

**NORCOT COMMUNITY CENTRE,
READING**

**FOUL & SURFACE WATER DRAINAGE
STRATEGY**

READING BOROUGH COUNCIL

Report Ref:
5264-RP01
ISSUE 01 – September 2020

SDS Consulting

Unit 16
Shrivenham Hundred Business Park
Swindon
SN6 8TZ

www.sds-consulting.co.uk

Tel: 01793 619188

Company Registration No. 6367988

Document Control Sheet

Project name: Norcot Community Centre, Reading

Project ref: 5264

Report Title Foul & Surface Water Drainage Strategy

Doc. ref: 5264-RP01

Date: 8th September 2020

	Name	Position	Signature	Date
Prepared by:	Mark Dyer	Senior Engineer		September 2020
Approved by:	Tafari Lewis	Partner		September 2020

Revision	Date	Description	Prepared	Approved
Issue 1	08/09/2020	First Issue	MTD	TL

Disclaimer

No part of this report may be copied or reproduced by any means without prior written permission from SDS Consulting. This report has been produced for the client in respect of the project stated. This report may not be used or relied upon by another person or by the client in relation to any other matters not covered by the scope of this report.

Opinions and information provided in this report are on the basis of SDS Consulting using due skill, care and diligence in the preparation of the same and no warranty is provided as to their accuracy.

It should be noted and is expressly stated that no independent verification of any information supplied to SDS Consulting has been made.

Copyright SDS Consulting. All rights reserved

PAGE LEFT INTENTIONALLY BLANK

CONTENTS

PAGE NO.

1.	INTRODUCTION	1
	Objectives & Scope	1
	Planning	1
	Limitations	2
	The Development Proposals	2
2.	PLANNING INFORMATION.....	3
	Reading Borough Council Local Plan (Adopted 2019).....	3
	WSP Drainage Strategy Statement June 2018	3
3.	EXISTING SITE	4
	Site Location	4
	Land Use.....	5
	Topography.....	5
	Hydrology.....	5
	Geology.....	5
	Site Investigation	6
	Hydrogeology.....	6
	Drainage.....	6
4.	FLOOD RISK.....	7
	Sources of Flood Risk	7
	Fluvial Flooding	7
	Pluvial Flooding	8
	Flooding from Groundwater	8
	Flooding from Overwhelmed Sewers and Drainage Systems	9
	Flooding from Artificial Sources	9
	Flood Risk Vulnerability and Flood Zone 'Compatibility'	9
	The Sequential & Exception Test	10
	Climate Change.....	10
	Standard of Protection.....	11
	Residual Risk	11
5.	SURFACE WATER MANAGEMENT	12
	Design Principles.....	12
	Non-statutory technical standards for sustainable drainage systems.....	12

Peak Flow Control	12
Volume Control	13
Sustainable Drainage Systems	13
SuDS Selection	13
Surface Water Flow Balancing	14
Catchment Areas	14
Greenfield Runoff Rate.....	15
Pre Development Peak Runoff Rate.....	15
Post development unattenuated Peak Runoff Rate.....	15
Proposed surface water discharge arrangements	16
Outfall Location.....	16
Infiltration	16
Surface water body	17
Surface water sewer, highway drain, or another drainage system;	17
Surface Water Drainage Strategy	17
Timetable for the implementation of SuDS	18
Pollution Prevention	18
Overland Flood Flow Paths	20
6. SuDS MANAGEMENT & MAINTENANCE PLAN	21
Management & Maintenance.....	21
Indicative Maintenance & Management Plan	21
Gravity Drains & Catchpits	21
Permeable Surfaces.....	21
Modular Storage	23
Flow Control Chambers	23
Blockages & Spillages	24
Implementation of the management plan & Adoption	25
7. PROPOSED FOUL WATER STRATEGY	26
Existing Drainage	26
Proposed Strategy	26
Adoption.....	26
8. CONCLUSIONS	27

FIGURES

Figure 1	Site Location Plan
Figure 2	Red Line Boundary
Figure 3	BGS Geological Map
Figure 4	Environment Agency's Flood Map for planning
Figure 5	Environment Agency's Risk of Flooding from Surface Water Map
Figure 6	Extract of NPPF Table 2
Figure 7	Extract of NPPF Table 3
Figure 8	CIRIA C753 Table 26.2
Figure 9	CIRIA C753 Table 26.3

APPENDICES

Appendix A	Saunders Architecture + Urban Design Drawing 7870_PL102 Revision D 'Rendered Site Plan'
Appendix B	Topographical Survey
Appendix C	Ground Investigation extract
Appendix D	Thames Water Assets
Appendix E	Micro Drainage ICP SuDS Greenfield Runoff
Appendix F	Drawing 5264-C-001 – 'Drainage Strategy'
Appendix G	Micro Drainage Calculations

1. INTRODUCTION

- 1.1. All forms of flooding and their impact on the natural and built environment are material planning considerations. The revised National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the revised NPPF and the supporting Planning Practice Guidance (PPG).
- 1.2. A Foul and Surface Water Drainage Strategy has been completed in accordance with the revised NPPF and the PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with national policy.

Objectives & Scope

- 1.3. This report will review the information provided to support the planning application in relation to drainage.
- 1.4. The objective of this report is:
- Review the information supplied for planning
 - Establish surface water runoff for the proposed development site.
 - Detail a suitable drainage strategy for the management and maintenance of the surface water generated from the proposed development
 - Provide sufficient information to discharge planning condition 10 of Reading Borough Council planning reference 181377
- 1.5. The scope of this drainage strategy is to provide sufficient information for the discharge of drainage related planning conditions.

Planning

- 1.6. Planning condition 10 is written as:

Planning Condition 10

The development hereby approved shall not be commenced on site until a Sustainable Drainage Strategy and associated detailed design, management and maintenance plan of surface water drainage for the site using SuDS methods has been submitted to and approved in writing by the Local Planning Authority. The plan shall include:

- i. a timetable for its implementation, and
- ii. a management and annual maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage scheme throughout its lifetime.

REASON: These details are required due to insufficient information being contained within this submission and in order to reduce the risk of flooding onsite or elsewhere in accordance with Policy EN18 of the Reading Borough Local Plan 2019.

Limitations

1.7. The general limitations of this report are that:

- SDS Consulting Ltd has prepared this Report for the sole use of the Client in accordance with the Agreement under which our services were performed. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by SDS Consulting Ltd. This Report is confidential and may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of SDS Consulting Ltd.
- A number of data sources have been used in compiling this report. Whilst SDS Consulting believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
- This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.
- The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by SDS Consulting Ltd has not been independently verified by SDS Consulting Ltd, unless otherwise stated in the Report.
- SDS Consulting Ltd disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to SDS Consulting Ltd's attention after the date of the Report.

The Development Proposals

- 1.1. The development proposals comprise the erection of a three storey building comprising 18 residential units with associated bin and cycle storage, a building for community use, vehicle parking, landscaping and associated works.
- 1.2. The site is classified as a brownfield site. Refer to Saunders Architecture + Urban Design drawing 7870_PL102 Revision D entitled 'Rendered Site Plan' reproduced in **Appendix A**.

2. PLANNING INFORMATION

Reading Borough Council Local Plan (Adopted 2019)

2.1. Policy EN18 of the Local Plan states:

EN18: FLOODING AND SUSTAINABLE DRAINAGE SYSTEMS

Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on- and off-site.

All major developments** must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards. Smaller schemes are encouraged to incorporate SuDS, where possible. Runoff rates should aim to reflect greenfield conditions and, in any case, must be no greater than the existing conditions of the site. Schemes should ensure that the movement of water through vertical infiltration as well as horizontal run-off does not worsen contamination effects. Wherever possible, SuDS provision should maximise ecological benefits, link into the existing Green Network, incorporate tree planting and landscaping and avoid damage to existing significant trees, including through changes to the site hydrology. All new developments in areas of flood risk should give priority to SuDS.

** 10 or more dwellings or equivalent non-residential or mixed developments

WSP Drainage Strategy Statement June 2018

2.2. Planning application 181377 was granted planning permission based upon WSP Drainage Strategy Statement in relation to drainage. Reading Borough Council commissioned WSP to provide advice on the provision of drainage.

2.3. The key conclusions in respects to surface water drainage are:

- The site may be suitable to support infiltration SuDS subject to ground investigations
- The existing site surface water discharge is calculated to be 14l/s based upon a 100mm pipe
- Greenfield runoff is low at 0.1l/s. Discharge is limited to 2l/s if infiltration is found not to be applicable.
- Micro Drainage calculations indicate 64m³ of attenuation storage is required in the site assuming 2l/s discharge from the site.
- Foul water drainage is to discharge to the adjacent Thames Water foul Sewer.

2.4. It is noted that the WSP statement does not provide a drainage strategy plan or provide communication with Thames Water for the acceptance of foul or surface water flows.

3. EXISTING SITE

Site Location

- 3.1. The proposed development site is located at the former Norcot Community Centre, Lyndhurst Road, Reading, Berkshire, RG30 6UB. The Ordnance Survey National Grid Reference for the site is SU 67887 74509 (approximate centre). The total site covers approximately 0.170 ha and is located red in **Figure 1**.

Figure 1 : Site Location Plan

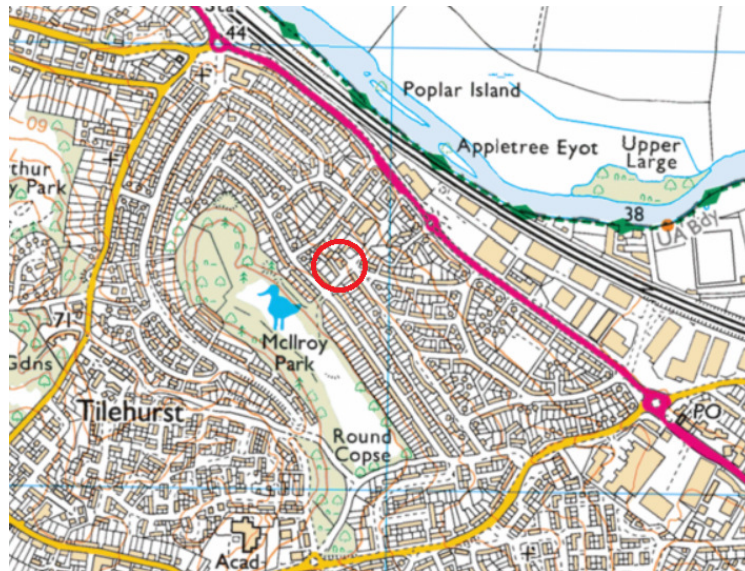


Image courtesy of © 2020 Microsoft – Bing Maps

- 3.2. The site is accessed off Lyndhurst Road to the east and is bound by residential development to the west, north and east. A footpath is located along the south eastern boundary which links Lyndhurst Road and Thirlmere Avenue.

Figure 2: Red line boundary



Image courtesy of © 2020 Google Maps

Land Use

- 3.3. The site is a brownfield site and currently comprises of an existing building and associated hard standing areas.

Topography

- 3.4. DANDO Surveying Ltd undertook a topographical survey of the site in June 2017. Refer to drawing WSPnorcotTOPO included in **Appendix B**. This topographical survey was commissioned by WSP to inform the development proposals.
- 3.5. The highest elevation is located to the southernmost corner of the site at 61.620mAOD. It is noted that this is the site level and the adjacent footpath is at a level of 62.20mAOD with a retaining wall forming the site boundary. The lowest elevation in the site is to the north of the site at a level of 58.79mAOD. A 2.83m fall is shown from south to north across the site.
- 3.6. The site entrance off Lyndhurst Road is at a general level of 59.540mAOD.

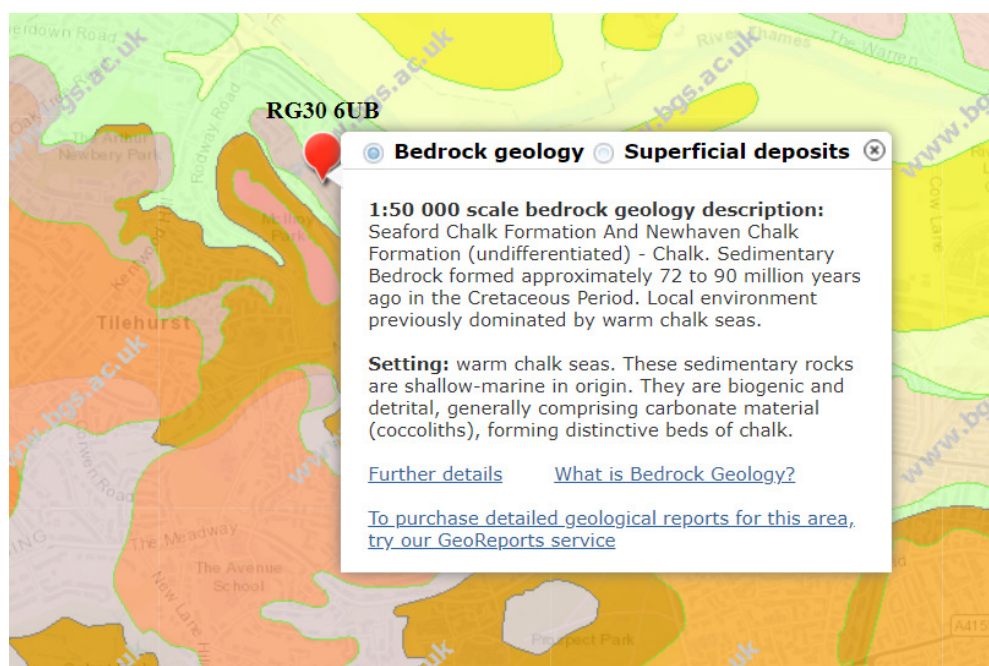
Hydrology

- 3.7. The nearest Environment Agency defined main river is the River Thames which is located approximately 175m to the north east of the development site.
- 3.8. There are no ordinary watercourses or ditches in the vicinity of the site.

Geology

- 3.9. The published geological information available through the British Geological Society (BGS) online records indicates that the site is underlain by a bedrock of the Seaford Chalk Formation and Newhaven Chalk Formation. The site is overlain by superficial deposits of Head – Gravel, sand, silt and clay.
- 3.10. **Figure 3** shows an extract from the British Geological Survey map for the site location

Figure 3: BGS Geological Map



Site Investigation

- 3.11. An intrusive ground investigation has been undertaken by Paddock Geoengineering in August 2020 to inform the development proposals.
- 3.12. The investigation identified made ground / topsoil to depths of 1m overlying head deposits of variably sandy gravelly clay between 2m and 4.5m depth. Head deposits beyond a depth of 2 to 3.9m were predominantly coarse grained and comprised dense brown and orange brown variably clayey sand and gravel. Chalk was encountered beneath the head deposits in two trial pits at 4.5m depth.
- 3.13. Infiltration testing was undertaken in trial pits SA1 & SA2 to BRE3654 methodology. A falling head test to BS5930 was undertaken in borehole WS101 where chalk was encountered at the base. Infiltration testing undertaken in SA1 and SA2 recorded no infiltration noting there was no or very little drop in water level over a three hour period.
- 3.14. WS101 indicated that infiltration may be applicable noting that a head of water could not be maintained / provided to provide measurements. It is further noted that the ground investigation identifies that the site is at high risk of ground instability due to dissolution cavities beneath the site within the chalk strata. Soakaways within Chalk strata can result in activation or propagation of existing dissolution features.
- 3.15. No groundwater was encountered during investigations.
- 3.16. Refer to **Appendix C** for an extract of the ground investigation report showing the results of infiltration testing.

Hydrogeology

- 3.17. From an inspection of the Environment Agency's Aquifer Designation Map (bedrock) the site is shown to be within a Principal Aquifer. These aquifers are described as layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- 3.18. From an inspection of the Environment Agency's Aquifer Designation Map (Superficial Drift) the site is located in a secondary A Aquifer.
- 3.19. From an inspection of the Environment Agency's Groundwater Source Protection Zone Map, it is shown that the site is not located in a source protection zone.
- 3.20. From an inspection of the Environment Agency's Groundwater Vulnerability Map, it is shown that the site lies within a medium – high risk area.

Drainage

- 3.21. Refer to **Appendix D** for Thames Water sewer records. A 225mm diameter foul and a 225mm diameter surface water sewer is located to the west of the site within Lyndhurst Road. These sewers discharge in a north westerly direction.
- 3.22. The topographical survey, refer to **Appendix B**, identifies a number of inspection chambers serving the site. It is assumed that these chambers provide foul and surface water connectivity to the Thames Water sewers.

4. FLOOD RISK

- 4.1. This section of the report reviews the existing risk of flooding to the site and requirements for a compliant drainage strategy to meet the requirements of the National Planning Policy Framework (NPPF, February 2019) and the Planning Practice Guidance (PPG, March 2014).
- 4.2. It is noted that the WSP drainage strategy statement did not review flood risk.
- 4.3. It is necessary to consider the potential consequences of flooding from all sources, which include directly from pluvial flows, rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

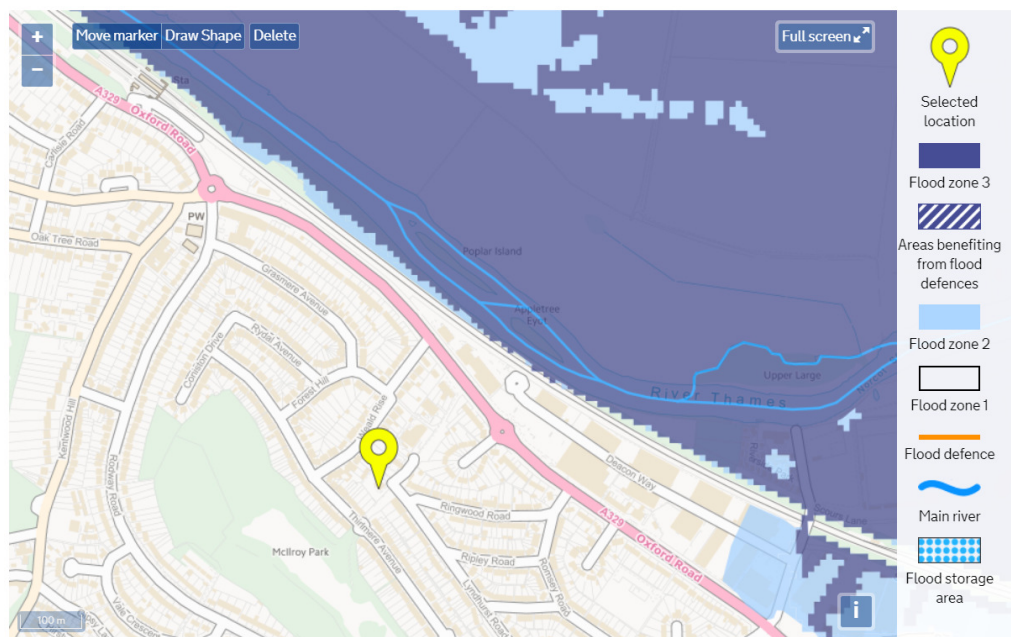
Sources of Flood Risk

- 4.4. It is necessary to consider the potential consequences of flooding from all sources, which include directly from pluvial flows, rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

Fluvial Flooding

- 4.5. The site falls within the catchment of the River Thames. **Figure 4** provides an extract of the Flood Risk Map for planning

Figure 4: Environment Agency's Flood Map for Planning



- 4.6. The Environment Agency's Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and show the extent of the natural floodplain and the additional extent of an extreme flood. The Environment Agency's Flood Map for Planning shows the area that could be affected by flooding, either from rivers or the sea, coloured dark blue corresponding to Flood Zone 3. The light blue area is Flood Zone 2 and shows the additional extent of an extreme flood from rivers or the sea. These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading, this shows the area where flooding from rivers and the sea is very unlikely corresponding to Flood Zone 1.

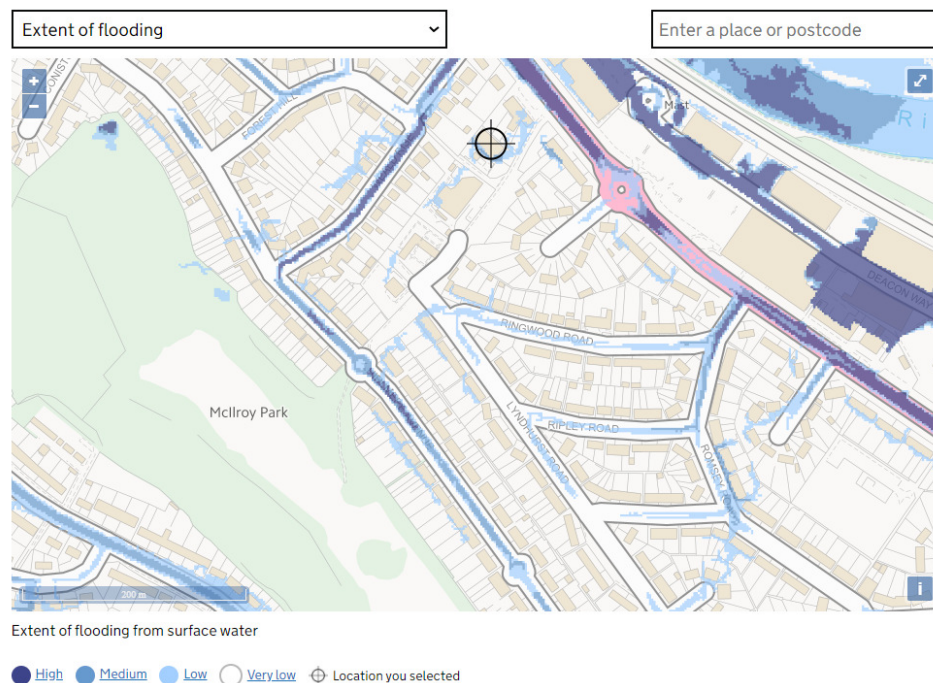
4.7. Flood Zone 1 Low Probability is defined as land having a less than 1 in 1000 annual probability of river or sea flooding. Flood Zone 2 Medium Probability is defined as land having between a 1 in 100 and 1 in 1000 annual probability of river flooding. Flood Zone 3a High Probability is defined as having a 1 in 100 or greater annual probability of river flooding. Flood Zone 3b The Functional Floodplain is defined as the zone which comprises land where water has to flow or be stored in times of flood.

4.8. From an inspection of the Flood Map it can be seen that the site lies within Flood Zone 1.

Pluvial Flooding

4.9. The Environment Agency's Risk of Flooding from Surface Water Map indicates where surface water may be expected to flood or pond. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. A copy of the Environment Agency's Risk of Flooding from Surface Water Map is reproduced in **Figure 5** below.

Figure 5: EA Risk of Flooding from Surface Water Map



4.10. The Risk of Flooding from Surface Water Map shows that there is a small section of low risk flooding to the rear of the existing building which is shown to discharge in a north westerly direction. The Reading Borough Council SFRA 2017 shows the same extent of surface water flood risk within Figure F6 of the Updated Flood Map for Surface Water.

Flooding from Groundwater

4.11. Groundwater flooding is most likely to occur in low-lying areas underlain by water-bearing permeable rocks such as sands, gravels, limestone and chalk. Groundwater flooding occurs as a result of water rising from the underlying rocks or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. In low-lying areas, the water table is usually at shallower depths, so during very wet periods, all the additional groundwater flowing towards these areas can cause the water table to rise to the surface causing groundwater flooding.

- 4.12. Map F8 of the Reading Borough Council SFRA 2017 Level 1 identifies that the site is located in an area susceptible to less than 25% groundwater flood risk.

Flooding from Overwhelmed Sewers and Drainage Systems

- 4.13. Flooding from sewers and drainage systems occurs when the sewer or drainage system is overwhelmed as a result of a blockage or excessive flow exceeding its capacity.
- 4.14. Map F9 of the Reading Borough Council SFRA 2017 Level 1 shows that the site lies in an area where Thames Water have registered over 101 incidents of sewer flooding. Figure F3 does not identify any historical flood incidents within the site or its immediate vicinity.

Flooding from Artificial Sources

- 4.15. The Environment Agency's Risk of Flooding from Reservoirs Map indicates the site is unaffected by flooding from any reservoirs.

Flood Risk Vulnerability and Flood Zone 'Compatibility'

- 4.16. Table 2: Flood Risk Vulnerability Classification, in Section 25 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-066-20140306), categorises different types of development according to their vulnerability to flood risk. Table 3: Flood risk vulnerability and flood zone 'compatibility', in Section 25 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-067-20140306), maps these vulnerability classes against the flood zones to indicate where development is appropriate and where development should not be permitted.

Figure 6: Extract of Table 2: Flood Risk Vulnerability Classification

More vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non-residential uses for health services, nurseries and educational establishments.

- 4.17. With reference to Table 2, the proposed residential development falls into the 'More Vulnerable' flood risk vulnerability classification, which includes buildings used for dwelling houses
- 4.18. With reference to Table 3, the proposed development is appropriate land use in Flood Zone 1.

Figure 7: Table 3: Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	x	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	x	x	x	✓*

Key:

✓ Development is appropriate

x Development should not be permitted.

The Sequential & Exception Test

- 4.19. The NPPF states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.
- 4.20. Paragraph 101 of the NPPF states: *‘The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding.’*
- 4.21. The site falls within Flood Zone 1 and on this basis the Sequential Test is passed. In accordance with the NPPF, a sequential approach has been used such that no built development would be located in Flood Zones 2 or 3. On this basis the Sequential Test is passed.

Climate Change

- 4.22. The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.
- 4.23. The peak rainfall intensity allowances to be used when designing urban drainage systems are given in Table 2 of ‘Flood risk assessments: climate change allowances. Both the central and upper end allowances need to be assessed to understand the range of impact. The total potential change anticipated for 2060 to 2115 is 20% for the central category, and 40% for the upper end category. The previous normal climate change allowance used for peak rainfall intensity was 30%.

Standard of Protection

- 4.24. In terms of providing an acceptable standard of protection against flooding for new development, paragraph 54 in Section 22 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-054-20150415) advises how development can be made safe from flood risk. Reference is made to the ability of residents and users to safely access and exit a building during a 'design flood'. Paragraph 55 in Section 22 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-055-20140306) defines a 'design flood': *'This is a flood event of a given annual probability, which is generally taken as:*

- *a fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year) or;*
- *tidal flooding with a 0.5 per cent annual probability (1 in 200 chance each year),*

against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.'

- 4.25. Therefore, in terms of providing an acceptable standard of protection against flooding for new development, no flooding of property should occur as a result of the 'design flood' corresponding to a 1 in 100-year fluvial flood event, or a 1 in 200 year tidal flood event.
- 4.26. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. They should be used in conjunction with the NPPF and planning practice guidance. Standard S7 states that the drainage system must be designed so that flooding does not occur on any part of the site for a 1 in 30 year rainfall event. Standard S8 goes on to state that the drainage system must be designed so that flooding does not occur during a 1 in 100 year rainfall event in any part of a building (including a basement); or in any utility plant susceptible to water within the development.

Residual Risk

- 4.27. Paragraph 41 in Section 14 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-041-20140306) advises that residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions.
- 4.28. The site lies within Flood Zone 1 and so the proposed development is fully in accordance with the sequential approach to development set out in the NPPF, the aim of which is to steer new development to areas with the lowest probability of flooding.
- 4.29. The proposed drainage measures would ensure that there is little or no residual risk of property flooding occurring during events well in excess of the minimum acceptable standard of protection for new property, which requires that no flooding of property should occur as a result of a one in 100 year storm event including an appropriate allowance for climate change.
- 4.30. For extreme events it is considered that the proposed development would intercept any uncontrolled overland flow and direct it into the proposed drainage system. The proposed drainage measures would ensure the proposed development would have adequate flood protection for extreme events over the lifetime of the development.

5. SURFACE WATER MANAGEMENT

Design Principles

- 5.1. Key design principles in the following guidance documents steer the approach to managing surface water runoff at sites:
- Building Regulations hierarchy of drainage (H3);
 - Interim Code of Practice for SuDS; and
 - CIRIA best practice guidance, including the use of the 'SuDS management train'
- 5.2. Building Regulations hierarchy of drainage outlines the preferred methods for the disposal of surface water with infiltration methods being the preferred option. If this is not possible the next favoured option is to drain to an existing watercourse. If neither of these options are feasible, the regulations state that rainwater discharge should be directed to a sewer.
- 5.3. The Interim Code of Practice for SuDS provides guidance about the hydraulic design criteria for Sustainable drainage systems. This in general refers to both peak rate of runoff and the volume of runoff, post development. Prior to mitigation measures such as the use of SuDS attenuation features, both the volume and peak rate of runoff may increase post development.
- 5.4. The design principles for surface water management extend beyond simple hydraulic criteria. CIRIA guidance promotes the use of the SuDS management train, a concept where SuDS techniques are used to treat, convey and store surface water runoff. This approach is considered as part of the SuDS selection methodology.

Non-statutory technical standards for sustainable drainage systems

- 5.5. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. The technical standards relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance. The Government expect these standards to apply to all developments of 10 homes or more and to major commercial development.
- 5.6. The Government's 'Non-statutory technical standards for sustainable drainage systems' set out peak flow control standards (S2 and S3) and volume control technical standards (S4, S5 and S6). Standard S1 states that where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body the peak flow control standards (S2 and S3) and volume control technical standards (S4 and S6) need not apply.
- 5.7. For the proposed development site, the following non-technical standards apply for a brownfield site –

Peak Flow Control

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

Volume Control

- 5.9. Standard S5 states: Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
- 5.10. Standard S6 states: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Sustainable Drainage Systems

- 5.11. Peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Sustainable Drainage Systems (SuDS) can address the four key sustainability objectives including: water quantity, water quality, amenity and biodiversity.
- 5.12. Paragraph 51 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-051-20150323) advises that sustainable drainage systems are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems provide opportunities to:
- reduce the causes and impacts of flooding;
 - remove pollutants from urban runoff at source;
 - combine water management with green space with benefits for amenity, recreation and wildlife.
- 5.13. Promoting SuDS to deal with surface water at the source, will limit the required attenuation and in turn reduce the volume of surface water in the nearby watercourse and sewer infrastructure. There may be the potential to utilise SuDS features for conveyance/attenuation of surface water flows within the proposed drainage strategy, opposed to the traditional below ground storage methods. Detailed design should confirm whether this site would be suitable for incorporation of SuDS following more detailed analysis of levels, ground conditions and attenuation requirements.

SuDS Selection

- 5.14. Based upon the indicative layout, SuDS can be incorporated into the development to provide a degree of treatment before flows are carried off site. The following SuDS Selection matrix reviews those measures that can be implemented in the site, this matrix is indicative only and does not impart that the viable SuDS within the site are to be installed. Appropriate selection and implementation of the various SuDS are to be discussed between the design team.
- 5.15. This drainage strategy provides a review of the minimum SuDS measures to be implemented based upon viable SuDS Selection Matrix (**Table A**) and based upon site requirements for conveyance, treatment and attenuation of surface water flows.

Table A: SuDS Feasibility Matrix

SuDS Component	Site Suitability	Comments
Green Roofs	✓	Potential for use
Soakaways	✗	Not proposed due to solution features
Rainwater harvesting systems	✗	Not proposed
Rainwater harvesting systems	✗	Not proposed
Filter Trenches	✗	Not proposed
Infiltration trenches	✗	Not proposed due to solution features
Swales	✗	Not suitable due to site layout constraints
Bioretention	✗	Not suitable due to site layout constraints
Pervious Pavements	✓	Potential for use
Geo-cellular Systems	✓	Potential for use
Infiltration Basins	✗	Not proposed due to solution features
Detention Basins	✗	Not suitable due to site layout constraints
Ponds	✗	Not suitable due to site layout constraints
Wetlands	✗	Not suitable due to site layout constraints
Proprietary Devices	✗	Not proposed

Surface Water Flow Balancing

Catchment Areas

- 5.16. The existing and proposed impermeable and permeable site areas have been reviewed and are presented in **Table B** below.

Table B: Pre and Post development Catchment Areas

	Permeable (Greenfield)	Impermeable (Hardstanding's)	Totals
Pre Development Catchment Areas	175 m ²	1525 m ²	1700 m ²
Post Development Catchment Areas	205 m ²	1495 m ²	1700 m ²

- 5.17. The proposed development will reduce impermeable areas by 30m² through the introduction of permeable areas in the form of soft landscaping.

Greenfield Runoff Rate

- 5.18. Greenfield runoff rates have been determined using XP Solutions' Micro Drainage software system (Version 2017.1) based on the method set out in IH Report 124, and with catchment descriptors obtained from the Flood Estimation Handbook (FEH), published by the Institute of Hydrology. FSSR 2 and 14 regional growth curve factors have been used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.
- 5.19. Copies of the Micro Drainage greenfield runoff calculations for the site are included in **Appendix E**. A summary of the greenfield runoff rates for the various return period events is shown in **Table C**. The mean annual peak rate of runoff, referred to as Q_{BAR} in IH Report 124, is 0.3 l/s/.

Table C: Greenfield Runoff Rates

Return Period (Years)	1	Q_{bar}	30	100
Greenfield Runoff Rates (l/s)	0.2	0.3	0.6	0.9

Pre Development Peak Runoff Rate

- 5.20. The Modified Rational Method has been used to determine the runoff from the impermeable areas of the existing site (refer to **Table D**)–

$$Q=2.78CiA$$

Where

Q= flow (l/s)

I = rainfall intensity (mm/hr)

A = Impermeable Area (ha)

C = runoff coefficient

Table D: Pre development site Modified Rational Method impermeable runoff

Return Period	C	I	A	Flow (l/s)
1:1 year	0.95	24.335	0.1525	9.800
1:30 year	0.95	59.521	0.1525	23.972
1:100 year	0.95	76.512	0.1525	30.815

Post development unattenuated Peak Runoff Rate

- 5.21. Where assessing the redeveloped sites peak runoff rate, including allowance for climate change and changes in impermeable areas, the unattenuated peak runoff rate is as presented in **Table E** (calculated utilising the Modified Rational Method).

Table E: Post development site Modified Rational Method impermeable runoff

Return Period	C	I	A	Flow (l/s)
1:1 year	0.95	24.335	0.1495	9.608
1:30 year (+10%cc)	0.95	65.743	0.1495	25.957
1:100 year (+40%cc)	0.95	107.117	0.1495	42.293

5.22. If the site were to discharge at unattenuated rates, the post development site would increase flows for all events due to the runoff coefficient and allowance for climate change.

5.23. It is noted that the surface water discharge off site may be limited to the capacity of the drain (as referred to in the WSP Drainage Strategy Statement) and as such the peak surface water discharge from the positively drained areas of the site may be limited to 14l/s.

Proposed surface water discharge arrangements

5.24. The site is a brownfield site and as such is to conform with the non-technical standards for SuDS and Reading Borough Council Local Plan policy EN18 where proposed surface water discharge should aim to reflect greenfield conditions.

5.25. The WSP Drainage strategy Statement proposes a discharge rate of 2l/s to which planning is approved. The drainage strategy presented in this report and for implementation within the site will utilise this approved discharge rate.

Outfall Location

5.26. In terms of what sort of sustainable drainage system should be considered, paragraph 80 in Section 21 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-080-20150323) advises that, generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable (also stated within The SuDS Manual (CIRIA C753) paragraph 3.2.3):

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

Infiltration

5.27. Intrusive ground investigations have been undertaken within the site to determine the infiltration capacity (Refer to **Appendix C**). It is concluded that there is no infiltration capacity in the Head Deposits.

5.28. Infiltration may be permissible within the chalk strata at depth via the use of borehole soakaways. This option is discounted from the site for the following reasons –

- The ground investigation identifies that the site is at high risk of ground instability due to dissolution cavities beneath the site within the chalk strata. Soakaways within Chalk strata can result in activation or propagation of existing dissolution features.
- CIRIA C574 recommends that soakaways in chalk should be sited 5-10m from sensitive structures depending on the density of the chalk. It is recommended that a 10m offset for the soakaway is applied dependent upon Soil Moisture Content (SMC) test results. If the chalks were proven to be of a higher density, the 5m offset could be adopted. A 10m offset

within the site cannot be achieved without siting a deep bore soakaway within the root protection areas and adjacent to the adopted highways.

Surface water body

- 5.29. There are no watercourses in close proximity to the site.

Surface water sewer, highway drain, or another drainage system;

- 5.30. It is proposed that the site is to discharge to the adjacent Thames Water sewers subject to necessary agreements and capacity enquiries with Thames Water. This is as per the existing site discharge methodology.

Surface Water Drainage Strategy

- 5.31. In view of the requirements of the NPPF, PPG, and design parameters and constraints associated with redeveloping this site, a surface water drainage strategy design has been devised and hydraulically modelled to demonstrate that the scheme can be suitably implemented without increasing the level of flood risk, when the surface water drainage system experiences a 1:100-year rainfall event (including 40% allowance for climate change).
- 5.32. The surface water drainage scheme has been designed to ensure:
- Sustainable Urban Drainage systems are wholly incorporated within the scheme.
 - Consideration is given for the improvement of water quality within the design.
 - The designed drainage scheme can satisfactorily retain a critical 1 in 100 Year storm event with climate change.
- 5.33. The surface water drainage strategy proposes the use of permeable paving to the car parking spaces and an attenuation tank beneath the 'road'. The form of the attenuation tank and permeable paving is dependent upon the requirements of highway adoptions.
- 5.34. The discharge from the site is proposed to be 2l/s as per the WSP approved Drainage Strategy Statement. This reduced discharge rate represents a significant reduction in pre development discharge rates.
- 5.35. Drawing 5264-C-001 entitled 'Drainage Strategy' is included in **Appendix F**, this drawing indicates the location and sizes of the required storage facilities to serve the various development areas. The layout is subject to detailed design.
- 5.36. The hydraulic assessment provides various scenarios up to and included the critical 1 in 100 Year storm event with additional 40% allowance for climate change. The simulations confirm that the storm can be managed and maintained within the site without flooding. The hydraulic models of the proposed surface water network and SuDS devices can be found in **Appendix G**.
- 5.37. The above plan and calculations demonstrate that a suitable means of drainage can be provided to drain the developed site in terms of surface water runoff in accordance with the guidance and standards.
- 5.38. The proposed drainage strategy option would ensure that surface water arising from the developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Timetable for the implementation of SuDS

- 5.39. Due to the small nature of the site, it is assumed that the car parking area of the site will be utilised as the construction compound / offices / welfare facilities. As such it is recommended that the implementation of the attenuation tank is undertaken either as –
- At the start of the works and prior to the installation of the site compound. The tank would be likely to require temporary protection due to the potential loads from plant or materials.
 - At the end of the project as works move off site and the road and parking areas are installed
- 5.40. The implementation of the SuDS will be dependent upon a workable construction programme and methodology. Due to the size of the site, the implementation will be restricted by other activities and as such will need to be considered for installation at the relevant time that causes minimal disruption.
- 5.41. Where SuDS are to be implemented towards the end of the proposed works, construction SuDS are to be considered for implementation in accordance with CIRIA C698.

Pollution Prevention

- 5.42. In terms of water quality, the proposed surface water system offers a suitable level of mitigation in accordance with Environment Agency, DEFRA and CIRIA guidance.
- 5.43. The CIRIA SuDS Manual C753, 2015 details an approach for establishing the hazard posed by the intended land use activities and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody. Referring to Table 26.2 – ‘Pollution hazard indices for different land use classifications’ (CIRIA C753, 2015) the proposed development and land use results in a low pollution hazard, therefore a ‘simple index’ method can be used to make a qualitative assessment of the proposed SuDS management.

Figure 8: CIRIA C753, 2015. Table 26.2 – ‘Pollution hazard indices for different land use classifications’

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

Notes

- Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).
- These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

- 5.44. To ensure that there is adequate treatment, all SuDS components utilised should have a pollution mitigation index that equals or exceeds the pollution hazard index. In reference to Table 26.2, the total pollution hazard index for the development site is (roofs and private driveway):

$$TSS = 0.7,$$

$$Metals = 0.6,$$

$$Hydrocarbons = 0.45.$$

- 5.45. In reference to Table 26.3 – ‘Indicative SuDS mitigation indices for discharges to surface waters’ (CIRIA C753, 2015) the inclusion of permeable paving provides a total mitigation of:

$$TSS = 0.7$$

$$Metals = 0.6$$

$$Hydrocarbons = 0.7.$$

Figure 9: CIRIA C753, 2015. Table 26.3 – ‘Indicative SuDS mitigation indices for discharges to surface waters’

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.			

Notes

- 1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
- 2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
- 3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- 4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
- 5 See **Chapter 14** for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: <http://tinyurl.com/qf7yuj7>
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

- 5.46. The inclusion of SuDS within the proposed scheme ensures that there is adequate mitigation of the potential hazards from surface water flows. Both sites provide a minimum mitigation measure of permeable paving, additional SuDS may be applicable within the site and as such the mitigation measures and water quality treatment is increased.

- 5.47. Where a variety of SuDS or a different arrangement of SuDS are proposed for the development site, the mitigation indices will need to be reviewed to ensure that sufficient treatment is being provided to surface water flows.

Overland Flood Flow Paths

- 5.48. Standard S9 in the Government's 'Non-statutory technical standards for sustainable drainage systems' states that the design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of 1 in 100 year rainfall event are managed in exceedance routes that minimise the risk to people or property.
- 5.49. Refer to drawing 5264-C-001 in **Appendix F** for an indication of the overland flow routes. The overland flows are to follow the existing topography of the site and discharge towards the site entrance.

6. SuDS MANAGEMENT & MAINTENANCE PLAN

Management & Maintenance

- 6.1. Maintenance refers to the inspections required to identify performance issues and plan maintenance as required, operation and maintenance of the drainage system, landscape management and waste management associated with contaminated silt and other waste materials resulting from maintenance.
- 6.2. CIRIA C753 The SuDS Manual provides information in Chapter 32 for the Operation and maintenance of SuDS. The maintenance activities are broadly defined as regular, occasional and remedial maintenance. It is noted that some scenarios may require one-off maintenance activities. The SuDS Manual defines maintenance as –
- Regular Maintenance: consists of basic tasks carried out to a frequent and predictable schedule, including inspections/monitoring, silt or oil removal if required more frequently than once a year, vegetation management, sweeping or surfaces and litter / debris removal.
 - Occasional maintenance: comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks.
 - Remedial maintenance: describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised with good design, constructions and regular maintenance activities.
- 6.3. Maintenance regimes are to be reviewed on an annual basis to ensure that the approach adopted is meeting its objectives.
- 6.4. All those responsible for the maintenance operations should adhere to the relevant health and safety legislation for the activities listed within this report (including lone working, if relevant). Method statements and risk assessments should always be completed prior to the undertaking of any works.

Indicative Maintenance & Management Plan

Gravity Drains & Catchpits

- 6.5. Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal. If maintenance is not undertaken for long periods, deposits can become hard-packed and require more effort to remove.

Permeable Surfaces

- 6.6. Permeable surfaces including permeable block paving, porous asphalt, gravel or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Permeable block paving and porous asphalt can be cleaned by suction brushing.
- 6.7. Regular inspection and maintenance is important for the effective operation of permeable pavements, they should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.
- 6.8. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. In instances where jointing material is lost, this material should be replaced immediately.

- 6.9. Depending on the amount of usage and the environment that the permeable pavement has been exposed to, the laying course material may require either replacement or cleaning after a 25 to 30 year period. This would be evident if the infiltration rate of the paving became prolonged, allowing ponding to develop. If this situation should occur, the uplifting and cleaning (or replacing, depending on the costings of the activity) of the laying course may be considered. The laying course material, jointing and blocks may be reused (once cleaned), to aid in minimising costs.
- 6.10. Inspection and maintenance of the permeable surfaces will be dependent upon the manufacturer's recommendations and installation as per manufacturers details.
- 6.11. The table below gives a summary of the operation and maintenance requirements for permeable paving –

PERMEABLE AND POROUS SURFACES	
Regular Maintenance	Frequency
Brush regularly and remove sweepings from all hard surfaces	Three times a year at end of winter, mid-summer and after autumnal leaf fall, or as required based upon site specific observations or as per manufacturers recommendations
Occasional Tasks	Frequency
Removal of weeds	As required
Stabilise and mow contributing and adjacent areas	As required
Remedial Works	Frequency
Remediate any landscaping which, through vegetation maintenance or soil slip has encroached upon the permeable surface	As required
Remedial work to any depressions, rutting, cracked or broken blocks considered to be detrimental to the structure or that pose a hazard to users	As required
Rehabilitation of surface and upper substructure by sweeping	As required if infiltration performance is reduced
Monitoring	Frequency
Initial Inspection	Monthly for 3 months after installation / regular usage
Inspection for evidence of poor operation and / or weed growth	3 monthly & 48 hours after large storms
Inspection of silt accumulation	Annually
Monitoring of inspection chambers	Annually
Inspection for depressions, ponding or rutting	Annually

Modular Storage

- 6.12. Modular plastic geocellular systems with a high void ratio, that can be used to create a below ground infiltration (soakaway) or storage structure.
- 6.13. Regular inspection and maintenance is required to ensure the effective long-term operation of below ground modular storage systems
- 6.14. Catchpits are installed at the inlet to the tanks to allow for removal of silt / debris as required. The tanks are utilised for the 1:100 year storm event and as such are envisaged to have minimal levels of silt due to the use of permeable paving and gullies within the system.
- 6.15. Inspection and maintenance of the tanks will be dependent upon the manufacturer's recommendations and installation as per manufacturers details.
- 6.16. The table below gives a summary of the operation and maintenance requirements for modular storage –

MODULAR STORAGE	
Regular Maintenance	Frequency
Inspect and identify any areas that are not operating correctly	Monthly for 3 months after installation / regular usage
Debris and silt removal from catchment areas	Monthly
Removal of sediment from pre-treatment structures	Annually or as required
Remedial Works	Frequency
Repair / rehabilitation of inlets, outlets, overflows and vents	As required
Monitoring	Frequency
Inspect / check all inlets, inspection wells, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms
Inspection of surface above units for sag points or depressions which may indicate structural failure.	Annually
Survey inside of the tank for sediment build-up and removal as required	Every 5 years or as required

Flow Control Chambers

- 6.17. The flow control chamber proposed for this site is a Hydro Brake which has no moving parts and are self-activating requiring minimal maintenance. The bypass disc is the only manually operated element and is applicable for use in the event of a blockage or issue with the drainage network. It is recommended that the chamber is inspected monthly for three months after installation and bi-annually thereafter to verify the condition and operation of the unit and check for blockages within the chamber or flow control device.

- 6.18. Any silt or debris found during inspections should be removed and cleaned out with the use of a sump vacuum cleaner.
- 6.19. The table below gives a summary of the operation and maintenance requirements for flow control devices –

CONTROL CHAMBERS	
Regular Maintenance	Frequency
Check there is no physical damage and that control is functioning. Ensure bypass arrangements are functional. Remove Debris and silt. Undertake inspection after autumnal leaf fall to ensure functionality of control and that there are no blockages	Monthly
Remedial Works	Frequency
Repair physical damage if required / replace unit is damaged	As required
Monitoring	Frequency
Inspect chamber and flow control units to ensure that they are in good condition and operating as designed.	Annually and after large storms

Blockages & Spillages

Blockage

- 6.20. In the event of a blockage within the drainage network, the key risk is that of flooding to the surrounding area. The extent and location of flooding is dependent upon the location of the blockage and the associated storm event.
- 6.21. In the event of a blockage within the network, the network is to be drained down by use of suction equipment and the blockage removed.
- 6.22. If a blockage does occur and results in flooding, the exceedance flow routes are anticipated to flow in a westerly direction.

Spillages

- 6.23. Due to the nature of the development, the likelihood of a spillage is minimal.
- 6.24. Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.
- 6.25. In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung. Contact the Environment Agency immediately.

Implementation of the management plan & Adoption

6.26. Shared drainage features such as SuDS and flow control chambers are to be maintained in accordance with the details provided in this report. The responsibility for the implementation of the management and maintenance of shared drainage features can only be indicated at this stage.

6.27. There are two viable options for this:

Option 1 – Adoption of the drainage network by the water authority

6.28. This option passes all adoption and maintenance responsibilities to the local water authority (Thames Water) through the adoption of the drainage network under S104.

6.29. Local water authorities can be approached to adopt SuDS following the Ofwat approval of the Sewage Sector Guidance documentation.

Option 2 – Private management company

6.30. This option seeks to have a management company tasked with the maintenance and management of the shared drainage assets.

6.31. There are a number of companies that offer this service however it is not reasonable to appoint a specific company and enter agreement prior to receiving planning permission or before the development is constructed. As such this option is presented at planning stages to show that it is viable to have a management company.

6.32. The form in which a management company is funded is dependent upon the designation of the proposed development. Funding towards the management company will be either via a commuted sum or a resident management fee. These details are to be determined by the developer / client and the associated management company in which they appoint at the relevant stage.

7. PROPOSED FOUL WATER STRATEGY

Existing Drainage

- 7.1. Refer to **Appendix D** for Thames Water Asset mapping. A Public Foul Water Sewer is located to the east of the site in Lyndhurst Road. This 225mm sewer discharges in an easterly direction.
- 7.2. An existing private foul water drain is identified within the existing site, refer to the topographical survey in **Appendix B**, it is assumed that this drain discharges to the Thames Water sewer to the east of the site.

Proposed Strategy

- 7.3. The proposed development will generate new and additional foul flows. In accordance with Sewers for Adoption, the development site will discharge 0.833l/s of foul flow from the 18 dwellings.
- 7.4. It is proposed that connection is made to the Thames Water foul sewer located to the east of the site and is to utilise the existing site connectivity subject to the proven connectivity and condition of the existing drain. Refer to **Appendix F** for an indication of the foul water proposal to serve the site.
- 7.5. A pre development enquiry has been submitted to Thames Water to assess the capacity of the receiving sewer. At the time of issue of this report, a response has not been received.

Adoption

- 7.6. The foul sewer is proposed to be adopted by Thames Water under a S104 agreement in accordance with sewers for adoption. Associated applications and design details will be provided to Thames Water in due course.

8. CONCLUSIONS

- 8.1. This Drainage Strategy has been prepared in connection with the erection of a three-storey building comprising 18 residential units with associated bin and cycle storage, a building for community use, vehicle parking, landscaping and associated works at Norcot Community Centre, Lyndhurst Road, Reading. The key conclusions are:
- The site area is 0.170 hectares and classified as a brownfield site.
 - Current Environment Agency flood risk mapping identifies that the site is located in Flood Zone 1
 - Flood risk from all sources has been reviewed.
 - Development proposals are appropriate for the flood zone classifications and flood risk vulnerability.
 - A viable surface water drainage strategy is shown for the site which implements SuDS.
 - Surface water discharge from the site is to be restricted to 2l/s for all storm events which provides a significant betterment on existing brownfield runoff rates. This is in accordance with the approved WSP Drainage Strategy Statement.
 - Surface water is proposed to discharge to Thames Water Sewers located in Lyndhurst Road
 - The implementation of a drainage strategy which implements an attenuation tank and permeable paving reduces the surface water flood risk of the site by the effective management and attenuation of surface water flows.
 - Foul drainage is proposed to discharge to the existing Thames Water sewer to the east of the site subject to agreement with Thames Water
- 8.2. The available flood risk information includes: Environment Agency data and interactive Flood Hazard Maps; local flood history data from all sources of flooding; modelled flood data: and flooding information in the SFRA.
- 8.3. In addition to flooding from rivers and the sea, this drainage strategy has considered the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources
- 8.4. The details in this report provide sufficient information to discharge planning condition 10 of planning approval 181377 with Reading Borough Council.
- 8.5. The overall conclusions drawn from this Drainage Strategy are that the development, located in flood zone 1, would be appropriately safe for its lifetime taking account of the vulnerability of its users and the development would not increase flood risk elsewhere.

APPENDICES

APPENDIX A



NOTES

This drawing is to be read in accordance with the specification/Bills of Materials and related drawings. No Dimensions to be scaled from this drawing. All stated dimensions to be verified on site and the Architect notified of any discrepancies

0 50
Scale bar 50mm at 1:1

D	Layout changes in accordance with discussion with Reading Borough Council planning team	09/05/19	JT
C	Parking layout revised	20/11/18	SB

Project

Norcot Community Centre
Lyndhurst Road
Tilehurst
Reading

Title

Rendered Site Plan

Scale 1:200	@ A1	Date 15/04/2018	
Drawn AS		Checked MS	
Drawing Number 7870_PL102		Revision D	

Saunders
Architecture + Urban Design

APPENDIX B

APPENDIX C

Window Sample
Borehole Location



Machine Excavated
Infiltration Test
Location



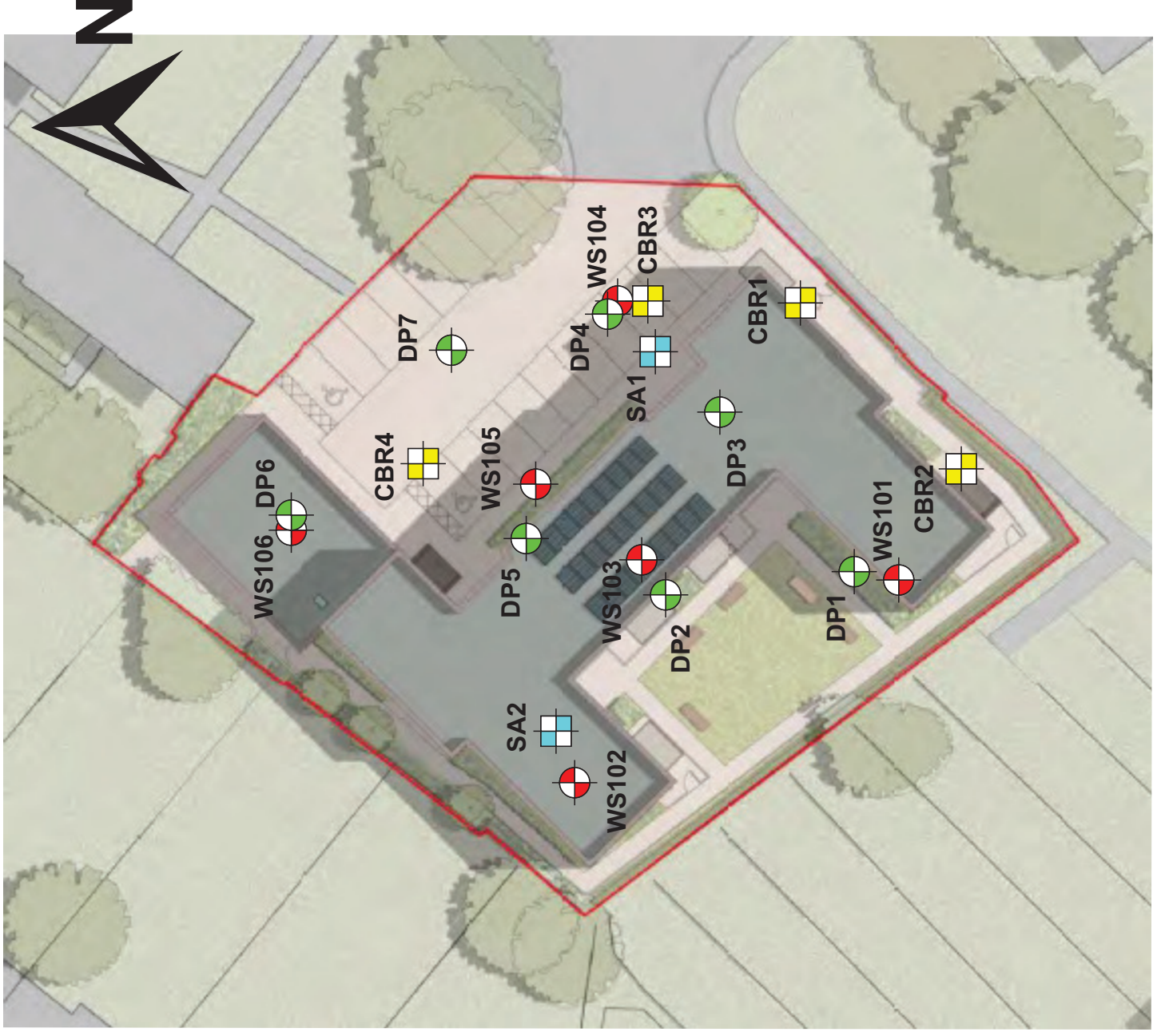
In-situ CBR
Test Location



Dynamic Probing
Test Position



Not to scale.
All positions are approximate and
subject to change.
Plan based on plan
provided by Saunders
Architecture and Urban Design
Drawing Number 7870_PL102



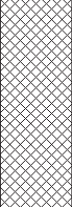
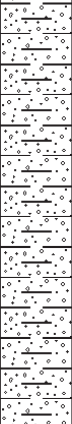
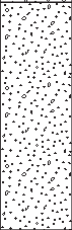
[illegible]

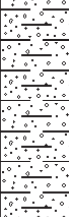
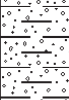
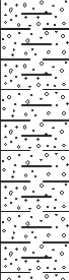
Scale (approx)	Logged By
1:40	SJF
Figure No. P20-069.WS101	

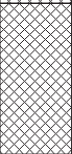
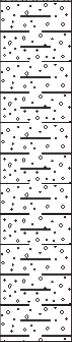
PADDOCK GEO ENGINEERING						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Number WS102	
Excavation Method Drive-in Windowless Sampler		Dimensions 87mm to 1.00m 57mm to 4.00m 77mm to 2.00m 47mm to 5.00m 67mm to 3.00m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 29/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.15	ES				(0.20) 0.20	Black and red GRAVEL of macadam, ash and brick. (MADE GROUND).			
0.60	ES				(0.80)	Brown slightly gravelly clayey silty SAND. Gravel is fine to coarse sub rounded flint, brick and concrete. (MADE GROUND)			
0.80	D					... becoming light brown from 0.70m depth.			
1.00-1.45	SPT(C) N=13		2,2/3,3,3,4		1.00	Stiff brown and orange brown slightly gravelly very sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint and chalk. (HEAD)			
1.60	D				(1.00)				
1.90	SV 23kPa								
2.00-2.45	SPT(C) N=20		3,3/4,4,5,7		2.00	Medium dense brown and orange brown clayey very sandy GRAVEL. Gravel is fine to coarse sub-angular to rounded flint and occasional sandstone. (HEAD)			
2.60	D				(1.00)				
3.00-3.45	SPT(C) N=28		9,6/6,7,8,7		3.00	Medium dense brown and orange brown gravelly SAND. Gravel is fine to coarse sub-angular to rounded flint and occasional sandstone. (HEAD)			
3.60	D				(1.50)				
4.00-4.45	SPT(C) N=25		3,3/3,3,8,11						
4.60	D				4.50 (0.50)	Structureless CHALK composed of white mottled cream with brown veining gravelly CLAY. Gravel is fine to medium angular extremely weak low density chalk and occasional black flint. (SEAFORD CHALK FORMATION AND NEWHAVEN CHALK FORMATION (UNDIFFERENTIATED), Grade Dm)			
5.00-5.45 5.00	SPT(C) N=16 D		4,5/4,5,3,4		5.00	Complete at 5.00m			
Remarks No collapse noted. No groundwater encountered.							Scale (approx) 1:40	Logged By SJF	
							Figure No. P20-069.WS102		

						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Number WS103	
Excavation Method Drive-in Windowless Sampler		Dimensions 87mm to 1.00m 57mm to 4.00m 77mm to 2.00m 47mm to 5.00m 67mm to 3.00m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 29/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10	ES				(0.10)	Grey fine to coarse angular limestone GRAVEL. (MADE GROUND)			
0.30	D				(0.30)	Soft orange brown very sandy CLAY. (MADE GROUND)			
0.70	SV 60kPa				(0.60)	Firm orange brown occasionally veined dark grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular flint and limestone. (HEAD)			
0.80	ES				1.00	Firm orange brown mottled light brown slightly gravelly very sandy CLAY. Gravel is fine to coarse sub angular flint. (HEAD)			
0.90	SV 70kPa								
0.90	D								
1.00-1.45	SPT(C) N=13		3,2/3,3,4,3			... becoming speckled black 1.5m depth.			
1.20	D								
1.80	D				(1.60)				
2.00-2.45	SPT(C) N=17		2,2/3,4,5,5						
2.60	D				2.60	Medium dense orange brown clayey SAND and GRAVEL. Gravel is fine to coarse sub rounded flint. (HEAD)			
3.00-3.45	SPT(C) N=25		7,6/5,7,6,7			... becoming very gravelly 3.0m depth.			
3.60	D				(2.40)				
4.60	D				5.00	Complete at 5.00m			
Remarks Monitoring standpipe installed upon completion. No groundwater encountered. No collapse noted.							Scale (approx) 1:40	Logged By SJF	Figure No. P20-069.WS103

PADDOCK GEO ENGINEERING						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Number WS104	
Excavation Method Drive-in Windowless Sampler		Dimensions 87mm to 1.00m 57mm to 4.00m 77mm to 2.00m 47mm to 5.00m 67mm to 3.00m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 29/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.10	ES				(0.20) 0.20	Grey brown gravelly SAND. (MADE GROUND)			
0.40 0.40	D ES				(0.40) 0.60	Soft dark brown slightly gravelly sandy CLAY with rootlet and rootlets up to 0.50m depth. Gravel is flint and concrete. (MADE GROUND)			
0.80 0.80	SV 44kPa D					Firm orange brown slight gravelly sandy to very sandy CLAY. Gravel is fine to coarse sub angular flint. (HEAD)			
1.00-1.45	SPT(C) N=10		1,1/2,2,3,3			... becoming mottled light grey, yellow brown and occasionally speckled black 1.0 depth.			
1.50 1.80	D SV 49kPa								
2.00-2.45	SPT(C) N=10		2,2/2,2,3,3		(3.30)				
2.50 2.60	D SV 23kPa								
3.00-3.45	SPT(C) N=17		5,3/4,4,4,5						
3.50	D								
3.90 4.00-4.45	D SPT(C) N=10		1,1/1,1,3,5		3.90 (0.60)	Medium dense orange brown gravelly SAND. Gravel is fine to coarse sub-rounded flint. (HEAD)			
4.50	D				4.50 (0.50)	Medium dense light brown clayey gravelly SAND. Gravel is fine to coarse sub-rounded flint. (HEAD)			
5.00-5.45	SPT(C) N=14		3,3/3,3,4,4		5.00	Complete at 5.00m			
Remarks No groundwater encountered. No collapse noted.							Scale (approx) 1:40	Logged By SJF	
							Figure No. P20-069.WS104		

					Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Number WS105		
Excavation Method Drive-in Windowless Sampler		Dimensions 87mm to 1.00m 57mm to 4.00m 77mm to 2.00m 47mm to 5.00m 67mm to 3.00m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 29/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.20	ES					Grey gravelly clayey SAND. Gravel is flint, brick fragments, ash, clinker. (MADE GROUND)			
0.50	D				(1.10)				
0.80	ES								
1.00-1.45	SPT(C) N=9		1,0/2,2,2,3		1.10	Stiff orange brown slightly gravelly sandy CLAY. Gravel is fine to coarse sub rounded to sub angular flint. (HEAD)			
1.20	ES								
1.50	D								
2.00-2.45	SPT(C) N=6		2,1/1,1,2,2			... becoming speckled black from 2.0m depth.			
2.50	D				(2.70)				
3.00-3.45	SPT(C) N=10		2,2/2,3,3,2						
3.50	D								
3.90	D				3.80	Medium dense orange brown clayey very gravelly SAND. Gravel is fine to coarse sub-angular to rounded flint. (HEAD)			
4.00-4.45	SPT(C) N=12		3,2/2,3,3,4		(1.20)				
4.50	D				5.00	Complete at 5.00m			
Remarks No collapse noted. No groundwater encountered. Monitoring standpipe installed upon completion.							Scale (approx) 1:40	Logged By SJF	
							Figure No. P20-069.WS105		

						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Number WS106	
Excavation Method Drive-in Windowless Sampler		Dimensions 87mm to 1.00m 57mm to 4.00m 77mm to 2.00m 47mm to 5.00m 67mm to 3.00m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 29/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.15	ES				(0.10) (0.10) (0.20) 0.40	Brown gravelly CLAY. Gravel is brick, concrete and macadam. (MADE GROUND) Red GRAVEL of crushed brick. (MADE GROUND) Black SAND of ash. (MADE GROUND)	  		
1.00-1.45	SPT(C) N=11		2,2/2,2,3,4			Firm to stiff brown mottled orange brown and yellow brown slightly gravelly sandy CLAY. Gravel is fine to coarse sub angular to rounded flint. (HEAD)			
1.50	D								
1.80	SV 55kPa								
2.00-2.45	SPT(C) N=12		4,2/2,3,3,4		(3.60)	... becoming very sandy from 2.0m depth.			
2.50	D								
3.00-3.45	SPT(C) N=6		2,2/2,2,1,1						
3.50	D								
3.80	SV 39kPa								
4.00-4.45	SPT(C) N=2		1,0/0,1,0,1		4.00	Loose brown sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded flint. (HEAD)			
4.50	D				(1.00)				
					5.00	Complete at 5.00m			
Remarks No groundwater encountered. No collapse noted.							Scale (approx) 1:40	Logged By SJF	Figure No. P20-069.WS106

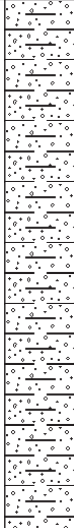
						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Trial Pit Number SA1	
Excavation Method Trial Pit		Dimensions 1.5m by 0.30m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069	
		Location		Dates 31/07/2020		Project Contractor PGE		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
1.00	SV 81kPa				(0.20)	Grey brown gravelly SAND (MADE GROUND).			
					0.20	Soft dark brown slightly gravelly sandy CLAY with rootlet and rootlets up to 0.50m. Gravel is flint and concrete (MADE GROUND)			
					(0.40)				
					0.60	Firm orange brown slightly gravelly sandy to very sandy CLAY. Gravel is fine to coarse sub angular flint (HEAD).			
					(0.90)				
					1.50	Complete at 1.50m			



Remarks

Infiltration testing undertaken.
 No groundwater encountered.
 Trial pit side remained stable and upright.

Scale (approx) 1:20	Logged By SJF	Figure No. P20-069.SA1
-------------------------------	-------------------------	----------------------------------

PADDOCK GEO ENGINEERING						Site Norcot Community Centre, Lyndhurst Road, Reading, RG30 6UB		Trial Pit Number SA2			
Excavation Method Trial Pit		Dimensions 2.00m by 0.30m		Ground Level (mOD)		Client Beard Construction Limited		Job Number P20-069			
		Location		Dates 31/07/2020		Project Contractor PGE		Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water			
1.00	SV 59kPa				(0.20)	Black and red GRAVEL of macadam, ash and brick fragments (MADE GROUND).					
					0.20	Brown slightly gravelly clayey silty SAND. Gravel is fine to coarse sub rounded flint, and rare brick and concrete. (MADE GROUND)					
2.00	SV 65kPa				(0.80)						
					1.00	Stiff brown and orange brown slightly gravelly very sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint and chalk. (HEAD)					
					(1.40)						
					2.40	Complete at 2.40m					
						Remarks Trial pit side remained upright and stable. No groundwater encountered. Infiltration testing undertaken.					
						Scale (approx) 1:20		Logged By SJF		Figure No. P20-069.SA2	

Infiltration Test to BRE365 - SA1 Test 1

Field Data

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	1.00
	1.0	60	1.00
	2.0	120	1.00
	5.0	300	1.00
	10.0	600	1.01
	16.0	960	1.01
	22.0	1320	1.01
	29.0	1740	1.01
	46.0	2760	1.02
	60.0	3600	1.02
	122.0	7320	1.02
	183.0	10980	1.02

Location: SA1
Weather: Sunny
Engineer: SJF
Date: 31/07/2020

TEST 1

Strata Tested Head

1.5m	SA1 - 1.5 m depth Assume invert level of incoming drain is 1m bgl. Effective depth = 0.5m	Pit Depths (m bgl)
		Length
		1.50
		Width
		0.30
		Depth
		1.50
		25% Effective Depth
		1.13
		75% Effective Depth
1.38		
Inlet Depth		
1.00		
	0.3m	

Linear extrapolated values for calculation

CALCULATION:

Soil Infiltration Rate(f) =
 $V_{p75-25} / (ap_{50} \times tp_{75-25})$

Where:
 V_{p75-25} = effective storage
 volume between 75% and 25%
 effective depth
 $1.5 \times 0.3 \times (1.375 - 1.125)$
 = **0.1125**

ap_{50} = internal area of TP upto
 50% effective depth + base of TP
 $2(1.5 \times) + 2(0.3 \times) + (1.5 \times 0.3)$
 = **1.35**

tp_{75-25} = the time for water level
 to fall from 75% - 25% effective
 depth
 = secs

f= **N/A** m/s

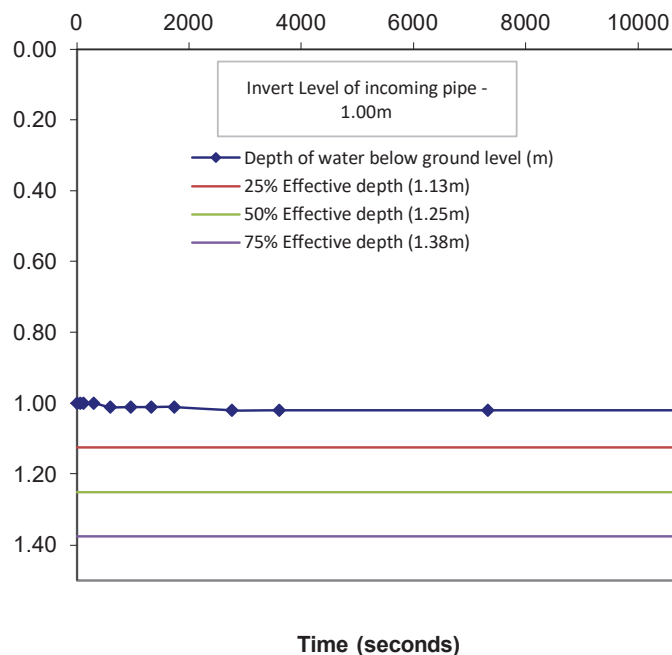
Comment

Insufficient infiltration in over 3 hours - Test Failed



Client: Beard Construction Limited
Project No: P20-069
Project: Norcot Community Centre,
 Lyndhurst Road, Reading,
 RG30 6UB

Depth of Water (bgl)



Infiltration Test to BRE365 - SA2 Test 1

Field Data

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	2.00
	1.0	60	2.00
	2.0	120	2.00
	5.0	300	2.00
	10.0	600	2.00
	15.0	900	2.00
	25.0	1500	2.00
	43.0	2580	2.00
	62.0	3720	2.00
	118.0	7080	2.00
	159.0	9540	2.00
	192.0	11520	2.00

Location: SA2
Weather: Sunny
Engineer: SJF
Date: 31/07/2020

TEST 1

Strata Tested Head

2m	SA2 - 2.4 m depth Assume invert level of incoming drain is 2m bgl. Effective depth = 0.4m	Pit Depths (m bgl)
		Length
		2.00
		Width
		0.30
		Depth
		2.40
		25% Effective Depth
		2.10
		75% Effective Depth
2.30		
Inlet Depth		
2.00		
	0.3m	

Linear extrapolated values for calculation

CALCULATION:

Soil Infiltration Rate(f) =
 $V_{p75-25} / (ap_{50} \times tp_{75-25})$

Where:
 V_{p75-25} = effective storage volume between 75% and 25% effective depth
 $2 \times 0.3 \times (2.3 - 2.1)$
 $= 0.12$

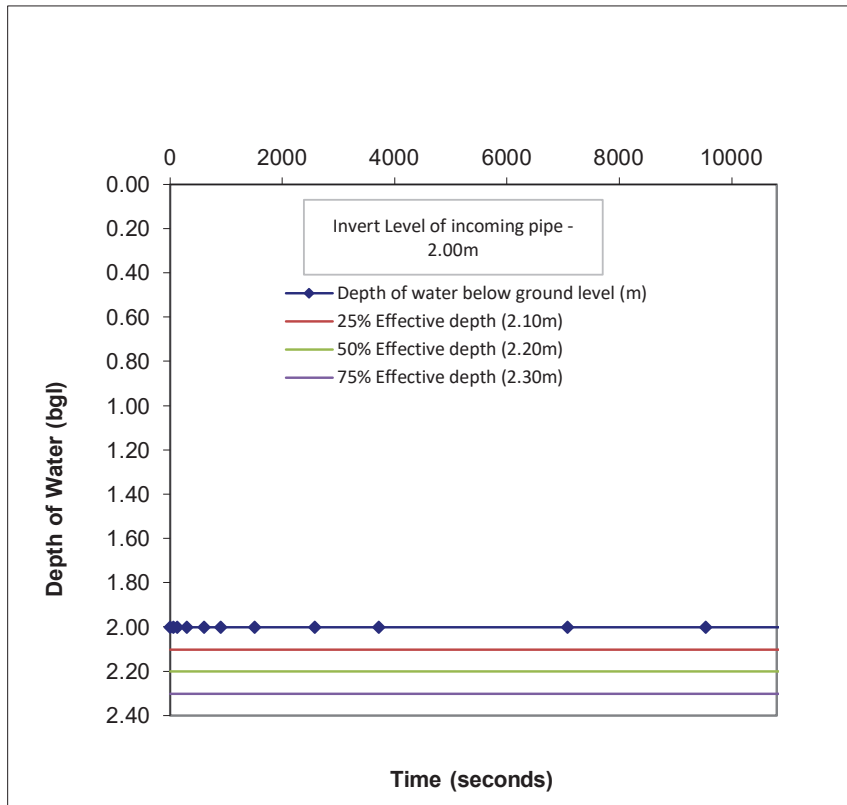
ap_{50} = internal area of TP upto 50% effective depth + base of TP
 $2(2 \times) + 2(0.3 \times) + (2 \times 0.3)$
 $= 1.52$

tp_{75-25} = the time for water level to fall from 75% - 25% effective depth
 $=$ secs

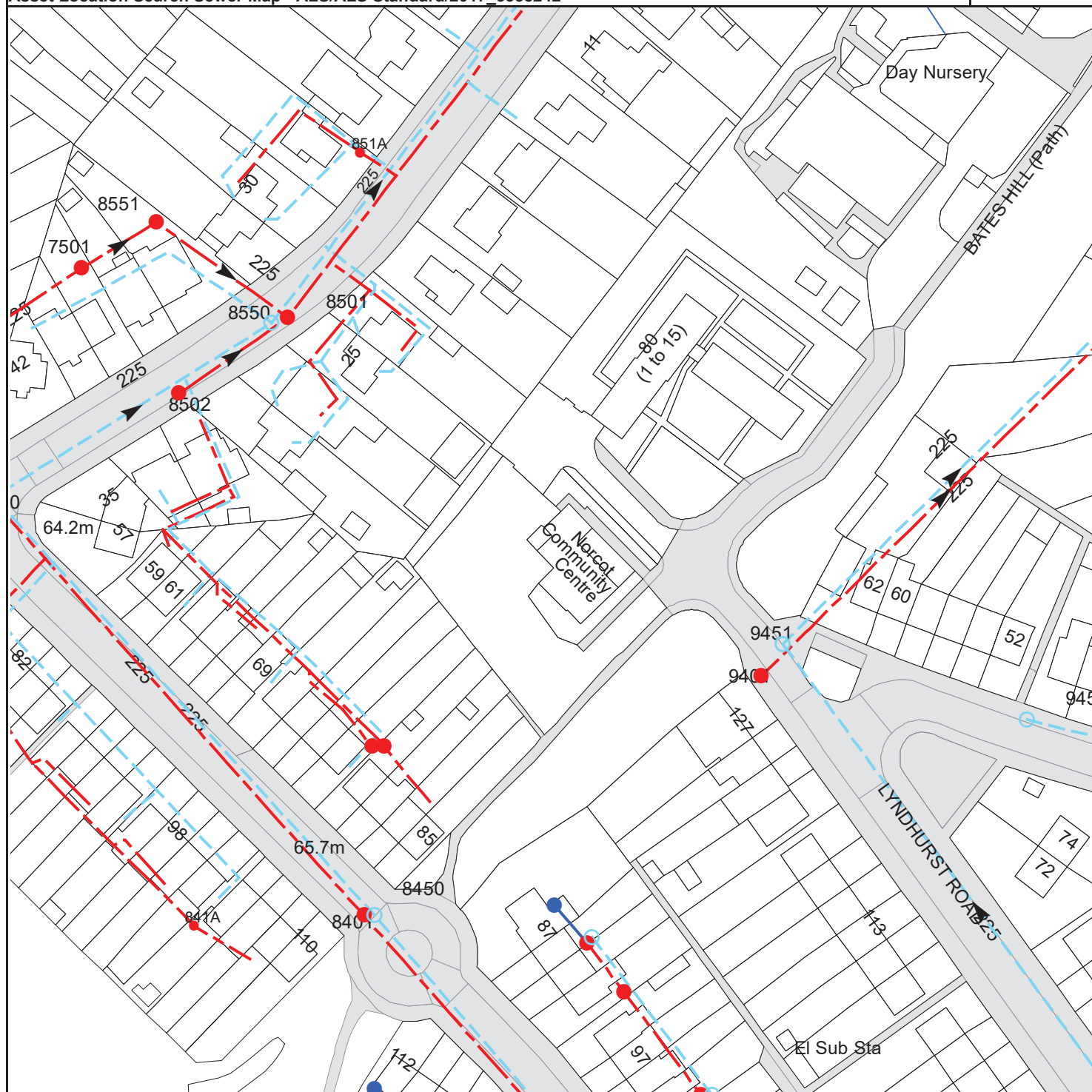
$f =$ **N/A** m/s

Comment

Insufficient infiltration in over 3 hours - Test Failed



APPENDIX D



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 467883,174515

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
84LN	n/a	n/a
8451	n/a	n/a
8452	n/a	n/a
9452	57.23	55.87
9401	59.27	57.1
9451	59.28	56.92
8502	61	59.58
8550	59.56	58.25
8501	54.44	52.78
7501	n/a	n/a
8551	n/a	n/a
851A	n/a	n/a
841A	n/a	n/a
8401	66.1	62.5
84LK	n/a	n/a
8450	66.12	62.71
84LM	n/a	n/a
84LL	n/a	n/a
8453	n/a	n/a
94LE	n/a	n/a
94LD	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

	Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Trunk Surface Water
	Trunk Foul
	Storm Relief
	Trunk Combined
	Bio-solids (Sludge)
	Vent Pipe
	Proposed Thames Surface Water Sewer
	Proposed Thames Foul Sewer
	Gallery
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Sludge Rising Main
	Proposed Thames Water Rising Main
	Vacuum

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	Air Valve
	Dam Chase
	Fitting
	Meter
	Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	Control Valve
	Drop Pipe
	Ancillary
	Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	Outfall
	Undefined End
	Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

	Public/Private Pumping Station
	Change of characteristic indicator (C.O.C.I.)
	Invert Level
	Summit
Areas	Lines denoting areas of underground surveys, etc.
	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

	Foul Sewer
	Surface Water Sewer
	Combined Sewer
	Culverted Watercourse
	Proposed
	Abandoned Sewer

APPENDIX E

SDS Consulting		Page 1
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott ICP SuDS	
Date 07/09/2020 12:59 File	Designed by MTD Checked by	
XP Solutions Source Control 2017.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	30	Soil	0.300
Area (ha)	0.170	Urban	0.000
SAAR (mm)	649	Region Number	Region 6

Results 1/s

QBAR Rural	0.3
QBAR Urban	0.3
Q30 years	0.6
Q1 year	0.2
Q30 years	0.6
Q100 years	0.9

©1982-2017 XP Solutions

APPENDIX F



- NOTES:
1. Drawing for information only
 2. Do not scale from this drawing
 3. Refer to Saunders Architecture + Urban Design drawing 7870_PL102 Revision D for proposed site layout
 4. Topographical survey from DANDO Surveying Ltd drawing WSPnorcotTOPO
 5. This drawing is intended to provide an indication of the drainage requirements for the site and is not to be used as a final design solution
 6. Existing drainage and level positions are indicative only
 7. Cover levels are to be reviewed against proposed site levels
 8. External paving and threshold drainage provisions to be developed in line with external level design

- KEY:
- Existing Drainage**
- Existing Thames Water Foul Water Sewer
 - Existing Thames Water Surface Water Sewer
 - Existing Foul drain
 - Existing Surface Drain
 - Existing drainage to be removed
- Proposed Drainage**
- Foul Water Drain
 - Surface Water Drain
 - PPG8
 - Proposed tanked permeable paving - Surface type TBC
 - Non permeable paving - surface type to match permeable paving
 - Exceedance Route Arrow

Rev	Date	Description	Initials	Check
Job Title				
NORCOT COMMUNITY CENTRE & AFFORDABLE HOUSING, TILEHURST, READING				
Drawing Title				
DRAINAGE STRATEGY				
Drawing No.				
5264-C-001				
Status				
For Approval				
Not for Construction				
Job Number	5264	Date	SEP 2020	
Scale	1:125 @ A1			
Drawn By	MTD	Checked By	LB	

APPENDIX G

SDS Consulting		Page 1
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions	Network 2017.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	10.573	0.105	100.7	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	11.643	0.120	97.0	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.854	0.100	98.5	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	24.748	0.325	76.1	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	8.972	0.090	99.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	12.248	0.415	29.5	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	22.162	1.060	20.9	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	9.670	0.100	96.7	0.006	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.18	59.550	0.010	0.0	0.0	0.0	1.00	17.7	1.3
1.001	50.00	5.37	59.445	0.014	0.0	0.0	0.0	1.02	18.0	1.9
1.002	50.00	5.53	59.325	0.023	0.0	0.0	0.0	1.01	17.9	3.1
2.000	50.00	5.36	59.550	0.008	0.0	0.0	0.0	1.15	20.4	1.1
1.003	50.00	5.68	59.225	0.031	0.0	0.0	0.0	1.01	17.8	4.2
3.000	50.00	5.11	59.550	0.024	0.0	0.0	0.0	1.86	32.9	3.3
1.004	50.00	5.81	59.060	0.060	0.0	0.0	0.0	2.87	114.3	8.1
4.000	50.00	5.16	59.550	0.006	0.0	0.0	0.0	1.02	18.1	0.8

SDS Consulting		Page 2
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions		Network 2017.1.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.001	7.887	1.375	5.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	8.026	0.020	401.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	2.792	1.020	2.7	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	11.518	0.030	383.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.000	3.855	0.975	4.0	0.022	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	29.082	0.955	30.5	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.001	50.00	5.19	59.450	0.006	0.0	0.0	0.0	4.24	74.9	0.8
1.005	50.00	6.01	58.000	0.065	0.0	0.0	0.0	0.65	25.7	8.9
5.000	50.00	5.01	59.000	0.010	0.0	0.0	0.0	6.14	108.5	1.4
1.006	50.00	6.30	57.980	0.075	0.0	0.0	0.0	0.66	26.3	10.2
6.000	50.00	5.01	59.000	0.022	0.0	0.0	0.0	5.10	90.2	3.0
1.007	50.00	6.57	57.950	0.108	0.0	0.0	0.0	1.83	32.4	14.6

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall C. Level Name	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	TW9451	59.280	56.995	56.920	0 0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

SDS Consulting		Page 3
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions	Network 2017.1.1	

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

SDS Consulting		Page 4
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions	Network 2017.1.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9-HB, DS/PN: 1.007, Volume (m³): 2.8

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	57.950
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

SDS Consulting		Page 5
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions	Network 2017.1.1	

Storage Structures for Storm

Porous Car Park Manhole: PP1, DS/PN: 5.000

Infiltration Coefficient Base (m/hr) 0.00000	Width (m) 4.8	
Membrane Percolation (mm/hr) 1000	Length (m) 10.5	
Max Percolation (l/s) 14.0	Slope (1:X) 0.0	
Safety Factor 2.0	Depression Storage (mm) 5	
Porosity 0.30	Evaporation (mm/day) 3	
Invert Level (m) 59.550	Cap Volume Depth (m) 0.300	

Cellular Storage Manhole: TANK, DS/PN: 1.006

Invert Level (m) 57.980	Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000	Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000	

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	20.0	20.0	0.801	0.0	34.3
0.800	20.0	34.3			

Porous Car Park Manhole: PP2 , DS/PN: 6.000

Infiltration Coefficient Base (m/hr) 0.00000	Width (m) 4.8	
Membrane Percolation (mm/hr) 1000	Length (m) 19.2	
Max Percolation (l/s) 25.6	Slope (1:X) 0.0	
Safety Factor 2.0	Depression Storage (mm) 5	
Porosity 0.30	Evaporation (mm/day) 3	
Invert Level (m) 59.550	Cap Volume Depth (m) 0.300	

SDS Consulting		Page 6
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions Network 2017.1.1		

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 10, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	1	+0%	100/60	Summer			59.576
1.001	S2	15 Winter	1	+0%	100/30	Summer			59.476
1.002	S3	15 Winter	1	+0%	100/15	Winter			59.364
2.000	RE	15 Winter	1	+0%					59.571
1.003	S4	15 Winter	1	+0%	100/15	Winter			59.272
3.000	S5	15 Winter	1	+0%	100/60	Summer			59.581
1.004	S6	15 Winter	1	+0%	30/120	Winter			59.097
4.000	RE	15 Winter	1	+0%					59.569
4.001	S7	15 Winter	1	+0%	100/30	Summer			59.458
1.005	S8	60 Winter	1	+0%	30/15	Summer			58.210
5.000	PP1	15 Summer	1	+0%	30/60	Winter			59.015
1.006	TANK	60 Winter	1	+0%	1/60	Winter			58.209
6.000	PP2	15 Winter	1	+0%	30/60	Winter			59.021
1.007	S9-HB	60 Winter	1	+0%	1/15	Summer			58.208

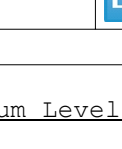
©1982-2017 XP Solutions

SDS Consulting		Page 7
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions		Network 2017.1.1

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)					
1.000	S1	-0.124	0.000	0.07		1.1	OK	
1.001	S2	-0.119	0.000	0.09		1.5	OK	
1.002	S3	-0.111	0.000	0.15		2.4	OK	
2.000	RE	-0.129	0.000	0.05		0.9	OK*	
1.003	S4	-0.103	0.000	0.22		3.4	OK	
3.000	S5	-0.119	0.000	0.10		2.9	OK	
1.004	S6	-0.188	0.000	0.06		6.6	OK	
4.000	RE	-0.131	0.000	0.04		0.7	OK*	
4.001	S7	-0.142	0.000	0.01		0.7	OK	
1.005	S8	-0.015	0.000	0.21		3.7	OK	
5.000	PP1	-0.135	0.000	0.02		1.1	OK	
1.006	TANK	0.004	0.000	0.06		1.2	SURCHARGED	
6.000	PP2	-0.129	0.000	0.04		2.6	OK	
1.007	S9-HB	0.108	0.000	0.04		1.3	SURCHARGED	

SDS Consulting		Page 8	
Unit 16		5264 Norcott Reading	
Shrivenham Hundred Business ...		SW Detailed Design	
Swindon SN6 8TZ		REV 1.0	
Date 07/09/2020 18:05		Designed by MTD	
File 5264-SW REV1.0.MDX		Checked by	
XP Solutions		Network 2017.1.1	



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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 10, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	30	+10%	100/60 Summer				59.594
1.001	S2	15 Winter	30	+10%	100/30 Summer				59.498
1.002	S3	15 Winter	30	+10%	100/15 Winter				59.398
2.000	RE	15 Winter	30	+10%					59.586
1.003	S4	120 Winter	30	+10%	100/15 Winter				59.334
3.000	S5	15 Winter	30	+10%	100/60 Summer				59.602
1.004	S6	120 Winter	30	+10%	30/120 Winter				59.333
4.000	RE	15 Winter	30	+10%					59.582
4.001	S7	15 Winter	30	+10%	100/30 Summer				59.467
1.005	S8	120 Winter	30	+10%	30/15 Summer				59.331
5.000	PP1	120 Winter	30	+10%	30/60 Winter				59.330
1.006	TANK	120 Winter	30	+10%	1/60 Winter				59.330
6.000	PP2	120 Winter	30	+10%	30/60 Winter				59.328
1.007	S9-HB	120 Winter	30	+10%	1/15 Summer				59.328

©1982-2017 XP Solutions

SDS Consulting		Page 9
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions		Network 2017.1.1

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)					
1.000	S1	-0.106	0.000	0.19		3.0	OK	
1.001	S2	-0.097	0.000	0.27		4.4	OK	
1.002	S3	-0.077	0.000	0.47		7.4	OK	
2.000	RE	-0.114	0.000	0.12		2.5	OK*	
1.003	S4	-0.041	0.000	0.20		3.2	OK	
3.000	S5	-0.098	0.000	0.26		7.7	OK	
1.004	S6	0.048	0.000	0.06		6.1	SURCHARGED	
4.000	RE	-0.118	0.000	0.10		1.9	OK*	
4.001	S7	-0.133	0.000	0.03		1.8	OK	
1.005	S8	1.106	0.000	0.33		5.8	SURCHARGED	
5.000	PP1	0.180	0.000	0.02		1.0	SURCHARGED	
1.006	TANK	1.125	0.000	0.07		1.4	SURCHARGED	
6.000	PP2	0.178	0.000	0.04		2.2	SURCHARGED	
1.007	S9-HB	1.228	0.000	0.05		1.7	SURCHARGED	

SDS Consulting								Page 10	
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ				5264 Norcott Reading SW Detailed Design REV 1.0					
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX				Designed by MTD Checked by					
XP Solutions				Network 2017.1.1					
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
<u>Simulation Criteria</u>									
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000									
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000									
Hot Start Level (mm) 0 Inlet Coefficient 0.800									
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000									
Foul Sewage per hectare (l/s) 0.000									
Number of Input Hydrographs 0 Number of Storage Structures 3									
Number of Online Controls 1 Number of Time/Area Diagrams 0									
Number of Offline Controls 0 Number of Real Time Controls 0									
<u>Synthetic Rainfall Details</u>									
Rainfall Model FSR Ratio R 0.400									
Region England and Wales Cv (Summer) 0.750									
M5-60 (mm) 17.000 Cv (Winter) 0.840									
Margin for Flood Risk Warning (mm) 300.0									
Analysis Timestep 2.5 Second Increment (Extended)									
DTS Status OFF									
DVD Status ON									
Inertia Status ON									
Profile(s) Summer and Winter									
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440									
Return Period(s) (years) 1, 30, 100									
Climate Change (%) 0, 10, 40									
									Water
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	S1	240 Winter	100	+40%	100/60 Summer				59.890
1.001	S2	240 Winter	100	+40%	100/30 Summer				59.889
1.002	S3	240 Winter	100	+40%	100/15 Winter				59.888
2.000	RE	240 Winter	100	+40%					59.700
1.003	S4	240 Winter	100	+40%	100/15 Winter				59.887
3.000	S5	240 Winter	100	+40%	100/60 Summer				59.887
1.004	S6	240 Winter	100	+40%	30/120 Winter				59.885
4.000	RE	240 Winter	100	+40%					59.700
4.001	S7	240 Winter	100	+40%	100/30 Summer				59.883
1.005	S8	240 Winter	100	+40%	30/15 Summer				59.883
5.000	PP1	240 Winter	100	+40%	30/60 Winter				59.882
1.006	TANK	240 Winter	100	+40%	1/60 Winter				59.881
6.000	PP2	240 Winter	100	+40%	30/60 Winter				59.880
1.007	S9-HB	240 Winter	100	+40%	1/15 Summer				59.879
©1982-2017 XP Solutions									

SDS Consulting		Page 11
Unit 16 Shrivenham Hundred Business ... Swindon SN6 8TZ	5264 Norcott Reading SW Detailed Design REV 1.0	
Date 07/09/2020 18:05 File 5264-SW REV1.0.MDX	Designed by MTD Checked by	
XP Solutions		Network 2017.1.1

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

PN	US/MH	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
	Name	Depth (m)	Volume (m³)			Flow (l/s)		
1.000	S1	0.190	0.000	0.06		1.0	FLOOD RISK	
1.001	S2	0.294	0.000	0.09		1.4	FLOOD RISK	
1.002	S3	0.413	0.000	0.15		2.3	FLOOD RISK	
2.000	RE	0.000	0.000	0.04		0.8	SURCHARGED*	
1.003	S4	0.512	0.000	0.20		3.1	FLOOD RISK	
3.000	S5	0.187	0.000	0.08		2.5	FLOOD RISK	
1.004	S6	0.600	0.000	0.06		5.9	FLOOD RISK	
4.000	RE	0.000	0.000	0.03		0.6	SURCHARGED*	
4.001	S7	0.283	0.000	0.01		0.6	FLOOD RISK	
1.005	S8	1.658	0.000	0.31		5.5	FLOOD RISK	
5.000	PP1	0.732	0.000	0.02		1.0	FLOOD RISK	
1.006	TANK	1.676	0.000	0.16		3.1	FLOOD RISK	
6.000	PP2	0.730	0.000	0.04		2.2	FLOOD RISK	
1.007	S9-HB	1.779	0.000	0.06		2.0	FLOOD RISK	