Also the infiltration basin includes a freeboard element during the peak 1 in 100 year plus climate change event. If the storage becomes completely full due to a larger event than used in the design then parts of the pitch surface will start to pond. As the northern edge in the eastern half of Far Field is the lowest it will start to pond first.

In terms of the drainage arrangements to manage runoff arising from a minimum 30% allowance for climate change, the strategy is divided in two parts,

- Source control in the sub-base, assuming all rainfall is slowly released so normal Cv values used;
- Attenuation of the overall pitches area;
- Attenuation in the non-playing margins, assuming runoff based on the SPR Host value of 37.9%.

To allow for the SPR Host of the non-playing zones these areas have been factored by 0.379 and connected to local elements of the drainage network. Pitches 1 – 6 take runoff from the bank plus spectator area. The Northern area has been equally divided and connected to drainage along that margin.



In line with the drainage hierarchy set out in the National Planning Policy Framework, the proposals for the finishing materials of the paths and reinforced access route will comprise permeable surfacing to promote infiltration of rainfall and runoff generated within this area into the surrounding soil.

Regarding the drainage arrangements to manage runoff from the pavilion roof, this follows National plus local SuDS Guidance with a green roof provided. The likely runoff volume benefit of this green roof provision has been ignored, but it is likely to absorb the rainfall from a 1 in 2 year event with no runoff. This benefit has been ignored in the attenuation calculations – but 5mm Interception Storage has been allowed.

As this is a football pitch renovation and the margins include many trees there will be no creep possible.

All rainfall landing on the pitch area, plus any overland flow from the green margins will enter the stone sub-base. The stone sub-base must be at least 400mm deep and at the Eastern half of the site laid at a formation slope of no greater than 1 in 350 to achieve the storage requirements.

The lower of the two flow controls in the flow control chamber releases the attenuated flows at a rate of 4.6 l/s in the 1 in 2 year event. For this 2.23 ha site and a flow of 2 l/s/ha that is representative of long term storage would be 4.5 l/s. This is the storage at the base of the drainage network and thus is filled first by any rainfall. Providing long term storage in an overflow arrangement is not possible due to the small areas of land within the non STP zone that is not above the pitch elevation and that the main reason for the pitch renovation is to avoid waterlogging at the playing surface.

4.3 Maintenance

The historically installed pitch drainage where located was in poor condition and not 100% functional. All drainage systems require ongoing care and inspections to ensure they function correctly.

The operation and maintenance requirements for permeable paving which is similar to a synthetic sports pitch in that it has attenuation storage below a permeable surface plus a detention storage tank are shown in Table 5 and Table 6.

Table 5 – CIRIA SuDS Operation and maintenance for permeable paving

TABLE 20.15 Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 6 – CIRIA SuDS Operation and maintenance for a storage tank

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

5. Foul Water Strategy

5.1 General considerations

The pavilion is existing and is retained with some small changes to the internal arrangement of the toilets. The existing foul drainage is also retained unchanged and this connects off site to the east into Courtenay Avenue. Figure 16 shows foul manhole A, with the drainage from the Pavilion on the left and the existing outlet off site on the right.

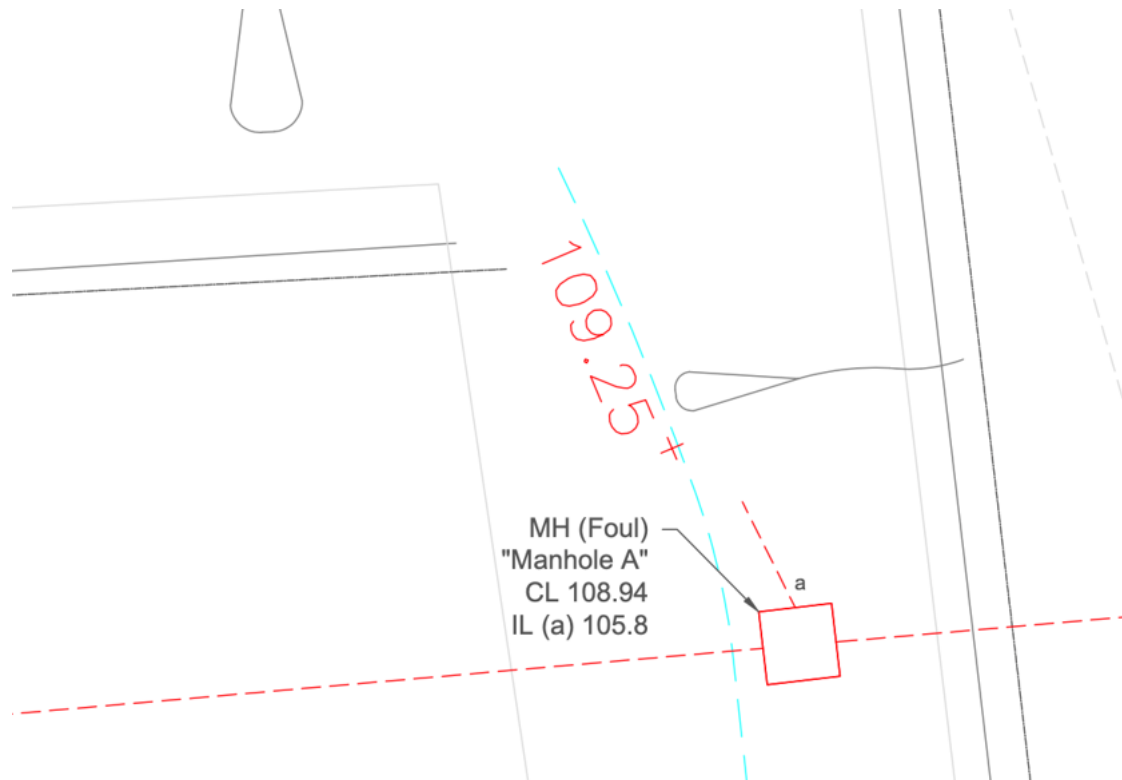


Figure 16 – Existing Foul Water sewers and outlet chamber

6. Summary and Conclusions

The main conclusions of the surface and foul water drainage strategies are summarised below.

- In terms of surface water flood risk, the site is located within a '*very low risk*' area, meaning a yearly chance of flooding of less than 0.1%. Regrading the site and adding a deep voided stone sub-base layer will improve the playing fields capacity to absorb rainfall during a storm;
- For fluvial and sea flooding, the site is located within Flood Zone 1, meaning a yearly chance of flood of less than 0.1%;
- Site-specific infiltration testing was undertaken and produced results that do not allow an infiltration only solution. Given the total plan area involved, the stone sub-base across the entire playing field zone will still discharge an amount of rainfall even at a low infiltration rate – however the actual volume has not been determined. The infiltration losses will act in combination with Interception Storage to prevent rainfall runoff leaving the site;
- The lower of the two Hydro-Brake vortex flow controls will allow the lowest portion of the storage to empty at a rate similar to 2 l/s/ha and thus act to provide Long Term Storage for some of the excess volume of rainfall that will occur as a result of Climate Change;
- Rainfall across the site will either fall directly onto the pitch playing surface and directly enter the stone sub-base below; or it will fall on the surrounding trees where as much as 30% will be retained in the canopy; or it will land on the Greenfield margins most of which slope towards the playing surface. Runoff from the Greenfield areas will enter land drainage or run onto the pitches and be contained within the drainage network;
- The internal paths and reinforced turf access track will be formed of permeable materials, with the capacity of promoting infiltration of surface water runoff into the local soil;
- The new surface water drainage system was designed to cater for the 1 in 100 year plus 30% climate change allowance in accordance with Haringey requirements. It will also accept the 1 in 100 plus 40% CC and outflow at less than the Greenfield rate for the 1 in 30 and 1 in 100 critical flooding events;
- The foul water drainage strategy ensures flows are kept separate from surface water runoff. The foul drainage is unchanged and serves the pavilion changing/toilet facilities building that is retained but upgraded;
- In terms of maintenance, it is advisable that the surface water drainage system is kept free of debris by cleaning silt traps and catchpit manholes. Note that the responsibility of maintaining the drainage systems falls with the school.

7. References

Author	Date	Title/Description
HM Government	2022	The Flood Map for Planning Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)
HM Government	2022	Long Term Flood Risk for England https://check-long-term-flood-risk.service.gov.uk
CIRIA	2015	The SUDS Manual – CIRIA Report C753
DEFRA	March 2015	Non-statutory technical standards for sustainable drainage systems
DCLG	2012	Technical Guidance to the National Planning Policy Framework.
Ministry of Housing, Communities and Local Government	2021	National Planning Policy Framework
Haringey Council	March 2013	Strategic Flood Risk Assessment
Haringey Council	Feb 2015	Strategic Flood Risk Assessment Level 2
Haringey Council	May 2016	SuDS Design Requirements
Haringey Council	July 2016	SuDS Flows and Volumes – LLFA Technical Assessment Proforma
Haringey Council	2011	Surface Water Management Plan
London Mayor	2021	The London Plan

Appendix A – Hydrology



Data taken from FEH Web Service (2.0.0.0) June 2022

At location GB 526993 187682 TQ 26993 87682

Parameters

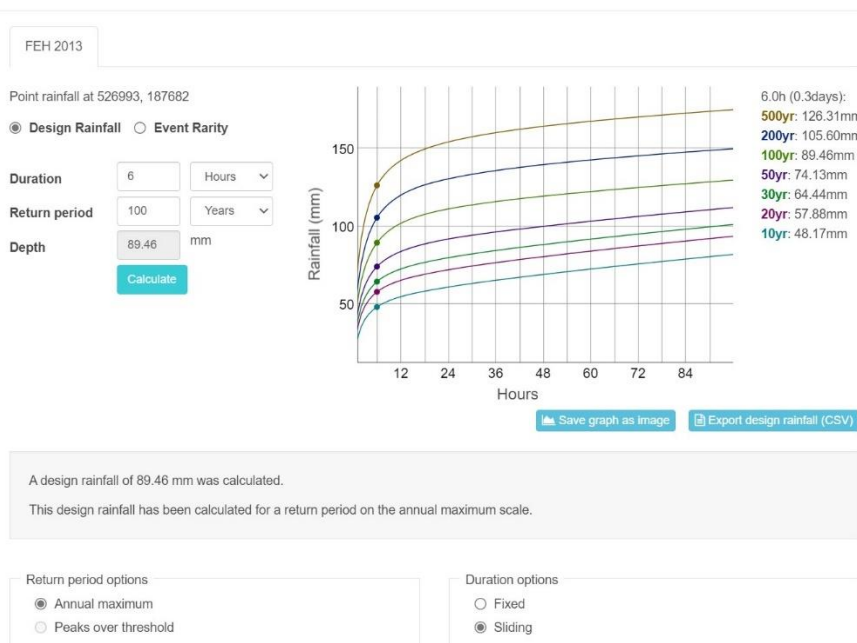
Rainfall model= FEH 2013
Calculation type= Design rainfall
Calculation mode= For a point
Duration= 6 Hours
Fixed duration= no
Return period= 100 Years
Annual maximum= yes

A design rainfall of 89.46 mm was calculated.

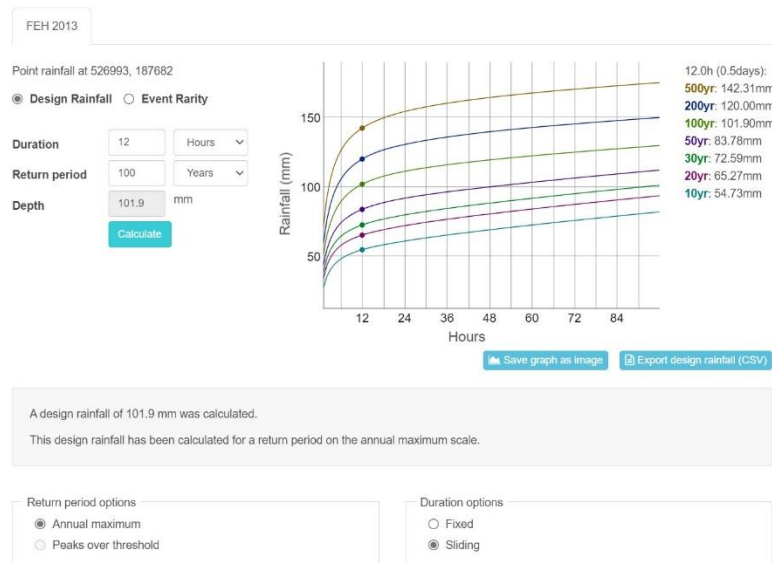
This design rainfall has been calculated for a return period on the annual maximum scale.

Created by FEH Web Service at 11:41:10 on Wed 08-Jun-2022
FEHCDROMExportedDescriptors version= 2.0.1 appVersion=2.0.0.0
PointDescriptors grid GB x=526993 y=187682 ngr=TQ 26993 87682
bfihost>0.567</bfihost>
propwet>0.29</propwet>
saar>680</saar>

RAINFALL MODELLING FOR FAR FIELDS PITCHES



✦ RAINFALL MODELLING FOR FAR FIELDS PITCHES



AREA	0.57
ALTBAR	94
ASPBAR	331
ASPVAR	0.76
BFIHOST	0.454
BFIHOST19	0.418
DPLBAR	0.78
DPSBAR	40.1
FARL	1
FPEXT	0.0175
FPDBAR	0.075
FPLOC	0.34
LDP	1.49
PROPWET	0.29
RMED-1H	11.2
RMED-1D	33.5
RMED-2D	43.7
SAAR	682
SAAR4170	680
SPRHOST	37.91
URBCONC1990	0.694
URBEXT1990	0.2939
URBLOC1990	0.891
URBCONC2000	0.876
URBEXT2000	0.4605
URBLOC2000	0.943
C	-0.027
D1	0.31734
D2	0.35396

D3	0.251
E	0.33603
F	2.4828
C(1 km)	-0.027
D1(1 km)	0.328
D2(1 km)	0.354
D3(1 km)	0.25
E(1 km)	0.335
F(1 km)	2.458



Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:
Site name:
Site location:

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:
Longitude:
Reference:
Date:

Site characteristics

Total site area (ha):
Significant public open space (ha):
Area positively drained (ha):
Impermeable area (ha):
Percentage of drained area that is impermeable (%):
Impervious area drained via infiltration (ha):
Return period for infiltration system design (year):
Impervious area drained to rainwater harvesting (ha):
Return period for rainwater harvesting system (year):
Compliance factor for rainwater harvesting system (%):
Net site area for storage volume design (ha):
Net impermeable area for storage volume design (ha):
Pervious area contribution to runoff (%):

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:
Urban creep allowance factor:
Volume control approach:
Interception rainfall depth (mm):
Minimum flow rate (l/s):

Methodology

esti:
 Q_{BAR} estimation method:
SPR estimation method:

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	89.5
Rainfall 100 yrs 12 hrs:	--	101.9
FEH / FSR conversion factor:	1.27	1.32
SAAR (mm):	670	670
M5-60 Rainfall Depth (mm):	20	20
I ^r Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	10.27	10.27
Q_{BAR} for net site area (l/s):	6.45	6.45

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	5.5	5.5	Attenuation storage 1/100 years (m³):	1096	1042
1 in 30 years (l/s):	14.8	14.8	Long term storage 1/100 years (m³):	292	415
1 in 100 year (l/s):	20.6	20.6	Total storage 1/100 years (m³):	1388	1457

This report was produced using the storage estimation tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Appendix B – Haringey LLFA Technical Assessment Proforma



SuDS Flows and Volumes – LLFA Technical Assessment Proforma

This form identifies the information required by Haringey LLFA to enable technical assessment of flows and volumes determined as part of drainage / SuDS calculations.

Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.

SITE DETAILS

1.1	Planning application reference		
1.2	Site name	Far Fields Highgate School	
1.3	Total application site area ⁽¹⁾	22,337m ²	2.23ha
1.4	Is the site located in a CDA or LFRZ	Y/N	No
1.5	Is the site located in a SPZ	Y/N	No

VOLUME AND FLOW DESIGN INPUTS

2.1	Site area which is positively drained by SuDS ⁽²⁾	21,115m ²
2.2	Impermeable area drained pre development ⁽³⁾	56 ex Pavilion Roofm ²
2.3	Impermeable area drained post development ⁽³⁾	56 Pavilion green roofm ²
2.4	Additional impermeable area (2.3 minus 2.2)	0m ²
2.5	Predevelopment use ⁽⁴⁾	Greenfield / Brownfield / Mixed* Greenfield
2.6	Method of discharge ⁽⁵⁾	Infiltration / waterbody / storm sewer / combined sewer* Storm Sewer
2.7	Infiltration rate (where applicable)	0.003m/hr
2.8	Influencing factors on infiltration	Clay subsoil and soil testing
2.9	Depth to highest known ground water table.....	mAOD
2.10	Coefficient of runoff (Cv) ⁽⁶⁾	0.379 for Greenfield
2.11	Justification for Cv used	Equals SPR Host for greenfield areas. Standard Cv x Cr of 1.3 used for drainage design. For Cv = 0.76 overall runoff coefficient is 0.988, Cv at 0.84 then coefficient = 1.092
2.12	FEH rainfall data used (Note that FSR is no longer the preferred rainfall calculation method)	Y/N Yes
2.13	Will storage be subject to surcharge by elevated water levels in watercourse / sewer	Y/N No
2.14	Invert level at outlet (invert level of final flow control)	Flow Control 109.304 Offsite sewer -104.80mAOD
2.15	Design level used for surcharge water level at point of discharge ⁽¹⁴⁾	N/AmAOD

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SuDS Flows and Volumes – LLFA Technical Assessment Proforma

CALCULATION OUTPUTS

Sections 3 and 4 refer to site where storage is provided by attenuation and / or partial infiltration. Where all flows are infiltrated to ground omit Sections 3 -5 and complete Section 6. Haringey SuDS Design / FEH assessment in Hydraulic Modelling

3.0 Defining rate of runoff from the site

		Actual Design
3.2	Max. discharge for 1 in 1 year rainfalll/s/ha,l/s for the site	
	8.93 / 6.9	2 year = 9.5 l/s
3.2	Max. discharge for Q _{med} rainfalll/s/ha,l/s for the site	
	20.77 / 15.4	30 year = 10.2 l/s
3.3	Max. discharge for 1 in 30 year rainfalll/s/ha,l/s for the site	
	28.8 / 19.5	100 year = 10.5 l/s
3.4	Max. discharge for 1 in 100 year rainfalll/s/ha,l/s for the site	
3.5	Max. discharge for 1 in 100 year plus 30%CCl/s/ha,l/s for the site	
	10.5	

4.0 Attenuation storage to manage peak runoff rates from the site

4.1	Storage - 1 in 1 yearm ³m ³ /m ² (of developed impermeable area)
4.2	Storage - 1in 30 year ⁽⁷⁾m ³m ³ /m ²
4.3	Storage - 1in 100 year ⁽⁸⁾m ³m ³ /m ²
4.4	Storage - 1 in 100 year plus 30%CC ⁽⁹⁾m ³m ³ /m ²
	1397

5.0 Controlling volume of runoff from the site

5.1	Pre development runoff volume ⁽¹⁰⁾m ³ for the site
	784
5.2	Post development runoff volume (unmitigated) ⁽¹⁰⁾m ³ for the site
	1200
5.3	Volume to be controlled/does not leave site ^(5.2 - 5.1)m ³ for the site
	414
5.4	Volume control provided by
-	Interception losses ⁽¹¹⁾m ³
-	Rain harvesting ⁽¹²⁾m ³
-	Infiltration (even at very low rates) Not calculated.....m ³
-	Separate area designated as long term storage ⁽¹³⁾m ³
5.5	Total volume control (sum of inputs for 5.4)m ³ ⁽¹⁵⁾
	112

6.0 Site storage volumes (full infiltration only)

6.1	Storage - 1in 30 year ⁽⁷⁾m ³m ³ /m ² (of developed impermeable area)
6.2	Storage - 1 in 100 year plus CC ⁽⁹⁾m ³m ³ /m ²

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SuDS Flows and Volumes – LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces includes, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain / demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
9. Climate change is specified as 30% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
10. To be determined using the 100 year return period 6 hour duration rainfall event.
11. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques.
12. Please refer to Rain harvesting BS for guidance on available storage.
13. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically LT storage may be provided on multi-functional open space or sacrificial car parking areas.
14. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 to 1 in 5year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
15. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.

Appendix C – Drainage Design Outputs

Corner Water Consulting		Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY			File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022			Page 3 Far Fields SWMP		
Pipeline Schedule										
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.567	243.0	300	FilterCarrier	111.000	109.861	0.839	111.000	109.764	0.936
5.000	29.068	150.0	150	Circular	111.100	110.500	0.450	111.000	110.306	0.544
1.005	30.293	202.0	300	FilterCarrier	111.000	109.764	0.936	111.000	109.614	1.086
1.006	30.376	121.5	300	FilterCarrier	111.000	109.614	1.086	111.000	109.364	1.336
6.000	33.062	30.4	150	FilterCarrier	111.200	110.600	0.450	111.000	109.514	1.336
7.000	10.669	21.3	225	Circular	111.000	109.940	0.835	111.000	109.439	1.336
1.007	20.870	242.7	300	FilterCarrier	111.000	109.364	1.336	111.000	109.278	1.422
8.000	34.392	25.1	150	Circular	111.250	110.650	0.450	111.000	109.278	1.572
9.000	6.166	9.3	225	Circular	111.000	109.940	0.835	111.000	109.278	1.497
1.008	8.439	14.6	150	Circular	111.000	109.278	1.572	109.300	108.700	0.450
1.009	6.978	17.4	150	Circular	109.300	106.200	2.950	107.100	105.800	1.150
1.010	11.880	11.9	150	Circular	107.100	105.800	1.150	106.800	104.800	1.850
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type		
1.004	5	450	Manhole	Adoptable	12	450	Manhole	Adoptable		
5.000	Pitch 3		Junction		12	450	Manhole	Adoptable		
1.005	12	450	Manhole	Adoptable	13	450	Manhole	Adoptable		
1.006	13	450	Manhole	Adoptable	14	450	Manhole	Adoptable		
6.000	Pitch 2		Junction		14	450	Manhole	Adoptable		
7.000	Pavilion 2		Junction		14	450	Manhole	Adoptable		
1.007	14	450	Manhole	Adoptable	Flow Control	1200	Manhole	Adoptable		
8.000	Pitch 1		Junction		Flow Control	1200	Manhole	Adoptable		
9.000	Pavilion 1		Junction		Flow Control	1200	Manhole	Adoptable		
1.008	Flow Control	1200	Manhole	Adoptable	9		Junction			
1.009	9		Junction		1	450	Manhole	Adoptable		
1.010	1	450	Manhole	Adoptable	3		Junction			
Manhole Schedule										
Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Pitch 7	9.317	80.669	111.370	0.600	450					
						0	1.000	110.770	150	
8	4.903	110.751	111.130	0.638	450		1	1.000	110.567	150
						0	1.001	110.492	225	
Pitch 6	34.487	83.780	111.300	0.600	450					
						0	2.000	110.700	150	
Pitch 5	64.279	95.125	111.300	0.600						
						0	3.000	110.700	150	
Pitch 4	91.205	106.076	111.250	0.600						
						0	4.000	110.650	150	
Flow+ v10.3 Copyright © 1988-2022 Causeway Technologies Ltd										

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022	Page 4 Far Fields SWMP						
Manhole Schedule									
Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Pitch 3	113.488	114.316	111.100	0.600					
						0	5.000	110.500	150
Pitch 2	174.074	118.758	111.200	0.600					
						0	6.000	110.600	150
Pitch 1	193.940	120.155	111.250	0.600					
						0	8.000	110.650	150
Pavilion 1	185.166	157.083	111.000	1.060					
						0	9.000	109.940	225
Pavilion 2	159.913	154.937	111.000	1.060					
						0	7.000	109.940	225
Flow Control	190.716	154.396	111.000	1.722	1200		1	9.000	109.278
							2	8.000	109.278
							3	1.007	109.278
							0	1.008	109.278
1	195.364	169.095	107.100	1.300	450		1	1.009	105.800
							0	1.010	105.800
3	205.815	174.745	106.800	2.000			1	1.010	104.800
4	59.644	130.346	111.065	1.004	450		1	3.000	110.211
							2	1.002	110.061
							0	1.003	110.061
5	86.624	139.835	111.000	1.139	450		1	4.000	110.011
							2	1.003	109.861
							0	1.004	109.861
9	193.311	162.426	109.300	3.100			1	1.008	108.700
							0	1.009	106.200
10	29.903	119.641	111.000	0.809			1	2.000	110.341
							2	1.001	110.266
							0	1.002	110.191
12	109.954	143.168	111.000	1.236	450		1	5.000	110.306
							2	1.004	109.764
							0	1.005	109.764

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Flow+ v10.3 Copyright © 1988-2022 Causeway Technologies Ltd

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022	Page 6 Far Fields SWMP
<u>Node Flow Control Online Hydro-Brake* Control</u>			
Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.008	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0095-6000-2500-6000
Invert Level (m)	109.278	Min Outlet Diameter (m)	0.150
Design Depth (m)	2.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	6.0		
<u>Node Flow Control Online Hydro-Brake* Control</u>			
Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.008	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0110-5500-1000-5500
Invert Level (m)	110.200	Min Outlet Diameter (m)	0.150
Design Depth (m)	1.000	Min Node Diameter (mm)	1200
Design Flow (l/s)	5.5		
<u>Node Pitch 7 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.770
Downstream Link	1.000	Design Depth (m)	0.400
Replaces Downstream Link	✓	Design Flow (l/s)	8.0
		Diameter (m)	0.079
		Discharge Coefficient	0.600
<u>Node Pitch 7 Online Weir Control</u>			
Flap Valve	x	Invert Level (m)	111.050
Downstream Link	1.000	Design Depth (m)	0.100
Replaces Downstream Link	✓	Design Flow (l/s)	10.0
		Width (m)	0.171
		Discharge Coefficient	0.590
<u>Node Pitch 6 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.700
Downstream Link	2.000	Design Depth (m)	0.400
Replaces Downstream Link	✓	Design Flow (l/s)	6.0
		Diameter (m)	0.068
		Discharge Coefficient	0.600
<u>Node Pitch 5 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.700
Downstream Link	3.000	Design Depth (m)	0.350
Replaces Downstream Link	✓	Design Flow (l/s)	4.0
		Diameter (m)	0.058
		Discharge Coefficient	0.600
<u>Node Pitch 4 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.650
Downstream Link	4.000	Design Depth (m)	0.350
Replaces Downstream Link	✓	Design Flow (l/s)	4.0
		Diameter (m)	0.058
		Discharge Coefficient	0.600
<u>Node Pitch 3 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.500
Downstream Link	5.000	Design Depth (m)	0.350
Replaces Downstream Link	✓	Design Flow (l/s)	8.0
		Diameter (m)	0.083
		Discharge Coefficient	0.600
Flow+ v10.3 Copyright © 1988-2022 Causeway Technologies Ltd			

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022	Page 7 Far Fields SWMP
<u>Node Pitch 2 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.600
Downstream Link	6.000	Design Depth (m)	0.350
Replaces Downstream Link	✓	Design Flow (l/s)	4.0
		Diameter (m)	0.058
		Discharge Coefficient	0.600
<u>Node Pitch 1 Online Orifice Control</u>			
Flap Valve	x	Invert Level (m)	110.650
Downstream Link	8.000	Design Depth (m)	0.350
Replaces Downstream Link	✓	Design Flow (l/s)	3.5
		Diameter (m)	0.054
		Discharge Coefficient	0.600
<u>Node Pitch 1 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.650
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	144
Safety Factor	2.0	Width (m)	30.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	350.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pitch 2 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.600
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	148
Safety Factor	2.0	Width (m)	30.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	350.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pitch 3 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.500
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	255
Safety Factor	2.0	Width (m)	30.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	350.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pitch 4 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.650
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	160
Safety Factor	2.0	Width (m)	30.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	300.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pitch 5 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.700
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	152
Safety Factor	2.0	Width (m)	30.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	300.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pitch 6 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.700
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	72
Safety Factor	2.0	Width (m)	20.000
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	300.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
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<u>Node Pitch 7 Carpark Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Invert Level (m)	110.770
Side Inf Coefficient (m/hr)	0.00300	Time to half empty (mins)	0
Safety Factor	2.0	Width (m)	16.700
Porosity	0.30	Length (m)	75.000
		Slope (1:X)	300.0
		Depth (m)	0.500
		Inf Depth (m)	0.400
<u>Node Pavilion 1 Depth/Area Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Safety Factor	2.0
Side Inf Coefficient (m/hr)	0.00300	Porosity	0.95
		Invert Level (m)	110.080
		Time to half empty (mins)	750
Depth	Area	Inf Area	
(m)	(m²)	(m²)	
0.000	250.0	0.0	
0.660	250.0	0.0	
0.661	0.0	0.0	
<u>Node Pavilion 2 Depth/Area Storage Structure</u>			
Base Inf Coefficient (m/hr)	0.00300	Safety Factor	2.0
Side Inf Coefficient (m/hr)	0.00300	Porosity	0.95
		Invert Level (m)	110.080
		Time to half empty (mins)	765
Depth	Area	Inf Area	
(m)	(m²)	(m²)	
0.000	140.0	0.0	
0.660	140.0	0.0	
0.661	0.0	0.0	
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Results for 2 year Critical Storm Duration. Lowest mass balance: 97.48%								
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Pitch 7	88	110.853	0.083	4.8	5.4649	0.0000	OK
120 minute winter	8	88	110.529	0.037	2.7	0.0058	0.0000	OK
180 minute winter	Pitch 6	132	110.828	0.128	7.6	15.5122	0.0000	OK
240 minute winter	Pitch 5	184	110.843	0.143	9.0	28.9247	0.0000	OK
240 minute winter	Pitch 4	184	110.793	0.143	9.0	28.9247	0.0000	OK
180 minute winter	Pitch 3	136	110.618	0.118	10.6	22.8770	0.0000	OK
240 minute winter	Pitch 2	184	110.734	0.134	9.0	29.3807	0.0000	OK
240 minute winter	Pitch 1	188	110.787	0.137	9.0	30.6990	0.0000	OK
480 minute winter	Pavilion 1	480	110.405	0.464	8.2	77.3153	0.0000	SURCHARGED
480 minute winter	Pavilion 2	480	110.406	0.466	4.7	43.5824	0.0000	SURCHARGED
480 minute winter	Flow Control	480	110.405	1.126	13.6	1.2740	0.0000	SURCHARGED
480 minute winter	1	480	105.844	0.044	9.5	0.0071	0.0000	OK
480 minute winter	3	480	104.844	0.044	9.5	0.0000	0.0000	OK
480 minute winter	4	472	110.410	0.349	7.0	0.1596	0.0000	SURCHARGED
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
120 minute winter	Pitch 7	Orifice	8	2.7				
15 minute summer	Pitch 7	Weir	8	0.0				
120 minute winter	Pitch 7	Infiltration		0.2				
120 minute winter	8	1.001	10	2.7	0.654	0.057	0.1101	
180 minute winter	Pitch 6	Orifice	10	3.0				
180 minute winter	Pitch 6	Infiltration		0.3				
240 minute winter	Pitch 5	Orifice	4	2.4				
240 minute winter	Pitch 5	Infiltration		0.5				
240 minute winter	Pitch 4	Orifice	5	2.4				
240 minute winter	Pitch 4	Infiltration		0.5				
180 minute winter	Pitch 3	Orifice	12	4.0				
180 minute winter	Pitch 3	Infiltration		0.5				
240 minute winter	Pitch 2	Orifice	14	2.3				
240 minute winter	Pitch 2	Infiltration		0.6				
240 minute winter	Pitch 1	Orifice	Flow Control	2.0				
240 minute winter	Pitch 1	Infiltration		0.6				
180 minute winter	Pavilion 1	9.000	Flow Control	-9.8	0.322	-0.057	0.2452	
15 minute summer	Pavilion 1	Infiltration		0.0				
60 minute winter	Pavilion 2	7.000	14	-8.2	0.711	-0.073	0.4243	
15 minute summer	Pavilion 2	Infiltration		0.0				
120 minute summer	Flow Control	Hydro-Brake*	9	4.6				
480 minute winter	Flow Control	Hydro-Brake*	9	5.4				
480 minute winter	1	1.010	3	9.5	2.213	0.183	0.0511	
60 minute winter	4	1.003	5	8.6	0.634	0.092	1.6841	
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	Results for 2 year Critical Storm Duration. Lowest mass balance: 97.48%								
	Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
	480 minute winter	5	472	110.409	0.548	9.1	0.2314	0.0000	SURCHARGED
480 minute winter	9	480	106.251	0.051	9.5	0.0000	0.0000	OK	
480 minute winter	10	472	110.410	0.219	4.6	0.0811	0.0000	OK	
480 minute winter	12	472	110.409	0.645	12.8	0.2591	0.0000	SURCHARGED	
480 minute winter	13	472	110.407	0.793	12.8	0.1261	0.0000	SURCHARGED	
480 minute winter	14	480	110.406	1.042	14.8	0.1657	0.0000	SURCHARGED	
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)		
30 minute summer	5	1.004	12	12.1	0.635	0.171	1.6596		
480 minute winter	9	1.009	1	9.5	1.983	0.222	0.0335		
120 minute winter	10	1.002	4	5.9	0.571	0.084	1.4363		
60 minute winter	12	1.005	13	16.2	0.819	0.208	2.1332		
60 minute winter	13	1.006	14	16.3	0.571	0.161	2.1391		
360 minute winter	14	1.007	Flow Control	11.9	0.230	0.167	1.4697		
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Results for 30 year Critical Storm Duration. Lowest mass balance: 97.48%								
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Pitch 7	96	110.934	0.164	13.0	20.6996	0.0000	SURCHARGED
600 minute winter	8	555	110.768	0.276	3.2	0.0438	0.0000	SURCHARGED
180 minute winter	Pitch 6	148	110.940	0.239	19.5	53.1887	0.0000	SURCHARGED
240 minute winter	Pitch 5	208	110.954	0.254	22.3	89.6362	0.0000	SURCHARGED
240 minute winter	Pitch 4	208	110.904	0.254	22.3	89.6362	0.0000	SURCHARGED
720 minute winter	Pitch 3	735	110.743	0.243	9.4	93.6279	0.0000	SURCHARGED
240 minute winter	Pitch 2	208	110.838	0.238	22.3	90.4632	0.0000	SURCHARGED
240 minute winter	Pitch 1	228	110.893	0.243	22.3	93.6447	0.0000	SURCHARGED
600 minute winter	Pavilion 1	555	110.760	0.820	10.5	157.2195	0.0000	FLOOD RISK
600 minute winter	Pavilion 2	555	110.761	0.821	5.9	88.1455	0.0000	FLOOD RISK
600 minute winter	Flow Control	555	110.760	1.482	19.8	1.6758	0.0000	FLOOD RISK
240 minute winter	1	256	105.845	0.045	9.9	0.0072	0.0000	OK
120 minute winter	3	254	104.844	0.044	9.9	0.0000	0.0000	OK
600 minute winter	4	555	110.767	0.706	10.8	0.3234	0.0000	FLOOD RISK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
120 minute winter	Pitch 7	Orifice	8	4.6				
15 minute summer	Pitch 7	Weir	8	0.0				
120 minute winter	Pitch 7	Infiltration		0.3				
120 minute winter	8	1.001	10	4.6	0.756	0.096	0.9601	
180 minute winter	Pitch 6	Orifice	10	4.4				
180 minute winter	Pitch 6	Infiltration		0.6				
240 minute winter	Pitch 5	Orifice	4	3.3				
240 minute winter	Pitch 5	Infiltration		0.9				
240 minute winter	Pitch 4	Orifice	5	3.3				
240 minute winter	Pitch 4	Infiltration		0.9				
180 minute winter	Pitch 3	Orifice	12	6.0				
720 minute winter	Pitch 3	Infiltration		0.9				
240 minute winter	Pitch 2	Orifice	14	3.2				
240 minute winter	Pitch 2	Infiltration		0.9				
240 minute winter	Pitch 1	Orifice	Flow Control	2.8				
240 minute winter	Pitch 1	Infiltration		0.9				
60 minute winter	Pavilion 1	9.000	Flow Control	-17.7	0.646	-0.103	0.2452	
15 minute summer	Pavilion 1	Infiltration		0.0				
30 minute winter	Pavilion 2	7.000	14	-18.3	0.954	-0.161	0.4243	
15 minute summer	Pavilion 2	Infiltration		0.0				
600 minute winter	Flow Control	Hydro-Brake®	9	4.7				
30 minute winter	Flow Control	Hydro-Brake®	9	5.5				
240 minute winter	1	1.010	3	9.9	2.237	0.190	0.0525	
15 minute winter	4	1.003	5	21.4	0.716	0.231	2.0140	
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Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022	Page 13 Far Fields SWMP					
Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 97.48%								
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Pitch 7	102	111.006	0.236	22.8	42.6098	0.0000	SURCHARGED
480 minute winter	8	464	110.976	0.484	5.1	0.0770	0.0000	FLOOD RISK
360 minute winter	Pitch 6	344	111.064	0.364	21.3	110.0385	0.0000	FLOOD RISK
360 minute winter	Pitch 5	352	111.102	0.402	29.7	190.4478	0.0000	FLOOD RISK
480 minute winter	Pitch 4	472	111.057	0.407	23.8	194.1306	0.0000	FLOOD RISK
720 minute winter	Pitch 3	720	110.971	0.470	19.8	249.2840	0.0000	FLOOD RISK
480 minute winter	Pitch 2	472	111.004	0.404	23.8	204.0035	0.0000	FLOOD RISK
480 minute winter	Pitch 1	472	111.051	0.401	23.8	201.7401	0.0000	FLOOD RISK
480 minute winter	Pavilion 1	464	110.968	1.028	16.1	157.2783	0.0000	FLOOD RISK
480 minute winter	Pavilion 2	464	110.969	1.029	9.2	88.2043	0.0000	FLOOD RISK
480 minute winter	Flow Control	464	110.968	1.690	25.3	1.9109	0.0000	FLOOD RISK
360 minute summer	1	240	105.845	0.045	9.9	0.0072	0.0000	OK
30 minute summer	3	217	104.844	0.044	9.9	0.0000	0.0000	OK
480 minute winter	4	464	110.976	0.915	15.9	0.4189	0.0000	FLOOD RISK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
120 minute winter	Pitch 7	Orifice	8	5.8				
15 minute summer	Pitch 7	Weir	8	0.0				
120 minute winter	Pitch 7	Infiltration		0.5				
120 minute winter	8	1.001	10	5.8	0.747	0.120	1.0553	
240 minute winter	Pitch 6	Orifice	10	5.5				
360 minute winter	Pitch 6	Infiltration		0.6				
180 minute winter	Pitch 5	Orifice	4	4.1				
360 minute winter	Pitch 5	Infiltration		1.0				
180 minute winter	Pitch 4	Orifice	5	4.1				
360 minute winter	Pitch 4	Infiltration		1.0				
120 minute winter	Pitch 3	Orifice	12	7.5				
360 minute winter	Pitch 3	Infiltration		1.0				
180 minute winter	Pitch 2	Orifice	14	4.0				
480 minute winter	Pitch 2	Infiltration		1.0				
240 minute winter	Pitch 1	Orifice	Flow Control	3.6				
480 minute winter	Pitch 1	Infiltration		1.0				
30 minute winter	Pavilion 1	9.000	Flow Control	-25.5	0.920	-0.149	0.2452	
15 minute summer	Pavilion 1	Infiltration		0.0				
15 minute winter	Pavilion 2	7.000	14	-21.8	1.268	-0.193	0.4243	
15 minute summer	Pavilion 2	Infiltration		0.0				
480 minute winter	Flow Control	Hydro-Brake®	9	5.0				
15 minute summer	Flow Control	Hydro-Brake®	9	5.5				
480 minute summer	1	1.010	3	9.9	2.237	0.190	0.0525	
30 minute summer	4	1.003	5	25.7	0.751	0.277	2.0140	
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	Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 97.48%							
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	5	464	110.974	1.113	20.6	0.4698	0.0000	FLOOD RISK
240 minute summer	9	196	106.252	0.052	9.9	0.0000	0.0000	OK
480 minute winter	10	464	110.976	0.785	11.0	0.2912	0.0000	FLOOD RISK
480 minute winter	12	464	110.972	1.208	26.3	0.4856	0.0000	FLOOD RISK
480 minute winter	13	464	110.971	1.357	26.3	0.2157	0.0000	FLOOD RISK
480 minute winter	14	464	110.969	1.605	29.5	0.2553	0.0000	FLOOD RISK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
15 minute winter	5	1.004	12	31.0	0.789	0.437	1.6596	
240 minute summer	9	1.009	1	9.9	2.003	0.231	0.0345	
15 minute winter	10	1.002	4	13.9	0.692	0.197	2.2259	
15 minute winter	12	1.005	13	42.9	1.094	0.550	2.1332	
15 minute winter	13	1.006	14	42.9	0.700	0.426	2.1391	
30 minute winter	14	1.007	Flow Control	27.0	0.383	0.380	1.4697	
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Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: 220628 Far Fields.pfd Network: Storm Network Alan Corner 28/06/2022	Page 15 Far Fields SWMP					
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.48%								
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Pitch 7	102	111.017	0.247	24.5	46.7555	0.0000	SURCHARGED
480 minute winter	8	440	111.002	0.510	5.2	0.0811	0.0000	FLOOD RISK
360 minute winter	Pitch 6	344	111.094	0.394	23.0	123.4602	0.0000	FLOOD RISK
360 minute winter	Pitch 5	360	111.130	0.430	32.0	209.7960	0.0000	FLOOD RISK
480 minute winter	Pitch 4	472	111.087	0.437	25.6	214.5153	0.0000	FLOOD RISK
720 minute winter	Pitch 3	705	111.005	0.505	22.3	269.8613	0.0000	FLOOD RISK
480 minute winter	Pitch 2	480	111.035	0.435	25.6	225.2014	0.0000	FLOOD RISK
480 minute winter	Pitch 1	472	111.081	0.431	25.6	222.1185	0.0000	FLOOD RISK
720 minute winter	Pavilion 1	705	110.994	1.054	13.0	157.2859	0.0000	FLOOD RISK
720 minute winter	Pavilion 2	705	110.996	1.056	7.3	88.2119	0.0000	FLOOD RISK
720 minute winter	Flow Control	705	110.994	1.716	21.9	1.9411	0.0000	FLOOD RISK
720 minute winter	1	705	105.846	0.046	10.0	0.0072	0.0000	OK
720 minute winter	3	705	104.845	0.045	10.0	0.0000	0.0000	OK
480 minute winter	4	440	111.002	0.941	16.3	0.4308	0.0000	FLOOD RISK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
120 minute winter	Pitch 7	Orifice	8	5.9				
15 minute summer	Pitch 7	Weir	8	0.0				
120 minute winter	Pitch 7	Infiltration		0.5				
120 minute winter	8	1.001	10	5.9	0.745	0.124	1.0553	
180 minute winter	Pitch 6	Orifice	10	5.7				
360 minute winter	Pitch 6	Infiltration		0.6				
180 minute winter	Pitch 5	Orifice	4	4.3				
180 minute winter	Pitch 5	Infiltration		1.0				
180 minute winter	Pitch 4	Orifice	5	4.2				
180 minute winter	Pitch 4	Infiltration		1.0				
120 minute winter	Pitch 3	Orifice	12	7.7				
240 minute winter	Pitch 3	Infiltration		1.0				
180 minute winter	Pitch 2	Orifice	14	4.1				
240 minute winter	Pitch 2	Infiltration		1.0				
240 minute winter	Pitch 1	Orifice	Flow Control	3.7				
240 minute winter	Pitch 1	Infiltration		1.0				
30 minute winter	Pavilion 1	9.000	Flow Control	-26.9	0.919	-0.157	0.2452	
15 minute summer	Pavilion 1	Infiltration		0.0				
15 minute summer	Pavilion 2	7.000	14	-22.6	1.209	-0.199	0.4243	
15 minute summer	Pavilion 2	Infiltration		0.0				
720 minute winter	Flow Control	Hydro-Brake*	9	5.0				
15 minute summer	Flow Control	Hydro-Brake*	9	5.5				
720 minute winter	1	1.010	3	10.0	2.243	0.192	0.0529	
15 minute winter	4	1.003	5	26.6	0.778	0.287	2.0140	
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Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.48%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	5	675	111.000	1.139	18.4	0.4807	2.8050	FLOOD
720 minute winter	9	705	106.252	0.052	10.0	0.0000	0.0000	OK
360 minute winter	10	344	111.000	0.809	12.0	0.3005	0.0000	FLOOD RISK
720 minute winter	12	705	110.999	1.235	22.3	0.4965	0.0000	FLOOD RISK
720 minute winter	13	705	110.998	1.384	22.3	0.2200	0.0000	FLOOD RISK
720 minute winter	14	705	110.996	1.632	25.4	0.2595	0.0000	FLOOD RISK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	5	1.004	12	32.7	0.761	0.461	1.6596
720 minute winter	9	1.009	1	10.0	2.008	0.233	0.0347
15 minute winter	10	1.002	4	14.8	0.693	0.209	2.2259
15 minute winter	12	1.005	13	44.8	1.057	0.575	2.1332
15 minute winter	13	1.006	14	44.7	0.697	0.443	2.1391
30 minute winter	14	1.007	Flow Control	28.3	0.402	0.398	1.4697

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