

Project: Drainage and SUDS
Design, 4 THE HORSEFAIR,
HINCKLEY, LEICESTERSHIRE

Project No: 1976-C-R01

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Arcelle Consulting

T: 0116 254 6694 E: info@arcelleconsulting.co.uk W: www.arcelleconsulting.co.uk

Leicester Office

103 London Road Leicester LE2 0PF

London Office

49 Constable House Adelaide Road London NW3 3QA

Executive Summary

This Drainage Assessment reviews the existing drainage arrangement at the application site and proposes a surface water drainage strategy in line with Hinckley and Bosworth Council and Leicestershire County Council guidance.

The site is currently occupied by a single building with associated hardstanding and gardens and is located on 4 Horsefair, Hinckley.

The proposed development comprises the construction of 2 new apartment blocks and associated hardstanding and external garden areas.

The site is less than 1 hectare in size and within flood zone 1, so no flood risk assessment is required.

Surface Water Drainage

The proposed strategy presented in detail in this report aims to reduce the surface water discharge to greenfield rates. All post development run-off from the site will be limited to 5 litres/second in accordance with best practice. Attenuation and reduced discharge will be provided for all storm events up to and including the 1 in 100-year storm plus 40% allowance for climate change. Sustainable Drainage Systems (SuDS) shall be used, including an area of tanked permeable paving and a cellular tank for surface water attenuation, as well as extensive green roofs and a green wall for surface water treatment.

It is proposed to reuse existing sewer connections where possible, or if these cannot be found, construct new sewer connections to both the foul and surface water sewers in the Horsefair.

An additional 10% allowance for urban creep has been included in the sizing of attenuation.

Maintenance/management of all onsite drainage infrastructure has been considered within a separate maintenance plan appended to this report. This will be updated through the development process.

The proposed drainage strategy is entirely based on-site and therefore the only off-site works will be the foul and surface water outlets to the Severn Trent Water sewer.

Overall, the proposals provide a high level of water treatment, runoff reduction and flooding protection for the proposed development and are in accordance with all requirements of the Lead Local Flood Authority (LLFA).

Foul Drainage

It is proposed to discharge the foul drainage from the site into the existing Severn Trent Water sewers.

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1 INTRODUCTION

- 1.1.1 Arcelle Consulting was commissioned to undertake a Drainage Assessment for the proposed development of land located at 4 The Horsefair, Hinckley LE10 0AN.
- 1.1.2 This Drainage Assessment has been produced in support of a planning application and should be read in conjunction with the other planning documents.
- 1.1.3 The development proposal comprises the construction of 2 apartment blocks and associated external works. Development proposals are provided in Appendix A.
- 1.1.4 The site is less than 1 hectare in size and within flood zone 1, so no flood risk assessment is required.
- 1.1.5 The total site area is 1350 square metres. Pre development the site is 100% impermeable. Pre-development the impermeable area is reduced to approx. 80% or 1075 square metres.
- 1.1.6 Since April 2015, Lead Local Flood Authorities (LLFA's) have become a statutory consultee on surface water drainage for many planning applications. For this site, the following is considered to be the required level of details for planning approval.
 - SuDS: Designs, Maintenance Plans & Calculations - for SuDS proposed, the LLFA require product specifications or design drawings, all supporting calculations and a maintenance plan. This needs to include details of any SuDS structures, and the type of SuDS system in accordance with the CIRIA C753 SuDS Manual.

2 Site Description

- 2.1.1 The site is approximately 1350 square metres in size and located at 4 The Horsefair, Hinckley.
- 2.1.2 The site location information is as follows:
- Nearest Postcode: LE10 0AN

2.2 Topography

Site Topography

- 2.2.1 An onsite topographic survey has been carried out and is provided in Appendix B.
- 2.2.2 The site is generally rectangular in shape and falls from south to north. However, the levels across the existing site are very irregular with an existing basement towards the south end of the site being significantly lower than the surrounding ground levels.

3 Design principles and policy requirements

3.1 General Principles for Proposed Site Run-Off

3.1.1 The DEFRA Sustainable Drainage Systems Non-Statutory Technical Standards for Sustainable Drainage Systems (March, 2015) states that the following options must be considered for disposal of surface water runoff in order of preference:

- Discharge to ground
- Discharge to a surface water body
- Discharge to a surface water sewer
- Discharge to a combined sewer

Discharge to Ground

3.1.2 The potential for surface water to discharge to ground has been assessed through a review of the likely ground conditions and possible infiltration structures.

3.1.3 The area in which this site is located is generally underlain by impermeable clays. Based upon this information, it is unlikely that infiltration is possible on this site.

3.1.4 As well as the underlying ground conditions, the site and surrounds are urban in nature and have existing sewer connections. Hence it is considered that infiltration is not possible on this site.

Discharge to Surface Water Body

3.1.5 There are no suitable surface water bodies near to the site that can be used for surface water discharge.

Discharge to Surface Water Sewer/Combined Sewer

3.1.6 Discharge to the public sewer network should only be considered once all other options for draining surface water from the site have been exhausted.

3.1.7 The existing site has a surface and foul water connection to the public sewer. It is proposed to reuse these existing connections if possible, however this is subject to survey. Should the existing sewer connections not be suitable for reuse, new surface water and foul connections will be constructed.

3.1.8 Attenuation will be provided in the form of an area of tanked permeable paving and an attenuation tank. The proposed attenuation structures will discharge via a pump to the Severn Trent Water combined sewer in The Horsefair, with a discharge rate of 5 litres/second in accordance with best practice. Severn Trent Water will be contacted for approval of the discharge to their sewer. See Appendix C for design drawings and calculations.

3.2 ***Sustainable Drainage Systems (SuDS)***

- 3.2.1 To maximise the potential use of SuDS at the site, a review has been undertaken as shown in Table 1 in accordance with the SuDS Hierarchy. This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be incorporated into the development.

Table 1: SuDS Selection Based on the SuDS Hierarchy

Component	Recommendation
Green (living) roofs	Whilst the use of green roofs provides additional environmental benefits such as enhanced aesthetics and ecology, its exposure to wind and orientation must be considered. Access to undertake the construction and maintenance easily and safely is also a high priority. If feasible, depending on the roof design, a green roof will provide water quality, biodiversity and aesthetic benefits to the site. Additionally, the green roof/s will offer some attenuation for run-off, reducing volumes of run-off and in higher frequency events (i.e. 1in2 year storms) will result in no run-off for the building. The roof is flat and green roofs are proposed on a number of levels throughout the development. As well as green roofs, there is an extensive green wall proposed for the central courtyard of the development.
Basins and Ponds	Ponds and attenuation basins can provide overland storage of surface water whilst also providing additional biodiversity and aesthetic/amenity value. There are no open areas on the site which are suitable for basins or ponds.
Filter Strips and Swales	Swales are linear vegetated drainage features, which provide overland conveyance and storage of surface water whilst trapping sediments and hydrocarbons within run-off. They also create biodiverse areas for planting and habitat. Swales are not considered suitable for this site due to the urban setting restricting the availability of space and suitability of swales.
Infiltration Devices	Infiltration devices are not suitable for this site in accordance with the recommendations of the section above.
Permeable Paving	Whilst incorporating attenuation storage, permeable paving also provides treatment through filtration of silt (and attached pollutants), settlement and retention of solids, adsorption of pollutants and biodegradation of organic pollutants, including petrol and diesel. A large area of tanked permeable paving is proposed for the ground level of the site.
Tanked	This is the least sustainable option in terms of the SuDS Hierarchy. However, the use of tanked systems would still be of benefit compared to

Component	Recommendation
Systems	traditional drainage systems as it does allow run-off to be slowed down to an acceptable discharge rate. There is a single tank proposed for the site.

4 Surface Water Drainage Design

4.1 *Existing Site Runoff*

- 4.1.1 The development area currently comprises a number of buildings with extensive areas of parking and hardstanding. The existing and proposed areas are summarised below.

Table 2: Site Areas

Parameter	Existing (m2)	Existing (%)	Proposed (m2)	Proposed (%)
Impermeable area	1350	000	1075	80
Permeable area	0	0	275	20
Total area	1350	100	1350	100

4.2 *Design Considerations*

- 4.2.1 Consideration has been given to the following when calculating the proposed impermeable areas.

- The 2013 EA 'Rainfall Run-off Management for Developments' Report (SC030219) states that urban creep, the process of gradually increasing impermeable area within an urban area (through paving soft landscaped surfaces and constructed outbuildings etc), is an acknowledged issue. To include an allowance for urban creep, the impermeable area used in the drainage calculations has been increased by 10% in accordance with the recommendation made in SC030219.

- 4.2.2 The climate change allowance used in the Drainage Strategy is in line with updated EA guidance values published in February 2016 for increased rainfall intensities by 2115.

4.3 *Existing Greenfield Run-Off Rates*

- 4.3.1 The existing run-off rates for a variety of return periods have been calculated using the Wallingford method.
- 4.3.2 The greenfield run-off rates are based on the parameters provided below in Table 3.

Table 3: Rural Run-off Calculator Parameters

Parameter	Value
-----------	-------

Area (ha)	0.135
SAAR (mm)	642
Soil Type	4

- 4.3.3 The calculations are presented in Appendix C and summarised below in table 4.

Table 4: Existing Greenfield Run-off Rates

Parameter	Value for site (l/s)	Value to be used (l/s)
QBAR	0.59	NA
Q1	0.49	5
Q30	1.18	5
Q100	1.51	5

- 4.3.4 As the greenfield rates from this site are low, in accordance with best practice, outflow controls will be set to discharge at a rate of 5 litres/second.

4.4 Flood Risk Reduction

- 4.4.1 As infiltration is not possible on this site, reducing post development run-off volumes to pre-development volumes is achieved through attenuation.
- 4.4.2 By controlling run-off rates to 5 litres/second and providing attenuation for all storm events up to and including a 1 in 100-year storm plus climate change allowance, the risk of downstream flooding will be minimised.
- 4.4.3 Details of the drainage system and attenuation structures are presented in the design drawings and calculations in Appendix C.
- 4.4.4 The calculations include an assessment of the attenuation for the 100-year storm +40% climate change.
- 4.4.5 A total attenuation volume of approximately 45 cubic metres is proposed to cater for the 100 year +40% storm event.
- 4.4.6 The attenuation is provided via an area of permeable paving and a cellular attenuation tank.
- 4.4.7 Discharge is via a package pump station to the STW sewer in The Horsefair.

4.5 Exceedance Flooding

- 4.5.1 The existing site is not subject to overland flow or surface water flooding. (See EA surface water flood map below). As the general layout of the site is unchanged, the proposed flow routes will mimic existing, and fall toward the

permeable paved areas where water can pond and slowly soak into the ground or flow into the sewer system.

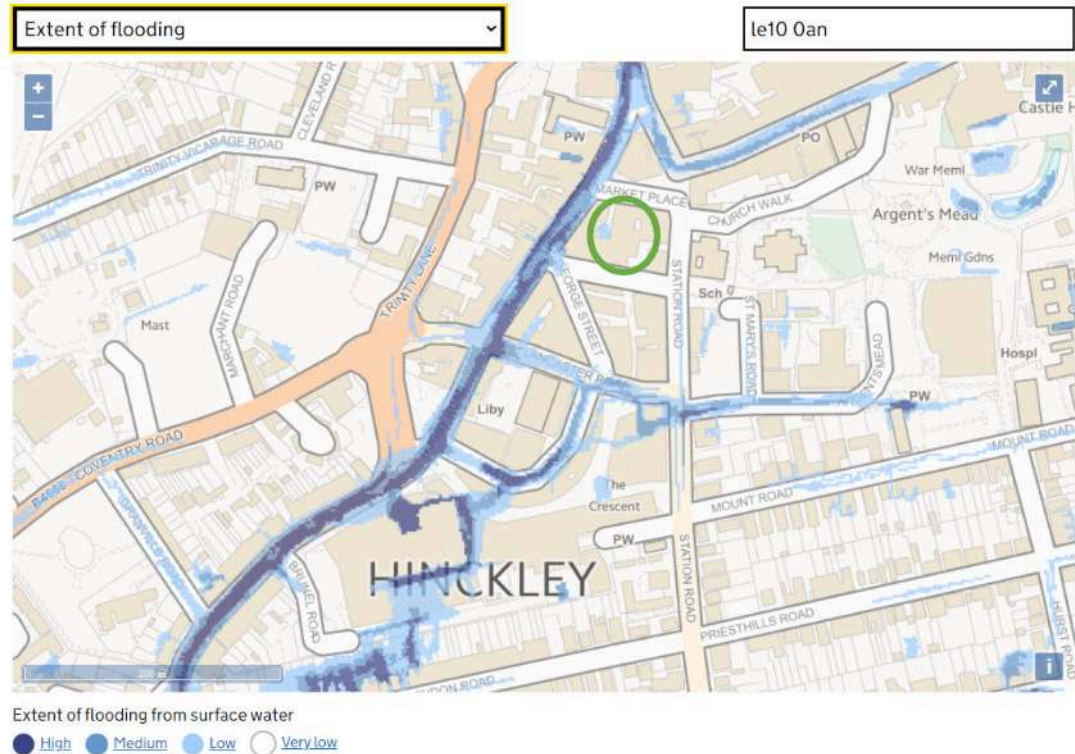


Figure 1: EA surface water flood map

- 4.5.2 It should be noted that the drainage system has been designed to cater for the 1 in 100 year + 40% climate change storm. ie in this storm event all surface water will be collected on site and slowly released. Thus, the flow route will only be in use in the event of drainage network failure or storms in excess of the 1 in 100 year + 40% climate change storm.

4.6 **Consents, Offsite Works and Diversions**

- 4.6.1 The proposed surface water drainage strategy is accommodated mostly on-site, with the only requirement for off-site works being the connection to the Severn Trent Water sewer.

4.7 **Maintenance**

- 4.7.1 A SuDS maintenance plan has been prepared to outline the management of the potential SuDS features. The maintenance plan is provided in Appendix D.

5 Water Quality

5.1 *Post-Development Water Quality Treatment*

5.1.1 In line with the 2015 SuDS Manual (CIRIA C753), certain criteria should be applied to manage the quality of run-off to support and protect the natural environment effectively. Treatment design, wherever practicable, should be based on good practice, comprising the following principles:

- Manage surface water run-off close to source
- Treat surface water run-off on the surface
- Treat surface water run-off to remove a range of contaminants
- Minimise risk of sediment remobilisation
- Minimise impacts from accidental spills

5.1.2 Managing pollution close to the source can help keep pollutant levels and accumulation rates low, essentially allowing natural treatment processes to be effective. This in turn can help maximise the amenity and biodiversity value of downstream surface SuDS components and keep maintenance activities straightforward and cost-effective.

5.1.3 The proposed development comprises just a single type of land use subject to surface water flow - residential roofs. There are no external areas subject to vehicle use. Roof space is classified as having very low pollution levels. See below in Table 5.

Table 5: Pollution Hazard Indices from 2015 SuDS Manual (C753)

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

5.1.4 The proposed drainage strategy utilises the following SuDS features:

- Permeable paving
- Green Roofs
- Attenuation Tank

5.1.5 The indicative SuDS mitigation indices, provided in Table 26.3 of the 2015 SuDS Manual (C753) have been reviewed for the roof. This table is provided below in Table 6.

Table 6: Indicative SuDS Mitigation Indices from 2015 SuDS Manual (C753)

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

5.1.6 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type), as follows:

$$\text{Total SuDS mitigation index} \geq \text{pollution hazard index}$$

(for each contaminant type) (for each contaminant type)

5.1.7 For each type of land-use, the pollution hazard indices, mitigation indices and concluding hazard have been outlined in Table 7 below.

Table 7: Roof Space Water Quality Mitigation Summary

Residential Roofs				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.2	0.2	0.05	Table 26.2

Mitigation Index (Permeable Paving and Green Roof)	0.7	0.6	0.7	Table 26.3
Total Mitigation index	0.7	0.6	0.7	Worst case only
Result	Total SuDS mitigation index $\geq$ pollution hazard index and therefore hazard is exceeded			

- 5.1.8 Therefore, it can be concluded that the provision of a green roof, permeable paving and an attenuation tank exceeds the required pollution mitigation indices and provides sufficient treatment as part of the surface water management train, in accordance with the 2015 SuDS Manual (CIRIA C753).

6 Foul Drainage

6.1 *Discharge to Public Sewer Network*

- 6.1.1 Severn Trent Water are the foul sewerage suppliers for the area.
- 6.1.2 The identified point of connection from the site is into the public foul sewer network in The Horsefair. A Sewer connection application will be submitted to Severn Trent Water for approval.

7 Drainage during construction

7.1 Construction Run-off Management

7.1.1 Installing the surface water and foul drainage system, whilst managing temporary run-off, are key aspects of the construction works involved in any development. The information provided below is in accordance with the 'C698 Site handbook for the construction of SUDS' (CIRIA, 2007).

7.1.2 Please note that the measures recommended below are recommendations only and need to be confirmed at the construction stage by the client and the contractor.

7.2 Management of Construction (Including Drainage)

7.2.1 Drainage is typically an early activity in the construction stage of a development, taking form during the earthworks phase. However, final construction i.e. piped drainage system connections to the SuDS devices, should not take place until the end of site development work, unless a robust strategy for silt-removal is implemented prior to occupation of the site.

7.2.2 A plan for the management of construction (including phasing of works, details of any offsite works etc.) cannot be provided at this early stage, as construction work plans are not yet known. However, the following key points are general construction issues associated with SuDS which will be addressed when these plans are complete:

- Silt-laden waters from construction sites represent a common form of waterborne pollution;
- These silt-laden waters cannot enter SUDS drainage systems unless specifically designed to accept this as it can clog the systems and pollute receiving waters. Therefore, piped drainage systems should not be connected to the attenuation SuDS devices until the late stages of construction.
- Any gullies and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to the attenuation SuDS devices.

7.3 Temporary Drainage During Construction

7.3.1 The three principal aspects of drainage control during construction are trapping sediment, conveying run-off, and controlling run-off.

7.3.2 Sediment traps and barriers can include basin traps and sediment fences (with any necessary boundary controls). The principal basins are to be installed after the construction site is accessed. Sediment fences and barriers will then be installed as needed during grading.

7.3.3 Conveyance of run-off can be achieved through small ditches/stream, storm drains, channels and sloped drains with sufficient inlet/outlet protection.

7.3.4 Slope stability needs to be considered when using any channels to convey run-off across the site into any basins etc.

7.3.5 Run-off control measures will need to be implemented in order not overwhelm the temporary system and cause flooding issues. Run-off rates

from the site will be managed so they are no greater than pre-development or in keeping with the best practice guidance to minimise risk of blockage. Any additional conveyance measures are to be installed as needed during grading.

- 7.3.6 Run-off control to include provision of perimeter ditches or appropriate levels grading to direct any water from the construction site to remain on site.
- 7.3.7 Any necessary surface stabilisation measures are to be applied immediately on all disturbed areas where construction work is either delayed or incomplete.
- 7.3.8 Maintenance inspections are to be performed weekly, and maintenance repairs to be made immediately after periods of rainfall.

7.4 *Protection of Drainage Infrastructure during Construction*

- 7.4.1 All drainage infrastructure should be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers, and storing construction materials away from the drainage infrastructure.

Appendix A: Proposed Development Details



Planning Only

Figure 4.44

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Proposed Off and First Floor Plans

Proposed GF and
Root Plants

Author	Ashton, B. A.
Date	1989

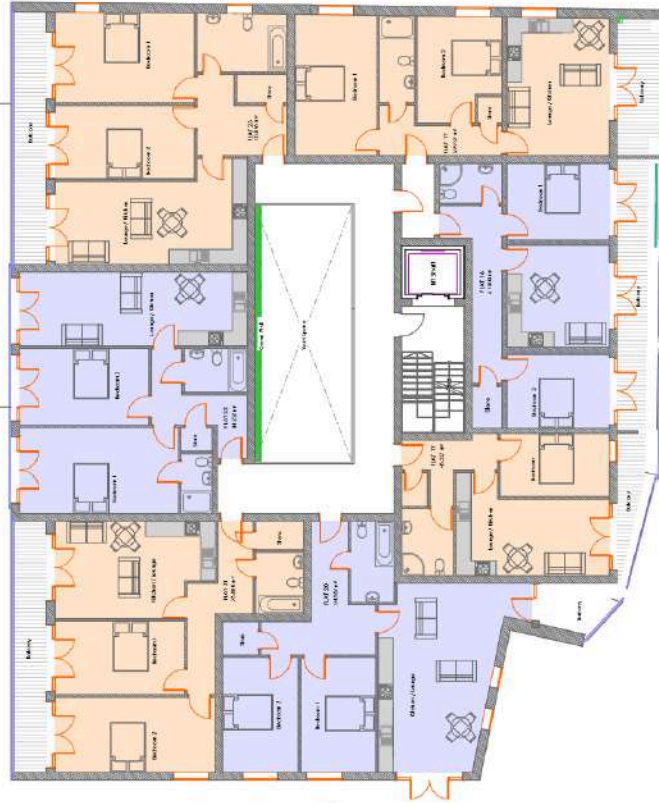
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		Notes:	1. See Data Sheet for Pin Connections.

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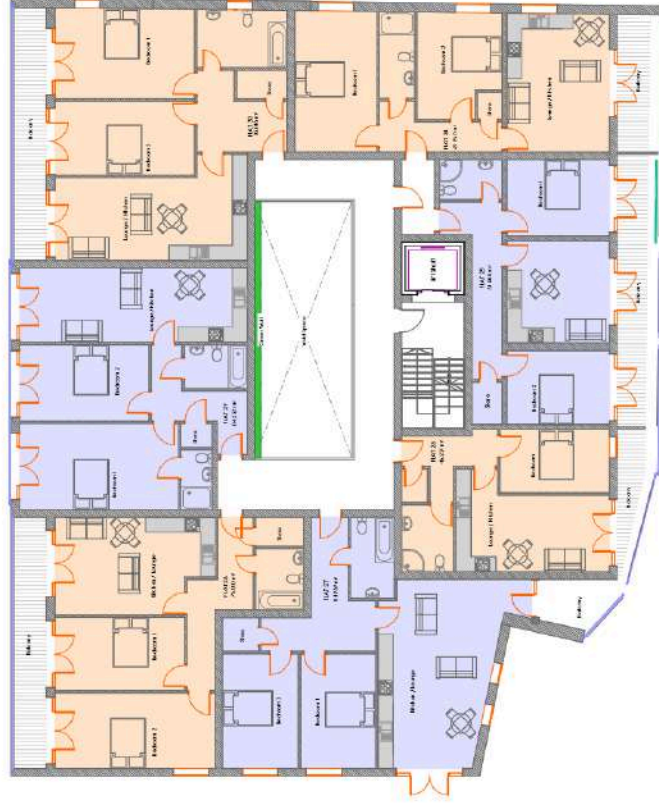
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Proposed Fourth Floor Plan @ 1:100



Proposed Fifth Floor Plan @ 1:100



Proposed 6th Floor Plan @ 1:50

Appendix B: Topographic Survey

Appendix C: Drainage Drawings and Calculations

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:

0800 783 4444 (24 hours)

- a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991 (a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.
- b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.
- c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.
- d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.
- e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).
- f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).
3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.
4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.
7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.
9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.
10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.
11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.
12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.
13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants.

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main or other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

3625	F	-	0	0
3908	F	-	0	0

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used 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). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	642	642
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

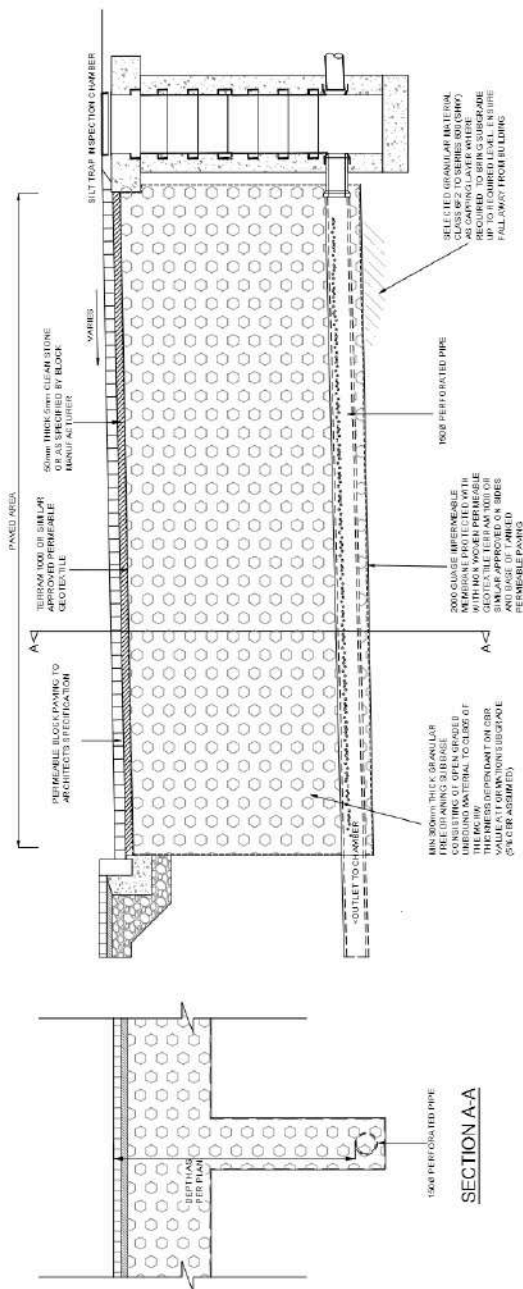
Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	0.59	0.59
1 in 1 year (l/s):	0.49	0.49
1 in 30 years (l/s):	1.18	1.18
1 in 100 year (l/s):	1.51	1.51
1 in 200 years (l/s):	1.79	1.79

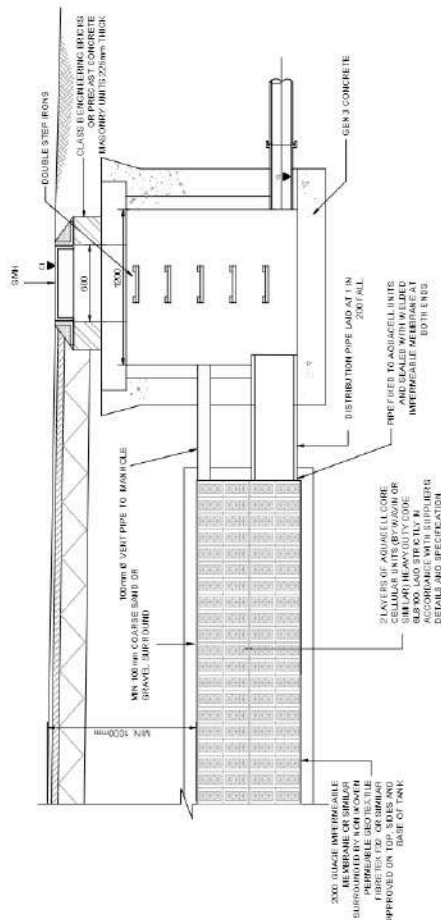
This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. 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 this data in the design or operational characteristics of any drainage scheme.

Victims

- 10 The drawing only to be used in connection with all relevant series design drawings, specifications and documentation.
- 11 Construction to be in accordance with all British and European standards and testing regulations.
- 12 All dimensions are in millimetres and levels in metres above local datum.
- 13 Any discrepancy in the details shown are to be taken in favour of the more appropriate engineering principle construction.
- 14 All existing services are to be located prior to the commencement of any work, the contractor must ensure the engineer immediately of any conflict with the proposed works.
- 15 For clarity reasons, all drainage and fittings to be fully installed (UPVC, cast iron, 110 or 160) to close to BS EN 255 or conform to BS5911 part 100.
- 16 Chapter walls 225 mm thick to be constructed in class 3 engineering material (M40) series 400 in drainage culverts and 225 mm thick in class 2 (M20) culverts to clause 3002.
- 17 All concrete walls and cover slabs to be constructed in placed concrete to BS EN 197-2 and BS 5911-3.
- 18 Concrete mixes indicated on the drawing are to be used unless otherwise stated, and approved in accordance with BS EN 12620-1:2000 as suitable for the applicable material.
- 19 All walls to have two internal and two external tie bars with a minimum length of 1000 mm, to be cast in accordance with the specification, the drawing mainly showing the reinforcement details and the reinforcement bars and their areas of reinforcement shall be the same as shown on the drawings. The reinforcement shall be placed in accordance with the relevant standards, published documents to highway works, BS 5400-12:1999 and BS 5400-13:1999, and BS 5400-12:1999, published by the statutory office.
- 20 All slabs to be cast and laid soft to self compacted



SCALE 1:20



TYPICAL SECTION THROUGH STORM
WATER STORAGE/ATTENUATION TANK

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VOLTA DESIGNS

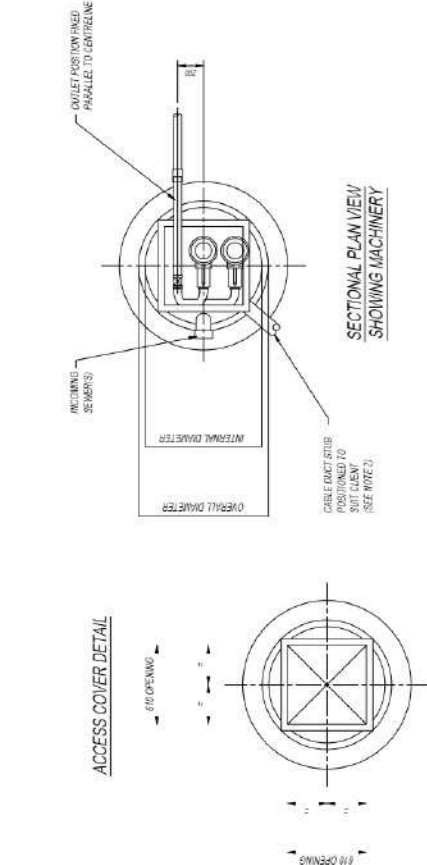
PROJECT
4 THE HORSEFAIR
HINCKLEY

CONSTRUCTION DETAILS
SHEET 2 OF 3

orcelle Consulting
T: 01746 254 5058 E: info@orcelleconsulting.co.uk
Leicester Office
18-19 De Montfort Street Leicester LE1 2GL
Leicester Office
49-51 Conventry House, Melbourne Road, Leicester LE9 3JH

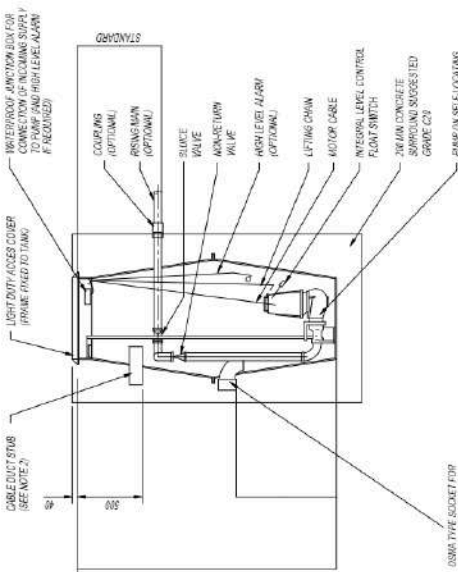
Notes

1. The drawing is to be read in conjunction with all relevant series design drawings, specifications and documentation.
2. Construction to be in accordance with all British and European standards and building regulations.
3. All dimensions are in millimetres and levels in metres above local datum.
4. Any dimension shown in detail should not be required if the unambiguous representation is sufficient for construction.
5. All cast-in services are to be located prior to the construction of any walls. The contractor must verify the engineer immediately if any conflict with the proposed work.
6. For gravity services, all castings and fittings are to be fully certified LPC to BS EN 10111 or castware to BS EN 285 or castware to BS EN 1111 part 100.
7. Chamber walls 225mm thick to be constructed in class B engineering bricks to BS EN 791 series 200 in designation and laid in a full brick bond. Class C 1600 concrete to BS EN 206.
8. Chamber walls and cover slab to be constructed in precast concrete to BS EN 1191 and BS EN 1111.
9. Concrete mixes indicated on this drawing are designated mixes in accordance with BS EN 12601:2006 and are to be supplied as indicated.
10. Backfill to all trenches under cartways to be type 1 sub-base material, elevations backfill to be in accordance with BS EN 12601:2006. All backfill to be compacted in layers not exceeding 150mm thick, free from rubber and organic matter, from soil clay, lime and large stones to be compacted in a layer not exceeding 150mm thick.
11. A flexible joint shall be provided at the end of the chamber to allow for any settlement into which a cable is laid, in accordance with the detail.
12. The general application of material and workmanship for the construction of the chamber, road, footpath and cartway shall be in accordance with the current standards for highway works published by the statutory office.
13. All slabs to be laid with a self-laying screed.
14. Manhole covers and frames shall comply with BS EN 124 and shall be of a non-slip design which does not rely on the use of cushion inserts. Class D covers shall be used in cartways, hard shoulders and footpaths. Class C shall be used in footways, pedestrian areas and all comparable locations.



PUMP NOTES

1. ALL DIMENSIONS IN MILLIMETRES, UNLESS OTHERWISE STATED.
2. CABLE DUCT AND INLET SERVING MAY BE POSITIONED AROUND PERIPHERY TO BUT CLIENTS REASONABLE REQUIREMENTS, WHERE A PIPE POSITION CONFLICTS WITH A STRUCTURAL JOINT IT WILL BE PLACED IN THE NEAREST POSSIBLE LOWER AND/OR ADJACENT LOCATION.
3. THE PUMPS SHALL BE PROVIDED TO WORK ALTERNATIVELY SO AS TO ALLOW BOTH PUMPS TO HAVE AN EQUAL OPERATION LONG AND PUMP LIFE.
4. A HIGH WATER LEVEL FLOAT SHALL BE PROVIDED AT A HIGH LEVEL WHICH IS APPROXIMATELY 300mm BELOW THE ROOF LEVEL OF THE BELOW GROUND TANK. THIS FLOAT SHOULD START THE OTHER PUMP THAT IS NOT OPERATING.
5. AN ALARM SYSTEM SHALL BE PROVIDED WITH A LAMP AND BELL. THE ALARM SYSTEM SHALL BE PROVIDED WITH A BATTERY BACK-UP IN CASE OF POWER FAILURE. CONTACT DETAILS FOR THE ORGANISATION RESPONSIBLE FOR MAINTAINING THE PUMP TO BE PROVIDED 'NEARBY' TO THE ALARM SYSTEM.



PART SECTION SHOWING SEPARATE ACCESS COVER

OPTIONAL LIGHT DUTY ESSENTIAL IF HEAVY DUTY OR NON-STANDARD

ACCESS COVER FRAME INDEPENDENTLY SUPPORTED IN COVER SLAB BY OTHERS



TYPICAL PACKAGE PUMP STATION DETAIL

SCALE 1:20

NOTE: PUMP DETAILS SHOWN INDICATIVELY ONLY AND DETAILED DESIGN SHOULD BE BY A SPECIALIST PUMP ORGANISATION SUCH AS XYLEM PUMPS.

VOLTA DESIGNS	
Project	4 THE HORSEFAIR HINKLEY
Title	CONSTRUCTION DETAILS SHEET 3 OF 3
orcelle Consulting	
T: 0145 355 555 E: info@orcelle.co.uk	
Leicester Office 10 De Montfort Street Leicester LE1 7DE	
London Office 40 Canfield House Redcar Road London W10 3JL	
Author	VOLTA DESIGNS
Drawing No	1076-003
Revision	1
By	J. J. J.
Date	10/10/20
Check	J. J. J.
Date	10/10/20
Approved By	J. J. J.
Date	10/10/20

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	2.00	Include Intermediate Ground	x
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1			103.600	1200	35.000	0.000	1.770
2			103.300	1200	35.000	5.000	1.300
3			103.300	1200	30.000	5.000	1.250
4	0.040	2.00	99.700	1200	25.000	35.000	3.200
5	0.040	2.00	99.700	1200	20.000	35.000	1.900
6	0.040	2.00	99.700	450	15.000	35.000	1.800

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	2	1	5.000	0.600	102.000	101.830	0.170	29.4	225	2.68	50.0
1.003	3	2	5.000	0.600	102.050	102.000	0.050	100.0	225	2.65	50.0
1.002	4	3	30.414	0.600	96.500	102.050	-5.550	-5.5	225	2.58	50.0
1.001	5	4	5.000	0.600	97.800	96.500	1.300	3.8	150	2.07	50.0
1.000	6	5	5.000	0.600	97.900	97.800	0.100	50.0	150	2.06	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	2.421	96.3	22.8	1.075	1.545	0.120	0.0	74	1.992
1.003	1.307	52.0	22.8	1.025	1.075	0.120	0.0	104	1.265
1.002	1.000	39.8	22.8	2.975	1.025	0.120	0.0	225	0.000
1.001	5.175	91.4	15.2	1.750	3.050	0.080	0.0	41	3.853
1.000	1.426	25.2	7.6	1.650	1.750	0.040	0.0	57	1.252

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	✓
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node 4 Online Pump Control

Flap Valve	x	Design Depth (m)	1.000	Switch off depth (m)	0.300
Replaces Downstream Link	✓	Design Flow (l/s)	5.0		
Invert Level (m)	96.500	Switch on depth (m)	2.000		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.000	2.000	5.000

Node 4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	99.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	22

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	1.0	0.0	0.700	1.0	0.0

Node 4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	97.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	102

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	0.0	0.0	0.801	50.0	0.0	1.602	1.0	0.0
0.800	0.0	0.0	1.601	50.0	0.0			

Results for 2 year Critical Storm Duration. Lowest mass balance: 94.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	1	140	101.865	0.035	5.0	0.0000	0.0000	OK
120 minute summer	2	106	102.037	0.037	5.0	0.0420	0.0000	OK
180 minute summer	3	116	102.104	0.054	5.0	0.0615	0.0000	OK
120 minute summer	4	104	98.500	2.000	7.7	12.2245	0.0000	SURCHARGED
360 minute winter	5	192	98.501	0.701	2.0	1.0885	0.0000	SURCHARGED
360 minute winter	6	192	98.502	0.602	1.0	0.3630	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute summer	2	1.004	1	5.0	1.226	0.052	0.0204	14.5
180 minute summer	3	1.003	2	5.8	1.034	0.111	0.0283	
120 minute summer	4	Pump	3	5.0				
360 minute winter	5	1.001	4	3.4	0.192	0.037	0.0880	
360 minute winter	6	1.000	5	1.5	0.560	0.060	0.0880	

Results for 30 year Critical Storm Duration. Lowest mass balance: 94.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	1	18	101.866	0.036	5.4	0.0000	0.0000	OK
60 minute winter	2	31	102.039	0.039	5.4	0.0441	0.0000	OK
60 minute summer	3	32	102.108	0.058	5.0	0.0651	0.0000	OK
120 minute winter	4	84	98.677	2.177	12.8	20.8875	0.0000	SURCHARGED
120 minute winter	5	84	98.680	0.880	8.6	1.3654	0.0000	SURCHARGED
15 minute summer	6	9	98.747	0.847	18.0	0.5105	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	2	1.004	1	5.2	1.226	0.054	0.0214	30.4
60 minute summer	3	1.003	2	5.0	1.091	0.096	0.0273	
120 minute winter	4	Pump	3	5.0				
120 minute winter	5	1.001	4	8.4	0.477	0.092	0.0880	
15 minute summer	6	1.000	5	16.5	1.131	0.653	0.0880	

Results for 100 year Critical Storm Duration. Lowest mass balance: 94.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	1	28	101.866	0.036	5.4	0.0000	0.0000	OK
60 minute summer	2	30	102.039	0.039	5.3	0.0442	0.0000	OK
180 minute winter	3	72	102.107	0.057	5.0	0.0648	0.0000	OK
120 minute winter	4	90	98.869	2.369	17.1	30.2610	0.0000	SURCHARGED
15 minute summer	5	9	98.888	1.088	45.2	1.6891	0.0000	SURCHARGED
15 minute summer	6	9	99.004	1.104	24.0	0.6654	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	2	1.004	1	5.4	1.235	0.056	0.0217	36.4
180 minute winter	3	1.003	2	5.0	1.067	0.096	0.0273	
120 minute winter	4	Pump	3	5.0				
15 minute summer	5	1.001	4	41.4	2.353	0.453	0.0880	
15 minute summer	6	1.000	5	21.3	1.208	0.844	0.0880	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 94.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	1	25	101.866	0.036	5.4	0.0000	0.0000	OK
60 minute winter	2	25	102.039	0.039	5.1	0.0437	0.0000	OK
15 minute summer	3	9	102.108	0.058	5.0	0.0650	0.0000	OK
120 minute winter	4	96	99.249	2.749	23.9	45.7319	0.0000	SURCHARGED
15 minute summer	5	9	99.318	1.518	62.1	2.3556	0.0000	SURCHARGED
15 minute summer	6	9	99.525	1.625	33.6	0.9799	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	2	1.004	1	5.4	1.254	0.056	0.0216	57.4
15 minute summer	3	1.003	2	5.0	1.082	0.096	0.0273	
120 minute winter	4	Pump	3	5.0				
15 minute summer	5	1.001	4	55.2	3.138	0.604	0.0880	
15 minute summer	6	1.000	5	28.5	1.621	1.132	0.0880	

Appendix D: SuDS Maintenance Report

Project: Drainage and SUDS
Maintenance Report, 4 THE
HORSEFAIR, HINCKLEY,
LEICESTERSHIRE

Project No: 1976-C-R02

Date: July 2020

Revision	Date	Author	Checker
-	30.07.20	AW	CA

Arcelle Consulting

T: 0116 254 6694 E: info@arcelleconsulting.co.uk W: www.arcelleconsulting.co.uk

Leicester Office

103 London Road Leicester LE2 0PF

London Office

49 Constable House Adelaide Road London NW3 3QA

1.0 General

- 1.1** Sustainable Drainage Systems (SuDS) are an environmentally friendly approach to managing rainfall. SuDS techniques use landscape features to deal with surface water with the aim to:
- 1.1.1 Control the flow, volume and frequency of water leaving a development.
 - 1.1.2 Prevent pollution by intercepting silt and cleaning runoff from hard surfaces.
 - 1.1.3 Provide attractive surroundings for the community.
- 1.2** The surface water drainage strategy for this development utilises tanked permeable paving as the main SUDS feature as well as a number of minor features (silt traps, trapped gullies). The following sections provides a brief description of these features and outlines the maintenance programme that should be adopted.

2.0 Cleaning of the Drainage System

- 2.1** Drainage systems should be inspected at regular intervals and where necessary, thoroughly cleaned out at the same time. Any defects discovered should be made good.
- 2.2** The following operations should be carried out during the periodic cleaning of a drainage system:-

Product Type	Period	Responsibility	Maintenance Methods
Silt Trap	As necessary and before wet season	Owner/ Maintenance Company	• Sediment and debris that accumulated during summer needs to be removed before the wet season. • Inspect and clean out routinely prior to inlet pipework to minimise debris reaching the tank. • Conduct inspections more frequently during the wet season for the area where sediment or trash accumulates more often. Clean and repair as needed.
Standard Manholes/ Inspection Chambers	As necessary	Owner/ Maintenance Company	• Remove and clean any soil and vegetation that covers the manhole cover to prevent blockage of the drainage system at the manhole. • Renew/replace any damaged/missing bolts and damaged/missing manhole

Product Type	Period	Responsibility	Maintenance Methods
			covers.
Drainage Pipes	Six monthly interval	Owner/ Maintenance Company	Inspect underground drainage pipes to ensure that the distribution pipework arrangement is operational and free from blockages. If required, take remedial action.
Yard Gully	Six monthly interval and before wet season	Owner/ Maintenance Company	Clean and empty the sediment and debris that has accumulated in the gully pot to prevent the blockage of the gully itself which may cause road flooding and to prevent any sediment from being carried into the drainage system.
Permeable Paving	As required	Owner/ Maintenance Company	Inspect the paving after any precipitation to ensure no displacement of any organic matter onto the surface of the pavement.
Drainage Channel	Six monthly (Ideally, this activity to be carried out in spring and autumn seasons)	Owner/ Maintenance Company	Agitate (e.g. brush, vacuum, etc.) the block paving to ensure no vegetation of any sort is allowed to grow and develop in the joints (where may affect performance).
Drainage Channel Grating	Winter season	Owner/ Maintenance Company	De-icing may be used without causing significant detrimental effects towards the permeable pavement's performance. When used carefully, the use of these chlorides will not result in an increase in the chloride levels in the local ground.
Pumps	As required	Specialist Maintenance Company	Maintenance to specialist company requirements

3.0 *Sketches and Plans*

- 3.1** The locations of the above features can be found by examining Drawing 1976/C01